MORRISON HERSHFIELD

Site Servicing and Stormwater Management Design Brief

Carleton University, New Student Residence

1125 Colonel By Drive

Ottawa, Ontario

Site Plan Application File No.: D07-12-19-0205

Presented to:

Diamond Schmitt Architects and KWC Architects in Joint Venture for the Carleton University New Student

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1 Introduction

1.1 Site Description and Proposed Development

This report describes the site servicing and stormwater management design and calculations pertaining to a proposed 9 storey New Student Residence (NSR) building at Carleton University. The proposed NSR will provide 166 dwelling accommodation units for a population of 450 new first year students as well as various amenity spaces for all students on campus. The ground floor of the building, accessible on all sides of the building as well as from a new extension to the tunnel system, will provide a secure entry to general campus amenities. The residence quarters on the upper floors will provide private amenity spaces separated from the ground floor public space.

The overall building layout as well as the conformity to the Carleton University Master Plan 2016 is described in greater detail in the *Planning Rationale and Design Brief, Diamond Schmitt/KWC Architects*. Excerpts of the 2016 Master Plan are provided in **Appendix K**.

The site is located at the north section of the campus, to the west of Campus Avenue, facing the main campus entrance (University Drive). The site currently contains a fire access road and turnaround, parking lot and a landscaped area with pedestrian pathways.

The existing infrastructure is described in **Section 1.4** below.

The site slopes south and west from an elevation of approximately 65.9 m within Parking Lot 6 along the north edge of the site, and from Campus Avenue along the east edge of the site, to approximately 63.0 m along the south edge of the site. Specifically, the existing tunnel portal and entrance to the courtyard of Stormont Dundas House are the lowest areas of the site. Drainage is provided by catch basins connected to storm sewers, and a trench drain at the tunnel portal.

Proposed grading and servicing for the NSR is shown on the drawings included in **Appendix A**.

The format of this report matches that of the development servicing study checklist found in Section 4 of the City of Ottawa's Servicing Study Guidelines for Development Applications. A completed copy of the checklist is provided in **Appendix I**.

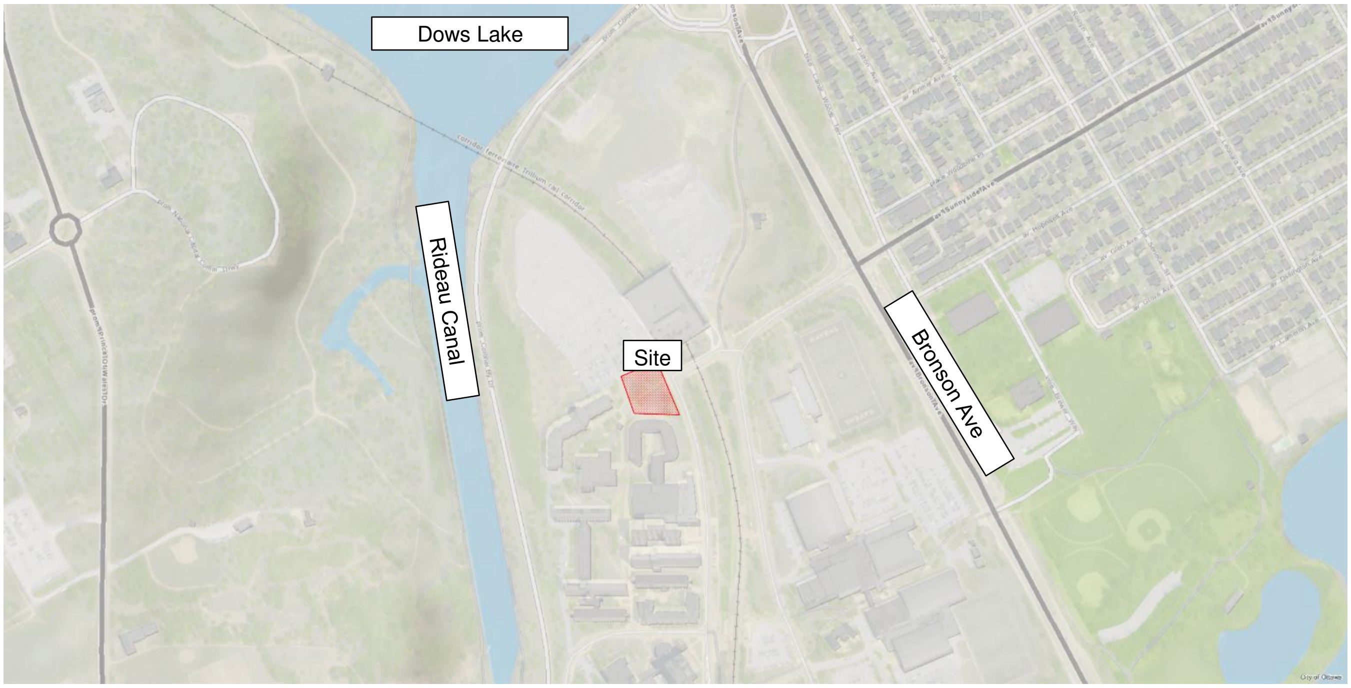
1.1.1 Statement of Objectives and Servicing Criteria

The objective of this Site Servicing and Stormwater Management Report is to demonstrate that the proposed design meets the servicing requirements for the proposed development, while adhering to the appropriate regulatory requirements and to the limitations and recommendations identified by the Campus Infrastructure Study and Master Plan (Genivar, 2008) (henceforward referred to as the "Infrastructure Master Plan") and appropriate regulatory agencies.

1.1.2 Location Map and Plan

The location of the site is illustrated in **Figure 1**. A detailed site layout is provided within the drawings in **Appendix A**.

Figure 1 Key Plan



The site is entirely within a property parcel (PIN 040870065) owned by Carleton University.

1.2 Background Documents

Existing conditions are shown on the Topographic and Legal Survey (**Appendix G**).

1.3 Consultation and Permits

1.3.1 Pre-consultation Meetings

A pre-consultation meeting was held with representatives of the City of Ottawa and the consultant design team on October 18th, 2018. The resulting comments that would affect this report are as follows:

- The capacity of the existing sanitary sewer network should be investigated, as some sanitary pipes on the campus are believed to have insufficient capacity
- A CCTV report is required to confirm that the existing sanitary sewers (local to the site) are in good condition to handle the proposed development
- The capacity of the existing storm sewer network should be investigated, as some storm pipes on the campus are believed to have insufficient capacity
- A CCTV report is required to confirm that the existing storm sewers (local to the site) is in good condition to handle the proposed development
- The City requires post-development flows from the site to be restricted to the 1:5 year pre-development level for all storm events up to and including 1:100 year storm. However, control to the 1:2 year pre-development level may be necessary due to limited capacity of the existing storm sewers
- Pre-development flow to be calculated using the smaller of a runoff coefficient of 0.5 or the actual existing runoff coefficient. Use either a T_c of 20 minutes or calculated the pre-development T_c but not less than 10 minutes

- Maximum ponding on the public and private roadways and parking lot surfaces during 1:100 year storm event = 350mm max.
- Consult with the RVCA regarding storm water quality control requirements/restrictions

The full comments regarding site-servicing and stormwater management-specific requirements can be found in **Appendix B**.

1.3.2 Adherence to Zoning and Related Requirements

The site is currently zoned I2 AF (1.5) – Major Institutional zone, Post-secondary educational facilities.

1.4 Available Existing Infrastructure and Utility Relocations

Sewer and watermain mapping collected from the City of Ottawa as well as records and as-built drawings obtained from Carleton University indicate that the following services exist in and surrounding the subject site:

North

- No watermains or sewers immediately north of the site

East

- 400mm diameter watermain (material unknown)
- 300mm diameter Conc. sanitary sewer
- 450mm diameter Conc. storm sewer

South

- 300mm diameter Conc. storm sewer

West

- 200mm diameter PVC sanitary sewer
- 150mm diameter PVC storm sewer
- 200mm diameter watermain (material unknown)

Within the site

- 200mm diameter Conc. sanitary sewer (flowing West to East)
- 300mm diameter Conc. sanitary sewer (flowing West to East)
- 200mm diameter watermain (material unknown)
- 200mm catchbasin leads (flowing North to South)

Figure 2 illustrates the location of existing infrastructure. As-built drawings are included in **Appendix L**.

The existing utilities within the site will be relocated to the south and west of the proposed building. In addition, existing utilities along the east edge of the site will be relocated into Campus Avenue.

Where utilities are relocated into Campus Avenue, they will be aligned as close as possible to the proposed NSR, while maintaining sufficient clearance for construction and 2.5 m clearance between watermains and sewers. This will enable the single access to Parking Lot 6 to be maintained during construction. All valves and maintenance holes will be located within the roadway or within winter-maintained areas (i.e. the fire access route and the main entrance plaza).

Figure 2 GeoOttawa Infrastructure Excerpt

Existing utilities (and proposed relocations) are shown in detail in Plan C001 found in **Appendix A.** CCTV inspections of existing storm and sanitary sewers have been carried out, and reports are provided in **Appendix H.** Sewer invert elevations were verified as part of the topographic survey (**Appendix F**). Confined space entry maintenance hole inspections were carried out to obtain missing data, where sewer inverts could not be seen/accessed from the surface (**Appendix J**).

1.5 Campus Infrastructure Study and Master Plan, 2008

The Infrastructure Master Plan, which was reviewed and accepted by the City of Ottawa at the time of its completion, contains a comprehensive analysis of the capability of the existing infrastructure to service proposed development on the campus.

Relevant excerpts from the Infrastructure Master Plan are included in **Appendix E**.

2 Geotechnical Study

A Geotechnical Investigation was undertaken by WSP and is documented in Report No. 191-12948-00 dated December 2019 and supplemented by a memorandum dated July 21st , 2020.

Thirteen boreholes were drilled to a depths varying between 10m and 18.6m below the existing ground surface. The subsurface profile at the borehole locations within the pavement structure consist of a pavement structure underlain by a fill layer to approximately 1.4 to 2.4 m depth. The fill is variable in nature and consists of sand with varying amounts of gravel and of silt. The fill was underlain by approximately 2.5m deposits of sand and gravel underlain by 4.5m of glacial till. Bedrock depth vary between 10.5m – 11.8m below grade. A similar profile is shown where topsoil is present.

Based on available geological mapping, the subject site is located in an area where the bedrock consists of interbedded limestone and shale of the Verulam formation.

Groundwater was encountered at depths of 4.5-6.7 m below the existing ground surface.

The geotechnical report provides recommendations for excavation, backfill, pavement structure and pipe bedding and backfill.

3 Water Services

3.1 Design Criteria

The water service has been designed in accordance with the 2010 City of Ottawa Water Design Guidelines as well as MECP Design Guidelines for Drinking Water Systems. The proposed development lies within the City of Ottawa 1W pressure zone as shown by the Pressure Zone map in **Appendix C.**

The NSR will be serviced from the relocated 400 mm diameter watermain on Campus Avenue. This watermain is part of Carleton University's private water distribution system, which is connected to municipal watermains at:

1. The northern end of the 400 mm diameter watermain, adjacent to Colonel By Drive/Bronson Avenue.
2. The eastern end of a 250 mm diameter watermain which runs across Brewer Park.

Because the main supply to the campus is provided by the 400 mm diameter watermain, and because there are no other significant water demands on this watermain north of the NSR, the adequacy of supply has been assessed by considering the entire domestic and institutional water demand of the campus, plus the NSR domestic, institutional and fire demands, to be supplied by the 400 mm diameter watermain alone. Boundary conditions have been obtained from the City for the northern end of the 400 mm diameter watermain, adjacent to Colonel By Drive/Bronson Avenue.

Table 1 summarizes the parameters used to estimate water demands, assess adequacy of service, and design the proposed watermains:

Table 1– Summary of Water Demand Parameters

Design Parameter	Design Criteria
Overall Campus Water Demand	
Residential Average Daily Demand	Metered Data[1]
Residential Max. Daily Peaking Factor	Varies[2]
Residential Max. Hourly Peaking Factor	Varies[2]
Institutional Average Daily Demand	Metered Data[3]
Institutional Max. Daily Peaking Factor	1.5 x Average Daily[4]
Institutional Max. Hourly Peaking Factor	1.8 x Max Daily[4]
NSR Water Demand	
Residential Average Daily Demand	350 l/person/day
Residential Max. Daily Peaking Factor	MOE Design Guidelines for Drinking-Water System, Table 3-3
Residential Max. Hourly Peaking Factor	MOE Design Guidelines for Drinking-Water System, Table 3-3
Fire Flow	Ottawa Design Guidelines (2010 incl. Technical Bulletins) and the Fire Underwriters Survey (1999)
Watermain Design Criteria	
Minimum Watermain Size	200mm diameter
Minimum Depth of Cover	2.4m from top of watermain to finished grade unless insulated
Adequacy of Service Criteria	
Desired pressure range during normal operating conditions	350kPa and 480kPa
Min. pressure during normal operating conditions	275kPa
Max. pressure during normal operating conditions	552kPa
Min. pressure during maximum hourly demand	276kPa
Min. pressure during maximum daily demand + fire flow	140kPa

[1] Metered data provided by Carleton University, maximum month taken over span of May 2018-April 2019 and averaged over 30 days.

[2] For Population <500, Table 3-3 of the MOE Design Guidelines for Drinking-Water Systems is used to determine peaking factors (Refer to Sheet 3, Table 3). For population >500, Table 4.2 of the City of Ottawa Water Design Guidelines is used. Peaking factors for total flow are based on total population.

[3] Metered data provided by Carleton University, maximum month taken over span of May 2018-April 2019 and averaged over 30 days

[4] City of Ottawa Water Design Guidelines (2010), Table 4.2

Table 2 summarizes the water demand/fire flow for the development based on the **Ottawa Design Guidelines (2010 incl. Technical Bulletins)** and the **Fire Underwriters Survey (1999)**:

Table 2– Summary of Water Demand Calculations

Design Parameter	Water Demand (L/s)
New Student Residence	
Residential Average Daily Demand	1.91
Residential Max. Daily Demand	5.64
Residential Max. Hourly Demand	8.43
Fire Flow	216.67
Entire Campus (including New Student Residence)	
Residential Average Daily Demand	7.40
Residential Max. Daily Demand	19.38
Residential Max. Hourly Demand	38.65
Institutional Average Daily Demand	9.21
Institutional Max. Daily Demand	13.81
Institutional Max. Hourly Demand	24.87
Total Maximum Hourly Demand	63.51
Total Maximum Daily Demand + NSR Fire	249.86

Domestic and fire flow calculations are provided in **Appendix C**. Supporting correspondence from the Architect is also provided in **Appendix C**.

3.2 Adequacy of Supply for Domestic and Fire Flows

The building will be serviced from the relocated 400 mm diameter watermain. The pressure drop in this watermain has been assessed as described above. The pressure drop in the proposed building service from the 400 mm watermain is also included in the results summarized in the following table.

Table 3– Summarization of Water Servicing Design Parameters/Calculation Results

	Scenario			Source of Data
	Max Day + Fire	**Max Hourly**	**Max Day**	
Flow Demand (L/s)	249.68	63.51	33.19	Calculated for NSR
Boundary Condition: Available Pressure under proposed demand (kPa)	385.53	414.96	414.96	Provided by City of Ottawa for 400mm Watermain[5]
Residual Pressure at Service Tee including losses in 400mm diameter pipe (kPa)	310.55	409.01	413.17	Calculated for NSR
Residual Pressure at Service Entry including pipe losses (200mm diameter pipe) (kPa)	305.10	408.48	413.01	Calculated for NSR
Minimum Allowable Pressure (kPa)	140.0	275.0	345.0	City of Ottawa Water Design Guidelines

[5] The City of Ottawa Boundary Conditions minus finished floor elevation (65.7m) of the proposed building.

Considering the calculated fire flow, and anticipated large fire pump capacity, 250 mmm diameter service connections are proposed to avoid excessive velocities and head losses.

All relocated watermains will be sized on a like-for-like basis. The relocated 400mm diameter watermain will be extended down to the southeastern corner of the proposed building so the existing condition is maintained (i.e. the 200mm watermain servicing Leeds and St. Patrick building remains connected to the 400mm watermain).

The following table demonstrates that the fire flow (calculated by the FUS method) can be provided by hydrants within 150m of the building.

Table 4 – Availability Fire Flow from Hydrants

Building	**Fire Flow Demand** (L/min)	**Fire Hydrant(s) within 75m**	**Fire Hydrant(s) within 150m**	**Combined Fire Flow** (L/min.)
NSR	13,000	5	1	28,500

A figure showing the location of these hydrants is provided within the fire flow calculations.

The primary fire hydrant is located within 45m of the proposed siamese connection (fire department connection), which is located immediately adjacent to the main building entrance.

3.3 Check of High Pressures

The site is within Pressure Zone 1W, which operates at a maximum head of 115 m (City of Ottawa Water Master Plan, 2013). This would result in a maximum pressure above the finished floor elevation of approximately 483kPa, which falls under the maximum 552kPa defined in the guidelines.

3.4 Reliability Requirements

Because the average demand exceeds 50 m³/d, dual service connections will be provided to the building. An isolation valve will be installed on the 400 mm watermain between the two service connections, to enable supply from either direction.

3.5 Summary and Conclusions

The proposed building will be serviced by dual 250 mm diameter water services connected to the relocated 400mm diameter watermain east of the proposed building.

4 Sanitary Servicing

4.1 Background and Existing Infrastructure

The sanitary service will be designed in accordance with the 2012 Ottawa City Sewer Design Guidelines. The surrounding municipal sanitary services are described in detail in **Section 1.4**. The site is serviced by separated storm and sanitary sewers.

4.2 Review of Ground Water and Soil Conditions

Recommendations regarding the installation of piped services that are provided in the geotechnical report will be incorporated into the contract specifications.

Some of the proposed sewers are expected to be installed below the groundwater table, noted as 4.5m - 6.7m below existing grade. The pipe specified (PVC SDR35 in accordance with the appropriate City of Ottawa specifications and approved products listing), is required to be have joints capable of withstanding a minimum hydrostatic pressure of 345 kPa (50 psi) without leakage. This is equivalent to

35 m of hydrostatic head. As such, the proposed pipe is suitable for installation below the water table. To verify that the joints are sufficiently watertight, leakage tests will be specified for all sanitary sewers.

4.3 Proposed Servicing and Calculations

The proposed development will require a new 200mm diameter PVC sanitary service. The new 200mm diameter PVC sanitary service will extend from the south side of the building. The service will outlet to a new maintenance hole on a relocated 250 mm diameter sanitary sewer south of the NSR and connect to proposed maintenance hole with a 250mm diameter outlet south of the proposed building. The sanitary servicing design parameters are defined in **Table 5**.

Table 5– Summarization of Sanitary Servicing Design Parameters

Design Parameter	Value
Occupancy	471 persons
Per capita flow	280 l/c/d
Academic per GFA flow[1]	6.6 l/m²/d
Institutional Peaking Factor	1.5 if institutional contribution>20%,else 1.0
Infiltration and Inflow Allowance	0.33 L/ha/s
Sanitary Sewer Sizing Based on the Manning's Equation	$Q = \frac{1}{n} \pi A R^{2/3} S^{1/2}$
Manning's Coefficient 'n'	0.013
Minimum Depth of Cover	2.5m from obvert of sewer to grade
Minimum Full Flowing Velocity	0.6m/s
Maximum Full Flowing Velocity	3.0m/s

As per Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012 incl. all Tech. Bulletins as of November 2019.
[1]The GFA-based flow rate for academic spaces is based on the analysis of monitoring data. The full analysis/results can be found in the Sanitary Sewer Design Flows Academic and Residence Buildings report by TSH, April 2007 (see **Appendix M)**.

The proposed building will produce a sanitary flow of 6.1 L/s as determined by the City of Ottawa 2012 Sewer Design Guidelines as well as the "*Sanitary Sewer Design Flows Academic and Residence Buildings report by TSH, April 2007*" (see **Appendix M**). To calculate the sanitary flow, the total flow rate determined using the per capita flow rate (280 l/c/d based on the City of Ottawa 2012 Sewer Design Guidelines) was added to an allowance for amenities on the ground floor of the residence, calculated using the 6.6 l/m²/d flow rate determined from monitoring date (TSH, 2007).

The proposed 200mm PVC service lateral (at 1% slope) has a maximum capacity of 32.8 L/s. This is sufficient for the calculated sanitary flow.

The proposed relocated sewer on Campus Avenue has sufficient capacity accommodate this calculated flow.

All other relocated sanitary sewers are sized based on proposed expansion defined in the Infrastructure Master Plan (excerpts provided in **Appendix E**). This takes into account the northern development, using the gross floor area of all the proposed building and a population density based on the proposed residence building. Full calculations can be found in **Appendix D**.

4.4 Review of Downstream Sanitary System

4.4.1 Pumping Station Capacity Check

The sanitary sewers on the Carleton University campus outlet to a City-owned pump station adjacent to Bronson Avenue. The capacity of the pump station to service the additional from the NSR has been reviewed and found to be sufficient.

The City provided raw pump station data which included measurements for the level of sewage in the wet well measured at 10 second intervals over a 24 hour period for six separate days in 2019/2020. The data also indicates the on/off status each pump at each 10 second interval.

The data was reviewed by MH and anomalous data points (points where no data was measured, negative values, etc.) were removed from the raw data. Using this data and the information available in the pumping station's Certificate of Approval (Residential Average Daily Demand), a pumping station inflow rate was determined was for each of the 6 days. For reference, the daily rainfall was obtained from Environment Canada data available online. This confirmed that three of the days monitored were representative of wet weather conditions. The results of this analysis can be found in **Table 6**:

Table 6– Summarization of Pumping Station Sanitary Flow Analysis

Measurement Date	Maximum average inflow over any 5 minute span (L/s)	Daily average Inflow (L/s)	Rainfall measured over 24 hr period (mm)
Sunday April 14th, 2019	39.14	23.76	35
Friday April 19th, 2019	35.41	20.68	24
Thursday July 25th, 2019	25.58	8.61	0
Saturday January 11th, 2020	33.41	10.63	21
Saturday February 1st, 2020	25.29	6.71	0
Sunday February 2nd, 2020	29.94	6.51	0
Monday February 3rd, 2020	30.51	8.97	0

As shown above, the maximum inflow over a 5 minute period is 39.14 L/s. The maximum capacity of the pumping station as per the Certificate of Approval is 81 L/s, which means there is approximately 41L/s in reserve capacity. This significantly exceeds the peak sanitary flow expected from the NSR of 6.1 L/s (refer to calculations in **Appendix D**).

4.4.2 Sanitary Sewer System

As shown in the Infrastructure Master Plan sanitary design sheets (excerpts provided in **Appendix E**), the capacity of all sewers downstream of the proposed building exceed the capacity of the pumping station (see **Section 4.4.1**). Therefore no additional sanitary sewers require upsizing.

4.5 Summary and Conclusions

In conclusion the proposed development meets all required servicing constraints and associated design criteria/requirements.

5 Storm Servicing and Stormwater Management

5.1 Background

The majority of the site presently drains to a network of catch basins. All storm water drained from the existing site flows into Network #1 (as defined by the Infrastructure Master Plan), which eventually discharges in the Rideau River at the east limit of Campus, near Bronson Avenue. There are currently no stormwater quantity control measures within the site.

As indicated in the Infrastructure Master Plan, Network #1 (which serves the project area) has pipes that are undersized for a 5-year storm event. This includes pipes within and downstream of the proposed site. The pipes within and downstream of the proposed site generally have sufficient (or near-sufficient) capacity for a 2-year storm event.

The majority of the University does not have a dual drainage system. Many existing catch basins and catch basin manholes are uncontrolled. Overland flow routes have not been engineered, for the most part, which has resulted in instances of surface flooding, often associated with high levels in the Rideau River. Accordingly, there is benefit to introducing flow control devices for the storm sewer system, during the implementation of new projects.

The Infrastructure Master Plan therefore recommends that all new buildings should be provided with storm water management quantity control to limit flows to be equal to or less than existing conditions.

The City of Ottawa's Sewer Design Guidelines require the 100-year post-development storm flow to be restricted to the 5-year pre-development run-off with an assumed pre-development coefficient no greater than 0.5.

5.2 Storm Servicing Strategy including Analysis of Existing Infrastructure

For the New Residence Building, it is proposed that the 100-year post-development flow be restricted to the 2-year pre-development run-off (calculated at a pre-development run-off coefficient of 0.5) to meet the capacity of downstream sewers. The 100-year flow will be detained on site. This will significantly reduce flows to the Network #1 storm sewers during storms exceeding the 2-year event, and will also reduce overland flows and associated flooding risks.

New storm sewers on the site will be designed with 5-year capacity in accordance with City requirements.

Quantity control meeting these requirements will be provided through the use of on-site detention and flow control devices. All quantity control requirements are currently proposed to be met through the use of underground storage tanks. During design development, opportunities to utilize low impact development technologies were explored. Opportunities considered, and the conclusions reached after evaluation, include:

- Possible implementation of a green roof on part of the proposed building: Part of the roof will be designed as a garden, but due to cost considerations moveable planters will be used. Although these will reduce run-off they cannot be guaranteed to be a permanent fixture, so have not been considered in the storm water management calculations.
- Use of permeable pavers: Carleton University prefers not to use permeable pavers due to maintenance considerations.
- Use of reinforced grass in lieu of asphalt for part of fire route to Stormont-Dundas House: This will be implemented, and will reduce run-off towards Stormont-Dunas House which is of particular benefit due to the lack of an emergency overland flow route in this area.
- Design of stormwater tanks as retention rather than detention systems (i.e. to allow infiltration): Not implemented due to retaining wall footings below stormwater tank.
- Inclusion of bioretention within proposed terraced retaining walls between proposed building and Stormont-Dundas House: Not implemented because this could result in overflow to the low area adjacent to Stormont-Dundas House.

5.3 Proposed Storm Servicing

Proposed storm servicing is indicated on Drawing C001 in **Appendix A**. The proposed pre-development and post-development catchment areas, runoff coefficients and catchment total areas are indicated on the Drainage Area Plans, also in **Appendix A**.

5.3.1 Design Criteria (Minor and Major Systems)

For the design of stormwater management (SWM), the City of Ottawa's criteria for a Commercial/ Institutional/ Industrial development in an existing area will be applied (Section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines), except where modified as described in the following summary of the City's key SWM requirements:

- On-site SWM measures required to avoid impact on downstream system (i.e. existing storm sewers).
- Runoff to be controlled to the 2-year pre-development level. (This is more stringent than the City's requirement for control to the 5-year pre-development level, and will be applied due to the limited capacity of the receiving sewers, as designed above).
- Pre-development flow to be calculated using the smaller of a runoff coefficient of 0.5 or the actual existing runoff coefficient. Use either a T_c of 20 minutes or calculated the pre-development T_c but not less than 10 minutes.
- All flow depths must be controlled on-site (i.e. no spill to adjacent properties or rights-of-way for flows up to the 100-year event).
- The design should consider the 100-year return period event, address performance for specified historical storms, and be stress tested for Climate Change using design storms calculated on the basis of a 20% increase of the City's IDF curves for rainfall events. Any instances of severe flooding identified through the stress test must be rectified.

Key drainage design requirements from the City of Ottawa Sewer Design Guidelines include:

- The minor system (underground storm sewers) is designed to capture the 5-year event (minimum). Inlet Control Devices should be utilized to minimize surcharging during the 100-year event.
- The minor system is designed to convey the 5-year event, with the hydraulic grade line (HGL) below the crown of the pipe (except where impacted by boundary conditions – in which case the HGL shall not exceed 0.3m below the underside of the footings during the 100-year event).
- For events greater than the 100 year return period, spillage is directed to a public ROW and not to neighbouring private property.
- The site grading ensures that the property being developed is higher than the spill elevation of the adjacent municipal ROW. This is considered especially critical if underground parking is being proposed. The grading ensures sufficient positive drainage away from the building, with a minimum slope from the building to the street of 2% and building openings a minimum of 0.3m above the 100-year ponding level. If reduced lot grading is considered for an increase in travel time and infiltration, the 2% minimum grade is still maintained for at least 4m from the building.

- The maximum water depth on streets (public, private and parking lots), static or dynamic, is 350 mm.

- Where underground storage is utilized, the design must ensure that backwater from the downstream system does not impact the required storage.

In addition to the City of Ottawa's guidelines, requirements for storm water quality control will be considered. The Rideau Valley Conservation Authority (RVCA) has been contacted and confirmed that on-site stormwater quality control for this site will not be required. The correspondence is included as part of **Appendix B**.

5.3.2 Stormwater Quantity Control

5.3.2.1 Runoff Coefficient and Peak Flows

Table 7 indicates the run-off coefficient for each catchment. The 100-year run-off coefficients include a 25% increase (to a maximum of 1.0) as required by the City of Ottawa Sewer Design Guidelines Section 5.4.5.2.1.

Table 7– Pre-development Run-off Coefficients

	Pre-Development Run-off Coefficients	
Storm Event	**2-Year Storm**	**100-Year Storm**
Site Area (in ha)	0.722	0.722
Run-off Coefficients	0.58	0.73

Intensity (i) is calculated using the formula:

$$i = \frac{A}{(T_d + C)^B}$$

Where A, B and C are all factors of the IDF Return Period, T_d being the time of concentration and A the drainage area (Detailed calculations provided in **Appendix F**).

Time of concentration is determined using the inlet time graph (Appendix 5D Ottawa City Sewer Design Guidelines) which results in a values less than 10 minutes. Therefore 10 minutes will be used to calculate peak flows. With the pre and post-development run-off coefficients and rainfall intensity, the peak flows for each drainage area can be calculated using the Rational Method. The results (using actual run-off coefficients) are summarized in **Table 8**.

Table 8– Pre-Development Peak Flows

	Pre-Development Peak Flows (actual run-off coefficients)	
Storm Event	**2-Year Storm**	**100-Year Storm**
Intensity (mm/hr)	76.8	178.6
Peak Flow (L/s)	89.5	260.2

Since the pre-development run-off coefficient exceeds 0.5, a value of 0.5 will be assumed for calculation of the allowable release rate. Considering time of concentration of 10 minutes, site area of 0.722 hectares and a 2 year storm, **the allowable release rate is 77.1 L/s**.

The project will result in an increase in impervious area. The post-development run-off coefficients are indicated in **Table 9**:

Table 9– Overall Post-Development Run-off Coefficients

	Overall Post-Development Run-off Coefficients	
Storm Event	**5-Year Storm**	**100-Year Storm**
Project Area (in ha)	0.722	0.722
Weighted Run-Off Coefficient	**0.90**	**1.00**

5.3.2.2 Stormwater Management Concept

Uncontrolled Drainage Areas (B1 and B2)

It is not feasible to capture run-off from the proposed sidewalks and paved entrance area along the east side of the site (Area B2). This run-off will be released uncontrolled to catchbasins on Campus Avenue.

In addition, due below-ground utilities, and the low elevation of Stormont-Dundas House, it is not feasible to provide stormwater detention storage for run-off from Area B1 (the proposed new fire route to Stormont-Dundas House, and the areas below the proposed terraced retaining wall). Run-off from Area B1 will be released uncontrolled to catchbasins.

Table 10– Post-Development Uncontrolled Release

	Post-Development Uncontrolled Release	
Storm Event	**5-Year Storm**	**100-Year Storm**
Drainage area (ha)	0.121	0.121
Run-off Coefficient	0.72	0.90
Peak Flow (L/s)	25.4	54.4

This leaves a remaining allowable release rate of **22.7 L/s**.

Controlled Drainage Areas BLDG, A1, A2, A3 and A4

The drainage from the roof (BLDG), paved area between the new building and Leeds House (A1 and A2), patio area (A3) and a landscaped area at the south-east of the proposed building (A4) will be captured and directed to an underground storage tank located below the proposed plaza south of the building. The building courtyard is included in the roof area, since the courtyard will be on a roof above the first storey and basement of the building.

The tank will outlet to a maintenance hole fitted with an Inlet Control Device (ICD). Downstream of the ICD the storm service will outlet to the proposed relocated storm sewer south of the building.

The underground storage tank is to be wrapped in a watertight impermeable geomembrane due to the soil condition and because the seasonally high groundwater table depth is less than 1m below the bottom of the tank. This is in accordance with the Ministry of Environment, Conservation and Parks Stormwater Management Planning and Design Manual (March 2003), which precludes infiltration galleries within 1m above the seasonally high groundwater table.

As indicated by the proposed storage calculations, the required underground storage for the southern tank is 176.9m^3. This will be provided using a rectangular plastic geocellular stormwater storage tank (ACO Storm Brixx). Assuming a void ratio of 0.97 (as per documentation for a typical tank in **Appendix F**), appropriate tank dimensions are 33.6m long by 3.0m wide by 1.8m tall, providing a volume of 178m^3. Shop drawings for the tank are provided in **Appendix F**. Because the tank is located close to the proposed building, it will be specified to be wrapped in a watertight geomembrane.

Based on the orifice calculation, the outlet will require a Hydrovex 125VHV-2 Vortex ICD, providing a maximum allowable release rate of 24.8 L/s during the 100-year event.

The tanks are designed such that the tank volume is based on the 100 year storm event, and therefore the 100-year HWL (62.55 m) is approximately at the top of the tank. All stormwater sewer pipes upstream of the ICD have been sized for the 100 year storm. A summary of the SWM results are provided in **Appendix F**.

Controlled Drainage Area A5

The drainage from the access road north of the building (A5) will be captured and directed to an underground storage tank located beneath the boulevard.

The tank will outlet to a maintenance hole fitted with an Inlet Control Device (ICD). Downstream of the ICD the storm service will outlet to the proposed relocated storm sewer south of the building.

The underground storage tank is to be wrapped in a watertight impermeable geomembrane due to the soil condition and because the seasonally high groundwater table depth is less than 1m below the bottom of the tank. This is in accordance with the Ministry of Environment, Conservation and Parks Stormwater Management Planning and Design Manual (March 2003), which precludes infiltration galleries within 1m above the seasonally high groundwater table.

As indicated by the proposed storage calculations, the required underground storage for the southern tank is 40.7m^3. This will be provided using a rectangular plastic geocellular stormwater storage tank (ACO Storm Brixx). Assuming a void ratio of 0.97 (as per documentation for a typical tank in **Appendix F**), appropriate tank dimensions are 12.0m long by 3.0m wide by 1.2m tall. Shop drawings for the tank are provided in **Appendix F**. Because the tank is located close to the proposed building, it will be specified to be wrapped in a watertight geomembrane.

Based on the orifice calculation, the outlet will require a Hydrovex 75VHV-1 Vortex ICD, providing a maximum allowable release rate of 6.0 L/s during the 100-year event.

The tanks are designed such that the tank volume is based on the 100 year storm event, and therefore the 100-year HWL (64.55 m) is approximately at the top of the tank. All stormwater sewer pipes upstream of the ICD have been sized for the 100 year storm. A summary of the SWM results are provided in **Appendix F**.

Summary

Table 11 summarizes the proposed release rates and confirms that the total release rate does not exceed the allowable release rate.

Table 11 – Post-Development Controlled Peak Flows

	Post-Development Controlled Peak Flows (L/s)
Allowable Release Rate	77.1
Release Rate from Uncontrolled Drainage Areas	46.3
Release Rate from Controlled Drainage Areas (South Tank)	24.8
Release Rate from Controlled Drainage Areas (North Tank)	6.0
Total Release Rate	77.1

Table 12 summarizes the stormwater management measures for the proposed development.

Table 12 – Stormwater Management Summary Table

Area ID	Area (ha)	Release Rates (L/s)		Storage Required		Max Storage Available		ICD	
		5-Yr	100-Yr	5-Yr	100-Yr	5-Yr	100-Yr	Size	Location
BLDG+A1+A2 +A3+A4	0.50	18.9	24.8	95.8	176.9	178.0	178.0	HYDRO VEX 125VHV-2	SWM Tank South
A5	0.102	4.5	6.0	22.2	40.7	42.0	42.0	HYDRO VEX 75VHV-1	SWM Tank North
Total	0.60	23.4	30.8	117.9	217.6	220.0	220.0	-	-

5.3.2.3 Impact on Existing Stormwater Infrastructure

Overall run-off from the site to the storm sewers will be significantly reduced by the proposed development:

Table 13 – Pre-Development Peak Flows vs. Post-Development Controlled Peak Flows

	Pre-Development Peak Flow (L/s)		Post-Development Controlled Peak Flow (L/s)	
Storm Event	**5-Year Storm**	**100-Year Storm**	**5-Year Storm**	**100-Year Storm**
Total run-off (L/s)	121.5	260.2	45.0	77.1

This shows a reduction in total run-off of 70% when compared to the uncontrolled pre-development peak flow.

Sewer Design Calculations and a summary of ICD and SWM results are provided in **Appendix F.**

5.3.2.4 Maintenance and Inspection of Stormwater Storage Tanks

In accordance with the manufacturer's guidelines, the proposed ACO Storm Brixx tanks will require maintenance and inspection similar to other sewer components (sewers, maintenance holes and catchbasins). This includes CCTV inspection and flushing, which is recommended to be carried out twice during the first year of operation. After the first year, an ongoing inspection and maintenance (CCTV and flushing) schedule should be developed. Ongoing inspection and maintenance is typically required to be carried out every 1-5 years, but the frequency should be determined based on the observed levels of sediment removed during the first year.

The proposed tanks are equipped with inspection and access ports, to allow CCTV and flushing to be carried out.

5.3.2.5 Catchbasin Capture Analysis

The following proposed catchbasins are required to capture the 100-year flow:

CBMH9 (dual flat grate), CB1 (single curb inlet), CBMH1, CB4, CB6, CB7, CB8 (all single inlet flat grate), DICB5 (ditch inlet)

The highest 100-year flow to a single curb inlet catchbasin is at CB1 (49.6 L/s L/s). As indicated by Figure A in **Appendix F**, the ponding depth under this flow rate is 58 mm.

The highest 100-year flow to a single inlet flat grate catchbasin is at CB6 (48.9 L/s L/s). As indicated by Figure B in **Appendix F**, the ponding depth under this flow rate is 96 mm.

The highest 100-year flow to a dual inlet catchbasin is at CBMH9 (79.9 L/s). As indicated by Figure B in **Appendix F**, the ponding depth under this flow rate is 76 mm.

The highest 100-year flow to a ditch inlet is at DICB5 (4.5 L/s L/s). As indicated by Figure C in **Appendix F**, the ponding depth under this flow rate is 20 mm.

In all cases this is less than the 350 mm maximum allowable.

5.3.2.6 Culvert Design

A pathway culvert is proposed at the south-east corner of the NSR to convey run-off to DICB5. Considering the very small catchment of this culvert, short culvert length, and to avoid an excessive drop adjacent to the pathway, a 300 mm diameter culvert is proposed. Landscape plantings are expected to be well maintained in this area, which reduces the likelihood of the culvert becoming blocked.

5.3.3 Storm Water Quality Control

As indicated in **Section 5.3.1** above, the RVCA does not require quality control for this project. Correspondence is provided in **Appendix B**.

5.3.4 Pre-Consultation with the Ontario Ministry of the Environment and Conservation and Parks, and Conservation Authority

The Ministry of Environment, Conservation and Parks (MECP) has been contacted and has confirmed that no ECA is required for this site. Correspondence is provided in **Appendix B**.

5.3.5 Minor and Major Systems

The minor storm sewer system consists of the sewers described above. The major system consists of flow south through the campus to the Rideau River. To the extent possible, the site will be graded to direct run-off from storms in excess of the 100-year event to Campus Avenue, from where flow can continue south towards the river. Further discussion is provided in **Section 5.4** below.

5.3.6 Impacts to Receiving Watercourses

No negative impacts to receiving watercourses are anticipated.

5.3.7 100 Year Flood Levels and Major Flow Routing

The site is not within a 100-year floodplain.

5.4 Grading

The proposed grading plan is shown in Drawing C003 in **Appendix A**. The key objectives of the proposed grading are as follows:

- Provide step-free access to ground floor at all entrances
- Provide a slope away from the building for drainage (minimum 2% to the curb)
- Direct overland flow from Parking Lot 6 away from the building, and away from the existing depressed area along the north side of Leeds House
- Minimize the area draining to catchbasins within the depressed area along the north side of Stormont-Dundas House

- Prevent overland flow on Campus Avenue from entering the proposed new fire route which slopes down to Stormont-Dundas House
- Direct flows in excess of the 100-year event towards Campus Avenue, to the extent possible.

Retaining walls are required to overcome the significant difference in grade between the site and Stormont-Dundas House. These walls should be designed by a structural engineer.

On the west side of the site, the proposed grades are high enough to enable the existing pedestrian tunnel to be extended into the basement of the building.

5.5 Emergency Overland Flow

As defined by the MOE Stormwater management plan and SWMP design guidelines:

"Overland flow paths must be designed to accommodate runoff that exceeds the storage capacity at the catchbasins. Debris blocking at the catchbasin grate can reduce outflow rates and create overflows. Overland flow paths can be sewers, swales or the roadway system."

The site grading design provides emergency overland flow via Campus Avenue, which is already designated a major system flow route in the Master Plan **(Appendix K)**. The system upstream of the southern SWM tank is designed to overflow via CB5 into Campus Avenue. Similarly the system upstream of the northern SWM tank is designed to overflow via CB1 into Campus Avenue.

The uncontrolled flow draining the area between Stormont-Dundas house and the proposed building via CB8 will overflow to the Stormont-Dundas House courtyard. As described in **Section 5.4** the area draining to this catchbasin has been greatly reduced, and thereby the emergency overflow shows an improvement over the existing conditions.

5.6 Fire Access Routes

Fire access to Leeds House and Stormont-Dundas House is currently provided by an access road and roundabout within the site boundary.

Fire access to Leeds House will be maintained by providing a clear 6m-wide route through the proposed paved plaza between the new building and Leeds House, connecting to the existing fire route along the south side of Leeds House. Since the length of this route is less than 90m (the actual length is approximately 85m), no turnaround is required.

Fire access to Stormont-Dundas House will be maintained by constructing a new 6m-wide access route from Campus Avenue to within 15m of the existing building entrance and fire department connection.

5.7 Erosion and Sediment Control

As described in the servicing guidelines, an erosion and sediment control plan is required for implementation during the construction phase. To minimize the migration of sediments, items such as silt fencing and sediment capture devices for catch-basins downstream of the site and around the building are to be installed to capture and retain sediment. Additionally, all stockpiles are to be covered.

During construction, all erosion control features shall be maintained and repaired as necessary and adjacent roadways kept free of construction debris and sediment this responsibility falls under the prevue of the Contractor.

6 Conclusions

In conclusion the proposed development meets all required servicing constraints and associated design criteria/requirements as well as the additional City of Ottawa requirements identified in the pre-consultation phase. It is recommended that this report be submitted to the City of Ottawa in support of the application for site plan approval.

Sincerely,

Morrison Hershfield Limited

James Fookes, P.Eng., C.Eng.
Senior Municipal Engineer

Daniel Glauser, B.Eng.
Municipal Designer

7 Appendices

Appendix A Site Servicing, Grading and Erosion and Sediment Control, Catchments Plans and Details

Appendix B MECP, RVCA and City of Ottawa Specific Requirements Correspondence

Appendix C Water Demand and FUS Calculations

Appendix D Sanitary Flow Calculations

Appendix E Excerpts from Infrastructure Master Plan

Appendix F Storm Sewer Design Calculations

Appendix G Topographic and Legal Survey

Appendix H Sewer CCTV Reports

Appendix I Site Servicing Checklist

Appendix J Maintenance Hole Inspections

Appendix K 2016 Master Plan Excerpts

Appendix L Relevant As-Builts from Carleton University Archives

Appendix M TSH Flow Monitoring Report

Appendix A

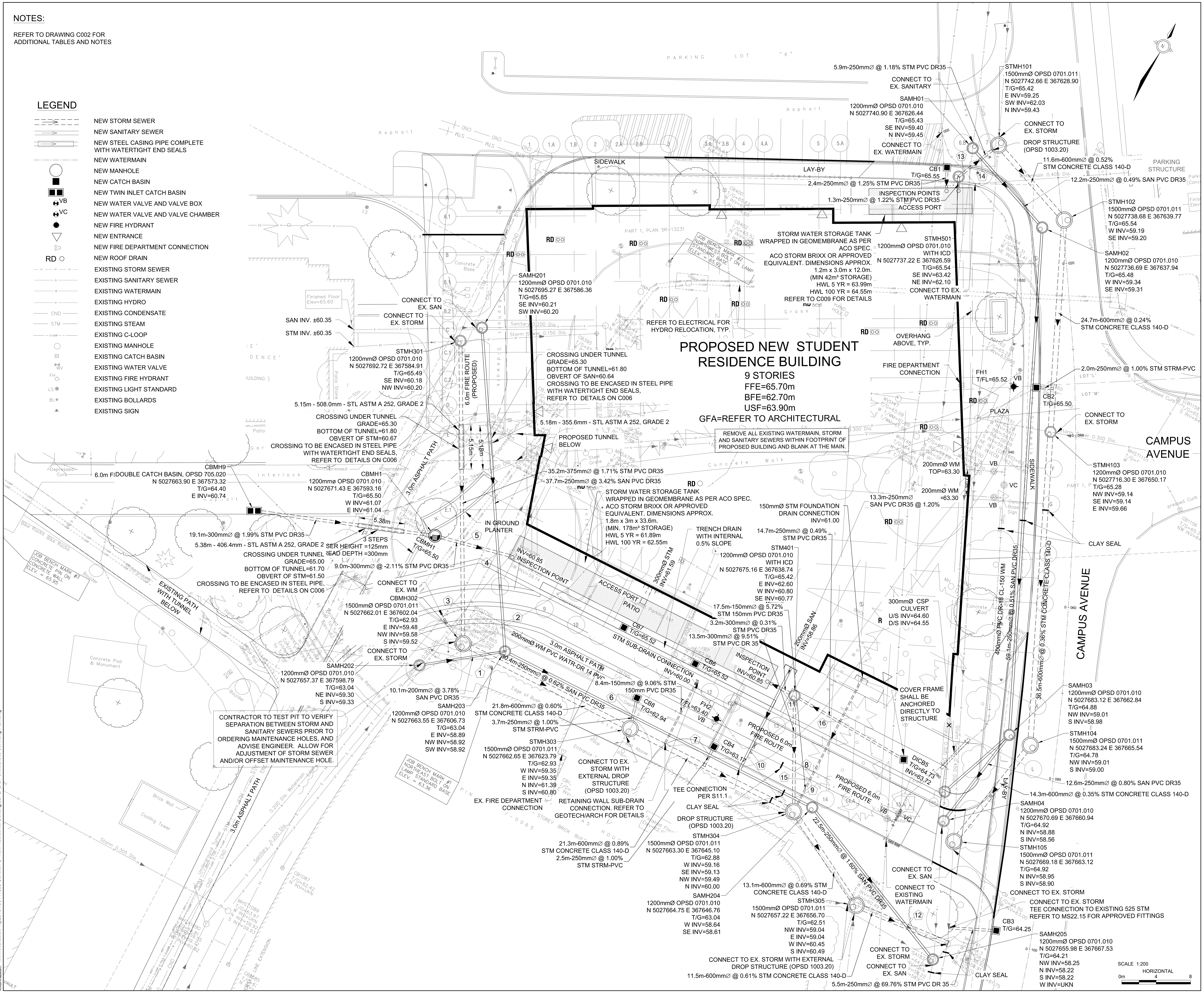
Site Servicing, Grading and Erosion and Sediment Control, Catchments Plans and Details

NOTES:

REFER TO DRAWING C002 FOR ADDITIONAL TABLES AND NOTES

LEGEND

- NEW STORM SEWER
- NEW SANITARY SEWER
- NEW STEEL CASING PIPE COMPLETE WITH WATERTIGHT END SEALS
- NEW WATERMAIN
- NEW MANHOLE
- NEW CATCH BASIN
- NEW TWIN INLET CATCH BASIN
- VB NEW WATER VALVE AND VALVE BOX
- VC NEW WATER VALVE AND VALVE CHAMBER
- NEW FIRE HYDRANT
- NEW ENTRANCE
- NEW FIRE DEPARTMENT CONNECTION
- RD NEW ROOF DRAIN
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING HYDRO
- CND EXISTING CONDENSATE
- STM EXISTING STEAM
- EXISTING C-LOOP
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- WV EXISTING WATER VALVE
- FH EXISTING FIRE HYDRANT
- LS EXISTING LIGHT STANDARD
- BL EXISTING BOLLARDS
- EXISTING SIGN



MORRISON HERSHFIELD

200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1

KEY PLAN

ISSUED

No.	Date	Description
1	13/12/2019	ISSUED FOR SITE PLAN APPROVAL
2	30/01/2020	ISSUED FOR 100% DD
3	16/03/2020	REISSUED FOR SITE PLAN APPROVAL
4	31/03/2020	ISSUED FOR COORDINATION
5	07/04/2020	ISSUED FOR FOUNDATION PERMIT
6	27/07/2020	ISSUED FOR 80% INTERNAL COORDINATION
7	11/08/2020	REISSUED FOR SITE PLAN APPROVAL
8	31/08/2020	REISSUED FOR SITE PLAN APPROVAL

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
AUG 31,2020
PROVINCE OF ONTARIO

Diamond Schmitt Architects

KWC Architects Inc.

CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

SITE SERVICING PLAN

Scale: 1:200
Project No: 190444600
Date: 31/08/20

C001

#18030

D07-12-19-0205

NOTES:

GENERAL

1. COORDINATES ARE IN MTM ZONE 9 (76°30' WEST LONGITUDE) NAD-27 (ORIGINAL)
2. OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA PRIOR TO STARTING CONSTRUCTION
3. SERVICES ARE TO BE CONSTRUCTED TO 1.0m FROM FACE OF BUILDING.
4. REFER TO "SITE SERVICING AND STORMWATER MANAGEMENT DESIGN BRIEF" PREPARED BY MORRISON HERSHFELD.
5. REFER TO GEOTECHNICAL INVESTIGATION REPORT (DEC 2019 GEOTECH REPORT AND JULY 2020 SUPPLEMENTARY MEMORANDUM) PREPARED BY WSP FOR SUBSURFACE CONDITIONS, CONSTRUCTION RECOMMENDATIONS AND GEOTECHNICAL INSPECTION REQUIREMENTS. THE GEOTECHNICAL CONSULTANT SHALL REVIEW EXCAVATIONS PRIOR TO THE PLACEMENT OF GRANULAR MATERIAL.
6. CONTRACTOR TO VERIFY ALL EXISTING UTILITY ELEVATIONS AT CONNECTION AND CROSSING LOCATIONS PRIOR TO CONSTRUCTION AND ADVISE THE ENGINEER OF ANY DISCREPANCIES.
7. UNLESS DIRECTED OTHERWISE ANY DAMAGED ASPHALT OR CURB (REGARDLESS OF WHETHER WITHIN OR EXTERNAL TO THE SITE) SHALL BE REINSTATED IN ACCORDANCE WITH CITY STD. DET. R10 AND S1.
8. UNLESS DIRECTED OTHERWISE THE CONTRACTOR SHALL REINSTATE ALL SIGNS, LIGHTING AND OTHER STREET FURNITURE DISTURBED BY THE WORK.
9. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT TRAFFIC MANAGEMENT PLANS FOR WORK IN RIGHT OF WAY (INCLUDING CAMPUS ROADWAYS) IN ACCORDANCE WITH OTM BOOK 7.
10. CLAY SEALS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA STANDARD DETAIL S8 AND SHALL BE INSTALLED WHERE SPECIFIED. CLAY SEAL TO EXTEND FULL TRENCH WIDTH AND FROM BOTTOM OF TRENCH EXCAVATION TO UNDERSIDE OF ROAD STRUCTURE, WITH A MINIMUM THICKNESS OF 1m ALONG PIPE.
11. LOCATE AND CAP ALL EXISTING STORM, SANITARY AND WATER SERVICES AT THE PROPERTY LINE. ABANDON EXISTING SERVICES WITHIN THE R.O.W. PER STANDARD CITY OF OTTAWA DETAIL S11.4. (TYPICAL)
12. REFER TO CCTV SEWER INSPECTION REPORT PREPARED BY CLEAN WATER WORKS INC. DATED NOVEMBER 19, 2019.
13. TOPOGRAPHICAL SURVEY PREPARED BY FAIRHALL MOFFATT & WOODLAND LIMITED DATED NOVEMBER 21, 2019.
14. CLASS S-3 CONCRETE IS REQUIRED FOR ANY CONCRETE WORKS PROPOSED 4M BELOW GRADE AS PER THE GEOTECHNICAL RECOMMENDATIONS.
15. REFER TO C006 FOR PIPE CASING DETAIL.

SEWERS

16. ALL STORM SEWERS, SANITARY SEWERS AND CATCH BASINS LEADS SHALL BE PVC DR 35 UNLESS OTHERWISE SPECIFIED.
17. REFER TO DETAIL ON DRAWING C005 FOR SEWER INSTALLATION.
18. MAINTENANCE HOLES AND CATCH BASIN MAINTENANCE HOLES ON STORM SEWERS LESS THAN 900mm DIAMETER SHALL BE CONSTRUCTED WITH A 300mm SUMP. BENCHING SHALL BE INSTALLED IN MAINTENANCE HOLES ON STORM SEWERS 900mm AND ABOVE.
19. CONTRACTOR SHALL MAINTAIN EXISTING SEWER FLOWS DURING CONSTRUCTION IN ACCORDANCE WITH CITY OF OTTAWA SPECIFICATIONS.
20. ALL MAINTENANCE HOLES, CATCHBASINS AND CLEANOUTS SHALL BE ADJUSTED TO POST-CONSTRUCTION GRADE.
21. CCTV INSPECTION OF ALL NEW SEWERS AND THE FIRST SEGMENT OF EXISTING SEWERS UPSTREAM AND DOWNSTREAM OF CONNECTION POINTS SHALL BE COMPLETED AS PER CITY OF OTTAWA SPECIFICATIONS PRIOR TO THE INSTALLATION OF BASE COURSE ASPHALT.

WATERMAINS

22. REFER TO DETAIL ON DRAWING C005 FOR WATERMAIN INSTALLATION.
23. ALL WATERMAIN MATERIALS AND CONSTRUCTION METHODS SHALL BE IN ACCORDANCE WITH THE 2019 EDITION OF THE CITY OF OTTAWA STANDARD SPECIFICATIONS AND STANDARD DRAWINGS. PVC PIPE TO BE CLASS 150 DR18 TO LATEST EDITION OF A.W.W.A. SPECIFICATION C900 AND CSA B137.3 LATEST AMENDMENT WITH GASKETED BELL AND SPIGOT COUPLINGS.
24. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING A WATER PERMIT AS REQUIRED FROM THE CITY OF OTTAWA, AND COMPLYING WITH ALL CITY OF OTTAWA REQUIREMENTS. THE CITY MAY REQUIRE THAT CERTAIN ACTIVITIES (E.G. VALVE OPERATION, CONNECTION OF NEW WATER SERVICE TO EXISTING WATERMAIN, DISINFECTION) BE CARRIED OUT ONLY BY CITY FORCES.
25. ALL VALVES 300mm DIAMETER AND SMALLER SHALL INCLUDE A VALVE BOX AS PER W24.
26. THE NEW WATERMAIN IS TO BE INSTALLED WITH A MINIMUM OF 2.4m COVER (INCLUDING HYDRANT LEAD). WHERE 2.4m COVER IS NOT POSSIBLE, PROVIDE INSULATION IN ACCORDANCE WITH CITY OF OTTAWA STANDARD DETAILS W22 & W23.
27. THRUST RESTRAINT SHALL BE PROVIDED BY BOTH RESTRAINING/RETAINING RINGS AND THRUST BLOCKS AT ALL DEAD END CAPS, PLUGS, VALVES, BENDS AND REDUCERS AS PER CITY OF OTTAWA STANDARD DETAILS W25.3, W25.4, W25.5 AND W25.6. ALL TEMPORARY THRUST RESTRAINTS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
28. TRACER WIRE SHALL BE PROVIDED FOR ALL NEW PVC WATERMAINS IN ACCORDANCE WITH THE SPECIFICATIONS AND CITY OF OTTAWA STANDARD DETAIL W36.
29. CATHODIC PROTECTION SHALL BE PROVIDED FOR ALL NEW WATERMAINS IN ACCORDANCE WITH THE SPECIFICATIONS AND CITY OF OTTAWA STANDARD DETAILS W39, W40, W41, W42 AND W47. CATHODIC PROTECTION OF EXISTING WATERMAINS SHALL ALSO BE PROVIDED AT CONNECTIONS BETWEEN EXISTING AND NEW WATERMAINS.
30. ADJUST ALL VALVE CHAMBERS, VALVE BOXES AND HYDRANTS TO FINISHED GRADE.
31. WATERMAIN SHUTDOWNS SHALL BE SCHEDULED A MINIMUM OF 72 HOURS IN ADVANCE. TIMING SHALL BE SUBJECT TO THE APPROVAL OF CARLETON UNIVERSITY, WHO MAY REQUIRE SHUTDOWNS TO BE AT NIGHT OR OVER WEEKENDS.

UTILITY NOTE

32. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM. THE CONTRACTOR WILL BE RESPONSIBLE FOR SUPPORTING AND PROTECTING ANY EXISTING UTILITIES, AS REQUIRED, IN ACCORDANCE WITH THE UTILITY OWNERS' REQUIREMENTS. CONTRACTOR IS REQUIRED TO OBTAIN LOCATES, IN ADVANCE OF EXCAVATION WORK, AND FORWARD COPIES OF THE LOCATES TO THE CONSULTANT AND THE OWNER PRIOR TO EXCAVATION.
33. ALL CROSSING OF EX. UTILITIES TO BE IN ACCORDANCE WITH CITY STD. DET. S10

PIPE CROSSING TABLE

1	600mmØ STM 0.26m CLEARANCE OVER 200mmØ SAN	STM INV=59.46, SAN OBV=59.20
2	200mmØ WM 1.25m CLEARANCE OVER 250mmØ SAN	WM INV=60.55, SAN OBV=59.29
3	200mmØ WM 1.38m CLEARANCE OVER 375mmØ STM	WM INV=61.40, STM OBV=60.02
4	300mmØ STM 1.26m CLEARANCE OVER 250mmØ SAN	STM INV=60.82, SAN OBV=59.56
5	300mmØ STM 0.76m CLEARANCE OVER 375mmØ STM	STM INV=60.92, STM OBV=60.15
6	250mmØ STM 2.33m CLEARANCE OVER 250mmØ SAN	STM INV=61.37, SAN OBV=59.03
7	250mmØ STM 1.87m CLEARANCE OVER 250mmØ SAN	STM INV=60.84, SAN OBV=58.97
8	200mmØ WM 0.40m CLEARANCE OVER 300mmØ STM	WM INV=60.65, STM OBV=60.24
9	300mmØ STM 0.72m CLEARANCE OVER 250mmØ SAN	STM INV=59.62, SAN OBV=58.90
10	200mmØ WM 1.81m CLEARANCE OVER 200mmØ SAN	WM INV=60.87, SAN OBV=59.06
11	250mmØ STM 1.73m CLEARANCE OVER 200mmØ SAN	STM INV=60.80, SAN OBV=59.06
12	600mmØ STM 0.42m CLEARANCE OVER 250mmØ SAN	STM INV=59.00, SAN OBV=58.58
13	400mmØ WM 0.39m CLEARANCE OVER 250mmØ STM	WM INV=62.73, STM OBV=62.33
14	250mmØ STM 2.40m CLEARANCE OVER 250mmØ SAN	STM INV=62.05, SAN OBV=59.64
15	200mmØ WM 1.79m CLEARANCE OVER 150mmØ STM	WM INV=61.70, STM OBV=59.90
16	250mmØ STM 1.76m CLEARANCE OVER 150mmØ STM	STM INV=62.23, STM OBV=60.47

INLET CONTROL DEVICE DATA TABLE - STMH401

DESIGN EVENT	ICD TYPE	DIAMETER OF OUTLET PIPE (mm)	DESIGN FLOW (L/s)	WATER ELEVATION (m)	REQUIRED VOLUME (m³)	TOTAL VOLUME PROVIDED (m³)
1:5 YR	HYDROVEX 125VHV-2	300mmØ PVC	12.7	61.89	95.8	179
1:100 YR	HYDROVEX 125VHV-2	300mmØ PVC	16.7	62.55	176.8	179

REFER TO PLAN C005 FOR ICD SELECTION CHARTS

NEW STORM STRUCTURE

STRUCTURE	STRUCTURE TYPE	COVER TYPE	TOP OF GRATE	INVERT	NORTHING	EASTING	NOTES
STMH101	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	65.42	59.25 (E) 62.03 (SW) 59.43 (N)	5027742.66	367628.90	SEE NOTE 2
STMH102	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	65.54	59.19 (W) 59.20 (SE)	5027738.68	367639.77	SEE NOTE 2
STMH103	701.010	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	65.28	59.14 (NW) 59.14 (SE) 59.66 (E)	5027716.30	367650.17	SEE NOTE 2
STMH104	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	64.78	59.00 (NW) 59.00 (S)	5027683.24	367665.54	SEE NOTE 2
STMH105	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	64.92	58.95 (N) 58.90 (S)	5027669.18	367663.12	SEE NOTE 2
STMH301	701.010	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	65.49	60.18 (SE) 60.20 (NW)	5027692.72	367584.91	SEE NOTE 2
CBMH302	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	62.93	59.48 (E) 59.58 (NW)* 59.52 (S)	5027662.01	367602.04	SEE NOTE 2 SEE NOTE 4
STMH303	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	62.93	59.35 (W) 59.35 (E) 61.39 (N) 60.80 (S)	5027662.65	367623.79	
STMH304	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	62.88	59.16 (W) 59.13 (SE) 59.49 (NW) 60.00 (N)	5027663.30	367645.10	SEE NOTE 1
STMH305	701.011	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	62.51	59.04 (NW) 59.04 (E) 60.45 (W) 60.49 (S)	5027657.22	367656.70	SEE NOTE 1
STMH401	701.010	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	65.42	62.60 (E) 60.80 (W) 60.77 (SE)	5027675.16	367638.74	SEE ICD TABLE SEE NOTE 1
STMH501	701.010	S24.1 OR OSPD 401.010 TYPE B (SEE NOTE 3)	65.54	63.42 (SE) 62.10 (NE)	5027737.22	367626.59	SEE NOTE 4

* ESTIMATED INVERT: CONTRACTOR TO VERIFY BY TEST-PITTING PRIOR TO ORDERING STRUCTURE.
NOTE 1: COVER FRAMES TO BE ANCHORED PER S.P. No. F-4070.
NOTE 2: SAFETY PLATFORM TO BE INSTALLED IN STRUCTURE PER OPSD 404.020.
NOTE 3: COVER TO INCLUDE 'STORM' TEXT OR FISH SYMBOL, AND 'DANGER' TEXT. NO 'OTTAWA' TEXT OR LOGO TO BE INCLUDED.
NOTE 4: INCLUDE INSULATION BETWEEN STRUCTURES AND WATERMAIN AS PER W23.

NEW SANITARY STRUCTURE

STRUCTURE	STRUCTURE TYPE	COVER TYPE	TOP OF GRATE	INVERT	NORTHING	EASTING	NOTES
SAMH01	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	65.43	59.45 (N)* 59.40 (SE)	5027740.90	367626.44	SEE NOTE 2 SEE NOTE 4
SAMH02	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	65.48	59.34 (W) 59.31 (SE)	5027736.69	367637.94	SEE NOTE 2
SAMH03	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	64.88	59.01 (NW) 58.98 (S)	5027683.12	367662.84	SEE NOTE 2 SEE NOTE 4
SAMH04	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	64.92	58.88 (N) 58.56 (S)*	5027670.69	367660.94	SEE NOTE 2
SAMH201	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	65.85	60.21 (SE) 60.20 (SW)*	5027695.27	367586.36	SEE NOTE 2
SAMH202	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	63.04	59.30 (NE) 59.33 (S)*	5027657.37	367598.79	SEE NOTE 5
SAMH203	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	63.04	58.92 (NW) 58.89 (E) 59.92 (SW)	5027663.55	367603.73	SEE NOTE 4 SEE NOTE 5
SAMH204	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	63.04	58.64 (W) 58.61 (SE)	5027664.75	367646.76	SEE NOTE 1 SEE NOTE 2
SAMH205	701.010	S24 OR OSPD 401.010 TYPE A (SEE NOTE 3)	64.21	58.25 (NW) 58.22 (N) 58.22 (S) UNK (W)*	5027655.98	367667.53	SEE NOTE 1 SEE NOTE 2

* ESTIMATED INVERT: CONTRACTOR TO VERIFY BY TEST-PITTING PRIOR TO ORDERING STRUCTURE.
NOTE 1: COVER FRAMES TO BE ANCHORED PER S.P. No. F-4070.
NOTE 2: SAFETY PLATFORM TO BE INSTALLED IN STRUCTURE PER OPSD 404.020.
NOTE 3: COVER TO INCLUDE 'SANITARY' TEXT OR TOILET SYMBOL, AND 'DANGER' TEXT. NO 'OTTAWA' TEXT OR LOGO TO BE INCLUDED.
NOTE 4: INCLUDE INSULATION BETWEEN STRUCTURES AND WATERMAIN AS PER W23
NOTE 5: WATERTIGHT PER OPSD 401.030

INLET CONTROL DEVICE DATA TABLE - STMH501

DESIGN EVENT	ICD TYPE	DIAMETER OF OUTLET PIPE (mm)	DESIGN FLOW (L/s)	WATER ELEVATION (m)	REQUIRED VOLUME (m³)	TOTAL VOLUME PROVIDED (m³)
1:5 YR	HYDROVEX 75VHV-2	250mmØ PVC	4.5	63.99	22.2	42
1:100 YR	HYDROVEX 75VHV-2	250mmØ PVC	6.0	64.55	40.7	42

REFER TO PLAN C005 FOR ICD SELECTION CHARTS

NEW 200mmØ WATERMAIN

STATION	DESCRIPTION	NORTHING	EASTING	FINISHED GRADE	TOP OF WM
0+000.00	HYMAX (OR APPROVED EQUIVALENT) COUPLING & 22.5° BEND	5027663.64	367598.47	64.87	62.47*
0+001.00	11.25° BEND	5027664.48	367599.02	64.88	62.48
0+002.37	22.5° BEND	5027665.45	367599.98	64.89	62.49
0+002.50	STM CROSSING	5027665.50	367600.11	64.88	62.48
0+004.29	22.5° BEND	5027666.20	367601.76	64.91	62.51
0+007.53	SAN CROSSING	5027666.29	367604.96	64.92	62.52
0+034.62	200x200x150 TEE	5027667.10	367632.06	63.09	60.69
0+034.62	150mm VALVE AND VALVE BOX, W24	5027668.10	367632.05	63.31	60.91
0+034.62	HYDRANT, W20	5027668.46	367632.05	63.40	61.00
0+045.44	STM CROSSING	5027667.42	367642.89	63.43	61.01
0+047.56	STM CROSSING	5027667.49	367644.99	63.51	61.11
0+049.32	SAN CROSSING	5027667.54	367646.77	63.59	61.19
0+057.59	200mm VALVE AND VALVE BOX, W24	5027667.78	367655.02	64.28	61.88

* DEPTH OF EXISTING WATERMAIN TO BE DETERMINED BY CONTRACTOR. USE 2x45° BENDS TO BRING NEW WATERMAIN TO 2.4m OF COVER.

NEW 400mmØ WATERMAIN

STATION	DESCRIPTION	NORTHING	EASTING	FINISHED GRADE	TOP OF WM
1+000.00	HYMAX (OR APPROVED EQUIVALENT) COUPLING & 22.5° BEND	5027740.80	367622.38	65.33	62.93*
1+002.65	22.5° BEND	5027739.00	367624.33	65.28	62.88
1+005.44	STM CROSSING	5027738.05	367626.95	65.34	62.94
1+012.39	22.5° BEND	5027735.66	367633.49	65.54	63.14
1+017.56	22.5° BEND	5027732.16	367637.29	65.50	63.10
1+032.35	200x200x150 TEE	5027718.74	367643.52	65.54	63.14
1+032.35	150mm VALVE AND VALVE BOX, W24	5027718.88	367643.87	65.53	63.13
1+032.35	HYDRANT, W20	5027718.91	367643.87	65.52	63.12
1+042.37	200x200x200 TEE	5027709.66	367647.74	65.54	63.14
1+042.37	200mm VALVE AND VALVE BOX, W24	5027709.12	367646.58	65.57	63.17
1+042.37	CAP (1m FROM BUILDING)	5027708.22	367644.56	65.68	63.28
1+043.87	400mm VALVE AND VALVE CHAMBER, W2	5027708.30	367648.37	65.55	63.15
1+045.38	200x200x200 TEE	5027706.93	367649.01	65.55	63.15
1+045.38	200mm VALVE AND VALVE BOX, W24	5027706.48	367648.04	65.58	63.18
1+045.38	CAP (1m FROM BUILDING)	5027705.48	367645.84	65.69	63.29
1+071.22	22.5° BEND	5027683.49	367659.90	65.12	62.72
1+072.22	22.5° BEND	5027682.50	367659.94	65.14	62.74
1+079.55	STM CROSSING	5027675.65	367655.79	65.20	62.80
1+084.31	22.5° BEND	5027671.14	367655.80	65.56	63.16
1+086.53	400mm VALVE AND VALVE CHAMBER, W2	5027668.93	367655.92	64.92	62.52
1+087.68	400x400x400 TEE	5027667.79	367655.98	64.75	62.35
1+089.896	HYMAX (OR APPROVED EQUIVALENT) COUPLING & 22.5° BEND	5027665.67	367656.10	64.24	61.84

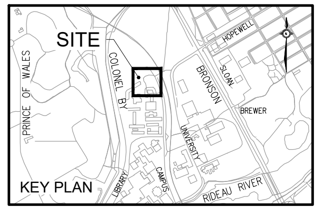
* DEPTH OF EXISTING WATERMAIN TO BE DETERMINED BY CONTRACTOR. USE 4x22.5° BENDS TO BRING NEW WATERMAIN TO 2.4m OF COVER.

CATCH BASIN DATA

NO.	COVER	STRUCT.	ELEVATION		NOTES	CB CONNECTION		
			T/FRAME	LOW/INV		DIA (mm)	TYPE	LENGTH (m)
CB1	S22	705.010B	65.55	63.32	SEE NOTE 1	250	PVC DR35	2.40
CB2	S22	705.010B	65.50	64.27	SEE NOTE 1	250	PVC DR35	2.00
CB3	S22	705.010A	64.25	63.02		250	PVC DR35	5.5
CB4	S19.1	705.010B	63.17	61.94	SEE NOTE 1	250	PVC DR35	2.50
DICB5	S19.1	705.010B	64.73	63.27	SEE NOTE 1	SEE PLAN		-
CB6	S19.1	705.010B	65.52	64.29	SEE NOTE 2	200	PVC DR35	
CB7	S19.1	705.010B	65.52	64.29	SEE NOTE 2	200	PVC DR35	
CB8	S19.1	705.010B	62.94	60.74	SEE NOTE 1	250	PVC DR35	3.70
CBMH9	S19.1	705.020	64.40	60.29		SEE PLAN		-
CBMH1	S19	701.010	65.50	59.48		SEE PLAN		-
CBMH302	S19	701.011	62.93	59.52		SEE PLAN		-

NOTE 1: INCLUDE INSULATION BETWEEN STRUCTURES AND WATERMAIN AS PER W23.
NOTE 2: CB6 AND CB7 TO OUTLET TO STORM TANK BELOW.

MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



ISSUED

No.	Date	Description
1	13/12/2019	ISSUED FOR SITE PLAN APPROVAL
2	30/01/2020	ISSUED FOR 100% DD
3	16/03/2020	REISSUED FOR SITE PLAN APPROVAL
4	31/03/2020	ISSUED FOR COORDINATION
5	07/04/2020	ISSUED FOR FOUNDATION PERMIT
6	27/07/2020	ISSUED FOR 80% INTERNAL COORDINATION
7	11/08/2020	REISSUED FOR SITE PLAN APPROVAL
8	31/08/2020	REISSUED FOR SITE PLAN APPROVAL

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
AUG 31,2020
PROVINCE OF ONTARIO

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CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

SITE SERVICING NOTES AND SCHEDULES

Scale: AS INDICATED
Project No: 190444600
Date: 31/08/20

D07-12-19-0205

C002

#18030

Consultant's Information: \\mh.local\data\Proj\2019\190444600-Carleton U- New Residence Building\09_CAD\07 Sheets\Site Servicing Plan.dwg

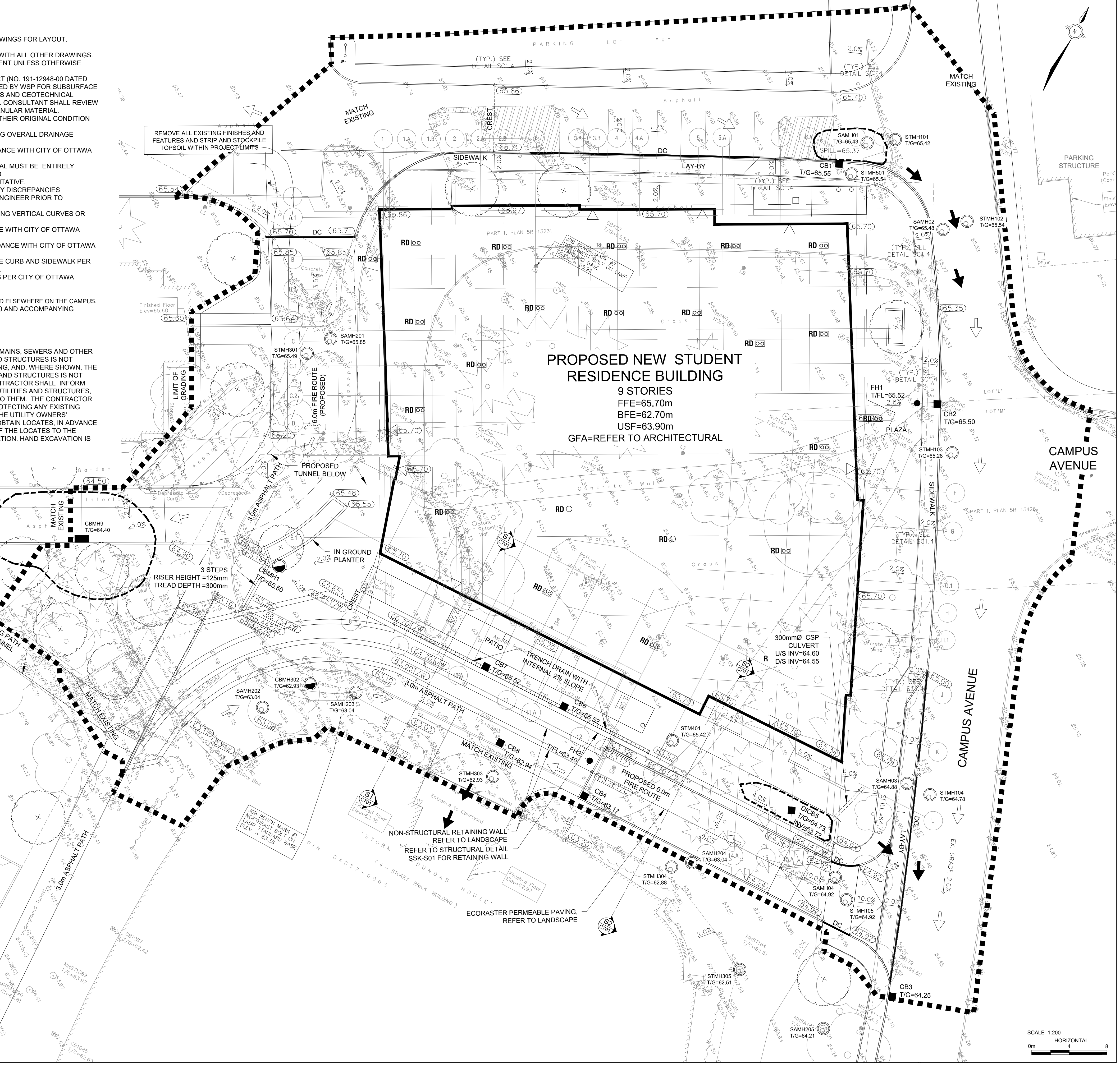
NOTES:

GRADING

1. ALL ELEVATIONS ARE GEODETIC.
2. REFER TO ARCHITECTURAL AND LANDSCAPE DRAWINGS FOR LAYOUT, DIMENSIONS AND SURFACE FINISHES.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS.
4. ALL ELEVATIONS BY CURBS ARE EDGE OF PAVEMENT UNLESS OTHERWISE INDICATED.
5. REFER TO GEOTECHNICAL INVESTIGATION REPORT (NO. 191-12948-00 DATED DECEMBER 2019, REVISED JULY 21, 2020) PREPARED BY WSP FOR SUBSURFACE CONDITIONS, CONSTRUCTION RECOMMENDATIONS AND GEOTECHNICAL INSPECTION REQUIREMENTS. THE GEOTECHNICAL CONSULTANT SHALL REVIEW EXCAVATIONS PRIOR TO THE PLACEMENT OF GRANULAR MATERIAL.
6. REINSTATE ALL DISTURBED/DAMAGED AREAS TO THEIR ORIGINAL CONDITION OR BETTER.
7. PROVIDE POSITIVE DRAINAGE, MATCHING EXISTING OVERALL DRAINAGE PATTERN INDICATED.
8. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA AND/OR ONTARIO PROVINCIAL STANDARDS.
9. ALL TOPSOIL, ORGANIC OR DELETERIOUS MATERIAL MUST BE ENTIRELY REMOVED FROM BENEATH THE PROPOSED PAVED
10. AREAS AS DIRECTED BY THE OWNER'S REPRESENTATIVE.
11. ALL AREAS SHALL DRAIN AT A MINIMUM OF 1%. ANY DISCREPANCIES PREVENTING THIS SHALL BE REPORTED TO THE ENGINEER PRIOR TO CONTINUING WORK.
12. BLEND NEW EARTHWORK INTO EXISTING, PROVIDING VERTICAL CURVES OR ROUNDING AT ALL TOP AND BOTTOM OF SLOPES.
13. CONCRETE SIDEWALKS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA STANDARD DRAWING SC1.4 AND SC4.
14. CONCRETE BARRIER CURBS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA STANDARD DRAWING SC1.1.
15. ALL SIDEWALKS SHALL BE MONOLITHIC CONCRETE CURB AND SIDEWALK PER STD. DETAIL SC 2 UNLESS OTHERWISE INDICATED.
16. SAW CUT AND KEY GRIND ASPHALT AT ALL TIE-INS PER CITY OF OTTAWA STANDARD R10.
17. PROVIDE LINE PAINTING.
18. SNOW IS TO BE REMOVED FROM THE SITE AND STORED ELSEWHERE ON THE CAMPUS.
19. REFER TO STRUCTURAL MEMO FROM MAY 05, 2020 AND ACCOMPANYING DRAWING SSK-S01 FOR RETAINING WALL DETAILS

UTILITY NOTE

20. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM. THE CONTRACTOR WILL BE RESPONSIBLE FOR SUPPORTING AND PROTECTING ANY EXISTING UTILITIES, AS REQUIRED, IN ACCORDANCE WITH THE UTILITY OWNERS' REQUIREMENTS. CONTRACTOR IS REQUIRED TO OBTAIN LOCATES, IN ADVANCE OF EXCAVATION WORK, AND FORWARD COPIES OF THE LOCATES TO THE CONSULTANT AND THE OWNER PRIOR TO EXCAVATION. HAND EXCAVATION IS REQUIRED PER UTILITY OWNERS REQUIREMENTS.



LEGEND

◎	NEW MANHOLE
■	NEW CATCH BASIN
×(64.74)	PROPOSED ELEVATION
× 71.65	EXISTING ELEVATION
×(65.50T)	PROPOSED FINISH GRADE AT TOP OF WALL OR STEP
×(63.32B)	PROPOSED FINISH GRADE AT BOTTOM OF WALL OR STEP
(63.26T/C)	PROPOSED TOP OF CURB ELEVATION
2.0%	PROPOSED SLOPE DIRECTION
⇨	DIRECTION OF MAJOR OVERLAND FLOW
➡	DIRECTION OF EMERGENCY OVERLAND FLOW
	PROPOSED CURB
DC	PROPOSED DEPRESSED CURB
	EMERGENCY SPILL ELEVATION
	HEAVY DUTY PAVEMENT - 40mm HL3 OR SP12.5 PG58-34 - 100mm HL8 OR SP19.0 PG58-34 - 150mm OF GRANULAR A - 450MM OF GRANULAR B
	MILL AND RESURFACE 40mm DEPTH
	ECORASTER PERMEABLE PAVING
	PROPOSED SWALE
	LIMIT OF PROJECT
RD	NEW ROOF DRAIN

CONTRACTOR MUST CHECK & VERIFY ALL DIMENSIONS ON THE JOB.

DO NOT SCALE DRAWINGS.

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNTIL SIGNED BY THE ARCHITECT.

MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1

KEY PLAN — SITE

ISSUED

No.	Date	Description
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4	31/03/2020	ISSUED FOR COORDINATION
5	07/04/2020	ISSUED FOR FOUNDATION PERMIT
6	27/07/2020	ISSUED FOR 80% INTERNAL COORDINATION
7	11/08/2020	REISSUED FOR SITE PLAN APPROVAL
8	31/08/2020	REISSUED FOR SITE PLAN APPROVAL

LICENSED PROFESSIONAL ENGINEER — J.G. FOOKES — AUG 31,2020 — PROVINCE OF ONTARIO

Diamond Schmitt Architects — 384 Adelaide Street West, Suite 100, Toronto, Ontario M5V 1R7 Canada — Tel: 416 862 8800, Fax: 416 862 5508, info@dsai.ca, www.dsai.ca

KWC Architects Inc. — 383 Parkdale Avenue, Suite 201, Ottawa, Ontario K1Y 4R4 Canada — Tel: 613 238 2117, Fax: 613 238 6595, kwc@kwc-arch.com, www.kwc-arch.com

CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

GRADING PLAN

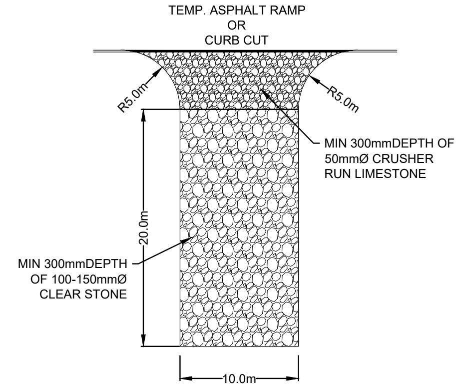
Scale: 1:200
Project No: 190444600
Date: 31/08/20

C003

#18030

D07-12-19-0205

Consultant's Information: \\mh.local\data\Proj\2019\190444600-Carleton U- New Residence Building\09_CAD\07 Sheets\Grading Plan.dwg

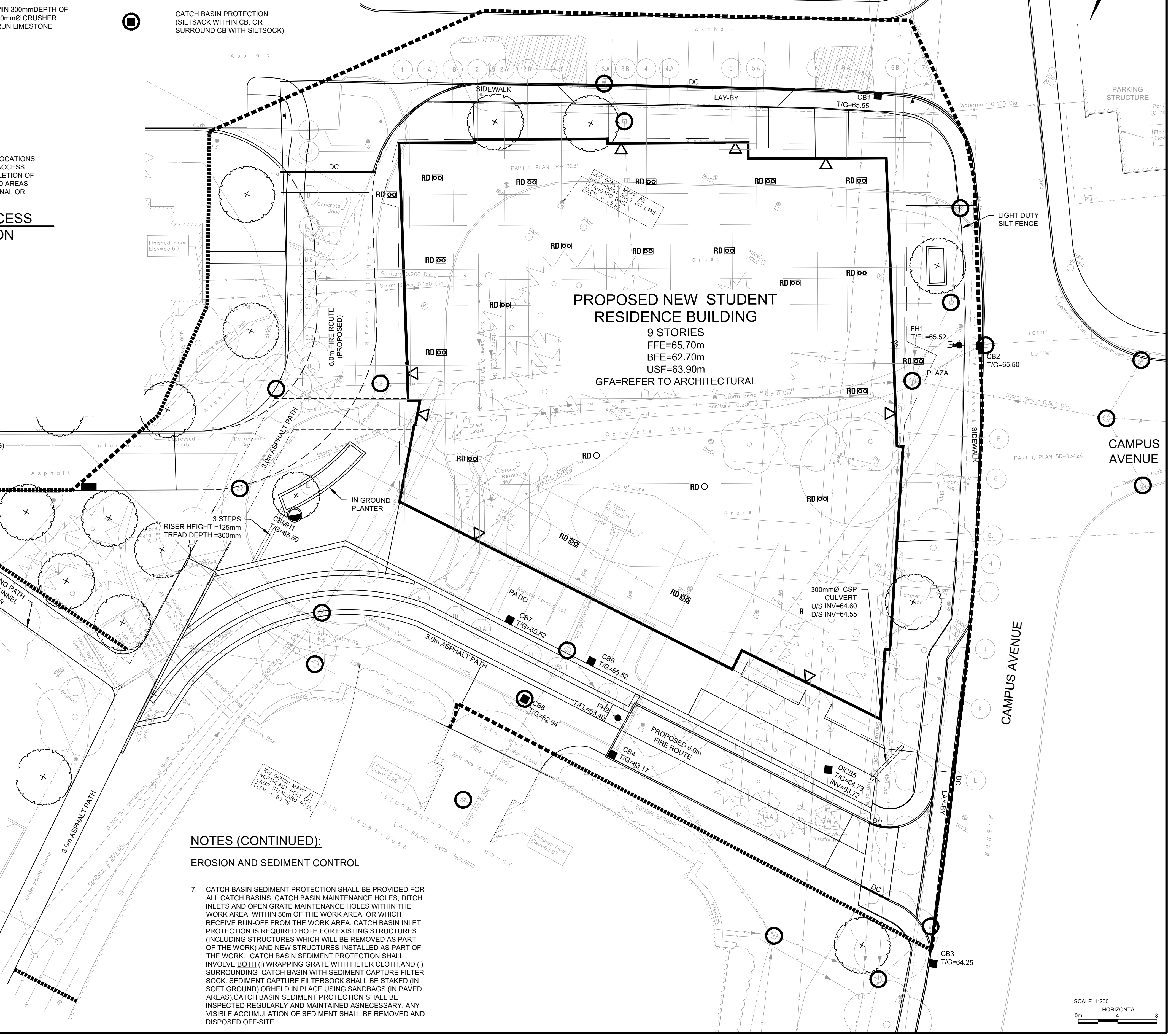


NOTES:
1. INSTALL AT ALL SITE ACCESS LOCATIONS.
2. TEMPORARY CONSTRUCTION ACCESS SHALL BE REMOVED ON COMPLETION OF THE WORK AND ALL DISTURBED AREAS SHALL BE RESTORED TO ORIGINAL OR BETTER CONDITION.

1 TEMPORARY ACCESS CONSTRUCTION
N.T.S.

LEGEND

- LIGHT DUTY SILT FENCE BARRIER (PER OPSD 219.110)
- SEDIMENT CAPTURE FILTER SOCK HELD IN PLACE USING SANDBAGS
- CATCH BASIN PROTECTION (SILTSACK WITHIN CB, OR SURROUND CB WITH SILTSOCK)



NOTES:

EROSION AND SEDIMENT CONTROL

1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES, AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
2. THE SEDIMENT CONTROL MEASURES SHALL ONLY BE REMOVED WHEN, IN THE OPINION OF THE ENGINEER, THE MEASURES ARE NO LONGER REQUIRED. NO CONTROL MEASURES MAY BE PERMANENTLY REMOVED WITHOUT PRIOR AUTHORIZATION FROM THE ENGINEER.
3. REGULAR INSPECTION AND MAINTENANCE OF THE EROSION AND SEDIMENT MEASURES SHALL BE UNDERTAKEN. THE IMPLEMENTATION AND ADJUSTMENT AND/OR CORRECTIVE MAINTENANCE OF THE EROSION AND SEDIMENT MEASURES IS AN INTEGRAL PART OF THE PLAN AND MUST BE PERFORMED.
4. THE CONTRACTOR IS RESPONSIBLE TO KEEP THE ROADS FREE AND CLEAN FROM MUD AND DEBRIS.
5. CONTRACTOR SHALL SUPPLY AND INSTALL EROSION BLANKET WHERE SLOPES ARE NOT SEEDED/SODDED IMMEDIATELY FOLLOWING GRADING.
6. THE SEDIMENT AND EROSION CONTROL MEASURES MAY BE MODIFIED IN THE FIELD AT THE DISCRETION OF THE CITY OF OTTAWA SITE INSPECTOR OR CONSERVATION AUTHORITY.

NOTES (CONTINUED):

EROSION AND SEDIMENT CONTROL

7. CATCH BASIN SEDIMENT PROTECTION SHALL BE PROVIDED FOR ALL CATCH BASINS, CATCH BASIN MAINTENANCE HOLES, DITCH INLETS AND OPEN GRATE MAINTENANCE HOLES WITHIN THE WORK AREA, WITHIN 50m OF THE WORK AREA, OR WHICH RECEIVE RUN-OFF FROM THE WORK AREA. CATCH BASIN INLET PROTECTION IS REQUIRED BOTH FOR EXISTING STRUCTURES (INCLUDING STRUCTURES WHICH WILL BE REMOVED AS PART OF THE WORK) AND NEW STRUCTURES INSTALLED AS PART OF THE WORK. CATCH BASIN SEDIMENT PROTECTION SHALL INVOLVE BOTH (i) WRAPPING GRATE WITH FILTER CLOTH,AND (i) SURROUNDING CATCH BASIN WITH SEDIMENT CAPTURE FILTER SOCK. SEDIMENT CAPTURE FILTERSOCK SHALL BE STAKED (IN SOFT GROUND) ORHELD IN PLACE USING SANDBAGS (IN PAVED AREAS).CATCH BASIN SEDIMENT PROTECTION SHALL BE INSPECTED REGULARLY AND MAINTAINED ASNECESSARY. ANY VISIBLE ACCUMULATION OF SEDIMENT SHALL BE REMOVED AND DISPOSED OFF-SITE.

MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1

KEY PLAN

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LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
AUG 31,2020
PROVINCE OF ONTARIO

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CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

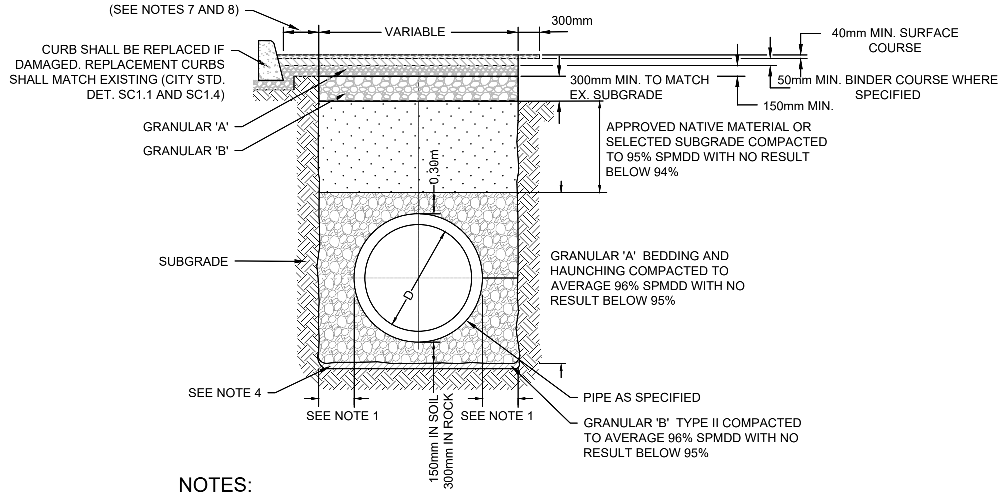
EROSION AND SEDIMENT CONTROL PLAN

Scale: 1:200
Project No: 190444600
Date: 31/08/20

C004

D07-12-19-0205

#18030



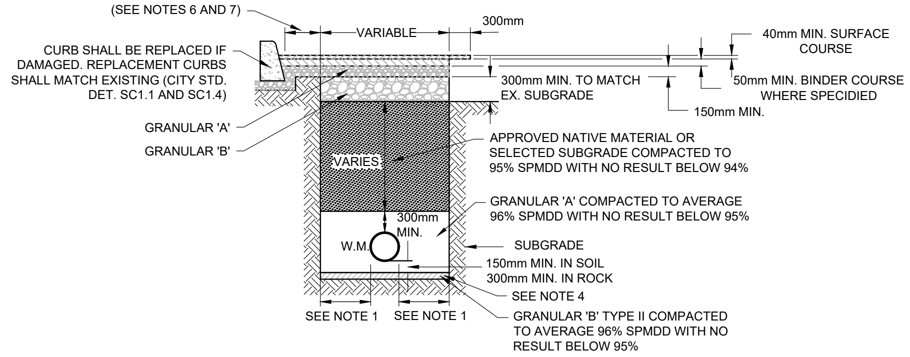
NOTES:

1.

PIPE INSIDE DIAMETER (mm)	CLEARANCE (mm)
900 OR LESS	CONC 450 PVC 450
OVER 900	500

2. FINAL BACKFILL - APPROVED NATIVE MATERIAL OR SELECT SUBGRADE
3. ALL DIMENSION ARE IN MILLIMETERS UNLESS SHOWN OTHERWISE.
4. WHEN NECESSARY POOR SOILS SHALL BE EXCAVATED TO CREATE A FOUNDATION THAT SHALL BE FILLED TO THE BOTTOM OF THE BEDDING WITH GRANULAR 'B'.
5. THE USE OF CLEAR CRUSHED STONE AS A BEDDING LAYER IS NOT PERMITTED ANYWHERE ON THIS SITE.
6. ALL EXISTING ASPHALT AND CONCRETE REMOVAL LIMITS TO BE SAWCUT.
7. 300 MM KEY TO BE SAWCUT AND REMOVED OR MILLED.
8. ROAD REINSTATEMENT ON THE CURB SIDE OF THE TRENCH EXCAVATION SHALL EXTEND TO THE CURB FACE.
9. TACK COAT SHALL BE APPLIED TO ALL MILLED SURFACES

1 SEWER AND WATERMAIN INSTALLATION
TYPICAL DETAIL
N.T.S.



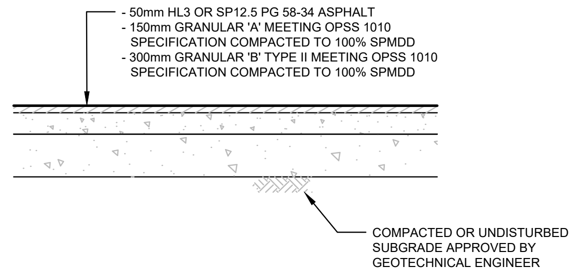
NOTES:

1.

PIPE INSIDE DIAMETER (mm)	CLEARANCE (mm)
900 OR LESS	450
OVER 900	500

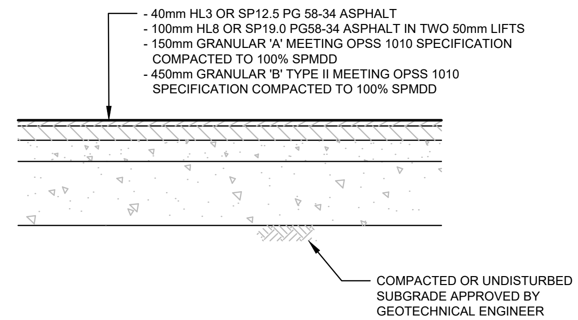
2. ALL EXISTING ASPHALT REMOVAL AND CONCRETE LIMITS TO BE SAWCUT.
3. TRENCH SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA STANDARD DETAIL W17.
4. WHEN NECESSARY POOR SOILS SHALL BE EXCAVATED TO CREATE A FOUNDATION THAT SHALL BE FILLED TO THE BOTTOM OF THE BEDDING WITH GRANULAR 'B'.
5. THE USE OF CLEAR CRUSHED STONE AS A BEDDING LAYER IS NOT PERMITTED ANYWHERE ON THIS SITE.
6. 300mm KEY TO BE SAWCUT AND REMOVED OR MILLED.
7. ROAD REINSTATEMENT ON THE CURB SIDE OF THE TRENCH EXCAVATION SHALL EXTEND TO THE CURB FACE.
8. TACK COAT SHALL BE APPLIED TO ALL MILLED SURFACES.

- 50mm HL3 OR SP12.5 PG 58-34 ASPHALT
- 150mm GRANULAR 'A' MEETING OPSS 1010 SPECIFICATION COMPACTED TO 100% SPMDD
- 300mm GRANULAR 'B' TYPE II MEETING OPSS 1010 SPECIFICATION COMPACTED TO 100% SPMDD

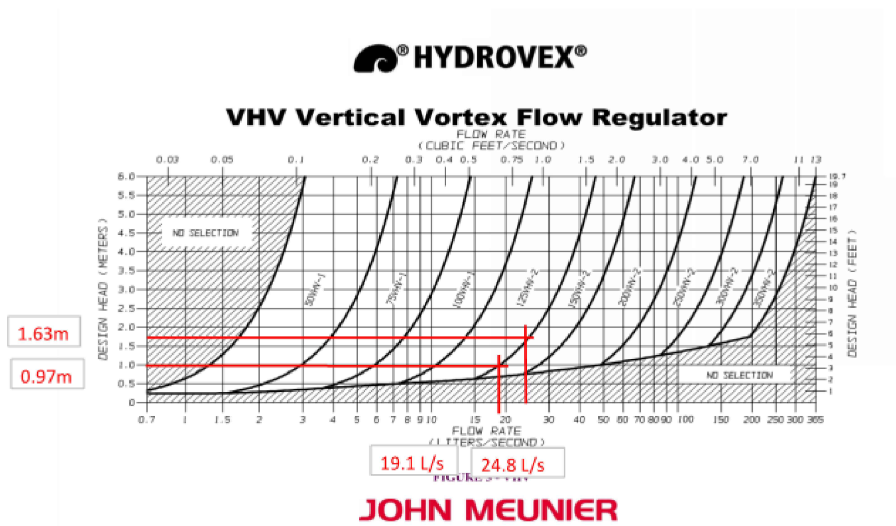


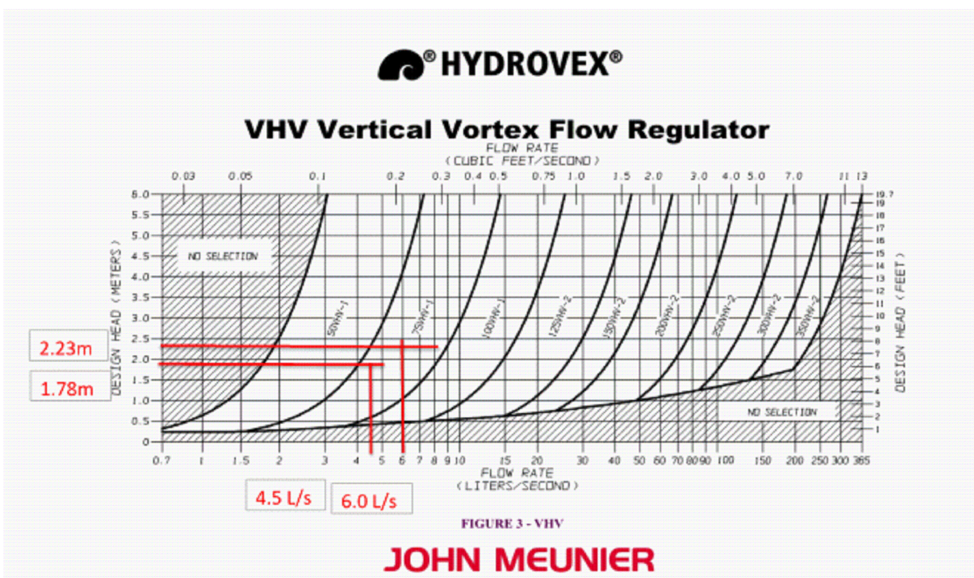
LIGHT DUTY PAVEMENT
N.T.S

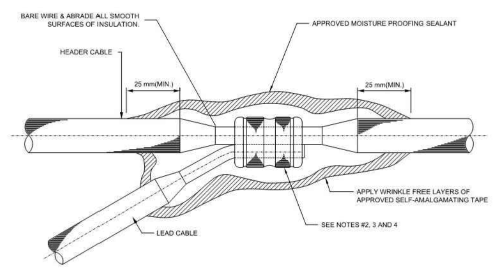
- 40mm HL3 OR SP12.5 PG 58-34 ASPHALT
- 100mm HL8 OR SP19.0 PG58-34 ASPHALT IN TWO 50mm LIFTS
- 150mm GRANULAR 'A' MEETING OPSS 1010 SPECIFICATION COMPACTED TO 100% SPMDD
- 450mm GRANULAR 'B' TYPE II MEETING OPSS 1010 SPECIFICATION COMPACTED TO 100% SPMDD



HEAVY DUTY PAVEMENT
N.T.S.



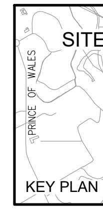




NOTES:
1. SEE MW-19.9 FOR WIRE SPECIFICATIONS.
2. C-TAP, THERMITE WELD OR DIRECT BURY LUG.
3. PRE SILVER SOLDER WIRES WITH C-TAP AND INSTALL USING APPROVED TOOL.
4. ILLUSTRATED PROTECTION MEASURES ARE NOT REQUIRED WITH DIRECT BURY LUGS.
5. SEE MS-22.15 FOR APPROVED PRODUCTS.

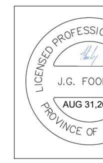
Ottawa	WATERPROOFING OF SPLICES	DATE: MAY 2001 REV. DATE: MARCH 2011 DWG. No.: W47

200-2932 B



ISSUED

No.	Date
1	13/03/20
2	31/03/20
3	07/04/20
4	27/07/20
5	11/08/20
6	31/08/20



Diamond Schmitt

KWC Architects In

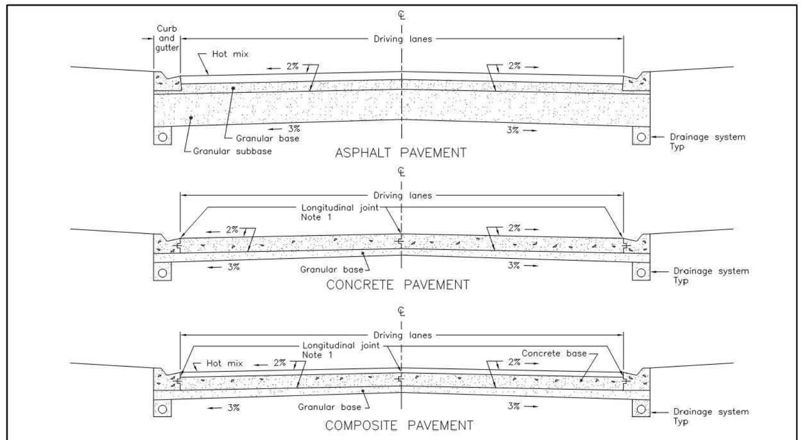
CARLETO
STUDENT

1125 Colonel By Driv
Ottawa, Ontario
K1S 5B6

DETAIL

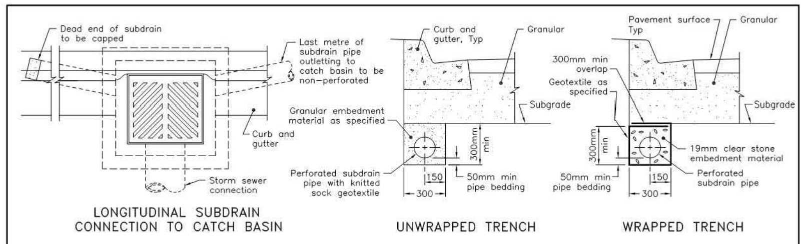
Scale: AS SHOWN
Project No:
Date:

C00

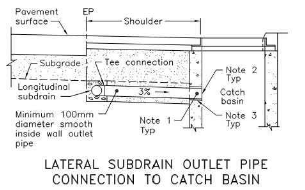


NOTES:
1 For longitudinal joint details refer to OPSD-552.010 and 552.020.
A Drainage system connection at every catch basin.
B Tie bars at all longitudinal joints.

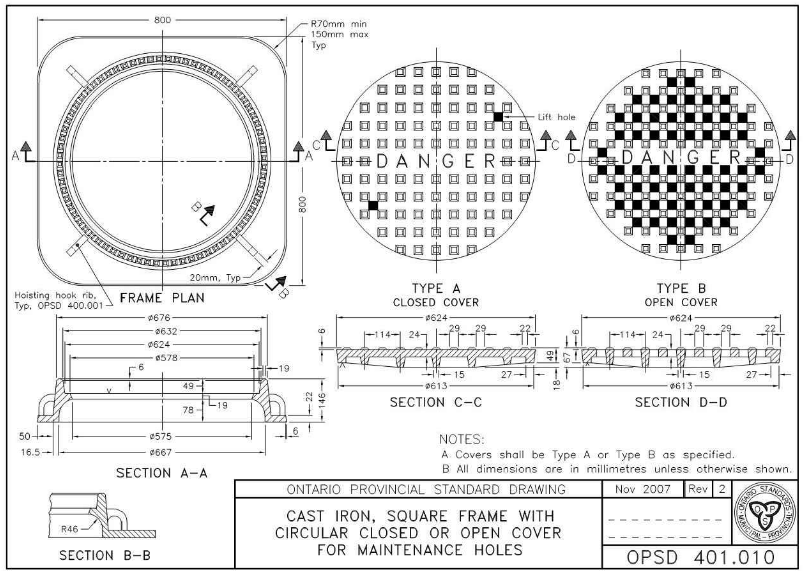
ONTARIO PROVINCIAL STANDARD DRAWING	April 1999 Rev
ASPHALT, CONCRETE AND COMPOSITE PAVEMENT ON GRANULAR BASE URBAN SECTION	OPSD – 216.020



NOTES:
1 Core hole diameter to allow outlet pipe into structure.
2 Install outlet pipe flush with inside face of catch basin.
3 Annular space around pipe to be filled with non-shrink grout.
A Use compatible manufactured fittings for all connectors, couplings, and caps.
B Trench dimensions shown to accommodate 100 or 150mm diameter subdrain pipe.
C Longitudinal subdrain pipe shall be installed parallel to the grade of the gutter.
D All dimensions are in millimetres unless otherwise shown.

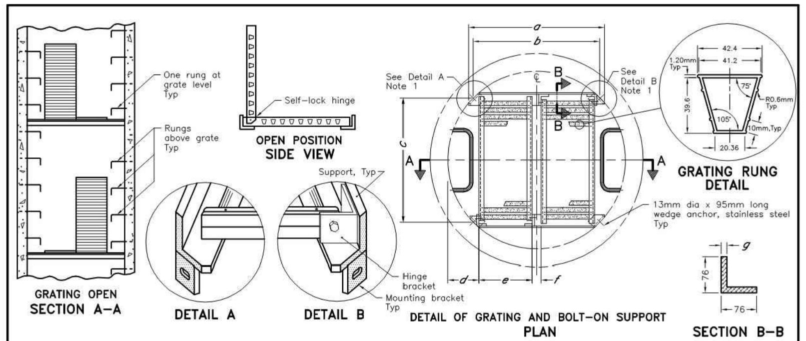


ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2008 Rev 2
SUBDRAIN PIPE CONNECTION AND OUTLET URBAN	OPSD 216.021



NOTES:
A Covers shall be Type A or Type B as specified.
B All dimensions are in millimetres unless otherwise shown.

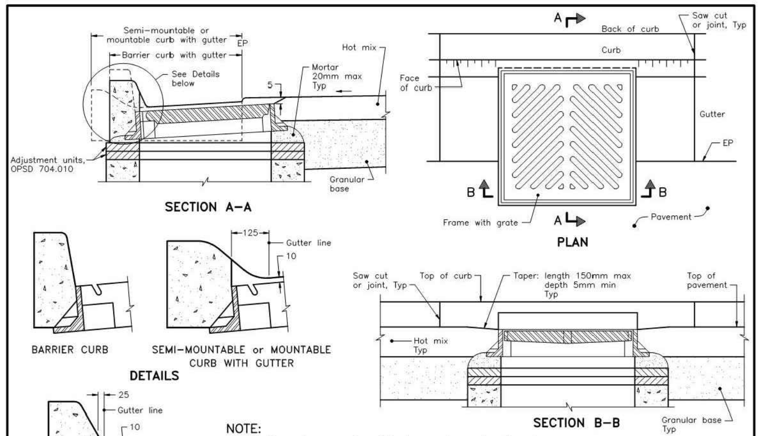
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2007 Rev 2
CAST IRON, SQUARE FRAME WITH CIRCULAR CLOSED OR OPEN COVER FOR MAINTENANCE HOLES	OPSD 401.010



NOTES:
1 All hinge brackets and mounting brackets shall be welded all around to support angle.
A All aluminum in contact with concrete shall be thoroughly coated with asphalt paint.
B Maintenance hole depth between 5.0m and 10.0m, grate shall be placed at midpoint. Maintenance hole depth between 10.0m and 15.0m, grates shall be placed at third-points.
C All fasteners shall be 304 stainless steel.
D All welding shall be according to CSA W47.2 and W59.2.
E All aluminum components shall be 6000 series structural aluminum.
F All dimensions are in millimetres unless otherwise shown.

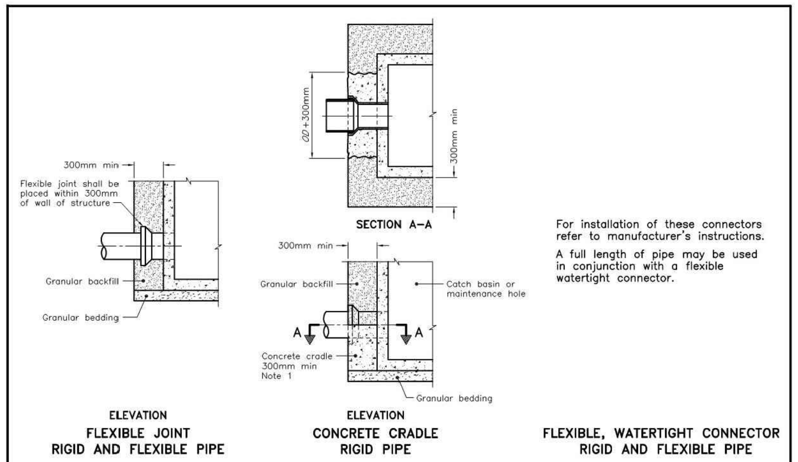
MH Diameter	No of Grates	a	b	c	d	e	f	g
1200	2	900	850	850	225	352	65	10
1500	2	1128	1078	1078	311	419	65	12
1800	3	1344	1293	1293	308	360	65	12
2400	4	1774	1724	1724	401	360	65	12

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2013 Rev 3
ALUMINUM SAFETY PLATFORM FOR CIRCULAR MAINTENANCE HOLES	OPSD 404.020



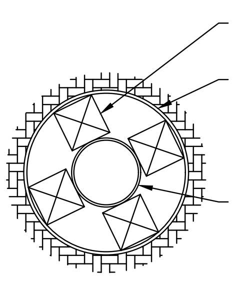
NOTE:
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018 Rev 2
CATCH BASIN FRAME WITH GRATE INSTALLATION AT CURB WITH GUTTER	OPSD 610.010

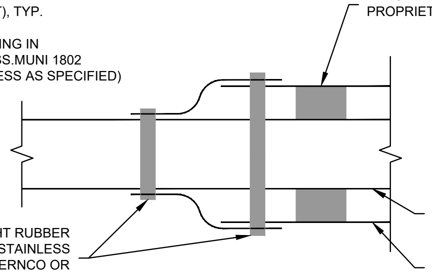


NOTES:
1 Pipe shall be supported with concrete or unshrinkable fill to the first pipe joint.
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2016 Rev 4
SUPPORT FOR PIPE AT CATCH BASIN OR MAINTENANCE HOLE	OPSD 708.020



CASING CROSS SECTION
N.T.S.



CASING END DETAIL
N.T.S.

CASING NOTES:
1. SUBMIT SHOP DRAWINGS FOR CASING, CATHODIC PROTECTION, COUPLERS, PROPRIETARY SPACERS.
2. INSTALL CATHODIC PROTECTION ON CASING IN ACCORDANCE WITH REQUIREMENTS FOR WATERMAINS AS SPECIFIED ELSEWHERE.
3. BEDDING, SURROUND AND BACKFILL TO BE AS SPECIFIED FOR WATERMAINS.
4. USE SINGLE LENGTH OF CASING PIPE (JOINTS ARE NOT PERMITTED).
5. FOR WATERMAINS RUN TRACER WIRE OUTSIDE CASING.

PVC DR35 NOMINAL DIA	STEEL CASING OD (mm)
250	355.6
300	406.4
375	508.0

PIPE CASING DETAIL
N.T.S.

200-2932 B

SITE
PRINCE OF WALES
KEY PLAN

ISSUED

No.	Date
1	13/03/2
2	31/03/2
3	07/04/2
4	27/07/2
5	11/08/2
6	31/08/2

LICENSED PROFESSIO J.G. FOO AUG 31,2 PROVINCE OF

Diamond Schmitt

KWC Architects In

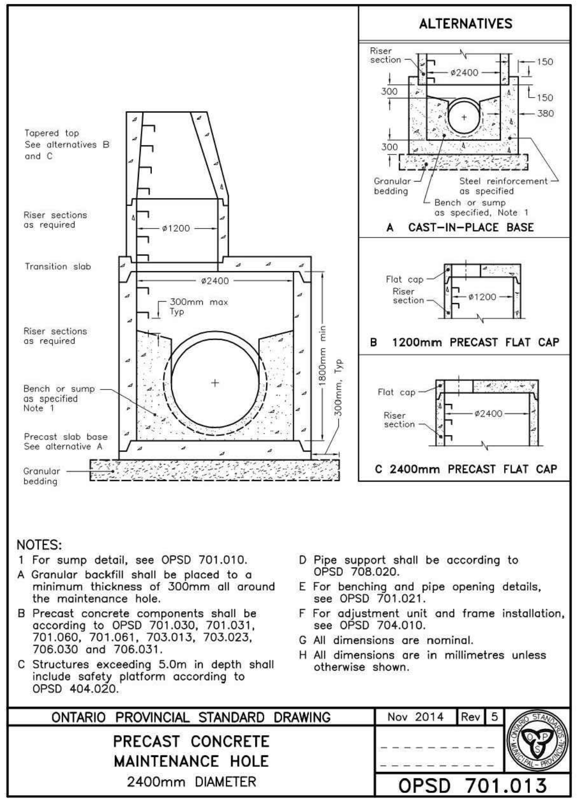
CARLETO
STUDENT

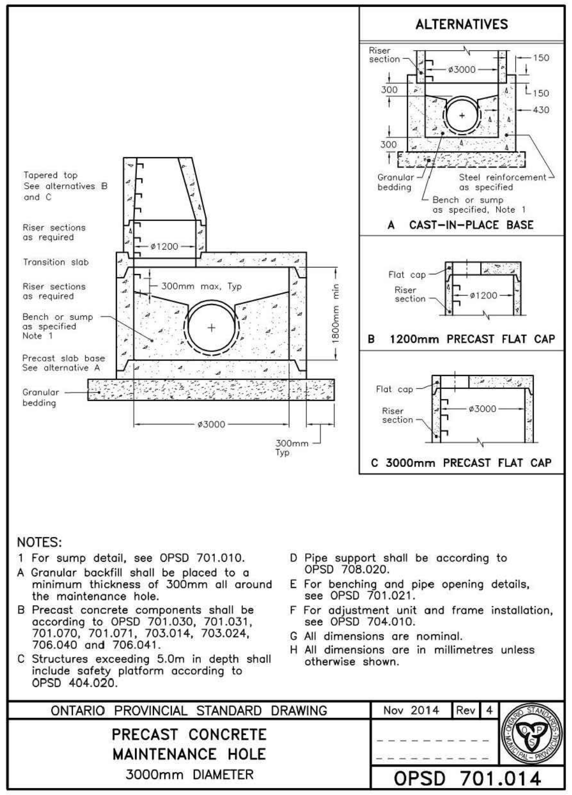
1125 Colonel By Driv
Ottawa, Ontario
K1S 5B6

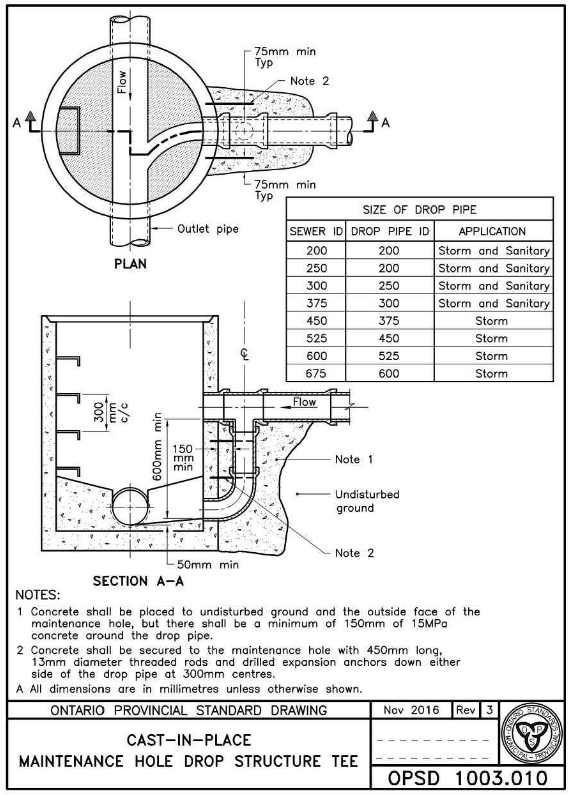
DETAIL

Scale: AS SHOWN
Project No:
Date:

C00

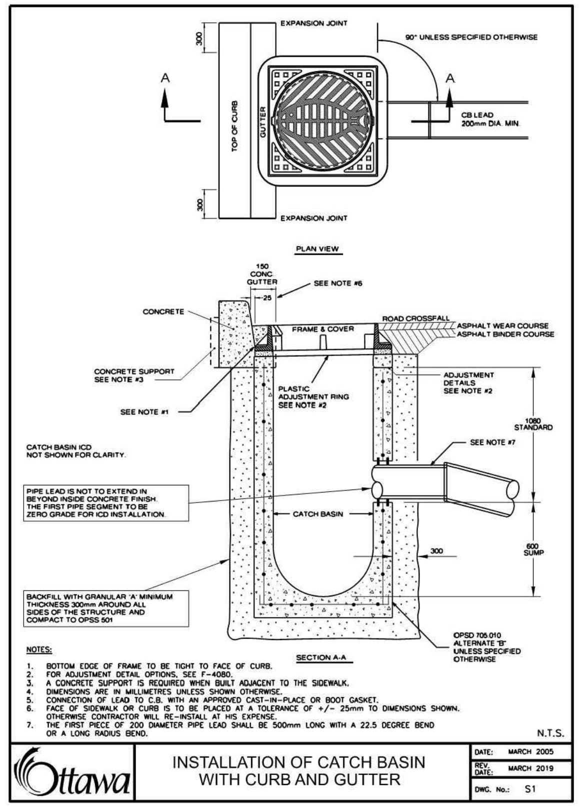


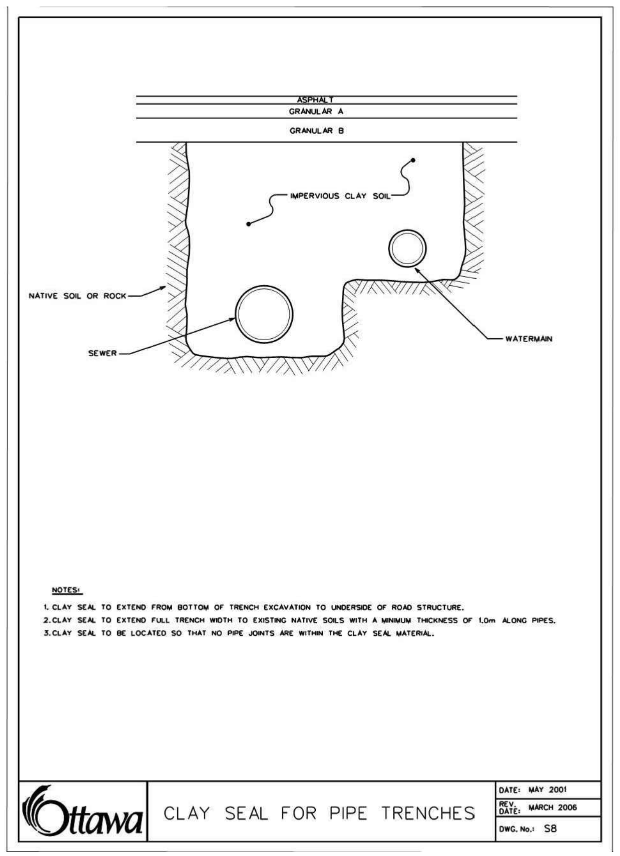


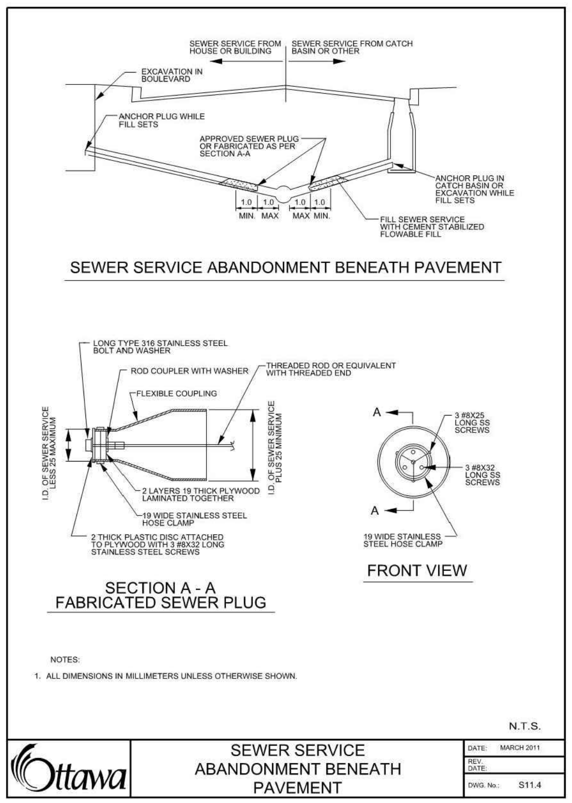


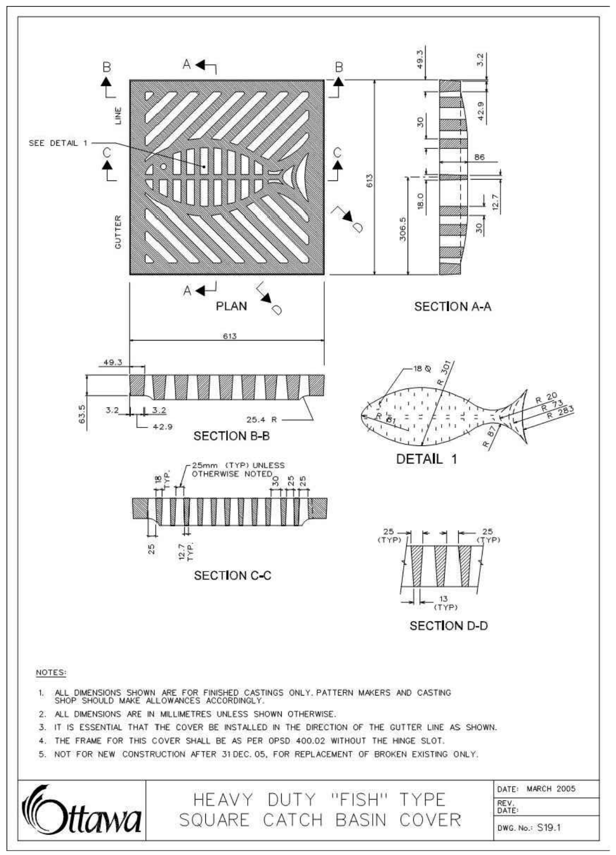
SIZE OF DROP PIPE

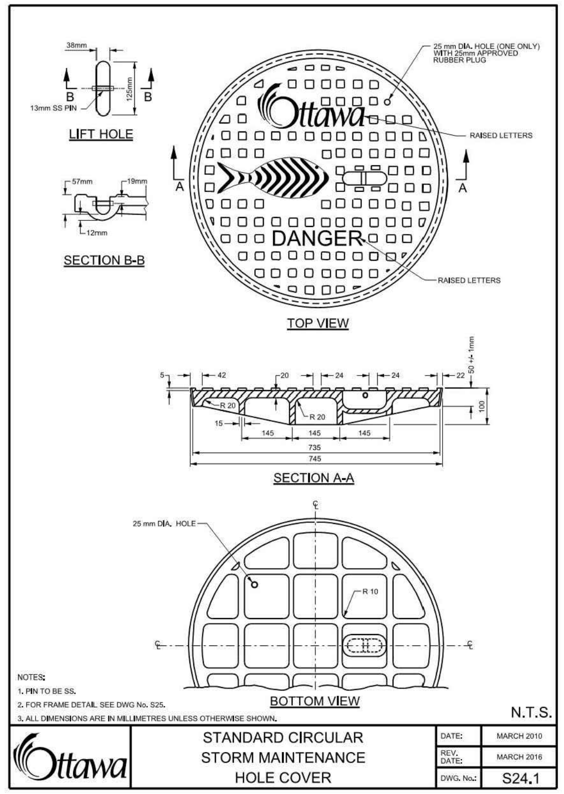
SEWER ID	DROP PIPE ID	APPLICATION
200	200	Storm and Sanitary
250	200	Storm and Sanitary
300	250	Storm and Sanitary
375	300	Storm and Sanitary
450	375	Storm
525	450	Storm
600	525	Storm
675	600	Storm











CONTRACTOR MUST CHECK

DO NOT SCALE DRAWINGS.

ISSUED

No.	Date
1	13/03/20
2	31/03/20
3	07/04/20
4	27/07/20
5	11/08/20
6	31/08/20

Diamond Schmitt

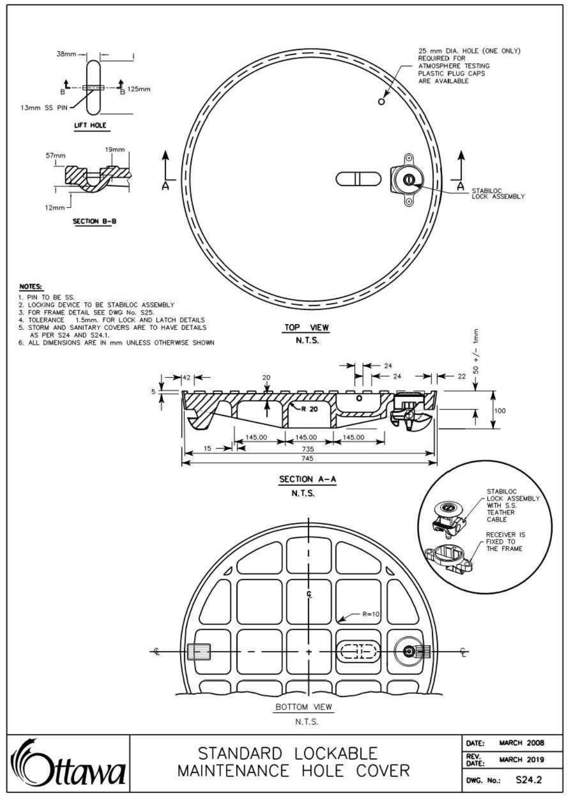
KWC Architects In

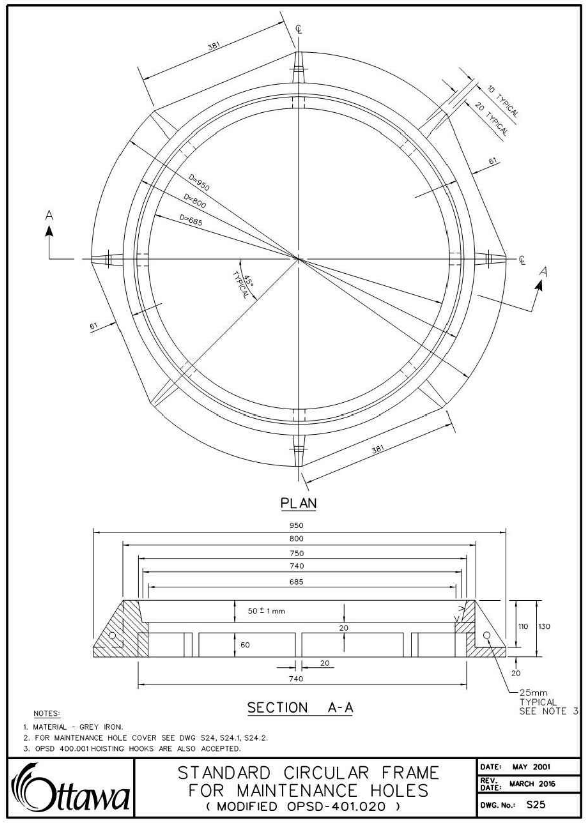
CARLETO
STUDENT

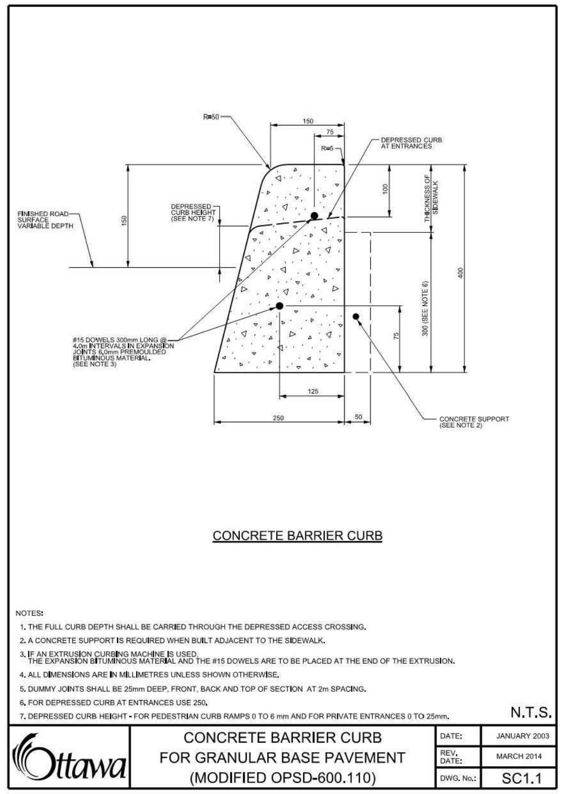
1125 Colonel By Driv
Ottawa, Ontario
K1S 5B6

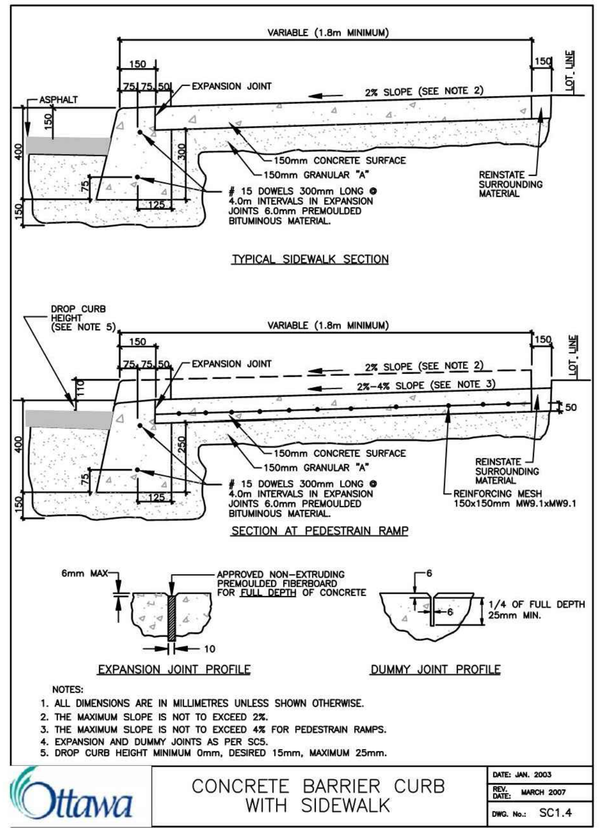
DETAIL

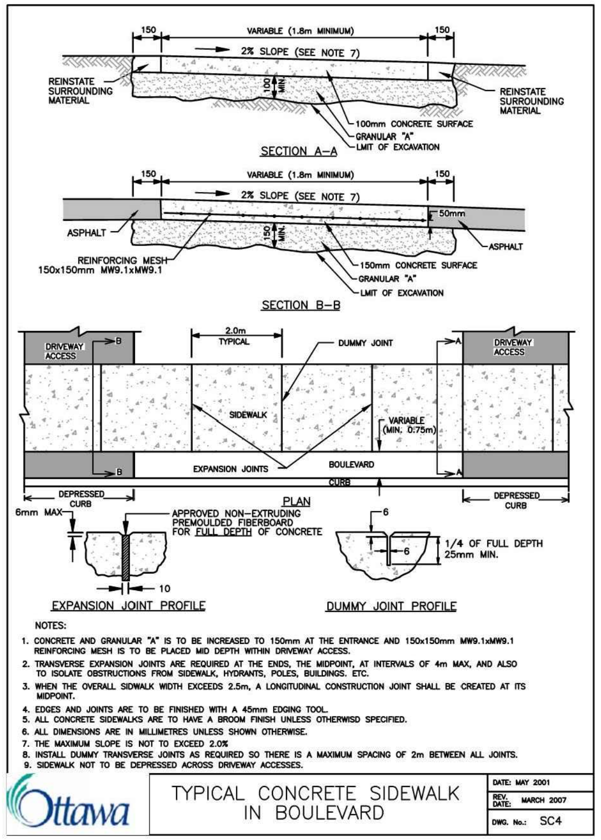
Scale: AS SHOWN
Project No:
Date:

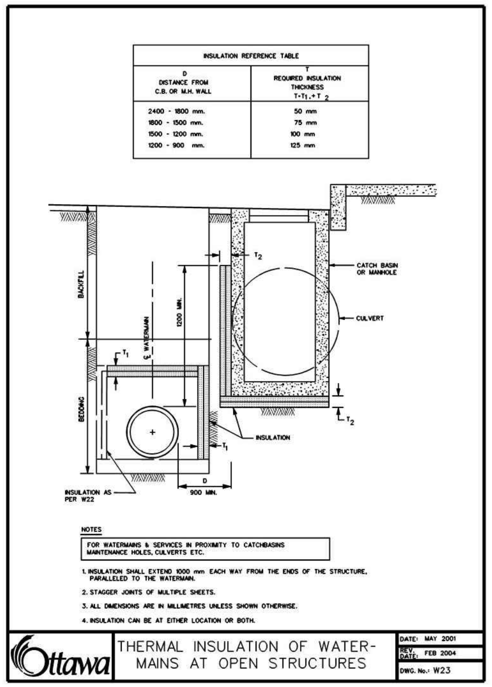


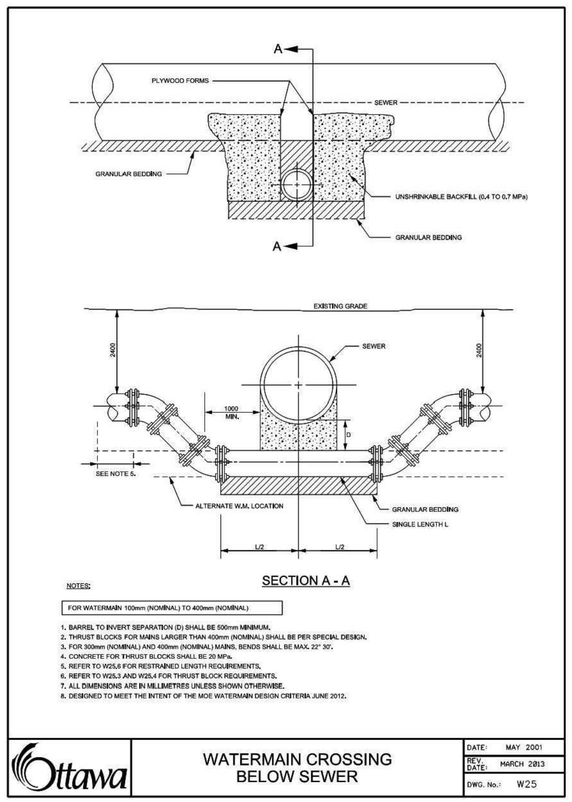


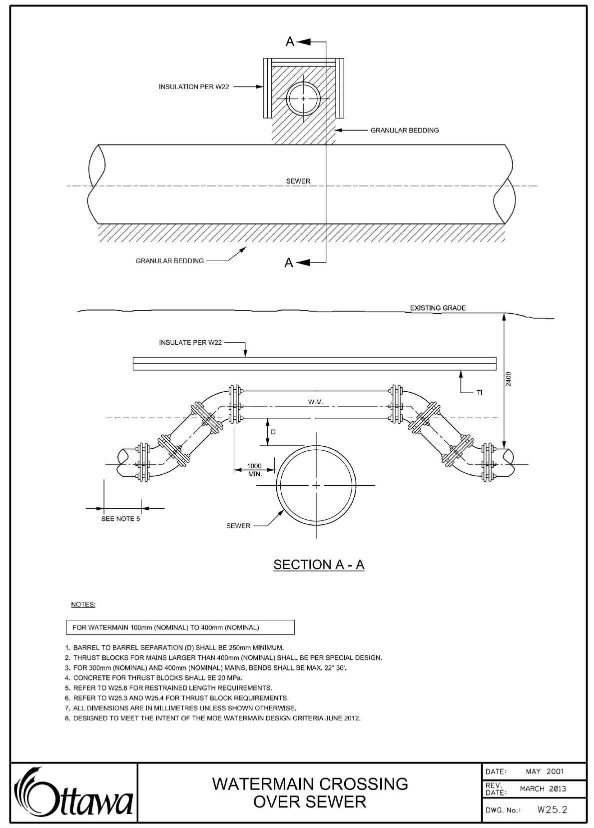












CONTRACTOR MUST CHECK &

DO NOT SCALE DRAWINGS.

ALL DRAWINGS, SPECIFICATI ARCHITECT AND MUST BE RE SPECIFICATIONS AND RELATE WRITTEN PERMISSION OF THE

THIS DRAWING IS NOT TO BE THE ARCHITECT.

200-2932 B

SITE

KEY PLAN

ISSUED

No.	Date
1	13/03/20
2	31/03/20
3	07/04/20
4	27/07/20
5	11/08/20
6	31/08/20

J.G. FOO
AUG 31,2

Diamond Schmitt

KWC Architects In

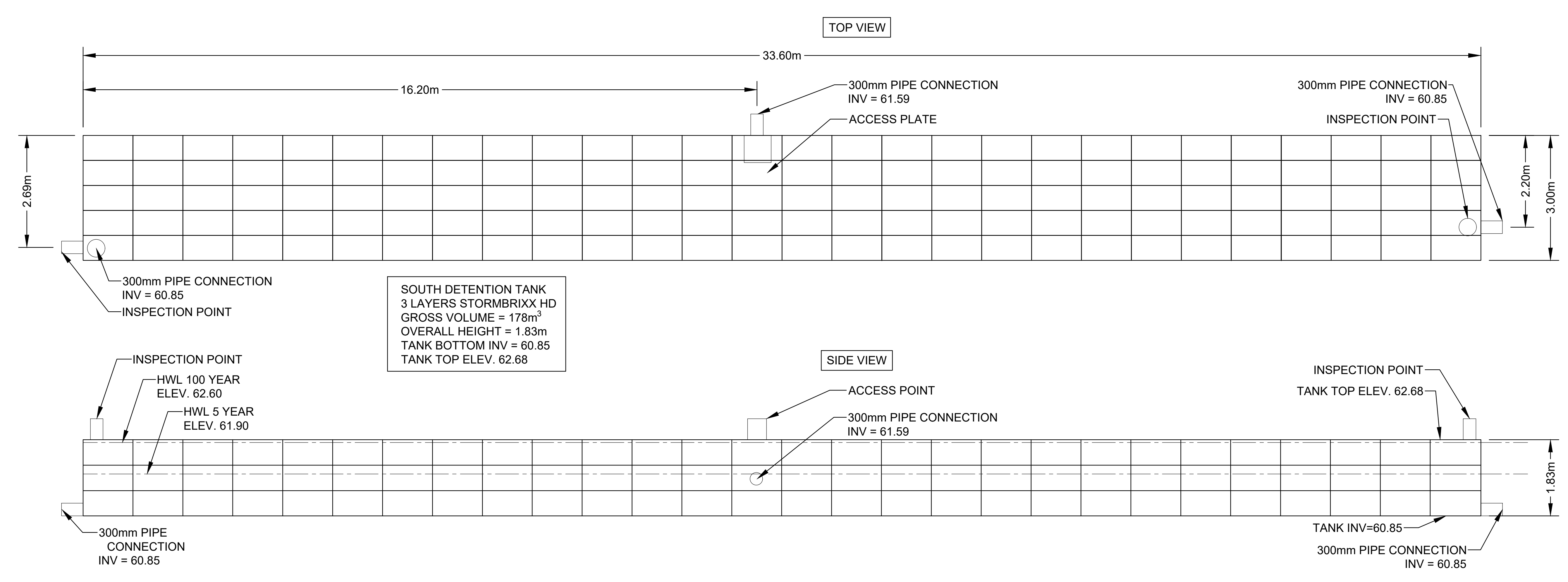
CARLETO
STUDENT

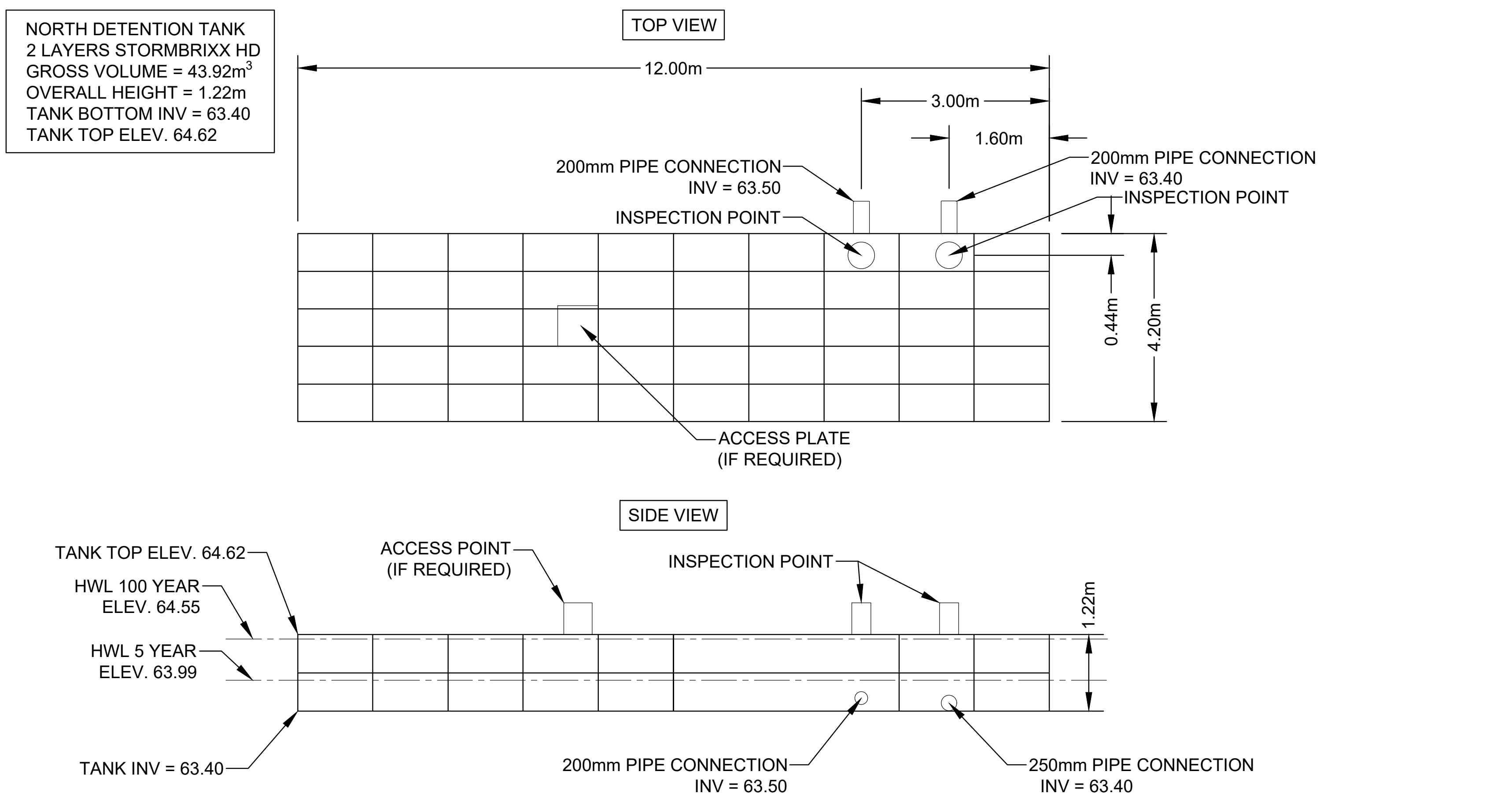
1125 Colonel By Driv
Ottawa, Ontario
K1S 5B6

DETAIL

Scale: AS SHOWN
Project No:
Date:

C00





NOTES:

1. SUBMIT SHOP DRAWINGS STAMPED BY AND ENGINEER LICENSED TO PRACTICE IN ONTARIO.
2. ALL COVERS TO BE OPSD 401.010 TYPE A OR APPROVED EQUIVALENT.
3. INSTALLATION (INCLUDING BEDDING, COMPACTION, AND BACKFILL) SHALL BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
4. ON COMPLETION OF INSTALLATION, SUBMIT CCTV VIDEO OF TANK INTERIOR AND LETTER FROM TANK SUPPLIER CONFIRMING THAT INSTALLATION WAS CARRIED OUT IN ACCORDANCE WITH THEIR RECOMMENDATIONS.
5. TANK TO BE DESIGNED FOR DEPTH OF FILL AS INDICATED BY GRADING PLAN AND HS20 LOADING.
6. TANK TO BE WATERTIGHT. A 40 MIL HEAT-WELDED LLDPE GEOMEMBRANE IS TO BE PROVIDED AND INSTALLED.
7. AFTER INSTALLATION PHYSICAL PROTECTION (BARRIERS OR EQUIVALENT) SHALL BE ERECTED TO PROTECT TANK FROM DAMAGE DUE TO CONSTRUCTION EQUIPMENT.
8. ALL COVERS FOR ACCESS POINT AND INSPECTIONS POINTS ARE TO BE LOCKABLE, WATERTIGHT PER OPSD 401.030

CONTRACTOR MUST CHECK
DO NOT SCALE DRAWINGS.

200-2932 B

SITE
KEY PLAN

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No.	Date
1	13/03/20
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4	27/07/20
5	11/08/20
6	31/08/20

J.G. FOO
AUG 31,2

Diamond Schmitt

KWC Architects In

CARLETO
STUDENT

1125 Colonel By Driv
Ottawa, Ontario
K1S 5B6

DETAIL

Scale: AS SHOWN
Project No:
Date:

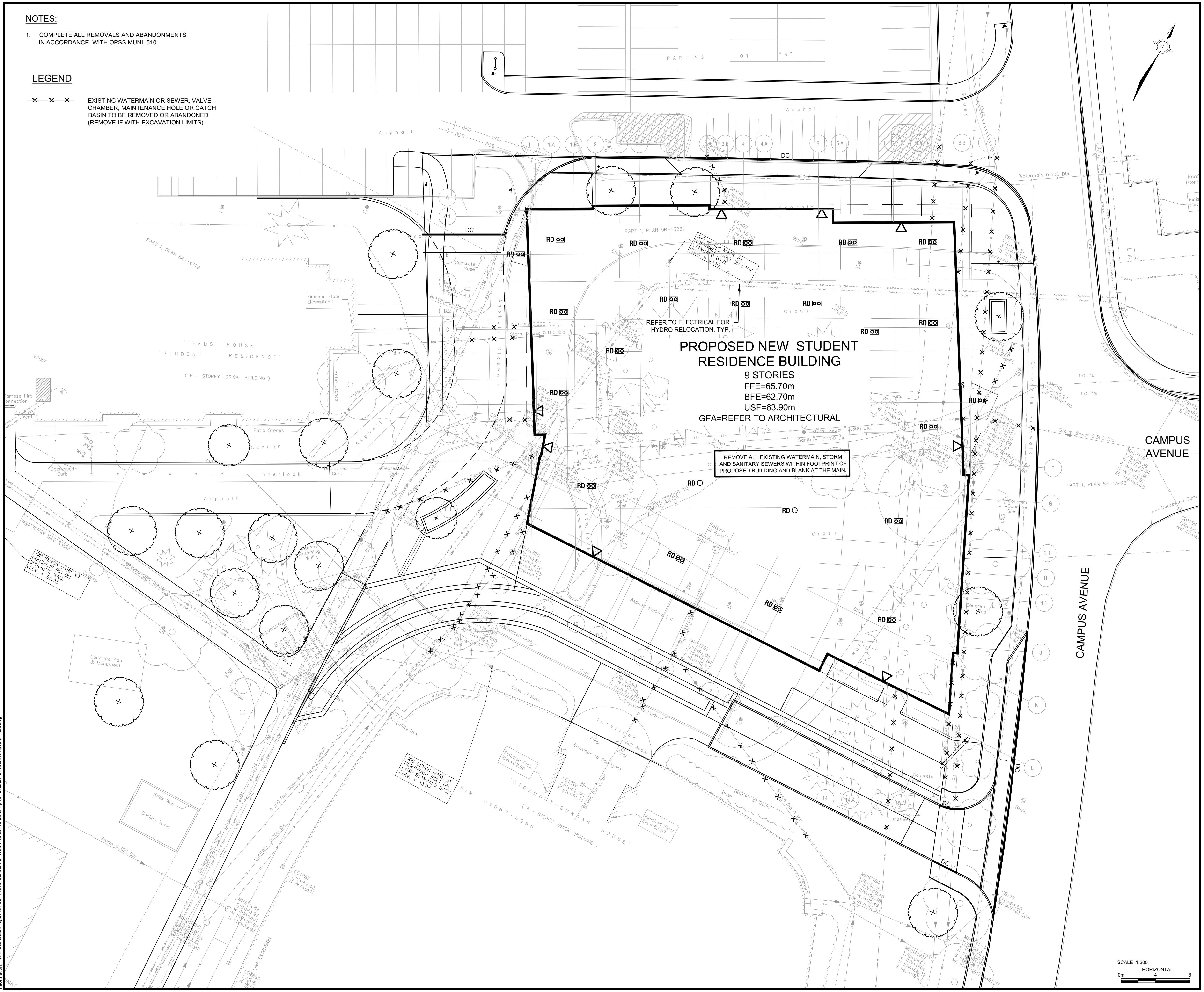
C00

NOTES:

1. COMPLETE ALL REMOVALS AND ABANDONMENTS IN ACCORDANCE WITH OPSS MUNI. 510.

LEGEND

× × × EXISTING WATERMAIN OR SEWER, VALVE CHAMBER, MAINTENANCE HOLE OR CATCH BASIN TO BE REMOVED OR ABANDONED (REMOVE IF WITH EXCAVATION LIMITS).

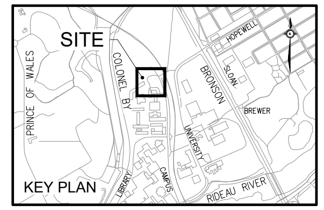


CONTRACTOR MUST CHECK & VERIFY ALL DIMENSIONS ON THE JOB.

DO NOT SCALE DRAWINGS.

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNTIL SIGNED BY THE ARCHITECT.

MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



ISSUED

No.	Date	Description
1	13/12/2020	ISSUED FOR SITE PLAN APPROVAL (R1)
2	31/03/2020	ISSUED FOR COORDINATION
3	07/04/2020	ISSUED FOR FOUNDATION PERMIT
4	27/07/2020	ISSUED FOR 80% INTERNAL COORDINATION
5	11/08/2020	REISSUED FOR SITE PLAN APPROVAL
6	31/08/2020	REISSUED FOR SITE PLAN APPROVAL

LICENSED PROFESSIONAL ENGINEER J.G. FOOKES AUG 31,2020 PROVINCE OF ONTARIO

Diamond Schmitt Architects 384 Adelaide Street West, Suite 100, Toronto, Ontario, M5V 1R7 Canada. Tel: 416 862 8800, Fax: 416 862 5508, info@dsai.ca, www.dsai.ca

KWC Architects Inc. 383 Parkdale Avenue, Suite 201, Ottawa, Ontario, K1Y 4R4 Canada. Tel: 613 238 2117, Fax: 613 238 6595, kwc@kwc-arch.com, www.kwc-arch.com

CARLETON UNIVERSITY NEW STUDENT RESIDENCE

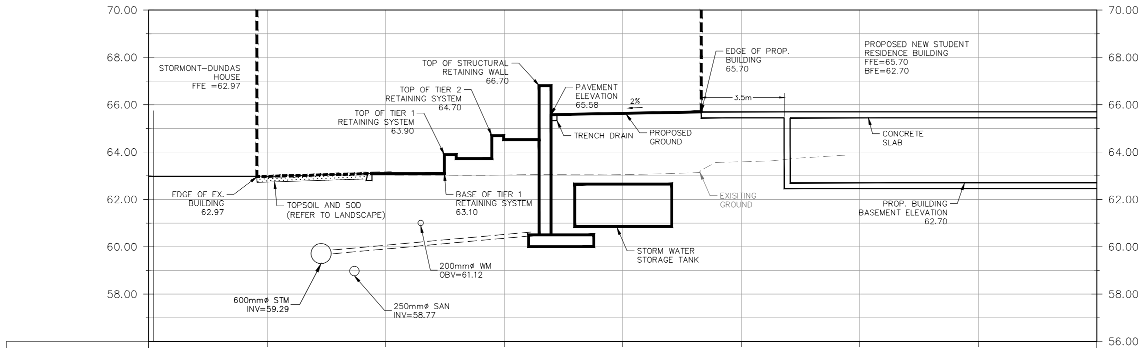
CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

REMOVALS PLAN

Scale: 1:200
Project No: 190444600
Date: 31/08/20

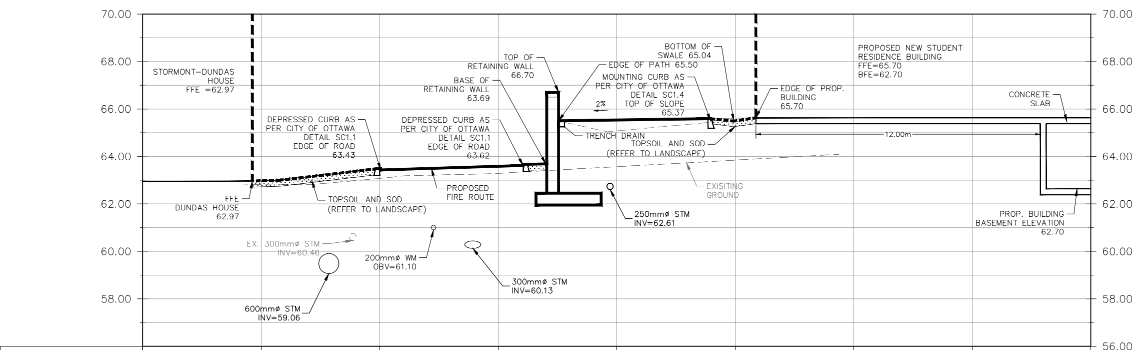
C700 #18030

D07-12-19-0205



FINAL GROUND ELEVATION	63.00	63.10	64.52	65.64			
EXISITING GROUND ELEVATION	62.96	63.17	63.03	63.05	63.59	63.91	64.18
STATION	0+005	0+010	0+015	0+020	0+025	0+030	0+035

S1 / C003 RETAINING WALL SECTION



FINAL GROUND ELEVATION	62.95	63.48	63.59	65.58	65.61		
EXISITING GROUND ELEVATION	62.82	63.08	63.28	63.57	63.85	64.13	64.45
STATION	0+005	0+010	0+015	0+020	0+025	0+030	0+035

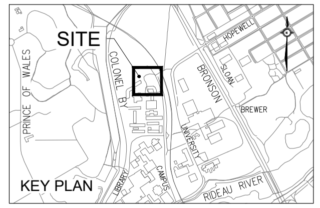
S2 / C003 RETAINING WALL SECTION

	PROPOSED ELEVATION
× 71.65	EXISTING ELEVATION
× 65.50T	PROPOSED FINISH GRADE AT TOP OF WALL OR STEP
× 63.32B	PROPOSED FINISH GRADE AT BOTTOM OF WALL OR STEP
63.26T/C	PROPOSED TOP OF CURB ELEVATION
2.0%	PROPOSED SLOPE DIRECTION
	DIRECTION OF MAJOR OVERLAND FLOW
	DIRECTION OF EMERGENCY OVERLAND FLOW
	PROPOSED CURB
DC	PROPOSED DEPRESSED CURB
	EMERGENCY SPILL ELEVATION
	HEAVY DUTY PAVEMENT - 40mm HL3 OR SP12.5 PG58-34 - 100mm HL8 OR SP19.0 PG58-34 - 150mm OF GRANULAR A - 450MM OF GRANULAR B
	MILL AND RESURFACE 40mm DEPTH
	ECORASTER PERMEABLE PAVING
	PROPOSED SWALE
	LIMIT OF PROJECT
RD	NEW ROOF DRAIN

Consultant's Information \\mh.local\data\Proj\2019\190444600-Carleton U- New Residence Building\09_CAD\07 Sheets\Grading Plan.dwg

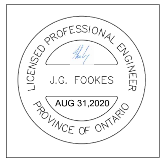
SCALE 1:150
HORIZONTAL & VERTICAL
0m 1 2 4

MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



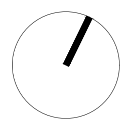
ISSUED

No.	Date	Description
1	16/03/2020	REISSUED FOR SITE PLAN APPROVAL
2	31/03/2020	ISSUED FOR COORDINATION
3	07/04/2020	ISSUED FOR FOUNDATION PERMIT
4	27/07/2020	ISSUED FOR 80% INTERNAL COORDINATION
5	11/08/2020	REISSUED FOR SITE PLAN APPROVAL
6	31/08/2020	REISSUED FOR SITE PLAN APPROVAL



Diamond Schmitt Architects 384 Adelaide Street West, Suite 100, Toronto, Ontario M5V 1R7 Canada. Tel: 416 862 8800 Fax: 416 862 5508 info@dsai.ca www.dsai.ca

KWC Architects Inc. 383 Parkdale Avenue, Suite 201, Ottawa, Ontario K1Y 4R4 Canada. Tel: 613 238 2117 Fax: 613 238 6595 kwc@kwc-arch.com www.kwc-arch.com



CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

RETAINING WALL SYSTEM PROFILES

Scale: 1:150
Project No: 190444600
Date: 31/08/20

C701 #18030

D07-12-19-0205

CONTRACTOR MUST CHECK & VERIFY ALL DIMENSIONS ON THE JOB.

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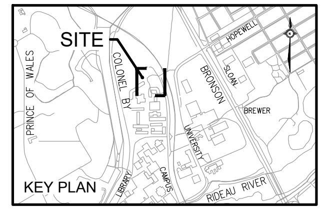
MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



ISSUED

No.	Date	Description
1	13/12/2020	ISSUED FOR SITE PLAN APPROVAL
2	31/03/2020	ISSUED FOR COORDINATION
3	07/04/2020	ISSUED FOR FOUNDATION PERMIT
4	27/07/2020	ISSUED FOR 80% INTERNAL COORDINATION
5	11/08/2020	REISSUED FOR SITE PLAN APPROVAL
6	31/08/2020	REISSUED FOR SITE PLAN APPROVAL

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
AUG 31,2020
PROVINCE OF ONTARIO

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kwc@kwc-arch.com
www.kwc-arch.com

CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

EXISTING CATCHMENTS
(1 OF 2)

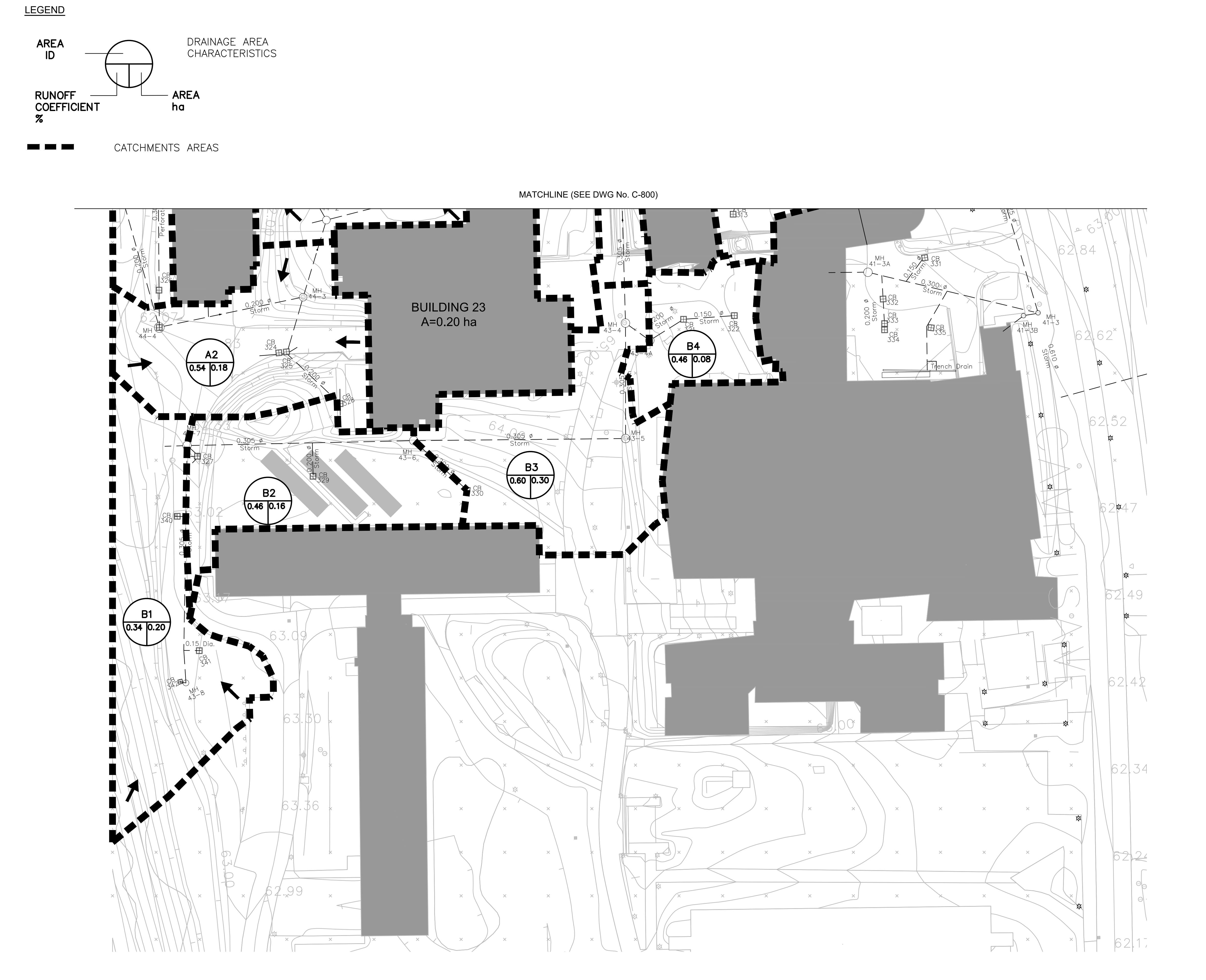
Scale: 1:400
Project No: 190444600
Date: 31/08/20

D07-12-19-0205

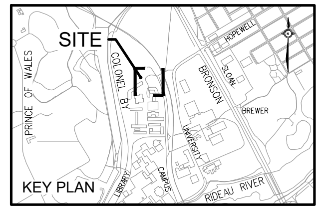
C800

#18030

Consultant's information:
\\mh.local\data\Proj\2019\190444600-Carleton U- New Residence Building\09_CAD\06 Analysis\Ex_Catchments.dwg



MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



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3	07/04/2020	ISSUED FOR FOUNDATION PERMIT
4	27/07/2020	ISSUED FOR 80% INTERNAL COORDINATION
5	11/08/2020	REISSUED FOR SITE PLAN APPROVAL
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J.G. FOOKES
AUG 31,2020
PROVINCE OF ONTARIO

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CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

EXISTING CATCHMENTS
(2 OF 2)

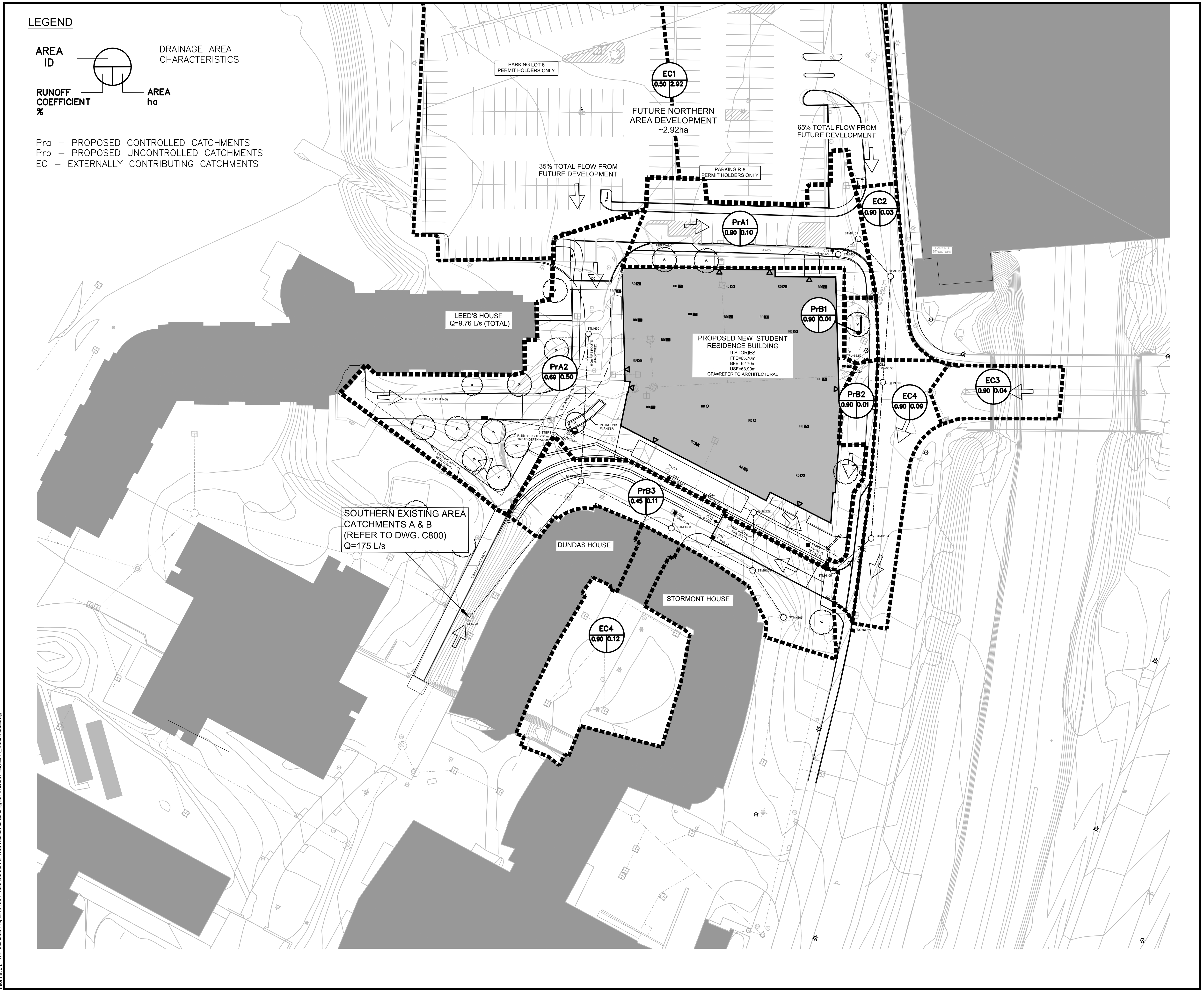
Scale: 1:400
Project No: 190444600
Date: 31/08/20

C801

#18030

D07-12-19-0205

Consultant's Information: \\mh.local\data\Proj\2019\190444600-Carleton U- New Residence Building\09_CAD\06 Analysis\Ex_Catchments.dwg



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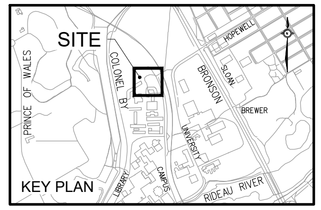
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



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6	31/08/2020	REISSUED FOR SITE PLAN APPROVAL

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
AUG 31,2020
PROVINCE OF ONTARIO

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CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

PROPOSED CATCHMENTS POST-DEVELOPMENT

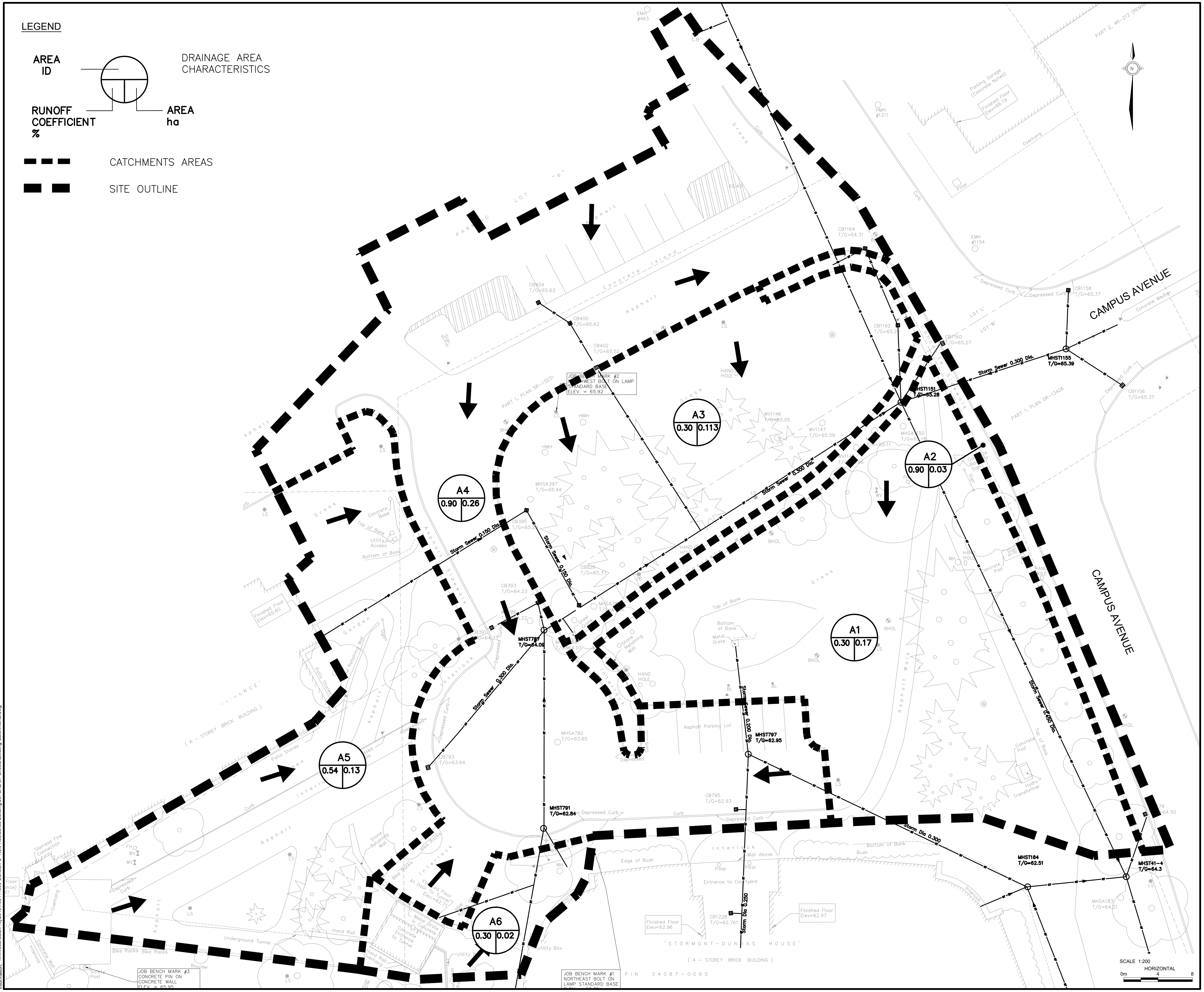
Scale: 1:400
Project No: 190444600
Date: 31/08/20

C802

#18030

D07-12-19-0205

Consultant's Information: \\mh.local\data\Proj\2019\190444600-Carleton U- New Residence Building\09. CAD\06 Analysis\Pr_Catchments.dwg



CONTRACTOR MUST CHECK & VERIFY ALL DIMENSIONS ON THE JOB.

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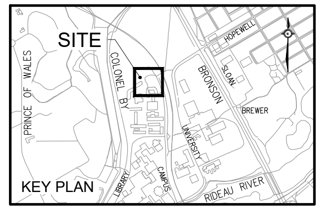
MORRISON HERSHFIELD

200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



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4	07/04/2020	ISSUED FOR FOUNDATION PERMIT
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7	31/08/2020	REISSUED FOR SITE PLAN APPROVAL

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CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

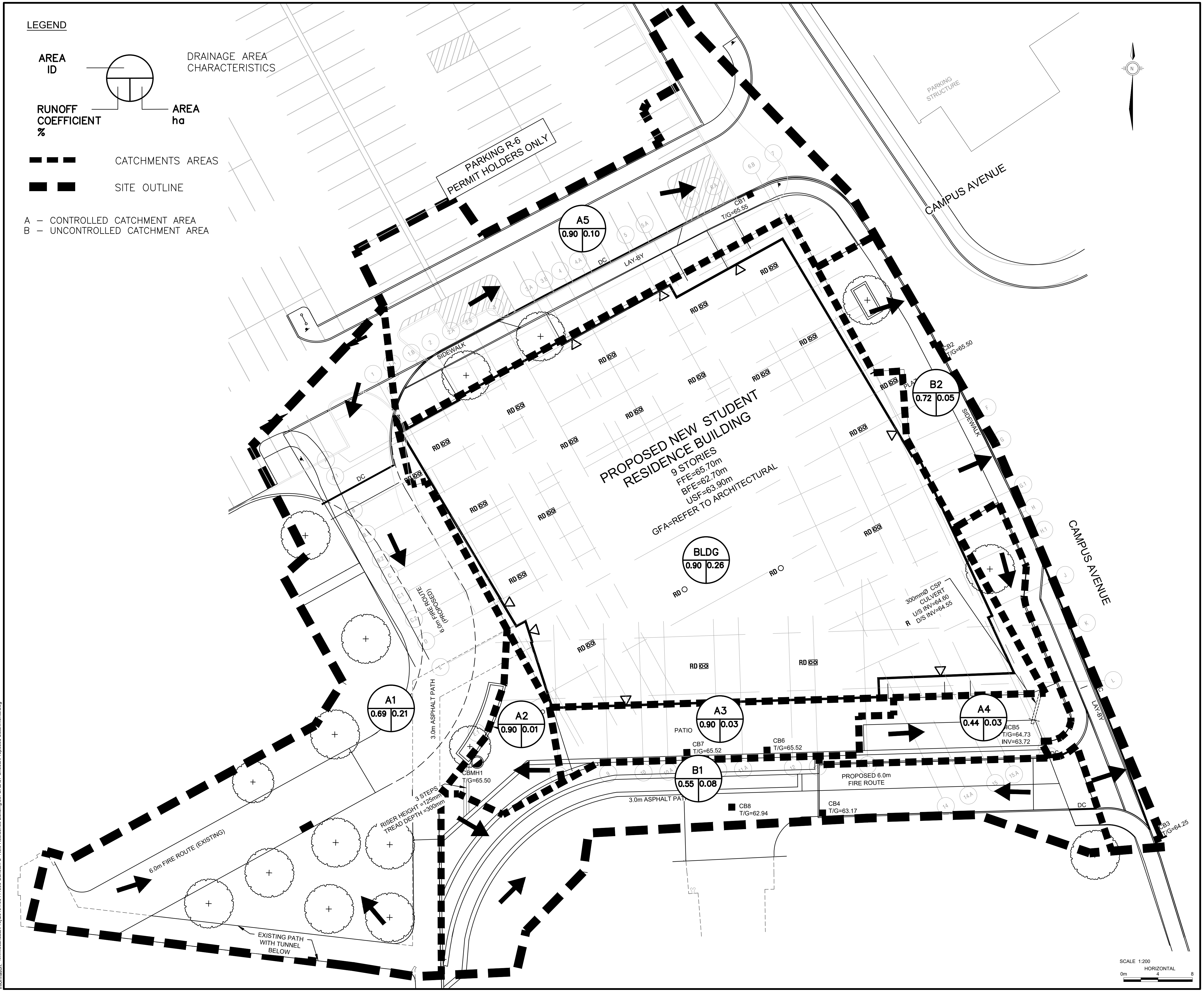
EXISTING SITE CATCHMENTS

Scale: 1:200
Project No: 190444600
Date: 31/08/20

C900

#18030

D07-12-19-0205



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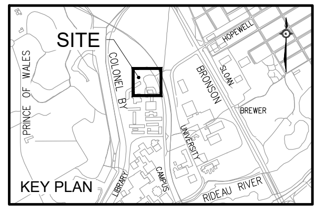
MORRISON HERSHFIELD
200-2932 BASELINE ROAD, OTTAWA, ON K2H 1B1



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LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
AUG 31,2020
PROVINCE OF ONTARIO

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CARLETON UNIVERSITY NEW STUDENT RESIDENCE

CARLETON UNIVERSITY
1125 COLONEL BY DRIVE
OTTAWA ON
K1S 5B6

PROPOSED SITE CATCHMENTS

Scale: 1:200
Project No: 190444600
Date: 31/08/20

C901

D07-12-19-0205

#18030

Appendix B

MECP, RVCA and City of Ottawa Specific Requirements Correspondence

Date of Pre-Consultation: **November 13, 2019**

Site: **1125 Colonel By Drive / Carleton University Student Residence**

This site will use existing infrastructures own by the University.

Comments:

- Please investigate the capacity of the existing sanitary sewer network as some sanitary pipes do not have capacity
- A CCTV report is required to confirm that the existing sanitary sewer is in good condition to handle the proposed development
- Please investigate the capacity of the existing storm sewer.
- A CCTV report is required to confirm that the existing storm sewer is in good condition to handle the proposed development
- Please make sure that the outlet of the storm sewer is connected into a stormceptor otherwise installation of an onsite stormceptor is required to handle the quality of the stormflow.
- Please contact RVC to get the quality control criteria.

Servicing template and Guideline

Please find the Servicing Report Template & Study Guidelines" in the attachment and prepare the servicing study accordingly. For capacity issue, please see section 3.2.1 page 3-3 and follow this section. A completed checklist with corresponding references from the servicing study is mandatory for the completeness of the study. Please add a completed checklist in the report.

ServicingGuideli
nes_final_Dec...

Servicing Report
Template Final Versi

Required information for Water boundary conditions

Boundary conditions are required to confirm that the require fire flows can be achieved as well as availability of the domestic water pressure on the city street in front of the development. Please use Table 3-3 of the MOE Design Guidelines for Drinking-Water System to determine Maximum Day and Maximum Hour peaking factors for 0 to 500 persons and use Table 4.2 of the Ottawa Design Guidelines, Water Distribution for 501 to 3,000 persons.

1. Location of Service
2. A sketch of the proposed water service to the city watermain
3. Street Number & Name
4. Type of development and units
5. Amount of fire flow required ___l/s (Calculation as per the FUS Method).
6. Average daily demand: -l/s
7. Maximum daily demand: -l/s
8. Maximum hourly daily demand: -l/s

Please note proposed development will require 2 separate service connections from the city watermains if the basic day demand is greater than $50m^3$/day to avoid the creation of a vulnerable service area. Two water meters will be required for two service connections and the service connections will have to be looped.

Utility conflict with the proposed servicing

- It is the consultant's sole responsibility to investigate the existing utilities in the proposed servicing area while preparing the Servicing and Grading Plans to avoid any conflict with the proposed services and will require a note stating this on the servicing plan.

SWM Criteria for the Catchment Area of the site being redeveloped: (Quantity control criteria)

- Allowable release rate will be pre-development rate 2 year for a local road, 5 year for Collectors.
- C Coefficient of runoff will need to be determined **as per existing conditions** but in no case more than 0.5
- TC =20 minutes or can be calculated,
- TC should not be less than 10 minutes, since the IDF curves become unrealistic less than 10min.
- Any storm events greater than 2 or 5 year, up to 100 year, and including 100-year storm event must be detained on site.

TECHNICAL BULLETIN PIEDTB-2016-01

Section 5.4.9.2,Page 5.31,

While rear yard grading will create low points and storage at each catch basin, the storage will not be considered in the available storage requirements. It will be assumed that all backyard flows in excess of the 2-year will flow towards the roads. Effective available storage will only be considered on streets and open space/park storage. Furthermore, there must be at least 30 cm of vertical clearance between the rear yard spill elevation and the ground elevation at the adjacent building envelope.

Major system storage in backyards is not to be included/accounted for in design computations, however the effect of flow attenuation can now be accounted for by assuming a constant slope ditch/swale draining to the street with the following geometry: a minimum slope of 1.5% and a minimum depth of 150 mm. The maximum allowable depth of a swale/ditch shall be 600 mm. The maximum side slope of swales/ditches shall be 3 horizontals to 1 vertical.

Section 8.3.11.6, Page 8.20:

Rear Yard storage cannot be accounted for in the water storage calculation. It should be assumed that all water in excess of the 2-year event will flow to the street. The maximum depth of flow depth in rear yards is 300 mm. Furthermore, there must be at least 30 cm of vertical clearance between the rear yard spill elevation and the ground elevation at the adjacent building envelope. See Section 5.4.9 for further information. Major system storage in backyards is not to be included/accounted for in design computations, however the effect of flow attenuation can now be accounted for by assuming a constant slope ditch/swale draining to the street.

Stormwater management criteria (Quality Control Issues)

Please note there will a section in the SWM report that will discuss about the quality control requirements for this site. It is consultant's responsibility to check with the Rideau Valley Conservation Authority (RVCA) for quality control issues and include this information in the SWM report under Quality Control Section. Please contact RVCA for further information.

Implementation considerations

- Accounting for external overland drainage
- Use of standard ICDs
- Requirement for ICD plans
- Requirement for plans showing 100-year and stress-test ponding limits
- Provide a foundation drain backwater valve installed as per Std Dwg S14.
- Provide a full port backwater valve, in the sanitary building drain, installed as per Std Dwg S14.1.

Studies required for Site Plan application

Studies Required:

- Serviceability Study
- Erosion and Sediment Control Plan, it can be combined with grading plan
- Stormwater Management Report
- Geotechnical Study
- Phase 2 Noise Control Detailed Study if the development occurs within 100m from the LRT line.
- ESA-Phase 1 Study needs to be prepared as per current MOE regulation not as per CSA standards
- ESA-Phase 2, Depend on the Phase I recommendation if required needs to be prepared as per current MOE regulation not as per CSA standard
- LRT _proximity study-Development Zone of influence – under Official Pan-under planning tag-please consult with the LRT office.

Plans Required:

a. Site Servicing Plan
b. Grade Control and Drainage Plan
c. Erosion and Sediment Control Plan
d. Pre-Development Drainage Area Plan
e. Post-Development Drainage Area Plan

MOECP application

- please consult with the local district office to verify an ECA is not required.

Relevant information

1. Servicing & site works shall be in accordance with the following documents:

   ⇨ Ottawa Sewer Design Guidelines (2012)
   ⇨ Ottawa Design Guidelines – Water Distribution (2010)

- ⇨ Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (2007)
- ⇨ City of Ottawa Slope Stability Guidelines for Development Applications (2004)
- ⇨ City of Ottawa Environmental Noise Control Guidelines (2006)
- ⇨ City of Ottawa Park and Pathway Development Manual (2012)
- ⇨ City of Ottawa Accessibility Design Standards (2012)
- ⇨ Ottawa Standard Tender Documents (2015)
- ⇨ Ontario Provincial Standards for Roads & Public Works (2015)

2. Record drawings and utility plans can be purchased from the City (Contact the City's Information Centre by email at InformationCentre@ottawa.ca or by phone at (613) 580-2424 x.44455).

Regards,

Mark Fraser, P. Eng.
Project Manager
Development Review , Central Group
Planning, Infrastructure and Economic Development Department
Services de la planification, de l'infrastructure et du développement économique
City of Ottawa | Ville d'Ottawa
110 Laurier Ave. West / 110, avenue Laurier Ouest, Ottawa K1P 1J1
Tel. 613-580-2424 ext. 27791 , Fax. 613-560-6006 ,E-mail: Mark.Fraser@ottawa.ca

MECP Correspondence for SPA

James Fookes

From:	Daniel Glauser
Sent:	Friday 06 December 2019 9:21 AM
To:	Diamond, Emily (MECP)
Cc:	James Fookes
Subject:	RE: ECA requirements; Carleton University New Residence Building

Hi Emily,

With the stringent deadlines of this project I appreciate the quick response.

Kind Regards

Daniel Glauser
Municipal Designer - Infrastructure Ottawa
Office: 613 739 2910 Ext. 1022323
DGlauser@morrisonhershfield.com

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morrisonhershfield.com

From: Diamond, Emily (MECP) [mailto:Emily.Diamond@ontario.ca]
Sent: Friday, December 6, 2019 8:53 AM
To: Daniel Glauser <DGlauser@morrisonhershfield.com>
Subject: RE: ECA requirements; Carleton University New Residence Building

Hi Daniel,

From the information provided, the project would fall under the Ontario Regulation 525/98 exemption. Therefore an ECA would not be required for this project.

You may use this email as a record of pre-consultation.

Regards,

Emily Diamond
Environmental Officer
Ministry of the Environment, Conservation and Parks
Ottawa District Office
2430 Don Reid Drive
Ottawa, Ontario, K1H 1E1
Tel: 613-521-3450 ext 238
Fax: 613-521-5437
e-mail: emily.diamond@ontario.ca

From: Daniel Glauser <DGlauser@morrisonhershfield.com>
Sent: December 4, 2019 4:58 PM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Cc: James Fookes <JFookes@morrisonhershfield.com>
Subject: ECA requirements; Carleton University New Residence Building

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Hi Emily,

We are designing a new student residence on Carleton University Campus located on Campus Avenue (Link to Map location).
As a result of the Pre-consultation meeting process, the City of Ottawa has asked that:

*"**MOECP application***

- *please consult with the local district office to verify an ECA is not required."*

As identified in the attached GeoOttawa plan, the servicing is for a "single lot". Our intention is to connect to the existing private separated storm and sanitary sewer adjacent to Campus Avenue. The University neither services industrial land, nor is located on industrial land. Stormwater quantity control will be provided in accordance with City of Ottawa requirements.

We will also be relocating existing watermains, storm and sanitary sewers adjacent to the proposed building.

We've contacted the RVCA with regards to the requirements for the on-site quality control / treatment measures and are waiting on a response. If required we will provide quality control using an OGS and or LID measures.

We believe that this is considered an exemption under O.Reg. 525/98 and therefore requires no ECA application/approval. Could you confirm this?
I've attached a few plans showing the intended building as well as the site servicing.

Please don't hesitate to contact us if you have and questions or comments.

Kind Regards

Daniel Glauser
Municipal Designer - Infrastructure Ottawa
Office: 613 739 2910 Ext. 1022323
DGlauser@morrisonhershfield.com

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Daniel Glauser

From:	Eric Lalande <eric.lalande@rvca.ca>
Sent:	Wednesday, February 12, 2020 2:11 PM
To:	Daniel Glauser; Glen McDonald
Cc:	James Fookes
Subject:	RE: SWM; Carleton University New Residence Building

Hi Daniel,

Glen passed this along to me to review. The RVCA will not require water quality protection for the project, however it is encouraged to provide opportunities where possible to maximize water quality on-site (such as maximizing opportunities for infiltration, grassed areas, on-site retention).

Please let me know if you require anything else.

Eric Lalande, MCIP, RPP
Planner, Rideau Valley Conservation Authority
613-692-3571 x1137

From: Daniel Glauser <DGlauser@morrisonhershfield.com>
Sent: Wednesday, February 12, 2020 2:00 PM
To: Glen McDonald <glen.mcdonald@rvca.ca>
Cc: James Fookes <JFookes@morrisonhershfield.com>; Eric Lalande <eric.lalande@rvca.ca>
Subject: FW: SWM; Carleton University New Residence Building

Hi Glen,

I was wondering if you had a moment to look over the e-mail I sent a few weeks ago (see below)? We received commentary from the city asking us to contact the RVCA and provide that correspondence. We were planning on submitting our revised plans and reports in the next 2 weeks.

Please let me know if you need any additional information.

Kind Regards

Daniel Glauser
Municipal Designer - Infrastructure Ottawa
Office: 613 739 2910 Ext. 1022323
DGlauser@morrisonhershfield.com

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From: Daniel Glauser
Sent: Wednesday, December 4, 2019 4:22 PM
To: 'Glen McDonald' <glen.mcdonald@rvca.ca>

Cc: Eric Lalande <eric.lalande@rvca.ca>; James Fookes <JFookes@morrisonhershfield.com>
Subject: SWM; Carleton University New Residence Building

Hi Glen,

We are designing a new student residence on Carleton University Campus located on Campus Avenue (Link to Map location). The new building will change the surrounding fire access routes and grading (see attached plan). Beyond the roof and terraced areas, no additional parking spaces are proposed. The proposed fire route to the north of the proposed building will reduce the existing parking by approximately 8 spaces. Both proposed fire routes will be used primarily as pedestrian walkways. The preliminary design shows the entirety of the building draining into an underground stormwater retention system to allow a reduced release rate.
Stormwater from the site will be directed into an existing storm sewer running parallel to Campus Avenue which outlets in Rideau River (existing 1350 Conc. storm sewer immediately west of Bronson Ave. Rideau River bridge crossing). I've attached an overview of the servicing for the campus and outlined the proposed additions, existing storm sewer alignment and outlet in red.

Please could you confirm whether on-site quality control is required for this site, and if required, what treatment level is required.

Kind Regards

Daniel Glauser
Municipal Designer - Infrastructure Ottawa
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DGlauser@morrisonhershfield.com

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Appendix C

Water Demand and FUS Calculations

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1a. Carleton University Campus Water Demands

Design Parameter	Value (L/s)	Design Criteria
Residential Average Daily Demand	7.40	Metered Data[1]
Residential Maximum Daily Demand	19.38	Varies[2]
Residential Maximum Hourly Demand	38.65	Varies[2]
Institutional Average Daily Demand	9.21	Metered Data[3]
Institutional Maximum Daily Demand	13.81	1.5 x Average Daily[4]
Institutional Maximum Hourly Demand	24.87	1.8 x Max Daily[4]
Fire Flow	216.67	Based on the FUS

Design Parameter	Value (L/s)	Boundary Conditions	
		Head (m) [5]	Pressure (kPa)
Average Daily Demand	16.61	108	414.963
		115	483.633
Total Max Daily + Fire Flow	249.86	105	385.533
Max Hourly	63.51	108	414.963
Max Daily	33.19	108	414.963

[1] Metered data provided by Carleton University, maximum month taken over span of May 2018-April 2019 and averaged over 30 days. Additional 1.91 L/s was included for the proposed New Student Residence

[2] For Population <500, Table 3-3 of the MOE Design Guidelines for Drinking-Water Systems is used to determine peaking factors (Refer to Sheet 3, Table 3). For population >500, Table 4.2 of the City of Ottawa Water Design Guidelines is used. Peaking factors for total flow are based on total population.

[3] Metered data provided by Carleton University, maximum month taken over span of May 2018-April 2019 and averaged over 30 days

[4] City of Ottawa Water Design Guidelines (2010), Table 4.2

[5] The City of Ottawa Boundary Conditions for 400mm water service, subsequent pressure measure from finished floor elevation (65.70m)

	Scenario		
	Max Day + Fire	Max Hourly	Max Day
Flow Demand (L/s)	249.86	63.51	33.19
Boundary Condition: Available Pressure under Future Conditions (kPa)	385.533	414.963	414.963
Residual Pressure at Service Tee including pipe losses (400mm diameter pipe) (kPa)	310.55	409.01	413.17
Residual Pressure at Service Entry including pipe losses (250mm diameter pipe) (kPa)	305.10	408.48	413.01
Minimum Allowable Pressure (kPa)	140	276	345
Pressure Check	OK	OK	OK

Designed: D. Glauser		Project: CU - New Flagship Residence Building Proposed Servicing	
Checked: J. Fookes	Date: March 13, 2020	Location: 1125 Colonel By Drive	
Dwg Reference: C-001	File Ref: 190444600		Sheet No.: 1 of 1

2a. Carleton University Campus Water Demands

Table 1: Residence Buildings metered water data, Provided by Carleton University

BUILDING INFORMATION				METERED DATA[1]		PEAKING FACTORS[2]			
BLDG #	BUILDING NAME	GROSS SQ. FT.	POPULATION	MAX. MONTHLY (m^3)	AVG. DAILY (L/s)	MAX DAILY FACTOR	MAX HOURLY FACTOR	MAX DAILY (L/s)	MAX HOURLY (L/s)
5	RENFREW HOUSE	52,680	168	423.00	0.16	4.74	7.16	0.77	5.54
6	LANARK HOUSE	51,469	195	827.50	0.32	4.51	6.80	1.44	9.79
14	RUSSELL GRENVILLE	95,726	372	1,540.26	0.59	3.31	4.97	1.97	9.78
18	GLENGARY HOUSE	154,715	614	1,841.00	0.71	2.50	2.20	1.78	3.91
26	STORMONT-DUNDAS HOUSE	118,192	497	1,267.00	0.49	2.91	4.31	1.42	6.13
30	LEEDS RESIDENCE	169,139	395	2,722.36	1.05	3.22	4.83	3.38	16.33
34	PRESCOTT HOUSE	135,005	398	2,022.00	0.78	3.21	4.81	2.50	12.04
41	FORONTENAC HOUSE	87,998	250	871.00	0.34	4.03	6.07	1.36	8.22
44	LENNOX & ADDINGTON BUIDLING	174,316	717	2,728.00	1.05	2.50	2.20	2.63	5.79
	TOTAL	1,039,240.00	3,606.00	14,242.12	5.49	2.50	2.20	13.74	30.22

[1] Metered data provided by Carleton University, maximum month taken over span of January 2018-December 2019 and averaged over 30 days

[2] For Population <500, Table 3-3 of the MOE Design Guidelines for Drinking-Water Systems is used to determine peaking factors (Refer to Sheet 3, Table 3). For population >500, Table 4.2 of the City of Ottawa Water Design Guidelines is used. Peaking factors for total flow are based on total population.

Table 2: Institutional Buildings metered water data, Provided by Carleton University

BUILDING INFORMATION				METERED DATA[1]		PEAKING FACTORS[2]			
	BUILDING NAME	GROSS SQ. FT.	POPULATION	MAX. MONTHLY (m^3)	AVG. DAILY (L/s)	MAX DAILY FACTOR	MAX HOURLY FACTOR	MAX DAILY (L/s)	MAX HOURLY (L/s)
	ALL INSTITUTIONAL BUILDINGS	5,278,161.85	N/A	23,870.74	9.21	1.5	1.8	13.81	24.87
	TOTAL			23,870.74	9.21	1.50	1.80	13.81	24.87

[1] Metered data provided by Carleton University, maximum month taken over span of May 2018-April 2019 and averaged over 30 days

[2] Table 4.2 of the City of Ottawa Water Design Guidelines

3a. Reference Tables

Table 1: Excerpt from City of Ottawa Water Design Guidelines (2010), Table 4.2

Demand Type	Amount	Units
AVERAGE DAILY DEMAND		
Residential	350	L/person/day
Industrial - Light	35000	L/gross ha/d
Industrial - Heavy	55000	L/gross ha/d
Commercial & Instutional		
Shopping Centre	2500	L/(100m2/d)
Hospital	900	L/(bed/day)
School	70	L/(Student/day)
Trailer Park no Hook-up	340	L/(space/day)
Trailer Park with Hook Up	800	L/(space/day)
Campgrounds	225	L/(Campsite/day)
Mobile Home Parks	1000	L/(space/day)
Motels	150	L/(bed-space/day)
Hotels	225	L/(bed-space/day)
Tourist Commercial	28000	L/gross ha/d
Other Commercial	28000	L/gross ha/d

MAXIMUM DAILY DEMAND			
Residential	2.5	x avg. day	L/person/day
Industrial	1.5	x avg. day	L/gross ha/d
Commercial	1.5	x avg. day	L/gross ha/d
Instutional	1.5	x avg. day	L/gross ha/d

MAXIMUM HOURLY DEMAND			
Residential	2.2	x max day	L/person/day
Industrial	1.8	x max day	L/gross ha/d
Commercial	1.8	x max day	L/gross ha/d
Instutional	1.8	x max day	L/gross ha/d

Table 2: Excerpt from Sanitary Sewer Design Flow Report prepared by TSH on April 16, 2007

SANITARY UNIT DESIGN FLOWS		
Academic	6.61	L/(m^2/day)
Residential	210	L/person/day
AVERAGE DAILY WATER DEMAND[1]		
Academic	7.34	L/(m^2/day)
Residential	233.33	L/person/day
[1]Assumption that sanitary flow is 90% of average daily water demand		

Table 3: Excerpt from the MOE Design Guidelines for Drinking-Water System, Table 3-3

Dwelling Units Serviced	Equivalent Population	Night Minimum Hour Demand	Maximum Daily Factor	Peak Hour Factor
10	30	0.1	9.5	14.3
50	150	0.1	4.9	7.4
100	300	0.2	3.6	5.4
150	450	0.3	3	4.5
167	500	0.4	2.9	4.3

MORRISON HERSHFIELD

4a. Building Service - Sizing - Max Hourly Demand

Scenario: *Max Hourly Demand*

P_{Road}= 60.19 (psi) Minimum Water Pressure at valve on Bronson Ave
P_{Road}= 414.96 (kpa)

Existing 400mm Service at Bronson Avenue/Colonel By Drive

Length

L= 770 (m)
2526 (ft)

Size

d= 400 (mm)
16 (in)

Flow

Q = 0.0635 (m3/s)
1007 (USG/min)

Velocity

$$V = \frac{1.274Q}{d^2}$$

V= 0.51 (m/s)

Head Loss

$$P_d = \frac{4.52Q^{1.85}}{C^{1.85}d^{4.87}}$$

$$P = 0.434hSG$$

Pipe Diameter	C-Factor
150	100
200-250	110
300-600	120
600+	130

SG= specific gravity of water
= 1
C = 120
P_d= 0.000342 (psi)
h= 0.000787 (ft/ft)
1.9884 (ft)

Pressure Loss

P_{ROAD}= 60.19 (psi)
P_L= 0.86 (psi)
$P_{AT\ METER}$= 59.32 (psi)
$P_{AT\ METER}$= 409.01 (kpa)

Min Allowable Pressure (Max Hourly Demand) 276 (kpa) OK

MORRISON HERSHFIELD

5a. Building Service - Sizing - Max Daily Demand

Scenario: *Max Daily Demand*

P_{Road}= 60.19 (psi) Minimum Water Pressure at valve on Bronson Ave

P_{Road}= 414.96 (kpa)

Existing 400mm Service at Bronson Avenue/Colonel By Drive

Length

L= 770 (m)

2526 (ft)

Size

d= 400 (mm)

16 (in)

Flow

Q = 0.0332 (m3/s)

526 (USG/min)

Velocity

$$V = \frac{1.274Q}{d^2}$$

V= 0.26 (m/s)

Head Loss

$$P_d = \frac{4.52Q^{1.85}}{C^{1.85}d^{4.87}}$$

$$P = 0.434hSG$$

Pipe Diameter	C-Factor
150	100
200-250	110
300-600	120
600+	130

SG= specific gravity of water

= 1

C = 120

P_d= 0.000103 (psi)

h= 0.000237 (ft/ft)

0.5987 (ft)

Pressure Loss

P_{ROAD}= 60.19 (psi)

P_L= 0.25982 (psi)

$P_{AT\ METER}$= 59.93 (psi)

$P_{AT\ METER}$= 413.17 (kpa)

Min Allowable Pressure (Max Daily Demand) 345 (kpa) OK

6a. Building Service - Sizing - Max Daily + Fire

Scenario: *Max Daily + Fire*

P_{Road}= 55.92 (psi) Minimum Water Pressure at valve on Bronson Ave

P_{Road}= 385.53 (kpa)

Existing 400mm Service at Bronson Avenue/Colonel By Drive

Length

L= 770 (m)

2526 (ft)

Size

d= 400 (mm)

16 (in)

Flow

Q = 0.2499 (m3/s)

3960 (USG/min)

Velocity

$$V = \frac{1.274Q}{d^2}$$

V= 1.99 (m/s)

Head Loss

$$P_d = \frac{4.52Q^{1.85}}{C^{1.85}d^{4.87}}$$

$$P = 0.434hSG$$

Pipe Diameter	C-Factor
150	100
200-250	110
300-600	120
600+	130

SG= specific gravity of water

= 1

C = 120

P_d= 0.004305011 (psi)

h= 0.009919 (ft/ft)

25.0587 (ft)

Pressure Loss

P_{ROAD}= 55.92 (psi)

P_L= 10.88 (psi)

$P_{AT\ METER}$= 45.04 (psi)

$P_{AT\ METER}$= 310.55 (kpa)

Min Allowable Pressure (Max Hourly Demand) 140 (kpa) OK

7a. CU - New Flagship Residence Building - Keyplan

Key Plan showing section of private 400mm watermain

1b. CU - New Flagship Residence Building - Water Demand Calculations

Project Name	CU - New Flagship Residence Building
Project Number	190444600
Site Address	1125 Colonel By Drive
Completed By	DG
Date	3/13/2020

Excerpt from the MOE Design Guidelines for Drinking-Water System, Table 3-3

Dwelling Units Serviced	Equivalent Population	Night Minimum Hour Demand	Maximum Daily Factor	Peak Hour Factor
10	30	0.1	9.5	14.3
50	150	0.1	4.9	7.4
100	300	0.2	3.6	5.4
150	450	0.3	3	4.5
167	500	0.4	2.9	4.3

MAXIMUM DAILY DEMAND	
Actual Population	**Corresponding Factor (Interpolated)**
471	2.958

MAXIMUM HOURLY DEMAND	
Actual Population	**Corresponding Factor (Interpolated)**
471	4.416

Average Daily Demand	164850.0	L/day
Maximum Daily Demand	487626.3	L/day
Maximum Hourly Demand	727977.6	L/day

2b. CU - New Flagship Residence Building - FUS Calculations

Project Name CU - New Flagship Residence Building
Project Number 190444600
Site Address 1125 Colonel By Drive
Completed By DG
Date 13-Mar-20

(Per Fire Underwriters Survey, Water Supply for Public Fire Protection, 1999)

1. Determine Estimated Fire Flow based on Building Floor Area

F= 220 C √A

F= Required flow in litres / minute
A= Total floor area in m^2
C= Coefficient related to Construction
= 1.5 for wood frame construction
= 1.0 for ordinary construction
= 0.8 for non-combustible construction
= 0.6 for fire-resistive construction

C= 0.8

Floor Areas

Floor	Area (m²)
Basement	1312
L1	2344
L2	1856
L3	1856
L4	1869
L5	1869
L6	1489
L7	1489
L8	1100
L9	1100
Total	16284

Area excl. basement at least 50% below grade = 14972 m^2

A= 14972 m^2

F= 21535.5 L/min
Round to nearest 1000 L/m, F = 22000.0 L/min

2. Adjust flow based on Fire hazard and contents

A	Non-combustible	-25%
B	Limited Combustible	-15%
C	Combustible	0%
D	Free Burning	15%
E	Rapid Burning	25%

Type of Construction (A,B,C,D)	B
Adjustment Factor	-15%
Flow From 1.	22000.0 L/min
Adjusted Flow	18700.0 L/min
Minimum Flow (2000 L/min)	18700.0 L/min
Flow	18700.0 L/min

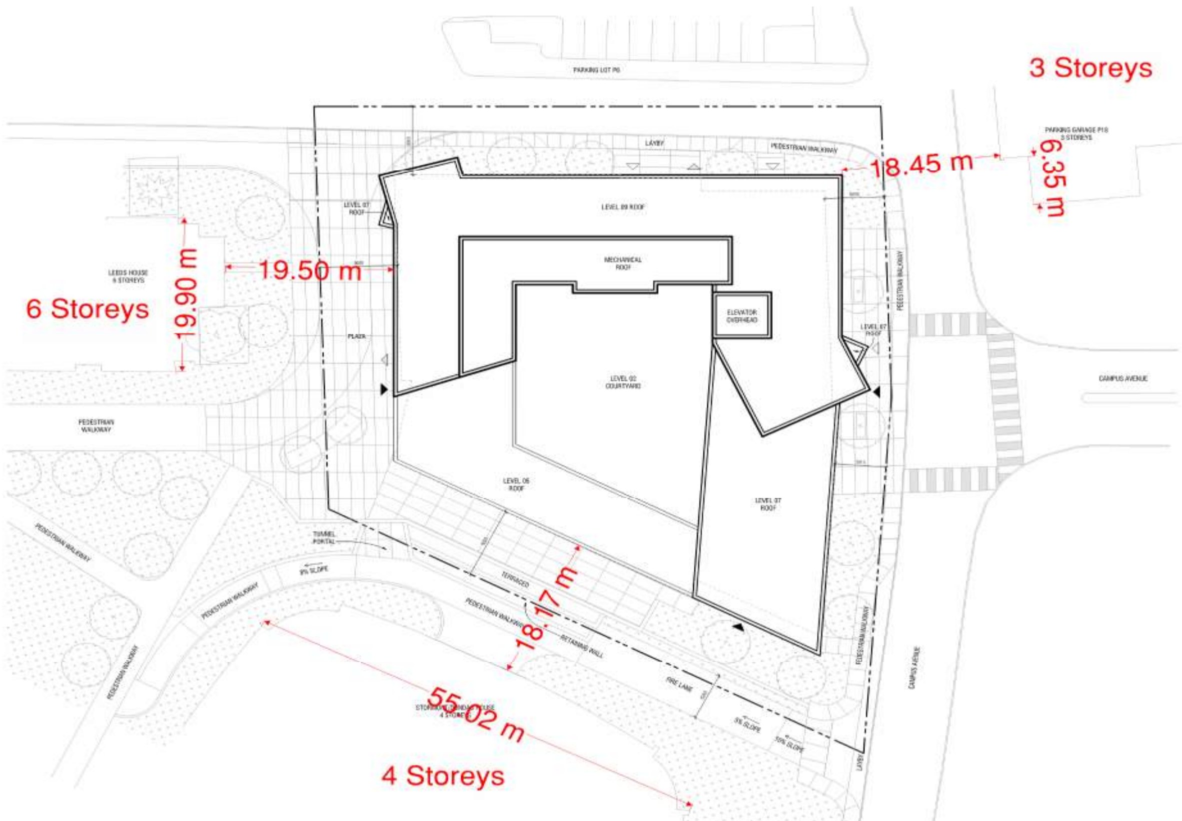
3. Reduce flow from No. 2. based on automatic sprinkler protection

Flow from 2.	18700.0 L/min
Complete Automatic Sprinkler Protection (yes/no)	Yes
Reduction	30%
Water supply is standard (yes/no)	Yes
Additional Reduction	10%
Sprinkler System is fully supervised (yes/no)	Yes
Additional Reduction	10%
Total Reduction	50%
Flow after Sprinkler Reduction	9350.0 L/min

4. Adjacent Structures / Fire Separation with other buildings

Flow from 3.	9350.0 L/min

Figure 1: Adjacent Buildings



Exposure charge based on Table G5:

Side	Construction Type	Storeys	Length (m)	LH Factor
North	N/A	0	0	0
East	Fire resistive with unprotected openings	3	6	18
South	Fire resistive with unprotected openings	4	55	220
West	Fire resistive with unprotected openings	6	20	120

Side	Separation Distance (m)	Exposure Charge
North	>45	0
East	18.5	10%
South	18.2	15%
West	19.5	15%

Cumulative Increase (Max 75%) 40%

MORRISON HERSHFIELD

Flow Increased for Adjacent Structures	13090.0	L/min
Maximum Permitted Flow (45 000 L/min)	13090.0	L/min
Minimum Permitted Flow (2 000 L/min)	13090.0	L/min
Required Fire Flow (rounded to nearest 1000 L/m)	13000.0	L/min
	216.67	L/s

3b. CU - New Flagship Residence Building - Water Demand Calculations

Project Name	CU - New Flagship Residence Building
Project Number	190444600
Site Address	1125 Colonel By Drive
Completed By	DG
Date	13-Mar-20

From City of Ottawa Water Distribution Systems Guidelines

Occupancy Preliminary Design

	ea.		persons per unit	
Bachelor/Studio	0	ea	1.4	0
1 Bedroom	4	ea	1.4	5.6
2 Bedroom	12	ea	2.1	25.2
3 Bedroom	142	ea	3.1	440.2
				471

Building Occupancy	471	people	Posted per Preliminary Design
Residential	471	persons	
Per Capita Flow	350	l/per/d	City of Ottawa Water Design Guidelines Table 4.2 - residential
Daily average flow	164850	l/d	
Daily average flow	1.91	l/s	
Maximum Daily Demand Peak			
Peak Factor	2.96	x average day	MOE Design Guidelines for Drinking-Water System, Table 3-3
Peak Flow	5.64	l/s	
	89.46	GPM	
Maximum Hourly Demand Peak			
Peak Factor	4.42	x average day	MOE Design Guidelines for Drinking-Water System, Table 3-3
Peak Flow	8.43	l/s	
	133.55	GPM	
Total Max Daily water demand	5.64	l/s	
Total Max Hourly water demand	8.43	l/s	
Fire Demand (refer to FUS calc)	216.67	l/s	
Max Day plus Fire demand	222.31	l/s	

4b. CU - New Flagship Residence Building - Water Demand Calculations

P_{Road}= 45.04 (psi) Dynamic pressure

P_{Road}= 310.54997 (kPa)

Existing Service off 400mm watermain at NSR

Length

L= 6 (m)

20 (ft)

Size

d= 250 (mm)

10 (in)

Flow

Q = 0.222 (m3/s)

3524 (Usg/min)

Velocity

$$V = \frac{1.274Q}{d^2}$$

V= 4.53 (m/s)

Head Loss

$$P_d = \frac{4.52Q^{1.85}}{C^{1.85}d^{4.87}}$$

$$P = 0.434hSG$$

Pipe Diameter	C-Factor
150	100
200-250	110
300-600	120
600+	130

SG= specific gravity of water

= 1

C = 110

P_d= 0.040186539 (psi)

h= 0.092596 (ft/ft)

1.8227 (ft)

Pressure Loss

P_{ROAD}= 45.04 (psi)

P_L= 0.79 (psi)

$P_{AT\ METER}$= 44.25 (psi)

$P_{AT\ METER}$= 305.0957207 (kPa)

Min Allowable Pressure (Max Hourly Demand) 140 (kpa) OK

5b. CU - New Flagship Residence Building - Water Demand Calculations

P_{Road}= 59.32 (psi) Dynamic pressure

P_{Road}= 409.01411 (kpa)

Existing Service off 400mm watermain at NSR

Length

L= 6 (m)
20 (ft)

Size

d= 250 (mm)
10 (in)

Flow

Q = 0.0635 (m3/s)
1007 (Usg/min)

Velocity

$$V = \frac{1.274Q}{d^2}$$

V= 1.29 (m/s)

Head Loss

$$P_d = \frac{4.52Q^{1.85}}{C^{1.85}d^{4.87}}$$

$$P = 0.434hSG$$

Pipe Diameter	C-Factor
150	100
200-250	110
300-600	120
600+	130

SG= specific gravity of water
= 1
C = 110
P_d= 0.00395806 (psi)
h= 0.009120 (ft/ft)
0.1795 (ft)

Pressure Loss

P_{ROAD}= 59.32 (psi)
P_L= 0.08 (psi)
$P_{AT\ METER}$= 59.24 (psi)
$P_{AT\ METER}$= 408.48 (kpa)

Min Allowable Pressure (Max Hourly Demand) 276 (kpa) OK

MORRISON HERSHFIELD

6b. Building Service - Sizing - Max Daily Demand

Scenario: *Max Daily Demand*

P_{Road}= 59.93 (psi) Dynamic Pressure
P_{Road}= 413.17 (kpa)

Existing Service off 400mm watermain at NSR

Length

L= 6 (m)
20 (ft)

Size

d= 250 (mm)
10 (in)

Flow

Q = 0.0332 (m3/s)
526 (USG/min)

Velocity

$$V = \frac{1.274Q}{d^2}$$

V= 0.68 (m/s)

Head Loss

$$P_d = \frac{4.52Q^{1.85}}{C^{1.85}d^{4.87}}$$

$$P = 0.434hSG$$

Pipe Diameter	C-Factor
150	100
200-250	110
300-600	120
600+	130

SG= specific gravity of water
= 1
C = 110
P_d= 0.001192 (psi)
h= 0.002746 (ft/ft)
0.0541 (ft)

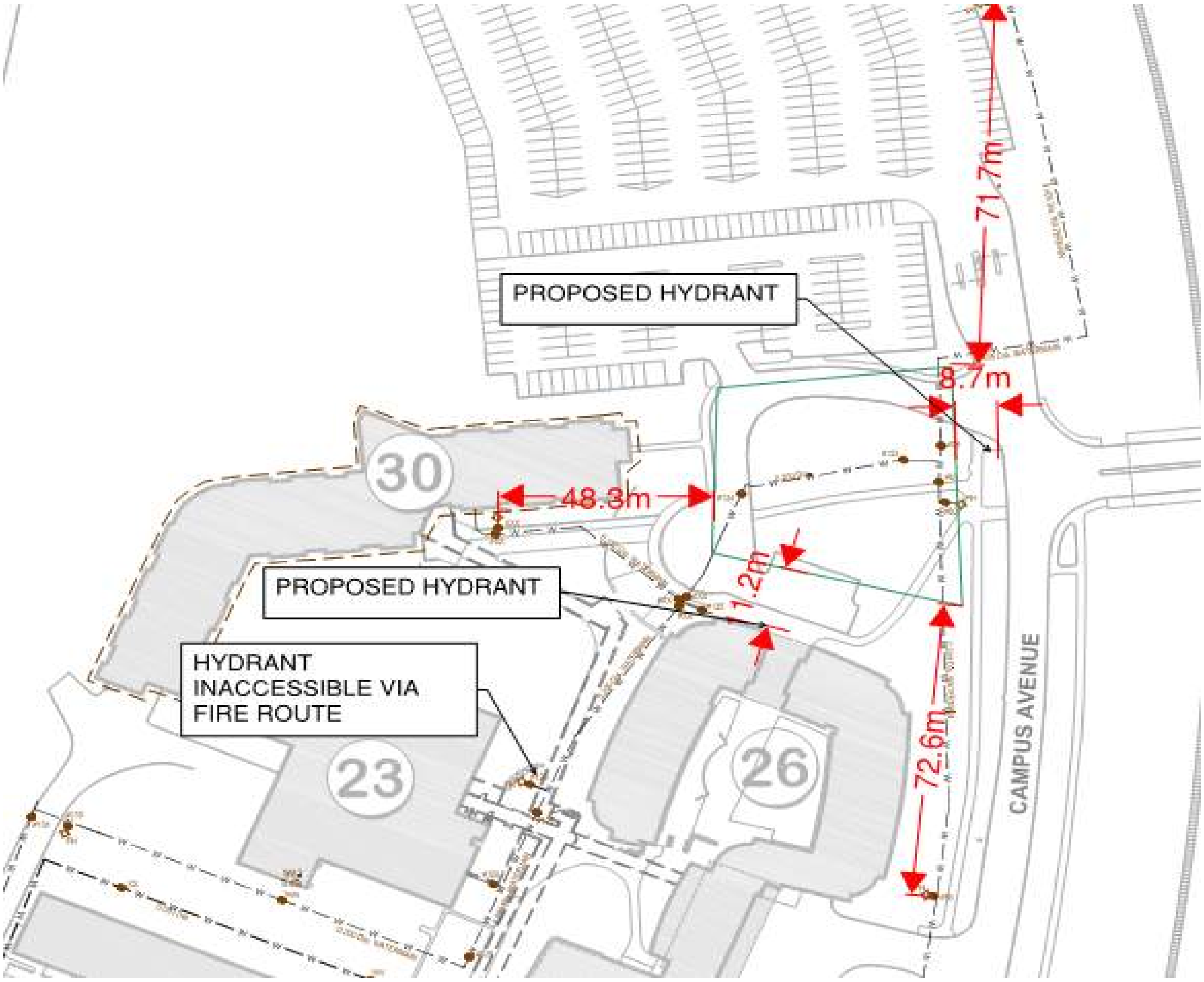
Pressure Loss

P_{ROAD}= 59.93 (psi)
P_L= 0.02346 (psi)
$P_{AT\ METER}$= 59.90 (psi)
$P_{AT\ METER}$= 413.01 (kpa)

Min Allowable Pressure (Max Daily Demand) 345 (kpa) OK

7b. CU - New Flagship Residence Building - Water Demand Calculations

Key Plan showing distances to hydrants within 150m



Hydrant	Distance from building (m)	Class	Contribution to required fire flow (L/m)
1	9	AA*	5700
2	11	AA*	5700
3	48	AA*	5700
4	72	AA*	5700
5	73	AA*	5700

Available Flow 28500 L/min

Required Flow (FUS calc) 13000 L/min

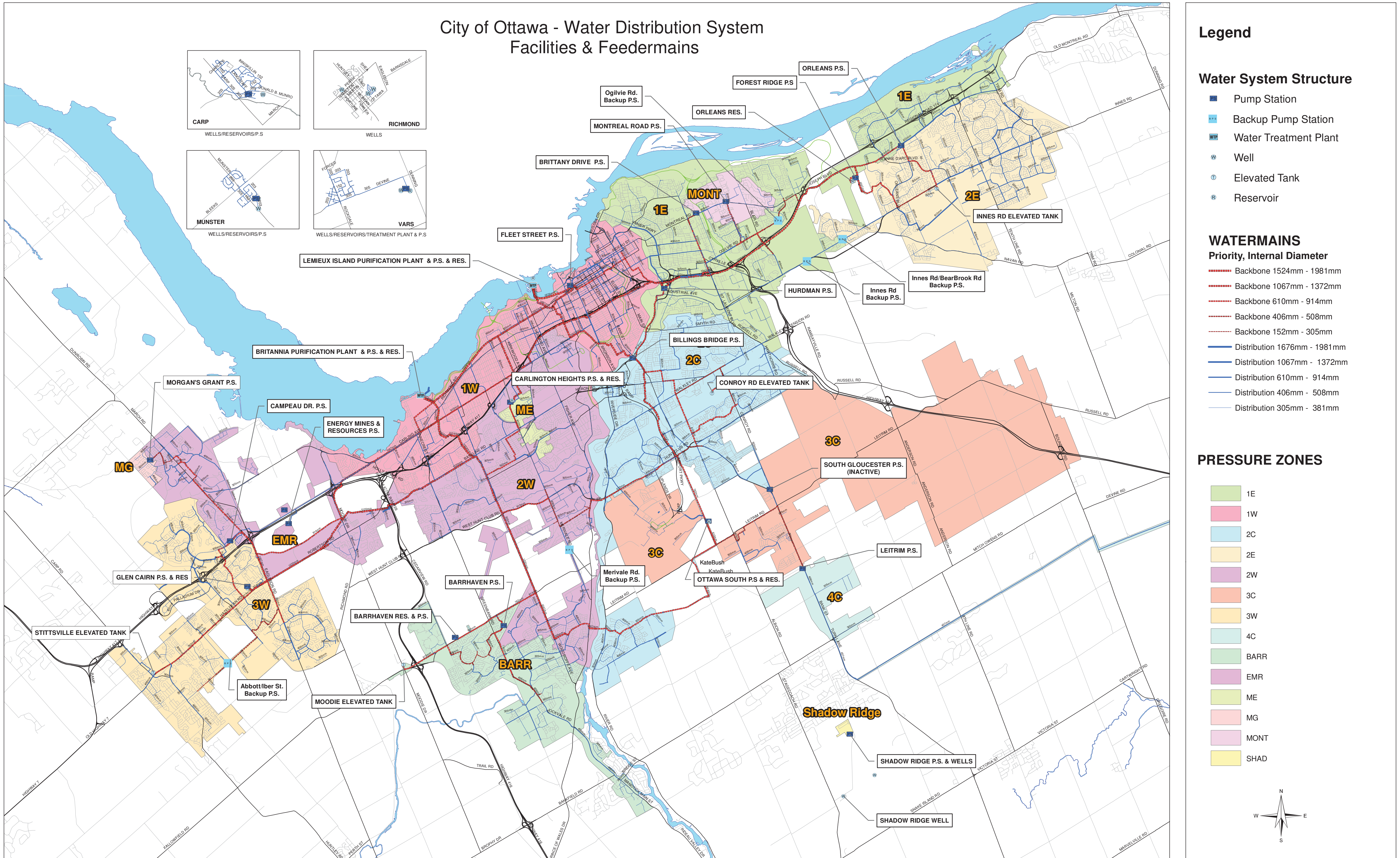
*Hydrants not colour coded - class AA assumed.

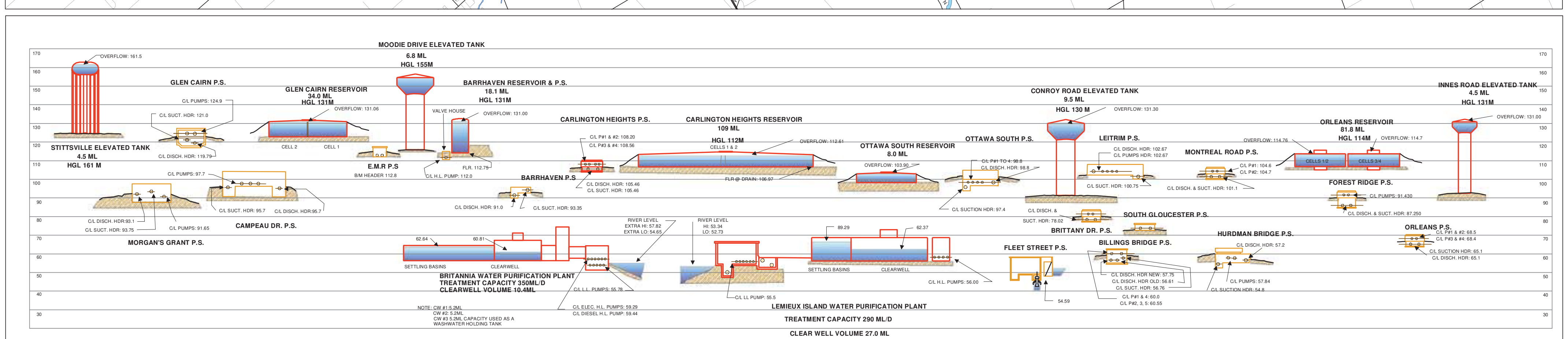
PROJECT STATISTICS: CARLETON NEW STUDENT RESIDENCE

GROSS FLOOR AREA CALCULATIONS (GFA)		
Level	Area Type	Area
LEVEL 02	Gross Floor Area	1259.60 m²
LEVEL 03	Gross Floor Area	1260.42 m²
LEVEL 04	Gross Floor Area	1258.99 m²
LEVEL 05	Gross Floor Area	1258.99 m²
LEVEL 06	Gross Floor Area	929.16 m²
LEVEL 07	Gross Floor Area	999.85 m²
LEVEL 08	Gross Floor Area	637.87 m²
LEVEL 09	Gross Floor Area	429.77 m²
Total Area		8034.66 m²

GROSS FLOOR AREA CALCULATIONS (EXEMPT)		
Level	Area Type	Area
BASEMENT (TUNNEL LEVEL)	Exempt	1311.53 m²
LEVEL 01	Exempt	2343.95 m²
LEVEL 02	Exempt	596.79 m²
LEVEL 03	Exempt	595.97 m²
LEVEL 04	Exempt	610.06 m²
LEVEL 05	Exempt	610.07 m²
LEVEL 06	Exempt	559.54 m²
LEVEL 07	Exempt	488.84 m²
LEVEL 08	Exempt	462.10 m²
LEVEL 09	Exempt	670.21 m²
Total Area		8249.06 m²

GROSS FLOOR AREA CALCULATIONS (COMBINED TOTAL)		
Level	Area Type	Area
BASEMENT (TUNNEL LEVEL)	Exempt	1311.53 m²
LEVEL 01	Exempt	2343.95 m²
LEVEL 02	Exempt	596.79 m²
LEVEL 02	Gross Floor Area	1259.60 m²
LEVEL 03	Exempt	595.97 m²
LEVEL 03	Gross Floor Area	1260.42 m²
LEVEL 04	Exempt	610.06 m²
LEVEL 04	Gross Floor Area	1258.99 m²
LEVEL 05	Exempt	610.07 m²
LEVEL 05	Gross Floor Area	1258.99 m²
LEVEL 06	Exempt	559.54 m²
LEVEL 06	Gross Floor Area	929.16 m²
LEVEL 07	Exempt	488.84 m²
LEVEL 07	Gross Floor Area	999.85 m²
LEVEL 08	Exempt	462.10 m²
LEVEL 08	Gross Floor Area	637.87 m²
LEVEL 09	Exempt	670.21 m²
LEVEL 09	Gross Floor Area	429.77 m²
Total Area		16283.72 m²



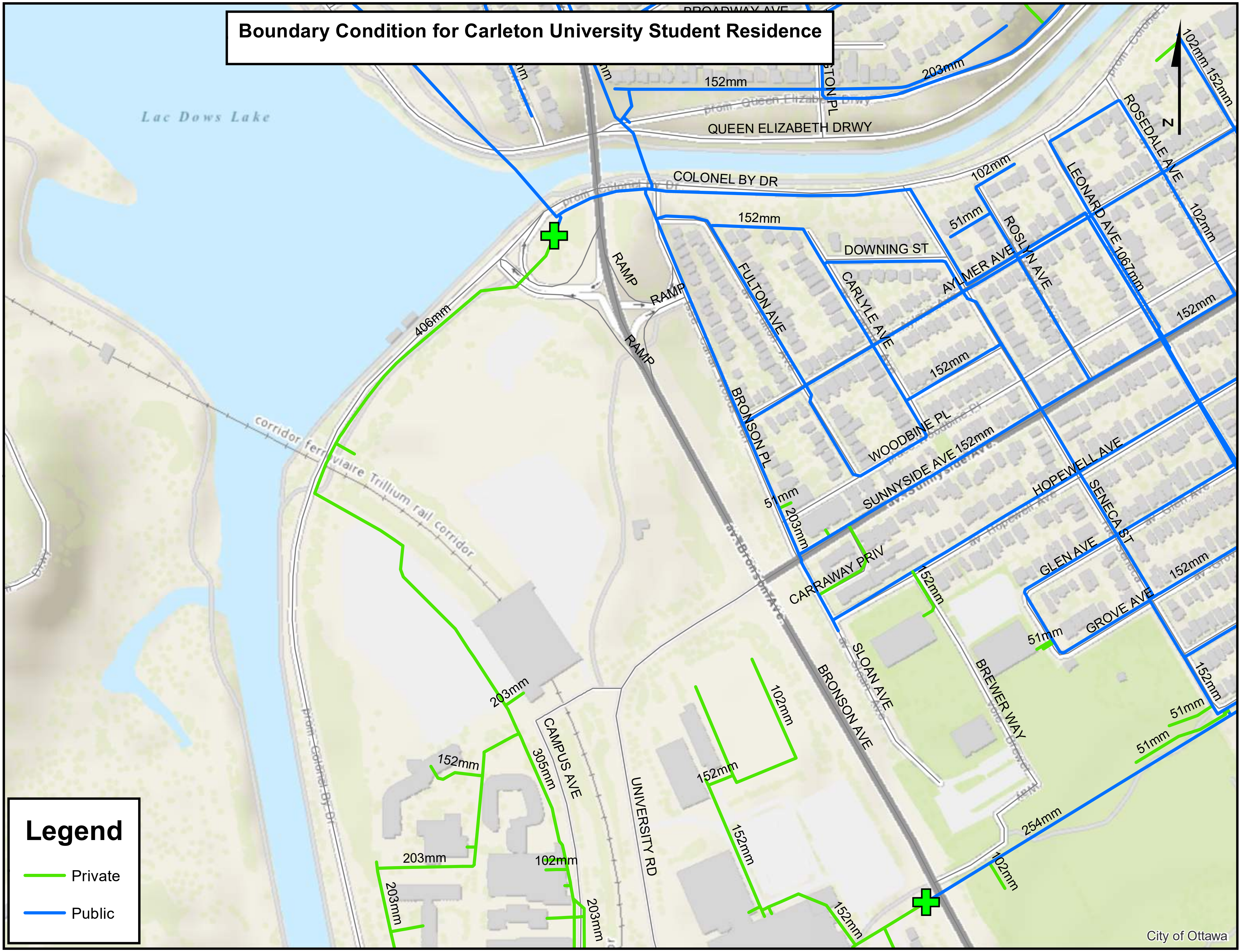


Infrastructure Services & Community Sustainability
Infrastructure Services

FIGURE 1-1

DRAWN BY: D. HESS DATE: 31 July 2013

Boundary Condition for Carleton University Student Residence



CORRESPONDENCE WITH THE CITY OF OTTAWA REGARDING BOUNDARY CONDITIONS FOR WATER DEMAND ANALYSIS

Daniel Glauser

From:	Fraser, Mark <Mark.Fraser@ottawa.ca>
Sent:	Thursday, March 12, 2020 3:36 PM
To:	Daniel Glauser
Cc:	James Fookes; rzaig@kwc-arch.ca
Subject:	RE: Boundary Conditions; Carleton University - New Student Residence
Attachments:	Carleton U Residence March 2020.pdf

Hi Daniel,

The following are boundary conditions, HGL, for hydraulic analysis at **Carleton University** (Zone 1W) assumed to be connected to the 406mm dia. watermain on Colonel By Dr. and 254mm on Brewers/Bronson Ave. (see attached PDF for location).

	406mm dia. Watermain on Colonel By Dr.	254mm dia. Watermain on Brewer Way/Bronson Ave.
Minimum HGL	105.0	104.0
Maximum HGL	115.5	115.5
MaxDay + FireFlow (217L/s)	108.0	105.0

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

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review Central Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Daniel Glauser <DGlauser@morrisonhershfield.com>
Sent: March 06, 2020 4:07 PM
To: Fraser, Mark <Mark.Fraser@ottawa.ca>
Cc: James Fookes <JFookes@morrisonhershfield.com>; Ran Zaig <rzaig@kwc-arch.ca>
Subject: Boundary Conditions; Carleton University - New Student Residence

Hi Mark,

As previously discussed, we have calculated the water demand using water meter data provided by Carleton University over a year. The rationale to the water demand is described below:

The following table outlines the relevant design parameters/criteria and the corresponding calculated values (The full calculations will be disclosed in the revised design brief):

1. Carleton University Campus Water Demands

Design Parameter	Value (L/s)	Design Criteria
Residential Average Daily Demand	7.40	Metered Data[1]
Residential Maximum Daily Demand	19.38	Varies[2]
Residential Maximum Hourly Demand	38.65	Varies[2]
Institutional Average Daily Demand	9.21	Metered Data[3]
Institutional Maximum Daily Demand	13.81	1.5 x Average Daily[4]
Institutional Maximum Hourly Demand	24.87	1.8 x Max Daily[4]
Fire Flow	216.67	Based on the FUS

Design Parameter	Value (L/s)	Boundary Conditions (kPa)
Average Daily Demand	16.61	
Total Max Daily + Fire Flow	249.86	
Max Hourly	63.51	
Max Daily	33.19	

[1] Metered data provided by Carleton University, maximum month taken over the span May 2018-April 2019 and averaged over 30 days. An additional 1.91 L
New Student Residence (based on 350 l/per/d – from City of Ottawa Water Design Guidelines Table 4.2 – residential)
[2] For Population <500, Table 3-3 of the MOE Design Guidelines for Drinking-Water Systems is used to determine peaking factors. For population >500, Table
Design Guidelines is used. Peaking factors for total flow are based on total population.
[3] Metered data provided by Carleton University, maximum month taken over span of May 2018-April 2019 and averaged over 30 days.
[4] City of Ottawa Water Design Guidelines (2010), Table 4.2.

The supporting data and calculations will be provided as part of the revised SPA submission, as well as an explanation included as part of the body of the design brief.

We ask that you provide the boundary conditions based on the proposed water service connection (See attached GeoOttawa plan).

Please feel free to contact me for any clarification/comments.

Daniel Glauser
Municipal Designer - Infrastructure Ottawa
Office: 613 739 2910 Ext. 1022323
DGlauser@morrisonhershfield.com

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CORRESPONDENCE WITH THE ARCHITECT REGARDING CONDITIONS FOR FIRE DEMAND ANALYSIS

James Fookes

From: Ran Zaig <rzaig@kwc-arch.ca>
Sent: Monday 09 December 2019 9:31 AM
To: James Fookes
Cc: Daniel Glauser; Nigel Tai; Jose Trinidad; Jessica Musialski
Subject: 2019-12-09_CU_NSRes - Information required for Fire Underwriters Survey Calculation
Attachments: Tech bulletin ISTB-2018-02_FUS extracts.pdf

Good morning James and Daniel,

Please see my reply below.

Regards,

Ran Zaig
Associate Partner, Architect
B.ARCH. l OAA l MRAIC l =^.^=

KWCarchitects
383 Parkdale Avenue, Suite 201, Ottawa, Ontario, K1Y 4R4
T: 613-238-2117; 223 **F:** 613-238-6595 **E:** rzaig@kwc-arch.com

---

From: James Fookes [mailto:JFookes@morrisonhershfield.com]
Sent: November-29-19 09:12 AM
To: Ran Zaig
Cc: Daniel Glauser
Subject: CU_NSRes - Information required for Fire Underwriters Survey Calculation

Hi Ran,

For Site Plan Control submission we are required to provide supporting correspondence for our assumptions with respect to the Fire Underwriters Survey fire flow calculations. These calculations are provided as part of the Site Servicing report, and are used by the City to verify that sufficient fire flow is available at hydrants in the vicinity of the building.

Could you please confirm the following.

1. GFA per floor and total GFA.***[KWC R.Z.]*** as previously provided via email form Nigel Tai 2019-11-29 (10:01)

2. Type of construction, based on the ISO classes and additional notes as follows. The ISO guide referenced here is attached as a PDF.***[KWC R.Z.]*** Using he definitions that are listed under item ***2. Classification of Basic Construction Type***, this building is proposed to be **Construction class 3 (Non-combustible).**

A. Determine the type of construction.

- Coefficient *C* in the FUS method is equivalent to coefficient *F* in the ISO method:

Correspondence between FUS and ISO construction coefficients

FUS type of construction	ISO class of construction	Coefficient C
Fire-resistive construction	Class 6 (fire resistive)	0.6
	Class 5 (modified fire resistive)	0.6
Non-combustible construction	Class 4 (masonry non-combustible)	0.8
	Class 3 (non-combustible)	0.8
Ordinary construction	Class 2 (joisted masonry)	1.0
Wood frame construction	Class 1 (frame)	1.5

However, the FUS definition of fire-resistive construction is more restrictive than those of ISO construction classes 5 and 6 (modified fire resistive and fire resistive). FUS requires structural members and floors in buildings of fire-resistive construction to have a fire-resistance rating of 3 hours or longer.

- With the exception of fire-resistive construction that is defined differently by FUS and ISO, practitioners can refer to the definitions of the ISO construction classes (and the supporting definitions of the types of materials and assemblies that make up the ISO construction classes) found in the current ISO guide [4] (see Annex i) to help select coefficient *C*.
- To identify the most appropriate type of construction for buildings of mixed construction, the rules included in the current ISO guide [4] can be followed (see Annex i). For a building to be assigned a given classification, the rules require ⅔ (67%) or more of the total wall area and ⅔ (67%) or more of the total floor and roof area of the building to be constructed according to the given construction class or a higher class.

3. Occupancy type based on the following classifications. Definitions are included in the attached PDF.***[KWC R.Z.]*** Based on the ***Occupancy Type Examples*** in the ISO document the propose building will be categorized ***Limited-Combustible (C-2)***

- The charge for occupancy class in the FUS method corresponds with the occupancy factor *O* in the ISO method (subtracting 1.00 from the ISO *O* factor values and converting to a percentage will yield the FUS charges):

Correspondence between FUS occupancy charges and ISO occupancy factors

FUS occupancy class	ISO occupancy combustibility class	Occupancy charge	Occupancy factor O
Non-combustible	C-1 (non-combustible)	−25%	0.75
Limited combustible	C-2 (limited combustibility)	−15%	0.85
Combustible	C-3 (combustible)	No charge	1.00
Free burning	C-4 (free burning)	+15%	1.15
Rapid burning	C-5 (rapid burning or flash burning)	+25%	1.25

4. Confirm that the building will be provided with complete automatic sprinkler protection.***[KWC R.Z.]*** Confirmed.

5. Confirm whether the sprinkler system is fully supervised. This requires a supervisory signal and water flow alarm to be transmitted to an approved monitoring location, meeting the NFPA requirements as follows:***[KWC R.Z.]*** Yes fully supervised sprinkler system will be provided.

- The FUS guide offers an additional credit of up to 10% for sprinkler systems that are considered "fully supervised", but the phrase is not clearly defined. In its *Life Safety Code* [10], the National Fire Protection Association (NFPA) describes "supervision" of sprinkler systems as requiring two types of signals:
  - a distinctive supervisory signal to indicate conditions that could impair the satisfactory operation of the sprinkler system (a fault alarm), which is to sound and be displayed, either at a location within the building that is constantly attended by qualified personnel (such as a security room), or at an approved remotely located receiving facility (such as a monitoring facility of the sprinkler system manufacturer); and
  - a water flow alarm to indicate that the sprinkler system has been activated, which is to be transmitted to an approved, proprietary alarm-receiving facility, a remote station, a central station or the fire department.

Thanks and regards,
James

James Fookes, P.Eng.
Department Manager, Municipal Infrastructure
jfookes@morrisonhershfield.com

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Smith + Andersen
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613 230 1186 f 613 230 2598 smithandandersen.com

2020-03-18

KWCArchitects.
383 Parkdale Ave., Suite 201
Ottawa, Ontario
K1Y 4R4

Attention: Mr. R. Zaig, Architect, OAA, RAIC

RE: CARTON UNIVERSITY NEW RESIDENCE
1125 COLONEL BY DRIVE, OTTAWA, ONTARIO
S+A PROJECT NUMBER 06111- CITY OF OTTAWA SITE PLAN COMMENTS

Dear Mr. Zaig,

This letter is to confirm that the sprinkler systems for the new residential building will be fully supervised. As per NFPA 13 requirements, the sprinkler system will be designed with a supervisory signal and water flow alarm.

We trust that the above meets with your approval. If you have any questions, please contact the undersigned.

Yours truly,

SMITH + ANDERSEN

Michael St. Louis, P. Eng.
Associate Principal

cc: Mr. Mike Leong, P. Eng., – Smith + Andersen

PROFESSIONAL ENGINEER
LICENSED
20/03/18
M. J. ST. LOUIS
06111.041
M001
PROVINCE OF ONTARIO

Appendix D

Sanitary Flow Calculations

EXISTING SANITARY SEWER CALCULATION SHEET

CU - New Flagship Residence Building

LOCATION			RESIDENTIAL AREA AND POPULATION							COMMERCIAL			INSTITUTIONAL			INDUSTRIA	IINFILTRATION			TOTAL	EXISTING SEWER										
Area ID	UP	Down	Area	Pop.	Cumulative		Qres	Peak.	Qres	Area	Accu	Qc	Area	Accu	Qins	QC+I+I	Total	Accu.	Flow	Flow	Length	Size	Area	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Qtot/Qfull	Notes
					area	pop.	avg.	Fact.				avg.			avg.		Area														
			(ha)	P	(ha)		(L/s)	(-)	(L/s)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(m)	(mm)	(m^2)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(-)	
St. Patricks	-	142-2	0	0	0.000	0	0.000	3.80	0.000	0.000	0.000	0.000	0.640	0.640	0.207	0.311	0.64	0.64	0.211	0.522											
Routing	142-2	142-1A																		0.522	5.5	200	0.031	0.480	1.00	22.7	0.72	0.13	22.2	0.02	
Leeds	-	142-1B	0.81	396	0.81	396	0.963	3.67	3.530	0.000	0.000	0.000	0.000	0.64	0.207	0.311	0.81	1.45	0.479	4.842											
Routing	142-1B	142-1A																		4.842	14.7	200	0.031	1.122	1.00	34.7	1.11	0.22	29.9	0.14	
Routing	142-1A	142-1																		4.842	38.6	200	0.031	2.122	1.00	47.8	1.52	0.42	42.9	0.10	
Parking Struc	-	144-1	0	0	0.00	0	0.000	3.80	0.000	0.000	0.000	0.044	0.000	0.00	0.000	0.044	0.00	0.00	0.000	4.886											6L/d per Parking Stall per Appendix 4-A of the Ottawa Sewer Design Guidelines
Routing	144-1	142-1																		4.886	76.5	250	0.049	0.500	0.43	42.0	0.86	1.49	37.2	0.12	
Routing	142-1	141-5																		4.886	3.5	200	0.031	3.890	1.00	64.7	2.06	0.03	59.8	0.08	
Routing	141-5	141-4																		4.886	60.4	300	0.071	0.330	0.34	55.6	0.79	1.28	50.7	0.09	
Stormont & Dundas	-	141-4	0.66	459	1.47	855	2.078	3.53	7.335	0.000	0.000	0.000	0.000	0.64	0.207	0.311	0.66	2.11	0.696	13.229											
Routing	141-4	141-3																		13.229	67.1	375	0.110	0.590	0.25	134.7	1.22	0.92	121.4	0.10	
Routing	141-3	141-2																		13.229	37	375	0.110	0.400	0.25	110.9	1.00	0.61	97.7	0.12	
Residence Commons	-	141-2	0.56	1764	0.56	1764	4.288	3.29	14.124	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.56	0.56	0.185	27.537											
Routing	141-2	141-1																		27.537	52	375	0.110	0.350	0.25	103.7	0.94	0.92	76.2	0.27	

Design Parameters

Avg. Daily Flow Res.	210 L/p/d [1]	Harmon's Equation	Infiltration / Inflow	0.33 L/s/ha	*Residence population from 2008 Genivar Report
Avg. Daily Flow Comm.	28000 L/ha/d	0%	Min. Pipe Velocity	0.06 L/s	
Avg. Daily Flow Instit.	28000 L/ha/d	1	Max. Pipe Velocity	3.00 L/s	
Avg. Daily Flow Indust	55000 L/ha/d	100%	Mannings Roughness Coefficie	0.013	
Avg. Academic per GFA flow	6.6 L/m^2/d [1]	1.5			
[1] Avg.Daily Flow Res. Per 2007 TSH Monitor Data		per MOE Graph			

Prepared By: Daniel Glauser

Checked by: James Fookes

Date: August 11, 2020

Project No. 190500700

PROPOSED SANITARY SEWER CALCULATION SHEET

CU - New Flagship Residence Building

LOCATION				RESIDENTIAL AREA AND POPULATION									COMMERCIAL			INSTITUTIONAL			
Area ID	UP	Down	Area	Number of Units By Type			Pop.	Cumulative area	Cumulative pop.	Qres avg.	Peak. Fact.	Qres	Area	Accu	Qc avg.	Area	Accu	Qins avg.	QC+I
			(ha)	Singles	Semi's	Town's	P	(ha)		(L/s)	(-)	(L/s)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)
St. Patrick	-	SAMH202	0.6				606	0.600	606	1.473	3.60	5.307	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Routing	SAMH202	SAMH203																	
Northern Dev	-	SAMH201	3.07				1712	3.070	1712	4.161	3.31	13.759	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Leeds	-	SAMH201	0.81				396	3.41	2115	5.140	3.21	16.524	0.000	0.000	0.000	0.000	0.00	0.000	0.000
Routing	SAMH201	SAMH203																	
Routing	SAMH203	SAMH204																	
New Res	-	Building	0.8035				471	0.80	471	1.526	3.64	5.563	0.000	0.000	0.000	0.235	0.24	0.180	0.269
Routing	Building	SAMH204																	
Routing	SAMH204	SAMH205																	
Parking Struc	-	144-1	0.71				0	0.71	599	1.456	3.60	5.250	0.000	0.000	0.044	0.000	0.00	0.000	0.044
Routing		142-1																	
Routing	144-1	SAMH01																	
Routing	SAMH01	SAMH02																	
Routing	SAMH02	SAMH03																	
Routing	SAMH03	SAMH04																	
Stormont & Dundas	-	SAMH205	0.66				459	4.87	3045	7.401	3.03	22.410	0.000	0.000	0.000	0.000	0.00	0.000	0.000
Routing	SAMH205	141-3																	
Routing	141-3	141-2																	
Residence Commons	-	141-2	0.56				1764	6.14	5408	13.145	2.67	35.104	0.000	0.000	0.000	0.000	0.00	0.000	0.000
Routing	141-2	141-1																	

Area ID	IINFILTRATION Total Area	Accu.	Flow	TOTAL Flow	EXISTING SEWER Length	Size	Area	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Qtot/Qfull	Notes
	(ha)	(ha)	(L/s)	(L/s)	(m)	(mm)	(m²)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(-)	
St. Patrick	0.60	0.60	0.198	5.505											
Routing				5.505	6.9	200	0.031	5.490	0.32	76.8	2.45	0.05	71.3	0.07	
Northern Dev	3.07	3.07	1.013	14.772											
Leeds	0.81	3.41	1.124	17.647											Assumed to receive 65% of flow from future northern development in order to facilitate design of proposed sanitary sewers
Routing				17.647	36.2	250	0.049	3.550	0.24	112.0	2.28	0.26	94.4	0.16	
Routing				17.647	43	250	0.049	0.580	0.24	45.3	0.92	0.78	27.6	0.39	
New Res	0.80	0.80	0.265	6.097											
Routing				6.097	16	200	0.031	0.500	0.32	23.2	0.74	0.36	17.1	0.26	To calculate the sanitary flow, the flow rate per capuita (determined in the TSH report) was used. Amenities may be added to the ground floor of the residence building and therefore the academic per GFA flow was used to estimate the additional flow from the ground floor. (see note ¹)
Routing				23.744	22.5	250	0.049	1.600	0.24	75.2	1.53	0.24	51.5	0.32	
Parking Struc	0.71	0.71	0.589	5.883											6L/d per Parking Stall per Appendix 4-A of the Ottawa Sewer Design Guidelines. Assumed to receive 35% of flow from future northern development in order to facilitate design of proposed sanitary sewers
Routing					77.6	250	0.049	0.500	0.24	42.0	0.86	1.51	42.0	0.00	
Routing				5.883	43.5	250	0.049	0.500	0.24	42.0	0.86	0.85	36.2	0.14	
Routing				5.883	12.2	250	0.049	0.490	0.24	41.6	0.85	0.24	35.7	0.14	
Routing				5.883	59.1	250	0.049	0.510	0.24	42.5	0.87	1.14	36.6	0.14	
Routing				5.883	10	250	0.049	0.800	0.24	53.2	1.08	0.15	47.3	0.11	
Stormont & Dundas	0.66	4.87	1.607	24.017											
Routing				24.017	67.1	375	0.110	0.590	0.14	134.7	1.22	0.92	110.7	0.18	
Routing				24.017	37	375	0.110	0.400	0.14	110.9	1.00	0.61	86.9	0.22	
Residence Commons	0.56	6.14	2.026	37.130											
Routing				37.130	52	375	0.110	0.350	0.14	103.7	0.94	0.92	66.6	0.36	

Design Parameters

Avg. Daily Flow Res.	280 L/p/d					
Avg. Daily Flow Inst itutional Res.	210 L/p/d ¹	Peak Fact. Res.	Harmon's Equation	Infiltration / Inflow	0.33 L/s/ha	
Avg. Daily Flow Comm.	28000 L/ha/d	Commercial Contri	0%	Min. Pipe Velocity	0.6 m/s	
Avg. Daily Flow Instit.	28000 L/ha/d	Peak Fact. Comm.	1	Max. Pipe Velocity	3.00 m/s	
Avg. Daily Flow Indust	55000 L/ha/d	Institutional Contri	100%	Mannings Roughness Coeffici	0.013	
Avg. Academic per GFA flow	6.6 L/m²/d ¹	Peak Fact. Instit.	1.5			
¹ Avg.Daily Flow Res. Per 2007 TSH Monitor Data		Peak Fact. Indust	per MOE Graph			

*Existing Residence population from 2008 Genivar Report
*Floor Area of new Residences in Northern Development from CU Master Plan 2016

Proposed northern development population calculation

Floor Area of new Residence building	14972 m²
Population/m² of new Residence building	0.03146 Pop/m²
Floor Area of new Residences in Northern Development	54422 m²
Population of Northern Development	1712.05 Pop

Prepared By: Daniel Glauser

Checked by: James Fookes

Date: August 11, 2020

Project No. 190500700

MORRISON HERSHFIELD

CU - New Flagship Residence Building - Sanitary Flow Estimate

Occupancy Based Calculation

Occupancy	471	persons	(per Architectural correspondence)
Per Capita Flow	280	l/c.d	(Sewer Design Guidelines, Figure 4.3)
Daily average flow	131 880	l/d	
	131.88	m³/d	
Peak Factor	3.64		(Sewer Design Guidelines, Figure 4.3)
Peak Flow	5.6	l/s	
Allowance for Ground Floor Amenities	6.6	l/m²/d	(Per Capita Flows based on Monitor Data; TSH Sanitary design flows , April 2007)
Ground floor GFA	2344.00	m²	
Daily average flow	0.2	l/s	
Peak Factor	1.5		(Sewer Design Guidelines, Figure 4.3)
Peak Flow	0.3	l/s	
Site Area	0.8035	ha	
Infiltration allowance	0.33	l/s.gross ha	(Sewer Design Guidelines, Figure 4.3)
Infiltration flow	0.265155	l/s	
Peak Flow	6.1	l/s	

Building Use Peak Flow

Gross Area	0.8035	ha	
Institutional Average Flow	28 000	L/ha/d	(Sewer Design Guidelines, Figure 4.3)
Peaking Factor	1.5		(Sewer Design Guidelines, Figure 4.3)
Peak Extraneous Flows	0.33	L/s/effective gross ha	(Sewer Design Guidelines, Figure 4.3)
Peak Flow	22 498	L/day	
	0.53	L/sec	

Peak flow occurs based on the occupancy-based estimate, so a peak sanitary flow of 6.1 L/sec will be used for design.

Designed: **D. Glauser**		Project: **CU - New Flagship Residence Building Proposed Servicing**	
Checked: **J. Fookes**	Date: **August 11, 2020**	Location: **1125 Colonel By Drive**	
Dwg Reference: **C-001**	File Ref: **190444600**		Sheet No.: **1 of 1**

MORRISON HERSHFIELD

CU - New Flagship Residence Building - Pumping Stations Sanitary Flow Analysis

Measurement Date	Maximum average inflow over any 5 minute span (L/s)	Daily average Inflow (L/s)	Rainfall measured over 24 hr period (mm)
Sunday April 14th, 2019	39.14	23.76	35
Friday April 19th, 2019	35.41	20.68	24
Thursday July 25th, 2019	25.58	8.61	0
Saturday January 11th, 2020	33.41	10.63	21
Saturday February 1st, 2020	25.29	6.71	0
Sunday February 2nd, 2020	29.94	6.51	0
Monday February 3rd, 2020	30.51	8.97	0

Designed: **D. Glauser**		Project: **CU - New Flagship Residence Building Proposed Servicing**	
Checked: **J. Fookes**	Date: **March 13, 2020**	Location: **1125 Colonel By Drive**	
Dwg Reference: **C-001**	File Ref: **190444600**		Sheet No.: **1 of 1**

Ontario

Ministry of the Environment
Ministère de l'Environnement

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 2590-8J8RZQ
Issue Date: June 29, 2011

Carleton University
1125 Colonel By Drive
Ottawa, Ontario
K1S 5B6

Site Location: Carleton University Sewage Pumping Station
1240 Bronson Avenue
Ward 17, City of Ottawa

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

upgrades to the existing sanitary sewage pumping station (Carleton University Sewage Pumping Station) serving the Carleton University campus as well as residential area located east of Bronson Avenue and north of Brewer Park, located within the Carleton University, at 1240 Bronson Avenue (on the west site of Bronson Avenue across from Brewer Park, in the City of Ottawa, consisting of construction of the following new sewage Works:

- relocation of existing 300 mm diameter and 525 mm diameter sanitary sewers located on the Carleton University Sewage Pumping Station site to redirect sewage flows to the new wet well;
- a 2.4 m diameter inlet manhole;
- a 3.6 m diameter and 8.2 m deep precast concrete new wet well located approx. 10 m southwest of the existing Carleton University Sewage Pumping Station control building, housing one (1) retractable trash screen, two (2) non clog, constant speed, submersible sewage pumps (one duty and one standby), each pump capable of handling 81 L/s against a total dynamic head (TDH) of 20 m, complete with a 525 mm diameter inlet sewer, a wet well ventilation (exhaust) fan, an aluminium access ladder, a 300 mm diameter overflow pipe to the existing wet well, piping, fittings, valves, an ultrasonic level transmitter and a backup Multitrode Probe control system, complete with a remote alarm system connected to the Robert O. Pickard Environmental Centre SCADA system, discharging via a 250 mm diameter forcemain (located within the Carleton University Sewage Pumping Station site) and a 350 mm diameter forcemain located along Brewer Road discharging to the existing sanitary manhole (SAN MH 186) located at the intersection of Cameron Avenue and Leonard Avenue;
- a 1.8 m by 3 m and 2.8 m deep inground precast concrete flowmeter chamber located approx. 18 m north of the new wet well, housing piping, fittings, valves and a 250 mm diameter magnetic flow meter;
- a 1.2 m diameter inground precast concrete by-pass chamber located approx. 8 m west of the flowmeter chamber, housing a 200 mm diameter by-pass connection;
- all other items associated with the new sewage Works necessary to have a complete and operable pumping station;

all in accordance with the application dated May 20, 2011 and received May 25, 2011, including report entitled "Carleton University Sewage Pumping Station and Forcemain Upgrades Design Brief" dated March 2011, final plans and specifications prepared by AECOM Canada Ltd.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

1. "Act" means the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended;

2. "Certificate" means this entire certificate of approval document, issued in accordance with Section 53 of the Act, and includes any schedules;

3. "Director" means any Ministry employee appointed by the Minister pursuant to section 5 of the Act;

4. "District Manager" means the District Manager of the Ottawa District Office of the Ministry;

5. "Ministry" means the Ontario Ministry of the Environment;

6. "Owner" means Carleton University, and includes its successors and assignees;

7. "Regional Director" means the Regional Director of the Eastern Region of the Ministry;

8. "Substantial Completion" has the same meaning as “substantial performance” in the Construction Lien Act; and

9. "Works" means the sewage works described in the Owner's application, this Certificate and in the supporting documentation referred to herein, to the extent approved by this Certificate.

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

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

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

1.2 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 Certificate, the application for approval of the Works and the submitted supporting documents and plans and specifications as listed in this Certificate.

1.3 Where there is a conflict between a provision of any submitted document referred to in this Certificate and the Conditions of this Certificate, the Conditions in this Certificate shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

1.4 Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

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

2. EXPIRY OF APPROVAL

2.1 The approval issued by this Certificate will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Certificate.

3. UPON THE SUBSTANTIAL COMPLETION OF THE WORKS

3.1 Upon the Substantial Completion of the Works, the Owner shall prepare a statement, certified by a Professional Engineer, that the Works are constructed in accordance with this Certificate, and upon request, shall make the written statement available for inspection by Ministry personnel.

3.2 Within one year of the Substantial Completion of the Works, a set of as-built drawings showing the works “as constructed” shall be prepared. These drawings shall be kept up to date through revisions undertaken from time to time and a copy shall be retained at the Works for the operational life of the Works.

4. OPERATION AND MAINTENANCE

4.1 The Owner shall exercise due diligence in ensuring that, at all times, the Works and the related equipment and appurtenances used to achieve compliance with this Certificate are properly operated and maintained. Proper operation and maintenance shall include effective performance, adequate funding, adequate operator staffing and training, including training in all procedures and other requirements of this Certificate and the Act and regulations, adequate laboratory facilities, process controls and alarms and the use of process chemicals and other substances used in the Works.

4.2 The Owner shall prepare an operations manual within six (6) months of Substantial Completion of the Works, that includes, but not necessarily limited to, the following information:

(a) operating 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) procedures for the inspection and calibration of monitoring equipment;

(e) a spill prevention control and countermeasures plan, consisting of contingency plans and procedures for dealing with equipment breakdowns, potential spills and any other abnormal situations, including notification of the District Manager; and

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

4.3 The Owner shall maintain the operations manual current and retain a copy at the location of the Works for the operational life of the Works. Upon request, the Owner shall make the manual available to Ministry staff.

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

1. Condition 1 is imposed to ensure that the Works are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the Certificate and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review. The condition also advises the Owners their responsibility to notify any person they authorized to carry out work pursuant to this Certificate the existence of this Certificate.

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 Works are constructed in accordance with the approval and that record drawings of the Works “as constructed” are maintained for future references.

4. Condition 4 is included to require that the Works be properly operated, maintained, funded, staffed and equipped such that the environment is protected and deterioration, loss, injury or damage to any person or property is prevented. As well, the inclusion of a comprehensive operations manual governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the Owner and made available to the Ministry. Such a manual is an integral part of the operation of the Works. Its compilation and use should assist the Owner in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for Ministry staff when reviewing the Owner's operation of the Works.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, 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 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

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

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

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, 15th Floor
Toronto, Ontario
M5G 1E5

AND

The Director
Section 53, Ontario Water Resources Act
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

* Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 29th day of June, 2011

Sherif Hegazy, P.Eng.
Director
Section 53, Ontario Water Resources Act

KC/
c: District Manager, MOE Ottawa District Office
Phil Porter, P.Eng., AECOM Canada Ltd.
John Wu, P.Eng., Infrastructure Approvals, City of Ottawa
Linda Carkner, Program Manager, Infrastructure Services, City of Ottawa
R. O'Connor, City Clerk and Solicitor, City of Ottawa

From: Fraser, Mark <Mark.Fraser@ottawa.ca>
Sent: Wednesday, February 19, 2020 2:41 PM
To: James Fookes
Cc: rzaig@kwc-arch.ca; Daniel Glauser
Subject: RE: D07-12-19-0205 Carleton University New Student Residence - Sanitary Pump Station
Attachments: Carleton University_Level Data.xlsx

Hi James,

Please find attached raw operating data level information as requested. The diameter of the wet well is 3.6m.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review Central Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Fraser, Mark
Sent: February 13, 2020 12:19 PM
To: James Fookes <JFookes@morrisonhershfield.com>
Cc: 'Ran Zaig' <rzaig@kwc-arch.ca>; Daniel Glauser <DGlauser@morrisonhershfield.com>
Subject: RE: D07-12-19-0205 Carleton University New Student Residence - Sanitary Pump Station

Hi James,

I have requested the monitoring data for this pump station and will provide once received.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review Central Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791

Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: James Fookes <JFookes@morrisonhershfield.com>
Sent: February 12, 2020 12:44 PM
To: Fraser, Mark <Mark.Fraser@ottawa.ca>
Cc: 'Ran Zaig' <rzaig@kwc-arch.ca>; Daniel Glauser <DGlauser@morrisonhershfield.com>
Subject: D07-12-19-0205 Carleton University New Student Residence - Sanitary Pump Station

Hi Mark,

We are working through your comments on the above file. Comment #19 states:
"Wastewater flows from the proposal are conveyed to a downstream pumping station (PS) upgraded in 2012 as per the IMP and has a design capacity of 81L/s. Please provide a copy of the ECA issued for this pumping station to review the terms and conditions of the ECA. Please demonstrate that this project is in compliance with the terms and conditions and confirm that the current design capacity of the PS can accommodate the proposed theoretical peak flow from this project and any other active campus development projects. Obtain pump station monitoring data from the City to determine the current pump peak flowrate at the station in relation to the capacity of the pump."

Please can you provide the pump station monitoring data, or advise who we can obtain this data from. I suggest that we would need either complete data (e.g. flows at 15 minute intervals) or a summary with peak and dry weather flows covering the last 3 years.

Regards,
James

James Fookes, P.Eng.
Department Manager, Municipal Infrastructure
jfookes@morrisonhershfield.com

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People • Culture • Capabilities
200 – 2932 Baseline Road | Ottawa, ON K2H 1B1 Canada
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morrisonhershfield.com

Appendix E

Campus Infrastructure Study Excerpts

Table 4.20 List of Campus Buildings with Sprinkler Systems and Fire Pumps		
Building Name	**Sprinkler System – Present**	**Fire Pump Capacity USGPM**
Stormont Dundas	Garbage Room Only	750 GPM @ 40 psig
Minto C.A.S.E.	Full	100 GPM @ 90 psig
Child Care	None	Not Sprinklered
Technology & Trade		City Pressure
Leeds Residence	Full	750 GPM @ 40 psig
Azrieli Theatre	Full	City Pressure
Azrieli Pavilion	Full	City Pressure
National Wildlife Research	Full	750 GPM @ 40 psig
Prescott House	Full	750 GPM @ 40 psig
Fieldhouse	Full	City Pressure
Alumni Hall & Sports	Full	City Pressure
HCI Building	Full	500 GPM @ 60 psig
VSIM (Visual Stimulation)	Full	500 GPM @ 60 psig
Ice Arena	Full	2500 GPM @ 74 psig

4.8 Sanitary Services

Description

The development of the sanitary sewer system at Carleton University has paralleled the development of the campus, with the major network elements having been in existence for 40 years or more. Today, the length of the network is approximately 4.2 kilometres. The majority of the pipe network ranges in size from 6 to 21 inches (150 to 530 mm) and is comprised of concrete pipe, with an increased use of plastic (PVC) pipe in more recent decades for smaller diameter pipe. A total of 143 sanitary sewer manholes were identified in an inventory performed in 2006.

The pipe network can be broken down as shown in Table 4.21. The total lengths for each pipe diameter have therefore been proportionally increased to account for the difference between the known length of 4094.6 metres and the estimated total length of approximately 4200 metres.

Figure 4.22 provides a campus map of the sanitary service. A detailed drawing that shows the line sizes is available in **Appendix B.**

Table 4.21 Sanitary Piping Breakdown by Pipe Diameter & Length				
Pipe Diameter (mm)	**Total Length**	**Estimated Unit Cost ($/m) (Pipe Only)**	**Replacement Value (2007 $) (Pipe Only)**	**Replacement Value (2007 $) (Full)**
525	270	$310	$83,700	$334,800
450	264	$290	$76,560	$306,240
375	229	$280	$64,120	$256,480
300	1,256	$270	$339,120	$1,356,480
250	1478	$260	$384,280	$1,537,120
200	674	$250	$168,500	$674,000
150	30	$240	$7,200	$28,800
Total	**4,201**		**$1,123,480**	**$4,493,920**

As shown in Table 4.21 the total replacement value (pipe only) is estimated at $1,123,480. The approximate value of manholes is estimated as $715,000.00 assuming $5,000 per manhole. When added to the pipe total above, the approximate present value of the sanitary sewer network is $1,838,480.00. This estimate is for the actual pipe and structures only, and does not take into account road or landscape reinstatement, and excludes pumping. The basis of this assumption is that replacement of the sewers is likely to take place in coordination with the rehabilitation and replacement of surface works. Replacement value, including full restoration, would increase costs by roughly a factor of 4 as suggested in the last column of Table 4.2.1.

Detailed tables that contains pipe diameter, length and estimated flows for both existing and proposed buildings are available in **Appendix D**. Four tables are present that provide detailed pipe information for the southwest, northwest, southeast and northeast sections of the campus. As noted on the tables full information on length and pipe diameter was not available for all pipe segments.

Condition and Functional Effectiveness of the Sanitary Piping

The sanitary sewer network has no significant deficiencies in terms of capacity although as noted below, the existing City of Ottawa sanitary sewage pumping station is considered to be very close to its capacity.

An extensive, although not complete, camera inspection of the sanitary sewer network was carried out in 2003. Totten Sims Hubicki reviewed the inspection tapes and provided recommendations for addressing deficiencies in a 2003 report. This was followed by a further report on the sanitary sewer structures in 2004, again by Totten Sims Hubicki. The basis for a rehabilitation program has therefore been established, and will be further refined as a result of the ongoing extraneous flow analysis.

Future replacement of sanitary piping will be a function of condition. Life expectancies for concrete piping and PVC pipe are not well defined. Literature and trade associations suggest life expectancies of 100 years for concrete pipe, but this can vary based on local conditions of chemical action and wear. PVC piping has a somewhat limited history, having been only introduced in North America in 1951, but its properties of chemical and abrasion resistance, and flexibility also suggest that a long service life should be expected.

Failures of both concrete and PVC piping as a result of wear or material shortcomings are extremely rare. Failure is more often accounted for as a result of poor installation or soil conditions resulting in unacceptable loads on the pipe. In the absence of specific failures, or a continued history of failures in a specific location, there is no need for immediate pipe replacement. Rather than failure, the more common reason for pipe replacement is capacity to service additional development, or to better serve present development with less surcharging. A reasonable estimate for planning purposes is that the network should be replaced within the next 50 years.

A phased replacement or upgrading program, in conjunction with storm sewer and watermain replacement/upgrading, is therefore suggested. The program should also be developed in coordination with the recommended TSH infiltration reduction program, with critical concentration on poorly performing sections and sections located adjacent to other planned infrastructure upgrades.

From a capacity standpoint the sanitary services peak flow has been estimated to be approximately 56.8 L/s. This value is estimated to increase to 59.3 L/s after the future residence R1 and future academic building A1 are added to the campus.[14] This peak flow is very close to the City of Ottawa pumping station capacity of 63 L/s that serves the campus. This pumping

[14] Based on a 2007 study completed by Tottem Sims Hubicki.

station has been the subject of examination by others, and is recognized as being a limiting factor for the future development of the campus.

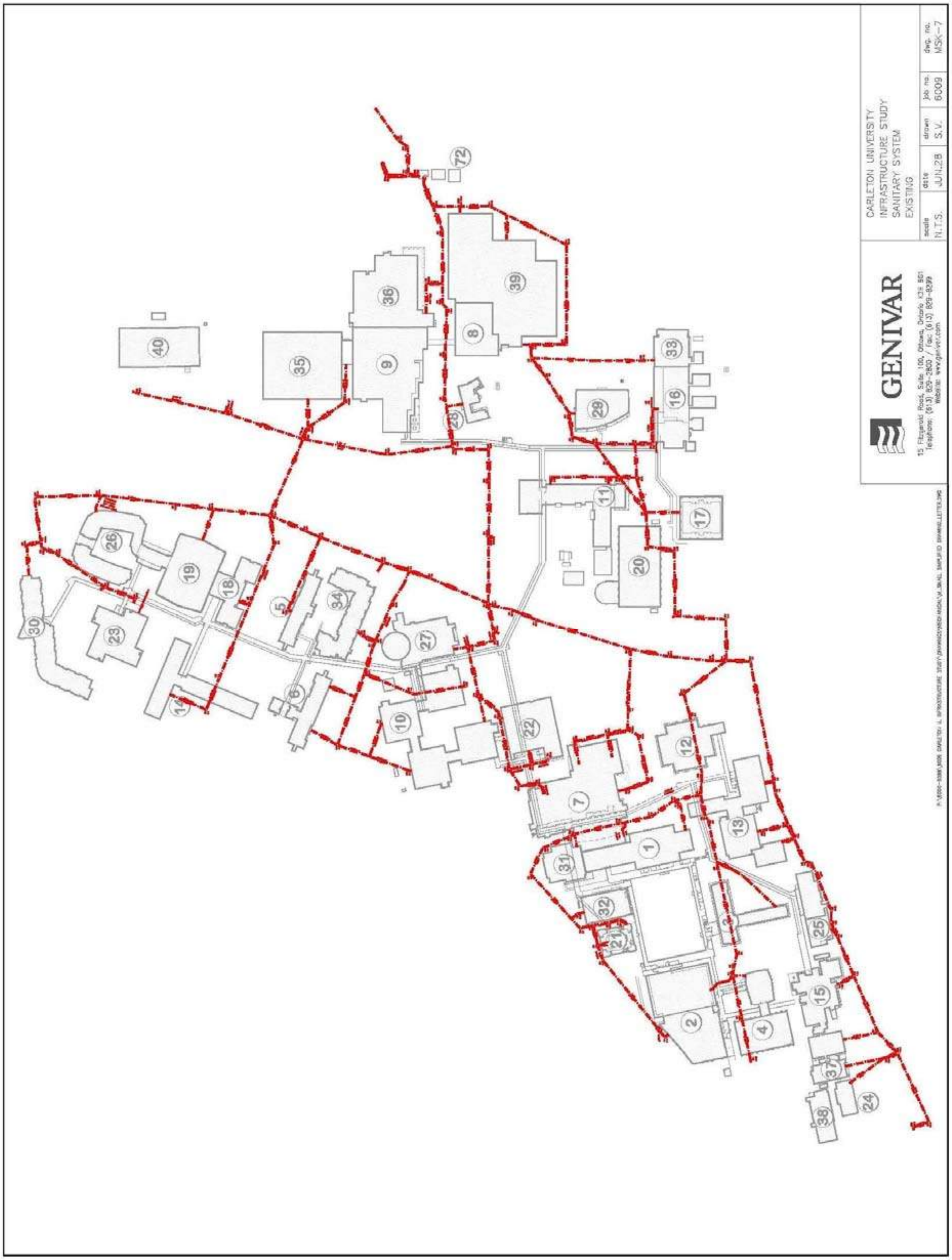
Information Gaps and Limitations

- There are a small number of present sewers for which information is incomplete as noted on the data tables found in **Appendix D**. This information is not considered critical, but nevertheless, it is recommended that the missing data be collected by the University.

Recommendations

- In order to deal with the current limitation of this service and adequately meet the future needs of the campus, Carleton University will need to achieve measurable reductions in extraneous flows within the present capacity of the pumping station. This reduction in extraneous flows has also been requested by the City of Ottawa as a condition of approval for the new residence building. A program has been established by the University and funded for this purpose. The first step in this program will be the elimination of open grates on the sanitary system, which has been estimated by Totten Sims Hubicki to reduce inflow by an amount equal to or greater than will be added by the first new residence and academic buildings.
- In addition, periodic monitoring of sewage flows will be necessary to track decreases in infiltration and inflow. Substantial improvements need to be implemented in order to produce measurable results. At some future point, upgrading of the pumping station will become a necessity for capacity as well as other reasons, as it is not considered feasible to reduce extraneous flows to the level that would allow for the complete future building program. It is understood that the City of Ottawa desires that planning for replacement of the pumping station be undertaken in the immediate future.
- For the current developed area of approximately 50 ha, the anticipated level of extraneous flow that would be allowed in a new sewer system design would be 14 litres per second. The 2007 G.A. Clark study indicated a present extraneous flow of approximately 28 litres per second. In theory therefore, the extraneous flow could be reduced by 14 litres per second, which would allow for the first 12 buildings in the proposed building program. A Totten Simms Hubicki report entitled "Sanitary Sewer System, Infiltration and Inflow Removal Study", dated May 2008, concludes that by undertaking remedial works to the existing sanitary system, infiltration can be reduced by 11 litres per second. No additional budget is proposed within this study for reductions in the infiltration and inflow as this program is already established and funded.

Figure 4.22 – Sanitary Piping Service



4.9 Storm Services

Description

The development of the storm sewer system at Carleton University has paralleled the development of the campus to some extent, although the major network elements have been in existence for 40 years or more. Today, the total length of the network is 5,199 metres, excluding building service connections and catchbasin leads. When building services and catchbasin leads are added, the total network length is approximately 7,000 metres. The majority of the pipe network is comprised of concrete pipe, with an increased use of plastic (PVC) pipe in more recent decades for smaller diameter pipe. A total of 544 structures (321 catch basins and 223 storm manholes) were identified in the 2006 Carleton University inventory.

The storm pipe network can be broken down as shown in Table 4.23. Figure 4.24 provides a campus map of the storm service. A detailed drawing in **Appendix B** shows the pipe diameter and location of catchbasins.

Table 4.23
Storm Piping Breakdown by Pipe Diameter & Length

Pipe Diameter (mm)	Total Length	Estimated Unit Cost ($/m) (Pipe Only)	Replacement Value (2007 $) (Pipe Only)	Replacement Value (2007 $) (Full)
1500	87	$940	$81,780	$327,120
1350-1400	373	$780	$290,940	$1,163,760
1050	582	$650	$378,300	$1,513,200
900	318	$540	$171,720	$686,880
750	185	$440	$81,400	$325,600
600	445	$330	$146,850	$587,400
525	171	$310	$53,010	$212,040
450	358	$290	$103,820	$415,280
375	966	$280	$270,480	$1,081,920
300	1075	$270	$290,250	$1,161,000
250	563	$260	$146,380	$585,520
Building services & catch basin leads	1800 (approximate length)	$300	$540,000	$2,160,000
Total	**6,923**		**$2,554,930**	**$10,219,720**

As shown in Table 4.23 the total replacement value is estimated at $2,554,930 for pipes only. The approximate value of manholes and catch basins is estimated as $1,984,500, assuming $3,500 per structure. When added to the pipe total above, the approximate present value of the storm sewer network is $4,539,430. This estimate is for the actual pipe and structures only, and does not take into account road or landscape reinstatement. The basis of this assumption is that replacement of the storm sewers is likely to take place in coordination with the rehabilitation and replacement of surface works. As shown by the last column in Table 4.23, the full replacement cost, including restoration, is likely on the order of 4 times higher than the pipe cost alone.

Condition and Functional Effectiveness of the Storm Service

The existing storm sewer systems were examined for their capacity to accept a rainfall event with return periods of 1:5 years and 1:2 years (with and without direct flow from building roofs). The modelling parameters used are as follows:

- The desirable design criteria for the minor system (storm sewer network) is the capability to accept the stormwater flow generated by a 1:5 year rainfall event. This rainfall event is expected, on average, to occur once every five years. This is the accepted standard in the City of Ottawa, and in many other municipalities.

- In the current study, existing storm sewer systems are also examined for their capacity to accept a rainfall event with a return period of 1:2 years (with and without direct flow from building roofs). The use of a 1:2 year storm event as the basis of storm sewer design was not uncommon in the past, and may have been used for the initial sizing of much of Carleton's storm sewer network. The 1968 Study of Sewer and Water Services prepared by De Leuw Cather for Carleton University did use the 2 year design criteria as the basis for their evaluation of the system at that time.
- Initially, the simulation of the storm sewer system was started using the computer software model XP-Storm. This type of model yields more precise results than the Rational Model (see below for further explanation of the latter model), but requires correspondingly more precise inputs in order to have useful results.

  The main parameter required for the use of XP-Storm is the width of each sub-basin. Due to the complexity of the campus storm sewer system, and the lack of information concerning the routing of roof top flows, it was impossible to determine the sub-basin widths with reasonable accuracy. As a result, the answers yielded by running the XP-Storm model were unacceptable.

  The storm sewer modelling was therefore done using the Rational Method, which is known to produce similar results to XP-Storm with appropriate input. The Rational Method estimates storm water flow rate as a factor of runoff coefficient, rainfall intensity and drainage area.

  The basic formula is as follows:

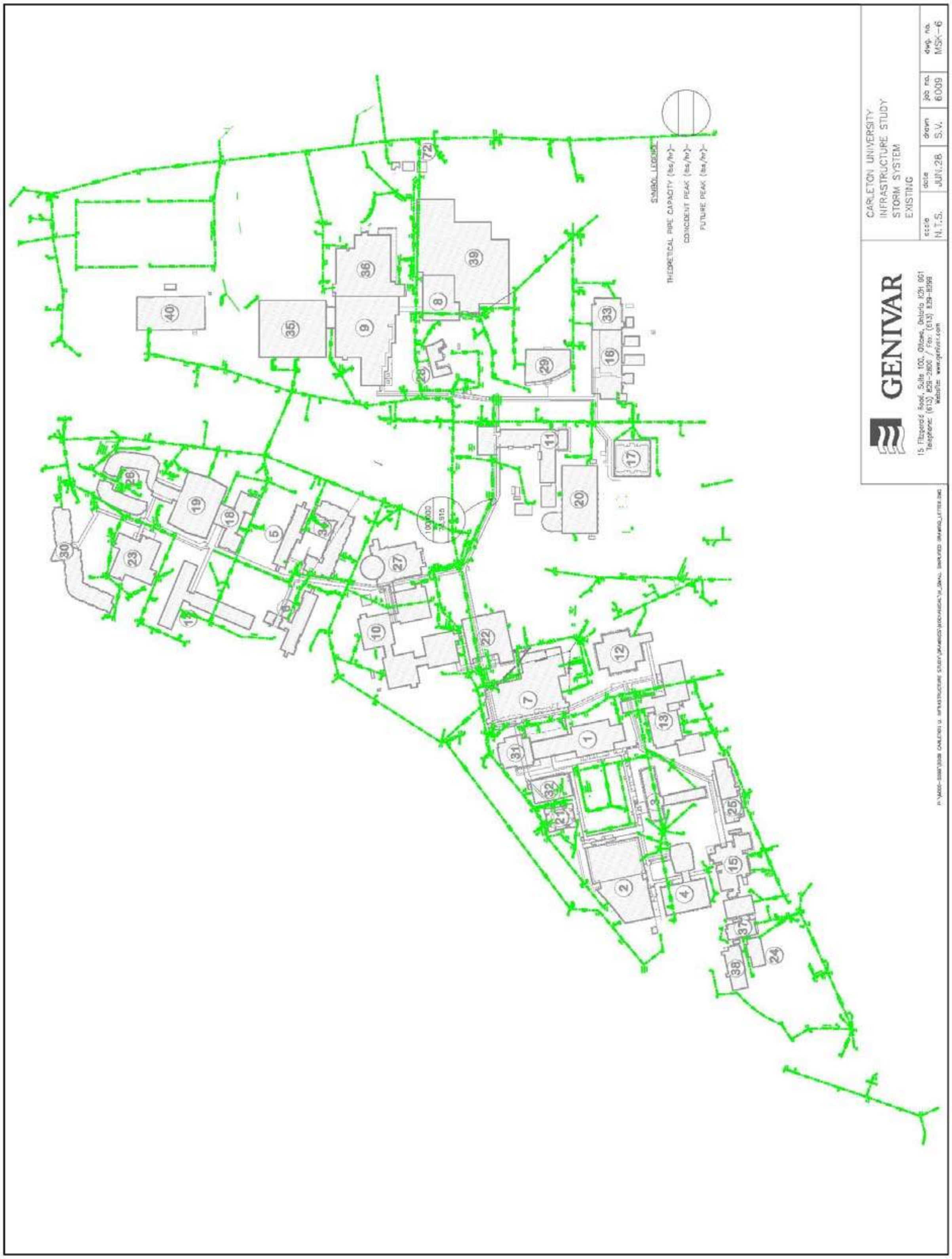
  Q = 2.78 x C x I x A, where
  Q = flow rate in litres per second
  C = runoff coefficient (based on type of ground surface)
  I = rainfall intensity (mm/hour)
  A = drainage area (hectares)

  The minimum Tc (time of concentration) assumed was 15 minutes. This is an approximation of the time taken for water to travel from the furthest point in the drainage area to the location where the flow is being estimated. The time of concentration is used in the determination of rainfall intensity.
- Rainfall intensities (mm/hour) were determined using the Ottawa IDF data presented in Table #5.1 of the Ottawa Sewer Design Guidelines;

$$I_{5\,years} = \frac{998.071}{(Tc + 6.053)^{0.814}} \qquad I_{2\,years} = \frac{732.951}{(Tc + 6.199)^{0.810}}$$

- All notations are based on the manhole numbers assigned on the Carleton University base plans showing the storm sewer network.
- Our assumptions are that there is no retention on the roof of the buildings (except for Building 39 where existing plans indicate storage is provided) and that the sewer outlets from the building roofs are located where pipes are visible on the base plan. Where there was more than one storm connection from a building (Buildings 3, 4, 8, 9, 10, 14, 16, 20, 27, 30, 35, 36, and 39), it was impossible to determine the direction or split of roof flow. For greater accuracy, the position of all of the outlets should be validated by dye testing. This however would only result in a marginal improvement in the accuracy of the system simulation, and is not expected to significantly alter the pipe size conclusions. We considered that storm water from the roofs is going directly into the exterior underground pipe system without any delay.
- Part of the P6 parking area is not included in the simulation of the existing network. We assume that there is retention on that site based on available mapping.

Figure 4.24 – Storm Piping Service



- Only approximately one third of the P5 area is included in the simulation. We assume that the storm water from the remaining two thirds of the site does not enter the piped network, but discharges overland.
- Runoff coefficients are assumed to be 0.9 for impervious areas (roof and pavement areas) and 0.2 for pervious (landscaped) areas;
- No backwater effects were considered in the simulations carried out in this study. Water levels in the Rideau River that are higher than the level of the storm sewers discharging water from the campus will decrease the capacity of the storm sewers.
- The network was simplified where necessary to account for missing data. Manholes were dropped from the model where data was not available, or where they were in close proximity of another manhole where the pipe parameters where not significantly different. In the case of missing manhole information, it was assumed that the slope and size of the pipe were equal upstream and downstream of the manhole.
- The different networks are illustrated on Figure 4.25 (Existing Storm Sewer Schematic). They can be described as follows:
  - Network 1: This network collects the majority of the campus runoff, including that from Buildings 2, 5, 6, 7, 9, 10, 14, 18, 19, 21, 22, 23, 26, 27, 28, 30, 32, 34, 35, 36, and 40;
  - Network 2: This second network captures the runoff of the South-West area (Buildings 8, 16, 29, 33 and 36). The outlet is into a pond which is connected with the south section of Network 1. Without hydraulic data about the value of the release flow from this pond, we assume in our simulation that the release flow is 100 L/s. This release flow has no significant consequence on Network 1.
  - Network 3: This small network collects the runoff of Buildings 11, 16, 17 and 20 on University Drive;
  - Network 4: Captures the runoff of the area located south of Campus Avenue and Building 12;
  - Network 5: Network 5 is the principal network of the South-West campus. It collects the runoff of Buildings 1, 3, 4, 13, 15, 25 and 31;
  - Network 6: Network 6 is localized in the extreme South-West area. It collects the runoff of Buildings 24, 37 and 38.

The existing storm sewer network was modelled using the various parameter described earlier in this section. The results of the analysis are provided in the spread sheets found in **Appendix E**.

The existing sewer networks were modelled under the following conditions:

- 5 year storm event – All networks.
- 2 year storm event – All networks that did not meet 5 year design criteria. (Networks 1, 2, 5 and 6)
- 2 year storm event without roofs – All networks that did not meet 2 year design criteria. (Networks 1 and 2).
- 5 year storm event with increased sewer diameters – All networks that did not meet the 5 year design criteria. (Networks 1, 2, 5 and 6).
- 5 year storm event with new outlets and detention – Network 1.

Undersized segments of the system are illustrated on Figure 4-26, and are listed in Tables 4.27 through 4.32. As shown, network sections 3 and 4 listed in Tables 4.29 and 4.30 meet the design criteria, while all other network sections are undersized by the percentage values shown.

Figure 4.25 – Existing Storm Sewer Schematic

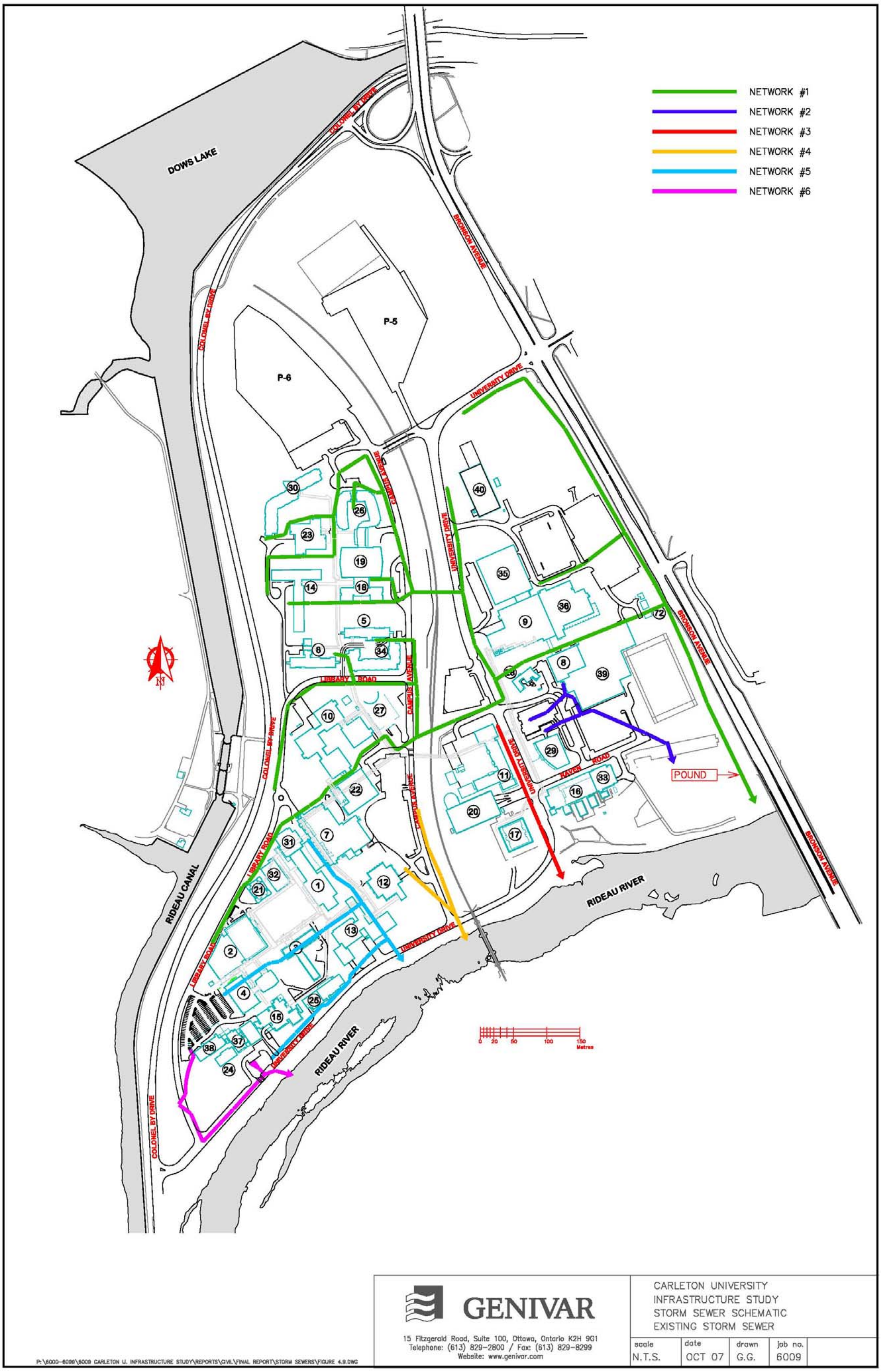


Figure 4.26 – Existing Storm Sewer Schematic – Sections Under Designed

Table 4.27 Storm Sewer Network #1 Results				
Design Criteria Return Period	**Proportion of Total Length Not Meeting Design Criteria[1]**	**Sewer Sections Not Meeting Design Criteria**		
1: 5 years	39 %	44.2-44.1 44.1-43.3 43.6-43.5 43.5-43.4 43.3-42.3 42.3-42.1 42.1-41.5 41.5-41.4 41.4c-41.4b 41.2-41.1	16.10-16.9 16.9-16.8 16.8-16.7 16.7-41.1 40.4-40.3 20.3-20.5 20.5-16.5a 16.5a-16.5 16.5-50.3 50.15-50.14	50.14-50.13a 50.13-50.12 50.8-50.7 50.7-50.6 31.4-31.3 31.3-31.1d 30.3-30.2 30.2-30.1
1: 2 years	26 %	44.2-44.1 43.6-43.5 43.3-42.3 42.3-42.1 42.1-41.5 41.5-41.4 41.4c-41.4b 41.2-41.1	16.10-16.9 16.9-16.8 16.8-16.7 16.7-41.1 20.3-20.5 20.5-16.5 16.5a-16.5 16.5-50.3 50.15-50.14	50.14-50.13a 50.13-50.12 31.4-31.3 30.3-30.2
1 : 2 years excluding building roofs [2]	13 %	 43.6-43.5 42.3-42.1 42.1-41.5 41.4c-41.4b	 16.9-16.8 20.5-16.5 16.5a-16.5 16.5-50.3	50.14-50.13a 50.13-50.12

(1) In relation to the total length of network 1
(2) This section of the analysis was completed assuming no input from the building roofs. Typically building roof drains offer a restriction to flow, and therefore alter the rate and timing of the peak flow. It is therefore possible that the contributing flow from the roof will not increase the peak flow from the ground surface.

Based on the above analysis, the existing Network 1 is generally capable of handling runoff from a 1:2 year event assuming non-coincidental flow from the building roofs.

Table 4.28 Storm Sewer Network #2 Results				
Return Period	**Under Designed Length[1]**	**Sewer Sections Not Meeting Design Criteria**		
1: 5 years	60 %	28.1-27.1	27.2-27.1	27.1-26.1
1: 2 years	48 %	–	27.2-27.1	27.1-26.1
1 : 2 years without buildings' roof	0 %	–	–	–

(1) In relation to the total length of network 2.

Table 4.29
Storm Sewer Network #3 Results

Return Period	Under Designed Length(1)	Sewer Sections Not Meeting Design Criteria		
1: 5 years	0 %	–	–	–
1: 2 years	0 %	–	–	–
1 : 2 years without buildings' roof	0 %	–	–	–

(1) In relation to the total length of network 3

Table 4.30
Storm Sewer Network #4 Results

Return Period	Under Designed Length(1)	Sewer Sections Not Meeting Design Criteria		
1: 5 years	0 %	–	–	–
1: 2 years	0 %	–	–	–
1 : 2 years without buildings' roof	0 %	–	–	–

(1) In relation to the total length of network 4

Table 4.31
Storm Sewer Network #5 Results

Return Period	Under Designed Length(1)	Sewer Sections Not Meeting Design Criteria		
1: 5 years	20 %	13.3-13.2	11.2c-11.6	11.6-Outlet
1: 2 years	0 %	–	–	–
1 : 2 years without buildings' roof	0 %	–	–	–

(1) In relation to the total length of network 5

Table 4.32
Storm Sewer Network #6 Results

Return Period	Under Designed Length(1)	Sewer Sections Not Meeting Design Criteria		
1: 5 years	15 %	61.1 – Outlet	–	–
1: 2 years	0 %	–	–	–
1 : 2 years without buildings' roof	0 %	–	–	–

(1) In relation to the total length of network 6

Modelling with Increased Diameter

In accordance with the Ottawa Sewer Design Guidelines, the storm sewer system would be designed for a return period of 1:5 years if it were being constructed at the current time. Modelling was undertaken to determine how the present system could be upgraded to meet this design standard.

Tables 4.33 to 4.36 indicate the pipe size changes necessary to achieve this goal.

Table 4.33
Storm Sewer Modelling With Increased Diameters Network #1 (Present Conditions)

Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)	Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)
44.2-44.1	305	450	**16.5-50.3**	381	600
44.1-43.3	305	450	**50.15-50.14**	250	375
43.6-43.5	305	450	**50.14-50.13a**	250	375
43.5-43.4	305	450	**50.13a-50.13**	305	375
43.4-43.3	305	450	**50.13-50.12**	200	450
43.3-42.3	305	450	**50.12-50.11**	381	450
42.3-42.1	305	525	**50.8-50.7**	610	675
42.1-41.5	305	525	**50.7-50.6**	610	675
41.5-41.4	450	600	**31.4-31.3**	1067	1500
41.4c-41.4b	250	375	**31.3-31.1d**	1067	1500
41.1b-41.4	305	375	**31.1d-31.1b**	1067	1500
41.2-41.1	600	750	**31.1b-31.1**	1400	1500
16.10-16.9	255	300	**31.1-30.4**	1350	1500
16.9-16.8	255	375	**32.3-32.1**	450	525
16.8-16.7	255	375	**32.1-30.6**	450	525
16.7-41.1	305	450	**30.3-30.2**	1371	1800
40.4-40.3	300	450	**20.2-30.1**	1371	1800
20.3-20.5	255	375	**30.1-Outlet**	1371	1800
20.5-16.5a	255	600	–	–	–
16.5a-16.5	381	600	–	–	–

Table 4.34
Storm Sewer Modelling With Increased Diameters Network #2 (Present Conditions)

Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)	Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)
28.1-27.22	305	450	**27.2-27.1**	305	450
27.1-26.1	305	525	**26.1-Outlet**	457	525

Table 4.35
Storm Sewer Modelling With Increased Diameters Network #5 (Present Conditions)

Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)	Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)
13.3-13.2	375	450	**11.2c-11.6**	375	450
11.6-Outlet	525	600	–	–	–

Table 4.36
Storm Sewer Modelling With Increased Diameters Network #6 (Present Conditions)

Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)	Sewer Section	Present Pipe Diameter (mm)	Required Pipe Diameter (mm)
61.1-Outlet	450	525	–	–	–

Alternative Solutions to Reduce the Flow in the Storm Sewer

There are two ways to reduce present flows in the storm sewer:

- Create new additional direct outlets into the Rideau Canal (see Figure 4.37).
- Introduce storm water detention on site. Specific areas on site where retention could be introduced are shown on Figure 4.37. We assume that the value of release flow of each detention site is 10 L/s.

If both these solutions are applied under present conditions, it would be possible to reduce the under-designed length to less than 28% of the total length.

It is considered highly unlikely that additional outlets to the Rideau Canal would be considered acceptable to regulatory authorities, as these would introduce additional storm water flows to the Rideau River system. Currently, any new storm outlets, or any increase in storm water flow rates into the Rideau system require attention to both quality and quantity of storm water. Flows must generally be restricted to present conditions, and therefore new outlets which will result in a net increase in storm water flows will not expected to be permitted.

Modelling Conclusions

The Carleton University storm sewer system is partially under-designed when compared against the standard design criteria of being able to accept the flow generated by a 1:5 year rainfall event. This condition results in parts of the system being surcharged under relatively frequent rainfall events.

This result is consistent with the general conclusions of the 2002 Carleton University Infrastructure Study completed by Totten Sims Hubicki, and the results and conclusions of this earlier study remain valid. As noted in this earlier study, the level of potential surcharging under a 5 year storm event is sufficient in a number of areas to result in visible flooding at surface level.

The performance of the storm sewer system during the future development of the campus is discussed in Section 6.5.

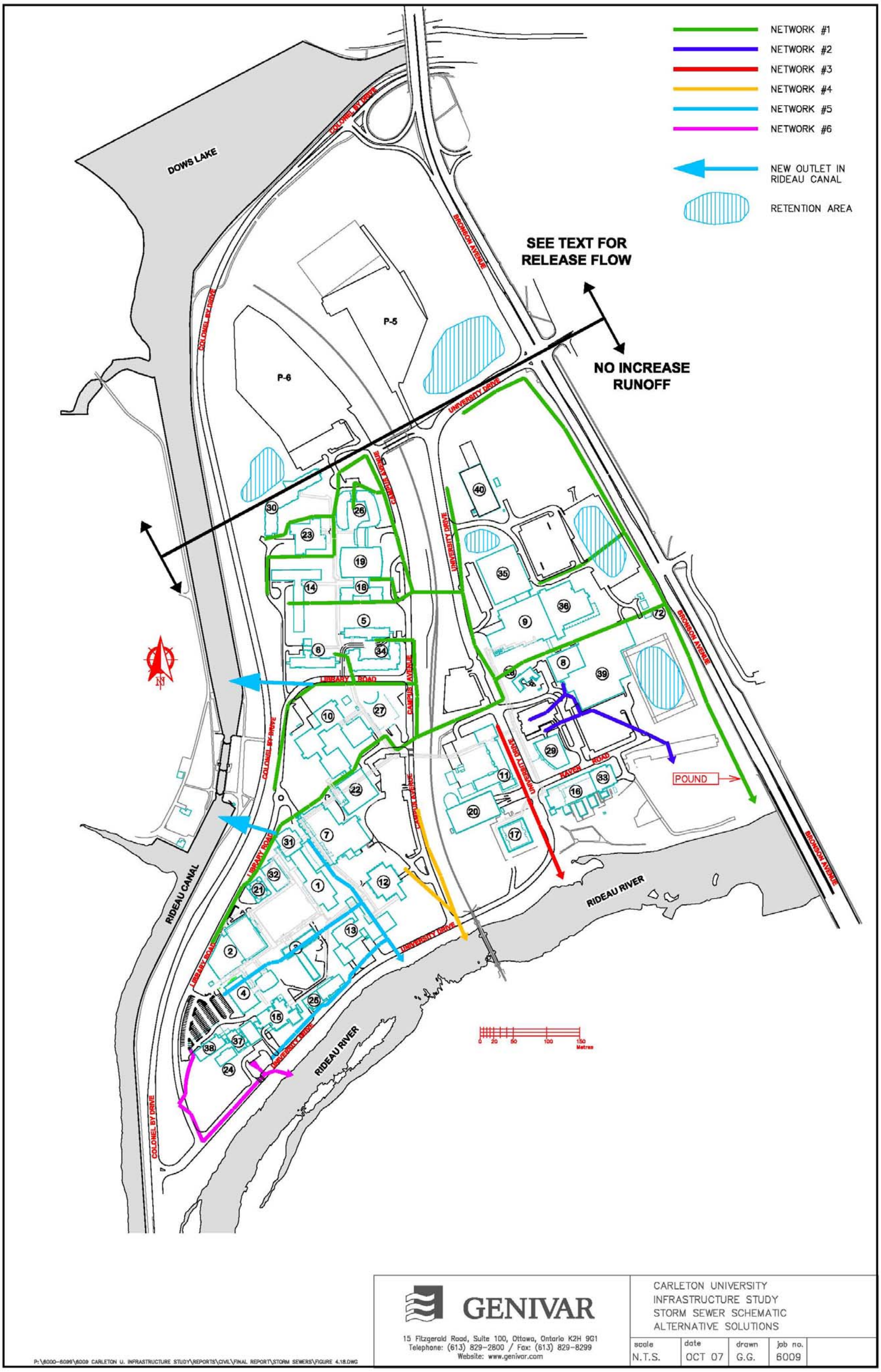
Information Gaps and Limitations

- There are a small number of present sewers for which information is incomplete as noted on the data tables found in **Appendix E**. This information is not considered critical for the analysis of the system as a whole, but nevertheless, it is recommended that the missing data be collected by the University.

Recommendations

- The present storm sewer system provides a level of service that is lower than current City of Ottawa design standards. It may therefore result in the inconvenience of slower removal of surface water when compared with systems meeting current design standards. The University should assess if this situation warrants additional attention. If improvements are desired, it is recommended that consultation be held with regulatory authorities to determine the feasibility of increasing sewer capacities or providing new outlets.
- As with the sanitary system, it is reasonable to estimate that the storm sewer system will require replacement within the next 50 years. A phased replacement or upgrading program in conjunction with sanitary sewer and watermain replacement/upgrading is therefore suggested. This program should also be coordinated with other planned infrastructure upgrades. A CCTV inspection of the storm sewer network can identify specific locations requiring more rapid attention.
- Consideration should be given to undertaking a major system flow study which will outline the overland route to be taken by stormwater when the storm sewer system overflows. This study can be used to ensure that buildings are protected from flooding and identify sewer segments where inflow controls may be warranted.

Figure 4.37 – Existing Storm Sewer Schematic – Alternative Solutions



4.10 Water Distribution

Description

The Carleton University water distribution network is comprised of approximately 7 kilometres of water mains and 45 hydrants, and is shown schematically in Figure 4.38 and Figure 4.39 (used for network modelling purposes) and Figure 4.37 (general schematic view), and in more detail on the Campus Master Plan – Water Distribution found in Appendix B. The earliest pipes were installed in 1959/1960, with the majority of existing pipes being installed in the 1960s and 1970s. The average pipe age now exceeds 40 years.

The system is supplied from the City of Ottawa via connections to the City system on Bronson Avenue. The existing system has proved adequate in providing desired domestic and fire flow requirements required for the building program completed to date.

A Water Main Condition Assessment and Rehabilitation Study was carried out by Totten Sims Hubicki in 1999. That study included an examination of water main break history, soil and ground water conditions, pipe samples and leakage. The study recommended a program installing cathodic protection to the primarily cast iron pipe system anytime the water main was exposed due to breaks or other excavation. A comprehensive corrosion control program was recommended for implementation over a 10 year period at a cost of $60,000.00 per year.

The condition of a water main is not strictly a direct function of age, but is related to pipe characteristics at the time of installation, the magnitude of the loads and forces exerted on each main over time, the extent of internal and external corrosion which has occurred, and the existence of special localized environmental conditions. The choice to replace a water main is generally made when the anticipated cost of repairing breaks exceeds the cost of replacement, in the absence of other factors. Given the age of the system, it is recommended that replacement of mains be considered in conjunction with all major projects such as road reconstruction or other major utility renewal in the same corridor as the watermain.

For maintenance planning purposes, the approximate value of the main water distribution network has been determined as noted Table 4.40 below. Pipe lengths, numbers of valves and hydrants, and sizes were determined from the Campus Master Plan drawing. Valve sizes were estimated where not indicated. The inventory does not include building service valves unless specifically shown on the plan.

Figure 4.38 – Domestic Piping Service

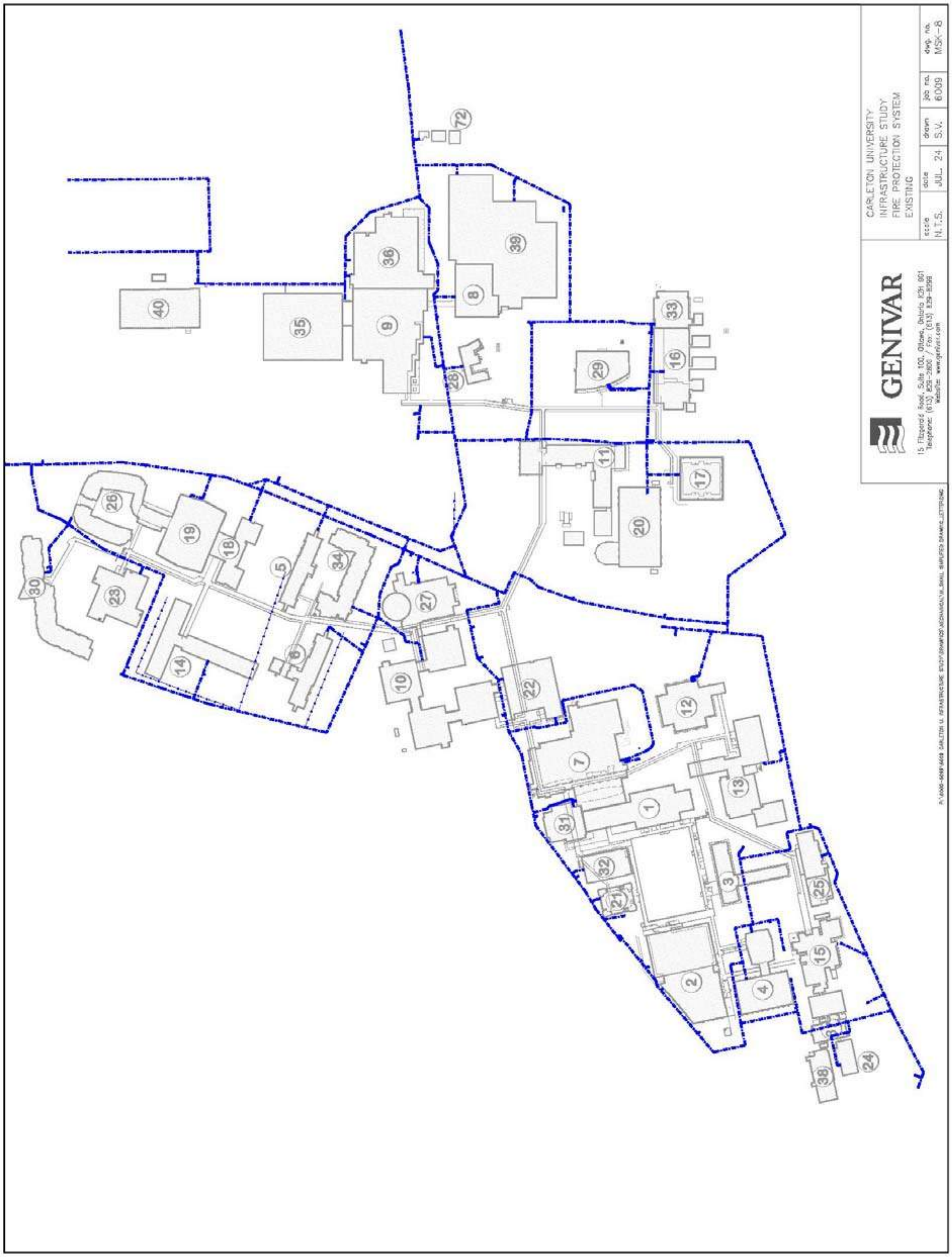


Figure 4.39 – Water Main Schematic – Existing Water Main System

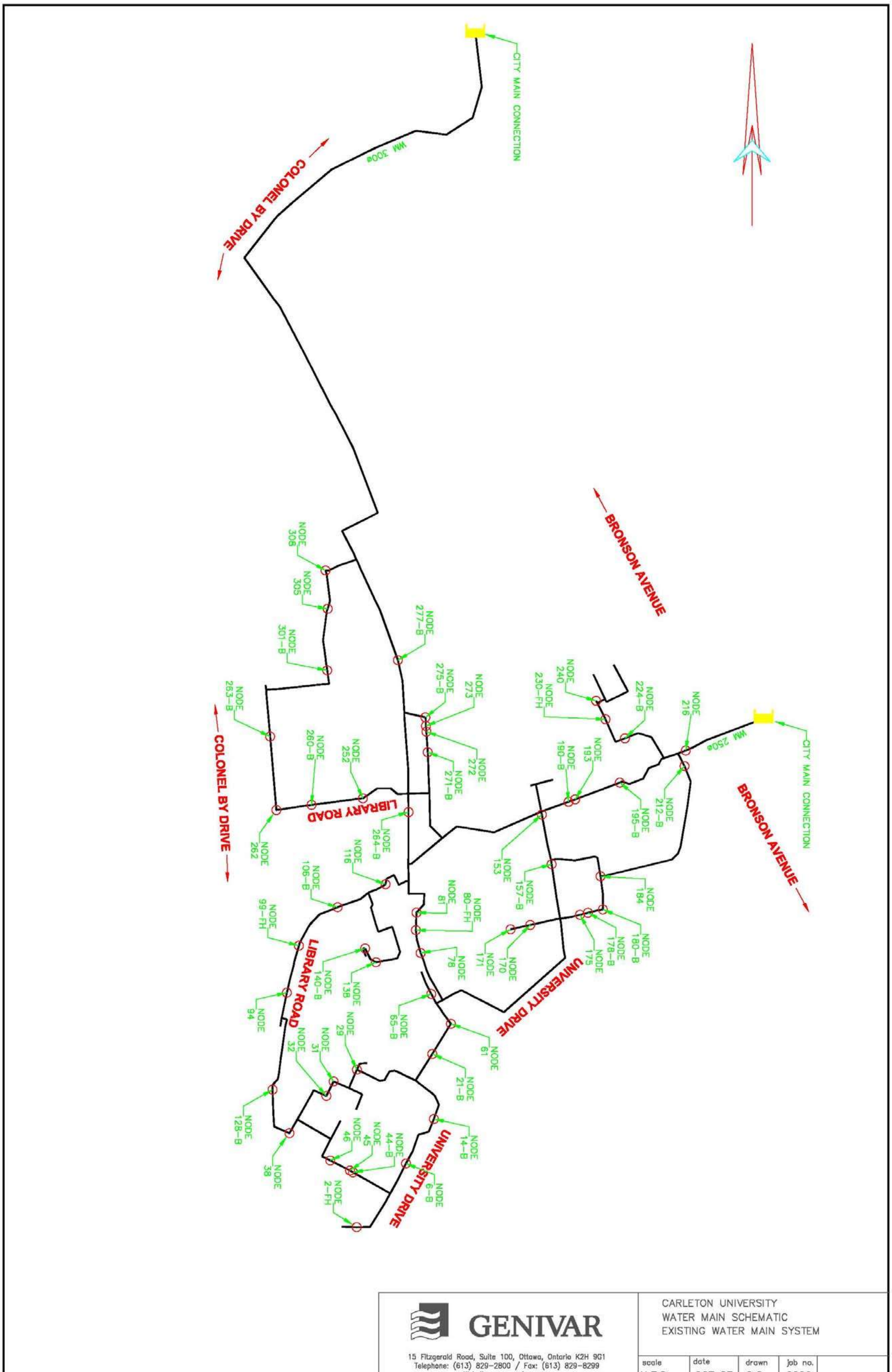


Table 4.40 Approximate Value of Main Water Distribution Network			
Main Diameter (mm)	**Length of Main (m)**	**Approximate Replacement Value $(2007) (Pipe Only)**	**Approximate Replacement Value $(2007) (Full)**
150	871.0	$283,075	$1,132,300
200	2792.0	$977,200	$3,908,800
250	1217.5	$535,700	$2,142,800
300	910.0	$477,750	$1,911,000
400	740.0	$481,000	$1,924,000
Sub-Total	**6530.5**	**$2,754,725**	**$11,018,900**
Appurtenances	**Number**	**Approximate Replacement Value $(2007) (Equipment Only)**	**Approximate Replacement Value $(2007) (Full)**
50, 75 & 100 mm valves	9	$7,000	$28,000
150 mm valves	81	$97,200	$388,800
200 mm valves	53	$132,500	$530,000
250 mm valves	19	$57,000	$228,000
300 mm valves	16	$56,000	$224,000
400 mm valves (includes chamber)	6	$60,000	$240,000
Hydrants & Leads	44	$330,000	$1,320,000
Sub-Total		**$739,700**	**$2,958,800**
	TOTAL	**$3,494,425**	**$13,977,700**

The above costs exclude surface restoration costs for the pipe and equipment only column.

The water distribution system was modeled using the software program EPANET. The assumptions used in creating and running the model were as follows:

- City of Ottawa guidelines were followed.
- Total metered yearly water consumption was used for average day demand calculation.
- Factor of 1.5 was used to multiply the average day demand in order to estimate the maximum day demand.
- Factor of 1.8 was used to multiply the maximum day demand in order to estimate the maximum hour demand.
- Watermains were assumed to be 2.0 metres below ground. Greater depths for the watermain, as exist in some parts of the campus, would result in increased pressures in the main, but would not alter available pressure at the reference datum.
- It was assumed that the pressure available at the connections to the City water system remained constant in the range of 60 to 65 psi (420 to 455 kPa).
- For existing academic buildings, total annual water consumption was averaged as 1.7 m^3 per square metre of gross floor area. For academic buildings where flow records did not exist, the simulation used an estimate of 2.0 m^3 per square metre of gross floor area for the annual consumption.
- The single largest demand for fire flow at the present time is 9,900 litres per minute in the southeast quadrant of the campus. Hydrant testing carried out by Vipond on September 14 and 15, 2005 revealed an available capacity of 10,100 litres per minute.

An estimate was made of required fire flow based on building size and construction, in accordance with the recommendations of the Fire Underwriter's Survey publication "Water Supply for Public Fire Protection" (1999). For a hypothetical building of 14,000 m^2 gross floor area, non-combustible construction, combustible contents, fully automatic sprinkler system and an exposure charge of 10%, the required fire flow is 12,000 litres per minute. This number is reasonably close, but conservatively higher than the present maximum number of 9,900 litres per minute.

In accordance with Ottawa guidelines, the system was modelled under conditions of peak hour demand, and also for maximum daily demand combined with a fire flow of 12,000 litres per minute at a single node. The design guidelines suggest that the following pressures should be achieved:

- Normal operating pressures between 350 and 550 kPa under maximum day demand.
- Maximum day plus fire flow should result in a minimum pressure of 140 kPa
- Maximum hour demand should result in a minimum pressure of 275 kPa.

Table 4.41 lists the campus buildings and their associated node numbers that were used in the analysis of water flows. Table 4.42 lists minimum and maximum pressures under various operating scenarios for the existing campus buildings.

A pressure of 300.9 kPa was generated at Node 38 under maximum day conditions. This is less than the desirable pressure of 350 kPa, but is not considered to be a significant problem.

Guideline pressure values are achieved under maximum hourly conditions.

Under conditions of maximum day combined with a fire flow of 12,000 litres per minute at node 2-FH, negative pressures are observed in the model, indicating a deficiency in the system under these conditions.

To establish if other problem areas existed, a fire flow of 12,000 litres per minute was simulated at each hydrant in the system. The nodes shown in Table 4.43 indicate hydrants where a fire flow of 12,000 litres per minute resulted in pressures of less than 140 kPa. The table also indicates the fire flows that are achievable at these locations while maintaining the minimum desirable pressure of 140 kPa.

The projected operation of the system under future conditions is examined in Section 6.6.

Information Gaps and Limitations

- No information gaps were observed that significantly influenced the analysis. Additional detail regarding service sizes and valve locations will be of benefit in planning future work.

Recommendations

- It is recommended that the University review their design criteria for water main sizing to determine if they wish to provide a water supply meeting the Fire Underwriter's Survey (FUS) recommendations for fire protection. If affirmative, fire demands should be calculated for existing buildings using the FUS method to determine if any deficient system sections exist.
- The frequency of watermain breaks and locations should be monitored to assist in determining when watermain replacement may be warranted. Destructive testing of pipe samples is suggested.
- Watermain replacement should be considered in conjunction with any major infrastructure work impacting the watermain corridor in order to minimize costs. A phased program for complete replacement in the next 50 years should be considered.
- Priority in the replacement program should be given to any pipes of less than 200 mm diameter as such pipes have very limited capacity for conveying fire flows for large buildings.

- "C" testing of the watermain network, commencing with the oldest sections, is recommended to identify watermain segments in poor condition.
- In conjunction with the corrosion control program previously recommended by Totten Sims Hubicki, corrosion protection testing is recommended.

Table 4.41
List of Buildings and Associated Nodes

Existing Campus Buildings			Future Campus Buildings		
Bldg. #	**Name**	**Node #**	**Bldg. #**	**Name**	**Node #**
01	H.M. Tory Building	106-B	R1	RES – adjacent to Lanark House 06	272
02	Macodrum Library	128-B	R2	RES – adjacent to Glengarry 18	273
03	Paterson Hall	29	R3	RES – adjacent to Leeds Res. 30	308
04	Southam Hall	32	R4	RES – In parking 7	18
05	Renfrew House	271-B	R5	RES – In parking 7	18
06	Lanark House	260-B	A1	ACAD – adjacent to Herzberg 13	61
07	University Centre	140-B	A2	ACAD – adjacent to U. Center 07	80-FH
08	Gymnasium	195-B	A3	ACAD – adjacent to Minto CASE 27	78
09	Athletic Centre	193	A4	ACAD – adjacent to Architecture 22	81
10	Mackenzie Bldgs (Eng.)	252	A5	ACAD. – adjacent to Steacie 12	138
11	Maintenance Building Addition STC Space	157-B	A6	ACAD – adjacent to Macodrum 02	31
12	Steacie	65-B	A7	ACAD – adjacent to Child Care 28	153
13	Herzberg	21-B	A8	ACAD – adjacent to Ice Arena 39	184
14	Russell + Grenville	263-B	A9	ACAD – In parking 7	20
15	Loeb	6-B	A10	ACAD – In parking 7	20
16	Nesbitt Biology	178-B	A11	ACAD – In parking 7	20
17	Robertson Hall	170	A12	ACAD – In parking 7	20
18	Glengarry House	275-B			
19	Commons	277-B			
20	Parking Garage	171			
21	Dunton Tower	94			
22	Architecture Building	116			
23	St. Patrick's	301-B			
24	Social Science Research	44-B			
25	Life Science Research	14-B			
26	Stormont Dundas	305			
27	Minto C.A.S.E.	264-B			
28	Child Care	190-B			
29	Technology & Trade	175			
30	Leeds Residence	305			
31	Azrieli Theatre	106-B			
32	Azrieli Pavilion	99-FH			
33	National Wildlife Research	180-B			
34	Prescott House	252			
35	Fieldhouse	230-FH			
36	Alumni Hall & Sports	224-B			
37	Hci Building	45			
38	VSIM (Visual Stimulation)	46			
39	Ice Arena	212-B			
40	Tennis Centre	240			
72	Bronson Substation	216			

Table 4.42 Scenarios for Existing Campus Buildings (See Drawing No. 1)						
Scenario	Minimum Pressure			Maximum Pressure		
	Pressure (m)	Pressure (kPa)	Node	Pressure (m)	Pressure (kPa)	Node
Max day	30.67	300.9	38	48.83	479	206 – 208
Max day + fire at node 2-FH*	negative	negative	2-FH	47.3	464	218
Max day + fire at node 77	21.62	212.1	38	47.3	464	218
Max day + fire at node 218	30.31	297.3	38	48.4	474.8	206-207-208
Max day + fire at node 262	19.43	190.6	262	47.34	464.4	218
Max day + fire at node 278-FH	26.09	255.9	38	47.35	464.5	218
Max day + fire at node 331	30.25	296.8	38	48.6	476.8	210 – 211
Max hourly	30.1	295.3	38	48.6	476.8	210-211

*Note: Negative pressures at node 2-FH are not acceptable

Table 4.43 Maximum Fire Flow Allowed on Maximum Day at Critical Nodes to Keep Pressures Above 14 m, <u>Without Improvement</u> to the Network	
Critical Nodes	Max Fire Flow (LPM) Existing Network
2-FH	7,900
5-FH	8,700
9-FH	9,200
20-FH	9,800
40-FH	9,800
55-FH	9,300
56-FH	8,600
59-FH	8,400
142-FH[(1)]	3,100
223-FH	10,800
230-FH	5,500

(1) The maximum fire flow at node142-FH is small in comparison to other hydrants because it is located at the end of a 247-metre-long pipe of diameter 150 mm.

4.11 Summary of Recommendations for Improved Maintenance, Testing and Data Collection

This section provides a summary of all the recommendations for improved maintenance, testing and data collection presented in the previous sections. Table 4.44 lists thirteen recommendations that cover all the infrastructure services. The table provides a brief description of the recommendation, a priority level and a budget cost.

Given the age of the building services infrastructure, it is critical that it be evaluated on a regular basis to prevent system failures. An unscheduled outage, resulting from a system failure can result in the extended loss of the system and present a higher level of risk, often when the systems demand is at it's highest and the repairs are often costly. System failures can often be avoid if the proper preventative maintenance program is implemented as outlined in the recommended list of projects presented in Table 8.1. The table lists the projects by service and type of project together with a brief description of the project and estimated implementation cost.

From a priority standpoint the most critical maintenance related projects are the ultrasonic testing of the steam and condensate lines followed by the life compliance testing of the emergency generators to ensure that the equipment will operate correctly under an emergency situation.

Table 4.44
List of Maintenance and Other Recommended Projects

Infrastructure Service	Priority	Type of Project	Description	Estimated Cost
Electrical Distribution	1	Life Compliance Testing	The actual loading on all generators needs to be confirmed to ensure that all emergency equipment will operate correctly under an emergency situation. Life compliance testing should be performed for all emergency distributions. The operation of the fire alarms, fire pumps and emergency generators should be verified	$23,300 per emergency distribution (~$186,000 for the campus)
	2	Testing / Load Study	The load on all emergency generators including firm pumps and seasonal loads should be confirmed. This should be performed via load monitoring on the load side of transfer switches for a period of 7 days, during peak loading periods. A detailed inventory and single line diagram of all the emergency loads on the generator should be prepared.	$64,000
	3	Maintenance/Testing	Existing medium voltage cables are approaching the end of their service life and risk failure. Perform scheduled testing of the medium voltage cables. Following each test, the test results should be compared to the previous results to evaluate the deterioration of the cable. If the deterioration is significant, Carleton University must make preparations to replace the deteriorating cable. Because of the existing Campus Loop system, replacing a cable could be completed without the Campus incurring a power disruption. Testing should be completed every 3-5 years. (Cables are defined here in this description as a medium voltage cable connecting one medium voltage campus substation to another, ie. The medium voltage cable connecting building 13 to building 15 in Campus Loop ‘A’, refer to Figure 4.1)	$1,200/cable (~$50,000 for the campus)
	4	Testing Medium Voltage Distribution	The operation of the main medium voltage distribution should be tested regularly to confirm operation of switches, breakers and over-current relays are properly calibrated. Testing should be completed every 3-5 years.	$10 000
Steam System	1	Ultrasonic Testing	The last inspection of the steam and condensate piping was completed approximately 25 years ago. Comprehensive ultrasonic testing should be carried out as soon as possible given the age of the piping. The level of effort using internal resources is estimated to be approximately 480 man-hours (12 weeks) plus the purchase of an Ultrasonic meter.	$25,000 (using internal resources)
	2	Study	A study needs to be commissioned, to asses the ability of the condensate pumps to adequately return condensate back to the CHP and verify pumps are adequately sized. Operation of the condensate high level alarms also needs to be verified. This study is important in the context of the planned campus expansion.	$30,000
	3	Repair/ Replacement	The multi-port, steam valve, located on the low pressure steam feeding the dearator should be repaired or replaced. This was already recommended in the heating plant audit undertaken by the Federal Industrial Boiler Program (FIBP).	$10,000
Medium Temperature Hot Water	1	Replacement	The circulating pumps used in the medium temperature hot water system are not suited for this service and require frequent replacement of the seals. The six circulating pumps should be replaced with pumps designed to operate with high temperature fluids	$25,000
	2	Replacement	MTHW converters have a remaining life of approximately 5 years and will require replacement by 2012.	$75,000

Table 4.44
List of Maintenance and Other Recommended Projects

Infrastructure Service	Priority	Type of Project	Description	Estimated Cost
Chilled Water System	1	Maintenance	Maintenance of the chilled water piping including flushing and cleaning of the piping that serves Bldgs. 7, 10, 17 and 21 is strongly recommended	$30,000
	2	Data Collection	Undertake an inventory of the small tonnage DX A/C equipment the information will be useful in a load reduction program that relies on purchasing guidelines to replace the equipment with high EER, Energy Star equipment.	$7,500
Natural Gas	3	Data Collection	Collect information on line sizes and meter capacities to populate the master drawing of infrastructure capacities.	$5,000
Domestic Water	1	Data Collection	A survey of all bathrooms fixtures in buildings built prior to 1996 is needed to determine the percentage that has been retrofitted to low flow devices. This will allow the University to determine accurately the potential reductions in domestic water that can be achieved.	$8,000
Water Distribution	3	Data Collection	“C” value testing of entire network to determine restrictions	$15,000
	4	Upgrade	Replace 150 mm diameter mains as suggested in Table 6.18. Estimated cost at right includes restoration.	$768,800
Storm Sewer	3	Data Collection	Conduct a review of the “major” storm system by which flows are conveyed when storm sewer capacity is exceeded.	$15,000
Sanitary Sewer	1	Maintenance	Continue with infiltration/inflow control program as developed by Totten Sims Hubicki.	Refer to TSH Report

5.0 DEMOGRAPHIC AND GEOGRAPHIC PROJECTIONS

5.1 Future Growth Projections

The Carleton University full time student population in November 2005 was estimated to be approximately 18,858 students and the total full-time and part-time population was approximately 23,839 students. Currently, the campus contains a total of 38 buildings having a gross floor area of 3,868,566 ft^2. The building student density based on the above total building gross area and student population is estimated to be approximately 205 ft^2/student.

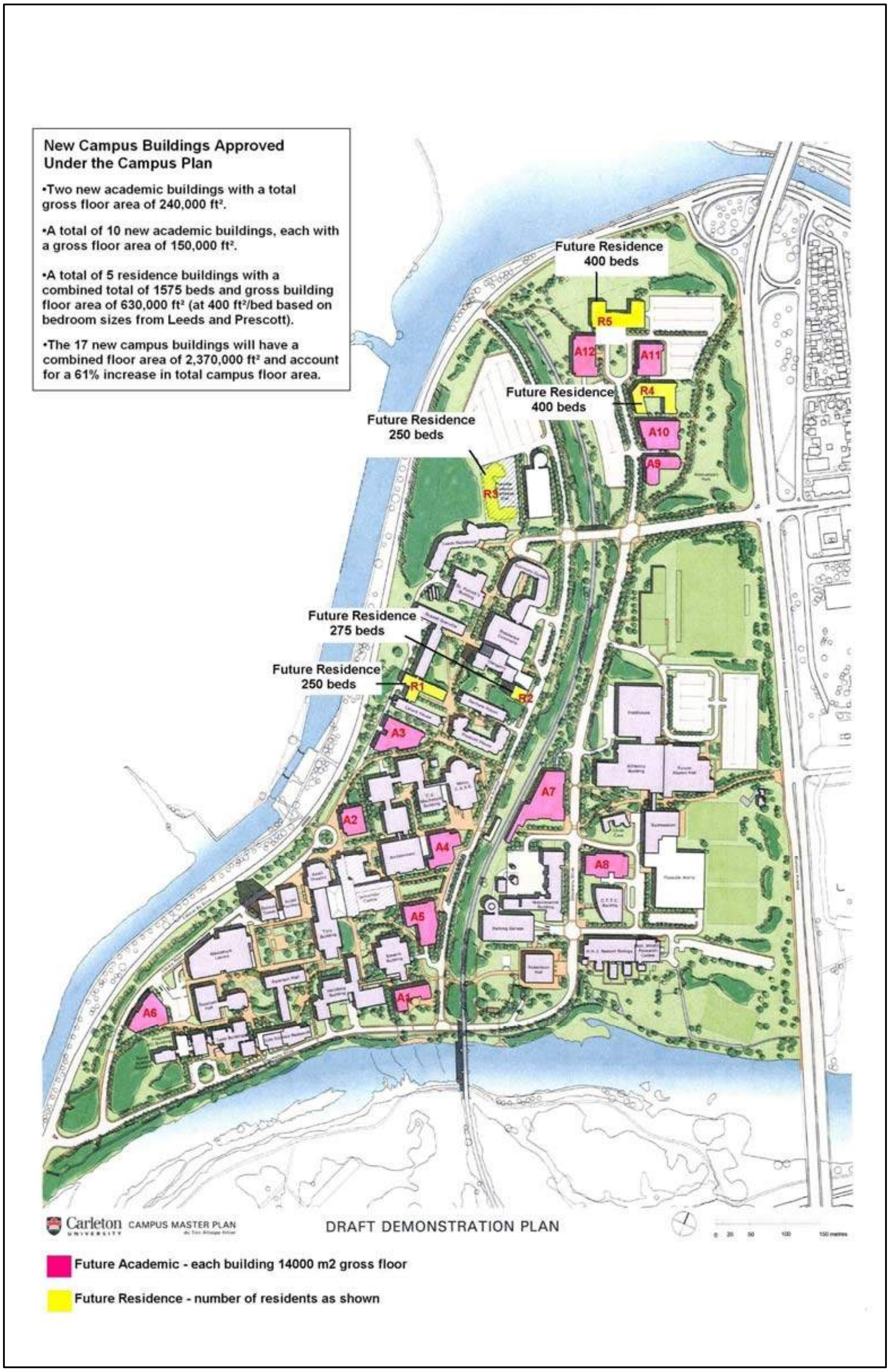
The Carleton University Campus Master Plan approved by the Board of Governors in January 29, 2004 proposed a total of seventeen (17) future facilities to be built throughout the campus. The location of these future facilities is shown in Figure 5.1. Academic buildings appear in fuchsia while student residences are marked in amber with the possible locations identified in the plan.

While it is recognized that the use, final location and size of the future buildings is uncertain, this plan forms the basis for the development of the master servicing plan. Additional assumptions have been developed in concert with Carleton University specifically for this project in order to be able to quantify the impact that the future facilities will have on all building services and site energy and water use. These assumptions are listed below:

- In the northeast sector, there will be four research or academic buildings, and two residences. The two residences will be assumed to each have 400 residents. Research uses can be assumed to be an even mixture of wet and dry uses. It is expected that research will take priority over academic buildings in this location due to the distance from the campus centre.
- The planned residence north of Lanark House will have 250 beds, as will the future building north of the Leeds Residence. The future tower at Glengarry will have 275 beds. The planned residence units will consist of two bedrooms sharing a common kitchenette and bathroom.
- For master planning purposes, the future research/academic buildings will be assumed to have gross floor areas of ~150,000 ft^2, and be 5~levels. After the servicing network is established on this basis, it is desired that the study also examine the impact of increasing the gross floor area to ~200,000 ft^2 for selected buildings.
- One 250-bed residence will be added in 2008 and two academic buildings by 2010. The first academic building will be 140,000 ft^2 and be used for arts programs such as journalism and international studies. The second academic building will be 100,000 ft^2 and will be located north of the University Centre. It will include lab and academic areas and is expected to house the biomedical engineering group. For modeling purposes the building will consist of 15% dry laboratories, 15% wet laboratories and 70% academic space.
- After 2010, one new facility will be added to the campus every three years. This rate of construction was decided as more realistic than building one facility every year given Carleton's past rate of growth.

Table 5.2 provides a summary of the growth in campus building floor area based on the above assumptions. The table includes a facility reference number, building description, size, total campus floor area and expected year of construction. As shown, the campus building floor area will increase to approximately 6.2 million ft^2, representing a 61% increase. At a three-year construction interval the last facility will be built in 2052, and at a two-year interval in 2038.

Figure 5.1 – Draft Demonstration Plan with Location of Future Academic Buildings & Student Residences



presently undeveloped north east sector, and will deliver sewage from this area to the pumping station. The north east sector sewer network will be designed at a future date when planning for that sector is further developed.

6.7 Storm Sewer Capacity for Future Growth

Section 4.9 noted that the present storm sewer system is considered to be under-sized when compared with current Ottawa design standards of supplying capacity to meet a 1:5 year storm event. Pipe improvements necessary to meet this criteria for the present system were identified.

For the identified building program, the release flows listed below should be respected in order to provide a system meeting the 1:5 year storm design criteria:

- 6.25 L/s/ha for P-6 area with increased pipe diameters as described in Section 4.9.
- 10.30 L/s/ha for P-5 area with increased pipe diameters as described in Section 4.9
- No increase in runoff for development in all other areas other than P5 and P6.

If areas P5 and P6 were developed without restriction of flows as mentioned above, pipe diameters should be increased as noted in Table 6.12.

Table 6.12
Storm Pipe Size Requirements – No Flow Restriction from P5/P6

Section	Present pipe diameter (mm)	Required pipe diameter (mm)	Section	Present pipe diameter (mm)	Required pipe diameter (mm)
44.2-44.1	305	450	**20.5-16.5a**	255	600
44.1-43.3	305	450	**16.5a-16.5**	381	600
43.6-43.5	305	450	**16.5-50.3**	381	600
43.5-43.4	305	450	**50.15-50.14**	250	375
43.4-43.3	305	450	**50.14-50.13a**	250	375
43.3-42.3	305	450	**50.13a-50.13**	305	375
42.3-42.1	305	525	**50.13-50.12**	200	450
42.1-41.5	305	525	**50.12-50.11**	381	450
41.5-41.4	450	750	**50.8-50.7**	610	675
41.4c-41.4b	250	375	**50.7-50.6**	610	675
41.1b-41.4	305	375	**31.4-31.3**	1067	1500
41.4-41.3	600	750	**31.3-31.1d**	1067	1500
41.3-41.2	600	750	**31.1d-31.1b**	1067	1500
41.2-41.1	600	900	**31.1b-31.1**	1400	1500
16.10-16.9	255	300	**31.1-30.4**	1350	1500
16.9-16.8	255	375	**32.3-32.1**	450	525
16.8-16.7	255	375	**32.1-30.6**	450	525
16.7-41.1	305	450	**30.3-30.2**	1371	2100
41.1-40.3	750	900	**20.2-30.1**	1371	2100
40.4-40.3	300	450	**30.1-Outlet**	1371	2100
20.3-20.5	255	375			

For all other areas, new development should not be allowed to increase flow. This is the practice that is currently being followed for new building projects.

Retention should be done on site, employing roof top, surface or subsurface ponding as appropriate to the individual site plan. Where possible, efforts should be made to not only match existing runoff rates but actually reduce the rate of runoff when compared with present conditions. These efforts will serve to reduce the load on the present system, and minimize surcharging. It is not anticipated that it would be possible to decrease system flows from new development areas to the point where the existing system would have capacity for a 5-year storm event.

If new development proceeds with no increase in flow as compared with present conditions, the new development in itself will not require the replacement of existing storm sewers. Replacement is therefore only expected to occur based on sewer condition, or as desired to improve upon the present level of service.

6.8 Water Distribution Network Capacity for Future Growth

The Carleton University water distribution system was described in Section 4.10, together with the operation of the system under present conditions. The present system is shown schematically in Figure 4.34 and Figure 4.35, and in more detail on the Campus Master Plan – Water Distribution found in **Appendix B**.

The system model was also run under future conditions, with all proposed buildings included. The future system is shown schematically on Figure 6.13, including new buildings under design/construction and future buildings. The basic parameters used for the hydraulic model are listed in Section 4.10. In addition, the following parameters were added for simulation of future conditions:

- New academic buildings were assumed to have gross floor areas of 10,800 square metres, and an average demand of 2 cubic metres per square metre of floor area per year.
- New residence buildings were assumed to have a maximum day demand of 130 litres per minute.

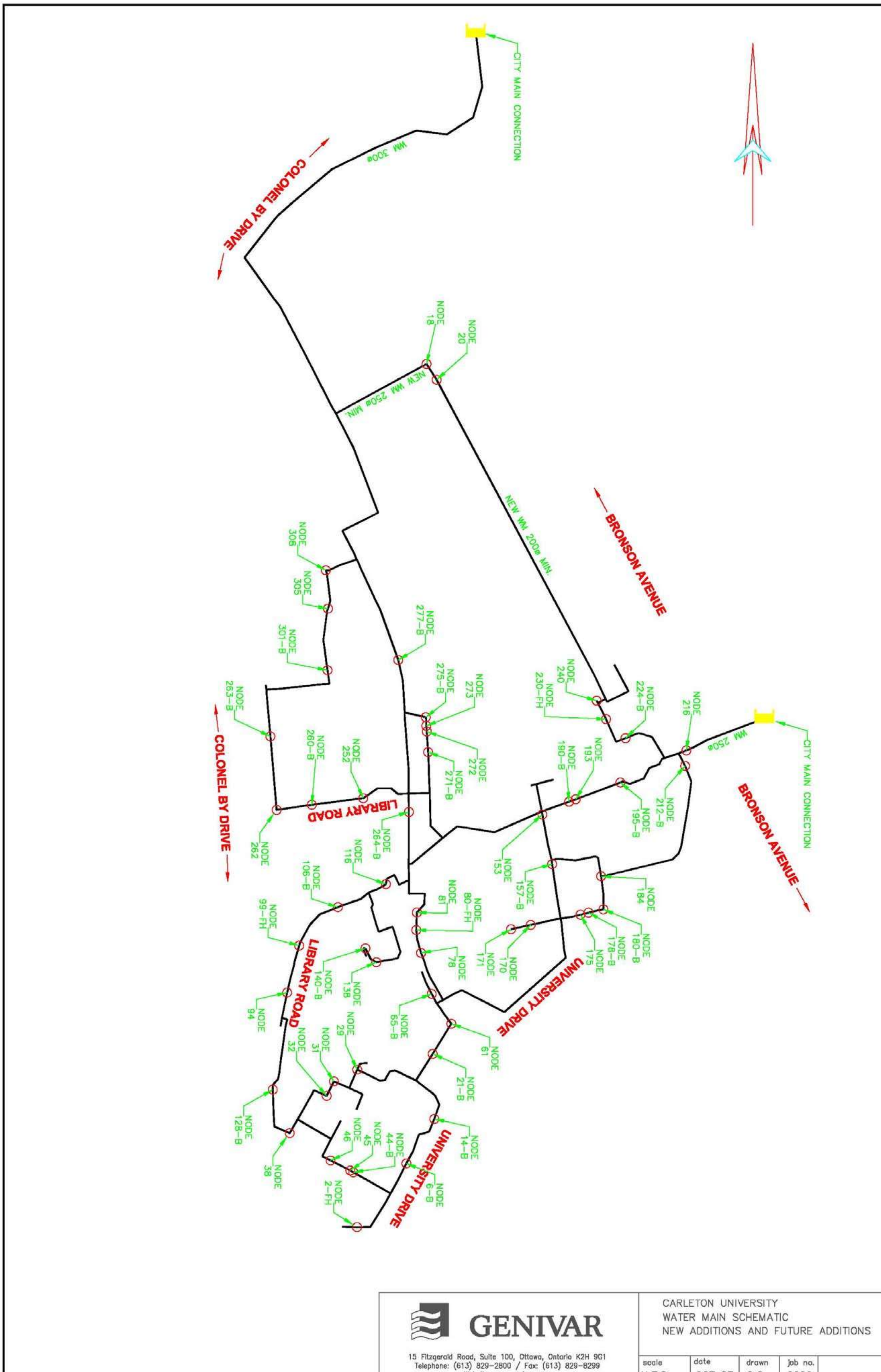
In accordance with Ottawa guidelines, the system was modelled under conditions of peak hour demand, and also for maximum daily demand combined with a fire flow of 12,000 litres per minute at a single node. The design guidelines suggest that the following pressures should be achieved:

- Normal operating pressures between 350 and 550 kPa under maximum day demand.
- Maximum day plus fire flow should result in a minimum pressure of 140 kPa
- Maximum hour demand should result in a minimum pressure of 275 kPa.

Table 4.41 in Section 4 lists the campus buildings and their associated node numbers that were used in the analysis of water flows. Table 6.14 lists minimum and maximum pressures under various operating scenarios for the existing and proposed campus buildings.

The proposed building expansion program does not result in any dramatic changes from the conditions estimated for the present system. A pressure of 299.5 kPa was generated at Node 38 under future maximum day conditions. By comparison, the simulation using only existing buildings resulted in a pressure at this node of 300.9 kPa. The pressure at this node is less than the desirable pressure of 350 kPa under maximum day conditions, but is not considered to be a significant problem.

Figure 6.13 – Water Main Schematic – New Additions and Future Additions



Guideline pressure values are achieved under maximum hourly conditions.

Under conditions of maximum day combined with a fire flow of 12,000 litres per minute at node 2-FH, negative pressures are observed in the model, indicating a deficiency in the system under these conditions. This node is a fire hydrant at the southwest corner of the campus, at the dead end of a water main.

To establish if other problem areas may exist, a fire flow of 12,000 litres per minute was simulated at each hydrant in the system. The nodes shown in Table 6.15 indicate hydrants where a fire flow of 12,000 litres per minute resulted in pressures of less than 140 kPa. The table also indicates the fire flows that are achievable at these locations while maintaining the minimum desirable pressure of 140 kPa. The fire flows available at hydrants range from a minimum of 3,000 litres per minute at hydrant 142-FH, to 7,900 litres per minute or higher at all other hydrants. These values should be compared with present building fire pump capacities, which vary up to 2500 Usgpm (9,458 litres per minute) at the Ice House. Fire pump requirements at all other buildings are equal to or less than 750 Usgpm (2,838 litres per minute).

Figure 6.16 indicates proposed water distribution system network changes that are necessary in order to achieve guideline values for pressures at fire flows of 12,000 litres per minute at any single hydrant. The pipes extending to Parking Area 7 proved to be essential in maintaining pressures above 140 kPa at all times. Table 6.17 indicates the minimum and maximum pressures obtained from the improved network.

Table 6.14
Scenarios for Existing and Future Campus Buildings (See Figure 6.13)

	Minimum Pressure			Maximum Pressure		
Scenario	**Pressure (m)**	**Pressure (kPa)**	**Node**	**Pressure (m)**	**Pressure (kPa)**	**Node**
Max day	30.53	299.5	38	48.81	478.8	210-211
Max day + fire at node 2-FH(1)	negative	negative	2-FH	47.36	464.6	218
Max day + fire at node 77	20.94	205.4	38	47.36	464.6	218
Max day + fire at node 218	30.21	296.4	38	47.01	461.2	206
Max day + fire at node 262	18.84	184.8	262	42.51	417.0	331
Max day + fire at node 278-FH	25.48	250.0	38	47.40	465.0	218
Max day + fire at node 331	30.11	295.4	38	48.55	476.3	210-211
Max hourly	29.60	290.4	38	48.35	474.3	210-211

(1) Note: Negative pressures at node 2-FH are not acceptable

Table 6.15
Maximum Fire Flow Allowed on Maximum Day at Critical Nodes to Keep Pressures Above 14 m, Without Improvement to the Network

Critical Nodes	Max fire flow (LPM)	
	Existing Network	Future Network[1]
2-FH	7,900	7,900
5-FH	8,700	8,500
9-FH	9,200	8,800
20-FH	9,800	9,600
40-FH	9,800	9,600
55-FH	9,300	9,100
56-FH	8,600	8,400
59-FH	8,400	8,200
142-FH[2]	3,100	3,000
223-FH	10,800	above 12,000[3]
230-FH	5,500	9,200[3]

(1) The future network includes the existing network and the northeast addition. It also includes existing demands and demands of future campus buildings

(2) The maximum fire flow at node 142-FH is small in comparison to other hydrants because it is located at the end of a 247-metre-long pipe of diameter 150 mm.

(3) The future network can accept much higher fire flows at nodes 223-FH and 230-FH because the added pipes connecting to parking 7 form a loop allowing water to reach those nodes more easily.

Figure 6.16 – Water Main Schematic – Improvement and to Existing Water Main System

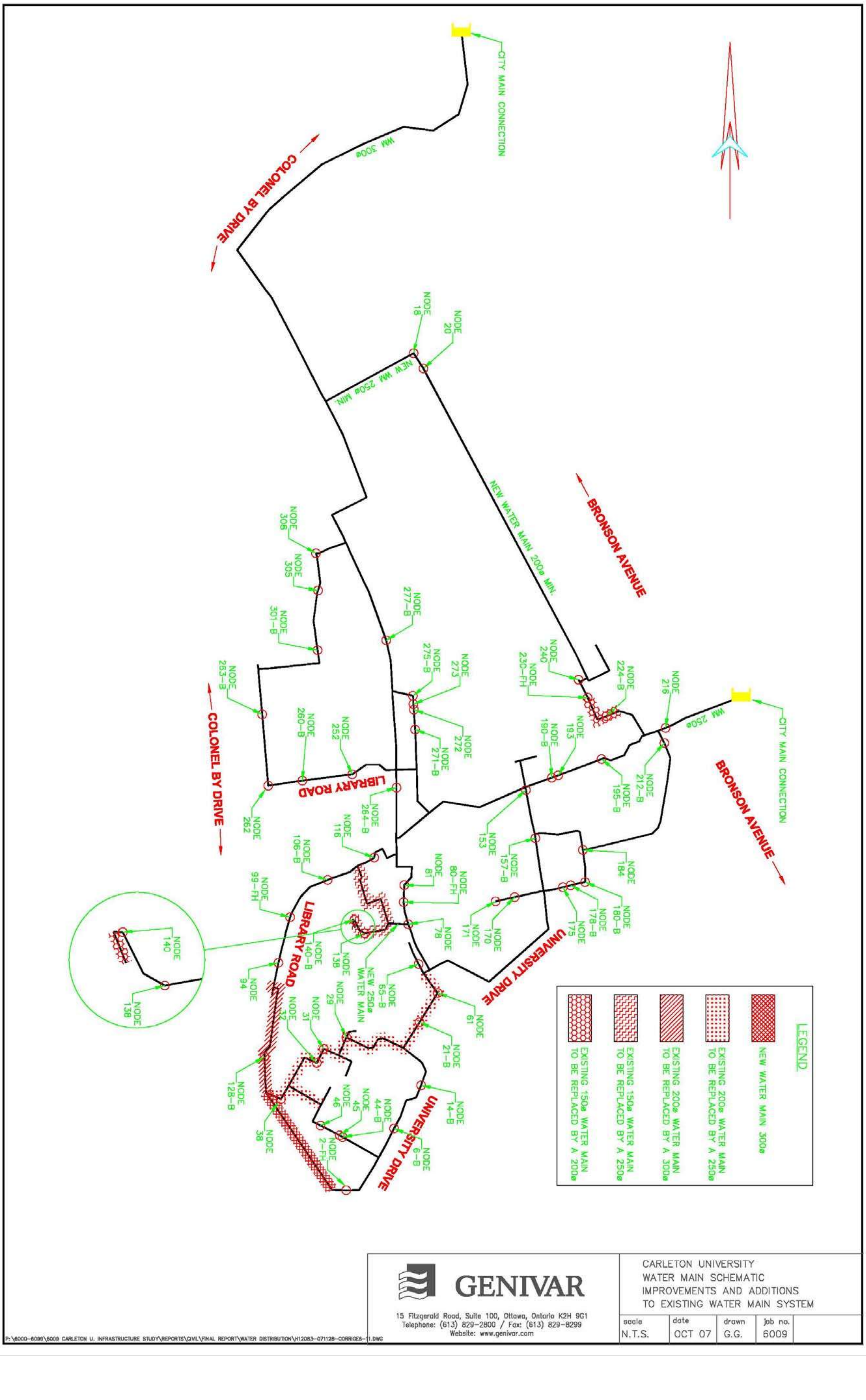


Table 6.17 Minimum and Maximum Pressures in the Improved Network[1] for Critical Hydrants Sustaining a Flow of 12,000 LPM						
Hydrant Sustaining the Fire Flow[2]	**Minimum Pressure**			**Maximum Pressure**		
	Pressure (m)	**Pressure (kPa)**	**Node**	**Pressure (m)**	**Pressure (kPa)**	**Node**
2-FH	15.81	155.1	38	47.29	463.9	218
5-FH	16.44	161.3	38	47.29	463.9	218
9-FH	16.44	161.3	38	47.29	463.9	218
20-FH	17.03	167.1	37-51	47.29	463.9	218
40-FH	16.15	158.4	38	47.29	463.9	218
55-FH	16.57	162.6	37-51	47.29	463.9	218
56-FH	16.07	157.6	33-34	47.29	463.9	218
59-FH	14.46	141.9	48	47.29	463.9	218
142-FH	17.00	166.8	142-FH	47.29	463.9	218
230-FH	24.87	244.0	230-FH	47.24	463.4	218

(1) The improved network includes the existing network and the northeast addition. It also includes existing demands and demands of future campus buildings. Moreover, it includes the pipe diameter changes and pipe additions shown in Figure 6.16

(2) 223-FH was not considered in the table because the system's pressures are already above 20 psi in the future network, without improvement .

The suggested improvements are indicated in Table 6.18.

Table 6.18 Suggested Improvements			
Network Improvement	**Length (metres)**	**Approximate Location**	**Budget Cost $ (2007)**
New 200 mm main (expected only for northeast development)	350	From Building 40 to P7	$122,500.
New 250 mm main (required only for northeast development)	100	From P7 to existing 300 mm main	$44,000.
New 300 mm main	200	South west corner of campus from Library Road to University Drive, west of Building 38	$105,000.
Replace existing 200 mm with 250 mm	500	From Building 2 to Campus Avenue	$220,000.
Replace existing 200 mm with 300 mm	135	Along Library Road adjacent to Building 2	$70,875.
Replace existing 150 mm with 250 mm	230	South and east of Building 7	$101,200.
Replace existing 150 mm with 200 mm	260	From Building 40 to southeast corner of Building 6	$91,000.

Budget costs above exclude surface restoration work, valves and hydrants. Restoration costs for the sections of water main indicated as being replaced could be a very significant cost if not associated with other restoration works.

It should be emphasized that the driving force behind these changes is the assumed requirement to achieve fire flows of 12,000 litres per minute. As noted earlier, this value is the recommended flow calculated for a hypothetical building using the Fire Underwriter's Survey recommendations. Existing campus buildings have not required this level of flow. Should lesser or greater flows be required, the network changes proposed could be significantly altered. Prior to any planned distribution network changes, it is therefore recommended that a thorough review be conducted of anticipated fire flow requirements at specific buildings. As this area of work is not defined, the work program has not been included in the estimates of Section 8.

For future buildings in the north east area, the connection to the existing 300 mm water main should have a diameter of at least 250 mm in order to maintain 140 kPa during the fire simulation. Also shown as proposed is a 200 mm link from the north east area to the existing water main terminus near Building 40. This link is needed to ensure that the network in the existing area meets the minimum pressure guideline under fire flow conditions. The link is not specifically needed to service the proposed north east area, as the north east area can be served by the proposed 250 mm connection to the existing 300 mm main. It is suggested that these two new sections of piping will only be considered as part of the development in the location of present Parking Area P7.

An additional benefit in linking the existing east and proposed northeast areas is to promote better water circulation. This may be a factor of interest if the north east area develops one building at a time, as a single building may not generate sufficient demand to maintain water quality in a dead end 250 mm link. The volume of water in such a link may not be replenished fast enough to prevent loss of chlorine residual.

APPENDIX D
Sanitary Sewer Network Capacity Analysis

Sanitary Flows - South West Section - Academic Buildings and 4 Residences

		Area					Flow l/s						Actual sewer design				
Number	Name	FROM M.H.	TO M.H.	Incr. Area (m^2)	Incr. Area (ha)	Cum. Area (ha)	Incr. Flow l/s	Cum flow l/s	Peak Fact.	Peak Flow (L/s)	Cum Infil. (L/s)	Tot flow (L/s)	Length (m)	Pipe Dia. (mm)	Slope (%)	Full Flow (L/s)	Full Flow Vel. (L/s)
38	WSIM			0	0.00	0.00	0.00	0.00	2.58	0.00		0.00					
24+38	Social Science	Build	160-1	4335	0.43	0.43	0.13	0.13	2.58	0.33	0.50	0.83	58.4	250	0.68	49.04	1.00
	38 estimated at 3000 m2																
37	HCI Building	Build	160-1	2973	0.30	0.73	0.09	0.22	2.58	0.56	0.50	1.06	58.4	250	0.68	49.04	1.00
	Routing	160-1	1-1	0	0.00	0.73	0.00	0.22	2.58	0.56	1.27	1.83	32.3	250	0.66	48.31	0.98
15	Loeb	Build	1-1	22145	2.21	2.21	0.66	0.66	2.58	1.69		1.69					
	Routing	1-1	1-2	0	0.00	2.95	0.00	0.87	2.58	2.25	2.03	4.28	88	250	0.97	58.57	1.19
25	Life Science	Build	1-2	2350	0.24	0.24	0.07	0.07	2.58	0.18	0.66	0.84	77.2	250	0.47	40.77	0.83
	Routing	1-2	1-2A	0	0.00	3.18	0.00	0.94	2.58	2.43	3.35	5.78	77.2	250	0.47	40.77	0.83
	Routing	1-2A	1-2B	0	0.00	3.18	0.00	0.94	2.58	2.43	4.01	6.44	77.2	250	0.47	40.77	0.83
	Routing	1-2B	1-3	0	0.00	3.18	0.00	0.94	2.58	2.43	4.67	7.10	77.2	250	0.47	40.77	0.83
	Routing	1-3	1-3A	0	0.00	3.18	0.00	0.94	2.58	2.43	5.33	7.76	77.2	250	0.47	40.77	0.83
13	Herzberg	Build	1-3A	14173	1.42	1.42	0.42	0.42	2.58	1.08		1.08					
	Routing	1-3A	1-7	0	0.00	4.60	0.00	1.36	2.58	3.51	5.62	9.13	34.5	250	0.71	50.11	1.02
	Routing	1-7	1-6	0	0.00	4.60	0.00	1.36	2.58	3.51	5.92	9.44	35.2	250	0.09	17.84	0.36
	Routing	1-6	1-4	0	0.00	4.60	0.00	1.36	2.58	3.51	6.93	10.44	117.7	250	0.52	42.88	0.87
A1	New Academic building	Build	1-4	14000	1.40	1.40	0.41	0.41	2.58	1.07		1.07					
	Routing	1-4	1-5	0	0.00	6.00	0.00	1.78	2.58	4.58	7.94	12.52	117.7	250	0.52	42.88	0.87
	Routing	1-5	151-6	0	0.00	6.00	0.00	1.78	2.58	4.58	8.13	12.71	22.5	250	0.07	15.73	0.32
4	Southam Hall	Build	2-10A	9246	0.92	0.92	0.27	0.27	2.58	0.71		0.71					
2	Macodrum	Build	2-10A	18968	1.90	1.90	0.56	0.56	2.58	1.45		1.45					
A6	Future Academic	Build	2-10A	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.28	1.22					
	May require additonal pipe work or go through building 4																
	Routing	2-10A	2-10							3.09	0.37	3.46	10.1	250	0.15	23.03	0.47
	Routing	2-10	2-9	0	0.00	0.00	0.00	0.00	2.58	0.00	0.54	0.54	20.8	250	0.57	44.90	0.91
	Routing	2-9	2-8	0	0.00	0.00	0.00	0.00	2.58	0.00	1.20	1.20	77	250	2.41	92.32	1.88
3	Paterson Hall	Build	2-8	7431	0.74	0.74	0.22	0.22	2.58	0.57		0.57					
	Routing	2-8	2-7	0	0.00	0.74	0.00	0.22	2.58	0.57	1.56	2.13	41.5	250	1.1	62.37	1.27
	Routing	2-7	2-6	0	0.00	0.74	0.00	0.22	2.58	0.57	1.60	2.17	5.1	250	0.3	32.57	0.66
	Routing	2-6	2-5	0	0.00	0.74	0.00	0.22	2.58	0.57	1.76	2.33	18.6	300	1.8	129.74	1.84
21	Dunton	Build	3-9	17175	1.72	1.72	0.51	0.51	2.58	1.31		1.31					
	Routing	3-9	3-8	0	0.00	1.72	0.00	0.51	2.58	1.31		1.31	NOT THE SAME SIZE			0.00	#DIV/0!
	Routing	3-8	3-7	0	0.00	1.72	0.00	0.51	2.58	1.31		1.31	NOT THE SAME SIZE			0.00	#DIV/0!

Sanitary Flows - South West Section - Academic Buildings and 4 Residences																	
		Area					Flow l/s						Actual sewer design				
Number	Name	FROM M.H.	TO M.H.	Incr. Area (m^2)	Incr. Area (ha)	Cum. Area (ha)	Incr. Flow l/s	Cum flow l/s	Peak Fact.	Peak Flow (L/s)	Cum Infil. (L/s)	Tot flow (L/s)	Length (m)	Pipe Dia. (mm)	Slope (%)	Full Flow (L/s)	Full Flow Vel. (L/s)
32	Azrieli Pavilion	Build	3-7	4600	0.46	0.46	0.14	0.14	2.58	0.35		0.35	80	200	0.21	15.03	0.48
	Routing	3-7	3-6	0	0.00	2.18	0.00	0.64	2.58	1.66		1.66	NOT THE SAME SIZE			0.00	#DIV/0!
	Routing	3-6	3-5	0	0.00	2.18	0.00	0.64	2.58	1.66		1.66	NOT THE SAME SIZE			0.00	#DIV/0!
31	Azrieli Theatre	Build	3-5	3510	0.35	0.35	0.10	0.10	2.58	0.27		0.27					
	Routing	3-5	3-4	0	0.00	2.53	0.00	0.75	2.58	1.93		1.93	NOT THE SAME SIZE			0.00	#DIV/0!
	Routing	3-4	3-3	0	0.00	2.53	0.00	0.75	2.58	1.93		1.93	NOT THE SAME SIZE			0.00	#DIV/0!
	Routing	3-3	3-2A	0	0.00	2.53	0.00	0.75	2.58	1.93		1.93	NOT THE SAME SIZE			0.00	#DIV/0!
	Routing	3-2A	3-2	0	0.00	2.53	0.00	0.75	2.58	1.93		1.93	NOT THE SAME SIZE			0.00	#DIV/0!
	Routing	3-2	3-1	0	0.00	2.53	0.00	0.75	2.58	1.93	0.23	2.16	26.7	300	2.28	146.01	2.07
1	H.M. Tory	Build	3-1	11857	1.19	1.19	0.35	0.35	2.58	0.91		0.91					
	Routing	3-1	2-5	0	0.00	3.71	0.00	1.10	2.58	2.84	0.51	3.35	33.5	300	1.46	116.84	1.65
	Routing	2-5	2-4	0	0.00	4.46	0.00	1.32	2.58	3.40	2.48	5.89	24.5	300	1.74	127.55	1.80
	Routing	2-4	2-3	0	0.00	4.46	0.00	1.32	2.58	3.40		3.40	55	300	0.39	60.39	0.85
12	Steacie	Build	2-3	9950	1.00	1.00	0.29	0.29	2.58	0.76		0.76					
	Routing	2-3	2-2	0	0.00	5.45	0.00	1.61	2.58	4.16	2.64	6.81	18.6	300	1.15	103.70	1.47
A5	Future Academic	Build	2-2	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.28	1.22					
	Routing	2-2	151-6							5.10	3.31	8.41	45.3	300	0.07	25.58	0.36
	Routing	151-6	151-4							9.68	12.27	21.96	97.5	300	0.6	74.90	1.06
7	University Center	Build	152-4	11857	1.19	1.19	0.35	0.35	2.58	0.91		0.91					
A2	Future Academic	Build	152-4	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.28	1.22					
	Routing	152-4	4-1							1.84	0.45	2.30	20	Only pipe leng		######	######
		4-1	151-4							1.84	0.92	2.77	55	250	3.4	109.65	2.23
	Routing	151-4	150-4							11.53	13.20	24.72	74.6	300	0.25	48.35	0.68
22	Architecture	Build	150-9	8614	0.86	0.86	0.26	0.26	2.58	0.66		0.66					
A4	Future Academic	Build	150-9	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.28	1.22					
	Routing	150-9	150-8							1.60	0.46	2.05	20.5	250	0.45	39.89	0.81
		150-8	150-7							1.60	0.74	2.34	33.6	250	0.45	39.89	0.81
27 and 10	Minto C.A.S.E.	Build	150-7	27751	2.78	2.78	0.82	0.82	2.58	2.12		2.12					
A3	Future Academic	Build	150-7	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.28	1.22					

Sanitary Flows - South West Section - Academic Buildings and 4 Residences

Number	Name	Area					Flow l/s						Actual sewer design				
		FROM M.H.	TO M.H.	Incr. Area (m^2)	Incr. Area (ha)	Cum. Area (ha)	Incr. Flow l/s	Cum flow l/s	Peak Fact.	Peak Flow (L/s)	Cum Infil. (L/s)	Tot flow (L/s)	Length (m)	Pipe Dia. (mm)	Slope (%)	Full Flow (L/s)	Full Flow Vel. (L/s)
		150-7	150-6	0	0.00	2.78	0.00	0.82	2.58	3.06	1.12	4.17	10.9	250	0.28	31.47	0.64
		150-6	150-5							3.06	1.30	4.35	21	250	0.07	15.73	0.32
		150-5	150-4							3.06	1.51	4.57	24.9	250	1.04	60.64	1.24
5	Renfrew House	Build	7-1B				0.41	0.41	1.75	0.71		0.71					
	(population = 168)		168														
		7-1B	7-2				0.00	0.41	1.75	0.71	0.52	1.24	61.2	300	0.55	71.71	1.01
		7-2	5-1				0.00	0.41	1.75	0.71	0.81	1.52	33.4	300	0.18	41.03	0.58
6	Lanark House	Build	5-1				0.43	0.43	1.75	0.74		0.74					
	(population = 175)		175														
R1	New Residence	Build	5-1				0.61	0.61	1.75	1.06		1.06					
	(population = 250)		250														
34	Prescott House	Build	5-1				0.97	0.97	1.75	1.70		1.70					
	(population = 400)		400														
	Routing	5-1	150-4				0.00	2.41	1.75	4.22	1.42	5.64	71	300	0.64	77.36	1.09
	Routing	150-4	150-3A				Residences and academic			18.81	16.67	35.48	64	450	0.33	163.78	1.03
	Routing	150-3A	150-3				Residences and academic			18.81	17.05	35.86	44.9	450	0.07	75.43	0.47
	Routing	150-3	150-2				Residences and academic			18.81	17.32	36.13	31.6	450	0.58	217.13	1.37
	Routing	150-2	150-1				Residences and academic			18.81	17.52	36.32	22.5	450	0.27	148.14	0.93
	Routing	150-1	137-2				Residences and academic			18.81	17.57	36.37	5.9	450	2.07	410.19	2.58

Notes :

1- Unit flow is 2.558 l/m2 gross floor area/d with a peak factor of 2.58 as per 2007 TSH study for existing academic buildings and A1.
For future buildings (A2 to A12), unit flow is 50,000 l/ha/d with peak factor of 1.5.
2- Area used is approx gross floor area for existing academic buildings and A1, and footprint for A2 to A12.
3- Infiltration calculated on a per meter of sewer main basis using 10 year flows as per 2007 TSH study
4- 2002 TSH Infrastructure Study used to obtain pipe diameter and slopes
5- No link is present from MH 151-6 to MH 8-11
6- Impossible to divide flows coming out of buildings when they have more than 1 service
Total flows has been assumed coming out of one pipe using the most upstream service
7- Peak factor of 1.75 and average flow of 210 L/c/d for existing residences and R1.
8- Design flow for future residences R2 to R5 is 350 l/c/c as per City of Ottawa standard with peak factor of 2.0
9- In yellow, unavailable pipe information
11- Building services not included in pipe network
11- Building 5 is assumed flowing toward south

For actual velocity calculations, flow depth assumed at normal depth
Manning's n used 0,013

Sanitary Flows - North West Section - 1 Academic Building and 6 Residences and Commons

				Area			Flow l/s						Actual sewer design				
Number	Name	FROM M.H.	TO M.H.	Incr. Area (m^2)	Incr. Area (ha)	Cum. Area (ha)	Incr. Flow l/s	Cum flow l/s	Peak Fact.	Peak Flow (L/s)	Cum Infil. (L/s)	Tot Flow (L/s)	Length (m)	Pipe Dia. (mm)	Slope (%)	Full Flow (L/s)	Full Flow Vel. (L/s)
R3	Future residence	Build	142-2				1.01	1.01	2.00	2.03	0.28	2.31					
	Population	250															
30	Leeds residence	Build	142-2				0.96	0.96	1.75	1.68		1.68					
	Population =	396															
23	St-Patrick's	Build	142-2	7013	0.70	0.70	0.21	0.21	2.58	0.54		0.54					
	(academic Building)																
	Routing	142-2	142-1		Academic and residence					4.25	0.66	4.91	44.7	200	0.48	22.72	0.72
	Routing	142-1	141-5		Academic and residence					4.25	0.70	4.95	4.7	200	3.89	64.69	2.06
	Routing	141-5	141-4		Academic and residence					4.25	1.25	5.50	63.7	300	0.33	55.55	0.79
26	Stormont	Build	141-4				1.12	1.12	1.75	1.95		1.95					
	Population =	459															
	Routing	141-4	141-3		Academic and residence					6.20	1.82	8.02	66.8	380	0.59	139.51	1.23
	Routing	141-3	141-2		Academic and residence					6.20	2.14	8.34	38	380	0.40	114.87	1.01
19	Commons	Build	141-2				4.29	4.29	1.75	7.50		7.50					
	Population =	1764															
	Routing	141-2	141-1		Academic and residence					13.70	2.51	16.22	43.2	380	0.35	107.45	0.95
14	Russel/Grenville House	Build	6-3				0.89	0.89	1.75	1.55		1.55					
	Population =	365															
	Routing	6-3	6-2							1.55	0.25	1.80	29.1	152	0.63	12.52	0.69
	Routing	6-2	6-1							1.55	0.88	2.44	74.3	250	0.41	38.08	0.78
18	Glengarry House	Build	6-1				1.54	1.54	1.75	2.70		2.70					
	Population =	635															
R2	Next to building 18	Build	6-1				1.12	1.12	2.00	2.23	0.28	2.51					
	Population =	275															
	Routing	6-1	6-0							6.48	1.65	8.14	57.2	250	1.28	67.28	1.37
	Routing	6-0	141-1							6.48	1.98	8.46	37.9	250	0.80	53.19	1.08
	Routing	141-1	140-2		Academic and residence					20.19	5.13	25.32	75.1	380	0.85	167.45	1.48

1- Existing residence population used as per 2007 GAC study
2- Population used for Commons is 1764 as shown in 2007 GAC study
3- Peak factor of 1.75 for existing residences as shown in 2007 GAC study
4- Design flow used for future residences 350 l/c/d as per City of Ottawa standard with peak factor of 2
5- 10,000 m2 of surface area used for the extraneous flow calculations of new residences at 0.28 L/ha/s

Sanitary Flows - North East Section - 5 New Academic and 2 New Residence Buildings

		Area					Flow l/s						Actual sewer design				
Number	Name	FROM M.H.	TO M.H.	Incr. Area (m^2)	Incr. Area (ha)	Cum. Area (ha)	Incr. Flow l/s	Cum flow l/s	Peak Fact.	Peak Flow (L/s)	Cum Infil. (L/s)	Tot Flow (L/s)	Length (m)	Pipe Dia. (mm)	Slope (%)	Full Flow (L/s)	Full Flow Vel. (L/s)
A9	New Academic building	Build	1140-4	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.30	1.24					
A10	New Academic building	Build	1140-4	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.30	1.24					
A11	New Academic building	Build	1140-4	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.30	1.24					
A12	New Academic building	Build	1140-4	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.30	1.24					
R4	Future residence	Build	1140-4				1.62	1.62	2.00	3.24	0.28	3.53					
	Population	400															
R5	Future residence	Build	1140-4				1.62	1.62	2.00	3.24	0.28	3.53					
	Population	400															
	Future Sewer	1140-4	140-4							10.24	1.77	12.01	400	200	1	32.80	1.04
40	Tennis Center	Build	140-4	2812	0.28	0.28	0.08	0.08	2.58	0.21		0.21					
	Routing	140-4	140-3							10.45	2.22	12.67	52.4	200	3.20	58.67	1.87
	Routing	140-3	140-2							10.45	2.86	13.32	75.5	200	0.73	28.02	0.89
35	Field House	Build	140-2	4459	0.45	0.45	0.13	0.13	2.58	0.34		0.34					
9	Athletic Center	Build	140-2	12240	1.22	1.22	0.36	0.36	2.58	0.94		0.94					
	Routing	140-2	140-1	Academic and residence						31.92	8.75	40.67	88.3	450	0.81	256.59	1.61
	Routing	140-1	132-7	Academic and residence						31.92	9.36	41.28	71	525	0.09	129.02	0.60
28	Child Care	Build	132-7	526	0.05	0.05	0.02	0.02	2.58	0.04		0.04					
A7	New academic	Build	132-7	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.28	1.22					
	Routing	132-7	132-6	Academic and residence						51.70	27.64	79.34	50.1	525	0.18	182.46	0.84
												0.00					
36	Alumni Hall	Build	132-3	3484	0.35	0.35	0.10	0.10	2.58	0.27		0.27					
	Routing	132-6	132-1	Academic and residence						51.97	28.85	80.82	141.7	525	0.22	201.71	0.93
	Routing	132-1	131-1							51.97	28.85	80.82	Nothing			0.00	#DIV/0!

1- For the Tennis Center, the foot print was used for the building area
2- No data available for MH 132-7,-6 or -5. For MH 132-4 and below, 2002 TSH study shows these MH to be in 131- instead of 132-
3- Connection from building 36 is shown in the pipe between MH 132-3 and 132-1
4- The number of meters between 132-5 and 132-1 correspond to 131-3 and 131-1, no data available between 132-1 and 131-1
5- Existing sports buildings and parking garage are classifed as academic buildings for flow calculation purposes
6- For future buildings, existing sewer ending at building 40 to be extended north
7- Infiltration allowance for future building used is 0.28 l/s/ha as per City guidelines
8- An area of 8000 m2 was used for infiltration of the 400 m long new sewer main

Sanitary Flows - South East Section - Academic Buildings

		Area					Flow l/s						Actual sewer design			
Number	Name	FROM M.H.	TO M.H.	Incr. Area (m^2)	Incr. Area (ha)	Cum. Area (ha)	Incr. Flow l/s	Cum flow l/s	Peak Fact.	Peak Flow (L/s)	Cum Infil. (L/s)	Tot Flow (L/s)	Length (m)	Pipe Dia. (mm)	Slope (%)	Full Flow (L/s)
20	Parking	Build	8-8	23862	2.39	2.39	0.71	0.71	2.58	1.82		1.82				
17	Robertson	Build	8-8	8659	0.87	0.87	0.26	0.26	2.58	0.66		0.66				
	Routing	8-8	8-7	0	0.00	3.25	0.00	0.96	2.58	2.48	0.30	2.79	35.3	300	0.43	63.41
11	Maintenance	Build	8-7	4308	0.43	0.43	0.13	0.13	2.58	0.33		0.33				
	Routing	8-7	8-6	0	0.00	3.68	0.00	1.09	2.58	2.81	0.61	3.42	36	300	0.28	51.17
	Routing	8-6	8-5C	0	0.00	3.68	0.00	1.09	2.58	2.81	0.77	3.58	18.2	300	0.75	83.74
16	Nesbitt	Build	8-5C	6320	0.63	0.63	0.19	0.19	2.58	0.48	0.75	1.24	88.3			
29	Technology	Build	8-5C	6365	0.64	0.64	0.19	0.19	2.58	0.49		0.49				
	Routing	8-5C	8-4	0	0.00	4.95	0.00	1.47	2.58	3.78	2.44	6.23	108	300	0.31	53.84
33	National	Build	8-4	5574	0.56	0.56	0.17	0.17	2.58	0.43		0.43				
	Routing	8-4	8-3	0	0.00	5.51	0.00	1.63	2.58	4.21	2.95	7.16	59	300	0.31	53.84
8	Gymnasium	Build	8-3	3137	0.31	0.31	0.09	0.09	2.58	0.24		0.24				
39	Ice Arena	Build	8-3	9600	0.96	0.96	0.28	0.28	2.58	0.73		0.73				
A8	New Academic	Build	8-3	10800	1.08	1.08	0.63	0.63	1.50	0.94	0.28	1.22				
	Routing	8-3	131-4	0	0.00	6.59	0.00	2.26		5.15	3.51	8.66	33.2	300	0.25	48.35
	Routing	131-4	131-3	0	0.00	6.59	0.00	2.26		5.15	4.30	9.44	91.9	300	0.25	48.35
	Routing	131-3	131-2	0	0.00	6.59	0.00	2.26		5.15	4.97	10.12	78.9	300	0.25	48.35
	Routing	131-2	131-1	0	0.00	6.59	0.00	2.26		5.15	5.42	10.56	52.2	300	0.25	48.35
	Routing	131-1	Station	Academic and residence						57.11	34.27	91.38	Nothing			
		131-1	Station	All buildings except North West section						36.93	34.27	71.19	Nothing			

1- Ice Arena area used : approx foot print
2- The networking around building 11 is unclear, 2002 study routing used
3- Info about MH 131-4, 131-3, 131-2 unavailable
4- Total flow at the pump station is obtained assuming a total flow phasing
5- Existing sports buildings and parking garage are classified as academic buildings for flow calculation purposes
6- Flows from Academic buildings and Residences are out of phase as per City of Ottwa Sewer guidelines section 4-11 and validated by 2007 GAC flow monitoring
7- Peak factor used for new academic is 1.5 and existing academic 2.58.

BUILDINGS

1. TORY BUILDING
2. MACODRUM LIBRARY
3. PATERSON HALL
4. SOUTHAM HALL
5. RENFREW HOUSE
6. LANARK HOUSE
7. UNIVERSITY CENTRE
8. GYMNASIUM
9. ATHLETICS BUILDING
10. C.J. MACKENZIE BUILDING
11. MAINTENANCE BUILDING
12. STEACIE BUILDING
13. HERZBERG BUILDING
14. RUSSELL HOUSE
    GRENVILLLE HOUSE
15. LOEB BUILDING
16. H.H.J. NESBITT BIOLOGY
17. ROBERTSON HALL
18. GLENGARRY HOUSE
19. RESIDENCE COMMONS
20. PARKING GARAGE
21. DUNTON TOWER
22. ARCHITECTURE BUILDING
23. ST. PATRICK'S BUILDING
24. SOCIAL SCIENCE RESEARCH BLDG
25. LIFE SCIENCE RESEARCH BLDG
26. STORMONT DUNDAS HOUSE
27. MINTO C.A.S.E.
28. CHILD CARE
29. C.T.T.C. BUILDING
30. LEEDS RESIDENCE
31. AZRIELI THEATRE
32. AZRIELI PAVILION
33. NATIONAL WILDLIFE RESEARCH CENTRE
34. PRESCOTT HOUSE
35. FIELD HOUSE
36. ALUMNI HALL AND SPORTS CENTRE
37. HUMAN COMPUTER INTER. BUILDING
38. VIRTUAL SIMULATION BUILDING
39. ICE HOUSE
40. TENNIS CENTRE
72. BRONSON SUBSTATION

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APPENDIX E

Detailed Tables of Storm Service Piping

STORM SEWER SYSTEM - NETWORK #1 - 1:2 Years - Without building roofs

Return Period 1:2	A	732.95	Coef Manning	0.013
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
44.4	15.00	0.2200	0.35	0.08	0.22	0.08	0.35	61.77	0.013	0.5	305	1.0	33	0.571	0.070	60.38	60.22	Building 30	0.90	0.22	0.35
44.3	15.57	0.0660	0.53	0.03	0.29	0.11	0.39	60.45	0.019	0.6	305	1.1	19	0.301	0.077	60.09	59.98			0.07	0.53
44.2	15.87	0.1500	0.20	0.03	0.44	0.14	0.33	59.78	0.023	0.2	305	0.5	39	1.198	0.040	59.95	59.89			0.15	0.20
44.1	17.07	0.2670	0.20	0.05	0.70	0.20	0.28	57.28	0.031	0.4	305	0.9	30	0.572	0.064	59.83	59.71	Building 23	0.90	0.27	0.20
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	61.77	0.019	1.1	305	1.4	54	0.628	0.105	61.54	60.96			0.31	0.36
43.7	15.63	0.0960	0.32	0.03	0.41	0.14	0.35	60.32	0.024	0.3	305	0.7	52	1.167	0.054	60.62	60.47			0.10	0.32
43.6	16.79	0.2900	0.36	0.10	0.70	0.25	0.35	57.83	0.039	0.1	305	0.5	49	1.687	0.035	60.47	60.41	Building 23	0.90	0.29	0.36
43.5	18.48	0.0000	#DIV/0!	0.00	0.70	0.25	0.35	54.61	0.037	0.4	305	0.9	27	0.488	0.067	60.41	60.29				
43.4	18.97	0.1100	0.40	0.04	0.81	0.29	0.36	53.75	0.043	0.9	305	1.3	34	0.429	0.096	60.29	59.98			0.11	0.40
43.3	19.40	0.0600	0.30	0.02	0.87	0.31	0.36	53.02	0.045	0.3	305	0.8	43	0.942	0.056	59.71	59.58			0.06	0.30
42.3	20.34	0.2700	0.70	0.19	1.76	0.69	0.39	51.49	0.098	0.5	305	1.0	23	0.384	0.073	59.56	59.44	Building 26	0.90	0.27	0.70
42.1	20.72	0.0000	#DIV/0!	0.00	1.76	0.69	0.39	50.89	0.097	0.8	305	1.2	45	0.624	0.088	59.44	59.10	Building 30	0.90		
41.5	21.35	0.3620	0.73	0.26	2.12	0.96	0.45	49.96	0.132	0.3	450	1.1	61	0.967	0.167	59.07	58.86			0.36	0.73
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	61.77	0.018	0.1	250	0.3	40	2.461	0.013	61.20	61.18			0.12	0.90
41.4b	17.46	0.2650	0.45	0.12	0.39	0.23	0.59	56.51	0.035	4.9	305	3.1	48	0.261	0.224	61.18	58.83			0.27	0.45
41.4	22.32	0.2200	0.30	0.07	2.73	1.25	0.46	48.58	0.167	0.8	525	1.7	71	0.677	0.379	58.83	58.28	Building 26	0.90	0.22	0.30
41.3	22.99	0.1320	0.30	0.04	2.86	1.29	0.45	47.67	0.169	0.4	610	1.5	36	0.410	0.428	58.16	58.00	Building 19	0.90	0.13	0.30
41.2	23.40	0.3900	0.42	0.16	3.25	1.45	0.45	47.13	0.188	0.2	610	1.1	50	0.775	0.314	58.00	57.88	Building 19	0.90	0.39	0.42
16.10	15.00	0.2600	0.33	0.09	0.26	0.09	0.33	61.77	0.015	0.6	255	0.9	34	0.602	0.048	60.11	59.91	Building 14	0.90	0.26	0.33
16.9	15.60	0.6300	0.39	0.25	0.89	0.33	0.37	60.38	0.055	0.5	255	0.9	76	1.405	0.046	59.91	59.50			0.63	0.39
16.8	17.01	0.2580	0.20	0.05	1.15	0.38	0.33	57.40	0.060	1.1	255	1.3	54	0.690	0.067	59.50	58.89	Building 18	0.90	0.26	0.20
16.7	17.70	0.2000	0.45	0.09	1.35	0.47	0.35	56.06	0.073	0.9	305	1.3	28	0.364	0.094	58.12	57.88			0.20	0.45
41.1	24.18	0.2700	0.46	0.12	4.87	2.05	0.42	46.16	0.260	0.3	762	1.4	75	0.868	0.657	57.79	57.55			0.27	0.46
40.5	15.00	0.6300	0.20	0.13	0.63	0.13	0.20	61.77	0.021	2.0	305	2.0	84	0.709	0.144	60.20	58.49	Building 40	0.90	0.63	0.20

STORM SEWER SYSTEM - NETWORK #1 - 1:2 Years - Without building roofs

Return Period 1:2			Coef Manning	0.013
	A	732.95		
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
40.4	15.71	0.6600	0.31	0.20	1.29	0.33	0.26	60.14	**0.055**	0.4	380	1.0	75	1.214	**0.117**	58.31	58.00			0.66	0.31
40.3	25.04	0.7140	0.30	0.21	6.87	2.60	0.38	45.12	**0.322**	0.4	914	1.8	71	0.655	**1.185**	57.52	57.24	Building 35	0.90	0.71	0.30
40.2a	25.70	0.4700	0.40	0.19	7.34	2.78	0.38	44.36	**0.340**	0.4	914	1.9	72	0.647	**1.218**	57.15	56.85	Building 9	0.90	0.47	0.40
16.6a	15.00	0.1600	0.40	0.06	0.16	0.06	0.40	61.77	**0.011**	3.5	381	3.0	83	0.463	**0.341**	61.00	58.12	Building 5 et 34	0.90	0.16	0.40
16.6	15.46	0.4200	0.30	0.13	0.58	0.19	0.33	60.70	**0.032**	1.0	381	1.6	25	0.260	**0.183**	58.13	57.88			0.42	0.30
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	61.77	**0.020**	0.8	250	1.1	132	1.980	**0.055**	63.04	61.93			0.58	0.20
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	57.46	**0.045**	1.0	305	1.4	22	0.271	**0.099**	61.84	61.63			0.33	0.52
21.2b	15.00	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	61.77	**0.000**	0.6	254	1.0	58	1.002	**0.049**	61.96	61.60	Building 10	0.90		
21.2	17.25	0.0000	#DIV/0!	0.00	0.91	0.29	0.32	56.92	**0.045**	1.2	305	1.5	29	0.323	**0.109**	61.57	61.23	Building 10	0.90		
21.1	17.57	0.3000	0.31	0.09	1.21	0.38	0.31	56.29	**0.059**	2.7	305	2.3	59	0.433	**0.166**	60.32	58.73			0.30	0.31
20.3	15.00	0.1300	0.90	0.12	0.13	0.12	0.90	61.77	**0.020**	0.3	254	0.6	61	1.573	**0.033**	58.90	58.73	Building 6	0.90	0.13	0.90
20.5	18.01	0.3300	0.39	0.13	1.67	0.63	0.38	55.47	**0.096**	0.1	305	0.5	92	3.362	**0.033**	58.83	58.73			0.33	0.39
16.5a	21.37	0.2300	0.53	0.12	2.25	0.94	0.42	49.93	**0.129**	0.4	381	0.9	20	0.351	**0.108**	57.88	57.81	Building 34	0.90	0.23	0.53
16.5	21.72	0.0000	#DIV/0!	0.00	2.25	0.94	0.42	49.42	**0.128**	0.3	381	0.9	61	1.107	**0.105**	57.81	57.61				
50.15	15.00	0.2800	0.61	0.17	0.28	0.17	0.61	61.77	**0.029**	0.6	250	0.9	96	1.707	**0.046**	68.06	67.48	Building 2	0.90	0.28	0.61
50.14	16.71	0.3700	0.52	0.19	0.65	0.36	0.56	58.01	**0.058**	0.7	250	1.0	12	0.202	**0.049**	67.48	67.40			0.37	0.52
50.13a	16.91	0.0000	#DIV/0!	0.00	0.65	0.36	0.56	57.60	**0.058**	2.4	305	2.2	23	0.178	**0.158**	67.40	66.84	Building 21	0.90		
50.13	17.09	0.4050	0.38	0.15	1.06	0.52	0.49	57.25	**0.081**	0.8	200	1.0	76	1.322	**0.030**	66.84	66.20	Building 32	0.90	0.41	0.38
50.12	18.41	0.0000	#DIV/0!	0.00	1.06	0.52	0.49	54.74	**0.078**	8.5	381	4.7	23	0.082	**0.533**	65.38	63.43				
50.11	18.49	0.1260	0.70	0.09	1.18	0.61	0.51	54.59	**0.091**	2.5	610	3.5	30	0.143	**1.021**	63.43	62.67			0.13	0.70
50.10	18.63	0.0000	#DIV/0!	0.00	1.18	0.61	0.51	54.34	**0.090**	13.9	610	8.2	20	0.041	**2.392**	61.48	58.70	Building 31	0.90		
50.9	18.67	0.0000	#DIV/0!	0.00	1.18	0.61	0.51	54.27	**0.090**	0.3	610	1.2	19	0.257	**0.361**	58.64	58.58	Building 7	0.90		
50.8	18.93	0.2500	0.61	0.15	1.43	0.76	0.53	53.82	**0.112**	0.2	610	1.1	48	0.729	**0.321**	58.58	58.46			0.25	0.61
50.7	19.66	0.2030	0.86	0.17	1.63	0.93	0.57	52.59	**0.135**	0.3	610	1.2	28	0.375	**0.364**	58.46	58.37	Building 22	0.90	0.20	0.86
50.6	20.03	0.1200	0.38	0.05	1.75	0.98	0.56	51.98	**0.140**	0.3	762	1.3	46	0.589	**0.593**	58.34	58.22	Building 10	0.90	0.12	0.38
																		Building 27			

STORM SEWER SYSTEM - NETWORK #1 - 1:2 Years - Without building roofs

Return Period 1:2	A	732.95	Coef Manning	0.013
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
50.5	20.62	0.1800	0.84	0.15	1.93	1.13	0.58	51.05	**0.159**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09		0.90	0.18	0.84
50.4	20.89	0.0000	#DIV/0!	0.00	1.93	1.13	0.58	50.64	**0.157**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06				
50.3	22.83	0.3400	0.52	0.18	4.52	2.24	0.50	47.89	**0.296**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52
50.2a	23.58	0.0000	#DIV/0!	0.00	4.52	2.24	0.50	46.91	**0.289**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84				
31.4	26.35	1.1700	0.46	0.54	13.03	5.57	0.43	43.65	**0.668**	0.1	1067	1.1	51	0.777	**0.978**	56.84	56.78	Building 28	0.90	1.17	0.46
31.3	27.12	0.3500	0.20	0.07	13.38	5.64	0.42	42.82	**0.664**	0.3	1067	1.9	85	0.761	**1.665**	56.78	56.49			0.35	0.20
31.1d	27.88	0.1500	0.60	0.09	13.53	5.73	0.42	42.04	**0.662**	0.4	1067	2.0	46	0.384	**1.783**	56.49	56.31	Building 36	0.90	0.15	0.60
31.1b	28.27	0.1000	0.60	0.06	13.63	5.79	0.42	41.66	**0.663**	0.5	1400	2.7	62	0.376	**4.225**	56.31	55.99			0.10	0.60
31.1	28.65	0.8300	0.38	0.32	14.46	6.10	0.42	41.30	**0.693**	1.3	1350	4.2	43	0.170	**6.036**	56.33	55.78			0.83	0.38
30.12	15.00	0.8000	0.57	0.46	0.80	0.46	0.57	61.77	**0.077**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			0.80	0.57
30.10	15.72	0.6320	0.20	0.13	1.43	0.58	0.41	60.13	**0.096**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			0.63	0.20
30.09	16.06	0.3600	0.50	0.18	1.79	0.76	0.43	59.37	**0.124**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50
30.07	17.94	1.2900	0.20	0.26	3.08	1.02	0.33	55.60	**0.156**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20
32.3	15.00	1.0400	0.80	0.83	1.04	0.83	0.80	61.77	**0.141**	0.7	450	1.5	70	0.770	**0.241**	59.50	59.00	Building 36	0.90	1.04	0.80
32.1	15.77	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	60.01	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77				
30.6	18.35	0.9300	0.80	0.74	4.01	1.76	0.44	54.85	**0.266**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			0.93	0.80
30.4	28.82	0.8000	0.80	0.64	19.28	8.51	0.44	41.14	**0.962**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			0.80	0.80
30.3	29.43	0.7650	0.20	0.15	20.04	8.66	0.43	40.56	**0.966**	0.0	1371	0.8	75	1.659	**1.112**	55.41	55.38			0.77	0.20
30.2	31.09	0.8820	0.20	0.18	20.92	8.84	0.42	39.10	**1.150**	0.1	1371	1.3	158	2.071	**1.877**	55.38	55.20			0.88	0.20
30.1	33.16	0.0000	#DIV/0!	0.00	20.92	8.84	0.42	37.42	**1.009**	0.6	1371	2.9	35	0.200	**4.308**	55.20	54.99				
Outlet																					

STORM SEWER SYSTEM - NETWORK #1 - 1:2 Years

Return Period 1:2			Coef Manning	0.013
	A	732.95		
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
44.4	15.00	0.3500	0.55	0.19	0.35	0.19	0.55	61.77	0.033	0.5	305	1.0	33	0.571	0.070	60.38	60.22	Building 30 0.13	0.90	0.22	0.35
44.3	15.57	0.0660	0.53	0.03	0.42	0.23	0.55	60.45	0.038	0.6	305	1.1	19	0.301	0.077	60.09	59.98			0.07	0.53
44.2	15.87	0.1500	0.20	0.03	0.57	0.26	0.46	59.78	0.043	0.2	305	0.5	39	1.198	0.040	59.95	59.89			0.15	0.20
44.1	17.07	0.3670	0.39	0.14	0.93	0.40	0.43	57.28	0.063	0.4	305	0.9	30	0.572	0.064	59.83	59.71	Building 23 0.10	0.90	0.27	0.20
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	61.77	0.019	1.1	305	1.4	54	0.628	0.105	61.54	60.96			0.31	0.36
43.7	15.63	0.0960	0.32	0.03	0.41	0.14	0.35	60.32	0.024	0.3	305	0.7	52	1.167	0.054	60.62	60.47			0.10	0.32
43.6	16.79	0.3900	0.50	0.19	0.80	0.34	0.42	57.83	0.054	0.1	305	0.5	49	1.687	0.035	60.47	60.41	Building 23 0.10	0.90	0.29	0.36
43.5	18.48	0.0000	#DIV/0!	0.00	0.80	0.34	0.42	54.61	0.051	0.4	305	0.9	27	0.488	0.067	60.41	60.29				
43.4	18.97	0.1100	0.40	0.04	0.91	0.38	0.42	53.75	0.056	0.9	305	1.3	34	0.429	0.096	60.29	59.98			0.11	0.40
43.3	19.40	0.0600	0.30	0.02	0.97	0.40	0.41	53.02	0.058	0.3	305	0.8	43	0.942	0.056	59.71	59.58			0.06	0.30
42.3	20.34	0.3600	0.75	0.27	2.17	1.07	0.49	51.49	0.152	0.5	305	1.0	23	0.384	0.073	59.56	59.44	Building 26 0.09	0.90	0.27	0.70
42.1	20.72	0.1300	0.90	0.12	2.30	1.19	0.52	50.89	0.166	0.8	305	1.2	45	0.624	0.088	59.44	59.10	Building 30 0.13	0.90		
41.5	21.35	0.3620	0.73	0.26	2.66	1.45	0.55	49.96	0.200	0.3	450	1.1	61	0.967	0.167	59.07	58.86			0.36	0.73
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	61.77	0.018	0.1	250	0.3	40	2.461	0.013	61.20	61.18			0.12	0.90
41.4b	17.46	0.2650	0.45	0.12	0.39	0.23	0.59	56.51	0.035	4.9	305	3.1	48	0.261	0.224	61.18	58.83			0.27	0.45
41.4	22.32	0.3100	0.47	0.15	3.36	1.83	0.54	48.58	0.244	0.8	525	1.7	71	0.677	0.379	58.83	58.28	Building 26 0.09	0.90	0.22	0.30
41.3	22.99	0.5570	0.76	0.42	3.91	2.25	0.57	47.67	0.295	0.4	610	1.5	36	0.410	0.428	58.16	58.00	Building 19 0.43	0.90	0.13	0.30
41.2	23.40	0.6600	0.62	0.41	4.57	2.66	0.58	47.13	0.344	0.2	610	1.1	50	0.775	0.314	58.00	57.88	Building 19 0.27	0.90	0.39	0.42
16.10	15.00	0.4900	0.60	0.29	0.49	0.29	0.60	61.77	0.050	0.6	255	0.9	34	0.602	0.048	60.11	59.91	Building 14 0.23	0.90	0.26	0.33
16.9	15.60	0.6300	0.39	0.25	1.12	0.54	0.48	60.38	0.089	0.5	255	0.9	76	1.405	0.046	59.91	59.50			0.63	0.39
16.8	17.01	0.4030	0.45	0.18	1.52	0.72	0.47	57.40	0.114	1.1	255	1.3	54	0.690	0.067	59.50	58.89	Building 18 0.15	0.90	0.26	0.20
16.7	17.70	0.2000	0.45	0.09	1.72	0.81	0.47	56.06	0.125	0.9	305	1.3	28	0.364	0.094	58.12	57.88			0.20	0.45
41.1	24.18	0.2700	0.46	0.12	6.57	3.59	0.55	46.16	0.456	0.3	762	1.4	75	0.868	0.657	57.79	57.55			0.27	0.46
40.5	15.00	0.8700	0.39	0.34	0.87	0.34	0.39	61.77	0.058	2.0	305	2.0	84	0.709	0.144	60.20	58.49	Building 40 0.24	0.90	0.63	0.20

STORM SEWER SYSTEM - NETWORK #1 - 1:2 Years

Return Period 1:2			Coef Manning	0.013
	A	732.95		
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
40.4	15.71	0.6600	0.31	0.20	1.53	0.55	0.36	60.14	**0.090**	0.4	380	1.0	75	1.214	**0.117**	58.31	58.00			0.66	0.31
40.3	25.04	1.1570	0.53	0.61	9.25	4.75	0.51	45.12	**0.589**	0.4	914	1.8	71	0.655	**1.185**	57.52	57.24	**Building 35** 0.44	0.90	0.71	0.30
40.2a	25.70	0.9840	0.66	0.65	10.24	5.40	0.53	44.36	**0.659**	0.4	914	1.9	72	0.647	**1.218**	57.15	56.85	**Building 9** 0.51	0.90	0.47	0.40
16.6a	15.00	0.2700	0.60	0.16	0.27	0.16	0.60	61.77	**0.028**	3.5	381	3.0	83	0.463	**0.341**	61.00	58.12	**Building 5 et 34** 0.11	0.90	0.16	0.40
16.6	15.46	0.4200	0.30	0.13	0.69	0.29	0.42	60.70	**0.048**	1.0	381	1.6	25	0.260	**0.183**	58.13	57.88			0.42	0.30
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	61.77	**0.020**	0.8	250	1.1	132	1.980	**0.055**	63.04	61.93			0.58	0.20
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	57.46	**0.045**	1.0	305	1.4	22	0.271	**0.099**	61.84	61.63			0.33	0.52
21.2b	15.00	0.1100	0.90	0.10	0.11	0.10	0.90	61.77	**0.017**	0.6	254	1.0	58	1.002	**0.049**	61.96	61.60	**Building 10** 0.11	0.90		
21.2	17.25	0.1100	0.90	0.10	1.13	0.49	0.43	56.92	**0.076**	1.2	305	1.5	29	0.323	**0.109**	61.57	61.23	**Building 10** 0.11	0.90		
21.1	17.57	0.3000	0.31	0.09	1.43	0.58	0.40	56.29	**0.090**	2.7	305	2.3	59	0.433	**0.166**	60.32	58.73			0.30	0.31
20.3	15.00	0.2700	0.90	0.24	0.27	0.24	0.90	61.77	**0.041**	0.3	254	0.6	61	1.573	**0.033**	58.90	58.73	**Building 6** 0.14	0.90	0.13	0.90
20.5	18.01	0.3300	0.39	0.13	2.03	0.95	0.47	55.47	**0.145**	0.1	305	0.5	92	3.362	**0.033**	58.83	58.73			0.33	0.39
16.5a	21.37	0.4200	0.70	0.29	2.72	1.53	0.56	49.93	**0.210**	0.4	381	0.9	20	0.351	**0.108**	57.88	57.81	**Building 34** 0.19	0.90	0.23	0.53
16.5	21.72	0.0000	#DIV/0!	0.00	2.72	1.53	0.56	49.42	**0.208**	0.3	381	0.9	61	1.107	**0.105**	57.81	57.61				
50.15	15.00	0.4900	0.73	0.36	0.49	0.36	0.73	61.77	**0.061**	0.6	250	0.9	96	1.707	**0.046**	68.06	67.48	**Building 2** 0.21	0.90	0.28	0.61
50.14	16.71	0.3700	0.52	0.19	0.86	0.55	0.64	58.01	**0.088**	0.7	250	1.0	12	0.202	**0.049**	67.48	67.40			0.37	0.52
50.13a	16.91	0.0800	0.90	0.07	0.94	0.62	0.66	57.60	**0.099**	2.4	305	2.2	23	0.178	**0.158**	67.40	66.84	**Building 21** 0.08	0.90		
50.13	17.09	0.5100	0.49	0.25	1.45	0.87	0.60	57.25	**0.137**	0.8	200	1.0	76	1.322	**0.030**	66.84	66.20	**Building 32** 0.11	0.90	0.41	0.38
50.12	18.41	0.0000	#DIV/0!	0.00	1.45	0.87	0.60	54.74	**0.131**	8.5	381	4.7	23	0.082	**0.533**	65.38	63.43				
50.11	18.49	0.1260	0.70	0.09	1.58	0.96	0.61	54.59	**0.144**	2.5	610	3.5	30	0.143	**1.021**	63.43	62.67			0.13	0.70
50.10	18.63	0.3100	0.90	0.28	1.89	1.24	0.66	54.34	**0.185**	13.9	610	8.2	20	0.041	**2.392**	61.48	58.70	**Building 31** 0.31	0.90		
50.9	18.67	0.4500	0.90	0.41	2.34	1.64	0.70	54.27	**0.245**	0.3	610	1.2	19	0.257	**0.361**	58.64	58.58	**Building 7** 0.45	0.90		
50.8	18.93	0.2500	0.61	0.15	2.59	1.80	0.70	53.82	**0.266**	0.2	610	1.1	48	0.729	**0.321**	58.58	58.46			0.25	0.61
50.7	19.66	0.4580	0.88	0.40	3.04	2.20	0.72	52.59	**0.318**	0.3	610	1.2	28	0.375	**0.364**	58.46	58.37	**Building 22** 0.26	0.90	0.20	0.86
50.6	20.03	0.2400	0.64	0.15	3.28	2.35	0.72	51.98	**0.337**	0.3	762	1.3	46	0.589	**0.593**	58.34	58.22	**Building 10** 0.12	0.90	0.12	0.38

Building 27

STORM SEWER SYSTEM - NETWORK #1 - 1:2 Years

Return Period 1:2		
	A	732.95
	B	6.199
Ottawa Airport	C	0.810

Coef Manning 0.013

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
50.5	20.62	0.5300	0.88	0.47	3.81	2.82	0.74	51.05	**0.396**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09	0.35	0.90	0.18	0.84
50.4	20.89	0.0000	#DIV/0!	0.00	3.81	2.82	0.74	50.64	**0.393**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06				
50.3	22.83	0.3400	0.52	0.18	6.87	4.53	0.66	47.89	**0.597**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52
50.2a	23.58	0.0000	#DIV/0!	0.00	6.87	4.53	0.66	46.91	**0.584**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84				
31.4	26.35	1.7000	0.60	1.02	18.81	10.95	0.58	43.65	**1.314**	0.1	1067	1.1	51	0.777	**0.978**	56.84	56.78	0.53 (Building 28)	0.90	1.17	0.46
31.3	27.12	0.3500	0.20	0.07	19.16	11.02	0.57	42.82	**1.297**	0.3	1067	1.9	85	0.761	**1.665**	56.78	56.49			0.35	0.20
31.1d	27.88	0.3500	0.77	0.27	19.51	11.29	0.58	42.04	**1.305**	0.4	1067	2.0	46	0.384	**1.783**	56.49	56.31	0.20 (Building 36)	0.90	0.15	0.60
31.1b	28.27	0.1000	0.60	0.06	19.61	11.35	0.58	41.66	**1.300**	0.5	1400	2.7	62	0.376	**4.225**	56.31	55.99			0.10	0.60
31.1	28.65	0.8300	0.38	0.32	20.44	11.66	0.57	41.30	**1.324**	1.3	1350	4.2	43	0.170	**6.036**	56.33	55.78			0.83	0.38
30.12	15.00	0.8000	0.57	0.46	0.80	0.46	0.57	61.77	**0.077**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			0.80	0.57
30.10	15.72	0.6320	0.20	0.13	1.43	0.58	0.41	60.13	**0.096**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			0.63	0.20
30.09	16.06	0.3600	0.50	0.18	1.79	0.76	0.43	59.37	**0.124**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50
30.07	17.94	1.2900	0.20	0.26	3.08	1.02	0.33	55.60	**0.156**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20
32.3	15.00	1.2400	0.82	1.01	1.24	1.01	0.82	61.77	**0.172**	0.7	450	1.5	70	0.770	**0.241**	59.50	59.00	0.20 (Building 36)	0.90	1.04	0.80
32.1	15.77	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	60.01	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77				
30.6	18.35	0.9300	0.80	0.74	4.01	1.76	0.44	54.85	**0.266**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			0.93	0.80
30.4	28.82	0.8000	0.80	0.64	25.25	14.07	0.56	41.14	**1.591**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			0.80	0.80
30.3	29.43	0.7650	0.20	0.15	26.02	14.22	0.55	40.56	**1.586**	0.0	1371	0.8	75	1.659	**1.112**	55.41	55.38			0.77	0.20
30.2	31.09	0.8820	0.20	0.18	26.90	14.39	0.54	39.10	**1.648**	0.1	1371	1.3	158	2.071	**1.877**	55.38	55.20			0.88	0.20
30.1	33.16	0.0000	#DIV/0!	0.00	26.90	14.39	0.54	37.42	**1.581**	0.6	1371	2.9	35	0.200	**4.308**	55.20	54.99				
Outlet																					

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
44.4	15.00	0.3500	0.55	0.19	0.35	0.19	0.55	83.56	0.045	0.5	305	1.0	33	0.571	0.070	60.38	60.22	Building 30 0.13	0.90	0.22	0.35
44.3	15.57	0.0660	0.53	0.03	0.42	0.23	0.55	81.76	0.051	0.6	305	1.1	19	0.301	0.077	60.09	59.98			0.07	0.53
44.2	15.87	0.1500	0.20	0.03	0.57	0.26	0.46	80.84	0.058	0.2	305	0.5	39	1.198	0.040	59.95	59.89			0.15	0.20
44.1	17.07	0.3670	0.39	0.14	0.93	0.40	0.43	77.42	0.086	0.4	305	0.9	30	0.572	0.064	59.83	59.71	Building 23 0.10	0.90	0.27	0.20
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	83.56	0.026	1.1	305	1.4	54	0.628	0.105	61.54	60.96			0.31	0.36
43.7	15.63	0.0960	0.32	0.03	0.41	0.14	0.35	81.58	0.032	0.3	305	0.7	52	1.167	0.054	60.62	60.47			0.10	0.32
43.6	16.79	0.3900	0.50	0.19	0.80	0.34	0.42	78.17	0.072	0.1	305	0.5	49	1.687	0.035	60.47	60.41	Building 23 0.10	0.90	0.29	0.36
43.5	18.48	0.0000	#DIV/0!	0.00	0.80	0.34	0.42	73.77	0.068	0.4	305	0.9	27	0.488	0.067	60.41	60.29				
43.4	18.97	0.1100	0.40	0.04	0.91	0.38	0.42	72.60	0.076	0.9	305	1.3	34	0.429	0.096	60.29	59.98			0.11	0.40
43.3	19.40	0.0600	0.30	0.02	0.97	0.40	0.41	71.60	0.079	0.3	305	0.8	43	0.942	0.056	59.71	59.58			0.06	0.30
42.3	20.34	0.3600	0.75	0.27	2.17	1.07	0.49	69.51	0.205	0.5	305	1.0	23	0.384	0.073	59.56	59.44	Building 26 0.09	0.90	0.27	0.70
42.1	20.72	0.1300	0.90	0.12	2.30	1.19	0.52	68.70	0.224	0.8	305	1.2	45	0.624	0.088	59.44	59.10	Building 30 0.13	0.90		
41.5	21.35	0.3620	0.73	0.26	2.66	1.45	0.55	67.42	0.269	0.3	450	1.1	61	0.967	0.167	59.07	58.86			0.36	0.73
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	83.56	0.025	0.1	250	0.3	40	2.461	0.013	61.20	61.18			0.12	0.90
41.4b	17.46	0.2650	0.45	0.12	0.39	0.23	0.59	76.37	0.048	4.9	305	3.1	48	0.261	0.224	61.18	58.83			0.27	0.45
41.4	22.32	0.3100	0.47	0.15	3.36	1.83	0.54	65.55	0.329	0.8	525	1.7	71	0.677	0.379	58.83	58.28	Building 26 0.09	0.90	0.22	0.30
41.3	22.99	0.5570	0.76	0.42	3.91	2.25	0.57	64.30	0.398	0.4	610	1.5	36	0.410	0.428	58.16	58.00	Building 19 0.43	0.90	0.13	0.30
41.2	23.40	0.6600	0.62	0.41	4.57	2.66	0.58	63.57	0.464	0.2	610	1.1	50	0.775	0.314	58.00	57.88	Building 19 0.27	0.90	0.39	0.42
16.10	15.00	0.4900	0.60	0.29	0.49	0.29	0.60	83.56	0.067	0.6	255	0.9	34	0.602	0.048	60.11	59.91	Building 14 0.23	0.90	0.26	0.33
16.9	15.60	0.6300	0.39	0.25	1.12	0.54	0.48	81.66	0.121	0.5	255	0.9	76	1.405	0.046	59.91	59.50			0.63	0.39
16.8	17.01	0.4030	0.45	0.18	1.52	0.72	0.47	77.59	0.154	1.1	255	1.3	54	0.690	0.067	59.50	58.89	Building 18 0.15	0.90	0.26	0.20
16.7	17.70	0.2000	0.45	0.09	1.72	0.81	0.47	75.75	0.169	0.9	305	1.3	28	0.364	0.094	58.12	57.88			0.20	0.45
41.1	24.18	0.2700	0.46	0.12	6.57	3.59	0.55	62.24	0.615	0.3	762	1.4	75	0.868	0.657	57.79	57.55			0.27	0.46
40.5	15.00	0.8700	0.39	0.34	0.87	0.34	0.39	83.56	0.079	2.0	305	2.0	84	0.709	0.144	60.20	58.49	Building 40 0.24	0.90	0.63	0.20

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years

Return Period 1:5		
	A	998.07
	B	6.053
Ottawa Airport	C	0.814

Coef Manning 0.013

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building	Building Area (ha)	Runoff Coefficient c	Ground Area (ha)	Runoff Coefficient c
40.4	15.71	0.6600	0.31	0.20	1.53	0.55	0.36	81.33	**0.122**	0.4	380	1.0	75	1.214	**0.117**	58.31	58.00				0.66	0.31
40.3	25.04	1.1570	0.53	0.61	9.25	4.75	0.51	60.83	**0.795**	0.4	914	1.8	71	0.655	**1.185**	57.52	57.24	Building 35	0.44	0.90	0.71	0.30
40.2a	25.70	0.9840	0.66	0.65	10.24	5.40	0.53	59.80	**0.888**	0.4	914	1.9	72	0.647	**1.218**	57.15	56.85	Building 9	0.51	0.90	0.47	0.40
16.6a	15.00	0.2700	0.60	0.16	0.27	0.16	0.60	83.56	**0.037**	3.5	381	3.0	83	0.463	**0.341**	61.00	58.12	Building 5 et 34	0.11	0.90	0.16	0.40
16.6	15.46	0.4200	0.30	0.13	0.69	0.29	0.42	82.09	**0.065**	1.0	381	1.6	25	0.260	**0.183**	58.13	57.88				0.42	0.30
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	83.56	**0.027**	0.8	250	1.1	132	1.980	**0.055**	63.04	61.93				0.58	0.20
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	77.66	**0.061**	1.0	305	1.4	22	0.271	**0.099**	61.84	61.63				0.33	0.52
21.2b	15.00	0.1100	0.90	0.10	0.11	0.10	0.90	83.56	**0.023**	0.6	254	1.0	58	1.002	**0.049**	61.96	61.60	Building 10	0.11	0.90		
21.2	17.25	0.1100	0.90	0.10	1.13	0.49	0.43	76.92	**0.103**	1.2	305	1.5	29	0.323	**0.109**	61.57	61.23	Building 10	0.11	0.90		
21.1	17.57	0.3000	0.31	0.09	1.43	0.58	0.40	76.07	**0.121**	2.7	305	2.3	59	0.433	**0.166**	60.32	58.73				0.30	0.31
20.3	15.00	0.2700	0.90	0.24	0.27	0.24	0.90	83.56	**0.056**	0.3	254	0.6	61	1.573	**0.033**	58.90	58.73	Building 6	0.14	0.90	0.13	0.90
20.5	18.01	0.3300	0.39	0.13	2.03	0.95	0.47	74.95	**0.196**	0.1	305	0.5	92	3.362	**0.033**	58.83	58.73				0.33	0.39
16.5a	21.37	0.4200	0.70	0.29	2.72	1.53	0.56	67.38	**0.284**	0.4	381	0.9	20	0.351	**0.108**	57.88	57.81	Building 34	0.19	0.90	0.23	0.53
16.5	21.72	0.0000	#DIV/0!	0.00	2.72	1.53	0.56	66.69	**0.281**	0.3	381	0.9	61	1.107	**0.105**	57.81	57.61					
50.15	15.00	0.4900	0.73	0.36	0.49	0.36	0.73	83.56	**0.083**	0.6	250	0.9	96	1.707	**0.046**	68.06	67.48	Building 2	0.21	0.90	0.28	0.61
50.14	16.71	0.3700	0.52	0.19	0.86	0.55	0.64	78.42	**0.119**	0.7	250	1.0	12	0.202	**0.049**	67.48	67.40				0.37	0.52
50.13a	16.91	0.0800	0.90	0.07	0.94	0.62	0.66	77.86	**0.134**	2.4	305	2.2	23	0.178	**0.158**	67.40	66.84	Building 21	0.08	0.90		
50.13	17.09	0.5100	0.49	0.25	1.45	0.87	0.60	77.37	**0.186**	0.8	200	1.0	76	1.322	**0.030**	66.84	66.20	Building 32	0.11	0.90	0.41	0.38
50.12	18.41	0.0000	#DIV/0!	0.00	1.45	0.87	0.60	73.95	**0.177**	8.5	381	4.7	23	0.082	**0.533**	65.38	63.43					
50.11	18.49	0.1260	0.70	0.09	1.58	0.96	0.61	73.75	**0.195**	2.5	610	3.5	30	0.143	**1.021**	63.43	62.67				0.13	0.70
50.10	18.63	0.3100	0.90	0.28	1.89	1.24	0.66	73.40	**0.250**	13.9	610	8.2	20	0.041	**2.392**	61.48	58.70	Building 31	0.31	0.90		
50.9	18.67	0.4500	0.90	0.41	2.34	1.64	0.70	73.30	**0.332**	0.3	610	1.2	19	0.257	**0.361**	58.64	58.58	Building 7	0.45	0.90		
50.8	18.93	0.2500	0.61	0.15	2.59	1.80	0.70	72.69	**0.359**	0.2	610	1.1	48	0.729	**0.321**	58.58	58.46				0.25	0.61
50.7	19.66	0.4580	0.88	0.40	3.04	2.20	0.72	71.01	**0.430**	0.3	610	1.2	28	0.375	**0.364**	58.46	58.37	Building 22	0.26	0.90	0.20	0.86
50.6	20.03	0.2400	0.64	0.15	3.28	2.35	0.72	70.18	**0.454**	0.3	762	1.3	46	0.589	**0.593**	58.34	58.22	Building 10	0.12	0.90	0.12	0.38
																		Building 27				

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
50.5	20.62	0.5300	0.88	0.47	3.81	2.82	0.74	68.91	**0.535**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09	0.35	0.90	0.18	0.84
50.4	20.89	0.0000	#DIV/0!	0.00	3.81	2.82	0.74	68.35	**0.530**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06				
50.3	22.83	0.3400	0.52	0.18	6.87	4.53	0.66	64.60	**0.805**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52
50.2a	23.58	0.0000	#DIV/0!	0.00	6.87	4.53	0.66	63.27	**0.788**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84				
31.4	26.35	1.7000	0.60	1.02	18.81	10.95	0.58	58.83	**1.771**	0.1	1067	1.1	51	0.777	**0.978**	56.84	56.78	Building 28 0.53	0.90	1.17	0.46
31.3	27.12	0.3500	0.20	0.07	19.16	11.02	0.57	57.70	**1.748**	0.3	1067	1.9	85	0.761	**1.665**	56.78	56.49			0.35	0.20
31.1d	27.88	0.3500	0.77	0.27	19.51	11.29	0.58	56.65	**1.758**	0.4	1067	2.0	46	0.384	**1.783**	56.49	56.31	Building 36 0.20	0.90	0.15	0.60
31.1b	28.27	0.1000	0.60	0.06	19.61	11.35	0.58	56.13	**1.751**	0.5	1400	2.7	62	0.376	**4.225**	56.31	55.99			0.10	0.60
31.1	28.65	0.8300	0.38	0.32	20.44	11.66	0.57	55.64	**1.784**	1.3	1350	4.2	43	0.170	**6.036**	56.33	55.78			0.83	0.38
30.12	15.00	0.8000	0.57	0.46	0.80	0.46	0.57	83.56	**0.105**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			0.80	0.57
30.10	15.72	0.6320	0.20	0.13	1.43	0.58	0.41	81.31	**0.130**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			0.63	0.20
30.09	16.06	0.3600	0.50	0.18	1.79	0.76	0.43	80.28	**0.168**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50
30.07	17.94	1.2900	0.20	0.26	3.08	1.02	0.33	75.13	**0.211**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20
32.3	15.00	1.2400	0.82	1.01	1.24	1.01	0.82	83.56	**0.233**	0.7	450	1.5	70	0.770	**0.241**	59.50	59.00	Building 36 0.20	0.90	1.04	0.80
32.1	15.77	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.15	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77				
30.6	18.35	0.9300	0.80	0.74	4.01	1.76	0.44	74.10	**0.360**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			0.93	0.80
30.4	28.82	0.8000	0.80	0.64	25.25	14.07	0.56	55.41	**2.143**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			0.80	0.80
30.3	29.43	0.7650	0.20	0.15	26.02	14.22	0.55	54.64	**2.136**	0.0	1371	0.8	75	1.659	**1.112**	55.41	55.38			0.77	0.20
30.2	31.09	0.8820	0.20	0.18	26.90	14.39	0.54	52.64	**2.184**	0.1	1371	1.3	158	2.071	**1.877**	55.38	55.20			0.88	0.20
30.1	33.16	0.0000	#DIV/0!	0.00	26.90	14.39	0.54	50.37	**2.094**	0.6	1371	2.9	35	0.200	**4.308**	55.20	54.99				
Outlet																					

STORM SEWER SYSTEM - NETWORK #1 - 1:5 years - Alternative solutions

Return Period 1:5		
	A	998.07
	B	6.053
Ottawa Airport	C	0.814

Coef Manning 0.013

Note 1 : Retention on site
Note 2 : Release flow in Rideau Canal

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR + release flow (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient	Release flow
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c	(m³/s)
44.4	15.00	0.2200	0.35	0.08	0.22	0.08	0.35	83.56	0.028	0.5	305	1.0	33	0.571	0.070	60.38	60.22	Building 30 Note 1	0.90	0.22	0.35	0.01
44.3	15.57	0.0660	0.53	0.03	0.29	0.11	0.39	81.76	0.035	0.6	305	1.1	19	0.301	0.077	60.09	59.98			0.07	0.53	0.01
44.2	15.87	0.1500	0.20	0.03	0.44	0.14	0.33	80.84	0.042	0.2	305	0.5	39	1.198	0.040	59.95	59.89			0.15	0.20	0.01
44.1	17.07	0.3670	0.39	0.14	0.80	0.29	0.36	77.42	0.071	0.4	305	0.9	30	0.572	0.064	59.83	59.71	Building 23 0.10	0.90	0.27	0.20	0.01
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	83.56	0.026	1.1	305	1.4	54	0.628	0.105	61.54	60.96			0.31	0.36	
43.7	15.63	0.0000	#DIV/0!	0.00	0.31	0.11	0.36	81.58	0.035	0.3	305	0.7	52	1.167	0.054	60.62	60.47			Note 1	0.32	0.01
43.6	16.79	0.3900	0.50	0.19	0.70	0.31	0.44	78.17	0.076	0.1	305	0.5	49	1.687	0.035	60.47	60.41	Building 23 0.10	0.90	0.29	0.36	0.01
43.5	18.48	0.0000	#DIV/0!	0.00	0.70	0.31	0.44	73.77	0.072	0.4	305	0.9	27	0.488	0.067	60.41	60.29					0.01
43.4	18.97	0.1100	0.40	0.04	0.81	0.35	0.43	72.60	0.080	0.9	305	1.3	34	0.429	0.096	60.29	59.98			0.11	0.40	0.01
43.3	19.40	0.0600	0.30	0.02	0.87	0.37	0.42	71.60	0.082	0.3	305	0.8	43	0.942	0.056	59.71	59.58			0.06	0.30	0.01
42.3	20.34	0.3600	0.75	0.27	1.94	0.92	0.48	69.51	0.197	0.5	305	1.0	23	0.384	0.073	59.56	59.44	Building 26 0.09	0.90	0.27	0.70	0.02
42.1	20.72	0.0000	#DIV/0!	0.00	1.94	0.92	0.48	68.70	0.204	0.8	305	1.2	45	0.624	0.088	59.44	59.10	Building 30 Note 1	0.90			0.03
41.5	21.35	0.3620	0.73	0.26	2.31	1.19	0.52	67.42	0.250	0.3	450	1.1	61	0.967	0.167	59.07	58.86			0.36	0.73	0.03
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	83.56	0.025	0.1	250	0.3	40	2.461	0.013	61.20	61.18			0.12	0.90	
41.4b	17.46	0.2650	0.45	0.12	0.39	0.23	0.59	76.37	0.048	4.9	305	3.1	48	0.261	0.224	61.18	58.83			0.27	0.45	
41.4	22.32	0.3100	0.47	0.15	3.00	1.56	0.52	65.55	0.312	0.8	525	1.7	71	0.677	0.379	58.83	58.28	Building 26 0.09	0.90	0.22	0.30	0.03
41.3	22.99	0.5570	0.76	0.42	3.56	1.98	0.56	64.30	0.381	0.4	610	1.5	36	0.410	0.428	58.16	58.00	Building 19 0.43	0.90	0.13	0.30	0.03
41.2	23.40	0.6600	0.62	0.41	4.22	2.39	0.57	63.57	0.448	0.2	610	1.1	50	0.775	0.314	58.00	57.88	Building 19 0.27	0.90	0.39	0.42	0.03
16.10	15.00	0.2600	0.33	0.09	0.26	0.09	0.33	83.56	0.030	0.6	255	0.9	34	0.602	0.048	60.11	59.91	Building 14 Note 1	0.90	0.26	0.33	0.01
16.9	15.60	0.6300	0.39	0.25	0.89	0.33	0.37	81.66	0.084	0.5	255	0.9	76	1.405	0.046	59.91	59.50			0.63	0.39	0.01
16.8	17.01	0.4030	0.45	0.18	1.29	0.51	0.40	77.59	0.120	1.1	255	1.3	54	0.690	0.067	59.50	58.89	Building 18 0.15	0.90	0.26	0.20	0.01
16.7	17.70	0.2000	0.45	0.09	1.49	0.60	0.40	75.75	0.136	0.9	305	1.3	28	0.364	0.094	58.12	57.88			0.20	0.45	0.01
41.1	24.18	0.2700	0.46	0.12	5.98	3.12	0.52	62.24	0.574	0.3	762	1.4	75	0.868	0.657	57.79	57.55			0.27	0.46	0.04
40.5	15.00	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	83.56	0.010	2.0	305	2.0	84	0.709	0.144	60.20	58.49	Building 40 Note 1	0.90	Note 1	0.20	0.01
40.4	15.71	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.33	0.020	0.4	380	1.0	75	1.214	0.117	58.31	58.00			Note 1	0.31	0.02

STORM SEWER SYSTEM - NETWORK #1 - 1:5 years - Alternative solutions

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

Note 1 : Retention on site
Note 2 : Release flow in Rideau Canal

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR + release flow (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c	Release flow (m³/s)
40.3	25.04	1.1570	0.53	0.61	7.14	3.73	0.52	60.83	**0.644**	0.4	914	1.8	71	0.655	**1.185**	57.52	57.24	Building 35: 0.44	0.90	0.71	0.30	0.02
40.2a	25.70	0.9840	0.66	0.65	8.12	4.38	0.54	59.80	**0.771**	0.4	914	1.9	72	0.647	**1.218**	57.15	56.85	Building 9: 0.51	0.90	0.47	0.40	0.05
16.6a	15.00	0.2700	0.60	0.16	0.27	0.16	0.60	83.56	**0.097**	3.5	381	3.0	83	0.463	**0.341**	61.00	58.12	Building 5 et 34: 0.11	0.90	0.16	0.40	0.06
16.6	15.46	0.4200	0.30	0.13	0.69	0.29	0.42	82.09	**0.065**	1.0	381	1.6	25	0.260	**0.183**	58.13	57.88			0.42	0.30	
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	83.56	**0.027**	0.8	250	1.1	132	1.980	**0.055**	63.04	61.93			0.58	0.20	
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	77.66	**0.061**	1.0	305	1.4	22	0.271	**0.099**	61.84	61.63			0.33	0.52	
21.2b	15.00	0.1100	0.90	0.10	0.11	0.10	0.90	83.56	**0.023**	0.6	254	1.0	58	1.002	**0.049**	61.96	61.60	Building 10: 0.11	0.90			
21.2	17.25	0.1100	0.90	0.10	1.13	0.49	0.43	76.92	**0.103**	1.2	305	1.5	29	0.323	**0.109**	61.57	61.23	Building 10: 0.11	0.90	Note 2		
21.1	17.57	0.3000	0.31	0.09	0.30	0.09	0.31	76.07	**0.019**	2.7	305	2.3	59	0.433	**0.166**	60.32	58.73			0.30	0.31	
20.3	15.00	0.2700	0.90	0.24	0.27	0.24	0.90	83.56	**0.056**	0.3	254	0.6	61	1.573	**0.033**	58.90	58.73	Building 6: 0.14	0.90	0.13	0.90	
20.5	18.01	0.3300	0.39	0.13	0.90	0.46	0.52	74.95	**0.096**	0.1	305	0.5	92	3.362	**0.033**	58.83	58.73			0.33	0.39	
16.5a	21.37	0.4200	0.70	0.29	1.59	1.05	0.66	67.38	**0.194**	0.4	381	0.9	20	0.351	**0.108**	57.88	57.81	Building 34: 0.19	0.90	0.23	0.53	
16.5	21.72	0.0000	#DIV/0!	0.00	1.59	1.05	0.66	66.69	**0.192**	0.3	381	0.9	61	1.107	**0.105**	57.81	57.61					
50.15	15.00	0.4900	0.73	0.36	0.49	0.36	0.73	83.56	**0.083**	0.6	250	0.9	96	1.707	**0.046**	68.06	67.48	Building 2: 0.21	0.90	0.28	0.61	
50.14	16.71	0.3700	0.52	0.19	0.86	0.55	0.64	78.42	**0.119**	0.7	250	1.0	12	0.202	**0.049**	67.48	67.40			0.37	0.52	
50.13a	16.91	0.0800	0.90	0.07	0.94	0.62	0.66	77.86	**0.134**	2.4	305	2.2	23	0.178	**0.158**	67.40	66.84	Building 21: 0.08	0.90			
50.13	17.09	0.5100	0.49	0.25	1.45	0.87	0.60	77.37	**0.186**	0.8	200	1.0	76	1.322	**0.030**	66.84	66.20	Building 32: 0.11	0.90	0.41	0.38	
50.12	18.41	0.0000	#DIV/0!	0.00	1.45	0.87	0.60	73.95	**0.177**	8.5	381	4.7	23	0.082	**0.533**	65.38	63.43	Note 2				
50.11	18.49	0.1260	0.70	0.09	0.13	0.09	0.70	73.75	**0.018**	2.5	610	3.5	30	0.143	**1.021**	63.43	62.67			0.13	0.70	
50.10	18.63	0.3100	0.90	0.28	0.44	0.37	0.84	73.40	**0.074**	13.9	610	8.2	20	0.041	**2.392**	61.48	58.70	Building 31: 0.31	0.90			
50.9	18.67	0.4500	0.90	0.41	0.89	0.77	0.87	73.30	**0.156**	0.3	610	1.2	19	0.257	**0.361**	58.64	58.58	Building 7: 0.45	0.90			
50.8	18.93	0.2500	0.61	0.15	1.14	0.92	0.81	72.69	**0.185**	0.2	610	1.1	48	0.729	**0.321**	58.58	58.46			0.25	0.61	
50.7	19.66	0.4580	0.88	0.40	1.59	1.33	0.83	71.01	**0.259**	0.3	610	1.2	28	0.375	**0.364**	58.46	58.37	Building 22: 0.26	0.90	0.20	0.86	
50.6	20.03	0.2400	0.64	0.15	1.83	1.48	0.81	70.18	**0.286**	0.3	762	1.3	46	0.589	**0.593**	58.34	58.22	Building 10: 0.12	0.90	0.12	0.38	
50.5	20.62	0.5300	0.88	0.47	2.36	1.95	0.82	68.91	**0.369**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09	Building 27: 0.35	0.90	0.18	0.84	

STORM SEWER SYSTEM - NETWORK #1 - 1:5 years - Alternative solutions

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

Note 1 : Retention on site
Note 2 : Release flow in Rideau Canal

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR + release flow (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient	Release flow
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c	(m³/s)
50.4	20.89	0.0000	#DIV/0!	0.00	2.36	1.95	0.82	68.35	**0.366**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06					
50.3	22.83	0.3400	0.52	0.18	4.29	3.17	0.74	64.60	**0.563**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52	
50.2a	23.58	0.0000	#DIV/0!	0.00	4.29	3.17	0.74	63.27	**0.552**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84					
31.4	26.35	1.7000	0.60	1.02	14.12	8.57	0.61	58.83	**1.446**	0.1	1067	1.1	51	0.777	**0.978**	56.84	56.78	Building 28 0.53	0.90	1.17	0.46	0.06
31.3	27.12	0.3500	0.20	0.07	14.47	8.64	0.60	57.70	**1.431**	0.3	1067	1.9	85	0.761	**1.665**	56.78	56.49			0.35	0.20	0.06
31.1d	27.88	0.3500	0.77	0.27	14.82	8.91	0.60	56.65	**1.448**	0.4	1067	2.0	46	0.384	**1.783**	56.49	56.31	Building 36 0.20	0.90	0.15	0.60	0.06
31.1b	28.27	0.1000	0.60	0.06	14.92	8.97	0.60	56.13	**1.445**	0.5	1400	2.7	62	0.376	**4.225**	56.31	55.99			0.10	0.60	0.06
31.1	28.65	0.8300	0.38	0.32	15.75	9.28	0.59	55.64	**1.481**	1.3	1350	4.2	43	0.170	**6.036**	56.33	55.78			0.83	0.38	0.06
30.12	15.00	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	83.56	**0.010**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			Note 1	0.57	0.01
30.10	15.72	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.31	**0.020**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			Note 1	0.20	0.02
30.09	16.06	0.3600	0.50	0.18	0.36	0.18	0.50	80.28	**0.060**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50	0.02
30.07	17.94	1.2900	0.20	0.26	1.65	0.44	0.27	75.13	**0.110**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20	0.02
32.3	15.00	1.2400	0.82	1.01	1.24	1.01	0.82	83.56	**0.233**	0.7	450	1.5	70	0.770	**0.241**	59.50	59.00	Building 36 0.20	0.90	1.04	0.80	
32.1	15.77	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.15	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77					
30.6	18.35	0.0000	#DIV/0!	0.00	1.65	0.44	0.27	74.10	**0.119**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			Note 1	0.80	0.03
30.4	28.82	0.0000	#DIV/0!	0.00	17.40	9.72	0.56	55.41	**1.582**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			Note 1	0.80	0.10
30.3	29.43	0.0000	#DIV/0!	0.00	17.40	9.72	0.56	54.64	**1.571**	0.0	1371	**0.8**	75	1.659	**1.112**	55.41	55.38			Note 1	0.20	0.11
30.2	31.09	0.8820	0.20	0.18	18.28	9.90	0.54	52.64	**1.643**	0.1	1371	1.3	158	2.071	**1.877**	55.38	55.20			0.88	0.20	0.11
30.1	33.16	0.0000	#DIV/0!	0.00	18.28	9.90	0.54	50.37	**1.581**	0.6	1371	2.9	35	0.200	**4.308**	55.20	54.99					0.11
Outlet																						

STORM SEWER SYSTEM - NETWORK #1 - 1:5 years -New development - Alternative solutions

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

Note 1 : Retention on site
Note 2 : Release flow in Rideau Canal

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR + release flow (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Runoff Coefficient c	Ground Area (ha)	Runoff Coefficient c	Release flow (m³/s)
44.4	15.00	0.2200	0.35	0.08	0.22	0.08	0.35	83.56	**0.028**	0.5	305	1.0	33	0.571	**0.070**	60.38	60.22	Building 30 Note 1	0.90	0.22	0.35	0.01
44.3	15.57	0.0660	0.53	0.03	0.29	0.11	0.39	81.76	**0.035**	0.6	305	1.1	19	0.301	**0.077**	60.09	59.98			0.07	0.53	0.01
44.2	15.87	0.1500	0.20	0.03	0.44	0.14	0.33	80.84	**0.042**	0.2	305	0.5	39	1.198	**0.040**	59.95	59.89			0.15	0.20	0.01
44.1	17.07	0.3670	0.39	0.14	0.80	0.29	0.36	77.42	**0.071**	0.4	305	0.9	30	0.572	**0.064**	59.83	59.71	Building 23 0.10	0.90	0.27	0.20	0.01
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	83.56	**0.026**	1.1	305	1.4	54	0.628	**0.105**	61.54	60.96			0.31	0.36	
43.7	15.63	0.0000	#DIV/0!	0.00	0.31	0.11	0.36	81.58	**0.035**	0.3	305	0.7	52	1.167	**0.054**	60.62	60.47			Note 1	0.32	0.01
43.6	16.79	0.3900	0.50	0.19	0.70	0.31	0.44	78.17	**0.076**	0.1	305	0.5	49	1.687	**0.035**	60.47	60.41	Building 23 0.10	0.90	0.29	0.36	0.01
43.5	18.48	0.0000	#DIV/0!	0.00	0.70	0.31	0.44	73.77	**0.072**	0.4	305	0.9	27	0.488	**0.067**	60.41	60.29					0.01
43.4	18.97	0.1100	0.40	0.04	0.81	0.35	0.43	72.60	**0.080**	0.9	305	1.3	34	0.429	**0.096**	60.29	59.98			0.11	0.40	0.01
43.3	19.40	0.0600	0.30	0.02	0.87	0.37	0.42	71.60	**0.082**	0.3	305	0.8	43	0.942	**0.056**	59.71	59.58			0.06	0.30	0.01
42.3	20.34	0.3600	0.75	0.27	1.94	0.92	0.48	69.51	**0.197**	0.5	305	1.0	23	0.384	**0.073**	59.56	59.44	Building 26 0.09	0.90	0.27	0.70	0.02
42.1	20.72	0.0000	#DIV/0!	0.00	1.94	0.92	0.48	68.70	**0.204**	0.8	305	1.2	45	0.624	**0.088**	59.44	59.10	Building 30 Note 1	0.90			0.03
41.5	21.35	0.3620	0.73	0.26	2.31	1.19	0.52	67.42	**0.250**	0.3	450	1.1	61	0.967	**0.167**	59.07	58.86			0.36	0.73	**0.03**
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	83.56	**0.025**	0.1	250	0.3	40	2.461	**0.013**	61.20	61.18			0.12	0.90	
41.4b	17.46	0.2650	0.45	0.12	0.39	0.23	0.59	76.37	**0.048**	4.9	305	3.1	48	0.261	**0.224**	61.18	58.83			0.27	0.45	
41.4	22.32	0.3100	0.47	0.15	3.00	1.56	0.52	65.55	**0.312**	0.8	525	1.7	71	0.677	**0.379**	58.83	58.28	Building 26 0.09	0.90	0.22	0.30	0.03
41.3	22.99	0.5570	0.76	0.42	3.56	1.98	0.56	64.30	**0.381**	0.4	610	1.5	36	0.410	**0.428**	58.16	58.00	Building 19 0.43	0.90	0.13	0.30	0.03
41.2	23.40	0.6600	0.62	0.41	4.22	2.39	0.57	63.57	**0.448**	0.2	610	1.1	50	0.775	**0.314**	58.00	57.88	Building 19 0.27	0.90	0.39	0.42	0.03
16.10	15.00	0.2600	0.33	0.09	0.26	0.09	0.33	83.56	**0.030**	0.6	255	0.9	34	0.602	**0.048**	60.11	59.91	Building 14 Note 1	0.90	0.26	0.33	0.01
16.9	15.60	0.6300	0.39	0.25	0.89	0.33	0.37	81.66	**0.084**	0.5	255	0.9	76	1.405	**0.046**	59.91	59.50			0.63	0.39	0.01
16.8	17.01	0.4030	0.45	0.18	1.29	0.51	0.40	77.59	**0.120**	1.1	255	1.3	54	0.690	**0.067**	59.50	58.89	Building 18 0.15	0.90	0.26	0.20	0.01
16.7	17.70	0.2000	0.45	0.09	1.49	0.60	0.40	75.75	**0.136**	0.9	305	1.3	28	0.364	**0.094**	58.12	57.88			0.20	0.45	0.01
41.1	24.18	0.2700	0.46	0.12	5.98	3.12	0.52	62.24	**0.574**	0.3	762	1.4	75	0.868	**0.657**	57.79	57.55			0.27	0.46	0.04
40.5	15.00	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	83.56	**0.010**	2.0	305	2.0	84	0.709	**0.144**	60.20	58.49	Building 40 Note 1	0.90	Note 1	0.20	0.01

STORM SEWER SYSTEM - NETWORK #1 - 1:5 years -New development - Alternative solutions

Return Period 1:5		
	A	998.07
	B	6.053
Ottawa Airport	C	0.814

Coef Manning 0.013

Note 1 : Retention on site
Note 2 : Release flow in Rideau Canal

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR + release flow (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient	Release flow
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c	(m³/s)
40.4	15.71	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.33	0.020	0.4	380	1.0	75	1.214	0.117	58.31	58.00			Note 1	0.31	0.02
40.3	25.04	1.1570	0.53	0.61	7.14	3.73	0.52	60.83	0.644	0.4	914	1.8	71	0.655	1.185	57.52	57.24	Building 35 0.44	0.90	0.71	0.30	0.02
40.2a	25.70	0.9840	0.66	0.65	8.12	4.38	0.54	59.80	0.781	0.4	914	1.9	72	0.647	1.218	57.15	56.85	Building 9 0.51	0.90	0.47	0.40	0.06
16.6a	15.00	0.2700	0.60	0.16	0.27	0.16	0.60	83.56	0.097	3.5	381	3.0	83	0.463	0.341	61.00	58.12	Building 5 et 34 0.11	0.90	0.16	0.40	0.06
16.6	15.46	0.4200	0.30	0.13	0.69	0.29	0.42	82.09	0.065	1.0	381	1.6	25	0.260	0.183	58.13	57.88			0.42	0.30	
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	83.56	0.027	0.8	250	1.1	132	1.980	0.055	63.04	61.93			0.58	0.20	
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	77.66	0.061	1.0	305	1.4	22	0.271	0.099	61.84	61.63			0.33	0.52	
21.2b	15.00	0.1100	0.90	0.10	0.11	0.10	0.90	83.56	0.023	0.6	254	1.0	58	1.002	0.049	61.96	61.60	Building 10 0.11	0.90			
21.2	17.25	0.1100	0.90	0.10	1.13	0.49	0.43	76.92	0.103	1.2	305	1.5	29	0.323	0.109	61.57	61.23	Building 10 0.11	0.90	Note 2		
21.1	17.57	0.3000	0.31	0.09	0.30	0.09	0.31	76.07	0.019	2.7	305	2.3	59	0.433	0.166	60.32	58.73			0.30	0.31	
20.3	15.00	0.2700	0.90	0.24	0.27	0.24	0.90	83.56	0.056	0.3	254	0.6	61	1.573	0.033	58.90	58.73	Building 6 0.14	0.90	0.13	0.90	
20.5	18.01	0.3300	0.39	0.13	0.90	0.46	0.52	74.95	0.096	0.1	305	0.5	92	3.362	0.033	58.83	58.73			0.33	0.39	
16.5a	21.37	0.4200	0.70	0.29	1.59	1.05	0.66	67.38	0.194	0.4	381	0.9	20	0.351	0.108	57.88	57.81	Building 34 0.19	0.90	0.23	0.53	
16.5	21.72	0.0000	#DIV/0!	0.00	1.59	1.05	0.66	66.69	0.192	0.3	381	0.9	61	1.107	0.105	57.81	57.61					
50.15	15.00	0.4900	0.73	0.36	0.49	0.36	0.73	83.56	0.083	0.6	250	0.9	96	1.707	0.046	68.06	67.48	Building 2 0.21	0.90	0.28	0.61	
50.14	16.71	0.3700	0.52	0.19	0.86	0.55	0.64	78.42	0.119	0.7	250	1.0	12	0.202	0.049	67.48	67.40			0.37	0.52	
50.13a	16.91	0.0800	0.90	0.07	0.94	0.62	0.66	77.86	0.134	2.4	305	2.2	23	0.178	0.158	67.40	66.84	Building 21 0.08	0.90			
50.13	17.09	0.5100	0.49	0.25	1.45	0.87	0.60	77.37	0.186	0.8	200	1.0	76	1.322	0.030	66.84	66.20	Building 32 0.11	0.90	0.41	0.38	
50.12	18.41	0.0000	#DIV/0!	0.00	1.45	0.87	0.60	73.95	0.177	8.5	381	4.7	23	0.082	0.533	65.38	63.43	Note 2				
50.11	18.49	0.1260	0.70	0.09	0.13	0.09	0.70	73.75	0.018	2.5	610	3.5	30	0.143	1.021	63.43	62.67			0.13	0.70	
50.10	18.63	0.3100	0.90	0.28	0.44	0.37	0.84	73.40	0.074	13.9	610	8.2	20	0.041	2.392	61.48	58.70	Building 31 0.31	0.90			
50.9	18.67	0.4500	0.90	0.41	0.89	0.77	0.87	73.30	0.156	0.3	610	1.2	19	0.257	0.361	58.64	58.58	Building 7 0.45	0.90			
50.8	18.93	0.2500	0.61	0.15	1.14	0.92	0.81	72.69	0.185	0.2	610	1.1	48	0.729	0.321	58.58	58.46			0.25	0.61	
50.7	19.66	0.4580	0.88	0.40	1.59	1.33	0.83	71.01	0.259	0.3	610	1.2	28	0.375	0.364	58.46	58.37	Building 22 0.26	0.90	0.20	0.86	
50.6	20.03	0.2400	0.64	0.15	1.83	1.48	0.81	70.18	0.286	0.3	762	1.3	46	0.589	0.593	58.34	58.22	Building 10 0.12	0.90	0.12	0.38	

Building 27

STORM SEWER SYSTEM - NETWORK #1 - 1:5 years -New development - Alternative solutions

Return Period 1:5	A	998.07
	B	6.053
Ottawa Airport	C	0.814

Coef Manning 0.013

Note 1 : Retention on site
Note 2 : Release flow in Rideau Canal

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR + release flow (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient	Release flow
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c	(m³/s)
50.5	20.62	0.5300	0.88	0.47	2.36	1.95	0.82	68.91	**0.369**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09	0.35	0.90	0.18	0.84	
50.4	20.89	0.0000	#DIV/0!	0.00	2.36	1.95	0.82	68.35	**0.366**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06					
50.3	22.83	0.3400	0.52	0.18	4.29	3.17	0.74	64.60	**0.563**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52	
50.2a	23.58	0.0000	#DIV/0!	0.00	4.29	3.17	0.74	63.27	**0.552**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84					
31.4	26.35	1.7000	0.60	1.02	14.12	8.57	0.61	58.83	**1.446**	0.1	1067	1.1	51	0.777	**0.978**	56.84	56.78	**Building 28** 0.53	0.90	1.17	0.46	0.06
31.3	27.12	0.3500	0.20	0.07	14.47	8.64	0.60	57.70	**1.431**	0.3	1067	1.9	85	0.761	**1.665**	56.78	56.49			0.35	0.20	0.06
31.1d	27.88	0.3500	0.77	0.27	14.82	8.91	0.60	56.65	**1.448**	0.4	1067	2.0	46	0.384	**1.783**	56.49	56.31	**Building 36** 0.20	0.90	0.15	0.60	0.06
31.1b	28.27	0.1000	0.60	0.06	14.92	8.97	0.60	56.13	**1.445**	0.5	1400	2.7	62	0.376	**4.225**	56.31	55.99			0.10	0.60	0.06
31.1	28.65	0.8300	0.38	0.32	15.75	9.28	0.59	55.64	**1.481**	1.3	1350	4.2	43	0.170	**6.036**	56.33	55.78			0.83	0.38	0.06
30.12	15.00	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	83.56	**0.010**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			Note 1	0.57	0.01
30.10	15.72	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.31	**0.020**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			Note 1	0.20	**0.02**
30.09	16.06	0.3600	0.50	0.18	0.36	0.18	0.50	80.28	**0.060**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50	0.02
30.07	17.94	1.2900	0.20	0.26	1.65	0.44	0.27	75.13	**0.110**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20	0.02
32.3	15.00	1.2400	0.82	1.01	1.24	1.01	0.82	83.56	**0.233**	0.7	450	1.5	70	0.770	**0.241**	59.50	59.00	**Building 36** 0.20	0.90	1.04	0.80	
32.1	15.77	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.15	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77					
30.6	18.35	0.0000	#DIV/0!	0.00	1.65	0.44	0.27	74.10	**0.119**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			Note 1	0.80	0.03
30.4	28.82	0.0000	#DIV/0!	0.00	17.40	9.72	0.56	55.41	**1.582**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			Note 1	0.80	0.10
30.3	29.43	0.0000	#DIV/0!	0.00	17.40	9.72	0.56	54.64	**1.571**	0.0	1371	**0.8**	75	1.659	**1.112**	55.41	55.38			Note 1	0.20	0.11
30.2	31.09	0.8820	0.20	0.18	18.28	9.90	0.54	52.64	**1.643**	0.1	1371	1.3	158	2.071	**1.877**	55.38	55.20			0.88	0.20	0.11
30.1	33.16	0.0000	#DIV/0!	0.00	18.28	9.90	0.54	50.37	**1.581**	0.6	1371	2.9	35	0.200	**4.308**	55.20	54.99					0.11
Outlet																						

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - New development - No retention

Return Period 1:5	A	998.07	Coef Manning	0.013
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
44.4	15.00	0.3500	0.55	0.19	0.35	0.19	0.55	83.56	**0.045**	0.5	305	1.0	33	0.571	**0.070**	60.38	60.22	Building 30 0.13	0.90	0.22	0.35
44.3	15.57	0.0660	0.53	0.03	0.42	0.23	0.55	81.76	**0.051**	0.6	305	1.1	19	0.301	**0.077**	60.09	59.98			0.07	0.53
44.2	15.87	0.1500	0.20	0.03	0.57	0.26	0.46	80.84	**0.058**	0.2	**450**	0.7	39	0.924	**0.112**	59.95	59.89			0.15	0.20
44.1	16.80	0.3670	0.39	0.14	0.93	0.40	0.43	78.17	**0.086**	0.4	**405**	1.1	30	0.473	**0.136**	59.83	59.71	Building 23 0.10	0.90	0.27	0.20
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	83.56	**0.026**	1.1	305	1.4	54	0.628	**0.105**	61.54	60.96			0.31	0.36
43.7	15.63	0.0960	0.32	0.03	0.41	0.14	0.35	81.58	**0.032**	0.3	305	0.7	52	1.167	**0.054**	60.62	60.47			0.10	0.32
43.6	16.79	0.3900	0.50	0.19	0.80	0.34	0.42	78.17	**0.072**	0.1	**405**	0.6	49	1.397	**0.075**	60.47	60.41	Building 23 0.10	0.90	0.29	0.36
43.5	18.19	0.0000	#DIV/0!	0.00	0.80	0.34	0.42	74.49	**0.069**	0.4	**405**	1.1	27	0.404	**0.144**	60.41	60.29				
43.4	18.60	0.1100	0.40	0.04	0.91	0.38	0.42	73.49	**0.077**	0.9	**405**	1.6	34	0.355	**0.206**	60.29	59.98			0.11	0.40
43.3	18.95	0.0600	0.30	0.02	0.97	0.40	0.41	72.64	**0.080**	0.3	**405**	0.9	43	0.780	**0.118**	59.71	59.58			0.06	0.30
42.3	19.73	0.3600	0.75	0.27	2.17	1.07	0.49	70.85	**0.209**	0.5	**525**	1.4	23	0.267	**0.311**	59.56	59.44	Building 26 0.09	0.90	0.27	0.70
42.1	20.00	0.1300	0.90	0.12	2.30	1.19	0.52	70.26	**0.230**	0.8	**525**	1.7	45	0.434	**0.374**	59.44	59.10	Building 30 0.13	0.90		
41.5	20.43	2.7600	0.70	1.93	5.06	3.12	0.62	69.32	**0.595**	0.3	**750**	1.5	61	0.688	**0.653**	59.07	58.86			**2.76**	**0.70**
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	83.56	**0.025**	0.1	**375**	0.4	40	1.878	**0.039**	61.20	61.18			0.12	0.90
41.4b	16.88	0.2650	0.45	0.12	0.39	0.23	0.59	77.94	**0.049**	4.9	**375**	3.5	48	0.228	**0.388**	61.18	58.83			0.27	0.45
41.4	21.12	0.3100	0.47	0.15	5.75	3.49	0.61	67.89	**0.652**	0.8	**750**	2.2	71	0.534	**0.980**	58.83	58.28	Building 26 0.09	0.90	0.22	0.30
41.3	21.65	0.5570	0.76	0.42	6.31	3.92	0.62	66.82	**0.720**	0.4	**750**	1.7	36	0.357	**0.742**	58.16	58.00	Building 19 0.43	0.90	0.13	0.30
41.2	22.01	0.6600	0.62	0.41	6.97	4.32	0.62	66.13	**0.786**	0.2	**900**	1.4	50	0.598	**0.887**	58.00	57.88	Building 19 0.27	0.90	0.39	0.42
16.10	15.00	0.4900	0.60	0.29	0.49	0.29	0.60	83.56	**0.067**	0.6	**300**	1.0	34	0.540	**0.074**	60.11	59.91	Building 14 0.23	0.90	0.26	0.33
16.9	15.54	0.6300	0.39	0.25	1.12	0.54	0.48	81.85	**0.121**	0.5	**375**	1.2	76	1.086	**0.129**	59.91	59.50			0.63	0.39
16.8	16.63	0.4030	0.45	0.18	1.52	0.72	0.47	78.65	**0.156**	1.1	**375**	1.7	54	0.533	**0.186**	59.50	58.89	Building 18 0.15	0.90	0.26	0.20
16.7	17.16	0.2000	0.45	0.09	1.72	0.81	0.47	77.17	**0.172**	0.9	**450**	1.7	28	0.281	**0.264**	58.12	57.88			0.20	0.45
41.1	22.61	0.2700	0.46	0.12	8.96	5.26	0.59	65.00	**0.940**	0.3	**900**	1.6	75	0.777	**1.024**	57.79	57.55			0.27	0.46
40.5	15.00	0.8700	0.39	0.34	0.87	0.34	0.39	83.56	**0.079**	2.0	305	2.0	84	0.709	**0.144**	60.20	58.49	Building 40 0.24	0.90	0.63	0.20

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - New development - No retention

Return Period 1:5	A	998.07	Coef Manning	0.013
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
40.4	15.71	0.6600	0.31	0.20	1.53	0.55	0.36	81.33	**0.122**	0.4	**450**	1.2	75	1.085	**0.183**	58.31	58.00			0.66	0.31
40.3	23.38	1.1570	0.53	0.61	11.65	6.42	0.55	63.60	**1.122**	0.4	914	1.8	71	0.655	**1.185**	57.52	57.24	Building 35: 0.44	0.90	0.71	0.30
40.2a	24.04	0.9840	0.66	0.65	12.64	7.07	0.56	62.47	**1.214**	0.4	914	1.9	72	0.647	**1.218**	57.15	56.85	Building 9: 0.51	0.90	0.47	0.40
16.6a	15.00	0.2700	0.60	0.16	0.27	0.16	0.60	83.56	**0.037**	3.5	381	3.0	83	0.463	**0.341**	61.00	58.12	Building 5 et 34: 0.11	0.90	0.16	0.40
16.6	15.46	0.4200	0.30	0.13	0.69	0.29	0.42	82.09	**0.065**	1.0	381	1.6	25	0.260	**0.183**	58.13	57.88			0.42	0.30
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	83.56	**0.027**	0.8	250	1.1	132	1.980	**0.055**	63.04	61.93			0.58	0.20
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	77.66	**0.061**	1.0	305	1.4	22	0.271	**0.099**	61.84	61.63			0.33	0.52
21.2b	15.00	0.1100	0.90	0.10	0.11	0.10	0.90	83.56	**0.023**	0.6	254	1.0	58	1.002	**0.049**	61.96	61.60	Building 10: 0.11	0.90		
21.2	17.25	0.1100	0.90	0.10	1.13	0.49	0.43	76.92	**0.103**	1.2	305	1.5	29	0.323	**0.109**	61.57	61.23	Building 10: 0.11	0.90		
21.1	17.57	0.3000	0.31	0.09	1.43	0.58	0.40	76.07	**0.121**	2.7	305	2.3	59	0.433	**0.166**	60.32	58.73			0.30	0.31
20.3	15.00	0.2700	0.90	0.24	0.27	0.24	0.90	83.56	**0.056**	0.3	**375**	0.8	61	1.213	**0.093**	58.90	58.73	Building 6: 0.14	0.90	0.13	0.90
20.5	18.01	0.3300	0.39	0.13	2.03	0.95	0.47	74.95	**0.196**	0.1	**600**	0.7	92	2.142	**0.202**	58.83	58.73			0.33	0.39
16.5a	20.15	0.4200	0.70	0.29	2.72	1.53	0.56	69.93	**0.295**	0.4	**600**	1.3	20	0.259	**0.363**	57.88	57.81	Building 34: 0.19	0.90	0.23	0.53
16.5	20.41	0.0000	#DIV/0!	0.00	2.72	1.53	0.56	69.37	**0.292**	0.3	**600**	1.2	61	0.818	**0.352**	57.81	57.61				
50.15	15.00	0.4900	0.73	0.36	0.49	0.36	0.73	83.56	**0.083**	0.6	**375**	1.2	96	1.302	**0.136**	68.06	67.48	Building 2: 0.21	0.90	0.28	0.61
50.14	16.30	0.3700	0.52	0.19	0.86	0.55	0.64	79.57	**0.121**	0.7	**375**	1.3	12	0.154	**0.143**	67.48	67.40			0.37	0.52
50.13a	16.46	0.0800	0.90	0.07	0.94	0.62	0.66	79.13	**0.136**	2.4	**375**	2.5	23	0.155	**0.274**	67.40	66.84	Building 21: 0.08	0.90		
50.13	16.61	0.5100	0.49	0.25	1.45	0.87	0.60	78.69	**0.189**	0.8	**450**	1.6	76	0.770	**0.262**	66.84	66.20	Building 32: 0.11	0.90	0.41	0.38
50.12	17.38	0.0000	#DIV/0!	0.00	1.45	0.87	0.60	76.58	**0.184**	8.5	**450**	5.2	23	0.073	**0.830**	65.38	63.43				
50.11	17.45	0.1260	0.70	0.09	1.58	0.96	0.61	76.38	**0.202**	2.5	610	3.5	30	0.143	**1.021**	63.43	62.67			0.13	0.70
50.10	17.60	0.3100	0.90	0.28	1.89	1.24	0.66	76.01	**0.259**	13.9	610	8.2	20	0.041	**2.392**	61.48	58.70	Building 31: 0.31	0.90		
50.9	17.64	0.4500	0.90	0.41	2.34	1.64	0.70	75.90	**0.343**	0.3	610	1.2	19	0.257	**0.361**	58.64	58.58	Building 7: 0.45	0.90		
50.8	17.90	0.2500	0.61	0.15	2.59	1.80	0.70	75.24	**0.372**	0.2	**675**	1.2	48	0.681	**0.420**	58.58	58.46			0.25	0.61
50.7	18.58	0.4580	0.88	0.40	3.04	2.20	0.72	73.54	**0.445**	0.3	**675**	1.3	28	0.350	**0.477**	58.46	58.37	Building 22: 0.26	0.90	0.20	0.86
50.6	18.93	0.2400	0.64	0.15	3.28	2.35	0.72	72.70	**0.471**	0.3	762	1.3	46	0.589	**0.593**	58.34	58.22	Building 10: 0.12	0.90	0.12	0.38

Building 27

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - New development - No retention

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn) Tc	Area (ha) ΔA	Catchment basin runoff ΔR	Impervious Area (ha) ΔAR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
50.5	19.52	0.5300	0.88	0.47	3.81	2.82	0.74	71.33	**0.553**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09	0.35	0.90	0.18	0.84
50.4	19.79	0.0000	#DIV/0!	0.00	3.81	2.82	0.74	70.73	**0.549**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06				
50.3	21.23	0.3400	0.52	0.18	6.87	4.53	0.66	67.67	**0.843**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52
50.2a	21.97	0.0000	#DIV/0!	0.00	6.87	4.53	0.66	66.20	**0.825**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84				
31.4	24.69	1.7000	0.60	1.02	21.21	12.61	0.59	61.40	**2.130**	0.1	**1500**	1.4	51	0.620	**2.425**	56.84	56.78	**Building 28** 0.53	0.90	1.17	0.46
31.3	25.31	0.3500	0.20	0.07	21.56	12.68	0.59	60.41	**2.107**	0.3	**1500**	2.3	85	0.606	**4.129**	56.78	56.49			0.35	0.20
31.1d	25.91	0.3500	0.77	0.27	21.91	12.95	0.59	59.48	**2.119**	0.4	**1500**	2.5	46	0.306	**4.422**	56.49	56.31	**Building 36** 0.20	0.90	0.15	0.60
31.1b	26.22	0.1000	0.60	0.06	22.01	13.01	0.59	59.02	**2.112**	0.5	**1500**	2.9	62	0.360	**5.078**	56.31	55.99			0.10	0.60
31.1	26.58	0.8300	0.38	0.32	22.84	13.33	0.58	58.49	**2.144**	1.3	**1500**	4.5	43	0.158	**7.995**	56.33	55.78			0.83	0.38
30.12	15.00	0.8000	0.57	0.46	0.80	0.46	0.57	83.56	**0.105**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			0.80	0.57
30.10	15.72	5.8000	0.70	4.06	6.60	4.52	0.68	81.31	**1.010**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			5.80	0.70
30.09	16.06	0.3600	0.50	0.18	6.96	4.70	0.67	80.28	**1.037**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50
30.07	17.94	1.2900	0.20	0.26	8.25	4.95	0.60	75.13	**1.024**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20
32.3	15.00	1.2400	0.82	1.01	1.24	1.01	0.82	83.56	**0.233**	0.7	**525**	1.7	70	0.695	**0.363**	59.50	59.00	**Building 36** 0.20	0.90	1.04	0.80
32.1	15.69	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.38	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77				
30.6	18.35	0.9300	0.80	0.74	9.18	5.70	0.62	74.10	**1.161**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			0.93	0.80
30.4	26.74	0.8000	0.80	0.64	32.82	19.67	0.60	58.26	**3.151**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			0.80	0.80
30.3	27.35	0.7650	0.20	0.15	33.58	19.82	0.59	57.39	**3.128**	0.0	**2100**	1.0	75	1.248	**3.468**	55.41	55.38			0.77	0.20
30.2	28.60	0.8820	0.20	0.18	34.47	20.00	0.58	55.70	**3.163**	0.1	**2100**	1.7	158	1.558	**5.852**	55.38	55.20			0.88	0.20
30.1	30.15	0.0000	#DIV/0!	0.00	34.47	20.00	0.58	53.74	**3.055**	0.6	**2100**	3.9	35	0.150	**13.431**	55.20	54.99				
Outlet																					

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - New development - With retention

Return Period 1:5	A	998.07
	B	6.053
Ottawa Airport	C	0.814

Coef Manning 0.013

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR + release flow (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Runoff Coefficient c	Ground Area (ha)	Runoff Coefficient c	Release flow (m³/s)
44.4	15.00	0.3500	0.55	0.19	0.35	0.19	0.55	83.56	**0.045**	0.5	305	1.0	33	0.571	**0.070**	60.38	60.22	(Building 30) 0.13	0.90	0.22	0.35	
44.3	15.57	0.0660	0.53	0.03	0.42	0.23	0.55	81.76	**0.051**	0.6	305	1.1	19	0.301	**0.077**	60.09	59.98			0.07	0.53	
44.2	15.87	0.1500	0.20	0.03	0.57	0.26	0.46	80.84	**0.058**	0.2	**450**	0.7	39	0.924	**0.112**	59.95	59.89			0.15	0.20	
44.1	16.80	0.3670	0.39	0.14	0.93	0.40	0.43	78.17	**0.086**	0.4	**405**	1.1	30	0.473	**0.136**	59.83	59.71	(Building 23) 0.10	0.90	0.27	0.20	
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	83.56	**0.026**	1.1	305	1.4	54	0.628	**0.105**	61.54	60.96			0.31	0.36	
43.7	15.63	0.0960	0.32	0.03	0.41	0.14	0.35	81.58	**0.032**	0.3	305	0.7	52	1.167	**0.054**	60.62	60.47			0.10	0.32	
43.6	16.79	0.3900	0.50	0.19	0.80	0.34	0.42	78.17	**0.072**	0.1	**405**	0.6	49	1.397	**0.075**	60.47	60.41	(Building 23) 0.10	0.90	0.29	0.36	
43.5	18.19	0.0000	#DIV/0!	0.00	0.80	0.34	0.42	74.49	**0.069**	0.4	**405**	1.1	27	0.404	**0.144**	60.41	60.29					
43.4	18.60	0.1100	0.40	0.04	0.91	0.38	0.42	73.49	**0.077**	0.9	**405**	1.6	34	0.355	**0.206**	60.29	59.98			0.11	0.40	
43.3	18.95	0.0600	0.30	0.02	0.97	0.40	0.41	72.64	**0.080**	0.3	**405**	0.9	43	0.780	**0.118**	59.71	59.58			0.06	0.30	
42.3	19.73	0.3600	0.75	0.27	2.17	1.07	0.49	70.85	**0.209**	0.5	**525**	1.4	23	0.267	**0.311**	59.56	59.44	(Building 26) 0.09	0.90	0.27	0.70	
42.1	20.00	0.1300	0.90	0.12	2.30	1.19	0.52	70.26	**0.230**	0.8	**525**	1.7	45	0.434	**0.374**	59.44	59.10	(Building 30) 0.13	0.90			
41.5	20.43	0.3620	0.73	0.26	2.66	1.45	0.55	69.32	**0.292**	0.3	**600**	1.3	61	0.798	**0.360**	59.07	58.86			0.36	0.73	**0.015**
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	83.56	**0.025**	0.1	**375**	0.4	40	1.878	**0.039**	61.20	61.18			0.12	0.90	
41.4b	16.88	0.2650	0.45	0.12	0.39	0.23	0.59	77.94	**0.049**	4.9	**375**	3.5	48	0.228	**0.388**	61.18	58.83			0.27	0.45	
41.4	21.23	0.3100	0.47	0.15	3.36	1.83	0.54	67.66	**0.355**	0.8	525	1.7	71	0.677	**0.379**	58.83	58.28	(Building 26) 0.09	0.90	0.22	0.30	0.015
41.3	21.91	0.5570	0.76	0.42	3.91	2.25	0.57	66.33	**0.425**	0.4	610	1.5	36	0.410	**0.428**	58.16	58.00	(Building 19) 0.43	0.90	0.13	0.30	0.015
41.2	22.32	0.6600	0.62	0.41	4.57	2.66	0.58	65.55	**0.494**	0.2	**750**	1.2	50	0.675	**0.545**	58.00	57.88	(Building 19) 0.27	0.90	0.39	0.42	0.015
16.10	15.00	0.4900	0.60	0.29	0.49	0.29	0.60	83.56	**0.067**	0.6	**300**	1.0	34	0.540	**0.074**	60.11	59.91	(Building 14) 0.23	0.90	0.26	0.33	
16.9	15.54	0.6300	0.39	0.25	1.12	0.54	0.48	81.85	**0.121**	0.5	**375**	1.2	76	1.086	**0.129**	59.91	59.50			0.63	0.39	
16.8	16.63	0.4030	0.45	0.18	1.52	0.72	0.47	78.65	**0.156**	1.1	**375**	1.7	54	0.533	**0.186**	59.50	58.89	(Building 18) 0.15	0.90	0.26	0.20	
16.7	17.16	0.2000	0.45	0.09	1.72	0.81	0.47	77.17	**0.172**	0.9	**450**	1.7	28	0.281	**0.264**	58.12	57.88			0.20	0.45	
41.1	22.99	0.2700	0.46	0.12	6.57	3.59	0.55	64.30	**0.650**	0.3	762	1.4	75	0.868	**0.657**	57.79	57.55			0.27	0.46	0.015
40.5	15.00	0.8700	0.39	0.34	0.87	0.34	0.39	83.56	**0.079**	2.0	305	2.0	84	0.709	**0.144**	60.20	58.49	(Building 40) 0.24	0.90	0.63	0.20	

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - New development - With retention

Return Period 1:5				Coef Manning	0.013
	A	998.07			
	B	6.053			
Ottawa Airport	C	0.814			

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR + release flow (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient	Release flow
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c	(m³/s)
40.4	15.71	0.6600	0.31	0.20	1.53	0.55	0.36	81.33	**0.122**	0.4	**450**	1.2	75	1.085	**0.183**	58.31	58.00			0.66	0.31	
40.3	23.86	1.1570	0.53	0.61	9.25	4.75	0.51	62.78	**0.835**	0.4	914	1.8	71	0.655	**1.185**	57.52	57.24	Building 35: 0.44	0.90	0.71	0.30	0.015
40.2a	24.51	0.9840	0.66	0.65	10.24	5.40	0.53	61.68	**0.916**	0.4	914	1.9	72	0.647	**1.218**	57.15	56.85	Building 9: 0.51	0.90	0.47	0.40	
16.6a	15.00	0.2700	0.60	0.16	0.27	0.16	0.60	83.56	**0.037**	3.5	381	3.0	83	0.463	**0.341**	61.00	58.12	Building 5 et 34: 0.11	0.90	0.16	0.40	
16.6	15.46	0.4200	0.30	0.13	0.69	0.29	0.42	82.09	**0.065**	1.0	381	1.6	25	0.260	**0.183**	58.13	57.88			0.42	0.30	
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	83.56	**0.027**	0.8	250	1.1	132	1.980	**0.055**	63.04	61.93			0.58	0.20	
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	77.66	**0.061**	1.0	305	1.4	22	0.271	**0.099**	61.84	61.63			0.33	0.52	
21.2b	15.00	0.1100	0.90	0.10	0.11	0.10	0.90	83.56	**0.023**	0.6	254	1.0	58	1.002	**0.049**	61.96	61.60	Building 10: 0.11	0.90			
21.2	17.25	0.1100	0.90	0.10	1.13	0.49	0.43	76.92	**0.103**	1.2	305	1.5	29	0.323	**0.109**	61.57	61.23	Building 10: 0.11	0.90			
21.1	17.57	0.3000	0.31	0.09	1.43	0.58	0.40	76.07	**0.121**	2.7	305	2.3	59	0.433	**0.166**	60.32	58.73			0.30	0.31	
20.3	15.00	0.2700	0.90	0.24	0.27	0.24	0.90	83.56	**0.056**	0.3	**375**	0.8	61	1.213	**0.093**	58.90	58.73	Building 6: 0.14	0.90	0.13	0.90	
20.5	18.01	0.3300	0.39	0.13	2.03	0.95	0.47	74.95	**0.196**	0.1	**600**	0.7	92	2.142	**0.202**	58.83	58.73			0.33	0.39	
16.5a	20.15	0.4200	0.70	0.29	2.72	1.53	0.56	69.93	**0.295**	0.4	**600**	1.3	20	0.259	**0.363**	57.88	57.81	Building 34: 0.19	0.90	0.23	0.53	
16.5	20.41	0.0000	#DIV/0!	0.00	2.72	1.53	0.56	69.37	**0.292**	0.3	**600**	1.2	61	0.818	**0.352**	57.81	57.61					
50.15	15.00	0.4900	0.73	0.36	0.49	0.36	0.73	83.56	**0.083**	0.6	**375**	1.2	96	1.302	**0.136**	68.06	67.48	Building 2: 0.21	0.90	0.28	0.61	
50.14	16.30	0.3700	0.52	0.19	0.86	0.55	0.64	79.57	**0.121**	0.7	**375**	1.3	12	0.154	**0.143**	67.48	67.40			0.37	0.52	
50.13a	16.46	0.0800	0.90	0.07	0.94	0.62	0.66	79.13	**0.136**	2.4	**375**	2.5	23	0.155	**0.274**	67.40	66.84	Building 21: 0.08	0.90			
50.13	16.61	0.5100	0.49	0.25	1.45	0.87	0.60	78.69	**0.189**	0.8	**450**	1.6	76	0.770	**0.262**	66.84	66.20	Building 32: 0.11	0.90	0.41	0.38	
50.12	17.38	0.0000	#DIV/0!	0.00	1.45	0.87	0.60	76.58	**0.184**	8.5	**450**	5.2	23	0.073	**0.830**	65.38	63.43					
50.11	17.45	0.1260	0.70	0.09	1.58	0.96	0.61	76.38	**0.202**	2.5	610	3.5	30	0.143	**1.021**	63.43	62.67			0.13	0.70	
50.10	17.60	0.3100	0.90	0.28	1.89	1.24	0.66	76.01	**0.259**	13.9	610	8.2	20	0.041	**2.392**	61.48	58.70	Building 31: 0.31	0.90			
50.9	17.64	0.4500	0.90	0.41	2.34	1.64	0.70	75.90	**0.343**	0.3	610	1.2	19	0.257	**0.361**	58.64	58.58	Building 7: 0.45	0.90			
50.8	17.90	0.2500	0.61	0.15	2.59	1.80	0.70	75.24	**0.372**	0.2	**675**	1.2	48	0.681	**0.420**	58.58	58.46			0.25	0.61	
50.7	18.58	0.4580	0.88	0.40	3.04	2.20	0.72	73.54	**0.445**	0.3	**675**	1.3	28	0.350	**0.477**	58.46	58.37	Building 22: 0.26	0.90	0.20	0.86	
50.6	18.93	0.2400	0.64	0.15	3.28	2.35	0.72	72.70	**0.471**	0.3	762	1.3	46	0.589	**0.593**	58.34	58.22	Building 10: 0.12	0.90	0.12	0.38	
																		Building 27				

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - New development - With retention

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow **Q= KAIR** + release flow (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient	Release flow
	Tc	**Δ A**	**Δ R**	**Δ AR**	**A**	**AR**	**R**	**I**	**K**=2.75E-3	**S**	**D**	**V**	**L**	**Tf**	**Q**	(m)	(m)	(ha)	c	(ha)	c	(m³/s)
50.5	19.52	0.5300	0.88	0.47	3.81	2.82	0.74	71.33	**0.553**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09	0.35	0.90	0.18	0.84	
50.4	19.79	0.0000	#DIV/0!	0.00	3.81	2.82	0.74	70.73	**0.549**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06					
50.3	21.23	0.3400	0.52	0.18	6.87	4.53	0.66	67.67	**0.843**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52	
50.2a	21.97	0.0000	#DIV/0!	0.00	6.87	4.53	0.66	66.20	**0.825**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84					
31.4	25.16	1.7000	0.60	1.02	18.81	10.95	0.58	60.64	**1.840**	0.1	**1500**	1.4	51	0.620	**2.425**	56.84	56.78	**Building 28** 0.53	0.90	1.17	0.46	0.015
31.3	25.78	0.3500	0.20	0.07	19.16	11.02	0.57	59.68	**1.823**	0.3	**1500**	2.3	85	0.606	**4.129**	56.78	56.49			0.35	0.20	0.015
31.1d	26.39	0.3500	0.77	0.27	19.51	11.29	0.58	58.77	**1.839**	0.4	**1500**	2.5	46	0.306	**4.422**	56.49	56.31	**Building 36** 0.20	0.90	0.15	0.60	0.015
31.1b	26.69	0.1000	0.60	0.06	19.61	11.35	0.58	58.32	**1.835**	0.5	**1500**	2.9	62	0.360	**5.078**	56.31	55.99			0.10	0.60	0.015
31.1	27.05	0.8300	0.38	0.32	20.44	11.66	0.57	57.80	**1.869**	1.3	**1500**	4.5	43	0.158	**7.995**	56.33	55.78			0.83	0.38	0.015
30.12	15.00	0.8000	0.57	0.46	0.80	0.46	0.57	83.56	**0.105**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			0.80	0.57	
30.10	15.72	0.6320	0.20	0.13	1.43	0.58	0.41	81.31	**0.195**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			0.63	0.20	**0.065**
30.09	16.06	0.3600	0.50	0.18	1.79	0.76	0.43	80.28	**0.233**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50	0.065
30.07	17.94	1.2900	0.20	0.26	3.08	1.02	0.33	75.13	**0.276**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20	0.065
32.3	15.00	1.2400	0.82	1.01	1.24	1.01	0.82	83.56	**0.233**	0.7	**525**	1.7	70	0.695	**0.363**	59.50	59.00	**Building 36** 0.20	0.90	1.04	0.80	
32.1	15.69	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.38	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77					
30.6	18.35	0.9300	0.80	0.74	4.01	1.76	0.44	74.10	**0.425**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			0.93	0.80	0.065
30.4	27.21	0.8000	0.80	0.64	25.25	14.07	0.56	57.58	**2.307**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			0.80	0.80	0.080
30.3	27.82	0.7650	0.20	0.15	26.02	14.22	0.55	56.73	**2.298**	0.0	**1800**	0.9	75	1.384	**2.299**	55.41	55.38			0.77	0.20	0.080
30.2	29.21	0.8820	0.20	0.18	26.90	14.39	0.54	54.91	**2.354**	0.1	**1800**	1.5	158	1.727	**3.880**	55.38	55.20			0.88	0.20	0.080
30.1	30.93	0.0000	#DIV/0!	0.00	26.90	14.39	0.54	52.82	**2.271**	0.6	**1800**	3.5	35	0.167	**8.904**	55.20	54.99					0.080
Outlet																						

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - Increased diameter

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
44.4	15.00	0.3500	0.55	0.19	0.35	0.19	0.55	83.56	**0.045**	0.5	305	1.0	33	0.571	**0.070**	60.38	60.22	Building 30 0.13	0.90	0.22	0.35
44.3	15.57	0.0660	0.53	0.03	0.42	0.23	0.55	81.76	**0.051**	0.6	305	1.1	19	0.301	**0.077**	60.09	59.98			0.07	0.53
44.2	15.87	0.1500	0.20	0.03	0.57	0.26	0.46	80.84	**0.058**	0.2	**450**	0.7	39	0.924	**0.112**	59.95	59.89			0.15	0.20
44.1	16.80	0.3670	0.39	0.14	0.93	0.40	0.43	78.17	**0.086**	0.4	**405**	1.1	30	0.473	**0.136**	59.83	59.71	Building 23 0.10	0.90	0.27	0.20
43.8	15.00	0.3100	0.36	0.11	0.31	0.11	0.36	83.56	**0.026**	1.1	305	1.4	54	0.628	**0.105**	61.54	60.96			0.31	0.36
43.7	15.63	0.0960	0.32	0.03	0.41	0.14	0.35	81.58	**0.032**	0.3	305	0.7	52	1.167	**0.054**	60.62	60.47			0.10	0.32
43.6	16.79	0.3900	0.50	0.19	0.80	0.34	0.42	78.17	**0.072**	0.1	**405**	0.6	49	1.397	**0.075**	60.47	60.41	Building 23 0.10	0.90	0.29	0.36
43.5	18.19	0.0000	#DIV/0!	0.00	0.80	0.34	0.42	74.49	**0.069**	0.4	**405**	1.1	27	0.404	**0.144**	60.41	60.29				
43.4	18.60	0.1100	0.40	0.04	0.91	0.38	0.42	73.49	**0.077**	0.9	**405**	1.6	34	0.355	**0.206**	60.29	59.98			0.11	0.40
43.3	18.95	0.0600	0.30	0.02	0.97	0.40	0.41	72.64	**0.080**	0.3	**405**	0.9	43	0.780	**0.118**	59.71	59.58			0.06	0.30
42.3	19.73	0.3600	0.75	0.27	2.17	1.07	0.49	70.85	**0.209**	0.5	**525**	1.4	23	0.267	**0.311**	59.56	59.44	Building 26 0.09	0.90	0.27	0.70
42.1	20.00	0.1300	0.90	0.12	2.30	1.19	0.52	70.26	**0.230**	0.8	**525**	1.7	45	0.434	**0.374**	59.44	59.10	Building 30 0.13	0.90		
41.5	20.43	0.3620	0.73	0.26	2.66	1.45	0.55	69.32	**0.277**	0.3	**600**	1.3	61	0.798	**0.360**	59.07	58.86			0.36	0.73
41.4c	15.00	0.1200	0.90	0.11	0.12	0.11	0.90	83.56	**0.025**	0.1	**375**	0.4	40	1.878	**0.039**	61.20	61.18			0.12	0.90
41.4b	16.88	0.2650	0.45	0.12	0.39	0.23	0.59	77.94	**0.049**	4.9	**375**	3.5	48	0.228	**0.388**	61.18	58.83			0.27	0.45
41.4	21.23	0.3100	0.47	0.15	3.36	1.83	0.54	67.66	**0.340**	0.8	525	1.7	71	0.677	**0.379**	58.83	58.28	Building 26 0.09	0.90	0.22	0.30
41.3	21.91	0.5570	0.76	0.42	3.91	2.25	0.57	66.33	**0.410**	0.4	610	1.5	36	0.410	**0.428**	58.16	58.00	Building 19 0.43	0.90	0.13	0.30
41.2	22.32	0.6600	0.62	0.41	4.57	2.66	0.58	65.55	**0.479**	0.2	**750**	1.2	50	0.675	**0.545**	58.00	57.88	Building 19 0.27	0.90	0.39	0.42
16.10	15.00	0.4900	0.60	0.29	0.49	0.29	0.60	83.56	**0.067**	0.6	**300**	1.0	34	0.540	**0.074**	60.11	59.91	Building 14 0.23	0.90	0.26	0.33
16.9	15.54	0.6300	0.39	0.25	1.12	0.54	0.48	81.85	**0.121**	0.5	**375**	1.2	76	1.086	**0.129**	59.91	59.50			0.63	0.39
16.8	16.63	0.4030	0.45	0.18	1.52	0.72	0.47	78.65	**0.156**	1.1	**375**	1.7	54	0.533	**0.186**	59.50	58.89	Building 18 0.15	0.90	0.26	0.20
16.7	17.16	0.2000	0.45	0.09	1.72	0.81	0.47	77.17	**0.172**	0.9	**450**	1.7	28	0.281	**0.264**	58.12	57.88			0.20	0.45
41.1	22.99	0.2700	0.46	0.12	6.57	3.59	0.55	64.30	**0.635**	0.3	762	1.4	75	0.868	**0.657**	57.79	57.55			0.27	0.46
40.5	15.00	0.8700	0.39	0.34	0.87	0.34	0.39	83.56	**0.079**	2.0	305	2.0	84	0.709	**0.144**	60.20	58.49	Building 40 0.24	0.90	0.63	0.20

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - Increased diameter

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q						
40.4	15.71	0.6600	0.31	0.20	1.53	0.55	0.36	81.33	**0.122**	0.4	**450**	1.2	75	1.085	**0.183**	58.31	58.00			0.66	0.31
40.3	23.86	1.1570	0.53	0.61	9.25	4.75	0.51	62.78	**0.820**	0.4	914	1.8	71	0.655	**1.185**	57.52	57.24	Building 35: 0.44	0.90	0.71	0.30
40.2a	24.51	0.9840	0.66	0.65	10.24	5.40	0.53	61.68	**0.916**	0.4	914	1.9	72	0.647	**1.218**	57.15	56.85	Building 9: 0.51	0.90	0.47	0.40
16.6a	15.00	0.2700	0.60	0.16	0.27	0.16	0.60	83.56	**0.037**	3.5	381	3.0	83	0.463	**0.341**	61.00	58.12	Building 5 et 34: 0.11	0.90	0.16	0.40
16.6	15.46	0.4200	0.30	0.13	0.69	0.29	0.42	82.09	**0.065**	1.0	381	1.6	25	0.260	**0.183**	58.13	57.88			0.42	0.30
53.1	15.00	0.5800	0.20	0.12	0.58	0.12	0.20	83.56	**0.027**	0.8	250	1.1	132	1.980	**0.055**	63.04	61.93			0.58	0.20
21.3	16.98	0.3300	0.52	0.17	0.91	0.29	0.32	77.66	**0.061**	1.0	305	1.4	22	0.271	**0.099**	61.84	61.63			0.33	0.52
21.2b	15.00	0.1100	0.90	0.10	0.11	0.10	0.90	83.56	**0.023**	0.6	254	1.0	58	1.002	**0.049**	61.96	61.60	Building 10: 0.11	0.90		
21.2	17.25	0.1100	0.90	0.10	1.13	0.49	0.43	76.92	**0.103**	1.2	305	1.5	29	0.323	**0.109**	61.57	61.23	Building 10: 0.11	0.90		
21.1	17.57	0.3000	0.31	0.09	1.43	0.58	0.40	76.07	**0.121**	2.7	305	2.3	59	0.433	**0.166**	60.32	58.73			0.30	0.31
20.3	15.00	0.2700	0.90	0.24	0.27	0.24	0.90	83.56	**0.056**	0.3	**375**	0.8	61	1.213	**0.093**	58.90	58.73	Building 6: 0.14	0.90	0.13	0.90
20.5	18.01	0.3300	0.39	0.13	2.03	0.95	0.47	74.95	**0.196**	0.1	**600**	0.7	92	2.142	**0.202**	58.83	58.73			0.33	0.39
16.5a	20.15	0.4200	0.70	0.29	2.72	1.53	0.56	69.93	**0.295**	0.4	**600**	1.3	20	0.259	**0.363**	57.88	57.81	Building 34: 0.19	0.90	0.23	0.53
16.5	20.41	0.0000	#DIV/0!	0.00	2.72	1.53	0.56	69.37	**0.292**	0.3	**600**	1.2	61	0.818	**0.352**	57.81	57.61				
50.15	15.00	0.4900	0.73	0.36	0.49	0.36	0.73	83.56	**0.083**	0.6	**375**	1.2	96	1.302	**0.136**	68.06	67.48	Building 2: 0.21	0.90	0.28	0.61
50.14	16.30	0.3700	0.52	0.19	0.86	0.55	0.64	79.57	**0.121**	0.7	**375**	1.3	12	0.154	**0.143**	67.48	67.40			0.37	0.52
50.13a	16.46	0.0800	0.90	0.07	0.94	0.62	0.66	79.13	**0.136**	2.4	**375**	2.5	23	0.155	**0.274**	67.40	66.84	Building 21: 0.08	0.90		
50.13	16.61	0.5100	0.49	0.25	1.45	0.87	0.60	78.69	**0.189**	0.8	**450**	1.6	76	0.770	**0.262**	66.84	66.20	Building 32: 0.11	0.90	0.41	0.38
50.12	17.38	0.0000	#DIV/0!	0.00	1.45	0.87	0.60	76.58	**0.184**	8.5	**450**	5.2	23	0.073	**0.830**	65.38	63.43				
50.11	17.45	0.1260	0.70	0.09	1.58	0.96	0.61	76.38	**0.202**	2.5	610	3.5	30	0.143	**1.021**	63.43	62.67			0.13	0.70
50.10	17.60	0.3100	0.90	0.28	1.89	1.24	0.66	76.01	**0.259**	13.9	610	8.2	20	0.041	**2.392**	61.48	58.70	Building 31: 0.31	0.90		
50.9	17.64	0.4500	0.90	0.41	2.34	1.64	0.70	75.90	**0.343**	0.3	610	1.2	19	0.257	**0.361**	58.64	58.58	Building 7: 0.45	0.90		
50.8	17.90	0.2500	0.61	0.15	2.59	1.80	0.70	75.24	**0.372**	0.2	**675**	1.2	48	0.681	**0.420**	58.58	58.46			0.25	0.61
50.7	18.58	0.4580	0.88	0.40	3.04	2.20	0.72	73.54	**0.445**	0.3	**675**	1.3	28	0.350	**0.477**	58.46	58.37	Building 22: 0.26	0.90	0.20	0.86
50.6	18.93	0.2400	0.64	0.15	3.28	2.35	0.72	72.70	**0.471**	0.3	762	1.3	46	0.589	**0.593**	58.34	58.22	Building 10: 0.12	0.90	0.12	0.38
																		Building 27			

STORM SEWER SYSTEM - NETWORK #1 - 1:5 Years - Increased diameter

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
50.5	19.52	0.5300	0.88	0.47	3.81	2.82	0.74	71.33	**0.553**	0.5	762	1.7	28	0.269	**0.791**	58.22	58.09	0.35	0.90	0.18	0.84
50.4	19.79	0.0000	#DIV/0!	0.00	3.81	2.82	0.74	70.73	**0.549**	0.8	762	2.2	36	0.267	**1.024**	58.34	58.06				
50.3	21.23	0.3400	0.52	0.18	6.87	4.53	0.66	67.67	**0.843**	0.2	914	1.4	63	0.748	**0.920**	57.30	57.15			0.34	0.52
50.2a	21.97	0.0000	#DIV/0!	0.00	6.87	4.53	0.66	66.20	**0.825**	0.3	914	1.5	112	1.234	**0.992**	57.15	56.84				
31.4	25.16	1.7000	0.60	1.02	18.81	10.95	0.58	60.64	**1.825**	0.1	**1500**	1.4	51	0.620	**2.425**	56.84	56.78	Building 28: 0.53	0.90	1.17	0.46
31.3	25.78	0.3500	0.20	0.07	19.16	11.02	0.57	59.68	**1.808**	0.3	**1500**	2.3	85	0.606	**4.129**	56.78	56.49			0.35	0.20
31.1d	26.39	0.3500	0.77	0.27	19.51	11.29	0.58	58.77	**1.824**	0.4	**1500**	2.5	46	0.306	**4.422**	56.49	56.31	Building 36: 0.20	0.90	0.15	0.60
31.1b	26.69	0.1000	0.60	0.06	19.61	11.35	0.58	58.32	**1.820**	0.5	**1500**	2.9	62	0.360	**5.078**	56.31	55.99			0.10	0.60
31.1	27.05	0.8300	0.38	0.32	20.44	11.66	0.57	57.80	**1.854**	1.3	**1500**	4.5	43	0.158	**7.995**	56.33	55.78			0.83	0.38
30.12	15.00	0.8000	0.57	0.46	0.80	0.46	0.57	83.56	**0.105**	3.6	300	2.6	112	0.717	**0.184**	61.48	57.42			0.80	0.57
30.10	15.72	0.6320	0.20	0.13	1.43	0.58	0.41	81.31	**0.130**	0.5	1066	2.3	47	0.344	**2.032**	57.42	57.18			0.63	0.20
30.09	16.06	0.3600	0.50	0.18	1.79	0.76	0.43	80.28	**0.168**	0.3	1066	1.7	186	1.877	**1.474**	57.44	56.94			0.36	0.50
30.07	17.94	1.2900	0.20	0.26	3.08	1.02	0.33	75.13	**0.211**	0.3	1066	1.8	44	0.408	**1.604**	56.92	56.78			1.29	0.20
32.3	15.00	1.2400	0.82	1.01	1.24	1.01	0.82	83.56	**0.233**	0.7	**525**	1.7	70	0.695	**0.363**	59.50	59.00	Building 36: 0.20	0.90	1.04	0.80
32.1	15.69	0.0000	#DIV/0!	0.00	0.00	0.00	#DIV/0!	81.38	**0.000**	2.8	450	3.0	80	0.445	**0.476**	59.00	56.77				
30.6	18.35	0.9300	0.80	0.74	4.01	1.76	0.44	74.10	**0.360**	0.8	1066	2.8	123	0.728	**2.512**	56.77	55.81			0.93	0.80
30.4	27.21	0.8000	0.80	0.64	25.25	14.07	0.56	57.58	**2.227**	0.3	1524	2.4	87	0.611	**4.330**	55.71	55.41			0.80	0.80
30.3	27.82	0.7650	0.20	0.15	26.02	14.22	0.55	56.73	**2.218**	0.0	**1800**	0.9	75	1.384	**2.299**	55.41	55.38			0.77	0.20
30.2	29.21	0.8820	0.20	0.18	26.90	14.39	0.54	54.91	**2.274**	0.1	**1800**	1.5	158	1.727	**3.880**	55.38	55.20			0.88	0.20
30.1	30.93	0.0000	#DIV/0!	0.00	26.90	14.39	0.54	52.82	**2.191**	0.6	**1800**	3.5	35	0.167	**8.904**	55.20	54.99				
Outlet																					

STORM SEWER SYSTEM - NETWORK #2 - 1:2 Years -Without building roofs

Return Period 1:2	A	732.95	Coef Manning 0.013
	B	6.199	
Ottawa Airport	C	0.810	

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow **Q= KAIR** (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	**Δ A**	**Δ R**	**Δ AR**	**A**	**AR**	**R**	**I**	**K**=2.75E-3	**S**	**D**	**V**	**L**	**Tf**	**Q**	(m)	(m)	(ha)	c	(ha)	c
28.1	15.00	0.4096	0.70	0.29	0.41	0.29	0.70	61.77	**0.049**	0.4	305	**0.9**	26	0.505	**0.063**	57.28	57.18	**Building 39 + 8**	0.90	0.41	0.70
27.2	15.00	0.2700	0.57	0.15	0.27	0.15	0.57	61.77	**0.026**	0.2	305	**0.6**	20	0.539	**0.045**	57.22	57.18	**Building 29**	0.90	0.27	0.57
27.1	15.54	0.0000	#DIV/0!	0.00	0.68	0.44	0.65	60.52	**0.073**	0.6	305	1.1	84	1.286	**0.080**	57.22	56.70				
26.2	15.00	0.5800	0.47	0.27	0.58	0.27	0.47	61.77	**0.046**	1.7	381	2.1	50	0.398	**0.238**	57.55	56.70	**Building 33**	0.90	0.58	0.47
26.1	16.83	0.7000	0.80	0.56	1.96	1.27	0.65	57.77	**0.202**	2.0	457	2.6	35	0.228	**0.420**	56.70	56.00			0.70	0.80
Outlet																					

STORM SEWER SYSTEM - NETWORK #2 - 1:2 Years

Return Period 1:2	A	732.95	Coef Manning	0.013
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
28.1	15.00	0.4096	0.70	0.29	0.41	0.29	0.70	61.77	0.059	0.4	305	0.9	26	0.505	0.063	57.28	57.18	Building 39 + 8 realease rate 10l/s		0.41	0.70
27.2	15.00	0.4450	0.70	0.31	0.45	0.31	0.70	61.77	0.053	0.2	305	0.6	20	0.539	0.045	57.22	57.18	Building 29 0.18	0.90	0.27	0.57
27.1	15.54	0.0000	#DIV/0!	0.00	0.85	0.60	0.70	60.52	0.100	0.6	305	1.1	84	1.286	0.080	57.22	56.70				
26.2	15.00	0.7028	0.55	0.38	0.70	0.38	0.55	61.77	0.065	1.7	381	2.1	50	0.398	0.238	57.55	56.70	Building 33 0.12	0.90	0.58	0.47
26.1	16.83	0.7000	0.80	0.56	2.26	1.54	0.68	57.77	0.245	2.0	457	2.6	35	0.228	0.420	56.70	56.00			0.70	0.80
Outlet																					

STORM SEWER SYSTEM - NETWORK #2 - 1:5 Years

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin Building Area	Catchment basin Runoff Coefficient	Catchment basin Ground Area	Catchment basin Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
28.1	15.00	0.4096	0.70	0.29	0.41	0.29	0.70	83.56	**0.066**	0.4	305	**0.9**	26	0.505	**0.063**	57.28	57.18	**Building 39 + 8** **realease rate 10l/s**		0.41	0.70
27.2	15.00	0.4450	0.70	0.31	0.45	0.31	0.70	83.56	**0.072**	0.2	305	**0.6**	20	0.539	**0.045**	57.22	57.18	**Building 29** 0.18	0.90	0.27	0.57
27.1	15.54	0.0000	#DIV/0!	0.00	0.85	0.60	0.70	81.86	**0.135**	0.6	305	1.1	84	1.286	**0.080**	57.22	56.70				
26.2	15.00	0.7028	0.55	0.38	0.70	0.38	0.55	83.56	**0.088**	1.7	381	2.1	50	0.398	**0.238**	57.55	56.70	**Building 33** 0.12	0.90	0.58	0.47
26.1	16.83	0.7000	0.80	0.56	2.26	1.54	0.68	78.09	**0.331**	2.0	457	2.6	35	0.228	**0.420**	56.70	56.00			0.70	0.80
Outlet																					

STORM SEWER SYSTEM - NETWORK #2 - 1:5 Years - Increased diameter

Return Period 1:5	A	998.07	Coef Manning 0.013
	B	6.053	
Ottawa Airport	C	0.814	

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
28.1	15.00	0.8676	0.81	0.70	0.87	0.70	0.81	83.56	**0.161**	0.4	**450**	1.1	26	0.390	**0.177**	57.28	57.18	0.46	0.90	0.41	0.70
27.2	15.00	0.4450	0.70	0.31	0.45	0.31	0.70	83.56	**0.072**	0.2	**450**	**0.8**	20	0.416	**0.128**	57.22	57.18	0.18	0.90	0.27	0.57
27.1	15.42	0.0000	#DIV/0!	0.00	1.31	1.01	0.77	82.24	**0.228**	0.6	**525**	1.6	84	0.896	**0.338**	57.22	56.70				
26.2	15.00	0.7028	0.55	0.38	0.70	0.38	0.55	83.56	**0.088**	1.7	381	2.1	50	0.398	**0.238**	57.55	56.70	0.12	0.90	0.58	0.47
26.1	16.31	0.8228	0.68	0.56	2.84	1.95	0.69	79.55	**0.427**	2.0	**525**	2.8	35	0.208	**0.608**	56.70	56.00	0.12		0.70	0.80
Outlet																					

STORM SEWER SYSTEM - NETWORK #3 - 1:5 Years

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
23.1	15.00	0.2430	0.66	0.16	0.24	0.16	0.66	83.56	**0.037**	0.2	600	1.0	90	1.545	**0.275**	59.34	59.16	**Building 11** 0.07	0.90	0.17	0.56
23.3	16.54	0.4700	0.65	0.31	0.71	0.47	0.66	78.88	**0.102**	0.7	600	1.8	30	0.275	**0.514**	59.16	58.95	**Building 11** 0.23	0.90	0.24	0.42
23.3A	16.82	0.5850	0.86	0.50	1.30	0.97	0.75	78.10	**0.208**	0.5	600	1.5	42	0.456	**0.434**	57.12	56.91	**Building 20** 0.33	0.90	0.26	0.80
23.5	17.28	1.2600	0.53	0.67	2.56	1.64	0.64	76.86	**0.347**	0.4	600	1.4	78	0.950	**0.387**	56.91	56.60	**Building 16 et 17** 0.45	0.90	0.81	0.33
Outlet																					

STORM SEWER SYSTEM - NETWORK #4 - 1:5 Years

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
16.2	15.00	0.3200	0.22	0.07	0.32	0.07	0.22	83.56	**0.016**	0.1	381	**0.6**	46	1.323	**0.066**	56.78	56.72			0.32	0.22
16.1A	16.32	0.3200	0.34	0.11	0.64	0.18	0.28	79.51	**0.039**	0.5	381	1.2	57	0.816	**0.133**	56.72	56.42	Building 12		0.32	0.34
16.1	17.14	0.6000	0.49	0.29	1.24	0.47	0.38	77.23	**0.100**	0.3	600	1.1	34	0.507	**0.316**	56.42	56.33	0.22	0.90	0.38	0.25
Outlet																					

STORM SEWER SYSTEM - NETWORK #5 - 1:2 Years

Return Period 1:2			Coef Manning	0.013
	A	739.95		
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Catchment basin: Runoff Coefficient	Catchment basin: Ground Area	Catchment basin: Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
13.4	15.00	0.2300	0.90	0.21	0.23	0.21	0.90	62.36	**0.035**	2.2	375	2.4	35	0.248	**0.260**	65.84	65.07	Building 4: 0.23	0.90		
13.3A	15.25	0.1400	0.80	0.11	0.37	0.32	0.86	61.77	**0.054**	0.9	375	1.5	10	0.111	**0.166**	65.07	64.98			0.14	0.80
13.3	15.36	0.3500	0.80	0.28	0.72	0.60	0.83	61.52	**0.101**	0.5	375	1.1	10	0.148	**0.124**	65.15	65.10			0.35	0.80
13.2	15.51	0.0000	#DIV/0!	0.00	0.72	0.60	0.83	61.18	**0.101**	2.2	375	2.4	81	0.567	**0.263**	65.10	63.28				
13.1	16.07	1.4300	0.40	0.57	2.15	1.17	0.54	59.91	**0.193**	2.4	375	2.4	65	0.445	**0.269**	63.28	61.75	Building 3: 0.13	0.90	1.30	0.35
12.3B	15.00	0.2400	0.85	0.20	0.24	0.20	0.85	62.36	**0.035**	3.0	375	2.7	25	0.153	**0.302**	64.11	63.37	Building 1 et 31: 0.11	0.90	0.13	0.80
12.3	15.15	0.7800	0.68	0.53	1.02	0.73	0.72	62.00	**0.124**	5.4	375	3.7	55	0.248	**0.409**	63.25	60.26	Building 1: 0.43	0.90	0.35	0.40
12.1	16.52	0.1200	0.90	0.11	3.29	2.01	0.61	58.96	**0.326**	2.9	525	3.4	65	0.322	**0.727**	60.26	58.40	Building 13: 0.12	0.90		
11.1	15.00	0.0600	0.90	0.05	0.06	0.05	0.90	62.36	**0.009**	1.4	375	1.9	30	0.263	**0.210**	60.20	59.77	Building 37: 0.06	0.90		
11.1A	15.26	0.5150	0.62	0.32	0.58	0.37	0.65	61.74	**0.063**	0.6	375	1.2	65	0.917	**0.130**	59.74	59.38	Building 15: 0.19	0.90	0.33	0.45
11.2	16.18	0.2950	0.68	0.20	0.87	0.57	0.66	59.68	**0.094**	0.5	375	1.2	70	1.011	**0.127**	59.38	59.01	Building 25: 0.15	0.90	0.15	0.47
11.2C	17.19	0.9300	0.38	0.35	1.80	0.92	0.51	57.58	**0.146**	0.8	375	1.4	80	0.962	**0.153**	59.01	58.40	Building 25: 0.17	0.90	0.76	0.26
11.6	18.15	0.9300	0.38	0.35	6.02	3.28	0.55	55.73	**0.503**	1.5	525	2.4	35	0.241	**0.524**	58.40	57.88	Building 13: 0.17	0.90	0.76	0.26
Outlet																					

STORM SEWER SYSTEM - NETWORK #5 - 1:5 Years

Return Period 1:5	A	998.07	Coef Manning	0.013
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
13.4	15.00	0.2300	0.90	0.21	0.23	0.21	0.90	83.56	**0.048**	2.2	375	2.4	35	0.248	**0.260**	65.84	65.07	Building 4: 0.23	0.90		
13.3A	15.25	0.1400	0.80	0.11	0.37	0.32	0.86	82.77	**0.073**	0.9	375	1.5	10	0.111	**0.166**	65.07	64.98			0.14	0.80
13.3	15.36	0.3500	0.80	0.28	0.72	0.60	0.83	82.42	**0.136**	0.5	375	1.1	10	0.148	**0.124**	65.15	65.10			0.35	0.80
13.2	15.51	0.0000	#DIV/0!	0.00	0.72	0.60	0.83	81.95	**0.135**	2.2	375	2.4	81	0.567	**0.263**	65.10	63.28				
13.1	16.07	1.4300	0.40	0.57	2.15	1.17	0.54	80.24	**0.258**	2.4	375	2.4	65	0.445	**0.269**	63.28	61.75	Building 3: 0.13	0.90	1.30	0.35
12.3B	15.00	0.2400	0.85	0.20	0.24	0.20	0.85	83.56	**0.047**	3.0	375	2.7	25	0.153	**0.302**	64.11	63.37	Building 1 et 31: 0.11	0.90	0.13	0.80
12.3	15.15	0.7800	0.68	0.53	1.02	0.73	0.72	83.07	**0.167**	5.4	375	3.7	55	0.248	**0.409**	63.25	60.26	Building 1: 0.43	0.90	0.35	0.40
12.1	16.52	0.1200	0.90	0.11	3.29	2.01	0.61	78.95	**0.436**	2.9	525	3.4	65	0.322	**0.727**	60.26	58.40	Building 13: 0.12	0.90		
11.1	15.00	0.0600	0.90	0.05	0.06	0.05	0.90	83.56	**0.012**	1.4	375	1.9	30	0.263	**0.210**	60.20	59.77	Building 37: 0.06	0.90		
11.1A	15.26	0.5150	0.62	0.32	0.58	0.37	0.65	82.72	**0.084**	0.6	375	1.2	65	0.917	**0.130**	59.74	59.38	Building 15: 0.19	0.90	0.33	0.45
11.2	16.18	0.2950	0.68	0.20	0.87	0.57	0.66	79.93	**0.126**	0.5	375	1.2	70	1.011	**0.127**	59.38	59.01	Building 25: 0.15	0.90	0.15	0.47
11.2C	17.19	0.9300	0.38	0.35	1.80	0.92	0.51	77.09	**0.196**	0.8	375	1.4	80	0.962	**0.153**	59.01	58.40	Building 25: 0.17	0.90	0.76	0.26
11.6	18.15	0.9300	0.38	0.35	6.02	3.28	0.55	74.58	**0.673**	1.5	525	2.4	35	0.241	**0.524**	58.40	57.88	Building 13: 0.17	0.90	0.76	0.26
Outlet																					

STORM SEWER SYSTEM - NETWORK #5 - 1:5 Years - Increased diameter

Return Period 1:5	A	998.07
	B	6.053
Ottawa Airport	C	0.814

Coef Manning 0.013

	Concentration time (mn) Tc	Area (ha) Δ A	Catchment basin runoff Δ R	Impervious Area (ha) Δ AR	Total Area (ha) A	Total Impervious Area (ha) AR	Global Runoff Coefficient R	Rainfall Intensity (mm/h) I	Design flow Q= KAIR (m³/sec) K=2.75E-3	Conduit slope % S	Diameter (mm) D	Design full velocity (m/s) V	Conduit Length (m) L	Additional Concentration time (mn) Tf	Design full flow (m³/s) Q	Invert Elev U/S (m)	Invert Elev D/S (m)	Catchment basin: Building	Catchment basin: Building Area (ha)	Catchment basin: Runoff Coefficient c	Catchment basin: Ground Area (ha)	Catchment basin: Runoff Coefficient c
13.4	15.00	0.2300	0.90	0.21	0.23	0.21	0.90	83.56	**0.048**	2.2	375	2.4	35	0.248	**0.260**	65.84	65.07	Building 4	0.23	0.90		
13.3A	15.25	0.1400	0.80	0.11	0.37	0.32	0.86	82.77	**0.073**	0.9	375	1.5	10	0.111	**0.166**	65.07	64.98				0.14	0.80
13.3	15.36	0.3500	0.80	0.28	0.72	0.60	0.83	82.42	**0.136**	0.5	**450**	1.3	10	0.131	**0.202**	65.15	65.10				0.35	0.80
13.2	15.49	0.0000	#DIV/0!	0.00	0.72	0.60	0.83	82.01	**0.135**	2.2	375	2.4	81	0.567	**0.263**	65.10	63.28					
13.1	16.06	1.4300	0.40	0.57	2.15	1.17	0.54	80.29	**0.259**	2.4	375	2.4	65	0.445	**0.269**	63.28	61.75	Building 3	0.13	0.90	1.30	0.35
12.3B	15.00	0.2400	0.85	0.20	0.24	0.20	0.85	83.56	**0.047**	3.0	375	2.7	25	0.153	**0.302**	64.11	63.37	Building 1 et 31	0.11	0.90	0.13	0.80
12.3	15.15	0.7800	0.68	0.53	1.02	0.73	0.72	83.07	**0.167**	5.4	375	3.7	55	0.248	**0.409**	63.25	60.26	Building 1	0.43	0.90	0.35	0.40
12.1	16.50	0.1200	0.90	0.11	3.29	2.01	0.61	79.00	**0.436**	2.9	525	3.4	65	0.322	**0.727**	60.26	58.40	Building 13	0.12	0.90		
11.1	15.00	0.0600	0.90	0.05	0.06	0.05	0.90	83.56	**0.012**	1.4	375	1.9	30	0.263	**0.210**	60.20	59.77	Building 37	0.06	0.90		
11.1A	15.26	0.5150	0.62	0.32	0.58	0.37	0.65	82.72	**0.084**	0.6	375	1.2	65	0.917	**0.130**	59.74	59.38	Building 15	0.19	0.90	0.33	0.45
11.2	16.18	0.2950	0.68	0.20	0.87	0.57	0.66	79.93	**0.126**	0.5	375	1.2	70	1.011	**0.127**	59.38	59.01	Building 25	0.15	0.90	0.15	0.47
11.2C	17.19	0.9300	0.38	0.35	1.80	0.92	0.51	77.09	**0.196**	0.8	**450**	1.6	80	0.852	**0.249**	59.01	58.40	Building 25	0.17	0.90	0.76	0.26
11.6	18.04	0.9300	0.38	0.35	6.02	3.28	0.55	74.86	**0.676**	1.5	**600**	2.6	35	0.220	**0.748**	58.40	57.88	Building 13	0.17	0.90	0.76	0.26
Outlet																						

N6009 - CARLETON UNIVERSITY - STORM SEWER SYSTEM - NETWORK #6 - 1:2 Years

Return Period 1:2			Coef Manning	0.013
	A	732.95		
	B	6.199		
Ottawa Airport	C	0.810		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
62.1	15.00	2.1000	0.48	1.01	2.10	1.01	0.48	61.77	**0.171**	1.5	450	2.2	65	0.492	**0.350**	63.46	62.48			2.10	0.48
60.3	15.49	0.5200	0.56	0.29	2.62	1.30	0.50	60.63	**0.217**	2.4	450	2.8	15	0.090	**0.442**	61.41	61.05	**Building 38** 0.20	0.90	0.32	0.35
60.2	15.58	0.5200	0.56	0.29	3.14	1.59	0.51	60.43	**0.265**	4.9	450	4.0	15	0.063	**0.629**	60.11	59.38	**Building 24 et 37** 0.20	0.90	0.32	0.35
61.1	15.65	0.0000	#DIV/0!	0.00	3.14	1.59	0.51	60.29	**0.264**	0.9	450	1.7	17	0.163	**0.277**	59.36	59.20				
Outlet																					

STORM SEWER SYSTEM - NETWORK #6- 1:5 Years

Return Period 1:5	A	998.07	Coef Manning 0.013
	B	6.053	
Ottawa Airport	C	0.814	

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
62.1	15.00	2.1000	0.48	1.01	2.10	1.01	0.48	83.56	**0.232**	1.5	450	2.2	65	0.492	**0.350**	63.46	62.48			2.10	0.48
60.3	15.49	0.5200	0.56	0.29	2.62	1.30	0.50	82.00	**0.293**	2.4	450	2.8	15	0.090	**0.442**	61.41	61.05	**Building 38** 0.20	0.90	0.32	0.35
60.2	15.58	0.5200	0.56	0.29	3.14	1.59	0.51	81.72	**0.358**	4.9	450	4.0	15	0.063	**0.629**	60.11	59.38	**Building 24 et 37** 0.20	0.90	0.32	0.35
61.1	15.65	0.0000	#DIV/0!	0.00	3.14	1.59	0.51	81.53	**0.357**	0.9	450	1.7	17	0.163	**0.277**	59.36	59.20				
Outlet																					

STORM SEWER SYSTEM - NETWORK #6 - 1:5 Years - Increased diameter

Return Period 1:5			Coef Manning	0.013
	A	998.07		
	B	6.053		
Ottawa Airport	C	0.814		

	Concentration time (mn)	Area (ha)	Catchment basin runoff	Impervious Area (ha)	Total Area (ha)	Total Impervious Area (ha)	Global Runoff Coefficient	Rainfall Intensity (mm/h)	Design flow Q= KAIR (m³/sec)	Conduit slope %	Diameter (mm)	Design full velocity (m/s)	Conduit Length (m)	Additional Concentration time (mn)	Design full flow (m³/s)	Invert Elev U/S	Invert Elev D/S	Catchment basin: Building Area	Runoff Coefficient	Ground Area	Runoff Coefficient
	Tc	Δ A	Δ R	Δ AR	A	AR	R	I	K=2.75E-3	S	D	V	L	Tf	Q	(m)	(m)	(ha)	c	(ha)	c
62.1	15.00	2.1000	0.48	1.01	2.10	1.01	0.48	83.56	**0.232**	1.5	450	2.2	65	0.492	**0.350**	63.46	62.48			2.10	0.48
60.3	15.49	0.5200	0.56	0.29	2.62	1.30	0.50	82.00	**0.293**	2.4	450	2.8	15	0.090	**0.442**	61.41	61.05	Building 38: 0.20	0.90	0.32	0.35
60.2	15.58	0.5200	0.56	0.29	3.14	1.59	0.51	81.72	**0.358**	4.9	450	4.0	15	0.063	**0.629**	60.11	59.38	Building 24 et 37: 0.20	0.90	0.32	0.35
61.1	15.65	0.0000	#DIV/0!	0.00	3.14	1.59	0.51	81.53	**0.357**	0.9	**525**	1.9	17	0.147	**0.417**	59.36	59.20				
Outlet																					

BUILDINGS

1. TORY BUILDING
2. MACODRUM LIBRARY
3. PATERSON HALL
4. SOUTHAM HALL
5. RENFREW HOUSE
6. LANARK HOUSE
7. UNIVERSITY CENTRE
8. GYMNASIUM
9. ATHLETICS BUILDING
10. C.J. MACKENZIE BUILDING
11. MAINTENANCE BUILDING
12. STEACIE BUILDING
13. HERZBERG BUILDING
14. RUSSELL HOUSE
    GRENVILLLE HOUSE
15. LOEB BUILDING
16. H.H.J. NESBITT BIOLOGY
17. ROBERTSON HALL
18. GLENGARRY HOUSE
19. RESIDENCE COMMONS
20. PARKING GARAGE
21. DUNTON TOWER
22. ARCHITECTURE BUILDING
23. ST. PATRICK'S BUILDING
24. SOCIAL SCIENCE RESEARCH BLDG
25. LIFE SCIENCE RESEARCH BLDG
26. STORMONT DUNDAS HOUSE
27. MINTO C.A.S.E.
28. CHILD CARE
29. C.T.T.C. BUILDING
30. LEEDS RESIDENCE
31. AZRIELI THEATRE
32. AZRIELI PAVILION
33. NATIONAL WILDLIFE RESEARCH CENTRE
34. PRESCOTT HOUSE
35. FIELD HOUSE
36. ALUMNI HALL AND SPORTS CENTRE
37. HUMAN COMPUTER INTER. BUILDING
38. VIRTUAL SIMULATION BUILDING
39. ICE HOUSE
40. TENNIS CENTRE
72. BRONSON SUBSTATION

P:\6000-6099\6009 CARLETON U. INFRASTRUCTURE STUDY\DRAWINGS\MECHANICAL\6009M_LARGE DRAWING_BW.DWG

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Website: www.genivar.com

CARLETON UNIVERSITY
INFRASTRUCTURE STUDY
STORM PIPING SERVICE
EXISTING

scale	date	drawn	job no.	dwg. no.
N.T.S.	28/11/07	G.G.	6009	MSK-6

Appendix F

Storm Sewer Design Calculations

1. Existing Conditions & Release Rate

Carleton University new Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

Existing Drainage Area Characteristics

Drainage Area (see C900)	Area, A (ha)	Runoff Coefficient, R
A1	0.17	0.30
A2	0.032	0.90
A3	0.113	0.30
A4	0.256	0.90
A5	0.127	0.54
A6	0.024	0.30
Total	0.722	0.58

Asphalt Area:	R = 0.90
Grassy Area:	R = 0.30
Building Area:	R = 0.90
Gravel Area:	R = 0.50
Concrete Area:	R = 0.90

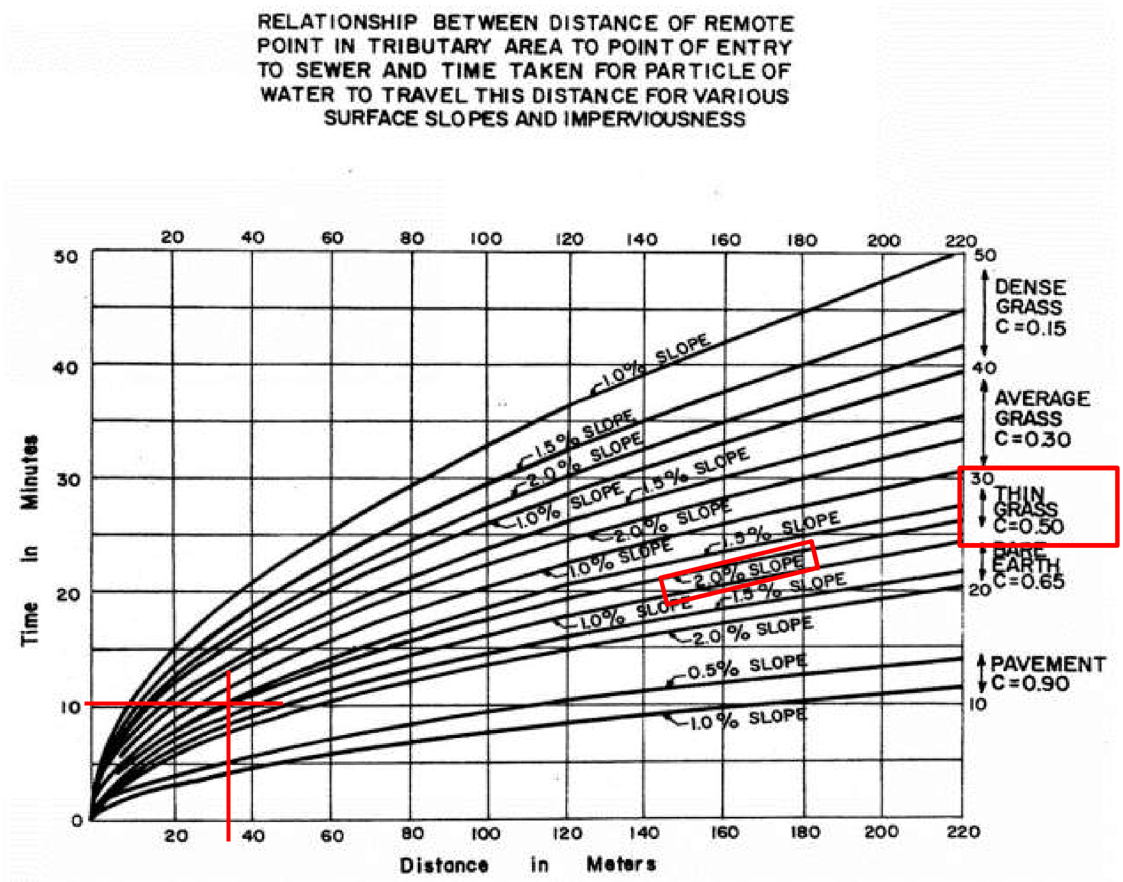
Existing Conditions

Q = RAIN where Q = runoff rate (L/s)
R = runoff coefficient
i = rainfall intensity (mm/hr)
A = drainage area (ha)
N = 2.78

and $i = \frac{A}{(T_d + C)^B}$

Determinination of Time of Concentration, using Inlet Time Graph (City of Ottawa Sewer Design Guidelines, Appendix 5D):

Existing drainage area with longest flow path = A1
Approx. length of longest flow path (remote point to point of entry) = 35 m
Surface type = Thin grass
Approximate surface slope = >2%



T_d = Time of Concentration = 10 (min)

Return Period (Years)	A	B	C	Intensity, I (mm/hr)	Area (ha)	Runoff Coefficient, R (Note 1)	Runoff Rate, Q (L/s)
2	732.951	0.81	6.199	76.8	0.722	0.58	89.5
5	998.071	0.814	6.053	104.2	0.722	0.58	121.5
100	1735.688	0.82	6.014	178.6	0.722	0.73	260.2

Note 1: For 100-year event, Runoff Coefficient is increased by 25% to a maximum of 1.0.

Allowable Release Rate

Criteria for calculation of allowable release rate:

Return Period 2 year (to suit capacity of downstream sewers)
Maximum Runoff Coefficient 0.5
Time of Concentration 10 minutes

Return Period (Years)	A	B	C	Intensity, I (mm/hr)	Area (ha)	Runoff Coefficient, R	Runoff Rate, Q (L/s)
2	732.951	0.81	6.199	76.8	0.722	0.50	77.1

Allowable release rate from site in 100-year storm is 77.1 L/s

2. Proposed Uncontrolled Flow

Carleton University new Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

Summary of All Proposed Drainage Areas

Drainage Area (see C901)	Area, A (ha)	Runoff Coefficient, R (5-year event)	Runoff Coefficient, R (100-year event, Note 1)
A1	0.176	0.67	0.84
A2	0.013	0.90	1.00
A3	0.025	0.90	1.00
A4	0.026	0.44	0.55
A5	0.102	0.90	1.00
B1	0.075	0.55	0.69
B2	0.046	0.72	0.90
BLDG	0.260	0.90	1.00
Total	0.723	0.78	0.91

(Refer to Proposed Storm Drainage Area Plan)

Proposed Uncontrolled Drainage Area Characteristics

Drainage Area	Area, A (ha)	Runoff Coefficient, R (5-year event)	Runoff Coefficient, R (100-year event, Note 1)
B1	0.075	0.55	0.69
B2	0.046	0.72	0.90
Total	0.121	0.62	0.77

(Refer to Proposed Storm Drainage Area Plan)

Note 1: For 100-year event, Runoff Coefficient is increased by 25% to a maximum of 1.0.

Runoff coefficients used in calculations:

Asphalt Area:	R = 0.90
Grassy Area:	R = 0.30
Building Area:	R = 0.90
Gravel Area:	R = 0.50
Permeable Pavers	R = 0.60
Concrete Area:	R = 0.90

Proposed Uncontrolled Runoff

Q = RAIN where Q = runoff rate (L/s)

R = runoff coefficient
i = rainfall intensity (mm/hr)
A = drainage area (ha)
N = 2.78

and $i = \frac{A}{(T_d + C)^B}$

T_d = Time of Concentration = 10 (min)

Return Period (Years)	A	B	C	Intensity, I (mm/hr)	Area (ha)	Runoff Coefficient	Runoff Rate, Q (L/s)
5	998.071	0.814	6.053	104.2	0.121	0.62	21.6
100	1735.688	0.82	6.014	178.6	0.121	0.77	46.3

Remaining Allowable Release Rate

Total Allowable Release Rate 77.1 (L/s)
Uncontrolled Runoff (100 year) 46.3 (L/s)
Remaining Allowable Release Rate 30.8 (L/s)

Runoff from remaining drainage areas in 100-year event will be controlled to 30.8 L/s

3a. Proposed Storage (South Tank)
Carleton University New Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

Proposed Controlled Drainage Area Characteristics

Drainage Area	Area, A (ha)	Runoff Coefficient, R (5-year event)	Runoff Coefficient, R (100-year event, Note 1)
BLDG	0.260	0.90	1.00
A1	0.176	0.67	0.84
A2	0.013	0.90	1.00
A3	0.025	0.90	1.00
A4	0.026	0.30	0.38
Total	0.500	0.79	0.91

(Refer to Proposed Storm Drainage Area Plan)
Note 1: For 100-year event, Runoff Coefficient is increased by 25% to a maximum of 1.0.

Allowable Release Rate from storage (100-year event) = 24.79 (L/s)
Average release rate for calculation of storage volume = 12.40 (L/s) (Conservatively estimated as 50% of allowable release rate)

Orifice Sizing

Q = CA(2gH)^0.5
C = 0.61
Design Flow Rate = 24.79 (L/s)
Proposed 100-year tank depth = 1.80 (m)
Proposed 100-year head above centreline of orifice = 1.63 (m)
Orifice Area = 7186 (mm2)
Orifice diameter = 96 (mm) (if <83mm then vortex ICD required)
Refer to Sheet 5a for detailed orifice calculations

Release Rates during 5-year event

Water depth during 5-year event = 0.97 (m) (based on result of Req. Storage Vol. calc below)
Proposed 5-year head above centreline of orifice = 0.80 (m)
Maximum release rate during 5-year event = 18.93 (L/s) (based on orifice calculation)
Average release rate during 5-year event = 9.47 (L/s) (Refer to attached calculation sheet)

Required Storage Volume (using Modified Rational Method)

Q = RAIN

Q = runoff rate (L/s)

R = runoff coefficient

i = rainfall intensity (mm/hr)

A = drainage area (ha)

N = 2.78

$$i = \frac{A}{(T_d + C)^B}$$

where i = Rainfall Intensity (mm/hr)

T_d = Time of Concentration (min)

Time, Td (min)	5-Year Event: Intensity (mm/hr)	5-Year Event: Peak Flow (L/s)	5-Year Event: Average Release Rate (L/s)	5-Year Event: Storage Volume (m^3)	100-Year Event: Intensity (mm/hr)	100-Year Event: Peak Flow (L/s)	100-Year Event: Average Release Rate (L/s)	100-Year Event: Storage Volume (m^3)
10	104.19	114.1	9.47	62.8	178.56	195.5	12.40	109.9
15	83.56	91.5	9.47	73.8	142.89	156.4	12.40	129.6
20	70.25	76.9	9.47	80.9	119.95	131.3	12.40	142.7
25	60.90	66.7	9.47	85.8	103.85	113.7	12.40	151.9
30	53.93	59.0	9.47	89.2	91.87	100.6	12.40	158.7
40	44.18	48.4	9.47	93.4	75.15	82.3	12.40	167.7
50	37.65	41.2	9.47	95.3	63.95	70.0	12.40	172.9
60	32.94	36.1	9.47	95.8	55.89	61.2	12.40	175.7
80	26.56	29.1	9.47	94.1	44.99	49.3	12.40	176.9
100	22.41	24.5	9.47	90.4	37.90	41.5	12.40	174.6
120	19.47	21.3	9.47	85.3	32.89	36.0	12.40	170.1
140	17.27	18.9	9.47	79.3	29.15	31.9	12.40	164.0
160	15.56	17.0	9.47	72.6	26.24	28.7	12.40	156.8
180	14.18	15.5	9.47	65.4	23.90	26.2	12.40	148.8
200	13.05	14.3	9.47	57.8	21.98	24.1	12.40	140.1
220	12.10	13.2	9.47	49.9	20.37	22.3	12.40	130.8
240	11.29	12.4	9.47	41.7	19.01	20.8	12.40	121.1
260	10.60	11.6	9.47	33.3	17.83	19.5	12.40	111.1
280	9.99	10.9	9.47	24.7	16.80	18.4	12.40	100.7
300	9.46	10.4	9.47	15.9	15.89	17.4	12.40	90.1
320	8.98	9.8	9.47	7.0	15.09	16.5	12.40	79.2
340	8.56	9.4	9.47	-2.0	14.37	15.7	12.40	68.0

minimum time = time of concentration

	Storage volume used 95.8 m^3	Storage volume used 176.9 m^3

A storage tank with a minimum volume of 176.9 m^3 is required.

4a. Tank Draindown Time (South Tank)

Carleton University new Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

Release Rate from Storage Tank

Equation 4.10 from MOE Stormwater Design Guidelines:

$$t = \frac{2A_P}{CA_P(2g)^{0.5}}\left(h_1^{\ 0.5} - h_2^{\ 0.5}\right)$$

where:

Tank Volume	178.0	cu.m
Water depth when full, h1	1.8	m
Water depth when empty, h2	0.0	m
Orifice coefficient, C	0.61	
Acceleration due to gravity, g	9.81	m/s²
Tank Area, Ap	98.9	sq.m (rectangular tank with vertical sides)

Incremental draindown calculation (100-year event), based on equivalent orifice to proposed ICD:

Water depth at start of step, h1 (m)	Water depth at end of step, h1 (m)	Duration of step, t (s)	Release rate (L/s)
1.80	1.75	191	25.9
1.75	1.70	194	25.5
1.70	1.65	197	25.1
1.65	1.60	200	24.8
1.60	1.55	203	24.4
1.55	1.50	206	24.0
1.50	1.45	210	23.6
1.45	1.40	213	23.2
1.40	1.35	217	22.8
1.35	1.30	221	22.4
1.30	1.25	226	21.9
1.25	1.20	230	21.5
1.20	1.15	235	21.0
1.15	1.10	240	20.6
1.10	1.05	246	20.1
1.05	1.00	252	19.7
1.00	0.95	258	19.2
0.95	0.90	265	18.7
0.90	0.85	272	18.2
0.85	0.80	280	17.6
0.80	0.75	289	17.1
0.75	0.70	299	16.5
0.70	0.65	310	16.0
0.65	0.60	322	15.3
0.60	0.55	336	14.7
0.55	0.50	352	14.1
0.50	0.45	370	13.4
0.45	0.40	391	12.7
0.40	0.35	416	11.9
0.35	0.30	447	11.1
0.30	0.25	486	10.2
0.25	0.20	538	9.2
0.20	0.15	610	8.1
0.15	0.10	724	6.8
0.10	0.05	943	5.2
0.05	0.00	2,278	2.2
	Total draindown duration	13,665	seconds
		4	hours

Average release rate (by water depth) **17.3 L/s**

Incremental draindown calculation (5-year event), based on equivalent orifice to proposed ICD:

Water depth at start of step, h1 (m)	Water depth at end of step, h1 (m)	Duration of step, t (s)	Release rate (L/s)
0.99	0.94	259	19.1
0.94	0.89	266	18.6
0.89	0.84	274	18.1
0.84	0.79	282	17.5
0.79	0.74	291	17.0
0.74	0.69	301	16.4
0.69	0.64	312	15.8
0.64	0.59	325	15.2
0.59	0.54	339	14.6
0.54	0.49	355	13.9
0.49	0.44	374	13.2
0.44	0.39	395	12.5
0.39	0.34	422	11.7
0.34	0.29	454	10.9
0.29	0.24	495	10.0
0.24	0.19	550	9.0
0.19	0.14	629	7.9
0.14	0.09	755	6.5
0.09	0.04	1,019	4.9
0.04	0.00	2,037	1.9
	Total draindown duration	8,097	seconds
		2	hours

Average release rate (by water depth) **12.7** **L/s**

5b. ICD Sizing (South Tank)

Carleton University New Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

ICD sizing - 100 year

100-yr elevation 62.55 m
Invert elevation 60.77 m
Outlet pipe dia 300 mm

Orifice Sizing:

100-yr depth 1.63 m (depth above centreline of orifice)
Design flow 24.8 l/s
Orifice area 7186 mm² (calculated by Orifice Equation: $Q=CA(2gh)^{0.5}$ where C=0.61)
Orifice diameter 96 mm (if less than 75mm then vortex ICD required)

ICD sizing - 5 year

5-yr elevation 61.89 m
Invert elevation 60.77 m
Outlet pipe dia 300 mm

Orifice Sizing:

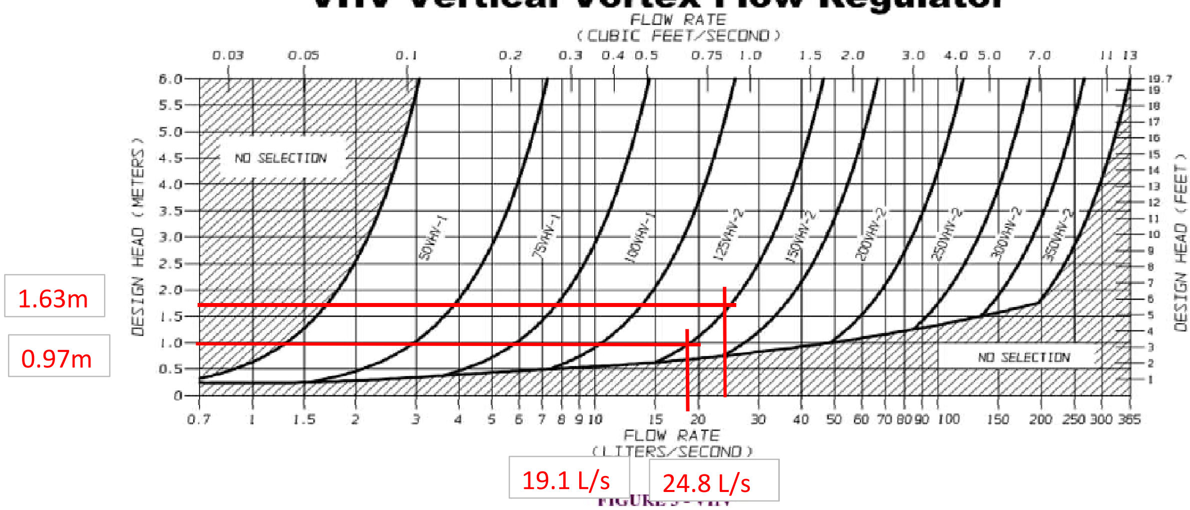
5-yr depth 0.97 m (depth above centreline of orifice)
Design flow 19.1 l/s

STMH401				
DESIGN EVENT	**DIAMETER OF OUTLET PIPE**	**ICD**	**DESIGN FLOW (l/s)**	**UPSTREAM HEAD (m)**
1:5 YR	300mm	HYDROVEX 125VHV-2	19.1	0.97
1:100 YR	300mm	HYDROVEX 125VHV-2	24.8	1.63

HYDROVEX VHV ICD Design Chart:

HYDROVEX®

VHV Vertical Vortex Flow Regulator



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3b. Proposed Storage (North Tank)
Carleton University New Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

Proposed Controlled Drainage Area Characteristics

Drainage Area	Area, A (ha)	Runoff Coefficient, R (5-year event)	Runoff Coefficient, R (100-year event, Note 1)
A5	0.102	0.90	1.00
Total	0.102	0.90	1.00

(Refer to Proposed Storm Drainage Area Plan)
Note 1: For 100-year event, Runoff Coefficient is increased by 25% to a maximum of 1.0.

Allowable Release Rate from storage (100-year event) = 6.00 (L/s)
Average release rate for calculation of storage volume = 3.00 (L/s) (Conservatively estimated as 50% of allowable release rate)

Orifice Sizing

Q = CA(2gH)^0.5
C = 0.61
Design Flow Rate = 6.0 (L/s)
Proposed 100-year tank depth = 1.20 (m)
Proposed 100-year head above centreline of orifice = 2.33 (m)
Orifice Area = 1456 (mm2)
Orifice diameter = 43 (mm) (if <83mm then vortex ICD required)
Refer to Sheet 5 for Vortex ICD selection

Release Rates during 5-year event

Water depth during 5-year event = 0.65 (m) (based on result of Req. Storage Vol. calc below)
Proposed 5-year head above centreline of orifice = 1.78 (m)
Maximum release rate during 5-year event = 4.50 (L/s) (based on ICD performance, see Sheet 5)
Average release rate during 5-year event = 2.25 (L/s) (Conservatively estimated as 50% of allowable release rate)

Required Storage Volume (using Modified Rational Method)

Q = RAIN

Q = runoff rate (L/s)

R = runoff coefficient

i = rainfall intensity (mm/hr)

A = drainage area (ha)

N = 2.78

$$i = \frac{A}{(T_d + C)^B}$$

where i = Rainfall Intensity (mm/hr)

T_d = Time of Concentration (min)

	5-Year Event				100-Year Event			
Time, Td (min)	Intensity (mm/hr)	Peak Flow (L/s)	Average Release Rate (L/s)	Storage Volume (m^3)	Intensity (mm/hr)	Peak Flow (L/s)	Average Release Rate (L/s)	Storage Volume (m^3)
10	104.19	26.6	2.25	14.6	178.56	45.6	3.00	25.5
15	83.56	21.3	2.25	17.2	142.89	36.5	3.00	30.1
20	70.25	17.9	2.25	18.8	119.95	30.6	3.00	33.1
25	60.90	15.5	2.25	19.9	103.85	26.5	3.00	35.3
30	53.93	13.8	2.25	20.7	91.87	23.4	3.00	36.8
40	44.18	11.3	2.25	21.7	75.15	19.2	3.00	38.8
50	37.65	9.6	2.25	22.1	63.95	16.3	3.00	40.0
60	32.94	8.4	2.25	22.2	55.89	14.3	3.00	40.6
80	26.56	6.8	2.25	21.7	44.99	11.5	3.00	40.7
100	22.41	5.7	2.25	20.8	37.90	9.7	3.00	40.0
120	19.47	5.0	2.25	19.6	32.89	8.4	3.00	38.8
140	17.27	4.4	2.25	18.1	29.15	7.4	3.00	37.3
160	15.56	4.0	2.25	16.5	26.24	6.7	3.00	35.5
180	14.18	3.6	2.25	14.8	23.90	6.1	3.00	33.5
200	13.05	3.3	2.25	13.0	21.98	5.6	3.00	31.3
220	12.10	3.1	2.25	11.1	20.37	5.2	3.00	29.0
240	11.29	2.9	2.25	9.1	19.01	4.9	3.00	26.6
260	10.60	2.7	2.25	7.1	17.83	4.5	3.00	24.2
280	9.99	2.5	2.25	5.0	16.80	4.3	3.00	21.6
300	9.46	2.4	2.25	2.9	15.89	4.1	3.00	19.0
320	8.98	2.3	2.25	0.8	15.09	3.9	3.00	16.3
340	8.56	2.2	2.25	-1.4	14.37	3.7	3.00	13.6

minimum time = time of concentration

Storage volume used	22.2 m^3	Storage volume used	40.7 m^3

A storage tank with a minimum volume of 40.7 m^3 is required.

4b. Tank Draindown Time (North Tank)

Carleton University new Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

Release Rate from Storage Tank

Equation 4.10 from MOE Stormwater Design Guidelines:

$$t = \frac{2A_P}{CA_P(2g)^{0.5}}\left(h_1{}^{0.5} - h_2{}^{0.5}\right)$$

where:

Tank Volume	40.7 cu.m	
Water depth when full, h1	1.2 m	
Water depth when empty, h2	0.0 m	
Orifice coefficient, C	0.61	
Acceleration due to gravity, g	9.81 m/s²	
Tank Area, Ap	33.9 sq.m	(rectangular tank with vertical sides)

Incremental draindown calculation (100-year event), based on equivalent orifice to proposed ICD:

Water depth at start of step, h1 (m)	Water depth at end of step, h1 (m)	Duration of step, t (s)	Release rate (L/s)
1.20	1.15	398	4.3
1.15	1.10	406	4.2
1.10	1.05	416	4.1
1.05	1.00	426	4.0
1.00	0.95	436	110.7
0.95	0.90	448	3.8
0.90	0.85	461	3.7
0.85	0.80	475	3.6
0.80	0.75	490	3.5
0.75	0.70	506	3.3
0.70	0.65	525	3.2
0.65	0.60	545	3.1
0.60	0.55	568	3.0
0.55	0.50	595	2.9
0.50	0.45	626	2.7
0.45	0.40	661	2.6
0.40	0.35	704	2.4
0.35	0.30	757	2.2
0.30	0.25	823	2.1
0.25	0.20	910	1.9
0.20	0.15	1,033	1.6
0.15	0.10	1,225	1.4
0.10	0.05	1,597	1.1
	Total draindown duration	15,029	seconds
		4	hours

Average release rate (by water depth) **7.6 L/s**

Incremental draindown calculation (5-year event), based on equivalent orifice to proposed ICD:

Water depth at start of step, h1 (m)	Water depth at end of step, h1 (m)	Duration of step, t (s)	Release rate (L/s)
0.64	0.59	111	15.2
0.59	0.54	116	14.6
0.54	0.49	122	13.9
0.49	0.44	128	13.2
0.44	0.39	136	12.5
0.39	0.34	145	11.7
0.34	0.29	156	10.9
0.29	0.24	170	10.0
0.24	0.19	189	9.0
0.19	0.14	216	7.9
0.14	0.09	259	6.5
0.09	0.04	349	4.9
0.04	0.00	699	1.9
	Total draindown duration	2,096	seconds
		1	hours

Average release rate (by water depth) 10.2 L/s

5b. Vortex ICD Sizing (North Tank)

Carleton University New Residence

Project No.	190444600
Date	13-May-20
Prepared By:	D Glauser
Checked By	J Fookes

ICD sizing - 100 year

100-yr elevation	64.55 m
Invert elevation	62.10 m
Outlet pipe dia	250 mm

Orifice Sizing:

100-yr depth	2.33 m (depth above centreline of orifice)
Design flow	6.0 l/s
Orifice area	1456 mm² (calculated by Orifice Equation: $Q=CA(2gh)^{0.5}$ where C=0.61)
Orifice diameter	43 mm (if less than 75mm then vortex ICD required)

ICD sizing - 5 year

5-yr elevation	64.01 m
Invert elevation	62.10 m
Outlet pipe dia	250 mm

Orifice Sizing:

5-yr depth	1.78 m (depth above centreline of orifice)
Design flow	4.5 l/s

MHST1				
DESIGN EVENT	DIAMETER OF OUTLET PIPE	ICD	DESIGN FLOW (l/s)	UPSTREAM HEAD (m)
1:5 YR	250mm	HYDROVEX 75VHV-1	4.5	1.78
1:100 YR	250mm	HYDROVEX 75VHV-1	6.0	2.33

HYDROVEX VHV ICD Design Chart:

HYDROVEX®

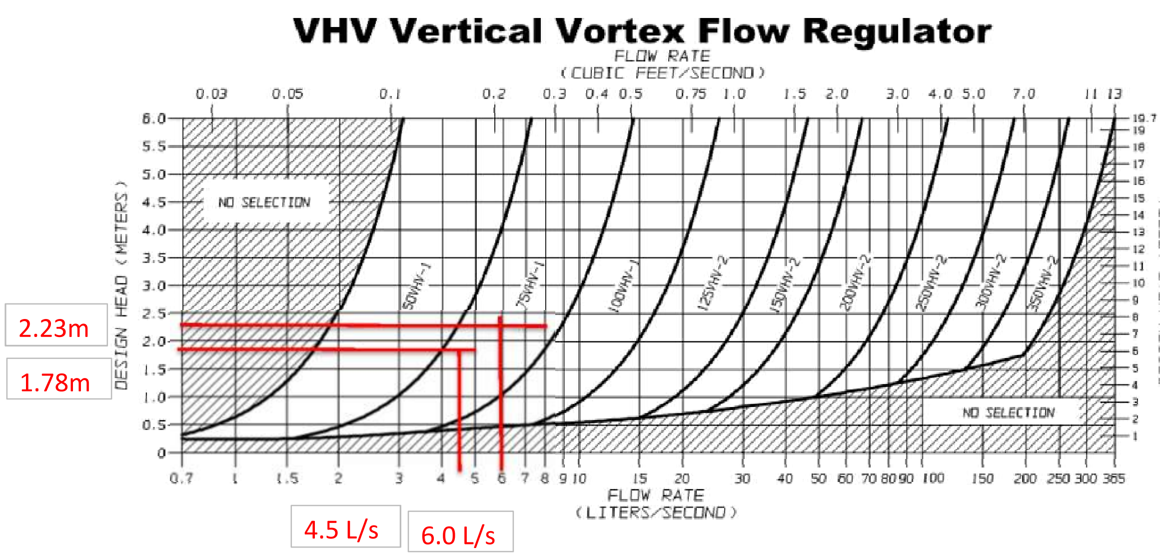

FIGURE 3 - VHV

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6. PROPOSED STORM SEWER CALCULATION SHEET

Carleton University New Residence

LOCATION					INDIVIDUAL							CUMULATIVE		DESIGN					PROPOSED SEWER											
Description (see C901)	From	Top of Cover	To	Top of Cover	Asphalt Area	Lawn Areas	Bldg. Area	Gravel Area	Conc. Area	Total	R*A*N	Area	R*A*N	Time of Conc.	Storm Event Return Period	Rainfall Intensity	Peak Flow		Length	Size	Area	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert	Notes
		(m)		(m)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(year)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(m^2)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)	
BLDG	BLDG		Storage				0.260			0.260	0.651	0.260	0.651	10.00	100.00	178.56	116.2	0.116	1.4	450	0.159	1.429	0.20	340.8	2.14	0.01	224.6	64.55	64.53	
A1	CB9		CBMH1		0.140			0.070		0.210	0.448	0.210	0.448	10.00	100.00	178.56	79.9	0.080	20	250	0.049	2.000	0.43	84.1	1.71	0.19	4.2	63.20	62.80	
A2	CBMH1		Storage		0.010					0.010	0.025	0.220	0.473	10.19	100.00	176.80	83.6	0.084	13.6	250	0.049	2.059	0.43	85.3	1.74	0.13	1.8	62.77	62.49	
A3	CB6+CB7		Storage		0.030					0.030	0.075	0.250	0.548	10.00	100.00	178.56	97.8	0.098												
A4	CB5		STMH401			0.030				0.030	0.025	0.280	0.025	10.00	100.00	178.56	4.5	0.004	21	250	0.049	3.333	0.43	108.6	2.21	0.16	104.1	63.30	62.60	
	STMH401		STMH304									0.790	1.223	10.16	2.00	76.20	93.2	0.093	13.4	250	0.049	3.284	0.43	107.8	2.20	0.10	14.5	61.94	61.50	
A5	CB1		Storage		0.100					0.100	0.278	0.100	0.278	10.00	100.00	178.56	49.6	0.050	3	250	0.049	2.000	0.43	84.1	1.71	0.03	34.5	63.90	63.84	
	Storage		STMH501							0.000	0.000	0.100	0.278	10.03	100.00	178.29	49.6	0.050	2	250	0.049	2.000	0.43	84.1	1.71	0.02	34.5	63.45	63.41	
	STMH501		STMH101							0.000	0.000	0.100	0.278	10.05	2.00	76.62	21.3	0.021	6	250	0.049	2.000	0.43	84.1	1.71	0.06	62.8	63.38	63.26	

Q = RAIN, where

Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.90
Grassy Area: R = 0.30
Building Area: R = 0.90
Gravel Area: R = 0.50
Concrete Area: R = 0.90

Mannings Roughness Coefficient = 0.013

Prepared By: Daniel Glauser

Checked by: James Fookes

Date: August 11, 2020

Project No. 190444600

7a. Curb Inlet/Catch Basin 100-yr Ponding Depth

Carleton University New Residence

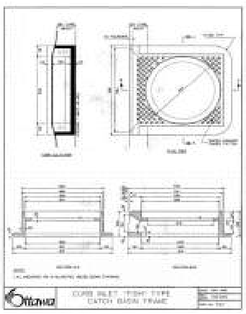
	190444600
	11-Aug-20
	D Glauser
	J Fookes

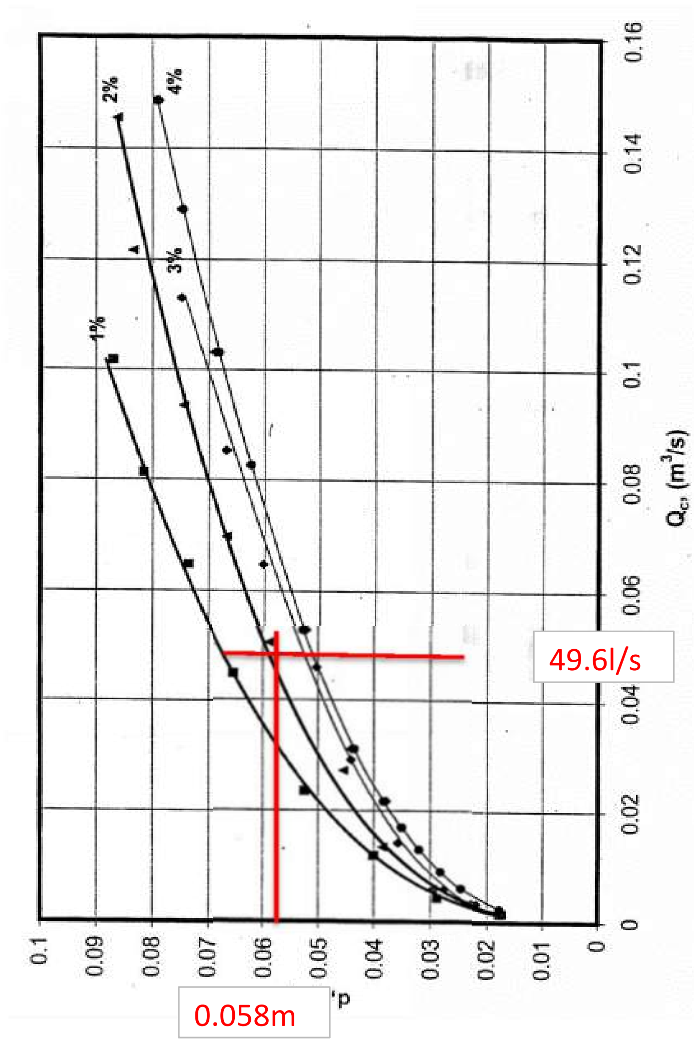
Figure A

The highest 100-year flow to a singlecurb inlet catchbasin is at CB1 (49.6 L/s). The ponding depth under this flow rate is 58mm.

Summary of d (depth) Vs. Q_c for 'road sag' condition[15]

Type S22 Curb Inlet Catch Basin





7b. Curb Inlet/Catch Basin 100-yr Ponding Depth

Carleton University New Residence

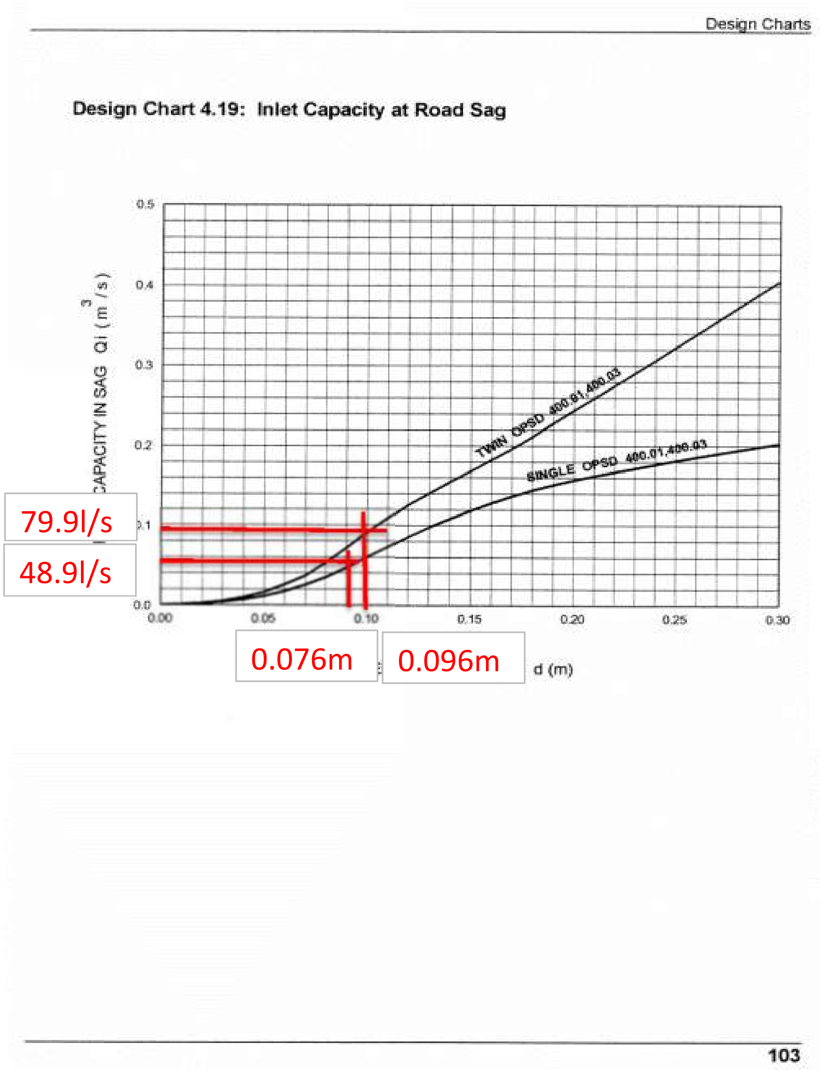
	190444600
	11-Aug-20
	D Glauser
	J Fookes

Figure B

The highest 100-year flow to a single inlet flat grate catchbasin is at CB6 (48.9 L/s). The ponding depth under this flow rate is 96 mm.

The highest 100-year flow to a dual inlet catchbasin is at CBMH9 (79.9L/s). The ponding depth under this flow rate is 76 mm.

Surface Inlet Capacity At Road Sags[8]



7c. Curb Inlet/Catch Basin 100-yr Ponding Depth

Carleton University New Residence

	190444600
	11-Aug-20
	D Glauser
	J Fookes

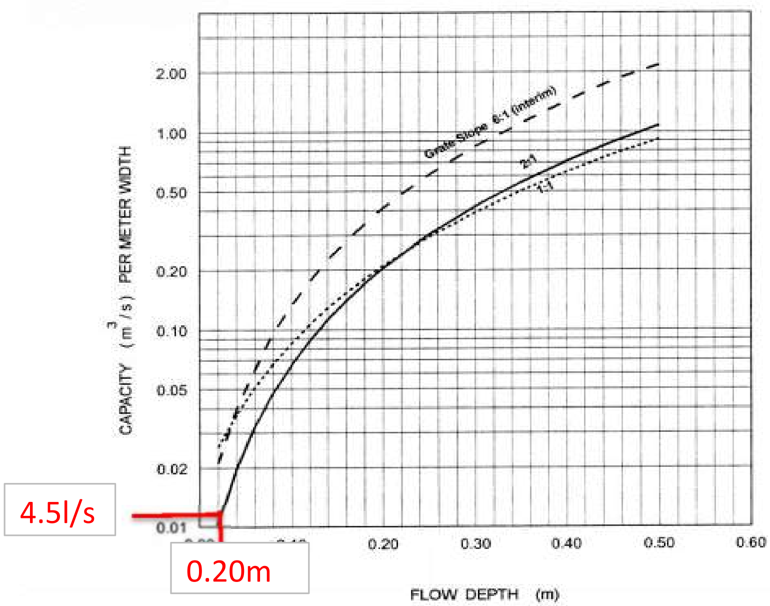
Figure C

The highest 100-year flow to a single inlet flat grate catchbasin is at CB6 (4.5 L/s). The ponding depth under this flow rate is 20 mm.

Ditch Inlet Capture Curves[17]

MTO Drainage Management Manual

Design Chart 4.20: Ditch Inlet Capacity



Notes:

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

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Summary - Stormwater Management
Carleton University New Residence

Project No.	190444600
Date	11-Aug-20
Prepared By:	D Glauser
Checked By	J Fookes

Area ID	Area (ha)	Allowable Release Rates (L/s)		Storage Required		Max Storage Available		ICD	
		5-Yr	100-Yr	5-Yr	100-Yr	5-Yr	100-Yr	Size	Location
BLDG+A1+A2+A3+A4	0.50	18.9	24.8	95.8	176.9	178.0	178.0	HYDROVEX 125VHV-2	SWM Tank South
A5	0.102	4.5	6.0	22.2	40.7	42.0	42.0	HYDROVEX 75VHV-1	SWM Tank North
Total	0.60	23.4	30.8	117.9	217.6	220.0	220.0	-	-

ICD Table: A2+P1										
Area ID	Location of ICD	ICD Type	Orifice Diameter	Controlled Flow (L/s)		Ponding Elevation (m)		Storage Volume (m^3)		Max Storage Available (m^3)
				5-Yr	100-Yr	5-Yr	100-Yr	5-Yr	100-Yr	
BLDG+A1+A2+A3+A4	SWM Tank South	HYDROVEX 125VHV-2	-	18.93	24.79	61.89	62.55	178.00	178.00	178.00
A5	SWM Tank North	HYDROVEX 75VHV-1	-	4.50	6.00	1.78	64.55	42.00	42.00	42.00
Total				23.43	30.79					

EXISTING STORM SEWER CALCULATION SHEET

Carelton U New Residence

1:5 Year Storm

LOCATION					INDIVIDUAL									CUMULATIVE	
Description (see C800)	From	Top of Cover	To	Top of Cover	Catchment Area	Landscaped Area (ha)	Lawn Areas	Bldg. Area	Gravel Area	Other	ΔR	Total	R*A*N	Area	R*A*N
		(m)		(m)		(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(ha)	
Catchment A - Leeds to St. Patrick	MH44-4		MH44-3		A1		0.204	0.130			0.534	0.334	0.170	0.334	0.170
	MH44-3		MH44-2		A2	0.071	0.105				0.542	0.175	0.264	0.509	0.434
	MH44-2		MH44-1		A3		0.191				0.300	0.191	0.159	0.700	0.593
	MH44-1		MH43-3		A4	0.016	0.073	0.100			0.668	0.189	0.351	0.889	0.944
Catchment B - Grenville House to St. Particks to Dundas	MH43-8		MH43-7		B1	0.013	0.190				0.337	0.202	0.189	0.202	0.189
	MH43-7		MH43-6		B2	0.021	0.116	0.020			0.457	0.157	0.200	0.359	0.389
	MH43-6		MH43-5		B3	0.048	0.150	0.100			0.598	0.298	0.495	0.657	0.884
	MH43-5		MH43-4											0.657	0.884
	MH43-4		MH43-3		B4	0.021	0.059				0.458	0.080	0.102	0.737	0.986
Catchment C - Stormont-Dundas	MH41-4C		MH41-4B		C1	0.118	0.063				0.691	0.181	0.347	0.181	0.347
	MH41-4B		MH41-4		C2	0.028	0.382	0.084			0.436	0.494	0.598	0.675	0.945
Catchment D - Leeds and Dundas and Propsed Site Area	MH43-3		MH42-3		D1	0.023	0.073				0.444	0.096	0.118	1.722	2.048
	MH42-3		MH42-1					0.130			0.900	0.130	0.325	1.852	2.374
	MH42-1		MH41-5		D2	0.170	0.110	0.130			0.739	0.410	0.517	2.262	2.891
	MH41-6		MH41-5		D3	0.408	0.697				0.521	1.105	1.601	1.105	1.601
	MH41-5		MH41-4		D4	0.150	0.070				0.709	0.220	0.434	2.482	3.324
	MH41-4		MH41-3		D5	0.083					0.900	0.083	0.206	2.564	3.531

From	To	DESIGN							EXISTING SEWER												
From	To	Time of Conc.	Storm Event Return Period	Rainfall Intensity	Flow from Catchments	External Contributing Flow	Peak Flow		Length	Size	Area	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert	Notes
		(min.)	(year)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3/s)	(m)	(mm)	(m^2)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)	
MH44-4	MH44-3	10.00	5.00	104.19	17.73	19.88	**37.61**	**0.038**	33	300	0.071	0.485	0.34	67.33	0.95	0.58	29.73	60.38	60.22	• Receives flow from back of Leeds building though CB412. CB412 is inlet contorlled with a flow rate of 15 L/s (Aecom 2010 Site Imporvements) • Recieves half of Leeds buidling. Leeds rood drains are controlled with a total flow rate of 9.76 L/s (See Leeds as-built)
MH44-3	MH44-2	10.58	5.00	101.24	63.79		**63.79**	**0.064**	19	300	0.071	0.579	0.34	73.58	1.04	0.30	9.79	60.09	59.98	
MH44-2	MH44-1	10.88	5.00	99.76	79.00		**79.00**	**0.079**	39	300	0.071	0.154	0.34	37.93	0.54	1.21	(41.07)	59.95	59.89	
MH44-1	MH43-3	12.09	5.00	94.30	108.88		**108.88**	**0.109**	30	300	0.071	0.400	0.34	61.16	0.87	0.58	(47.72)	59.83	59.71	Recives flow from half of St. Patrick's building roof
MH43-8	MH43-7	10.00	5.00	104.19	19.73		**19.73**	**0.020**	54	300	0.071	1.074	0.34	100.22	1.42	0.63	80.49	61.54	60.96	
MH43-7	MH43-6	10.63	5.00	100.96	39.27		**39.27**	**0.039**	52	300	0.071	0.288	0.34	51.94	0.73	1.18	12.67	60.62	60.47	
MH43-6	MH43-5	11.81	5.00	95.50	84.46		**84.46**	**0.084**	49	300	0.071	0.122	0.34	33.84	0.48	1.71	(50.62)	60.47	60.41	
MH43-5	MH43-4	13.52	5.00	88.66	78.42		**78.42**	**0.078**	27	300	0.071	0.444	0.34	64.47	0.91	0.49	(13.95)	60.41	60.29	Recives flow from half of St. Patrick's building roof
MH43-4	MH43-3	14.01	5.00	86.89	85.69		**85.69**	**0.086**	34	300	0.071	0.912	0.34	92.34	1.31	0.43	6.65	60.29	59.98	
MH41-4C	MH41-4B	10.00	5.00	104.19	36.13		**36.13**	**0.036**	40	250	0.049	0.050	0.43	13.30	0.27	2.46	(22.83)	61.20	61.18	
MH41-4B	MH41-4	12.46	5.00	92.77	87.66		**87.66**	**0.088**	48	300	0.071	4.896	0.34	213.97	3.03	0.26	126.30	61.18	58.83	Recieves flow from Stormont house roof
MH43-3	MH42-3	14.45	5.00	85.39	174.90		**174.90**	**0.175**	43	300	0.071	0.302	0.34	53.17	0.75	0.95	(121.73)	59.71	59.58	Recieves flows from Catchments A & B
MH42-3	MH42-1	15.40	5.00	82.29	195.32		**195.32**	**0.195**	23	300	0.071	0.522	0.34	69.85	0.99	0.39	(125.47)	59.56	59.44	Recieves flow from Dundas house roof
MH42-1	MH41-5	15.79	5.00	81.09	234.42	4.88	**239.30**	**0.239**	45	300	0.071	0.756	0.34	84.05	1.19	0.63	(155.25)	59.44	59.10	Recieves half of Leeds buidling. Leeds rood drains are controlled with a total flow rate of 9.76 L/s (See Leeds as-built)
MH41-6	MH41-5	15.00	5.00	83.56	133.76		**133.76**	**0.134**	74.5	450	0.159	1.289	0.20	323.64	2.03	0.61	189.88	60.06	59.10	• Pipe from new parking strucutre and northern area • Took area of grass area pre-development of the parking structure, assuming when they built it they restricted the flow to 5-year pre-development
MH41-5	MH41-4	16.42	5.00	79.24	263.42		**263.42**	**0.263**	61	450	0.159	0.246	0.20	141.38	0.89	1.14	(122.04)	59.01	58.86	
MH41-4	MH41-3	17.56	5.00	76.10	268.69		**268.69**	**0.269**	71	525	0.21648	0.775	0.16	378.52	1.75	0.68	109.82	58.83	58.28	

Q = RAIN, where

Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area:	R =	0.90
Lawn Area:	R =	0.30
Building Area:	R =	0.90
Gravel Area:	R =	0.50
Landscaped Area:	R =	0.90

Mannings Roughness Coefficient = 0.013

Prepared By: Noah Chauvin

Checked by: James Fookes

Date: March 13, 2020

Project No. 190444600

PROPOSED RELOCATED STORM SEWER CALCULATION SHEET

Carleton University New Residence Building

LOCATION					INDIVIDUAL								CUMULATIVE		DESIGN					PROPOSED SEWER												
Description (see C801)	From	Top of Cover	To	Top of Cover	Catchment Area	Asphalt Area	Lawn Areas	Bldg. Area	Gravel Area	Other	Total	R*A*N	Area	R*A*N	Time of Conc.	Storm Event Return Period	Rainfall Intensity	Peak Flow		Length	Size	Area	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Percent Full	Upstream Invert	Downstream Invert	Notes
		(m)		(m)		(ha)	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(year)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(m^2)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(%)	(m)	(m)	
Future Northern Development Area	*MH41-6*		*STMH101*		*EC1*					*2.920*	*2.920*	*4.059*	*2.920*	*4.059*	*10.00*	*5.00*	*104.19*	*422.90*	*0.423*	*74.5*	*450*	*0.159*	*0.336*	*0.20*	*165.16*	*1.04*	*1.20*	*(257.74)*		*60.06*	*59.81*	*The STM sewer connecting P-18 to the existing system lacks the capacity to convey the water from the proposed northern development. Calculations are based on the assumption that the entire northern area will be designed to restrict storm flows to the 2-year pre-development flow rate with a max runoff coefficient of 0.5.*
Campus Ave.	STMH501		STMH101		PrA1	0.102					0.102	0.255	0.102	0.255	10.00	5.00	104.19	26.59	0.027	5.9	250	0.049	1.190	0.43	64.87	1.32	0.07	38.28	41	63.39	63.32	Northern tank outlet, designed assuming no inlet control as per SPA requirements.
	STMH101		STMH102								0.000	0.000	1.898	2.638	10.07	5.00	103.80	300.44	0.300	11.6	600	0.283	0.340	0.13	358.03	1.27	0.15	57.59	84	59.25	59.21	Assumed to receive 65% of flow from future northern development in order to facilitate design of proposed storm sewers
	STMH102		STMH103		PrB1	0.011					0.011	0.028	1.943	2.751	10.23	5.00	103.01	309.95	0.310	24.7	600	0.283	0.320	0.13	347.34	1.23	0.34	37.39	89	59.21	59.13	
					EC2	0.034					0.034	0.085																				
	STMH103		STMH104		EC3	0.035					0.035	0.089	1.978	2.839	10.56	5.00	101.31	314.26	0.314	36.5	600	0.283	0.360	0.13	368.41	1.30	0.47	54.15	85	59.13	59.00	
	STMH104		STMH105								0.000	0.000	1.978	2.839	11.03	5.00	99.05	307.84	0.308	11.6	600	0.283	0.430	0.13	402.63	1.42	0.14	94.79	76	59.00	58.95	
Southern Existing Area (See existing catchment drawing)	*MH43-3*		*MH42-3*			*0.023*	*0.073*				*0.096*	*0.118*	*1.722*	*2.048*	*14.45*	*5.00*	*85.39*	*174.90*	*0.00*	*43*	*300*	*0.07069*	*0.302*	*0.34*	*53.17*	*0.75*	*0.95*	*(121.73)*		*59.71*	*59.58*	*The total cumulative area represents area upstream of MH 42-3 (specifically Leeds, Dundas and Russell house as well as St. Patrick's Building). The upstream sewer's have been identified in the Infrastructure Master Plan as unable to convey the 5-yr event and will need to be upsized as part of a separate contract*
Fire Access & Building	STMH301		STMH302								0.000	0.000	1.022	1.421	10.00	5.00	104.19	152.89	0.153	34.3	375	0.110	1.750	0.25	231.94	2.10	0.27	79.05	66	60.18	59.58	• Half of Leed's, controlled to 9.76 L/s total (4.88 each) • Assumed to receive the remaining 35% of flow from the future northern development
	STMH302		STMH303					0.130			0.130	0.325	2.874	3.794	15.40	5.00	82.29	465.11	0.465	23.8	600	0.283	0.840	0.13	562.75	1.99	0.20	97.64	83	59.55	59.35	
	STMH303		STMH304		PrB3	0.056	0.059				0.114	0.188	3.105	4.174	15.60	5.00	81.67	493.77	0.494	21.3	600	0.283	0.890	0.13	579.26	2.05	0.17	85.49	85	59.35	59.16	
					EC4	0.057	0.060				0.117	0.192																				
	STMH401		STMH304		PrA2	0.147	0.093	0.260			0.500	1.096	0.500	1.096	10.00	5.00	104.19	114.17	0.114	13.5	300	0.071	3.260	0.34	174.60	2.47	0.09	60.42	65	61.94	61.50	Southern tank outlet, designed assuming no inlet control
	STMH304		STMH305								0.000	0.000	3.605	5.270	15.69	5.00	81.39	428.90	0.429	13.1	600	0.283	0.690	0.13	510.04	1.80	0.12	81.14	84	59.13	59.04	
	STMH305		*MH41-4*					0.130			0.130	0.325	3.735	5.595	15.81	5.00	81.02	453.32	0.453	9.6	600	0.283	0.730	0.13	524.61	1.86	0.09	71.29	86	59.04	58.97	
Existing Sewers	*MH41-4*		*MH41-3*		*PrB2*	*0.028*					*0.028*	*0.070*	*3.826*	*5.824*	*10.07*	*5.00*	*103.81*	*604.65*	*0.605*	*69.4*	*600*	*0.283*	*0.920*	*0.13*	*588.94*	*2.08*	*0.56*	*(15.71)*		*58.91*	*58.27*	*The down stream sewer's have been identified in the Infrastructure Master Plan as unable to convey the 5-yr event and will need to be upsized as part of a separate*
					EC4	*0.064*					*0.064*	*0.159*																				

Q = RAIN, where
Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

EC: External Contributing Area
PrA: Proposed Controlled Area
PrB: Proposed Uncontrolled Area

Asphalt Area:	R = 0.90
Lawn Area:	R = 0.30
Building Area:	R = 0.90
Gravel Area:	R = 0.70
Landscaped Area:	R = 0.90

Manning's Roughness Coefficient = 0.013

Prepared By: **N.Chauvin**

Checked by: **E. Emery**

Date: March 13, 2020

Project No. 190444600

6. PROPOSED NEW STORM SEWER CALCULATION SHEET

Carleton University New Residence

LOCATION					INDIVIDUAL							CUMULATIVE		DESIGN					PROPOSED SEWER											
Description (see C901)	From	Top of Cover	To	Top of Cover	Asphalt Area	Lawn Areas	Bldg. Area	Gravel Area	Conc. Area	Total	R*A*N	Area	R*A*N	Time of Conc.	Storm Event Return Period	Rainfall Intensity	Peak Flow		Length	Size	Area	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert	Notes
		(m)		(m)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(year)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(m^2)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)	
BLDG	BLDG		Storage S				0.260			0.260	0.651	0.260	0.651	10.00	100.00	178.56	116.2	0.116	1.4	300	0.071	2.143	0.34	141.6	2.00	0.01	25.4	61.62	61.59	
A1	CBMH9		CBMH1		0.140			0.070		0.210	0.448	0.210	0.448	10.00	100.00	178.56	79.9	0.080	21.2	300	0.071	1.981	0.34	136.1	1.93	0.18	56.2	61.56	61.14	
A2	CBMH1		Storage S		0.010					0.010	0.025	0.220	0.473	10.18	100.00	176.90	83.6	0.084	14.3	300	0.071	2.028	0.34	137.7	1.95	0.12	54.1	61.14	60.85	
A3	CB6+CB7		Storage S		0.030					0.030	0.075	0.250	0.548	10.00	100.00	178.56	97.8	0.098												These CB's will drain directly into storage
A4	CB5		STMH401			0.030				0.030	0.025	0.280	0.025	10.00	100.00	178.56	4.5	0.004	21	250	0.049	3.333	0.43	108.6	2.21	0.16	104.1	63.30	62.60	
	STMH401		STMH304									0.790	1.223	10.16	5.00	103.36	126.4	0.126	13.4	300	0.071	3.284	0.34	175.2	2.48	0.09	48.8	61.94	61.50	
A5	CB1		Storage N		0.100					0.100	0.278	0.100	0.278	10.00	100.00	178.56	49.6	0.050	3	250	0.049	2.000	0.43	84.1	1.71	0.03	34.5	63.90	63.84	
	Storage		STMH501							0.000	0.000	0.100	0.278	10.03	100.00	178.29	49.6	0.050	2	250	0.049	2.000	0.43	84.1	1.71	0.02	34.5	63.45	63.41	
	STMH501		STMH101							0.000	0.000	0.100	0.278	10.05	5.00	103.94	28.9	0.029	6	250	0.049	2.000	0.43	84.1	1.71	0.06	55.2	63.38	63.26	

Q = RAIN, where

Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.90
Grassy Area: R = 0.30
Building Area: R = 0.90
Gravel Area: R = 0.50
Concrete Area: R = 0.90

Mannings Roughness Coefficient = 0.013

Prepared By: Daniel Glauser

Checked by: James Fookes

Date: March 13, 2020

Project No. 1904446000

PRODUCT DATASHEET

ACO StormBrixx stormwater attenuation and infiltration range

ACO StormBrixx is a unique and patented plastic geocellular stormwater management system. Its versatile design allows the system to be used in applications across all construction environments as a standalone solution or as part of an integrated sustainable urban drainage (SuDS) scheme.

The patented brickbonding and cross bonding feature provides a strong, long term installation and also helps to improve the construction speed of the tank.

ACO StormBrixx simplifies delivery, site logistics and installation as a result of its stackable design. For each delivery of StormBrixx, up to 4 loads of competitor product may be required, making StormBrixx approximately 75% more efficient in delivery.

ACO StormBrixx addresses the fundamental requirement of access and maintenance for SuDS Approval Boards (SABS) and water companies. The open cell structure permits completely free access for CCTV and jetting equipment which allows the whole system, including all the extremities, to be inspected and maintained from just a few access points.

The range consists of ACO StormBrixx HD (Heavy-duty) which has a depth to invert of up to 6.0m and includes man access and 3D inspection access units, plus the new ACO StormBrixx SD (Standard-duty) which has a depth to invert of up to 4.5m and includes access plates to allow easy access for CCTV and jetting equipment.

StormBrixx HD

StormBrixx SD

KEY BENEFITS

- Allows **three dimensional unrestricted flow** of water
- **High void ratio** minimises excavation volume
- **Brick bonded** and **cross bonding** for optimum stability
- **Stackable 'nested' design** improves build efficiency through dramatically simplified delivery, on site storage and handling during installation
- **Fully certified performance**
- **Man access** and 3D inspection access to tank interior (HD)
- **Low flow, drain down** and **silt management** facility
- Manufactured from **recyclable polypropylene**
- **50/60 year design life**

STRUCTURAL INTEGRITY

The patented brickbonding and cross bonding feature enables strong, long term installation and improved construction speed of the tank.

SIMPLIFIED HANDLING AND LOGISTICS

Each single injection moulded body nestles optimising logistical and installation costs, thus helping to reduce carbon footprint of the system.

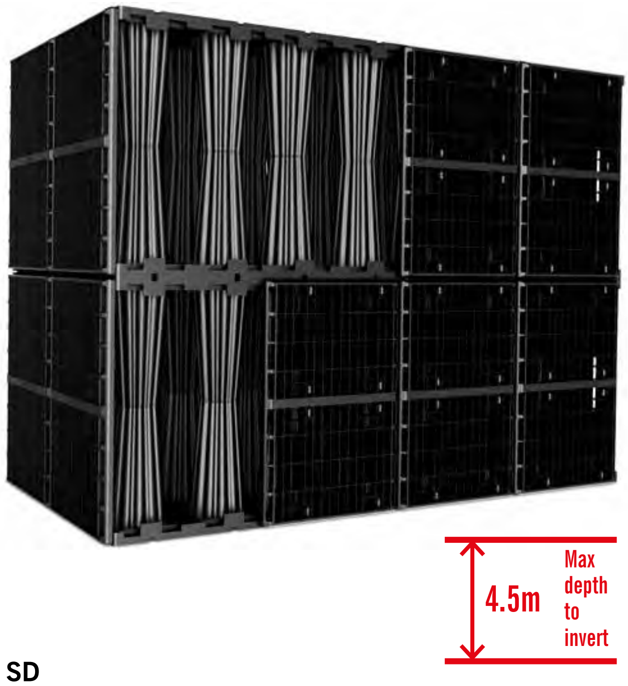
ACCESS AND MAINTENANCE

The whole system, including all the extremities can be inspected and maintained from just a few access points thanks to the open cell structure.

The stackable design reduces transportation costs and improves the carbon footprint of the product

Example:
280m³ storage volume is required for project A.
Using ACO StormBrixx the project requirement can be transported on a single vehicle whereas up to four vehicles may be required for other comparable systems.

MAIN COMPONENTS

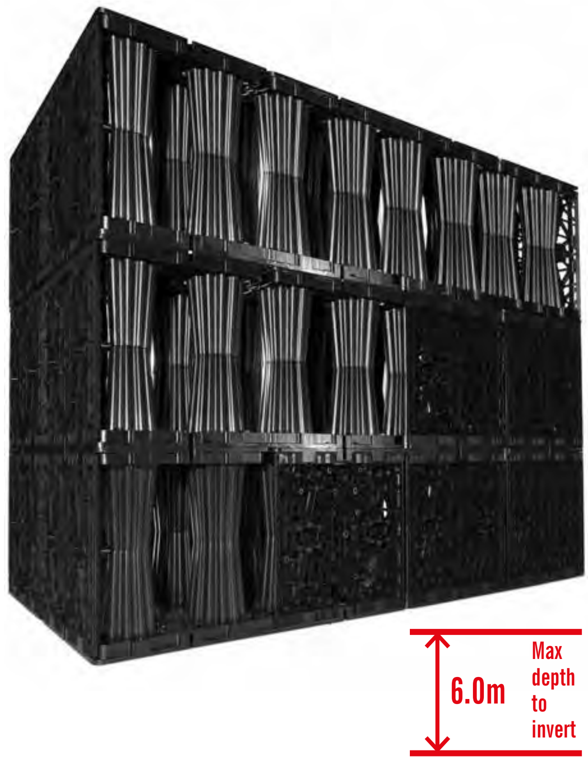


SD

Technical specification	
No. of assembled units per m³ 1 assembled unit = 2 half bodies (1.2 x 0.6 x 0.914)	1.52
Gross storage volume (m³)	0.658
Nett storage volume (m³)	0.638
Void ratio	97%
Short term vertical compressive strength	350kN/m²
Short term lateral compressive strength	70kN/m²

Components overview - dimensions and weights

Product code	Description	Length (mm)	Width (mm)	Height (mm)	Weight (kg)
314125	Half Body	1200	600	494	9.41
314126	Side Panel	907	592	104	3.13
314127	Top Cover	550	550	45	0.76
314093	Connectors	53.4	44.2	26.5	0.1
314075	Remote access plate	650	650	120	4.74



HD

Technical specification	
No. of assembled units per m³ 1 assembled unit = 2 half bodies (1.2 x 0.6 x 0.61)	2.28
Gross storage volume (m³)	0.439
Nett storage volume (m³)	0.417
Void ratio	95%
Short term vertical compressive strength	455kN/m²
Short term lateral compressive strength	95kN/m²

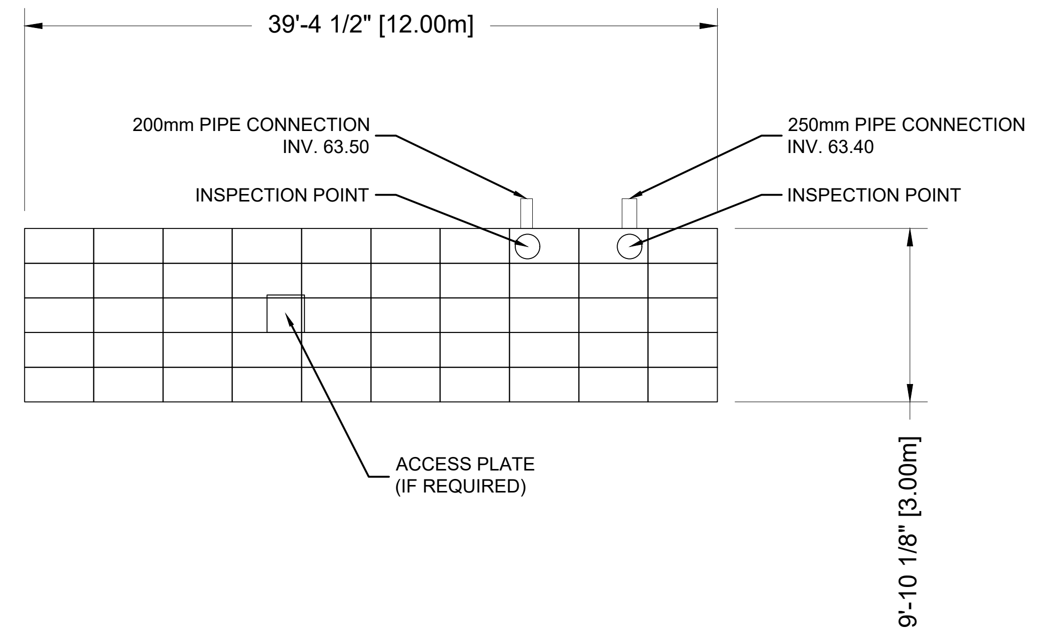
Components overview - dimensions and weights

Product code	Description	Length (mm)	Width (mm)	Height (mm)	Weight (kg)
314020	Half Body	1200	600	305	10
314021	Side Panel	600	600	55	1.6
314022	Top Cover	548	548	43	0.8
314023	Connectors	100	40	46	0.1

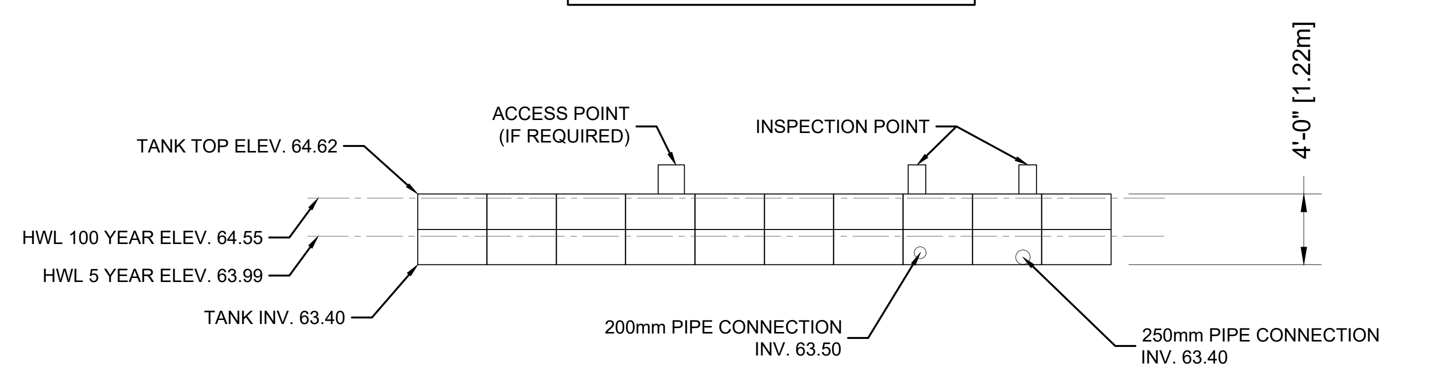
ACO Pty Ltd
134-140 Old Bathurst Road, Emu Plains NSW 2750
Tel: +61 2 4747 4000 Fax: +61 2 4747 4040
Email: sales@acoaus.com.au Website: www.acoaus.com.au

NORTH DETENTION TANK
2 LAYER STOMRBRIXX HD
GROSS VOLUME = 43.92m3
NET VOLUME = 41.72m3
OVERALL HEIGHT = 1.22m
TANK BOTTOM INV. 63.40
TANK TOP ELEV. 64.62

TOP VIEW

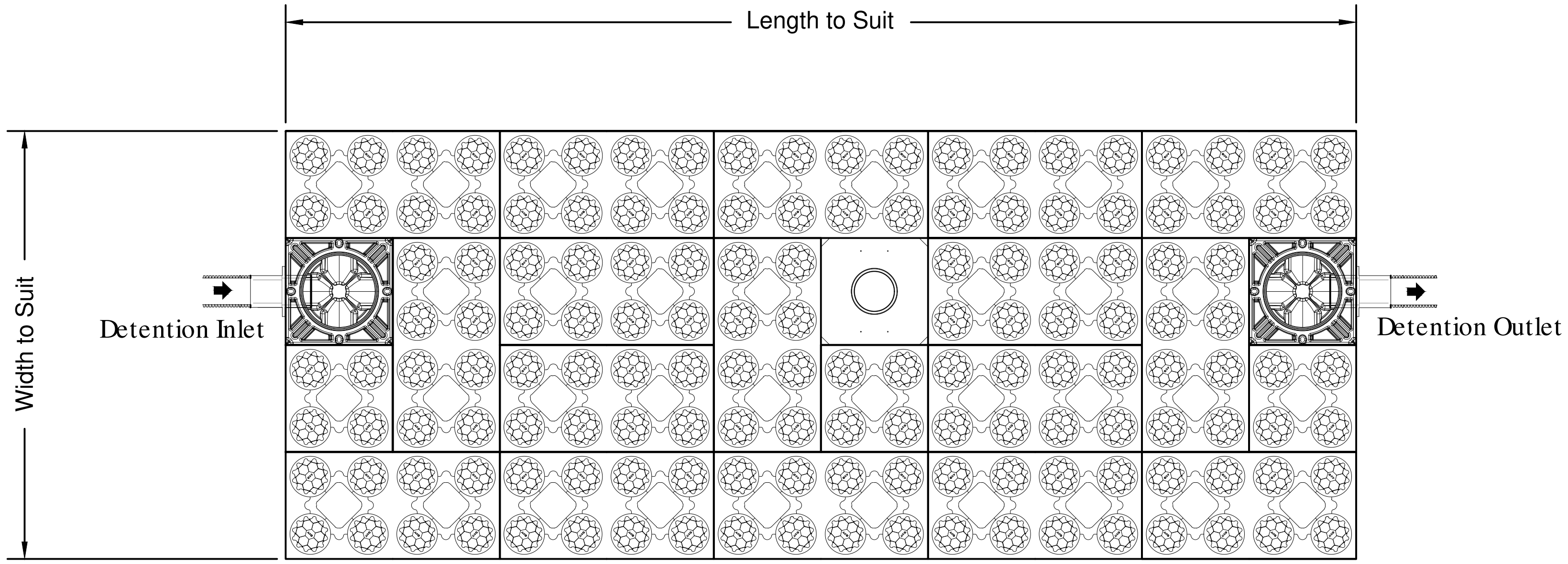


SIDE VIEW



CARLETON UNIVERSITY NEW RESIDENCE OTTAWA, ON		**STORMBRIXX LAYOUT**			
		SYSTEM(S) **STORMBRIXX HD** GRATE(S) **NA**			
DRAWN BY: **KZ**	EMAIL: KYLE.ZHENG@ACO.COM	**REVISIONS**			
		NO.	DESCRIPTION	DATE	BY
DATE **03-10-2020**	CHECKED BY:	A			
SHEET NO. **SHEET 1 OF 2**	DESIGN SERV. NO. REV. **920-184B**	B			
		C			

CANADA
ACO SYSTEMS LTD.
2910 BRIGHTON RD
OAKVILLE, ON
L6H 5S3
TEL: (905)-829-0665
FAX: (905)-829-2908
EMAIL: info@acocan.ca
WEB: www.acocan.co
CANADIAN



Installation depths (1) of ACO StormBrixx HD	
Location	Minimum cover depth ft (m) (4)
Non-Trafficked areas i.e. Landscaping (2)	1.64 (0.5)
Car parks, vehicles up to 5512lbs gross mass	1.97 (0.6)
Car parks, occasional vehicles greater than 5512lbs (3) gross mass	2.00 (0.6)
Occasional heavy truck traffic up to HS-20 loading	Please consult with ACO
Maximum depth to invert of ACO StormBrixx HD (5)	19.68ft (6.0m)
Maximum depth of the cover	11.15ft (3.4m)

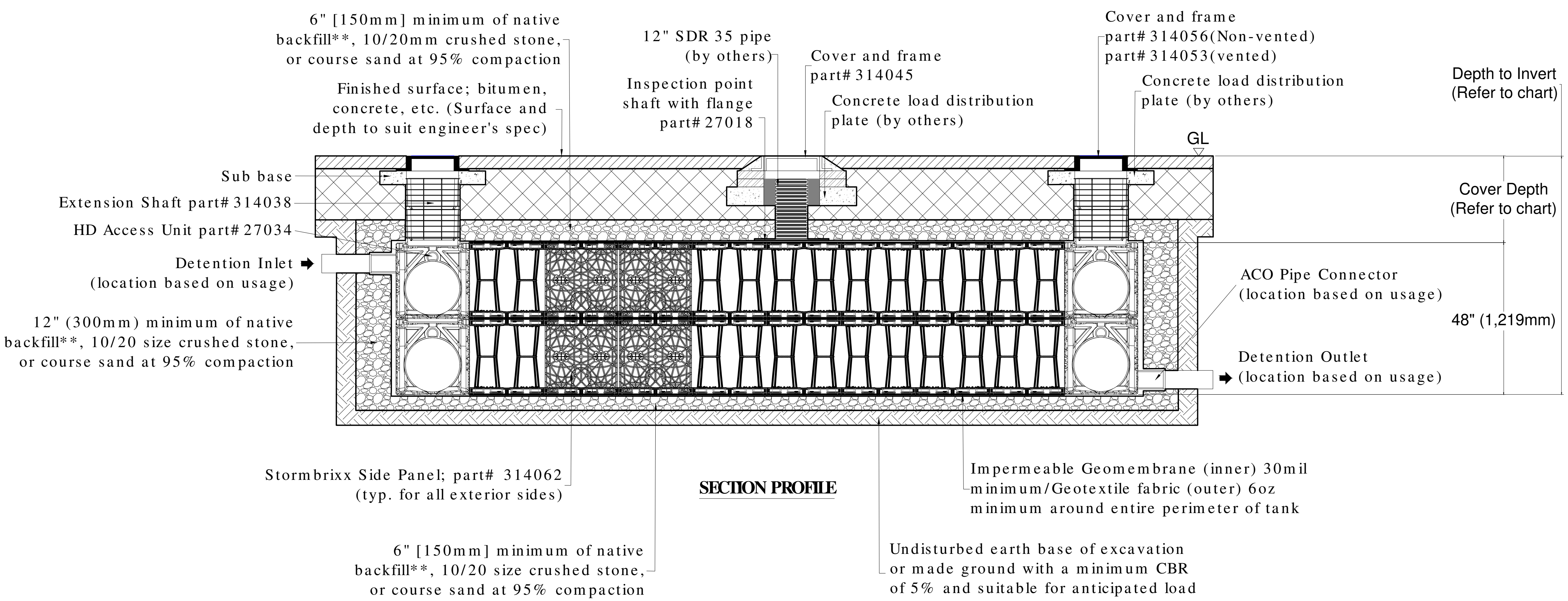
(1) Assumes 27 degree load distribution through fill material and overlaying surface asphalt or block paving

(2) Minimum cover depth to avoid accidental damage from gardening/landscaping work

(3) Occasional Trafficking by refuse collection or similar vehicles (typically one per week)

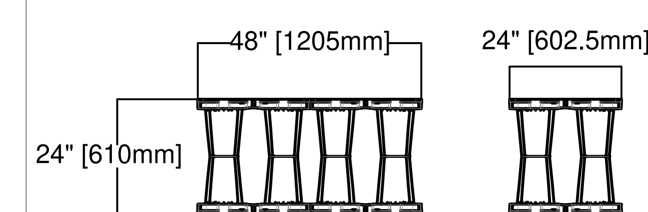
(4) Please check minimum frost cover depths for geographical location

(5) Ground improvement may be required and ground water has not been taken into account



SECTION PROFILE

ACO StormBrixx HD Module
48"x24"x24" [1205x602.5x610mm (H)]
418L net volume per completed module
Brick or Cross Bonded (where applicable)
part# 314061



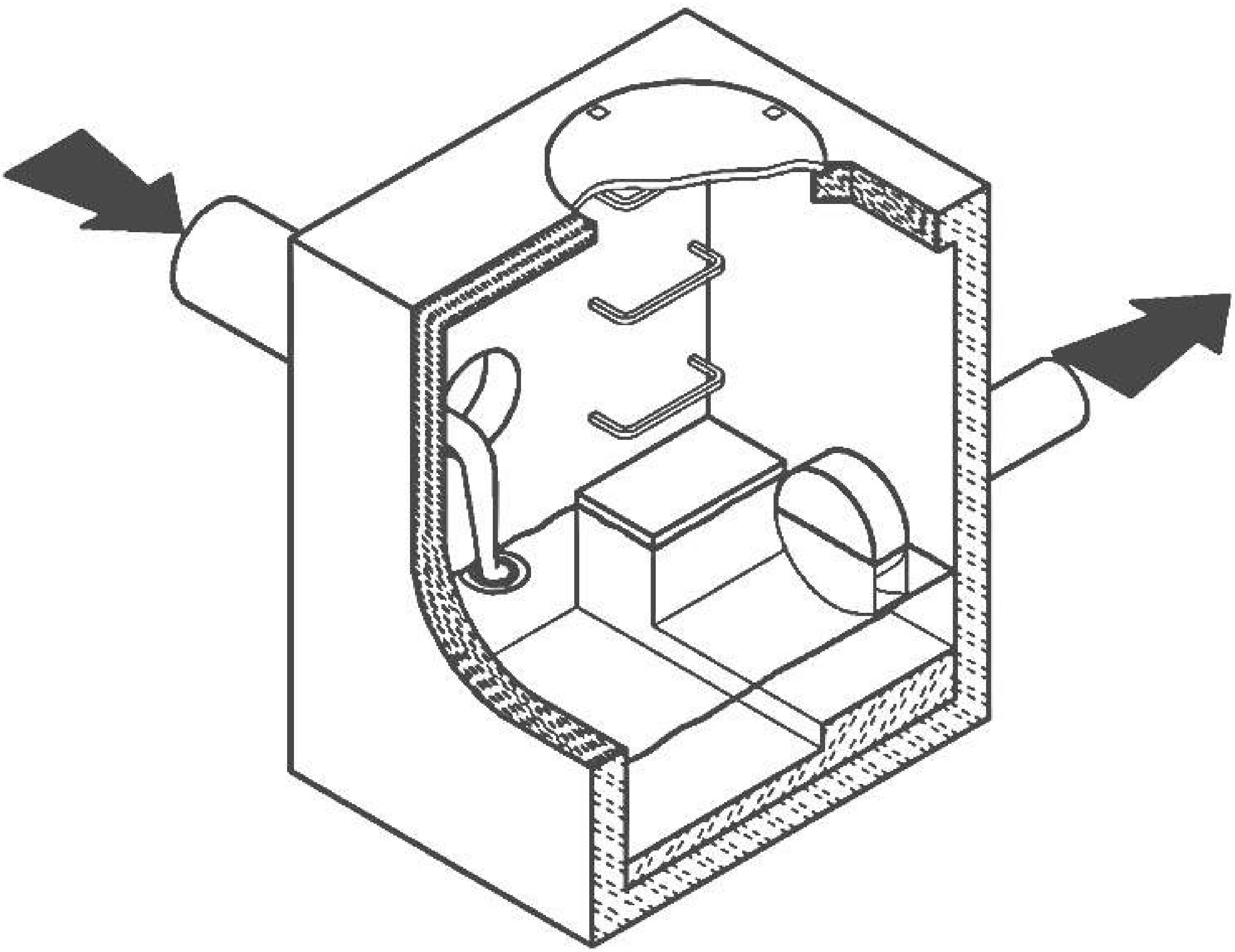
*All systems must be designed and installed to meet or exceed ACO StormBrixx minimum requirements. Although ACO StormBrixx offers support during the design, review, and construction phases of the module system, it is the ultimate responsibility of the Engineer of Record to design the system in full compliance with all applicable engineering practices, laws, and regulations.
**Native soil must be free of organic material and have minimum angle of friction of 28 degree.

D-HD-2L-DVT	DETENTION - STORMBRIXX HD TWO LAYERS WITH ACCESS UNITS	ACO Systems Ltd.	
ACO	INSTALLATION DRAWING - ACO STORMBRIXX HD	Unit 1, 2880 Brighton Rd Oakville, ON L6H5S3 Tel: 905-829-0665 Fax: 905-829-2908	#112-1750 Coast Meridian Rd Port Coquitlam, BC V3C 6R8 Tel: 604-554-0688 Fax: 604-554-0693
DATE: 09/06/2019			
ISSUE: A			

info@acocan.ca WWW.ACOSTORMBRIXX.CA

CSO/STORMWATER MANAGEMENT

® HYDROVEX® VHV / SVHV
Vertical Vortex Flow Regulator



JOHN MEUNIER

APPLICATIONS

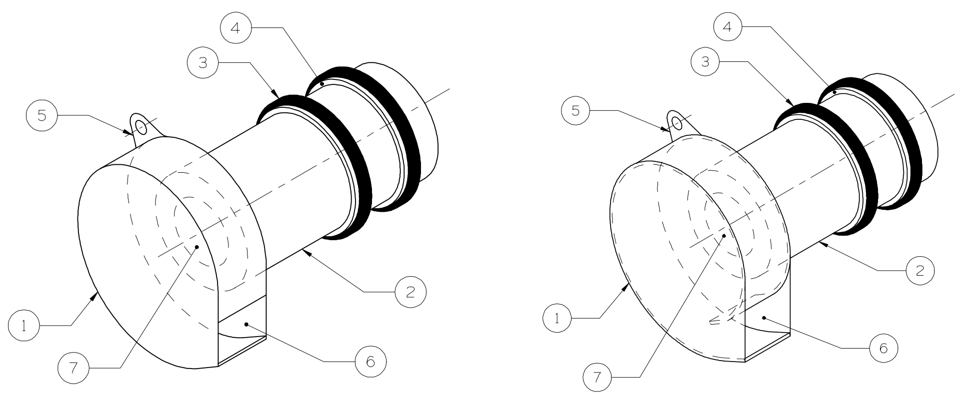
One of the major problems of urban wet weather flow management is the runoff generated after a heavy rainfall. During a storm, uncontrolled flows may overload the drainage system and cause flooding. Due to increased velocities, sewer pipe wear is increased dramatically and results in network deterioration. In a combined sewer system, the wastewater treatment plant may also experience significant increases in flows during storms, thereby losing its treatment efficiency.

A simple means of controlling excessive water runoff is by controlling excessive flows at their origin (manholes). **John Meunier Inc.** manufactures the **HYDROVEX® VHV / SVHV** line of vortex flow regulators to control stormwater flows in sewer networks, as well as manholes.

The vortex flow regulator design is based on the fluid mechanics principle of the forced vortex. This grants flow regulation without any moving parts, thus reducing maintenance. The operation of the regulator, depending on the upstream head and discharge, switches between orifice flow (gravity flow) and vortex flow. Although the concept is quite simple, over 12 years of research have been carried out in order to get a high performance.

The **HYDROVEX® VHV / SVHV** Vertical Vortex Flow Regulators **(refer to Figure 1)** are manufactured entirely of stainless steel, and consist of a hollow body (**1**) (in which flow control takes place) and an outlet orifice (**7**). Two rubber "O" rings (**3**) seal and retain the unit inside the outlet pipe. Two stainless steel retaining rings (**4**) are welded on the outlet sleeve to ensure that there is no shifting of the "O" rings during installation and use.

1. **BODY**
2. **SLEEVE**
3. **O-RING**
4. **RETAINING RINGS (SQUARE BAR)**
5. **ANCHOR PLATE**
6. **INLET**
7. **OUTLET ORIFICE**



VHV ***SVHV***

FIGURE 1: HYDROVEX® VHV-SVHV VERTICAL VORTREX FLOW REGULATORS

ADVANTAGES

- The **HYDROVEX® VHV / SVHV** line of flow regulators are manufactured entirely of stainless steel, making them durable and corrosion resistant.
- Having no moving parts, they require minimal maintenance.
- The geometry of the **HYDROVEX® VHV / SVHV** flow regulators allows a control equal to an orifice plate, having a cross section area 4 to 6 times smaller. This decreases the chance of blockage of the regulator, due to sediments and debris found in stormwater flows. **Figure 2** illustrates the comparison between a regulator model 100 SVHV-2 and an equivalent orifice plate. One can see that for the same height of water, the regulator controls a flow approximately four times smaller than an equivalent orifice plate.
- Installation of the **HYDROVEX® VHV / SVHV** flow regulators is quick and straightforward and is performed after all civil works are completed.
- Installation requires no special tools or equipment and may be carried out by any contractor.
- Installation may be carried out in existing structures.

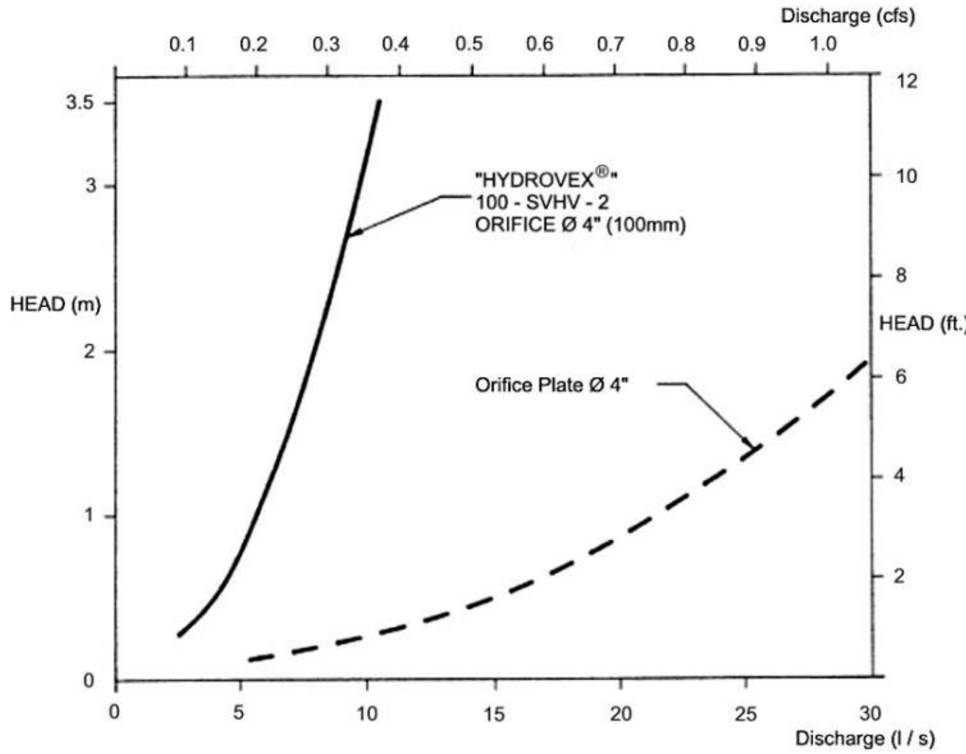


FIGURE 2: DISCHARGE CURVE SHOWING A HYDROVEX® FLOW REGULATOR VS AN ORIFICE PLATE

SELECTION

Selection of a **VHV or SVHV** regulator can be easily made using the selection charts found at the back of this brochure (see **Figure 3**). These charts are a graphical representation of the maximum upstream water pressure (head) and the maximum discharge at the manhole outlet. The maximum design head is the difference between the maximum upstream water level and the invert of the outlet pipe. All selections should be verified by John Meunier Inc. personnel prior to fabrication.

Example:

✓ Maximum design head	2m (6.56 ft.)
✓ Maximum discharge	6 L/s (0.2 cfs)
✓ Using **Figure 3** - VHV	model required is a **75 VHV-1**

INSTALLATION REQUIREMENTS

All **HYDROVEX® VHV / SVHV** flow regulators can be installed in circular or square manholes. **Figure 4** gives the various minimum dimensions required for a given regulator. ***It is imperative to respect the minimum clearances shown to ensure easy installation and proper functioning of the regulator.***

SPECIFICATIONS

In order to specify a **HYDROVEX®** regulator, the following parameters must be defined:

- The model number (ex: 75-VHV-1)
- The diameter and type of outlet pipe (ex: 6" diam. SDR 35)
- The desired discharge (ex: 6 l/s or 0.21 CFS)
- The upstream head (ex: 2 m or 6.56 ft.) *
- The manhole diameter (ex: 36" diam.)
- The minimum clearance "H" (ex: 10 inches)
- The material type (ex: 304 s/s, 11 Ga. standard)

***	Upstream head is defined as the difference in elevation between the maximum upstream water level and the invert of the outlet pipe where the HYDROVEX® flow regulator is to be installed.***

PLEASE NOTE THAT WHEN REQUESTING A PROPOSAL, WE SIMPLY REQUIRE THAT YOU PROVIDE US WITH THE FOLLOWING:

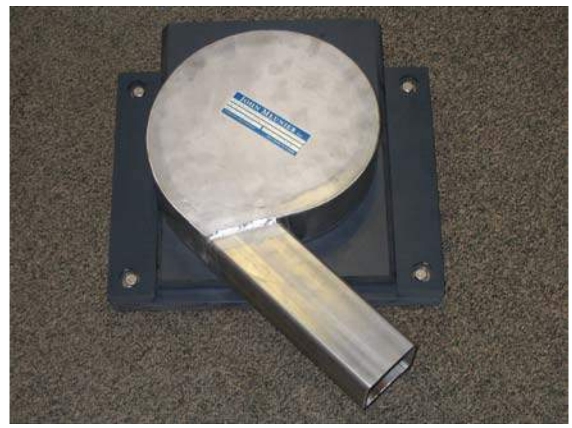
- ***project design flow rate***
- ***pressure head***
- ***chamber's outlet pipe diameter and type***

Typical VHV model in factory

OPTIONS

FV – SVHV (mounted on sliding plate)

VHV-1-O (standard model with odour control inlet)



FV – VHV-O (mounted on sliding plate with odour control inlet)

VHV with Gooseneck assembly in existing chamber without minimum release at the bottom

VHV with air vent for minimal slopes

VHV Vertical Vortex Flow Regulator

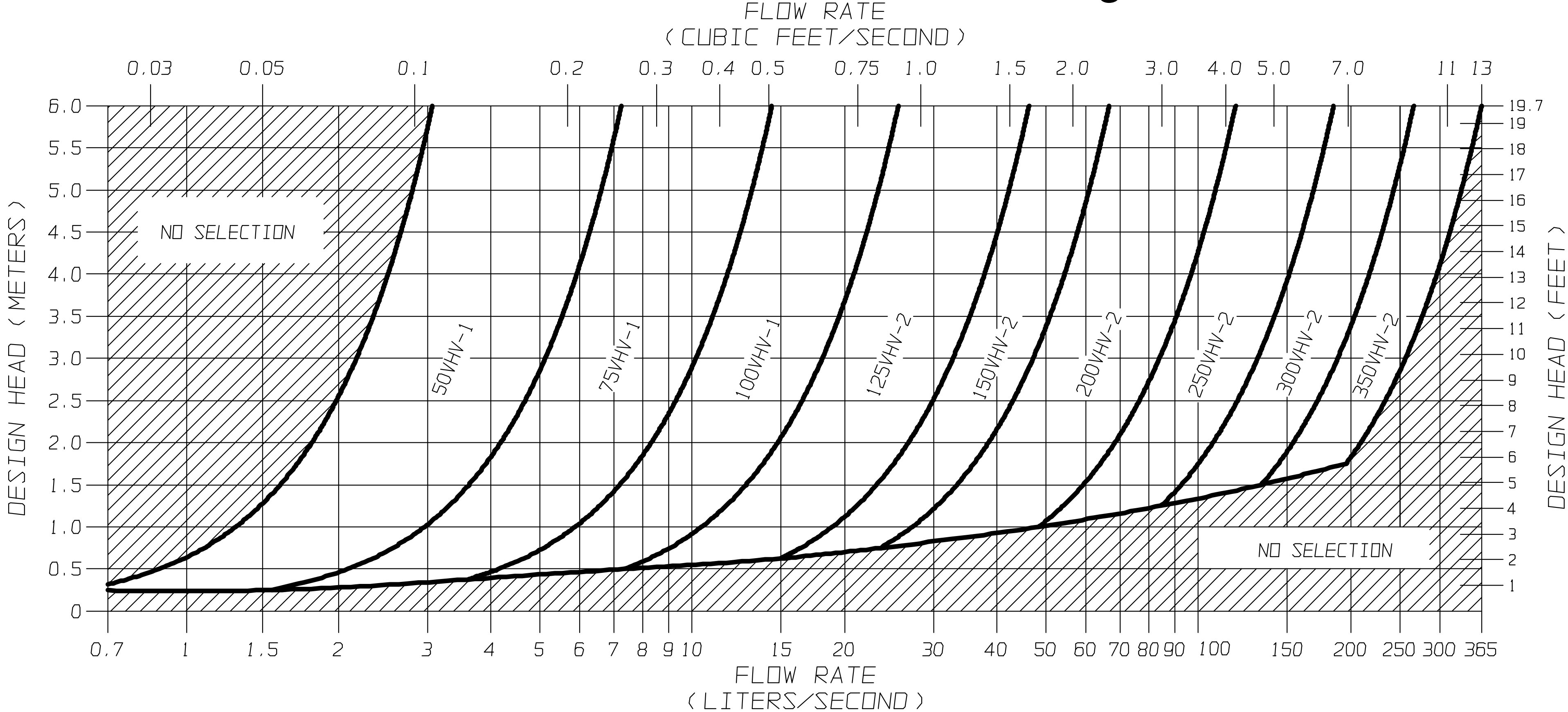


FIGURE 3 - VHV

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HYDROVEX®

SVHV Vertical Vortex Flow Regulator

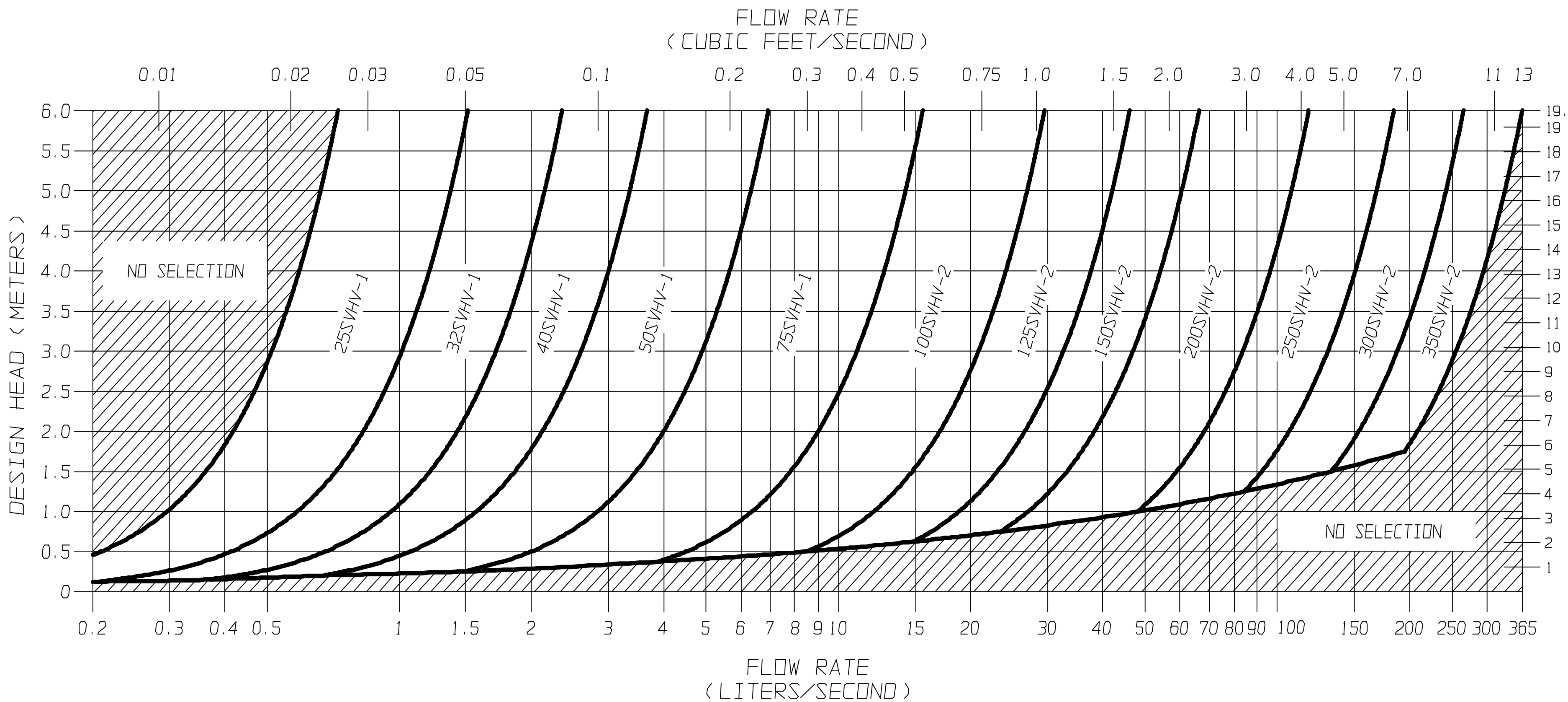
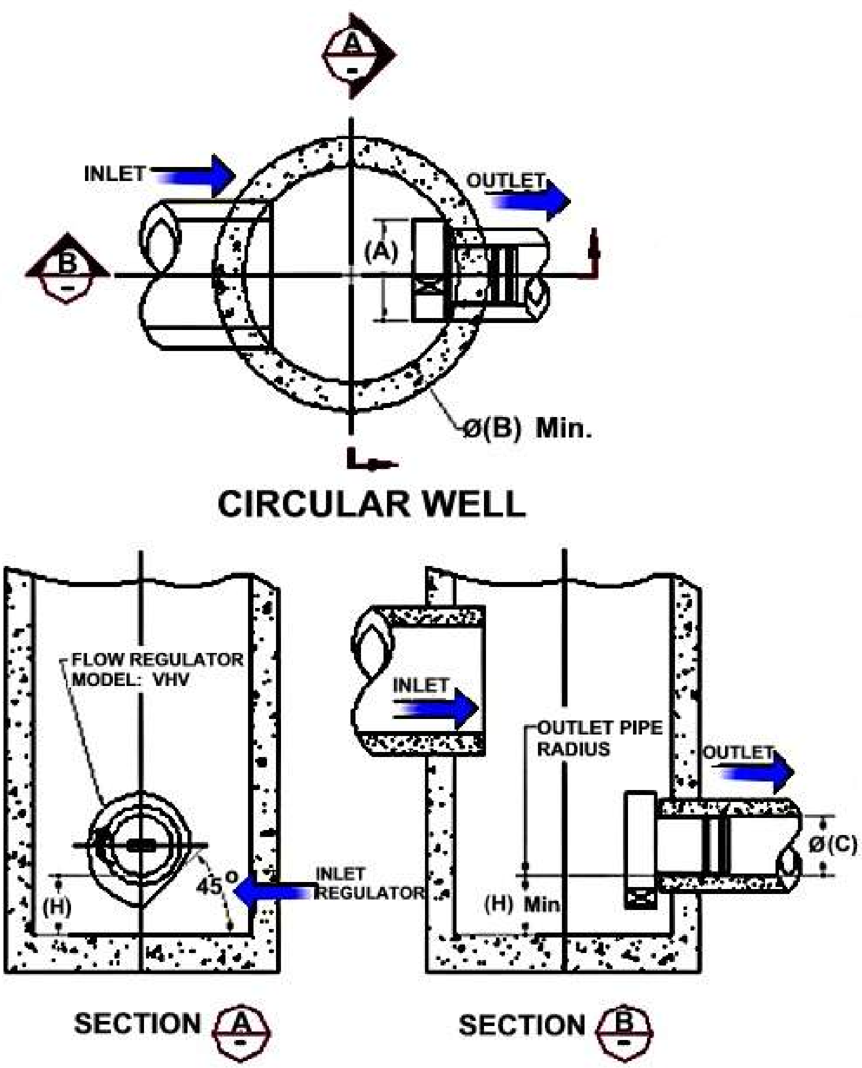


FIGURE 3 - SVHV

JOHN MEUNIER

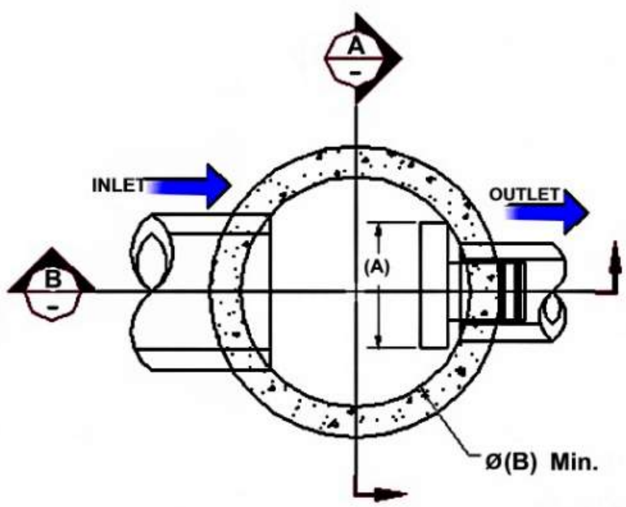
FLOW REGULATOR TYPICAL INSTALLATION IN CIRCULAR MANHOLE
FIGURE 4 (MODEL VHV)

Model Number	Regulator Diameter		Minimum Manhole Diameter		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
50VHV-1	150	6	600	24	150	6	150	6
75VHV-1	250	10	600	24	150	6	150	6
100VHV-1	325	13	900	36	150	6	200	8
125VHV-2	275	11	900	36	150	6	200	8
150VHV-2	350	14	900	36	150	6	225	9
200VHV-2	450	18	1200	48	200	8	300	12
250VHV-2	575	23	1200	48	250	10	350	14
300VHV-2	675	27	1600	64	250	10	400	16
350VHV-2	800	32	1800	72	300	12	500	20

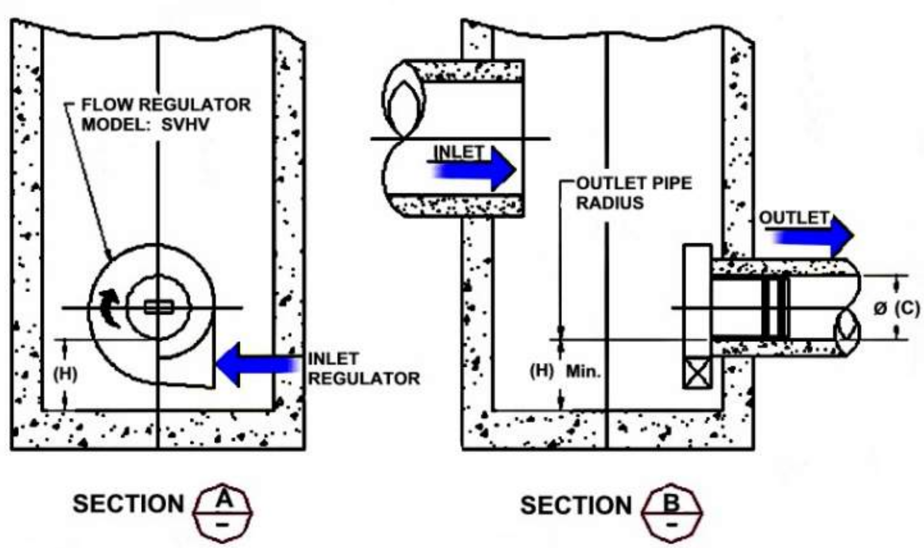


FLOW REGULATOR TYPICAL INSTALLATION IN CIRCULAR MANHOLE
FIGURE 4 (MODEL SVHV)

Model Number	Regulator Diameter		Minimum Manhole Diameter		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
25 SVHV-1	125	5	600	24	150	6	150	6
32 SVHV-1	150	6	600	24	150	6	150	6
40 SVHV-1	200	8	600	24	150	6	150	6
50 SVHV-1	250	10	600	24	150	6	150	6
75 SVHV-1	375	15	900	36	150	6	275	11
100 SVHV-2	275	11	900	36	150	6	250	10
125 SVHV-2	350	14	900	36	150	6	300	12
150 SVHV-2	425	17	1200	48	150	6	350	14
200 SVHV-2	575	23	1600	64	200	8	450	18
250 SVHV-2	700	28	1800	72	250	10	550	22
300 SVHV-2	850	34	2400	96	250	10	650	26
350 SVHV-2	1000	40	2400	96	250	10	700	28



CIRCULAR WELL



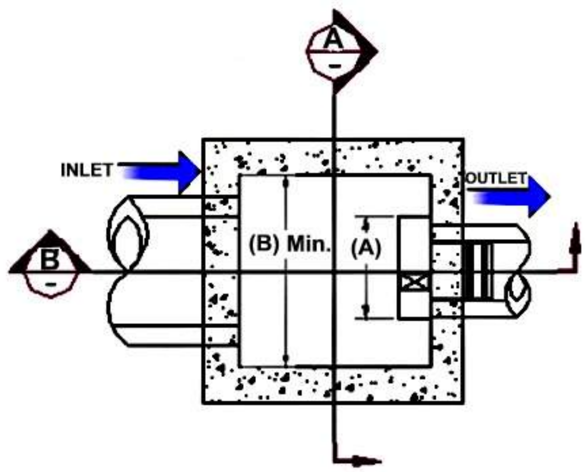
SECTION A

SECTION B

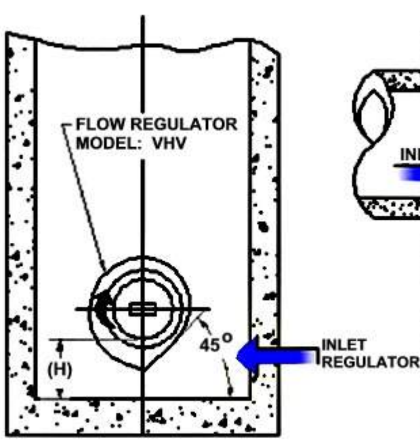
FLOW REGULATOR TYPICAL INSTALLATION IN SQUARE MANHOLE
FIGURE 4 (MODEL VHV)

Model Number	Regulator Diameter		Minimum Chamber Width		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
50VHV-1	150	6	600	24	150	6	150	6
75VHV-1	250	10	600	24	150	6	150	6
100VHV-1	325	13	600	24	150	6	200	8
125VHV-2	275	11	600	24	150	6	200	8
150VHV-2	350	14	600	24	150	6	225	9
200VHV-2	450	18	900	36	200	8	300	12
250VHV-2	575	23	900	36	250	10	350	14
300VHV-2	675	27	1200	48	250	10	400	16
350VHV-2	800	32	1200	48	300	12	500	20

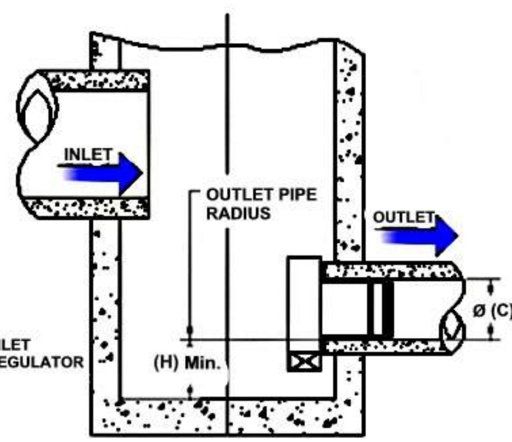
NOTE: ***In the case of a square manhole, the outlet flow pipe must be centered on the wall to ensure enough clearance for the unit.***



SQUARE / RECTANGULAR WELL



SECTION A

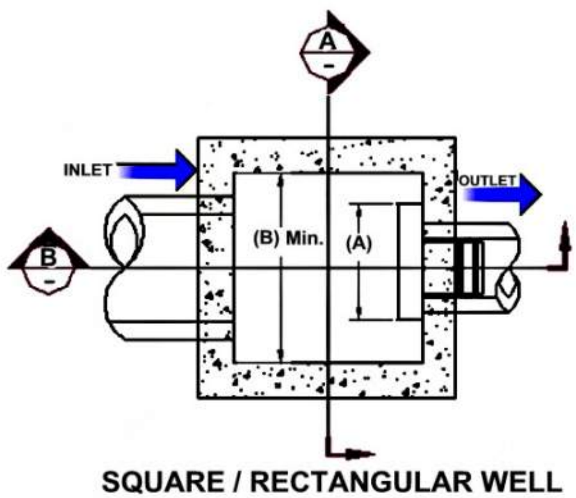


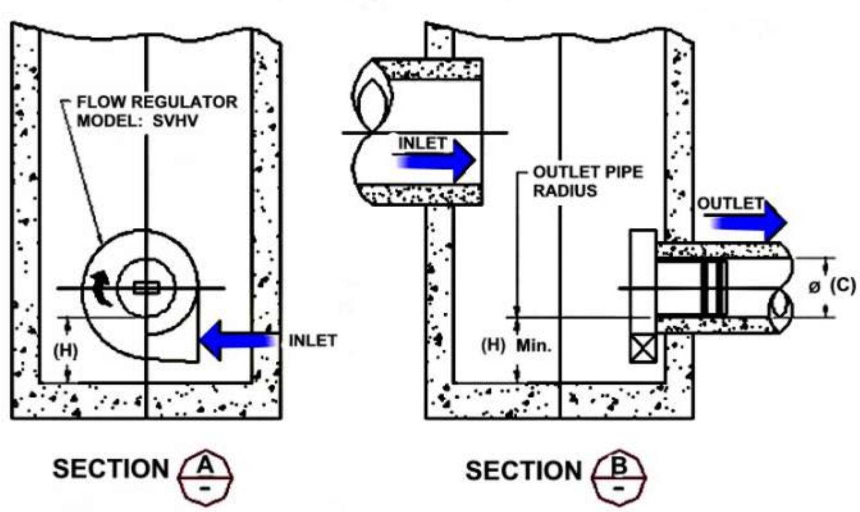
SECTION B

FLOW REGULATOR TYPICAL INSTALLATION IN SQUARE MANHOLE
FIGURE 4 (MODEL SVHV)

Model Number	Regulator Diameter		Minimum Chamber Width		Minimum Outlet Pipe Diameter		Minimum Clearance	
	A (mm)	**A** (in.)	**B** (mm)	**B** (in.)	**C** (mm)	**C** (in.)	**H** (mm)	**H** (in.)
25 SVHV-1	125	5	600	24	150	6	150	6
32 SVHV-1	150	6	600	24	150	6	150	6
40 SVHV-1	200	8	600	24	150	6	150	6
50 SVHV-1	250	10	600	24	150	6	150	6
75 SVHV-1	375	15	600	24	150	6	275	11
100 SVHV-2	275	11	600	24	150	6	250	10
125 SVHV-2	350	14	600	24	150	6	300	12
150 SVHV-2	425	17	600	24	150	6	350	14
200 SVHV-2	575	23	900	36	200	8	450	18
250 SVHV-2	700	28	900	36	250	10	550	22
300 SVHV-2	850	34	1200	48	250	10	650	26
350 SVHV-2	1000	40	1200	48	250	10	700	28

NOTE: ***In the case of a square manhole, the outlet flow pipe must be centered on the wall to ensure enough clearance for the unit.***





INSTALLATION

The installation of a **HYDROVEX®** regulator may be undertaken once the manhole and piping is in place. Installation consists of simply fitting the regulator into the outlet pipe of the manhole. **John Meunier Inc.** recommends the use of a lubricant on the outlet pipe, in order to facilitate the insertion and orientation of the flow controller.

MAINTENANCE

HYDROVEX® regulators are manufactured in such a way as to be maintenance free; however, a periodic inspection (every 3-6 months) is suggested in order to ensure that neither the inlet nor the outlet has become blocked with debris. The manhole should undergo periodically, particularly after major storms, inspection and cleaning as established by the municipality

GUARANTY

The **HYDROVEX®** line of **VHV / SVHV** regulators are guaranteed against both design and manufacturing defects for a period of 5 years. Should a unit be defective, **John Meunier Inc.** is solely responsible for either modification or replacement of the unit.

Smith + Andersen
1600 Carling Ave Suite 530 Ottawa Ontario K1Z 1G3
613 230 1186 f 613 230 2598 smithandandersen.com

2020-07-31

KWCArchitects.
383 Parkdale Ave., Suite 201
Ottawa, Ontario
K1Y 4R4

Attention: Mr. R. Zaig, Architect, OAA, RAIC

RE: CARTON UNIVERSITY NEW RESIDENCE
1125 COLONEL BY DRIVE, OTTAWA, ONTARIO
CITY OF OTTAWA FILE NUMBER: D07-12-19-0205,
CONSULTANT FILE NUMBER: 190444600
S+A PROJECT NUMBER 06111.041
ROOF DRAIN DESIGN

Dear Mr. Zaig,

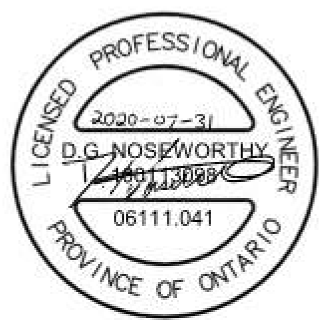
This letter is to confirm that the roof drains will be designed with emergency overflows in accordance with the Ontario Building Code Section 7.4.10.4(3) (a) and (b).

We trust that the above meets with your approval. If you have any questions, please contact the undersigned.

Yours truly,

SMITH + ANDERSEN

Darrell Noseworthy, P. Eng.
Associate



cc: Mr. Mike Leong, P. Eng., Michael St.Louis – Smith + Andersen

Appendix G

Topographic and Legal Survey

METRIC
DISTANCES AND ELEVATIONS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

TOPOGRAPHIC SURVEY OF

AREA BOUNDED BY LEEDS HOUSE, STORMONT-DUNDAS HOUSE AND CAMPUS AVENUE CARLETON UNIVERSITY BEING PART OF LOTS 'L' AND 'M' CONCESSION 'B' (RIDEAU FRONT) GEOGRAPHIC TOWNSHIP OF NEPEAN CITY OF OTTAWA

SCALE 1 : 200
0 5 10 20 metres

FAIRHALL, MOFFATT & WOODLAND LIMITED
ONTARIO LAND SURVEYORS

NOTES

1. THIS DRAWING IS ON THE MTM GRID CO-ORDINATE SYSTEM AND IS REFERRED TO THE CENTRAL MERIDIAN, 76°30'W LONGITUDE MTM ZONE 9, **(NAD27).**
2. DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR 0.999939.
3. THE SURVEY REPRESENTED BY THIS PLAN WAS COMPLETED ON NOVEMBER 19, 2019.

ELEVATION NOTES

1. ELEVATIONS SHOWN HEREON ARE REFERRED TO GEODETIC DATUM (CVGD28).
2. ELEVATIONS FOR MANHOLE COVERS AND CATCH BASINS HAVE TO BE INDEPENDENTLY CONFIRMED BEFORE THEY CAN BE ACCEPTED FOR FINAL DESIGN OR CONSTRUCTION PURPOSES.
3. IT IS THE RESPONSIBILITY OF THE USER OF THIS INFORMATION TO VERIFY THAT THE JOB BENCHMARKS HAVE NOT BEEN ALTERED OR DISTURBED AND THAT THEIR RELATIVE ELEVATION AND DESCRIPTION AGREE WITH THE INFORMATION SHOWN ON THIS DRAWING.

UTILITY NOTES

1. THIS DRAWING CANNOT BE ACCEPTED AS ACKNOWLEDGING ALL OF THE UTILITIES AND IT WILL BE THE RESPONSIBILITY OF THE USER TO CONTACT THE RESPECTIVE UTILITY AUTHORITIES FOR CONFIRMATION OR LOCATION.
2. UNDERGROUND UTILITIES, AS REPORTED ON THIS DRAWING, ARE NOT BASED ON AN ACTUAL 'FIELD LOCATE' BY THE RESPECTIVE UTILITY AGENCIES BUT HAVE BEEN COMPILED FROM DATA OBTAINED FROM THE FOLLOWING SOURCE:
   a) CARLETON UNIVERSITY – FACILITIES ENGINEERING & CONSTRUCTION.
3. BEFORE ANY WORK INVOLVING PROBING, EXCAVATING, ETC., A FIELD LOCATION OF UNDERGROUND PLANT BY THE PERTINENT UTILITY AUTHORITY IS MANDATORY.

LEGEND

- (C) – CEILING OF TUNNEL
- (F) – FLOOR OF TUNNEL
- DIA. – DIAMETER
- CB – CATCH BASIN
- MH – MANHOLE
- HMH – HYDRO MANHOLE
- WMH – WATER MANHOLE
- EMH – ELECTRICAL MANHOLE
- WV – WATER VALVE
- FH – FIRE HYDRANT
- PM – PARKING METER
- – SIGN
- – BOLLARD
- – GAS METER
- BHOL – BORE HOLE
- LS – LAMP STANDARD
- – CONIFEROUS TREE
- – DECIDUOUS TREE
- —W— – WATERMAIN
- —H— – UNDERGROUND HYDRO
- —G— – GAS MAIN
- —ST— – STORM SEWER
- —S— – SANITARY SEWER

STORM AND SANITARY SEWER INVERT SCHEDULE

NUMBER	TOP	WEST	EAST	NORTH	SOUTH	NW	SW	NE	SE
177	63.22	62.19							
179	64.50						63.0±		
181	62.57			61.18					
183	64.21	INVERTS INACCESSIBLE							
184	62.51	60.45	58.90		60.49	60.315			
391	64.33		63.125						
393	64.23	62.95			62.95				
395	65.29	60.03		60.01					
397	65.44	60.14		59.985					
400	65.62			64.63	64.65				
402	65.52	INVERTS INACCESSIBLE							
404	65.63				64.65				
464	65.12		63.89						
787	64.09		59.39	62.63	59.42		59.445		
788	64.07		59.03		59.205				
789	64.16	59.04	59.02	59.815					
790	63.65			59.10	59.125		59.14		
791	62.84			59.53	59.575		60.865		59.525
793	63.64							59.74	
795	62.93		61.95	61.91					
797	62.95			61.84	60.73				60.645
826	64.13	59.365	59.375	59.88					
1085	62.63			61.60					
1087	62.42	INVERTS INACCESSIBLE							
1089	63.97	INVERTS INACCESSIBLE							
1090	64.81			INACCESSIBLE	59.72			60.82	
1149	65.11	INVERTS INACCESSIBLE							
1150	65.18	Inaccessible		58.73	58.74				
1151	65.28	59.11	59.16	59.09	59.09			62.80 To #1162 63.62 To #1160	
1155	65.39	60.34	60.36	63.55					63.40
1156	65.37					64.13			
1158	65.41				64.19				
1160	65.27						63.93		
1162	65.23				63.965				
1164	64.31	63.41							
1228	62.76		61.71						
1272	65.44		60.03		60.06			63.04	
1273	65.46		63.47		60.09			59.54	

WATER PIPE INVERT SCHEDULE

NUMBER	TOP	
786	64.22	TOP OF PIPES INVERTS INACCESSIBLE
792	63.04	2 PIPES, TOP OF PIPE 60.45, TOP OF PIPE 61.07, TOP OF GRAVEL BASE 60.26
1146	65.05	TOP OF PIPE 61.50, TOP OF GRAVEL BASE 61.50
1147	65.09	TOP OF PIPE 61.59, TOP OF GRAVEL BASE 61.34
1148	64.96	TOP OF PIPE 61.85, TOP OF GRAVEL BASE 61.58

THIS IS NOT A VALID COPY UNLESS EMBOSSED WITH SEAL

Fairhall Moffatt & Woodland LIMITED
ONTARIO LAND SURVEYORS
OTTAWA
Surveying and Land Information Services
235 TERENCE MATTHEWS CRESCENT, KANATA, ONTARIO K2M 2B3
TEL: (613) 591-2580 FAX: (613) 591-1495
www.fmw.on.ca

JOB No. Z33700
E 367632, N 5027902
REFERENCE No. 141 – B (RF) NP
S:\JOBS\Z33700\DWGS 21/11/2019
TP_Z337.DWG (ss)

Appendix H

Sewer CCTV Reports

MEMORANDUM

TO:	**Nigel Tai** Project Manager - Diamond Schmitt Architects	**FROM:**	James Fookes, P.Eng.
		PROJECT No.:	190444600
RE:	**Storm and Sanitary Sewer Condition Assessment** **Carleton University, New Student Residence**	**DATE:**	January 21st, 2020

\\MH.LOCAL\DATA\PROJ\2019\190444600-CARLETON U- NEW RESIDENCE BUILDING\08. WORKING\CCTV-CONDITION ASSESSMENT.DOCX

1 Introduction

1.1 Background and objectives of condition assessment

A CCTV inspection that was carried out by Clean Water Works (CWW) for sewers at Carleton University as part of the proposed Engineering Design Center. (CWW reports #87830SA1 and #87830ST1 dated November 18, 2019, provided in **Attachment 1**). Morrison Hershfield (MH) was requested to review the CCTV footage and provide a condition assessment of the sewers, with recommendations regarding the extent and type of repairs required.

Figure 1 (overleaf) shows the sewers inspected, including the maintenance hole numbering used in CWW's reports, and provides a summary of the issues identified.

Figure 1: Overview of existing sanitary and storm sewer system

1.2 Assessment of Storm and Sanitary Sewers

The following tables have been prepared based on our review of the CWW reports and CCTV footage, and provides a description of the damage observed. The table is organized by section of sewer (maintenance hole to maintenance hole). Locations of damage are indicated by length from the starting maintenance hole. The position of the damage within the pipe is indicated by clock position (e.g. 12 o'clock indicated damage in the obvert, or top, of the pipe).

Table 1 – Assessment of Storm Sewers

Section of Sewer	Summary of CWW comments	MH comments	MH Recommended Action
CB1 – STM2 (200mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
CB2 – STM8 (250mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
CB3 – CB2 (250mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
CB04 – Main (200mm diameter)	Alignment Down 15% @2.3m	No additional comments	To be replaced as part of proposed building
CB5 – CB4 (200mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
CB6 – CB5 (200mm diameter)	Alignment Left 25% @1.2m Alignment Left 25% @3.3m	Reduction in pipe size from 250mm to 200mm after 1.2 mm and transition piece after 3.3m	To be replaced as part of proposed building
CB7 – STMM8 (200mm diameter)	Longitudinal Fracture @ 12 o'clock @ 6.5m Longitudinal Fracture @ 12 o'clock @ 20.9m	No additional comments	To be replaced as part of proposed building

Section of Sewer	Summary of CWW comments	MH comments	MH Recommended Action
STMM5 – CB8 (200mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
LIMIT – STM5 (450mm diameter)	No issues identified	No additional comments	No action required.
STM1 – STM2 (250mm diameter)	No issues identified Pipe connections @ 6.1m, 15.6m, 30.9m and 32.3m	No additional comments	To be partially replaced as part of proposed building.
STM2 – STM3 (300mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
STM3 – STM4 (450mm diameter)	Fine material deposit 5% @0.0m Longitudinal Fracture @ 12 o'clock @ 0.0m Alignment Left 25% @ 10.0m Broken @ 12 o'clock @ 10.5m Longitudinal Fracture @ 12 o'clock @10.6m	Alignment left shows slight joint offset	To be replaced as part of proposed building
STM5 – STM4 (450mm diameter)	Fine material deposit 10% @2.4m Longitudinal Fracture @ 12 o'clock @ 3.3m Longitudinal Fracture @ 12 o'clock @ 10.9m Longitudinal Fracture @ 12 o'clock @ 32.4m Longitudinal Fracture @ 12 o'clock @ 33.7m Longitudinal Fracture @ 12 o'clock @ 58.5m Crack Circumferential @ 5 o'clock @ 58.9m	No additional comments	To be replaced as part of proposed building
STM6 – STM5 (200mm diameter)	Longitudinal Fracture @ 12 o'clock @ 6.9m Longitudinal Fracture @ 12 o'clock @ 19.4m	No additional comments	To be partially replaced as part of proposed building. No additional action required.

Section of Sewer	Summary of CWW comments	MH comments	MH Recommended Action
STM7 – STM5 (300mm diameter)	Longitudinal Fracture @ 12 o'clock @ 1.8m Connecting pipe @9.9m Gravel material deposit 10% @2.4m Longitudinal Fracture @ 12 o'clock @35.6m Crack Circumferential @ 6 o'clock @ 44.9 (35.6m from original measurement)	No additional comments	To be replaced as part of proposed building
STM8 – STM7 (300mm diameter)	Longitudinal Fracture @ 12 o'clock @ 2.9m Connecting pipe; Cored @9.9m Longitudinal Fracture @ 12 o'clock @ 4.9m	No additional comments	To be replaced as part of proposed building
STM9 – STM8 (300mm diameter)	Longitudinal Fracture @ 12 o'clock @ 7.5m Longitudinal Fracture @ 12 o'clock @ 18.7m	No additional comments	To be replaced as part of proposed building
STM10 – STM9 (200mm diameter)	No issues identified	No additional comments	No additional action required
STM11 – BLDG (150mm diameter)	Connecting pipe; Cored, intruding @9.9m	Should be trimmed flush using robot	To be partially replaced as part of proposed building No additional action required
STM11 – STM7 (150mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building

Table 2 – Assessment of Sanitary Sewers

Section of Sewer	Summary of CWW comments	MH comments	MH Recommended Action
SAN5 – BLDG (150mm diameter)	Slight deformation @10.0m Connecting pipes @ 34.3m and 43.5m	No additional comments	To be partially replaced as part of proposed building No additional action required
SAN8 – BLDG (200mm diameter)	Survey abandoned, MH blocked	No additional comments	Service to existing Stormont building, can be reassessed during construction and replaced if required
LIMIT – SAN6 (150mm diameter)	No issues identified	No additional comments	To be partially replaced as part of proposed building No additional action required
SAN2 – SAN1 (200mm diameter)	Longitudinal Fracture @ 12 o'clock @ 4.3m Full of debris @ 14.7m (cleared)	No additional comments	To be partially replaced as part of proposed building No additional action required
SAN2 – SAN1 (200mm diameter)	Debris cleared	No additional comments	To be partially replaced as part of proposed building No additional action required
SAN2 – SAN3 (200mm diameter)	Full of debris @ 10.6 m (cleared)	No additional comments	To be replaced as part of proposed building
SAN2 – SAN3 (200mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
SAN3 – SAN4 (200mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building

Section of Sewer	Summary of CWW comments	MH comments	MH Recommended Action
SAN4 – SAN6 (200mm) diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
SAN5 – SAN4 (200mm diameter)	Sag in pipe @4.9m; Water pools	No additional comments	To be replaced as part of proposed building
SAN6 – SAN7 (200mm diameter)	No issues identified	No additional comments	To be replaced as part of proposed building
SAN7 – SAN8 (450mm diameter)	Pipe effectively full of material; Survey abandoned	Pipe should be inspected prior to construction and repair/replacement measures determined thereof	To be partially replaced as part of proposed building

2 Conclusions and Recommendations

The following recommendations and conclusions are made based on the inspection carried out by CWW.

Due to the location of the proposed building, much of the existing infrastructure will need to be relocated. For sections of sewer that need to be relocated as part of the proposed building, the extent of the replacement is shown on the project plans.

The storm (STM10-STM9) and sanitary (SAN1-SAN2) sewers running South-North parallel to Dundas House will be partially replaced. There were no issues found in the portions of pipes that are not planned to be replaced.

The majority of storm sewer (STM5-STM4) will need to be relocated as part of the proposed project. The remaining section of the pipe shows a small fracture. The full replacement of this is not foreseen part of the project.

The majority of sanitary sewer SAN7-SAN8 will need to be relocated as part of the proposed project. The pipe should be inspected to show if additional measures need to be taken during construction.

The full replacement of the Leeds House services are not proposed as part of the proposed project. The sanitary line show some slight deformation, however not severe enough to justify replacement. The storm service has a protruding service connection. The portion of the pipe containing this protrusion is not proposed to be replaced and therefore the protrusion should be replaced by means of an open-cut excavation.

The sewers for the Stormont and Dundas Houses appear in generally poor condition, however these sewers are proposed to be replaced as part of the project.

3 Closure

We trust that this report is sufficient for your current requirements. Please contact the undersigned with any questions or clarifications.

Daniel Glauser, B.Eng.
Municipal Designer

James Fookes, P.Eng.
Senior Municipal Engineer

Attachment 1

CCTV Documentation

Ottawa (Head Office)
1800 Bantree Street
Ottawa, Ontario K1B 5L6
☎ 613.745.2444
613.745.9994
www.cwwcanada.com
1.866.695.0155

Montreal
2700 Sabourin Street
St-Laurent, Quebec H4S 1M2
☎ 514.738.2666
514.738.9762

CLEAN WATER WORKS INC.
INTEGRATED SEWER SOLUTIONS

Carleton UNIVERSITY

Carleton University

SEWER CCTV INSPECTION REPORT

Report ID	Sewer Use
87830SA1	Sanitary
Completion Date	**Inspected Length**
November 18, 2019	256.90 meters

Table of contents

Page

1. Index of pipes

12 items

Inspected length : 256.90
Total length : 289.80

Pipe	Start/End	Direction	Road	Date	Inspected	Total	Page
BUILDING SAN 5	SAN 5 --> BUILDING	Against flow	Campus Avenue	14/11/2019 10:34 AM	43.5	43.5	5
BUILDING SAN 8	SAN 8 --> BUILDING	Against flow	Campus Avenue	18/11/2019 11:02 AM	0	0	7
LIMIT SAN 6	SAN 6 --> LIMIT	Against flow	Campus Avenue	14/11/2019 1:54 PM	50.5	50.5	9
SAN 1 SAN 2	SAN 2 --> SAN 1	Against flow	Campus Avenue	18/11/2019 3:13 PM	61.5	61.5	13
SAN 1 SAN 2	SAN 2 --> SAN 1	Against flow	Campus Avenue	13/11/2019 12:58 PM	14.7	14.7	11
SAN 2 SAN 3	SAN 2 --> SAN 3	Direction of flow	Campus Avenue	18/11/2019 2:45 PM	13.7	12	17
SAN 2 SAN 3	SAN 2 --> SAN 3	Direction of flow	Campus Avenue	13/11/2019 12:54 PM	10.7	12	15
SAN 3 SAN 4	SAN 3 --> SAN 4	Direction of flow	Campus Avenue	13/11/2019 1:26 PM	4.8	4.8	19
SAN 4 SAN 6	SAN 4 --> SAN 6	Direction of flow	Campus Avenue	14/11/2019 12:55 PM	39.8	39.8	21
SAN 5 SAN 4	SAN 5 --> SAN 4	Direction of flow	Campus Avenue	14/11/2019 10:13 AM	14.7	14.7	23
SAN 6 SAN 7	SAN 6 --> SAN 7	Direction of flow	Campus Avenue	14/11/2019 1:36 PM	3	3	25
SAN 7 SAN 8	SAN 7 --> SAN 8	Direction of flow	Campus Avenue	18/11/2019 10:11 AM	0	60	27

2. Structural rating

12 items

5 - Immediate Attention (1 of 12 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
8	5131	4	SAN 1 SAN 2	SAN 2 --> SAN 1	Against flow	Campus Avenue	11

4 - Poor (1 of 12 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
4	4100	4	BUILDING SAN 5	SAN 5 --> BUILDING	Against flow	Campus Avenue	5

2 - Good (1 of 12 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
2	2100	2	SAN 5 SAN 4	SAN 5 --> SAN 4	Direction of flow	Campus Avenue	23

0 - No Defects (9 of 12 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
0	0000	0	BUILDING SAN 8	SAN 8 --> BUILDING	Against flow	Campus Avenue	7
0	0000	0	LIMIT SAN 6	SAN 6 --> LIMIT	Against flow	Campus Avenue	9
0	0000	0	SAN 1 SAN 2	SAN 2 --> SAN 1	Against flow	Campus Avenue	13
0	0000	0	SAN 2 SAN 3	SAN 2 --> SAN 3	Direction of flow	Campus Avenue	17
0	0000	0	SAN 2 SAN 3	SAN 2 --> SAN 3	Direction of flow	Campus Avenue	15
0	0000	0	SAN 3 SAN 4	SAN 3 --> SAN 4	Direction of flow	Campus Avenue	19
0	0000	0	SAN 4 SAN 6	SAN 4 --> SAN 6	Direction of flow	Campus Avenue	21
0	0000	0	SAN 6 SAN 7	SAN 6 --> SAN 7	Direction of flow	Campus Avenue	25
0	0000	0	SAN 7 SAN 8	SAN 7 --> SAN 8	Direction of flow	Campus Avenue	27

3. O&M rating

12 items

5 - Immediate Attention (2 of 12 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
5	5100	5	5	SAN 1 SAN 2	SAN 2 --> SAN 1	Against flow	Campus Avenue	11
5	5100	5	0	SAN 7 SAN 8	SAN 7 --> SAN 8	Direction of flow	Campus Avenue	27

4 - Poor (1 of 12 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
4	4100	4	0	SAN 2 SAN 3	SAN 2 --> SAN 3	Direction of flow	Campus Avenue	15

2 - Good (1 of 12 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
2	2100	2	0	SAN 3 SAN 4	SAN 3 --> SAN 4	Direction of flow	Campus Avenue	19

0 - No Defects (8 of 12 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
0	0000	0	4	BUILDING SAN 5	SAN 5 --> BUILDING	Against flow	Campus Avenue	5
0	0000	0	0	BUILDING SAN 8	SAN 8 --> BUILDING	Against flow	Campus Avenue	7
0	0000	0	0	LIMIT SAN 6	SAN 6 --> LIMIT	Against flow	Campus Avenue	9
0	0000	0	0	SAN 1 SAN 2	SAN 2 --> SAN 1	Against flow	Campus Avenue	13
0	0000	0	0	SAN 2 SAN 3	SAN 2 --> SAN 3	Direction of flow	Campus Avenue	17
0	0000	0	0	SAN 4 SAN 6	SAN 4 --> SAN 6	Direction of flow	Campus Avenue	21
0	0000	0	2	SAN 5 SAN 4	SAN 5 --> SAN 4	Direction of flow	Campus Avenue	23
0	0000	0	0	SAN 6 SAN 7	SAN 6 --> SAN 7	Direction of flow	Campus Avenue	25

4. Pipe summary and condition details

CLEAN WATER WORKS

Pipe identification

Pipe: BUILDING SAN 5	**Direction of inspection:** SAN 5 --> BUILDING
Direction of flow: BUILDING --> SAN 5	**Direction:** Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	43.5
Height:	200	**Total length:**	43.5
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 10:34 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	4	**Peak:**	0	**Peak:**	4
Quick rating:	4100	**Quick rating:**	0000	**Quick rating:**	4100
Score:	4	**Score:**	0	**Score:**	4
Index:	4	**Index:**	0	**Index:**	4

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

Downstream
SAN 5

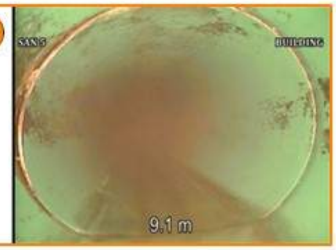
Invert
NA

1	0.00 m
AMH - Manhole, SAN 5	

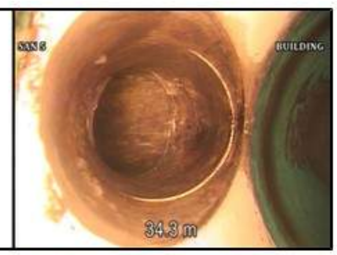
2	0.00 m
MWL - Water Level, 15%	

3	9.10 m
D - Deformed, 5%	

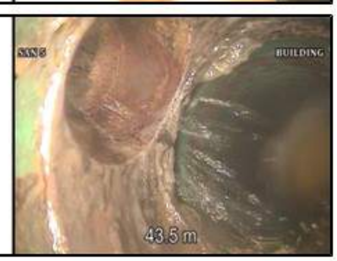
4



4	34.30 m
TF - Tap Factory, at 12 o'clock, Dim.1=150	



5	43.50 m
TFA - Tap Factory Active, at 12 o'clock, Dim.1=150	



6	43.50 m
AEP - End of Pipe, BUILDING	

Invert
NA

Upstream
BUILDING

4. Pipe summary and condition details

Pipe identification

Pipe:	BUILDING SAN 8	**Direction of inspection:**	SAN 8 --> BUILDING
Direction of flow:	BUILDING --> SAN 8	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:			
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	0
Height:	200	**Total length:**	0
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Not Known	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	0	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 11:02 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3

1 / 1

Downstream
SAN 8

Invert
NA

1	0.00 m
AMH - Manhole, SAN 8	

2	0.00 m
MWL - Water Level, 100%	

3	0.00 m
MSA - Abandoned Survey, MH blocked	

Invert
NA

Upstream
BUILDING

4. Pipe summary and condition details

Pipe identification

Pipe:	LIMIT SAN 6	**Direction of inspection:**	SAN 6 --> LIMIT
Direction of flow:	LIMIT --> SAN 6	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway		
Owner:	Carleton university		**GPS Accuracy:**
Road segment:			**Corrdinate System:**
			Vertical Datum:

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	50.5
Height:	200	**Total length:**	50.5
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 1:54 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

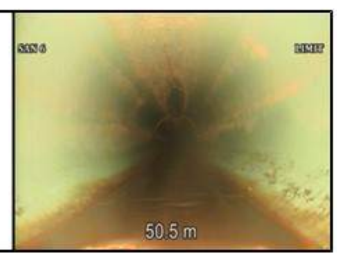
REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1	0.00 m
AMH - Manhole, SAN 6	

2	0.00 m
MWL - Water Level, 10%	

3	50.50 m
AEP - End of Pipe, LIMIT	



4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 1 SAN 2	**Direction of inspection:**	SAN 2 --> SAN 1
Direction of flow:	SAN 1 --> SAN 2	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	14.7
Height:	200	**Total length:**	14.7
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 12:58 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	5	**Peak:**	5	**Peak:**	5
Quick rating:	5131	**Quick rating:**	5100	**Quick rating:**	5231
Score:	8	**Score:**	5	**Score:**	13
Index:	4	**Index:**	5	**Index:**	4.3

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

Downstream
SAN 2

Invert
NA

Invert
NA

Upstream
SAN 1

1 | **0.00 m**

AMH - Manhole, SAN 2

2 | **0.00 m**

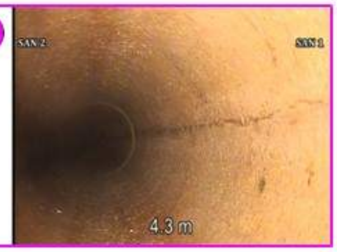
MWL - Water Level, 10%

3 | **1.60 m**

RPP - Repair Patch, from 10 o'clock to 11 o'clock, PVC patch

4 | **4.30 m** | 3

FL - Fracture Longitudinal, at 12 o'clock



5 | **14.70 m** | 5

OBR - Obstacle Rocks, from 12 o'clock to 12 o'clock, 90%

6 | **14.70 m** | 5

BVV - Broken Void Visible, from 11 o'clock to 1 o'clock

7 | **14.70 m**

MSA - Abandoned Survey, Obstacle rocks

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 1 SAN 2	**Direction of inspection:**	SAN 2 --> SAN 1
Direction of flow:	SAN 1 --> SAN 2	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	61.5
Height:	200	**Total length:**	61.5
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 3:13 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

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

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1/1

Downstream
SAN 2

Invert
NA

1	↓ 0.00 m	AMH - Manhole, SAN 2
2	↓ 0.00 m	MWL - Water Level, 10%
3	↓ 61.50 m	AMH - Manhole, SAN 1

Invert
NA

Upstream
SAN 1

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 2 SAN 3	**Direction of inspection:**	SAN 2 --> SAN 3
Direction of flow:	SAN 2 --> SAN 3	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	10.7
Height:	200	**Total length:**	12
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 12:54 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	4	**Peak:**	4
Quick rating:	0000	**Quick rating:**	4100	**Quick rating:**	4100
Score:	0	**Score:**	4	**Score:**	4
Index:	0	**Index:**	4	**Index:**	4

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

Upstream
SAN 2

Invert
NA

1	0.00 m
AMH - Manhole, SAN 2	

2	0.00 m
MWL - Water Level, 10%	

3	9.40 m
MWL - Water Level, 15%	

4	10.60 m
OBR - Obstacle Rocks, from 5 o'clock to 6 o'clock, 25%	4

5	10.70 m
MSA - Abandoned Survey, Obstacle rock	

Invert
NA

Downstream
SAN 3

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 2 SAN 3	**Direction of inspection:**	SAN 2 --> SAN 3
Direction of flow:	SAN 2 --> SAN 3	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	13.7
Height:	200	**Total length:**	12
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 2:45 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

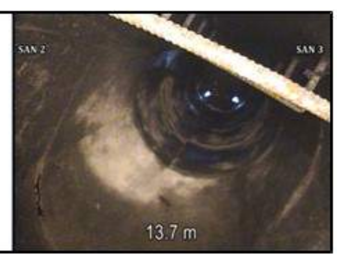
Upstream
SAN 2

1	0.00 m
AMH - Manhole, SAN 2	

2	0.00 m
MWL - Water Level, 10%	

Invert
NA

3	13.70 m
AMH - Manhole, SAN 3	



Invert
NA

Downstream
SAN 3

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 3 SAN 4	**Direction of inspection:**	SAN 3 --> SAN 4
Direction of flow:	SAN 3 --> SAN 4	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	4.8
Height:	200	**Total length:**	4.8
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 1:26 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	2	**Peak:**	2
Quick rating:	0000	**Quick rating:**	2100	**Quick rating:**	2100
Score:	0	**Score:**	2	**Score:**	2
Index:	0	**Index:**	2	**Index:**	2

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

CLEAN WATER WORKS

1 2 3 4

1 / 1

Upstream
SAN 3

Invert
NA

Invert
NA

Downstream
SAN 4

1	0.00 m	AMH - Manhole, SAN 3
2	0.00 m	MWL - Water Level, 10%

3 ↓ **4.80 m** **2**

OBZ - Obstacle Other, from 1 o'clock to 2 o'clock, 5%, Rag

4 ↓ **4.80 m**

AMH - Manhole, SAN 4

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 4 SAN 6	**Direction of inspection:**	SAN 4 --> SAN 6
Direction of flow:	SAN 4 --> SAN 6	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university		**GPS Accuracy:**	
Road segment:			**Corrdinate System:**	
			Vertical Datum:	

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	39.8
Height:	200	**Total length:**	39.8
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 12:55 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3

1 / 1

Upstream
SAN 4

1	0.00 m
AMH - Manhole, SAN 4	

2	0.00 m
MWL - Water Level, 10%	

Invert
NA

3	39.80 m
AMH - Manhole, SAN 6	

Invert
NA

Downstream
SAN 6

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 5 SAN 4	**Direction of inspection:**	SAN 5 --> SAN 4
Direction of flow:	SAN 5 --> SAN 4	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	14.7
Height:	200	**Total length:**	14.7
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Plastic/Steel Composite	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 10:13 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	2	**Peak:**	0	**Peak:**	2
Quick rating:	2100	**Quick rating:**	0000	**Quick rating:**	2100
Score:	2	**Score:**	0	**Score:**	2
Index:	2	**Index:**	0	**Index:**	2

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

Upstream
SAN 5

Invert
NA

1	0.00 m
AMH - Manhole, SAN 5	

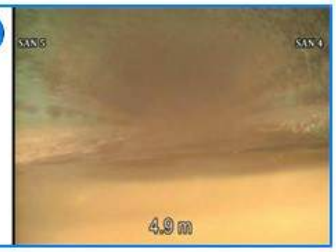
2	0.00 m
MWL - Water Level, 5%	

3	3.90 m
MWL - Water Level, 15%	

4	4.00 m
MWL - Water Level, 25%	

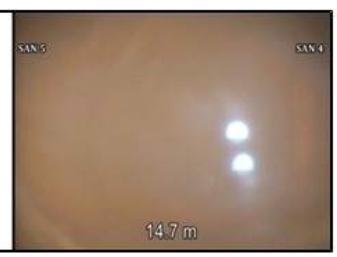
5	4.90 m
MWLS - Water Level Sag, 5%	

2



6	9.00 m
MWL - Water Level, 10%	

7	14.70 m
AMH - Manhole, SAN 4	



Invert
NA

Downstream
SAN 4

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 6 SAN 7	**Direction of inspection:**	SAN 6 --> SAN 7
Direction of flow:	SAN 6 --> SAN 7	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**		**Easting (X):**
Drainage Area:		**Northing (Y):**		**Northing (Y):**
City:	Ottawa	**Elevation (Z):**		**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university	**GPS Accuracy:**		
Road segment:		**Corrdinate System:**		
		Vertical Datum:		

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	3
Height:	200	**Total length:**	3
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 1:36 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3

1 / 1

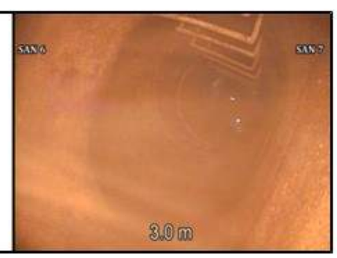
Upstream
SAN 6

Invert
NA

1	0.00 m
AMH - Manhole, SAN 6	

2	0.00 m
MWL - Water Level, 10%	

3	3.00 m
AMH - Manhole, SAN 7	



Invert
NA

Downstream
SAN 7

4. Pipe summary and condition details

Pipe identification

Pipe:	SAN 7 SAN 8	**Direction of inspection:**	SAN 7 --> SAN 8
Direction of flow:	SAN 7 --> SAN 8	**Direction:**	Direction of flow

Pipe location

			UPSTREAM	DOWNSTREAM
Road:	Campus Avenue			
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Sanitary	**Inspected length:**	0
Height:	450	**Total length:**	60
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 10:11 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	5	**Peak:**	5
Quick rating:	0000	**Quick rating:**	5100	**Quick rating:**	5100
Score:	0	**Score:**	5	**Score:**	5
Index:	0	**Index:**	5	**Index:**	5

Additional information

Other information

REPORT ID:	87830SA1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

CLEAN WATER WORKS

1 2 3 4

1 / 1

Upstream
SAN 7

Invert
NA

1	0.00 m	
AMH - Manhole, SAN 7		

2	0.00 m	
MWL - Water Level, 75%		

3	0.00 m	5
DAR - Deposits Attached Ragging, from 3 o'clock to 9 o'clock, 35%		

4	0.00 m
MSA - Abandoned Survey, debris, rag ball in line	

Invert
NA

Downstream
SAN 8

Vision Report© Legend

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

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

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

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CLEAN WATER WORKS INC.
INTEGRATED SEWER SOLUTIONS

Carleton UNIVERSITY

Carleton University

SEWER CCTV INSPECTION REPORT

Report ID
87830ST1

Sewer Use
Storm

Completion Date
November 18, 2019

Inspected Length
415.50 meters

Table of contents

Page

1. Index of pipes

22 items

Inspected length : 415.50
Total length : 402.10

2. Structural rating

22 items

4 - Poor (1 of 22 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
25	4137	3.1	STM 3 STM 4	STM 3 --> STM 4	Direction of flow	Campus Avenue	27

3 - Fair (7 of 22 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
89	3D21	3	STM 7 STM 5	STM 7 --> STM 5	Direction of flow	Campus Avenue	39
66	3C00	3	STM 7 STM 5	STM 7 --> STM 5	Direction of flow	Campus Avenue	36
49	3B11	2.9	STM 5 STM 4	STM 5 --> STM 4	Direction of flow	Campus Avenue	31
27	3900	3	CB 7 STM 8	CB 7 --> STM 8	Direction of flow	Campus Avenue	17
24	3800	3	STM 6 STM 5	STM 5 --> STM 6	Against flow	Campus Avenue	34
21	3700	3	STM 9 STM 8	STM 9 --> STM 8	Direction of flow	Campus Avenue	43
3	3100	3	STM 8 STM 7	STM 8 --> STM 7	Direction of flow	Campus Avenue	41

2 - Good (1 of 22 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
2	2100	2	STM 11 STM 7	STM 11 --> STM 7	Direction of flow	Campus Avenue	49

0 - No Defects (13 of 22 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
0	0000	0	CB 1 STM 2	STM 2 --> CB 1	Against flow	Campus Avenue	5
0	0000	0	CB 2 STM 8	CB 2 --> STM 8	Direction of flow	Campus Avenue	7
0	0000	0	CB 3 CB 2	CB 2 --> CB 3	Against flow	Campus Avenue	9
0	0000	0	CB 4 MAIN	CB 4 --> MAIN	Direction of flow	Campus Avenue	11
0	0000	0	CB 5 CB 4	CB 5 --> CB 4	Direction of flow	Campus Avenue	13
0	0000	0	CB 6 CB 5	CB 6 --> CB 5	Direction of flow	Campus Avenue	15
0	0000	0	CB 8 STM 5	STM 5 --> CB 8	Against flow	Campus Avenue	19
0	0000	0	LIMIT STM 5	STM 5 --> LIMIT	Against flow	Campus Avenue	21
0	0000	0	STM 1 STM 2	STM 2 --> STM 1	Against flow	Campus Avenue	23
0	0000	0	STM 2 STM 3	STM 2 --> STM 3	Direction of flow	Campus Avenue	25
0	0000	0	STM 3 STM 12	STM 3 --> STM 4	Direction of flow	Campus Avenue	29
0	0000	0	STM 10 STM 9	STM 9 --> STM 10	Against flow	Campus Avenue	45
0	0000	0	STM 11 BUILDING	STM 11 --> BUILDING	Against flow	Campus Avenue	47

3. O&M rating

22 items

5 - Immediate Attention (1 of 22 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
5	5100	5	0	STM 11 BUILDING	STM 11 --> BUILDING	Against flow	Campus Avenue	47

4 - Poor (3 of 22 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
8	4200	4	0	CB 6 CB 5	CB 6 --> CB 5	Direction of flow	Campus Avenue	15
6	4121	3	0	CB 4 MAIN	CB 4 --> MAIN	Direction of flow	Campus Avenue	11
6	4121	3	4	STM 3 STM 4	STM 3 --> STM 4	Direction of flow	Campus Avenue	27

2 - Good (4 of 22 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
2	2100	2	0	STM 3 STM 12	STM 3 --> STM 4	Direction of flow	Campus Avenue	29
2	2100	2	3	STM 5 STM 4	STM 5 --> STM 4	Direction of flow	Campus Avenue	31
2	2100	2	3	STM 7 STM 5	STM 7 --> STM 5	Direction of flow	Campus Avenue	36
2	2100	2	0	STM 10 STM 9	STM 9 --> STM 10	Against flow	Campus Avenue	45

0 - No Defects (14 of 22 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
0	0000	0	0	CB 1 STM 2	STM 2 --> CB 1	Against flow	Campus Avenue	5
0	0000	0	0	CB 2 STM 8	CB 2 --> STM 8	Direction of flow	Campus Avenue	7
0	0000	0	0	CB 3 CB 2	CB 2 --> CB 3	Against flow	Campus Avenue	9
0	0000	0	0	CB 5 CB 4	CB 5 --> CB 4	Direction of flow	Campus Avenue	13
0	0000	0	3	CB 7 STM 8	CB 7 --> STM 8	Direction of flow	Campus Avenue	17
0	0000	0	0	CB 8 STM 5	STM 5 --> CB 8	Against flow	Campus Avenue	19
0	0000	0	0	LIMIT STM 5	STM 5 --> LIMIT	Against flow	Campus Avenue	21
0	0000	0	0	STM 1 STM 2	STM 2 --> STM 1	Against flow	Campus Avenue	23
0	0000	0	0	STM 2 STM 3	STM 2 --> STM 3	Direction of flow	Campus Avenue	25
0	0000	0	3	STM 6 STM 5	STM 5 --> STM 6	Against flow	Campus Avenue	34
0	0000	0	3	STM 7 STM 5	STM 7 --> STM 5	Direction of flow	Campus Avenue	39
0	0000	0	3	STM 8 STM 7	STM 8 --> STM 7	Direction of flow	Campus Avenue	41
0	0000	0	3	STM 9 STM 8	STM 9 --> STM 8	Direction of flow	Campus Avenue	43
0	0000	0	2	STM 11 STM 7	STM 11 --> STM 7	Direction of flow	Campus Avenue	49

4. Pipe summary and condition details

Pipe identification

Pipe:	CB 1 STM 2	**Direction of inspection:**	STM 2 --> CB 1
Direction of flow:	CB 1 --> STM 2	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	11.3
Height:	200	**Total length:**	11.3
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 10:03 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3 4

1 / 1

Downstream
STM 2

Invert
NA

1	0.00 m
AMH - Manhole, STM 2	

2	0.00 m
MWL - Water Level, 10%	

3	2.70 m
MWL - Water Level, 5%	

4	11.30 m
AMH - Manhole, CB 1	

Invert
NA

Upstream
CB 1

4. Pipe summary and condition details

Pipe identification

Pipe:	CB 2 STM 8	**Direction of inspection:**	CB 2 --> STM 8
Direction of flow:	CB 2 --> STM 8	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	3
Height:	250	**Total length:**	3
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 1:59 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1/1

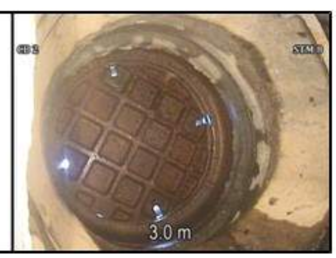
Upstream
CB 2

Invert
NA

1	0.00 m
AMH - Manhole, CB 2	

2	0.00 m
MWL - Water Level, 0%	

3	3.00 m
AMH - Manhole, STM 8	



Invert
NA

Downstream
STM 8

4. Pipe summary and condition details

Pipe identification

Pipe:	CB 3 CB 2	**Direction of inspection:**	CB 2 --> CB 3
Direction of flow:	CB 3 --> CB 2	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	5.5
Height:	250	**Total length:**	5.5
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1.5	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 2:26 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

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

Additional information

Broken Lid at upstream CB

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

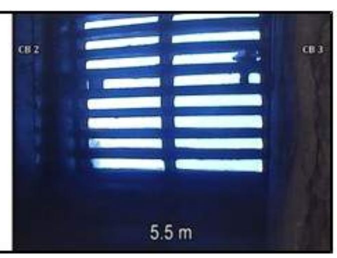
Downstream
CB 2

Invert
NA

1	0.00 m
AMH - Manhole, CB 2	

2	0.00 m
MWL - Water Level, 0%	

3	5.50 m
AMH - Manhole, CB 3	



Invert
NA

Upstream
CB 3

4. Pipe summary and condition details

CLEAN WATER WORKS

Pipe identification

Pipe:	CB 4 MAIN	**Direction of inspection:**	CB 4 --> MAIN
Direction of flow:	CB 4 --> MAIN	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM / DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:			
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	9.8
Height:	200	**Total length:**	9.8
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 9:26 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	4	**Peak:**	4
Quick rating:	0000	**Quick rating:**	4121	**Quick rating:**	4121
Score:	0	**Score:**	6	**Score:**	6
Index:	0	**Index:**	3	**Index:**	3

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

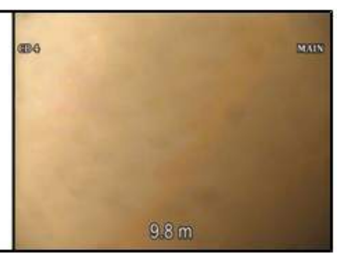
4. Pipe summary and condition details

1 / 1

Upstream
CB 4

Invert
NA

1	0.00 m	
AMH - Manhole, CB 4		
2	0.00 m	
MWL - Water Level, 0%		
3	2.30 m	2
LD - Alignment Down, 15%		
4	4.10 m	
MMC - Material Change, Polyvinyl Chloride		
5	7.00 m	
MWL - Water Level, 25%		
6	7.60 m	
MWL - Water Level, 50%		
7	8.10 m	4
MCU - Camera Underwater		
8	9.80 m	
MSA - Abandoned Survey, Camera under water		



Invert
NA

Downstream
MAIN

4. Pipe summary and condition details

CLEAN WATER WORKS

Pipe identification

Pipe:	CB 5 CB 4	**Direction of inspection:**	CB 5 --> CB 4
Direction of flow:	CB 5 --> CB 4	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:			
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	6.3
Height:	200	**Total length:**	6.3
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 9:16 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3

1 / 1

Upstream
CB 5

1	0.00 m
AMH - Manhole, CB 5	

Invert
NA

2	0.00 m
MWL - Water Level, 0%	

3	6.30 m
AMH - Manhole, CB 4	

Invert
NA

Downstream
CB 4

4. Pipe summary and condition details

Pipe identification

Pipe:	CB 6 CB 5	**Direction of inspection:**	CB 6 --> CB 5
Direction of flow:	CB 6 --> CB 5	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	4.6
Height:	200	**Total length:**	4.6
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 8:53 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	4	**Peak:**	4
Quick rating:	0000	**Quick rating:**	4200	**Quick rating:**	4200
Score:	0	**Score:**	8	**Score:**	8
Index:	0	**Index:**	4	**Index:**	4

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3 4 5

1 / 1

Upstream
CB 6

Invert
NA

1	0.00 m
AMH - Manhole, CB 6	

2	0.00 m
MWL - Water Level, 0%	

3	1.20 m	4
LL - Alignment Left, 25%		

4	3.30 m	4
LR - Alignment Right, 25%		

5	4.60 m
AMH - Manhole, CB 5	

Invert
NA

Downstream
CB 5

4. Pipe summary and condition details

Pipe identification

Pipe: CB 7 STM 8	**Direction of inspection:** CB 7 --> STM 8
Direction of flow: CB 7 --> STM 8	**Direction:** Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university		**GPS Accuracy:**
Road segment:			**Corrdinate System:**
			Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	20.9
Height:	200	**Total length:**	21
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 3:33 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	3	**Peak:**	0	**Peak:**	3
Quick rating:	3900	**Quick rating:**	0000	**Quick rating:**	3900
Score:	27	**Score:**	0	**Score:**	27
Index:	3	**Index:**	0	**Index:**	3

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1/1

Upstream
CB 7

Invert
NA

1 ↓ **0.00 m**
AMH - Manhole, CB 7

2 ↓ **0.00 m**
MWL - Water Level, 5%

3 ↓ **6.50 m** (3)
(S01) FL - Fracture Longitudinal, at joint, at 12 o'clock

4 ↓ **14.00 m**
MWL - Water Level, 15%

5 ↓ **20.90 m** (3)
(F01) FL - Fracture Longitudinal, at joint, at 12 o'clock

6 ↓ **20.90 m**
AMH - Manhole, STM 8

Invert
NA

Downstream
STM 8

4. Pipe summary and condition details

Pipe identification

Pipe:	CB 8 STM 5	**Direction of inspection:**	STM 5 --> CB 8
Direction of flow:	CB 8 --> STM 5	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue		UPSTREAM / DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	8.5
Height:	200	**Total length:**	8.5
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 2:30 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3 4

1 / 1

Downstream
STM 5

Invert
NA

1	0.00 m
AMH - Manhole, STM 5	

2	0.00 m
MWL - Water Level, 0%	

3	3.80 m
MMC - Material Change, Concrete Segments (unbolted)	

4	8.50 m
AMH - Manhole, CB 8	

Invert
NA

Upstream
CB 8

4. Pipe summary and condition details

Pipe identification

Pipe:	LIMIT STM 5	**Direction of inspection:**	STM 5 --> LIMIT
Direction of flow:	LIMIT --> STM 5	**Direction:**	Against flow

Pipe location

			UPSTREAM	DOWNSTREAM
Road:	Campus Avenue			
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	49.9
Height:	450	**Total length:**	49.9
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 3:57 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

Downstream
STM 5

Invert
NA

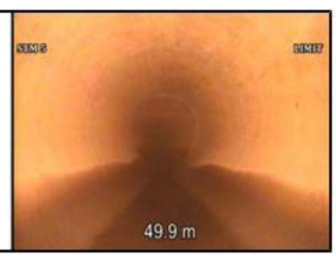
1 ↓ **0.00 m**
AMH - Manhole, STM 5

2 ↓ **0.00 m**
MWL - Water Level, 25%

3 ↓ **15.40 m**
MWL - Water Level, 15%

4 ↓ **21.20 m**
MWL - Water Level, 5%

5 ↓ **49.90 m**
AEP - End of Pipe, LIMIT



Invert
NA

Upstream
LIMIT

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 1 STM 2	**Direction of inspection:**	STM 2 --> STM 1
Direction of flow:	STM 1 --> STM 2	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	34.3
Height:	250	**Total length:**	34.3
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 10:23 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3 4 5 6 7

1 / 1

Downstream
STM 2

Invert
NA

1 **0.00 m**

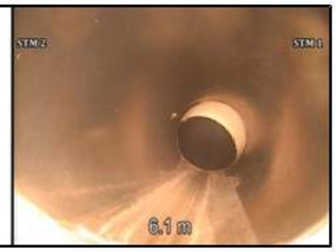
AMH - Manhole, STM 2

2 **0.00 m**

MWL - Water Level, 0%

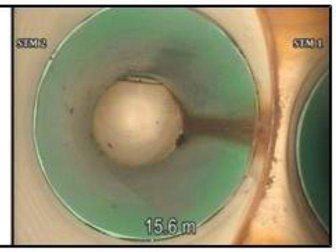
3 **6.10 m**

TF - Tap Factory, at 2 o'clock, Dim.1=150



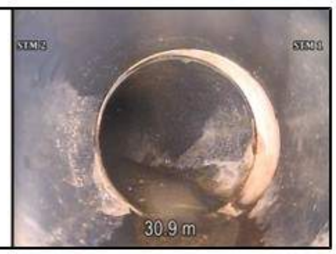
4 **15.60 m**

TF - Tap Factory, at 12 o'clock, Dim.1=250



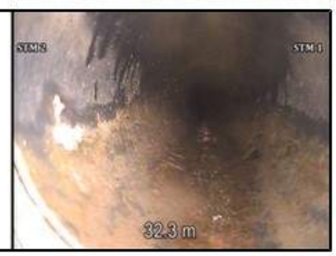
5 **30.90 m**

TF - Tap Factory, at 8 o'clock, Dim.1=150



6 **32.30 m**

TF - Tap Factory, at 3 o'clock, Dim.1=150



7 **34.30 m**

AMH - Manhole, STM 1

Invert
NA

Upstream
STM 1

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 2 STM 3	**Direction of inspection:**	STM 2 --> STM 3
Direction of flow:	STM 2 --> STM 3	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	29.4
Height:	300	**Total length:**	29.4
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	3	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 3:34 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3

1 / 1

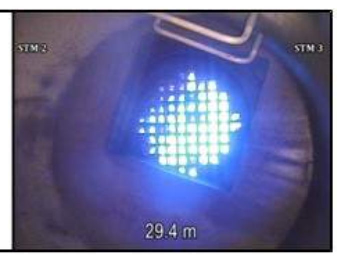
Upstream
STM 2

Invert
NA

1	0.00 m
AMH - Manhole, STM 2	

2	0.00 m
MWL - Water Level, 0%	

3	29.40 m
AMH - Manhole, STM 3	



Invert
NA

Downstream
STM 3

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 3 STM 4	**Direction of inspection:**	STM 3 --> STM 4
Direction of flow:	STM 3 --> STM 4	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	11.4
Height:	450	**Total length:**	11.4
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 1:57 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

Structural rating		O&M rating		Overall rating	
Peak:	4	**Peak:**	4	**Peak:**	4
Quick rating:	4137	**Quick rating:**	4121	**Quick rating:**	4237
Score:	25	**Score:**	6	**Score:**	31
Index:	3.1	**Index:**	3	**Index:**	3.1

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1/1

Upstream
STM 3

Invert
NA

1 ↓ **0.00 m**

AMH - Manhole, STM 3

2 ↓ **0.00 m**

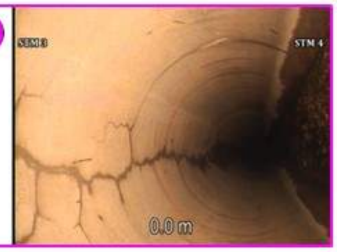
MWL - Water Level, 15%

3 ↓ **0.00 m** 2

DSF - Deposits Settled Fine, from 5 o'clock to 7 o'clock, 5%

4 ↓ **0.00 m** 3

(S01) FL - Fracture Longitudinal, at joint, at 12 o'clock

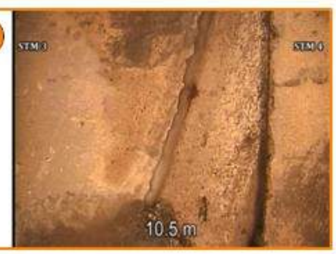


5 ↓ **10.00 m** 4

LL - Alignment Left, 25%

6 ↓ **10.50 m** 4

B - Broken, from 12 o'clock to 2 o'clock

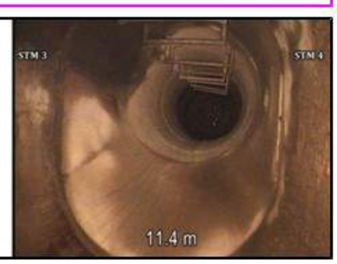


7 ↓ **10.60 m** 3

(F01) FL - Fracture Longitudinal, at joint, at 12 o'clock

8 ↓ **11.40 m**

AMH - Manhole, STM 4



Invert
NA

Downstream
STM 4

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 3 STM 12	**Direction of inspection:**	STM 3 --> STM 4
Direction of flow:	STM 3 --> STM 4	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	2.8
Height:	450	**Total length:**	10
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:		**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 4:26 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	2	**Peak:**	2
Quick rating:	0000	**Quick rating:**	2100	**Quick rating:**	2100
Score:	0	**Score:**	2	**Score:**	2
Index:	0	**Index:**	2	**Index:**	2

Additional information

Incorrect struction ID. Correction structure ID STM 3 to STM 4

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3 4

1 / 1

Upstream
STM 3

Invert
NA

1	0.00 m	
AMH - Manhole, STM 3		

2	0.00 m	
MWL - Water Level, 15%		

3	2.70 m	2
DSF - Deposits Settled Fine, from 5 o'clock to 7 o'clock, 10%		

4	2.80 m	
MSA - Abandoned Survey, debris		

Invert
NA

Downstream
STM 4

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 5 STM 4	**Direction of inspection:**	STM 5 --> STM 4
Direction of flow:	STM 5 --> STM 4	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	60.3
Height:	450	**Total length:**	60
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 3:34 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

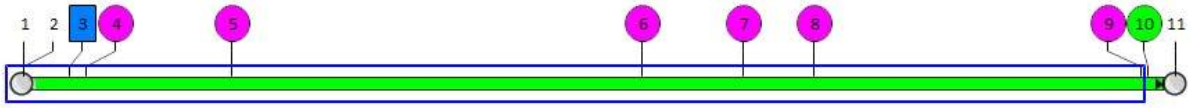
Structural rating		O&M rating		Overall rating	
Peak:	3	**Peak:**	2	**Peak:**	3
Quick rating:	3B11	**Quick rating:**	2100	**Quick rating:**	3B21
Score:	49	**Score:**	2	**Score:**	51
Index:	2.9	**Index:**	2	**Index:**	2.8

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details



Upstream
STM 5

Invert
NA

1	0.00 m
AMH - Manhole, STM 5	

2	0.00 m
MWL - Water Level, 5%	

3 ↓ **2.40 m** — 2

DSGV - Deposits Settled Gravel, from 5 o'clock to 7 o'clock, 10%

4 ↓ **3.30 m** — 3

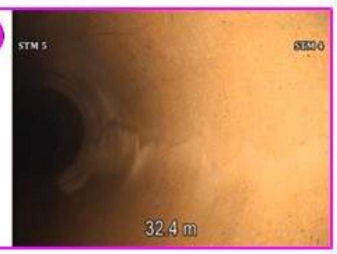
FL - Fracture Longitudinal, at 11 o'clock

5 ↓ **10.90 m** — 3

FL - Fracture Longitudinal, at 12 o'clock

6 ↓ **32.40 m** — 3

(S01) FL - Fracture Longitudinal, at joint, at 12 o'clock

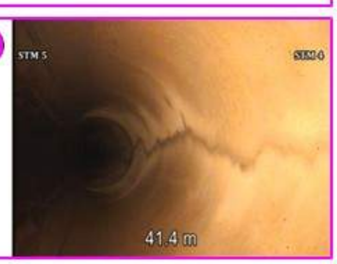


7 ↓ **37.70 m** — 3

(F01) FL - Fracture Longitudinal, at joint, at 12 o'clock

8 ↓ **41.40 m** — 3

(S02) FL - Fracture Longitudinal, at joint, at 12 o'clock



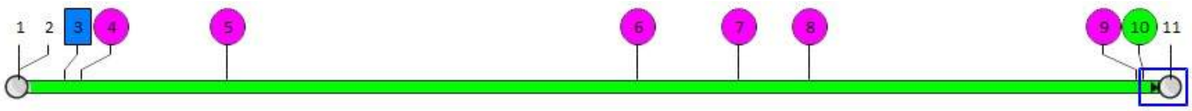
9 ↓ **58.50 m** — 3

(F02) FL - Fracture Longitudinal, at joint, at 12 o'clock

Invert
NA

Downstream
STM 4

4. Pipe summary and condition details



◀2 / 2

Upstream
STM 5

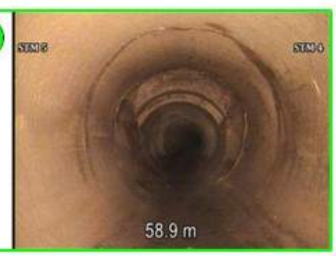
Invert
NA

Invert
NA

Downstream
STM 4

10 ↓ **58.90 m** (1)

CC - Crack Circumferential, from 7 o'clock to 4 o'clock



11 ↓ **60.30 m**

AMH - Manhole, STM 4

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 6 STM 5	**Direction of inspection:**	STM 5 --> STM 6
Direction of flow:	STM 6 --> STM 5	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university		**GPS Accuracy:**	
Road segment:			**Corrdinate System:**	
			Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	20.7
Height:	200	**Total length:**	20.7
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 2:17 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

	Structural rating	O&M rating	Overall rating
Peak:	3	0	3
Quick rating:	3800	0000	3800
Score:	24	0	24
Index:	3	0	3

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

Downstream
STM 5

Invert
NA

1 ↓ **0.00 m**

AMH - Manhole, STM 5

2 ↓ **0.00 m**

MWL - Water Level, 0%

3 ↓ **6.90 m** 3

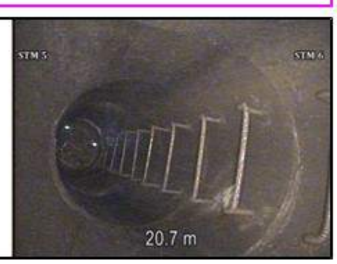
(S01) FL - Fracture Longitudinal, at 12 o'clock

4 ↓ **19.40 m** 3

(F01) FL - Fracture Longitudinal, at 12 o'clock

5 ↓ **20.70 m**

AMH - Manhole, STM 6



Invert
NA

Upstream
STM 6

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 7 STM 5	**Direction of inspection:**	STM 7 --> STM 5
Direction of flow:	STM 7 --> STM 5	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot		
Owner:	Carleton university	**GPS Accuracy:**	
Road segment:		**Corrdinate System:**	
		Vertical Datum:	

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	36.3
Height:	300	**Total length:**	44
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 2:10 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

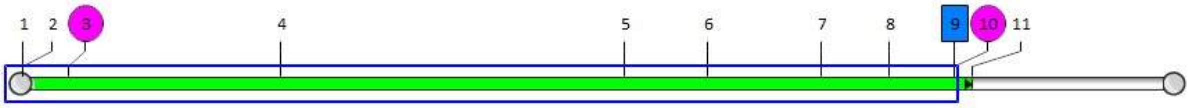
Structural rating		O&M rating		Overall rating	
Peak:	3	**Peak:**	2	**Peak:**	3
Quick rating:	3C00	**Quick rating:**	2100	**Quick rating:**	3C21
Score:	66	**Score:**	2	**Score:**	68
Index:	3	**Index:**	2	**Index:**	3

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**
Information 2:		**Information 7:**
Information 3:		**Information 8:**
Information 4:		**Information 9:**
Information 5:		**Information 10:**

4. Pipe summary and condition details



1 / 2 ▶

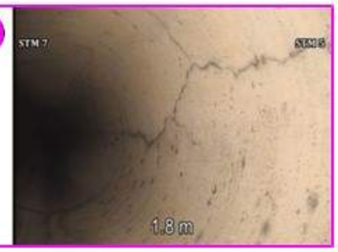
Upstream
STM 7

Invert
NA

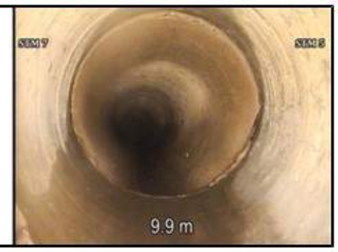
1	↓ 0.00 m
	AMH - Manhole, STM 7

2	↓ 0.00 m
	MWL - Water Level, 5%

3	↓ 1.80 m	3
	(S01) FL - Fracture Longitudinal, at joint, at 12 o'clock	



4	↓ 9.90 m
	TB - Tap Break-in, at 9 o'clock, Dim.1=200



5	↓ 23.00 m
	MWL - Water Level, 25%

6	↓ 26.20 m
	MWL - Water Level, 35%

7	↓ 30.50 m
	MWL - Water Level, 25%

8	↓ 33.10 m
	MWL - Water Level, 15%

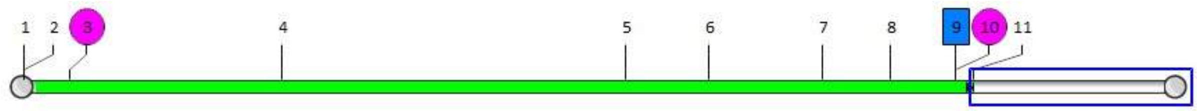
9	↓ 35.60 m	2
	DSGV - Deposits Settled Gravel, from 5 o'clock to 7 o'clock, 10%	

10	↓ 35.60 m	3
	(F01) FL - Fracture Longitudinal, at joint, at 12 o'clock	

Invert
NA

Downstream
STM 5

4. Pipe summary and condition details

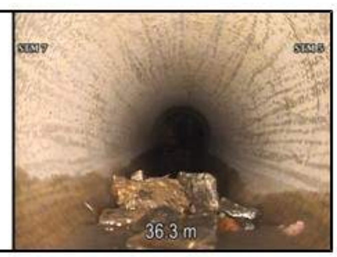


◀2 / 2

Upstream
STM 7

Invert
NA

11	36.30 m
MSA - Abandoned Survey, debris, rocks in line	



Invert
NA

Downstream
STM 5

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 7 STM 5	**Direction of inspection:**	STM 7 --> STM 5
Direction of flow:	STM 7 --> STM 5	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	44.9
Height:	300	**Total length:**	44
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 12:57 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		**O&M rating**		**Overall rating**	
Peak:	3	**Peak:**	0	**Peak:**	3
Quick rating:	3D21	**Quick rating:**	0000	**Quick rating:**	3D21
Score:	89	**Score:**	0	**Score:**	89
Index:	3	**Index:**	0	**Index:**	3

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1/1

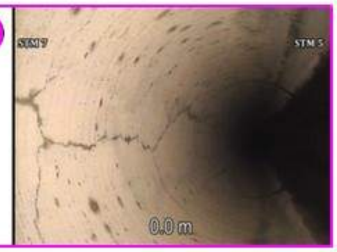
Upstream
STM 7

Invert
NA

1	**↓ 0.00 m**	
AMH - Manhole, STM 7		

2	**↓ 0.00 m**	
MWL - Water Level, 5%		

3	**↓ 0.00 m**	3
(S01) FL - Fracture Longitudinal, at joint, at 12 o'clock		



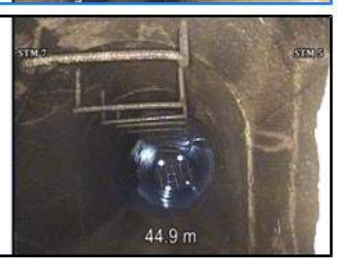
4	**↓ 11.60 m**	
TB - Tap Break-in, at 10 o'clock, Dim.1=250		

5	**↓ 28.60 m**	
MWL - Water Level, 25%		

6	**↓ 44.60 m**	3
(F01) FL - Fracture Longitudinal, at joint, at 12 o'clock		

7	**↓ 44.90 m**	2
FC - Fracture Circumferential, from 7 o'clock to 5 o'clock		

8	**↓ 44.90 m**	
AMH - Manhole, STM 5		



Invert
NA

Downstream
STM 5

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 8 STM 7	**Direction of inspection:**	STM 8 --> STM 7
Direction of flow:	STM 8 --> STM 7	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	4.7
Height:	300	**Total length:**	4.7
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	1	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 2:03 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

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

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3 4 5 6

1 / 1

Upstream
STM 8

Invert
NA

1 ↓ **0.00 m**

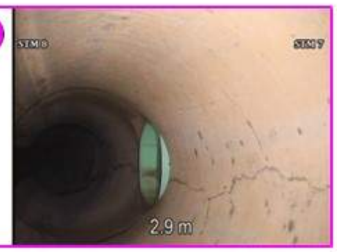
AMH - Manhole, STM 8

2 ↓ **0.00 m**

MWL - Water Level, 5%

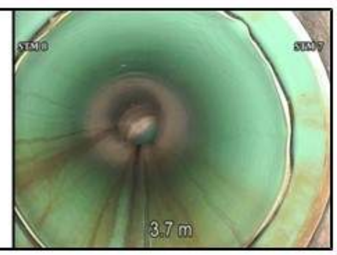
3 ↓ **2.90 m** (3)

(S01) FL - Fracture Longitudinal, at joint, at 12 o'clock



4 ↓ **3.70 m**

TB - Tap Break-in, at 12 o'clock, Dim.1=200



5 ↓ **4.70 m** (3)

(F01) FL - Fracture Longitudinal, at joint, at 12 o'clock

6 ↓ **4.70 m**

AMH - Manhole, STM 7

Invert
NA

Downstream
STM 7

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 9 STM 8	**Direction of inspection:**	STM 9 --> STM 8
Direction of flow:	STM 9 --> STM 8	**Direction:**	Direction of flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	18.7
Height:	300	**Total length:**	18.7
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Concrete Segments (unbolted)	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	2	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	13/11/2019 11:43 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	3	**Peak:**	0	**Peak:**	3
Quick rating:	3700	**Quick rating:**	0000	**Quick rating:**	3700
Score:	21	**Score:**	0	**Score:**	21
Index:	3	**Index:**	0	**Index:**	3

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1/1

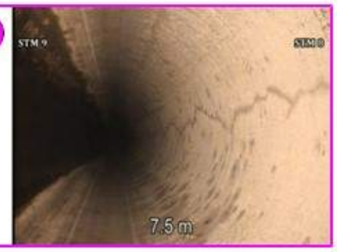
Upstream
STM 9

Invert
NA

1	0.00 m
AMH - Manhole, STM 9	

2	0.00 m
MWL - Water Level, 5%	

3	7.50 m
(S01) FL - Fracture Longitudinal, at 12 o'clock	3



4	8.20 m
MWL - Water Level, 10%	

5	18.70 m
(F01) FL - Fracture Longitudinal, at 12 o'clock	3

6	18.70 m
AMH - Manhole, STM 8	

Invert
NA

Downstream
STM 8

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 10 STM 9	**Direction of inspection:**	STM 9 --> STM 10
Direction of flow:	STM 10 --> STM 9	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Parking Lot			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	1.9
Height:	200	**Total length:**	1.9
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:		**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	18/11/2019 2:19 PM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Dry	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	2	**Peak:**	2
Quick rating:	0000	**Quick rating:**	2100	**Quick rating:**	2100
Score:	0	**Score:**	2	**Score:**	2
Index:	0	**Index:**	2	**Index:**	2

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 / 1

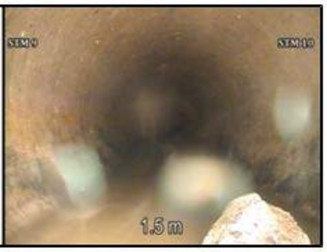
Downstream
STM 9

Invert
NA

1	0.00 m	AMH - Manhole, STM 9
2	0.00 m	MWL - Water Level, 10%
3	1.50 m	MMC - Material Change, Concrete Segments (unbolted)

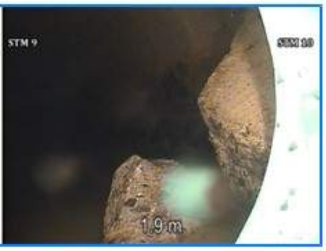
4 ↓ **1.50 m**

MSC - Shape or Size Change, Dim.1=300



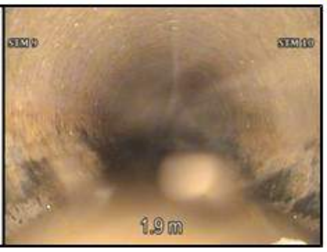
5 ↓ **1.90 m** **2**

OBR - Obstacle Rocks, from 4 o'clock to 6 o'clock, 10%



6 ↓ **1.90 m**

MSA - Abandoned Survey, Size change from 200 to 300, obstacle rocks



Invert
NA

Upstream
STM 10

4. Pipe summary and condition details

Pipe identification

Pipe:	STM 11 BUILDING	**Direction of inspection:**	STM 11 --> BUILDING
Direction of flow:	BUILDING --> STM 11	**Direction:**	Against flow

Pipe location

Road:	Campus Avenue		UPSTREAM	DOWNSTREAM
Crossroad:			**Easting (X):**	**Easting (X):**
Drainage Area:			**Northing (Y):**	**Northing (Y):**
City:	Ottawa		**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway			
Owner:	Carleton university			**GPS Accuracy:**
Road segment:				**Corrdinate System:**
				Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	18.2
Height:	150	**Total length:**	35
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 11:32 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating / O&M rating / Overall rating

Structural rating		O&M rating		Overall rating	
Peak:	0	**Peak:**	5	**Peak:**	5
Quick rating:	0000	**Quick rating:**	5100	**Quick rating:**	5100
Score:	0	**Score:**	5	**Score:**	5
Index:	0	**Index:**	5	**Index:**	5

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

1 2 3 4

1 / 1

Downstream
STM 11

Invert
NA

1	↓ 0.00 m
	AMH - Manhole, STM 11

2	↓ 0.00 m
	MWL - Water Level, 5%

3	↓ 18.20 m	5
	TFI - Tap Factory Intruding, at 2 o'clock, Dim.1=125, Dim.2=125, 75% intruding	

4	↓ 18.20 m
	MSA - Abandoned Survey, Intruding connection

Invert
NA

Upstream
BUILDING

4. Pipe summary and condition details

Pipe identification

Pipe: STM 11 STM 7	**Direction of inspection:** STM 11 --> STM 7
Direction of flow: STM 11 --> STM 7	**Direction:** Direction of flow

Pipe location

Road:	Campus Avenue	UPSTREAM	DOWNSTREAM
Crossroad:		**Easting (X):**	**Easting (X):**
Drainage Area:		**Northing (Y):**	**Northing (Y):**
City:	Ottawa	**Elevation (Z):**	**Elevation (Z):**
Location:	Light Highway		
Owner:	Carleton university		**GPS Accuracy:**
Road segment:			**Corrdinate System:**
			Vertical Datum:

Pipe characteristics

Sewer Use:	Stormwater	**Inspected length:**	12.1
Height:	150	**Total length:**	12.1
Width:		**Rim/Inv.:**	
Shape:	Circular	**Grade/Inv.:**	
Material:	Polyvinyl Chloride	**Rim/Grade:**	
Lining:		**Rim/Inv.:**	
Joint length:	4	**Grade/Inv.:**	
Year laid:		**Rim/Grade:**	
Year renewed:		**Sewer category:**	

Additional details

Date:	14/11/2019 11:23 AM	**Location details:**	
Project Number:	Carleton University	**Surveyed by:**	Jonathan Larocque
Customer:	Carleton University-87830	**Certificate #:**	U06180703002189
PO number:		**Pre-Cleaning:**	Jetting
Work order:	87830	**Date cleaned:**	
Purpose:		**Unit of measurement:**	Metric
Weather:	Snow	**Media label:**	
Flow control:	Not Controlled	**Sheet #:**	

Structural rating		O&M rating		Overall rating	
Peak:	2	**Peak:**	0	**Peak:**	2
Quick rating:	2100	**Quick rating:**	0000	**Quick rating:**	2100
Score:	2	**Score:**	0	**Score:**	2
Index:	2	**Index:**	0	**Index:**	2

Additional information

Other information

REPORT ID:	87830ST1	**Information 6:**	
Information 2:		**Information 7:**	
Information 3:		**Information 8:**	
Information 4:		**Information 9:**	
Information 5:		**Information 10:**	

4. Pipe summary and condition details

Upstream
STM 11

Invert
NA

1	0.00 m
AMH - Manhole, STM 11	

2	0.00 m
MWL - Water Level, 5%	

3	3.20 m
MWLS - Water Level Sag, 5%	

4	4.20 m
MWL - Water Level, 25%	

5	5.40 m
MWL - Water Level, 10%	

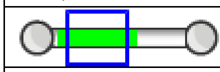
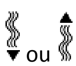
6	12.10 m
AMH - Manhole, STM 7	

Invert
NA

Downstream
STM 7

0 5 10 20 30 40 50
SCALE 1:600 (METRIC)
30
23
26
CAMPUS AVENUE
Include CCTV to upstream manhole on storm and sanitary sewer
LIMIT
0.405 Dia. WATERMAIN
SAN1
SAN2
SAN3
SAN4
SAN5
SAN6
SAN7
SAN8
STM1
STM2
STM3
STM4
STM5
STM6
STM8
STM9
STM10
CB1
CB2
CB3
CB4
CB5
CB6
CB7
CB8
Gas Meter
SCULPTURE ON CONCRETE PAD

Vision Report© Legend

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

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

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

Appendix I

Site Servicing Checklist

4. Development Servicing Study Checklist

The following section describes the checklist of the required content of servicing studies. It is expected that the proponent will address each one of the following items for the study to be deemed complete and ready for review by City of Ottawa Infrastructure Approvals staff.

The level of required detail in the Servicing Study will increase depending on the type of application. For example, for Official Plan amendments and re-zoning applications, the main issues will be to determine the capacity requirements for the proposed change in land use and confirm this against the existing capacity constraint, and to define the solutions, phasing of works and the financing of works to address the capacity constraint. For subdivisions and site plans, the above will be required with additional detailed information supporting the servicing within the development boundary.

4.1 General Content

N/A ☐ Executive Summary (for larger reports only).

☒ Date and revision number of the report.

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

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

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

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

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

☒ Statement of objectives and servicing criteria.

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

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

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

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

☒ Proposed phasing of the development, if applicable.

☒ Reference to geotechnical studies and recommendations concerning servicing.

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

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

4.2 Development Servicing Report: Water

☒ Confirm consistency with Master Servicing Study, if available

☒ Availability of public infrastructure to service proposed development

☒ Identification of system constraints

☒ Identify boundary conditions

☒ Confirmation of adequate domestic supply and pressure

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

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

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

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

N/A ☐ Check on the necessity of a pressure zone boundary modification.

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

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

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

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

N/A ☐ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

4.3 Development Servicing Report: Wastewater

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

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

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

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

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

☒ Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix ‘C’) format.

☒ Description of proposed sewer network including sewers, pumping stations, and forcemains.

N/A ☐ Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).

N/A ☐ Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.

N/A ☐ Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.

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

☒ Special considerations such as contamination, corrosive environment etc.

4.4 Development Servicing Report: Stormwater Checklist

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

☒ Analysis of available capacity in existing public infrastructure.

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

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

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

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

N/A ☐ Set-back from private sewage disposal systems.

N/A ☐ Watercourse and hazard lands setbacks.

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

N/A ☐ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

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

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

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

N/A ☐ Any proposed diversion of drainage catchment areas from one outlet to another.

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

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

N/A ☐ Identification of potential impacts to receiving watercourses

N/A ☐ Identification of municipal drains and related approval requirements.

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

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

N/A ☐ Inclusion of hydraulic analysis including hydraulic grade line elevations.

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

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

N/A ☐ Identification of fill constraints related to floodplain and geotechnical investigation.

4.5 Approval and Permit Requirements: Checklist

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

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

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

N/A ☐ Changes to Municipal Drains.

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

4.6 Conclusion Checklist

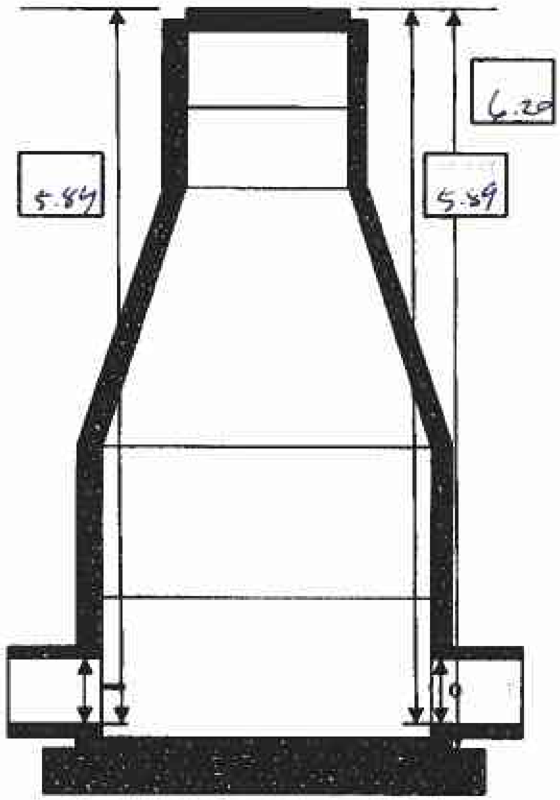
☒ Clearly stated conclusions and recommendations

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

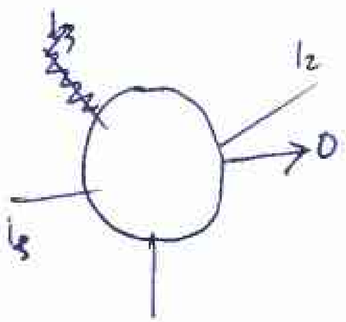
☒ All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

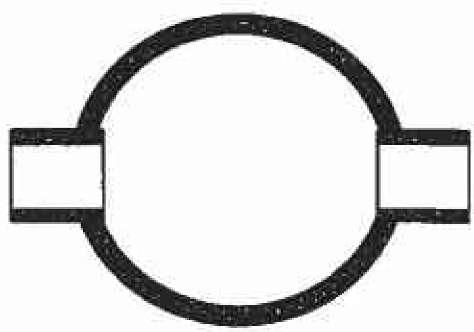
Appendix J

Maintenance Hole Inspections



300





NONE

CLEAN WATER WORKS INC.
1800 BANTREE STREET
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MANHOLE INSPECTION SHEET

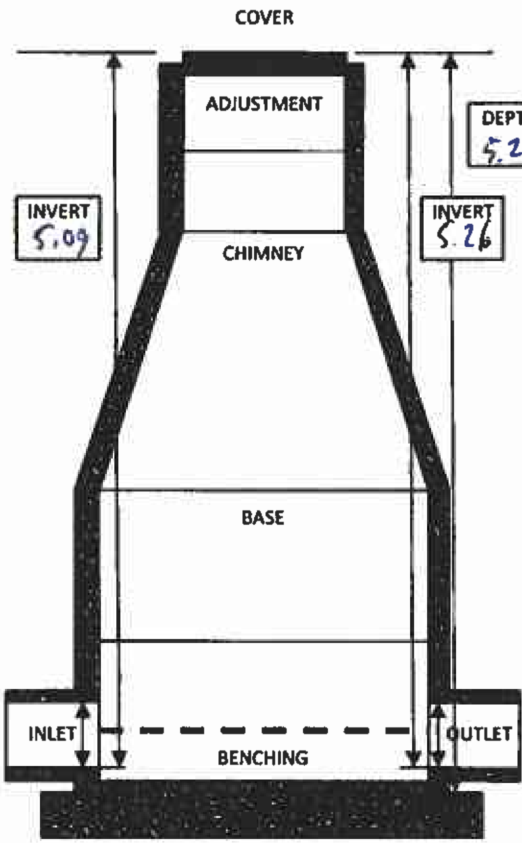
T/G: 64.81

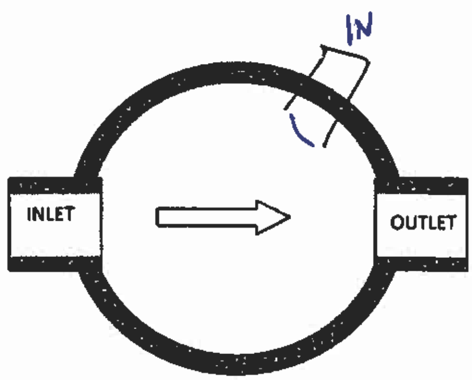
CLEAN WATER WORKS INC.
PIPELINE REHABILITATION

STRUCTURE TYPE
- SANITARY: ☑
- STORM: ☐
- WATER: ☐
- UTILITY: ☐
- OTHER: ☐

SURFACE
- ASPHALT: ☐
- GRAVEL: ☐
- CONCRETE: ☐
- GRASS: ☑
- OTHER: ☐

COVER
- OPEN ROUND: ☐
- CLOSED ROUND: ☑
- OPEN SQUARE: ☐
- CLOSED SQUARE: ☐
- OTHER: ☐
- LOCKED/BOLTED: ☐





STRUCTURE ID: 1090
LOCATION: Carleton University
DATE: March 11, 2020
CUSTOMER: CCW
JOB #:
INSPECTED BY: P. Ouimet

STRUCTURE SIZE:
COVER SIZE (mm): 620mm
DEPTH (M): 0.05m

OUTLET 1:
PIPE DIAMETER (mm):
DIRECTION: N
INVERT (M): 5.26 Depth

INLET 1:
PIPE DIAMETER (mm):
DIRECTION: South
INVERT (M): 5.09

INLET 2: 200mm
PIPE DIAMETER (mm):
DIRECTION: N/W
INVERT (M): 3.92

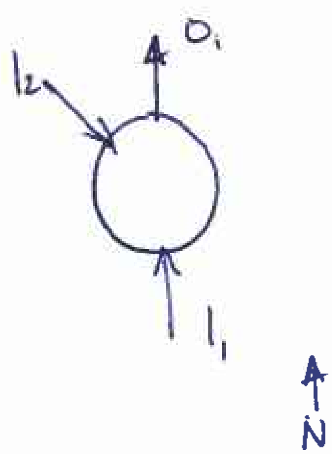
INLET 3:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 4:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 5:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 6:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

COMMENTS



CONDITION	COVER	ADJUSTMENT	CHIMNEY	RISER	BASE	BENCHING	RUNGS
EXCELLENT							
GOOD	✓	✓	✓	✓			✓
AVERAGE					✓		
POOR						NONE	
INFILTRATION							
CRACKS/SPALLING		SMALL					

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MANHOLE INSPECTION SHEET

CLEAN WATER WORKS INC.
PIPELINE REHABILITATION

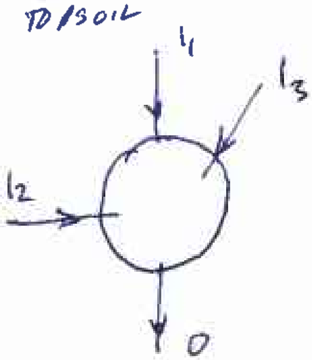
T/G : 64.31 +/-

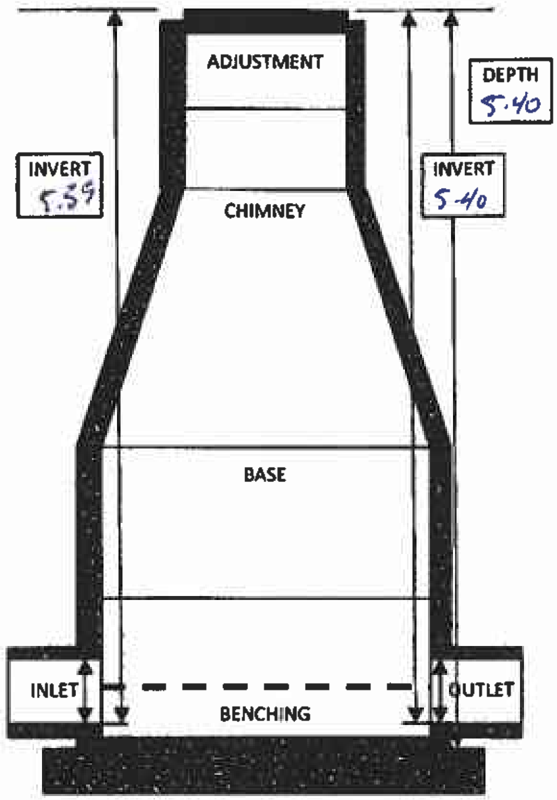
STRUCTURE TYPE	
SANITARY:	☐
STORM:	☑
WATER:	☐
UTILITY:	☐
OTHER:	☐

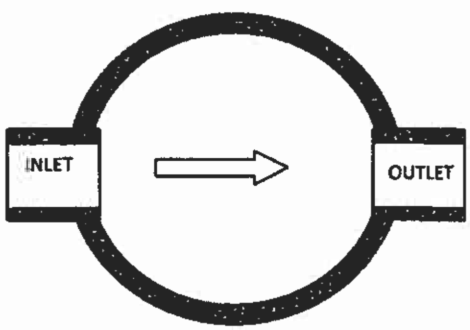
SURFACE	
ASPHALT:	☐
GRAVEL:	☐
CONCRETE:	☐
GRASS:	☑
OTHER:	☐

COVER	
OPEN ROUND:	☐
CLOSED ROUND:	☐
OPEN SQUARE:	☐
CLOSED SQUARE:	☐
OTHER:	☐
LOCKED/BOLTED:	☐

COMMENTS
FOUND UNDER TOPSOIL







STRUCTURE ID: 182
LOCATION:
DATE:
CUSTOMER:
JOB #:
INSPECTED BY:

STRUCTURE SIZE:
COVER SIZE (mm):
DEPTH (M):

OUTLET 1:
PIPE DIAMETER (mm): 525
DIRECTION:
INVERT (M): 5.4

INLET 1:
PIPE DIAMETER (mm): 525
DIRECTION:
INVERT (M): 5.39

INLET 2:
PIPE DIAMETER (mm): 450
DIRECTION:
INVERT (M): 5.34

INLET 3:
PIPE DIAMETER (mm): 200
DIRECTION:
INVERT (M): 2.56

INLET 4:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 5:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 6:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

CONDITION	COVER	ADJUSTMENT	CHIMNEY	RISER	BASE	BENCHING	RUNGS
EXCELLENT							
GOOD	✓	✓	✓	✓	✓	✓	✓
AVERAGE							
POOR							
INFILTRATION							
CRACKS/SPALLING							

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MANHOLE INSPECTION SHEET

T/6 : 65.11

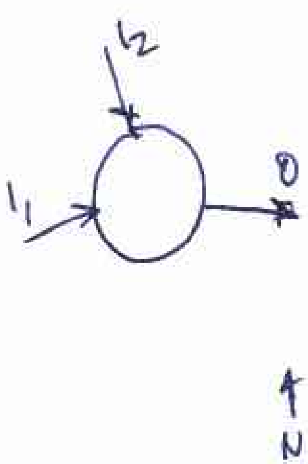
CLEAN WATER WORKS INC.
PIPELINE REHABILITATION

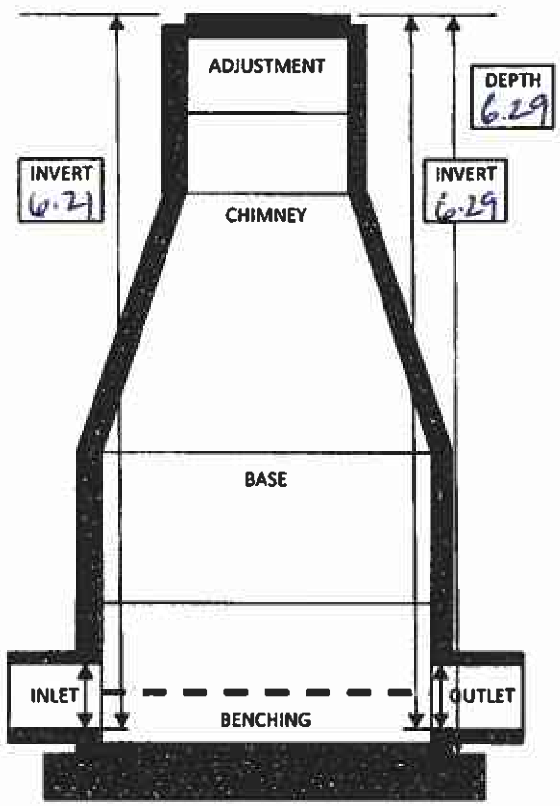
STRUCTURE TYPE
- SANITARY: ☑
- STORM: ☐
- WATER: ☐
- UTILITY: ☐
- OTHER: ☐

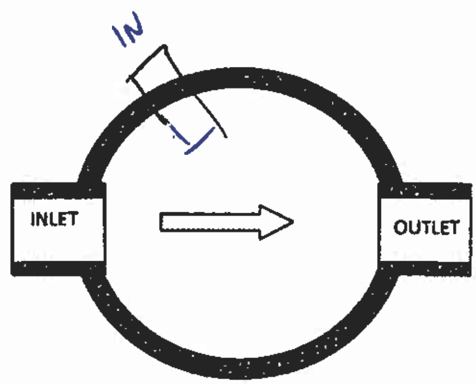
SURFACE
- ASPHALT: ☐
- GRAVEL: ☐
- CONCRETE: ☑
- GRASS: ☐
- OTHER: ☐

COVER
- OPEN ROUND: ☐
- CLOSED ROUND: ☑
- OPEN SQUARE: ☐
- CLOSED SQUARE: ☐
- OTHER: ☐
- LOCKED/BOLTED: ☐

COMMENTS







STRUCTURE ID: 1149
LOCATION:
DATE:

CUSTOMER:
JOB #:
INSPECTED BY:

STRUCTURE SIZE: 750/825
COVER SIZE (mm): 620mm
DEPTH (M): 0.08m

OUTLET 1:
PIPE DIAMETER (mm): 200mm
DIRECTION:
INVERT (M): 6.29

INLET 1:
PIPE DIAMETER (mm): 200mm
DIRECTION:
INVERT (M): 6.29

INLET 2:
PIPE DIAMETER (mm): 250mm
DIRECTION:
INVERT (M): 5.42

INLET 3:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 4:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 5:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 6:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

CONDITION	COVER	ADJUSTMENT	CHIMNEY	RISER	BASE	BENCHING	RUNGS
EXCELLENT							
GOOD		✓	✓	✓	✓	✓	✓
AVERAGE	BROKEN						
POOR							
INFILTRATION							
CRACKS/SPALLING							

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MANHOLE INSPECTION SHEET

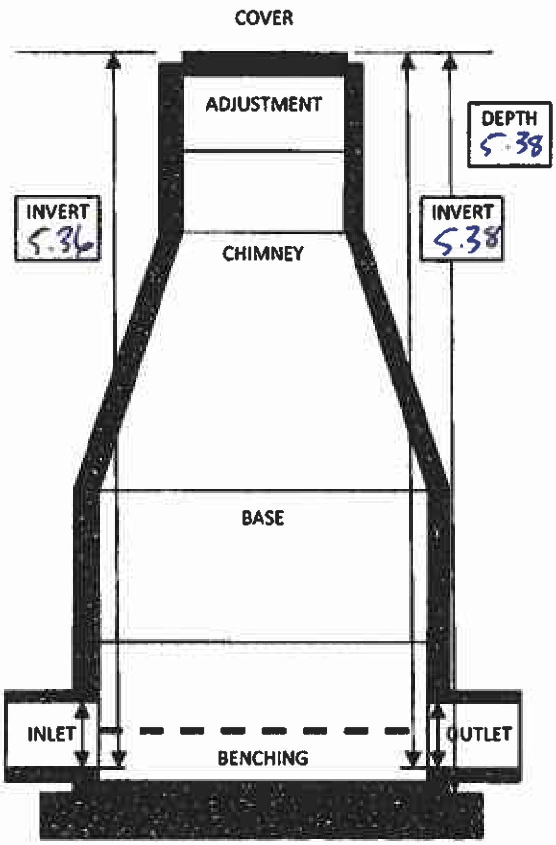
T/G: 65.44

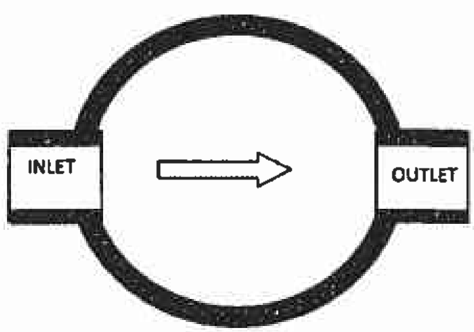
CLEAN WATER WORKS INC.
PIPELINE REHABILITATION

STRUCTURE TYPE
- SANITARY: ☑
- STORM: ☐
- WATER: ☐
- UTILITY: ☐
- OTHER: ☐

SURFACE
- ASPHALT: ☑
- GRAVEL: ☐
- CONCRETE: ☐
- GRASS: ☐
- OTHER: ☐

COVER
- OPEN ROUND: ☐
- CLOSED ROUND: ☑
- OPEN SQUARE: ☐
- CLOSED SQUARE: ☐
- OTHER: ☐
- LOCKED/BOLTED: ☐





STRUCTURE ID: 1272
LOCATION:
DATE:

CUSTOMER:
JOB #:
INSPECTED BY:

STRUCTURE SIZE: 1200

COVER SIZE (mm): 620

DEPTH (M): 0.05

OUTLET 1:
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DIRECTION: S
INVERT (M): 5.38

INLET 1: DROP STRUCTURE E
PIPE DIAMETER (mm): 150
DIRECTION: E
INVERT (M): 2.0

INLET 2:
PIPE DIAMETER (mm): 150
DIRECTION: E
INVERT (M): 5.36

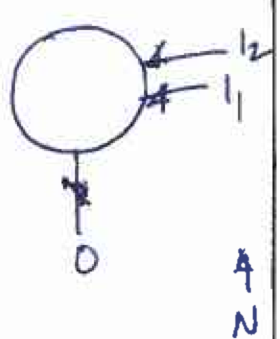
INLET 3:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 4:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 5:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 6:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

COMMENTS



CONDITION	COVER	ADJUSTMENT	CHIMNEY	RISER	BASE	BENCHING	RUNGS
EXCELLENT							
GOOD	✓	✓	✓	✓	✓	✓	✓
AVERAGE							
POOR							
INFILTRATION							
CRACKS/SPALLING		✓					

CLEAN WATER WORKS INC.
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613-745-2444 TELEPHONE
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MANHOLE INSPECTION SHEET

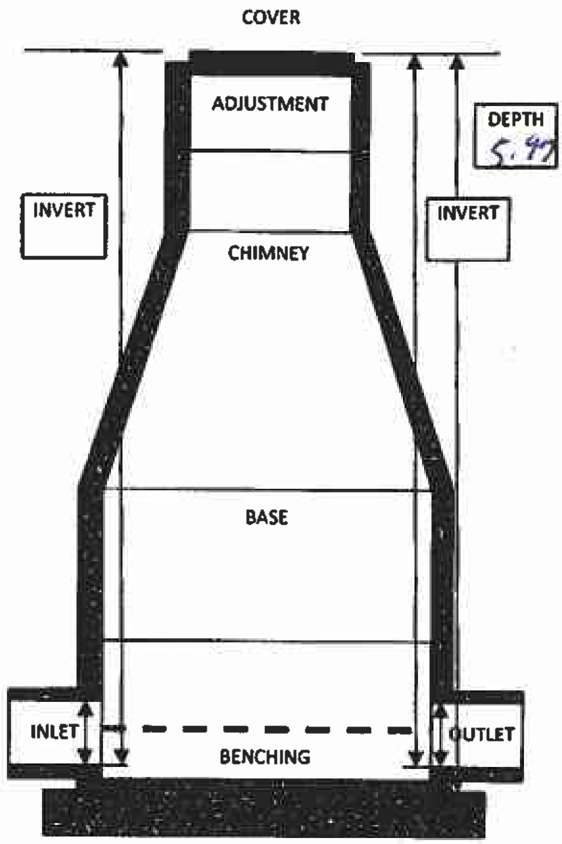
T/G : 64.24

CLEAN WATER WORKS INC.
PIPELINE REHABILITATION

STRUCTURE TYPE
- SANITARY: ☑
- STORM: ☐
- WATER: ☐
- UTILITY: ☐
- OTHER: ☐

SURFACE
- ASPHALT: ☐
- GRAVEL: ☐
- CONCRETE: ☐
- GRASS: ☑
- OTHER: ☐

COVER
- OPEN ROUND: ☐
- CLOSED ROUND: ☑
- OPEN SQUARE: ☐
- CLOSED SQUARE: ☐
- OTHER: ☐
- LOCKED/BOLTED: ☐



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LOCATION:
DATE:

CUSTOMER:
JOB #:
INSPECTED BY:

STRUCTURE SIZE: 750 x 825
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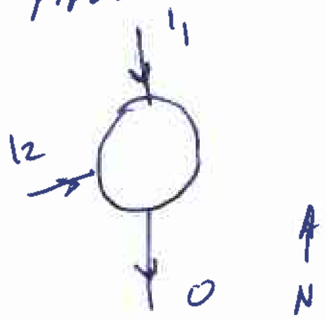
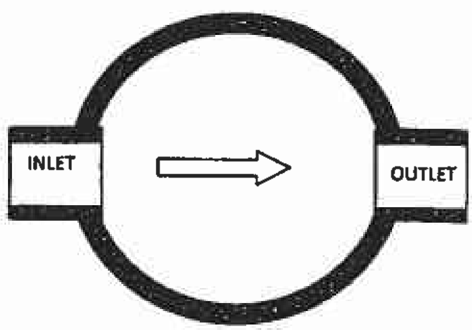
DEPTH (M):

COMMENTS

OVER 2' OF WATER SUBMERGED PIPES





OUTLET 1:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 1:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 2:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 3:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 4:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 5:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 6:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

CONDITION	COVER	ADJUSTMENT	CHIMNEY	RISER	BASE	BENCHING	RUNGS
EXCELLENT							
GOOD	✓	✓	✓	✓	N/A	N/A	✓
AVERAGE							
POOR							
INFILTRATION							
CRACKS/SPALLING							

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MANHOLE INSPECTION SHEET

CLEAN WATER WORKS INC.
PIPELINE REHABILITATION

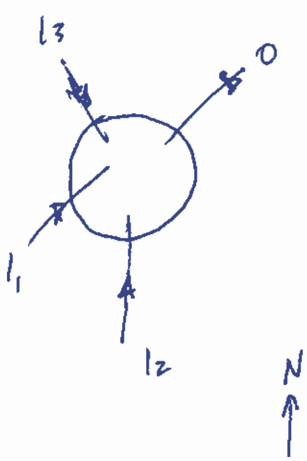
T/G: ~~65.46~~ 62.51

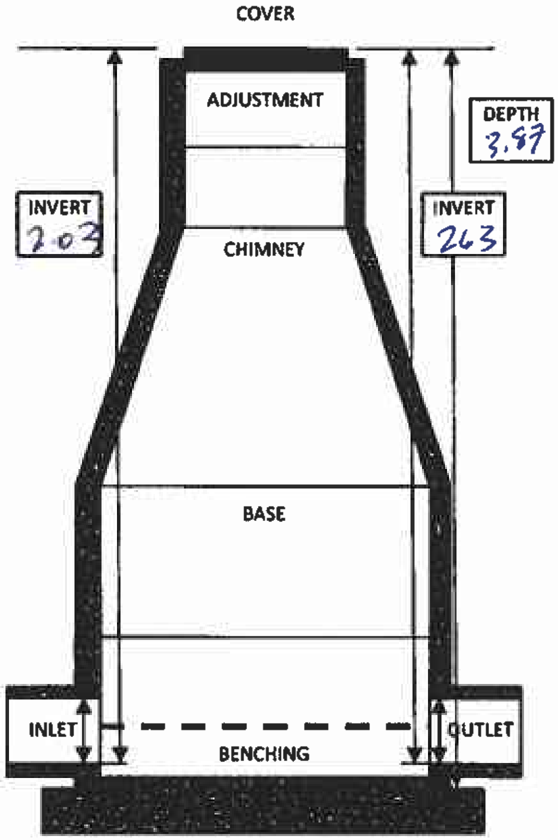
STRUCTURE TYPE
- SANITARY: ☐
- STORM: ☑
- WATER: ☐
- UTILITY: ☐
- OTHER: ☐

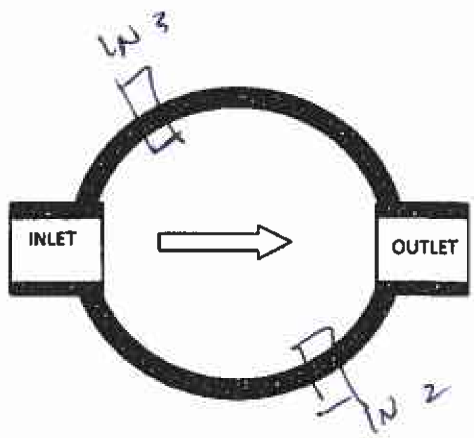
SURFACE
- ASPHALT: ☐
- GRAVEL: ☐
- CONCRETE: ☐
- GRASS: ☑
- OTHER: ☐

COVER
- OPEN ROUND: ☑
- CLOSED ROUND: ☐
- OPEN SQUARE: ☐
- CLOSED SQUARE: ☐
- OTHER: ☐
- LOCKED/BOLTED: ☐

COMMENTS







STRUCTURE ID: ~~1273~~ 184
LOCATION:
DATE:
CUSTOMER:
JOB #:
INSPECTED BY:

STRUCTURE SIZE: 1200
COVER SIZE (mm): 620
DEPTH (M):

OUTLET 1:
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DIRECTION:
INVERT (M): ~~5.89~~ 2.63

INLET 1:
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DIRECTION:
INVERT (M): ~~5.84~~ 2.03

INLET 2:
PIPE DIAMETER (mm): ~~150~~ 200
DIRECTION: E
INVERT (M): ~~2.0~~ 2.0

INLET 3:
PIPE DIAMETER (mm): 300
DIRECTION:
INVERT (M): 2.14

INLET 4:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 5:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 6:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

CONDITION	COVER	ADJUSTMENT	CHIMNEY	RISER	BASE	BENCHING	RUNGS
EXCELLENT							
GOOD	✓	✓	✓	✓	✓	NONE	✓
AVERAGE							
POOR							
INFILTRATION							
CRACKS/SPALLING							

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MANHOLE INSPECTION SHEET

T/G : 63.97

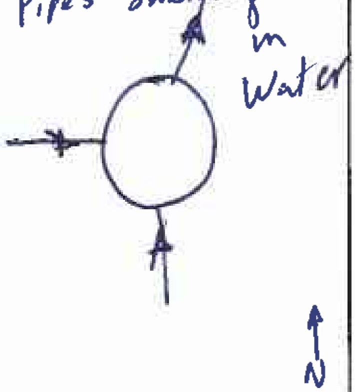
CLEAN WATER WORKS INC.
PIPELINE REHABILITATION

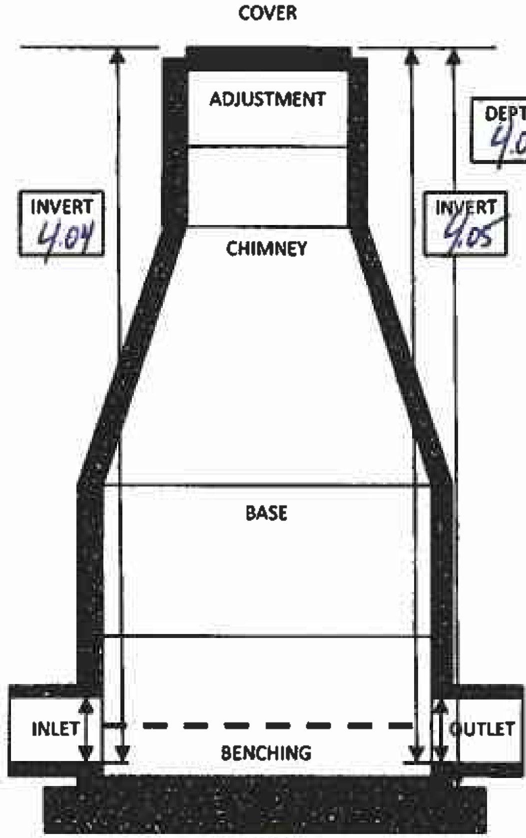
STRUCTURE TYPE
- SANITARY: ☐
- STORM: ☐
- WATER: ☐
- UTILITY: ☐
- OTHER: ☐

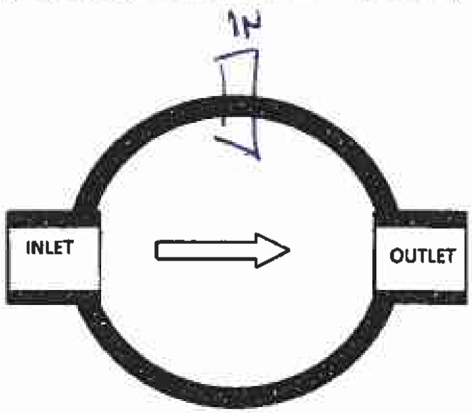
SURFACE
- ASPHALT: ☐
- GRAVEL: ☐
- CONCRETE: ☐
- GRASS: ☑
- OTHER: ☐

COVER
- OPEN ROUND: ☐
- CLOSED ROUND: ☑
- OPEN SQUARE: ☐
- CLOSED SQUARE: ☐
- OTHER: ☐
- LOCKED/BOLTED: ☐

COMMENTS
Could not verify inverts due to Pipes Submerged in Water







STRUCTURE ID: 1089
LOCATION: Carleton U.
DATE:

CUSTOMER:
JOB #:
INSPECTED BY:

STRUCTURE SIZE:

COVER SIZE (mm): 620mm

DEPTH (M): 0.05m

OUTLET 1:
PIPE DIAMETER (mm):
DIRECTION: N
INVERT (M):

INLET 1:
PIPE DIAMETER (mm):
DIRECTION: S
INVERT (M):

INLET 2:
PIPE DIAMETER (mm):
DIRECTION: W
INVERT (M):

INLET 3:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 4:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 5:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

INLET 6:
PIPE DIAMETER (mm):
DIRECTION:
INVERT (M):

CONDITION	COVER	ADJUSTMENT	CHIMNEY	RISER	BASE	BENCHING	RUNGS
EXCELLENT							
GOOD	✓	✓	✓	✓	✓		✓
AVERAGE							
POOR							
INFILTRATION							
CRACKS/SPALLING							

Appendix K

2016 Master Plan Excerpts

Campus Master Site Plan

The campus grounds are divided into Academic (West and East), Residential, Mid and North Campus areas.

Names of campus areas used in Campus Master Plan

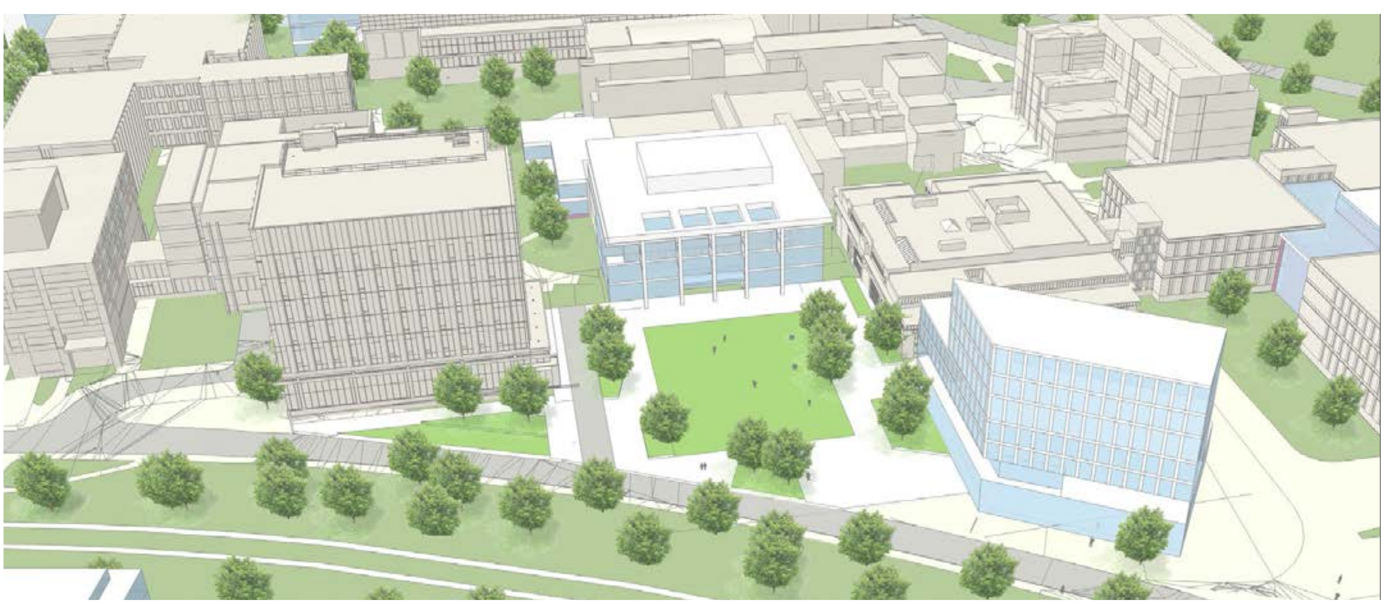
The 2016 Campus Master Plan was initiated in September 2015 and completed in June 2016. This update tests the 2010 Master Plan's key principles and finds that they continue to be relevant and have been reconfirmed through an extensive consultation process. The consultation process included two campus wide events, a focused design workshop with the School of Architecture, two detailed online questionnaires (with over 160 combined responses), and internal and external stakeholder interviews. Through that consultation process it has been determined that the 2016 Master Plan Update should provide additional direction in four (4) key areas, including:

- The design, programming and maintenance of campus-wide landscaped spaces;
- The height and massing of new buildings relative to their location on campus and proximity to streets, open spaces and existing buildings;
- The hierarchy / character of pedestrian and cyclist routes on campus including streetscape design for Campus Avenue and Library Road; and,
- A visionary new design for the North Campus with a strong focus on integrated circulation, reduced surface parking, new open space and a mix of building types, heights and sizes.

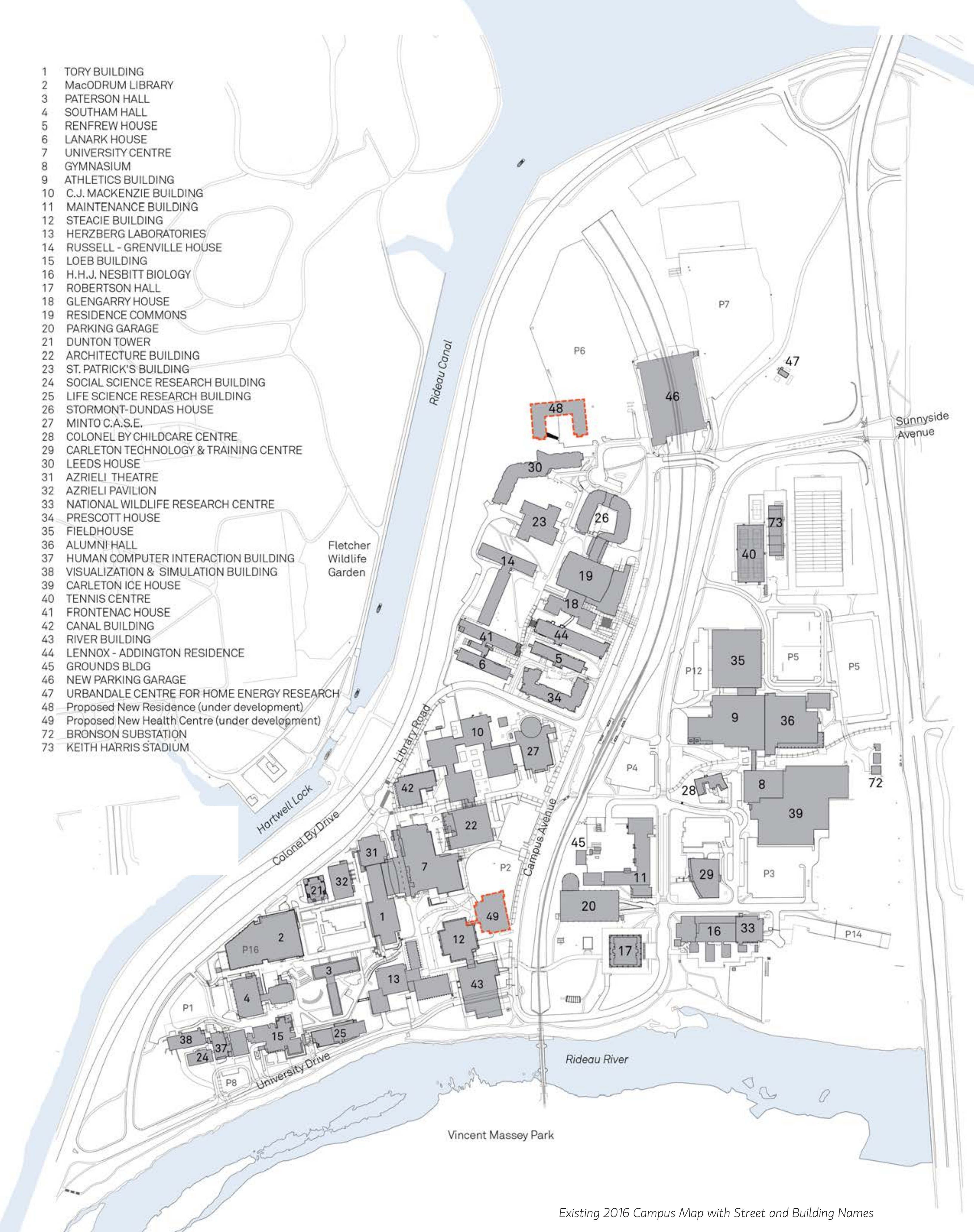
The areas of focus listed above are addressed throughout this document and have resulted in two new principles and an overall update to the 2010 directions.

The site plan and digital model illustrated in the next two pages show a campus built to capacity with buildings in the 4-6 storey range in the Academic Campus (East and West Campus) and 6-15 storeys in the North and Residential Campus. Existing buildings on the plan view are white, proposed are orange, and vertical additions are hatched. The model shows general massing, not building design.

The identified sites provide Carleton University with a menu of available site for future development. Some of them have greater potential to improve the campus environment than others. The most transformative sites focus around the Main Quad which provides an opportunity to create a positive connection to the river, and at the west entrance to the University Centre which will create an Entry Quad as the future centre of gravity for the campus.



Massing view looking west across O-Train tracks towards a future Entry Quad



Existing 2016 Campus Map with Street and Building Names

Proposed Campus Master Plan

Existing aerial view of the campus looking north

Campus Master Plan massing with existing building sites shown in beige and future buildings in white

Internal streets will be framed by new development with buildings reinforcing the street edges

Bronson Avenue will be framed by a series of new buildings and buffered open spaces

Existing and future open spaces will provide structure to inform building design and placement

Future development will be informed by the existing network of pedestrian trails and walkways throughout the Campus

Diagram showing the hierarchy of landscape open spaces on Campus

6 Focus on Creating Streets and Walkways for People (Movement)

Transportation Priority: When prioritizing the various modes of movement on campus, pedestrians have first priority, followed by bicycles, transit, cars and service vehicles.

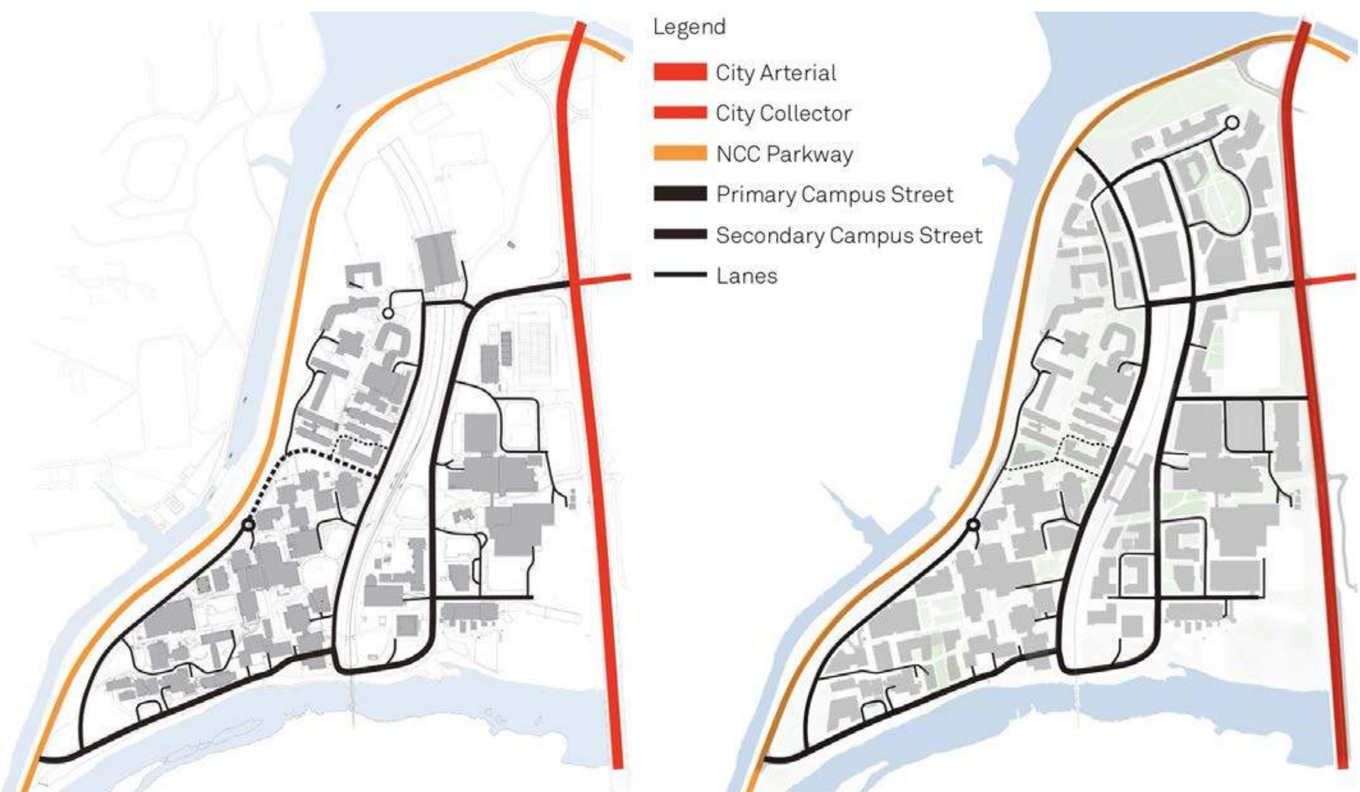
Barrier Free Environment: Carleton is committed to creating a barrier free environment throughout the campus. The proposed expansion to the tunnel system and its integration with flanking buildings will improve the campus' accessibility. Where terrain or other features make these logistically impossible, special services for people with disabilities will be incorporated.

Streets: Carleton will balance the use of streets for vehicular traffic and prioritize use by pedestrians and bicycles, requiring more emphasis on generous sidewalks, street trees, dedicated cycling routes, and the animation of flanking buildings.

A northern extension of Campus Avenue to Colonel By Drive and a link to Bronson Avenue north of the field house may alleviate some of the current rush hour congestion.

University Drive will extend to serve the North Campus. Library Road will continue to be terminated at the Canal Building; the northern section replaced with a pedestrian path wide enough to take emergency and residential traffic on moving day. The proposed elements for Library Road, University Drive and Campus Avenue are outlined in the sections shown on pages 32 and 33. The ultimate configurations of the road sections will be determined through a detailed design process.

Pedestrians: The pedestrian environment will provide a sense of comfort for users throughout the day and evening hours with well-lit walkways, shade trees and outdoor recreational and study/seating areas in sheltered locations. The aim is for pedestrians to have a sense of pride in the campus.



Existing (2016) Street System

Planned Street System

Bicycles: The accommodation of cycling will be further improved, with secure bicycle parking nodes at key locations throughout the campus, and integrated within building entrances. In the Residential Campus, bicycle parking should be available for both residents and visitors. The bike route on Campus Avenue links to the recreational pathway by the canal and to Vincent Massey Park on the south side of the river, accompanying the rail transit line.

Transportation Demand Management (TDM): Techniques will aim to reduce car use per person using tools such as incentives for multiple vehicle occupancy, increased parking charges and reduced availability, and improved bicycle access and storage. The University will support the City of Ottawa's continual improvement of the rail and bus transit initiatives that will enhance the University's TDM strategy.

Planned Pedestrian Pathway Hierarchy

Rail Transit: The O-Train Station tracks are centrally located on campus. A City of Ottawa initiative to twin track the service may enable construction of a combined academic building and covered station, providing climate-controlled cross-platform and cross-campus connection.

Bus Transit: Buses uses the efficient loop of University Drive and Campus Avenue, with a series of pick-up and/or drop-off stops and two major stops on either side of the rail station, forming a transportation hub.

Recommended Cycling Routes and types of trails

The redesign of the intersection at the north entrance (where University Drive turns to meet Sunnyside Avenue at Bronson Avenue) may trigger a change in bus circulation. A change to the direction of the bus circulation should be considered to maximize the efficiency of the loop. Should a directional change occur, opportunities to co-locate the O-Train and transit stops on Campus Avenue should be considered. Overall the intersection change should better facilitate exiting from Campus .

Taxis: Pick-up and drop-off from taxis are accommodated at the proposed Entry Quad, together with visitor information. Passengers will be able to wait indoors in the proposed buildings flanking the Entry Quad.

Transit plan showing trains and buses relative to the Entry Quad

Service and emergency vehicles: Service vehicles will use the campus street system where possible, and use shared pedestrian/service routes where street access is unavailable. The negative visual impact of service areas will be mitigated through building and landscape design. New campus development will consider the delivery needs of future programs. These needs will be addressed in the detailed design of the building to minimize impacts on streets and pedestrian areas.

Diagram showing service / access roads and locations

13 A Sustainable Approach to Storm Water Management

The 2016 approach to Storm Water Management remains consistent with the 2010 Master Plan with no major changes or updates.

Rainwater flows to the Rideau River over the land surface and via six piped sewer catchment areas from building roofs and pipe-drained surfaces. Overland flow currently discharges in two primary locations: near the rail track crossing and near Bronson Avenue, flowing to those points along routes marked by blue arrows in the diagram below. The largest piped catchment outlet is at the Bronson Avenue Bridge, which is complicated by the fact that it, along with the overland flow at that point, is within the flood plain and riparian zone.

Diagram showing overland flow and storm water management ponds

Water quantity control for the piped system will be provided mainly through rooftop storage as the North, Residential and East Campus is developed. Rainwater harvesting for grey water systems, green roofs and irrigation will also be explored. Infrequent heavy surface flow will be interrupted by "dry ponds" in the North Campus, surface parking lots and the practice field and a small "wet pond" north of the Leeds Residence. Spring or high river water flooding of low ground along Bronson Avenue has been held back by the Raven Road berm. The practice field provides temporary storage for overland flow.

Water quality can be improved, if existing water quality proves inadequate, in sewer networks 2 to 6 with oil grit separators at discharge points. Network 1, at Bronson Avenue Bridge, is more complex and would rely on source control at roofs and parking lots.

Diagram showing storm sewer and quality/quantity control

14 Identify Development Priorities

The priorities for new constructions and renovations will be assessed based on the following:

- A space needs perspective (for academic, residential, administrative and ancillary functions), as well as from the point of view of energy savings and facility renewal; and,
- A campus-wide perspective, choosing sites which have one or more of the following attributes: are relatively free of constraints; contribute to place-making by spatially containing positive open space; provide a greater sense of river access; help connect the East and West Campus; and animate the tunnels.

Key construction projects, studies and future initiatives identified through the consultation process include the following recommendations:

- Completion of the Entry Courtyard with a renovated entrance to the University Centre and upgrades to Alumni Park including the removal of the water fountain to the west of the Robertson Building and the investigation of more permanent weather protection structures in the park for events.
- Investigation of creating more usable informal sports facilities (in coordination with the RVCA) along the river on the west side of campus should be undertaken through an Athletics and Recreation Review.
- Retrofit of the north entrance along University Drive to facilitate better driving access in and out of campus.
- Securing approvals for and constructing the new north entrance off of Colonel By Drive as an extension of Campus Avenue.
- Review required building upgrades for the Robertson Building.
- Undertake detailed design for the Campus Avenue North Campus entrance at Colonel By Drive.
- Determine if heritage conservation should be included as a Campus Master Plan principle.
- Examine all new development projects with an aim to further enliven and connect the existing tunnel system.

16 Implement a Visionary Approach to the North Campus Reserve

The North Campus is a short and midterm resource as a way to postpone some (but not all) of the need to construct structured parking, and a long term resource for academic use once the rest of the campus is fully developed. Alternatively, it could be developed for land-consuming uses affiliated with the university such as a research park or major cultural facility. This will require a full site infrastructure plan and should only be undertaken with a clear understanding of the programming and densities for the entire area.

The North Campus design will be guided by a number of key campus recommendations that were development through the 2016 Master Plan Update process. These key directions include:

- Create a new North Campus Quad framed by new development.
- Limit the amount of surface parking in favour of additional development and open spaces.
- Facilitate a strong diagonal connection from the centre of the campus to Bronson Avenue for both pedestrians and cyclists.
- Consider additional height and density along Bronson Avenue and Colonel By Drive where shadow impacts are reduced and where development can benefit from clear views to Dow's Lake.

The North Campus demonstration plan is described in more detail on the following pages.

North Campus precedent image showing development facing the North Quad with a range of informal seating and built form

Key Design Considerations for the North Campus

1. A New Central Oval Quad framed with new development
2. New campus development facing onto Bronson Avenue with a series of mid block walkways
3. A pedestrian boulevard connecting the new Quad to University Drive
4. A second parking garage over the O-Train Tracks
5. A vertical addition of up to 2 storeys on top of the existing structured parking garage.
6. A new signalized entrance off of Colonel By Drive
7. Taller campus development facing Dow's Lake and the canal (10-15 storeys)
8. Flexible building sites to allow for a mix of building footprints
9. An urbanized and green Bronson Avenue Streetscape

Demonstration Plan for North Campus Area

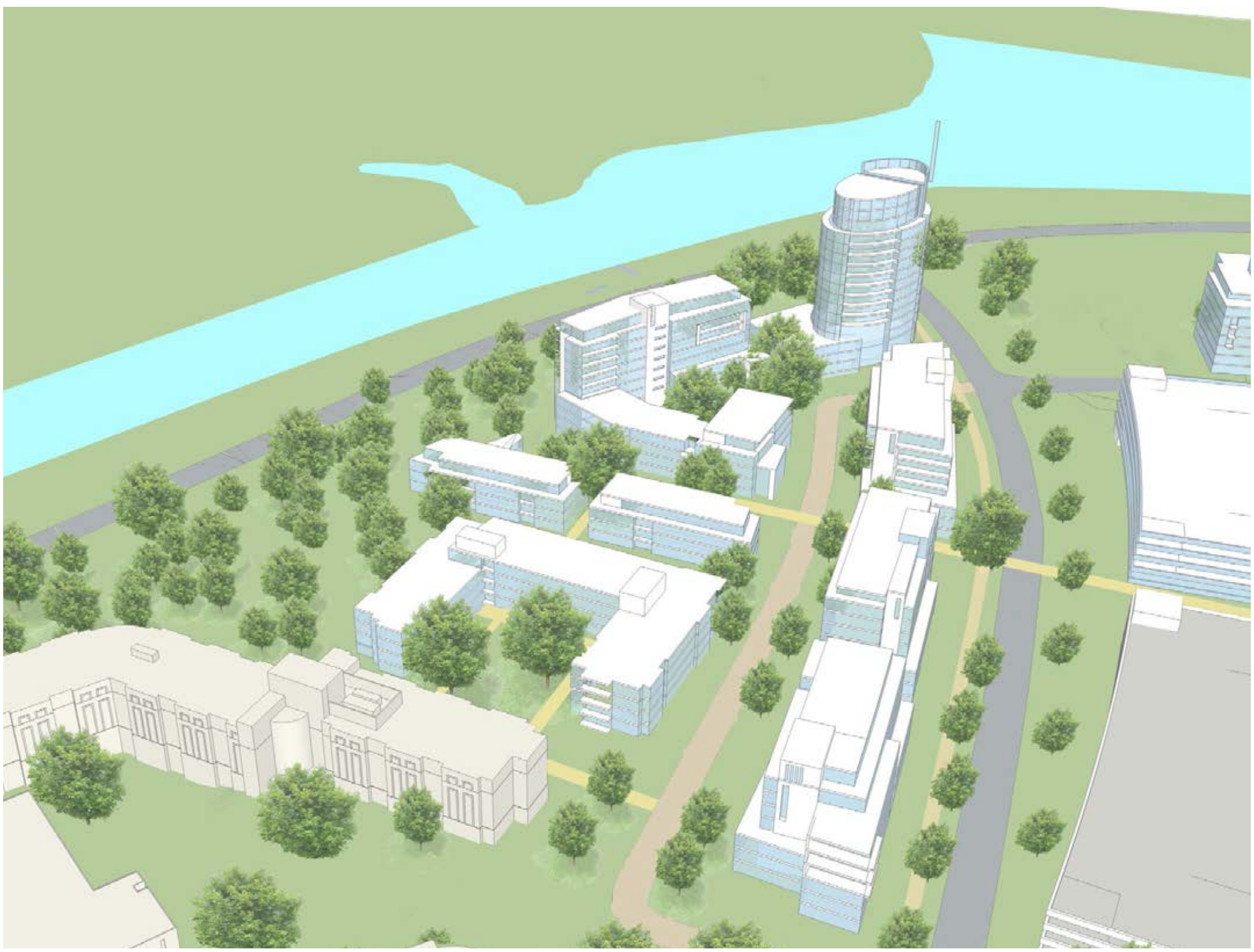
7
7
2
8
9
2
4
1
8
8
2
5
8
3
Bronson Avenue

4.6 Residential Campus

The residential campus will expand northward, structured around an extended Campus Avenue and the central walk. The layout proposed establishes a series of courtyards and a streetscape framed by buildings along Campus Avenue. Design parameters for the scale and siting of new residence buildings is outlined in Section 04, which provides guidance with respect to creating usable open space to supports residence life.

Existing aerial image highlighting the Residential Campus

Future Residence Buildings expanding the Residential Campus northwards



Massing Model View: Looking north towards the expanded Residential Campus with taller gateway buildings located at the new Colonel By Drive entrance


Legend
Academic Campus
C1 Core Area
I1 Infill
V1 Vertical Development
P1 New Parking Building
M1 Mid Campus
N1 North Campus
R1 Residential Campus
Colonel By Drive
Library Road
Campus Avenue
University Drive
Bronson Avenue
N1
N2
N3
N4
N5
N6
N7
N8
N9
P1
P2
R1
R2
R3
R4
R5
R6
R7
R8
M1
M2
M3
I1
I2
I3
I4
I5
V1
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13

5.1 Plan Implementation

An Approved Plan

The Campus Master Plan should be approved as University policy by the Board of Governors.

The Department of Facilities Management and Planning will ensure that every project is measured against the Campus Master Plan at all stages of the Project Development Process.

Updating the Plan

In order to respond to changing needs over time, the plan will evolve through amendments as necessary and updates every five years.

Plan Amendment: All projects must follow the principles of the Plan, or else an amendment is required. The Assistant Vice-President (Facilities Management and Planning) will review and advise as to whether a proposed project is consistent with the Plan, and will determine whether a major or minor amendment should be made. Major amendments – when the change would significantly affect the university communal interest or the quality of the campus environment – will reintroduce Steering Committee and campus community participation and must be approved by the Board of Governors. Minor amendments would be approved by the Vice-President (Finance and Administration), who will report the changes to the Building Program Committee of the Board of Governors and the campus community.

Plan Monitoring: Each year, a report on any measures taken to implement the Plan is made to the Building Program Committee of the Board of Governors.

General Updates: The Plan will be publicly reviewed at five year intervals, and approved by the Board of Governors. The principles and demonstration plans will be reconsidered, and accumulated amendments incorporated.

5.2 Supplementary Planning Studies

Future supplementary planning studies (such as Transportation Studies) should be formally approved as sub-sets of the Campus Master Plan, and thus have the status of policy. If parts of a supplementary plan contradict the Plan and the contradiction is justifiable and desirable, and if this occurs in between the five-year general review period, a plan amendment is required. If the timing coincides with that of the general review, the supplementary plan can be affirmed as part of that review.

5.3 Testing Projects

The Assistant Vice-President (Facilities Management and Planning) or designate (The Campus Plan Administrator) tests all projects against the Plan at all stages, and reports consistency or otherwise to the Board.

When a potential project is identified, an appropriate site in the Plan is selected. An important criterion is how the project's program and location will contribute to the needs of the campus as a whole, as well as to the needs of the specific group of users, by meeting a majority of the campus plan principles.

During schematic design, the Plan's principles and demonstration plans provide guidance, and measures for establishing compliance.

Each submission for approval at the Board's Building Program Committee includes a report on the project evaluated against the Plan.

5.4 Selecting Sites: A Checklist

Guidance for site selection is provided throughout this report. The most relevant points are summarized here, with references to the source in the Plan. The palette of sites from which a selection can be made are contained in the Massing Studies section.

1. **Building type:** If an academic function, is it within the Academic Campus? See Strategy 2, Compact Academic and Research Campus. If an athletic or non-academic function but related to university programs, is it within the Mid Campus? If a residential function, is it within the Residential Campus?
2. **Program size:** How closely does the size of buildings match the size of a site? If a potential site can accommodate a greater program, can it be subdivided? See Massing Studies and Appendix A: Statistics.
3. **Programmatic relationships:** How closely connected is the site to related programs for ease of student and faculty interchange?
4. **Landscape Design:** How does the building and its proposed uses address the surrounding opens paces? See Strategy 4, Landscape Design.
5. **Space management:** Can the program be met without building on a new site? See Strategy 15, Space Management.
6. **Contribution to spatial structure:** How can the program and building type enhance the spatial structure of the campus? See Strategy 3, Campus structure and Strategy 14, Development Priority.
7. **Movement:** How would development enhance movement priorities? See Strategy 6, Movement.
8. **Connections:** How would development encourage connections and presence to Bronson Avenue, the Rideau River and Massey Park, and the Canal and Arboretum? See Strategies 7, Connections to Surroundings; 10, River Access; and 14, Development Priority.
9. **Parking:** Can the budget accommodate the added cost of structured parking? See Strategy 11, Parking.
10. **Development priority:** How well can the site and program meet campus-wide development priorities? See Strategy 14.
11. **Cost:** What is the comparative cost for developing the site for new infrastructure, loss of parking, need to build structured parking, removal of buildings, etc.

The greatest transformation of the campus will come from the completion of two projects: the Entry Quad and flanking buildings, and the Main Quad Revitalization including the Dunton Tower podium addition and the replacement of Paterson Hall and the Life Sciences Building.


Legend
Academic Campus
C1 Core Area
I1 Infill
V1 Vertical Development
P1 New Parking Building
M1 Mid Campus
N1 North Campus
R1 Residential Campus
Colonel By Drive
University Drive
Campus Avenue
Bronson Avenue
Library Road
N1
N2
N3
N4
N5
N6
N7
N8
N9
P1
P2
R1
R2
R3
R4
R5
R6
R7
R8
M1
M2
M3
I1
I2
I3
I4
I5
V1
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13

I1. Dunton Towor

Flrs	Area s.m.	Area s.f.
1	1,818	19,569
2	1,103	11,873
3	1,130	12,163
4	1,112	11,969
	5,163	55,574

I2. UniCentre Expansion

Flrs	Area s.m.	Area s.f.
1	590	6,351
2	514	5,533
	1,104	11,883

I3. UniCentre Expansion

Flrs	Area s.m.	Area s.f.
1	920	9,903
2	920	9,903
3	920	9,903
4	920	9,903
	3,680	39,611

I4. McKenzie Infill

Flrs	Area s.m.	Area s.f.
1	1,297	13,961
2	363	3,907
3	363	3,907
	2,023	21,775

I5. Fieldhouse

Flrs	Area s.m.	Area s.f.
1	1,760	18,944
2	1,760	18,944
3	1,760	18,944
	5,280	56,833

V1. UniCentre Expansion

Flrs	Area s.m.	Area s.f.
1	965	10,387
	965	10,387

Building Expansions	**18,215**	Area s.m.
	196,064	Area s.f.

C1. S.S.R. Replacement

Flrs	Area s.m.	Area s.f.
1	2,647	28,492
2	2,535	27,286
3	2,432	26,178
4	2,432	26,178
5	1,607	17,298
6	803	8,643
	12,456	134,075

C2. Parking Lot 1

Flrs	Area s.m.	Area s.f.
1	2,255	24,273
2	2,255	24,273
3	1,330	14,316
4	1,330	14,316
5	1,330	14,316
6	1,175	12,648
	9,675	104,141

C3. Paterson/L.S.R. Replacement

Flrs	Area s.m.	Area s.f.
1	5,120	55,111
2	5,120	55,111
3	5,120	55,111
4	5,120	55,111
5	5,120	55,111
6	4,320	46,500
7	2,450	26,372
	32,370	348,427

C4. Parking Lot 2 S.

Flrs	Area s.m.	Area s.f.
1	1,730	18,622
2	1,050	11,302
3	1,520	16,361
4	1,520	16,361
5	1,520	16,361
6	1,520	16,361
7	1,520	16,361
8	1,520	16,361
	11,900	128,090

C5. Parking Lot 2 N.

Flrs	Area s.m.	Area s.f.
1	2,133	22,959
2	2,133	22,959
3	2,133	22,959
4	2,133	22,959
5	2,133	22,959
6	884	9,515
7	884	9,515
8	884	9,515
	13,317	143,343

C6. Library Road

Flrs	Area s.m.	Area s.f.
1	1,515	16,307
2	1,515	16,307
3	950	10,226
4	950	10,226
	4,930	53,066

C7. Over Rail

Flrs	Area s.m.	Area s.f.
1	6,393	68,814
2	5,567	59,923
3	1,882	20,258
4	1,220	13,132
	15,062	162,126

C8. Parking Lot 11

Flrs	Area s.m.	Area s.f.
1	3,160	34,014
2	3,160	34,014
3	3,160	34,014
4	2,425	26,102
5	2,425	26,102
	14,330	154,247

C9. Alumni Park Back

Flrs	Area s.m.	Area s.f.
1	1,614	17,373
2	1,343	14,456
3	1,140	12,271
4	1,140	12,271
	5,237	56,371

C10. Maintenance Replacement

Flrs	Area s.m.	Area s.f.
1	2,310	24,865
2	2,310	24,865
3	2,310	24,865
4	1,600	17,222
5	1,600	17,222
	10,130	109,038

C11.Parking Lot 4 E.

Flrs	Area s.m.	Area s.f.
1	897	9,655
2	897	9,655
3	663	7,136
4	663	7,136
5	663	7,136
	3,783	40,720

C12. Garage Replacement

Flrs	Area s.m.	Area s.f.
1	2,446	26,328
2	2,153	23,175
3	2,153	23,175
4	1,502	16,167
5	1,502	16,167
	9,756	105,013

C13. Parking Lot 4 W.

Flrs	Area s.m.	Area s.f.
1	900	9,688
2	900	9,688
3	900	9,688
4	790	8,503
5	790	8,503
	4,280	46,069

West Campus	**84,648**	Area s.m.
	911,143	Area s.f.
East Campus	**62,578**	Area s.m.
	673,583	Area s.f.
Total Core	**147,226**	Area s.m.
	1,584,726	Area s.f.

M1. Tennis Replacement

Flrs	Area s.m.	Area s.f.
1	2,087	22,464
2	2,087	22,464
3	2,087	22,464
4	2,087	22,464
5	2,087	22,464
	10,435	112,321

M2. Bronson Frontage

Flrs	Area s.m.	Area s.f.
1	7,089	76,305
2	6,669	71,784
3	4,809	51,764
4	4,809	51,764
5	4,809	51,764
6	2,049	22,055
	30,234	325,436

M3. New Maintenance

Flrs	Area s.m.	Area s.f.
1	2,387	25,693
2	2,387	25,693
3	1,479	15,920
4	1,479	15,920
5	1,479	15,920
	9,211	99,146

Mid Campus	**49,880**	Area s.m.
	536,903	Area s.f.

N1. North Campus

Flrs	Area s.m.	Area s.f.
1	4,633	49,869
2	4,633	49,869
3	4,045	43,540
4	2,806	30,204
5		0
	16,117	173,482

N2. North Campus

Flrs	Area s.m.	Area s.f.
1	3,165	34,068
2	3,165	34,068
3	3,165	34,068
4	2,055	22,120
5	2,055	22,120
	13,605	146,443

N3. North Campus

Flrs	Area s.m.	Area s.f.
1	4,227	45,499
2	4,227	45,499
3	4,227	45,499
4	4,227	45,499
5	2,049	22,055
6	2,049	22,055
	21,006	226,106

N4. North Campus

Flrs	Area s.m.	Area s.f.
1	3,300	35,521
2	3,300	35,521
3	2,850	30,677
4	2,850	30,677
5	2,850	30,677
6	2,850	30,677
7	2,850	30,677
8	2,850	30,677
	23,700	255,104

N5. North Campus

Flrs	Area s.m.	Area s.f.
1	1,136	12,228
2	1,136	12,228
3	1,136	12,228
4	1,136	12,228
5	1,136	12,228
6	1,136	12,228
7	1,136	12,228
8	1,136	12,228
	9,088	97,822

N6. North Campus

Flrs	Area s.m.	Area s.f.
1	2,290	24,649
2	2,290	24,649
3	2,007	21,603
4	2,007	21,603
	8,594	92,505

N7. North Campus

Flrs	Area s.m.	Area s.f.
1	1,038	11,173
2	1,038	11,173
3	1,038	11,173
4	1,038	11,173
	4,152	44,692

N8. North Campus

Flrs	Area s.m.	Area s.f.
1	1,240	13,347
2	1,240	13,347
3	1,240	13,347
4	1,240	13,347
	4,960	53,389

N9. North Campus

Flrs	Area s.m.	Area s.f.
1	5,534	59,567
2	1,992	21,442
	7,526	81,009

North Campus	**108,748**	Area s.m.
	1,170,553	Area s.f.

P1.

Flrs	Area s.m.	Area s.f.
1	5,990	64,476
2	5,990	64,476
3	5,990	64,476
4	5,990	64,476
	23,960	257,903

P2.

Flrs	Area s.m.	Area s.f.
1	5,383	57,942
2	5,383	57,942
3	5,383	57,942
4	5,383	57,942
	21,532	231,768

Parking Garage	**45,492**	Area s.m.
	489,671	Area s.f.

R1. Residence

Flrs	Area s.m.	Area s.f.
1	1,127	12,131
2	1,127	12,131
3	1,127	12,131
4	902	9,709
5	902	9,709
6	902	9,709
7	902	9,709
	6,989	75,229

R2. Residence

Flrs	Area s.m.	Area s.f.
1	997	10,732
2	997	10,732
3	997	10,732
4	759	8,170
5	759	8,170
6	759	8,170
7	759	8,170
	6,027	64,874

R3. Residence

Flrs	Area s.m.	Area s.f.
1	1,244	13,390
2	1,244	13,390
3	1,244	13,390
4	1,244	13,390
5	1,085	11,679
6	1,085	11,679
7	1,085	11,679
	8,231	88,598

R4. Residence

Flrs	Area s.m.	Area s.f.
1	1,996	21,485
2	1,996	21,485
3	1,996	21,485
4	1,996	21,485
	7,984	85,939

R5. Residence

Flrs	Area s.m.	Area s.f.
1	574	6,178
2	574	6,178
3	574	6,178
4	574	6,178
	2,296	24,714

R6. Residence

Flrs	Area s.m.	Area s.f.
1	605	6,512
2	605	6,512
3	605	6,512
4	605	6,512
	2,420	26,049

R8. Residence / Commons

Flrs	Area s.m.	Area s.f.
1	1,279	13,767
2	1,279	13,767
3	1,279	13,767
4	1,279	13,767
5	744	8,008
6	744	8,008
7	744	8,008
8	744	8,008
9	744	8,008
10	744	8,008
11	744	8,008
12	744	8,008
13	744	8,008
14	744	8,008
15	744	8,008
	13,300	103,118

R7. Residence

Flrs	Area s.m.	Area s.f.
1	2,104	22,647
2	2,104	22,647
3	2,104	22,647
4	2,104	22,647
5	958	10,312
6	958	10,312
7	958	10,312
8	958	10,312
9	958	10,312
10	958	10,312
	14,164	152,460

Buildings Removed	Area s.m.
Soc. Sci. Res. Bldg.	1,335
Paterson Hall	7,431
Life Sciences	2,350
Daycare	526
Tennis Bubble	3,345
Parking Garage	23,862
Maintenance	4,072
Total Removed	**42,921**
Current Area (2016)	442,220
Future Remaining	**399,299**

Residential Campus	**61,411**	Area s.m.
	661,022	Area s.f.

Total New Buildings	**430,972**	Area s.m.
	4,638,940	Area s.f.
Existing Remaining Bldgs	**399,299**	Area s.m.
	4,298,015	Area s.f.
Grand Total	**830,271**	Area s.m.
	8,936,954	Area s.f.
Approx. Land Area	**597,122**	Area s.m.
Density	**1.39**	FSI

Appendix L

As Built Drawings

INVERT SCHEDULE		
STRUCTURE #	TOP	INVERT
STM MH 135	63.78	SOUTH=59.98 EAST=59.96 NORTHWEST=60.19
STM MH 136	62.88	SOUTH=60.12 NORTH=60.09 WEST=60.22
STM CBMH 182	64.17	SOUTHWEST=59.60 NORTHEAST=59.60 NORTHWEST=59.60
SAN MH 183	65.49	SOUTHWEST=59.03 NORTHEAST=59.03 NORTHWEST=59.31
STM CBMH 184	65.34	SOUTHEAST=58.82 SOUTHWEST=58.82
SAN MH 185	65.08	SOUTHEAST=60.14 SOUTHWEST=60.14
CB 186	64.99	SOUTHEAST=63.39
CB 187	62.73	WEST=61.08
CB 188	62.62	WEST=60.12
CB 189	63.40	SOUTH=61.90
CB 190	61.75	SOUTHEAST=60.30
STM CBMH 191	61.94	EAST=60.39 NORTHWEST=60.39
STM CB 192	61.35	SOUTH=60.49

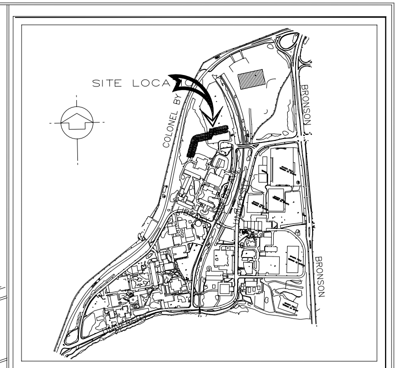
WATERMAIN ELEVATIONS "LINE 1"

DESCRIPTION	STATION	TOP OF PIPE ELEVATION	GROUND ELEVATION
22.5° H BEND	0+000.000	60.40	65.03
200x200x150 TEE	0+005.760	60.45	65.04
22.5° H BEND	0+020.330	60.50	65.07
11.25° H BEND	0+029.430	60.52	62.91

WATERMAIN ELEVATIONS "LINE 2"

DESCRIPTION	STATION	TOP OF PIPE ELEVATION	GROUND ELEVATION
TAPPING VALVE & SLEEVE	0+000.000	61.36	63.76
VALVE BOX	0+000.600	61.10	63.50
45° H BEND	0+028.500	64.50	66.92
150 x 150 x 150 TEE	0+044.950	65.29	67.69
VALVE BOX	0+045.800	65.30	67.70
45° V BEND	0+049.100	65.30	67.70
45° V BEND	0+051.100	65.30	67.70
BUILDING CONNECT	0+056.000	65.42	67.83

*PEAK DESIGN FLOW RATE: 2170 F.U. = 19.0 L/S



KEY PLAN N.T.S.

SURVEY OBTAINED BY

JOB No. B13800

TOPOGRAPHIC SURVEY AREA OF
ST. PATRICK'S BUILDING,
STORMONT-DUNDAS HOUSE,
RUSSELL HOUSE AND
UNIVERSITY COMMONS
CARLETON UNIVERSITY
CITY OF OTTAWA
REGIONAL MUNICIPALITY OF OTTAWA-CARLETON

Fairhall Moffatt & Woodland LIMITED
ONTARIO LAND SURVEYORS
OTTAWA KANATA

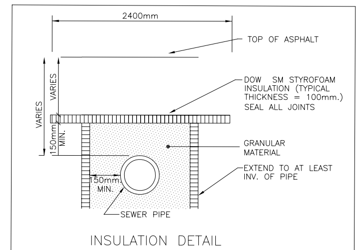
SURVEYORS NOTES

NOTES

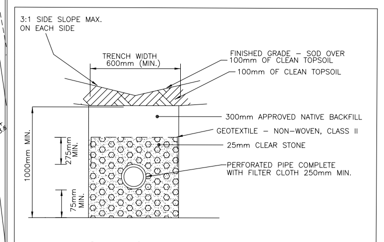
1. UTILITY INFORMATION SHOWN HEREON HAS BEEN COMPILED FROM A VARIETY OF SOURCES AND VERIFIED IN THE FIELD WHERE POSSIBLE. BEFORE ANY FINAL DESIGN, THIS INFORMATION HAS TO BE CONFIRMED WITH THE PERTINENT UTILITY AUTHORITY.
2. ELEVATIONS SHOWN HEREON ARE REFERRED TO GEODETIC DATUM.
3. ELEVATIONS AT CURBS WERE TAKEN TO THE BOTTOM (ROAD SIDE) OF CURB. CURBS TYPICALLY 0.10 TO 0.15 HIGH.

SITE BENCHMARK

JOB BENCH MARK #2, FAIRHALL, MOFFATT & WOODLAND LIMITED PLAN OF PARKING LOT 6A, JOB N' 6556.



INSULATION DETAIL
N.T.S.



SWALE DETAIL
N.T.S.

NO.		DATE	BY
	RECORD DRAWING	NOV. 22, 2001	WJC

Carleton UNIVERSITY

Proposed Student Residence

SITE SERVICES AND UTILITY COMPOSITE

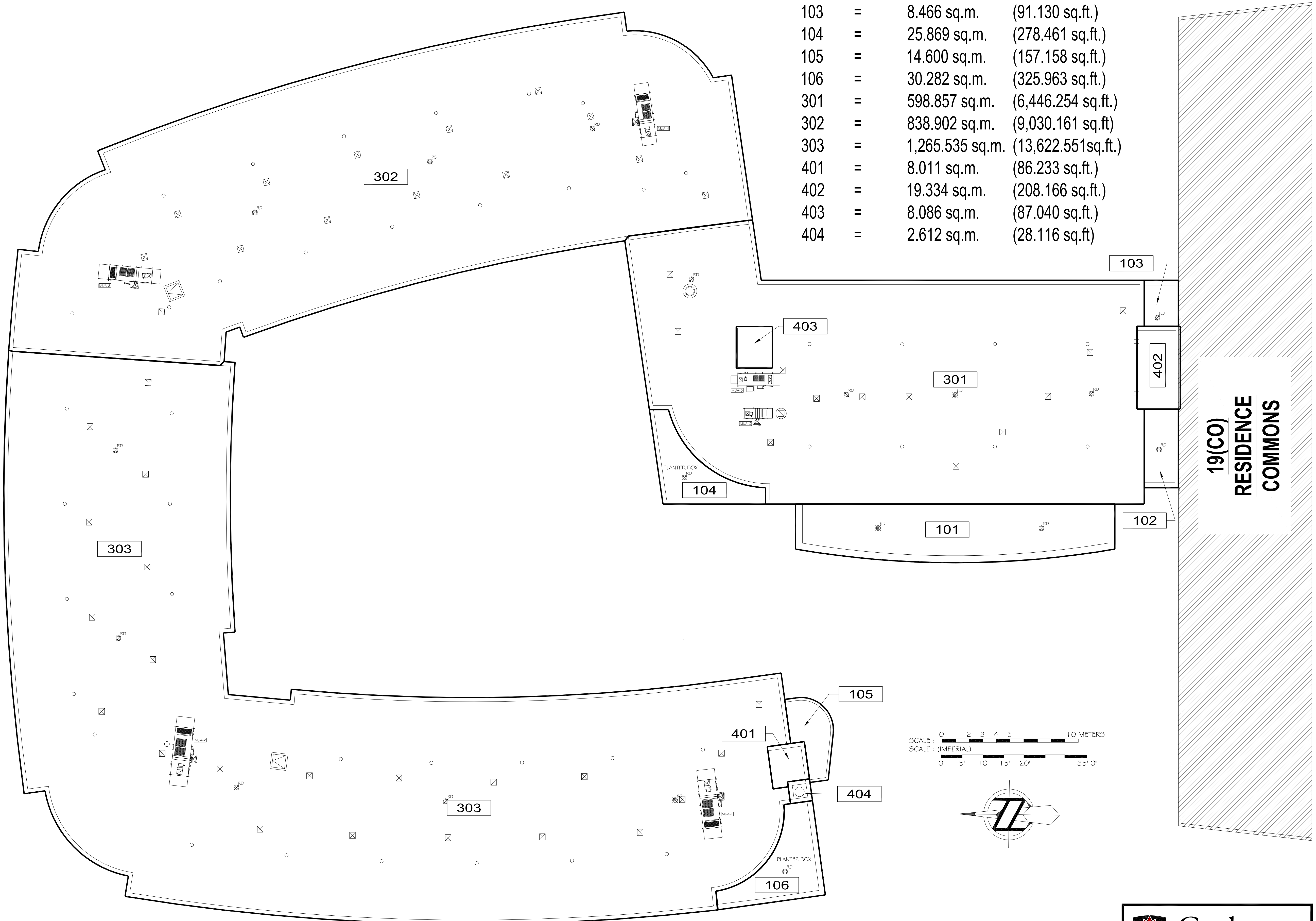
R.V. Anderson Associates Limited
consulting engineers, architects, technology managers
1750 Courtwood Crescent, Suit 220, Ottawa, Ontario 226-1844 ottawa@rvanderson.com

SCALE : 1:250
5325
DRAWN BY : W.J.C.
DESIGNED BY : J.M.M.
CHECKED BY : G.S.H.
DATE : MAY 2000
DRAWING No. SG1

H:\1-ARCHIVE FILES\01-DWG ARCHIVES\30 (LE)\01\2002-RV ANDERSON CIVIL\CAD FILE-AS BUILT\5325_SG1_ASBUILT.DWG

ROOF AREA:

101	=	92.962 sq.m.	(1,000.667 sq.ft.)
102	=	14.490 sq.m.	(155.974 sq.ft.)
103	=	8.466 sq.m.	(91.130 sq.ft.)
104	=	25.869 sq.m.	(278.461 sq.ft.)
105	=	14.600 sq.m.	(157.158 sq.ft.)
106	=	30.282 sq.m.	(325.963 sq.ft.)
301	=	598.857 sq.m.	(6,446.254 sq.ft.)
302	=	838.902 sq.m.	(9,030.161 sq.ft)
303	=	1,265.535 sq.m.	(13,622.551sq.ft.)
401	=	8.011 sq.m.	(86.233 sq.ft.)
402	=	19.334 sq.m.	(208.166 sq.ft.)
403	=	8.086 sq.m.	(87.040 sq.ft.)
404	=	2.612 sq.m.	(28.116 sq.ft)



ROOF LEVEL

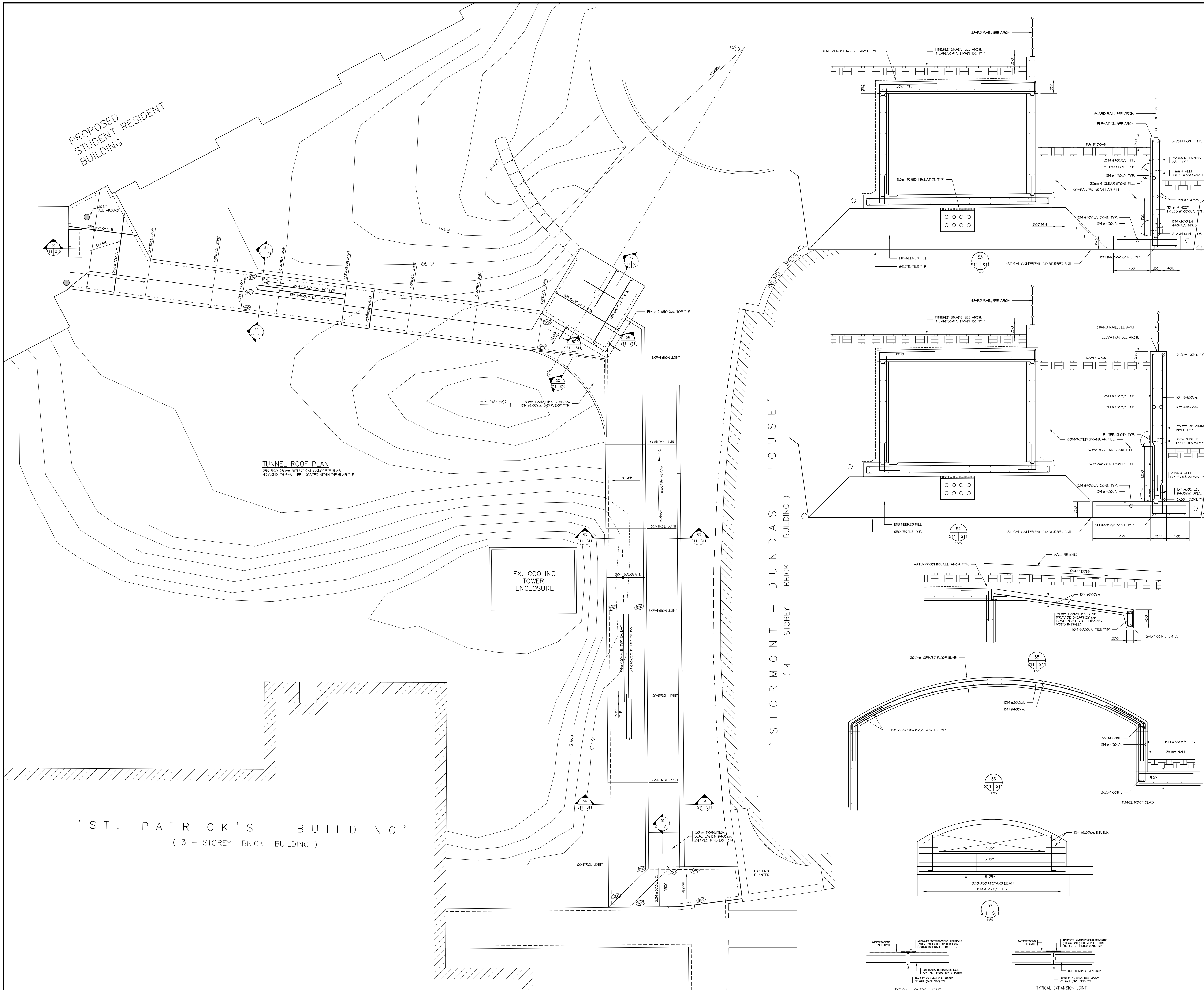
STORMONT - DUNDAS HOUSE

November 17, 2015 FILE NAME : 26(SD)-LVRF.DWG

Carleton UNIVERSITY

Facilities Engineering & Construction

Prepared by : Raymond G. Dufresne (CAD)



Carleton UNIVERSITY

PRINT RECORD

No.	DATE	ISSUED TO	BY	CK.

REVISIONS

No.	DATE	DESCRIPTION	BY	CK.
03	02/01/07	AS BUILT	M.N.	J.S.
02	00/08/11	ISSUED FOR CONSTRUCTION	M.N.	J.S.
01	00/07/11	ISSUED FOR TENDER	M.N.	J.S.

DRAWINGS ARE NOT TO BE SCALED.

CONTRACTOR MUST VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO ARCHITECTS BEFORE PROCEEDING WITH THE WORK.

ALL DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF THE ARCHITECT AND MUST BE RETURNED AT THE COMPLETION OF THE WORK.

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNTIL COUNTERSIGNED. DATE

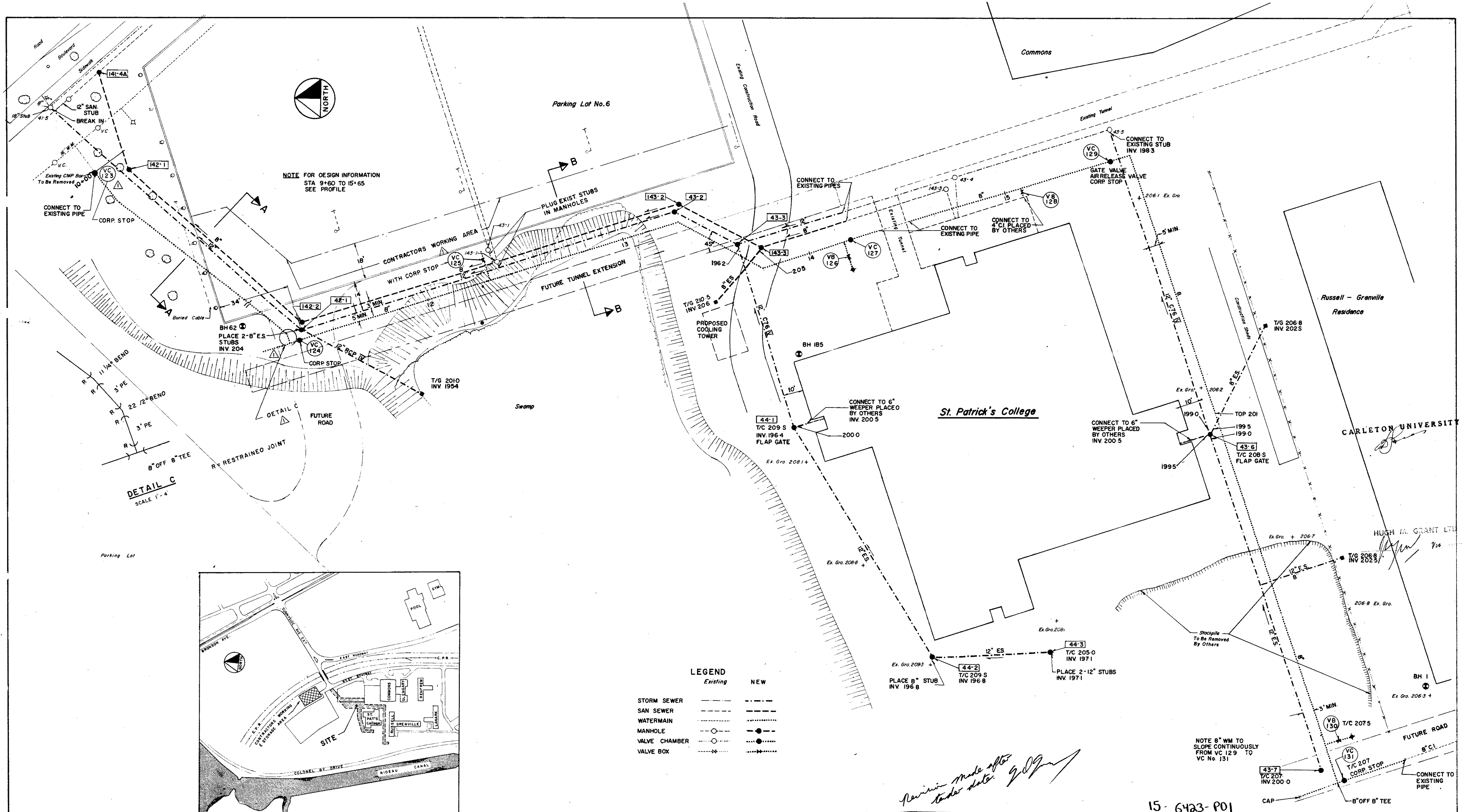
SEALS

SBA
Sauvé Boucher Associates Inc.
engineering consultants
325 Dalhousie St., suite 510, Ottawa, Ontario, K1N 7G2
Tel.: (613) 241-1119 Fax.: (613) 241-9807 e-mail sba@sba.ca

PROJECT
STUDENT RESIDENCE
CARLETON UNIVERSITY
OTTAWA, ONTARIO

SHEET TITLE
TUNNEL ROOF PLAN

DATE	PLOT DATE	FILE NO.
JULY 2000	JULY 10, 2000	00-564
DRAWN: M. NICOLL	CHECKED: P.L. / J.G.S.	
SCALES: 1:100		
SHEET NO. S11.03/11		



REVISIONS			
BY	No.	DESCRIPTION	DATE
H.V.M.	1	DETAIL C ADDED, VC 125, VC 123	MAR 22/73

CARLETON UNIVERSITY

ST. PATRICK'S COLLEGE

De Leuw Cather
CONSULTING ENGINEERS & PLANNERS

SEWER & WATER SERVICES STAGE II

PLAN

SCALE:	1" = 20'	DWG. No.	4319 - 12
DATE:	MARCH 1973	SHEET	1 OF 2

Appendix M

TSH Flow Monitoring Report

Sanitary Sewer Design Flows
Academic and Residence Buildings

Carleton University Campus

Prepared for: Carleton University
Prepared by: Totten Sims Hubicki

Rev2
April 16, 2007

TSH
engineers
architects
planners

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Summary

With two new buildings planned (academic - 18,581 m2; residence - 250 beds), Carleton University (CU) needs to identify and address the potential impact of the new sanitary sewer loads on the City of Ottawa Pumping Station (PS).

Totten Sims Hubicki (TSH) and G. A. Clark and Associates (GAC) have identified design flows based on an assessment of field monitoring and compared "future flows" to the "firm capacity" of the pumping station, with due regard to observed wet weather flows, especially over the past 3 years. Based on previous statements of "firm capacity" at the pumping station, TSH estimates that the new facilities will contribute a combined flow of 2.5 l/s to the pumping station which will leave 3.7 l/s capacity still available.

Notwithstanding the available capacity and in recognition of ongoing concerns with the operation and maintenance of the PS, CU has indicated its intention of undertaking a comprehensive I+I identification and removal program, which will be initiated in 2007, in order to identify and subsequently and progressively remove I+I flows at least equal to the amount of flow which will be contributed by the two new proposed buildings.

This, in part, will be accomplished by carrying out the necessary survey in order to identify/confirm the sources of I&I. This will be followed by: replacement of perforated MH covers; removal of storm sewer interconnections as indicated by dye/smoke tests and CCTV inspections; and, if required, the removal of foundation/roof drainage confirmed through the survey process.

1.0 Background

Carleton University requires site plan approval for the construction of two new facilities commencing in 2007: an academic facility of 18,581 m2; and a student residence with 250 beds. The City of Ottawa has previously expressed concern regarding flows and capacity at their sanitary sewer pumping station; which is essentially dedicated to servicing the Carleton University Campus (see Appendix A - internal Ottawa memo regarding PS firm capacity of 63.0 l/s)

A review of sanitary sewer design flows for university based academic and residence facilities provides a broad range of flows as indicated in Table 1. The intent of this report is to establish design flows that are relevant to Carleton University and use those to assess the impact of the proposed new facilities on the PS.

Table 1 - Typical Sanitary Sewer Design Flows (DWF) used in North America

Source	***Facility Type***	***Academic (litres/m2/d)***	***Residence (litres/c/d)***
Ottawa (City)	boarding school		275
	rooming house		200
	institutional		400
Calgary U.	academic	9.5	
Virginia T	residence hall		285
Florida U	residence		195
.	academic	7.5	
UBC	residence		230
Carleton (proposed 2006)	residence		210
	academic	6.6	

Sanitary flows were monitored at locations that represent common facility use. Residence and academic uses are represented at site 1 and site 2 respectively while site 3 monitored CU sanitary flow to the PS. **Figure 1** illustrates the monitoring locations and sewersheds.

Sanitary sewer monitoring was undertaken by GAC from October 2006 through to the end of January 2007. Observed peaks are provided in **Table 2** and are consistent with previous results. Average "dry weather flows" and peaking factors were determined for the three sites and are reported in **Table 3**.

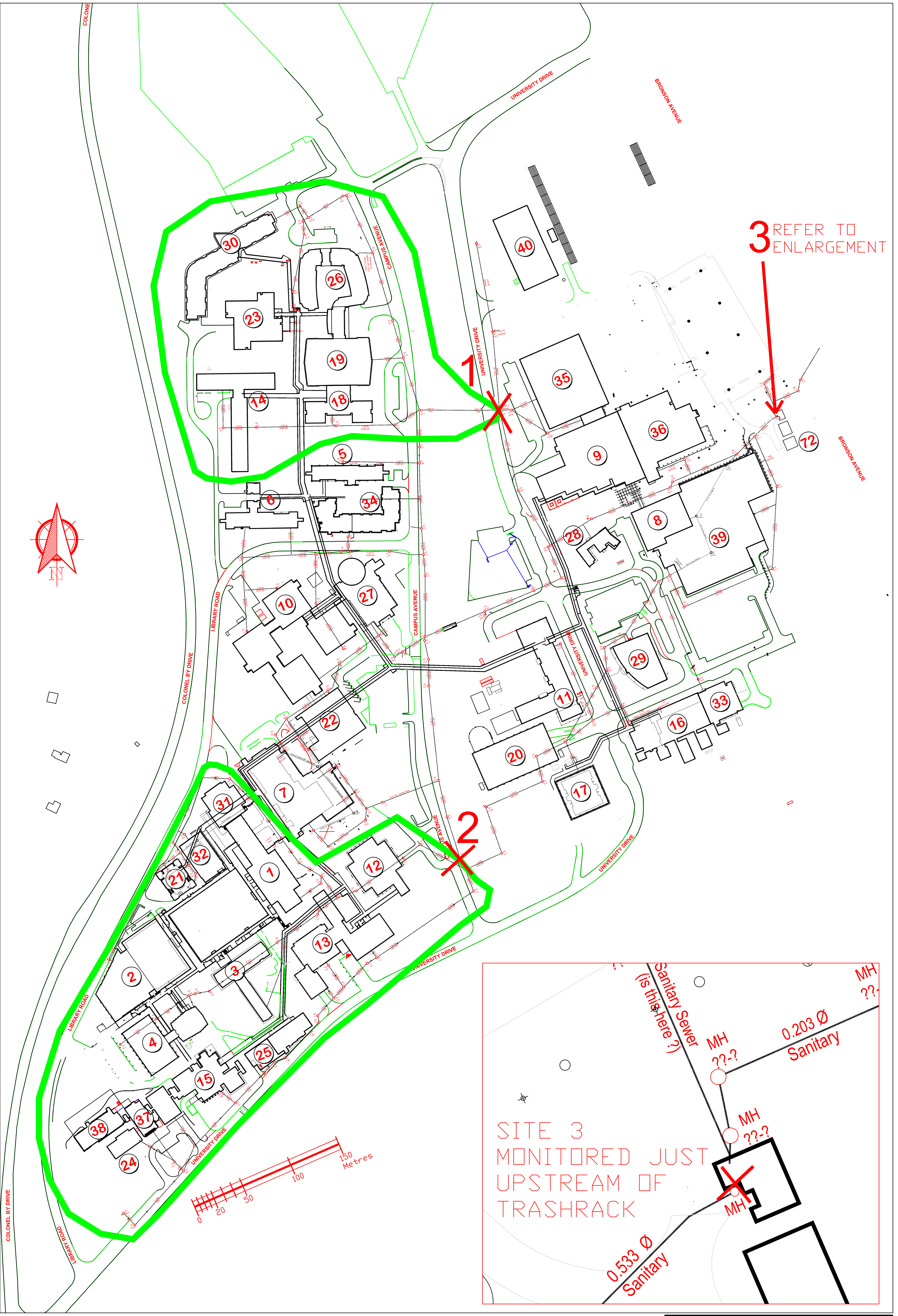


Figure 1 : Monitoring Locations and Sewersheds

Table 2: Peak Flows (l/s) at Pumping Station (Site 3)

Monitoring Period	ADDWF (peak observed)	WWF (peak observed)	WWF (10 year estimated)
Fall 2006/Winter 2007	21.4	37.0	49
Spring 2006	na	35.0	na
Spring 2004	20.4	39.4	na

Table 3: DWF and Peaking Factors (PF) - Fall/Winter 2006/2007

site 1 (residence)
- Average weekday DWF - 9.0 l/s PF=1.8
- Average weekend DWF - 7.7 l/s PF=1.7

site 2 (academic)
- Average weekday DWF - 3.9 l/s PF=2.6
- Average weekend DWF - 2.1 l/s PF=1.4

site 3 (PS)
- Average weekday DWF - 13.2 l/s PF=1.6
- Average weekend DWF - 10.5 l/s PF=1.5

2.0 Design Flow Estimates

Design flows for the new facilities were determined based on derived unit rates in litre/square metre/day for an academic facility and litre/capita/day for a residence facility using data applicable to Carleton University. As described in the GAC report (reference 5) the unit rates were developed by converting the weekday DWF to a daily volume and then dividing by the appropriate metric: for academic facilities, the gross floor area draining to site 2 was used, while for residence facilities, the total population contributing to site 1 was used. The unit rates were then multiplied by the PF and appropriate metric for the new facility to obtain the peak daily design flow contributing to the pumping station as shown in **Table 4**.

Table 4: DWF unit rates and New Facility flows

DWF (unit rate) academic: 6.6 l/m2/d => peak daily flow (18,581m2) =1.41 l/s
DWF (unit rate) residence: 210 l/c/d => peak daily flow (250 pop) = 1.06 l/s

The "unit rates" were benchmarked and found comparable with other North American practices, as illustrated in **Table 1**

With regards to **extraneous flows**, the GAC report identified two classes of extraneous flows: one related to rainfall and the other most likely related to campus maintenance operations that involve pool or tank emptying. It should be noted that the observed wet weather peaks mostly reflect the impact of infiltration due to high groundwater levels rather than any significant I+I related to intense rainfall events. To this end, it may be appropriate to identify a maximum wet weather flow from CU to the pumping station. This could be achieved by applying a conversion factor to the maximum extraneous flow observed in the 2006 monitoring period (see **Figure 2**). A factor of 1.59 was identified in the GAC report and represents conversion from a 1 year flow to a 10 year flow. The factored maximum extraneous flow of 27.8 l/s would be added to the peak daily DWF of 21.1 l/s, as illustrated in **Table 5**, to suggest a maximum wet weather flow of 48.9 l/s, with I+I accounted for.

The maximum wet weather flow for CU would be added to the city residential component (7.9 l/s as identified in **Table 6**) for a total existing flow to the PS of 56.8 l/s. This would imply an existing available PS capacity of 6.2 l/s. With the addition of sanitary flows from the two new facilities totalling 2.5 l/s, the remaining capacity would be reduced to 3.7 l/s.

Table 5: Determination of Maximum Wet Weather Flow at PS

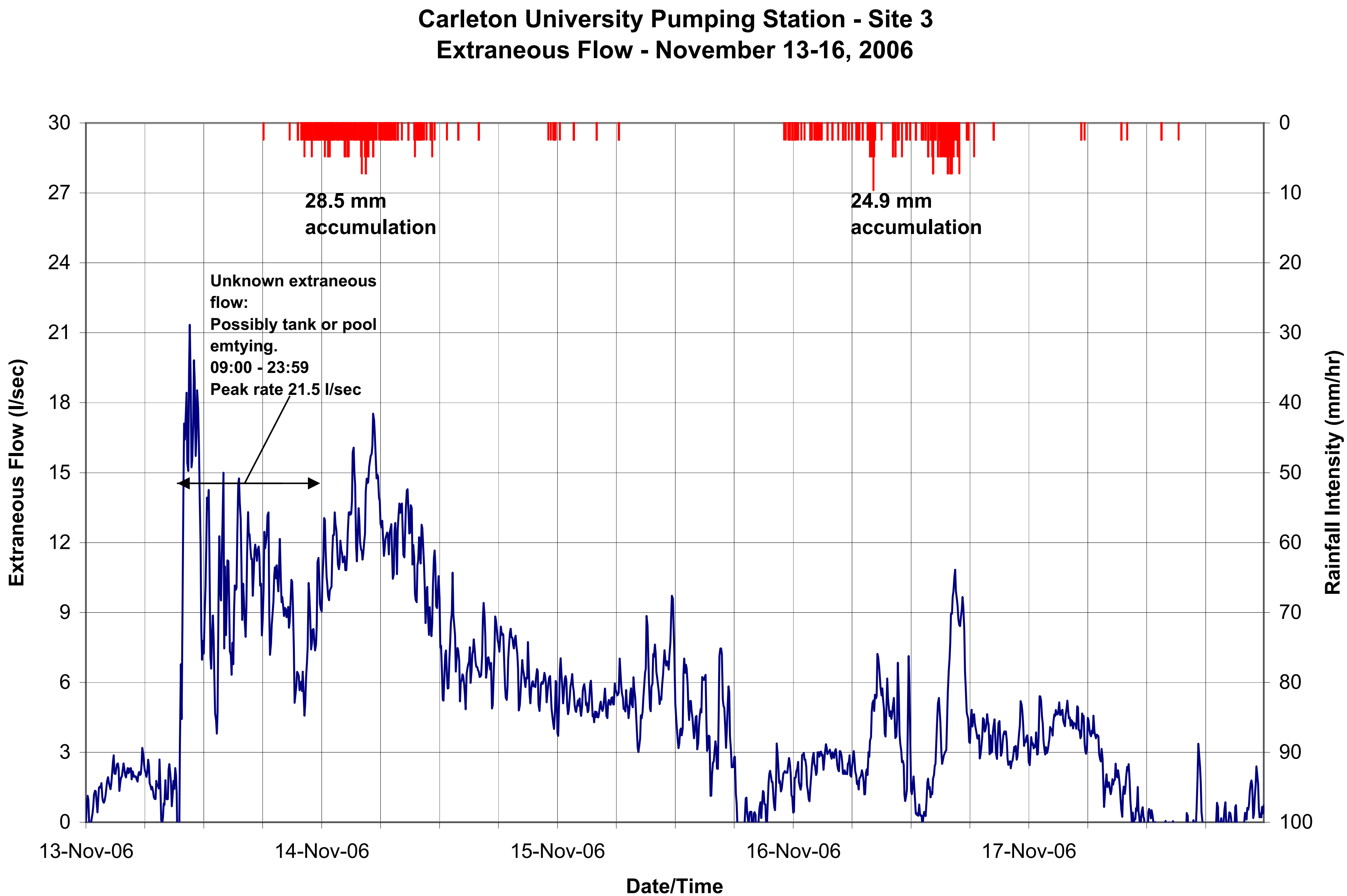
Max observed extraneous flow = (November 14th 2006 - see **Figure 2**)	17.5 l/s	=> x1.59[1.] (1 year to 10 year = conversion)	27.8 l/s
Average weekday DWF =	13.2 l/s	=> x1.6[2.] (peaking factor) =	21.1 l/s
Maximum WWF =			48.9 l/s

Notes 1. based on MTO
2. based in Table 2

Table 6 - Comparison of Inflow Scenarios versus PS Firm Capacity (63 l/s) (based on reference 3 - Table 2)

Scenario	Existing Campus Flows (l/s)	Future Campus Flows(l/s)	Flows from East of Bronson(l/s)	Future Available PSCapacity(l/s)
Peak Design Flows 1	85	90.7	7.5	-35.2
Peak Design Flows 2	74.2	79.9	7.5	-24.2
Peak Design Flows 2	51.7	57.4	7.5	-1.9
Monitored Peak DWF(2004)	20.4	26.1	5.1	31.8
Monitored Peak WWF(2004)	39.4	45.1	7.9	10.0
Monitored Peak DWF (2006)	21.4			
Estimated Peak WWF(2006)	48.9	51.4		3.7

Carleton University Sanitary Sewer Flow Monitoring - 2006



GCA

Figure 2:
Maximum Extraneous
Flows at PS - 2006

Table 7: PS Capacity Considerations

Firm capacity	63.0 l/s	(from Table 6)
Minus existing Ottawa flow	7.9 l/s	(from Table 6)
Minus existing CU load (WWF)	48.9 l/s	(from Table 5)
Existing Available PS Capacity	*6.2 l/s*	

Proposed academic facility (18,581m2) - peak daily flow -	1.41 l/s
Proposed residence facility (250 population) - peak daily flow -	1.06 l/s
Total proposed additional peak daily flow at pumping station-	2.47 l/s

Future available PS capacity => (6.2-2.5) = 3.7 l/s

3.0 Infiltration/Inflow Identification and Removal Program

A study would be undertaken to identify infiltration and inflow with regards to the CU sanitary sewer system. This will include, not only identifying the source but also the potential magnitude of the I/I flow and would consider:

- A review of design drawings
- A review of previous monitoring results and characterisation of the I/I element
- Smoke testing in the sanitary sewers with supplementary dye testing in storm sewers
- Physical inspection
    i. sump pumps
    ii. rainwater connections/roof leaders - identify those to sanitary
    iii. sanitary MH cover survey
- review previous CCTV tapes and undertake new CCTV studies, as necessary

Once the identification process has been completed, a phased I/I removal program will be identified. Priorities will be established based on cost and effectiveness of the operation. Actions could include:

- manhole cover replacement
- stormsewer catchbasin disconnect
- roof drain and foundation drain disconnect
- sump pump disconnect
- sewer replacement; pipe bursting
- sewer rehabilitation - grouting, relining, spot repairs

Phase one would identify and remove at least 2.5 l/s, equivalent to the estimated contribution form the two proposed facilities.

4.0 Conclusions and Recommendations

Based on the preceding sections, it is concluded that:

1. appropriate unit design flows for academic and residence facilities at the Carleton University Campus are 6.6 l/m2/day and 210 l/c/d respectively
2. these unit design flows can be used to estimate an increase in flow, at the Ottawa PS, of 2.5 l/s for two new facilities: an 18,581m2 academic building and a 250 bed residence building.
3. A reasonable estimate of extraneous wet weather flow to the PS is 27.8 l/s; obtained by factoring the maximum extraneous flow observed in 2006-2007. The peak daily DWF is 21.1 l/s from the Campus and 7.9 l/s from the City of Ottawa.
4. PS firm capacity of 63.0 l/s is not reached when the potential flow increase from the new facilities is added to the estimated maximum wet weather flows that could be currently experienced by the PS and the current peak daily DWF: a capacity of 3.7 l/s remains.

Based in the Conclusions, it is recommended that:

1. The University proceed with its site plan application based on the recommended design flows
2. In recognition of current operational problems with the City of Ottawa Pumping Station, and in recognition of the substantial I/I contribution to sanitary sewer flows, the University undertake an Infiltration/Inflow removal program, as soon as possible, to relieve current operating conditions at the pumping station

References:

1. CCTV Inspection Review - Sanitary Sewer System - 2003 - TSH

2. Parkwood Hills and Carleton University Sanitary Sewer Flow Monitoring Report - June 2004 - GA Clark and Associates

3. Carleton University Pump Station Capacity Assessment - Memo February 23 2005 - George Blow to Dave McCartney

4. Carleton University Sewer Monitoring Report - 2006 (Spring) - Stantec

5. Carleton University Sewer Flow Monitoring Report - March 2006 - GA Clark and Associates

APPENDIX A
23feb05 - City of Ottawa
Internal memo re PS capacity

MEMO / NOTE DE SERVICE

To / Destinataire	Dave McCartney	File/N° de fichier: NA
From / Expéditeur	George Blow, P.Eng. Water Resources Engineer Infrastructure Management	
Subject / Objet	Carleton University Pump Station Capacity Assessment	Date: 23 February 2005

1.0 Summary

- City of Ottawa Sewer Design Guideline flows currently exceed the firm capacity of the Carleton University Pump Station
- Flow monitoring conducted in 2004 indicates that there is currently limited available station capacity which is at most 15 L/s
- Based on flow monitoring data there is sufficient available station capacity to allow for the proposed additional flows (5.68 L/s) as described in the letter from TSH dated February 21, 2005, although based on City of Ottawa Sewer Design Guidelines there is no available capacity for any additional growth

2.0 Introduction

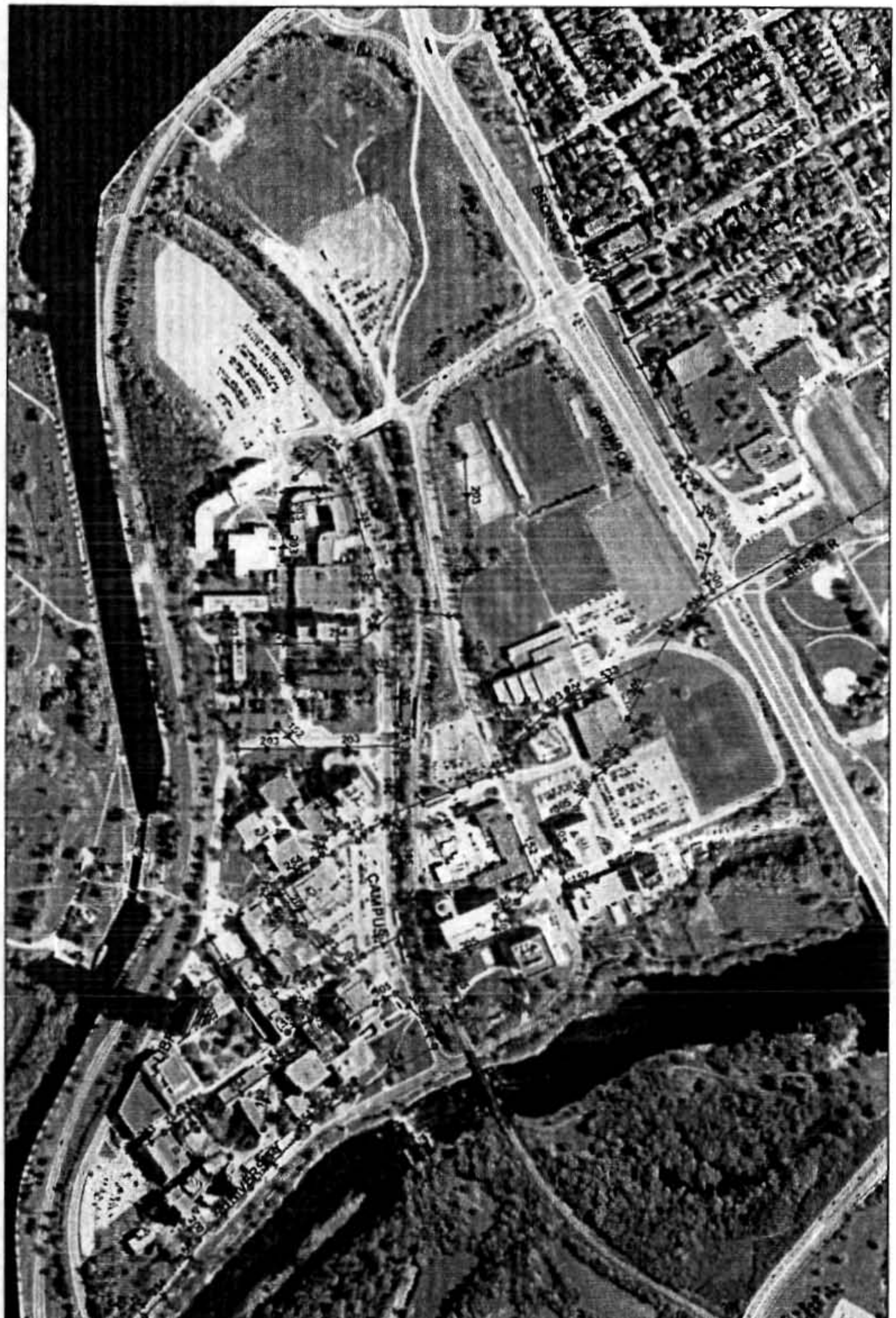
This memo has been prepared in response to a request by Utility Services to assess the current capacity of the Carleton University sanitary pump station (hereafter referred to as the pump station) in light of development pressures within the campus of Carleton University (hereafter referred to as the campus). In order to quantify existing flows a review of the following sources was undertaken:

- Carleton University Infrastructure Study prepared by TSH in March 2002
- Options Review Report –Upgrades to Carleton University Pumping Station prepared by CH2MHILL in April 2004
- Parkwood Hills & Carleton University Sanitary Sewer Flow Monitoring Report prepared by GA Clark and Associates in June 2004
- Letter Re: Carleton University site plan applications for the HCI & V-Sims Buildings (Site Plan File # D07-12-04-0014) and, the Unicentre Addition (Site Plan File #D07-12-04-0297) prepared by TSH on February 21, 2005

The 21 hectare area serviced by the pump station is presented in figure 1 and can be divided into two main areas as follows:

- 5 ha on the east side of Bronson Avenue including 150 residential dwelling units;
- and the entire 16 ha campus which includes 2,623 residence units and 25,935 students and faculty.

Figure 1 – Sanitary Sewers to the Carleton University Pump Station



3.0 Background

The station was built in 1959, expanded by the City of Ottawa in 1983 and currently has a firm capacity of 63 L/s. A single 200 mm diameter forcemain travels across Brewer Park and outlets to a 450 mm diameter sewer tributary to the Rideau River Interceptor. Estimated pumped flows, based on wet well level calculations, indicate that the forcemain has a theoretical roughness coefficient of approximately 75. The condition of this forcemain was unknown at the time of this report.

4.0 Analysis

Flow monitoring conducted in 2004 was reviewed in order to assess actual flows reaching the pump station. Dry weather flow data indicates that actual flows represent approximately 25% to 40% of peak design flows, depending on the chosen method of design flow calculations. Wet weather flow data shows that while there are negligible extraneous flows arriving from east of Bronson, there are measurable wet weather impacts on the Campus sanitary sewer network. The two largest wet weather events recorded during the monitoring period occurred on April 13, 2004 and May 2, 2004 with 23.6 mm and 28.0 mm of rainfall respectively. The following two tables present wet weather flow results and a comparison of various inflow scenarios versus station capacity.

Table 1 – Recorded Wet Weather Flow Events

Event	Rainfall Accumulation (mm)	Maximum Extraneous Flow (L/s)	Maximum Infiltration Rate (L/ha/s)
Average Dry Weather Flow	NA	4.8	0.30
April 13, 2004	23.6	11.7	0.73
May 2, 2004	28.0	14.0	0.88

Table 2 – Comparison of Inflow Scenarios versus Station firm Capacity

Scenario	Existing Campus Flows (L/s)	Future Campus Flows (L/s)	Flows from east of Bronson (L/s)	Future available Station Capacity (L/s)
Peak Design Flows 1	85.0	90.7	7.5	-35.2
Peak Design Flows 2	74.2	79.9	7.5	-24.4
Peak Design Flows 3	51.7	57.4	7.5	-1.9
Monitored Peak DWF	20.4	26.1	5.1	31.8
Monitored Peak WWF	39.4	45.1	7.9	10.0

Notes:

- Future campus flows are based on addition of HCI & V-Sims Buildings and Unicentre Addition
- "Peak design flows 1" is based on TSH report which is based on City of Ottawa design guidelines using 350 L/cap/d (Harmon peak) for residents, 50,000 L/ha/d (1.5 peak) for institutional flows and 0.28 L/ha/s for infiltration allowance
- "Peak design flows 2" is based on City of Ottawa design guidelines using 350 L/cap/d (Harmon peak factor) for residents, 50,000 L/ha/d (1.5 peak factor) for institutional flows and 0.28 L/ha/s for infiltration allowance. This scenario includes slightly smaller land areas contributing to the infiltration allowance
- "Peak design flows 3" is based on City of Ottawa design guidelines using 275 L/cap/d (Harmon peak factor) for residents, 50 L/cap/d (1.5 peak factor) for staff and students and 0.28 L/ha/s for infiltration allowance
- Flows from east of Bronson are based on existing conditions as there are no significant plans for additional growth in this area in the near future

The shape and volume of the extraneous flow hydrographs for the above described wet weather events indicate that it is highly unlikely that the source of extraneous flow is originating from direct inflows such as cross connected catch basins or roof drains. The high levels of extraneous flow are found in other City sewers of similar age and indicate a generally "leaky" system where extraneous flows enter the system through cracks in pipes, service connections and manholes.

5.0 Conclusions and Recommendations

Based on flow monitoring data there is sufficient available station capacity to allow for the proposed additional flows as described in the letter from TSH dated February 21, 2005, although based on City of Ottawa Sewer Design Guidelines there is no available capacity for any additional growth. This discrepancy in flows should lead to caution before approving any additional sources of flows within the are tributary to the pump station. Consideration should be given to removing sources of extraneous flows within the Campus of Carleton University to free up additional pump station capacity to allow for additional growth. Although there are no reported cases of flooding in recent years within this area, should inflows to the station exceed capacity even for a short period of time, there would be a high risk of basement flooding due to the shallow nature of the sanitary sewers and the limited available storage within the small diameter sewers. While the report from CH2M HILL recommends remedial work to improve current operation of the pump station it will do nothing to improve capacity of the station. The report also indicated that the station has been identified by the City for a complete upgrade and expansion in the future. It is clear that any station expansion will be driven by the rate of growth within the University campus and not related to any limited residential "infill" that may occur east of Bronson.

If you have any questions related to the information contained within this memo please do not hesitate to contact me at extension 21514 or at george.blow@ottawa.ca.

Sincerely,

George Blow

Attach.

cc: Pat LeBlanc