CAPITAL ENGINEERING GROUP LTD
Municipal / Environmental / Land Development

CAPITAL ENGINEERING GROUP LTD

Municipal / Environmental / Land Development

SERVICING AND STORMWATER MANAGEMENT REPORT
UPPER HUNT CLUB CENTRE
2582 - 2626 BANK STREET, CITY OF OTTAWA
August 25, 2021

EXISTING CONDITIONS

This site is located along the south side of Bank Street just east of the intersection with Albion Road, at the northern edge of Blossom Park neighborhood in the City of Ottawa's south central area. The site is irregular in shape with a frontage of approximately 150 m along Bank Street and a total site area of 1.25 hectares.

The property is made up of two parcels (2582 and 2600 Bank Street) both zoned Commercial (AM). 2600 is fully developed with an existing one storey commercial building and paved parking and laneways. 2582 is currently vacant.

A separate block owned by the applicant (2626 Bank Street) backs onto Sawmill Creek behind (southeast) of the other two parcels. It has an area of 0.38 hectares and is zoned high density Residential (R3Y). It is currently vacant.

The existing building at 2600 is serviced with sanitary and water connections off the existing municipal infrastructure along Bank Street. The site also has a storm sewer network collecting drainage from the building and surrounding development, with an apparent outlet to the sanitary sewer pipe on Bank Street.

The existing municipal infrastructure along Bank Street includes a 400 mm watermain along the north edge of the roadway and 250 mm sanitary sewer along the south boulevard area. There is also covered storm culverts (varying sizes) adjacent to the sanitary pipe near the north edge of the property.

There is an existing 600 mm diameter sanitary trunk along the south side of Sawmill Creek

Current site drainage is either northerly towards Bank Street or southerly towards Swamill Creek. A breakdown of the pre-development drainage areas is illustrated on drawing 20046, G1.

Sawmill Creek flows westerly then northerly through South Keys, Brookfield and Billings Bridge neighborhoods eventually discharging to the Rideau River Just east of Billings Bridge Plaza.

Other utilities including hydro, gas and telephone are also available along Bank Street.

PROPOSED DEVELOPMENT

The property owners propose to keep the existing building at 2600 Bank and construct three additional 3-storey commercial buildings, intended for retail use on the ground floor and offices on the upper floors. The development maintains the existing access at 2600 Bank and adds a new entry at the west end of the site.

The foot prints of the new buildings (A, B and C) are approximately 1,633 m^2, 1,066 m^2, 1,160 m^2 respectively. They will all be equipped with sprinkler systems. The existing one storey building has a floor area of 370 m^2.

The new site development will include underground parking below and adjoining buildings A and B as well as the underground parking roof deck. Fire routes / access laneways are provided to all the buildings with two entries off Bank Street.

Laneway access will also be provided to Block 2626 Bank Street which will be developed at a later date.

The existing paved areas around the existing building will be reconfigured to suit the new development, re-graded and re-instated as shown on the site plan and engineering drawings.

BUILDING SERVICES

Details of the sanitary and water services to the existing and the new buildings are shown on the Servicing Plan (drawing 20046, G2). The services are outlined as follows.

Building B will be serviced by a 200 mm diameter sanitary pipe and a 300 mm pressure pipe water service. The two services will enter the building along the north wall, and connect to the existing municipal infrastructure on Bank Street. A monitoring manhole and a water valve will be installed as shown on drawing G2. The water service will be extended towards building A to feed a new hydrant to be located adjacent to the access laneway.

A new 200 mm sanitary line will be installed with an outlet to the existing municipal sewer near the west end of 2600 Bank Street. This line will run easterly and southerly along the existing laneways to service buildings A and C. A new 300 mm pressure pipe water service with a second connection to the 400 mm watermain near the existing entrance to 2600 will run southerly along the existing and new laneways to service buildings A and C. A second fire hydrants will be added south of building A to provide spatial coverage to the buildings.

The existing sanitary service to 2600 Bank Street will connected to the new sanitary line mentioned above and the current outlet will be plugged. The existing water service to the building will remain.

The water service feeding buildings A and C, will be extended to the common property line with Block 2626 and plugged. It will be used to service the future development in the block. It is not practical to provide gravity flow from block 2626 to the Bank Street sanitary. The future outlet from this block will have be connected to the existing 600 mm trunk sewer along Sawmill Creek.

The average and peak sewage flows can be estimated using the City of Ottawa Sewer Design Guidelines (Section 4.4.1.3) for Commercial Zone, as follows:

Flow per Hectare	28,000 Liters per day
Peaking factor	1.5
Infiltration allowance	0.33 L/s per hectare
Average flow rate to be based on 12 hour daily operation	

The tributary areas to each sanitary outlet are broken down as follows

Building B	0.35 Ha
Buildings A, C and existing	0.90 Ha

Average daily flows

Building B	9,800 Liters per day
Buildings A, C and existing	25,200 Liters per day

Average flow rates

Building B	0.23 L/s
Buildings A, C and existing	0.58 L/s
	0.81 L/s

Peak flow rates (incl. infiltration allowance)

Building B	0.46 L/s
Buildings A, C and existing	1.05 L/s

The proposed sanitary outlets (200 mm @ 1.0 % and 0.5 %) as well as the existing municipal sewers (250 mm @ 1.99 %), all have adequate capacity to accommodate the projected peak flows.

The average domestic water demand is assumed to be equivalent to the sewage flow of 0.81 L/s. Applying peaking factors of 1.5 and 1.8 will result in a maximum day and peak hourly demands of 1.21 L/s and 2.19 L/s respectively. Meter sizing for the new buildings will be based on the fixture unit value and detailed in the Water Data Cards, to be submitted separately.

FIRE FLOW

Spatial fire flow coverage will be provided by the existing municipal fire hydrants along Bank Street, plus the new private hydrants mentioned above.

The required fire flow is calculated using the Fire Underwriters Survey (1999) guidelines, as follows:

$F = 220\ C\ A^{0.5}$

Where F is the required fire flow in liters per minute
C = 0.8 for non-combustible construction
A is the floor area of the building

Building A – Floor Area (3 floors) = 4,900 m^2

F1 = 12,320 L/minute (round to 12,000)

Apply 40 % reduction for automatic sprinkler system – Subtract 4,800 L/minute
Apply 17 % for low hazard occupancy (upper two floors are offices) – Subtract 2,000 L/minute
Add 50 % for exposure (25 % east, 15 % west and 10 % south) – Add 6,000 L/minute

F2 = 12,000 – 4,800 – 2,000 + 6,000 = 11,200 Liter per minute (**round to 11,000**)

Building B – Floor Area (3 floors) = 3,200 m^2

F1 = 9,956 L/minute (round to 10,000)

Apply 40 % reduction for automatic sprinkler system – Subtract 4,000 L/minute
Apply 17 % for low hazard occupancy (upper two floors are offices) – Subtract 1,700 L/minute
Add 35 % for exposure (15 % east and 20 % west) – Add 3,500 L/minute

F2 = 10,000 - 4,000 - 1,700 + 3,500 = 7,800 Liter per minute (**round to 8,000**)

Building C – Floor Area (3 floors) = 3,478 m^2

F1 = 10,380 L/minute (round to 10,000)

Apply 40 % reduction for automatic sprinkler system – Subtract 4,000 L/minute
Apply 17 % for low hazard occupancy (upper two floors are offices) – Subtract 1,700 L/minute
Add 40 % for exposure (15 % north, 15 % west and 10 % south) – Add 4,000 L/minute

F2 = 10,000 – 4,000 – 1,700 + 4,000 = 8,300 Liter per minute (**round to 8,000**)

The Hydraulic Grade line in the water network in this area, under Maximum Day demand plus fire flow of 11,000 L/minute (183 L/s) is 125.5 m. Please refer to the attached Boundary Conditions provided by the City.

The ground elevation at the buildings is 99.0 m. This results in a residual pressure of 26.5 m (38 psi), which exceed the Building Code requirements.

Detailed design of the sprinkler systems will be carried out by the mechanical consultant and system supplier who will ensure that NFPA and Building Code requirements are met.

POST DEVELOPMENT GRADING AND DRAINAGE

The post development grading and drainage design is indicated on the Grading and SWM Plan prepared by Capital Engineering Group Ltd (Drawing 20046, G3).

The grading and drainage design will include sub drainage piping in the landscaped areas adjacent to buildings B and C plus two separate storm networks.

Subdrains near Building B will be connected to the existing culvert along Bank Street Boulevard.

A roof outlet will convey drainage from the new roofs, underground access ramp and the sub drainage system adjacent to building C. Flow from this system will be routed through block 2626 with a storm outlet located at the edge of Sawmill Creek buffer. The flow will then be directed via a grassed swale prior to outletting to the Creek. All the roof drains will be equipped with flow control weirs.

A surface network will collect drainage from the surface areas (including underground parking roof deck) as well as the laneways and remaining paved areas and adjacent landscaping. This system will also be routed through block 2626 and connected to the existing 450 mm perforated storm pipe, installed previously as part of the adjacent development.

A flow control device (ICD) plus an underground storage system will be installed at the end of the surface outlet as well as a water quality unit; To provide quantity and quality controls to meet the required SWM criteria.

STORMWATER MANAGEMENT

Criteria

The City of Ottawa and Rideau Valley Conservation Authority require that post development runoff from this site be subject to SWM quantity and quality control.

The SWM criteria will generally be in accordance with the Sawmill Creek Subwatershed Study for Infill Sites. The following is an outline of the required criteria (see attached pre-consultation notes).

- Quantity control to be based on pre-development levels, for 2 to 100 year storm events
- Calculated time of concentration, not to be less than 10 minutes
- Flows in excess of the allowable release rate, up to the 100 year storm event, to be retained on site
- Enhanced level quality control (80 % TSS removal).
- Water Balance and erosion control. These will be addressed by on site Best Management Practices.

The BMP's will include measures to promote onsite infiltration by directing runoff from impervious areas (where practical) through landscaping or grassed swales. One BMP option that was discussed with RVCA and accepted in principle will separate the flow from the new roofs and release it through a vegetated swale across the Sawmill Creek buffer area within block 2626. The swale cross section and slopes will be designed in accordance with the MOE guidelines. Check dams will be added to maximize infiltration and enhance the quality of the runoff.

Construction work within the Sawmill Creek proper will require a permit from RVCA.

Quantity Control

The following calculations include the future development at block 2626 Bank Street (predevelopment area as well as allowance for future drainage areas)

The 2 and 100 year pre-development peak flow rates are calculated using the Rational Method, as follows:

$Q = 2.78\ CIA$

Where C is the runoff coefficient.

I is the rainfall intensity for a given time of concentration (Tc), using the City's IDF information. Tc = 20 minutes will be used in our SWM calculations. This exceeds the 10 minute minimum.
The rainfall intensities are I_2 = 52 mm/hr and I_{100} = 120 mm/hr

A is the drainage area in hectares

The predevelopment drainage areas are broken down as follows

Building and Parking	5,000 m^2	C = 0.90 (C_{100} = 1.0)
Landscaping	11,300 m^2	C = 0.20 (0.25)
	16,300 m^2	C = 0.41 (0.48)

Q_2 = 2.78 x 1.63 x 0.41 x 52 = 89.2 L/s
Q_{100} = 2.78 x 1.63 x 0.48 x 120 = 261.0 L/s

Uncontrolled drainage

The following drainage areas will not be subject to flow controls.

To Bank Street culvert (driveway and landscaping)	1,200 m^2	C = 0.37 (0.43)
Ramp to underground parking	360 m^2	C = 0.90 (1.0)
Creek buffer and side yard setbacks at 2626	1,500 m^2	C = 0.2 (0.25)
Setbacks at building C (w/w and landscaping)	790 m^2	C = 0.26 (0.33)
Total uncontrolled drainage	**3,850 m^2**	C = 0.33 (0.37)

$Q_2 = 2.78 \times 0.385 \times 0.33 \times 52 = 18.4$ L/s
$Q_{100} = 2.78 \times 0.385 \times 0.37 \times 120 = 47.5$ L/s

Balance of allowable outflow rates

Q_2 **89.2 – 18.4 = 70.8 L/s**
Q_{100} **261.0 – 47.5 = 213.5 L/s**

On Site Stormwater Retention

The drainage areas subject to SWM (including allowance for future development at lot 2626 Bank Street) are broken down as follows:

New Roofs	4,860 m^2	C = 0.90 (C_{100} = 1.0)

Remaining site areas

Existing building	370 m^2	C = 0.90 (1.0)
Pavement and concrete	6,970 m^2	C = 0.90 (1.0)
Landscaping	250 m^2	C = 0.20 (0.25)
Total	7,590 m^2	C = 0.86 (0.95)

Total area subject to SWM **12,450 m^2**

The attached spreadsheet provides detailed calculations of the required storage during major storm events. The maximum retention volumes during the 2 and 100 year storm events are:

Drainage Area	Outflow Rate	2 Year Retention	100 Year Retention
Building A	4.5 L/s	20 m^3	76 m^3
Building B	3.0 L/s	14 m^3	50 m^3
Building C	3.0 L/s	16 m^3	55 m^3
Future Building	3.0 L/s		
Surface Drainage	57.3 L/s	49 m^3	228 m^3
	70.8 L/s		

On site retention for the buildings is accommodated by roof storage based on the available roof area and 0.15 m ponding depth at the drains, as follows:

Building A	82 m^3
Building B	53 m^3
Building C	58 m^3

The roof drains (3 for building A and 2 each for buildings B and C) will be equipped with adjustable flow control weirs to limit the outflow to 1.5 L/s per drain. The roofs will also have emergency overflow mechanism (scuppers), in accordance with the Building Code requirements.

On site retention for the surface drainage is accommodated by the proposed Hydrostor HS 180 Stormwater Chamber System supplied by Armtec, or equivalent. The system consists of 47 underground open bottom chambers embedded in crushed clear stone (19 – 50 mm size) and surrounded by geotextile fabric. The system has a total storage capacity of 287 m^3 to provide sufficient capacity to accommodate the current site plan as well as future development in block 2626. Please refer to the attached system layout provided by the supplier.

Outflow from the underground storage chambers will be limited to 57.3 L/s by installing a Hydrovex 200VHV-2 flow regulator in the outlet pipe of the downstream manhole, as indicated on the drawings. The hydraulic head during the 100 year storm event is 2.38 m.

QUALITY CONTROL

A SDD3-2400 ETV Verified OGS water quality unit by Armtec (or equivalent) will be installed at the end of the surface storm outlet to provide quality control of the runoff. The unit is sized to provide net annual TSS removal efficiency exceeding the 80 % threshold. Please refer to the attached sizing calculations and standard details provided by the supplier.

The roof outlet conveys drainage mainly from the new roofs where the runoff is considered clean (95 %TSS removal). This outlet is routed through a grassed swale with rock check dams which provides additional quality control treatment.

SEDIMENT AND EROSION CONTROL

Erosion and sediment control measures will be put in place prior to construction to minimize off site silt runoff. The measures will conform to MOE Guideline B-6, “Guidelines for Evaluating Construction Activities Impacting on Water Resources”. Please refer to the Erosion and Sediment Control Plan (Drawing 20046, G4).

All erosion and sediment control installations will remain in place until pavement and landscaping works are completed.

WATER BALANCE

Reference is made to the Infill / Redevelopment Sites under Section 9.6 – Summary of SWM Techniques for New Developments of the Sawmill Creek Subwatershed Study (attached). The summary recommends SWM quantity and quality control as well as Best management practices to promote on site infiltration and pollutant source control.

Quantity and quality controls are discussed in the preceding sections of this report.

To maximize on site infiltration, our design proposes to install subdrains in the landscaped areas around the buildings, plus re-route the roof outlet through a grassed swale prior to discharging to Sawmill Creek.

The hard surface areas that have been re-routed through the grassed swale represent over 40 % of the post development impervious areas. Please refer to the Post Development Drainage Areas Plan (drawing 20046, G5) for a break down.

Additional infiltration will also occur within the open bottom HydroStor Stormwater Chamber System to be installed at the downstream end of the surface outlet, as well as the existing 450 mm diameter perforated storm pipe.

The proposed SWM and BMP measures, coupled with the elevated permeability of the soil (and low groundwater table elevation), create suitable conditions to allow for a large portion of captured runoff to infiltrate/recharge the groundwater system beneath the site.

Swale Design

Flow through the swale includes the combined outflow from the new roofs (13.5 L/s) plus runoff from the underground parking ramp (360 m^2) as well as the landscaped tributary areas (2,290 m^2), resulting in total peak flows of

Q_2 = 24.6 L/s
Q_{100} = 44.4 l/s

The peak flow depths and velocities in the swale can be estimated by applying Manning's formula to the swale cross sections, as shown on the engineering drawings

$$Q = A \times R^{0.67} \times S^{0.5} / n$$

Where Q is the peak flow calculated above
A is the area of flow, varies with the depth of flow
S is the longitudinal slope S = 1 %
n is the roughness coefficient, n = 0.035.

The depths of flow and velocities during the 2 and 100 year storm events are calculated as follows:

2 year storm		100 year storm	
Depth	Velocity	Depth	Velocity
0.06 m	0.36 m/s	0.08 m	0.43 m/s

The swale cross section (> 0.75 m bottom width) and longitudinal slope (< 1%) as well as the calculated velocities (< 0.5 m/s) during major storm events all conform to the recommendations in the MOE SWM Planning and Design Manual. Relevant page of the manual is attached for reference.

CHANNEL EROSION

As noted above, the post development outflow rates are restricted to predevelopment levels for the 2 to 100 year storm frequencies. Flows in excess of the allowable release rate will be retained on site.

Also as discussed in the preceding sections, on site infiltration has been maximized. It is expected that a significant percentage of precipitation during frequent storm events will infiltrate on site.

Due to the proposed SWM and BMP measures, this development should not result in increased erosion potential to the receiving creek.

REVIEW BY OTHER AGENCIES

The engineering drawings and report will be circulated to other agencies, including the Rideau Valley Conservation Authority as part of the site plan application process.

SUMMARY / CONCLUSIONS

The proposed site services are designed in accordance with the City of Ottawa design guidelines.

Fire flow coverage for the proposed buildings meets the requirements of the Ontario Building Code.

On-site stormwater management has been designed to generally meet the criteria established by the Sawmill Creek Subwatershed Study for Infill Sites. The criteria are outlined in the Stormwater Management section on page 5 of this report.

Prepared by
Capital Engineering Group Ltd.

Andy Naoum, P.Eng
Senior Consultant

LICENSED PROFESSIONAL ENGINEER
AMINE NAOUM
Aug 25/21
PROVINCE OF ONTARIO

List of Attachments

- Water Boundary Conditions
- Pre-consultation Notes – City and RVCA
- Relevant Pages from Sawmill Creek Subwatershed Study
- On Site Stormwater Management Retention – Spreadsheet
- HydroStor HS 180 Underground Storage System Layout – Provided by Supplier
- Water Quality Unit Sizing – Provided by Supplier
- Water Quality Unit – SDD3-2400 Drawing – Provided by Supplier
- Relevant Pages from MOE SWM Planning and Design Manual – Grassed Swales

Andy Naoum

From: Sharif, Golam <sharif.sharif@ottawa.ca>
Sent: August 5, 2021 2:32 PM
To: Andy Naoum
Subject: RE: 2582, 2600, 2626 Bank Street
Attachments: 2582, 2600, 2626 Bank Street July 2021.pdf

Hi Andy,

Here are the requested boundary conditions. If you have any question let me know.

The following are boundary conditions, HGL, for hydraulic analysis at 2582, 2600 and 2626 Bank Street (zone 2W2C) assumed to be a dual connection to the 406 mm on Bank Street (see attached PDF for location).
Both Connections:
Minimum HGL: 123.9 m
Maximum HGL: 131.1 m
Max Day + Fire Flow (133.3 L/s): 126.3 m (Connection 1) and 126.1 m (Connection 2) Max Day + Fire Flow (183.3 L/s): 125.7 m (Connection 1) and 125.5 m (Connection 2)

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,

Sharif

-----Original Message-----
From: Andy Naoum <cegl@rogers.com>
Sent: July 26, 2021 10:29 AM
To: Sharif, Golam <sharif.sharif@ottawa.ca>
Subject: RE: 2582, 2600, 2626 Bank Street

Hi Sharif,

Can I get the water boundary conditions for this site, please?

Domestic Demand

Average 0.81 L/s
Maximum Day 1.21 L/s
Peak Hourly 2.19 L/s

The calculated fire flow demands for buildings A, B and C are is 11,000, 8,000 and 8,000 liters per minute respectively.

Thanks,
Andy Naoum, P.Eng.
Capital Engineering Group Ltd.
(613) 739-0776

-----Original Message-----
From: Sharif, Golam [mailto:sharif.sharif@ottawa.ca]
Sent: December 21, 2020 10:44 AM
To: Andy Naoum <cegl@rogers.com>
Cc: 'Nabil Abdulla' <nabil@ottawapowerteam.com>
Subject: RE: 2582, 2600, 2626 Bank Street

Hi Andy,

I looked into the old hard copy files. However only an old Geotech report was there and few site plan/ elevation plans. Unfortunately no servicing or engineering plans. I am sending them to you by attachment. Thanks.

Sharif

-----Original Message-----
From: Andy Naoum <cegl@rogers.com>
Sent: December 01, 2020 5:07 PM
To: Sharif, Golam <sharif.sharif@ottawa.ca>
Cc: 'Nabil Abdulla' <nabil@ottawapowerteam.com>
Subject: RE: 2582, 2600, 2626 Bank Street

CAUTION: This email originated from an External Sender. Please do not click links or open attachments unless you recognize the source.

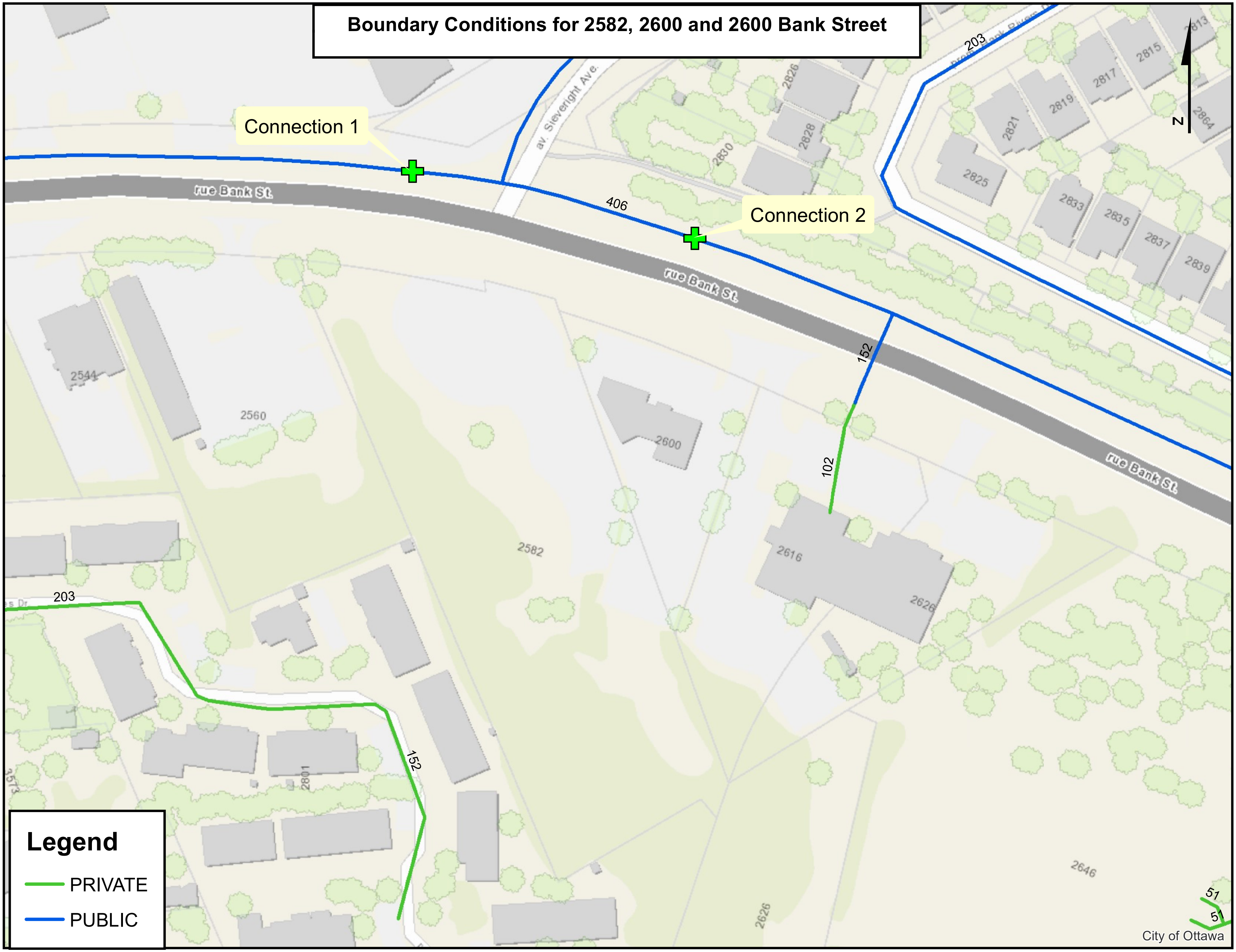
ATTENTION : Ce courriel provient d’un expéditeur externe. Ne cliquez sur aucun lien et n’ouvrez pas de pièce jointe, excepté si vous connaissez l’expéditeur.

Thank you for trying Sharif,

We'll wait and see if you find something.

Andy Naoum, P.Eng.
Capital Engineering Group Ltd.
(613) 739-0776

-----Original Message-----
From: Sharif, Golam [mailto:sharif.sharif@ottawa.ca]
Sent: December 1, 2020 4:54 PM



Boundary Conditions for 2582, 2600 and 2600 Bank Street
Connection 1
Connection 2
rue Bank St.
av. Sieveright Ave.
406
203
152
102
2544
2560
2582
2600
2616
2626
2646
2801
2825
2826
2828
2830
2813
2815
2817
2819
2821
2833
2835
2837
2839
2864
N
Legend
PRIVATE
PUBLIC
51
City of Ottawa

<u>2582, 2600, 2626 Bank Street</u>

Meeting Summary Notes

Nov. 14, 2019, Ottawa City Hall

Attendees:

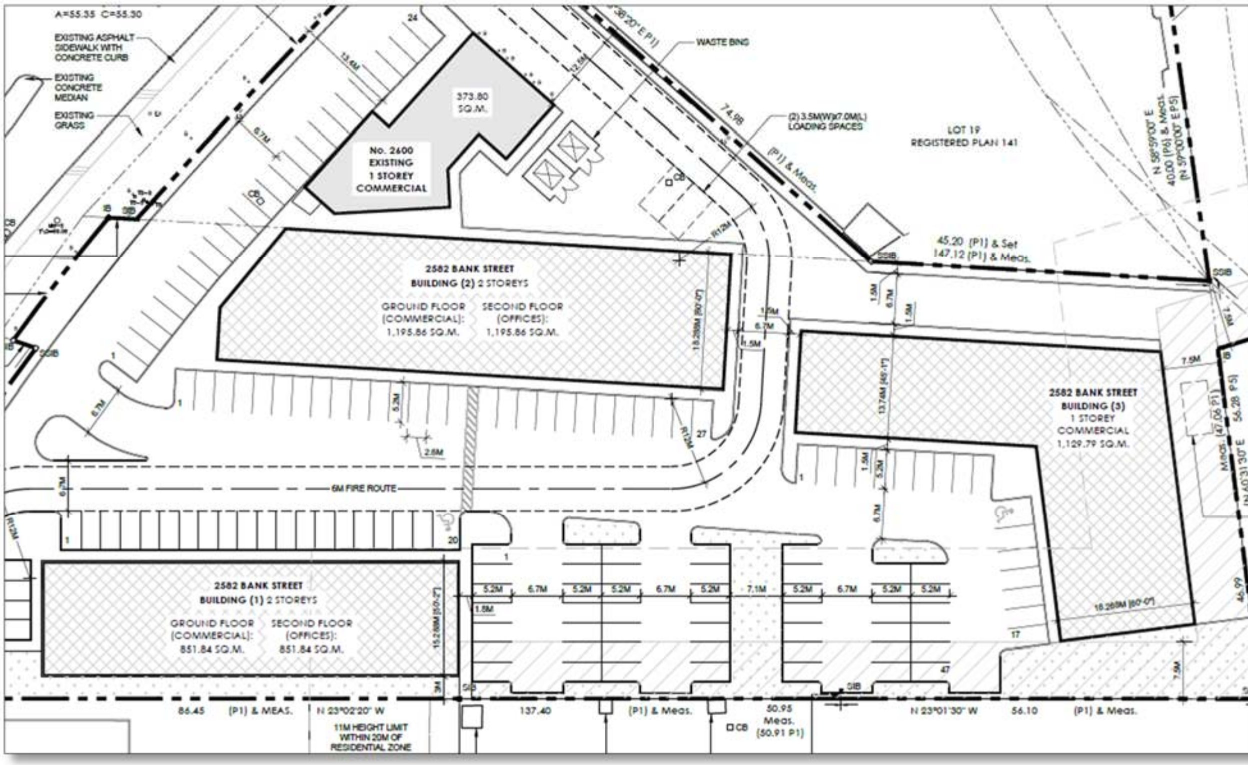
- Ahmed Aref
- Nabil Abdulla, Power Marketing, Real Estate Brokerage
- Carl Furney, Consultant, Fotenn
- Matthew Hayley, Environmental Planner, City of Ottawa
- Christopher Moise, Urban Designer, City of Ottawa
- Tracey Scaramozzino File Lead, Planner, City of Ottawa

Unable to attend:

- Golam Sharif Project Manager, City of Ottawa
- Wally Dubyk Transportation Project Manager, City of Ottawa
- Mark Richardson Forestry Planner, City of Ottawa
- Jamie Batchelor, RVCA

Issue of Discussion (as presented by the Applicants):

- The 3 subject parcels are being sold as a package
- Proposed development for 3 properties, 2582, 2600, 2626 Bank Street
- Commercial Plaza with separate owners and multiple tenants
- 2582 Bank: One, 2-storey, commercial on ground floor, office on 2nd floor; Existing Car Rental Bldg to remain, business to re-locate.
- 2582 Bank: One, 2-storey bldg. – commercial on ground, office on 2nd; One 1-storey commercial bldg. at the rear
- 2626 Bank: Difficult to develop due to access, zoning and floodplain from Mosquito Creek; This property may develop in the future – if determined to be feasible by the City and Applicant.
- All 3 properties together are 16,873 metres squared (the 2 AM zoned sites may be under the gfa required in the Zoning By-law)
- This would be a phased development
- No proposed minor variances



1. **Official Plan -** designated “Arterial Mainstreet” and “General Urban” and “Urban Natural Features”
   a. The intent of Arterial Mainstreet (S. 3.6.3) designation is to intensify over time, become a more pleasing streetscape with a focus on pedestrian, cycling and transit users while providing a wide range of uses that are more compact in nature.
      - Arterial Mainstreet policies include the following:
        - Planned as compact, mixed-use, pedestrian oriented streets to evolve over time
        - Deep lots are to be developed in a coordinated fashion
        - Reduce the impact of surface parking
        - Adequate landscaping, trees along street frontage
   b. The intent of General Urban designation (S. 3.6.1) is to permit a wide range of uses from residential to retail to institutional.
      - General Urban polices include the following:
        - The General Urban Area designation permits all types and densities of housing, as well as employment, retail uses, service, industrial, cultural, leisure, greenspace, entertainment and institutional uses.

- When considering a proposal for residential intensification through infill or redevelopment in the General Urban Area, the City will:
    - Recognize the importance of new development relating to existing community character so that it enhances and builds upon desirable established patterns and built form;
    - Apply the policies of Section 2.5.1 and Section 4.11;
    - Consider its contribution to the maintenance and achievement of a balance of housing types and tenures to provide a full range of housing for a variety of demographic profiles throughout the General Urban Area;
    - Assess ground-oriented multiple housing forms, such as duplex, triplex and fourplex, as one means of intensifying within established low-rise residential communities.

c. The intent of Urban Natural Features designation (3.2.3) is to preserve natural features
    - Urban Natural Features polices include the following:
        - Development and site alteration will not be permitted within 30metres of the boundary of this designation unless an EIS demonstrates that there will be no negative impacts

2. **South Keys to Blossom Park, Bank Street CDP:**
    a. Some guidelines are as follows:
        1. This area is a target area for intensification
        2. Good urban design is crucial and high standard of design is required
        3. Presentation to the Urban Design Review Panel is required
        4. Transform Bank St. into a true arterial mainstreet for pedestrians and cyclists with ample trees and landscaping
        5. Recognize and reinforce stable residential neighbourhoods as areas of established character (this includes Des Mesanges).

3. **Zoning Information**
    a. Arterial Mainstreet - AM H(30) for two of the lots fronting onto Bank
        1. This AM zone has a maximum height of 30 metres
        2. Purpose of the AM zone is:
            1. *accommodate a broad range of uses*
            2. *impose development standards that will promote intensification while ensuring that they are compatible with the surrounding uses.*
            3. *Many uses are permitted, including convenience store, restaurant, retail store…*

4. **Infrastructure/Servicing (Golam Sharif):**
Please note the following information regarding the engineering design submission for the above noted site:

1. The Servicing Study Guidelines for Development Applications are available at the following address: https://ottawa.ca/en/city-hall/planning-and-development/how-develop-property/development-application-review-process-2/guide-preparing-studies-and-plans

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

   ⇨ Ottawa Sewer Design Guidelines (October 2012) and Technical Bulletin PIEDTB-2016-01

   ⇨ Ottawa Design Guidelines – Water Distribution (2010) and Technical Bulletins ISD-2010-2 and ISDTB-2014-02

   ⇨ Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (2007)

   ⇨ City of Ottawa Slope Stability Guidelines for Development Applications (revised 2012)

   ⇨ City of Ottawa Environmental Noise Control Guidelines (January, 2016)

   ⇨ City of Ottawa Park and Pathway Development Manual (2012)

   ⇨ City of Ottawa Accessibility Design Standards (2012)

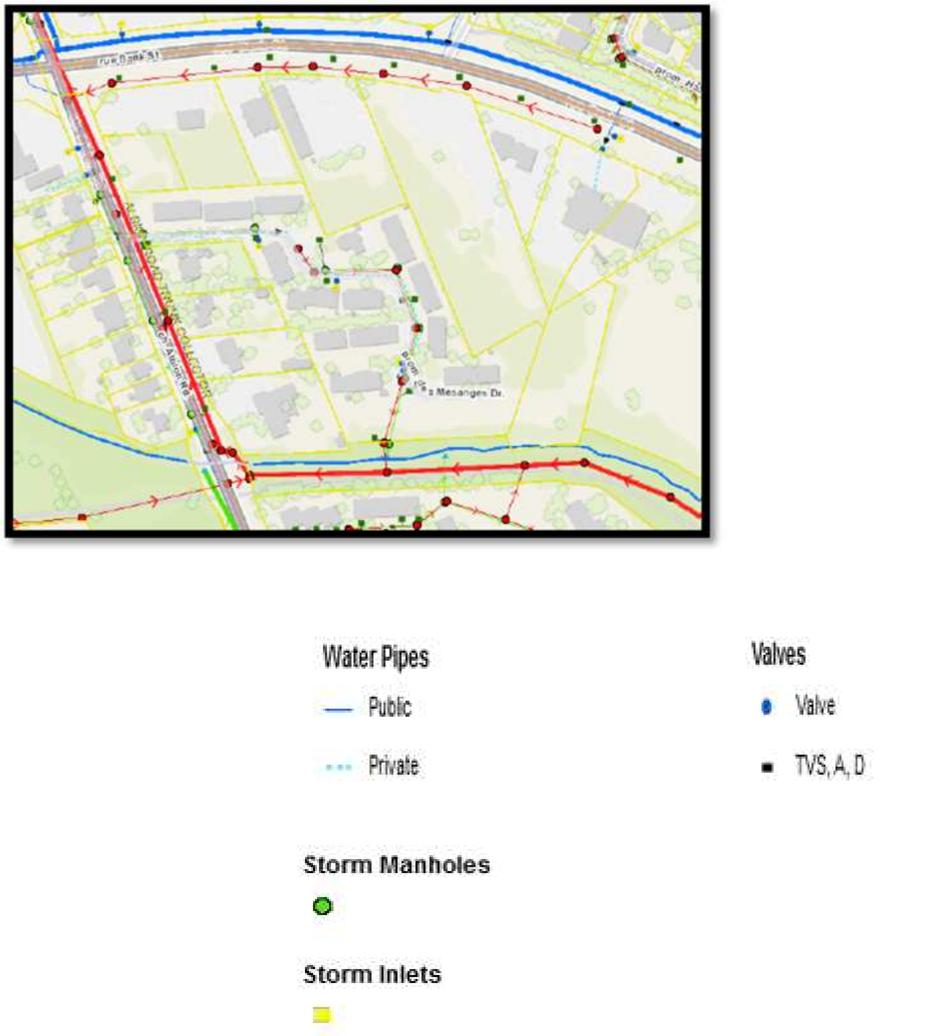
⇨ Ottawa Standard Tender Documents (latest version)

⇨ Ontario Provincial Standards for Roads & Public Works (2013)

3. Record drawings and utility plans are also available for purchase from the City (Contact the City's Information Centre by email at InformationCentre@ottawa.ca or by phone at (613) 580-2424 x.44455).
4. The Stormwater Management Criteria, for the subject site, is to be based on the following:

   i. All the stormwater management criteria must be followed as per the report "Sawmill Creek Subwatershed Study- Final Report" dated May 2003.

5. Deep Services (Storm, Sanitary & Water Supply)



i. A plan view of the existing services may be seen above. Services should ideally be grouped in a common trench to minimize the number of road cuts. The sizing of existing services is:

   a. Bank Street:

      i. Sanitary – 250 PVC.

      ii. Storm – N/A.

      iii. Water – 406 mm Ductile Iron.

   b. Albion Road:

      i. Sanitary – 600 mm (Albion Sanitary Trunk).

ii. Storm – N/A.

iii. Water – N/A.

ii. As per City's Sewer Design guideline a monitoring manhole shall be required just inside the property line located in an accessible location (ie. Not in a parking area) for all non-residential and multi residential buildings connections from a private sewer to a public sewer.

iii. As per City's Sewer Design guideline it is expected that the alternative of a high level sewer in a public right-of-way and connected to the collector sewer is the preferred method of servicing properties.

iv. New connections to sewer or watermain services within the City right of way is subject to City approval and are to be made above the springline of the sewermain as per:

a. Std Dwg S11.1 for flexible main sewers – *connections made using approved tee or wye fittings.*

b. Std Dwg S11 (For rigid main sewers) – *lateral must be less that 50% the diameter of the sewermain,*

c. Std Dwg S11.2 (for rigid main sewers using bell end insert method) – *for larger diameter laterals where manufactured inserts are not available; lateral must be less that 50% the diameter of the sewermain,*

d. Connections to manholes permitted when the connection is to rigid main sewers where the lateral exceeds 50% the diameter of the sewermain. – Connect obvert to obvert with the outlet pipe unless pipes are a similar size.

e. No submerged outlet connections.

6. Water Boundary condition requests must include the location of the service and the expected loads required by the proposed development. Please provide the following information:

i. Location of service

ii. Type of development and the amount of fire flow required (as per FUS, 1999).

iii. Average daily demand: ___ l/s.

iv. Maximum daily demand: ___l/s.

v. Maximum hourly daily demand: ___ l/s.

vi. Hydrant location and spacing to meet City's Water Design guidelines.

vii. The water main on McGarry Terrace is a dead end main. Future water servicing may be required to connect the water servicing from McGarry Terrace to Marketplace Ave.

7. MOECC ECA Requirements –

An MOECC Environmental Compliance Approval may be required for the proposed development. Please contact Ontario Ministry of the Environment and Climate Change, Ottawa District Office to arrange a pre-submission consultation:

For residential applications:	Charlie Primeau
	(613) 521-3450, ext. 251
	Charlie.Primeau@ontario.ca
For I/C/I applications:	Emily Diamond
	(613) 521-3450, ext. 238
	Emily.Diamond@ontario.ca

5. **Planning Forester (Mark Richardson)**
    - a Tree Conservation Report (TCR) must be supplied for review along with the suite of other plans/reports required by the City; an approved TCR is a requirement of Site Plan or Plan of Subdivision approval
    - any removal of privately-owned trees 10cm or larger in diameter require a tree permit issued under the Urban Tree Conservation Bylaw; the permit is based on the approved TCR
    - in this case, the TCR may be combined with the Environmental Impact Statement (EIS)
    - the TCR must list all trees on site by species, diameter and health condition. Groupings of trees may be combined together using averages, and diameter ranges.
    - the TCR must address all trees on adjacent properties with a critical root zone (CRZ) that extends into the developable area.

- If trees are to be removed, the TCR must clearly show where they are and document the reason they can not be retained
- All retained trees must also be shown and all retained trees within the area impacted by the development process must be protected as per the City guidelines listed on Ottawa.ca
- Trees with a trunk that crosses/touches a property line are considered co-owned by both property owners; permission from the adjoining property owner must be obtained prior to the removal of co-owned trees
- the City does encourage the retention of healthy trees wherever possible; please ask your design/planning team to find opportunities for retention wherever possible if the trees are healthy and will contribute to the design/function of the site.
- the removal of City-owned trees will require the permission of Forestry Services who will also review the submitted TCR; note that Forestry Services may ask for compensation for any City-owned tree that has to be removed.
- Trees cannot be removed between April 15-August 30
- If trees are on the property line, they are con
- For more information on the process or help with tree retention/removal options, contact Mark Richardson mark.richardson@ottawa.ca

6. **Environmental Planning (Matthew Hayley):**
   - Sawmill Creek is located at the rear of the property and is designated as an Urban Natural Feature in the Official Plan. This triggers an EIS for the development of this site. Sawmill Creek also requires a 30 m setback, as per the OP Section 4.7.3, the set back is a no touch area to be in a natural condition. (no parking, no development within the 30m setback from the Creek)
   - The 30m setback area should be re-instated with natural, native vegetation, as opposed to allowing it to be overrun with weeds. Keeping it neat will show pride of ownership and will help maintain property standards.
   - The EIS will need to conform to the EIS Guidelines http://documents.ottawa.ca/sites/documents.ottawa.ca/files/documents/eis_guidelines2015_en.pdf and demonstrate there will be no negative impact on the natural features and functions of the UNF (Sawmill Creek) and it will also need to ensure there are no endangered and/or threatened species or their habitat present on the site. This includes butternut and also other species, a consultation with MNRF is required as part of the EIS. A list of EIS consultants is attached as discussed at our meeting.
   - They will need to consult with the Rideau Valley Conservation Authority, in particular as they will require advice regarding stormwater and a connection to the creek.

7. **Conservation Authority (Jamie Batchelor, RVCA):**
   - The above noted properties fall within the Sawmill Creek Subwatershed Study area. Stormwater management for this site must include water quality and quantity controls as set out in the study and any other recommendations such as onsite infiltration to maintain baseflows, etc…. For further information the

applicant should consult the report “Sawmill Creek Subwatershed Study- Final Report” dated May 2003, prepared by CH2MHill.

- In addition, a portion of the property abuts Sawmill Creek. Any development (parking, pathways, structure, etc…) on this property must meet the minimum development setbacks as per the City’s Official Plan, including the greater of 30 metres from the normal highwater mark, 15 metres from top of bank and that as determined by a geotechnical study. The geotechnical study will be required to establish the limit of hazard lands in accordance with the MNR Technical Guidelines for Natural Hazards.
- In addition, any development on this site will be expected to implement the recommendations in the Sawmill Creek Subwatershed Study as it pertains to the Valley Management Strategy including revegetation of the riparian corridor with native species, etc… For further information the applicant can refer to the study.

8. Initial Planning/Design Comments

a. The site is within the Ottawa Airport Bird Hazard Zone, so must be designed and developed to not increase and preferably decrease the attraction for birds to this area.
b. Please note the Hydro lines along Bank Street and how they may impede access to the site (please contact Hydro Ottawa directly).
c. A comprehensive Planning Rationale will be required for development.
d. Please speak to the local councillor to obtain feedback.
e. This site is within the City’s Design Priority area and as such will be required to go through the “Urban Design Review Process” if the GFA is greater than 1858 square metres. This development will require a high level of urban and architectural design. An early meeting with the City’s Architect, Christopher Moise and with the UDRP panel is strongly suggested.
f. Cash-in-lieu of Parkland will be required at a rate of 2% of the property value.

9. Transportation

a. Submit a “screening report” (as provided to you at the meeting) prior to the submission of any site plan control application so that transportation issues can be dealt with ahead of the design of the site.
b. A road widening is required to provide a full 44.5 metre Right-Of-Way – equal distance from the centreline.

10. Waste Collection

a. This retail/office development will be on private waste collection.

11. Process/Required Applications

a. This will be considered as a “Complex, with Public Consultation” Site Plan Control Application
b. Please see the following link on the details of submitting an application form.
    1. https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/development-application-forms#

c. Please see the link below on how to prepare guides and studies:
    1. https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans
d. See below for more information on the UDRP
    1. https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/urban-design-review-panel
e. If you wish to proceed with a rezoning, you will also be required to apply for a 'Zoning By-law Amendment - major rezoning' for the rear parcel.
    1. https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/development-application-forms#zoning-law-amendment

12. Additional Information

a. City to confirm property line – whether the City owns up to the River
    1. I have received confirmation from the City Mapping group that the parcel of land in the middle of the watercourse and further described by Part 18 on 5R2898(copy att.) is not displayed properly. The said part is owned by the city and should be included in the city parcel identified by Pin 04340-0850. The map correction will be included with the next map data update by the City.

Andy Naoum

From: Andy Naoum <cegl@rogers.com>
Sent: December 13, 2020 1:08 PM
To: 'Jamie Batchelor'; Evelyn Liu
Cc: 'Nabil Abdulla'; 'Aaref'; 'Ghassan'; Andrew Naoum
Subject: RE: Corporate Tax Return 2020 and HST

Hi Jamie / Evelyn,

Thanks again for taking the time to discuss the RVCA requirements for this site.

Here is a summary of our discussions at Friday's virtual meeting.

- Flood plain mapping will not be required

- Storm outlet from this development maybe connected to the existing storm sewers (450 mm perforated pipe) located in an easement within lot 2626. The existing storm currently serves as an outfall to the adjacent property (veterinary hospital). Its capacity to accommodate the additional flow will have to be confirmed.

- The SWM criteria will generally be in accordance with the Sawmill Creek Subwatershed Study for Infill sites.

    - Quantity control to be based on pre-development levels, for 2 to 100 year storm events

    - Enhanced level quality control

    - Water Balance and erosion control will be addressed by on site Best Management Practices.

    - The BMP's will include measures to promote onsite infiltration by directing runoff from impervious areas (where practical) through landscaping or grassed swales.

    - One BMP option that was discussed will separate the flow from the roofs and released it through a vegetated swale across the Creek setback buffer area. The swale cross section and slopes will be designed in accordance with the MOE guidelines. Check dams will be added to maximize infiltration.

- Construction work within the Sawmill Creek proper will require a permit from RVCA. This may include a sanitary connection to the existing Trunk sewer located across the creek from this site

- RVCA staff are doing further review of slope stability, as discussed in the geotechnical report prepared by Paterson Group. They will let us know if they have any comments

Please let me know if you have any comments or questions.

Thanks,
Andy Naoum, P.Eng.
Capital Engineering Group Ltd.
(613) 739-0776

-----Original Message-----
From: Jamie Batchelor [mailto:jamie.batchelor@rvca.ca]

Andy Naoum

From: Jamie Batchelor <jamie.batchelor@rvca.ca>
Sent: October 5, 2020 10:05 PM
To: Andy Naoum
Subject: RE: 2582, 2600, 2626 Bank Street

Hi Andy,

New outlet creation:

- for a new outlet creation you will need to demonstrate that the flows from the new outlet will not cause any issues from a control of flooding perspective, and erosion. Consideration for existing conditions and possible erosion thresholds should be considered if this information is not present in the Sawmill Creek subwatershed study. - For any consideration of connecting to an existing outlet, the same considerations as above will need to be taken into account.

- the stormwater management plan will need to ensure the targets of the Sawmill Creek subwatershed study have been met. It will be up to the designing engineer to determine and demonstrate how the stormwater management plan will achieve the targets including Water balance / water table recharge. In the absence of any direction on certain criteria provided for in the Sawmill Creek Subwatershed Study, the design criteria would then default to MOE Design Manual.

The water quality target is enhanced (80% TSS removal).

There is no floodplain mapping available for this area of Sawmill Creek. The extent of flooding is unknown and should be investigated. I am going to consult with our Engineer regarding what/if additional studies on this regard are required.

Jamie Batchelor, MCIP, RPP
Planner, ext. 1191
Jamie.batchelor@rvca.ca

-----Original Message-----
From: Jamie Batchelor
Sent: Friday, October 2, 2020 4:04 PM
To: Andy Naoum <cegl@rogers.com>
Subject: RE: 2582, 2600, 2626 Bank Street

Hi Andy,

I will try and provide you a response on Monday.

Jamie Batchelor, MCIP, RPP
Planner, ext. 1191
Jamie.batchelor@rvca.ca

9.6 Summary of SWM Techniques for New Developments

Given the importance of reducing peak flows and duration for the control of downstream erosion, and in maintaining on-site infiltration for the protection of creek baseflow (in addition to the water quality requirements), the selection of appropriate stormwater management techniques for development sites will be important. It is expected that no single technique will be sufficient to achieve the recommended water management goals, and a "treatment train" approach will be required. For example, utilizing site design modifications and possibly changes in design standards (e.g. rural road sections and surface drainage technique instead of curb and gutter/storm sewer systems), source control techniques (e.g. roof drainage to infiltration areas or "rain gardens", reduced impervious areas), conveyance measures (grassed swales or pervious pipe systems) and "end-of-pipe" facilities (e.g. wet ponds or constructed wetlands) will be required to achieve the multiple objectives. With high groundwater levels throughout much of the proposed development areas, design of the SWM systems will be a challenge. Systems will need to be fully integrated into the site design.

The MOE Stormwater Management guidelines provide a list of possible techniques that can be utilized for SWM, and provide guidance on the applications for each technique. Given the importance of groundwater recharge maintenance for baseflow protection, preventing increases in runoff and changes to the existing hydrologic conditions through innovative site design will be a key in achieving the water management goals.

Given local site conditions, alternative design standards and/or a limit to site imperviousness may be required to meet pre-development recharge rates. For areas in shallow deposits of sand/silty sand and shallow aquifer depth, as is most of the subwatershed, conventional methods for construction drainage (e.g. ditching in advance of excavation) and perimeter drainage for basements, groundwater sumps, and road subdrains could significantly affect groundwater levels. Disconnecting roof drainage from impervious areas may not be sufficient to meet targets. Alternative design and construction measures may be required contingent on local soil and groundwater conditions. Examples of these measures are summarized in Table 17 for areas in shallow deposits of sand/silty sand, as is most of the subwatershed, and also in areas of glaciofluival sand and gravel, such as the commercial/industrial development within the airport lands.

Infill/Redevelopment Sites

Infill sites (generally less than 5 ha) should achieve quantity control to avoid sewer surcharging issues, and explore all opportunities for promoting infiltration and pollutant source control. Table 5.1 in the Stormwater Management Planning & Design Manual (MOE, March 2003) should be referred to for a list of potential SWMPs for infill sites.

Financial contributions in lieu of on-site water quality control is still warranted to continue to defray the cost of the constructed wetland and flow diversion facility. A calculation approach for unit rates for the proposed constructed wetland and flow diversion facility and the proposed disinfection facility at the mouth of the creek has been developed for the City to use in the interim pending the outcome of the Lower Rideau Strategy. The suggested unit rate calculation approach is given in Appendix O.

Table 17 Site specific techniques for enhancing recharge at the lot level in Sawmill Creek subwatershed

Soil	Groundwater Levels	Foundations	SWM	Infiltration	Site Design
Shallow deposits of sand/silty sand	Generally above depth of foundations and services. Levels decrease with construction drainage and conventional perimeter drainage.	Commercial/industrial and Institutional - Shallow foundations. Frost protection achieved using earth cover and extruded polystyrene insulation. Residential – Foundations above groundwater level by adding fill and/or using a reduced depth for the basements. Grade raise filling likely required to achieve drainage in areas of shallow groundwater depth.	Roof drainage to pervious areas. Additional lot level infiltration techniques required where soil conditions permit. Sheet drain impervious areas, roofs, road subdrains, and sumps to: ▪ Reduced lot grading to less than 2 percent beyond 4 to 6 m from the foundation ▪ Scarification of native soil prior to placing earth fill and topsoil ▪ Shallow infiltration ponds and basins ▪ Infiltration pits and trenches ▪ Grassed swales or shallow depressions ▪ Shallow pervious pipe systems ▪ Bio-retention areas.	Variable percolation rates. Detailed investigations required for SWM measures. Percolation rates may range from about 15 to 100 mm/hour for silty sand and clean uniform sand, respectively, which are suitable for infiltration. For finer materials (e.g. sandy silt or clays), percolation times may be less, and the range of applicable infiltration systems may be limited. Pretreatment may be required to reduce clogging and maintenance requirements.	Minimize impervious areas Provide sump pumps, if required, to discharge foundation drains to infiltration pits/trenches/basins, swales, etc. Use relatively permeable sandy fill material as grade raise fill within landscaped areas. Mitigate leakage at sewers & manholes installed below the pre-development groundwater level. Seepage barriers along service trenches to prevent groundwater lowering due to "French drain effects". Implement cluster development / site layout to permit landscape-based SWM solutions.
Glacio-fluvial sand and gravel	Generally below depth of foundations and services. Minimal groundwater level impacts from construction and foundations.	Standard depths (1.5 to 1.8 m below finished ground surface)	See above	Percolation rate for native sand and gravel could be 50 to 100 minutes per centimeter, which is suitable for infiltration.	See above

End-of-pipe controls for peak flow control should be mandatory where there is concern for downstream storm sewer capacity or where there are flooding concerns and no opportunity for centralized flood control facilities. Facilities for erosion control should only be applied where there is a clear need or where there is a potential to combine the requirements for water quality/quantity and erosion control (e.g., a dry pond). Even where there is a plan for use of off-site systems (OSS) within the subwatershed, additional water quality controls may be required where there is a high potential for wash-off of contaminants (e.g., oil and grease at gas stations, etc.).

Table 5.1: SWMPs Applicable to Infill Development

SWMP Type	Type of Control	Comments
Rooftop Storage	Peak Flow	Application dependent upon building design
Parking Lot Storage	Peak Flow	Application dependent upon site grading
Superpipe Storage	Peak Flow	Application dependent upon invert of street storm sewer
Dry Pond (quantity control)	Peak Flow	Application dependent upon available surface area
Pervious Pipe	Water Quality	Application dependent upon soils. May be combined with superpipe to provide both peak flow and some water quality control
Swales*	Water Quality	Most useful where infiltration capacities are high
Pocket Wetland*	Water Quality	Requires high water table to sustain wetland
Dry Pond (24 hr. retention)	Erosion	Application dependent upon available surface area. Minimum orifice size may govern feasibility.
Dry Pond (48 hr. retention)	Water Quality and Erosion	Application dependent upon available surface area. Minimum orifice size may govern feasibility.
Infiltration Trench*	Water Quality	Application dependent upon soil infiltration capacity and protection of groundwater
Sand or Organic Filters*	Water Quality	Generally applicable
Bioretention Filters*	Water Quality	Generally applicable
Oil/Grit Separators*	Spills/Water Quality*	Generally applicable

* Should be used as part of a multi-component approach including more than one SWMP when used as a water quality control unless it is demonstrated on a case-by-case basis that the water quality criteria can be met.

iv) Off-site systems (OSS) to address stormwater cumulative impacts

Off-site systems (OSS) have been used where on-site stormwater management practices are ineffective or impractical because of physical constraints. In order to try and offset stormwater impacts from the development, the project proponent may be required to make a financial contribution to a SWM system at another location within the same subwatershed. A number of municipalities have used this approach using various formulas to calculate the required financial contribution. Although on-site controls are typically preferred, an OSS can be used as an alternative to help address water quality, erosion and flood control impacts caused by development

STORMWATER MANAGEMENT CALCULATIONS
UPPER HUNT CLUB CENTRE
2582, 2600, 2626 BANKSTREET
August 10, 2021

ON SITE RETENTION FOR 2 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
ROOF STORAGE BUILDING A	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.163	0.90	0.41	5	104	42.32	4.50	38	11.35
	0.163	0.90	0.41	10	77	31.38	4.50	27	16.13
	0.163	0.90	0.41	15	62	25.24	4.50	21	18.66
	0.163	0.90	0.41	20	52	21.26	4.50	17	20.11
	0.163	0.90	0.41	25	45	18.45	4.50	14	20.93
	0.163	0.90	0.41	30	40	16.36	4.50	12	21.35
	0.163	0.90	0.41	60	25	10.03	4.50	6	**19.92**
	0.163	0.90	0.41	70	22	8.95	4.50	4	18.70
	0.163								

ON SITE RETENTION FOR 100 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
ROOF STORAGE BUILDING A	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.163	1.00	0.45	5	243	109.98	4.50	105	31.64
	0.163	1.00	0.45	10	179	80.91	4.50	76	45.85
	0.163	1.00	0.45	15	143	64.75	4.50	60	54.23
	0.163	1.00	0.45	20	120	54.35	4.50	50	59.83
	0.163	1.00	0.45	25	104	47.06	4.50	43	63.84
	0.163	1.00	0.45	30	92	41.63	4.50	37	66.83
	0.163	1.00	0.45	60	56	25.33	4.50	21	74.98
	0.163	1.00	0.45	90	41	18.63	4.50	14	**76.30**
	0.163	1.00	0.45	100	38	17.18	4.50	13	76.05

ON SITE RETENTION FOR 2 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
ROOF STORAGE BUILDING B	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.107	0.90	0.27	5	104	27.73	3.00	25	7.42
	0.107	0.90	0.27	10	77	20.56	3.00	18	10.54
	0.107	0.90	0.27	15	62	16.54	3.00	14	12.18
	0.107	0.90	0.27	20	52	13.93	3.00	11	13.12
	0.107	0.90	0.27	25	45	12.09	3.00	9	13.64
	0.107	0.90	0.27	30	40	10.72	3.00	8	**13.90**
	0.107	0.90	0.27	60	25	6.57	3.00	4	12.87

ON SITE RETENTION FOR 100 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
ROOF STORAGE BUILDING B	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.107	1.00	0.30	5	243	72.19	3.00	69	20.76
	0.107	1.00	0.30	10	179	53.11	3.00	50	30.07
	0.107	1.00	0.30	15	143	42.51	3.00	40	35.55
	0.107	1.00	0.30	20	120	35.68	3.00	33	39.22
	0.107	1.00	0.30	25	104	30.89	3.00	28	41.84
	0.107	1.00	0.30	30	92	27.33	3.00	24	43.79
	0.107	1.00	0.30	60	56	16.63	3.00	14	49.06
	0.107	1.00	0.30	80	45	13.38	3.00	10	**49.84**
	0.107	1.00	0.30	90	41	12.23	3.00	9	49.84

STORMWATER MANAGEMENT CALCULATIONS
UPPER HUNT CLUB CENTRE
CONT'D

ON SITE RETENTION FOR 2 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
ROOF STORAGE BUILDING C	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.116	0.90	0.29	5	104	30.06	3.00	27	8.12
	0.116	0.90	0.29	10	77	22.29	3.00	19	11.57
	0.116	0.90	0.29	15	62	17.93	3.00	15	13.43
	0.116	0.90	0.29	20	52	15.10	3.00	12	14.52
	0.116	0.90	0.29	25	45	13.11	3.00	10	15.16
	0.116	0.90	0.29	30	40	11.62	3.00	9	**15.52**
	0.116	0.90	0.29	60	25	7.13	3.00	4	14.86
ON SITE RETENTION FOR 100 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
ROOF STORAGE BUILDING C	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.116	1.00	0.32	5	243	78.27	3.00	75	22.58
	0.116	1.00	0.32	10	179	57.58	3.00	55	32.75
	0.116	1.00	0.32	15	143	46.08	3.00	43	38.77
	0.116	1.00	0.32	20	120	38.68	3.00	36	42.82
	0.116	1.00	0.32	25	104	33.49	3.00	30	45.73
	0.116	1.00	0.32	30	92	29.63	3.00	27	47.93
	0.116	1.00	0.32	60	56	18.02	3.00	15	54.09
	0.116	1.00	0.32	90	41	13.26	3.00	10	**55.39**
	0.116	1.00	0.32	100	38	12.22	3.00	9	55.34
ON SITE RETENTION FOR 2 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
SURFACE DRAINAGE / UNDERGROUND STORAGE	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.759	0.86	1.81	5	104	187.94	57.30	131	39.19
	0.759	0.86	1.81	10	77	139.37	57.30	82	**49.24**
	0.759	0.86	1.81	15	62	112.08	57.30	55	49.31
	0.759	0.86	1.81	20	52	94.42	57.30	37	44.54
	0.759	0.86	1.81	25	45	81.96	57.30	25	36.99
	0.759	0.86	1.81	30	40	72.66	57.30	15	27.65
	0.759	0.86	1.81	60	25	44.56	57.30	-13	-45.85
ON SITE RETENTION FOR 100 YEAR STORM	AREA	RUNOFF	2.78 CA	DURATION	INTENSITY	PEAK FLOW	OUTFLOW	RETENTION	STORED
SURFACE DRAINAGE / UNDERGROUND STORAGE	(ha)	COEFF.		(min)	(mm/hr)	(L/s)	RATE(L/s)	RATE(L/s)	VOLUME(m3)
	0.759	0.95	2.00	5	243	486.50	57.30	429	128.76
	0.759	0.95	2.00	10	179	357.92	57.30	301	180.37
	0.759	0.95	2.00	15	143	286.43	57.30	229	206.22
	0.759	0.95	2.00	20	120	240.44	57.30	183	219.77
	0.759	0.95	2.00	25	104	208.16	57.30	151	226.30
	0.759	0.95	2.00	30	92	184.15	57.30	127	**228.33**
	0.759	0.95	2.00	60	56	112.04	57.30	55	197.07

LOCATION	MH FROM	MH TO	AREA (ha)	RUNOFF COEFF.	2.78CA INCR.	2.78CA ACCUM.	T of C (min)	INTENSITY (mm/hr)	PEAK FLOW (L/s)	LENGTH OF PIPE (m)	DIAM. OF PIPE (mm)	SLOPE %	PIPE CAPACITY	VELOCITY (m/s)	TIME IN SECTION (min)	TOTAL n VALUE
						SURFACE OUTLET										
Bank Street	CB1	CBMH1	0.107	0.83	0.25	0.25	20	70	17.34	42	250	1.00	61.83	1.22	0.57	0.013
	CBMH1	CBMH2	0.100	0.81	0.23	0.47	20	70	33.16	50	250	1.00	61.83	1.22	0.68	0.013
	CBMH2	CBMH3	0.030	0.82	0.07	0.54	21	68	36.82	16	250	1.00	61.83	1.22	0.22	0.013
	CBMH3	CBMH4	0.400	0.89	0.99	1.53	22	66	101.21	69	300	1.10	105.45	1.45	0.79	0.013
	CBMH4	CBMH5	0.000	0.90	0.00	1.53	22	66	101.21	6	300	3.00	174.14	2.39	0.04	0.013
	CBMH5	U/G ST	0.130	0.90	0.33	1.86	23	64	119.28	U/G STORAGE CHAMBERS						
	CBMH5	EX.	0.000	0.90	0.00	1.86	23	64	**57.3****	7	250	1.10	64.84	1.28	0.09	0.013
	EX	OUTLET	0.740	0.90	1.85	3.71	23	64	**175****	50	450	2.00	419.21	2.56	0.33	0.013
			1.507													
						ROOF OUTLET										
	BLDG A	STMH2	0.280	0.90	0.70	0.70	20	70	**7.5****	60	250	1.00	61.83	1.22	0.82	0.013
	BLDG B	CBMH5	0.140	0.90	0.35	0.35	20	70	**16.8****	0	250	1.00	61.83	1.22	0.00	0.013
	CBMH5	STMH1	0.080	0.26	0.06	0.06	21	68	**20.9****	92	250	1.00	61.83	1.22	1.25	0.013
	STMH1	STMH2	0.000	0.90	0.00	0.00	22	66	**20.9****	48	250	1.00	61.83	1.22	0.65	0.013
	STMH2	STMH3	0.000	0.90	0.00	0.00	23	64	**20.9****	15	250	1.00	61.83	1.22	0.20	0.013
	STMH3	OUTLET	0.100	0.90	0.25	0.25	23	64	**23.9****	48	250	1.00	61.83	1.22	0.65	0.013

**** Flow rate restricted by upstream flow control devices**

**** Surface Outlet includes flow from the the adjacent (Veterenary Hospital) site - 5 year storm with no controls**

CONSULTANT : CAPITAL ENGINEERING GROUP LTD
PROJECT: UPPER HUNT CLUB CENTRE
LOCATION : 2600 BANK STREET
OTTAWA, ONTARIO
DESIGNED BY : A. NAOUM
CHECKED BY : AN
DATE :AUGUST 10, 2021

STORM SEWER DESIGN SHEET
5 YEAR STORM EVENT

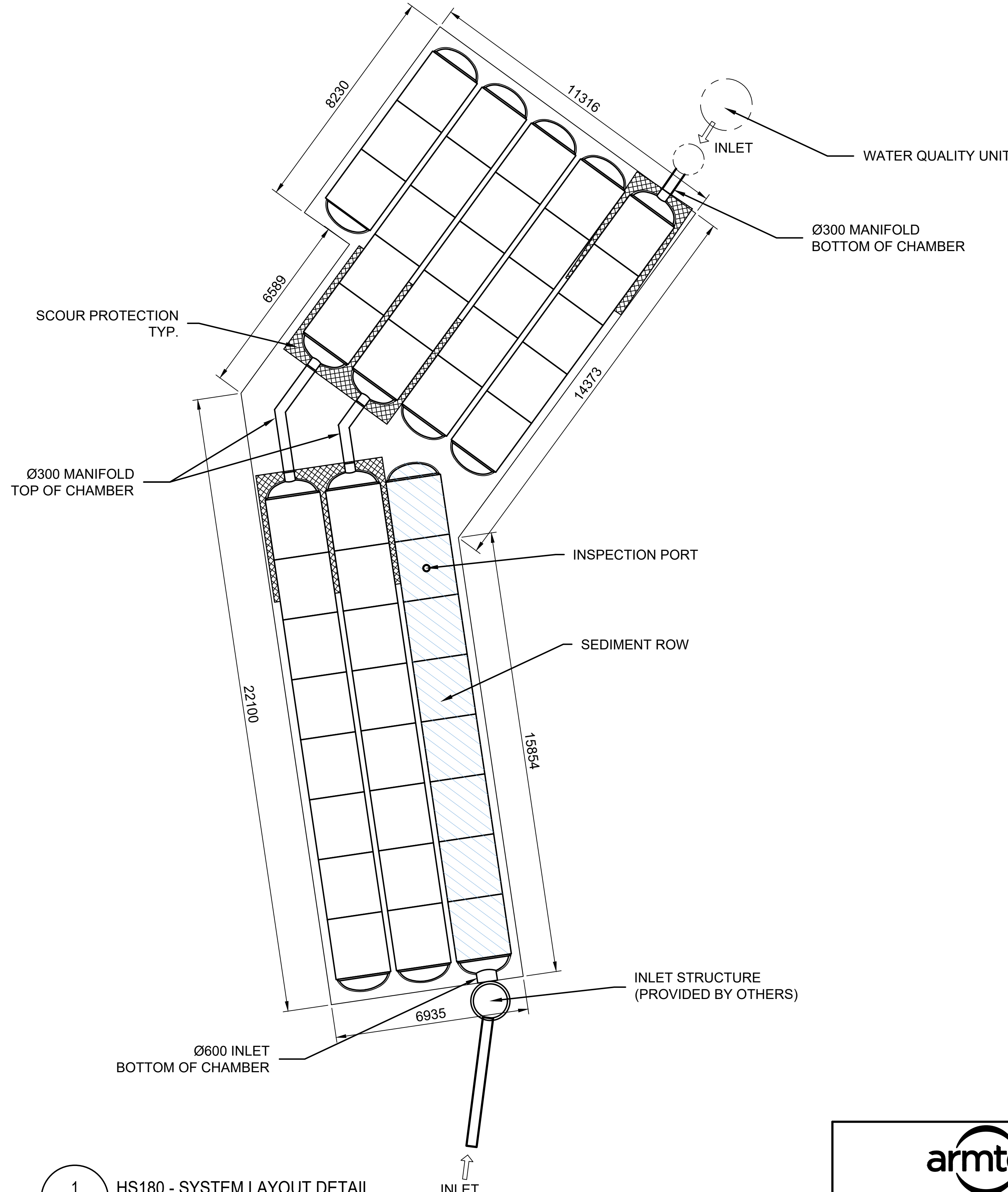
SHEET 1 OF 1

PROPOSED SYSTEM LAYOUT HS180

INSTALLED SYSTEM VOLUME (m^3)	287
INSTALLED SYSTEM FOOTPRINT (m^2)	283.87
SYSTEM PERIMETER (m)	87.37
TOTAL CHAMBERS	47
TOTAL END CAPS	16
STONE REQUIRED (m^3)	320
NON-WOVEN GEOTEXTILE (m^2)	858
WOVEN GEOTEXTILE (m^2)	137

CHAMBER SYSTEM LAYOUT BASED ON CAPITAL ENGINEERING GROUP LTD. DRAWING FOR PROJECT NAME: UPPER HUNT CLUB CENTRE, DRAWING No. G1, REV# 1, DATED 2021-03-08.

NOTE:
ALL DIMENSIONS AND ELEVATIONS ARE TO BE CONFIRMED BY OWNER / CONTRACTOR'S ENGINEER.



1 / SK01 HS180 - SYSTEM LAYOUT DETAIL
SCALE 1:200

PRELIMINARY
FOR INFORMATION ONLY

REV.	REVISION NOTE	BY	CK'D	REV'D	DATE
A	ISSUED FOR INFORMATION	SP	-	ML	2021-08-05

armtec
ARMTEC.COM

APPROVALS		DATE
DESIGN BY	BY	OTHERS
DESIGN CHECK	BY	OTHERS
DRAFT BY	SP	2021-08-05
DRAFT CHECK	SM	---

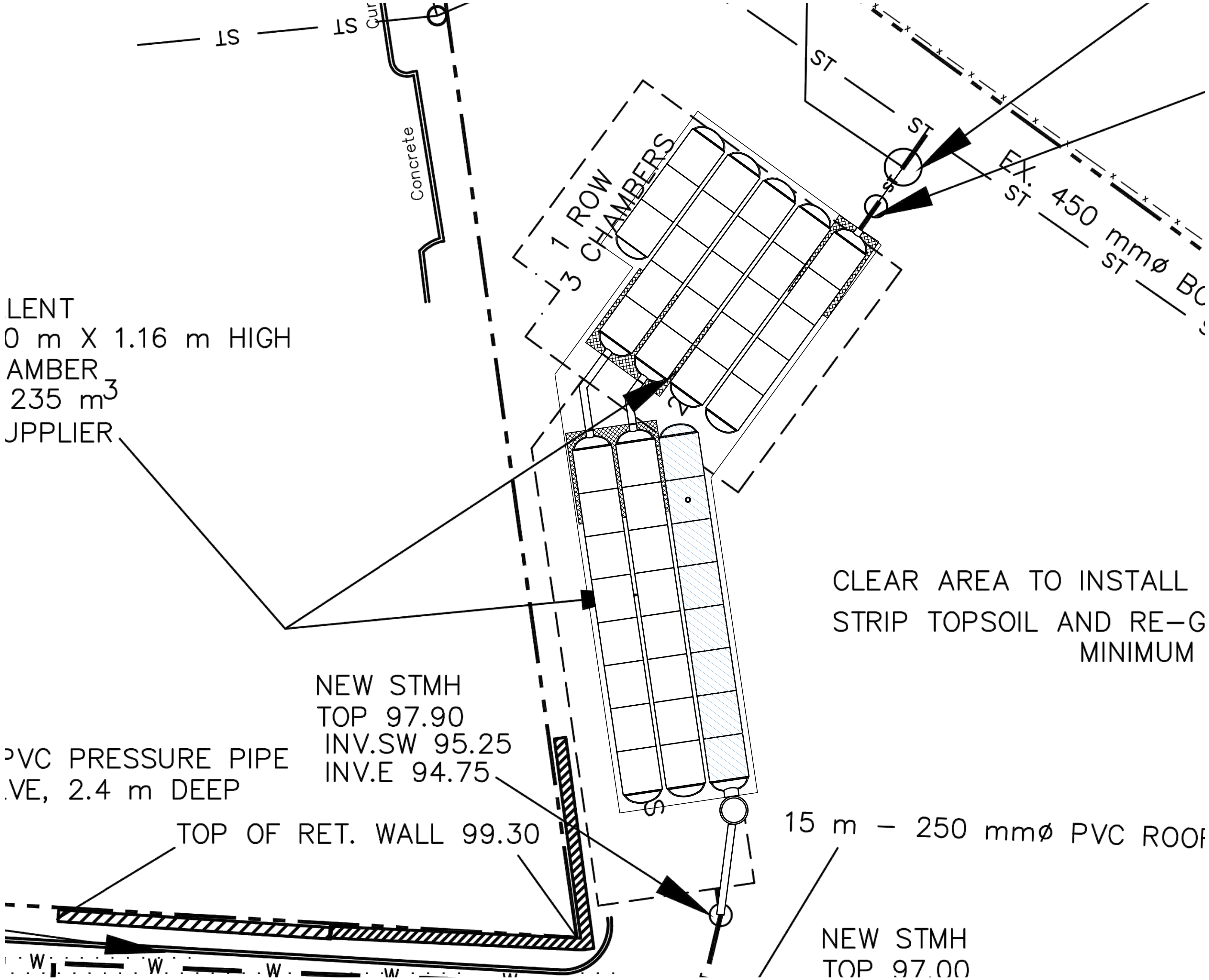
CUSTOMER

PROJECT NAME
UPPER HUNT CLUB CENTRE
2600 BANK STREET, OTTAWA, ON

DRAWING TITLE
HS180 SYSTEM LAYOUT DETAIL

SALES ORDER NO.	SHEET NO.	SCALE	PROJECT NO.	DRAWING NO.	REV.
TBD	1 OF 3	AS NOTED	21-365	SK01	A

Plot Date & Time: 2021-08-05, 6:04:25 PM
z:\1_projects\2021\21-365 on pc upper hunt club centre - bank street\drawings\1. ifi_r.a\21-365_ifi_r.a.dwg



2 SK02 HYDROSTOR HS180 - OVERLAY SYSTEM

SCALE 1:250

PRELIMINARY
FOR INFORMATION ONLY

REV.	REVISION NOTE	BY	CK'D	REV'D	DATE
A	ISSUED FOR INFORMATION	SP	-	ML	2021-08-05

armtec
ARMTEC.COM

APPROVALS		DATE
DESIGN BY	BY	OTHERS
DESIGN CHECK	BY	OTHERS
DRAFT BY	SP	2021-08-05
DRAFT CHECK	SM	---

CUSTOMER

PROJECT NAME
UPPER HUNT CLUB CENTRE
2600 BANK STREET, OTTAWA, ON

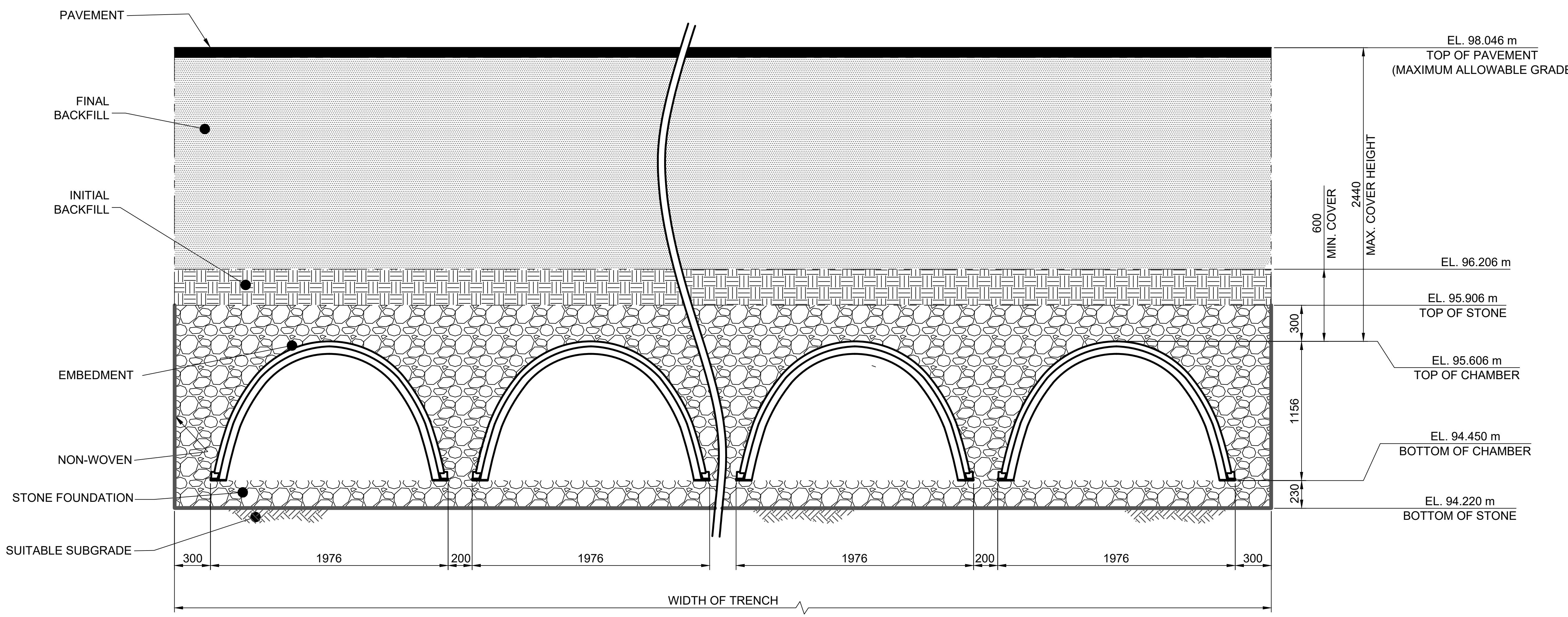
DRAWING TITLE
HYDROSTOR HS180 - OVERLAY SYSTEM

SALES ORDER NO.	SHEET NO.	SCALE	PROJECT NO.	DRAWING NO.	REV.
TBD	2 OF 3	AS NOTED	21-365	SK02	A

Plot Date & Time: 2021-08-05, 6:04:37 PM

TYPICAL ELEVATIONS - HS180 BEDS (m)

MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)	98.046
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)	96.346
MINIMUM ALLOWABLE GRADE (UNPAVED WITH NO TRAFFIC)	96.196
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)	96.196
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT)	96.196
TOP OF STONE (MIN)	95.906
TOP OF HS180 CHAMBER	95.606
BOTTOM OF HS180 CHAMBER (INVERT)	94.450
BOTTOM OF STONE	94.220



3 / SK03 HYDROSTOR HS180 - CROSS SECTION DETAILS
SCALE 1:40

PRELIMINARY
FOR INFORMATION ONLY

REV.	REVISION NOTE	BY	CK'D	REV'D	DATE
A	ISSUED FOR INFORMATION	SP	-	ML	2021-08-05

armtec
ARMTEC.COM

APPROVALS		DATE
DESIGN BY	BY	OTHERS
DESIGN CHECK	BY	OTHERS
DRAFT BY	SP	2021-08-05
DRAFT CHECK	SM	---

CUSTOMER

PROJECT NAME
UPPER HUNT CLUB CENTRE
2600 BANK STREET, OTTAWA, ON

DRAWING TITLE
HYDROSTOR HS180 - CROSS SECTION DETAILS

SALES ORDER NO.	SHEET NO.	SCALE	PROJECT NO.	DRAWING NO.	REV.
TBD	3 OF 3	AS NOTED	21-365	SK03	A

z:\1_projects\2021\21-365 on pc upper hunt club centre - bank street\drawings\1. ifi_r.a\21-365_ifi_r.a.dwg

SDD3 SIZING REPORT

PROJECT INFORMATION

Project Name :	Upper Hunt Club Centre
Location	Ottawa, ON
Unit :	OGS1

SITE INFORMATION AND SIZING CRITERIA

Site Area (hectares)	0.76
Cumulative runoff	0.85
Target TSS removal (%)	80%
Rainfall station :	Ottawa 37 yrs
ETV Particle Size Distribution	20-1000 um

STORMWATER TREATEMENT RECOMMENDATION

RESULTS SUMMARY		
Model	TSS	Volume
SDD3-1200	73.72%	100.0%
SDD3-1600	77.79%	100.0%
SDD3-1800	79.69%	100.0%
SDD3-2100	81.61%	100.0%
SDD3-2400	83.24%	100.0%
SDD3-3000	85.50%	100.0%
SDD3-3200	85.92%	100.0%
SDD3-3600	86.83%	100.0%
SDD3-4000	87.40%	100.0%

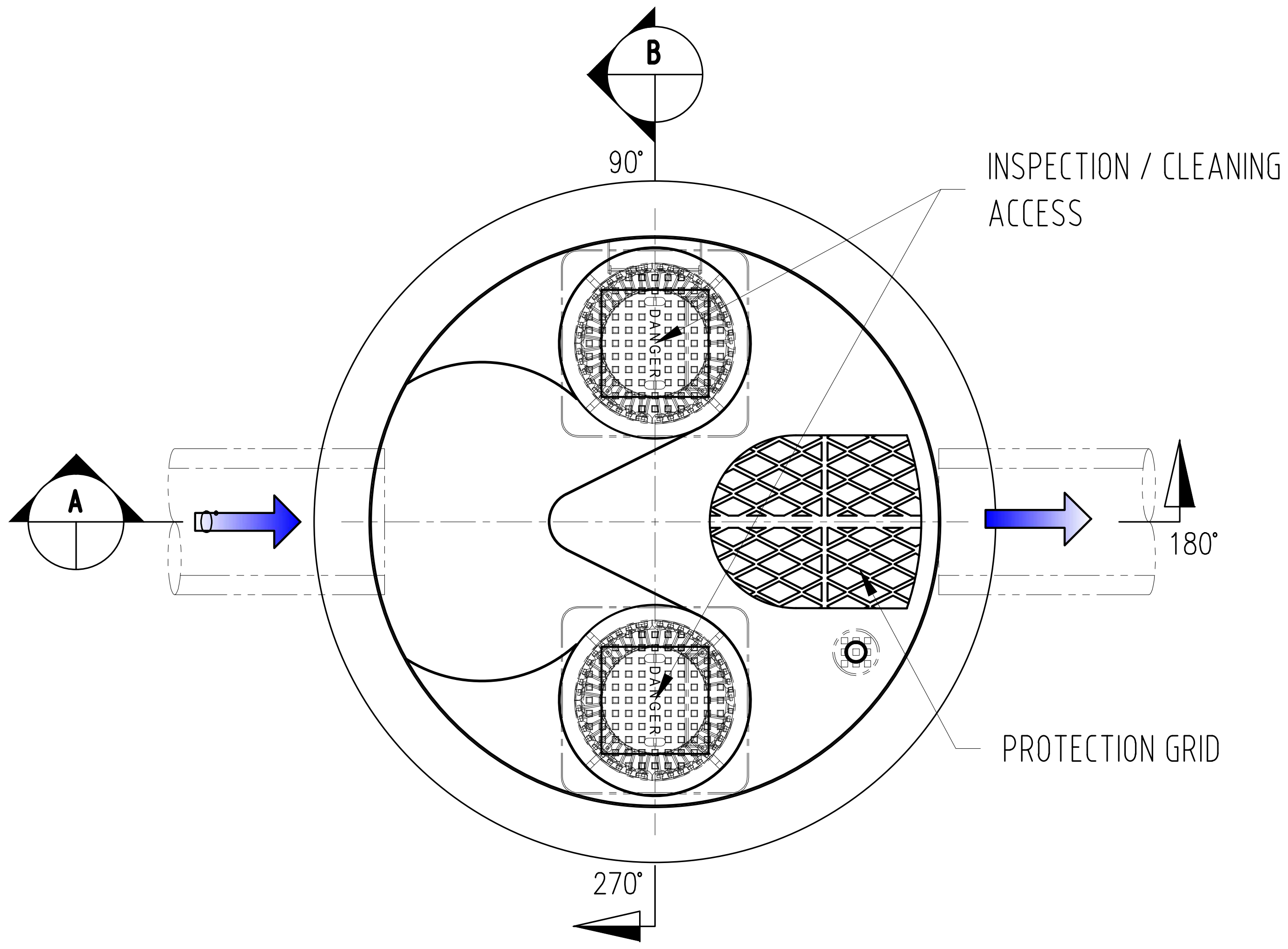
Recommended Model	**SDD3-2100**

Annual TSS removal efficiency (%)[1]	Manhole Diameter (mm)	No Bypass Flow (lps)	Maximum Flow (lps)	Maximum Pipe Diameter (mm)	Oil Storage Capacity (L)	Sediment Storage Capacity (m^3)	Height from invert to SDD floor (m)	Treatment area (m^2)
81.61%	2130	83	154	900	1.55	3.94	2.79	3.56

DETAILED SDD3 SIZING REPORT

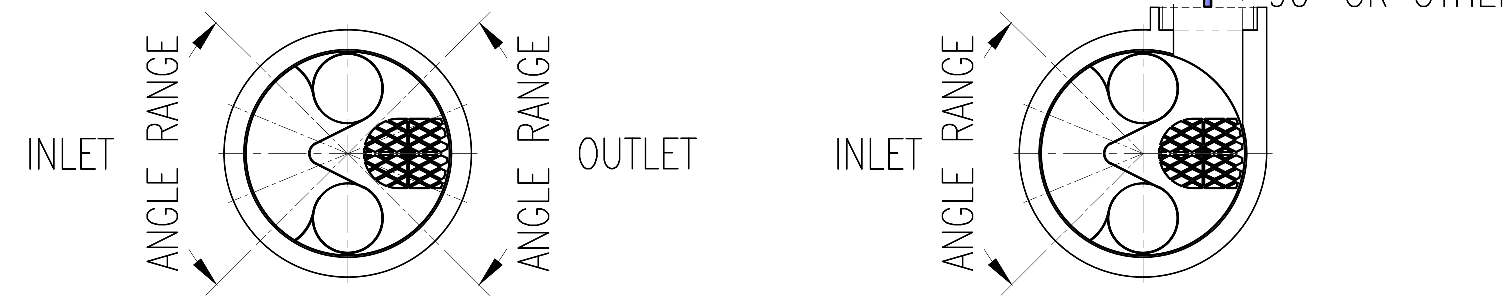
Rainfall Interval Point (mm/hr)[2]	Flow Rate (Lps)	Loading Rate (Lps/m^2)	Loading Rate (Lpm/m^2)	Total Rainfall (%)	Removal Efficiency (%)	Cumulative rainfall volume (%)	Relative Efficiency (%)
0.50	0.9	0.3	15.1	9.32%	88.89	9.32%	8.28%
1.00	1.8	0.5	30.2	10.73%	88.89	20.04%	9.54%
1.50	2.7	0.8	45.3	10.34%	88.28	30.39%	9.13%
2.00	3.6	1.0	60.4	7.84%	86.56	38.23%	6.79%
3.00	5.4	1.5	90.6	16.39%	83.64	54.62%	13.71%
4.00	7.2	2.0	120.9	9.09%	81.68	63.71%	7.42%
5.00	9.0	2.5	151.1	7.83%	79.71	71.55%	6.24%
6.00	10.8	3.0	181.3	5.11%	77.75	76.65%	3.97%
7.00	12.6	3.5	211.5	2.99%	76.10	79.64%	2.28%
8.00	14.4	4.0	241.7	3.48%	74.95	83.12%	2.61%
9.00	16.2	4.5	271.9	2.29%	73.80	85.41%	1.69%
10.00	17.9	5.0	302.2	1.23%	72.65	86.64%	0.89%
11.00	19.7	5.5	332.4	1.47%	71.50	88.10%	1.05%
12.00	21.5	6.0	362.6	2.27%	70.35	90.37%	1.60%
15.00	26.9	7.6	453.2	3.52%	68.08	93.89%	2.39%
20.00	35.9	10.1	604.3	6.11%	65.76	100.00%	4.02%
			Total cumulative rainfall (%)[4] :	100.0%		Net Annual (%) :	81.61%

Performance based on 20-1000 um PSD and ETV verification protocol
Information to be confirmed by manufacturer prior to order.

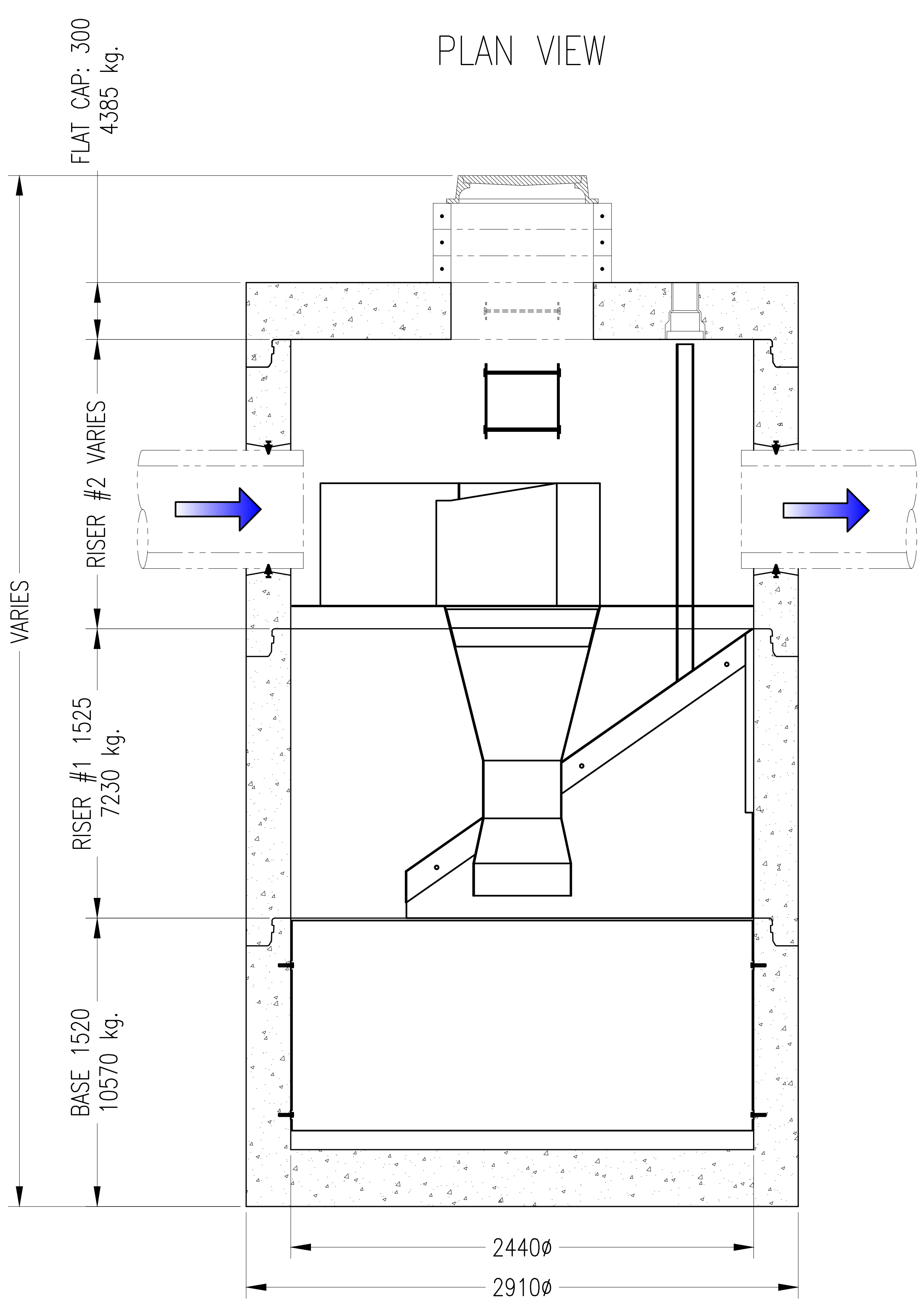


PLAN VIEW

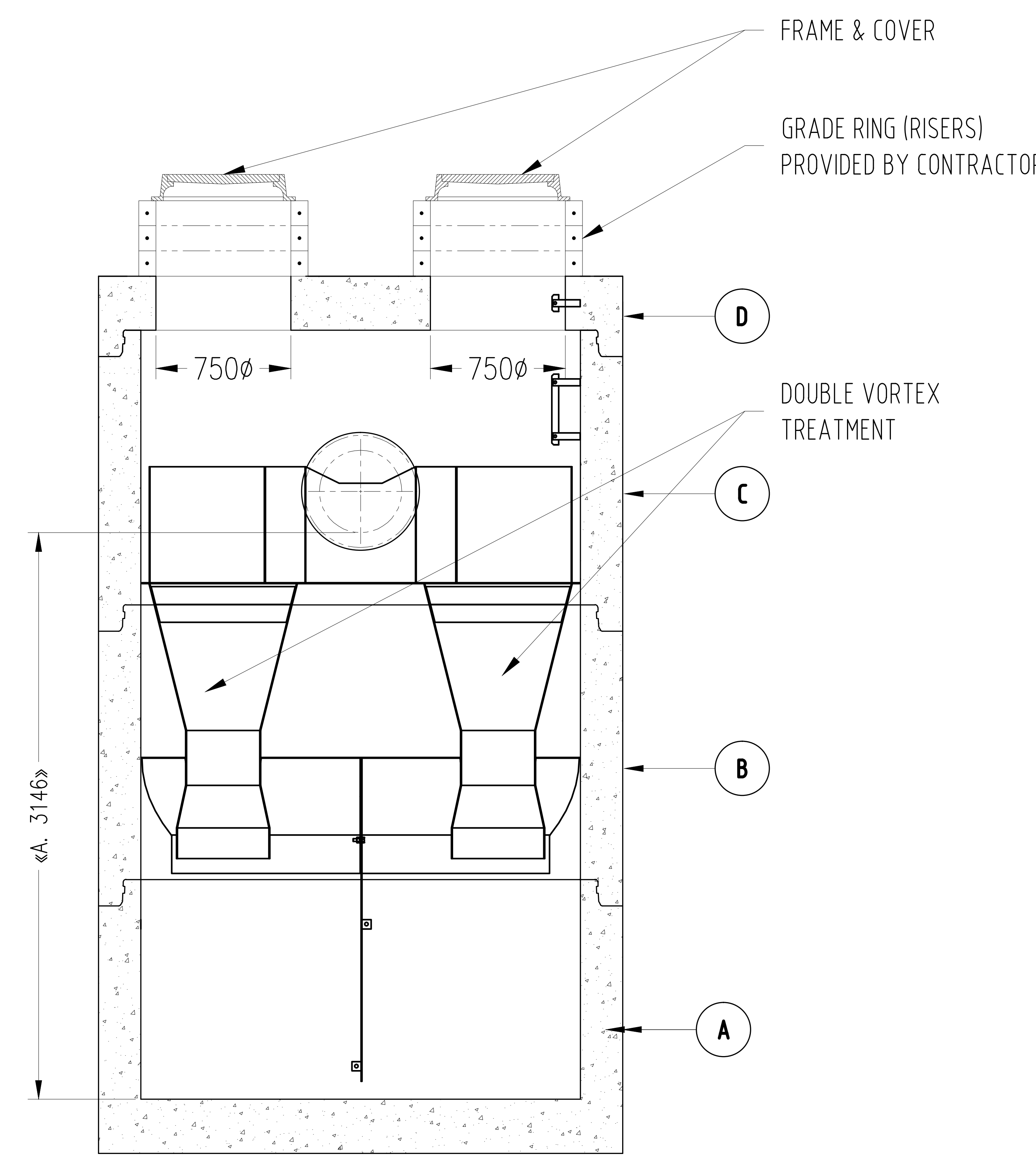
CONFIGURATION POSSIBILITIES



NOTE: CONFIGURATION VARIES ACCORDING TO PIPE DIAMETER AND/OR ANGLE



SECTION A



SECTION B

BILL OF MATERIALS			
QTY.	PART	DESCRIPTION	WEIGHT (Kg)
1	A	MONOLITHIC BASE SDD3 2400	10570
1	B	RISER #1 SDD3 2400 (H=1525)	7230
1	C	RISER #2 SDD3 2400 (H=VARIES)	VARIES
1	D	FLAT CAP SDD3 2400 (H=300)	4385
2	–	CLOSED COVER	–
2	–	GRADE RING (RISER)	–
2	–	SEAL TRIM	–

GENERAL NOTES:
- PRECAST CONCRETE COMPONENTS SHALL BE ACCORDING TO OPSD 701.031, AND 701.032
- ALL REINFORCING STEEL HAS 30mm MIN. COVER
- GALVANIZED STEEL LADDER COMPLY WITH CSA 257.4
- ALL DIMENSIONS ARE NOMINAL.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.

FLOW AND POLLUTANTS
- H: 60% DIAMETER CONDUCT
- 100% TSS VOLUME STORAGE _____m^3
- EFFECT ON PIEZOMETRIC LINE: NIL
- IN-LINE

MEASUREMENT MAINTENANCE
- TOTAL HEIGHT (A): 3,146m

SDD3 2400 PROJECT DATA			
PIPE DATA	TYPE	DIAMETER mm	INVERT ELEV.
INLET			
OUTLET			
TOP ELEV.			
NOTES / EXPLICIT REQUIREMENTS:			

FOR APPROVAL
NOT FOR "PRODUCTION"
__/__/2020

A		ISSUED FOR APPROVAL	_/_/2020	M.S.
NO	LOCATION	REVISIONS	DATE	BY

DESCRIPTION: SDD3 2400
CLIENT: STORMCON
PROJECT:

DRAWN BY: M. SARDI — DATE _/_/0000
VERIFIED BY: P. GOMEZ — DATE _/_/0000
APPROVED BY: — DATE 00/00/0000
CLIENT'S DRAWING:
CLIENT'S ORDER No:
DRAWING No:

STORMCON
STORMWATER MANAGEMENT SOLUTIONS

NEXT stormwater solutions
Division Béton Brunet
1625, boul. Mgr Langlois
Salaberry-de-Valleyfield
Québec, Canada,J6S 1C2
Téléphone: (450) 373-8262
Télécopieur: (450) 373-0042

SHEET: SCA: N.T.S. REV: A

PROJECT No: XXXXXXXXXXXX

FORMAT C

Winter Operation
In general, infiltration facilities are unsuitable for water quality treatment during the winter/ spring period. They are subject to reductions in capacity due to freezing or saturation of the soil. If road runoff is received, there is an increased likelihood of clogging due to high sediment loads and an increased risk of groundwater contamination from road salt.

If infiltration practices are used as an all-season water quality treatment facility, then doubling the design storage volume for surface infiltration devices to account for reduced infiltration rates is recommended. Redundant pre-treatment (more than one pre-treatment device in series) is recommended for all infiltration facilities receiving road runoff. A pre-treatment volume of about 15 mm/impervious hectare is recommended.

Technical Effectiveness
Centralized infiltration trenches have a poor historical record of success (Lindsey et al., 1992; Metropolitan Washington Council of Governments, 1992). This lack of success is attributable to many factors:

- poor site selection (industrial/commercial land use, high water table depth, poor soil type);
- poor design (lack of pre-treatment, clogging by native material);
- poor construction techniques (smearing, over-compaction, trench operation during construction period); and
- large drainage area (high sediment loadings, groundwater mounding).

There are many reasons why an infiltration trench can fail. One of the main problems with centralized infiltration trenches is that water from a large area is expected to infiltrate into a relatively small area. This does not reflect the natural hydrologic cycle and generally leads to problems (groundwater mounding, clogging, compaction).

Water quality enhancement can be achieved using infiltration trenches. However, care must be taken to avoid degradation of groundwater quality. Trenches are ineffective quantity control facilities unless substantial storage is provided and the soil conditions are optimum.

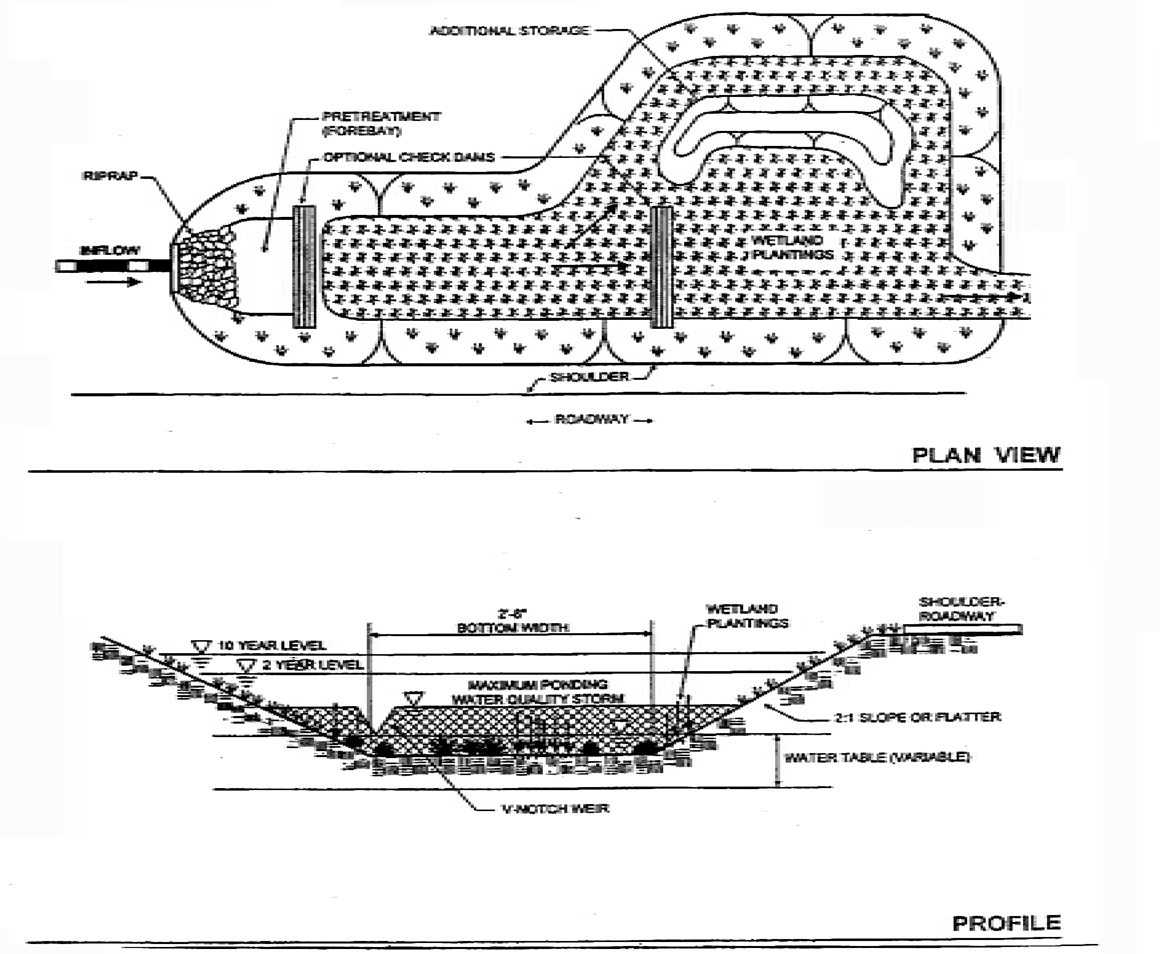
4.5.9 Grassed Swales

Grassed swales have historically been associated with rural drainage and have been constructed primarily for stormwater conveyance. Stormwater management objectives have changed and grassed swales are now being promoted to filter and detain stormwater runoff. Swale drainage can be a useful technique in areas of low grade, as long as the distance that the flow is to be conveyed is not too long.

The majority of swale systems in Ontario have been designed as “dry” swales. The guidance provided below is for such systems. An alternate design, the “wet” swale, can also be useful in areas where there is sufficient space, especially where soils are not highly permeable, or where there are low lying areas with a high water table.

Wet swales combine elements of dry swale systems and wetland systems. Wet swales are typically wider than dry swales (e.g., 4 m - 6 m) and the check dams are used to create shallow impoundments in which wetland vegetation is planted or allowed to colonize. Because of their width, wet swales are not generally implemented along the front of residential properties, but rather are included where overland flow routes use linear open space areas. Combined systems of dry and wet ponds may be used. Wet swales have been implemented in several highway projects, but monitoring results are limited. A schematic of a wet swale is provided in Figure 4.9.

Figure 4.9: Schematic of a Wet Swale



Wet swales are ideal for treating highway runoff in low lying or flat terrain areas.

Source: Maryland Stormwater Manual, Volume 1, 1998.

Design Guidance

Swale Cross-section

Grassed swales can be effective SWMPs for pollutant removal if designed properly. The water quality benefits associated with grassed swales depend on the contact area between the water and the swale and the swale slope. Deep narrow swales are less effective for pollutant removal compared to shallow wide swales. Given typical urban swale dimensions (0.75 m bottom width, 2.5:1 side slopes and 0.5 m depth), the contributing drainage area is generally limited to ≤ 2 ha (to maintain flow ≤ 0.15 m^3/s and velocity ≤ 0.5 m/s). Table 4.5 indicates drainage area restrictions for various degrees of imperviousness, based on the assumptions given regarding channel cross-section, slope and cover. The swales evaluated in Table 4.5 are indicative of swales servicing an urban subdivision and not a transportation corridor.

Table 4.5: Grassed Swale Drainage Area Guidelines*

% Imperviousness	Maximum Drainage Area (ha)
35	2.0
75	1.5
90	1.0

** Based on the following assumptions: trapezoidal channel, grassed lined (n = 0.035), slope of drainage area = 2%, 2.5:1 side slopes, 0.75 m bottom width, 0.5% channel slope, max. allowable Q = 0.15 m^3/s, max. allowable V = 0.5 m/s.*

Grassed swales are most effective for stormwater treatment when depth of flow is minimized, bottom width is maximized (≥ 0.75 m) and channel slope is minimized (e.g., ≤ 1%). Grassed swales with a slope up to 4% can be used for water quality purposes, but effectiveness diminishes as velocity increases. Grass should be allowed to grow higher than 75 mm to enhance the filtration of suspended solids.

Flow Velocity

As a general guideline, grassed swales designed for water quality enhancement should be designed to convey the peak flow from a 4 hour 25 mm Chicago storm with a velocity ≤ 0.5 m/s. This guideline results in a requirement for wide, flat swales for larger drainage areas.

All grass swales must be evaluated under major system and minor system events to ensure that the swale can convey these storms effectively.

Ditch and Culvert Servicing

Ditch and culvert servicing is viable for lots which will accommodate swale lengths ≥ the culvert length underneath the driveway (not just the driveway pavement width). The swale length should also be ≥ 5 m for aesthetic and maintenance purposes. This is generally achievable for small lots (9 m) with single driveways or larger lots (15 m) with double driveways.

Winter Operation

Swale systems which receive road runoff may have their infiltration capacity diminished over time, as salt effects on soil structure and clogging occur. Swale systems need to be maintained periodically (removal of accumulated sand and addition of mulch to the soil structure) in order to maintain their ability to infiltrate.

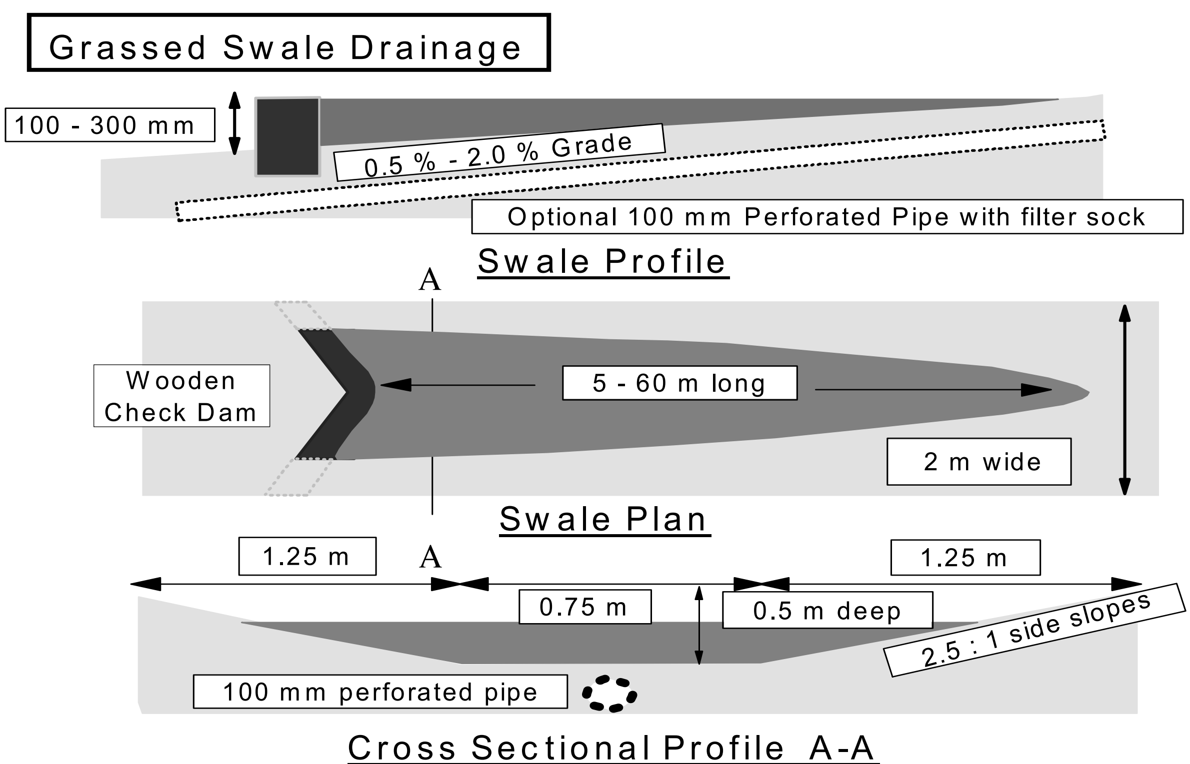
Relatively few design modifications are warranted for swales in cold climates, primarily due to their inherent simplicity. The following design modifications will tend to enhance their performance:

- Culverts should have a minimum diameter of 450 mm and a slope of 1% or greater; and
- For swale systems with an underdrain system, the underdrain should have a minimum diameter of 200 mm and should be bedded in gravel.

Performance Enhancements

In order to promote infiltration of stormwater and the settling of pollutants, permanent check dams can be constructed at intervals along the swale system. These enhancements are best utilized on large swales where the cumulative flow depth and rate is not conducive to water quality enhancement ($V \geq 0.5$ m/s or $Q \geq 0.15$ m³/s during the 25 mm 4 hour storm). The distance between check dams can be calculated based on the depth of water at the check dam and the swale channel slope. For example, if a swale has a 1% slope and a check dam height of 0.3 m, the distance between check dams should be 30 metres (or less). Figure 4.10 illustrates an enhanced grassed swale design.

Figure 4.10: Enhanced Grass Swale



The dam should be constructed out of durable material (wood) which blends into the surrounding landscape. A rock check dam can be used if the swale is located in a remote area which is not subject to vandalism. The dam should be configured in a V shape to help minimize scour and erosion of the downstream swale banks (V points upstream). The dam should be securely embedded in the swale banks and some rip-rap should be placed downstream of the dam to prevent scour and erosion. The velocity of the design conveyance storm should be kept to approximately 1 m/s whereby smaller stone sizes can be utilized (75 mm diameter).

In areas where the swales are separated by driveway culverts, the culverts can be raised such that the driveway embankment (up to the invert of the driveway culvert) acts as the check dam. This design is more aesthetically appealing and negates the need for rip-rap erosion protection. The driveway culvert should be underdrained, however, to ensure that a permanent pool of water is not created in the swale.

A low flow opening can be created in the check dam to ensure a drawdown time ≤ 24 hours. However, recognizing the potential for clogging of the low flow opening, it is recommended that swales with check dams be underdrained in soils with poor infiltration potential (e.g., clays).

Standard 100 mm perforated pipe (or larger) should be used in combination with a filter sock in any type of underdrain system. Stone storage can be provided around perforated pipes that are installed under swales as a secondary storage medium to promote exfiltration. The appropriate depth of soil cover for the stone storage should be based on the surrounding soil conditions and the potential for frost heave. Figure 4.4 indicates the recommended soil cover based on the native soil type and trench depth.

All grass swales must be evaluated under major system and minor system events neglecting the storage/conveyance below the overflow of any check dam to ensure that the swale can convey these storms effectively.

Technical Effectiveness

The effectiveness of swale systems is highly dependent on their design and maintenance. It is therefore recommended that they be used as part of a multi-component approach (i.e., one measure in a series of stormwater quality measures). They may be used for pre-treatment or polishing.