350 PRINCE CHARLES DRIVE SOUTH DEVELOPMENT
350 PRINCE CHARLES DRIVE SOUTH, WELLAND

STORM WATER MANAGEMENT DESIGN BRIEF
NEW DEVELOPMENT DRAINAGE SYSTEM

REV 3 – June 09, 2021

PREPARED BY:

HALLEX PROJECT #200724

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1. PRE-DEVELOPMENT CONDITIONS

1.1 LOCATION

The proposed Prince Charles development is located at 350 Prince Charles Drive South, which is south of Lincoln Street and Prince Charles Drive South intersection in the City of Welland, ON.

1.2 DRAINAGE PATTERN

The current drainage path for the site consists partly of overland sheet flow and an existing stormwater management system to the existing 600mm Regional storm sewer at Prince Charles Drive South. The existing 600mm Regional storm sewer runs through the subject property in an easement and eventually discharges directly to the Welland River. The existing storm water management design had been designed for the future development of the subject parcel. A stormwater management pond and storm sewer pipes had previously been designed and partly installed to accommodate stormwater quantity control and a Stormceptor STC-2000 had been designed and installed to accommodate stormwater quantity controls with a TSS removal efficiency of at least 80% as per the R.J. Burnside & Associates Ltd. Stormwater Management Report dated March 2007 (File: PTD 10303), which can be found in Appendix 'A' below. Given the development is proposed to be quite different from the original design, an analysis of the existing stormwater management systems has been completed to ensure the SWM design will ensure the storm flows are controlled to the pre-development flow rate to the existing 600mm Regional storm sewer as indicated in the R.J. Burnside & Associates Ltd. Stormwater Management Report, which can be found in Appendix 'A' below.

2. PROPOSED WORK

2.1 GRADING

The objective of the design is to utilize the existing natural slope and achieve the minimum and maximum slopes in the grading of the granular/asphalt surfaces. This will ensure the surface not only drains as per the design, but is not too steep. The grading of the site also ensures that the storm water flow will mostly drain through the onsite drainage system for storm water quantity and quality controls. The proposed drainage system onsite has been designed according to the five and one-hundred-year storm events as per the City of Welland intensity-duration-frequency curve.

2.2 DRAINAGE

The proposed design requires 278.1 metres of storm sewer piping, two precast catch basins, five precast catch basin maintenance holes, two precast maintenance hole, a parking garage trench drain complete with a pump chamber, 9 Zurn Control Flo Z121-10-77-X4 roof drains, a Hydroguard HG 10 oil/grit separator and the reuse of the existing stormwater management pond with minor modifications.

3. DESIGN CONSIDERATIONS

3.1 SITE DRAINAGE

3.1.1 Pre-Development

A. Peak Runoff

The total drainage area for the proposed development is 2.460 hectares with an allowable average runoff coefficient of 0.31 as indicated in Table 1: Site Statistics for Existing Site Conditions of the R.J. Burnside & Associates Ltd. Stormwater Management Report dated March 2007 (File: PTD 10303).

The time of concentration is determined to be 10 minutes to the start of the existing drainage system as required by the City of Welland municipal standards.

Using the Rational Method, the peak flow rates are $Q = \frac{CiA}{360}$

Subcatchment	**Description**	**Draining to**	**Area, ha**	**Tc, min**
Area.1	Sheet	Welland River	2.460	10
5-year Storm	**A,ha**	**C**	**i,mm/h**	**Q, L/s**
TOTAL	2.460	0.31	91	191.9
100-year Storm	**A,ha**	**C**	**i,mm/h**	**Q, L/s**
TOTAL	2.460	0.31	143	302.9

Therefore, the total pre-development flow for the subject site is 191.9L/s for the five-year storm and 302.9L/s for the one-hundred-year storm.

B. Quantity

As per Section 3.2.1 Quantity Control of the Stormwater Management Report by R.J. Burnside & Associates Ltd., water quantity control is provided for the 5 and the 100-year storm events by controlling the post-development storm to the pre-development levels.

C. Quality

As per Section 3.2.2 Stormwater Quality Control of the Stormwater Management Report by R.J. Burnside & Associates Ltd., water quality control is provided by a Stormceptor STC-2000, which achieves a total suspended solids removal of at least 82%. This value is greater than the required 'Enhanced' treatment of 80% as indicated in the MOE Stormwater Management Planning and Design Manual, dated March 2003 (refer to Chapter 3: Environmental Design Criteria, Section 3.3.1.1. Level of Protection).

3.1.2 Post-Development

A. Peak Runoff

The proposed Prince Charles development consists of the existing Phase 1 development and the construction of new buildings, asphalt laneway & parking areas and grass areas. The resulting runoff coefficient in the post-development condition of the site is 0.68.

The existing Phase 1 development included the installation of the stormwater management pond and most of the stormwater management controls included a tiered orifice pipe design and the Stormceptor STC-2000. The existing stormwater management system discharges to the existing 600mm Regional storm sewer at Prince Charles Drive South The proposed development will drain through the proposed onsite storm drainage system and shall discharge to the existing stormwater management system on the subject site

The site's storm sewer pipes are designed according to the 5-year minor storm. Utilizing the minimum recommended time of concentration of 10 minutes, the time for storm water to flow from the farthest drainage area to the existing 600mm Regional storm sewer at Prince Charles Drive South, as outlined in Exhibit #1, is calculated to be 13.74 minutes.

Using the Rational Method, the peak flow rates are as follows:

Subcatchment	**Description**	**Draining to**	**Area, ha**	**Tc, min**
Area.2	Sheet	River	0.207	10
Prop. Sewer	Sewer	Street	2.253	10
5-year Storm	**A,ha**	**C**	***i*,mm/h**	**Q, L/s**
Area.2	0.207	0.57	91	29.7
Prop. Sewer	2.253	0.69	91	382.1
TOTAL	**2.460**	**0.68**	**91**	**411.8**
100-year Storm	**A,ha**	**C**	***i*,mm/h**	**Q, L/s**
Area.2	0.207	0.57	143	46.9
Prop. Sewer	2.253	0.69	143	602.0
TOTAL	**2.460**	**0.68**	**143**	**648.9**

Therefore, the total post-development flow for the subject site is 411.8L/s for the five-year storm and 648.9L/s for the one-hundred-year storm. The flows and other design information are contained in Exhibit #1 for the five -year storm and Exhibit #2 for the one-hundred-year storm at the end of the design brief.

B. Quantity

The post-development storm water runoff to the existing 600mm Regional storm sewer at Prince Charles Drive South is higher than the allowable pre-development runoff. As such, storm water detention is required to ensure that the existing regional sewer ditch does not surcharge as a result of the proposed development.

Stormwater quantity controls for the site will be achieved by utilizing a total of 9 Zurn Control Flo Z121-10-77-X4 roof drains (4 on each five-storey building and 1 on the four-storey building) and the resulting storm volume shall be detained on the roof. The roof construction is to consist of a minimum 1.0% roof slope allowing a maximum 150mm depth at each drain for rooftop storage. The five-year storm storage capacity of the roof is calculated to be 24m³ on each five-storey building and 5m³ on the four-storey building resulting in a 0.47L/s flow rate per drain on each five-storey building a 0.44L/s flow rate per drain on the four-storey building. The one-hundred-year storm storage capacity of the roof is calculated to be 44m³ on each five-storey building and 10m³ on the three-storey building resulting in a 0.57L/s flow rate per drain on each five-storey building a 0.56L/s flow rate per drain on the four-storey building.

Although most of the SWM quantity controls are provided by the roof detention, additional stormwater quantity controls for the site will be achieved by replacing the existing tiered orifice pipe system but keeping the general intent. The existing lower 150mm diameter orifice pipe between XMH.6 and XMH.7 is proposed to be replaced with a 200mm diameter orifice pipe. The orifice pipe will ensure the post-development runoff is controlled to the pre-development runoff rate for the five-year storm event. The resulting 110m^3 volume generated from the five-year storm will be contained within the modified stormwater management pond.

The one-hundred-year storm will also be controlled by the new 200mm diameter lower orifice pipe however the existing 150mm diameter upper orifice pipe between XMH.6 and XMH.7 is proposed to be replaced with a 250mm diameter orifice pipe. The invert elevation of the 250mm diameter upper orifice pipe is proposed to be at the same elevation of the 5-year ponding elevation so as not to affect the SWM controls for the 5-year storm. Both the upper and lower orifice pipes will ensure the post-development runoff is controlled to the pre-development runoff rate for the one-hundred-year storm event. The resulting 224m^3 volume generated from the one-hundred-year-storm will be contained within the modified stormwater management pond. The original storm system was designed so that once the storm system begins to fill and eventually surcharge the pipes it will back flow into the existing pond. The pond will fill up to the one-hundred-year storm retention elevation, at this point water will start to flow through the orifice pipes resulting in the water slowly draining away from the pond.

The following table summarizes the pre-development flow rates, the post-development uncontrolled flow rates and the post-development-controlled flow rates for the subject site:

	Pre- Development Flow Rate (L/s)	Post- Development Uncontrolled Flow Rate (L/s)	Post- Development Controlled Flow Rate (L/s)
5-year Storm			
Area.2		29.7	29.7
Prop. Sewer		382.1	124.5
TOTAL	**191.9**	**411.8**	**154.2**
100-year Storm			
Area.2		46.9	46.9
Prop. Sewer		602.0	146.0
TOTAL	**302.9**	**648.9**	**192.9**

The roof drain and orifice pipe sizing and subsequent storage volume for the detained flow are indicated in Exhibit #3 for the five -year storm and Exhibit #4 for the one-hundred-year storm at the end of the design brief.

C. Quality

The storm water collected in the proposed development currently passes through a Stormceptor STC-2000, which will only achieve a total suspended solids removal of at least 71%. Given this value is significantly less than the required 'Enhanced' treatment of 80% a new oil/grit separator is designed for the site.

A Hydroguard HG10 is proposed to replace the existing STC2000, which achieves a total suspended solids removal of at least 84%. This value is greater than the required 'Enhanced' treatment of 80% as indicated in the MOE Stormwater Management Planning and Design Manual, dated March 2003 (refer to Chapter 3: Environmental Design Criteria, Section 3.3.1.1. Level of Protection). The design calculations from the manufacturer as well as the drawings for the unit are included in Appendix 'B' of this report.

D. Maintenance Recommendations

The storm sewer system includes pipes, catchbasins, maintenance holes, control flow roof drains, the oil/grit separator and stormwater management pond. It is important to regularly inspect the elements to ensure that storm water is flowing as originally designed. Debris and sediment commonly clog the system and reduce the overall effectiveness.

The following maintenance and inspection tasks should be done:

1. Inspect the inlet pipes and outlet pipes for structural integrity. (Annually) Check inlet/ outlet pipes for structural integrity to ensure they aren't crumbling or broken.
2. Conduct routine inspections for trash or other debris that may be blocking the inlet and outlet pipes and the stormwater management pond. (Monthly and after rain events) Remove all trash and debris.

3. Inspect and clean the storm sewer system (Every 5 years or as needed). Catchbasins to be inspected annually and debris removed when the debris reaches a depth of ½ from the bottom of the sump to the bottom of the pipe.
4. Conduct routine inspections for erosion of the stormwater management pond. (Annually and after rain events). Any erosion shall be corrected by sodding the area. There may be a need to provide further erosion control (ie rip-rap) to prevent the re-occurrence of erosion.
5. If there is a visible accumulation of sediment in the bottom of the pond or around the high-water line of the pond, then removal of sediment accumulation is required.
6. Conduct routine maintenance of swales and pond including grass cutting.
7. The frequency of grass cutting correlates on the surrounding land uses, and ultimately local municipal by-laws. Grass cutting should be done as infrequently as possible recognizing the aesthetic concerns of nearby residents. Grass around wet facilities should not be cut to the edge of the permanent pool.
8. As a safety precaution, grass cutting should be done parallel to the shoreline with grass clippings being ejected upland to reduce the potential for organic loadings to the pond.
9. Inspect for sediment accumulation at pipes (Semi-annually and after rain events). It is important to clean out sediment that might be restricting water flow.
10. Do not dump any materials in the storm sewer system.
11. Inspect the Hydroguard Oil/Grit Separator (Annually). Procedures for inspection are provided in the Hydroguard Owner's Manual. A vacuum truck is to be used for maintenance of the Hydroguard.

4. CONCLUSION

The aforementioned calculations and recommendations for the storm drainage system are based on the current design for the site as of writing this report.

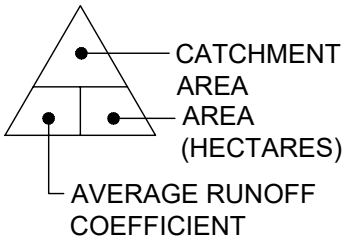
We trust this report meets your approval. Please contact the undersigned should you have any questions or comments.

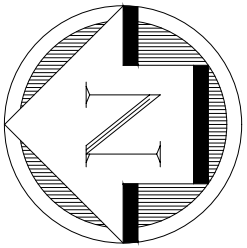
Yours truly,
HALLEX ENGINEERING LTD

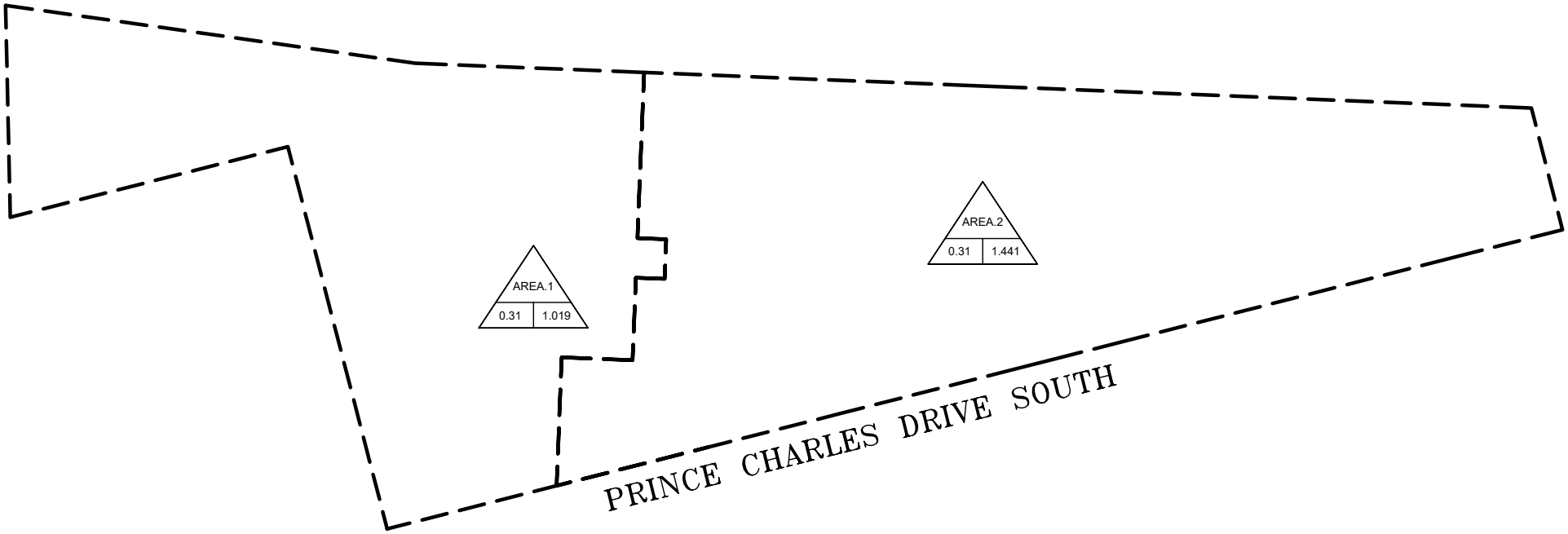
Jim Halucha P.Eng
Civil/Structural Engineer

Jonathan Skinner, C.E.T., B.Tech
Civil Technologist

LEGEND







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PROJECT:
PRINCE CHARLES DEVELOPMENT PHASE 2
350 PRINCE CHARLES DRIVE, WELLAND ON

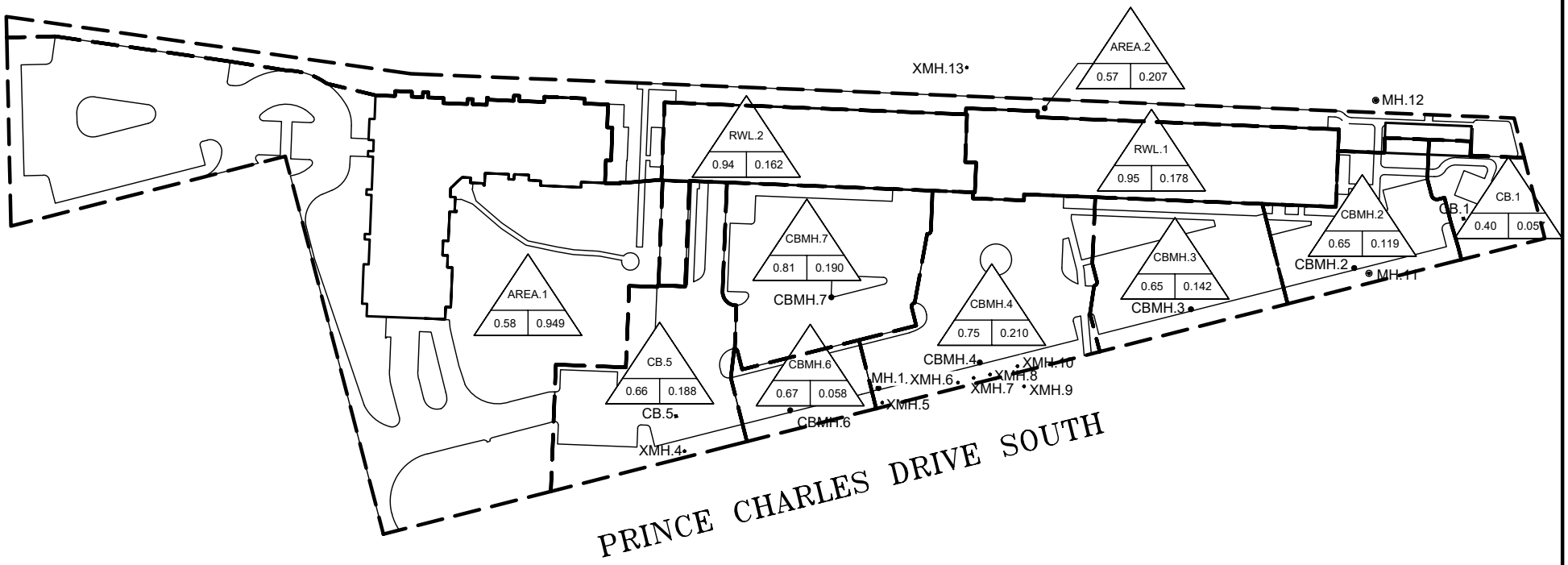
SHEET TITLE:
PRE-DEVELOPMENT CATCHMENT AREA PLAN

DATE: 2021/06/09
SCALE: 1:1500
DR. BY: AI
CH. BY: JS / JH

JOB No.: 200724
DWG. CSK1
REV. 3

LEGEND

CATCHMENT AREA
AREA (HECTARES)
AVERAGE RUNOFF COEFFICIENT



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PROJECT:
PRINCE CHARLES DEVELOPMENT PHASE 2
350 PRINCE CHARLES DRIVE, WELLAND ON

SHEET TITLE:
POST-DEVELOPMENT CATCHMENT AREA PLAN

DATE: 2021/06/09
SCALE: 1:1500
DR. BY: AI
CH. BY: JS / JH

JOB No.: 200724
DWG. CSK2
REV. 3

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Welland - 5 Year Storm

Prince Charles Development
Exhibit #1 - 5 Year Post - Development Calculations

2021-06-09
Job: 200724

Rainfall Intensity Values = A= 830.000, B= 7.300, C= 0.777

manning's n = 0.013 PVC Pipe; 0.013 Conc Pipe; 0.024 Corr. Stl Pipe; 0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow			Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**XMH. 5**	**N/A**	**0.949**	**0.949**	**10.00**	**N/A**	**91**	**44574**	**12060.0**	**0.1396**	**0.1396**	**N/A**	**N/A**	**N/A**	**N/A**		
Roof	-	-	-	0.185	-	-	-	-	20656.2	3821.4	-	-	-	-	-	-	-	-
Paved	-	-	-	0.323	-	-	-	-	19569.1	6320.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.441	-	-	-	-	4348.7	1917.8	-	-	-	-	-	-	-	-
2	**Area 2**	**River.**	**N/A**	**0.207**	**0.207**	**10.00**	**N/A**	**91**	**44574**	**2567.9**	**0.0297**	**0.0297**	**N/A**	**N/A**	**N/A**	**N/A**		
Roof	-	-	-	0.008	-	-	-	-	20656.2	165.2	-	-	-	-	-	-	-	-
Paved	-	-	-	0.101	-	-	-	-	19569.1	1976.5	-	-	-	-	-	-	-	-
Grass	-	-	-	0.098	-	-	-	-	4348.7	426.2	-	-	-	-	-	-	-	-
3	**CB. 1**	**CBMH. 2**	**28.6**	**0.057**	**0.057**	**10.00**	**0.59**	**91**	**44574**	**495.7**	**0.0057**	**0.0057**	**0.0060**	**0.0254**	**0.8087**	**0.200**		
Roof	-	-	-	0.004	-	-	-	-	20656.2	82.6	-	-	-	-	-	-	-	-
Paved	-	-	-	0.012	-	-	-	-	19569.1	234.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.041	-	-	-	-	4348.7	178.3	-	-	-	-	-	-	-	-
4	**CBMH. 2**	**CBMH. 3**	**40.3**	**0.119**	**0.176**	**10.59**	**0.88**	**88**	**43428**	**2146.0**	**0.0248**	**0.0248**	**0.0040**	**0.0376**	**0.7662**	**0.250**		
Roof	-	-	-	0.004	-	-	-	-	20124.9	80.5	-	-	-	-	-	-	-	-
Paved	-	-	-	0.073	-	-	-	-	19065.7	1391.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.042	-	-	-	-	4236.8	177.9	-	-	-	-	-	-	-	-
5	**RWL. 1**	**CBMH. 3**	**25.2**	**0.178**	**0.178**	**10.00**	**0.35**	**91**	**20656**	**3676.8**	**0.0426**	**0.0019**		**0.0595**	**1.2115**			
Roof	-	-	-	0.178	-	-	-	-	20656.2	3676.8	-	-	-	-	-	-	-	-
6	**CBMH. 3**	**CBMH. 4**	**52.4**	**0.142**	**0.496**	**11.47**	**1.11**	**85**	**22449**	**7716.7**	**0.0893**	**0.0267**	**0.0025**	**0.0877**	**0.7937**	**0.375**		
Paved	-	-	-	0.092	-	-	-	-	18367.5	1689.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.050	-	-	-	-	4081.7	204.1	-	-	-	-	-	-	-	-
7	**CBMH. 4**	**MH. 1**	**24.5**	**0.210**	**0.706**	**12.58**	**0.34**	**81**	**21469**	**10804.3**	**0.1251**	**0.0267**	**0.0060**	**0.1358**	**1.2296**	**0.375**		
Paved	-	-	-	0.166	-	-	-	-	17565.6	2915.9	-	-	-	-	-	-	-	-
Grass	-	-	-	0.044	-	-	-	-	3903.5	171.8	-	-	-	-	-	-	-	-
8	**CB. 5**	**CBMH. 6**	**27.3**	**0.188**	**0.188**	**10.00**	**0.49**	**91**	**23918**	**2720.1**	**0.0315**	**0.0315**	**0.0060**	**0.0461**	**0.9384**	**0.250**		
Paved	-	-	-	0.125	-	-	-	-	19569.1	2446.1	-	-	-	-	-	-	-	-
Grass	-	-	-	0.063	-	-	-	-	4348.7	274.0	-	-	-	-	-	-	-	-
9	**CBMH. 6**	**MH. 1**	**21.1**	**0.058**	**0.246**	**10.49**	**0.41**	**89**	**23404**	**3547.8**	**0.0411**	**0.0411**	**0.0040**	**0.0612**	**0.8652**	**0.300**		
Paved	-	-	-	0.039	-	-	-	-	19149.0	746.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.019	-	-	-	-	4255.3	80.9	-	-	-	-	-	-	-	-

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Prince Charles Development
Exhibit #1 - 5 Year Post - Development Calculations

2021-06-09
Job: 200724

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow			Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
10	**RWL. 2**	**CBMH. 7**	**25.1**	**0.162**	**0.162**	**10.00**	**0.35**	**91**	**44574**	**3311.5**	**0.0383**	**0.0058**	**0.0100**	**0.0595**	**1.2115**	**0.250**	**176.15**	**175.89**
Roof	-	-	-	0.144	-	-	-	-	20656.2	2974.5	-	-	-	-	-	-	-	-
Paved	-	-	-	0.017	-	-	-	-	19569.1	332.7	-	-	-	-	-	-	-	-
Grass	-	-	-	0.001	-	-	-	-	4348.7	4.3	-	-	-	-	-	-	-	-
11	**CBMH. 7**	**MH. 1**	**24**	**0.190**	**0.352**	**10.35**	**0.30**	**89**	**23548**	**6597.6**	**0.0764**	**0.0058**	**0.0100**	**0.0967**	**1.3680**	**0.300**	**175.86**	**175.62**
Paved	-	-	-	0.165	-	-	-	-	19266.9	3179.0	-	-	-	-	-	-	-	-
Grass	-	-	-	0.025	-	-	-	-	4281.5	107.0	-	-	-	-	-	-	-	-
12	**MH. 1**	**XMH. 5**	**2.8**	**0.000**	**1.304**	**12.92**	**0.03**	**80**	**0**	**20949.7**	**0.2425**	**0.0736**	**0.0100**	**0.2851**	**1.7926**	**0.450**	**175.59**	**175.56**
13	**XMH. 5**	**XMH. 6**	**18.6**	**0.000**	**2.253**	**12.95**	**0.40**	**80**	**0**	**33009.7**	**0.3821**	**0.2132**	**0.0016**	**0.1720**	**0.7947**	**0.525**	**175.50**	**175.47**
14	**XMH. 6**	**XMH. 7**	**3.4**	**0.000**	**2.253**	**13.35**	**0.11**	**79**	**0**	**33009.7**	**0.3821**	**0.1245**	**0.0029**	**0.0177**	**0.5622**	**0.200**	**175.45**	**175.44**
15	**XMH. 7**	**XMH. 8**	**3.5**	**0.000**	**2.253**	**13.46**	**0.08**	**79**	**0**	**33009.7**	**0.3821**	**0.1245**	**0.0029**	**0.0521**	**0.7367**	**0.300**	**175.43**	**175.42**
16	**XMH. 8**	**XMH. 10**	**6.4**	**0.000**	**2.253**	**13.54**	**0.20**	**78**	**0**	**33009.7**	**0.3821**	**0.1245**	**0.0016**	**0.0387**	**0.5472**	**0.300**	**175.35**	**175.34**

Run-off Coefficients Used:

Roof Structure C = 0.95
Paved Surface C = 0.90
Grass Surface C = 0.20

Velocity Range:

Minimum Velocity = 0.75 m/s
Maximum Velocity = 6.00 m/s

Time of Concentration:

Time of Concentration = 10 min

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Prince Charles Development
Exhibit #2 - 100 Year Post - Development Calculations

2021-06-09
Job: 200724

Welland - 100 Year Storm

Rainfall Intensity Values = A= 1020.000, B= 4.700, C= 0.731

manning's n = 0.013 PVC Pipe; 0.013 Conc Pipe; 0.024 Corr. Stl Pipe; 0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow			Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**XMH. 5**	**N/A**	**0.949**	**0.949**	**10.00**	**N/A**	**143**	**70349**	**19033.6**	**0.2203**	**0.2203**	**N/A**	**N/A**	**N/A**	**N/A**		
Roof	-	-	-	0.185	-	-	-	-	32600.6	6031.1	-	-	-	-	-	-	-	-
Paved	-	-	-	0.323	-	-	-	-	30884.8	9975.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.441	-	-	-	-	6863.3	3026.7	-	-	-	-	-	-	-	-
2	**Area 2**	**River.**	**N/A**	**0.207**	**0.207**	**10.00**	**N/A**	**143**	**70349**	**4052.8**	**0.0469**	**0.0469**	**N/A**	**N/A**	**N/A**	**N/A**		
Roof	-	-	-	0.008	-	-	-	-	32600.6	260.8	-	-	-	-	-	-	-	-
Paved	-	-	-	0.101	-	-	-	-	30884.8	3119.4	-	-	-	-	-	-	-	-
Grass	-	-	-	0.098	-	-	-	-	6863.3	672.6	-	-	-	-	-	-	-	-
3	**CB. 1**	**CBMH. 2**	**28.6**	**0.057**	**0.057**	**10.00**	**0.59**	**143**	**70349**	**782.4**	**0.0091**	**0.0091**	**0.0060**	**0.0254**	**0.8087**	**0.200**		
Roof	-	-	-	0.004	-	-	-	-	32600.6	130.4	-	-	-	-	-	-	-	-
Paved	-	-	-	0.012	-	-	-	-	30884.8	370.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.041	-	-	-	-	6863.3	281.4	-	-	-	-	-	-	-	-
4	**CBMH. 2**	**CBMH. 3**	**40.3**	**0.119**	**0.176**	**10.59**	**0.88**	**139**	**68354**	**3379.9**	**0.0391**	**0.0391**	**0.0040**	**0.0376**	**0.7662**	**0.250**		
Roof	-	-	-	0.004	-	-	-	-	31676.2	126.7	-	-	-	-	-	-	-	-
Paved	-	-	-	0.073	-	-	-	-	30009.0	2190.7	-	-	-	-	-	-	-	-
Grass	-	-	-	0.042	-	-	-	-	6668.7	280.1	-	-	-	-	-	-	-	-
5	**RWL. 1**	**CBMH. 3**	**25.2**	**0.178**	**0.178**	**10.00**	**0.35**	**143**	**32601**	**5802.9**	**0.0672**	**0.0023**		**0.0595**	**1.2115**			
Roof	-	-	-	0.178	-	-	-	-	32600.6	5802.9	-	-	-	-	-	-	-	-
6	**CBMH. 3**	**CBMH. 4**	**52.4**	**0.142**	**0.496**	**11.47**	**1.11**	**133**	**35208**	**12153.0**	**0.1407**	**0.0414**	**0.0025**	**0.0877**	**0.7937**	**0.375**		
Paved	-	-	-	0.092	-	-	-	-	28806.3	2650.2	-	-	-	-	-	-	-	-
Grass	-	-	-	0.050	-	-	-	-	6401.4	320.1	-	-	-	-	-	-	-	-
7	**CBMH. 4**	**MH. 1**	**24.5**	**0.210**	**0.706**	**12.58**	**0.34**	**127**	**33540**	**16976.6**	**0.1965**	**0.0414**	**0.0060**	**0.1358**	**1.2296**	**0.375**		
Paved	-	-	-	0.166	-	-	-	-	27441.6	4555.3	-	-	-	-	-	-	-	-
Grass	-	-	-	0.044	-	-	-	-	6098.1	268.3	-	-	-	-	-	-	-	-
8	**CB. 5**	**CBMH. 6**	**27.3**	**0.188**	**0.188**	**10.00**	**0.49**	**143**	**37748**	**4293.0**	**0.0497**	**0.0497**	**0.0060**	**0.0461**	**0.9384**	**0.250**		
Paved	-	-	-	0.125	-	-	-	-	30884.8	3860.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.063	-	-	-	-	6863.3	432.4	-	-	-	-	-	-	-	-
9	**CBMH. 6**	**MH. 1**	**21.1**	**0.058**	**0.246**	**10.49**	**0.41**	**140**	**36854**	**5596.3**	**0.0648**	**0.0648**	**0.0040**	**0.0612**	**0.8652**	**0.300**		
Paved	-	-	-	0.039	-	-	-	-	30153.3	1176.0	-	-	-	-	-	-	-	-
Grass	-	-	-	0.019	-	-	-	-	6700.7	127.3	-	-	-	-	-	-	-	-

HALLEX ENGINEERING LTD.

Prince Charles Development
Exhibit #2 - 100 Year Post - Development Calculations

2021-06-09
Job: 200724

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow	Cum Flow		Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
10	**RWL. 2**	**CBMH. 7**	**25.1**	**0.162**	**0.162**	**10.00**	**0.35**	**143**	**70349**	**5226.4**	**0.0605**	**0.0084**	**0.0100**	**0.0595**	**1.2115**	**0.250**	**176.15**	**175.89**
Roof	-	-	-	0.144	-	-	-	-	32600.6	4694.5	-	-	-	-	-	-	-	-
Paved	-	-	-	0.017	-	-	-	-	30884.8	525.0	-	-	-	-	-	-	-	-
Grass	-	-	-	0.001	-	-	-	-	6863.3	6.9	-	-	-	-	-	-	-	-
11	**CBMH. 7**	**MH. 1**	**24**	**0.190**	**0.352**	**10.35**	**0.30**	**141**	**37104**	**10404.1**	**0.1204**	**0.0084**	**0.0100**	**0.0967**	**1.3680**	**0.300**	**175.86**	**175.62**
Paved	-	-	-	0.165	-	-	-	-	30358.1	5009.1	-	-	-	-	-	-	-	-
Grass	-	-	-	0.025	-	-	-	-	6746.2	168.7	-	-	-	-	-	-	-	-
12	**MH. 1**	**XMH. 5**	**2.8**	**0.000**	**1.304**	**12.92**	**0.03**	**125**	**0**	**32977.1**	**0.3817**	**0.1146**	**0.0100**	**0.2851**	**1.7926**	**0.450**	**175.59**	**175.56**
13	**XMH. 5**	**XMH. 6**	**18.6**	**0.000**	**2.253**	**12.95**	**0.40**	**125**	**0**	**52010.7**	**0.6020**	**0.3349**	**0.0016**	**0.1720**	**0.7947**	**0.525**	**175.50**	**175.47**
14	**XMH. 6**	**XMH. 7**	**3.4**	**0.000**	**2.253**	**13.35**	**0.11**	**123**	**0**	**52010.7**	**0.6020**	**0.1460**	**0.0029**	**0.0177**	**0.5622**	**0.200**	**175.45**	**175.44**
15	**XMH. 7**	**XMH. 8**	**3.5**	**0.000**	**2.253**	**13.46**	**0.08**	**123**	**0**	**52010.7**	**0.6020**	**0.1460**	**0.0029**	**0.0521**	**0.7367**	**0.300**	**175.43**	**175.42**
16	**XMH. 8**	**XMH. 10**	**6.4**	**0.000**	**2.253**	**13.54**	**0.20**	**122**	**0**	**52010.7**	**0.6020**	**0.1460**	**0.0016**	**0.0387**	**0.5472**	**0.300**	**175.35**	**175.34**

Run-off Coefficients Used:

Roof Structure C = 0.95
Paved Surface C = 0.90
Grass Surface C = 0.20

Velocity Range:

Minimum Velocity = 0.75 m/s
Maximum Velocity = 6.00 m/s

Time of Concentration:

Time of Concentration = 10 min

Prince Charles Development
Exhibit #3 - 5 Year Orifice Plate and Storage Volume Calcs

Roof Data

Roof Discharge	Total Flow (m^3/s)	Description
Control Flow Discharge	0.00016	Flow per 25mm in head per Z121 roof drain
5 year Roof Flow	0.0809	Un-controlled flow rate

Required Storage on Roof

Roof Discharge	Required Storage Volume* (m^3)	Roof Ponding (100 year storm) Area (m^2)	Depth (m)	Allowable (m^3)	Z121 Flow Rate (m^3/s)
Roof Drain 1a	6.0	163.4	0.076	6.21	0.00047
Roof Drain 1b	6.0	163.4	0.076	6.21	0.00047
Roof Drain 1c	6.0	163.4	0.076	6.21	0.00047
Roof Drain 1d	6.0	163.4	0.076	6.21	0.00047
Roof Drain 2	5.0	146.0	0.071	5.18	0.00044
Roof Drain 3a	6.0	163.4	0.076	6.21	0.00047
Roof Drain 3b	6.0	163.4	0.076	6.21	0.00047
Roof Drain 3c	6.0	163.4	0.076	6.21	0.00047
Roof Drain 3d	6.0	163.4	0.076	6.21	0.00047
Total	53.0			54.86	0.00422

* Calculated using using SWMM 5.1 modelling software

Site Data

Site Discharge	Flow (m^3/s)	Adj. Flow (w/o Surface Runoff) (m^3/s)	Adj. Flow (w/ Roof Controls) (m^3/s)	Total Storm Volume (m^3)
Pre - Develop.	0.1919	0.1622	0.1622	
Post - Develop.	0.4118	0.3821	0.2132	110.0

* Calculated using using SWMM 5.1 modelling software

Control Node Data

Outlet Pipe	Storm Control Node	Outlet Pipe Size (m)	Outlet Invert Elev. (m)	Elev. @ Orifice (m)
15	XMH. 6	0.200	175.45	175.55

Head Height 1.25 m **Storm Retention Elev. Check** **176.80 m**

Pond Storage

Pond Sections	Pond Dimensions Depth (m)	Avg Area (m)	Storage Volume (m^3)
Pond	0.660	167.36	110.46
Total			**110.5**

Total Storage = 110.5 m^3 Required Storage Achieved

Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.8	(tube)	0.62 Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.1622	m^3/s	0.80 Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s	
Head Height	h =	1.25	m	
Dia of Max. Orifice	dia =	228.37	mm	Use - 200 mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0314	m^2
Flow Rate through Orifice	Q =	0.1245	m^3/s

Prince Charles Development
Exhibit #4 - 100 Year Orifice Plate and Storage Volume Calcs

Roof Data

Roof Discharge	Total Flow (m^3/s)	Description
Control Flow Discharge	0.00016	Flow per 25mm in head per Z121 roof drain
100 year Roof Flow	0.1277	Un-controlled flow rate

Required Storage on Roof

Roof Discharge	Required Storage Volume*	Roof Ponding (100 year storm)			Z121 Flow Rate
		Area	Depth	Allowable	
	(m^3)	(m^2)	(m)	(m^3)	(m^3/s)
Roof Drain 1a	11.0	239.4	0.092	11.01	0.00057
Roof Drain 1b	11.0	239.4	0.092	11.01	0.00057
Roof Drain 1c	11.0	239.4	0.092	11.01	0.00057
Roof Drain 1d	11.0	239.4	0.092	11.01	0.00057
Roof Drain 2	10.0	226.2	0.090	10.18	0.00056
Roof Drain 3a	11.0	239.4	0.092	11.01	0.00057
Roof Drain 3b	11.0	239.4	0.092	11.01	0.00057
Roof Drain 3c	11.0	239.4	0.092	11.01	0.00057
Roof Drain 3d	11.0	239.4	0.092	11.01	0.00057
Total	98.0			98.26	0.00513

* Calculated using using SWMM 5.1 modelling software

Site Data

Site Discharge	Flow	Adj. Flow (w/o Surface Runoff)	Adj. Flow (w/ Roof Controls)	Total Storm Volume
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3)
Pre - Develop.	0.3029	0.2560	0.2560	
Post - Develop.	0.6489	0.6020	0.3349	224.0

* Calculated using using SWMM 5.1 modelling software

Control Node Data

Outlet Pipe	Storm Control Node	Outlet Pipe Size	Outlet Invert Elev.	Elev. @ Orifice
		(m)	(m)	(m)
15	XMH. 6	0.200	175.45	175.55

Head Height 1.72 m **Storm Retention Elev. Check** **177.27 m**

Pond Storage

Pond Sections	Pond Dimensions		Storage Volume
	Depth	Avg Area	
	(m)	(m)	(m^3)
Pond	1.180	190.14	224.4
Total			**224.4**

Total Storage = 224.4 m^3 **Required Storage Achieved**

Lower Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.8	(tube)	0.62 Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.2560	m^3/s	0.80 Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s	
Head Height	h =	1.72	m	
Dia of Max. Orifice	dia =	264.89	mm	Use - 200 mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0314	m^2
Flow Rate through Orifice	Q =	0.1460	m^3/s

Prince Charles Development
Exhibit #4 - 100 Year Orifice Plate and Storage Volume Calcs

Upper Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.8	(tube)	0.62	Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.1100	m^3/s	0.80	Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s		
Head Height	h =	0.35	m		
Dia of Max. Orifice	dia =	259.45	mm	Use -	250 mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0491	m^2
Flow Rate through Orifice	Q =	0.1022	m^3/s
Total Flow Rate	Q=	0.2482	m^3/s

APPENDIX 'A'

R.J Burnside & Associates Ltd.

Stormwater Management Report

BURNSIDE

Stonecreek Pointe Developments
Residential Condiminium Development
Prince Charles Street South
Welland, ON
Stormwater Management Report

Prepared by

R. J. Burnside & Associates Limited
1053 Brock Road, Suite 202
Pickering, ON
L1W 3T7

March 2007

File No: PTD 10303

The material in this report reflects best judgement in light of the information available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. R. J. Burnside & Associates Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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Tables

Figures and Drawings

Appendices

1.0 INTRODUCTION

1.1 General Information

R. J. Burnside and Associates Limited has been retained by Pointe of View Developments Limited to prepare a Stormwater Management Report for a proposed residential condominium development in the City of Welland, Ontario. The Property is located between Prince Charles Drive South (Regional Road 54) and the Welland Canal, immediately north of the CNR rail track and south of Lincoln Street, as shown in **Figure 1**.

1.2 Objectives

The objectives of this stormwater management report are to:

- Calculate the pre-development runoff rates from the property
- Determine the governing stormwater management criteria, specifically:
  - Allowable post-development runoff rate
  - Required stormwater quality control
- Determine requirements for, and suitable methods for, attenuation and treatment of stormwater runoff
- Examine the theoretical performance of proposed attenuation measures and demonstrate compliance with the governing stormwater management criteria.

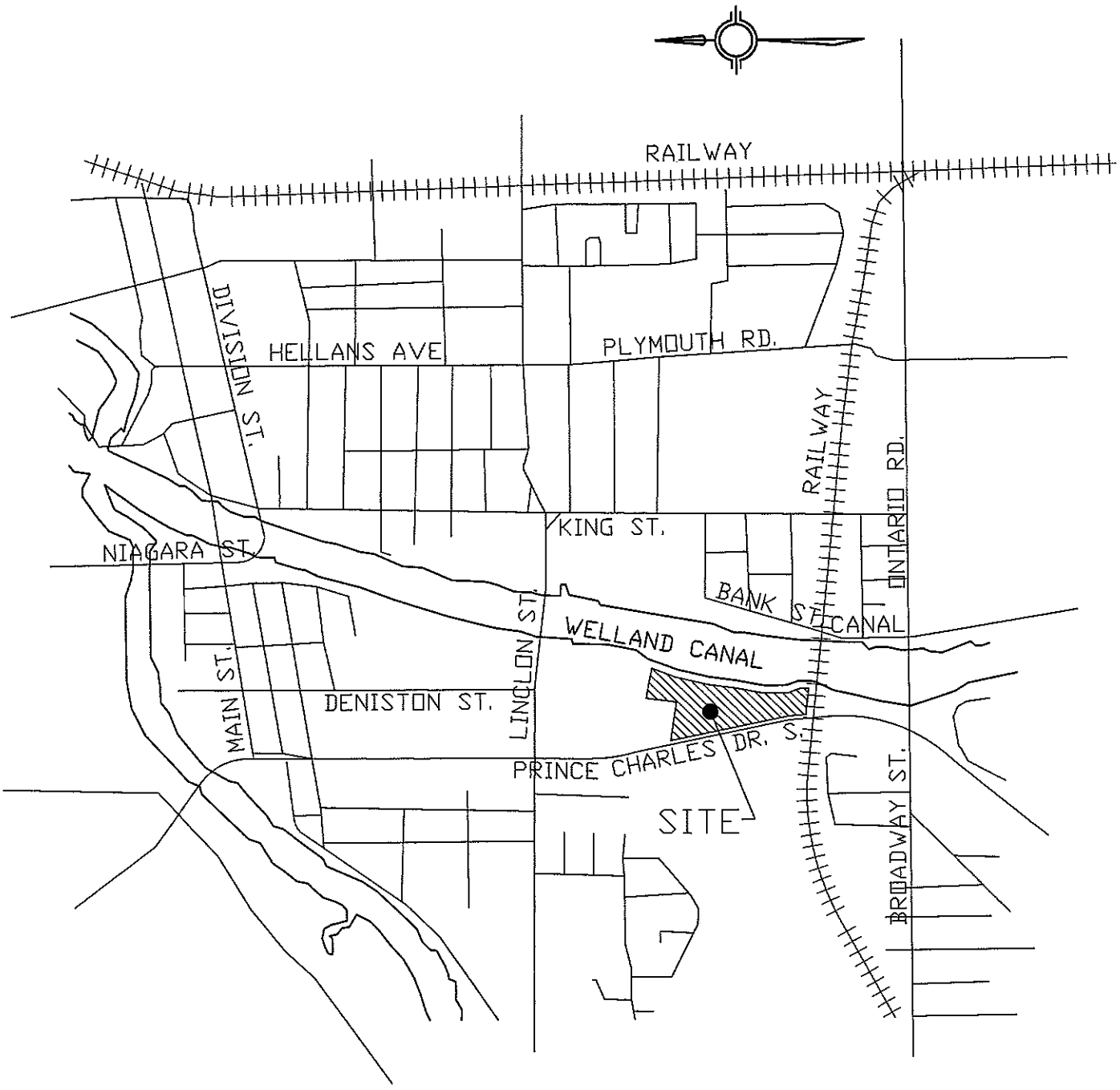
All of the above will be done in accordance with accepted engineering practices.

1.3 Existing Conditions

The subject site comprises an area of 2.45 ha (6.05 acres). The lands are currently vacant with surface cover consisting of a generally unimproved grassed area (2.40 ha), with a small central area occupied by the remains of a concrete foundation (0.05 ha). The existing topography generally slopes from the northwest to the southeast, towards the Welland Canal. Typical existing grades across the site range from 1% up to 20%, with a total elevation range from 180m to 175.4m. Site statistics relating to the existing site conditions are outlined in **Table 1**.

Table 1 Site Statistics for Existing Site Conditions

Surface Cover	Area (ha)	Runoff Coeff. (C)
Unimproved / Grassed Area	2.40 ha	0.30
Former Concrete Foundation	0.05 ha	0.90
Pavement	0.00 ha	0.90
Total Site:	2.45 ha	Avg. = 0.31



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Drawing Title
SITE LOCATION PLAN
Project Title
PROPOSED SEAWAY POINTE DEVELOPMENT
PRINCE CHARLES DRIVE SOUTH
WELLAND, ONTARIO

Drawn By	Checked By	Figure No.
ZG	RG	1
Scale	Project No.	
N.T.S	PTD 10303	

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An existing network of storm sewer and CB Inlets is located adjacent to the property along the north and west property lines. This storm sewer network crosses the subject property from west to east near the southern portion of the site, discharging directly into the Welland Canal. This storm sewer conveys external area drainage as well as site drainage. Site drainage from the western portion of the site (0.71 ha) is conveyed overland by existing swales into the CB Inlets located outside of the west property line. Site drainage from the remainder of the site (1.74 ha) flows overland to the east, and is then conveyed by existing swales to the downstream-most ditch inlet, located near the east property line.

The site is bounded by the Welland Canal to the east, existing commercial/residential to the north, Prince Charles Drive South to the west, and an existing rail track to the south. **Figure 2** shows the existing condition drainage.

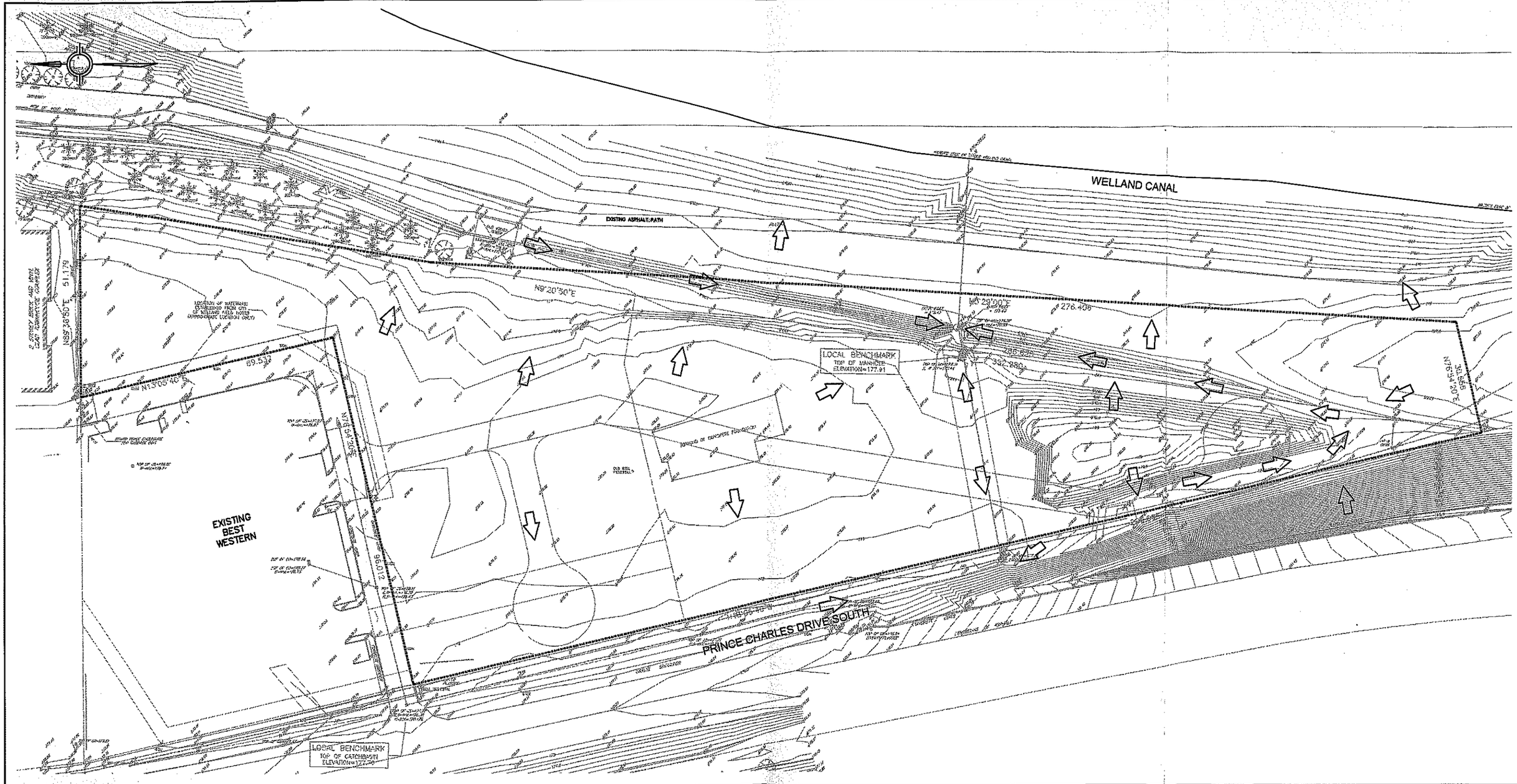
1.4 Proposed Development

The proposed development consists of a three-phase residential condominium development with a total of 235 units and a total building area of 6021 sq.m. A single driveway accesses to the site will be provided from the existing driveway to the Best Western motel located at the north side of the site. **Figure 3** shows the proposed development.

Site statistics relating to the proposed land uses are outlined in **Table 2**.

Table 2 Site Statistics for Proposed Development

Surface Cover	Area (ha)	Runoff Coeff. (C)
Total Building Area	0.60 ha	0.90
Pavement	0.84 ha	0.90
Landscape	1.01 ha	0.30
Total Site:	2.45 ha	0.59



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LEGEND

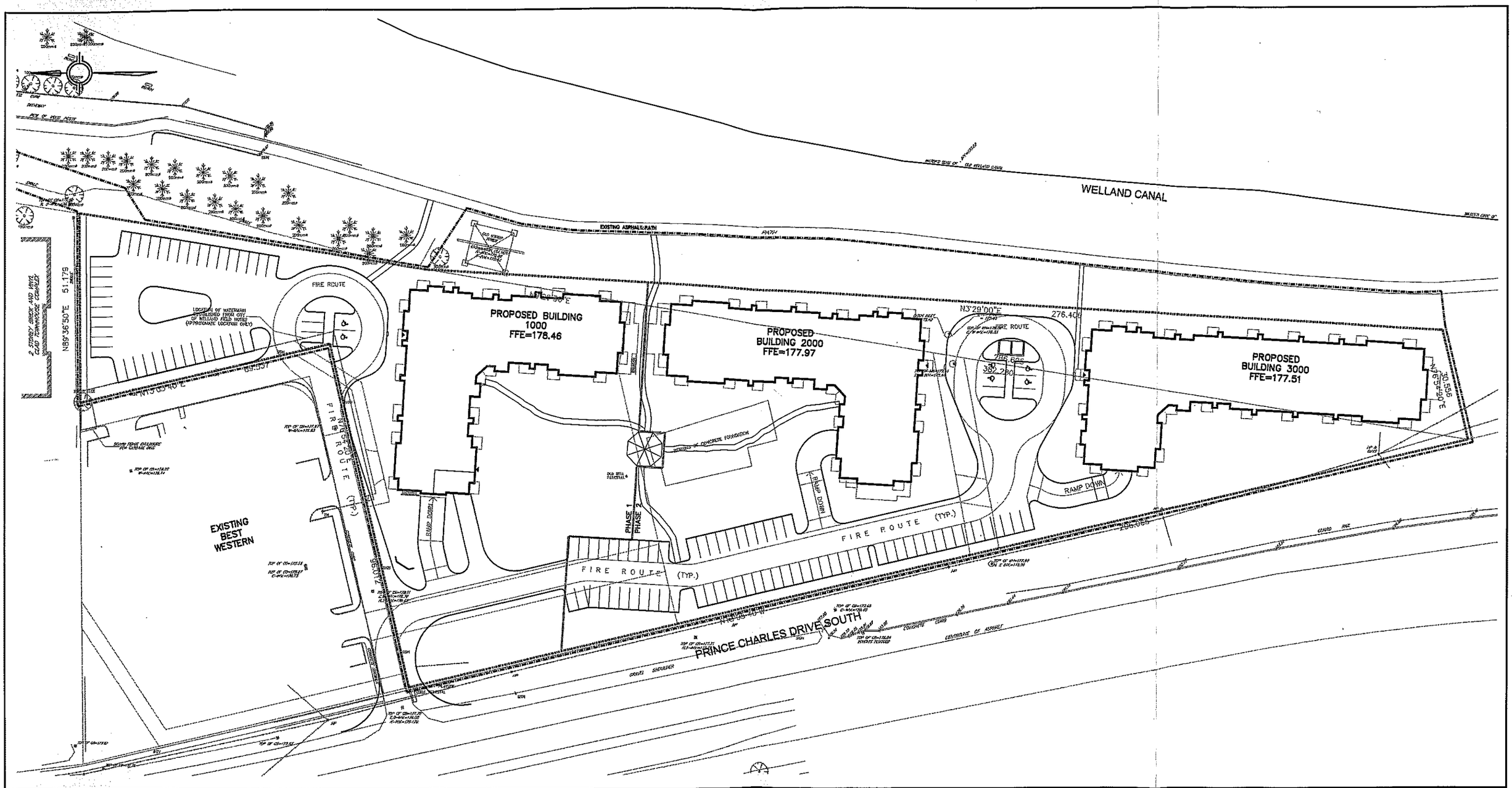
⇨ DIRECTION OF STORM WATER FLOW

Drawing Title
EXISTING DRAINAGE CONDITIONS

Project Title
PROPOSED SPRING POINTE DEVELOPMENT
PRINCE CHARLES DRIVE SOUTH
WELLAND, ONTARIO

Drawn By	Checked By	Figure No.
ZG	R.G.	2
Scale	Project No.	
N.T.S	PTD 10303	

H:\Projects\PTD10303 Welland -- P.O.V\CAD and Design\Internal\SWM\2006-10-27 SWM FIGURE .



BURNSIDE

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LEGEND

Drawing Title
PROPOSED DEVELOPMENT CONCEPT

Project Title
PROPOSED SPRING POINTE DEVELOPMENT
PRINCE CHARLES DRIVE SOUTH
WELLAND, ONTARIO

Drawn By	Checked By	Figure No.
ZG	R.G.	3
Scale	Project No.	
N.T.S	PTD 10303	

H:\Projects\PTD10303 Welland – P.O.V\CAD and Design\Internal\SWM\2006-10-27 SWM FIGURE .

2.0 Stormwater Management

2.1 Design Criteria

The following stormwater management criteria for the proposed development have been obtained through consultation with staff at the City of Welland:

- Runoff generated by storms from during the post-development condition must be detained on-site and released at the equivalent runoff rate from the pre-development event;
- A major overland flow route shall be provided within the developed site to direct runoff in excess of the 100 year storm to an approved overland flow outlet;
- Stormwater quality treatment is required for the parking areas of the site as per discussion with City of Welland Engineering Department
- Rooftop leaders must drain at grade and overland to storm catch basins

2.2 Method of Analysis

The Modified Rational Method was used to model the flows from the portion of the site to be developed under post and pre-development conditions.

As per City of Welland Standards, City of Welland IDF (Intensity Duration Frequency), curves were used to produce rainfall hyetographs for the 2 to 100 year storm events, with a time of concentration of ten minutes.

3.0 Stormwater Management Plan

3.1 Existing Conditions

The Modified Rational Method (MRM) was used to estimate pre-development stormwater flows for the 5-year and 100-year storm event.

Table 3 Modified Rational Method Pre-Development Flow Input Parameters

Catchment Outlet	Welland Canal
Catchment Area (ha)	2.45
Runoff Coefficient	0.31
Time of Concentration (min)	10

The maximum allowable release rate, based on the flow produced for a 5-year and 100-year pre-development storm event is 206.3 L/s and 325.1 L/s respectively. Refer to **Appendix A** for calculations.

3.2 Proposed Conditions

Controlled runoff for the site is collected by catch basins and conveyed by storm sewers to an existing 600 mm stormwater main running to the Welland Canal from Prince Charles Drive South. Uncontrolled runoff from the site will be generated from areas 1C, 1D, 2C, 2D, 4C, and 4D. As discussed with City staff, this runoff is from rooftop and landscaped areas (with the exception of a portion of the entrance feature to Building 1000) and does not require quality control. See **Figure 4** for a summary of drainage areas and summary sheets in **Appendix A & B**.

Site grading is such that an external area of 0.19 ha will contribute to the site, shown as a portion of Area 5A on **Figure 4**.

3.2.1 Quantity Control

Paved internal parking areas will be generally graded towards a series of on-site catch basin inlets connected to an internal storm sewer network. The internal storm sewers will connect to the existing 600 mm diameter storm sewer discharging to the Welland Canal.

The site requires approximately 156 m^3 of storage to control the 5-year storm and 252 m^3 to control the 100-year storm to pre-development levels. Parking lot and grassed areas around catch basins, and pipe storage provide approximately 157 m^3 of storage. To provide for the storage requirements, a detention area has been sized in the northwest corner of the site to hold approximately 108 m^3 of storage. Thus, 265 m^3 of storage is provided. See **Drawings G1** and **S1** for details.

The Servicing Plan (**Drawing S1**) illustrates the downstream quantity control structures for the development. Orifice plates will be used at the outlet to catchments Area 1, Area 4 and Area 5. Controls at Area 1 and Area 5 have been sized to maximize storage during the 100 year storm, and provide some storage during the 5 year storm. The orifice plate at the outlet to Area 4 has been designed to maximize storage during the 5 year storm. During the 100 year storm, the control structure will back water up entering the storm system such that it flows overland through the curb cut as shown on drawing G1.

A staged control structure will be used at the outlet to Area 3. The structure will act similar to a weir, with the five-year flow passing through the lower tube orifice, and the 100-year flow overflowing into the upper orifice tube. See **Appendix A** for a complete summary of calculations, and **Drawing S1** for the orifice details.

Table 4 Summary of Proposed Drainage Conditions

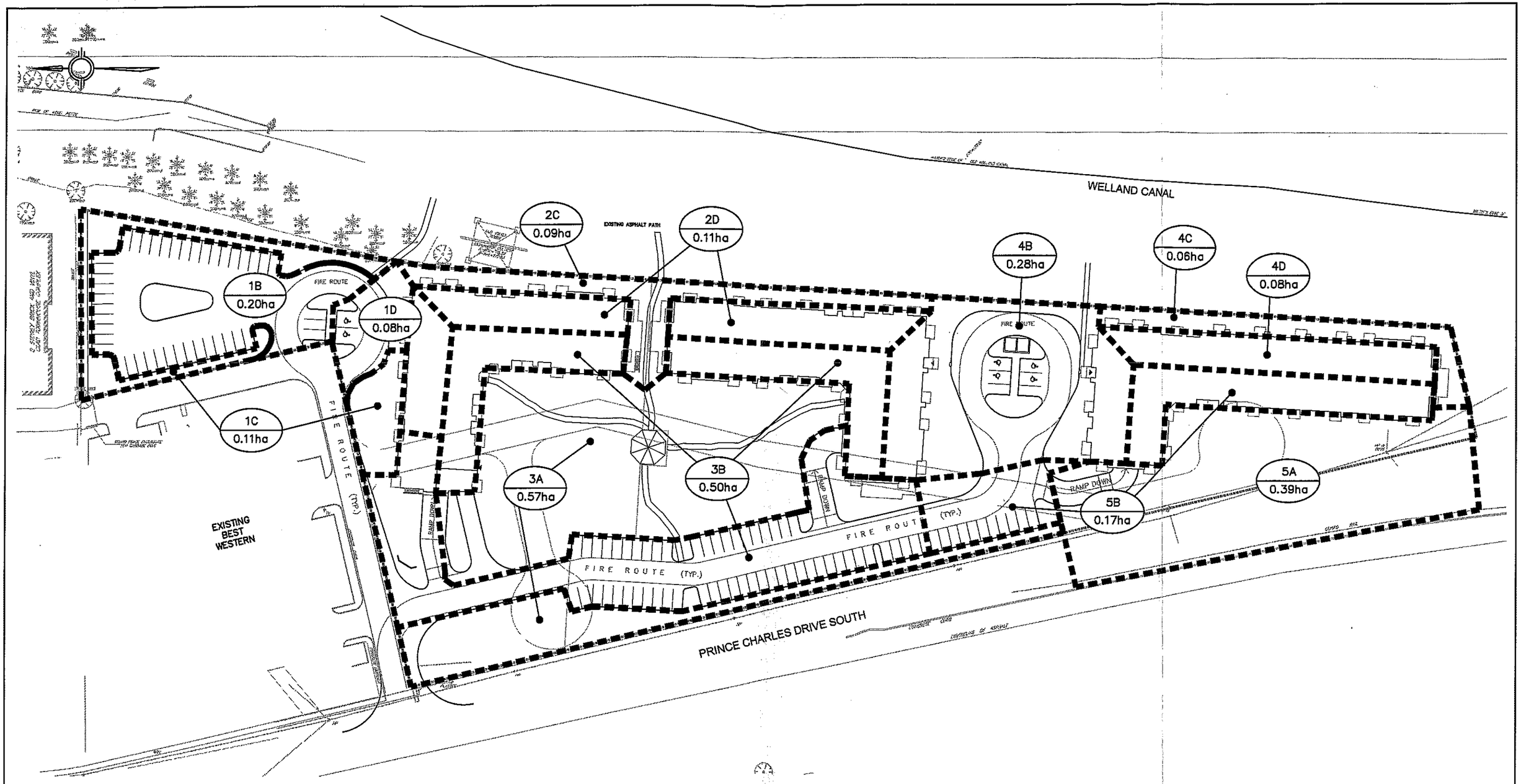
	Peak Flows (L/s)		Required Storage (m^3)		Storage Provided (m^3)
Catchment Name	**5 Year**	**100 Year**	**5 Year**	**100 Year**	
Area 1	45.5	62.6	16.8	34.9	36.0
Area 2	32.1	50.6	0.0	0.0	0.0
Area 3	31.4	51.7	98.4	145.6	146.0
Area 4	70.7	137.1	9.7	0.0	10.2
Area 5	22.3	16.5	31.0	72.9	73.1
Total	202.0	318.4	152.2	253.4	265.3

3.2.2 Stormwater Quality Controls

Stormwater Quality controls are required for the site. A TSS removal efficiency of 80% is targeted, as per MOE Stormwater Management Planning and Design Manual, dated March 2003. Due to the small size of the site, water quality treatment measures such as wet ponds and wetlands were ruled out. The MOE Stormwater Management Planning and Design Manual states that the minimum tributary area for wet ponds, wetlands and dry ponds is 5.0 hectares, with a preferred tributary area of 10 hectares.

Flows that will drain to the Welland Canal will achieve water quality treatment by incorporating oil-grit separators for the parking areas. A Stormceptor 2000 or equivalent will be required to provide the 80% TSS removal. The Stormceptor sizing sheet is shown in **Appendix B**.

Goss traps will be used at CB5 and CB6 in order to provide quality treatment from the southern parking lot areas. The location of the easement does not make it practical to use oil grit separators at these locations. A detail for the Goss traps is shown on **Drawing S1**.



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web www.rjburnside.com

LEGEND

AREA NAME
1B
0.20ha
AREA IN HECTARES

Drawing Title
STORM WATER DRAINAGE AREAS

Project Title
PROPOSED SPRING POINTE DEVELOPMENT
PRINCE CHARLES DRIVE SOUTH
WELLAND, ONTARIO

Drawn By	Checked By	Figure No.
ZG	R.G.	4
Scale	Project No.	
N.T.S	PTD 10303	

H:\Projects\PTD10303 Welland – P.O.V\CAD and Design\Internal\SWM\2006-10-25 SWM FIGURE

4.0 Erosion and Sediment Control

Given the topography and soils condition of the existing site, the subject property is considered to have moderate erosion potential. Special care must be taken during construction so that silt and other deleterious materials do not escape the designated limits of construction. As such, it is recommended that the following practices be implemented to minimize on-site erosion and transport of eroded material offsite:

- Restore exposed surfaces with vegetative and non-vegetative cover material as soon as construction schedules reasonably permit.
- Provide silt fence at designated limits of construction to prevent disturbance to the surrounding rights-of-way and adjacent property
- Designate fuelling, fuel storage and material stockpile areas, ensuring that these areas are properly designed to contain leaks and other surface spills;
- Line proposed catchbasins with geotextile silt traps to minimize silt deposits in the existing storm sewer system;
- Construct a coarse granular mud mat at the construction entrances to minimize mud tracking from the site onto adjacent streets;
- Undertake regular monitoring of the stormwater quality treatment units, and cleanout as necessary;
- Construct interceptor swales complete with intermittent rock flow check dams during the construction phase;

Through the implementation of the proposed construction practices discussed above and regular maintenance of these controls, it can be ensured that satisfactory protection of the neighbouring properties and downstream municipal infrastructure will occur during the construction stage of the proposed development. Refer to drawing ES1.

5.0 Conclusions and Recommendations

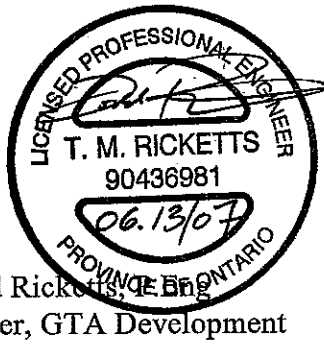
Stormwater management measures for the site can be summarized as follows:

- Post development flows will be controlled to pre-development levels for the site. Under the proposed conditions, the 5 year and 100-year post-development flows can be controlled to 204 L/s and 321 L/s respectively.
- Approximately 253 m^3 of storage is required on-site to achieve the proposed flow control. Approximately 265 m^3 of storage has been provided.
- A Stormceptor 2000 will provide stormwater quality treatment for Area 1 and 3
- Measures for mitigation of silt-laden runoff leaving the site during construction have been identified in this report.

In summary, the site is to be serviced with an on-site stormwater management system capable of satisfying the applicable SWM criteria. Accordingly, we hereby recommend the adoption of this report as it relates to the provision of SWM works, and for the purposes of the Site Plan Application.

Prepared by:

R. J. Burnside & Associates Limited



Todd Ricketts, P.Eng
Leader, GTA Development

Rob Grech
Engineering Assistant

TR:cv

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Appendix A
5 Year Stormwater Management Calculations

Summary of Post Development Areas - 5 Year Flow

Cover Type	Runoff Coefficient	Area (ha)	Flow	Required Storage (m^3)	Storage Provided (m^3)	Orifice Size (mm)
Area 1						
Uncontrolled						
1C Landscaped	0.30	0.11				
1D Asphalt/Roof	0.90	0.08				
Sub-Total	0.56	0.19	27.3			
Controlled						
1A Landscaped	0.30	0.00				
1B Asphalt/Roof	0.90	0.20				
Sub-Total	0.90	0.20	18.2	16.8	36.0	
Total Area 1	**0.73**	**0.39**	**45.5**	**16.8**	**36.0**	**85**
Area 2						
Uncontrolled						
2C Landscaped	0.30	0.09				
2D Asphalt/Roof	0.90	0.11				
Sub-Total	0.62	0.20	32.1			
Controlled						
2A Landscaped	0.30	0.00				
2B Asphalt/Roof	0.90	0.00				
Sub-Total	0.00	0.00	0.0	0.0	0.0	
Total Area 2	**0.62**	**0.20**	**32.1**	**0.0**	**0.0**	
Area 3						
Uncontrolled						
3C Landscaped	0.30	0.00				
3D Asphalt/Roof	0.90	0.00				
Sub-Total	0.00	0.00	0.00			
Controlled						
3A Landscaped	0.30	0.57				
3B Asphalt/Roof	0.90	0.50				
Sub-Total	0.58	1.07	31.4	98.4	146.0	
Total Area 3	**0.58**	**1.07**	**31.4**	**98.4**	**146.0**	**125**
Area 4						
Uncontrolled						
4C Landscaped	0.30	0.06				
4D Asphalt/Roof	0.90	0.08				
Sub-Total	0.00	0.15	24.0			
Controlled						
4A Landscaped	0.30	0.00				
4B Asphalt/Roof	0.90	0.28				
Sub-Total	0.90	0.28	46.7	9.7	10.2	
Total Area 4	**0.59**	**0.43**	**70.7**	**9.7**	**10.2**	**135**
Area 5						
Uncontrolled						
5C Landscaped	0.30	0.00				
5D Asphalt/Roof	0.90	0.00				
Sub-Total	0.00	0.00	0.0			
Controlled						
5A Landscaped	0.30	0.39				
5B Asphalt/Roof	0.90	0.17				
Sub-Total	0.48	0.56	22.3	31.0	73.1	
Total Area 5	**0.48**	**0.55**	**22.3**	**31.0**	**73.1**	**80**
Total - Area 1-5	**0.59**	**2.65**	**202.0**	**155.9**	**265.3**	

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Project: **Welland P.O.V**
Task: **Pre-Development Flowrates**
Date: **13-Jun-07**

Prepared by: **RG**
Checked by: **TR**
Project no.: **PTD 10303**

5-year Pre-Development Flow

A	830					
B	7.3					
C	0.777					
T	10.0	min				

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Entire Site	0.31	90.60	2.65	206.5

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

$$= 206.5\ L/s$$

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Project: **Welland P.O.V**
Task: **Pre-Development Flowrates**
Date: **13-Jun-07**

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Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Entire Site	0.31	90.60	2.65	206.5

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

$$= 206.5\ L/s$$

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CALCULATION SHEET

Project: **P.O.V. - Welland**	Prepared by: R. Grech	Date: 06/13/07
	Checked by: T. Ricketts	Sheet:

A. **5 Year Controlled Flow - Area 1**

	Description	C	Area	
1A	Landscaped Area	0.30	0.00	ha
1B	Asphalt/Roof Area	0.90	0.20	ha
	Controlled Total/average	0.90	0.20	ha
1C	Uncontrolled Landscaped	0.30	0.11	ha
1D	Uncontrolled Asphalt/Roof	0.90	0.08	ha
	Uncontrolled Total/average	0.56	0.19	ha
	Total Area 1		0.39	

Rainfall intensity

$$I = \frac{830}{7.3 + t^{0.777}}$$

where, $t =$ 10 minutes (initial time of concentration)

therefore, $I =$ 90.60 mm/hr

Allowable Release Rate= 44.50 l/s

Uncontrolled Flow= 27.31 l/s

Available flow= 17.19 l/s

			Design		***Actual***	
Time (min)	Intensity (mm/hr)	Uncont. Runoff (1)	Controlled Runoff (1)	Storage (m^3)	Controlled Runoff (1)	Storage (m3)
10	90.60	44.96	17.19	16.66	18.22	16.04
15	74.38	36.91	17.19	17.75	18.22	16.82
20	63.56	31.54	17.19	17.22	18.22	15.98
25	55.77	27.68	17.19	15.73	18.22	14.18
30	49.87	24.75	17.19	13.61	18.22	11.75
35	45.23	22.45	17.19	11.04	18.22	8.87
40	41.47	20.58	17.19	8.14	18.22	5.66
45	38.35	19.03	17.19	4.98	18.22	2.19
50	35.73	17.73	17.19	1.62	18.22	0.00
55	33.48	16.61	17.19	0.00	18.22	0.00
60	31.53	15.65	17.19	0.00	18.22	0.00
65	29.82	14.80	17.19	0.00	18.22	0.00

Orifice Design

Diameter= 85 mm

Area= 5.67E-03 m^2

Invert= 176.83 m

C= 0.62

HWL= 178.24 m

Design Flow= 18.22 l/s

Storage Required= 16.82 m^3

Storage Provided= 35.78 m^3

$Q = CA(\sqrt{2gh})$

Discharge Coefficients Plate = 0.62, Tube = 0.84

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Project: **Welland P.O.V**

Task: **Uncontrolled Runoff - Area 2**

Date: **13-Jun-07**

Prepared by: **RG**

Checked by: **TR**

Project no.: **PTD 10303**

5-year Post-Development Flow

A	830					
B	7.3					
C	0.777					
T	10.0	min				

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Area 2	0.62	90.60	0.20	32.1

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

$$= 32.1\ L/s$$

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CALCULATION SHEET

Project: **P.O.V. - Welland**	Prepared by: R. Grech	Date: 06/13/07
	Checked by: T. Ricketts	Sheet:

A. **5 Year Controlled Flow - Area 3**

	Description	C	Area	
3A	Landscaped Area	0.30	0.57	ha
3B	Asphalt/Roof Area	0.90	0.50	ha
	Total/average	0.58	1.07	ha
3C	Uncontrolled Grass	0.30	0.00	ha
3D	Uncontrolled Asphalt/Roof	0.90	0.00	ha
	Total/average	0.00	0.00	ha
	Total Area 3	0.58	1.07	

Rainfall intensity

$$I = \frac{830}{7.3 + t^{0.777}}$$

where, $t =$ 10 minutes (initial time of concentration)

therefore, $I =$ 90.60 mm/hr

Allowable Release Rate= 17.80 l/s

Uncontrolled Flow= 0.00 l/s

Available flow= 17.80 l/s

			Design		***Actual***	
Time (min)	Intensity (mm/hr)	Uncont. Runoff (1)	Controlled Runoff (1)	Storage (m^3)	Controlled Runoff (1)	Storage (m3)
10	90.60	156.29	17.80	83.10	31.38	74.95
15	74.38	128.31	17.80	99.46	31.38	87.24
20	63.56	109.65	17.80	110.22	31.38	93.93
25	55.77	96.22	17.80	117.63	31.38	97.26
30	49.87	86.04	17.80	122.83	31.38	98.39
35	45.23	78.03	17.80	126.47	31.38	97.96
40	41.47	71.54	17.80	128.97	31.38	96.39
45	38.35	66.16	17.80	130.58	31.38	93.93
50	35.73	61.63	17.80	131.50	31.38	90.77
55	33.48	57.75	17.80	131.85	31.38	87.05
60	31.53	54.39	17.80	131.73	31.38	82.86
65	29.82	51.45	17.80	131.22	31.38	78.27

Orifice Design (Low Flow)

Diameter=	125 mm	Storage Required=	98.39 m^3
Area=	1.23E-02 m^2	Storage Provided=	146.00 m^3
Invert=	175.82 m		
C=	0.84		
HWL=	177.00 m	$Q = CA(\sqrt{2gh})$	
Design Flow=	49.60 l/s	Discharge Coefficients Plate = 0.62, Tube = 0.84	

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CALCULATION SHEET

Project: **P.O.V. - Welland**	Prepared by: R. Grech	Date: 06/13/07
	Checked by: T. Ricketts	Sheet:

A. **5 Year Controlled Flow - Area 4**

	Description	C	Area	
3A	Landscaped Area	0.30	0.00	ha
3B	Asphalt/Roof Area	0.90	0.28	ha
	Total/average	0.90	0.28	ha
3C	Uncontrolled Grass	0.30	0.06	ha
3D	Uncontrolled Asphalt/Roof	0.90	0.08	ha
	Total/average	0.64	0.15	ha
	Total Area 4	0.90	0.43	

Rainfall intensity

$$I = \frac{830}{7.3 + t^{0.777}}$$

where, t = 10 minutes (initial time of concentration)

therefore, I = 90.60 mm/hr

Allowable Release Rate= 70.70 l/s

Uncontrolled Flow= 24.04 l/s

Available flow= 46.66 l/s

			Design		***Actual***	
Time (min)	Intensity (mm/hr)	Uncont. Runoff (1)	Controlled Runoff (1)	Storage (m^3)	Controlled Runoff (1)	Storage (m3)
10	90.60	62.83	46.66	9.70	46.68	9.69
15	74.38	51.59	46.66	4.43	46.68	4.42
20	63.56	44.08	46.66	0.00	46.68	0.00
25	55.77	38.68	46.66	0.00	46.68	0.00
30	49.87	34.59	46.66	0.00	46.68	0.00
35	45.23	31.37	46.66	0.00	46.68	0.00
40	41.47	28.76	46.66	0.00	46.68	0.00
45	38.35	26.60	46.66	0.00	46.68	0.00
50	35.73	24.78	46.66	0.00	46.68	0.00
55	33.48	23.22	46.66	0.00	46.68	0.00
60	31.53	21.87	46.66	0.00	46.68	0.00
65	29.82	20.68	46.66	0.00	46.68	0.00

Orifice Design

Diameter= 135 mm

Area= 1.43E-02 m^2

Invert= 175.68 m

C= 0.62

HWL= 177.09 m

Design Flow= 46.68 l/s

Storage Required= 9.69 m^3

Storage Provided= 10.20 m^3

$Q = CA(\sqrt{2gh})$

Discharge Coefficients Plate = 0.62, Tube = 0.84

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CALCULATION SHEET

Project: **P.O.V. - Welland**	Prepared by: R. Grech	Date: 06/13/07
	Checked by:	Sheet:

A. **5 Year Controlled Flow - Area 5**

	Description	C	Area	
5A	Landscaped Area	0.30	0.39	ha
5B	Asphalt/Roof Area	0.90	0.17	ha
	Total/average	0.48	0.55	ha
5C	Uncontrolled Landscaped	0.30	0.00	ha
5D	Uncontrolled Asphalt/Roof	0.90	0.00	ha
	Total/average	0.00	0.00	ha
	Total Area 5		0.55	

Rainfall intensity

$$I = \frac{830}{7.3 + t^{0.777}}$$

where, $t =$ 10 minutes (initial time of concentration)

therefore, $I =$ 90.60 mm/hr

Allowable Release Rate= 22.30 l/s

Uncontrolled Flow= 0.00 l/s

Available flow= 22.30 l/s

			Design		***Actual***	
Time (min)	Intensity (mm/hr)	Uncont. Runoff (1)	Controlled Runoff (1)	Storage (m^3)	Controlled Runoff (1)	Storage (m3)
10	90.60	66.91	21.08	27.50	21.08	27.50
15	74.38	54.93	22.30	29.37	21.08	30.47
20	63.56	46.94	22.30	29.57	21.08	31.04
25	55.77	41.19	22.30	28.34	21.08	30.17
30	49.87	36.83	22.30	26.16	21.08	28.36
35	45.23	33.40	22.30	23.32	21.08	25.89
40	41.47	30.63	22.30	19.98	21.08	22.92
45	38.35	28.33	22.30	16.27	21.08	19.57
50	35.73	26.39	22.30	12.26	21.08	15.93
55	33.48	24.73	22.30	8.00	21.08	12.04
60	31.53	23.29	22.30	3.55	21.08	7.95
65	29.82	22.02	22.30	0.00	21.08	3.70

Orifice Design

Diameter= 80 mm

Area= 5.03E-03 m^2

Invert= 175.88 m

C= 0.84

HWL= 177.15 m

Storage Required= 31.04 m^3

Storage Provided= 73.10 m^3

$$Q = CA(\sqrt{2gh})$$

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Appendix B
100 Year Stormwater Management Calculations

Summary of Post Development Areas - 100 Year Flow

Cover Type	Runoff Coefficient	Area (ha)	Flow	Required Storage (m^3)	Storage Provided (m^3)	Orifice Size (mm)
Area 1						
Uncontrolled						
1C Landscaped	0.30	0.11				
1D Asphalt/Roof	0.90	0.08				
Sub-Total	0.56	0.19	43.1			
Controlled						
1A Landscaped	0.30	0.00				
1B Asphalt/Roof	0.90	0.20				
Sub-Total	0.90	0.20	19.5	34.9	36.0	
Total Area 1	**0.73**	**0.39**	**62.6**	**34.9**	**36.0**	**85**
Area 2						
Uncontrolled						
2C Landscaped	0.30	0.09				
2D Asphalt/Roof	0.90	0.11				
Sub-Total	0.62	0.20	50.6			
Controlled						
2A Landscaped	0.30	0.00				
2B Asphalt/Roof	0.90	0.00				
Sub-Total	0.00	0.00	0.0	0.0	0.0	
Total Area 2	**0.62**	**0.20**	**50.6**	**0.0**	**0.0**	
Area 3						
Uncontrolled						
3C Landscaped	0.30	0.00				
3D Asphalt/Roof	0.90	0.00				
Sub-Total	0.00	0.00	0.00			
Controlled						
3A Landscaped	0.30	0.57				
3B Asphalt/Roof	0.90	0.50				
Sub-Total	0.58	1.07	51.7	143.9	146.0	
Total Area 3	**0.58**	**1.07**	**51.7**	**143.9**	**146.0**	**125**
Area 4						
Uncontrolled						
4C Landscaped	0.30	0.06				
4D Asphalt/Roof	0.90	0.36				
Sub-Total	0.81	0.43	137.1			
Controlled						
4A Landscaped	0.30	0.00				
4B Asphalt/Roof	0.90	0.00				
Sub-Total	0.81	0.00	0.0	0.0	10.2	
Total Area 4	**0.81**	**0.43**	**137.1**	**0.0**	**10.2**	
Area 5						
Uncontrolled						
5C Landscaped	0.30	0.00				
5D Asphalt/Roof	0.90	0.00				
Sub-Total	0.00	0.00	0.0			
Controlled						
5A Landscaped	0.30	0.39				
5B Asphalt/Roof	0.90	0.17				
Sub-Total	0.48	0.55	16.5	72.9	73.1	
Total Area 5	**0.48**	**0.55**	**16.5**	**72.9**	**73.1**	**80**
Total - Area 1-5	**0.62**	**2.65**	**318.4**	**251.7**	**265.3**	

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Project: **Welland P.O.V**
Task: **Pre-Development Flowrates**
Date: **13-Jun-07**

Prepared by: **RG**
Checked by: **TR**
Project no.: **PTD 10303**

100-year Pre-Development Flow

A	1020					
B	4.7					
C	0.731					
T	10.0	min				

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Entire Site	0.31	142.99	2.64	325.1

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

$$= 325.1\ L/s$$

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CALCULATION SHEET

Project: **P.O.V. - Welland**	Prepared by: R. Grech	Date: 06/13/07
	Checked by: T. Ricketts	Sheet:

A. **100 Year Controlled Flow - Area 1**

	Description	C	Area	
1A	Landscaped Area	0.30	0.00	ha
1B	Asphalt/Roof Area	0.90	0.20	ha
	Controlled Total/average	0.90	0.20	ha
1C	Uncontrolled Landscaped	0.30	0.11	ha
1D	Uncontrolled Asphalt/Roof	0.90	0.08	ha
	Uncontrolled Total/average	0.56	0.19	ha
	Total Area 1		0.39	

Rainfall intensity

$$I = \frac{1020}{4.7 + t^{0.731}}$$

where, $t =$ 10 minutes (initial time of concentration)

therefore, $I =$ 142.99 mm/hr

Allowable Release Rate= 60.95 l/s

Uncontrolled Flow= 43.10 l/s

Available flow= 17.85 l/s

			Design		***Actual***	
Time (min)	Intensity (mm/hr)	Uncont. Runoff (1)	Controlled Runoff (1)	Storage (m^3)	Controlled Runoff (1)	Storage (m3)
10	142.99	70.96	17.85	31.87	19.46	30.90
15	115.44	57.29	17.85	35.50	19.46	34.04
20	97.85	48.56	17.85	36.85	19.46	34.91
25	85.51	42.44	17.85	36.88	19.46	34.46
30	76.32	37.88	17.85	36.05	19.46	33.14
35	69.16	34.33	17.85	34.60	19.46	31.21
40	63.42	31.47	17.85	32.70	19.46	28.83
45	58.69	29.13	17.85	30.45	19.46	26.09
50	54.72	27.16	17.85	27.92	19.46	23.08
55	51.33	25.47	17.85	25.16	19.46	19.83
60	48.40	24.02	17.85	22.22	19.46	16.40
65	45.83	22.75	17.85	19.11	19.46	12.81

Orifice Design

Diameter= 85 mm

Area= 5.67E-03 m^2

Invert= 176.83 m

C= 0.62

HWL= 178.39 m

Design Flow= 19.46 l/s

Storage Required= 34.91 m^3

Storage Provided= 35.78 m^3

$Q = CA(\sqrt{2gh})$

Discharge Coefficients Plate = 0.62, Tube = 0.84

BURNSIDE

Project: **Welland P.O.V**

Task: **Uncontrolled Runoff - Area 2**

Date: **13-Jun-07**

Prepared by: **RG**

Checked by: **TR**

Project no.: **PTD 10303**

100-year Post-Development Flow

A	1020					
B	4.7					
C	0.731					
T	10.0	min				

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Area 2	0.62	142.99	0.20	50.6

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

$$= 50.6\ L/s$$

BURNSIDE

CALCULATION SHEET

Project: **P.O.V. - Welland**	Prepared by: R. Grech	Date: 06/13/07
	Checked by: T. Ricketts	Sheet:

A. **100 Year Controlled Flow - Area 3**

	Description	C	Area	
3A	Landscaped Area	0.30	0.57	ha
3B	Asphalt/Roof Area	0.90	0.50	ha
	Total/average	0.58	1.07	ha
3C	Uncontrolled Grass	0.30	0.00	ha
3D	Uncontrolled Asphalt/Roof	0.90	0.00	ha
	Total/average	0.00	0.00	ha
	Total Area 3	0.58	1.07	

Rainfall intensity

$$I = \frac{1020}{4.7 + t^{0.731}}$$

where, $t =$ 10 minutes (initial time of concentration)

therefore, $I =$ 142.99 mm/hr

Allowable Release Rate= 51.70 l/s

Uncontrolled Flow= 0.00 l/s

Available flow= 51.70 l/s

			Design		***Actual***	
Time (min)	Intensity (mm/hr)	Uncont. Runoff (1)	Controlled Runoff (1)	Storage (m^3)	Controlled Runoff (1)	Storage (m3)
10	142.99	246.67	51.70	116.98	51.72	116.97
15	115.44	199.14	51.70	132.70	51.72	132.68
20	97.85	168.80	51.70	140.52	51.72	140.49
25	85.51	147.52	51.70	143.72	51.72	143.70
30	76.32	131.66	51.70	143.92	51.72	143.89
35	69.16	119.32	51.70	142.00	51.72	141.96
40	63.42	109.41	51.70	138.50	51.72	138.46
45	58.69	101.25	51.70	133.78	51.72	133.73
50	54.72	94.40	51.70	128.09	51.72	128.04
55	51.33	88.55	51.70	121.60	51.72	121.55
60	48.40	83.49	51.70	114.46	51.72	114.39
65	45.83	79.07	51.70	106.75	51.72	106.68

Orifice Design (Low Flow)

Diameter=	125 mm	Storage Required=	143.89 m^3
Area=	1.23E-02 m^2	Storage Provided=	146.00 m^3
Invert=	175.82 m		
C=	0.84		
HWL=	177.09 m	$Q = CA(\sqrt{2gh})$	
Design Flow=	51.46 l/s	Discharge Coefficients Plate = 0.62, Tube = 0.84	

Orifice Design (High Flows)

Diameter=	150 mm
Area=	1.77E-02 m^2
Invert=	177.00 m
C=	0.84
HWL=	177.09 m
Design Flow=	19.73 l/s

BURNSIDE

Project: **Welland P.O.V**

Task: **Uncontrolled Runoff - Area 4**

Date: **13-Jun-07**

Prepared by: **RG**

Checked by: **TR**

Project no.: **PTD 10303**

100-year Post-Development Flow

A	1020					
B	4.7					
C	0.731					
T	10.0	min				

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Area 4	0.81	142.99	0.43	137.1

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

$$= 137.1\ L/s$$

BURNSIDE

CALCULATION SHEET

Project: **P.O.V. - Welland**	Prepared by: R. Grech	Date: 06/13/07
	Checked by:	Sheet:

A. **100 Year Controlled Flow - Area 5**

	Description	C	Area	
5A	Landscaped Area	0.30	0.39	ha
5B	Asphalt/Roof Area	0.90	0.17	ha
	Total/average	0.48	0.55	ha
5C	Uncontrolled Landscaped	0.30	0.00	ha
5D	Uncontrolled Asphalt/Roof	0.90	0.00	ha
	Total/average	0.00	0.00	ha
	Total Area 5		0.55	

Rainfall intensity $I = \frac{1020}{4.7 + t^{0.731}}$

where, t = 10 minutes (initial time of concentration)

therefore, I = 142.99 mm/hr

Allowable Release Rate= 16.45 l/s

Uncontrolled Flow= 0.00 l/s

Available flow= 16.45 l/s

			Design		***Actual***	
Time (min)	Intensity (mm/hr)	Uncont. Runoff (1)	Controlled Runoff (1)	Storage (m^3)	Controlled Runoff (1)	Storage (m3)
10	142.99	105.60	16.45	53.49	16.45	53.49
15	115.44	85.26	16.45	61.93	16.45	61.93
20	97.85	72.26	16.45	66.98	16.45	66.98
25	85.51	63.15	16.45	70.06	16.45	70.06
30	76.32	56.36	16.45	71.85	16.45	71.85
35	69.16	51.08	16.45	72.73	16.45	72.73
40	63.42	46.84	16.45	72.93	16.45	72.94
45	58.69	43.35	16.45	72.62	16.45	72.62
50	54.72	40.41	16.45	71.89	16.45	71.89
55	51.33	37.91	16.45	70.82	16.45	70.82
60	48.40	35.74	16.45	69.46	16.45	69.46
65	45.83	33.85	16.45	67.87	16.45	67.87

Orifice Design

Diameter= 80 mm

Area= 5.03E-03 m^2

Invert= 175.88 m

C= 0.62

HWL= 177.30 m

Design Flow= 16.45 l/s

Storage Required= 72.94 m^3

Storage Provided= 73.10 m^3

$Q = CA(\sqrt{2gh})$

Discharge Coefficients Plate = 0.62, Tube = 0.84

BURNSIDE

Appendix C
Stormceptor Sizing Information

Stormceptor CD Sizing Program
Canada
Version 4.0.0

Project Details			
Project	POV Welland	Project #	PTD 10303
Location	Welland, ON	Company	RJ Burnside
Date	June 13/07	Contact	R Grech

Selected Rainfall Station	
State	ONTARIO
Name	TORONTO CENTRAL
ID #	
Elev. (m)	100
Latitude	N 45 deg 30 min
Longitude	W 90 deg 30 min

Site Parameters	
Total Area (ha)	1.27
Imperviousness (%)	60.
Impervious Area (ha)	.76

Particle Size Distribution		
Diam. (um)	Percent (%)	Spec. Gravity
20	20	1.30
60	20	1.80
150	20	2.20
400	20	2.65
2000	20	2.65

Stormceptor Sizing Table		
Stormceptor Model	% Runoff Treated	% TSS Removal
STC 300	83	68
STC 750	95	78
STC 1000	95	79
STC 1500	95	79
STC 2000	98	82
STC 3000	98	83
STC 4000	99	86
STC 5000	99	87
STC 6000	99	89
STC 9000	100	91
STC 10000	100	91
STC 14000	100	93

Comments :

Upstream Quantity Storage

Storage (ha-m)	Flow (cms)
0.000	0.000
0.012	0.077
0.018	0.095

APPENDIX ‘B’

Hydroguard HG10

Sizing Calculations and Schematic

Hydroworks Sizing Summary

350 Prince Charles Drive South

03-26-2021

Recommended Size: HG 10

A Hydroguard HG 10 is recommended to provide 80 % annual TSS removal based on a drainage area of 2.25 (ha) with an imperviousness of 68.6 % and St. Catherines A, Ontario rainfall for the ETV Canada particle size distribution.

The recommended Hydroguard HG 10 treats 94 % of the annual runoff and provides 84 % annual TSS removal for the St. Catherines A rainfall records and ETV Canada particle size distribution.

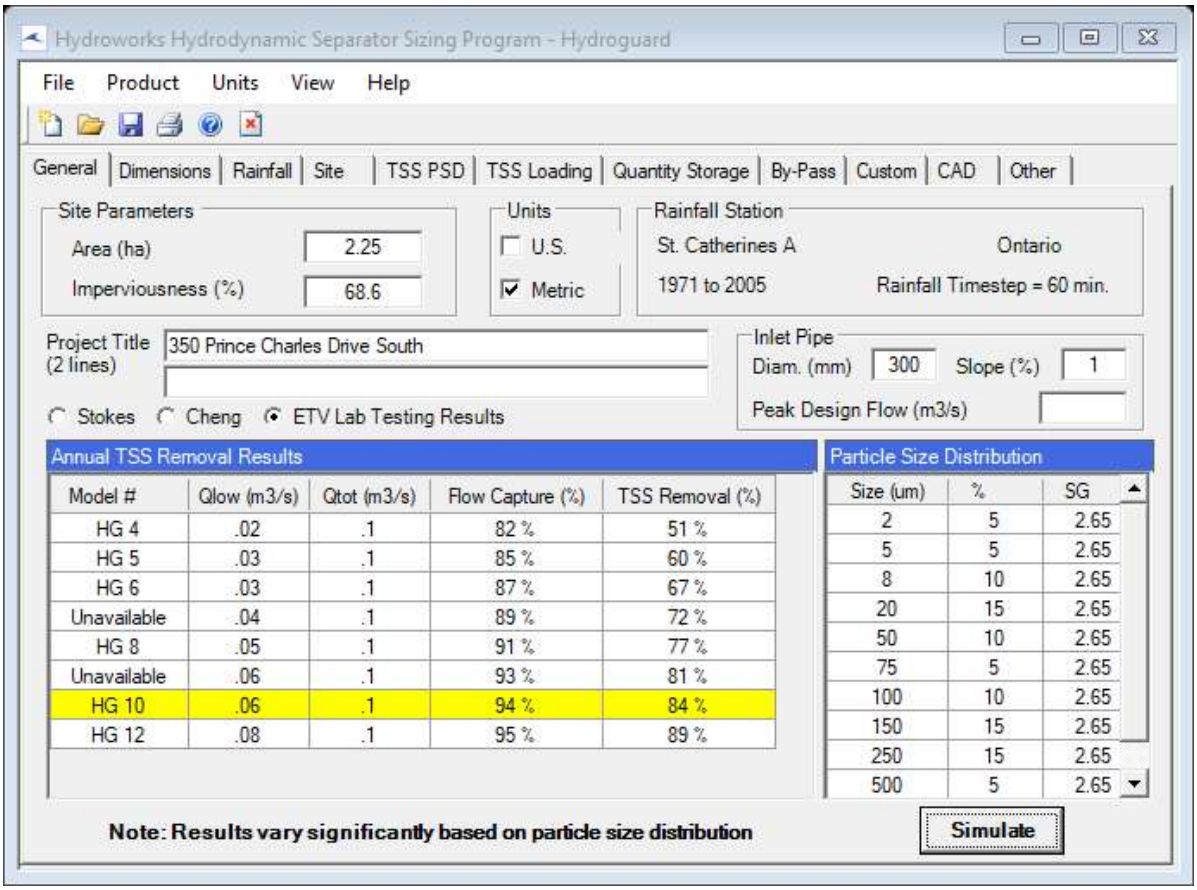
The Hydroguard has a headloss coefficient (K) of 1.6. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .1 (m3/s) for the given 300 (mm) pipe diameter at 1% slope. The headloss was calculated to be 153 (mm) based on a flow depth of 300 (mm) (full pipe flow).

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

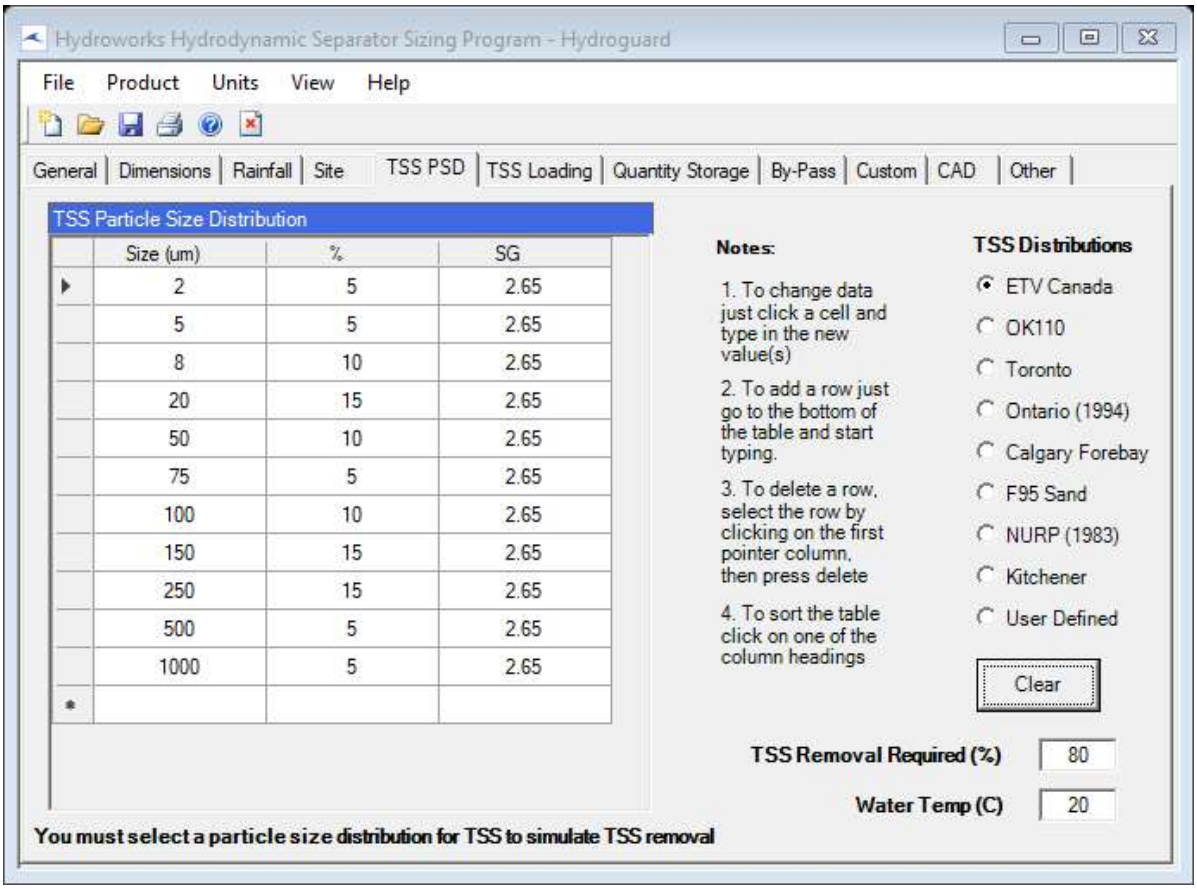
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the Hydroguard . Design liability is only valid for lawsuits brought within the United States where Hydroworks has its corporate headquarters.

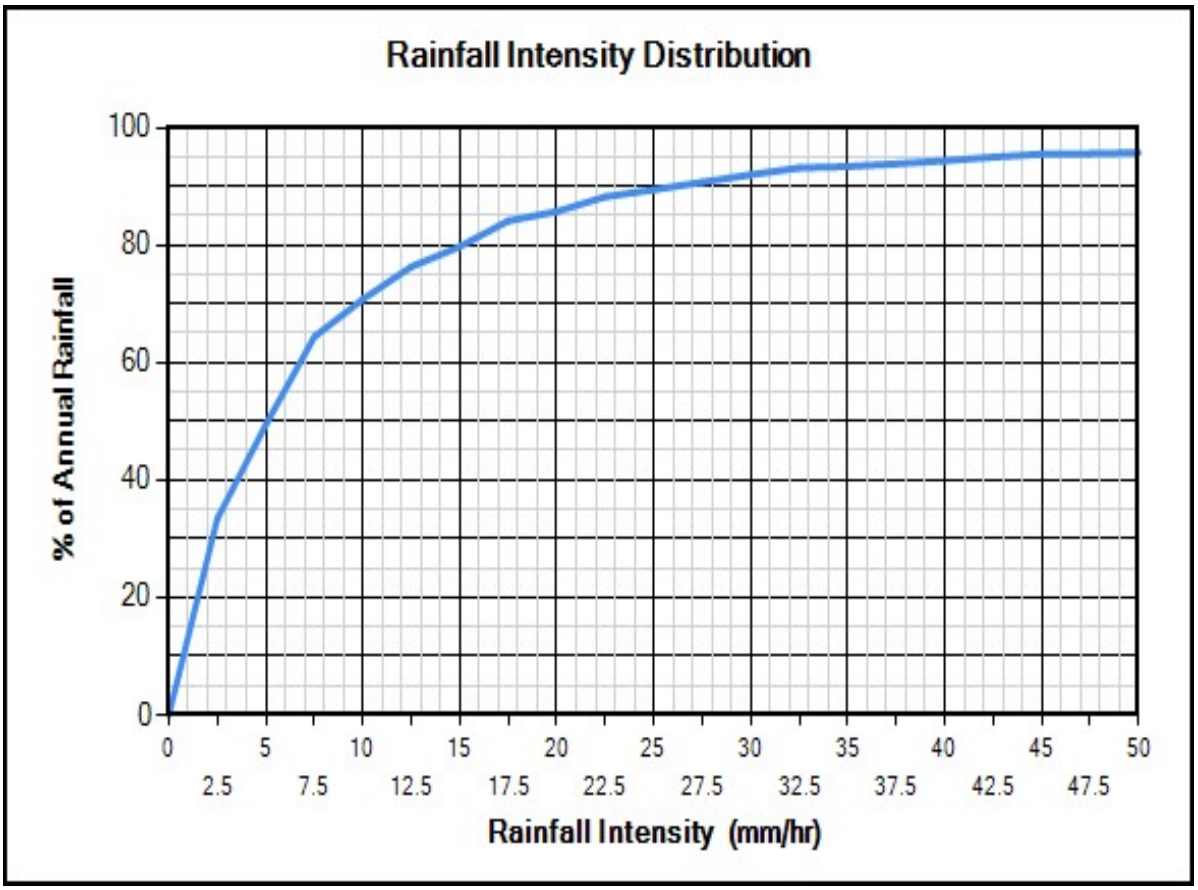
TSS Removal Sizing Summary



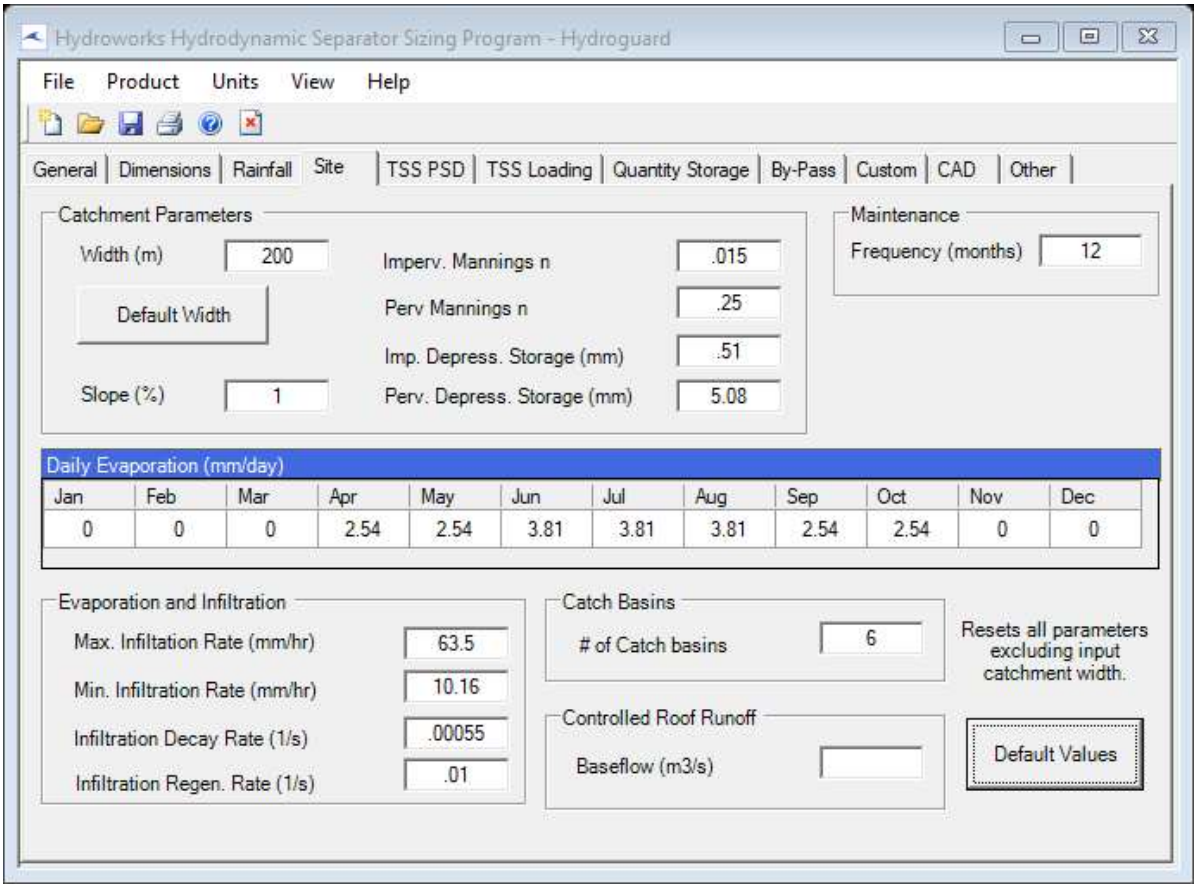
TSS Particle Size Distribution



Rainfall Station - St. Catherines A, Ontario(1971 to 2005)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - Hydroguard

File Product Units View Help

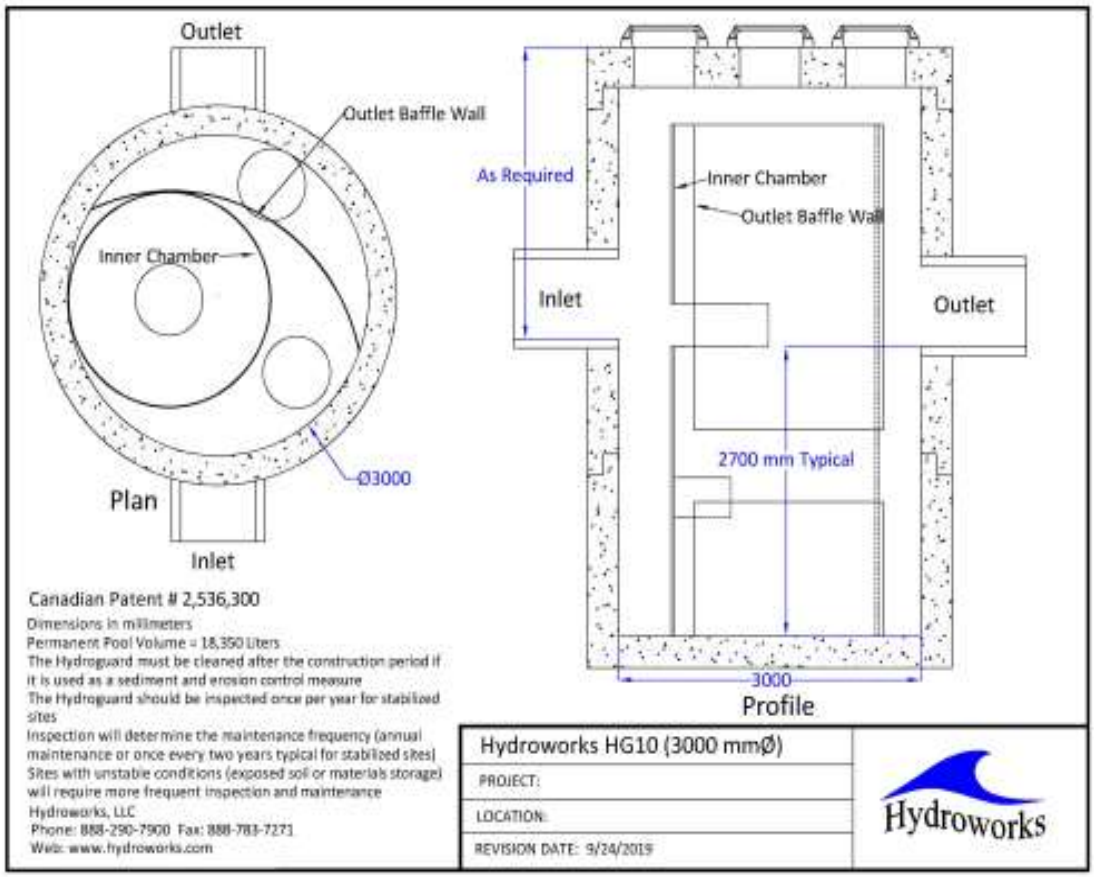
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Other

Dimensions and Capacities

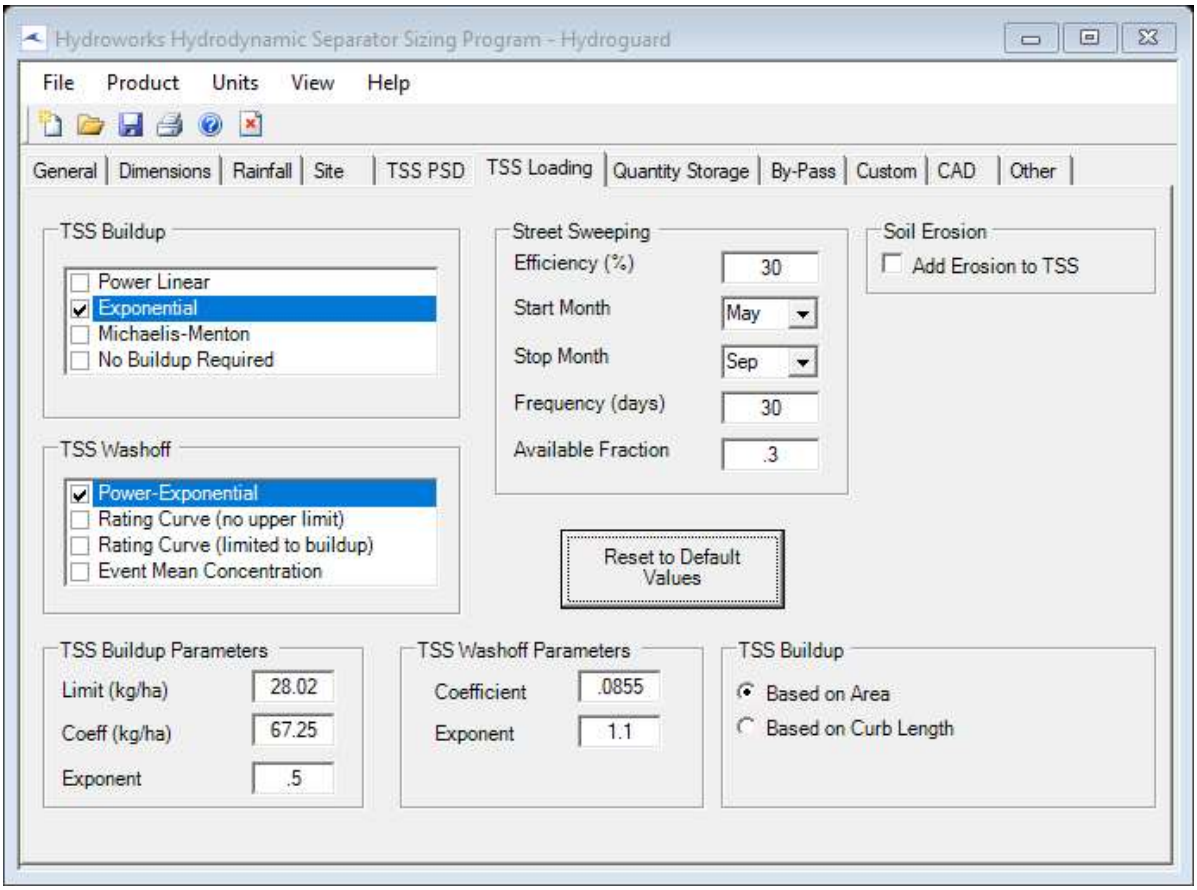
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HG 4	1.22	1.52	278	1.1	1.8
HG 5	1.52	1.68	504	1.9	3
HG 6	1.83	1.83	833	3	4.8
Unavailable	2.13	1.98	1270	4.4	7.1
HG 8	2.44	2.13	1853	6.3	10
Unavailable	2.74	2.44	2686	9.3	14.4
HG 10	3.05	2.74	3619	13.4	20
HG 12	3.66	3.35	6672	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

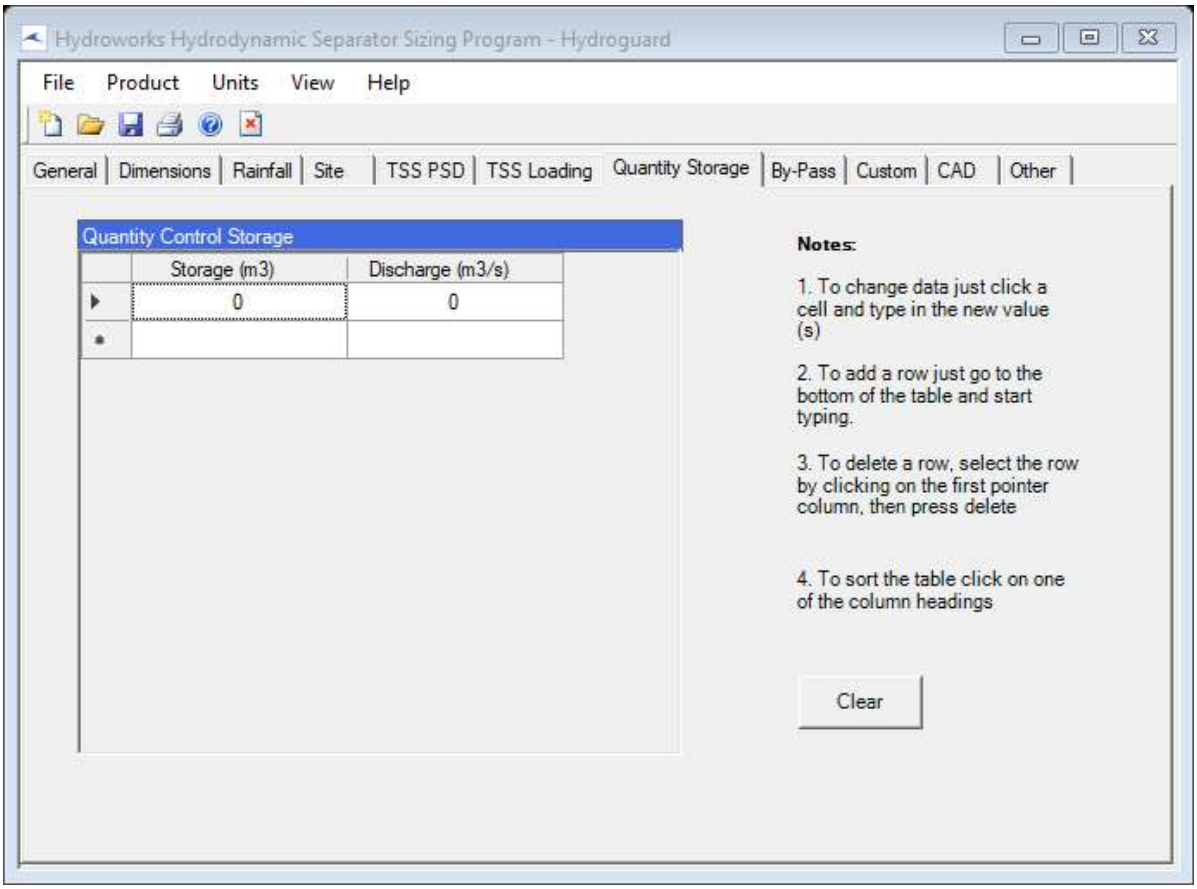
Generic HG 10 CAD Drawing



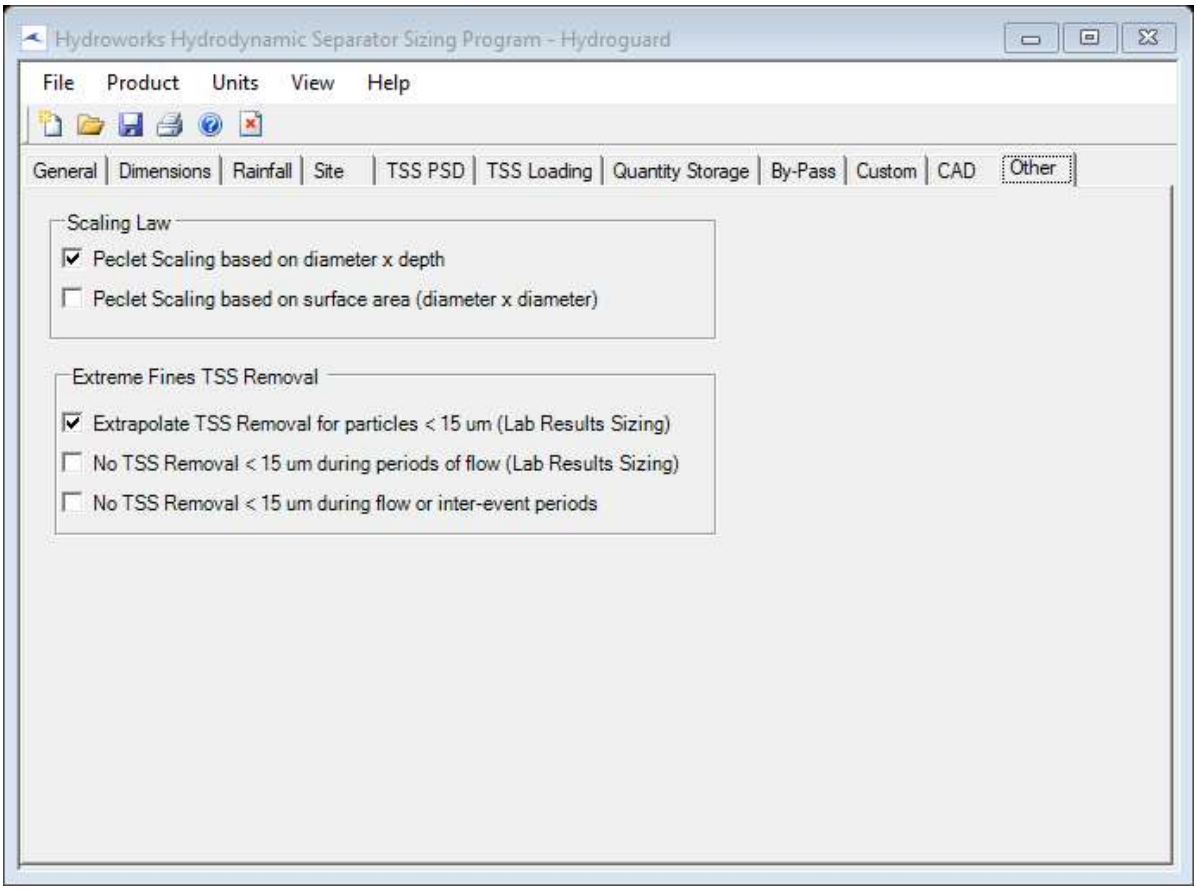
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Hydroworks Sizing Program - Version 5.0
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