Preliminary Stormwater Management Report

Draft Plan of Proposed Subdivision
Part of Lot 13, Concession 2
County Road 4
Township of Douro-Dummer
County of Peterborough

Previous Project No. 17-1016

September, 2022

Prepared for:
Mr. Jason Riel

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Figures List

1.0 Introduction

The Stormwater Management Report has been prepared in support of the proposed Residential Subdivision Development. The entire property is 23.88 hectares in area, but only 12.07 hectares will be developed for the 12 lot Subdivision. An area breakdown is presented later in the report.

The site is located in the northeast part of the Hamlet of Warsaw, approximately 20 km northeast of Peterborough. The property is Part of Lot 13, Concession 2 (Dummer), in the Township of Douro Dummer. Access to the development will be from County Road 4. The development will require the construction of approximately 595m of municipal roadway. Both Street 'A' (375m +/-) and Street 'B' (220m+/-) will be constructed with end of road turning circle.

Figure 1 illustrates the location of the development.

2.0 Stormwater Management

Any land development project will alter the runoff characteristics of the site. Normal stormwater management practice is to provide both stormwater quality and stormwater quantity controls for a new land development project. The types of controls selected are dependent on the site conditions.

2.1 Stormwater Quantity Controls

Typically, the peak post-development discharge rates cannot exceed the peak pre-development discharge rates, ensuring that the development does not negatively impact downstream lands. Surface storage facilities include parking lot storage, building rooftop storage, or stormwater management ponds. Sub-surface storage in large structures or oversized pipes is also possible, but more costly.

2.2 Stormwater Quality Controls

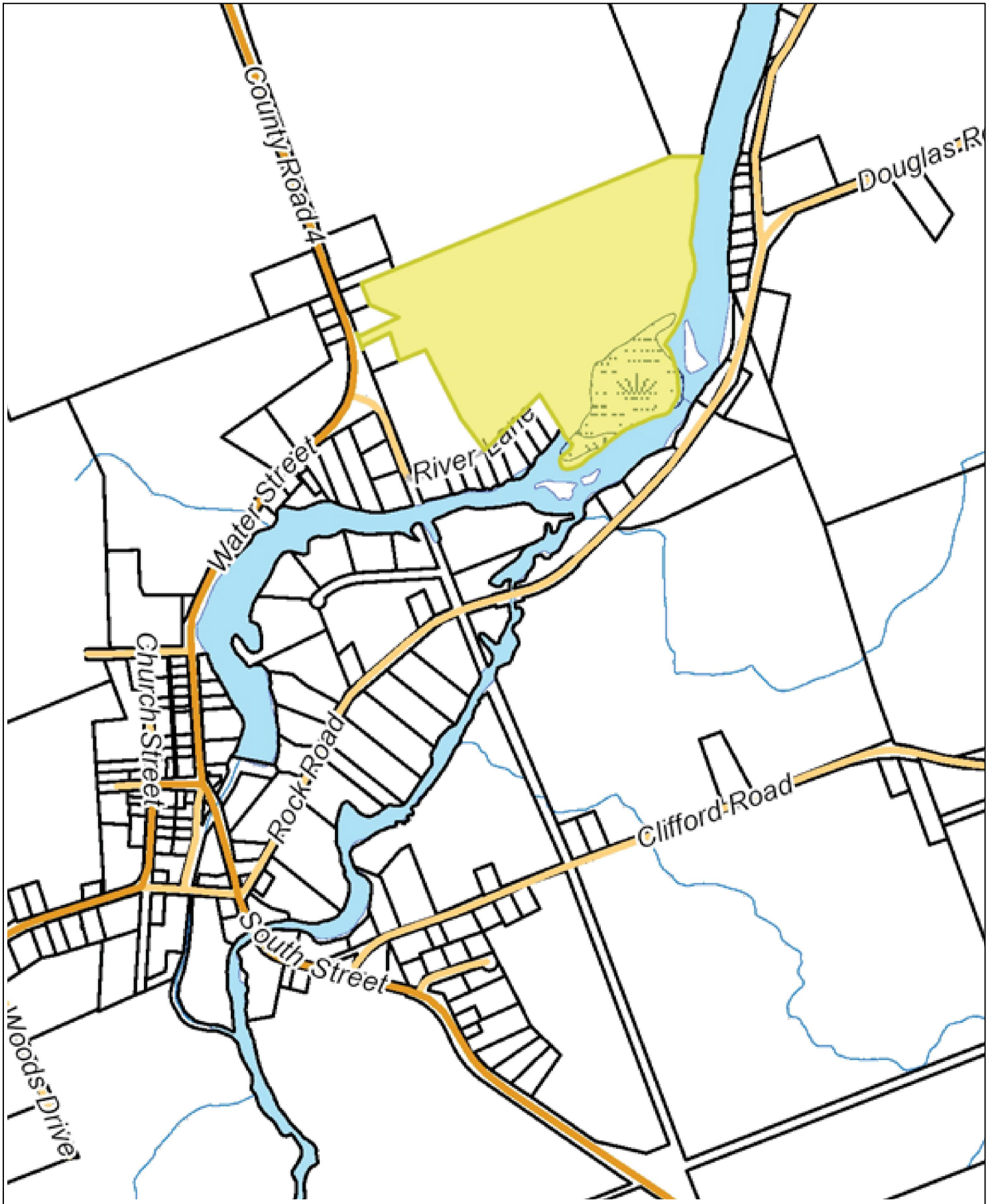
The level of protection to be provided is determined by the sensitivity of the aquatic habitat which may be impacted by the end-of-pipe discharge. The 3 levels of protection are:

'Enhanced Protection' where habitat is very sensitive to sediment and siltation.

'Normal Protection' where conditions for enhanced protection don't exist.

'Basic Protection' where habitat is not sensitive to stormwater impacts.

For this development, a normal level of protection would be appropriate.



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PROPOSED WARSAW SUBDIVISION (RIEL)
PART LOT 13, CONCESSION 2 (DUMMER)
TOWNSHIP OF DOURO-DUMMER
COUNTY OF PETERBOROUGH

PROJECT NO. 85010	DATE: August 2022
SOURCE: County of Peterborough Public Online GIS	
SCALE: 1:3000m	DRAWING NO. FIGURE 1

Temporary stormwater quality controls during construction typically include:

- the construction of temporary sediment control ponds (large sites)
- the installation of silt fences along property boundaries or around earth stockpiles
- the installation of rock check dams or straw bales within swales or drainage channels
- the installation of a mud-mat at the road entrance.

Permanent stormwater quality controls typically implemented are:

Lot level controls	- reduce grade to promote infiltration - rear yard ponding areas or soak-away pits - infiltration trenches - grassed swales - pervious pipe systems - vegetated filter strips - stream & valley corridor buffer strips
End-of-pipe controls	- wet ponds - dry ponds - wetlands - infiltration basins

The topography, soil type, bedrock elevation, water table elevation and the catchment area are all factors in which must be considered to decide on the appropriate stormwater control selected.

Oakridge Environmental Ltd. (ORE) prepared a Hydrogeological and Site Servicing Study in September 2020. The surficial soils consist of silty sand or gravelly silt, having a percolation rate of 8-20 min.cm, or an infiltration rate of 30-75mm/hr. The shallow water table is generally about 4m below existing grade within the subdivision area.

The site is suitable for the construction of an infiltration system to provide both stormwater quality and quantity control. Table 4.1 in the MOE Manual notes a minimum soils infiltration rate of 15mm/hr. (0.25mm/min)

3.0 Stormwater Quality Analysis

The immediate effects that the development will have on the quality of stormwater runoff is directly associated with the construction activities. A heavy duty silt fence should be installed along the limits of the Consolidated Protection Area (rear part of lot 6 thru 11), and light duty silt fence should be installed along lots 1, 4, 5 & 6. A

mud mat will also be installed at the road entrance. **Figure 3** provides mud mat details.

During construction activities (roadway, earthworks) silt fence will be placed around any earth stockpiles and rock check dams or straw bales will be installed in swales/ditches (along concentrated flow paths). All disturbed areas are to be stabilized as soon as possible. **Figure 2** illustrates these mitigation measures.

The above will provide erosion and sediment controls during construction. An inspection and maintenance schedule for the erosion and sedimentation measures should be established and strictly adhered to. All erosion and sedimentation measures should be installed in accordance with sections B and C of "Guidelines on Erosion and Sedimentation Control for Urban Construction Sites", published by the Government of Ontario (MNR, MOE, MMA, MTO, Conservation Authorities, Municipal Engineers Association and the Urban Development Institute).

Surface water runoff from the Municipal right-of-way (1.29ha) will be conveyed along the road ditch and outlet near the SE corner of the site. The discharge will be overland through the severed undisturbed vegetated land prior to discharging into the Indian River, approximately 220m downstream. This is the Consolidated Protection Area or buffer area recommended in the EIS, also completed by ORE.

Infiltration will be promoted by installing a sub drain under the entire road ditch. The sub drain will be constructed using 150mm perforated Big 'O' pipe in a 450mm X 300mm deep stone trench using 19mm clear stone. The stone trench will have a void ratio of 40%. Approximately 1000m of sub drain will be installed, providing runoff storage of 64.3 cu.m (1,190 X 0.45 X 0.30 X 0.40 = 64.3).

Table 3.2 of the MOE Design Manual notes the infiltration volumes required for water quality control. At a 55% impervious surface level an infiltration volume of 30cu.m/ha is required to provide Enhanced water quality protection. The ROW area of 1.29ha would require 38.7 cu.m of storage. The proposed sub drain exceeds the requirement.

In addition to the available storage, the road ditch sub drain is capable of infiltrating 16.1 cu.m of runoff per hour (1,190 x 0.45 x 0.03 = 16.1).

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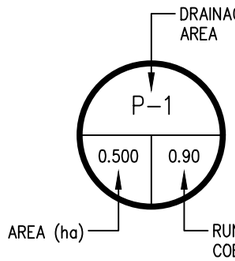
LEGEND:



DRAINAGE BOUNDARY

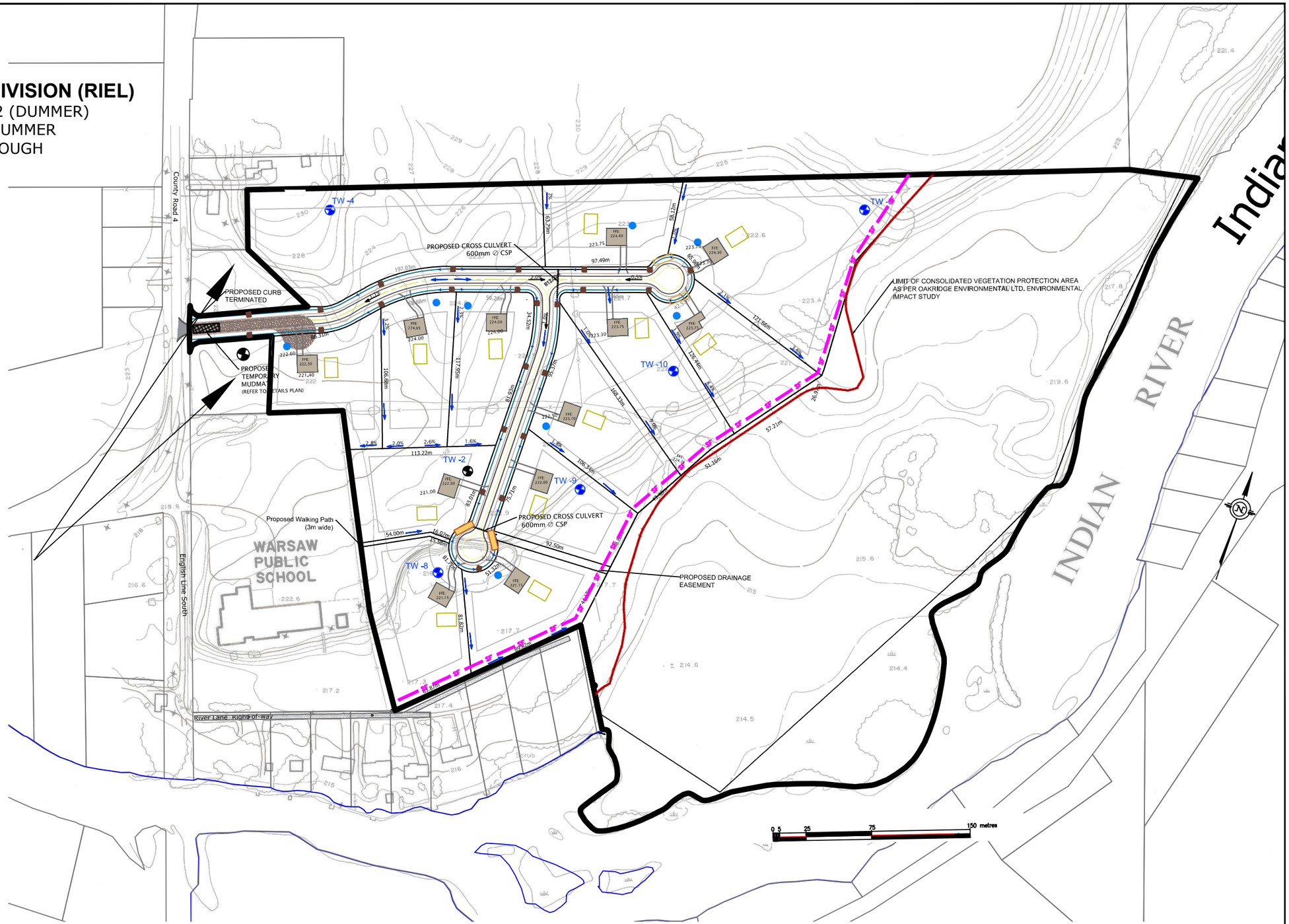
DRAINAGE DIRECTION

TOTAL SITE = 37.92± ha

EROSION AND SEDIMENT CONTROL

TEMPORARY ROCK CHECK DAM AS PER OPSD 219.211

TEMPORARY SEDIMENT CONTROL POND (REFER TO DETAILS PLAN)



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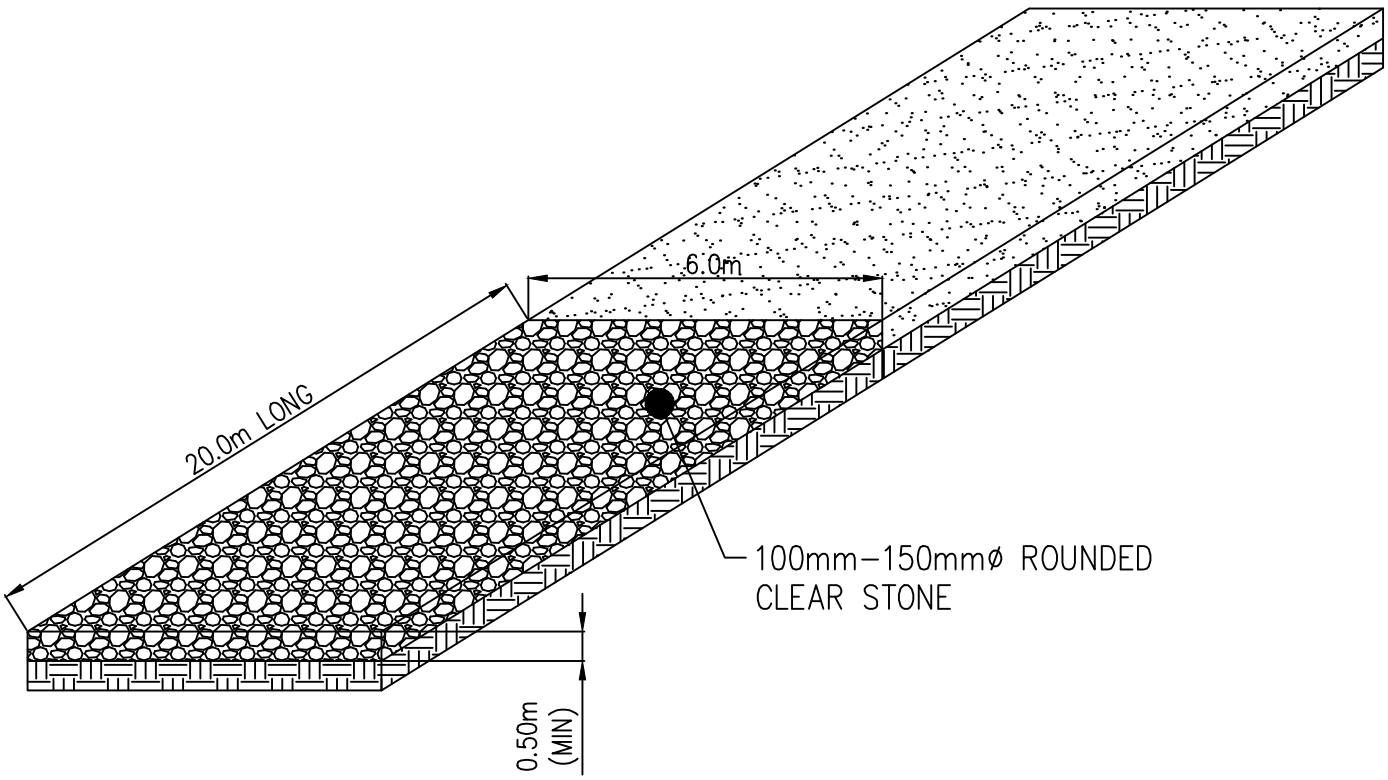
EROSION AND SEDIMENT CONTROL PLAN

DESIGNED: B. DOBRI	DATE: August 2022
DRAWN: J. WHALEN	PROJECT: 85010
CHECKED: B. DOBRI	CAD FILE: P11-896
APPROVED: B. DOBRI	DRAWING: FIGURE 2



NOTE:
SHALL BE INSTALLED PRIOR TO CONSTRUCTION AND SHALL BE MAINTAINED THROUGHOUT ENTIRE CONSTRUCTION PERIOD.

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TEMPORARY MUD MAT

PROJECT NO.	DATE:
P11-896	August 2022
SCALE:	DRAWING NO.
NOT TO SCALE	FIGURE 3

4.0 Stormwater Quantity Analysis

The development of this site will increase the overall runoff coefficient, as a result of the increased impervious surface (roadway, driveways, and buildings). The analysis completed for the surface water runoff is based on the following:

1. Using MTO IDF data

Return Period	*Regression constants*	
	A	B
2-yr	21.5	-0.699
5-yr	28.5	-0.699
10-yr	33.2	-0.699
25-yr	39	-0.699
50-yr	43.3	-0.699
100-yr	47.6	-0.699
*Where i (mm/hr) =A*t^B, and t is in hours*		

2. Rational Method Q_p = CIA/360
3. Airport Formula Tc=(3.26(1.1-C)D^1/2)/S^1/3
4. MTO Drainage Manual
5. MOE – Stormwater Management Planning & Design Manual, 2003
6. Runoff Coefficient of 0.30 for woodland, MTO Chart 1.07 in appendix (Pre-Development)
7. Runoff Coefficient of 0.20 for open field and landscaped areas (Post-Development)
8. Runoff Coefficient of 0.90 for paved surface, concrete and building roof
9. Runoff Coefficient of 0.60 for gravel surface

4.1 Pre-Development Conditions

Figure 3 illustrates the Pre-Development conditions. Three catchment drainage areas are identified as noted in the following table.

Catchment ID	Area (ha)	Comment
PR1	7.91	Surface drainage directed westerly towards the School and the roadway (County Road 4 and English Line South).
PR2	4.16	Surface drainage directed to the Consolidated Vegetative Protected Area and through the PP and the existing residential lots prior to discharging into the Indian River.
PP	11.81	The Consolidated Vegetation Protection Area adjacent the Indian River.
Total	23.88	All runoff discharges into the Indian River.

CATCHMENT PR1

Calculate the time of concentration, Tc.

Calculate T_c D= 200m

S= 0.74%

T_c = (3.26(1.1-C)D^1/2)/S^1/3

= 40.78 minutes Pre-Development conditions

Calculate the peak discharge using the Rational Method.

Peak Runoff Q_p = CIA/360

Where:

Q_p = peak runoff, cms

C = runoff coefficient

I = rainfall intensity, mm/hr

A = area, hectares

The peak discharge for Pre-Development conditions is tabulated below.

PRE	*t=(min)*	*40.78*	*C=*	*0.30*	*A=*	*7.910*	
		2-yr	*5-yr*	*10-yr*	*25-yr*	*50-yr*	*100-yr*
	I=(mm/hr)	*28.16*	*37.33*	*43.49*	*51.09*	*56.72*	*62.35*
	Q=(cms)	*0.187*	*0.248*	*0.289*	*0.339*	*0.377*	*0.414*

CATCHMENT PR2

Calculate the time of concentration, Tc.

Calculate T_c D= 90m

S= 6.1%

T_c = (3.26(1.1-C)D^1/2)/S^1/3

= 13.54 minutes Pre-Development conditions

Calculate the peak discharge using the Rational Method.

Peak Runoff Q_p = CIA/360

The peak discharge for Pre-Development conditions is tabulated below.

PRE	*t=(min)*	*13.54*	*C=*	*0.30*	*A=*	*4.160*	
		2-yr	*5-yr*	*10-yr*	*25-yr*	*50-yr*	*100-yr*
	I=(mm/hr)	*60.86*	*80.68*	*93.98*	*110.40*	*122.57*	*134.74*
	Q=(cms)	*0.212*	*0.281*	*0.328*	*0.385*	*0.427*	*0.470*

Catchment PP will not be disturbed and a runoff analysis through this catchment has not been completed. The Post-development conditions will match the Pre-Development conditions for the catchment.

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SCALE 1: 3000m

30 0 30 60 90 120 Meters

LEGEND:

DRAINAGE CATCHMENT AREA

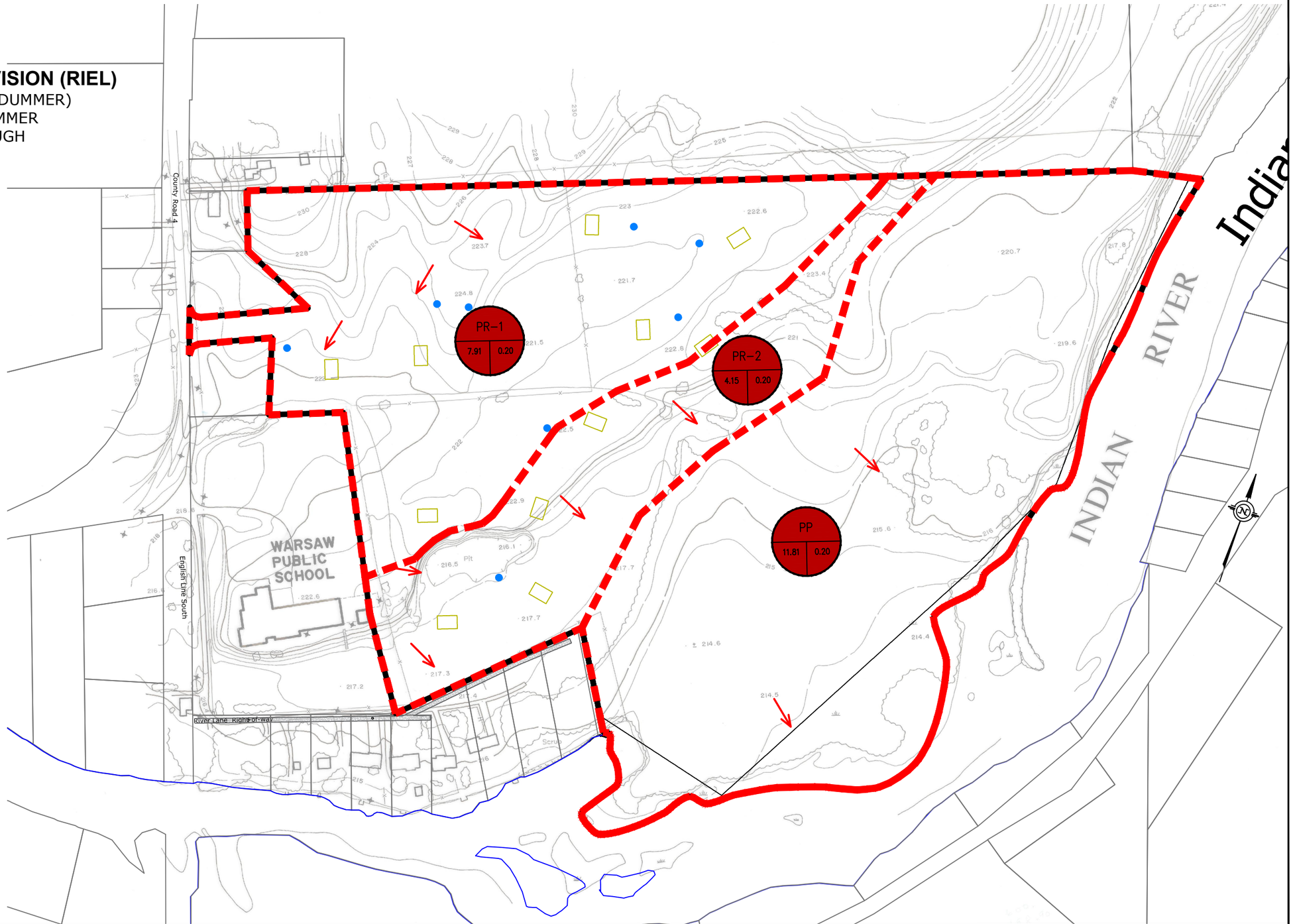
P-1
0.500 | 0.90

AREA (ha) — RUNOFF COEFFICIENT

DRAINAGE BOUNDARY

DRAINAGE DIRECTION

TOTAL SITE = 23.88± ha



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PRE DEVELOPMENT PLAN

DESIGNED: B. DOBRI	DATE: August 2022
DRAWN: J. WHALEN	PROJECT: 85010
CHECKED: B. DOBRI	CAD FILE: P11-896
APPROVED: B. DOBRI	DRAWING: FIGURE 4

4.2 Post-Development Conditions

Figure 5 illustrates the Post-Development conditions.

Calculate C, the runoff coefficient (Post-Development).

Surface	**Area (ha)**	**C**	**A*C**
Grass	9.46	0.3	2.84
Asphalt	0.42	0.9	0.37
Shoulder	0.18	0.9	0.16
Building	0.24	0.9	0.22
Driveway	0.15	0.9	0.14
Blocks	1.63	0.3	0.49
TOTAL	12.07		4.21
	Avg C	**0.35**	

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LEGEND:

DRAINAGE CATCHMENT AREA

P–1
0.500 | 0.90

AREA (ha) — RUNOFF COEFFICIENT

DRAINAGE BOUNDARY

DRAINAGE DIRECTION

TOTAL SITE = 37.92± ha

PT–1 1.49 | 0.35
PT–2 1.69 | 0.35
PT–3 3.22 | 0.35
PT–4 5.68 | 0.35
PP 11.81 | 0.20

TW -2
TW -3
TW -4
TW -8
TW -9
TW -10

County Road 4
English Line South
River Lane Right-of-way
Proposed Walking Path (3m wide)
WARSAW PUBLIC SCHOOL
PROPOSED CURB TERMINATED
PROPOSED DRAINAGE EASEMENT
LIMIT OF CONSOLIDATED VEGETATION PROTECTION AREA AS PER OAKRIDGE ENVIRONMENTAL LTD. ENVIRONMENTAL IMPACT STUDY
INDIAN RIVER

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POST DEVELOPMENT PLAN

DESIGNED: B. DOBRI	DATE: August 2022
DRAWN: J. WHALEN	PROJECT: 85010
CHECKED: B. DOBRI	CAD FILE: P11-896
APPROVED: B. DOBRI	DRAWING: FIGURE 5

The property areas are tabulated below.

Description	Area (ha)	Comment
Lot 1	0.62	Residential Lot
Lot 2	0.61	Residential Lot
Lot 3	0.61	Residential Lot
Lot 4	0.65	Residential Lot
Lot 5	0.81	Residential Lot
Lot 6	0.67	Residential Lot
Lot 7	0.62	Residential Lot
Lot 8	0.79	Residential Lot
Lot 9	0.82	Residential Lot
Lot 10	0.85	Residential Lot
Lot 11	1.66	Residential Lot
Lot 12	0.64	Residential Lot
Street 'A'	0.81	Road
Street 'B'	0.48	Road
Block A	1.56	Severed - Northwest corner of site
Block B	0.02	Walkway from School
Block C	0.05	Drainage Easement
Severed	11.81	Adjacent Indian River
Total	**23.88**	

Five catchment drainage areas are identified as noted in the following table.

Catchment ID	Area (ha)	Comment
PT1	1.49	Surface drainage directed towards new roadway and conveyed west within the road ditch towards County Road 4. The area includes Part of Block A, which will not be disturbed.
PT2	1.68	Surface drainage from Lot 1 and 2, and Part of Lot 4 is directed west through the existing residential lot and the School yard. Surface runoff is discharged onto County Road 4 and English Line South.
PT3	3.21	The central part of the development, collecting runoff in the road right of way and conveying it to the proposed drainage easement between Lots 6 & 7.
PT4	5.69	The majority of Lots 5 through 11, discharging to the Consolidated Vegetative Protected Area and through the PP and the existing residential lots prior to discharging into the Indian River.
PP	11.81	The Consolidated Vegetation Protection Area adjacent the Indian River.
Total	23.88	All runoff discharges into the Indian River.

CATCHMENT PT1

Calculate the time of concentration, Tc.

Calculate T_c D= 200m

S= 1.1%

T_c = (3.26(1.1-C) D^1/2)/S^1/3

= 33.5 minutes Pre-Development conditions

Calculate the peak discharge using the Rational Method.

Peak Runoff Q_p = CIA/360

The peak discharge for Post-Development conditions is tabulated below.

POST	*t=(min)*	*33.50*	*C=*	*0.35*	*A=*	*1.56*	
		2-yr	*5-yr*	*10-yr*	*25-yr*	*50-yr*	*100-yr*
	I=(mm/hr)	*32.31*	*42.84*	*49.90*	*58.62*	*65.08*	*71.54*
	Q=(cms)	*0.049*	*0.065*	*0.076*	*0.090*	*0.099*	*0.109*

Surface runoff from Catchment PT1 will be directed towards the new roadway, and conveyed via the road ditch to County Road 4. The peak discharge off site will be reduced.

CATCHMENT PT2

Calculate the time of concentration, Tc.

Calculate T_c D= 125m

S= 2.0%

T_c = (3.26(1.1-C)D^1/2)/S^1/3

= 21.7 minutes Pre-Development conditions

Calculate the peak discharge using the Rational Method.

Peak Runoff Q_p = CIA/360

The peak discharge for Post -Development conditions is tabulated below.

POST	*t=(min)*	*21.71*	*C=*	*0.35*	*A=*	*1.68*	
		2-yr	*5-yr*	*10-yr*	*25-yr*	*50-yr*	*100-yr*
	I=(mm/hr)	*43.78*	*58.03*	*67.60*	*79.41*	*88.16*	*96.92*
	Q=(cms)	*0.072*	*0.096*	*0.111*	*0.131*	*0.145*	*0.160*

Stormwater runoff from Catchment P2 will be directed towards the school yard and onto County Road 4 and English Line South. The peak discharge off site will be reduced.

The peak discharge directed westerly from the development, through the school yard and onto County Road 4 and English Line South will be reduced. The combined peak flow from PT1 and PT2 will be 0.161cms and 0.269cms for the 5-yr and 100-yr storm events respectively. This is approximately 65% of the peak flow for Pre-Development conditions. The combined runoff will be discharged into the Indian River.

CATCHMENT PT3

Calculate the time of concentration, Tc.

Calculate T_c D= 390m

S= 1.5%

T_c = (3.26(1.1-C) D^1/2)/S^1/3

= 42.18 minutes Pre-Development conditions

Calculate the peak discharge using the Rational Method.

Peak Runoff Q_p = CIA/360

The peak discharge for Post -Development conditions is tabulated below.

POST	*t=(min)*	*42.18*	*C=*	*0.35*	*A=*	*3.21*	
		2-yr	*5-yr*	*10-yr*	*25-yr*	*50-yr*	*100-yr*
	I=(mm/hr)	*27.50*	*36.46*	*42.47*	*49.89*	*55.39*	*60.89*
	Q=(cms)	*0.087*	*0.115*	*0.134*	*0.157*	*0.174*	*0.192*

Surface runoff from Catchment PT3 will be directed towards the new roadway and conveyed via the road ditch to the proposed drainage easement between lot 6 & lot 7. It will be discharged easterly through Catchment PP prior to discharging into the Indian River.

CATCHMENT PT4

Calculate the time of concentration, Tc.

Calculate T_c D= 60m

S= 6%

T_c = (3.26(1.1-C) D^1/2)/S^1/3

= 10.42 minutes Pre-Development conditions

Calculate the peak discharge using the Rational Method.

Peak Runoff Q_p = CIA/360

The peak discharge for Post -Development conditions is tabulated below.

POST	*t=(min)*	*23.81*	*C=*	*0.35*	*A=*	*5.69*	
		2-yr	*5-yr*	*10-yr*	*25-yr*	*50-yr*	*100-yr*
	I=(mm/hr)	*41.02*	*54.38*	*63.34*	*74.41*	*82.61*	*90.82*
	Q=(cms)	*0.229*	*0.303*	*0.353*	*0.415*	*0.461*	*0.506*

5.0 Drainage Easement Swale Design

The drainage easement will convey the runoff from catchment PT3, having a peak flow of 0.192cms during the 100-yr storm event. Use the Open Channel Flow equation to design the drainage channel through the easement between lot 6 & 7.

Q=A*V

Where: Q= flow (cms)

A= channel cross section (sq. m)

V= velocity (m/s)

V=R^2/3 * S^1/2 / N

Where: V= velocity (m/s)

S= channel slope (%)

N= channel roughness coefficient (0.09 grass, maintained)

R=A/P

A= channel cross section (sq. m)

P= wetted perimeter

The grassed swale will be a simple V-swale (B=0), with side slopes of 3:1. At a swale slope of 2.4%, the 100-yr storm peak flow of 0.192cms will be conveyed at a depth of 0.233m, and a velocity of 1.19m/s.

6.0 Conclusions and Recommendations

Standard Stormwater Management practices can be implemented to provide both quality and quantity control for this proposed development. Based on this evaluation, we make the following conclusions and recommendations:

1. Erosion and sedimentation control measures, both before and during construction, should be carried out as detailed herein. All controls need to be maintained and repaired for the duration of construction.

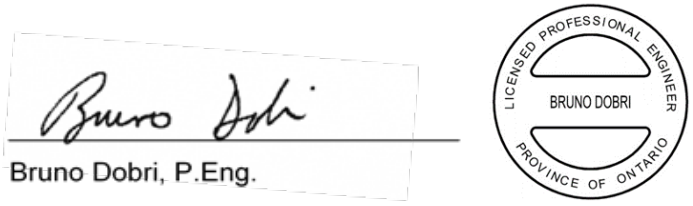
2. The Contractor is to follow good housekeeping practices (ie: fueling and cleaning of equipment is not to be carried out near swales, ditches).

3. The native soils are sandy and are able to provide stormwater quality control via infiltration.

4. The entire road ditch will be constructed with a sub drain, promoting infiltration.

5. Temporary rock check dams will be installed at 30m intervals along the entire road ditch. These can be removed once the vegetation is established in the ditch.

All of which is respectfully submitted,



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