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Prepared initially: 12th October 2015
Updated: 6th January 2017

Mr Peter Smith
City of Greater Geelong
PO Box 104
Geelong 3220, VIC

Dear Peter,

Re: Storm Water Management Strategy- 176-194 Thornhill Road, Highton

We enclose for your information a Storm Water Management Strategy (SWMS) for the proposed residential subdivision at 176-194 Thornhill Road Highton. This is to accompany the Planning Scheme Amendment application (C338) lodged with the City of Greater Geelong.

Background

SMEC has met with Council to discuss storm water quality and quantity requirements for the proposed development. Council confirmed stormwater run-off would need to be treated on site and flows retarded, so to not exceed the capacity of the existing downstream infrastructure. The details in this storm water management strategy have previously been submitted to Council and a subsequent meeting was held to explain the findings. No further information has been requested since the meeting held on the 22nd of September 2015.

Scope of Investigation

The objective of the investigation, following on from the discussions with Council, was to highlight the stormwater management principles to be adopted for the proposed development, covering the following elements:

- Stormwater Quantity
- Drainage Design (Minor and major flows paths)
- Stormwater Quality

Analysis

1.1 Hydrologic and hydraulic analysis

- Pre-developed and post-developed flow comparison
- Boyd's method, storage calculations and sizing.
- Overland flow conveyance.

1.2 Minor and Major Flows

- The rational method has been used to determine the underground pipe network and major overland flows for the proposed development.
- Layout and size of stormwater pipes for the proposed development.
- Explanation of the retardation function.

1.3 Stormwater Quality Analysis

Using MUSIC (Model for Urban Water Stormwater Improvement Conceptualisation) version 6, the proposed stormwater quality treatment strategy has been developed for the proposed residential subdivision. Council advised the payment of contributions was not an option and there was no existing or proposed treatment asset planned for the broader catchment, thus treatment of stormwater run-off must be provided on site.

Conclusion

Through meeting the objectives outlined above, this SWMS ascertains that the proposed development, at Barwon Water's surplus Highton Basin, site manages stormwater in accordance with Council's requirements.

In summary the findings of the investigation are:

- Based on a "Net No Change" analysis for the catchment, the discharge from the site is to be restricted to 0.137m³/s.
- The analysis has confirmed the 5 year ARI developed flows are to be retarded on site prior to connecting to the existing 300mm diameter pipeline in Augustine's Drive.
- A retarding basin must be sized to store a volume of 265m³.
- The external roads have enough capacity to safely convey the 100 year developed flows.
- A MUSIC model has been completed and best practice pollutant removal targets are achieved by incorporating a swale within Barwon Water's easement on the eastern boundary and a bio-retention system within the retarding basin. Further details are to be provided to Council at detailed design stage, regarding the constructability of the bio-retention system and suitable filter media to be adopted.
- A reserve area is to be located in the south east corner for retardation and treatment purposes. Further details are to be provided to Council at detailed design stage, regarding the size of the reserve, the depth of the retarding basin and its siting within the reserve.
- Council advised they will maintain the treatment and storage assets in the future.

The following documents are enclosed:

- Drainage Layout Plan
- Drainage Catchment Plan
- Storage Calculations
- Comparison of pre-developed and post-developed flows.
- Required Retarding Basin Area
- MUSIC layout

Please do not hesitate to contact the undersigned should you have any queries in relation to the above.

Yours faithfully

Tess Barrett
Project Manager- Urban Drainage

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Principal
Barwon Water

All setting out should be carried out in accordance with GAA/Council's standard drawings or as nominated on hard copy plans provided by SMEC. Any digital information supplied by this office is for information only. Any discrepancies should be discussed with the superintendent.

Designed

Drawn

Checked

Authorised

Date

N

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HIGHTON, THORNHILL ROAD

Greater City of Geelong
Drainage Catchment 5 Yr Plan
Layout Plan

Drawing No. 3004800F-28-C5 **Rev A**

Sheet No. 1 of 1

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STAGE 2

STAGE 1

RETARDING BASIN VOLUME: 265m3
DIMENSION: BASE 14m X 20m
DEPTH 1.25m
AT TOP 29m X 35m (ASSUME 600mm FREEBOARD)

RETARDING BASIN FILL EMBANKMENT
OVER EX WATER SCOUR & OVERFLOW MAIN

EXISTING DRAINAGE 300Ø
5YR DESIGN FLOW 0.137m3/S.

HIGHTON DEVELOPMENT 5 YR FLOW
STAGE 1 : 0.331m3/s
STAGE 1 & 2: 0.427m3/s

DEVELOPER TO PROVIDE RETARDATION STORAGE
STAGE 1 : 165m3
STAGE 1 & 2: 265m3

AUGUSTINES ROAD
THORNHILL ROAD
EX 300 DIA
EX 300 DIA
GREENWAY COURT
PRINCES

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Principal
Barwon Water

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HIGHTON, THORNHILL ROAD

Greater City of Geelong
Retardation Requirement
Option B

Drawing No. 3004800F-28-B **Rev A**

Sheet No. 1 of 1

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14 July 2015

Highton Basin

Retarding Basin Calculations

Zone: City of Greater Geelong
ARI: 1 in 5 years
No. of Catchments: 1

Option	Area	Permissible Site Discharge from Undeveloped Catchment	Developed Catchment Time of Concentration	Developed Catchment Discharge (Q_{100})	Maximum Storage Volume for Developed Catchment
B	*Development of Stage 1 & 2 utilising existing drainage infrastructure in Augustines Drive (300mm dia).*				
	4.700 ha	0.137 m3/sec	9.0 min	0.427 m3/sec	265 m3
D	*Development of Stage 1 only utilising existing drainage infrastructure in Augustines Drive (300mm dia).*				
	4.010 ha	0.137 m3/sec	9.0 min	0.331 m3/sec	161 m3

DEVELOPED CATCHMENT DATA

Catchment	B	
Area of Catchment	4.700 ha	
Calculated t_c	14.3 min	*Rural*
Input t_c	9.0 min	*Urban*
Fraction Impervious (f)	0.57	
ARI	1 in 5 years	
$^{10}I_{60}$ =	26.33 mm/hr	
C^1_{10} =	0.12 mm/hr	
F_A	1	
C_{10}	0.562 mm/hr	
F_y	0.90	
C 5=	**0.51**	
$I_{tc,y}$	**64.6 mm/hr**	
Q_y	**0.427 m3/sec**	

UNDEVELOPED FLOW - PERMISSIBLE SITE DISCHARGE

SURFACE FLOW TIMES

time of concentration for areas with sheet flow

$C_{ro\ Rural}$	N/A
Mannings n	N/A
Length of Flow	N/A
Slope %	N/A
t_c	N/A
I_{100}	N/A
Q_{100}	**0.137 m3/sec**

Frequency Factors for Rational Method Runoff Coefficient

ARI (years)	Frequency factor (F_y)	C_y
1	0.65	0.37
2	0.75	0.42
5	0.90	0.51
10	1.00	0.56
20	1.10	0.62
50	1.20	0.67
100	1.30	0.73

Discharge

ARI	Intensity from IFD Diagram & t_c	Discharge	
1	35.7	Q_1	0.170 m3/sec
2	47.4	Q_2	0.261 m3/sec
5	64.6	Q_5	**0.427 m3/sec**
10	76.4	Q_{10}	0.560 m3/sec
20	92.0	Q_{20}	0.743 m3/sec
50	114.6	Q_{50}	1.009 m3/sec
100	133.3	Q_{100}	**1.272 m3/sec**

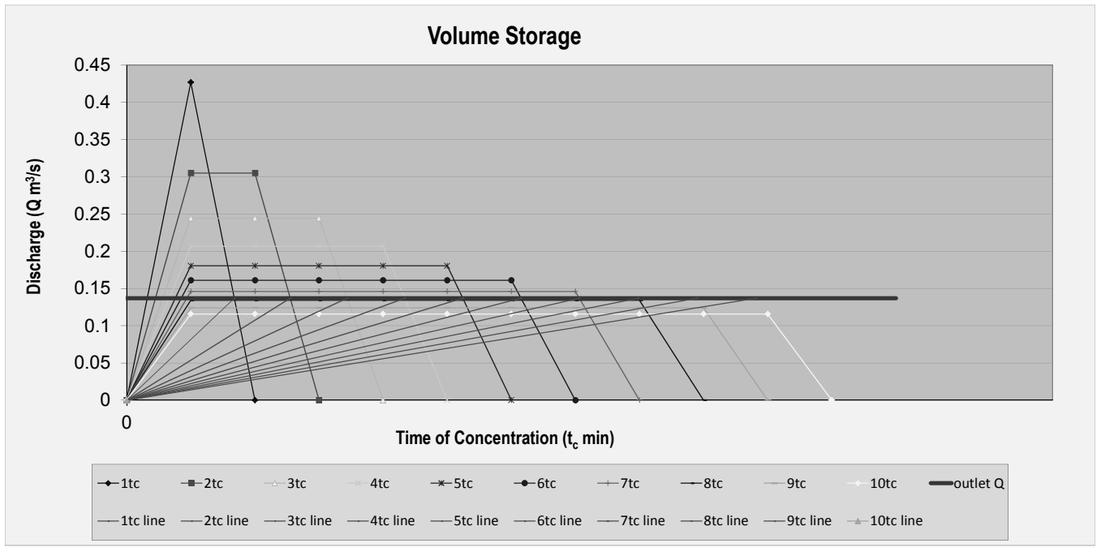
FINAL OUTPUTS

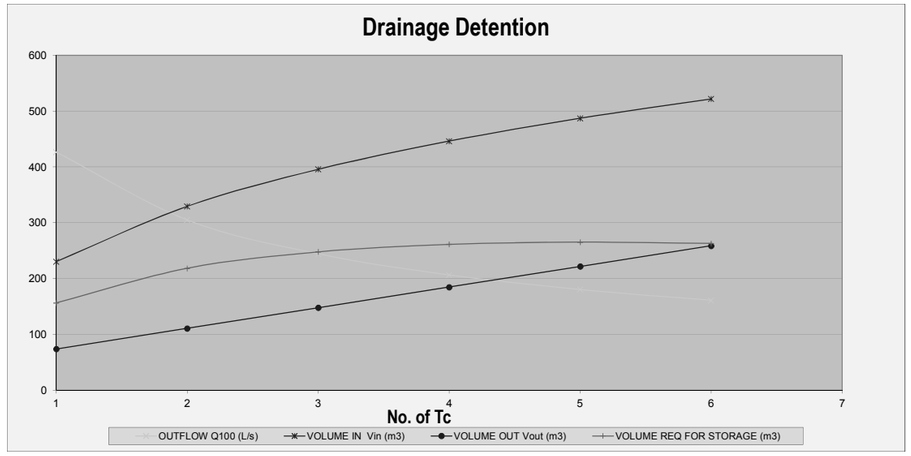
Permissible Site Discharge from Undeveloped Catchment	**0.137 m3/sec**
Maximum Storage Volume for Developed Catchment	**265 m3**

Drainage Detention

n	n.t_c (min)	INTENSITY (mm/h)	OUTFLOW Q_{100} (m^3/s)	OUTFLOW Q_{100} (L/s)	VOLUME IN V_{in} (m^3)	VOLUME OUT V_{out} (m^3)	VOLUME REQ FOR STORAGE (m^3)
1	9.00	64.62	0.427	427	230	74	156
2	18.00	46.19	0.305	305	329	111	219
3	27.00	37.00	0.244	244	396	148	248
4	36.00	31.29	0.207	207	446	185	261
5	45.00	27.32	0.180	180	487	222	265
6	54.00	24.39	0.161	161	522	259	263
7	63.00	22.11	0.146	146	552	296	256
8	72.00	20.29	0.134	134	579	333	246
9	81.00	18.79	0.124	124	603	370	233
10	90.00	17.54	0.116	116	625	407	219
11	99.00	16.47	0.109	109	646	444	202
12	108.00	15.54	0.103	103	665	481	184
13	117.00	14.73	0.097	97	683	518	165
14	126.00	14.02	0.093	93	700	555	145
15	135.00	13.38	0.088	88	716	592	124
16	144.00	12.82	0.085	85	731	629	102
17	153.00	12.30	0.081	81	746	666	80
18	162.00	11.84	0.078	78	760	703	57
19	171.00	11.41	0.075	75	773	740	33

Intervals *Time of concentration of "n" interval*





DEVELOPED CATCHMENT DATA

Catchment	D	
Area of Catchment	4.010 ha	
Calculated t_c	13.4 min	*Rural*
Input t_c	9.0 min	*Urban*
Fraction Impervious (f)	0.50	
ARI	1 in 5 years	
$^{10}I_{60}$ =	26.33 mm/hr	
C^{1}_{10} =	0.12 mm/hr	
F_A	1	
C_{10}	0.511 mm/hr	
F_y	0.90	
C 5=	**0.46**	
$I_{tc,y}$	**64.6 mm/hr**	
Q_y	**0.331 m3/sec**	

UNDEVELOPED FLOW - PERMISSIBLE SITE DISCHARGE

SURFACE FLOW TIMES

time of concentration for areas with sheet flow

$C_{ro\ Rural}$	N/A
Mannings n	N/A
Length of Flow	N/A
Slope %	N/A
t_c	N/A
I_{100}	N/A
Q_{100}	**0.137 m3/sec**

Frequency Factors for Rational Method Runoff Coefficient

ARI (years)	Frequency factor (F_y)	C_y
1	0.65	0.33
2	0.75	0.38
5	0.90	0.46
10	1.00	0.51
20	1.10	0.56
50	1.20	0.61
100	1.30	0.66

Discharge

ARI	Intensity from IFD Diagram & t_c	Discharge	
1	35.7	Q_1	0.132 m3/sec
2	47.4	Q_2	0.203 m3/sec
5	64.6	Q_5	**0.331 m3/sec**
10	76.4	Q_{10}	0.435 m3/sec
20	92.0	Q_{20}	0.576 m3/sec
50	114.6	Q_{50}	0.783 m3/sec
100	133.3	Q_{100}	**0.987 m3/sec**

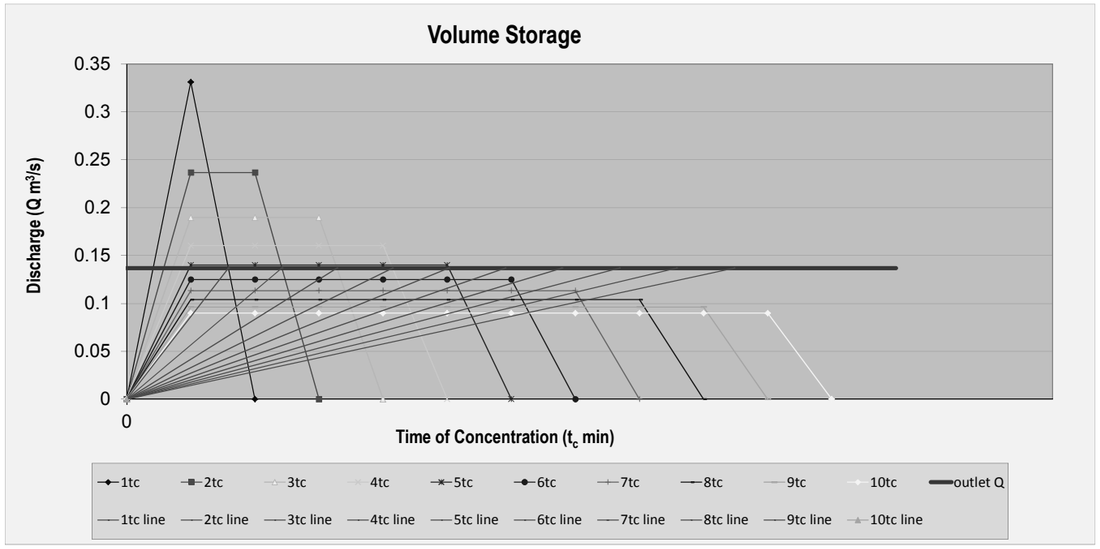
FINAL OUTPUTS

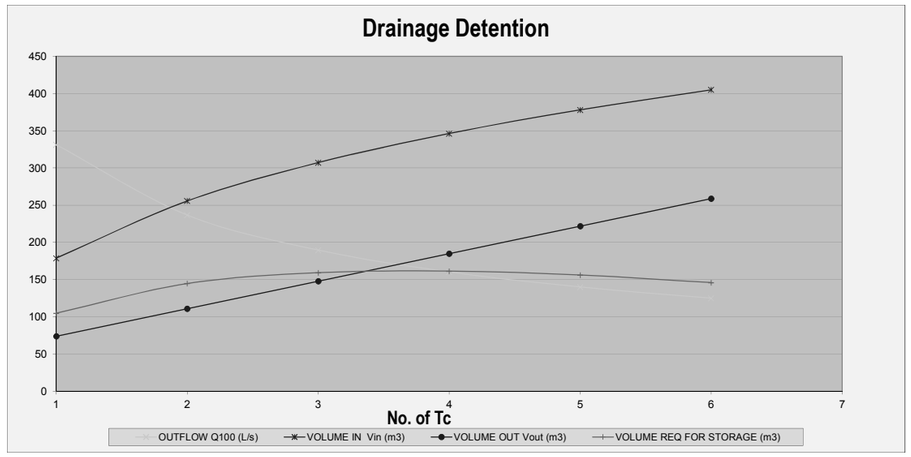
Permissible Site Discharge from Undeveloped Catchment	**0.137 m3/sec**
Maximum Storage Volume for Developed Catchment	**161 m3**

Drainage Detention

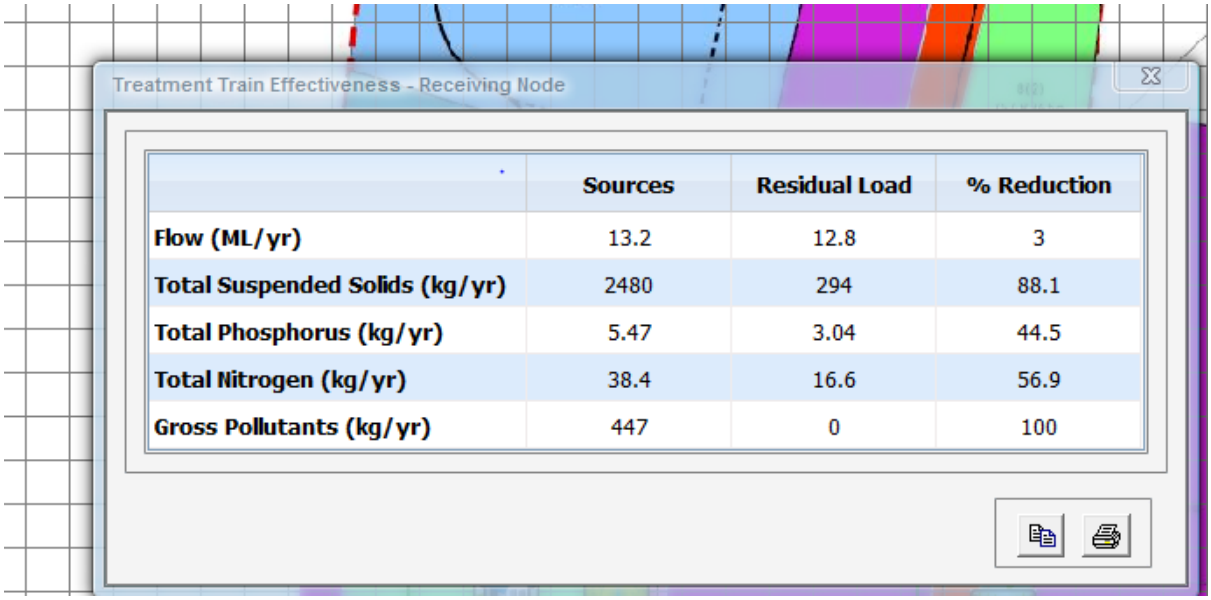
n	n.t_c (min)	INTENSITY (mm/h)	OUTFLOW Q_{100} (m^3/s)	OUTFLOW Q_{100} (L/s)	VOLUME IN V_{in} (m^3)	VOLUME OUT V_{out} (m^3)	VOLUME REQ FOR STORAGE (m^3)
1	9.00	64.62	0.331	331	179	74	105
2	18.00	46.19	0.237	237	256	111	145
3	27.00	37.00	0.190	190	307	148	159
4	36.00	31.29	0.160	160	346	185	161
5	45.00	27.32	0.140	140	378	222	156
6	54.00	24.39	0.125	125	405	259	146
7	63.00	22.11	0.113	113	428	296	133
8	72.00	20.29	0.104	104	449	333	116
9	81.00	18.79	0.096	96	468	370	98
10	90.00	17.54	0.090	90	485	407	78
11	99.00	16.47	0.084	84	501	444	57
12	108.00	15.54	0.080	80	516	481	35
13	117.00	14.73	0.076	76	530	518	12
14	126.00	14.02	0.072	72	543	555	0
15	135.00	13.38	0.069	69	556	592	0
16	144.00	12.82	0.066	66	567	629	0
17	153.00	12.30	0.063	63	579	666	0
18	162.00	11.84	0.061	61	590	703	0
19	171.00	11.41	0.058	58	600	740	0

Intervals *Time of concentration of "n" interval*





MUSIC SCHEMATIC



	Sources	Residual Load	% Reduction
Flow (ML/yr)	13.2	12.8	3
Total Suspended Solids (kg/yr)	2480	294	88.1
Total Phosphorus (kg/yr)	5.47	3.04	44.5
Total Nitrogen (kg/yr)	38.4	16.6	56.9
Gross Pollutants (kg/yr)	447	0	100