

**ocdl**

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Stormwater Disposal Report  
For  
Exploration Heights Development

Prepared for  
  
Progeni Ltd

4 December 2017

## 1. BACKGROUND

Progeni Ltd have a resource consent to create a 10-lot subdivision at their land at the end of Exploration Way, known as Exploration Heights. The detailed design of the roading and services has been completed and OCDL have reviewed the design and completed the assessment of the stormwater solution for the development. This report sets out the details of the stormwater solution.

## 2. STORMWATER CATCHMENTS AND ESTIMATED FLOWS

The stormwater catchments are shown on the attached stormwater catchment plan. Catchments A – D are affected by development.

The expected runoff from the catchments for both the pre-developed and post-developed situations are shown in the attached calculation sheet -Stormwater Design – Assessment of Ponds and Piped Sections.

As part of the calculation of the flows for the various catchments, we have included the additional runoff from roof area and additional driveway for the new houses in the post-development situation. The calculations are based on Lots 4 and 10 having individual stormwater detention, which will be covered by a consent notice on the title for these lots.

## 3. MANAGEMENT OF STORMWATER

It is proposed to manage the additional runoff from the new houses and roads with 3 small detention basins/ponds. These are on Catchments B, C & D. The existing pre-developed 1-hour peak flow for the development is 76l/s with a total volume discharge of 274m<sup>3</sup>. The three ponds will have a peak 1-hour event discharge of 17.5l/s plus 20.5l/s plus 22.5l/s for the three ponds plus 17l/s for the other 3 catchments that are not connected to a pond, being a total of 77.5l/s. This is effectively the same as the pre-developed flows, taking the accuracy of the calculations into account. Therefore, the additional runoff is being managed to pre-developed levels.

Pond 1 is by the entry into the development and is the biggest of the three ponds. This pond has a capacity of 38m<sup>3</sup>. Catchment B drains to this pond. The runoff from the roof areas on Lots 2 & 3 drain to the pond. The house on Lot 4 will have a storage tank, which will overflow to the Catchment B pond if it is full.

The expected operation of Pond 1, during the design event, is shown on the attached calculation sheet – Assessment of Pond 1 Filling and Emptying. The design outlet pipe of a 125OD HDPE at a grade of 1 in 33 has been selected to achieve the correct filling and emptying. As can be seen from the calculations, the water level in the pond is at RL77.580 at the height of a 1-hour event, which is just 20mm below the overflow level (top water level is RL77.600) i.e. the pond is all but full. The peak discharge at this peak time is 17.5l/s compared to an inlet flow of 20.7l/s. This compares to an existing pre-developed Catchment B peak flow in a 1-hour event to the head of Exploration Way of 16l/s. The proposed Pond 1 will therefore achieve a similar post-development peak outlet flow to the road as the existing situation.

Pond 2 is situated by Lot 8 and is a small pond on the existing gully. As the gully is steep, the maximum volume achievable in the pond is 15m<sup>3</sup>. Catchment D drains to this pond. The runoff from the roof areas on Lots 8 & 9 drain to the pond.

The expected operation of Pond 2, during the design event, is shown on the attached calculation sheet – Assessment of Pond 2 Filling and Emptying. The design outlet pipe of a 125OD HDPE at a grade of 1 in 100 has been selected to achieve the correct filling and emptying. As can be seen from the calculations, the water level in the pond is at RL80.495 at the height of a 1-hour event, which is just 5mm below the overflow level (top water level is RL80.500) i.e. the pond is all but full. The peak discharge at this peak time is 20.5l/s compared to an inlet flow of 24.8l/s. This compares to an existing pre-developed Catchment D peak flow in a 1-hour event to the gully of 23l/s. The proposed Pond 2 will therefore achieve a reduction in the peak post-development outlet flow to the gully.

Pond 3 is situated opposite Lot 6 and is a small pond on the existing gully in Catchment C. As the gully is steep, the maximum volume achievable in the pond is only 12m<sup>3</sup>. This pond will discharge to a piped system leading to the gully below Catchment D. The runoff from the roof areas on Lots 5 & 7 drain to the pond and the roof area from Lot 6 will be connected to the piped system downstream of the pond.

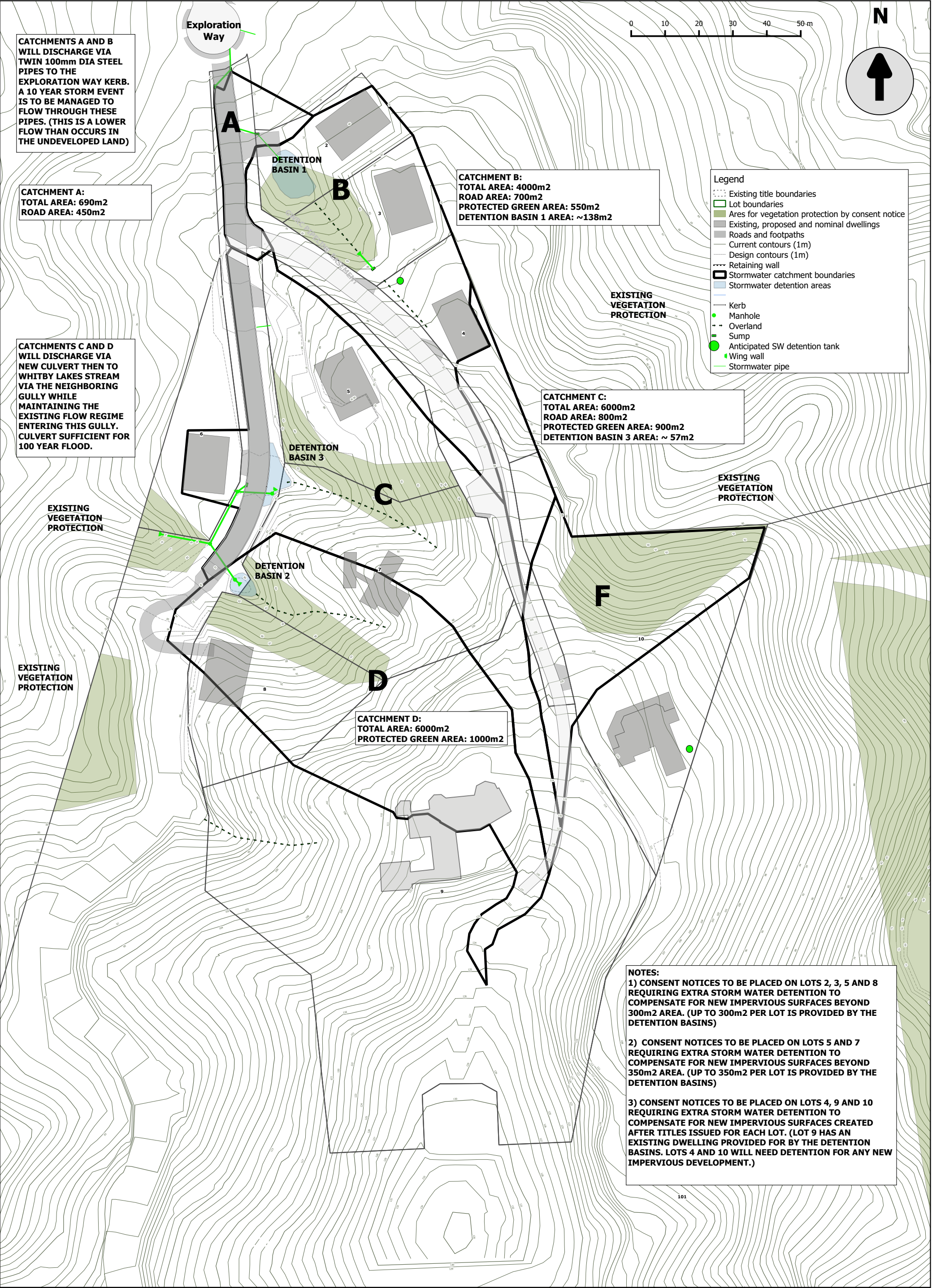
The expected operation of Pond 3, during the design event, is shown on the attached calculation sheet – Assessment of Pond 3 Filling and Emptying. The design outlet pipe of a 125OD HDPE at a grade of 1 in 15 has been selected to achieve the correct filling and emptying. As can be seen from the calculations, the water level in the pond is at RL79.980 at the height of a 1-hour event, which is just 20mm below the overflow level (top water level is RL80.000) i.e. the pond is all but full. The peak discharge from the pond at this peak time is 22.5l/s. In addition, a flow of 2.6l/s would be discharged from the roof of the house on Lot 6, being a total outflow of 25l/s. This compares to an existing pre-developed Catchment C peak flow in a 1-hour event to the gully of 21l/s. The proposed Pond 3 will therefore have a peak post-development outlet flow of slightly greater than pre-developed flows, but this is off-set by the slight reduction achieved by Pond 2.

The above assessment shows that the use of the 3 detention ponds will essentially maintain post-developed flows to pre-developed levels, taking the accuracy of the calculations into account. These calculations have been based on rainfall intensity from the PCC Code of Practice with the allowance for climate change etc.



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<b>Progeni Ltd</b> 68 Exploration Way, Porirua 5024 Ph 64 022 0819600	Client: Progeni Ltd		Fieldwork: -	-	Scale: 1:500 at A1; 1:1000 at A3
	Project: Exploration Heights		Designed: Harpham(Progeni)	01/14	ID: P1.ENG014 Rev: 2016-01-26
	Title: <b>Stormwater catchments</b>		Drawn: Harpham(Progeni)	01/16	Issued by: David Harpham
			Checked: O'CALLAGHAN		Date: 2017-11-02

## Stormwater Design - Assessment of Ponds and Piped Sections

### ASSUME:

the 300m<sup>2</sup> of the sites/building platforms are hardstand

0.05 slope correction factor added to bush surfaces

- 10 year ARI design Storm

Rainfall intensity =

63mm/hr + 16% factor for climate change and 1.2 factor for location within Porirua

87.7 mm/hr

### Pond storage determined for 1 hour event

### Composite Runoff Coefficient

Runoff coefficients calculated as composite coefficients using (area \* "C"/total area)

The appropriate value for "C" has been calculated on a weighted surface area/characteristics basis, as per the NZ Building Code E1 calculation of "C"

Surface type "C" 10yr ARI

roof/hardstand 0.95

road 0.95

bush/grass 0.35

### Area breakdown and estimate of peak flows in a 10 minute event

House on Lot 4 to have storage tank so excluded from additional runoff calculation

House on Lot 10 to also have storage tank but the runoff from this lot is excluded from these calculations as it is to another catchment to the northeast

### Estimate of Pre - Developed Runoff

Catchment	Lots	Post Developed Area (m <sup>2</sup> )				Pre Developed (10-minute event)		Pre Developed (1 hour event)	
		Roof / Hardstand	Road	Grass	Total	C	Q (l/s)	Q (l/s)	Volume (m <sup>3</sup> ) in 1 hr event
A		0	350	300	650	0.67	11	4	15
B		0	500	3,400	3,900	0.43	41	16	58
C		0	150	5,850	6,000	0.37	53	21	76
D		300	150	5,550	6,000	0.40	58	23	82
E		0	0	710	710	0.35	6	2	9
F		0	150	2,450	2,600	0.38	24	10	35
Total		300	1,300	18,260	19,860		193	76	274

### Estimate of Post - Developed Runoff

Catchment	Lots	Post Developed Area (m <sup>2</sup> )				Post Developed		Post Developed (1 hour event)		Additional Volume to be stored (m <sup>3</sup> )	Notes for pond storage
		Roof / Hardstand	Road	Grass	Total	C	Q	Q (l/s)	Volume (m <sup>3</sup> ) in 1 hr event		
A	-	0	450	200	650	0.77	12	5	17	2	compensatory storage in pond (lot 2) storage in pond (Lot 2), Lot 4 to have storage tank storage in pond opposite Lot 6 & lot 8 storage in pond on Lot 8
B	2 & 3	600	700	2,600	3,900	0.55	52	21	74	17	
C	5, 6 & 7	900	800	4,300	6,000	0.52	76	30	108	32	
D	8 & 9	600	200	5,200	6,000	0.43	63	25	89	7	
E	-	0	0	710	710	0.35	6	2	9	0	
F	-	0	150	2,450	2,600	0.38	24	10	35	0	no change
Total		2,100	2,300	15,460	19,860		233.6	92	332	58	no change

### Calculation of compensatory detention of increased flows - Use 1 hr event for volume calculation as 10 minute event too short

- 10 year ARI design Storm for storage - 1 hour event  
Rainfall intensity =

24.9mm/hr + 16% factor for climate change and 1.2 factor for location within Porirua

34.7 mm/hr

Check on additional volume of runoff

Total Pre-developed runoff = (209.9\*34.7/63)\*3.6 m<sup>3</sup> in 1 hour = 274 m<sup>3</sup>

Total Post-developed runoff = (264\*34.7/63)\*3.6 m<sup>3</sup> in 1 hour = 332 m<sup>3</sup>

Total storage required = 58 m<sup>3</sup>

## Assessment of Pond 1 Filling and Emptying

### Pond 1 - Beside Lot 2

Pond base level is just below RL77.0 and pond overflow weir is at RL77.60m.

#### Pond 1 Characteristics

surface areas derived from plans for each level

#### Outflow Pipe Characteristics -

125OD HDPE outlet pipe (101mm ID for an SDR11 pipe) with 150mm entry to reduce inlet control flow from Figure 6 NZBC Code (E1)

Pond water Level	surface area (m <sup>2</sup> )	Volume (m <sup>3</sup> )	cumulative volume (m <sup>3</sup> )	head @ inlet (150 dia) HW/D	depth	Area	R	excl inlet control Q (l/s)	pipe flow with inlet control	
76.95	0									
77	1	0.1	0.1	0.2	0.033	0.0014	0.0083	0.9	2	
77.1	12	0.7	0.7	0.4	0.066	0.005208	0.0167	5.4	3	inlet contro
77.2	34	2.3	3.0	0.7	0.1	0.008012	0.0250	10.8	6	inlet contro
77.3	55	4.5	7.5	1.0	0.15			11.6	12	pipe contro
77.4	93	7.4	14.9	1.3	0.2			12.4	15	pipe contro
77.5	115	10.4	25.3	1.7	0.25			13.2	20	pipe contro
77.6	138	12.7	38.0	2.0	0.3			13.9	>20	pipe contro
				2.3	0.35			14.6		pipe contro
				2.7	0.4			15.2		pipe contro
				3.0	0.45			15.9		pipe contro
				3.3	0.5			16.5		pipe contro
				3.7	0.55			17.0		pipe contro
				4.0	0.6			17.6		pipe contro

### Assessment of pond Filling and emptying in a 1 Hour Storm

100mm dia outlet pipe (125mm OD HDPE) but with a 150mm short section at entry to reduce entry losses

Time step	Time (minutes)	Rainfall (mm/hr)	inflow Q (l/s)	volume inflow (m <sup>3</sup> )	RL in pond	water depth in pond	outflow (l/s)	outflow (m <sup>3</sup> )	volume in pond	is pond full
0	0	0	0	0	77.00	0.000	0.0	0	0	
5	5	34.66	20.7	6.2	77.220	0.220	12.0	3.6	2.6	no
5	10	34.66	20.7	6.2	77.280	0.280	13	3.9	4.9	no
5	15	34.66	20.7	6.2	77.330	0.330	14	4.2	6.9	no
5	20	34.66	20.7	6.2	77.370	0.370	14.5	4.35	8.7	no
5	25	34.66	20.7	6.2	77.400	0.400	15	4.5	10.4	no
5	30	34.66	20.7	6.2	77.440	0.440	15.5	4.65	12.0	no
5	35	34.66	20.7	6.2	77.480	0.480	16	4.8	13.4	no
5	40	34.66	20.7	6.2	77.510	0.510	16.5	4.95	14.6	no
5	45	34.66	20.7	6.2	77.540	0.540	17	5.1	15.7	no
5	50	34.66	20.7	6.2	77.560	0.560	17	5.1	16.8	no
5	55	34.66	20.7	6.2	77.570	0.570	17.5	5.25	17.8	no
5	60	34.66	20.7	6.2	77.580	0.580	17.5	5.25	18.7	no
5	65	0.00	0	0.0	77.550	0.550	17	5.1	13.6	emptying
5	70	0.00	0	0.0	77.480	0.480	16	4.8	8.8	emptying
5	75	0.00	0	0.0	77.420	0.420	15	4.5	4.3	emptying
5	80	0.00	0	0.0	77.360	0.360	14.5	4.35	-0.1	emptying
5	85	0.00	0	0.0	77.290	0.290	13.5	4.05	-4.1	emptying
5	90	0.00	0	0.0	77.220	0.220	13	3.9	-8.0	emptying
5	95	0.00	0	0.0	77.100	0.100	10	3	-11.0	empty
5	100	0.00	0	0.0	77.380	0.380	0	0	0.0	
5	105	0.00	0	0.0	77.330	0.330	0	0	0.0	
5	110	0.00	0	0.0	77.300	0.300	0	0	0.0	
5	115	0.00	0	0.0	77.250	0.250	0	0	0.0	
5	120	0.00	0	0.0	77.150	0.150	0	0	0.0	

#### Notes

Maximum pond outlet flow is 17.5l/s

Existing pre-developed flow is 18l/s so outlet post development is no more than pre-developed flow

Pond almost full (.02m below overflow weir) in a one hour event with a 100mm dia (ID) outlet pipe - so close to full so assume full

### Assessment of pond Filling and emptying in a 10 minute Storm Event

100mm dia outlet pipe (125mm OD HDPE) but with a 150mm short section at entry to reduce entry losses

Time step	Time (minutes)	Rainfall (mm/hr)	inflow Q (l/s)	volume inflow (m <sup>3</sup> )	RL in pond	water depth in pond	outflow (l/s)	outflow (m <sup>3</sup> )	volume in pond	is pond full
0	0	0	0	0	77.00	0.000	0.0	0	0	
1	1	87.70	52.3	3.1	77.220	0.220	12.0	0.72	2.4	no
1	2	87.70	52.3	3.1	77.260	0.260	13	0.78	4.8	no
1	3	87.70	52.3	3.1	77.320	0.320	14	0.84	7.1	no
1	4	87.70	52.3	3.1	77.350	0.350	14.5	0.87	9.3	no
1	5	87.70	52.3	3.1	77.400	0.400	15	0.9	11.6	no
1	6	87.70	52.3	3.1	77.430	0.430	15.5	0.93	13.8	no
1	7	87.70	52.3	3.1	77.465	0.465	16	0.96	15.9	no
1	8	87.70	52.3	3.1	77.510	0.510	16.5	0.99	18.1	no

1	9	87.70	52.3	3.1	77.540	0.540	17	1.02	20.2	no
1	10	87.70	52.3	3.1	77.560	0.560	17	1.02	22.3	no
1	11	0.00	0.0	0.0	77.550	0.550	17	1.02	21.3	no
1	12	0.00	0.0	0.0	77.540	0.540	17	1.02	20.3	emptying
1	13	0.00	0	0.0	77.530	0.530	16.5	0.99	19.3	emptying
1	14	0.00	0	0.0	77.520	0.520	16.5	0.99	18.3	emptying
1	15	0.00	0	0.0	77.510	0.510	16.5	0.99	17.3	emptying
1	16	0.00	0	0.0	77.500	0.500	16.5	0.99	16.3	emptying
1	17	0.00	0	0.0	77.480	0.480	16.5	0.99	15.3	emptying
1	18	0.00	0	0.0	77.460	0.460	16	0.96	14.4	emptying
1	19	0.00	0	0.0	77.450	0.450	16	0.96	13.4	emptying
1	20	0.00	0	0.0	77.440	0.440	15.5	0.93	12.5	emptying
1	21	0.00	0	0.0	77.430	0.430	15.4	0.924	11.6	emptying
1	22	0.00	0	0.0	77.420	0.420	15.5	0.93	10.6	emptying
1	23	0.00	0	0.0	77.400	0.400	15.0	0.9	9.7	emptying
1	24	0.00	0	0.0	77.380	0.380	15.0	0.9	8.8	emptying

#### Notes

Maximum pond outlet flow is 17l/s

Existing pre-developed flow is 45l/s for a 10 minute event so outflow from pond is much less than pre-developed flow

Pond about 0.05m from fill in a 10 minute event with a 100mm dia outlet pipe and is empty about 20 -25 minutes after rainfall stops

Outlet pipe to kerb & Channel

Services catchments A & B

Flows in 10 minute event = 17 l/s from pond and 12l/s from catchment A = 29l/s.

Existing pre-developed flow to the kerb is 53l/s (without any existing storage effects)

proposed pipe is a twin 100mm diameter steel pipe.

Grade is 1 in 16

Q (per pipe) =  $1/0.12 * (1/16)^{.5} * (.1/4)^{.667} * A$   
14.0 l/s

Twin pipe discharge = 28 l/s without surcharge and so twin pipe will discharge the design 29l/s with minor surcharge

Proposed twin 100mm pipe at 6.2% grade matches expected inlet flows.



## Assessment of Pond 2 Filling and Emptying

### Pond 2 - Beside Lot 8

Pond base level is at RL79.9 and pond overflow weir is at RL80.5m.

#### Pond 2 Characteristics

surface areas derived from plans for each level

#### Outflow Pipe Characteristics -

125OD HDPE outlet pipe (101mm ID for an SDR11 pipe) at 1 in 100 grade with 150mm entry section to reduce inlet losses

Inlet control flow from Figure 6 NZBC Code (E1)

Pond water Level	surface area (m2)	Volume (m3)	cumulative volume (m3)	head @ inlet (150 dia)	depth	Area	R	excl inlet control Q (l/s)	pipe flow with inlet control
79.9	0			HW/D					
80	12	1.2	1.2	0.2	0.033	0.0014	0.0083	0.5	2
80.1	17	1.5	2.7	0.4	0.066	0.005208	0.0167	3.1	3 inlet controlled
80.2	23	2.0	4.7	0.7	0.1	0.008012	0.0250	6.2	6 inlet controlled
80.25	26	1.2	5.9	1.0	0.15			8.4	12 pipe controlled
80.3	30	1.4	7.3	1.3	0.2			10.5	15 pipe controlled
80.4	38	3.4	10.7	1.7	0.25			12.2	20 pipe controlled
80.5	46	4.2	15.0	2.0	0.3			13.7	>20 pipe controlled
				2.3	0.35			15.0	pipe controlled
				2.7	0.4			16.3	pipe controlled
				3.0	0.45			17.4	pipe controlled
				3.3	0.5			18.5	pipe controlled
				3.7	0.55			19.5	pipe controlled
				4.0	0.6			20.5	pipe controlled

### Assessment of pond Filling and emptying in a 1 Hour Storm

100mm dia outlet pipe (125mm OD HDPE) but with a 150mm short section at entry to reduce entry losses

Time step	Time (minutes)	Rainfall (mm/hr)	inflow Q (l/s)	inflow (m3)	RL in pond	depth in pond	outflow (l/s)	outflow (m3)	volume in pond	is pond full
0	0	0	0	0	79.90	0.000	0.0	0.0	0	
5	5	34.66	24.8	7.5	80.15	0.250	10.0	3.0	4.5	no
5	10	34.66	24.8	7.5	80.24	0.340	14.5	4.4	7.6	no
5	15	34.66	24.8	7.5	80.31	0.410	16.0	4.8	10.2	no
5	20	34.66	24.8	7.5	80.35	0.450	17.0	5.1	12.6	no
5	25	34.66	24.8	7.5	80.39	0.490	18.0	5.4	14.6	no
5	30	34.66	24.8	7.5	80.42	0.520	18.5	5.6	16.5	no
5	35	34.66	24.8	7.5	80.44	0.540	19.0	5.7	18.3	no
5	40	34.66	24.8	7.5	80.46	0.560	19.5	5.9	19.9	no
5	45	34.66	24.8	7.5	80.47	0.570	20.0	6.0	21.3	no
5	50	34.66	24.8	7.5	80.48	0.580	20.0	6.0	22.8	no
5	55	34.66	24.8	7.5	80.49	0.590	20.2	6.1	24.2	no
5	60	34.66	24.8	7.5	80.50	0.595	20.5	6.2	25.5	no
5	65	0.00	0	0.0	80.40	0.450	16.5	5.0	20.5	emptying
5	70	0.00	0	0.0	80.23	0.290	13.0	3.9	16.6	emptying
5	75	0.00	0	0.0	80.00	0.100	10.0	3.0	13.6	emptying
5	80	0.00	0	0.0	79.90	0.050	5.5	1.7	12.0	empty

#### Notes

Maximum pond outlet flow is 20.5l/s

Existing pre-developed flow is 20l/s - outlet flow post development is the same (within accuracy of calculations) as pre-developed flow

Pond is virtually full in 1 hr event, within accuracy of the calculations (5mm from overflow weir level)

### Assessment of pond Filling and emptying in a 10 minute Storm Event

100mm dia outlet pipe (125mm OD HDPE) but with a 150mm short section at entry to reduce entry losses

Time step	Time (minutes)	Rainfall (mm/hr)	inflow Q (l/s)	inflow (m3)	RL in pond	depth in pond	outflow (l/s)	outflow (m3)	volume in pond	is pond full
0	0	0	0	0	79.90	0.000	0.0	0	0	
1	1	87.70	62.8	3.8	80.18	0.280	10.0	0.6	3.2	no
1	2	87.70	62.8	3.8	80.22	0.320	14	0.84	6.1	no
1	3	87.70	62.8	3.8	80.31	0.410	16.0	0.96	8.9	no
1	4	87.70	62.8	3.8	80.38	0.480	17.5	1.05	11.6	no
1	5	87.70	62.8	3.8	80.45	0.550	19.5	1.17	14.2	no
1	6	87.70	62.8	3.8	80.49	0.590	20.5	1.23	16.8	no
1	7	87.70	62.8	3.8	80.50	0.600	62.8	3.77	15.0	yes
1	8	87.70	62.8	3.8	80.50	0.600	62.8	3.77	15.0	yes
1	9	87.70	62.8	3.8	80.50	0.600	62.8	3.77	15.0	yes
1	10	87.70	62.8	3.8	80.50	0.600	62.8	3.77	15.0	yes
1	11	0.00	0.0	0.0	80.48	0.580	20.2	1.21	13.8	emptying
1	12	0.00	0.0	0.0	80.46	0.560	20.5	1.23	12.6	emptying
1	13	0.00	0.0	0.0	80.43	0.530	16.5	0.99	11.6	emptying
1	14	0.00	0.0	0.0	80.42	0.520	13.0	0.78	10.8	emptying
1	15	0.00	0.0	0.0	80.38	0.480	10.0	0.60	10.2	emptying
1	16	0.00	0.0	0.0	80.35	0.450	5.5	0.33	9.9	emptying
1	17	0.00	0.0	0.0	80.33	0.425	15.5	0.93	8.9	emptying
1	18	0.00	0.0	0.0	80.29	0.390	15	0.90	8.0	emptying
1	19	0.00	0.0	0.0	80.25	0.350	14.5	0.87	7.2	emptying
1	20	0.00	0.0	0.0	80.23	0.325	14	0.84	6.3	emptying



1	21	0.00	0.0	0.0	80.19	0.290	13.5	0.81	5.5	emptying
1	22	0.00	0.0	0.0	80.14	0.240	13	0.78	4.7	emptying
1	23	0.00	0.0	0.0	80.10	0.200	12.0	0.72	4.0	emptying
1	24	0.00	0.0	0.0	80.28	0.380	11.0	0.66	3.3	emptying

**Notes**

Maximum pond outlet flow is 20.5l/s prior to overflow

Existing pre-developed flow is 50l/s for a 10 minute event - outflow is much less than pre-developed flow until the pond overflows

Pond is empty about 15 minutes after rainfall stops

## Assessment of Pond 3 Filling and Emptying

### Pond 3 - Opposite Lot 6

Pond base level is at RL79.5 and pond overflow weir is at RL80.0m.

#### Pond 3 Characteristics

surface areas derived from plans for each level

#### Outflow Pipe Characteristics -

125OD HDPE outlet pipe (101mm ID for an SDR11 pipe) at 1 in 15 grade with 150mm entry to reduce inlet losses

Inlet control flow from Figure 6 NZBC Code (E1)

Pond water Level	surface area (m2)	Volume (m3)	cumulative volume (m3)	head @ inlet (150 dia)	depth	Area	R	excl inlet control Q (l/s)	pipe flow with inlet control	
79.5	3			HW/D						
79.6	8	0.6	0.6	0.2	0.033	0.0014	0.0083	0.9	2	
79.7	15	1.2	1.7	0.4	0.066	0.005208	0.0167	5.4	3	inlet controlled
79.8	26	2.1	3.8	0.7	0.1	0.008012	0.0250	10.8	6	inlet controlled
79.9	41	3.4	7.1	1.0	0.15			17.9	12	inlet controlled
80.0	57	4.9	12.0	1.3	0.2			18.7	15	inlet controlled
				1.7	0.25			19.4	20	pipe controlled
				2.0	0.3			20.2	>20	pipe controlled
				2.3	0.35			20.9		pipe controlled
				2.7	0.4			21.5		pipe controlled
				3.0	0.45			22.2		pipe controlled
				3.3	0.5			22.9		pipe controlled

### Assessment of pond Filling and emptying in a 1 Hour Storm

100mm dia outlet pipe (125mm OD HDPE) but with a 150mm short section at entry to reduce entry losses

Catchment area and flow to the pond excludes the road as that goes to the sump and is discharged to the piped system

Catchment area = 5,200 m2

weighted "C" = 0.45

Time step	Time (minutes)	Rainfall (mm/hr)	inflow Q (l/s)	volume inflow (m3)	RL in pond	water depth in pond	outflow (l/s)	outflow (m3)	volume in pond	is pond full
0	0	0	0	0	79.50	0.000	0.0	0	0	
5	5	34.66	22.7	6.8	79.72	0.220	16	4.8	2.0	no
5	10	34.66	22.7	6.8	79.79	0.290	19	5.7	3.1	no
5	15	34.66	22.7	6.8	79.83	0.330	20.5	6.15	3.8	no
5	20	34.66	22.7	6.8	79.86	0.360	21	6.3	4.3	no
5	25	34.66	22.7	6.8	79.89	0.390	21.5	6.45	4.7	no
5	30	34.66	22.7	6.8	79.91	0.410	21.5	6.45	5.0	no
5	35	34.66	22.7	6.8	79.93	0.425	22	6.6	5.3	no
5	40	34.66	22.7	6.8	79.94	0.440	22	6.6	5.5	no
5	45	34.66	22.7	6.8	79.96	0.460	22	6.6	5.7	no
5	50	34.66	22.7	6.8	79.97	0.470	22.5	6.75	5.8	no
5	55	34.66	22.7	6.8	79.98	0.475	22.5	6.75	5.8	no
5	60	34.66	22.7	6.8	79.98	0.480	22.5	6.75	5.9	no
5	65	0.00	0.0	0.0	79.80	0.300	22	6.6	-0.7	emptying
5	70	0.00	0.0	0.0	79.55	0.050	12	3.6	-4.3	emptying
5	75	0.00	0.0	0.0	80.00	0.000	0	0	0.0	empty

#### Notes

Maximum pond outlet flow is 22.5l/s

Existing pre-developed flow is 23l/s in a one hour event and 57l/s in a 10-minute event.

Pond will fill in an event with a duration of just under an hour and will limit outlet flows to predeveloped flows in this event

Pond is not quite full in a 1-hour event (but only 50mm from overflow level but will fill in a slightly shorter event)

### Assessment of pond Filling and emptying in a 10 minute Storm Event

100mm dia outlet pipe (125mm OD HDPE) but with a 150mm short section at entry to reduce entry losses

Time step	Time (minutes)	Rainfall (mm/hr)	inflow Q (l/s)	volume inflow (m3)	RL in pond	water depth in pond	outflow (l/s)	outflow (m3)	volume in pond	is pond full
0	0	0	0	0	79.50	0.000	0.0	0	0	
1	1	87.70	57	3.4	79.72	0.220	16	0.96	2.5	no
1	2	87.70	57	3.4	79.84	0.340	20	1.2	4.7	no
1	3	87.70	57	3.4	79.91	0.410	21.5	1.29	6.9	no
1	4	87.70	57	3.4	79.97	0.465	22.5	1.35	9.0	no
1	5	87.70	57	3.4	80.00	0.500	22.5	1.35	12.05	yes
1	6	87.70	57	3.4	80.00	0.500	57	3.4	12.05	yes
1	7	87.70	57	3.4	80.00	0.500	57	3.4	12.05	yes
1	8	87.70	57	3.4	80.00	0.500	57	3.4	12.05	yes
1	9	87.70	57	3.4	80.00	0.500	57	3.4	12.05	yes
1	10	87.70	57	3.4	80.00	0.500	57	3.4	12.05	yes
1	11	0.00	0.0	0.0	79.99	0.485	22.5	1.35	10.7	emptying
1	12	0.00	0.0	0.0	79.96	0.460	22.5	1.35	9.4	emptying

1	13	0.00	0.0	0.0	79.92	0.420	22	1.32	8.0	emptying
1	14	0.00	0.0	0.0	79.88	0.380	22	1.32	6.7	emptying
1	15	0.00	0.0	0.0	79.85	0.350	21	1.26	5.5	emptying
1	16	0.00	0.0	0.0	79.82	0.320	20	1.2	4.3	emptying
1	17	0.00	0.0	0.0	79.76	0.260	19	1.14	3.1	emptying
1	18	0.00	0.0	0.0	79.70	0.200	18	1.08	2.0	emptying
1	19	0.00	0.0	0.0	79.63	0.130	12	0.72	1.3	emptying
1	20	0.00	0.0	0.0	79.58	0.080	8	0.48	0.8	emptying
1	21	0.00	0.0	0.0	79.55	0.050	5	0.3	0.5	emptying
1	22	0.00	0.0	0.0	79.53	0.030	4	0.24	0.3	emptying
1	23	0.00	0.0	0.0	79.51	0.010	3	0.18	0.1	emptying
1	24	0.00	0.0	0.0	79.50	0.000	2	0.12	0.0	empty

Notes

Maximum pond outlet flow just before being full is 22.5l/s compared to a pre-developed flow of 57l/s (in 10-minute event)  
Pond is empty about 15 minutes after rainfall stops