Memorandum

To:	Malory Osmond	**Date:**	27 November 2017
From:	Kristi Whyte	**Our Ref:**	2663104
Copy:			
Subject:	Creswell NZ Ltd - Pond Volume		

Response to BOPRC request:

"Rivers Schemes: Whakatane – Tauranga ; Rangitaiki – Tarawera ; Waioeka – Otara

The proposed land use activity is located within a catchment that flows into the Bay of Plenty Regional Council managed Rangitāiki – Tarawera Rivers Scheme.

Bay of Plenty Regional Council is an affected party based on the nature of the infrastructure and environmental purpose for the rivers scheme. BOPRC opposes the proposed land use activity unless a condition of consent is imposed ***requiring on-site detention be provided to prevent an increase in runoff from the site in a 72 hour 100 year event. This detention should be to a minimum standard of 80% of pre-development peak discharge.***

If the requirement for this post-development stormwater discharge mitigation condition is not provided for, BOPRC requests the application be declined or publicly notified.

Note: The stormwater mitigation will need to provide for the 1% AEP for the year 2117 climate adjusted storm for the critical duration, being the 72 hour storm."

Following discussions between Graham Levy (Beca), and Peter Blackwood (BOPRC) the following was agreed:

- The 72hr storm is the applicable storm. While this does not appear explicitly in the BOPRC guidelines at the moment it is not unreasonable, both in terms of the overall response times of a flat drainage catchment downstream (where ponding effects will end up) and the need to not pond water on the grass any longer than 72 hours.
- BOPRC have applied it to the 100 year storm, even though the drainage schemes are designed for 5 of 10 year storms, because it is the spill-over effect in larger storms is what they are concerned about.
- It is a volume control issue: no increase in the volume discharged from site over the 72 hour storm.
- The allowable runoff volume target is 100% of pre development runoff volume, not 80%. The 80% applies when targeting peak rates only, and it was noted instantaneous peak flow rate to the drain was not critical (current pond design) in this case
- A common climate basis is to be used, i.e. the same climate changes rainfall depth for both.
- HIRDS v3 is an appropriate design rainfall source.

Storage Requirements – 100 year, 72 hour storm event

The volume of storage has been calculated based on the current concept design.

This is assumed as the worst case scenario in terms of increase in impermeable surface areas. During detailed design investigation will be undertaken into reducing the impermeable surface and therefore the volume of storage required. However the same principles as used in this memo will apply in the detailed design.

Table 1 below shows the parameters used to calculate the required storage volume. The area used is the area of developed site. Refer attached calculation for more detail.

Table 1: Key Parameters

Parameter	Pre-development	Post-development
C coefficient (permeability)	0.33	0.67
Flow Rate (100yr-72hr)	0.031 m^3/s	0.064 m^3/s
Discharge Volume	8,035 m^3	16,585 m^3
Storage required		**8,550 m^3**

This volume is significantly larger than the previously calculated volume based off peak flows. It is expected that due to this significant volume storage that all site stormwater in events less than a 100year – 72hr event will discharge via ground soakage.

It the 100yr-72hr event the pond outlet will be restricted to only allow 0.031 m^3/s (pre development). The outlet will be detailed at a later design stage. There will also be an emergency overflow for any events greater than the 100yr-72hr event.

The volume will be contained on site by a combination of a stormwater pond (currently designed as ~3,600m^3) and other storages methods (~4,950m^3) for the site.

The type of storage method will be confirmed at detailed design stage but could include a Ecobloc Inspect-Flex System, Hynds concrete retention tank or similar. Checks have been completed to confirm that either of these systems or similar systems are feasible. The maximum footprint required is less than the available areas (e.g greenspace, car parking area) on site and the systems are suitable for the appropriate loading.

During the detailed design stage the pond will be increased to the maximum feasible size and use of underground storage tanks minimised.

Summary

Based on the current concept design the volume of storage required is 8,550m^3. The volume required will be recalculated in the detailed design stage but the principle as discussed in this memo will apply.

The volume will be contained on site by a combination of the currently designed stormwater pond (~3,600m^3) and storages methods (~4,950m^3).

Due to the large storage volume on the site it is expected that the stormwater on the site will drain to ground soakage. However, there will be an emergency overflow connection to Hallett's Drain encase of saturated ground (no soakage occurring). This overflow will be limited to the 100yr-72hr predevelopment flow rate restricted to only allow 0.031m^3/s runoff. There will also be an emergency overflow for any events greater than the 100yr-72hr event.

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Attached – Calculations

Beca

Calculation Sheet

Job Number 2663104 Date 25/11/17

Job Name Project Otaki

Subject Pond Volume Sizing 100yr-72yr

By KNW Page No 1 of 2

Otaki Pond Volumes (100-72yr Storm event

Areas —Refer Attachment (A)

- Pre-development

		C	CA
1322 m²	Roof	0.9	1189.8
1350 m²	Pavement	0.9	1215
5.9 ha	Grass	0.3	17700
61672			20104.8

Cpe = 0.33
A = 6.2ha

- Post-development

		C	CA
18902 m²	Roof	0.9	17011.8
19576 m²	Pavement	0.9	17618.4
2.35 ha	Grass	0.3	7050
61978			41680.2

Cpost = 0.67
A = 6.2 ha

NOTE: Areas are measured off a contour plan and are not 100% accurate. This will be updated at detailed design to reflect design changes and to increase accuracy.

Rainfall depths —Refer Attachment (B) HIRDS Data

$I_{100y,72hr}$ (no climate change) = 316.1mm

$I_{100y,72hr}$ (climate change 3.2°) = 397.0mm
Approx to 2130 ↗

→ Climate changed rainfall to be used for both pre and post development cases.

Beca

Calculation Sheet

Job Number 2663104 Date 25/11/17.

Job Name Project Otaki

Subject Pond Volume Sizing 100yr-72hr

By KNW Page No 2 of 2

Flow rates $Q = \frac{CIA}{360}$

- Predevelopment

$$Q = \frac{CIA}{360} = \frac{0.33 \times \left(\frac{397}{72}\right) \times 6.2}{360}$$

$$Q_{pre,100} = 0.031\ m^3/s$$

- Post development

$$Q = \frac{CIA}{360} = \frac{0.67 \times \left(\frac{397}{72}\right) \times 6.2}{360}$$

$$Q_{post,100} = 0.064\ m^3/s$$

Volumes $V = Q \times duration$ $V = C \times A \times depth$

- Predevelopment

Method 1

$V = 0.031 \times 72 \times 60 \times 60$

$= 8035.2\ m^3$

Method 2

$V = 0.33 \times 62000 \times \frac{397}{1000}$

$= 8122.62\ m^3$

- Post development

$V = 0.064 \times 72 \times 60 \times 60$

$= 16588.8$

$V = 0.67 \times 62000 \times \frac{397}{1000}$

$= 16491.38$

Different between Vpost and Vpre is storage requirement

Method 1

$V = 8553.6$

Method 2

$V = 8368.76$

Volume required to be stored on site

$$Vol = 8550\ m^3$$

Drawing Plotted: 19 Sep 2017 8:09 a.m.

Attachment A

Total Site areas

Pre development
1322m2 - roof
~1350m2 pavement

2672m2 (0.27ha) - impermeable
5.9 ha - permeable

Post Development
18902m2 - roof
19576m2 - pavement

38478 (3.85ha) - impermeable
2.35 ha - permeable

3 FACILITY

OOR AREA 16800m²

151 sq m
90 sq m
8 sq m
44 sq m
51 sq m
86 sq m
7 sq m
1,322 sq m
16,894 sq m
21 sq m
204 sq m
24 sq m
19,576 sq m

Total area to pond
40,315 sq m

Total site
62,282 sq m

FOR RESOURCE CONSENT

0 5 10 15 20 25 30 35 40 45 50

SCALE BAR: METRES AT A1 SIZE

No.	Revision	By	Chk	Appd	Date
0E	CONCEPT UPDATE	MG			15.09.17
0D	CONCEPT UPDATE	MG			4.09.17
0C	CONCEPT UPDATE	MG			31.08.17
0B	CONCEPT UPDATE	MG			30.08.17

Drawing Originator: Beca

Original Scale (A1) 1:500
Reduced Scale (A3) 1:1000

Design	M.G.	NOV. 16
Drawn	M.G.	NOV. 16
Dsg Verifier	H.J.	DEC.16
Dwg Check	I.T.	DEC.16

Client: NONGFU SPRING LTD

Project:

Title: SITE PLAN
CATCHMENT AREAS

Discipline: ARCHITECTURE

Drawing No. 2663104 - AR-101

Rev. 0E

DO NOT SCALE

IF IN DOUBT ASK.

Document No. AR-101 PLAN.DWG

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Attachment B

High Intensity Rainfall System V3

Results for 57 Johnson Rd

Depth-Duration-Frequency results (produced on Monday 27th of November 2017)
Sitename: 57 Johnson Rd
Coordinate system: NZMG
Easting: 2838995
Northing: 6347936

Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	9.7	14.2	17.9	26.4	34.6	53.2	69.8	91.6	105.3	114.3
2.00	0.500	10.4	15.3	19.2	28.3	37.3	57.5	75.6	99.4	114.3	124.0
5.00	0.200	13.0	19.1	24.0	35.4	46.8	73.0	96.6	127.8	146.8	159.3
10.00	0.100	15.0	22.2	27.8	41.0	54.5	85.5	113.5	150.8	173.3	188.0
20.00	0.050	17.3	25.5	32.0	47.3	63.0	99.4	132.6	176.8	203.2	220.4
30.00	0.033	18.8	27.7	34.8	51.3	68.5	108.5	145.0	193.8	222.7	241.6
40.00	0.025	19.9	29.3	36.8	54.3	72.7	115.4	154.4	206.7	237.6	257.7
50.00	0.020	20.8	30.7	38.5	56.7	76.0	121.0	162.1	217.3	249.7	270.9
60.00	0.017	21.6	31.8	39.9	58.8	78.9	125.7	168.7	226.4	260.1	282.1
80.00	0.012	22.8	33.6	42.2	62.3	83.7	133.6	179.6	241.3	277.3	300.8
100.00	0.010	23.8	35.2	44.1	65.1	87.5	140.1	188.5	253.6	291.4	316.1

Coefficients

c1	c2	c3	d1	d2	d3	e	f
-0.0001	0.0078	-0.0001	0.5606	0.3920	0.2008	0.1962	3.2726

Standard errors (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	2.1	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.6
2.00	0.500	2.1	2.1	2.2	2.2	2.2	2.4	2.5	2.5	2.6	2.7
5.00	0.200	2.1	2.2	2.2	2.3	2.4	2.8	3.2	3.0	3.3	3.4
10.00	0.100	2.2	2.2	2.3	2.4	2.8	3.5	4.2	3.8	4.3	4.4
20.00	0.050	2.2	2.4	2.5	2.7	3.5	4.8	6.1	5.2	5.9	6.2
30.00	0.033	2.2	2.5	2.6	2.9	4.2	5.9	7.6	6.3	7.2	7.6
40.00	0.025	2.3	2.6	2.8	3.2	4.7	6.8	8.8	7.2	8.4	8.8
50.00	0.020	2.3	2.7	2.9	3.4	5.2	7.7	10.0	8.1	9.3	9.8
60.00	0.017	2.4	2.8	3.1	3.6	5.7	8.4	10.9	8.8	10.2	10.7
80.00	0.012	2.4	3.0	3.3	3.9	6.5	9.7	12.7	10.0	11.6	12.3
100.00	0.010	2.5	3.1	3.5	4.2	7.2	10.8	14.1	11.1	12.9	13.6

Extreme rainfall assessment with climate change

Projected temperature change: 3.2 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	**aep**	**10m**	**20m**	**30m**	**60m**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**
1.58	0.633	12.2	17.7	22.0	32.1	41.5	62.2	80.5	104.2	118.1	127.1
2.00	0.500	13.1	19.1	23.6	34.4	44.7	67.3	87.2	113.1	128.2	137.9
5.00	0.200	16.3	23.8	29.7	43.4	56.8	87.2	114.5	149.9	170.3	183.8
10.00	0.100	18.8	27.7	34.6	50.7	67.1	104.1	137.1	181.2	207.1	223.5
20.00	0.050	21.7	32.0	40.0	59.0	78.3	122.9	163.6	217.5	249.4	269.8
30.00	0.033	23.6	34.8	43.7	64.4	86.0	136.3	182.1	243.4	278.3	301.1
40.00	0.025	25.0	36.8	46.2	68.2	91.3	144.9	193.9	259.6	297.7	322.4
50.00	0.020	26.1	38.6	48.4	71.2	95.5	152.0	203.6	272.9	313.6	340.3
60.00	0.017	27.1	39.9	50.1	73.9	99.1	157.9	211.9	284.4	326.7	354.3
80.00	0.012	28.6	42.2	53.0	78.2	105.1	167.8	225.6	303.1	348.3	377.8
100.00	0.010	29.9	44.2	55.4	81.8	109.9	176.0	236.8	318.5	366.0	397.0