Stormwater Facility 1 Volume Calculations - Current Zoning

Refer to Catchment Plan E18431 SC01.1

Date: 16-Sep-2023 Completed by: Jamie Verstappen Revision: R1

Assumptions:

1. Critical storm duration is 36hrs

2. Release of the storm is over four days

3. Average dewatering from site will be at 1 l/s/ha

4. Assumed 0.51/s/ha already leaving site from spring flow

Stormwater flow and volume calculations using the requirements of Ecan consent CRC231955 and the Christchurch City Council Waterway, Wetlands & Drainage Guide (WWDG).

			FF Runoff	Peak F Coeffi	low Runoff cients	
Zone		Area (Ha),A	Coefficients, Cff	(50 ye	ar),C	
Catchment A, Commercial	(KAC) (CCC)	3.16	0.81	0.	.82	
Catchment B, Commercial	(KAC)	11.3	0.81	0.	.82	
Catchment C, RNN Equival	lent	18.4	0.63	0.	.65	
Catchment D, RNN Equiva	lent	1.1	0.63	0.	.65	
Catchment E, Stormwater	facility	9.8	0		0.9	
Catchment F, MRZ, RNN E	quivalent (CCC)	12.6	0.63	0.	.65	
Catchment G, MRZ, RNN E	quivalent (CCC)	18.1	0.63	0.	.65	
Catchment H, MRZ, RNN E	quivalent (CCC)	6.5	0.63	0.	.65	
Total Area		87.56				
Christchurch Rainfall inter	sity for 36hr event:			4.95 mm/h	r HIRDS RCF	P8.5 2081 -2100
First flush Volume (WWD0	6,Eqn 6-2), V = 10CAd,	d = 25mm as pe	er consent condition			
Commercial (KAC):	V = 10*25 * 0.81 *	14.46		2928.15 m3		
Residential (RNN Equiv):	V = 10*25 * 0.63 *	63.3		9969.75 m3		
Residential (HRZ)	V = 10*25 * 0.81 *	0		0 m3		
Holewall Commons Facilit	. FF volume required			12000 m2		
Mith E% codiment retenti	y FF volume required			12090 III5	This fits in	to the existing FF basin by raisin
Constructed EF Basin Volu	on added.			19010 m2	the coille	au to BL10.4
Constructed FF Basin Voil	ime			18010 m3	the spinwa	ay to RL19.4
FF Volume Split						
Spreydon Lodge	V = 10*25*(B x C <sub>ff</sub> B +	- C x C <sub>ff</sub> C + D x C <sub>f</sub>	<sub>f</sub> D)	6399 m3		
ССС	V = 10*25*(A x C <sub>ff</sub> A +	F x C <sub>ff</sub> F + F x C <sub>ff</sub>	F)	6499 m3		
FF Outflow Rate based on	volume discharging o	ver 4 days		39.2 l/s		
Full Flood Volume calculat	ion = 2.78CiA					
					%	m³
Catchment A, Commercial	(KAC) (CCC)			35.7 l/s	4.19	2321
Catchment B, Commercial	(KAC)			127.5 l/s	14.99	8298
Catchment C, RNN Equiva	lent			164.6 l/s	19.35	10711
Catchment D, RNN Equiva	lent			68.9 l/s	8.10	4482
Catchment E, Stormwater	facility			121.4 l/s	14.27	7899
Catchment F, MRZ, RNN E	quivalent (CCC)			112.7 l/s	13.25	7335
Catchment G, MRZ, RNN E	quivalent (CCC)			161.9 l/s	19.03	10537
Catchment H, MRZ, RNN E	quivalent (CCC)			58.1 l/s	6.83	3784
CCC Portion					17.44	
Spreydon Lodge Portion					56.70	
Storm water detention vo	lume required			850.7 l/s		
				110255.3 m3 fo	r 36hrs	
Discharge rate of storm vo	olume over a 4 day tin	ne frame,	110255.3	/ 4 / 24 / 60 / 60		
				0.319 m3/s		
Discharge rate over the 36	Shrs storm event,		0.319 * 60 *60 *36 =	41345.7 m3		
Volume of detention basin	n required, less discha	rge over storm e	event and FF volumes,			
V = 110255.3	-41345.7	-13543		55367 m3		
Total basin volume storag	e volume required			55367 m3		
Less spare FF capacity				4467 m3		
Total basin volume to be	constructed			50900 m3		

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### Stormwater Facility 1 Volume Calculations - PC14 Notified Zoning

Refer to Catchment Plan E18431 SC01.2

Date: 16-Sep-2023 Completed by: Jamie Verstappen Revision: R1

Assumptions:

1. Critical storm duration is 36hrs

2. Release of the storm is over four days

3. Average dewatering from site will be at 1 l/s/ha

4. Assumed 0.5l/s/ha already leaving site from spring flow

Stormwater flow and volume calculations using the requirements of Ecan consent CRC231955 and the Christchurch City Council Waterway, Wetlands & Drainage Guide (WWDG).

Zone		Area (Ha) A	FF Runoff Coefficients, Cff	Peak Coef (50 y	Flow Runoff ficients rear) C		
		/		(30)	601//0		
Catchment A, Commercia	I (KAC) (CCC)	3.16	0.81		0.82		
Catchment B, Commercia	I (KAC)	11.3	0.81		0.82		
Catchment C, HRZ		18.4	0.81		0.82		
Catchment D, RNN Equiva	llent	7.7	0.63		0.65		
Catchment E, Stormwater	facility	9.8	0		0.9		
Catchment F, HRZ		12.6	0.81		0.82		
Catchment G, MRZ, RNN B	Equivalent (CCC)	18.1	0.63		0.65		
Catchment H, MRZ, RNN I	Equivalent (CCC)	6.5	0.63		0.65		
Total Area		87.56					
Christchurch Rainfall inter	nsity for 36hr event:			4.95 mm/	hr HIRDS R	CP8.5 2081 -2100	
First flush Volume (WWD	G,Eqn 6-2), V = 10CAd	, d = 25mm as j	per consent condition				
Commercial (KAC):	V = 10*25 * 0.81 *	14.46		2928.15 m3			
Residential (RNN Equiv):	V = 10*25 * 0.63 *	32.3		5087.25 m3			
Residential (HRZ)	V = 10*25 * 0.81 *	31		4882.5 m3			
Halswell Commons Facilit	v FF volume required			12898 m3			
With 5% sediment retent	ion added.			13543 m3	This fits	into the existing FF basin	by raising
FF capacity provided				18010 m3	the spill	way to RL19.4	-,
FF Volume Split							
Spreydon Lodge	$V = 10*25*(B \times C_{ff}B)$	+ C x C <sub>ff</sub> C + D x	C <sub>ff</sub> D)	7227 m3			
ссс	V = 10*25*(A x C <sub>ff</sub> A	+ F x C <sub>ff</sub> F + F x C	C <sub>ff</sub> F)	7066 m3			
FF Outflow Rate based on	volume discharging c	over 4 days		39.2 l/s			
Full Flood Volume calcula	tion = 2.78CiA						
					%	m <sup>3</sup>	
Catchment A, Commercia	I (KAC) (CCC)			35.7 l/s	3.86	2365	
Catchment B, Commercia	I (KAC)			127.5 I/s	13.81	8458	
Catchment C, HRZ	lont			207.6 1/5	22.49	13772	
Catchment D, RNN Equiva	ilent facility			08.9 I/S	7.40	4569	
Catchment E HP7	lacinty			121.4 1/3 142.2 1/c	15.13	0421	
Catchment G MR7 RNN F	quivalent (CCC)			142.2 1/3 161 9 1/s	17.40	10739	
Catchment H, MRZ, RNN I	Equivalent (CCC)			58.1 l/s	6.30	3857	
CCC Portion					19.26		
Spreydon Lodge Portion					56.91		
Storm water detention vo	lume required			923.3 l/s	an Ochar		
				119653.9 m3 f	or 36hrs		
Discharge rate of storm ve	olume over a 4 day tir	ne frame,	119653.9	/ 4 / 24 / 60 / 60 0.346 m3/s	5		
Discharge rate over the 30	Shrs storm event,		0.346 * 60 * 60 * 36 =	44870.2 m3			
Volume of detention basi	n required, less discha	arge over storm	n event and FF volumes,				
V = 119653.9	-44870.2	-13543		61241 m3			
Total basin volume storag	ge volume required			61241 m3			
Less spare FF capacity				4467 m3			
Total basin volume to be	constructed			56774 m3			

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#### Stormwater Facility 1 Volume Calculations - s42A Recommended

Refer to Catchment Plan E18431 SC01.3

Date: 16-Sep-2023 Completed by: Jamie Verstappen Revision: R1

Assumptions:

1. Critical storm duration is 36hrs

2. Release of the storm is over four days

3. Average dewatering from site will be at 1 l/s/ha

4. Assumed 0.5l/s/ha already leaving site from spring flow

Stormwater flow and volume calculations using the requirements of Ecan consent CRC231955 and the Christchurch City Council Waterway, Wetlands & Drainage Guide (WWDG).

Zone		Area (Ha),A	FF Runoff Coefficients, Cff	Peak Coef (50 y	Flow Runoff ficients /ear),C		
			,				
Catchment A, Commercia	(KAC) (CCC)	3.16	0.81		0.82		
Catchment B, Commercia	(KAC)	11.3	0.81		0.82		
Catchment C, HRZ		18.4	0.81		0.82		
Catchment D, HRZ		7.7	0.81		0.82		
Catchment E, Stormwater	facility	9.8	0		0.9		
Catchment F, HRZ	(000)	12.6	0.81		0.82		
Catchment G, MRZ, RNN E	quivalent (CCC)	18.1	0.63		0.65		
Catchment H, HRZ		6.5	0.81		0.82		
Total Area		87.56					
Christchurch Rainfall inter	nsity for 36hr event:			4.95 mm/	/hr HIRDS RC	CP8.5 2081 -2100	
First flush Volume (WWD	G,Eqn 6-2), V = 10CAd	, d = 25mm as p	er consent condition				
Commercial (KAC):	V = 10*25 * 0.81 *	14.46		2928.15 m3			
Residential (RNN Equiv):	V = 10*25 * 0.63 *	63.3		12818.25 m3			
Residential (HRZ)	V = 10*25 * 0.81 *	0		0 m3			
Halswell Commons Facilit	v EE volume required			157/6 m3			
With 5% sediment retent	y FF Volume required			15740 m3	This fits i	nto the existing EE basin by r	raicing
FF capacity provided	ion added.			18010 m3	the spillw	ay to RL19.4	arsing
						,	
FF Volume Split	V = 10*2E*/D v C D		D)	7574 m2			
spreydon Louge	$V = 10^{\circ} 25^{\circ} (B \times C_{ff} B)$	$+C \times C_{\rm ff}C + D \times C$	ffD)	7574 1115			
CCC	$V = 10*25*(A \times C_{ff}A)$	+	<sub>f</sub> F)	7358 m3			
FF Outflow Rate based on	volume discharging o	over 4 days		47.8 l/s			
Full Flood Volume calculat	tion = 2.78CiA						
	(((, , , ), (, , , , , )))				%	m³	
Catchment A, Commercia	(KAC) (CCC)			35.7 l/s	3.73	2272	
Catchment B, Commercial	(KAC)			127.5 I/s	13.33	8124	
Catchment C, HRZ				207.6 l/s	21./1	13229	
Catchment D, HRZ	f 1114			86.9 I/s	9.08	5536	
Catchment E, Stormwater	Tacility			121.4 1/5	12.69	//33	
Catchment F, HRZ				142.2 l/s	14.86	9059	
Catchment G, MRZ, RNN E	quivalent (CCC)			161.9 1/5	16.93	10315	
Catchment H, HKZ				/3.3 1/5	7.67	4673	
CCC Portion					18.59		
Spreydon Lodge Portion					56.81		
Storm water detention vo	lume required			956.5 l/s			
	·			123959.1 m3 f	or 36hrs		
Discharge rate of storm vo	blume over a 4 day tin	ne frame,	123959.1	/ 4 / 24 / 60 / 60 0.359 m3/s	5		
Discharge rate over the 36	Shrs storm event,		0.359 * 60 *60 *36 =	46484.7 m3			
Volume of detention basi	n required, less discha	arge over storm	event and FF volumes.				
V = 123959.1	-46484.7	-16534		60941 m3			
Total basin volume storag	ge volume required			60941 m3			
Less spare FF capacity Total basin volume to be	constructed			1476 m3 59464 m3			

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Stormwater Facility 2 Volume Calculations - Current Zoning

Refer to Catchment Plan E18431 SC01.1

16-Sep-2023 Date: Completed by: Jamie Verstappen Revision: R1

-2100

Assumptions:

1. Critical storm duration is 36hrs

2. Release of the storm is over four days

3. Average dewatering from site will be at 1 l/s/ha

4. Assumed 0.5l/s/ha already leaving site from spring flow

Stormwater flow and volume calculations using the requirements of Ecan consent CRC231955 and the Christchurch City Council Waterway, Wetlands & Drainage Guide (WWDG).

Zone	Area (Ha),A	FF Runoff Coefficients, Cff		Peak Flo Coefficie (50 year	ow Runoff ents ),C	
Catchmont A. Commorcial (KAC)	2.0	0.91		0.02	,	
Catchment A, Commercial (NAC)	2.9 14.2	0.53		0.82	5	
Catchment C. 12 Equivalent	9.8	0.53		0.50	5	
Catchment D. L2 Equivalent	5.3	0.53		0.56	5	
Catchment E, Completed I 2 Equivalent	10	0.53		0.56	5	
Catchment E. Completed L2 Equivalent	10.2	0.53		0.56	5	
Catchment G. L2 Equivalent	4	0.53		0.56	5	
Catchment H. Partially completed 12 Equivalent	16.7	0.53		0.56	5	
Catchment I. Partially completed 13 Res	3.5	0.63		0.65	5	
Catchment J, Stormwater Facility	5.2	0		0.9	Ð	
Total Area	81.8					
Christchurch Rainfall intensity for 36hr event:			4.95	mm/hr	HIRDS RC	P8.5 2081 -2100
First flush Volume (WWDG,Eqn 6-2), V = 10CAd, d	= 25mm as per	consent condition				
Residential (RNN/L3): V = 10*25 * 0.63 *	3.5		463.75	m3		
Residential (L2 Equiv): V = 10*25 * 0.53 *	16.7		2212.75	m3		
SW Facility 2 FF volume required			2677	m3		
Constructed FF Basin Volume			2810	m3		
FF Outflow Rate based on volume discharging over	er 4 days		8.1	l/s		
Volume of FF required upstream of site						
Commercial (KAC): V = 10*25 * 0.81 *	2.9		587.25	m3		
Residential (RNN/L3): V = 10*25 * 0.63 *	18.2		2411.5	m3		
Residential (L2 Equiv): V = 10*25 * 0.53 *	35.3		4677.25	m3		
Total FF Volume within catchment			10494	m3		
Full Flood Volume calculation = 2.78CiA					0/	m <sup>3</sup>
Catchment A. Commercial (KAC)			32.7	1/s	/ 89	2138
Catchment B, L2 Equivalent			109.4	1/s	16 35	7148
Catchment C. 12 Equivalent			75.5	1/s	11.28	4933
Catchment D, 12 Equivalent			40.8	1/s	6.10	2668
Catchment E. Completed L2 Equivalent			77.1	l/s	11.51	5034
Catchment E. Completed L2 Equivalent			78.6	l/s	11.74	5135
Catchment G. L2 Equivalent			30.8	l/s	4.60	2014
Catchment H. Partially completed L2 Equivalent			128.7	l/s	19.22	8407
Catchment I. Partially completed L3 Res			31.3	l/s	4.68	2045
Catchment J, Stormwater Facility			64.4	l/s	9.62	4207
Storm water detention volume required			669.4 86754.7	l/s m3 for 3	6hrs	
Discharge rate of storm volume over a 4 day time	frame.	86754.7	/ 4 / 24 / 60 / 60	I		
	,		0.251	m3/s		
Discharge rate over the 36hrs storm event,		0.251 * 60 *60 *36 =	32533.0	m3		
Volume of detention basin required, less discharg	e over storm ev -10494	ent and FF volumes,	12720	m3		
Total basin volume storage volume required	10-17-		43728	m3		

Stormwater Facility 2 Volume Calculations - PC14 Zoning

Refer to Catchment Plan E18431 SC01.2

Date: 16-Sep-2023 Completed by: Jamie Verstappen Revision: R1

Assumptions:

1. Critical storm duration is 36hrs

2. Release of the storm is over four days

3. Average dewatering from site will be at 1 l/s/ha

4. Assumed 0.5l/s/ha already leaving site from spring flow

Stormwater flow and volume calculations using the requirements of Ecan consent CRC231955 and the Christchurch City Council Waterway, Wetlands & Drainage Guide (WWDG).

one		Area (Ha),A	FF Runoff Coefficients, Cff	Peak Fl Coeffici (50 yea	Peak Flow Runoff Coefficients (50 year),C		
Catchmant & Commarcial	(KAC)	2.0	0.81	0.0	n		
Catchment B. Progressive	HRZ	2.9 14 2	0.81	0.8	2		
Catchment C. L2 Equivaler	nt	9.8	0.53	0.5	6		
Catchment D. L2 Equivale	nt	5.3	0.53	0.5	6		
Catchment E. Completed	2 Equivalent	10	0.53	0.5	6		
Catchment F. Completed	L2 Equivalent	10.2	0.53	0.5	6		
Catchment G, Progressive	RNN	4	0.63	0.6	5		
Catchment H, Partially cor	npleted L2 Equivalent	16.7	0.53	0.5	6		
Catchment I, Partially com	pleted L3 Res	3.5	0.63	0.6	5		
Catchment J, Stormwater	Facility	5.2	0	0.	9		
Total Area		81.8					
Christchurch Rainfall inter	nsity for 36hr event:			4.95 mm/hr	HIRDS RCF	98.5 2081 -2100	
First flush Volume (WWD0	G,Eqn 6-2), V = 10CAd, d	l = 25mm as per c	onsent condition				
Residential (RNN/L3):	V = 10*25 * 0.63 *	3.5		463.75 m3			
Residential (L2 Equiv):	V = 10*25 * 0.53 *	16.7		2212.75 m3			
SW Facility 2 FF volume re	equired			2677 m3			
Constructed FF Basin Volu	ıme			2810 m3			
FF Outflow Rate based on	volume discharging over	er 4 days		8.1 l/s			
Volume of FF required up	stream of site						
Commercial (KAC):	V = 10*25 * 0.81 *	2.9		587.25 m3			
Residential (RNN/L3):	V = 10*25 * 0.63 *	18.2		3685.5 m3			
Residential (L2 Equiv):	V = 10*25 * 0.53 *	35.3		4677.25 m3			
Total FF Volume within ca	atchment			11768 m3			
Full Flood Volume calculation	tion = 2.78CiA				%	m <sup>3</sup>	
Catchment A. Commercial	(KAC)			32.7 l/s	4.51	2120	
Catchment B. Progressive	HRZ			160.2 l/s	22.10	10379	
Catchment C, L2 Equivaler	nt			75.5 l/s	10.41	4892	
Catchment D. L2 Equivale	nt			40.8 l/s	5.63	2645	
Catchment E, Completed	L2 Equivalent			77.1 l/s	10.63	4991	
Catchment F, Completed	L2 Equivalent			78.6 l/s	10.84	5091	
Catchment G, Progressive	RNN			35.8 l/s	4.93	2317	
Catchment H, Partially cor	npleted L2 Equivalent			128.7 l/s	17.75	8336	
Catchment I, Partially com	pleted L3 Res			31.3 l/s	4.32	2028	
Catchment J, Stormwater	Facility			64.4 l/s	8.88	4171	
Storm water detention vo	lume required			725.2 l/s 93981.2 m3 for	36hrs		
Discharge rate of storm vo	olume over a 4 day time	frame,	93981.2	/ 4 / 24 / 60 / 60			
				0.272 m3/s			
Discharge rate over the 36	Shrs storm event,	C	0.272 * 60 *60 *36 =	35242.9 m3			
Volume of detention basis	n required, less dischar -35242 ۹	ge over storm ever	nt and FF volumes,	46970 m3			
Total basin volume storag	ge volume required	11.00		46970 m3			

Stormwater Facility 2 Volume Calculations - PC14 Zoning

Refer to Catchment Plan E18431 SC01.3

16-Sep-2023 Date: Completed by: Jamie Verstappen Revision: R1

Assumptions:

1. Critical storm duration is 36hrs

2. Release of the storm is over four days

3. Average dewatering from site will be at 1 l/s/ha

4. Assumed 0.5l/s/ha already leaving site from spring flow

Stormwater flow and volume calculations using the requirements of Ecan consent CRC231955 and the Christchurch City Council Waterway, Wetlands & Drainage Guide (WWDG).

Zone		Area (Ha),A	FF Runoff Coefficients, Cff	Peak Coef (50 y	: Flow Runoff ficients vear),C	
Catchmant & Commara		2.0	0.81		0.00	
Catchment B. Progressiv		2.9 14.2	0.81		0.82 0.82	
Catchment C. L2 Equival	ent	9.8	0.53		0.56	
Catchment D. HRZ		5.3	0.81		0.82	
Catchment E. Complete	d L2 Equivalent	10	0.53		0.56	
Catchment F, HRZ		10.2	0.81		0.82	
Catchment G, HRZ		4	0.81		0.82	
Catchment H. Partially c	ompleted L2 Equivalent	16.7	0.53		0.56	
Catchment I. Partially co	mpleted L3 Res	3.5	0.63		0.65	
Catchment J, Stormwate	er Facility	5.2	0		0.9	
Total Area		81.8				
Christchurch Rainfall int	ensity for 36hr event:			4.95 mm,	hr HIRDS RC	P8.5 2081 -2100
First flush Volume (WW	DG,Eqn 6-2), V = 10CAd, c	l = 25mm as per c	onsent condition			
Residential (RNN/L3):	V = 10*25 * 0.63 *	3.5		708.75 m3		
Residential (L2 Equiv):	V = 10*25 * 0.53 *	16.7		2212.75 m3		
SW Facility 2 FF volume	required			2922 m3		
Constructed FF Basin Vo	blume			2810 m3		
FF Outflow Rate based of	on volume discharging ov	er 4 days		8.1 l/s		
Volume of FF required u	upstream of site					
Commercial (KAC):	V = 10*25 * 0.81 *	2.9		587.25 m3		
Residential (RNN/L3):	V = 10*25 * 0.63 *	18.2		3685.5 m3		
Residential (L2 Equiv):	V = 10*25 * 0.53 *	35.3		4677.25 m3		
Total FF Volume within	catchment			11768 m3		
Full Flood Volume calcu	lation = 2.78CiA				02	m <sup>3</sup>
Catchment A Commerc	ial (KAC)			32 7 1/s	4 14	2163
Catchment B. Progressiv	re HRZ			160.2 J/s	20.28	10592
Catchment C. L2 Equival	ent			75.5 l/s	9.56	4992
Catchment D. HRZ				59.8 l/s	7.57	3953
Catchment E. Complete	d L2 Equivalent			77.1 l/s	9.75	5094
Catchment F. HRZ				115.1 l/s	14.57	7608
Catchment G. HRZ				45.1 l/s	5.71	2984
Catchment H. Partially c	ompleted L2 Equivalent			128.7 l/s	16.29	8507
Catchment I. Partially co	mpleted L3 Res			31.3 l/s	3.96	2069
Catchment J, Stormwate	er Facility			64.4 l/s	8.15	4257
Storm water detention	volume required			790.0 l/s	2.51	
				102381.1 m3 f	or 36hrs	
Discharge rate of storm	volume over a 4 day time	frame,	102381.1	/ 4 / 24 / 60 / 60 0 296 m3/9		
Discharge rate over the	36hrs storm event,	С	.296 * 60 *60 *36 =	38392.9 m3	-	
Volume of detention ba	sin required, less discharg	ge over storm ever	nt and FF volumes,			
V = 102381.1	-38392.9	-11768		52220 m3		
iotal pasili volume stor	age volume required			52220 m3		