TMK Consulting Engineers
Level 6 100 Pirie Street Adelaide SA 5000
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au

Principal:	CITYFY & BFC Pty Ltd	**Job Number:**	1806063
Project Title:	Proposed Apartment	**Date:**	26 June 2019
Site:	82 Johns Road, Prospect, SA.		

ATTACHMENTS:

SW1 – SW3 - Stormwater Detention Calculations 1:100 Yr ARI, 'Critical Storm' Duration
BG1 - Box Gutter Calculations 1:100 Yr ARI

DESIGN:

The pre development flow off the two allotments is 54.20L/s. 100% of the roof and surface area is to be detained within 13 x 1,500L detention tanks for the units, 13,500L 'ROCLA' box culvert for the apartments & 3 above ground basins of 21,333L. Total proposed volume is 54,333L. The OSD is to be discharged at 15.22L/sec into the existing SEP. The 0.9 coefficient is used as only the roof area is being considered for detention.

GENERAL NOTES:

1. These calculations are to be read in conjunction with the relevant associated Drawings, Footing Construction Report, Civil Drawings and / or details.

2. All work is to comply with relevant SAA Standards and Guides.

AS 2876-1987: Concrete kerbs and channels (gutters) – manually or machine placed
AS 2200-2006: Design charts for water supply and sewerage
AS/NZS 3500: Plumbing and drainage
AS 3798-1990: Guidelines on earthworks for commercial and residential developments
AS 4000-1997:
and General conditions of contract
AS 2124-1992:
ARRB Special Report 35: Subsurface drainage of road structures
Australian Rainfall and Run-off Volumes 1 and 2: A guide to flood estimation
Austroads 2008 – Guide to pavement technology
NAASRA 1987 – Pavement design
Storm drainage design in small urban catchments: A handbook for Australian practice
Water Sensitive Urban Design (WSUD) Engineering Procedure: Stormwater
Water Services Association of Australia Code (WSAA).

For and on behalf of
TMK Consulting Engineers

Alex Perez
Civil Engineer

TMK CONSULTING ENGINEERS

Ref.: 1806063
Date: 21-May-19
Design: ALP
Page: SW1

STORMWATER CALCULATIONS - DETERMINATION OF DETENTION TANK SIZES

Design Storm Intensity Table (mm/hr) - (from http://www.bom.gov.au/cgi-bin/hydro/has/CDIRSWebBasic)

STORM LOCATION Adelaide — Latitude 34°59'S; Longitude 138°44'E

Adelaide

	AVERAGE RETURN INTERVAL (YEARS)						
DURATION	**1**	**2**	**5**	**10**	**20**	**50**	**100**
5 mins	52.60	69.00	89.40	104.00	123.00	151.00	175.00
6 mins	49.10	64.50	83.50	96.70	115.00	141.00	163.00
10 mins	39.80	52.00	66.90	77.10	91.30	112.00	129.00
20 mins	28.30	36.80	46.80	53.40	62.80	76.20	87.30
30 mins	22.70	29.40	37.10	42.30	49.50	59.80	68.30
1 hour	15.20	19.70	24.60	27.90	32.50	39.00	44.40
2 hours	10.10	13.00	16.20	18.30	21.20	25.40	28.90
3 hours	7.92	10.20	12.70	14.30	16.60	19.90	22.50
6 hours	5.24	6.75	8.37	9.44	11.00	13.10	14.90
12 hours	3.45	4.44	5.52	6.23	7.23	8.65	9.83
24 hours	2.22	2.86	3.58	4.05	4.72	5.66	6.44
48 hours	1.38	1.78	2.24	2.55	2.98	3.60	4.11
72 hours	1.02	1.32	1.67	1.90	2.23	2.70	3.10

PRE-DEVELOPMENT

Design ARI (yr) 20 yr
Design Duration (min) 10 min
Design Storm Intensity (mm/hr) **91.30** mm/hr

Design Parameters	**C**	**Area (m^2)**	**% Area Detained**
Roof	0.90	393	0.00
Paving	0.75	2378	0.00
Grass / Landscaping	0.12	0	0.00
Total Area		**2771** m^2	
Weighted C (C_w)*	0.77		

Max pre-development flow $Q_i=\Sigma(CiA/3600)$:

Roof	**8.97** L/s
Paving	**45.23** L/s
Grass / Landscaping	**0.00** L/s
Pre-development flow =	**54.20** L/s

Use Max Allowable Flow = **54.20** L/s

Note: The weighted average value of the runoff coefficient, C_w, includes roof, paving, grassed and landscaped areas of the site.

POST-DEVELOPMENT (*Determine Critical Storm)

Design ARI (yr) 100 yr
Design Duration (min) 45 min
Design Storm Intensity (mm/hr) **56.35** mm/hr

Design Parameters	**C**	**Area (m^2)**	**% Area Detained**	
Roof	0.90	1400	100.00	O
Paving	0.75	1071	100.00	O
Grass / Landscaping	0.12	300	0.00	
Total Area		**2771** m^2		
Weighted C (C_w)*	0.76			

Summary of Design Flows

Undetained flow, $Q_u=\Sigma(CiA_u/3600)$:

Roof	**0.00** L/s
Paving	**0.00** L/s
Grass / Landscaping	**0.56** L/s
Design undetained flow =	**0.56** L/s

Max. outflows from detention tanks:

Site water runoff	
Pumped	**0.00** L/s
Piped	**0.00** L/s
Roof water runoff	
Orifice-restricted	**18.72** L/s
Total Max. Design Outflow =	**19.29** L/s

< 54.20 L/s Allowed :. OK

STORMWATER CALCULATIONS - STORMWATER RUN-OFF - ORIFICE-RESTRICTED

Time of Concentration, T_C

Design Storm ARI (yr)	100	yr	(from page SW1)
Design Storm Duration (mins)	45	mins	(from page SW1)
Design Storm Intensity, i	56.35	mm/hr	(from page SW1)
=> For run-off calculations, use T_C =	**5.0**	mins	**<=Duration :. Use Tc = 5 mins.**

Design Parameters	C	Area (m^2)	% Area Detained
Roof	0.90	1400	100.00
Paving	0.75	1071	100.00
Grass / Landscaping	0.12	300	0.00

Detained flow, $Q_d=\Sigma(CiA_d/3600)$:

Roof	19.72	L/s
Paving	12.57	L/s
Grass / Landscaping	0.00	L/s
Design detained flow =	**32.30**	L/s

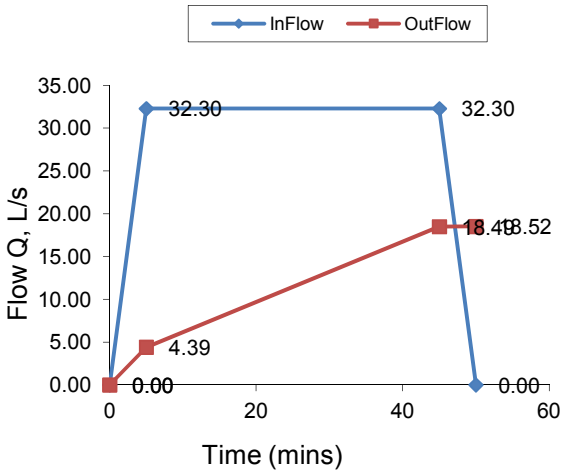
=> Try the following retention tank design parameters:

Max Allowable outflow from storage = **18.73** L/s **(34.91 L/s is still available for outflow)**

Number of orifice detention tanks	1	Each tank volume above orifice	50,000 L
Max. head allowed above orifice	2,000 mm	**=> Each Tank Plan Area =**	25.00 m^2
Outlet coefficient,C_O	0.6		
Orifice diameter, D_O	80 mm	=> Orifice area, A_O =π*(D_O/2)^2	5,027 mm^2

Graph Time v Flow:

Time (mins)	InFlow (L/s)	OutFlow (L/s)
0	0.00	0.00
5	32.30	4.39
45	32.30	18.49
50	0.00	18.52



Max. Calculated Outflow:

$Qmax_{out}$ = **18.72 L/s**

< 18.73 L/s Max. Allowed :. OK

Max. Calculated Head of Water:

H = **1,985 mm**

< 2,000 mm Max. Allowed :. OK

=> Volume of Water To Be Detained:

V = **49,621 L**

i.e. V = **49.62 m^3**

=>USE

Duration (mins)	Intensity (mm/hr)	Proposed Inflow Rate (L/s)	Proposed Inflow Rate x Duration (L)	Orifice Outflow Rate (L/s)	Orifice Outflow Volume (L)	Net Storage (L)
5	175.00	100.3	30,089	-18.73	-3,371	26,718
6	163.00	93.4	33,631	-18.73	-4,046	29,585
7	154.50	88.5	37,190	-18.73	-4,720	32,470
8	146.00	83.7	40,165	-18.73	-5,394	34,770
9	137.50	78.8	42,555	-18.73	-6,069	36,486
10	129.00	73.9	44,360	-18.73	-6,743	37,617
11	124.83	71.5	47,219	-18.73	-7,417	39,801
12	120.66	69.2	49,790	-18.73	-8,091	41,699
13	116.49	66.8	52,075	-18.73	-8,766	43,310
14	112.32	64.4	54,074	-18.73	-9,440	44,634
15	108.15	62.0	55,785	-18.73	-10,114	45,671
16	103.98	59.6	57,210	-18.73	-10,788	46,421
17	99.81	57.2	58,348	-18.73	-11,463	46,885
18	95.64	54.8	59,199	-18.73	-12,137	47,062
19	91.47	52.4	59,763	-18.73	-12,811	46,952
20	87.30	50.0	60,041	-18.73	-13,486	46,555
25	77.80	44.6	66,884	-18.73	-16,857	50,027
30	68.30	39.1	70,460	-18.73	-20,228	50,232
35	64.32	36.9	77,409	-18.73	-23,600	53,809
40	60.33	34.6	82,989	-18.73	-26,971	56,017
45	***56.35***	***32.3***	***87,198***	***-18.73***	***-30,343***	***56,856***
50	52.37	30.0	90,038	-18.73	-33,714	56,324
55	48.38	27.7	91,508	-18.73	-37,085	54,423
60	44.40	25.4	91,608	-18.73	-40,457	51,152
75	40.53	23.2	104,517	-18.73	-50,571	53,946
90	36.65	21.0	113,427	-18.73	-60,685	52,742
120	28.90	16.6	119,256	-18.73	-80,914	38,342
150	25.70	14.7	132,564	-18.73	-101,142	31,422
180	22.50	12.9	139,269	-18.73	-121,370	17,899
210	21.23	12.2	153,334	-18.73	-141,599	11,735
240	19.97	11.4	164,785	-18.73	-161,827	2,958
270	18.70	10.7	173,622	-18.73	-182,056	- 8,433

Ref.: 1806063

Date: 21-May-19

Design: ALP

Page: SW3

CRITICAL STORM DURATION
ORIFICE OUTLOW

Critical Storm Duration = 45 mins
Max Storage Volume = 56,856 Litres

***Notes:** This calculation is used for determining the critical storm duration at the location shown on the main calculation sheet for the case where the maximum outflow rate from the tank orifice is as shown in the table.

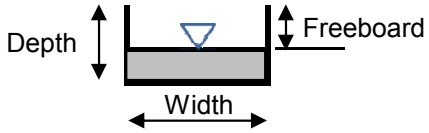
The Net Storage Volume values shown in this table are approximate. The design uses results obtained from calculations where the effects of the change in head in the storage tank and the Time of Concentration have been included.

The critical storm results are shown highlighted in bold italics.

Ref.:	**1806063**
Date:	**26-Jun-19**
Design:	**ALP**
Page:	**BG1**

BOX GUTTER & DOWNPIPE SPECIFICATIONS

INPUT DATA:



Gutter Geometry

Design Storm Event – ARI =	**100**	years
Design Storm Event – Duration =	**5**	minutes
Gutter width =	**0.400**	metres
Gutter depth =	**0.100**	metres
Gutter freeboard =	**0.025**	metres
Box gutter sump depth (below gutter invert) =	**0.100**	metres
Longest gutter run =	**12.00**	metres
Downpipe diameter =	**0.150**	metres

Cross section area of downpipe, A_{pipe} =	0.0177	m^2
Design water section area in box gutter, A_{box} =	0.03	m^2
Roughness coefficient, n =	0.009	
Fittings head loss coefficient, k =	2.5	
Average gradient, s =	0.005	

DETERMINE FLOWS:

A_{roof} =	**210**	m^2	(The largest roof area contributing runoff into a downpipe/sump)
C =	1.08		(Runoff coefficient (C_{10}*F_y))
I =	**175**	mm/hr	

Q_{roof} = CIA_{roof} / 3600 = 11.03 L/Sec

Q_{box} = $A_{box} R^{2/3} S^{1/2} / n$ = 33.90 L/Sec ***:. OK. Qbox > Qroof***

where $R = A_{box} / P_{box\ (wetted\ perimeter)}$ = 0.05 metres

CHECK ENTRY INTO DOWNPIPE AND WATER LEVEL BUILD-UP:

V = (Q_{roof} / A_{pipe}) / 1000 = 0.624 m/s

Velocity head required = $kV^2/2g$ =	0.050	m
Depth required due to length of gutter fall =	0.060	m
Adopted freeboard =	0.025	m
Total gutter & sump depth required =	***0.135***	***m***
Selected gutter & sump depth =	***0.200***	***m***

:. Box Gutter size is OK

ADOPT:

0.400 m wide x 0.100 m Deep Box Gutter
0.150 m Diameter Downpipes
0.100 m Deep Box Gutter Sumps