Costin Roe Consulting

Value in Engineering and Management

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26 September 2012

Western Sydney Parklands Trust
Attention: Mr Tim Colless
Level 4, 10 Valentine Avenue
PARRAMATTA NSW 2150

Dear Sir

Re: Horsley Drive Business Park
Fairfield Council Stormwater Queries

Further to the recent State Significant Planning Submission at the above project address, we hereby provide the following response to comments from Fairfield City Council contained in a memo titled "*Comments on Horsley Drive Business Park – Costin Roe Consulting Civil Engineering Report by Catchment Management Branch*", dated 18 September 2012.

The following response is to be read in conjunction with the updated documents and computer models noted below:

- Civil Engineering Report, Horsley Drive Business Park, Development Application, Ref: Co11492.00-03.rpt, Revision B.
- Costin Roe Consulting drawings Co11492.00-DA41-1, DA41-8, DA41-9, DA46, DA47, DA70.
- DRAINS computer models "*11492.00 SWSP PREDEVELOPED REV 2 (12.09.18).drn*" and "*11492.00 SWSP DEVELOPED REV 3 (12.09.18).drn*".

Response to council letter as follows:

Comments on Report		
Section	Page	Comment
5.1.2	*10*	*…event of a piped system failure* ***for flows above capacity of the piped system.*** Response Wording in report has been adjusted – refer to updated report, Revision B.

5.1.4	*10*	*…catchment modelling software DRAINS* ***and RAFTS****.* Response Wording in report has been adjusted – refer to updated report, Revision B.
5.1.4	*11*	*Replace ILSAX with DRAINS* Response Wording in report has been adjusted – refer to updated report, Revision B.
5.2.2	*11*	*Replace Major System with Minor System* Response Wording in report has been adjusted – refer to updated report, Revision B.
5.2.5	*12*	*Why are the basins temporary? They should be permanent.* Response We confirm the basins are permanent and the wording in report has been adjusted – refer to updated report, Revision B.
5.2.5	*12*	*Which adjacent creek? Are you referring to the Wetherill Park drainage channel?* Response We confirm this is referring to the Wetherill Park Drainage channel and the wording in report has been adjusted – refer to updated report, Revision B.
5.3.1	*12*	*Catchment areas stated within this section of the report do not correlate to those presented on drawing Co11492.00-DA70. Need to confirm which catchment areas are correct and make necessary changes.* Response Catchment areas have been checked and minor differences noted have been adjusted in the report and on plan. Refer to updated report, Revision B and revised drawing DA70.

5.3.3	*13*	*The NSW Office of Water document 'Controlled Activities: Guidelines for Outlet Structures' is not a design manual, only a design guideline. A more relevant design guideline should be reference. One example is the Catchments & Creeks Rock sizing for single pipe outlets August 2011* <u>Response</u> The general arrangement/ configuration of the outlet will be made as a "natural outlet" in accordance with the guidelines of the NSW Office of Water document noted above – this document has not been used for sizing of the outlet structure. The sizing of the outlet was previously based on the method shown in the Blue Book which is considered to be appropriate and not for a temporary structure. We have however reviewed the current sizing against the method suggested by council and this results in slightly smaller less conservative apron sizes and similar rock scour sizes. We have adjusted the proposed outlets to this and note that this will be further addressed during detail design stage. Refer to updated report, Revision B and revised drawing DA46.
5.3.5	*13*	*The outlet structures guidelines found within the blue book are for temporary structures, and are not appropriate for this situation.* <u>Response</u> Refer to above comments.
5.3.5	*13*	*Need to ensure the peak flow rate from the catchment are being used as the flow rate to size the rock protection* <u>Response</u> We confirm the peak flow rates are used for the rock protection.
5.4	*14*	*…drainage network to convey* ***runoff from*** *the two external catchments…* <u>Response</u> Wording in report has been adjusted – refer to updated report, Revision B.
5.4	*14*	*'…only minor flows are requires to be allowed at this location.' – No, just a reduced catchment size*

		Response Wording in report has been adjusted – refer to updated report, Revision B.
5.4	*14*	*Need to ensure that there is sufficient grade on the overland channel around northern extent of the development. Please provide calculations undertaken to ensure the channel is sufficient.* Response We confirm there is sufficient capacity in the channel to convey the Q100 peak flow of 3.45m3/s. Refer enclosed preliminary Mannings calculations for the flow path. Note that the flow path will be further assessed during detail design stage to ensure the adopted cross section and profile will be suitable for the re-routed overland flow path. Refer Appendix A of this letter.
5.5	*14*	*Please clarify what the 'Catchment 2 receiving drainage' consists of, and its location, and how do we know it is limitied?* Response The Catchment 2 drainage consists of 2x triple 900mm diameter culverts which connect to a large box culvert system known as the Wetherill Park Drainage Channel. The configuration, which was provided by Fairfield Council is shown on a Fairfield City Council Plan dated 1998 which is contained in Appendix D of our report. Any piped drainage system is inherently limited – this is a general statement which has been removed from the report – Refer Appendix B.
5.5	*14*	*Total catchment of 87.9ha should be smaller as it should not include catchment C1 of 7.56 ha.* Response The total catchment has been reviewed and we confirm it is 83.6Ha (this now includes 2.06Ha from Trivet St which was requested by Fairfield Council). Refer to updated report Revision B and drawing DA70.
5.5	*15*	*What stage storage relationship was used for the two basins?* Response Refer to Appendix B of this report.

5.5	*15*	*What are the characteristics of the Cowpasture Road broad-crested weir* <u>Response</u> The discharge characteristics of the Cowpasture Road were modeled as a series of weirs whose overtopping level increased in 250mm increments. Refer to Appendix B of this report for calculations.
5.5	*15*	*It is noted that stormwater flows will overtop Cowpasture Road for storm durations greater than or equal to the one hour event in the 100 year ARI. In which events does it overtop for other ARIs?* <u>Response</u> The road is not expect to be overtopped during a Q2 ARI storm however we would expect overtopping to take place during a Q5 year storm – this is further discussed in the updated report. Refer to updated report Revision B
5.5	*15*	*The following statement is a little unclear. 'We furthermore note that, due to the restrictive nature of the receiving drainage network that there will be little or no change to the outflow hydrograph in a storm event.' Can you please clarify if it is the downstream road crossing or box culvert that is restrictive, and clarify the exact location of the outflow hydrograph.* <u>Response</u> The statement is meant to relate the no-worsening effect due to the stormwater management provided as part of the development. We agree the statement is a little ambiguous and it has now been removed from the report. Refer to updated report Revision B
5.6	*16*	*It is noted that for catchment C1 the estimated time of concentration is 7 minutes (drawing Co11492.00-DA70). This seems to contradict the flows listed in table 5.3 and 5.4 with the peak flow for the predeveloped site being higher for the 2 hour duration over the 30 minute duration. Can yo please clarify this.* <u>Response</u> Generally when performing a rational method calculation, the peak flow corresponds to the time of concentration. The model used however is a runoff-routing model which has multiple parameters

		which include varying rainfall patterns, initial and continuous runoff parameters, flow times etc. This does not necessarily mean that the peak flow for the development will occur during a small duration storm and the provided DRAINS/RAFT model clearly shows that the 2hour storm is indeed the storm which produces the highest peak flow and stormwater volume for the site. This has been discussed with council and further clarification has been sought from the developers of DRAINS Mr Bob Stack and Professor Geoff O'Laughlin. Correspondence on this matter has already been forwarded to Fairfield Council and has been included in this letter in Appendix C. Refer Appendix C.
5.6	*16*	*Table 5.3 (and 5.4) lists the storage. How was the storage capacity optimised?* <u>Response</u> The storage capacity for Basins 1 & 2 was optimized as follows: • A number of outlet configurations were trialed to optimize the outflow configuration. • The low flow outlet pipe has been set to the Q2 year ARI storm flow. • The high flow has been set to be above the Q20 ARI water level (ie overtopping only occurs in storms greater than Q20). • A check on the 9hour storm show the PSD is less than council requirement of 140 l/s/ha.
5.6	*16*	*Details need to be provided with respect to the outlet configuration of both of the basins to ensure they are in compliance with Councils OSD policy requirements.* <u>Response</u> Please refer to new drawing DA47 for typical outlet configuration of the basins. Concept details shown will be further developed during detail design phase of the project. Refer drawing DA47.
5.6	*16*	*Do the calculations for OSD include the western undeveloped catchments, as per modelling of flooding at the intersection of Cowpasture Road and Victoria Street.*

		<u>Response</u> Basin 2 includes the catchments from undeveloped catchments upstream of the development. The outlet control has been set to ensure the post development flow is less than the pre-development flow for the total catchment. This means a no-worsening effect on the downstream catchment occurs.
Comments on DRAINS Model		
1		*Model Outlet/Downstream Boundary Condition* <u>Response</u> The downstream boundary condition has been updated to include revised invert levels and downstream boundary levels as per email correspondence from Mr Andrew Voutsis from Fairfield City Council dated 18 September 2012. The inclusion of the downstream boundary condition results in approximately 300mm increase in expected flood level at Cowpasture Road/ Vitoria Road intersection. Refer to revised DRAINS modeling and drawing DA70.
2		*Additional Catchment Area* <u>Response</u> The additional catchment area of 2.06Ha has been included in the modeling – this results in increase water level of approximately 50mm. Refer to revised DRAINS modeling and drawing DA70.
3		*Overland Flow Path OF19320/OF19990* <u>Response</u> The overland flow path has been adjusted. Refer to revised DRAINS modeling.
4		*Report Section 5.6, Table 5.4* <u>Response</u> The peak flows have been checked and minor adjustments have been made to the report and drawing. Refer to revised report Revision B and drawing DA41-1 and DA41-

		8.
5		*Time of Concentration* <u>Response</u> Refer to previous comments and Appendix C of this letter.
Additional Conditions Required		
		The proponent is to undertake a risk assessment for the proposed on site detention/water quality basis. <u>Response</u> A risk assessment of the basins can be provided during the detail design/ construction certificate component of the development and this requirement can be conditioned as such.
		Formal access must be provided to each of the detention basin. It must be suitable for a car to reverse into and for people to the access the basin for cleaning. <u>Response</u> Formal access can be provided – concept locations have been included in revised drawings which can be formalized with council during detail design stage. Refer to revised drawings DA41-1 & DA41-8.

We trust the above and enclosed documentation meets you current needs. Please do not hesitate to contact the undersigned for further clarification if required.

Yours faithfully
COSTIN ROE CONSULTING PTY LTD

M. Wil

MARK WILSON MIEAust
Senior Design Engineer

APPENDIX A

OVERLAND FLOW CHANNEL CALCULATIONS

Costin Roe Consulting
Value in Engineering and Management

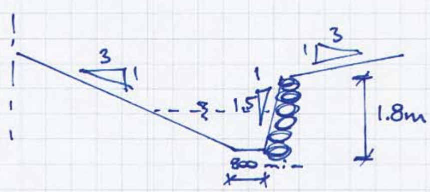
Job No:	11492.00
Page No:	1
DESIGNED by	MW	Date
CHECKED by		Date

Horsley Business Park

Overland Flow Channel (Flows from upstream of SW Channel)

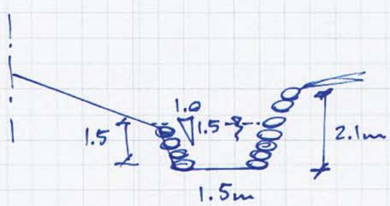
Q100 Peak Flow = 3.45 m^3/s

Channel Slope = 0.5%
Manning n = 0.07



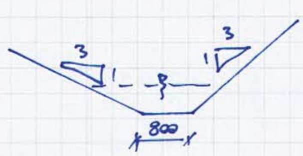
Q100 depth = 1.35m

Typical Cross Section 1



Q100 depth = 1.6m

Typical Cross Section 2

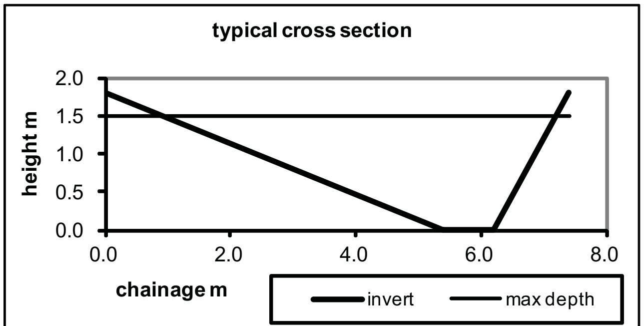


Q100 depth = 1.3m

Typical Cross Section 3

Project:	Horsley Drive Business Park - XS1	Job No:	11492.000
		Minimum Channel Depth	1.8

CHANNEL CAPACITY CALCULATIONS — Based on Manning's formula $V = 1/n\ R^{2/3} S^{1/2}$

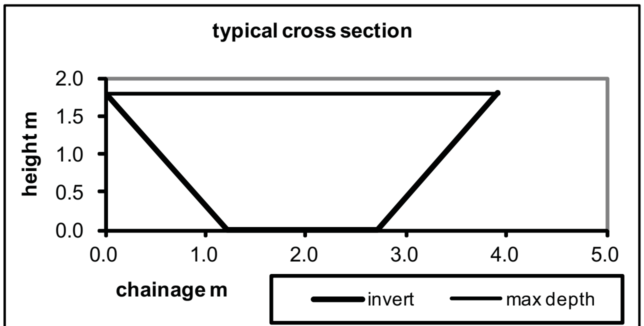


Required Flow m^3/s	3.450
Manning's coefficient "n"	0.070
Bed slope 1 in..	200.0
Left bank slope (Sl)1 in..	3.000
Bed width (m)	0.800
Right bank slope(Sr)1 in..	0.670
For channel depth (m) of..	1.800
Minimum Water Level	0.000
Maximum Water Level	1.500
Required increments	0.100
number of increments	16

CHANNEL DEPTH d (m)	CHANNEL CAPACITY Q(cumec)	CHANNEL VELOCITY V(m/s)	Vxd (m^2/s)	FLOW WIDTH Ww (m)	FLOW AREA m^2	WETTED PERIMETER m	HYDRAULIC RADIUS R (m)
0.000	0.000	0.00	0.00	0.80	0.00	0.80	0.00
0.100	0.018	0.19	0.02	1.17	0.10	1.24	0.08
0.200	0.063	0.27	0.05	1.53	0.23	1.67	0.14
0.300	0.136	0.34	0.10	1.90	0.41	2.11	0.19
0.400	0.240	0.39	0.16	2.27	0.61	2.55	0.24
0.500	0.378	0.44	0.22	2.64	0.86	2.98	0.29
0.600	0.554	0.49	0.29	3.00	1.14	3.42	0.33
0.700	0.771	0.53	0.37	3.37	1.46	3.86	0.38
0.800	1.032	0.57	0.46	3.74	1.81	4.29	0.42
0.900	1.341	0.61	0.55	4.10	2.21	4.73	0.47
1.000	1.699	0.64	0.64	4.47	2.64	5.17	0.51
1.100	2.111	0.68	0.75	4.84	3.10	5.60	0.55
1.200	2.579	0.72	0.86	5.20	3.60	6.04	0.60
1.300	3.105	0.75	0.97	5.57	4.14	6.48	0.64
1.400	3.693	0.78	1.10	5.94	4.72	6.91	0.68
1.500	4.345	0.82	1.22	6.31	5.33	7.35	0.73

Project:	Horsley Drive Business Park - XS2	Job No:	11492.000
		Minimum Channel Depth	1.8

CHANNEL CAPACITY CALCULATIONS — Based on Manning's formula V = 1/n R^2/3 S^1/2

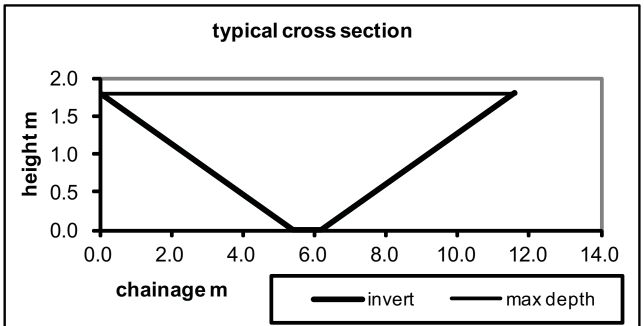


Required Flow m^3/s	3.450
Manning's coefficient "n"	0.070
Bed slope 1 in..	200.0
Left bank slope (Sl)1 in..	0.670
Bed width (m)	1.500
Right bank slope(Sr)1 in..	0.670
For channel depth (m) of..	1.800
Minimum Water Level	0.000
Maximum Water Level	1.800
Required increments	0.100
number of increments	19

CHANNEL DEPTH d (m)	CHANNEL CAPACITY Q(cumec)	CHANNEL VELOCITY V(m/s)	Vxd (m^2/s)	FLOW WIDTH Ww (m)	FLOW AREA m^2	WETTED PERIMETER m	HYDRAULIC RADIUS R (m)
0.000	0.000	0.00	0.00	1.50	0.00	1.50	0.00
0.100	0.032	0.20	0.02	1.63	0.16	1.74	0.09
0.200	0.099	0.30	0.06	1.77	0.33	1.98	0.16
0.300	0.193	0.38	0.11	1.90	0.51	2.22	0.23
0.400	0.311	0.44	0.18	2.04	0.71	2.46	0.29
0.500	0.451	0.49	0.25	2.17	0.92	2.70	0.34
0.600	0.613	0.54	0.32	2.30	1.14	2.94	0.39
0.700	0.797	0.58	0.40	2.44	1.38	3.19	0.43
0.800	1.002	0.62	0.49	2.57	1.63	3.43	0.48
0.900	1.230	0.65	0.59	2.71	1.89	3.67	0.52
1.000	1.481	0.68	0.68	2.84	2.17	3.91	0.56
1.100	1.755	0.71	0.78	2.97	2.46	4.15	0.59
1.200	2.052	0.74	0.89	3.11	2.76	4.39	0.63
1.300	2.374	0.77	1.00	3.24	3.08	4.63	0.67
1.400	2.720	0.80	1.12	3.38	3.41	4.87	0.70
1.500	3.092	0.82	1.23	3.51	3.76	5.11	0.74
1.600	3.489	0.85	1.36	3.64	4.12	5.35	0.77
1.700	3.913	0.87	1.48	3.78	4.49	5.59	0.80
1.800	4.363	0.90	1.61	3.91	4.87	5.83	0.83

Project:	Horsley Drive Business Park - XS3	Job No:	11492.000
		Minimum Channel Depth	1.8

CHANNEL CAPACITY CALCULATIONS — Based on Manning's formula V = 1/n R^2/3 S^1/2

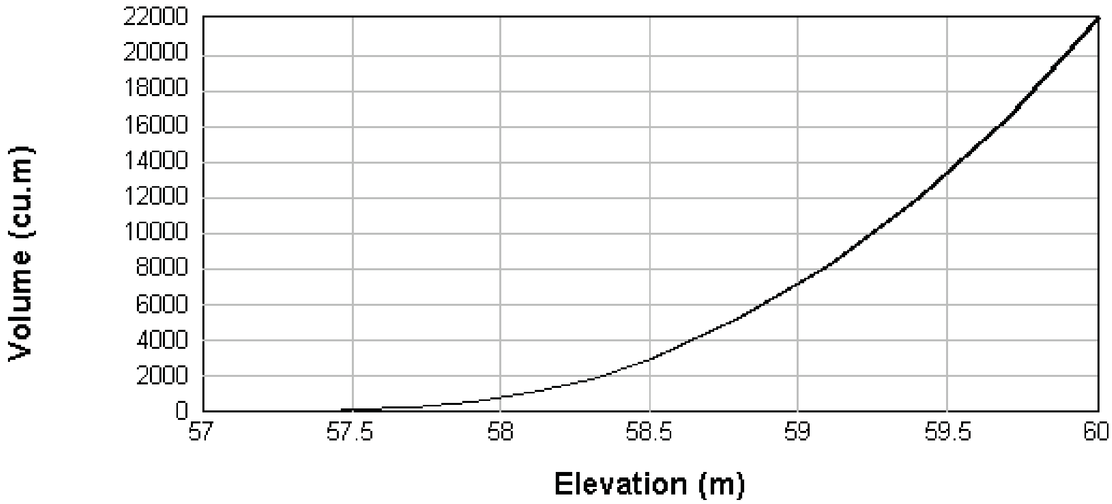


Required Flow m^3/s	3.450
Manning's coefficient "n"	0.070
Bed slope 1 in..	200.0
Left bank slope (Sl)1 in..	3.000
Bed width (m)	0.800
Right bank slope(Sr)1 in..	3.000
For channel depth (m) of..	1.800
Minimum Water Level	0.000
Maximum Water Level	1.800
Required increments	0.100
number of increments	19

CHANNEL DEPTH d (m)	CHANNEL CAPACITY Q(cumec)	CHANNEL VELOCITY V(m/s)	Vxd (m^2/s)	FLOW WIDTH Ww (m)	FLOW AREA m^2	WETTED PERIMETER m	HYDRAULIC RADIUS R (m)
0.000	0.000	0.00	0.00	0.80	0.00	0.80	0.00
0.100	0.020	0.18	0.02	1.40	0.11	1.43	0.08
0.200	0.075	0.27	0.05	2.00	0.28	2.06	0.14
0.300	0.170	0.33	0.10	2.60	0.51	2.70	0.19
0.400	0.312	0.39	0.16	3.20	0.80	3.33	0.24
0.500	0.509	0.44	0.22	3.80	1.15	3.96	0.29
0.600	0.767	0.49	0.29	4.40	1.56	4.59	0.34
0.700	1.092	0.54	0.38	5.00	2.03	5.23	0.39
0.800	1.489	0.58	0.47	5.60	2.56	5.86	0.44
0.900	1.965	0.62	0.56	6.20	3.15	6.49	0.49
1.000	2.525	0.66	0.66	6.80	3.80	7.12	0.53
1.100	3.174	0.70	0.77	7.40	4.51	7.76	0.58
1.200	3.917	0.74	0.89	8.00	5.28	8.39	0.63
1.300	4.760	0.78	1.01	8.60	6.11	9.02	0.68
1.400	5.707	0.82	1.14	9.20	7.00	9.65	0.73
1.500	6.763	0.85	1.28	9.80	7.95	10.29	0.77
1.600	7.933	0.89	1.42	10.40	8.96	10.92	0.82
1.700	9.221	0.92	1.56	11.00	10.03	11.55	0.87
1.800	10.632	0.95	1.71	11.60	11.16	12.18	0.92

APPENDIX B

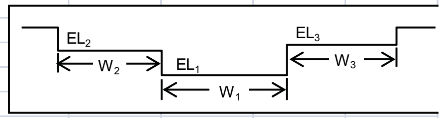
COWPASTURE ROAD "BASIN" STAGE STORAGE RELATIONSHIP



COWPASTURE ROAD WEIR STAGE DISCHARGE RELATIONSHIP

1. Worksheet Calculating an Elevation-Discharge Relationship for a Series of Weirs

This can be used to model a number of rectangular weirs at different levels.



FOLLOW THE PROCEDURES BELOW, ENTERING VALUES IN THE YELLOW BOXES.

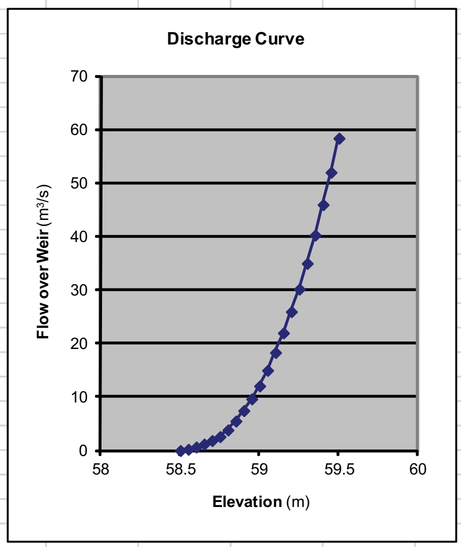
1. Enter Parameters for 1 to 10 weirs.

Weir No.	1	2	3	4	5	6	7	8	9	10
Crest Elevation (m AHD)	58.5	58.75	59	59.25	59.5					
Weir Width (m)	12.5	22.5	16	17.5	19					
Weir Coefficient	1.67	1.67	1.67	1.67	1.67					

The lowest weir should be placed first.

2. Fill in the Required Depths in the yellow column in the table below.

Depth (m)	Elevation (m AHD)	Discharge (m^3/s)
0	58.5	0
0.05	58.55	0.23339
0.1	58.6	0.660125
0.15	58.65	1.212728
0.2	58.7	1.867117
0.25	58.75	2.609375
0.3	58.8	3.850214
0.35	58.85	5.510662
0.4	58.9	7.463914
0.45	58.95	9.662329
0.5	59	12.0773
0.55	59.05	14.98766
0.6	59.1	18.32717
0.65	59.15	21.99757
0.7	59.2	25.95834
0.75	59.25	30.18348
0.8	59.3	34.98072
0.85	59.35	40.2791
0.9	59.4	45.97195
0.95	59.45	52.01527
1	59.5	58.38075



APPENDIX C

CORRESPONDANCE WITH DRAINS SOFTWARE DEVELOPERS

Andrew,
We are working through the items of your email and will be providing updated model and report ASAP.
Regarding Item 5 of your email, I have been in contact with the developers of DRAINS, Geoff O'Loughlin and Bob Stack on the matter of the peak flow for a particular tc and that computed in DRAINS.
Please see below responses from both Bob and Geoff, I hope this clarifies your query and we can move on from this point.

Best Regards,

Mark Wilson
Senior Design Engineer

From: Bob stack [mailto:bobstack1949@gmail.com]
Sent: Wednesday, 19 September 2012 7:03 PM
To: Mark Wilson
Subject: Re: Geoff's response to Mark, Costin Roe Consulting

Hi Mark,

I agree with Geoff's comments. With Ilsax hydrology a storm duration longer than the time of concentration may produce the worst case (e.g. the 25 minute storm is often the critical storm even though the sub-catchment time of concentration may be say 5 or 10 minutes). This is because the peak 5 minute rainfall block may occur between 15 and 20 minutes after the start of the storm. During the course of the storm the catchment gets wetter and less rainfall soaks into the ground. This results in more of the rainfall turning into runoff. If the peak rainfall occurs later in the storm it will generate more runoff because the catchment will be wetter.

Regards,
Bob Stack

On Wed, Sep 19, 2012 at 4:41 PM, Kasia Tatar <silver--jewel@hotmail.com> wrote:
Hello Mark,
I'm currently in Amsterdam, and will be back in Sydney next Sunday.
I disagree with the assertion that you mentioned, namely that the "storm duration that matches the time of concentration must yield the peak flow". This is not true for the rational method, and is also untrue for more complex methods that produce flow hydrographs, such as the time-area procedures used in DRAINS.
With the rational method, you can have 'partial area' effects that give a higher flowrate for a time less than the time of concentration. In the pipe system design procedure in Australian Rainfall and Runoff (ARR87) the design flowrates at each pit are usually calculated for two times, the full-area time of concentration and a shorter time of concentration for impervious areas. The shorter 'partial-area' time usually provides the largest flowrate.
With hydrograph methods, the position of the peak depends on many factors: (a) the particular rainfall hyetograph or block diagram that is used, (b) the catchment characteristics assumed – percentage impervious, times of concentration for pervious and impervious areas, the soil type and antecedent conditions, and (c) the network of pipes and overflow routes that can deliver flows to a point over different routes with different times of travel. With all these influences, It is not possible to generalise where peaks will occur.
A well-known criticism of the ARR87 storm patterns is that the 25 minute pattern often contains a ten

minute segment that is more intense that the stand-alone 10 minute pattern. This would mean that a sub-catchment with a 10 minute time of concentration would have the peak occurring later than 10 minutes in a 25 minute storm that would be higher than the peak flowrate from a 10 year storm.
As a final argument, suppose that you had a 25 minute ARR87 rainfall pattern consisting of 5 minute blocks with intensities 66, 109, 152, 35 and 27 mm/h. If a catchment has a 5 minute time of concentration, would the peak runoff occur at 5 minutes, well before the most intense rainfall occurs?
I hope these arguments clarify the situation. If not, please contact me next week.
Regards,
Geoffrey O'Loughlin

On Tue, Sep 18th, 2012 at 2:38 PM, Mark Wilson <Mark@costinroe.com.au> wrote:
> Geoff/ Bob,
> We are having some difficulty with Fairfield Council regarding peak flows
> in a critical storm in the DRAINS model versus the peak flow at time of
> concentration for the catchment.
> Our catchment has a time of concentration of around 15-20minutes whereas
> our DRAINS model tells us the critical storm is the 2hour storm duration.
> Council will not accept that this is the case based on the general
> definition that the "storm duration that matches the time of concentration
> must yield the peak flow".
> I have tried to explain why this is different as best I can and there is
> no real answer to this in the DRAINS manual that I could find .
> Any help in this regard would be appreciated, thanks.
>
>
>
>
> Best Regards,
>
> Mark Wilson
> Senior Design Engineer

CIVIL ENGINEERING REPORT
HORSLEY DRIVE BUSINESS PARK
DEVELOPMENT APPLICATION

PROPOSED DEVELOPMENT AT
HORSLEY DRIVE & COWPASTURE ROAD
WETHERILL PARK NSW

Prepared For:
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***Rev*: B**

DOCUMENT VERIFICATION

Project Title	Horsley Drive Business Park
Document Title	Civil Engineering Report for Development Application
Project No.	Co11492.00
Description	Civil engineering report for proposed industrial lease hold subdivision development.
Client Contact	Mr Tim Colless, Western Sydney Parkland Trust

	Name	**Signature**
Prepared by	Mark Wilson	
Checked by	Grant Roe	
Issued by	Mark Wilson	
File Name	11492.00-03a.rpt.docx	

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TABLE OF CONTENTS

1 INTRODUCTION

1.1 Introduction

The Western Sydney Parkland Trust, proposes to develop a tract of land at Wetherill Park, NSW, as an industrial estate. The land, located on the corner of The Horsley Drive and Cowpasture Road comprises an area of 21.38Ha Ha and is located within the Western Sydney Parkland corridor in the South Western Sydney region.

1.2 Scope

Costin Roe Consulting Pty Ltd has been commissioned by The Western Sydney Parkland Trust to prepare this Engineering Report in support of the proposed Development Application for the site.

This report provides a summary of the design principles and planning objectives for the following civil engineering components of the project:

- Roads and Transportation
- Earthworks;
- Stormwater Management; and
- Erosion Control.

The engineering objectives for the development are to create a site which, based on the proposed architectural layout, responds to the topography and site constraints and to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design and is consistent with the requirements of council's water quality objectives.

A concept set of drawings have been prepared to show the proposed road construction, bulk earthworks for future lots, retaining walls, stormwater drainage and services. The information provided is conceptual only, providing sufficient detail to show that the development can be performed within the objectives of Fairfield City Council and The NSW Department of Planning.

1.3 Authority Jurisdiction

The subject site is located within Fairfield City Council area however as a state significant development, the NSW Department of Planning is the consent authority. The development is to be completed in accordance with the Director General's Environmental Assessment Requirements, SSD5169 dated 16 March 2012.

2 DEVELOPMENT SITE

2.1 Existing Site

The property is currently generally undeveloped however two residential dwellings are located within the bounds of the site and we understand the site has previously been used for farming and other rural uses. The rectangular shaped site covers a total area of 21.84Ha and is bounded by the undeveloped Parkland Trust land to the north, Cowpasture Road to the East, The Horsley Drive to the south and a Sydney Water Supply Channel to the west.

The property currently comprises undeveloped rural land and some residential dwellings. The topography consists of undulating land of grades generally between 2% to 10%. The highest elevation is approximately RL 85m (AHD) and the lowest is at RL 63m.

2.2 Proposed Development

The proposed development is for a 12 lot industrial lease-hold estate and incorporates the following civil engineering elements:

- Earthworks walls to facilitate a local roads and development blocks;
- Local subdivision access road;
- Infrastructure works including stormwater, energy, telecommunications and sewer; and potable water supply;
- Realignment of an overland flow path from an upstream catchment to facilitate the development earthworks;
- Provision of a culvert crossing of the above noted overland flow path beneath the proposed estate access road; and
- The construction of two stormwater detention/ stormwater quality basins.

3 ROADS AND TRANSPORTATION

3.1 Road Widths

The proposed road cross section has been discussed and agreed upon with Fairfield City Council and can be defined as follows:

Road Type & Traffic Volume	Carriageway	Verge (1.2m Footpath Pedestrian)	Verge	Total Road Reserve	Number of lanes
Access Road	13.0m (2 x 6.5m)	3.5m	3.5m	20.0m	2 travel/ 1 parking lane

Table 3.1. Proposed Estate Road Cross Section

All roads will have concrete kerb and gutter and carriageway surface finished with asphaltic concrete as per the requirements of Fairfield City Council.

The dimensions of the adopted design cross section are shown on Drawing No. Co11492.00-DA50, Appendix A.

3.2 Road Alignments

The proposed road alignments generally meet Council requirements. The proposed road layout incorporates best practice for both horizontal and vertical alignments with empathy to the landform and proposed development lot layout. Priority has been given in the design for the safety of vehicles and pedestrians.

The B-Double has been adopted as the design vehicle for the development.

The Horizontal alignments generally meet Council standards. Minimum horizontal radii in accordance with Austroads, have been provided.

A minimum longitudinal grade of 1% and a maximum of 6% have been generally provided. Where change of grade is in excess of 0.6%, a vertical curve in accordance with the RTA Road Design Guide, for a design speed of 70 km/h (60km/hr posted), has been provided.

3.3 Estate Access and Proposed Intersection

The estate access is proposed to be located opposite Newton Road at its intersection with Cowpasture Road. It is proposed that the existing roundabout be removed and a new signalised intersection be provided. The analysis behind the adopted approach is fully detailed by the Traffic Engineering Consultants, Traffix Pty Ltd, in their report *Traffic Impact Assessment for a Part 4 Concept Plan Application* (Ref: 12.096r01v1 TRAFFIX Report).

A concept layout for the intersection has been shown on drawings Co11492.00-DA41-1 & DA41-2.

3.4 Pedestrian Facilities and Transportation

As discussed and agreed with Fairfield City Council, a pedestrian path is to be provided to one side of the new access road.

Bus shelters and transport routes are available in nearby streets. Provision for pedestrian access has been provided within the estate. Strategic crossings at intersections to enable access to these locations are available or will be provided as part of intersection works for the development.

Typical sections shown on drawing Co11492.00-DA50 nominate allowances for pedestrian paths.

4 SITE WORKS

4.1 Bulk Earthworks

The proposed development attempts to be sympathetic to the site topography and the environment by minimising excessive cut and fill. This will be achieved by a smoothing of contours to provide smooth transition across the site and to facilitate access through the proposed internal estate layout. However, given that the differences between existing and future levels and the falls over the existing site, it is inevitable that some areas will be in large amounts of cut, and others in fill.

The existing surface levels and proposed pad levels are shown on Drawings Co11492.00-DA31 to da38 in Appendix A.

The finished Bulk Earthwork Levels (B.E.L) shown on above plans are based on creating a balance of the earthworks. This will require neither importation nor exportation of material other than stripped topsoil and any other deleterious vegetation. The Bulk Earthwork Levels have been selected based on the proposed estate lot layout and site access while attempting to follow the surrounding levels and to allow for access and minimise retaining walls.

The earthwork cut to fill balance allows for a calculated shortfall of fill to allow for material bulking, detail excavation and services excavation as follows:

Factor	**Allowance**
Clay Bulking Factor	4% of cut material
Rock Bulking Factor	8% of cut material
Detailed/service excavation	1200 m^3/Ha

Table 4.1. Earthworks Allowances

Soil Erosion and Sediment Control measures including sedimentation basins are to be placed in accordance with submitted drawings and the Soil and Water Management Plan in Section 6 of this report.

4.2 Embankment Stability

To assist in maintaining embankment stability permanent batters slopes in clay will be no steeper than 3 horizontal to 1 vertical while temporary batters will be no steeper than 2 horizontal to 1 vertical.

Permanent batters in rock may be formed no steeper than 1 horizontal to 1 vertical while temporary batters will be no steeper than 0.75 horizontal to 1 vertical.

Permanent batters will also be adequately vegetated or turfed which will assist in maintaining embankment stability. Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan in Section 7.

4.3 Supervision of Earthworks

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS3798-1996.

4.4 Retaining Walls

Due to the existing topography and the nature of the proposed development, retaining walls will be required over the site. These are generally confined to internal lot boundaries and an indicative retaining wall layout has however been provided to give an indication of potential retaining wall heights, location and construction.

The intention is to limit retaining walls through landscaped batters and fitting of pads to external contours and the proposed access road levels. Retaining walls between lots may however be up to 4m in height.

5 STORMWATER MANAGEMENT

5.1 Hydrologic Modelling and Analysis

5.1.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, Fairfield City Council (FCC) and accepted engineering practice.

Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.

Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (1987 Edition), Volumes 1 and 2 (AR&R).

Storm events for the 2 to 100 Year ARI event have been assessed.

5.1.2 Minor/ Major System Design

In accordance with FCC Engineering Guide for Development and generally accepted engineering practice, the piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure for flows above the capacity of the piped system.

5.1.3 Rainfall Data

Rainfall intensity Frequency Duration (IFD) data used as a basis for ILSAX modelling for the 2 to 100 Year ARI events, was taken from FCC's drainage policy

5.1.4 Runoff Models

In accordance with the recommendations and standards of FCC, the calculation of the runoff from storms of the design ARI will be calculated with the catchment modelling software DRAINS and RAFTS.

The design parameters for the DRAINS/ ILSAX model are to be based on typically accepted parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type-Normal	3.0	
	Paved (Impervious) Area Depression Storage	1	mm
	Supplementary Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition (ARI=1-5 years)	2.5	
AMC	Antecedent Moisture Condition (ARI=10-20 years)	3.0	
AMC	Antecedent Moisture Condition (ARI=50-100 years)	3.5	
	Sag Pit Blocking Factor	0.5	
	On Grade Pit Blocking Factor	0.2	

Table 5.1: DRAINS ILSAX Parameters

5.2 Hydraulics

5.2.1 General Requirements

Hydraulic calculations will be carried out utilising DRAINS modelling software during the detail design stage to ensure that all surface and subsurface drainage systems perform to or exceed the required standard.

5.2.2 Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground level, for the peak runoff from the Minor System runoff. Where the pipes and junctions are sealed, this freeboard would not be required.

5.2.3 Public Safety

For all areas subject to pedestrian traffic, the product (dV) of the depth of flow d (in metres) and the velocity of flow V (in metres per second) will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

5.2.4 Inlet Pit Spacing

The spacing of inlets throughout the site will be such that the depth of flow, for the Major System design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

5.2.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the estate road system to the estate basins and Wetherill Park Drainage Channel.

5.3 Site Drainage

5.3.1 Existing Site Drainage

The property is currently undeveloped with little to no formal drainage located on site. The proposed site comprises a catchment area of 21.44Ha which can be considered as 100% pervious.

The property essentially comprises two catchments with areas of 7.56Ha (Catchment C1) and 13.88Ha (Catchment C2). The site is split roughly through the bottom third by a peak and spur with falls to the north and south of the site.

Catchment C1 discharges to the south of the site at the intersection of The Horsley Drive and Cowpasture Road.

Catchment C2 discharges to the north of the site via an overland flow path and three 900mm R.C.P. culverts located at the intersection of Cowpasture Road and Victoria Street. Catchment C2 is part of a greater catchment of approximately 83.6Ha which drains to this point. The greater catchment comprises agricultural land and Parkland Trust land.

5.3.2 Proposed Site Drainage

The proposed stormwater system consists of a major/ minor system which conveys surface water from roadways with provision for connection of individual development lots at strategic locations (i.e. rear lot easements or connection to street drainage). The two catchments will generally be kept at or near to the existing catchment breakup to ensure that pre and post development stormwater flows closely match each other.

On-site detention will be provided at an estate level as discussed in Section 5.5. Provision for water quality will also be provided as discussed in Section 6.

Provision for piped discharge into the overland flow path will be made as a "natural outlet" with consideration to the guidelines contained in the NSW Office of Water document *Controlled Activities: Guidelines for Outlet Structures*. Apron and rock