Winten Property Group/ Australand JV

Macquarie Park Commerce Centre

Stormwater Management & Water Recycling

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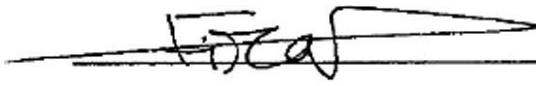
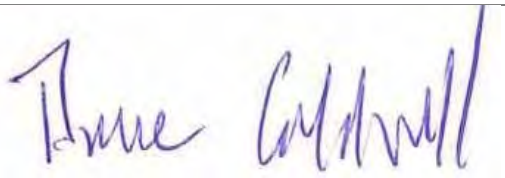
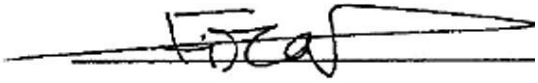
Author	Firas Naji	
Checker	Bruce Caldwell	
Approver	Firas Naji	

Report No

Date 14 September 2010

This report has been prepared for Winten Property Group/ Australand JV in accordance with the terms and conditions of appointment for Stormwater Management & Water Recycling dated . Hyder Consulting Pty Ltd (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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Appendices

1 Introduction

1.1 Background

The Winten Property Group and Australand Holdings Limited joint venture proposes a 4 building commercial development at the south-western corner of Waterloo Road and Lane Cove Road, Macquarie Park.

The proposed development has been declared by the NSW Department of Planning as a project to which Part 3A of the *Environmental Planning & Assessment Act 1979* applies. Hyder Consulting Pty has been commissioned to address the Director General's Requirements (DGRs) in relation to stormwater, Water Sensitive Urban Design (WSUD), on-site detention (OSD) and water conservation/recycling. This report has been specifically prepared to identify issues and undertake assessment in relation to:

- Ryde Council's DCP 2010 regarding drainage and flooding issues associated with the development site including stormwater, drainage infrastructure, OSD and WSUD elements.
- Sydney Water's request that the proposal be connected to the recycled water scheme currently being planned for the Macquarie Park area.

1.2 Project description

Macquarie Park Commerce Centre is a new commercial and retail development located in Macquarie Park, bounded by Lane Cove Road, Waterloo Road, Coolinga Street and Giffnock Avenue. The site has an area of approximately 1.56 ha and is currently occupied by two 2-storey light industrial buildings and the western entrance portal to the Macquarie Park railway station. The eastern boundary of the site partially fronts Lane Cove Road with the remainder abutting a new development occupied by Hyundai. A figure showing the development site in the context of the upstream catchment is presented in Appendix A. This shows that the site drains to two outlets at different catchments, one to Lane Cove Road and the other to Coolinga Street.

The proposed development consists of one 17-storey building and three 8-storey buildings with common basement carparks. The proposal involves significant landscaped and open space areas that include streetscapes, central courtyard to the rear of the site and courtyard links between the buildings. The buildings will be designed to provide A-Grade commercial floor space and will seek to achieve a minimum 4.5 star Green Star rating.

2 Water Sensitive Urban Design

2.1 Stormwater quality objectives & treatment targets

The City of Ryde DCP 2010 states the following management objectives in relation to stormwater quality:

- Improve water quality within the City of Ryde and to the receiving waters (Lane Cove River & Parramatta River).
- Integrate stormwater treatment with stormwater quality management where possible.
- Encourage consideration of Ecologically Sustainable Development and Catchment management while providing requirements for water management when developing a site.

Water Sensitive Urban Design (WSUD) measures are to be incorporated into the urban design of the proposed development so as to achieve the following:

- 90% reduction in the post development average annual gross pollutant load;
- 85% reduction in the post development average annual load of Total Suspended Solids load;
- 60% reduction in the post development average annual load of Total Phosphorus load;
- 45% reduction in the post development average annual load of Total Nitrogen load;

2.2 Proposed stormwater quality measures

A number of stormwater quality measures are proposed to be implemented as part of the proposed development to ensure that the set treatment targets are met. These include the following.

2.2.1 Rainwater tanks

Rainwater tanks are proposed to satisfy sustainability building requirements for the project and the water conservation principles included in the planning for the Macquarie Park Corridor. Rainwater tanks will be used to collect roof water from the site's roofs to be used for non-potable water demands for toilet flushing, cooling tower, car washing and for outdoor irrigation use. All rainwater tanks are assumed to have a first-flush device to capture gross pollutants and sediments accumulating on the roof when storms happen. Rainwater tanks also provide stormwater treatment through settling and harvesting in addition to their main purpose of providing alternative source of water for non-potable water uses.

Estimation of non-potable water demand

The Water Efficiency Guide: Office and Public Buildings (Department of Environment and Heritage 2006) provides an estimation guideline for the median water consumption in office buildings based on the net lettable floor area for the building. Based on this guideline, the median water consumption for the proposed project can be estimated as follows:

Net lettable area for the proposed development = 75,582 m^2

The median water consumption for office buildings in Sydney = 1.13 kL/m^2/year

The irrigation water consumption in office buildings is estimated to be 1% of the total demand, thus the median water consumption for the project without irrigation = 1.11 kL/m^2/year

Based on the above, the estimated total water consumption for the proposed development without irrigation = 1.11 kL/m^2/year x 75,582 m^2 = 83,896 kL/year

The typical office building water consumption is shown in Table 1 below.

Table 1: Typical office Building Water Consumption (leakage factor is neutralised)

Water use	**% of total**
Amenities	50%
Cooling Tower	42%
Other (including retail)	6%
Irrigation	1%

Based on the above, we can assume that the non-potable water demand, which can supply the entire cooling tower demand and 50% of the amenities demand equals to 67% of the total estimated water consumption for the proposed office building project. The irrigation demand can be estimated as an average of 300 mm per year for the estimated 2500 m^2 landscaped area.

Thus the total non-potable water demand for the proposed project can be estimated:

67% x 83,896 kL/year + 300/1000 x 2500 m^2 = 56,960 kL/year

2.2.2 Bio-retention systems (rain gardens)

Rain gardens are bio-retention systems that comprise a combination of vegetation and filter substrate, which provide treatment of stormwater through filtration, extended detention and some biological uptake. Rain gardens are proposed to treat runoff from the majority of the site excluding a small area as shown in the Stormwater Plan presented in Appendix B. When stormwater flow exceeds the filtration capacity of rain gardens 3, 4 & 6, a high level overflow system is provided to bypass excess runoff to the OSD system. The proposed rain garden areas for the various catchments of the site are presented in Table 2. Typical detail is presented in Appendix B.

Table 2: Proposed Stormwater Quality Treatment Measures for the Site (Refer to Stormwater Plan in Appendix B).

Catchment	**Rain garden area**
1	25 m^2
3	30 m^2
4	30 m^2
6	300 m^2
8	10 m^2
11	10 m^2

2.3 Methodology for assessment

Assessment of the performance of the proposed stormwater quality measures has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC V4.0). A MUSIC model for the proposed development has been developed assuming that the site has commercial land use with imperviousness shown in Table 3. The MUSIC model layout and key modelling parameters are presented in Appendix C.

Table 3: MUSIC Model Catchment Details

Catchment	Surface type	Area (m^2)	Imperviousness
1	Ground level	787	92%
2	Roof	2179	100%
3	Ground level	1214	78%
4	Ground level	1099	66%
5	Roof	2192	100%
6	Ground level	2374	25%
7	Ground level	450	100%
8	Ground level	467	57%
9	Roof	2220	100%
10	Roof	2190	100%
11	Ground level	452	98%

2.4 Results

Based on the proposed stormwater quality measures the treatment performance for the whole site is presented in Table 4. Treatment performance for each catchment is presented in Appendix C.

Table 4: Treatment Performance Summary for the Site

Catchment	Pollutant reduction			
	Gross pollutants (%)	TSS (%)	TP (%)	TN (%)
Total site	97	86	83	78
Treatment targets	90	85	60	45

3 Flooding & On-site Stormwater Detention

3.1 Flooding

Flood level information affecting the site was provided by the City of Ryde and is presented in Appendix D. This information provides flood levels for the 20 year and 100 year ARI flood events as well as the Probable Maximum Flood (PMF) event.

This information was considered in determining the finished floor levels for the proposed development buildings. The finished floor levels for the site buildings, which are presented in Appendix B, are all set at least 300 mm above the predicted design flood level (100 year ARI) to ensure that they are not subject to stormwater inundation. This is in line with the requirements of the City of Ryde DCP 2010.

3.2 On-site detention

On-site detention (OSD) of stormwater involves storing stormwater on the site then slowly releasing it to counteract the effects of urban development within a catchment by reducing the peak discharge during storms to a specified level.

3.2.1 Design standard

The design criteria for the OSD system is to provide sufficient storage to ensure peak flow rates at any point within the downstream drainage system do not increase as a result of the development during storms from the 5-year to the 100-year ARI storm events of all durations. The City of Ryde DCP 2010 notes that where the site contains existing buildings or hard surfaces which are to be removed or substantially modified for a proposed development (similar to the case of this development), the site will be considered vacant and site runoff determined for "state of nature" conditions.

3.2.2 Existing conditions

DRAINS software has been used to develop a rainfall runoff model to assess the performance of the existing site drainage.

The site is split into two existing catchments based on the catchment plan provided by the City of Ryde, which is presented in Appendix A of this report. Catchment A has an area of 0.507 ha and drains to Lane Cove Road, while Catchment B has an area of 1.054 ha and drains to Cooliga Street. A 100% pervious ground was assumed for the existing conditions to reflect the guidelines in the City of Ryde DCP 2010. No external catchments were assumed to enter the site as the Hyundai building in 394 Lane Cove Road drains to Lane Cove Road and Giffnock Avenue.

The calculated maximum peak flow from the site in pre-development (natural) conditions is 0.199 m^3/s discharging to Lane Cove Road and 0.395 m^3/s discharging to Coolinga Street.

3.2.3 Post development conditions

The DRAINS software has been used to develop a rainfall runoff model to assess the performance of the proposed site OSD stormwater system with respect to mitigating potential flow impacts on neighbouring downstream areas.

All roof catchments (Catchments 2, 5, 9 & 10), which drain initially to the rainwater tank, overflow to the OSD tank, which drains to the existing Council's pit at the low point in Coolinga Street. Additionally, Catchments 3, 4 and 6, which drain initially to rain garden systems, would discharge to the OSD tank via underdrains and overflow pipes. Catchments 1, 7, 8 & 11 would bypass the OSD system. The OSD outlet is set at a level higher than the 100 year level of the connection point with Council's drainage system to ensure that the controlled flow from the OSD system is free flowing. This is illustrated in the Stormwater Plan for the site presented in Appendix B.

Detention volume of 750 m^3 was required to reduce peak flows from the site to pre-development (natural) levels. Details of the DRAINS model and results for pre and post development conditions are presented in Appendix E.

The City of Ryde DCP 2010 provides for rainwater tank offset for OSD systems. This can be estimated as equal to the internal reuse demand within the proposed project. As discussed in Section 2 earlier, the internal non-potable water demand for the project can be estimated as follows:

67% x 67,488 kL/year / 365 = 124 m^3

Thus, the minimum OSD volume required to be provided is 750 – 124 = 626 m^3. It is recommended at this stage of the project to provide 700 m^3 OSD volume to cater for any design changes and allowance for headroom and overflow from the OSD tank.

4 Water Conservation & Recycling

Water conservation measures are essential as part of the sustainability building requirements for the project and the water conservation principles included in the planning for the Macquarie Park Corridor. Additionally, Sydney Water requested in their letter of 6 April 2010 that the proposed development be connected to the recycled water scheme currently being planned for the Macquarie Park area.

In their letter of 6 April 2010, Sydney Water requested that an integrated water management plan be prepared for the proposed development that would include any proposed alternative water supply, proposed end uses of potable and non-potable water, demonstration of WSUD and any water conservation measures. They have indicated that they are near the completion of a feasibility study for the provision of a recycled water scheme for the Macquarie Park area and if the cost was affordable, that the next step would be seeking approval for allocation of funding for the scheme.

4.1 Estimation of non-potable water demand & wastewater discharges

As presented earlier in Section 2, the non-potable demands for the proposed development comprise the majority of the estimated water demand (about 68%) and is estimated to be 56,960 kL/year.

Typically, commercial buildings are assumed to have wastewater discharge factor of 0.9 (i.e 90% of their estimated water use would be discharged to the sewer). Thus, the estimated average wastewater discharge for the proposed development = 0.9 x 56,960 = 51,264 kL/year.

4.2 Water conservation measures

4.2.1 Efficient water appliances

The proposed buildings on the site will have to achieve a minimum 4.5 star Green Star rating, and as such water efficient fixtures and water saving measures will have to be allowed for in the design of the buildings and implemented before being occupied.

4.2.2 Rainwater reuse

As discussed earlier in Section 2, a rainwater reuse strategy is proposed for the project, which involves collecting rainwater from the building roofs into a 700 m^3 rainwater tank. This tank will be used to supply reuse water for all the non-potable demands such as toilet flushing, cooling tower, irrigation of the landscaped areas within the development and for car washing facilities.

The first flush (first 2 mm of rain) should be diverted away from the storage tank. Stored water should be filtered and disinfected before using it in the reticulated non-potable water supply system within the building. It is also recommended that a site-specific risk assessment be undertaken before finalising the detailed design for the rainwater reuse system according to The Australian Guidelines for Water Recycling: Managing Health and Environmental Risks: Stormwater Harvesting and Reuse (NRMMC 2009) and/or Managing Urban Stormwater: Harvesting and Reuse (DEC 2006).

Based on the water balance results for the proposed development using the MUSIC model, the proposed 700 m^3 rainwater tank will be sufficient to reuse about 90% of the collected rainwater from the site's roofs, satisfying about 15% of the estimated non-potable water demand of the

proposed development. This rainwater reuse strategy also works as part of the broader WSUD strategy for the site, which aims to improve stormwater quality and reduce stormwater volume discharged from the site as discussed earlier in this report.

4.3 Recycled water supply scheme

Hyder have spoken to Sarah Cannon from Sydney Water regarding the Macquarie Park recycled water scheme and the following is noted:

- Over the last 18 months Sydney Water has been doing a feasibility study for a potential reticulated recycled water scheme in Macquarie Park area.
- This has included technical and feasibility analysis and stakeholder consultation with major land owners and other interested parties.
- A report is now being prepared with a refined business case for detailed assessment.
- The option considered is a localised sewer mining system with a reticulated recycled water supply.
- The main risk associated with the proposed recycled water scheme is uncertainty of connection of customers. Sydney Water is now looking into mandating the connection of future developers to this scheme.
- The scheme will be funded by developers in a similar way to the usual Sydney Water's developer's services charges that they levy from developers of Greenfield developments with an approximate estimate of $6000/Equivalent Tenement (ET). The operational fees for the scheme will be covered by charging connection and usage fees for recycled water supply in a similar fashion to potable water supply.
- The expected recycled water uses would be for non-potable demands such as toilet flushing, cooling tower, irrigation and washdown.

Based on the above and the earlier analysis of the proposed water conservation measures for the proposed development, it can be concluded that the proposed water saving measures and rainwater reuse system can only meet a fraction (15-20%) of the estimated non-potable water demands for the development. These proposed measures are important for the proposed development to meet its WSUD objectives and its sustainability building requirements (a minimum 4.5 star Green Star rating) Thus, should Sydney Water progress their feasibility analysis of the proposed recycled water scheme for Macquarie Park further and start planning for this scheme, there is still an opportunity to supply the proposed development with recycled water from this scheme.

5 Conclusion

The following conclusion can be drawn from this assessment:

i. A suite of WSUD measures are proposed to sustainably manage stormwater on the site and meet the treatment standard required by Ryde City Council. These include rainwater tank and rain garden systems.

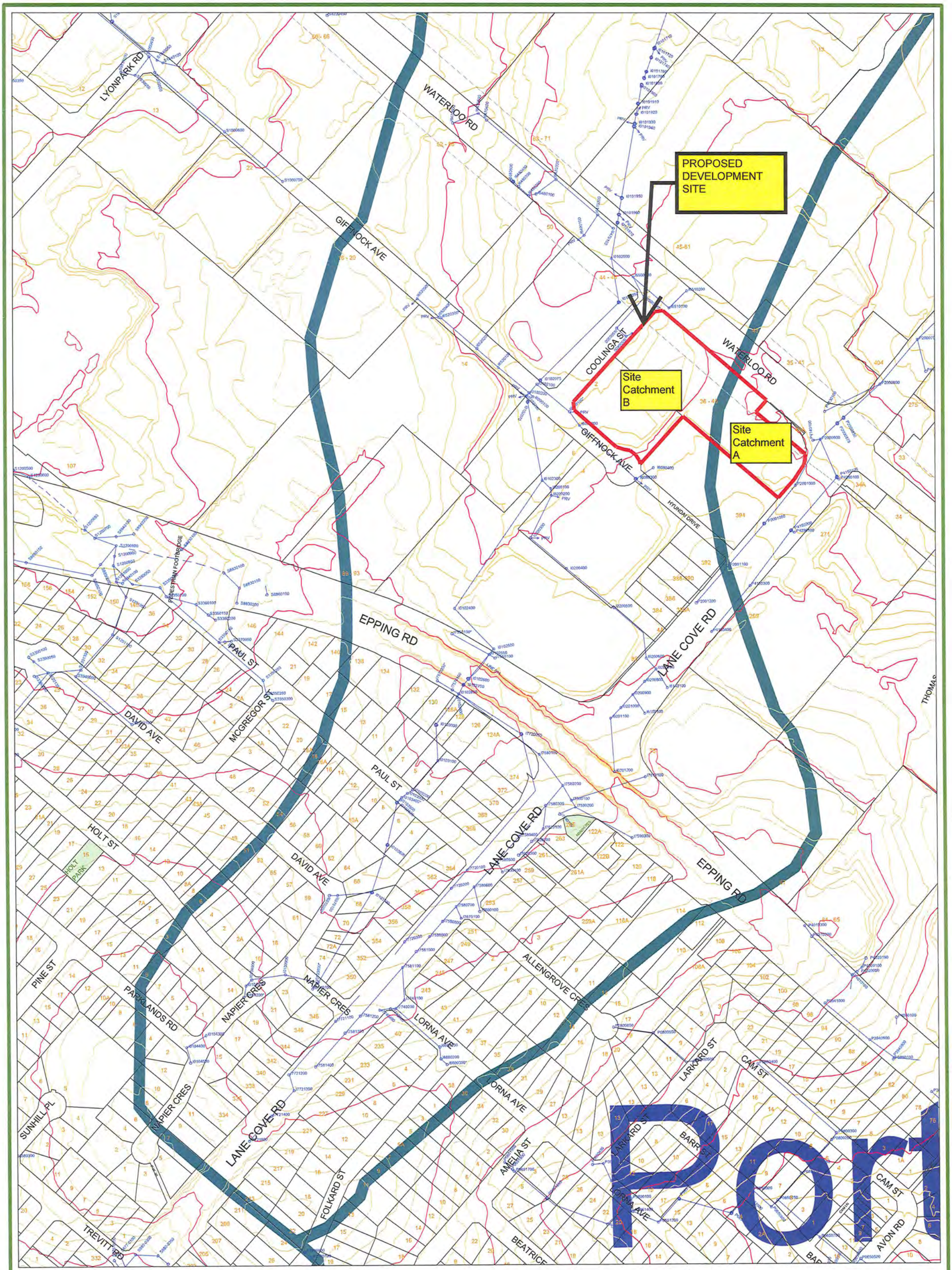
ii. The proposed OSD system would be capable of mitigating potential peak runoff flows from the site to no greater than pre-development (natural) levels as required by Ryde City Council DCP 2010.

iii. Rainwater reuse system and water conservation measures will be utilised to meet the building sustainability requirements for the proposed development.

iv. There is potential for recycled water supply for the site from a centralised Sydney Water recycled water scheme for the Macquarie Park area should this scheme goes ahead.

Appendix A

Development Site & Catchment Map



City of Ryde

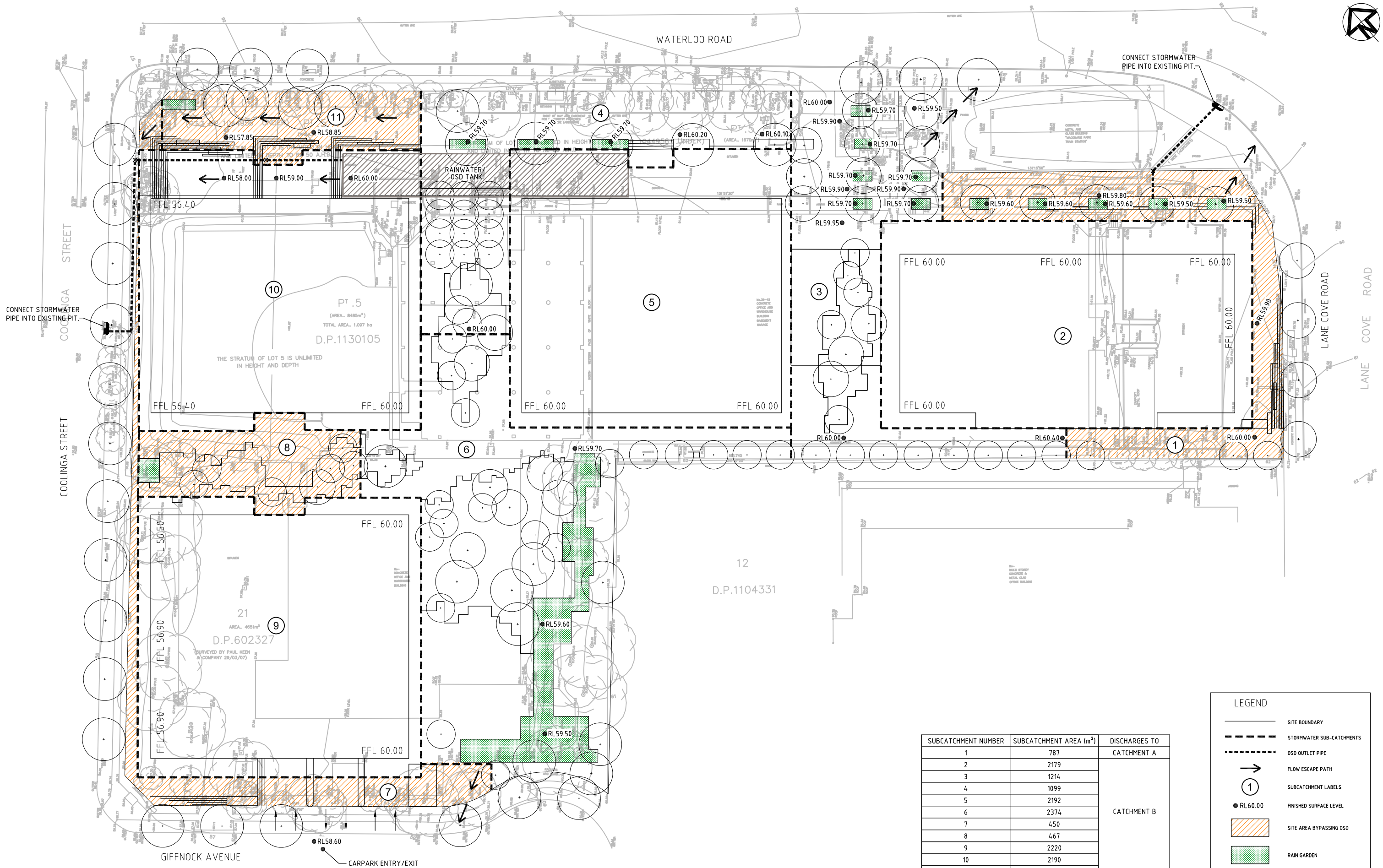
DISCLAIMER
This map has been compiled from various sources and the publisher and/or contributors accept no responsibility for any injury, loss or damage arising from its use or errors or omissions therein. While all care is taken to ensure a high degree of accuracy, users are invited to notify Council of any discrepancies.

N W E S

File Name:	
Date:	06/07/2010
Scale:	1:3000

Appendix B

Site's Stormwater Plan & Typical Section



SUBCATCHMENT NUMBER	SUBCATCHMENT AREA (m^2)	DISCHARGES TO
1	787	CATCHMENT A
2	2179	CATCHMENT B
3	1214	
4	1099	
5	2192	
6	2374	
7	450	
8	467	
9	2220	
10	2190	
11	452	

LEGEND

- SITE BOUNDARY
- STORMWATER SUB-CATCHMENTS
- OSD OUTLET PIPE
- FLOW ESCAPE PATH
- (1) SUBCATCHMENT LABELS
- ● RL60.00 FINISHED SURFACE LEVEL
- SITE AREA BYPASSING OSD
- RAIN GARDEN

Issue	Description	Date
P1	ISSUE FOR INFORMATION	XX-08-10

0 5 10 15 20 25m

1 : 250

Client: WINTEN PROPERTY GROUP / AUSTRALAND

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Scales	1:250	Current Issue Signatures	
		Drawn GB	
Original Size	B1	Designed FN	
Height Datum	AHD	Checked FN	
Grid		Approved	

Filename: SKC001-AA003465-NSK-00-StormwaterPlan.dwg

Project: MACQUARIE PARK COMMERCE CENTRE

Title: STORMWATER PLAN

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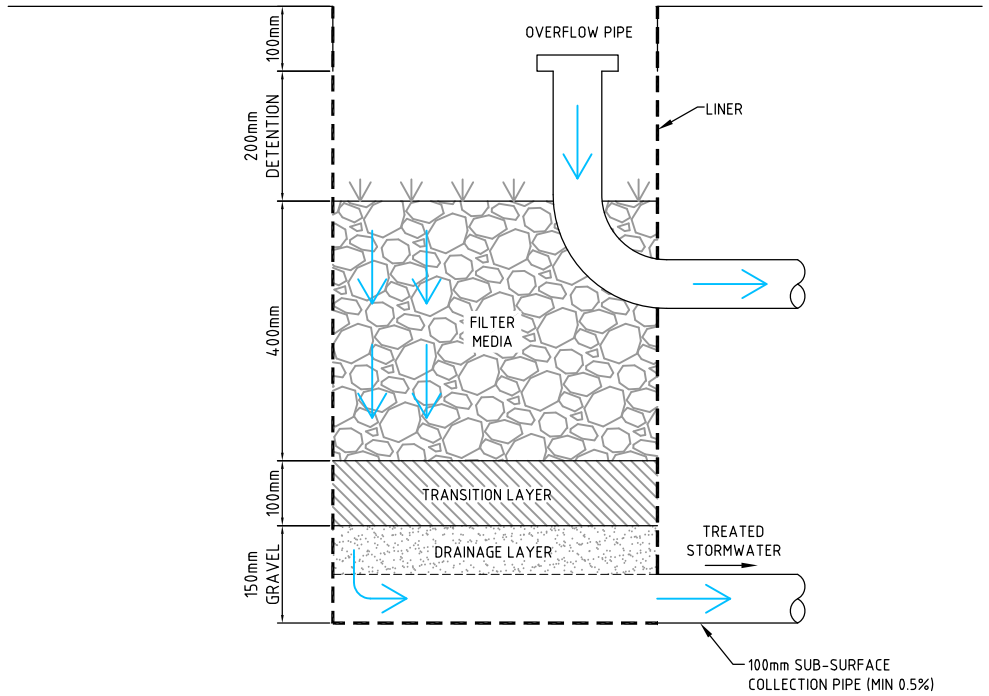
Drawing No.	Project No.	Issue
SKC001	AA003465	P1



TYPICAL SECTION IN RAIN GARDEN

1 : 10

TYPICAL SECTION THROUGH OSD/RAINWATER TANK

NTS

Issue	Description	Date
P1	ISSUE FOR INFORMATION	XX-08-10

0 50 100 200 300 400 500mm

1 : 5

Client: WINTEN PROPERTY GROUP / AUSTRALAND

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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Grid		Approved	

Filename: SKC002-AA003465-NSK-00-StormwaterSection.dwg

Project: MACQUARIE PARK COMMERCE CENTRE

Title: STORMWATER TYPICAL SECTION

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Drawing No.	Project No.	Issue
SKC002	AA003465	P1

Appendix C

MUSIC Model Parameters and Results

Rainfall

6 minute interval pluviograph data were used from the nearest BoM stations to the site. Pluviograph record from Wahroonga Reservoir (Station no. 66063) from 1st January 1963 through until 31 December 1972 was selected for the MUSIC modelling because this period had an average annual rainfall of 1034mm, which is closest to the average annual rainfall for the Wahroonga Estate.

Input parameters

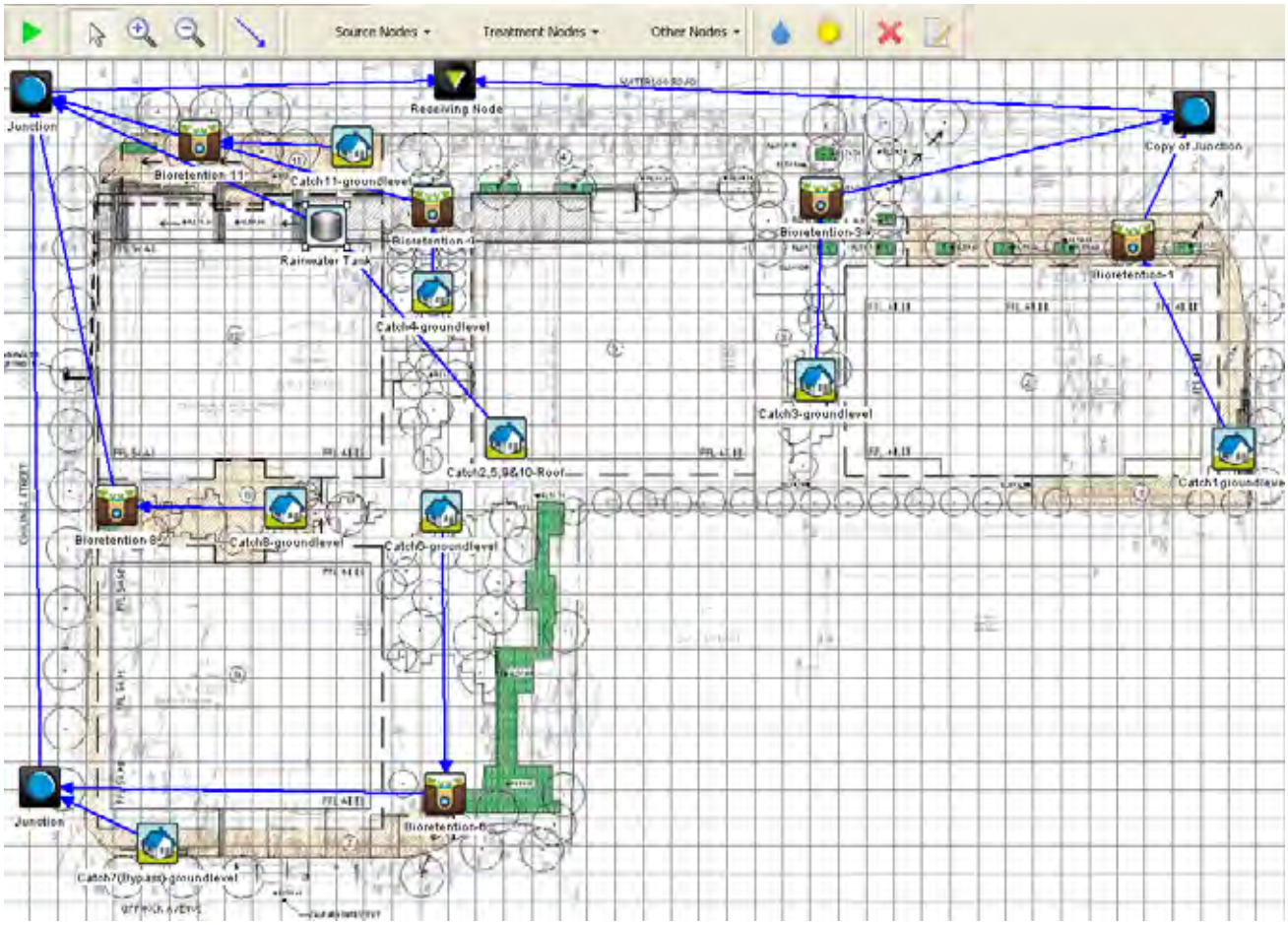
The following input parameters for commercial developments were used (Music Modelling Guidelines for South East Queensland- Draft Dec 2009):

	Storm Flow						Base Flow					
	Total Suspended Solids		Total Phosphorus		Total Nitrogen		Total Suspended Solids		Total Phosphorus		Total Nitrogen	
Land Use	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
(all values expressed as log_{10}mg/l												
Ground level	2.16	0.38	-0.39	0.34	0.37	0.34	0.78	0.39	-0.60	0.50	0.32	0.30
Roofs	1.30	0.38	-0.89	0.34	0.37	0.34	N/A	N/A	N/A	N/A	N/A	N/A

Note: SD = Standard Deviation

	Units	Ground level/ Roof
Rainfall Threshold	mm/day	1.0
Soil Storage Capacity	mm	200
Initial Storage	% of capacity	30
Field Capacity	mm	170
Infiltration Capacity Coefficient - a		200
Infiltration Capacity Coefficient – b		1.0
Initial Depth	mm	10
Daily Recharge Rate	%	25
Daily Baseflow Rate	%	5.0
Daily Deep Seepage Rate		0.0

MUSIC model layout



Results

	Pre-treatment load (kg/year)	Post-treatment load (kg/year)	% reduction
Catchment 1			
Flow (ML/yr)	0.70	0.65	7.40
Total Suspended Solids (kg/yr)	148.00	8.67	94.10
Total Phosphorus (kg/yr)	0.37	0.06	84.20
Total Nitrogen (kg/yr)	2.23	0.91	59.20
Gross Pollutants (kg/yr)	17.50	0.00	100.00
Catchment 3			
Flow (ML/yr)	0.95	0.89	6.70
Total Suspended Solids (kg/yr)	212.00	13.40	93.70
Total Phosphorus (kg/yr)	0.52	0.08	84.50
Total Nitrogen (kg/yr)	3.16	1.26	60.20
Gross Pollutants (kg/yr)	24.90	0.00	100.00
Catchment 4			
Flow (ML/yr)	0.69	0.63	9.10
Total Suspended Solids (kg/yr)	142.00	5.90	95.80
Total Phosphorus (kg/yr)	0.38	0.05	87.30
Total Nitrogen (kg/yr)	2.25	0.83	63.20

Gross Pollutants (kg/yr)	19.00	0.00	100.00
Catchments 2,5,9&10			
Flow (ML/yr)	8.37	0.886	89.4
Total Suspended Solids (kg/yr)	254.00	25.4	90.0
Total Phosphorus (kg/yr)	1.38	0.136	90.2
Total Nitrogen (kg/yr)	25.10	2.68	89.3
Gross Pollutants (kg/yr)	202.00	0.00	100.00
Catchment 6			
Flow (ML/yr)	0.86	0.45	47.20
Total Suspended Solids (kg/yr)	146.00	1.38	99.10
Total Phosphorus (kg/yr)	0.47	0.03	94.50
Total Nitrogen (kg/yr)	2.48	0.52	78.90
Gross Pollutants (kg/yr)	24.90	0.00	100.00
Catchment 7			
Flow (ML/yr)	0.43	0.43	0.0
Total Suspended Solids (kg/yr)	87.90	87.90	0.0
Total Phosphorus (kg/yr)	0.23	0.23	0.0
Total Nitrogen (kg/yr)	1.34	1.34	0.0
Gross Pollutants (kg/yr)	10.30	10.30	0.0
Catchment 8			
Flow (ML/yr)	0.29	0.27	7.50
Total Suspended Solids (kg/yr)	57.80	3.38	94.20
Total Phosphorus (kg/yr)	0.17	0.02	85.70
Total Nitrogen (kg/yr)	0.92	0.36	61.10
Gross Pollutants (kg/yr)	8.20	0.00	100.00
Catchment 11			
Flow (ML/yr)	0.42	0.40	4.80
Total Suspended Solids (kg/yr)	94.70	9.67	89.80
Total Phosphorus (kg/yr)	0.24	0.04	81.50
Total Nitrogen (kg/yr)	1.35	0.63	53.50
Gross Pollutants (kg/yr)	10.20	0.00	100.00
WHOLE SITE			
Flow (ML/yr)	12.70	4.61	63.8
Total Suspended Solids (kg/yr)	1160.00	164.0	85.9
Total Phosphorus (kg/yr)	3.70	0.64	82.7
Total Nitrogen (kg/yr)	39.10	8.51	78.3
Gross Pollutants (kg/yr)	317	10.3	96.7

Appendix D

Flood Information for the Site from the City of Ryde

City of Ryde
ABN 81 621 292 610
Civic Centre
1 Devlin Street Ryde
Locked Bag 2069
North Ryde NSW 1670
DX 8403 Ryde
cityofryde@ryde.nsw.gov.au
www.ryde.nsw.gov.au
TTY (02) 9952 8470
Facsimile (02) 9952 8070
Telephone (02) 9952 8222

Mr Firas Naji
L5, 141 Walker Street
NORTH SYDNEY NSW 2060

22 July 2010

Our ref: D10/52576

Dear Mr. Naji,

RE: Request for Flood Information – No. 396 Lane Cove Road, Macquarie Park

Reference is made to your application dated 19 July 2010 seeking flood level information pertaining to the above-mentioned address.

Please find attached flood level data sheet providing flood levels for the 20 year and 100 year ARI (Average Recurrence Interval) flood events as well as the PMF (Probable Maximum Flood) event.

Please be advised that flood models only approximate flood behaviour. Care and expertise is required in the interpretation of these flood levels. In addition, this flood information does not take into account any local overland flow issues.

Any person or organisation who acts on the information provided does so at his / her / its own risk. To the extent permitted by law, the City of Ryde accepts no responsibility and excludes all liability whatsoever in respect of any use of or reliance upon this information.

Should you require any further information, please feel free to contact me on (02) 9952 8222.

Yours sincerely,

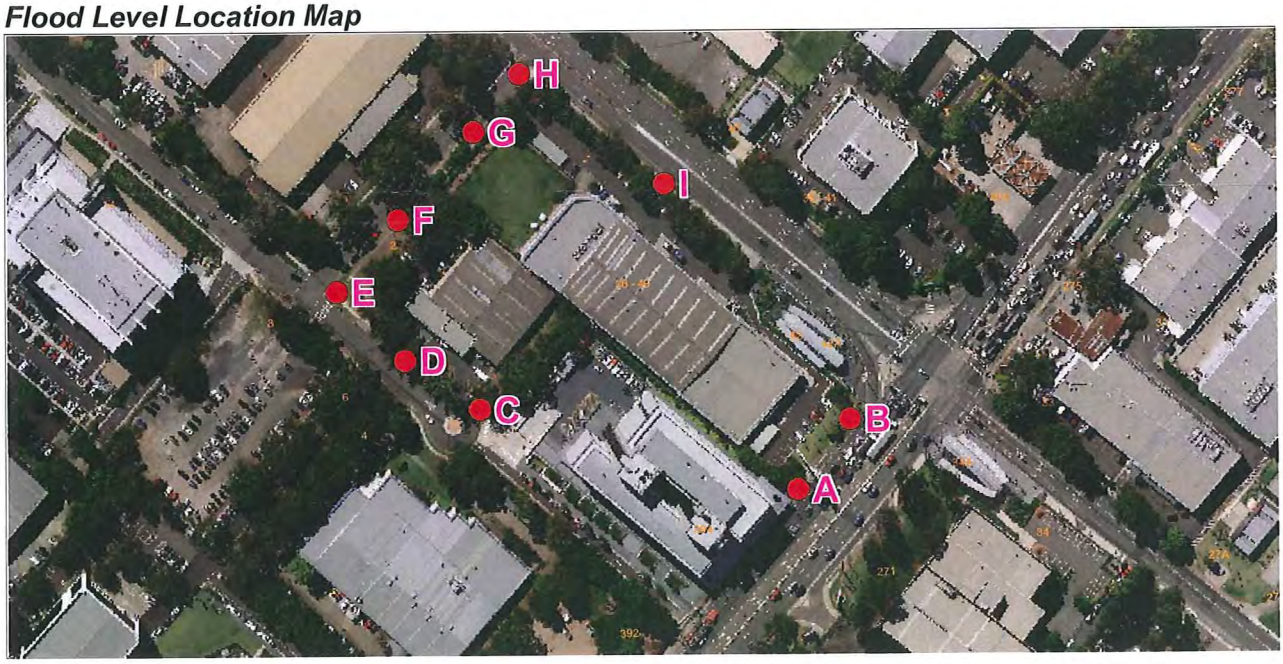
Guna Veerasingham
Acting Manager – Stormwater and Park Assets

City of Ryde

FLOOD INFORMATION REQUEST

Property Address: No. 396 Lane Cove Road, Macquarie Park
Issue Date: 22 July 2010
Flood Study Reference: Draft Macquarie Park Flood Study Report (Dec 2009)
Flood Model Reference: TUFLOW Model (July 2010)

Flood Level Location Map



Flood Level Data Table

Location	20 Year ARI Flood (m AHD)	100 Year ARI Flood (m AHD)	Probable Maximum Flood (m AHD)
A	61.5	**61.6**	61.6
B	Nil	**Nil**	Nil
C	Nil	**Nil**	60.5
D	Nil	**58.5**	58.6
E	56.8	**56.8**	57.0
F	Nil	**56.1**	56.3
G	55.8	**55.8**	56.2
H	56.6	**56.6**	56.6
I	Nil	**Nil**	Nil

Notes:

- All levels are based on Australian Height Datum (AHD).
- This flood level information is for existing site conditions only.
- A site specific flood study / risk assessment may be required for any future development. Engage a suitably qualified engineer to assist you in this matter. Any study or assessment shall be in accordance with the NSW Government's Floodplain Development Manual 2005 and the City of Ryde Development Control Plan 2006.
- Site specific ground and building survey levels should be used to relate flood levels and to assess the impact of flooding.

Appendix E

Drains Model & Results

Existing Catchments

- Total Area of site is approximately 1.56ha
- The site was split into two existing catchments based on the catchment diagram from City of Ryde Council.
- Catchment A has an area of 0.507ha (Cnr of Waterloo Rd and Lane Cove Rd)
- Catchment B has an area of 1.054ha (Cnr of Cooling St and Waterloo Rd)
- There are currently two outlets draining the site, these connect to the street drainage.
- While the site currently has a building, the council requires new developments to design stormwater discharge to 'natural state' conditions. 100% pervious ground for 'natural state' conditions was assumed.
- 100 year ARI Peak flow from site 0.199 m^3/s and 0.394 m^3/s, a total of 0.593 m^3/s
- No external catchments enter the site

Modelling existing conditions

- The time of concentration (t_c) is important in determining the peak discharge from each storm event.
- The tc for Catchment A included 20m of sheet flow and then a remaining 140m of channelised flow. The grade for this catchment was 3%. This resulted in a time of concentration (t_c) of 15min
- The tc for Catchment B include 20m of sheet flow and then a remaining 120m of channelised flow. The grade for this catchment was 1%. This resulted in a time of concentration (t_c) of 17min.

Post Development Conditions

- One OSD tank located in Catchment B with outflows connecting to existing street drainage. The OSD system has two-stage outlet.
  - 200mm Low-Flow
  - 150mm High-Flow
  - Weir height of 58m

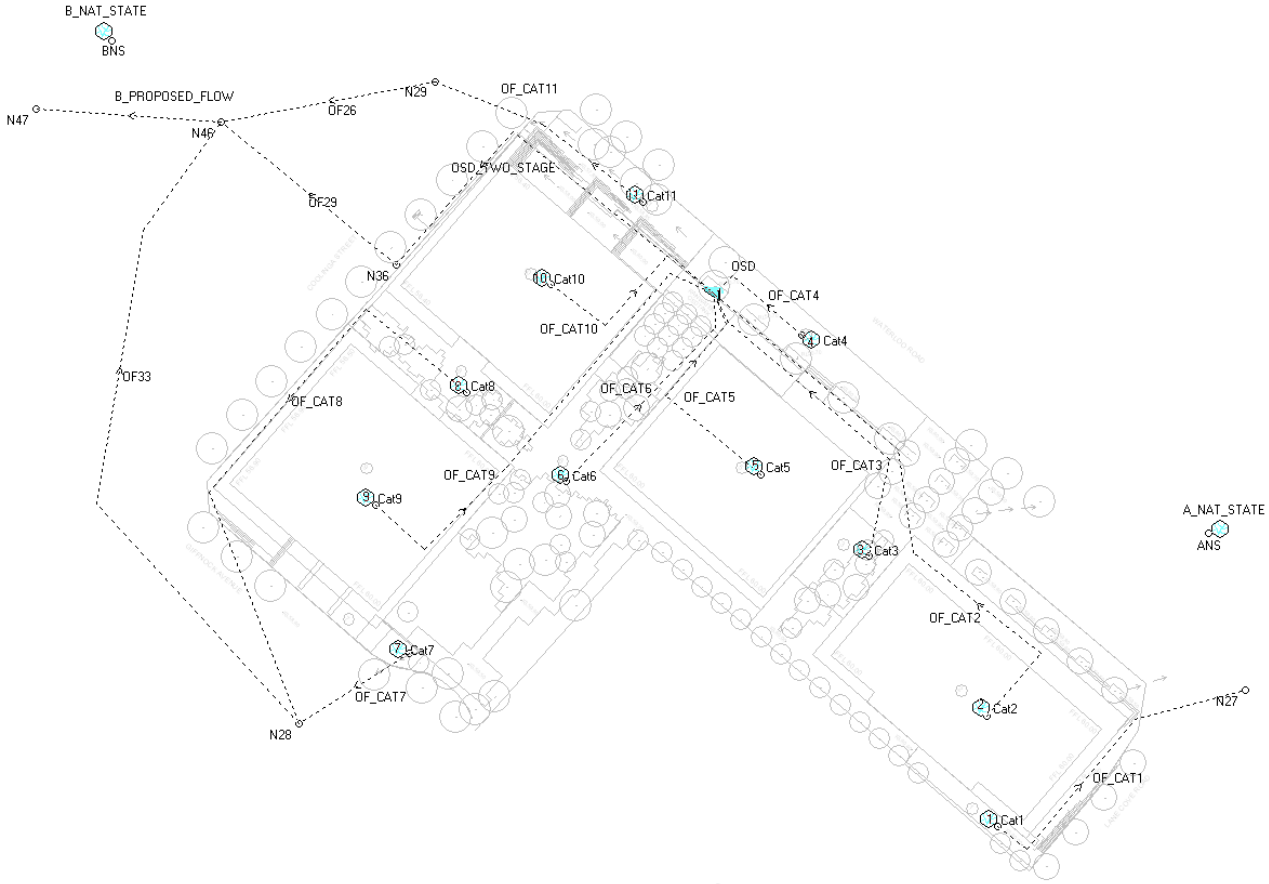
Modelling post-development conditions

- DRAINS software used to model the site.
- The OSD had to be sufficient to ensure peak flow rates from the 5 year to the 100 year ARI storm events over all durations. (6min to 180min from council DCP)
- The IFD data was taken from the City of Ryde Council DCP for Stormwater Management.
- The volume of storage required was $750m^3$
- An ARI 100Yr tail water level of 55.80m AHD was used in the analysis.

OSD Required

- Detention volume of $750m^3$ is sufficient to reduce peak flows for the entire site.
- These volumes do not take into account headroom which may be required at the top of the tank.

DRAINS Model



DRAINS Model Name and File Path:	F:\AA003465\D-Calculations\Stormwater\OSD_Final.drn
DRAINS Version:	2010.01 - 5 August 2010
Modeller's Name:	Chris McClelland
Description:	Macquarie Park Commerce Centre OSD DRAINS Model

DATA

PIT / NODE DETAILS			Version 9												
Name	Type	Family	Size	Ponding	Pressure	Surface	Max Pond	Base	Blocking	x	y	Bolt-down	id	Part Full
				Volume	Change	Elev (m)	Depth (m)	Inflow	Factor			lid		Shock Loss
				(cu.m)	Coeff. Ku			(cu.m/s)						
1	Node							0		200.316	220.13		69	
2	Node							0		197.824	244.626		70	
3	Node							0		171.668	280.333		71	
4	Node							0		156.721	329.325		72	
5	Node							0		147.587	298.186		73	
6	Node							0		104.407	296.94		74	
7	Node							0		69.531	258.743		75	
8	Node							0		82.402	316.454		76	
9	Node							0		62.058	291.543		77	
10	Node							0		101.085	340.535		78	
11	Node							0		121.43	358.803		79	
ANS	Node							0		247.232	285.349		80	
BNS	Node							0		3.597	394.625		81	
N27	Node							0		255.209	250.606		82	
N28	Node							0		45.173	242.966		83	
N29	Node							0		75.275	385.514		84	
N36	Node					55		0		66.636	344.913		119	
N46	Node							0		27.816	376.749		75490	
N47	Node							0		-13.414	379.632		75498	

DETENTION BASIN DETAILS														
Name	Elev	Volume	Init Vol. (cu.m)	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length
OSD	56.75	0	0	None						137.254	338.388	No		
	58.75	750												

SUB-CATCHMENT DETAILS														
Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	Slope	Slope
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%
Cat1	1	0.0787	91.6	8.4	0	5	6	0						
Cat2	2	0.2179	100	0	0	3	0	0						
Cat3	3	0.1214	78.5	21.5	0	6	3	0						
Cat4	4	0.1099	65.7	34.3	0	3	6	0						
Cat5	5	0.2192	100	0	0	3	0	0						
Cat6	6	0.2374	25.1	74.9	0	6	7	0						
Cat7	7	0.045	100	0	0	6	0	0						
Cat8	8	0.0467	56.8	43.3	0	6	7	0						
Cat9	9	0.222	100	0	0	3	0	0						
Cat10	10	0.219	100	0	0	3	0	0						
Cat11	11	0.0452	97.8	2.2	0	4	5	0						
A_NAT_STATE	ANS	0.507	0	100	0	0	15	0						
B_NAT_STATE	BNS	1.054	0	100	0	0	17	0						

PIPE DETAILS														
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pipes	Chg From	At Chg
			(m)	(m)	(m)	(%)		(mm)	(mm)					

DETAILS of SERVICES CROSSING PIPES													
Pipe	Chg	Bottom	Height of Service	Chg	Bottom	Height of S	Chg	Bottom	Height of S	etc				
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc				

CHANNEL DETAILS													
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Width	L.B. Slope	R.B. Slope	Manning	Depth	Roofed	
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)		

OVERFLOW ROUTE DETAILS														
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth	SafeDepth	Safe	Bed	D/S Area		id
			Time	Level	Length	Coeff. C	Section	Major Storr	Minor Storr	DxV	Slope	Contributing		
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%		
OF_CAT1	1	N27	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		85
OF_CAT2	2	OSD	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		94
OF_CAT3	3	OSD	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		95
OF_CAT4	4	OSD	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		96
OF_CAT5	5	OSD	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		97
OF_CAT6	6	OSD	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		98
OF_CAT7	7	N28	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		86
OF_CAT8	8	N28	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		87
OF_CAT9	9	OSD	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		99
OF_CAT10	10	OSD	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		100
OF_CAT11	11	N29	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		88
OF33	N28	N46	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		75497
OF26	N29	N46	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		75489
OSD_TWO_STAG	OSD	N36	0.1	56.75			Dummy used to model flow across r	0.2	0.05	0.6	1	0		7802901
OF29	N36	N46	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		75492
B_PROPOSED_FL	N46	N47	0.1				Dummy used to model flow across r	0.2	0.05	0.6	1	0		75499

DRAINS Model Name and File Path:	F:\AA003465\D-Calculations\Stormwater\OSD_Final.drn
DRAINS Version:	2010.01 - 5 August 2010
Modeller's Name:	Chris McClelland
Description:	Macquarie Park Commerce Centre OSD DRAINS Model

DRAINS results prepared 30 August, 2010 from Version 2010.09

RESULTS 5 YEAR ARI

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Cat1	0.033	0.031	0.002	5	6	0	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
Cat2	0.094	0.094	0	3	0	0	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
Cat3	0.048	0.039	0.009	6	3	0	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
Cat4	0.044	0.031	0.013	3	6	0	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
Cat5	0.094	0.094	0	3	0	0	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
Cat6	0.082	0.024	0.058	6	7	0	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
Cat7	0.018	0.018	0	6	0	0	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
Cat8	0.017	0.011	0.007	6	7	0	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
Cat9	0.095	0.095	0	3	0	0	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
Cat10	0.094	0.094	0	3	0	0	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
Cat11	0.019	0.019	0	4	5	0	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
A_NAT_STATE	0.113	0	0.113	0	15	0	AR&R 5 year, 2 hours storm, average 33 mm/h, Zone 1
B_NAT_STATE	0.22	0	0.22	0	17	0	AR&R 5 year, 2 hours storm, average 33 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.29 impervious + 1.83 pervious = 3.12 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ru cu.m (Runoff %	Pervious Runoff cu.m (Runoff %)
AR&R 5 year, 5 min	402.14	200.43 (49.8%	153.52 (92.2%	46.91 (19.9%)
AR&R 5 year, 10 mi	621.56	386.12 (62.1%	244.35 (95.0%	141.78 (38.9%)
AR&R 5 year, 15 mi	785.54	524.70 (66.8%	312.22 (96.0%	212.48 (46.2%)
AR&R 5 year, 20 mi	918.28	634.72 (69.1%	367.17 (96.6%	267.56 (49.7%)
AR&R 5 year, 25 mi	1029.42	721.19 (70.1%	413.17 (97.0%	308.02 (51.1%)
AR&R 5 year, 30 mi	1127.55	792.31 (70.3%	453.79 (97.2%	338.52 (51.2%)
AR&R 5 year, 45 mi	1363.36	973.17 (71.4%	551.40 (97.7%	421.77 (52.8%)
AR&R 5 year, 1 hou	1549.21	1115.30 (72.0	628.32 (98.0%	486.98 (53.6%)
AR&R 5 year, 1.5 ho	1836.56	1326.02 (72.2	747.27 (98.3%	578.75 (53.8%)
AR&R 5 year, 2 hou	2061.44	1487.72 (72.2	840.35 (98.5%	647.38 (53.6%)
AR&R 5 year, 3 hou	2417.51	1748.22 (72.3	987.75 (98.7%	760.47 (53.7%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF_CAT1	0.033	0.033	0.256	0.023	0.01	7.63	0.38	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF_CAT2	0.094	0.094	0.256	0.034	0.02	10.74	0.5	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
OF_CAT3	0.048	0.048	0.256	0.026	0.01	8.83	0.41	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF_CAT4	0.044	0.044	0.256	0.026	0.01	8.53	0.4	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF_CAT5	0.094	0.094	0.256	0.035	0.02	10.91	0.48	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
OF_CAT6	0.082	0.082	0.256	0.033	0.02	10.56	0.46	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF_CAT7	0.018	0.018	0.256	0.018	0.01	6.14	0.33	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF_CAT8	0.017	0.017	0.256	0.018	0.01	6.14	0.31	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF_CAT9	0.095	0.095	0.256	0.035	0.02	10.91	0.48	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
OF_CAT10	0.094	0.094	0.256	0.034	0.02	10.74	0.5	AR&R 5 year, 5 minutes storm, average 154.5 mm/h, Zone 1
OF_CAT11	0.019	0.019	0.256	0.019	0.01	6.44	0.31	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF33	0.036	0.036	0.256	0.024	0.01	7.93	0.38	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OF26	0.019	0.019	0.256	0.019	0.01	6.44	0.31	AR&R 5 year, 25 minutes storm, average 79.1 mm/h, Zone 1
OSD_TWO_STAGE	0.134	0.134	0.256	0.039	0.02	11.81	0.54	AR&R 5 year, 3 hours storm, average 25.8 mm/h, Zone 1
OF29	0.134	0.134	0.256	0.039	0.02	11.81	0.54	AR&R 5 year, 3 hours storm, average 25.8 mm/h, Zone 1
B_PROPOSED_FLO	0.147	0.147	0.256	0.04	0.02	11.99	0.57	AR&R 5 year, 3 hours storm, average 25.8 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD	58.03	480.9	0.134	0	0.134

CONTINUITY CHECK for AR&R 5 year, 2 hours storm, average 33 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Chan (cu.m)	Difference %
1	49.21	49.21	0	0
2	141.63	141.63	0	0
3	71.24	71.24	0	0
4	60.31	60.31	0	0
5	142.48	142.48	0	0
6	101.84	101.84	0	0
7	29.25	29.25	0	0
8	24.4	24.4	0	0
9	144.3	144.3	0	0
10	142.35	142.35	0	0
11	29.09	29.09	0	0
ANS	179.27	179.27	0	0
BNS	372.35	372.35	0	0
N27	49.21	49.21	0	0
N28	53.65	53.65	0	0
N29	29.09	29.09	0	0
OSD	804.16	445.88	358.33	0
N36	445.72	445.72	0	0
N46	528.29	528.29	0	0
N47	528.13	528.13	0	0

Run Log for OSD_FINAL.drn run at 15:59:51 on 30/8/2010

DRAINS Model Name and File Path:	F:\AA003465\D-Calculations\Stormwater\OSD_Final.drn
DRAINS Version:	2010.01 - 5 August 2010
Modeller's Name:	Chris McClelland
Description:	Macquarie Park Commerce Centre OSD DRAINS Model

DRAINS results prepared 30 August, 2010 from Version 2010.09

RESULTS
20 YEAR ARI

PIT / NODE DETAILS — Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Cat1	0.043	0.04	0.003	5	6	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat2	0.119	0.119	0	3	0	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat3	0.062	0.05	0.013	6	3	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat4	0.057	0.04	0.017	3	6	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat5	0.12	0.12	0	3	0	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat6	0.108	0.031	0.077	6	7	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat7	0.024	0.024	0	6	0	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat8	0.023	0.014	0.009	6	7	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat9	0.122	0.122	0	3	0	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat10	0.12	0.12	0	3	0	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
Cat11	0.025	0.024	0	4	5	0	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
A_NAT_STATE	0.155	0	0.155	0	15	0	AR&R 20 year, 2 hours storm, average 43.2 mm/h, Zone 1
B_NAT_STATE	0.304	0	0.304	0	17	0	AR&R 20 year, 2 hours storm, average 43.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.29 impervious + 1.83 pervious = 3.12 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ru cu.m (Runoff 9	Pervious Runoff cu.m (Runoff %)
AR&R 20 year, 5 m	507.29	303.20 (59.8%	197.05 (93.8%	106.15 (35.7%)
AR&R 20 year, 10 r	787.62	549.67 (69.8%	313.08 (96.0%	236.59 (51.3%)
AR&R 20 year, 15 r	998.71	734.33 (73.5%	400.46 (96.9%	333.87 (57.0%)
AR&R 20 year, 20 r	1170.23	883.41 (75.5%	471.46 (97.3%	411.96 (60.1%)
AR&R 20 year, 25 r	1317.03	1003.66 (76.2	532.22 (97.6%	471.44 (61.1%)
AR&R 20 year, 30 r	1443.01	1104.29 (76.5	584.36 (97.8%	519.93 (61.5%)
AR&R 20 year, 45 r	1754.57	1357.46 (77.4	713.33 (98.2%	644.13 (62.6%)
AR&R 20 year, 1 ho	2002.1	1561.05 (78.0	815.78 (98.4%	745.26 (63.5%)
AR&R 20 year, 1.5	2389.4	1873.21 (78.4	976.09 (98.7%	897.12 (64.1%)
AR&R 20 year, 2 ho	2698.62	2120.22 (78.6	1104.08 (98.8	1016.14 (64.2%)
AR&R 20 year, 3 ho	3185.87	2505.70 (78.7	1305.74 (99.0	1199.96 (64.3%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF_CAT1	0.043	0.043	0.256	0.026	0.01	8.53	0.39	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT2	0.119	0.119	0.256	0.037	0.02	11.45	0.52	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT3	0.062	0.062	0.256	0.029	0.01	9.73	0.44	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT4	0.057	0.057	0.256	0.028	0.01	9.43	0.43	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT5	0.12	0.12	0.256	0.037	0.02	11.45	0.53	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT6	0.108	0.108	0.256	0.036	0.02	11.27	0.5	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT7	0.024	0.024	0.256	0.02	0.01	6.74	0.35	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT8	0.023	0.023	0.256	0.02	0.01	6.74	0.33	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT9	0.122	0.122	0.256	0.037	0.02	11.45	0.53	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT10	0.12	0.12	0.256	0.037	0.02	11.45	0.53	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF_CAT11	0.025	0.025	0.256	0.021	0.01	7.03	0.33	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF33	0.046	0.046	0.256	0.026	0.01	8.83	0.39	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OF26	0.025	0.025	0.256	0.021	0.01	7.03	0.33	AR&R 20 year, 25 minutes storm, average 101.2 mm/h, Zone 1
OSD_TWO_STAGE	0.204	0.204	0.256	0.045	0.03	13.07	0.62	AR&R 20 year, 2 hours storm, average 43.2 mm/h, Zone 1
OF29	0.204	0.204	0.256	0.045	0.03	13.07	0.62	AR&R 20 year, 2 hours storm, average 43.2 mm/h, Zone 1
B_PROPOSED_FL	0.256	0.256	0.256	0.05	0.03	13.97	0.66	AR&R 20 year, 1.5 hours storm, average 51 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD	58.25	564.2	0.204	0	0.204

CONTINUITY CHECK for AR&R 20 year, 2 hours storm, average 43.2 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Chan (cu.m)	Difference %
1	65.25	65.25	0	0
2	186.09	186.09	0	0
3	95.96	95.96	0	0
4	82.67	82.67	0	0
5	187.2	187.2	0	0
6	149.96	149.96	0	0
7	38.43	38.43	0	0
8	33.89	33.89	0	0
9	189.59	189.59	0	0
10	187.03	187.03	0	0
11	38.31	38.31	0	0
ANS	281.4	281.4	0	0
BNS	584.46	584.46	0	0
N27	65.25	65.25	0	0
N28	72.32	72.32	0	0
N29	38.31	38.31	0	0
OSD	1078.49	718.89	359.66	0
N36	718.73	718.73	0	0
N46	829.19	829.2	0	0
N47	829.04	829.04	0	0

Run Log for OSD_FINAL.drn run at 16:13:42 on 30/8/2010

The maximum flow exceeded the safe value in the following overflow routes: B_PROPOSED_FLOW

DRAINS Model Name and File Path:	F:\AA003465\D-Calculations\Stormwater\OSD_Final.drn
DRAINS Version:	2010.01 - 5 August 2010
Modeller's Name:	Chris McClelland
Description:	Macquarie Park Commerce Centre OSD DRAINS Model

DRAINS results prepared 30 August, 2010 from Version 2010.09

RESULTS
100 YEAR ARI

PIT / NODE DETAILS — Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N36	55.8		0.232				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Cat1	0.05	0.047	0.004	5	6	0	AR&R 100 year, 1.5 hours storm, average 66.4 mm/h, Zone 1
Cat2	0.15	0.15	0	3	0	0	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
Cat3	0.073	0.058	0.015	6	3	0	AR&R 100 year, 15 minutes storm, average 163.6 mm/h, Zone 1
Cat4	0.067	0.047	0.021	3	6	0	AR&R 100 year, 1.5 hours storm, average 66.4 mm/h, Zone 1
Cat5	0.151	0.151	0	3	0	0	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
Cat6	0.129	0.036	0.095	6	7	0	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1
Cat7	0.028	0.028	0	6	0	0	AR&R 100 year, 20 minutes storm, average 144.1 mm/h, Zone 1
Cat8	0.026	0.016	0.01	6	7	0	AR&R 100 year, 25 minutes storm, average 129.8 mm/h, Zone 1
Cat9	0.153	0.153	0	3	0	0	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
Cat10	0.151	0.151	0	3	0	0	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
Cat11	0.031	0.03	0	4	5	0	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
A_NAT_STATE	0.199	0	0.199	0	15	0	AR&R 100 year, 1 hour storm, average 82.9 mm/h, Zone 1
B_NAT_STATE	0.394	0	0.394	0	17	0	AR&R 100 year, 1 hour storm, average 82.9 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.29 impervious + 1.83 pervious = 3.12 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ru cu.m (Runoff %	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 m	643.94	438.25 (68.1%	253.61 (95.1%	184.64 (48.9%)
AR&R 100 year, 10	1003.65	763.30 (76.1%	402.50 (96.9%	360.80 (61.3%)
AR&R 100 year, 15	1277.47	1008.81 (79.0	515.84 (97.6%	492.96 (65.8%)
AR&R 100 year, 20	1500.27	1207.49 (80.5	608.07 (97.9%	599.42 (68.2%)
AR&R 100 year, 25	1689.24	1367.68 (81.0	686.28 (98.2%	681.40 (68.8%)
AR&R 100 year, 30	1855.3	1510.59 (81.4	755.02 (98.3%	755.57 (69.5%)
AR&R 100 year, 45	2262.9	1861.78 (82.3	923.73 (98.6%	938.04 (70.7%)
AR&R 100 year, 1 h	2589.3	2143.02 (82.8	1058.84 (98.8	1084.18 (71.4%)
AR&R 100 year, 1.5	3110.91	2590.73 (83.3	1274.73 (99.0	1316.00 (72.2%)
AR&R 100 year, 2 h	3529.44	2946.49 (83.5	1447.98 (99.1	1498.51 (72.4%)
AR&R 100 year, 3 h	4207.22	3514.74 (83.5	1728.54 (99.3	1786.20 (72.4%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF_CAT1	0.05	0.05	7.665	0.027	0.01	9.13	0.4	AR&R 100 year, 1.5 hours storm, average 66.4 mm/h, Zone 1
OF_CAT2	0.15	0.15	7.665	0.041	0.02	12.17	0.55	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
OF_CAT3	0.073	0.073	7.665	0.031	0.01	10.2	0.46	AR&R 100 year, 15 minutes storm, average 163.6 mm/h, Zone 1
OF_CAT4	0.067	0.067	7.665	0.03	0.01	10.02	0.45	AR&R 100 year, 1.5 hours storm, average 66.4 mm/h, Zone 1
OF_CAT5	0.151	0.151	7.665	0.041	0.02	12.17	0.56	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
OF_CAT6	0.129	0.129	7.665	0.038	0.02	11.63	0.54	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1
OF_CAT7	0.028	0.028	7.665	0.022	0.01	7.33	0.34	AR&R 100 year, 20 minutes storm, average 144.1 mm/h, Zone 1
OF_CAT8	0.026	0.026	7.665	0.021	0.01	7.03	0.36	AR&R 100 year, 25 minutes storm, average 129.8 mm/h, Zone 1
OF_CAT9	0.153	0.153	7.665	0.041	0.02	12.17	0.56	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
OF_CAT10	0.151	0.151	7.665	0.041	0.02	12.17	0.56	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
OF_CAT11	0.031	0.031	7.665	0.023	0.01	7.63	0.35	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
OF33	0.054	0.054	7.665	0.028	0.01	9.43	0.4	AR&R 100 year, 20 minutes storm, average 144.1 mm/h, Zone 1
OF26	0.031	0.031	7.665	0.023	0.01	7.63	0.35	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
OSD_TWO_STAGE	0.232	0.232	7.665	0.048	0.03	13.61	0.64	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1
OF29	0.232	0.232	7.665	0.048	0.03	13.61	0.64	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1
B_PROPOSED_FL	0.293	0.293	7.665	0.053	0.04	14.51	0.69	AR&R 100 year, 1.5 hours storm, average 66.4 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD	58.64	710.1	0.232	0	0.232

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 82.9 mm/h, Zone 1

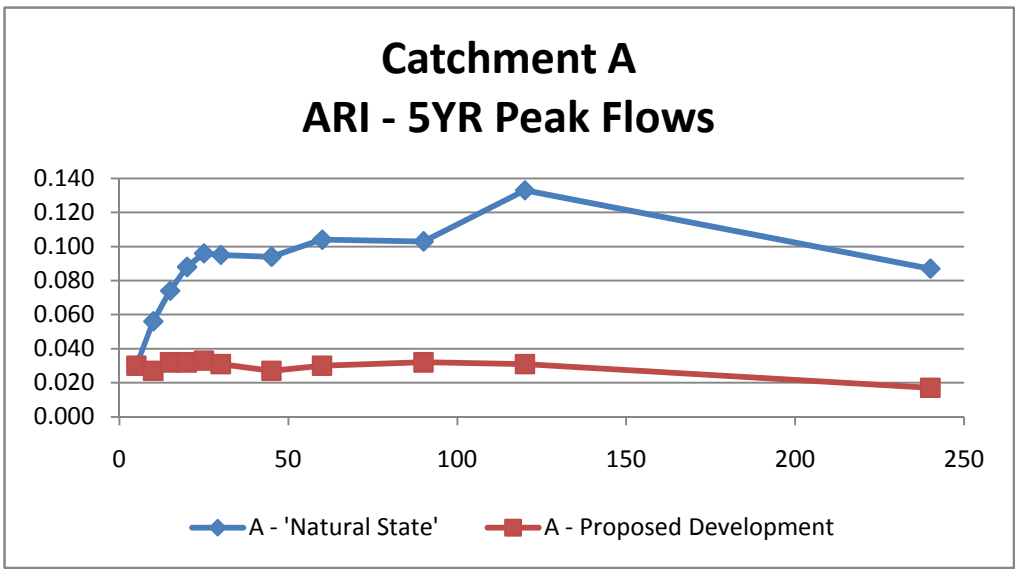
Node	Inflow (cu.m)	Outflow (cu.m)	Storage Chan (cu.m)	Difference %
1	62.98	62.98	0	0
2	178.46	178.46	0	0
3	93.65	93.65	0	0
4	81.6	81.6	0	0
5	179.52	179.52	0	0
6	154.73	154.73	0	0
7	36.85	36.85	0	0
8	33.74	33.74	0	0
9	181.82	181.82	0	0
10	179.36	179.36	0	0
11	36.8	36.8	0	0
ANS	300.26	300.26	0	0
BNS	623.22	623.22	0	0
N27	62.98	62.98	0	0
N28	70.6	70.6	0	0
N29	36.8	36.8	0	0
OSD	1049.15	677.21	372.02	0
N36	677.04	677.04	0	0
N46	784.27	784.27	0	0
N47	784.1	784.1	0	0

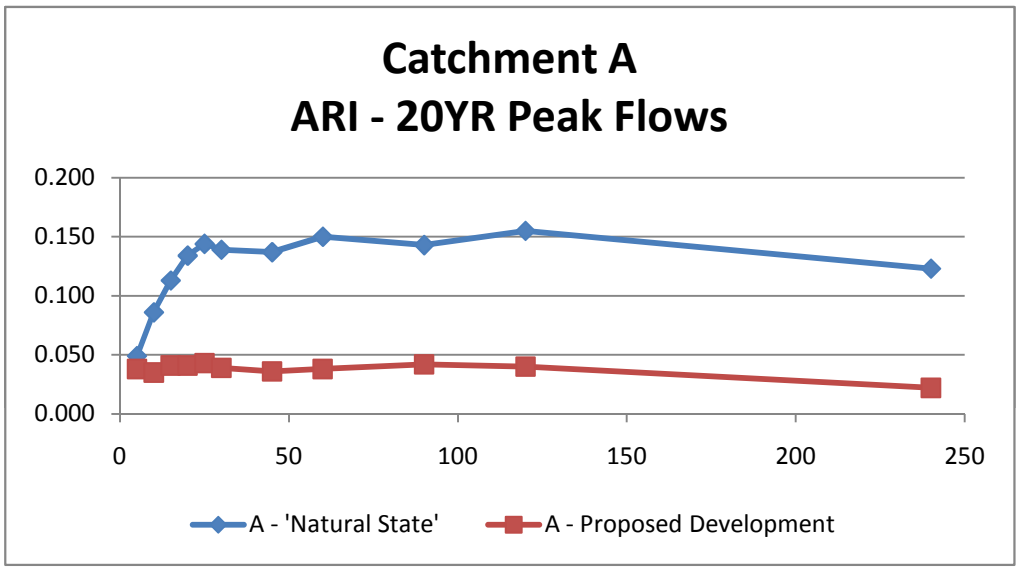
Run Log for OSD_FINAL.drn run at 16:13:42 on 30/8/2010

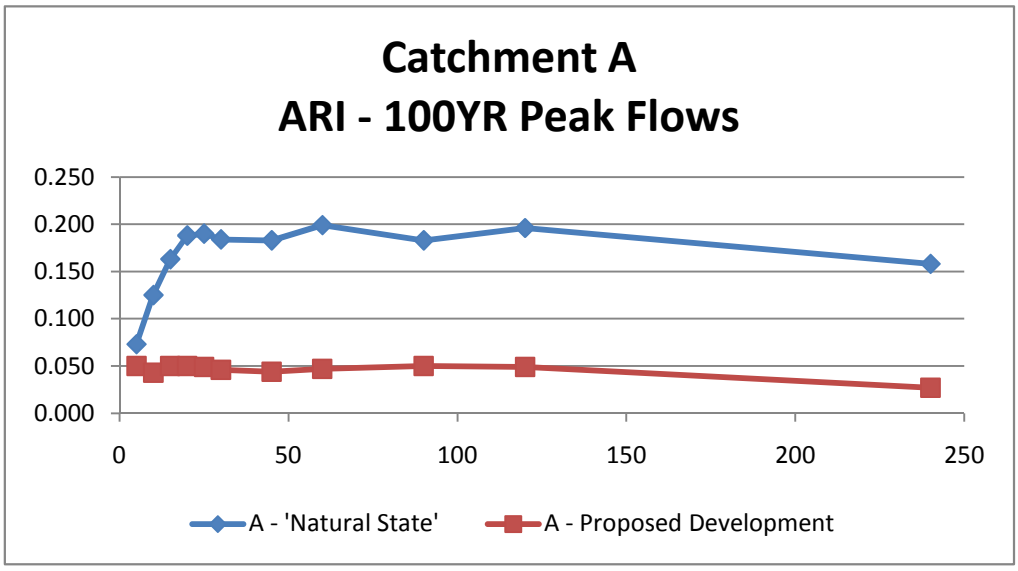
ARI - 5YR Peak Flows					
Duration (min)	A - 'Natural State'	A - Proposed Development	B - 'Natural State'	B - Proposed Development	WL (mAHD)
5	0.030	0.030	0.054	0.057	57.110
10	0.056	0.027	0.103	0.058	57.330
15	0.074	0.032	0.136	0.070	57.500
20	0.088	0.032	0.162	0.069	57.630
25	0.096	0.033	0.179	0.078	57.730
30	0.095	0.031	0.184	0.073	57.810
45	0.094	0.027	0.187	0.063	58.000
60	0.104	0.030	0.206	0.110	58.020
90	0.103	0.032	0.216	0.120	58.020
120	0.133	0.031	0.220	0.131	58.030
240	0.087	0.017	0.171	0.147	58.030
Peak	**0.133**	**0.033**	**0.220**	**0.147**	**58.030**

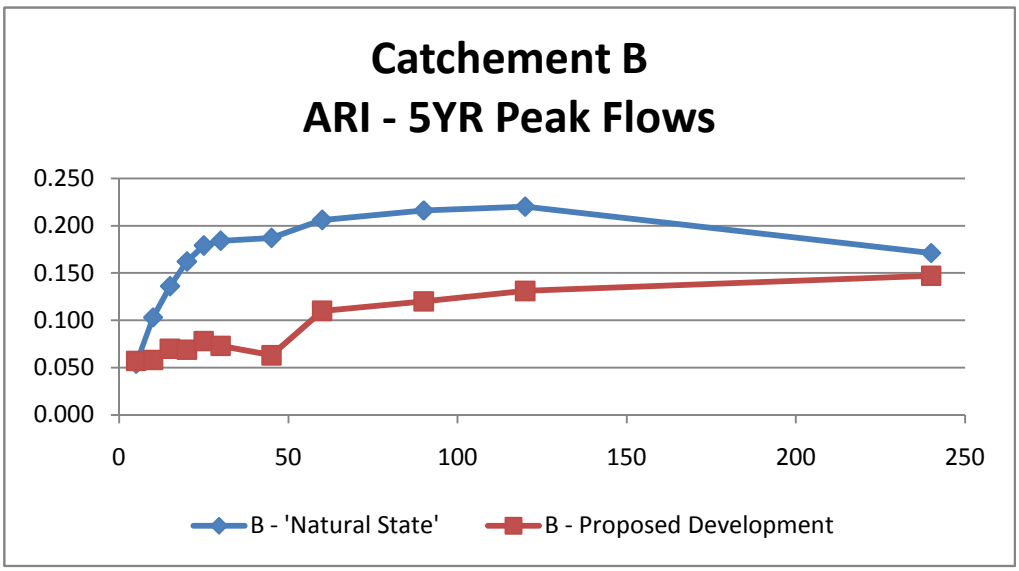
ARI - 20YR Peak Flows					
Duration (min)	A - 'Natural State'	A - Proposed Development	B - 'Natural State'	B - Proposed Development	WL (mAHD)
5	0.049	0.038	0.089	0.072	57.230
10	0.086	0.035	0.158	0.073	57.520
15	0.113	0.041	0.207	0.089	57.730
20	0.134	0.041	0.245	0.087	57.910
25	0.144	0.043	0.269	0.100	58.020
30	0.139	0.039	0.269	0.177	58.040
45	0.137	0.036	0.271	0.218	58.080
60	0.150	0.038	0.296	0.228	58.140
90	0.143	0.042	0.301	0.256	58.200
120	0.155	0.040	0.304	0.249	58.250
240	0.123	0.022	0.244	0.230	58.120
Peak	**0.155**	**0.043**	**0.304**	**0.256**	**58.250**

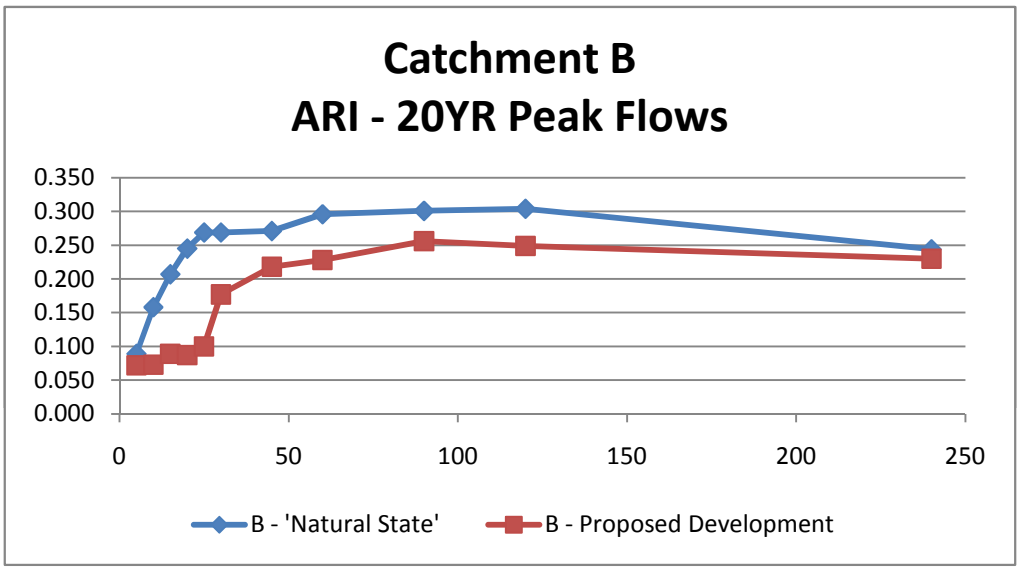
ARI - 100YR Peak Flows					
Duration (min)	A - 'Natural State'	A - Proposed Development	B - 'Natural State'	B - Proposed Development	WL (mAHD)
5	0.073	0.050	0.134	0.093	57.380
10	0.125	0.043	0.229	0.093	57.760
15	0.163	0.050	0.299	0.128	58.020
20	0.188	0.050	0.354	0.243	58.120
25	0.190	0.049	0.365	0.354	58.180
30	0.184	0.046	0.356	0.245	58.220
45	0.183	0.044	0.359	0.243	58.350
60	0.199	0.047	0.394	0.272	58.490
90	0.183	0.050	0.385	0.293	58.560
120	0.196	0.049	0.391	0.286	58.640
240	0.158	0.027	0.315	0.258	58.400
Peak	**0.199**	**0.050**	**0.394**	**0.354**	**58.640**

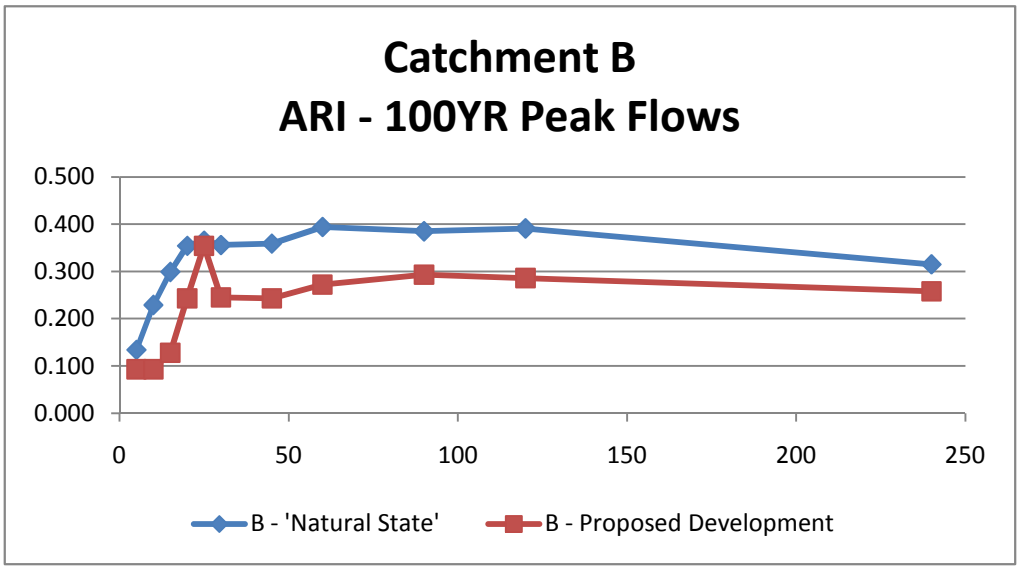

Catchment A
ARI - 5YR Peak Flows
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
0
50
100
150
200
250
A - 'Natural State'
A - Proposed Development


Catchment A
ARI - 20YR Peak Flows
0.200
0.150
0.100
0.050
0.000
0
50
100
150
200
250
A - 'Natural State'
A - Proposed Development


Catchment A
ARI - 100YR Peak Flows
0.250
0.200
0.150
0.100
0.050
0.000
0
50
100
150
200
250
A - 'Natural State'
A - Proposed Development


Catchement B
ARI - 5YR Peak Flows
0.250
0.200
0.150
0.100
0.050
0.000
0
50
100
150
200
250
B - 'Natural State'
B - Proposed Development


Catchment B
ARI - 20YR Peak Flows
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0
50
100
150
200
250
B - 'Natural State'
B - Proposed Development


Catchment B
ARI - 100YR Peak Flows
0.500
0.400
0.300
0.200
0.100
0.000
0
50
100
150
200
250
B - 'Natural State'
B - Proposed Development