STORMWATER CONCEPT PLAN
EASTERN LANDS ERSKINE PARK

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Prepared for CSR Limited

BROWN CONSULTING

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PEOPLE & PROJECTS

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STORMWATER CONCEPT PLAN
EASTERN LANDS

ERSKINE PARK

FOR CSR LIMITED

TABLE OF CONTENTS

LIST OF APPENDICIES

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
DIPNR	Department of Infrastructure, Planning and Natural Resources
DLWC	Department of Land and Water Conservation NSW
DNR	Department of Natural Resources
DEM	Digital Elevation Model
DTM	Digital Terrain Model
FPDM	Floodplain Development Manual
FPL	Flood Planning Level
FPMM	Floodplain Management Manual
FPRMS	Floodplain Risk Management Study
FSL	Flood Surface Level
GIS	Geographic Information System
ha	Hectare (Area = 10,000m^2)
LEP	Local Environmental Plan
LGA	Local Government Area
MGA	Map Grid Australia
m^3/s	Cubic meters per second
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RCP	Reinforced Concrete Pipe
RCBC	Reinforced Concrete Box Culvert
RTA	Roads and Traffic Authority of NSW
SEPP	State Environmental Planning Policy
SMP	Stormwater Management Plan
TIN	Triangular Irregular Network

STORMWATER CONCEPT PLAN
EASTERN LANDS

ERSKINE PARK

FOR CSR LIMITED

1 INTRODUCTION

Brown Consulting has been commissioned to develop a stormwater concept plan for a proposed industrial development on CSR's property located within the Erskine Park Employment Area, see **Figure 1.1**. This concept plan covers stormwater quality and quantity management issues to support the project application for the earthworks, subdivision and associated infrastructure works to create building pads and to prepare the land for industrial development.

This report should be read in conjunction with the following reports:

- Brown Consulting (2006). *Relocation of South Eastern Creek, CSR Lands Erskine Park*, for CSR Limited. (Report No. W03033.12-02E)
- Brown Consulting (2006). *South Eastern Creek Realignment – Hydrology and Hydraulics, CSR Lands Erskine Park*, for CSR Limited. (Report No. W03033.12-03E)

These reports have been submitted with the project application.

1.1 OBJECTIVES

The Stormwater Masterplan for the development has considered the objectives of the Development Control Plan for the Erskine Park Employment Area. To meet the objectives of the DCP, the report:

- Describes the operation of the stormwater management for the development.
- Provides a concept sizing for detention basins to reduce the developed peak flows off the proposed development site to ensure no increase in the flows downstream of the development.
- Provides a conceptual stormwater management system that will reduce the post-developed pollutant loads to meet the requirements of the DCP for the area.
- Describes the management of major and minor overland flows from the development.

- Provides a concept sediment and erosion control plan for the bulk earthworks.

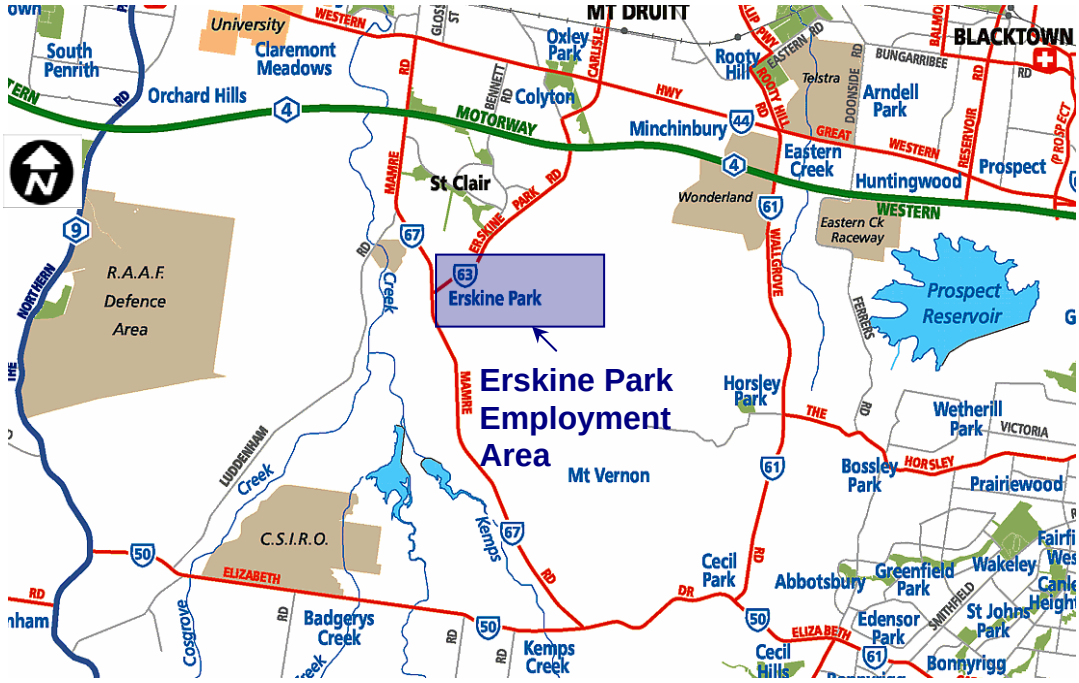

Figure 1.1 Locality Plan (Source: UBD 2004)

1.2 DESCRIPTION OF STUDY AREA

The land to which the applications relate is located off Lenore Lane at Erskine Park, within the Penrith local government area. The site is located in the plan of the proposed subdivision of Lot 5 in DP 1090772, see **Appendix A**. Lot 5 is part of an approved subdivision of the above lots into 3 lots, a residual lot and public road.

The proposed development is generally located within the central and eastern portions of proposed Lot 5. The works will occupy an area of approximately 37.6 Ha. The associated creekworks spread onto the adjoining Crown road reserve to the south of the site and occupy an area of 1.1 Ha.

1.3 PREVIOUS STUDIES

The following studies have been undertaken for the site and adjoining properties. These studies have been reviewed as part of the preparation of this Plan.

- Boyden & Partners (1999). *Review of Stormwater Drainage & Water Management Systems Erskine Park Employment Area*, for Penrith City Council.
- Robinson GRC Consulting (2001). *Erskine Park Industrial Subdivision Drainage Requirements*, for CSR Limited.

- Buckton Lysenko (2002). *Stormwater Management Plan Comprising Creek Realignment Proposal for the Stramit Warehouse and Office Development at Corner Erskine Park Road and Mamre Road, Erskine Park,* for McRoss Developments Pty Ltd.
- Buckton Lysenko (2003). *Flood Study for Watercourse "A" for Industrial Development at Corner Erskine Park Road and Mamre Road, Erskine Park Incorporating Bridge Structure,* for Walker Corporation.
- WP Brown & Partners (2004). *Stormwater Masterplan*, for CSR Limited.
- Brown Consulting (2004). *Concept Stormwater Management Plan, Proposed Industrial Development Lot 93 Lenore Lane, Erskine Park*, for CSR Limited.
- Brown Consulting (2005). *Concept Stormwater Management Plan, Proposed Warehouse and Distribution Facility, Erskine Park*, for Walker Corporation.
- Brown Consulting (2005). *Stormwater Concept Plan, Proposed Woolworths Distribution Centre, CSR Lands Erskine Park*, for Australand.

2 MANAGEMENT OF MINOR AND MAJOR FLOWS

The concept stormwater management plan is shown in the drawings in **Appendix A**. The site has been divided into 6 main sub-catchments and the management of the discharges varies between sub-catchments. The sub catchments generally refer to the proposed building pads and for the drainage of the public roads, which has been kept separate.

Council's DCP for the area allows for the discharge of the water collected from the roof to be discharged from the site to the creeks without treatment. As a result, it is proposed that two separate detention systems will be provided. The first system is for the roof areas of the buildings and the second for the remainder of the site.

The runoff from the site will be discharged to the creek systems northern and southern boundaries of the site The peak flow discharged from the site does not exceed the existing rate from the site as detailed in **Section 3**.

2.1 MINOR FLOW MANAGEMENT

Runoff from the development area for storms up to the 20 year ARI will be collected by the following systems:

- For the car and truck parking/ manoeuvring areas, a combination pit and pipe and swale system discharging to bioretention basins.
- The roof water will be directed to a detention basin at the western side of the site.

The runoff from the site will be discharged to the creek systems northern and southern boundaries of the site.

Details of the drainage systems are shown in **Appendix A.**

2.2 MAJOR FLOW MANAGEMENT

Major flows are considered those flows in excess of the 20 year ARI peak flow. Such flows from the parking and manoeuvring areas will be directed by pipe and overland using the internal access-ways and swales (where appropriate). From here the flows are conveyed to the bioretention basins, where detention is provided to reduce the peak flows to pre development levels.

Stormwater flows from the roof areas will be directed to the detention basin within the site. The downpipes and drainage network for this system need to be sized to convey the 100 year ARI flows to the basin.

It is proposed to provide an overland flowpath for the upper part of site along the northern boundary of the site. This system will consist of a swale to convey flows up to the 100 year ARI to the creek system and will cater for pads 8 and 9.

It is proposed to provide a reconstructed creek system for the part of the site (pads 4, 5 and 7 and the road drainage) draining to the southern boundary of the site. This is covered in detail in the report *Relocation of South Eastern Creek, Erskine Park* by Brown Consulting.

3 CONCEPT DETENTION BASIN DESIGN

3.1 PADS 4, 5, 7, 8 & 9

3.1.1 Pre-Developed Flows

The predeveloped site flows for each of the pads has been determined using the *DRAINS* computer package with the RAFTS hydrology. The results of the pre-development analysis are attached in **Appendix B.**

Table 3.1 below summarises the pre development catchment characteristics adopted to determine the flows.

Table 3.1: Pre Development Catchment Characteristics

Variable	Pre Developed Flow (m^3/s)				
	4	**5**	**7**	**8**	**9**
Area (ha)	7.31	10.3	5.5	2.8	4.5
Slope (%)	5	3.3	2.8	5.1	4.8
% Imp	5	5	5	5	5
Manning 'n'	0.035	0.035	0.035	0.035	0.035

Table 3.2 below summarises the peak flows of each block for the pre development scenario.

Table 3.2: Pre Development Peak Flows

ARI	Pre Developed Flow (m^3/s)				
Years	**4**	**5**	**7**	**8**	**9**
5	0.805	1.68	0.78	0.57	0.835
20	1.18	2.42	1.1	0.811	1.19
100	1.79	3.43	1.65	1.07	1.61

3.1.2 Post-Developed Flows

For the post developed scenario the same pad area adopted for the pre developed flows was adopted, however the fraction impervious was increased to 90% impervious as per Table 4 of the "Penrith City Council Guidelines for Engineering Works for Subdivision and Developments." The slope was also reduced to 1% as this is the estimated finished grade on all pipes and surfaces for the post development scenario.

Table 3.3 below summarises the peak flow of the site for the post-developed scenario. The results of the *DRAINS* run have been attached in **Appendix C**.

Table 3.3: Post Development Peak Flows

ARI	Post Developed Flow (m^3/s)				
Years	**4**	**5**	**7**	**8**	**9**
5	2.47	3.48	1.86	0.95	1.54
20	3.28	4.62	2.46	1.26	2.03
100	4.01	5.65	3.03	1.56	2.51

As the post development peak flows exceed the pre developed flows On-Site Stormwater Detention (OSD) will need to be provided.

3.1.3 Post-Developed Flows With Basins

The proposed OSD has been designed to limit the post developed flows to the predevelopment flows summarised in **Table 3.1**.

The proposed basin are to be a combination of Stormwater quality treatment and OSD, thus the base area of the basins was determined to satisfy the water quality objectives outlined in *Section 2* of this report.

Table 3.4 below summarises the design characteristics adopted for each of the basins. The *DRAINS* results for these basins are attached in **Appendix D**, and the peak flows for the 5, 20, and 100 year ARI are summarised in **Table 3.5**.

Table 3.5: Basin Characteristics

Variable	Pad				
	4	5	7	8	9
Base RL	47.60	51.00	58.80	56.00	54.00
WQ TWL	48.50	51.75	59.60	56.90	54.75
Q_{100} TWL	49.86	52.78	60.5	57.47	55.46
Low Level Outlet RL	48.50	51.75	59.60	56.90	54.75
Diamater	500	750	525	2 x 300	525
High Level outlet RL	49.50	52.45	60.25	57.30	55.25
Width	2.0	3.0	3.0	3.0	3.0
Base Area (m^2)	546	1024	520	169	441

Table 3.6 demonstrates that the proposed OSD basins will satisfactorily reduce the post developed flows to the pre developed flows.

Table 3.6: Post Development Peak Flows With OSD

ARI	Post Developed Flow With OSD (m^3/s)				
Years	4	5	7	8	9
5	0.794	1.59	0.807	0.558	0.776
20	0.858	1.72	0.867	0.592	0.827
100	1.632	2.784	1.534	0.977	1.357

3.2 PUBLIC ROADS

3.2.1 Drainage Design

The road pavement stormwater drainage system (Minor drainage system) has been designed to cater for the 20 year ARI storm event as required by Penrith City Council's Guidelines *For Engineering Works For Subdivisions and Developments.*

It is proposed that an overland flowpath will be create within pad 5a to convey the 100 year safely to the discharge to the creek.

The *DRAINS* results for the drainage network have been attached in **Appendix E**.

3.2.2 Water Quality Basin Outlet Design

The basin has been designed to store the 6 month ARI storm event and drain this via a subsoil drainage system. All flows which exceed the 6 month ARI will still be directed to the water quality pond and detention is provided for storms up to the 100 year ARI storm event.

4 STORMWATER TREATMENT

4.1 STORMWATER QUALITY OBJECTIVES

The stormwater treatment objectives for the proposed bio-filtration basin have been adopted from the "Erskine Park Employment Area" DCP. The identified pollutant removal efficiencies from this document are summarised below in **Table 4.1**.

Table 4.1: Pollutant Removal Objectives

Nutrient	Pollutant Removal Criteria (%)
Total Phosphorous	45
Total Nitrogen	45
Total Suspended Solids	80

4.2 PRE AND POST DEVELOPED WATER QUALITY

To scope the impact of the proposed development on the downstream waters, a Level 1 modelling approach is adequate to estimate pollutant loads for this purpose. This approach estimates annual pollutant loads by using event mean concentrations (EMC) and annual runoff estimates, derived from a volumetric runoff coefficient applied to annual rainfall over the site area.

Pollutant loads can be estimated from the formulae $L = P.C_v.C.A$ as used in Annexure A of the EPA (1997a), where:

L = average annual pollutant load (kg/y)
P = average annual rainfall (mm)
C_v = volumetric runoff coefficient
A = catchment area (km^2)
C = EMC value

The DCP for the area has determined the EMC values for various land uses, as shown in **Table 4.2**.

Table 4.2 DCP EMC Values

Land use	Runoff Coeff	Mean EMC (kg/ha/y)		
		TSS	TP	TN
Natural	0.15	15	0.03	0.54
Pre-Development	0.20	90	0.16	1.26
Residential	0.35	500	0.80	4.80
Commercial	0.50	900	1.60	8.10
Industrial	0.52	950	1.70	9.50

4.3 STORMWATER TREATMENT STRATEGY

The stormwater treatment strategy for the site includes; filter strips, biofiltration basins, litter pits and swales. In addition, stormwater reuse will be undertaken to reduce potable water demand. This will take the form of rainwater tanks that will be allocated to the site for potential use for irrigation, toilet flushing and other non-potable uses, possibly such as truck washing.

The water from the roof areas of the site are directed to separate basins from the water quality basins.

4.4 PADS 4, 5, 7, 8 & 9

The estimated pre and post development pollutant loads have been estimated for the Roads and are shown in **Table 4.3**.

Table 4.3: Pre & Post Development Pollutant Loads

Pad	Loads (kg/y)		
	TSS	TP	TN
Pre-Development			
Pad 4	1406	2.50	19.69
Pad 5	1950	3.47	27.31
Pad 7	771.1	1.37	10.80
Pad 8	499.0	0.89	6.99
Pad 9	786.2	1.40	11.00
Post Development			
Pad 4	66792	119.5	669.0
Pad 5	92647	165.8	92.5
Pad 7	36628	65.6	366.3
Pad 8	23700	42.4	237.0
Pad 9	37346	66.8	373.5

Table 4.3 shows a substantive increase in pollutant loads. Details of the water quality calculation are given in **Appendix F.**

4.4.1 Conceptual Basin Sizing

As mentioned previously the proposed basin has been designed using the methodology outlined in the "Water Sensitive Urban Design – Technical Guidelines for Western Sydney". The design calculations have been attached in **Appendix G** and a summary of the designed basin is summarised below in **Table 4.4**.

Table 4.4: Bio-Filtration Basin Details

Parameter	Pad 4	Pad 5	Pad 7	Pad 8	Pad 9
Basin Base Area (m^2)	546	1024	520	169	441
Bio-filter Area (m^2)	443	626	290	170	293
Depth of Ponding (m)	0.9	0.75	0.8	0.9	0.75
Volume 6 month ARI (m^3)	709	1001	532	272	440
Peak Flow 6 month ARI(m^3/s)	1.03	1.46	0.777	0.4	0.642
Filter Depth (m)	0.6	0.6	0.6	0.6	0.6

4.5 PUBLIC ROADS

The proposed basin has been designed using the methodology outlined in the "Water Sensitive Urban Design – Technical Guidelines for Western Sydney". The design calculations have been attached in **Appendix H** and a summary of the designed basin is summarised below in **Table 4.5**.

The basin has also been designed to provide an emergency spill control basin with a capacity of 60,000L capacity.

Table 4.5: Bio-Filtration Basin Details

Parameter	Value
Basin Base Area (m^2)	360
Bio-filter Area (m^2)	217
Depth of Ponding (m)	0.75
Volume 6 month ARI (m^3)	351
Peak Flow 6 month ARI(m^3/s)	0.21
Peak Flow 100 Year ARI (m^3/s)	1.274
Volume of Filtration Basin (m^3)	504
Filter Depth (m)	0.6

4.5.1 MUSIC Modelling

The basin designed in *Section 2.3* has then been run through the *MUSIC* program to assess whether the design will meet the requirements spelled out in the "Erskine Park Employment Area – Development Control Plan". The input data and results of this model have been attached in **Appendix I**, and the results are summarised below in **Table 4.6**.

Table 4.6: Bio-filter Pollutant Removal Efficiency

Polluant	Pollutant Removal
TSS	89.1
TP	75.9
TN	60.4

Table 4.7 below compares the Post developed annual pollutant loads with the pre developed pollutant loads calculated in the *MUSIC* model.

Table 4.7: Comparison of Pre developed and treated post developed pollutant Loads From the *MUSIC* Model

Site	Loads (kg/y)		
	TSS	TP	TN
Pre-Development	1550	4.86	34.7
Post Development	68	1.17	13.7

Table 4.6 and **Table 4.7** above demonstrates that the treatment train designed will adequately, meet the requirements of the Erskine Park Employment Area DCP, and reduce the post developed pollutant loads to pre development levels.

5 SOIL & WATER MANAGEMENT DURING CONSTRUCTION

Sedimentation and erosion controls will be constructed prior to commencement of any work to minimise the discharge of sediment from the site. The controls will be designed and installed in accordance with the requirements of the NSW Department of Housing 'Soils & Construction' manual.

5.1 TEMPORARY SEDIMENT & EROSION CONTROLS

The engineering bulk earthworks drawings show the concept sediment and erosion control plan for the development.

- A single all weather access way at the front of the property consisting of 50-75mm aggregate or similar material at a minimum thickness of 150mm, laid over geo-fabric and constructed prior to commencement of works.
- A shaker pad will be used at the entrance to the site to remove clay from vehicles leaving the site so as to maintain public roads in a clean condition.
- This sediment control basin should be located where the proposed water quality basin is to be constructed immediately to the west of the site. Once the majority of the site has been constructed the basin should then be converted to its ultimate use as a water quality control basin.
- Disturbed areas will be rehabilitated with indigenous plant species, landscaped and treated by approved methods of erosion mitigation such as mulching, revegetation with native grasses or other suitable stabilising processes within fifteen days of the completion of works.
- All runoff and erosion controls will be installed before any works are carried out at the site.

- Upslope clean surface runoff will be diverted via diversion drains and sediment fencing around the disturbed areas.
- Installing *SoilLocker* at the down-slope of the disturbed areas to capture sediment and debris escaping from the site.
- *SoilLocker* shall be installed on the boundary of the creek buffer area.
- Topsoil stockpiling stripped from the construction site shall be diverted away from drainage lines, stormwater inlets and be suitably covered by impervious membrane material and screened by sediment fencing.
- Sediment end erosion controls shall be inspected weekly or after each storm event for litter, sediment, and organic waste accumulation. All sediment/debris shall be removed within two (2) working days.

5.2 SEDIMENT BASIN CONCEPT DESIGN

The sediment basin has been design to capture the first 25mm runoff from the 75th percentile, 5-day rainfall event, as per the NSW Department of Housing Guidelines. An additional 50% capacity has been provided for storage of sediment.

The concept design is based on the equation: $V = 10.C_v.A.R_{5day\ 75th\%\ ile}$

As recommended by the *NSW Department of Housing (1998)*, a volumetric runoff coefficient (C_v) of 0.5 has been adopted for the construction phase. The outlet to each of the basins will be a slow control discharge. A spillway will be incorporated into the basin design for an overflow.

5.3 SEDIMENT BASIN FLOCCULATION & DISCHARGE WATER QUALITY CRITERIA

Runoff captured in the sediment basin will be treated with an approved flocculating agent before discharging water, as the catchment contains soils that are classified as fine dispersible, which do not readily settle from suspension. The flocculation should ensure that discharges contain no more than 50 mg/L of suspended solids or 30 NTU before being discharged. Furthermore, dewatering should preferably be over existing stable, grassed areas and not directly into the creek.

6 CONCLUSION

This Stormwater Concept Plan describes the management of stormwater within the proposed pads and public roads within the site. The report sets out the basic stormwater parameters that need to be met by the future development of the pads.

The proposal satisfies the requirements for stormwater quality and quantity control identified by Council.

7 REFERENCES

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8 APPENDICES

Appendix A	Drawings
Appendix B	Pre Development Flows Pads 4 -9
Appendix C	Post Development Flows Pads 4 -9
Appendix D	Post Development Flows with Detention Pads 4 -9
Appendix E	Flows Results Public Roads
Appendix F	Water Quality Results Pads 4 -9
Appendix G	Basin Concept Design Pads 4 -9
Appendix H	Basin Concept Design Water Quality
Appendix I	Water Quality Results

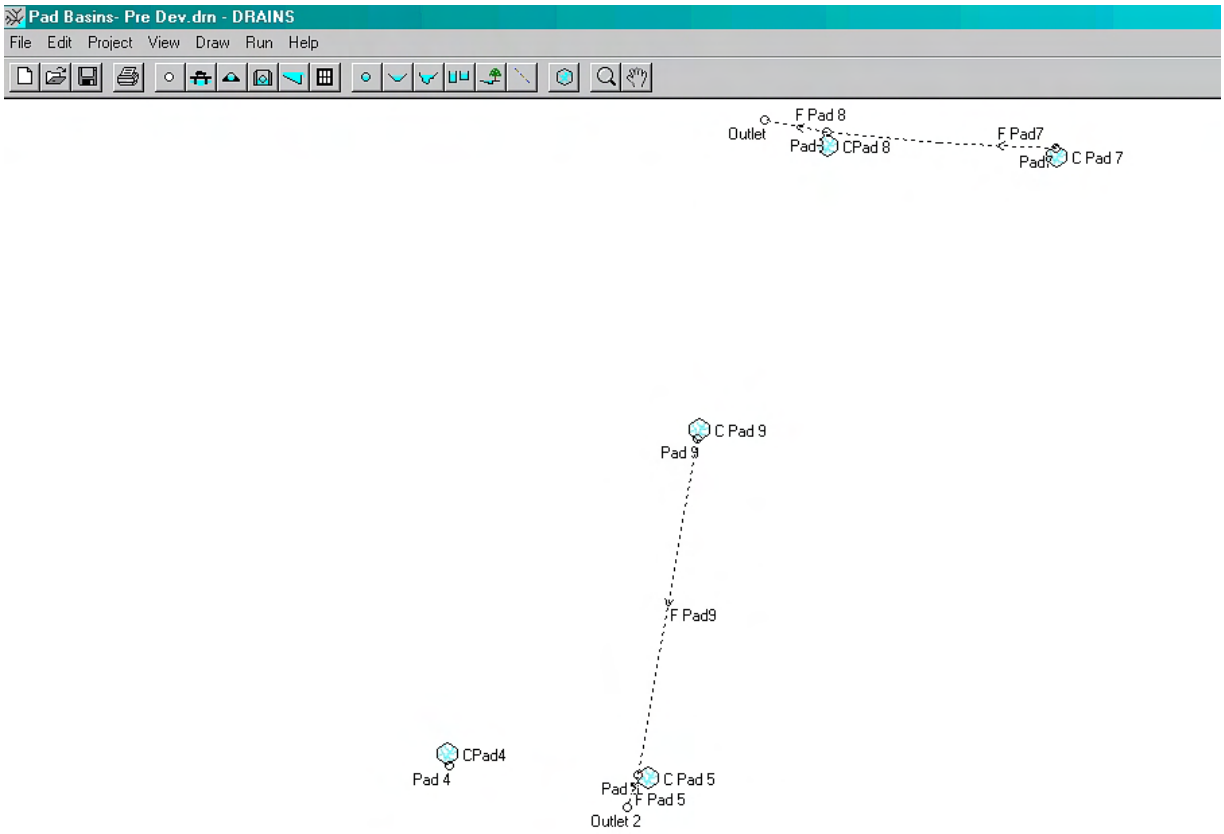
APPENDIX A

DRAWINGS

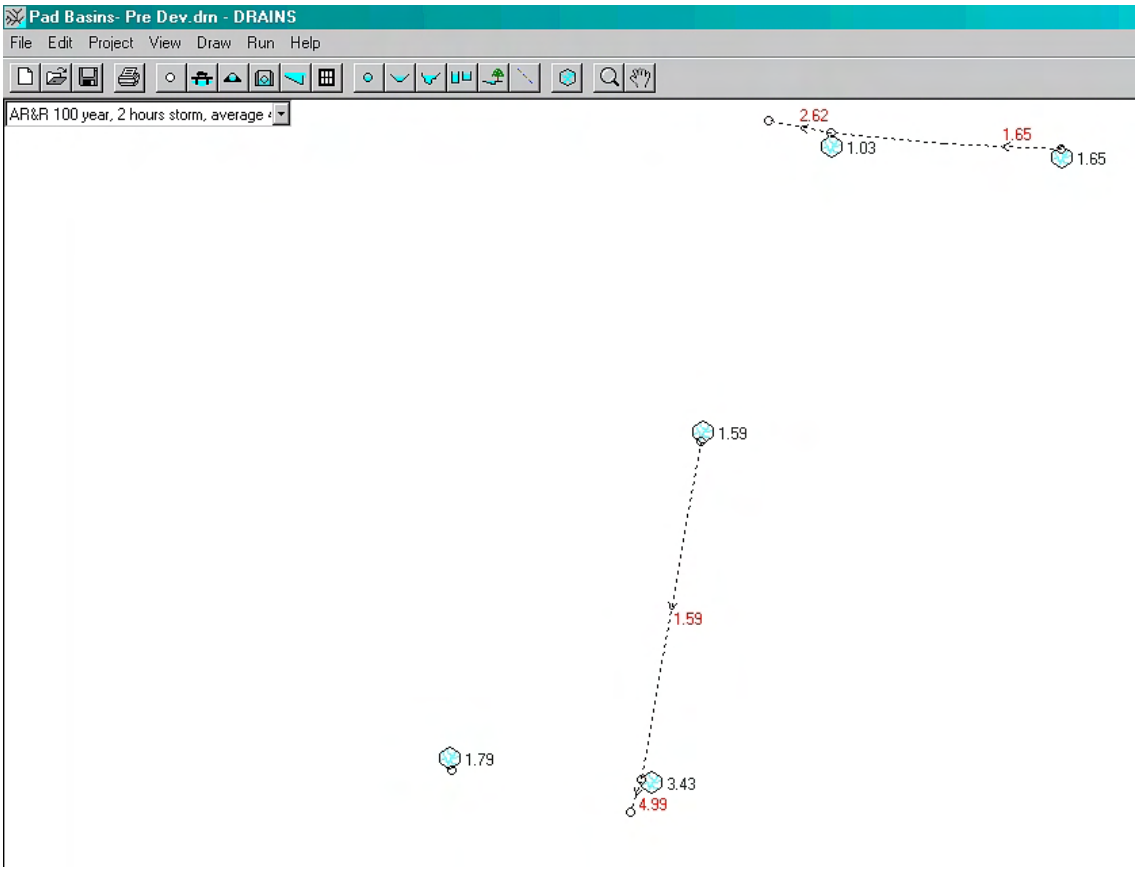
APPENDIX B

Pre Development Flows Pads 4 -9

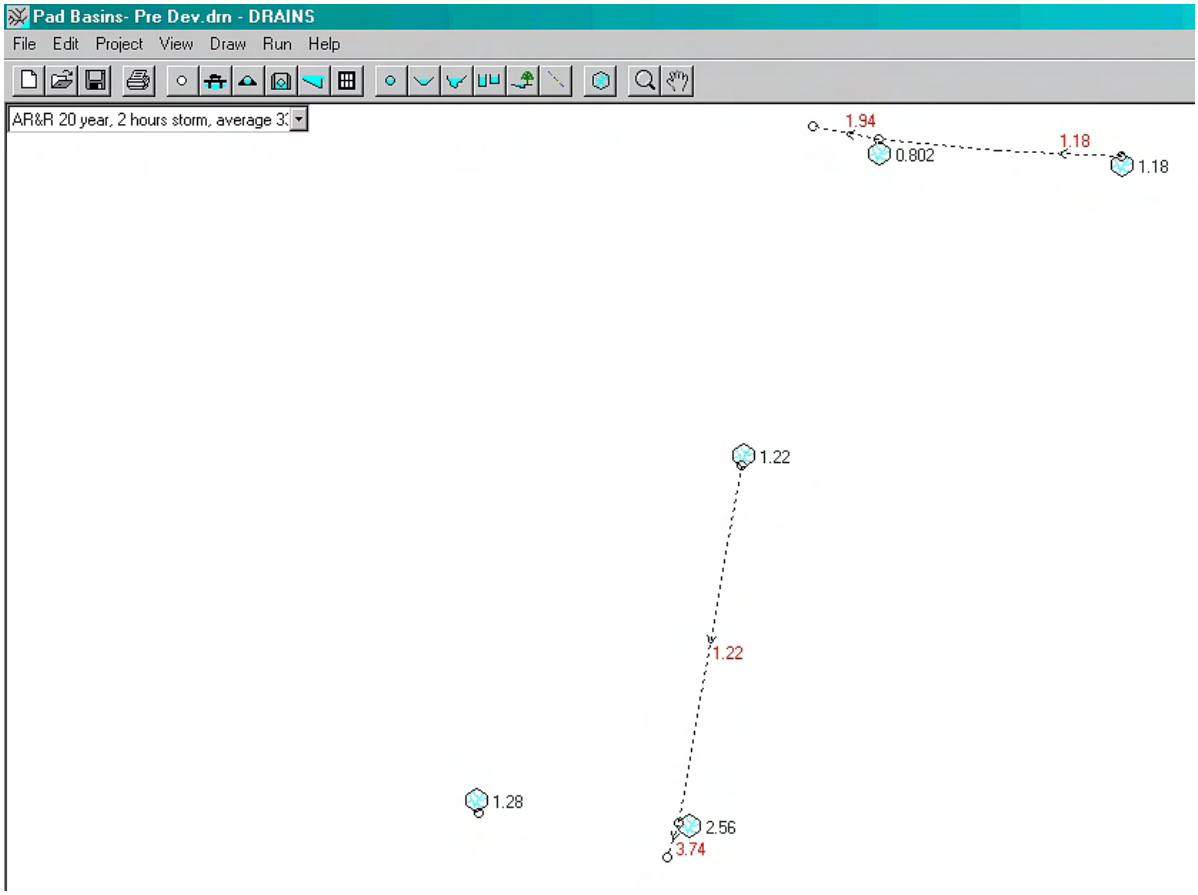
PREDEVELOPMENT *DRAINS* MODEL



100 YEAR ARI RESULTS



20 YEAR ARI RESULTS



PREDEVELOPMENT INPUT DATA

PIT / NODE DETAILS Version 9

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
Pad8	Node								0	296215.8	6256056		27531430	
Pad7	Node								0	296420.7	6256042		27531431	
Outlet	Node								0	296159.9	6256067		27531438	
Pad 9	Node								0	296099.6	6255780		27531443	
Pad 5	Node								0	296046.1	6255477		27531444	
Outlet 2	Node								0	296036.8	6255448		27531447	
Pad 4	Node								0	295876.8	6255486		27531472	

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng	id

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Impervious Area	Hydrological Model	
CPad 8	Pad8	2.8101	5	5.1	EP RAFTS
C Pad 7	Pad7	5.4846	5	2.8	EP RAFTS
C Pad 9	Pad 9	4.5304	5	4.8	EP RAFTS
C Pad 5	Pad 5	10.3294	5	3.3	EP RAFTS
CPad4	Pad 4	7.31	5	1.9	EP RAFTS

PIPE DETAILS

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

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc etc

CHANNEL DETAILS

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

OVERFLOW ROUTE DETAILS

Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth	SafeDepth	Safe	Bed	D/S Area	id

PREDEVELOPMENT INPUT DATA

			Time (min)	Level (m)	Length (m)	Coeff. C	Section	Major Storr (m)	Minor Storr (m)	DxV (sq.m/sec)	Slope (%)	Contributing %	
F Pad 8	Pad8	Outlet		0.2			Dummy use	0.2	0.05	0.6	1	0	27531439
F Pad7	Pad7	Pad8		0.2			Dummy use	0.2	0.05	0.6	1	0	27531434
F Pad9	Pad 9	Pad 5		0.2			Dummy use	0.2	0.05	0.6	1	0	27531445
F Pad 5	Pad 5	Outlet 2		0.2			Dummy use	0.2	0.05	0.6	1	0	27531446

PREDEVELOPMENT 100 YEAR ARI RESULTS

PIT / NODE DETAILS Version 7

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

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
CPad 8	1.066	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
C Pad 7	1.65	AR&R 100 year, 2 hours storm, average 44.3 mm/h, Zone 1
C Pad 9	1.613	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
C Pad 5	3.428	AR&R 100 year, 2 hours storm, average 44.3 mm/h, Zone 1
CPad4	1.794	AR&R 100 year, 2 hours storm, average 44.3 mm/h, Zone 1

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
F Pad 8	2.617	2.617	7.665	0.13	0.16	29.95	1.22	AR&R 100 year, 2 hours storm, average 44.3 mm/h, Zone 1
F Pad7	1.65	1.65	7.665	0.107	0.12	25.46	1.08	AR&R 100 year, 2 hours storm, average 44.3 mm/h, Zone 1
F Pad9	1.613	1.613	7.665	0.106	0.11	25.28	1.08	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
F Pad 5	4.991	4.991	7.665	0.168	0.24	37.68	1.45	AR&R 100 year, 2 hours storm, average 44.3 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

CONTINUITY CHECK for AR&R 100 year, 2 hours storm, average 44.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %

PREDEVELOPMENT 100 YEAR ARI RESULTS

Pad8	6150.61	6150.61	0	0
Pad7	4061.63	4061.63	0	0
Outlet	6149.83	6149.83	0	0
Pad 9	3366.24	3366.24	0	0
Pad 5	11031.97	11031.97	0	0
Outlet 2	11030.91	11030.91	0	0
Pad 4	5381.69	5381.69	0	0

PREDEVELOPMENT 20 YEAR ARI RESULTS

PIT / NODE DETAILS Version 7

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

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
CPad 8	0.811	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
C Pad 7	1.184	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1
C Pad 9	1.221	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1
C Pad 5	2.557	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1
CPad4	1.278	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1

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
F Pad 8	1.941	1.941	0.256	0.115	0.13	26.9	1.14	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1
F Pad7	1.184	1.184	0.256	0.093	0.09	22.59	1.01	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1
F Pad9	1.221	1.221	0.256	0.095	0.1	22.95	1	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1
F Pad 5	3.744	3.744	0.256	0.15	0.2	33.9	1.35	AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

CONTINUITY CHECK for AR&R 20 year, 2 hours storm, average 33.6 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %

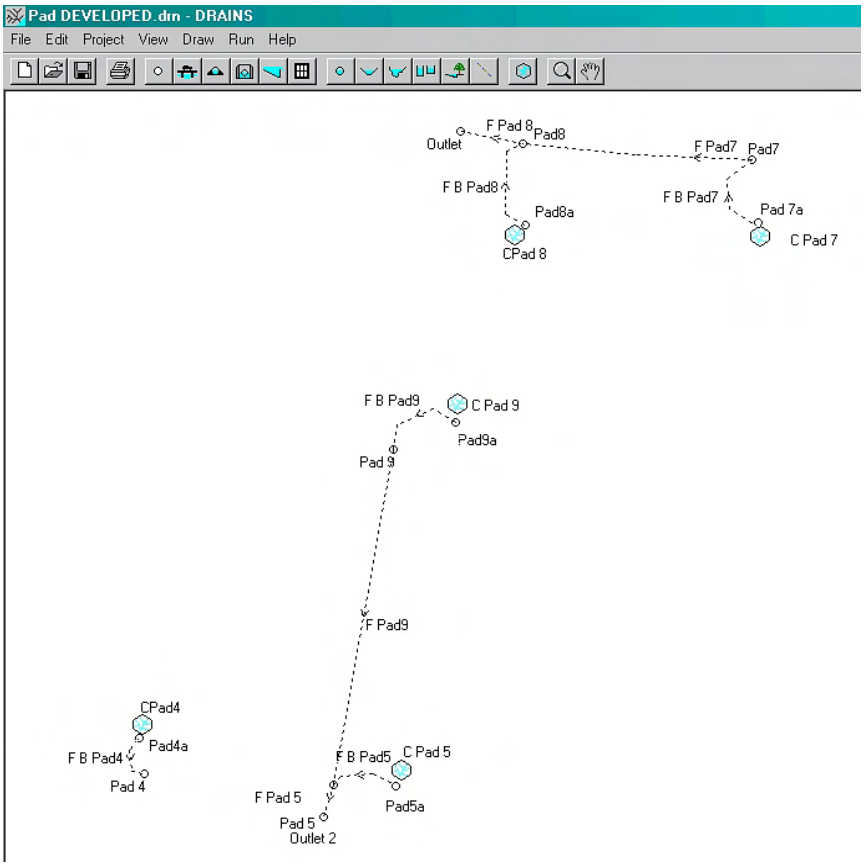
PREDEVELOPMENT 20 YEAR ARI RESULTS

Pad8	4401.52	4401.52	0	0
Pad7	2905.58	2905.58	0	0
Outlet	4400.84	4400.84	0	0
Pad 9	2410.22	2410.22	0	0
Pad 5	7897.03	7897.03	0	0
Outlet 2	7896.09	7896.09	0	0
Pad 4	3844.79	3844.79	0	0

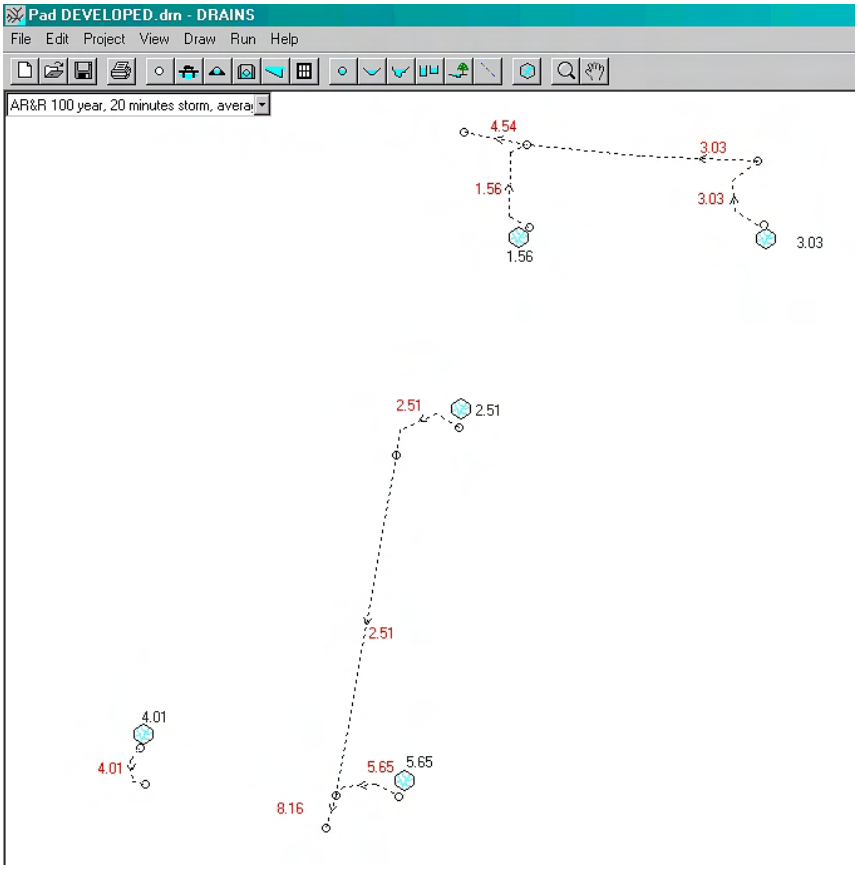
APPENDIX C

Post Development Flows Pads 4 -9

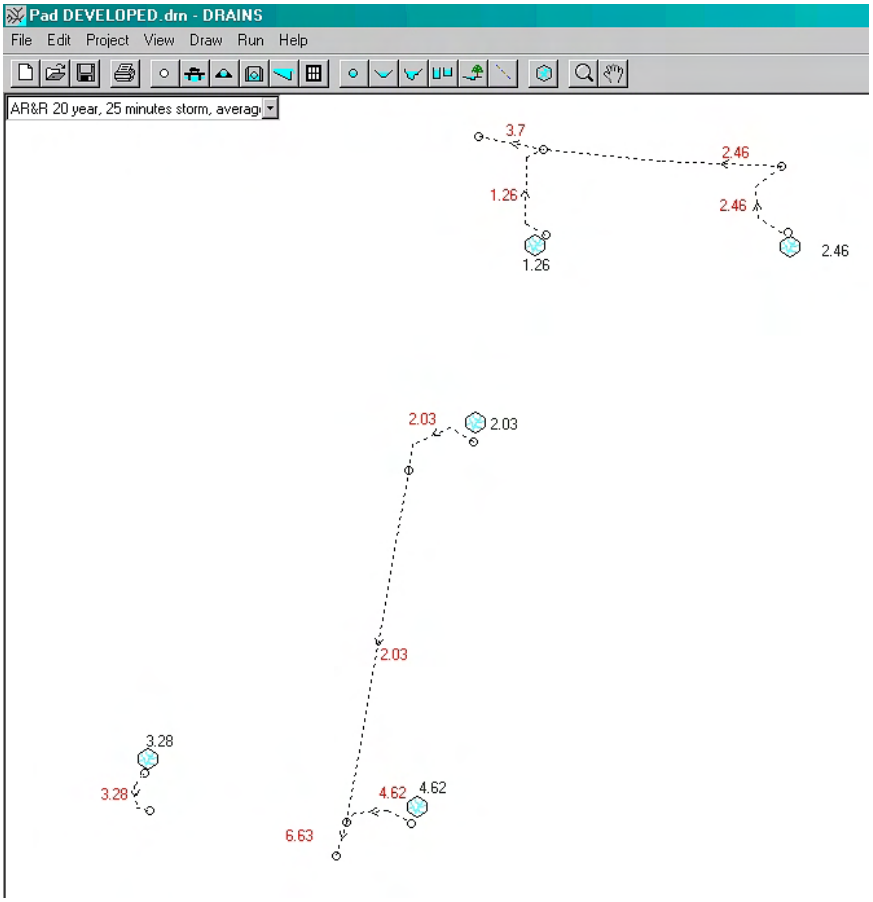
DEVELOPED *DRAINS* MODEL



100 YEAR ARI RESULTS



20 YEAR ARI RESULTS



POST DEVELOPMENT INPUT DATA

PIT / NODE DETAILS Version 9

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
Pad8	Node					54.255		0		296215.8	6256056		27531430	
Pad7	Node					56.9		0		296420.7	6256042		27531431	
Outlet	Node							0		296159.9	6256067		27531438	
Pad 9	Node					52		0		296099.6	6255780		27531443	
Pad 5	Node					48.25		0		296046.1	6255477		27531444	
Outlet 2	Node							0		296036.8	6255448		27531447	
Pad 4	Node					42.5		0		295876.8	6255486		27531472	
Pad4a	Node					43		0		295872.7	6255519		27575188	
Pad5a	Node					49		0		296101.6	6255475		27575195	
Pad9a	Node					52.5		0		296155	6255804		27575200	
Pad8a	Node					54.5		0		296217.2	6255982		27575206	
Pad 7a	Node					57.3		0		296426.5	6255984		27575210	

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng	id

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Impervious Area	Hydrological Model	
CPad4	Pad4a	7.31	90	1	EP RAFTS
C Pad 5	Pad5a	10.3294	90	1	EP RAFTS
C Pad 9	Pad9a	4.5304	90	1	EP RAFTS
CPad 8	Pad8a	2.8101	90	1	EP RAFTS
C Pad 7	Pad 7a	5.4846	90	1	EP RAFTS

PIPE DETAILS

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

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc	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

POST DEVELOPMENT INPUT DATA

				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)	
OVERFLOW ROUTE DETAILS													
Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storr (m)	Safe Depth Minor Storr (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
F Pad 8	Pad8	Outlet	0.2				Dummy use	0.2	0.05	0.6	1	0	27531439
F Pad7	Pad7	Pad8	0.2				Dummy use	0.2	0.05	0.6	1	0	27531434
F Pad9	Pad 9	Pad 5	0.2				Dummy use	0.2	0.05	0.6	1	0	27531445
F Pad 5	Pad 5	Outlet 2	0.2				Dummy use	0.2	0.05	0.6	1	0	27531446
F B Pad4	Pad4a	Pad 4	0.2				Dummy use	0.2	0.05	0.6	1	0	27531497
F B Pad5	Pad5a	Pad 5	0.2				Dummy use	0.2	0.05	0.6	1	0	27535988
F B Pad9	Pad9a	Pad 9	0.2				Dummy use	0.2	0.05	0.6	1	0	27549403
F B Pad8	Pad8a	Pad8	0.2				Dummy use	0.2	0.05	0.6	1	0	27554005
F B Pad7	Pad 7a	Pad7	0.2				Dummy use	0.2	0.05	0.6	1	0	27551494

POST DEVELOPMENT 100 YEAR ARI RESULTS

PIT / NODE DETAILS — Version 7

Name	Max 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 (cu.m/s)	Due to Storm
CPad4	4.014	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C Pad 5	5.651	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C Pad 9	2.51	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
CPad 8	1.561	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C Pad 7	3.03	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1

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
F Pad 8	4.542	4.542	7.665	0.162	0.23	36.42	1.41	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F Pad7	3.03	3.03	7.665	0.137	0.18	31.39	1.28	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F Pad9	2.51	2.51	7.665	0.127	0.15	29.41	1.22	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F Pad 5	8.162	8.162	7.665	0.205	0.34	45.04	1.64	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F B Pad4	4.014	4.014	7.665	0.154	0.21	34.8	1.37	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F B Pad5	5.651	5.651	7.665	0.176	0.27	39.29	1.5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F B Pad9	2.51	2.51	7.665	0.127	0.15	29.41	1.22	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F B Pad8	1.561	1.561	7.665	0.105	0.11	24.92	1.07	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
F B Pad7	3.03	3.03	7.665	0.137	0.18	31.39	1.28	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q

POST DEVELOPMENT 100 YEAR ARI RESULTS

Total Low Level High Level

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
Pad8	3075.92	3075.92	0	0
Pad7	2033.77	2033.77	0	0
Outlet	3075.92	3075.92	0	0
Pad 9	1679.94	1679.94	0	0
Pad 5	5510.22	5510.22	0	0
Outlet 2	5510.22	5510.22	0	0
Pad 4	2710.65	2710.65	0	0
Pad4a	2710.65	2710.65	0	0
Pad5a	3830.28	3830.28	0	0
Pad9a	1679.94	1679.94	0	0
Pad8a	1042.15	1042.15	0	0
Pad 7a	2033.77	2033.77	0	0

POST DEVELOPMENT 20 YEAR ARI RESULTS

PIT / NODE DETAILS Version 7

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

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
CPad4	3.277	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 5	4.616	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 9	2.034	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
CPad 8	1.261	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 7	2.462	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

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
F Pad 8	3.703	3.703	0.256	0.149	0.2	33.73	1.35	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F Pad7	2.462	2.462	0.256	0.126	0.15	29.24	1.21	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F Pad9	2.034	2.034	0.256	0.116	0.13	27.26	1.16	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F Pad 5	6.635	6.635	0.256	0.189	0.29	41.81	1.55	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F B Pad4	3.277	3.277	0.256	0.141	0.18	32.29	1.31	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F B Pad5	4.616	4.616	0.256	0.163	0.23	36.6	1.42	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F B Pad9	2.034	2.034	0.256	0.116	0.13	27.26	1.16	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F B Pad8	1.261	1.261	0.256	0.096	0.1	23.13	1.02	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F B Pad7	2.462	2.462	0.256	0.126	0.15	29.24	1.21	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q

POST DEVELOPMENT 20 YEAR ARI RESULTS

Total Low Level High Level

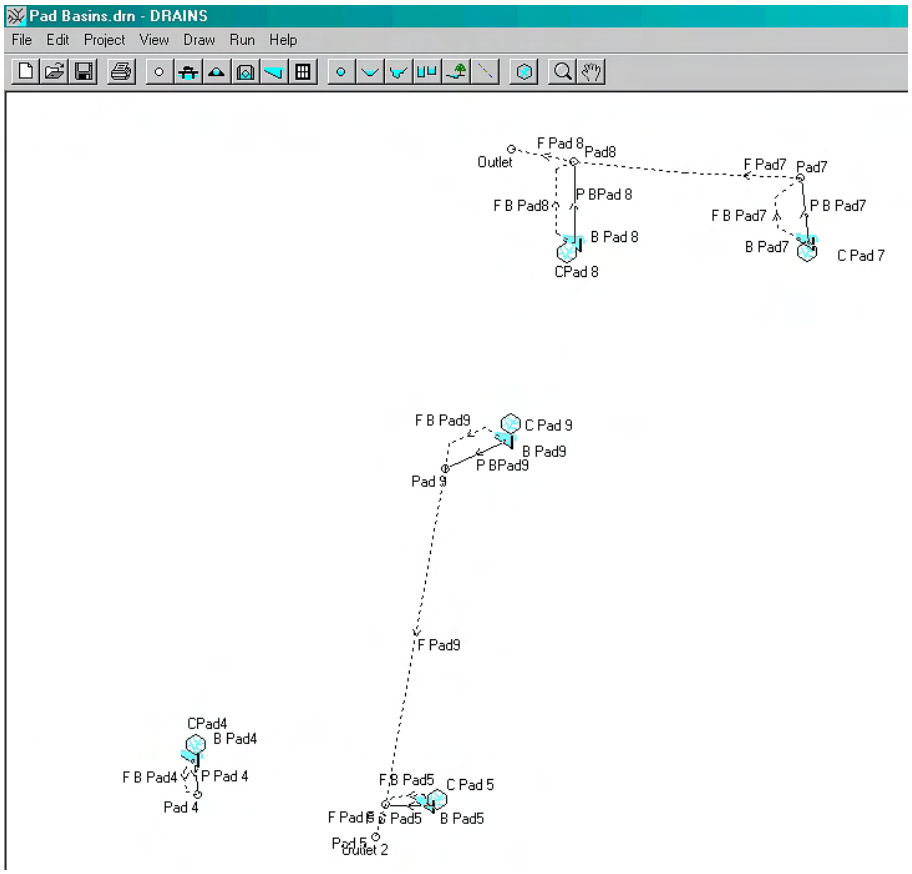
CONTINUITY CHECK for AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %	
Pad8	2573.83	2573.83	0	0	
Pad7	1701.86	1701.86	0	0	
Outlet	2573.82	2573.82	0	0	
Pad 9	1405.77	1405.77	0	0	
Pad 5	4610.94	4610.94	0	0	
Outlet 2	4610.94	4610.94	0	0	
Pad 4	2268.27	2268.27	0	0	
Pad4a	2268.27	2268.27	0	0	
Pad5a	3205.17	3205.17	0	0	
Pad9a	1405.77	1405.77	0	0	
Pad8a	871.97	871.97	0	0	
Pad 7a	1701.86	1701.86	0	0	

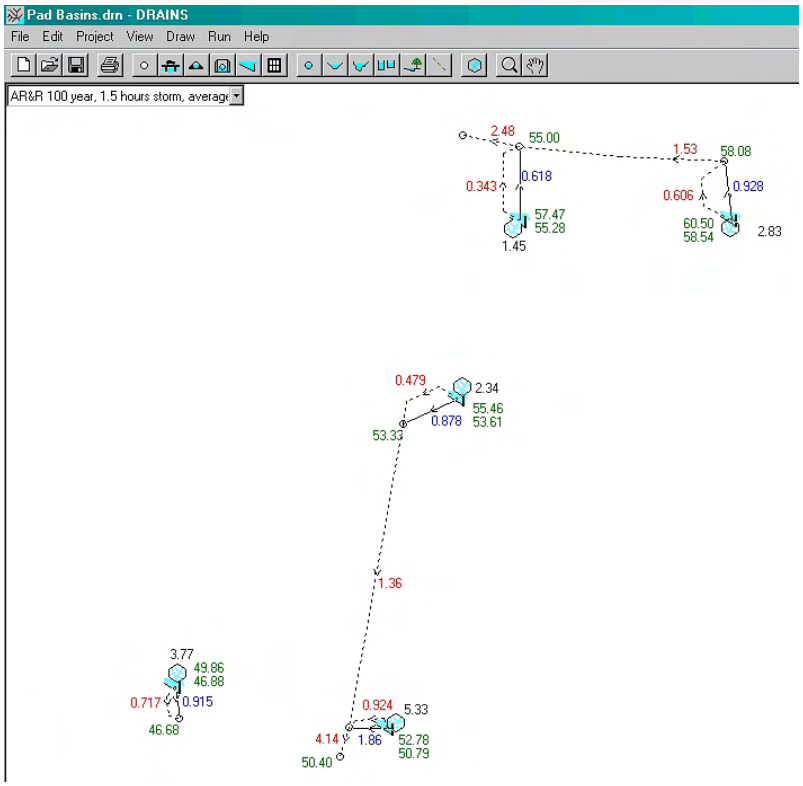
APPENDIX D

Post Development Flows with Detention Pads 4 -9

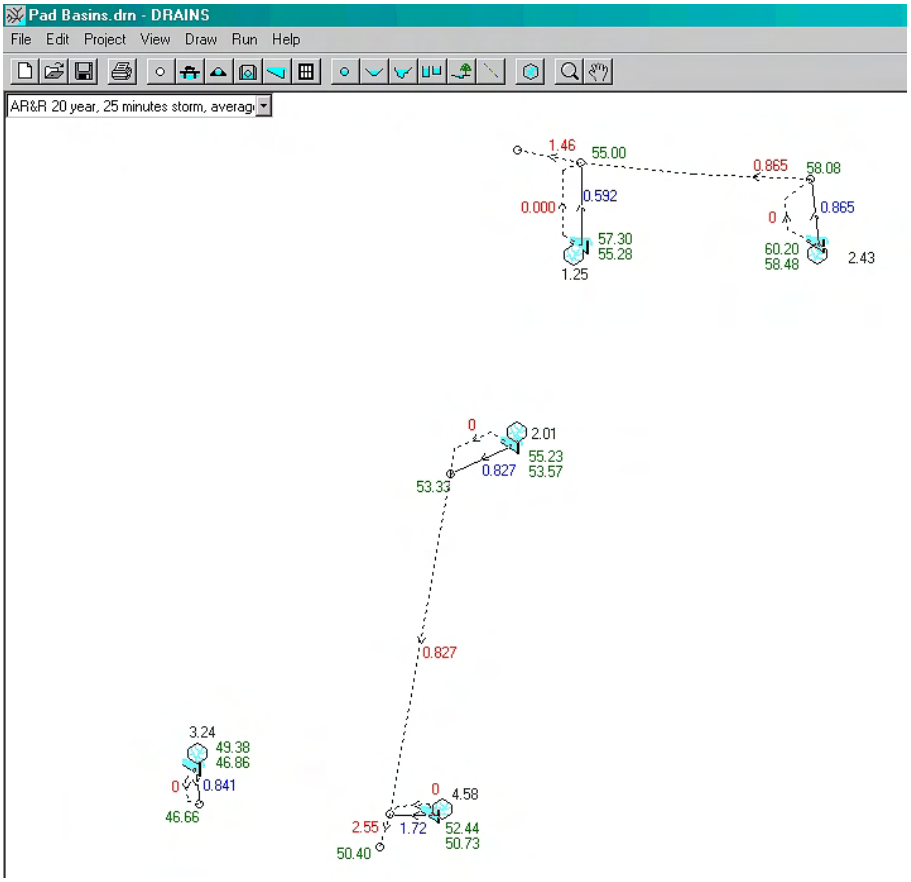
DEVELOPED WITH BASINS *DRAINS* MODEL



100 YEAR ARI RESULTS



20 YEAR ARI RESULTS



DRAINS INPUT DATA

PIT / NODE DETAILS Version 9

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
Outlet	Node							0		296159.91	6256066.721		27531438	
Outlet 2	Node							0		296036.80	6255447.978		27531447	
Pad 4	Node					42.5		0		295876.78	6255486.365		27531472	
Pad 5	Node					48.25		0		296046.07	6255476.977		27531444	
Pad 9	Node					52		0		296099.58	6255779.683		27531443	
Pad7	Node					56.9		0		296420.68	6256041.559		27531431	
Pad8	Node					54.255		0		296215.82	6256055.637		27531430	

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng	id
B Pad4	48.5	0	0	Orifice		500	46.75			295872.04	6255517.9	No			27531492
	49.6	1583.5													
B Pad5	51.75	0	0	Culvert	0.5					296084.49	6255476.2	No			27535986
	53.1	2683													
B Pad9	54.75	0	0	Culvert	0.5					296154.82	6255804.3	No			27549400
	56.1	1518													
B Pad7	59.6	0	0	Culvert	0.5					296427.13	6255982.6	No			27551492
	60.9	1646													
B Pad 8	56.9	0	0	Culvert	0.5					296216.76	6255982.1	No			27554003
	58.1	841													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Impervious Area	Hydrological Model	
CPad4	B Pad4	7.3100	90.0	1.0	EP RAFTS
C Pad 5	B Pad5	10.3294	90.0	1.0	EP RAFTS
C Pad 9	B Pad9	4.5304	90.0	1.0	EP RAFTS
C Pad 7	B Pad7	5.4846	90.0	1.0	EP RAFTS
CPad 8	B Pad 8	2.8101	90.0	1.0	EP RAFTS

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)
P Pad 4	B Pad4	Pad 4	20	46.500	46.300	1.00	Concrete, r	525	525	0.3	NewFixed	2	B Pad4	0	
P B Pad5	B Pad5	Pad 5	20	49.850	49.650	1.00	Concrete F	750	750	0.3	NewFixed	1	B Pad5	0	

DRAINS INPUT DATA

P BPad9	B Pad9	Pad 9	10	52.900	52.800	1.00	Concrete F	525	525	0.3	NewFixed	1	B Pad9	0
P B Pad7	B Pad7	Pad7	15	57.700	57.550	1.00	Concrete F	525	525	0.3	NewFixed	1	B Pad7	0
P BPad 8	B Pad 8	Pad8	20	54.900	54.700	1.00	Concrete F	300	300	0.3	NewFixed	2	B Pad 8	0

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc etc

CHANNEL DETAILS

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

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storm (m)	SafeDepth Minor Storm (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
F B Pad4	B Pad4	Pad 4	0.2	49.500	2	1.65	Dummy us	0.2	0.05	0.6	1	0	27531497
F B Pad5	B Pad5	Pad 5	0.2	52.450	3	1.65	Dummy us	0.2	0.05	0.6	1	0	27535988
F Pad 5	Pad 5	Outlet 2	0.2				Dummy us	0.2	0.05	0.6	1	0	27531446
F B Pad9	B Pad9	Pad 9	0.2	55.250	3	1.65	Dummy us	0.2	0.05	0.6	1	0	27549403
F Pad9	Pad 9	Pad 5	0.2				Dummy us	0.2	0.05	0.6	1	0	27531445
F B Pad7	B Pad7	Pad7	0.2	60.250	3	1.65	Dummy us	0.2	0.05	0.6	1	0	27551494
F Pad7	Pad7	Pad8	0.2				Dummy us	0.2	0.05	0.6	1	0	27531434
F B Pad8	B Pad 8	Pad8	0.2	57.300	3	1.65	Dummy us	0.2	0.05	0.6	1	0	27554005
F Pad 8	Pad8	Outlet	0.2				Dummy us	0.2	0.05	0.6	1	0	27531439

DEVELOPED WITH BASINS 100 YEAR ARI RESULTS

PIT / NODE DETAILS Version 7

Name	Max HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pad 4	46.68	0				
Pad 5	50.4	0				
Pad 9	53.33	0				
Pad7	58.08	0				
Pad8	55	0				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
CPad4	3.959	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C Pad 5	5.593	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C Pad 9	2.453	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C Pad 7	2.97	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
CPad 8	1.522	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1

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
P Pad 4	0.915	2.7	46.884	46.684	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
P B Pad5	1.861	4.2	50.79	50.4	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
P BPad9	0.878	4.1	53.605	53.325	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
P B Pad7	0.928	4.3	58.544	58.075	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
P BPad 8	0.619	4.4	55.283	55	AR&R 100 year, 25 minutes storm, average 109 mm/h, Zone 1

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
F B Pad4	0.717	0.717	7.665	0.076	0.07	19.18	0.88	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
F B Pad5	0.924	0.924	7.665	0.084	0.08	20.79	0.94	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
F Pad 5	4.14	4.14	7.665	0.156	0.22	35.16	1.38	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1

F B Pad9	0.479	0.479	7.665	0.064	0.05	16.84	0.79	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
F Pad9	1.357	1.357	7.665	0.098	0.1	23.67	1.04	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
F B Pad7	0.606	0.606	7.665	0.07	0.06	18.1	0.84	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
F Pad7	1.534	1.534	7.665	0.104	0.11	24.74	1.07	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1
F B Pad8	0.358	0.358	7.665	0.057	0.04	15.41	0.73	AR&R 100 year, 25 minutes storm, average 109 mm/h, Zone 1
F Pad 8	2.476	2.476	7.665	0.126	0.15	29.24	1.22	AR&R 100 year, 1.5 hours storm, average 53 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
B Pad4	49.86	1959.8	1.632	0.915	0.717
B Pad5	52.78	2040.2	2.785	1.861	0.924
B Pad9	55.46	799.1	1.357	0.878	0.479
B Pad7	60.5	1135.1	1.534	0.928	0.606
B Pad 8	57.47	401.9	0.976	0.619	0.358

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
Outlet	3216.52	3216.52	0	0
Outlet 2	5758.74	5758.74	0	0
B Pad4	2820.26	2834.45	0	-0.5
Pad 4	2834.45	2834.45	0	0
B Pad5	3985.18	4002.48	0	-0.4
Pad 5	5758.73	5758.73	0	0
B Pad9	1747.87	1756.27	0	-0.5
Pad 9	1756.27	1756.27	0	0
B Pad7	2116.01	2127.85	0	-0.6
Pad7	2127.85	2127.85	0	0
B Pad 8	1084.17	1088.67	0	-0.4
Pad8	3216.51	3216.51	0	0

Run Log for Pad Basins run at 08:26:28 on 14/3/2006

DRAINS RESULTS 20 Year ARI

PIT / NODE DETAILS

Version 7

Name	Max HGL	Max Surfac Flow Arrivii (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pad 4	46.66	0.000				
Pad 5	50.40	0.000				
Pad 9	53.33	0.000				
Pad7	58.08	0.000				
Pad8	55.00	0.000				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
CPad4	3.242	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 5	4.581	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 9	2.009	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 7	2.432	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
CPad 8	1.246	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

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
P Pad 4	0.858	2.7	46.865	46.665	AR&R 20 year, 1 hour storm, average 51 mm/h, Zone 1
P B Pad5	1.722	3.9	50.735	50.400	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P BPad9	0.827	3.8	53.574	53.325	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P B Pad7	0.867	4.0	58.485	58.075	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
P BPad 8	0.592	4.2	55.284	55.000	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

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
F B Pad4	0	0	0.256	0	0	0	0	
F B Pad5	0	0	0.256	0	0	0	0	
F Pad 5	2.549	2.549	0.256	0.128	0.16	29.59	1.22	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

DRAINS RESULTS 20 Year ARI

F B Pad9	0	0	0.256	0	0	0	0	
F Pad9	0.827	0.827	0.256	0.080	0.07	20.08	0.91	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F B Pad7	0	0	0.256	0	0	0	0	
F Pad7	0.867	0.867	0.256	0.082	0.08	20.43	0.92	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
F B Pad8	0	0	0.256	0	0	0	0	
F Pad 8	1.456	1.456	0.256	0.102	0.11	24.39	1.05	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
B Pad4	49.48	1417.9	0.858	0.858	0.000
B Pad5	52.44	1366.2	1.722	1.722	0.000
B Pad9	55.23	539.8	0.827	0.827	0.000
B Pad7	60.21	771.4	0.867	0.867	0.000
B Pad 8	57.30	280.6	0.592	0.592	0.000

CONTINUITY CHECK for AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
Outlet	2686.42	2686.42	0.00	0.0
Outlet 2	4803.94	4803.94	0.00	0.0
B Pad4	2346.73	2358.39	0.00	-0.5
Pad 4	2358.39	2358.39	0.00	0.0
B Pad5	3316.04	3338.79	0.00	-0.7
Pad 5	4803.93	4803.93	0.00	0.0
B Pad9	1454.39	1465.17	0.00	-0.7
Pad 9	1465.17	1465.17	0.00	0.0
B Pad7	1760.72	1772.00	0.00	-0.6
Pad7	1772.00	1772.00	0.00	0.0
B Pad 8	902.13	914.43	0.00	-1.4
Pad8	2686.41	2686.41	0.00	0.0

Run Log for Pad Basins.drn run at 13:16:27 on 9/3/2006
The maximum flow exceeded the safe value in the following overflow routes: F Pad7, F Pad 8, F Pad 5, F Pad9

DRAINS RESULTS 10 Year ARI

PIT / NODE DETAILS

Version 7

Name	Max HGL	Max Surfac Flow Arrivii (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pad 4	46.66	0.000				
Pad 5	50.40	0.000				
Pad 9	53.33	0.000				
Pad7	58.08	0.000				
Pad8	55.00	0.000				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
CPad4	3.242	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 5	4.581	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 9	2.009	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C Pad 7	2.432	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
CPad 8	1.246	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

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
P Pad 4	0.858	2.7	46.865	46.665	AR&R 20 year, 1 hour storm, average 51 mm/h, Zone 1
P B Pad5	1.722	3.9	50.735	50.400	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P BPad9	0.827	3.8	53.574	53.325	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P B Pad7	0.867	4.0	58.485	58.075	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
P BPad 8	0.592	4.2	55.284	55.000	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

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
F B Pad4	0	0	0.256	0	0	0	0	
F B Pad5	0	0	0.256	0	0	0	0	
F Pad 5	2.549	2.549	0.256	0.128	0.16	29.59	1.22	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

DRAINS RESULTS 10 Year ARI

F B Pad9	0	0	0.256	0	0	0	0	
F Pad9	0.827	0.827	0.256	0.080	0.07	20.08	0.91	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F B Pad7	0	0	0.256	0	0	0	0	
F Pad7	0.867	0.867	0.256	0.082	0.08	20.43	0.92	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
F B Pad8	0	0	0.256	0	0	0	0	
F Pad 8	1.456	1.456	0.256	0.102	0.11	24.39	1.05	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
B Pad4	49.48	1417.9	0.858	0.858	0.000
B Pad5	52.44	1366.2	1.722	1.722	0.000
B Pad9	55.23	539.8	0.827	0.827	0.000
B Pad7	60.21	771.4	0.867	0.867	0.000
B Pad 8	57.30	280.6	0.592	0.592	0.000

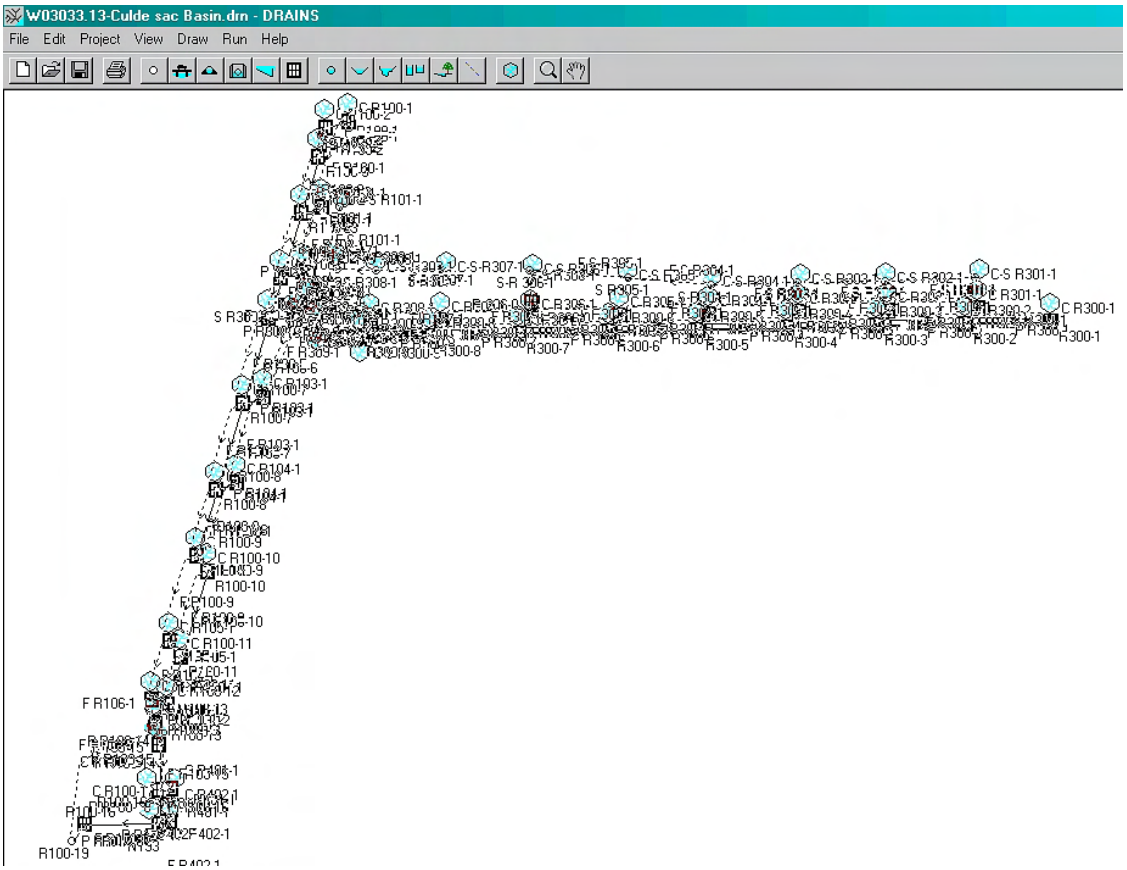
CONTINUITY CHECK for AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
Outlet	2686.42	2686.42	0.00	0.0
Outlet 2	4803.94	4803.94	0.00	0.0
B Pad4	2346.73	2358.39	0.00	-0.5
Pad 4	2358.39	2358.39	0.00	0.0
B Pad5	3316.04	3338.79	0.00	-0.7
Pad 5	4803.93	4803.93	0.00	0.0
B Pad9	1454.39	1465.17	0.00	-0.7
Pad 9	1465.17	1465.17	0.00	0.0
B Pad7	1760.72	1772.00	0.00	-0.6
Pad7	1772.00	1772.00	0.00	0.0
B Pad 8	902.13	914.43	0.00	-1.4
Pad8	2686.41	2686.41	0.00	0.0

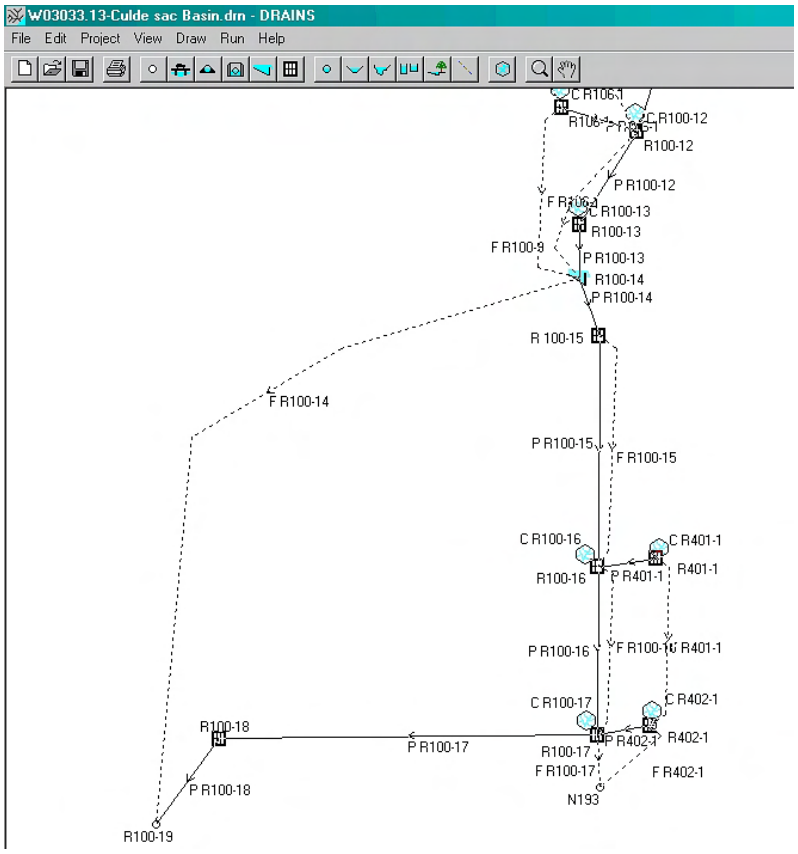
APPENDIX E

Flows Results Public Roads

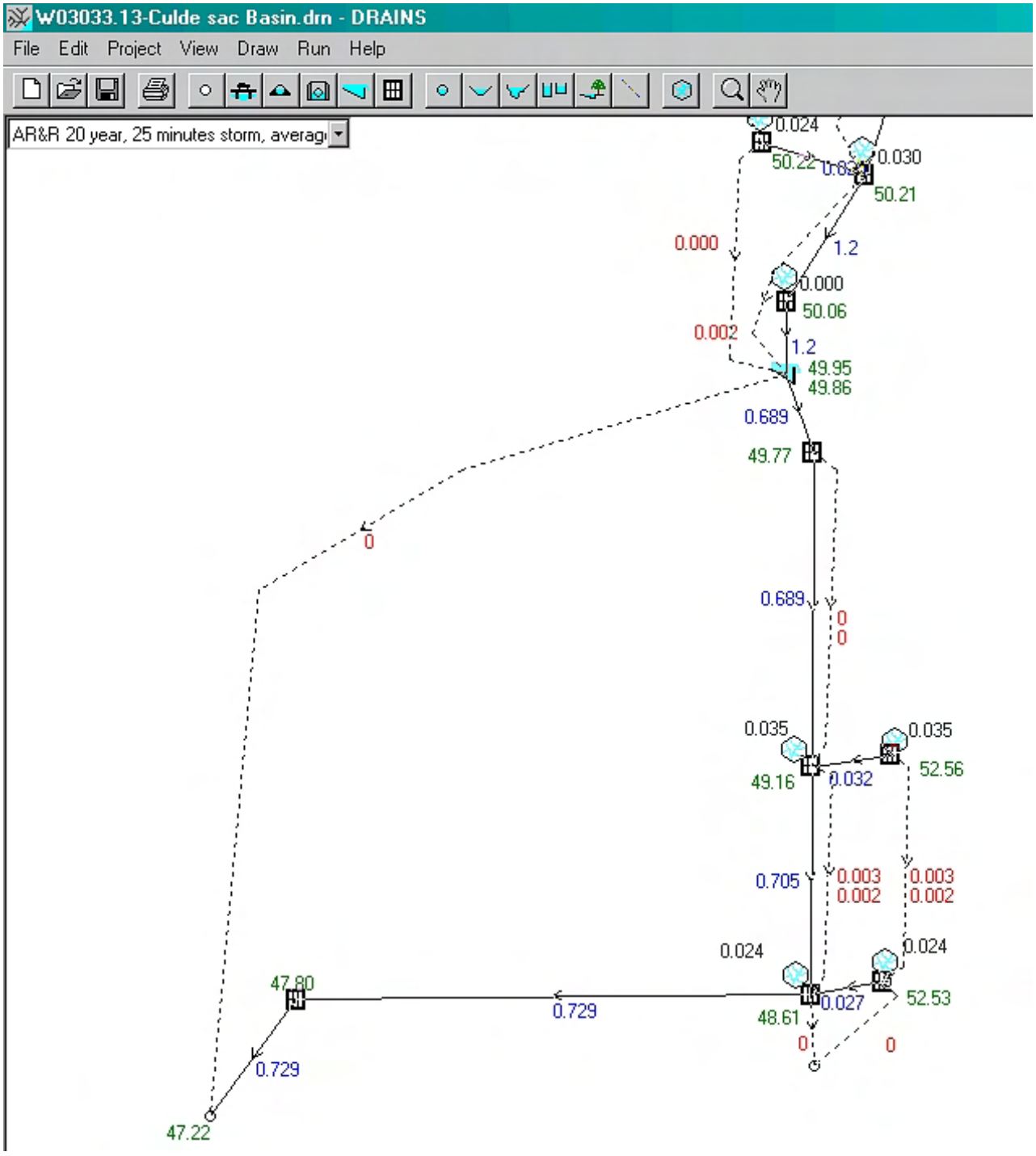
ROADS 1 & 3 OVERALL *DRAINS* MODEL



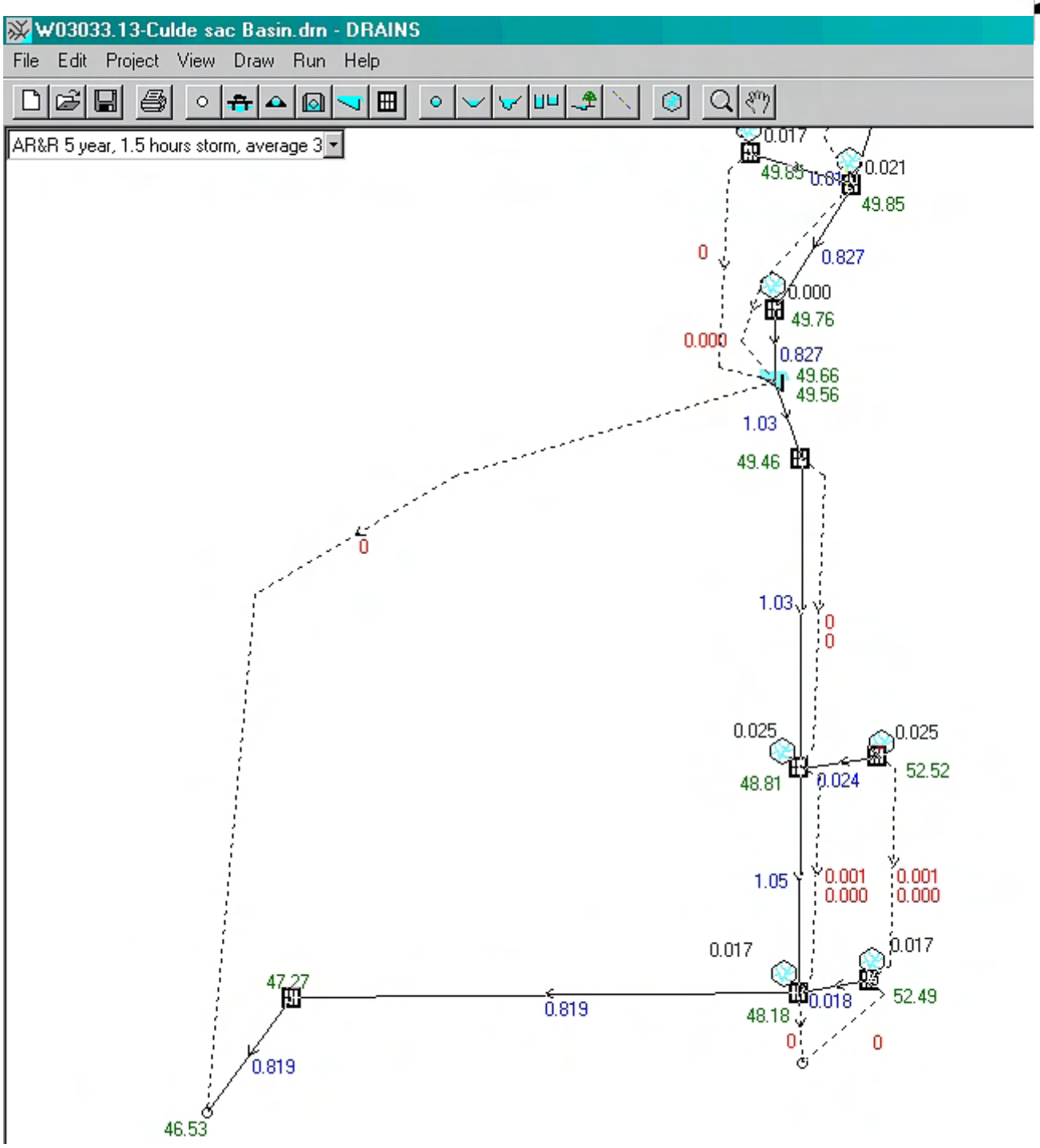
ROADS 1 & 3 BASIN DETAIL *DRAINS* MODEL



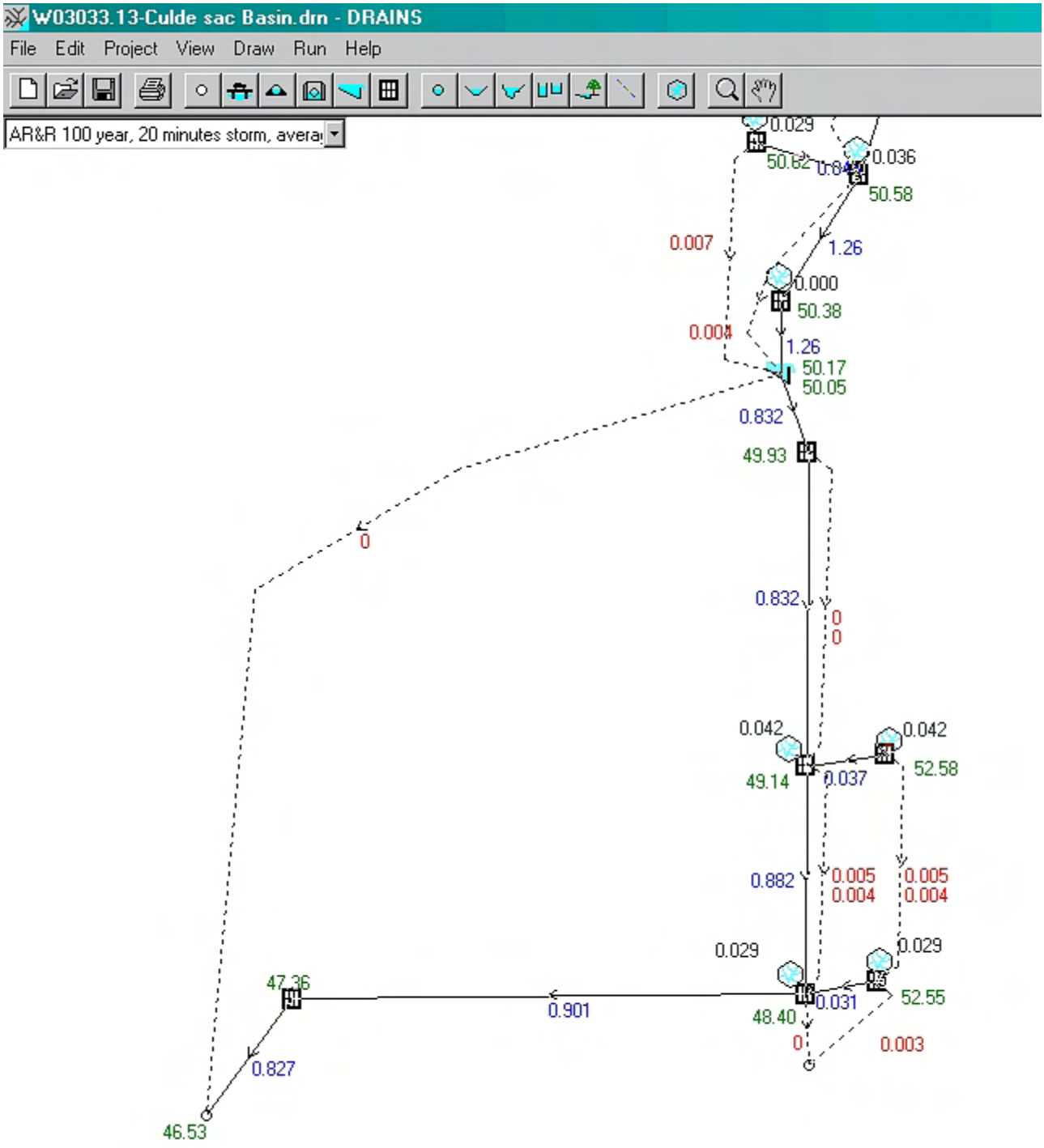
20 YEAR ARI RESULTS



5 YEAR ARI RESULTS



100 YEAR ARI RESULTS



DRAINS DATA

PIT / NODE DETAILS Version 9

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
R100-1	OnGrade	Hornsby C	2.4 m lintel		4.0	54.412		0	0.2	296093.51	6256051.2	No	1	0.3 x Ku
R100-2	OnGrade	Hornsby C	2.4 m lintel		3.5	54.324		0	0.2	296074.56	6256046.6	No	2	0.3 x Ku
R100-3	OnGrade	Hornsby C	2.4 m lintel		1.6	54.213		0	0	296068.35	6256022.1	No	2096964	0.3 x Ku
R100-4	OnGrade	Hornsby C	2.4 m lintel		1.5	53.820		0	0.2	296053.75	6255974.5	No	4	0.3 x Ku
R100-5	OnGrade	Hornsby C	2.4 m lintel		1.0	53.370		0	0.2	296037.02	6255920.0	No	6	0.3 x Ku
R100-6	OnGrade	Hornsby C	2.4 m lintel		1.4	53.093		0	0.2	296026.75	6255886.6	No	26	0.3 x Ku
R100-7	OnGrade	Hornsby C	2.4 m lintel		0.6	52.501		0	0.2	296004.74	6255814.9	No	27	0.3 x Ku
R100-8	OnGrade	Hornsby C	2.4 m lintel		0.6	51.908		0	0	295982.73	6255743.2	No	2096965	0.3 x Ku
R100-9	OnGrade	Hornsby C	2.4 m lintel		0.6	51.601		0	0	295965.71	6255687.7	No	2096971	0.3 x Ku
R100-10	OnGrade	Hornsby C	2.4 m lintel		0.6	51.626		0	0.2	295975.20	6255674.4	No	30	0.3 x Ku
R100-11	OnGrade	Hornsby C	2.4 m lintel		0.3	51.251		0	0	295953.19	6255602.7	No	2096972	0.3 x Ku
R100-12	OnGrade	Hornsby C	2.4 m lintel		0.7	51.045		0	0.2	295941.08	6255563.2	No	32	0.3 x Ku
R100-17	Node					49.964		0		295949.02	6255551.817		63	
R103-1	OnGrade	Hornsby C	2.4 m lintel		4.0	52.580		0	0	296022.49	6255819.9	No	2096968	0.3 x Ku
R300-1	OnGrade	Hornsby C	2.4 m lintel		4.0	60.864		0	0.2	296682.85	6255883.4	No	7	0.3 x Ku
R300-2	OnGrade	Hornsby C	2.4 m lintel		2.0	60.509		0	0.2	296611.88	6255881.8	No	9	0.3 x Ku
R300-3	OnGrade	Hornsby C	2.4 m lintel		1.5	60.134		0	0.2	296536.90	6255880.2	No	11	0.3 x Ku
R300-4	OnGrade	Hornsby C	2.4 m lintel		1.3	59.759		0	0.2	296461.92	6255878.5	No	13	0.3 x Ku
R300-5	OnGrade	Hornsby C	2.4 m lintel		1.1	59.384		0	0.2	296386.93	6255876.9	No	15	0.3 x Ku
R300-6	OnGrade	Hornsby C	2.4 m lintel		1.0	59.009		0	0.2	296311.95	6255875.2	No	17	0.3 x Ku
R300-7	OnGrade	Hornsby C	2.4 m lintel		0.9	58.333		0	0.2	296236.97	6255873.6	No	19	0.3 x Ku
R300-8	OnGrade	Hornsby C	2.4 m lintel		0.9	56.184		0	0.2	296161.98	6255872.0	No	21	0.3 x Ku
R300-9	OnGrade	Hornsby C	2.4 m lintel		0.3	54.378		0	0.2	296101.79	6255870.6	No	23	0.3 x Ku
R300-10	OnGrade	Hornsby C	2.4 m lintel		0.1	53.5		0	0.2	296064.99	6255879.9	No	2096967	0.3 x Ku
R300-11	OnGrade	Sutherland	Grated pit with Durhan		0.4	53.218		0	0.2	296048.29	6255885.0	Yes	25	0.3 x Ku
R301-1	OnGrade	Hornsby C	2.4 m lintel		4.0	60.559		0	0.2	296621.59	6255895.0	No	8	0.3 x Ku
S-R 306-1	Node							0		296245.18	6255926.352		2637612	
S R302-1	Node							0		296543.78	6255917.303		2637616	
S R301-1	Node							0		296619.19	6255920.320		2637617	
S R101-1	Node							0		296085.79	6255979.930		2908352	
R309-0	Sag	Sutherland	Grated pit \	9	4.0	53.662	0.3	0	0	296068.48	6255909.5	No	20363656	1 x Ku
R309-1	Sag	Hornsby C	2.4 m lintel	5	0.7	53.151	0.15	0	0.5	296059.35	6255898.0	No	24	0.3 x Ku
R305-0	Sag	Sutherland	Grated pit \	3	4.0	59.308	0.15	0	0.2	296322.47	6255901.5	No	27296212	1 x Ku
R305-1	OnGrade	Hornsby C	2.4 m lintel		1.5	59.059		0	0.2	296321.66	6255888.5	No	16	0.3 x Ku
R310-1	OnGrade	Sutherland	Grated pit with Durhan		4.0	53.693		0	0.2	296064.86	6255870.2	No	27296215	1 x Ku
S R 300-9	Node							0		296102.02	6255859.588		27296220	
S-R307-1	Node							0		296170.53	6255927.860		2637611	
S-R308-1	Node							0		296116.24	6255926.352		2637610	
S R303-1	Node							0		296469.89	6255916.549		2637615	
S-R304-1	Node							0		296397.50	6255914.287		2637614	
S R305-1	Node							0		296327.37	6255921.074		2637613	
N71	Node							0		296075.61	6255935.930		2908353	
N68	Node							0		296083.94	6255927.923		2637642	
S R 310-1	Node							0		296065.16	6255865.151		27296221	

DRAINS DATA

R302-1	OnGrade	Hornsby C	2.4 m lintel	4.0	60.184	0	0.2	296546.61	6255893.4	No	10	0.3 x Ku	
R303-1	OnGrade	Hornsby C	2.4 m lintel	4.0	59.809	0	0.2	296471.63	6255891.7	No	12	0.3 x Ku	
R304-1	OnGrade	Hornsby C	2.4 m lintel	4.0	59.434	0	0.2	296396.65	6255890.1	No	14	0.3 x Ku	
R306-1	OnGrade	Hornsby C	2.4 m lintel	4.0	58.521	0	0.2	296246.68	6255886.8	No	18	0.3 x Ku	
R307-1	OnGrade	Hornsby C	2.4 m lintel	4.0	56.484	0	0.2	296171.69	6255885.2	No	20	0.3 x Ku	
R308-1	OnGrade	Hornsby C	2.4 m lintel	4.0	54.684	0	0.2	296111.71	6255883.9	No	22	0.3 x Ku	
R104-1	OnGrade	Hornsby C	2.4 m lintel	4.0	52.019	0	0.2	295999.47	6255748.5	No	29	0.3 x Ku	
R101-1	OnGrade	Hornsby C	2.4 m lintel	4.0	53.899	0	0.2	296071.50	6255979.5	No	3	0.3 x Ku	
R102-1	OnGrade	Hornsby C	2.4 m lintel	1.0	53.454	0	0.2	296054.96	6255925.6	No	5	0.3 x Ku	
R105-1	OnGrade	Hornsby C	2.4 m lintel	4.0	51.226	0	0.2	295943.69	6255616.0	No	31	0.3 x Ku	
R106-1	OnGrade	Hornsby C	2.4 m lintel	4.0	50.970	0	0	295928.64	6255567.0	No	2096975	0.3 x Ku	

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng	id
Basin11	48.85	0	0	None						295944.27	6255559.6	No			25564643
	49.6	365													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough
C R100-1	R100-1	0.1177	85.0	15.0	0.0	5	7	0								
C R100-2	R100-2	0.1224	85.0	15.0	0.0	5	7	0								
C R100-3	R100-3	0.0306	85.0	15.0	0.0	5	10	0								
C R100-4	R100-4	0.0572	85.0	15.0	0.0	5	7	0								
C R100-5	R100-5	0.0642	85.0	15.0	0.0	5	7	0								
C R100-6	R100-6	0.0394	85.0	15.0	0.0	5	7	0								
C R100-7	R100-7	0.0844	85.0	15.0	0.0	5	7	0								
C R100-8	R100-8	0.0001	85.0	15.0	0.0	5	10	0								
C R100-9	R100-9	0.0001	85.0	15.0	0.0	5	10	0								
C R100-10	R100-10	0.0838	85.0	15.0	0.0	5	7	0								
C R100-11	R100-11	0.0656	85.0	15.0	0.0	5	10	0								
C R100-12	R100-12	0.0695	85.0	15.0	0.0	5	7	0								
C R103-1	R103-1	0.1157	85.0	15.0	0.0	5	10	0								
C R300-1	R300-1	0.0149	85.0	15.0	0.0	5	7	0								
C R300-2	R300-2	0.0723	85.0	15.0	0.0	5	7	0								
C R300-3	R300-3	0.0753	85.0	15.0	0.0	5	7	0								
C R300-4	R300-4	0.0750	85.0	15.0	0.0	5	7	0								
C R300-5	R300-5	0.0750	85.0	15.0	0.0	5	7	0								
C R300-6	R300-6	0.0753	85.0	15.0	0.0	5	7	0								
C R300-7	R300-7	0.0740	85.0	15.0	0.0	5	7	0								
C R300-8	R300-8	0.0740	85.0	15.0	0.0	5	7	0								
C R300-9	R300-9	0.0601	85.0	15.0	0.0	5	7	0								
C R300-10	R300-10	0.0001	85.0	15.0	0.0	5	10	0								
C R300-11	R300-11	0.0001	85.0	15.0	0.0	5	7	0								
C R301-1	R301-1	0.1435	85.0	15.0	0.0	5	7	0								
C-S-R306-	S-R 306-1	0.0461	0.0	100.0	0.0	5	7	0								
C-S R302-1	S R302-1	0.0284	0.0	100.0	0.0	5	7	0								

DRAINS DATA

C-S R301-:	S R301-1	0.0129	0.0	100.0	0.0	5	7	0
C-S R101-:	S R101-1	0.1142	0.0	100.0	0.0	5	7	0
C R309-1	R309-1	0.1241	85.0	15.0	0.0	5	7	0
C R305-1	R305-1	0.0825	85.0	15.0	0.0	5	7	0
C S R300-9	S R 300-9	0.0298	0.0	100.0	0.0	5	7	0
C-S-R307-	S-R307-1	0.0242	0.0	100.0	0.0	5	7	0
C-S-R308-	S-R308-1	0.0811	0.0	100.0	0.0	5	7	0
C-S R303-:	S R303-1	0.0376	0.0	100.0	0.0	5	7	0
C-S R304-:	S-R304-1	0.0468	0.0	100.0	0.0	5	7	0
C-S R305-:	S R305-1	0.0580	0.0	100.0	0.0	5	7	0
Cat71	N71	0.1257	0.0	100.0	0.0	5	7	0
C-S-R309-	N68	0.0748	0.0	100.0	0.0	5	7	0
C R 310-1	S R 310-1	0.0402	0.0	100.0	0.0	5	7	0
C R302-1	R302-1	0.0825	85.0	15.0	0.0	5	7	0
C R303-1	R303-1	0.0825	85.0	15.0	0.0	5	7	0
C R304-1	R304-1	0.0825	85.0	15.0	0.0	5	7	0
C R306-1	R306-1	0.0818	85.0	15.0	0.0	5	7	0
C R307-1	R307-1	0.0815	85.0	15.0	0.0	5	7	0
C R308-1	R308-1	0.0659	85.0	15.0	0.0	5	7	0
C R104-1	R104-1	0.0844	85.0	15.0	0.0	5	7	0
C R101-1	R101-1	0.0912	85.0	15.0	0.0	5	7	0
C R102-1	R102-1	0.0685	85.0	15.0	0.0	5	7	0
C R105-1	R105-1	0.0653	85.0	15.0	0.0	5	7	0
C R106-1	R106-1	0.0580	85.0	15.0	0.0	5	10	0

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)
P R100-1	R100-1	R100-2	19.511	53.060	52.880	0.92	Concrete P	375	375	0.3	Existing	1	R100-1	0	0
P R100-2	R100-2	R100-3	25.272	52.840	52.675	0.65	Concrete P	375	375	0.3	Existing	1	R100-2	0	0
P R100-3	R100-3	R100-4	49.759	52.670	52.330	0.68	Concrete P	375	375	0.3	New	1	R100-3	0	49.759
P R100-4	R100-4	R100-5	57	52.250	51.850	0.70	Concrete P	375	375	0.3	Existing	1	R100-4	0	57
P R100-5	R100-5	R100-6	35	51.820	51.550	0.77	Concrete P	450	450	0.3	Existing	1	R100-5	0	0
P R100-6	R100-6	R100-7	75	51.150	50.790	0.48	Concrete P	750	750	0.3	Existing	1	R100-6	0	75
P R100-7	R100-7	R100-8	75	50.720	50.270	0.60	Concrete P	750	750	0.3	Existing	1	R100-7	0	75
P R100-8	R100-8	R100-9	58	50.200	49.920	0.48	Concrete P	750	750	0.3	New	1	R100-8	0	8
P R100-9	R100-9	R100-10	16.401	49.950	49.850	0.61	Concrete P	750	750	0.3	New	1	R100-9	0	0
P R100-10	R100-10	R100-11	75	49.810	49.255	0.74	Concrete P	825	825	0.3	Existing	1	R100-10	0	75
P R100-11	R100-11	R100-12	41.256	49.250	48.880	0.90	Concrete P	825	825	0.3	NewFixed	1	R100-11	0	0
Pipe78	R100-12	Basin11	5	48.880	48.830	1.00	Concrete P	825	825	0.3	NewFixed	1	R100-12	0	
P R103-1	R103-1	R100-7	18.446	51.170	51.010	0.87	Concrete P	375	375	0.3	New	1	R103-1	0	0
P R300-1	R300-1	R300-2	70.991	59.481	58.731	1.06	Concrete P	375	375	0.3	Existing	1	R300-1	0	70.991
P R300-2	R300-2	R300-3	75	58.701	57.951	1.00	Concrete P	375	375	0.3	Existing	1	R300-2	0	75
P R300-3	R300-3	R300-4	75	57.921	57.171	1.00	Concrete P	375	375	0.3	Existing	1	R300-3	0	75
P R300-4	R300-4	R300-5	75	57.096	56.346	1.00	Concrete P	450	450	0.3	Existing	1	R300-4	0	75
P R300-5	R300-5	R300-6	75	56.316	55.566	1.00	Concrete P	450	450	0.3	Existing	1	R300-5	0	75
P R300-6	R300-6	R300-7	75	55.536	54.786	1.00	Concrete P	450	450	0.3	Existing	1	R300-6	0	42.009
P R300-7	R300-7	R300-8	75.009	54.756	54.006	1.00	Concrete P	450	450	0.3	Existing	1	R300-7	0	9.009

DRAINS DATA

P	R300-8	R300-8	R300-9	60.205	53.976	52.594	2.30	Concrete	P	450	450	0.3	Existing	1	R300-8	0	60.205
P	R300-9	R300-9	R300-10	30.8	52.519	51.826	2.25	Concrete	P	600	600	0.3	Existing	1	R300-9	0	2.202
P	R300-10	R300-10	R300-11	24.698	51.738	51.491	1.00	Concrete	P	600	600	0.3	New	1	R300-10	0	0
P	R300-11	R300-11	R100-6	21.6	51.461	51.245	1.00	Concrete	P	675	675	0.3	Existing	1	R300-11	0	0
P	R301-1	R301-1	R300-2	16.401	59.156	58.992	1.00	Concrete	P	375	375	0.3	Existing	1	R301-1	0	0
P	R309-0	R309-0	R309-1	5	51.738	51.688	1.00	Concrete	P	450	450	0.3	NewFixed	1	R309-0	0	
P	R309-1	R309-1	R300-11	17.028	51.688	51.517	1.00	Concrete	P	450	450	0.3	Existing	1	R309-1	0	0
P	R305-0	R305-0	R305-1	8.133	57.767	57.686	1.00	Concrete,	r	375	375	0.3	New	1	R305-0	0	
P	R305-1	R305-1	R300-6	16.401	57.656	57.492	1.00	Concrete	P	375	375	0.3	Existing	1	R305-1	0	0
P	R310-1	R310-1	R300-10	4.5	52.280	52.100	4.00	Concrete	P	375	375	0.3	New	1	R310-1	0	
P	R302-1	R302-1	R300-3	16.401	58.781	58.617	1.00	Concrete	P	375	375	0.3	Existing	1	R302-1	0	0
P	R303-1	R303-1	R300-4	16.401	58.406	58.242	1.00	Concrete	P	375	375	0.3	Existing	1	R303-1	0	0
P	R304-1	R304-1	R300-5	16.401	58.031	57.867	1.00	Concrete	P	375	375	0.3	Existing	1	R304-1	0	0
P	R306-1	R306-1	R300-7	16.401	57.118	56.954	1.00	Concrete	P	375	375	0.3	Existing	1	R306-1	0	0
P	R307-1	R307-1	R300-8	16.401	54.950	54.786	1.00	Concrete	P	375	375	0.3	Existing	1	R307-1	0	0
P	R308-1	R308-1	R300-9	16.527	52.921	52.757	0.99	Concrete	P	375	375	0.3	Existing	1	R308-1	0	0
P	R104-1	R104-1	R100-8	17.569	50.720	50.550	0.97	Concrete	P	375	375	0.3	Existing	1	R104-1	0	0
P	R101-1	R101-1	R100-4	18.446	52.470	52.260	1.14	Concrete	P	375	375	0.3	Existing	1	R101-1	0	0
P	R102-1	R102-1	R100-5	18.793	52.040	51.850	1.01	Concrete	P	375	375	0.3	Existing	1	R102-1	0	0
P	R105-1	R105-1	R100-11	16.401	49.880	49.790	0.55	Concrete	P	375	375	0.3	Existing	1	R105-1	0	0
P	R106-1	R106-1	R100-12	13	49.610	49.400	1.62	Concrete	P	375	375	0.3	New	1	R106-1	0	0

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc	etc

CHANNEL DETAILS

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

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storm (m)	SafeDepth Minor Storm (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
F	R100-3	R100-4	1				8m wide ro	0.14	0.14	0.6	0.790	0	2097080
F	R100-12	R100-12	Basin11	1				8m wide ro	0.14	0.14	0.6	0.000	100	2097114
OF	123	Basin11	R100-17	0.2	49.600	10	1.65	Dummy1	0.3	0.3	0.6	1	0	23420317
F	R300-10	R300-10	R103-1	1				8m wide ro	0.14	0.14	0.6	1.0	0	2097102
F-S	R301-1	S R301-1	S R302-1	75				swale	0.1	0.1	0.6	0.5	100	2637618
F	R309-1	R309-1	R103-1	1				8m wide ro	0.14	0.14	0.6	0.000	50	2097103
F-S	R305-1	S R305-1	R305-0	0.2				swale	0.1	0.1	0.6	0.5	0	2637622
OF	79	N68	R309-0	0.2				Dummy1	0.3	0.3	0.6	1	0	2637645
C	R310-1	S R 310-1	R310-1	0.2				Dummy1	0.3	0.3	0.4	1	0	27296223
F	R102-1	R102-1	R309-1	1				8m wide ro	0.14	0.14	0.6	1.050	0	2097083

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storm (m)	SafeDepth Minor Storm (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id

DRAINS DATA

F R100-1	R100-1	R101-1	75	8m wide ro	0.14	0.14	0.6	0.790	100	2097078
F R100-2	R100-2	R100-3	25.3	8m wide ro	0.14	0.14	0.6	0.8	100	2097079
F R100-4	R100-4	R100-5	57	8m wide ro	0.14	0.14	0.6	0.790	100	2097082
F R100-5	R100-5	R100-6	35	8m wide ro	0.14	0.14	0.6	0.790	100	2097084
F R100-6	R100-6	R100-7	75	8m wide ro	0.14	0.14	0.6	00.5	100	2097104
F R100-7	R100-7	R100-8	75	8m wide ro	0.14	0.14	0.6	0.5	100	2097106
F R100-8	R100-8	R100-9	58	8m wide ro	0.14	0.14	0.6	0.5	100	2097108
F R100-9	R100-9	R105-1	75	8m wide ro	0.14	0.14	0.6	0.500	0	2097109
F R100-10	R100-10	R100-11	75	8m wide ro	0.14	0.14	0.6	0.5	100	2097110
F R100-11	R100-11	R100-12	41.256	8m wide ro	0.14	0.14	0.6	0.500	0	2097112
F R103-1	R103-1	R104-1	75	8m wide ro	0.14	0.14	0.6	0.790	100	2097105
F R300-1	R300-1	R300-2	70.991	8m wide ro	0.14	0.14	0.6	0.500	100	2097085
F R300-2	R300-2	R300-3	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097087
F R300-3	R300-3	R300-4	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097089
F R300-4	R300-4	R300-5	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097091
F R300-5	R300-5	R300-6	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097093
F R300-6	R300-6	R300-7	75	8m wide ro	0.14	0.14	0.6	2.021	100	2097095
F R300-7	R300-7	R300-8	75	8m wide ro	0.14	0.14	0.6	3.000	100	2097097
F R300-8	R300-8	R300-9	60.205	8m wide ro	0.14	0.14	0.6	3.000	100	2097099
F R300-9	R300-9	R300-10	30.8	6.5m Road	0.115	0.115	0.4	1	0	30963324
F R301-1	R301-1	R302-1	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097086
F-S R306-1	S-R 306-1	S-R307-1	75	swale	0.1	0.1	0.6	0.5	0	2637623
F-S R302-1	S R302-1	S R303-1	75	swale	0.1	0.1	0.6	0.5	0	2637619
F-S R101-1	S R101-1	N71	60	swale	0.1	0.1	0.6	1	0	2908354
F R305-1	R305-1	R306-1	75	8m wide ro	0.14	0.14	0.6	1.604	100	2097094
F S R300-9	S R 300-9	S R 310-1	30.8	swale	0.1	0.1	0.6	1	0	27296222
F-S-R307-1	S-R307-1	S-R308-1	75	swale	0.1	0.1	0.6	0.5	0	2637624
F-S R308-1	S-R308-1	N68	43	swale	0.1	0.1	0.6	0.5	0	2637643
F-S R303-1	S R303-1	S-R304-1	75	swale	0.1	0.1	0.6	0.5	0	2637620
F-S R304-1	S-R304-1	S R305-1	75	swale	0.1	0.1	0.6	0.5	0	2637621
OF83	N71	N68	22	swale	0.1	0.1	0.6	0.5	0	2908355
F R302-1	R302-1	R303-1	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097088
F R303-1	R303-1	R304-1	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097090
F R304-1	R304-1	R305-1	75	8m wide ro	0.14	0.14	0.6	0.500	100	2097092
F R306-1	R306-1	R307-1	75	8m wide ro	0.14	0.14	0.6	3.000	100	2097096
F R307-1	R307-1	R308-1	60.205	8m wide ro	0.14	0.14	0.6	3.000	100	2097098
F R308-1	R308-1	R309-1	55.5	8m wide ro	0.14	0.14	0.6	1.050	100	2097100
F R104-1	R104-1	R100-10	58	8m wide ro	0.14	0.14	0.6	0.500	100	2097107
F R101-1	R101-1	R102-1	57	8m wide ro	0.14	0.14	0.6	0.790	100	2097081
F R105-1	R105-1	R106-1	41.256	8m wide ro	0.14	0.14	0.6	0.5	100	2097111

DRAINS 20Y ARI RESULTS

PIT / NODE DETAILS Version 7

Name	Max HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
R100-1	54.22	0.025	0.0	0.19	0.007	Inlet Capacity
R100-2	54.18	0.026	0.0	0.14	0.008	Inlet Capacity
R100-3	54.03	0.008	0.0	0.18	0.000	None
R100-4	53.82	0.012	0.0	0.00	0.001	Outlet System
R100-5	53.27	0.014	0.0	0.10	0.002	Inlet Capacity
R100-6	53.01	0.008	0.0	0.09	0.000	None
R100-7	52.23	0.018	0.0	0.27	0.004	Inlet Capacity
R100-8	51.57	0.000	0.0	0.34	0.000	None
R100-9	50.98	0.000	0.0	0.62	0.000	None
R100-10	50.68	0.018	0.0	0.95	0.005	Inlet Capacity
R100-11	50.25	0.014	0.0	1.00	0.001	Inlet Capacity
R100-12	49.97	0.015	0.0	1.08	0.002	Inlet Capacity
R103-1	52.26	0.025	0.0	0.32	0.006	Inlet Capacity
R300-1	60.14	0.003	0.0	0.72	0.000	None
R300-2	60.14	0.015	0.0	0.37	0.002	Inlet Capacity
R300-3	59.95	0.016	0.0	0.18	0.003	Inlet Capacity
R300-4	59.40	0.016	0.0	0.35	0.003	Inlet Capacity
R300-5	58.97	0.016	0.0	0.42	0.003	Inlet Capacity
R300-6	58.27	0.016	0.0	0.74	0.003	Inlet Capacity
R300-7	57.04	0.016	0.0	1.29	0.003	Inlet Capacity
R300-8	55.42	0.016	0.0	0.77	0.003	Inlet Capacity
R300-9	53.64	0.013	0.0	0.74	0.000	None
R300-10	53.40	0.000	0.0	0.10	0.000	None
R300-11	53.21	0.000	0.0	0.00		None
R301-1	60.19	0.031	0.0	0.37	0.010	Inlet Capacity
R309-0	53.41	0.080	2.3	0.26		Inlet Capacity
R309-1	53.28	0.027	2.5	-0.13	0.000	Outlet System
R305-0	58.34	0.027	0.2	0.97		Inlet Capacity
R305-1	58.32	0.018	0.0	0.74	0.005	Inlet Capacity
R310-1	53.41	0.013	0.0	0.29		None
R302-1	59.98	0.019	0.0	0.20	0.006	Inlet Capacity
R303-1	59.43	0.018	0.0	0.38	0.005	Inlet Capacity
R304-1	58.99	0.018	0.0	0.44	0.005	Inlet Capacity
R306-1	57.31	0.017	0.0	1.21	0.004	Inlet Capacity
R307-1	55.44	0.017	0.0	1.04	0.004	Inlet Capacity
R308-1	53.66	0.014	0.0	1.02	0.002	Inlet Capacity
R104-1	51.60	0.018	0.0	0.42	0.005	Inlet Capacity

R101-1	53.85	0.020	0.0	0.05	0.006	Inlet Capacity
R102-1	53.28	0.015	0.0	0.18	0.003	Inlet Capacity
R105-1	50.25	0.014	0.0	0.97	0.001	Inlet Capacity
R106-1	49.97	0.012	0.0	1.00		None

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
C R100-1	0.050	0.044	0.006	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-2	0.052	0.046	0.006	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-3	0.013	0.012	0.001	5.00	10.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-4	0.025	0.022	0.003	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-5	0.028	0.024	0.003	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-6	0.017	0.015	0.002	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-7	0.036	0.032	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-8	0.000	0.000	0.000	5.00	10.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-9	0.000	0.000	0.000	5.00	10.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-10	0.036	0.032	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-11	0.028	0.025	0.003	5.00	10.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R100-12	0.030	0.026	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R103-1	0.049	0.044	0.005	5.00	10.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-1	0.006	0.006	0.001	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-2	0.031	0.027	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-3	0.032	0.028	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-4	0.032	0.028	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-5	0.032	0.028	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-6	0.032	0.028	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-7	0.032	0.028	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-8	0.032	0.028	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-9	0.026	0.023	0.003	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-10	0.000	0.000	0.000	5.00	10.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R300-11	0.000	0.000	0.000	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R301-1	0.061	0.054	0.007	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S-R306-	0.016	0.000	0.016	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S R302-1	0.010	0.000	0.010	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S R301-1	0.004	0.000	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S R101-1	0.039	0.000	0.039	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R309-1	0.053	0.047	0.006	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R305-1	0.035	0.031	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C S R300-9	0.010	0.000	0.010	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

C-S-R307-	0.008	0.000	0.008	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S-R308-	0.027	0.000	0.027	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S R303-1	0.013	0.000	0.013	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S R304-1	0.016	0.000	0.016	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S R305-1	0.020	0.000	0.020	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
Cat71	0.043	0.000	0.043	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C-S-R309-	0.025	0.000	0.025	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R 310-1	0.014	0.000	0.014	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R302-1	0.035	0.031	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R303-1	0.035	0.031	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R304-1	0.035	0.031	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R306-1	0.035	0.031	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R307-1	0.035	0.031	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R308-1	0.028	0.025	0.003	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R104-1	0.036	0.032	0.004	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R101-1	0.039	0.034	0.005	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R102-1	0.029	0.026	0.003	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R105-1	0.028	0.025	0.003	5.00	7.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R106-1	0.024	0.022	0.002	5.00	10.00	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

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
P R100-1	0.043	0.4	54.193	54.185	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-2	0.088	0.8	54.075	54.034	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-3	0.112	1.0	53.952	53.820	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-4	0.176	1.6	53.632	53.266	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-5	0.236	1.5	53.158	53.007	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-6	1.027	2.3	52.646	52.229	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-7	1.102	2.5	52.051	51.570	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-8	1.141	2.6	51.380	50.982	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-9	1.141	2.6	50.791	50.678	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-10	1.176	2.2	50.592	50.247	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R100-11	1.231	2.3	50.166	49.967	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
Pipe78	1.284	2.4	49.790	49.768	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R103-1	0.043	0.4	52.236	52.229	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-1	0.006	0.1	60.138	60.138	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-2	0.086	0.8	60.075	59.952	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-3	0.156	1.4	59.799	59.405	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-4	0.223	1.4	59.274	58.966	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

P R300-5	0.288	1.8	58.782	58.270	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-6	0.388	2.4	57.966	57.044	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-7	0.454	2.9	56.669	55.417	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-8	0.521	3.3	54.936	53.642	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-9	0.580	2.1	53.580	53.396	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-10	0.605	2.1	53.373	53.213	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R300-11	0.772	2.2	53.125	53.007	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R301-1	0.051	0.5	60.147	60.138	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R309-0	0.130	0.8	53.290	53.284	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R309-1	0.186	1.2	53.249	53.213	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R305-0	0.040	0.4	58.320	58.317	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
P R305-1	0.069	0.6	58.288	58.270	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R310-1	0.023	0.2	53.396	53.396	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R302-1	0.039	0.4	59.958	59.952	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R303-1	0.035	0.3	59.409	59.405	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R304-1	0.034	0.3	58.971	58.966	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R306-1	0.035	1.5	57.216	57.052	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R307-1	0.035	0.3	55.421	55.417	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R308-1	0.031	0.3	53.646	53.642	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R104-1	0.036	0.3	51.576	51.570	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R101-1	0.040	0.4	53.827	53.820	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R102-1	0.032	0.3	53.271	53.266	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R105-1	0.026	0.2	50.250	50.247	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
P R106-1	0.026	0.2	49.969	49.967	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

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
F R100-1	0.007	0.045	0.221	0.086	0.06	1.82	0.74	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R100-2	0.008	0.020	0.222	0.067	0.04	1.25	0.64	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R100-3	0	0	0.221	0	0	0	0	
F R100-4	0.001	0.028	0.221	0.073	0.05	1.45	0.69	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R100-5	0.002	0.018	0.221	0.065	0.04	1.19	0.61	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R100-6	0.000	0.036	0.175	0.086	0.05	1.82	0.59	AR&R 20 year, 15 minutes storm, average 106 mm/h, Zone 1
F R100-7	0.004	0.002	0.175	0.043	0.02	0.53	0.37	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R100-8	0	0	0.175	0	0	0	0	
F R100-9	0	0	0.175	0	0	0	0	
F R100-10	0.005	0.030	0.175	0.081	0.05	1.68	0.58	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

DRAINS 20Y ARI RESULTS

F R100-11	0.001	0.000	0.175	0.028	0.01	0.32	0.28	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R100-12	0.002	0.002	0.000	0.490	0.00	12.90	0.00	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
OF123	1.137	1.137	4.474	0.105	0.15	7.41	1.46	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R103-1	0.006	0.040	0.221	0.082	0.06	1.71	0.74	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-1	0.000	0.031	0.175	0.082	0.05	1.71	0.57	AR&R 20 year, 15 minutes storm, average 106 mm/h, Zone 1
F R300-2	0.002	0.033	0.175	0.084	0.05	1.76	0.58	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-3	0.003	0.034	0.175	0.084	0.05	1.76	0.59	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-4	0.003	0.034	0.175	0.084	0.05	1.76	0.59	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-5	0.003	0.034	0.175	0.084	0.05	1.76	0.59	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-6	0.003	0.034	0.353	0.067	0.07	1.28	1.04	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-7	0.003	0.034	0.430	0.064	0.08	1.16	1.20	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-8	0.003	0.028	0.430	0.060	0.07	1.05	1.17	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R300-9	0	0	0.126	0	0	0	0	
F R300-10	0	0	0.248	0	0	0	0	
F R301-1	0.010	0.044	0.175	0.090	0.06	1.97	0.63	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F-S R306-1	0.016	0.012	0.005	0.153	0.05	0.61	0.34	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F-S R302-1	0.010	0.007	0.005	0.127	0.04	0.51	0.30	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F-S R301-1	0.004	0.014	0.005	0.146	0.05	0.58	0.33	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F-S R101-1	0.039	0.035	0.007	0.188	0.10	0.75	0.55	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R309-1	0.000	0.024	0.000	0.490	0.00	12.90	0.01	AR&R 20 year, 15 minutes storm, average 106 mm/h, Zone 1
F R305-1	0.005	0.038	0.314	0.072	0.07	1.42	0.98	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F S R300-9	0.010	0.009	0.007	0.113	0.04	0.45	0.39	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F-S-R307-1	0.019	0.016	0.005	0.164	0.06	0.65	0.35	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F-S R308-1	0.038	0.037	0.005	0.212	0.09	0.85	0.42	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
F-S R303-1	0.019	0.015	0.005	0.163	0.06	0.65	0.35	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F-S R304-1	0.028	0.025	0.005	0.190	0.07	0.76	0.39	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
F-S-R305-1	0.040	0.040	0.005	0.218	0.09	0.87	0.43	AR&R 20 year, 1.5 hours storm, average 39.9 mm/h, Zone 1
OF83	0.076	0.075	0.005	0.276	0.14	1.10	0.50	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
OF79	0.132	0.132	4.474	0.028	0.02	7.40	0.63	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
C R310-1	0.023	0.023	2.969	0.010	0.00	7.40	0.32	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R302-1	0.006	0.040	0.175	0.089	0.05	1.91	0.60	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R303-1	0.005	0.038	0.175	0.087	0.05	1.85	0.61	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R304-1	0.005	0.038	0.175	0.087	0.05	1.85	0.61	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R306-1	0.004	0.038	0.430	0.067	0.08	1.25	1.21	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R307-1	0.004	0.032	0.430	0.063	0.07	1.13	1.18	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R308-1	0.002	0.054	0.254	0.087	0.07	1.85	0.86	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R104-1	0.005	0.039	0.175	0.088	0.05	1.88	0.61	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R101-1	0.006	0.035	0.221	0.079	0.06	1.62	0.70	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R102-1	0.003	0.003	0.254	0.035	0.02	0.39	0.46	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1
F R105-1	0.001	0.025	0.175	0.076	0.04	1.53	0.56	AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

DRAINS 20Y ARI RESULTS

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin11	49.77	446.8	1.137	0.000	1.137

CONTINUITY CHECK for AR&R 20 year, 25 minutes storm, average 82 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
R100-1	36.44	36.44	0.00	0.0
R100-2	71.52	71.47	0.00	0.1
R100-3	81.22	84.16	0.00	-3.6
R100-4	132.82	132.64	0.00	0.1
R100-5	176.54	176.57	0.00	-0.0
R100-6	779.14	779.79	0.00	-0.1
R100-7	840.02	839.89	0.00	0.0
R100-8	868.65	868.91	0.00	-0.0
R100-9	868.94	870.40	0.00	-0.2
R100-10	898.41	899.04	0.00	-0.1
R100-11	939.85	940.18	0.00	-0.0
R100-12	981.00	979.88	0.00	0.1
Basin11	979.88	979.88	367.11	-37.5
R100-17	613.55	613.55	0.00	0.0
R103-1	35.79	35.79	0.00	0.0
R300-1	4.61	4.61	0.00	0.0
R300-2	67.00	67.00	0.00	-0.0
R300-3	120.92	121.21	0.00	-0.2
R300-4	172.49	172.86	0.00	-0.2
R300-5	223.58	223.94	0.00	-0.2
R300-6	306.43	306.76	0.00	-0.1
R300-7	356.55	357.23	0.00	-0.2
R300-8	407.23	407.76	0.00	-0.1
R300-9	449.43	449.99	0.00	-0.1
R300-10	463.03	463.98	0.00	-0.2
R300-11	590.17	590.12	0.00	0.0
R301-1	44.43	44.43	0.00	0.0
S-R 306-1	8.51	8.51	0.00	0.0
S R302-1	7.36	7.36	0.00	0.0
S R301-1	2.38	2.38	0.00	0.0
S R101-1	21.07	21.07	0.00	0.0
R309-0	86.62	86.28	0.34	-0.0

DRAINS 20Y ARI RESULTS

R309-1	125.82	126.16	0.01	-0.3
R305-0	32.01	31.77	0.24	-0.0
R305-1	59.20	59.74	0.00	-0.9
R310-1	13.01	13.01	0.00	0.0
S R 300-9	5.50	5.50	0.00	0.0
S-R307-1	13.16	13.16	0.00	0.0
S-R308-1	28.41	28.41	0.00	0.0
S R303-1	13.61	13.61	0.00	0.0
S-R304-1	21.73	21.73	0.00	0.0
S R305-1	32.02	32.02	0.00	0.0
N71	44.56	44.56	0.00	0.0
N68	86.63	86.63	0.00	0.0
S R 310-1	13.01	13.01	0.00	0.0
R302-1	30.80	31.69	0.00	-2.9
R303-1	28.12	28.76	0.00	-2.3
R304-1	27.54	28.10	0.00	-2.0
R306-1	26.86	27.56	0.00	-2.6
R307-1	26.86	27.69	0.00	-3.1
R308-1	21.95	22.78	0.00	-3.8
R104-1	28.67	29.47	0.00	-2.8
R101-1	32.08	32.93	0.00	-2.6
R102-1	23.48	24.31	0.00	-3.6
R105-1	20.22	20.21	0.00	0.0
R106-1	18.49	19.05	0.00	-3.0

APPENDIX F

Water Quality Results Pads 4 -9

Water Quality Loadings Pad 4

Base Information

		Developed	Rural	Pond	
	TN	9.5	1.26	0.00	mg/L
EMC	TP	1.7	0.16	0	mg/L
	SS	950	90	0	mg/L
Cv		0.9	0.2	1	

Annual Rainfall

	Ave
Rainfall	840

Existing Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	0	9.3	0	9.300	ha
SS	0	1406	0	1406.16	kg
TP	0	2.5	0	2.50	kg
TN	0	19.7	0	19.69	kg
Vol Runoff	0	15624	0	15624	m3
Hydraulic Loading	43	m3/day			

Proposed Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	9.3	0	0.03	9.330	ha
SS	66793	0	0	66792.60	kg
TP	119.5	0	0	119.52	kg
TN	667.9	0	0	667.93	kg
Vol Runoff	70308	0	252	70560	m3
Hydraulic Loading	193	m3/day			

Pre Treatment (NO PRE TREAT

	% Capture	Capture	To Basin		
SS	0	0.00	66792.60	946.61	mg/L
TP	0	0.00	119.52	1.69	mg/L
TN	0	0.00	667.93	9.47	mg/L
Weighted Cv	0.90				

Summary

	Existing	Proposed	Pre Treatment	To Basin	
SS	1406	66793	0	66793	kg/annum
TP	2.5	119.5	0.0	119.5	kg/annum
TN	19.7	667.9	0.0	667.9	kg/annum
Vol Runoff	15624	70560			m3/annum

Basin Performance Requirements

	% Capture	Basin In	Capture	Basin Out	
SS	80	66792.60	53434.08	13358.52	kg/annum
TP	45	119.52	53.79	65.74	kg/annum
TN	45	667.93	300.57	367.36	kg/annum
SS	80	946.61		189.32	mg/L
TP	45	1.69		0.93	mg/L
TN	45	9.47		5.21	mg/L

Water Quality Loadings Pad 5

Base Information

		Developed	Rural	Pond	
	TN	9.5	1.26	0.00	mg/L
EMC	TP	1.7	0.16	0	mg/L
	SS	950	90	0	mg/L
Cv		0.9	0.2	1	

Annual Rainfall

	Ave
Rainfall	840

Existing Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	0	12.9	0	12.900	ha
SS	0	1950	0	1950.48	kg
TP	0	3.5	0	3.47	kg
TN	0	27.3	0	27.31	kg
Vol Runoff	0	21672	0	21672	m3
Hydraulic Loading	59	m3/day			

Proposed Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	12.9	0	0.03	12.930	ha
SS	92648	0	0	92647.80	kg
TP	165.8	0	0	165.79	kg
TN	926.5	0	0	926.48	kg
Vol Runoff	97524	0	252	97776	m3
Hydraulic Loading	268	m3/day			

Pre Treatment (NO PRE TREAT

	% Capture	Capture	To Basin		
SS	0	0.00	92647.80	947.55	mg/L
TP	0	0.00	165.79	1.70	mg/L
TN	0	0.00	926.48	9.48	mg/L
Weighted Cv	0.90				

Summary

	Existing	Proposed	Pre Treatment	To Basin	
SS	1950	92648	0	92648	kg/annum
TP	3.5	165.8	0.0	165.8	kg/annum
TN	27.3	926.5	0.0	926.5	kg/annum
Vol Runoff	21672	97776			m3/annum

Basin Performance Requirements

	% Capture	Basin In	Capture	Basin Out	
SS	80	92647.80	74118.24	18529.56	kg/annum
TP	45	165.79	74.61	91.18	kg/annum
TN	45	926.48	416.92	509.56	kg/annum
SS	80	947.55		189.51	mg/L
TP	45	1.70		0.93	mg/L
TN	45	9.48		5.21	mg/L

Water Quality Loadings Pad 7

Base Information

		Developed	Rural	Pond	
	TN	9.5	1.26	0.00	mg/L
EMC	TP	1.7	0.16	0	mg/L
	SS	950	90	0	mg/L
Cv		0.9	0.2	1	

Annual Rainfall

	Ave
Rainfall	840

Existing Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	0	5.1	0	5.100	ha
SS	0	771	0	771.12	kg
TP	0	1.4	0	1.37	kg
TN	0	10.8	0	10.80	kg
Vol Runoff	0	8568	0	8568	m3
Hydraulic Loading	23	m3/day			

Proposed Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	5.1	0	0.03	5.130	ha
SS	36628	0	0	36628.20	kg
TP	65.5	0	0	65.55	kg
TN	366.3	0	0	366.28	kg
Vol Runoff	38556	0	252	38808	m3
Hydraulic Loading	106	m3/day			

Pre Treatment (NO PRE TREAT

	% Capture	Capture	To Basin		
SS	0	0.00	36628.20	943.83	mg/L
TP	0	0.00	65.55	1.69	mg/L
TN	0	0.00	366.28	9.44	mg/L
Weighted Cv	0.90				

Summary

	Existing	Proposed	Pre Treatment	To Basin	
SS	771	36628	0	36628	kg/annum
TP	1.4	65.5	0.0	65.5	kg/annum
TN	10.8	366.3	0.0	366.3	kg/annum
Vol Runoff	8568	38808			m3/annum

Basin Performance Requirements

	% Capture	Basin In	Capture	Basin Out	
SS	80	36628.20	29302.56	7325.64	kg/annum
TP	45	65.55	29.50	36.05	kg/annum
TN	45	366.28	164.83	201.46	kg/annum
SS	80	943.83		188.77	mg/L
TP	45	1.69		0.93	mg/L
TN	45	9.44		5.19	mg/L

Water Quality Loadings Pad 8

Base Information

		Developed	Rural	Pond	
	TN	9.5	1.26	0.00	mg/L
EMC	TP	1.7	0.16	0	mg/L
	SS	950	90	0	mg/L
Cv		0.9	0.2	1	

Annual Rainfall

	Ave
Rainfall	840

Existing Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	0	3.3	0	3.300	ha
SS	0	499	0	498.96	kg
TP	0	0.9	0	0.89	kg
TN	0	7.0	0	6.99	kg
Vol Runoff	0	5544	0	5544	m3
Hydraulic Loading	15	m3/day			

Proposed Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	3.3	0	0.03	3.330	ha
SS	3	0	0	3.00	kg
TP	42.4	0	0	42.41	kg
TN	237.0	0	0	237.01	kg
Vol Runoff	24948	0	252	25200	m3
Hydraulic Loading	69	m3/day			

Pre Treatment (NO PRE TREAT

	% Capture	Capture	To Basin		
SS	0	0.00	3.00	0.12	mg/L
TP	0	0.00	42.41	1.68	mg/L
TN	0	0.00	237.01	9.41	mg/L
Weighted Cv	0.90				

Summary

	Existing	Proposed	Pre Treatment	To Basin	
SS	499	3	0	3	kg/annum
TP	0.9	42.4	0.0	42.4	kg/annum
TN	7.0	237.0	0.0	237.0	kg/annum
Vol Runoff	5544	25200			m3/annum

Basin Performance Requirements

	% Capture	Basin In	Capture	Basin Out	
SS	80	3.00	2.40	0.60	kg/annum
TP	45	42.41	19.09	23.33	kg/annum
TN	45	237.01	106.65	130.35	kg/annum
SS	80	0.12		0.02	mg/L
TP	45	1.68		0.93	mg/L
TN	45	9.41		5.17	mg/L

Water Quality Loadings Pad 9

Base Information

		Developed	Rural	Pond	
	TN	9.5	1.26	0.00	mg/L
EMC	TP	1.7	0.16	0	mg/L
	SS	950	90	0	mg/L
Cv		0.9	0.2	1	

Annual Rainfall

	Ave
Rainfall	840

Existing Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	0	5.2	0	5.200	ha
SS	0	786	0	786.24	kg
TP	0	1.4	0	1.40	kg
TN	0	11.0	0	11.01	kg
Vol Runoff	0	8736	0	8736	m3
Hydraulic Loading	24	m3/day			

Proposed Conditions - Average Year

	Developed	Rural	Pond	Total	
Area	5.2	0	0.03	5.230	ha
SS	37346	0	0	37346.40	kg
TP	66.8	0	0	66.83	kg
TN	373.5	0	0	373.46	kg
Vol Runoff	39312	0	252	39564	m3
Hydraulic Loading	108	m3/day			

Pre Treatment (NO PRE TREAT

	% Capture	Capture	To Basin		
SS	0	0.00	37346.40	943.95	mg/L
TP	0	0.00	66.83	1.69	mg/L
TN	0	0.00	373.46	9.44	mg/L
Weighted Cv	0.90				

Summary

	Existing	Proposed	Pre Treatment	To Basin	
SS	786	37346	0	37346	kg/annum
TP	1.4	66.8	0.0	66.8	kg/annum
TN	11.0	373.5	0.0	373.5	kg/annum
Vol Runoff	8736	39564			m3/annum

Basin Performance Requirements

	% Capture	Basin In	Capture	Basin Out	
SS	80	37346.40	29877.12	7469.28	kg/annum
TP	45	66.83	30.07	36.76	kg/annum
TN	45	373.46	168.06	205.41	kg/annum
SS	80	943.95		188.79	mg/L
TP	45	1.69		0.93	mg/L
TN	45	9.44		5.19	mg/L

APPENDIX G

Basin Concept Design Pads 4 -9

Pad 4

WSUD TECHINCAL GUIDELINES FOR WESTERN SYDNEY

BIORETENTION SYSTEMS (Planter Boxes) Refer to Design Specifications and Procedure Section 5

Treatable Volume (V_t)	1001.4	m^3
Treatable Flow Rate (Q_d)	1.46	m^3/s
Peak Flow Rate (Q_p)	5.65	m^3/s
Max Ponding Surface Water Depth (d_{max})	1	
Particle size of sand filter material for which 10% of Particules are smaller (d_{10})	0.01	cm
Filter Media hydraulic Conductivity (k)	0.01	cm/s
Filter Media hydraulic Conductivity (k)	0.0001	cm/s
Filter Media Hydraulic Conductivity (k)	1	(m/day)
Filtration Time (t)	1	Days
Average Depth of Water above the filter media (h)	0.3	m
Filter Media Depth (d)	0.5	m
Surface Area (A)	626	m^2
Max outflow from system (Qmax)	0.2	m^3/s

Bioretention System Design Checklist

Treatable Volume/Flow Rate
Off Line/On Line System
Pre-treatment System
Primary Filter Media Permeability
Detention Time 1 day>t>2 days
Primary Filter Media Depth
Underdrainage System
Surface Velocity (on-line system)
Low Permeability Liner Required
Perforated Pipe Backflush System

Table DS4.1 Maximum Flow Velocities in Vegetated Channels

Ground Cover	Maximum Velocity (m/s)		
	Soil Erodibility		
	Low	Moderate	High
Mat or sword grasses with UV stabilised mesh	3.0	2.7	2.4
Kikuyu grass	2.5	2.2	1.9
Couch grass, carpet grass, rhodes grass, sword forming grasses	2.0	1.8	1.4
Other improved perennials	1.6	1.3	0.9
Tussock grasses	1.3	0.9	0.5

Pad 5

WSUD TECHINCAL GUIDELINES FOR WESTERN SYDNEY

BIORETENTION SYSTEMS (Planter Boxes) Refer to Design Specifications and Procedure Section 5

Treatable Volume (V_t)	708.7	m^3
Treatable Flow Rate (Q_d)	1.03	m^3/s
Peak Flow Rate (Q_p)	4.01	m^3/s
Max Ponding Surface Water Depth (d_{max})	1	
Particle size of sand filter material for which 10% of Particules are smaller (d_{10})	0.01	cm
Filter Media hydraulic Conductivity (k)	0.01	cm/s
Filter Media hydraulic Conductivity (k)	0.0001	cm/s
Filter Media Hydraulic Conductivity (k)	1	(m/day)
Filtration Time (t)	1	Days
Average Depth of Water above the filter media (h)	0.3	m
Filter Media Depth (d)	0.5	m
Surface Area (A)	443	m^2
Max outflow from system (Qmax)	0.1	m^3/s

Bioretention System Design Checklist

Treatable Volume/Flow Rate
Off Line/On Line System
Pre-treatment System
Primary Filter Media Permeability
Detention Time 1 day>t>2 days
Primary Filter Media Depth
Underdrainage System
Surface Velocity (on-line system)
Low Permeability Liner Required
Perforated Pipe Backflush System

Table DS4.1 Maximum Flow Velocities in Vegetated Channels

Ground Cover	Maximum Velocity (m/s)		
	Soil Erodibility		
	Low	Moderate	High
Mat or sword grasses with UV stabilised mesh	3.0	2.7	2.4
Kikuyu grass	2.5	2.2	1.9
Couch grass, carpet grass, rhodes grass, sword forming grasses	2.0	1.8	1.4
Other improved perennials	1.6	1.3	0.9
Tussock grasses	1.3	0.9	0.5

Pad 7

WSUD TECHINCAL GUIDELINES FOR WESTERN SYDNEY

BIORETENTION SYSTEMS (Planter Boxes) Refer to Design Specifications and Procedure Section 5

Treatable Volume (V_t)	531.7	m^3
Treatable Flow Rate (Q_d)	0.777	m^3/s
Peak Flow Rate (Q_p)	3.03	m^3/s
Max Ponding Surface Water Depth (d_{max})	1	
Particle size of sand filter material for which 10% of Particules are smaller (d_{10})	0.01	cm
Filter Media hydraulic Conductivity (k)	0.005	cm/s
Filter Media hydraulic Conductivity (k)	0.00005	m/s
Filter Media Hydraulic Conductivity (k)	1	(m/day)
Filtration Time (t)	1	Days
Average Depth of Water above the filter media (h)	0.5	m
Filter Media Depth (d)	0.6	m
Surface Area (A)	290	m^2
Max outflow from system (Qmax)	0.0	m^3/s

Bioretention System Design Checklist

Treatable Volume/Flow Rate
Off Line/On Line System
Pre-treatment System
Primary Filter Media Permeability
Detention Time 1 day>t>2 days
Primary Filter Media Depth
Underdrainage System
Surface Velocity (on-line system)
Low Permeability Liner Required
Perforated Pipe Backflush System

Table DS4.1 Maximum Flow Velocities in Vegetated Channels

Ground Cover	Maximum Velocity (m/s)		
	Soil Erodibility		
	Low	Moderate	High
Mat or sword grasses with UV stabilised mesh	3.0	2.7	2.4
Kikuyu grass	2.5	2.2	1.9
Couch grass, carpet grass, rhodes grass, sword forming grasses	2.0	1.8	1.4
Other improved perennials	1.6	1.3	0.9
Tussock grasses	1.3	0.9	0.5

Pad 8

WSUD TECHINCAL GUIDELINES FOR WESTERN SYDNEY

BIORETENTION SYSTEMS (Planter Boxes) Refer to Design Specifications and Procedure Section 5

Treatable Volume (V_t)	272.4	m^3
Treatable Flow Rate (Q_d)	0.4	m^3/s
Peak Flow Rate (Q_p)	1.56	m^3/s
Max Ponding Surface Water Depth (d_{max})	1	
Particle size of sand filter material for which 10% of Particules are smaller (d_{10})	0.01	cm
Filter Media hydraulic Conductivity (k)	0.01	cm/s
Filter Media hydraulic Conductivity (k)	0.0001	m/s
Filter Media Hydraulic Conductivity (k)	1	(m/day)
Filtration Time (t)	1	Days
Average Depth of Water above the filter media (h)	0.3	m
Filter Media Depth (d)	0.5	m
Surface Area (A)	170	m^2
Max outflow from system (Qmax)	0.1	m^3/s

Bioretention System Design Checklist

Treatable Volume/Flow Rate
Off Line/On Line System
Pre-treatment System
Primary Filter Media Permeability
Detention Time 1 day>t>2 days
Primary Filter Media Depth
Underdrainage System
Surface Velocity (on-line system)
Low Permeability Liner Required
Perforated Pipe Backflush System

Table DS4.1 Maximum Flow Velocities in Vegetated Channels

Ground Cover	Maximum Velocity (m/s)		
	Soil Erodibility		
	Low	Moderate	High
Mat or sword grasses with UV stabilised mesh	3.0	2.7	2.4
Kikuyu grass	2.5	2.2	1.9
Couch grass, carpet grass, rhodes grass, sword forming grasses	2.0	1.8	1.4
Other improved perennials	1.6	1.3	0.9
Tussock grasses	1.3	0.9	0.5

Pad 9

WSUD TECHINCAL GUIDELINES FOR WESTERN SYDNEY

BIORETENTION SYSTEMS (Planter Boxes) Refer to Design Specifications and Procedure Section 5

Treatable Volume (V_t)	439.2	m^3
Treatable Flow Rate (Q_d)	0.642	m^3/s
Peak Flow Rate (Q_p)	3.48	m^3/s
Max Ponding Surface Water Depth (d_{max})	1	
Particle size of sand filter material for which 10% of Particules are smaller (d_{10})	0.01	cm
Filter Media hydraulic Conductivity (k)	0.005	cm/s
Filter Media hydraulic Conductivity (k)	0.00005	cm/s
Filter Media Hydraulic Conductivity (k)	1	(m/day)
Filtration Time (t)	1	Days
Average Depth of Water above the filter media (h)	0.3	m
Filter Media Depth (d)	0.6	m
Surface Area (A)	293	m^2
Max outflow from system (Qmax)	0.0	m^3/s

Bioretention System Design Checklist

Treatable Volume/Flow Rate
Off Line/On Line System
Pre-treatment System
Primary Filter Media Permeability
Detention Time 1 day>t>2 days
Primary Filter Media Depth
Underdrainage System
Surface Velocity (on-line system)
Low Permeability Liner Required
Perforated Pipe Backflush System

Table DS4.1 Maximum Flow Velocities in Vegetated Channels

Ground Cover	Maximum Velocity (m/s)		
	Soil Erodibility		
	Low	Moderate	High
Mat or sword grasses with UV stabilised mesh	3.0	2.7	2.4
Kikuyu grass	2.5	2.2	1.9
Couch grass, carpet grass, rhodes grass, sword forming grasses	2.0	1.8	1.4
Other improved perennials	1.6	1.3	0.9
Tussock grasses	1.3	0.9	0.5

APPENDIX H

Basin Concept Design Water Quality

WSUD TECHINCAL GUIDELINES FOR WESTERN SYDNEY

BIORETENTION SYSTEMS (Planter Boxes) Refer to Design Specifications and Procedure Section 5

Treatable Volume (V_t)	344	m^3
Treatable Flow Rate (Q_d)	0.21	m^3/s
Peak Flow Rate (Q_p)	1.274	m^3/s
Max Ponding Surface Water Depth (d_{max})	0.7	
Particle size of sand filter material for which 10% of Particules are smaller (d_{10})	0.01	cm
Filter Media hydraulic Conductivity (k)	0.005	cm/s
Filter Media hydraulic Conductivity (k)	0.00005	m/s
Filter Media Hydraulic Conductivity (k)	1	(m/day)
Filtration Time (t)	1	Days
Average Depth of Water above the filter media (h)	0.35	m
Filter Media Depth (d)	0.6	m
Surface Area (A)	217	m^2
Max outflow from system (Qmax)	0.024	m^3/s

Bioretention System Design Checklist
Treatable Volume/Flow Rate
Off Line/On Line System
Pre-treatment System
Primary Filter Media Permeability
Detention Time 1 day>t>2 days
Primary Filter Media Depth
Underdrainage System
Surface Velocity (on-line system)
Low Permeability Liner Required
Perforated Pipe Backflush System

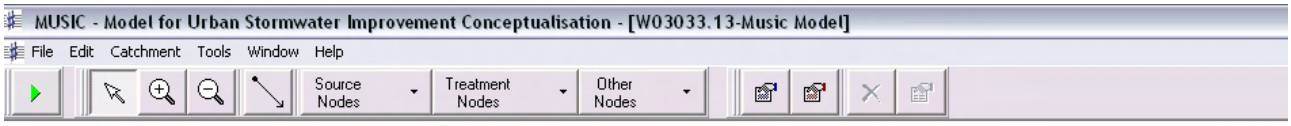
Table DS4.1 Maximum Flow Velocities in Vegetated Channels

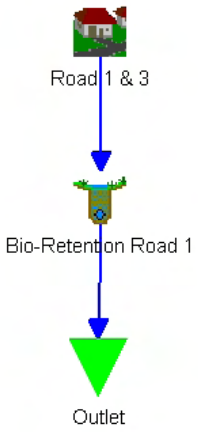
Ground Cover	Maximum Velocity (m/s)		
	Soil Erodibility		
	Low	Moderate	High
Mat or sword grasses with UV stabilised mesh	3.0	2.7	2.4
Kikuyu grass	2.5	2.2	1.9
Couch grass, carpet grass, rhodes grass, sword forming grasses	2.0	1.8	1.4
Other improved perennials	1.6	1.3	0.9
Tussock grasses	1.3	0.9	0.5

APPENDIX I

Water Quality Results

MUSIC MODEL LAYOUT





Source nodes

Location	Road 1
ID	2
Node Type	UrbanSourceNode
Total Area (ha)	3.346
Area Impervious (ha)	2.545601579
Area Pervious (ha)	0.800398421
Field Capacity (mm)	80
Pervious Area Infiltration Capacity coefficient - a	200
Pervious Area Infiltration Capacity exponent - b	1
Impervious Area Rainfall Threshold (mm/day)	1
Pervious Area Soil Storage Capacity (mm)	120
Pervious Area Soil Initial Storage (% of Capacity)	25
Groundwater Initial Depth (mm)	50
Groundwater Daily Recharge Rate (%)	25
Groundwater Daily Baseflow Rate (%)	5
Groundwater Daily Deep Seepage Rate (%)	0
Stormflow Total Suspended Solids Mean (log mg/L)	1.92
Stormflow Total Suspended Solids Standard Deviation (log mg/L)	0.44
Stormflow Total Suspended Solids Estimation Method	Mean
Stormflow Total Suspended Solids Serial Correlation	0
Stormflow Total Phosphorus Mean (log mg/L)	-0.59
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.36
Stormflow Total Phosphorus Estimation Method	Mean
Stormflow Total Phosphorus Serial Correlation	0
Stormflow Total Nitrogen Mean (log mg/L)	0.25
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.32
Stormflow Total Nitrogen Estimation Method	Mean
Stormflow Total Nitrogen Serial Correlation	0
Baseflow Total Suspended Solids Mean (log mg/L)	0.78
Baseflow Total Suspended Solids Standard Deviation (log mg/L)	0.45
Baseflow Total Suspended Solids Estimation Method	Mean
Baseflow Total Suspended Solids Serial Correlation	0
Baseflow Total Phosphorus Mean (log mg/L)	-1.11
Baseflow Total Phosphorus Standard Deviation (log mg/L)	0.48
Baseflow Total Phosphorus Estimation Method	Mean
Baseflow Total Phosphorus Serial Correlation	0
Baseflow Total Nitrogen Mean (log mg/L)	0.14
Baseflow Total Nitrogen Standard Deviation (log mg/L)	0.2
Baseflow Total Nitrogen Estimation Method	Mean
Baseflow Total Nitrogen Serial Correlation	0
OUT - Mean Annual Flow (ML/yr)	19.8
OUT - TSS Mean Annual Load (kg/yr)	1.55E+03
OUT - TP Mean Annual Load (kg/yr)	4.86
OUT - TN Mean Annual Load (kg/yr)	34.7
OUT - Gross Pollutant Mean Annual Load (kg/yr)	606

USTM treatment nodes

Location	Bio-Retention Road 1
ID	3
Node Type	BioRetentionNode
Lo-flow bypass rate (cum/sec)	0
Hi-flow bypass rate (cum/sec)	0.39
Inlet pond volume	
Area (sqm)	359

Extended detention depth (m)	0.75
Permanent pool volume (cum)	
Proportion vegetated	
Equivalent pipe diameter (mm)	
Overflow weir width (m)	1.8
Notional Detention Time (hrs)	
Orifice discharge coefficient	
Weir coefficient	1.7
Number of CSTR cells	3
Total Suspended Solids k (m/yr)	1000
Total Suspended Solids C* (mg/L)	12
Total Suspended Solids C** (mg/L)	
Total Phosphorus k (m/yr)	500
Total Phosphorus C* (mg/L)	0.13
Total Phosphorus C** (mg/L)	
Total Nitrogen k (m/yr)	50
Total Nitrogen C* (mg/L)	1.3
Total Nitrogen C** (mg/L)	
Threshold hydraulic loading for C** (m/yr)	
Extraction for Re-use	Off
Annual Re-use Demand - scaled by daily PET (ML)	
Constant Daily Re-use Demand (kL)	
User-defined Annual Re-use Demand (ML)	
Filter area (sqm)	217
Filter depth (m)	0.6
Filter median particle diameter (mm)	1
Saturated hydraulic conductivity (mm/hr)	120
Voids ratio	0.3
Length (m)	
Bed slope	
Base Width (m)	
Top width (m)	
Vegetation height (m)	
Proportion of upstream impervious area treated	
Seepage Rate (mm/hr)	35
Evap Loss as proportion of PET	
Depth in metres below the drain pipe	0
IN - Mean Annual Flow (ML/yr)	19.8
IN - TSS Mean Annual Load (kg/yr)	1.55E+03
IN - TP Mean Annual Load (kg/yr)	4.86
IN - TN Mean Annual Load (kg/yr)	34.7
IN - Gross Pollutant Mean Annual Load (kg/yr)	606
OUT - Mean Annual Flow (ML/yr)	13.1
OUT - TSS Mean Annual Load (kg/yr)	168
OUT - TP Mean Annual Load (kg/yr)	1.17
OUT - TN Mean Annual Load (kg/yr)	13.7
OUT - Gross Pollutant Mean Annual Load (kg/yr)	6.01

No Generic treatment nodes

Other nodes

Location	Outlet
ID	1
Node Type	ReceivingNode
IN - Mean Annual Flow (ML/yr)	13.1
IN - TSS Mean Annual Load (kg/yr)	168

IN - TP Mean Annual Load (kg/yr)	1.17
IN - TN Mean Annual Load (kg/yr)	13.7
IN - Gross Pollutant Mean Annual Load (kg/yr)	6.01
OUT - Mean Annual Flow (ML/yr)	0
OUT - TSS Mean Annual Load (kg/yr)	0
OUT - TP Mean Annual Load (kg/yr)	0
OUT - TN Mean Annual Load (kg/yr)	0
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0

Links

Location	Drainage Link	Drainage Link
Source node ID	2	3
Target node ID	3	1
Muskingum-Cunge Routing	Not Routed	Not Routed
Muskingum K		
Muskingum theta		
IN - Mean Annual Flow (ML/yr)	19.8	13.1
IN - TSS Mean Annual Load (kg/yr)	1.55E+03	168
IN - TP Mean Annual Load (kg/yr)	4.86	1.17
IN - TN Mean Annual Load (kg/yr)	34.7	13.7
IN - Gross Pollutant Mean Annual Load (kg/yr)	606	6.01
OUT - Mean Annual Flow (ML/yr)	19.8	13.1
OUT - TSS Mean Annual Load (kg/yr)	1.55E+03	168
OUT - TP Mean Annual Load (kg/yr)	4.86	1.17
OUT - TN Mean Annual Load (kg/yr)	34.7	13.7
OUT - Gross Pollutant Mean Annual Load (kg/yr)	606	6.01