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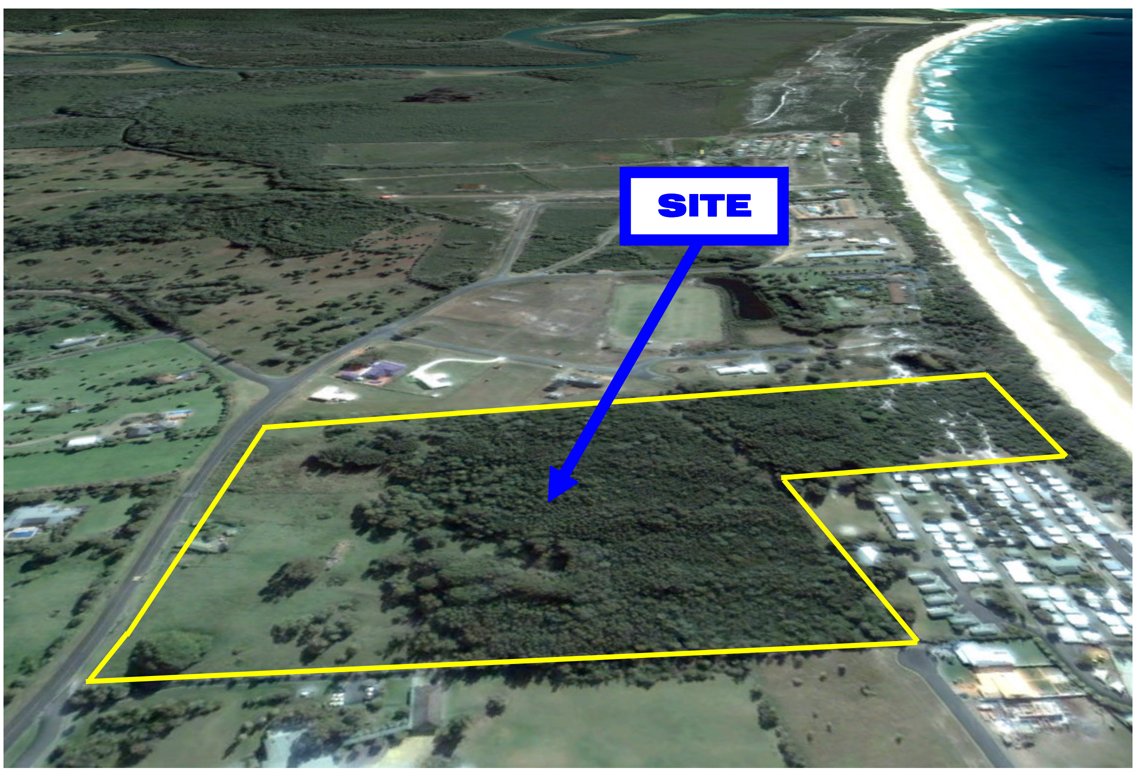
Your Ref:
Our Ref: 7420
Document Ref: 7420SWStrategy
Date: 16 April 2010

STORMWATER STRATEGY FOR



PROPOSED SUBDIVISION OF LOT 6 DP244030 & LOT 9 DP250425, EDGEWATER DRIVE DIAMOND BEACH

April 2010
Issue 1

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TABLE OF CONTENTS

1 **PREFACE** 1
2 **INTRODUCTION** 1
2.1 Site Description 1
2.2 Proposed Development 2
3 **PROPOSED STORMWATER MANAGEMENT STRATEGY** 4
3.1 Relevant Guidelines and Objectives 4
3.2 Objectives 4
3.3 Proposed Measures 4
4 **HYDROLOGIC ANALYSIS** 5
4.1 Discussion 5
4.2 Permeability and Groundwater 6
4.3 XP-Rafts Parameters 6
4.4 Minor Storm Flows 7
4.5 Major Storm Flows 8
4.6 Climate Change 9
5 **WATER QUALITY ASSESSMENT** 10
5.1 Water Quality Objectives 10
5.2 Music Water Quality Model 10
5.3 Rainfall and Evaporation 10
5.3.1 Rainfall 11
5.3.2 Evaporation 11
5.4 Soil Data and Model Calibration 11
5.5 Pollutant Concentrations 12
5.6 Catchment Definition 13
5.7 Modelling Stormwater Management Controls 13
5.7.1 Sediment Reduction (GPT) Pits 13
5.7.2 Rainwater Tanks 13
5.7.3 Water Quality Raingardens 14
5.7.4 Detention Basins 15
5.7.5 Preservation of Native Vegetation 15
5.8 Model Results 17
5.9 Construction Stage 17
5.10 Maintenance 17
6 **SUMMARY** 18
6.1 Stormwater Quantity Summary 18
6.1.1 Q_5 Peak Storm Event 18
6.1.2 Q_{100} Peak Storm Event 18
6.2 Stormwater Quality Summary 20

A HYDRAULIC OUTPUT FILES 21
A.1 XP-Rafts Schematic Layout (Existing) 21
A.1.1 Rafts Schematic Layout (Developed) 21
A.2 Catchment Summary 22
A.3 Rafts-XP Output Summary 23
A.4 Rafts Q5 Existing Discharge Output File (West) 24
A.4.1 Rafts Q5 Existing Discharge Output File (East) 25
A.5 Rafts Q100 Existing Discharge Output File (West) 26
A.5.1 Rafts Q100 Existing Discharge Output File (East) 27
A.6 Rafts Q5 Developed Discharge Output File (West) 28
A.7 Rafts Q100 Developed Discharge Output File (West) 31
A.8 Summary of Detention Basin Inflow Weirs Design 34
B MUSIC OUTPUT FILES 35
B.1 Pre-Development Music Model 35
B.2 Post-Development Music Model 37
C Pre-Developed Catchment Plan 42
Developed Catchment Plan 42
Stormwater Strategy Plan 42

1 PREFACE

This document has been prepared to address stormwater management strategies for a proposed subdivision of Lot 6 DP244030 & Lot 9 DP250425, Edgewater Drive, Diamond Beach.

The strategy will address stormwater water quantity proposals in regard to the existing site conditions as well as measures to control stormwater quality.

The 11ha site is located at the northern end of Diamond Beach Road in the coastal village of Diamond Beach on the NSW Mid North Coast.

The development proposes to create a residential subdivision consisting of individual lots, public reserve (eastern end of site to be retained as public reserve), detention basins and water quality raingardens, associated infrastructure and roadways.

Stormwater will be treated by a combination of traditional drainage measures, as well as water sensitive urban design (WSUD) techniques.

2 INTRODUCTION

2.1 Site Description

The site is located at the northern end of Diamond Beach Road, Diamond Beach and is bordered by a rural residential development to the north, a Primary School to the south, the existing *Diamond Beach Holiday Park* and the Pacific Ocean to the east and Diamond Beach Road to the west.

The proposed development site is partly cleared with vegetation covering the eastern two-thirds of the site. An abandoned derelict house exists in the western part of the site, and existing sewer rising main and gravity sewer reticulation mains run north-south through the site.

The site primarily grades in a north-easterly direction with slopes of between 0.5 to 15% ranging from elevations of 5m to 27m AHD.

The site is drained via overland flow towards an informal drainage path that flows north, eventually entering a roadside swale on Edgewater Drive and northwards to an existing large detention basin to the north of Dune Springs Close. Infiltration would occur in the eastern part of the site, where surface sands are present. A small farm dam is located in the centre of the site.

The soils on the site generally consist of residual clayey soils underlain primarily by weathered siltstone and sandstone in the western part of the site, shallow alluvial clays in the drainage path in the centre of the site and aeolian sands in the eastern part of the site (*Coffey Geotechnics* Environmental Assessment and Land Capability Study November 2008).

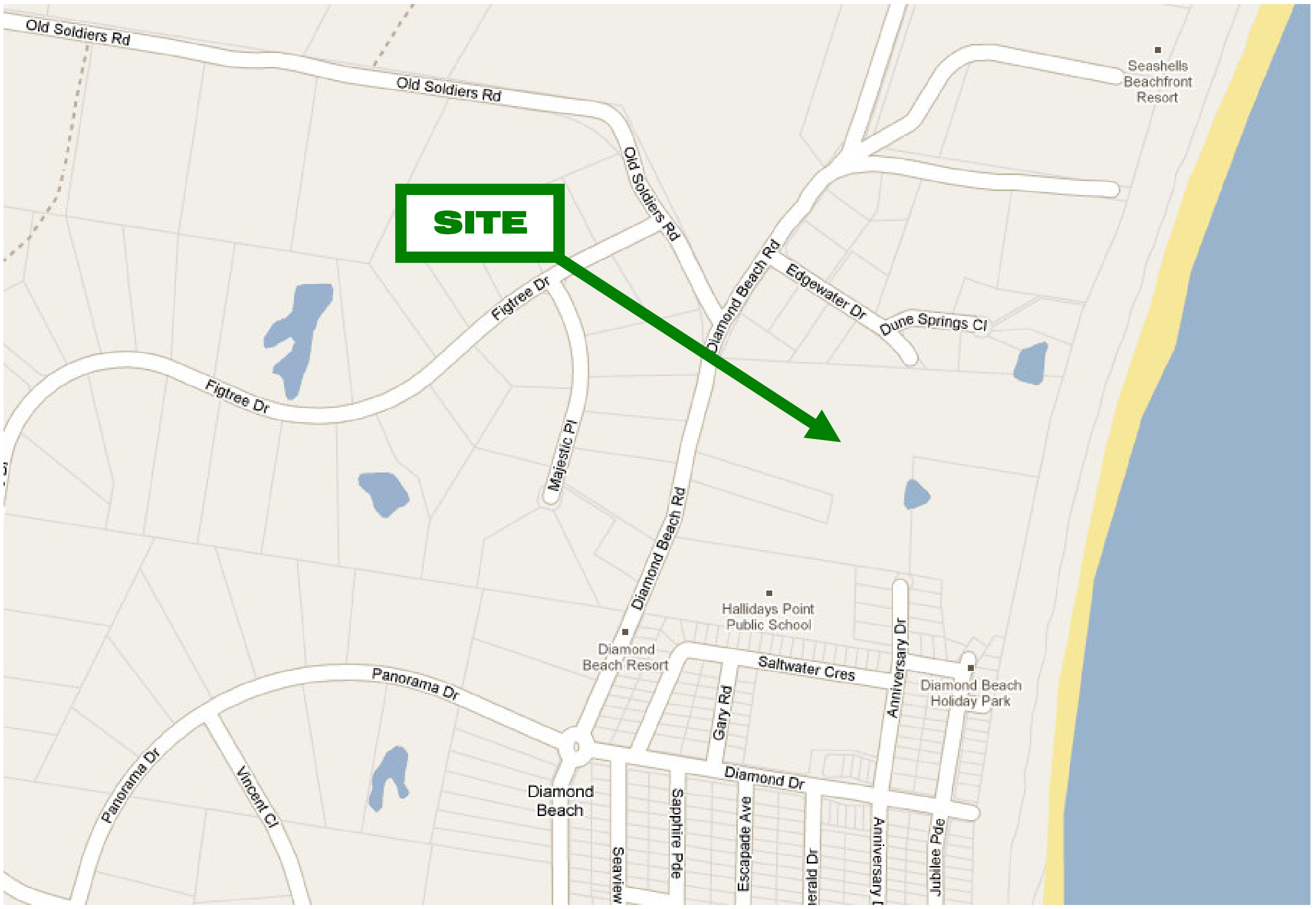


Figure 1 - Locality Plan

2.2 Proposed Development

As discussed above, the proposed development is a residential subdivision, consisting of:

- 89 Individual Lots (potential for eastern lots to be developed Medium Density)
- Public Reserve (eastern end), detention basins and water quality raingardens
- Associated Infrastructure
- Roadways

The proposed development is shown in Figure 2.

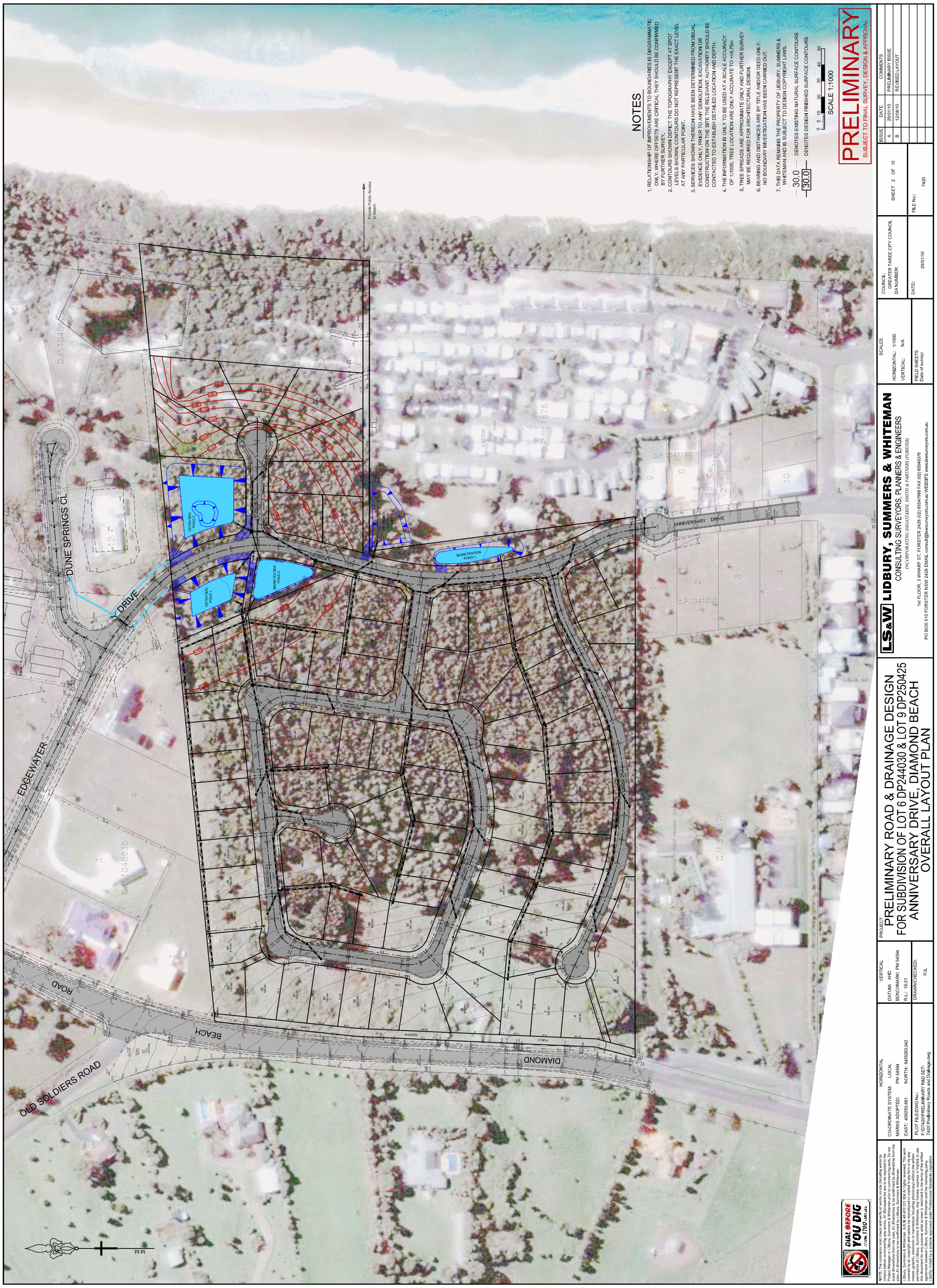


Figure 2 – Proposed Development

3 PROPOSED STORMWATER MANAGEMENT STRATEGY

3.1 Relevant Guidelines and Objectives

The studies and relevant guidelines pertaining to the site are:

- “Greater Taree Urban Stormwater Management Plan 2000” – Greater Taree City Council, 2000
- “Australian Runoff Quality”, Engineers Australia, 2006

3.2 Objectives

The objectives adopted for this Stormwater Management Strategy are:

- Post development loads of Gross Pollutants, TSS, TN and TP are to be reduced by 70%, 80%, 45% and 45% respectively compared to the untreated post developed pollutant loads (Table 4.2 of Council’s Urban Stormwater Plan 2000).
- Attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 100 year ARI rainfall event.

3.3 Proposed Measures

This Stormwater Strategy proposes to:

- Incorporate a Water Sensitive Urban Design (WSUD) “treatment train” approach, consisting of control measures at source and end-of-line measures to manage the discharge of nutrients and pollutants leaving the site to be reduced to the targets proposed above.
- Incorporate stormwater detention within the site to maintain post-developed peak flows less than or equal to the pre-developed flows from the site for all storm events up to and including 100 year ARI peak rainfall event.

4 HYDROLOGIC ANALYSIS

4.1 Discussion

Hydraulic modelling has been undertaken using XP-Rafts runoff routing design and analysis software.

As a portion of the existing external Caravan Park catchment currently enters the subject site's catchment, it was necessary to include external catchments in the modelling to allow volumetric pre and post developed peak flows to mimic actual conditions. The existing catchments are shown in Appendix C.

As it is unachievable to separate or divert the Caravan Park's post-development flow from the subject site's flow, it has been assumed in this strategy for the Caravan Park to undertake works to attenuate post-development peak discharges to pre-development flows (i.e. 100% pervious) for all storm events up to and including the 100 year ARI rainfall event. This will most likely be via a small detention basin in the north-western corner of the Caravan Park, with piped outlet and overflow weir into the subject site.

All captured stormwater will pass through sediment reduction/pre-filter pits prior to entering any underground stormwater system or water quality raingarden. These grated surface inlet pits, which act as gross pollutant traps will capture coarse sediment, trash and vegetation matter.

All captured stormwater will drain to kerb and gutter which will convey stormwater and pass through sediment reduction/pre-filter pits prior to entering any underground stormwater system or outlet. All roadside grated surface inlet pits will contain Enviropod (or similar) pit inserts which will act as gross pollutant traps and will capture coarse sediment, trash and vegetation matter, and screen finer particulates. Roofwater will be captured by rainwater tanks, which will surcharge to the street system.

For other impervious areas such as patios and paths etc., runoff will directly flow from the surfaces as sheet flow and naturally infiltrate the existing soil or drain to the road stormwater system.

All flow from the site will enter two large detention basins on the northern end of the site. The road grading has been designed so that all post-developed discharges up to and including the 100 year ARI rainfall event will be attenuated in the detention basins and/or the roadway to pre-developed discharges. The high flow controls consist of the roadway crest (approx. chainage 285) and two weirs in the detention basins. Flows leaving the site will enter two roadside drains on the extension of Edgewater Close, before being conveyed northwards to the existing detention basin in Dune Springs Close.

A culvert is proposed at the end of the existing road formation in Edgewater Drive and will be designed to convey the discharge in the roadside drains and be designed as part of the final road and drainage design. A sag above this proposed culvert will act as a broad-crested weir will become inundated in events greater than the 20 year ARI rainfall event in accordance with AUS-SPEC and subject to the final culvert design.

For modelling purposes, the detention basins have been analysed as one basin. In large events, road surcharge flows have one single flow path and discharge into both basins equally. It is therefore difficult to separate the flow into the road sag when modelling. The separate basins will be fully detailed in the final design.

4.2 Permeability and Groundwater

Geotechnical analysis assessing insitu soil infiltration and groundwater analysis has been undertaken on the subject site by *Coffey Geotechnics* (GEOTTUN01754AA-AD 30th November 2008). The report found that groundwater was encountered in the majority of test pits at approximately 1-2m below the existing surface. No groundwater was observed in the higher westerly part of the site. At the time of the geotechnical survey, the groundwater was approximately R.L.4.3 in the vicinity of the proposed detention basin locations. The base of the proposed detention basins will grade at minimum 0.5% and have a minimum level of R.L.4.6. The base of the detention basin will sit on the existing clay profile and no infiltration has been included in the hydrologic modelling.

The existing site contains clayey soils in the majority of the site and it is not proposed to utilise infiltration measures as part of the stormwater strategy at this time. If future strategies require onsite infiltration measures, we propose that future specific geotechnical assessment will need to be undertaken to verify actual infiltration rates prior to the implementation.

4.3 XP-Rafts Parameters

The XP-Rafts Parameters were modified to provide a realistic hydrological model for the subject site. The following parameters were adopted for the XP-Rafts Models:

	Pervious Areas	**Impervious Areas**
Initial Loss (IL)	10 mm	2.5 mm/hr
Continuing Loss (CL)	1.5 mm	0 mm/hr
Manning's n	0.03 (grass) 0.06 (brush)	0.015

Rainfall inputs were entered using IFD relationships and temporal patterns from AR&R (2001).

Peak Flows were also calculated using the Probabilistic Rational Method (methodology as per AR&R 2001) for the entire site. Table 1 below shows favourable correlation between XP-Rafts and the Probabilistic Rational Method.

Table 1 - XP-Rafts v Probabilistic Rational Method

	Q_5 Natural RAFTS	**Q_{100} Natural RAFTS**	**Q_5 Natural PRM**	**Q_{100} Natural PRM**
Outlet West (A)	1.91	3.83	1.74	3.79
Outlet East (B)	0.80	1.33	0.71	1.49
Total	**2.71**	**5.16**	**2.45**	**5.27**

Individual post-developed lots were modelled as 60% impervious (low density residential in accordance with AUS-SPEC). Post-developed catchment C7 was modelled as 75% impervious (to allow for possible medium density residential in accordance with AUS-SPEC).

4.4 Minor Storm Flows

In discussion with Greater Taree City Council, Rainwater Tanks will be used for BASIX re-use requirements only and no consideration has been allowed for detention in the rainwater tanks.

As part of the development of the site, it is proposed to construct two water quality raingardens. These raingardens will treat stormwater runoff from the site (other than any flows lost to infiltration) up to and including the 3 month ARI peak storm event.

The raingardens will have an extended detention depth of 0.25m – 0.3m (crest level of outlet pit and/or emergency weir). Splitter pits in the roadside drainage system will divert any flows greater than the Q3 month peak flow to bypass the raingarden systems.

It is also proposed to construct two dry bottom stormwater detention basins in lieu of individual allotment onsite detention systems. The basins will be located at the northern end of the site and capture all excess stormwater runoff from the site.

The basins will have a base level of RL 4.6m AHD. The top water level for the ponds will be RL 5.8m AHD. The proposed road has a lowpoint at the northern boundary and each detention basin will have a 6m spillway at R.L.5.68m to allow for overtopping in the extreme events.

Each basin is drained by a 1200 x 450 RCBC (modelled as equivalent 9 x 375Ø's for both basins) directly into the roadside drains in Edgewater Drive.

All flow is contained in the detention basins and the spillway is not utilised in the minor (Q5) storm event.

The minor flow (Q_5) modelling criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 5 year ARI peak rainfall event.

The modelling shows that for the 5 year ARI peak storm event, the peak water level reached in the detention basins will be RL5.32m AHD. This demonstrates that for the Q_5 peak storm event, stormwater will be contained within the basins without any overtopping. As the minimum road level is R.L.5.5m AHD there will also be no surcharge or ponding in the roadway in the Q_5 peak storm event.

Additionally, the peak discharge from the 5 year ARI peak storm event for the western catchment is 1.88m^3/s, being less than the pre-developed 1.91m^3/s. Refer to Table 2 below for a summary of pre and post developed discharges.

4.5 Major Storm Flows

As discussed above, the proposed stormwater treatment measures for the minor flows (up to and including the 5 year ARI peak storm event) include GPT's, rainwater tanks, together with water quality raingardens and detention basins.

The major flow (Q_{100}) modelling criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 100 year ARI peak rainfall event.

In the major storm event, flows will pond in the road sag located near the intersection of Road No.1 and Road No.6. Flows will pond to a level of R.L.5.74m before flowing over 2 x 20m weirs into the detention basins. This will require a flattening of the footpath section over these weir sections. The water will pond to a maximum R.L. of 5.885m. This is a maximum depth of 0.39m above the gutter sag invert in Road No.6 of R.L.5.50m. This depth allows for safe wading and the flow velocity over the weirs is 0.65m/s with a Velocity x Depth product of 0.094m^2/s which is safe for wading by children in accordance with AUS-SPEC.

Therefore, it has been adopted for the purpose of this strategy that the maximum allowable ponding level for the Q_{100} peak storm event is RL 5.885m AHD. Minimum filling of adjacent lots will be to R.L.6.0m and a 0.5m freeboard will be applied to the Q_{100} TWL and therefore the minimum floor levels of dwellings will be R.L.6.4m.

The modelling shows that for the 100 year ARI peak storm event, the peak water level reached in the detention basin will be RL5.814m AHD. Additionally, the peak discharge from the 100 year ARI peak storm event for the western catchment is 3.76m^3/s, being less than the pre-developed 3.83m^3/s. Refer to Table 2 below for a summary of pre and post developed discharges.

The road has been designed with a crest to contain all flows in this sag without bypassing the detention basin weirs. The level of the gutter invert at this crest is R.L.5.886m. If flows do increase beyond the Q_{100} peak flows as modelled (i.e. due to climate change – see section 4.6 below), the flows will then also discharge over this roadway weir, before leaving the site. The entire roadway (up to back of footpaths) has a capacity of approximately 1.5m^3/s (at 0.5% longitudinal grade) and would safely convey a 30% increase in the Q_{100} peak flow (approximately 30% of 4.16m3/s (peak inflow to node DB in 90min storm) is 1.25m^3/s).

Table 2 – Summary of Stormwater Quantity

NODE	Q_5	Q_5	Q_5	Q_{100}	Q_{100}	Q_{100}
	Natural	**Developed**	**Detention**	**Natural**	**Developed**	**Detention**
		(No measures)	(Detention Basins)		(No measures)	(Detention Basins)
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
Outlet West (A)	1.91	3.83	1.88	3.83	6.23	3.76
Outlet East (B)	0.80	0.80	0.80	1.33	1.33	1.33
Total	**2.71**	**4.63**	**2.68**	**5.16**	**7.55**	**5.08**

4.6 Climate Change

The minimum internal road level will be 5.5m AHD and minimum fill level on the habitable lots will be 6.0m AHD.

The strategy proposes that all proposed dwellings within the site have a minimum freeboard of 0.5m above the 1% design flood level (R.L.5.9m) giving a minimum floor level of 6.4m AHD.

The lowest level on the site is above Greater Taree City Council's current flood planning level and is also above Council's interim draft sea level rise policy flood planning level.

The roadway capacity has been checked to safely convey a 30% increase in the total flow leaving the site (currently a draft consideration from DECCW for increase in rainfall due to climate change).

5 WATER QUALITY ASSESSMENT

5.1 Water Quality Objectives

The water quality objectives have been determined based on the recommendations contained in the *'Greater Taree Urban Stormwater Management Plan 2000'* prepared by Greater Taree City Council (2000) and *'Australian Runoff Quality'* prepared by Engineers Australia (2006).

Accordingly, the water quality objectives adopted for this study are:

- Post development loads of Gross Pollutants, TSS, TN and TP are to be reduced by 70%, 80%, 45% and 45% respectively compared to the untreated post developed pollutant loads (Table 4.2 of Council's Urban Stormwater Management Plan 2000).

5.2 Music Water Quality Model

MUSIC (Model for Stormwater Improvement Conceptualisation) Version 4 was developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC is a conceptual continuous simulation water quality assessment design tool that estimates stormwater pollutant generation from different land uses and routes the stormwater pollutants through a user defined network of stormwater treatment measures ('treatment train') to estimate the performance of a proposed water quality strategy in meeting specified water quality objectives.

As the name suggests, MUSIC is a conceptual tool that simplifies a complex system. MUSIC is based on observed average water quality data, and while all effort has been made to accurately model the proposed scenario, there should be some recognition of the variability in the final performance of the proposed water quality treatment measures to the estimated average results modelled in MUSIC.

To undertake the water quality assessment, a MUSIC model was established for the subject site with a pre and post development scenario. The results from the pre development modelling were compared to the post development (with water quality treatment measures) modelling to assess the performance of the proposed stormwater quality controls to meet the water quality objectives stated above.

5.3 Rainfall and Evaporation

In order to establish a MUSIC model, rainfall and evaporation records in the vicinity of Diamond Beach were sought.

5.3.1 Rainfall

Bureau of Meteorology records from Station 60013 (Forster Post Office) were reviewed to determine that the average annual rainfall depth is approximately 1,122mm. The nearest reliable *Bureau of Meteorology* station with complete 6 minute pluviograph data was Taree (S*tation 060030*). A 5-year consecutive period of data was required which included both wet and dry years with an average annual rainfall over the 5-year period being close to the historic average. The period from January 1970 to December 1974 was considered to be the most appropriate period to use for modelling.

A 6 minute rainfall time step was considered necessary to more accurately model the performance of the bioretention systems and rainwater tank devices.

It should be noted that this water quality modelling exercise is a comparative assessment (i.e. pre development versus post development with treatment). Therefore the actual rainfall year selected is not significant to the final outcome provided a reasonable correlation to the average rainfall depth is achieved.

5.3.2 Evaporation

Monthly areal potential evapotranspiration values were obtained for the site from `Climate Atlas of Australia, Evapotranspiration' (*BoM, 2001*) and are shown in Table 3.

Table 3 – Monthly Areal Potential Evapotranspiration

Month	Areal Potential Evapotranspiration (mm)
January	180
February	135
March	135
April	90
May	65
June	50
July	50
August	70
September	100
October	135
November	150
December	165

5.4 Soil Data and Model Calibration

A rainfall-runoff calibration was undertaken to match the predicted runoff to expected values. The model was calibrated so the annual volumetric runoff for a free draining, 100% pervious site consisting of approximately 7ha of Forest (AVRC 0.19) and approximately 4ha of Rural (AVRC 0.26) was approximately 28.4ML/year. The adopted soil parameters for pervious soils are attached in Appendix B.

5.5 Pollutant Concentrations

The pollutant concentrations adopted for existing-state and developed state modelling are shown in Table 4. The event mean concentrations (EMC's) for each of these land uses were derived from *Fletcher et al (2004).*

Table 4 – Pollutant Concentrations

Land use/ Surface Type	Storm flow Concentration Log_{10} mg/l	Std. Dev. Log_{10} mg/l	Baseflow Concentration Log_{10} mg/l	Std. Dev. Log_{10} mg/
Rural				
Suspended Solids	1.95	0.32	1.15	0.17
Total Phosphorous	-0.66	0.25	-1.22	0.19
Total Nitrogen	0.30	0.19	-0.05	0.12
Forest				
Suspended Solids	1.60	0.20	0.78	0.13
Total Phosphorous	-1.10	0.22	-1.52	0.13
Total Nitrogen	-0.05	0.24	-0.52	0.13
Urban Residential				
Suspended Solids	2.15	0.32	1.20	0.17
Total Phosphorous	-0.60	0.25	-0.85	0.19
Total Nitrogen	0.30	0.19	0.11	0.12
Roofs				
Suspended Solids	1.30	0.32	-	-
Total Phosphorous	-0.89	0.25	-	-
Total Nitrogen	0.30	0.19	-	-
Sealed Roads/Driveways				
Suspended Solids	2.43	0.32	1.20	0.17
Total Phosphorous	-0.30	0.25	-0.85	0.19
Total Nitrogen	0.34	0.19	0.11	0.12

Rural EMC's were adopted for the existing cleared/grazed section of the subject site (100% pervious). Forest EMC’s were adopted for the remainder of the site (100% pervious).

For the developed model the proposed site was separated into Roof Area, Roads and Driveways (impervious area) and pervious areas. Lot Pervious and impervious areas have been assigned the Urban Residential EMC's.

5.6 Catchment Definition

For the purpose of the water quality modelling, the sub-catchments used for the hydrologic modelling were adopted. The external catchments (Caravan Park and eastern catchment C6) have been excluded from the MUSIC analysis as they are not part of the subject site and/or will be maintained in their existing state and as such would be included in the pre and post developed models equally.

The catchments were separated into Roof Area, Roads and Driveways (impervious area) and pervious areas. See Appendix B.2 for the catchment summaries.

5.7 Modelling Stormwater Management Controls

The following water quality treatment devices were included in the developed state water quality model:

5.7.1 Sediment Reduction (GPT) Pits

Grated surface sediment reduction/pre-filter pits are a type of at source *Gross Pollutant Trap (GPT)* and is a stormwater treatment *Best Management Practice* device designed to capture coarse sediment, trash and vegetation matter. *GPT's* play an important role in stormwater quality management as pre-treatment for other downstream treatment measures, such as retention and infiltration systems, by removing coarse material and preventing downstream measures from being overloaded.

For this development the use of 'at source' *GPT's* are proposed to be installed in all roadside pits prior to any captured stormwater entering the underground stormwater pipe system and the water quality raingardens. These devices are to filter litter and vegetative matter as well as sediment loads from all 'minor' storm events.

An Operations and Maintenance Manual is to be prepared for the stormwater quality devices proposed for the development. This document will be prepared at the construction certificate stage in accordance with final DA conditions.

It was assumed that GPT's had the following pollutant removal efficiencies:

- 50% Total Suspended Solids removal
- 10% Total Phosphorus Removal
- 8% Total Nitrogen Removal
- 90% Gross Pollutant Removal

5.7.2 Rainwater Tanks

Providing water for an increasing population in Australian climatic conditions is becoming a significant issue, rainwater collection and re-use tanks are considered an important *Best Management Practice* for all developments.

For all new and existing dwellings in the development, it is proposed to utilise 3,000 litre rainwater tanks for the collection of all roof area runoff (utilising a sealed downpipe system or two separate tanks if required) for the purpose of indoor (plumbed to toilets, hot water and laundry) and outdoor re-use. Any further overtopping of this captured roof water, will then surcharge as overland surface flow onto the road surface drainage system.

Each tank is to be fitted with a council approved first flush stormwater filter device, prior to water entering each unit. To ensure tanks will always contain water for indoor re-use, a potable water top-up device with backflow prevention device is to be fitted to all tanks.

The rainwater tanks are to have re-use capabilities in accordance with BASIX requirements.

Re-use of the collected stormwater runoff is to be used for non-potable indoor and outdoor purposes only including toilet flushing, laundry, hot water services, garden irrigation and car washing. All taps connected to the rainwater tanks are to be identified as *'Rainwater'* with a sign complying with AS1319.

An Operations and Maintenance Manual is to be prepared for the stormwater quality devices proposed for the development. This document will be prepared at the construction certificate stage in accordance with final DA conditions.

For MUSIC modelling, the following parameters were used:

- 3kL of tank dedicated for re-use per dwelling capturing all roof area (100% capture)
- Constant Internal Re-use of 266L/day/dwelling (based on *Western Sydney WSUD Technical Guidelines, 2004* with 2.5 persons/dwelling and re-use for toilet, laundry and hot water)
- Seasonal Outdoor Re-use of 240L/day/dwelling (based on *Western Sydney WSUD Technical Guidelines, 2004*) with seasonal demand based shown in Table 5.

Table 5 - Typical annual distribution of irrigation demand*

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
17%	9%	6%	1%	0%	0%	0%	5%	11%	14%	16%	21%

* Wyong Council WSUD Technical Guide No. 3, April 2008)

The conservative PET – Rain option was chosen for re-use modelling (i.e. outdoor re-use demand is zero when the rainfall exceeds the PET).

5.7.3 Water Quality Raingardens

Constructed water quality raingardens are shallow, extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater.

These processes are engaged by slowly passing runoff through vegetated areas.
Plants filter sediments and pollutants from the water, while bio-films that grow on the plants can absorb nutrients and other associated contaminants.

For this development, it is proposed to construct two water quality raingardens and undertake vegetation planting so as to provide water quality benefits. The raingardens will have an extended

detention depth of between 0.25m – 0.30m and a proposed filter depth of between 0.4m.

For MUSIC modelling, the following parameters were used:

- 0.25m – 0.3m deep, 1:3 side batters (WQ1 fenced at southern end)
- longitudinal grade of 0.5% of drainage layer. Effective vegetation planted.
- Filter media 400mm thick (Sandy Loam) with potential 100mm transition layer and 200mm drainage layer
- Subsoil drains directly to table drain outlet in Edgewater Drive (i.e. no secondary treatments).

The raingardens will also offer benefits to residents by providing aesthetic qualities and habitat for wildlife.

5.7.4 Detention Basins

Constructed detention basins are deeper water bodies that use sedimentation settling processes to remove pollutants from stormwater.

For this development, it is proposed to construct two detention basins at the end of the treatment train so as to provide attenuation of post-development flows.

Even though the detention basins modelled in version 4 of MUSIC actually have minimal water quality benefits, it is necessary that they be included in the treatment train to mimic the actual conditions expected.

The detention basins will also offer benefits to residents by providing aesthetic qualities and habitat for wildlife (some existing vegetation can be preserved in the detention basins).

5.7.5 Preservation of Native Vegetation

Even though this has not been modelled in MUSIC, all native vegetation should be retained on site wherever possible. Vegetation should only be cleared within the building and road construction envelopes (although an ecological offset agreement has been negotiated on this site, which allows for greater reductions in existing vegetation). Where landscaping is designed for the development, the use of native vegetation is encouraged.

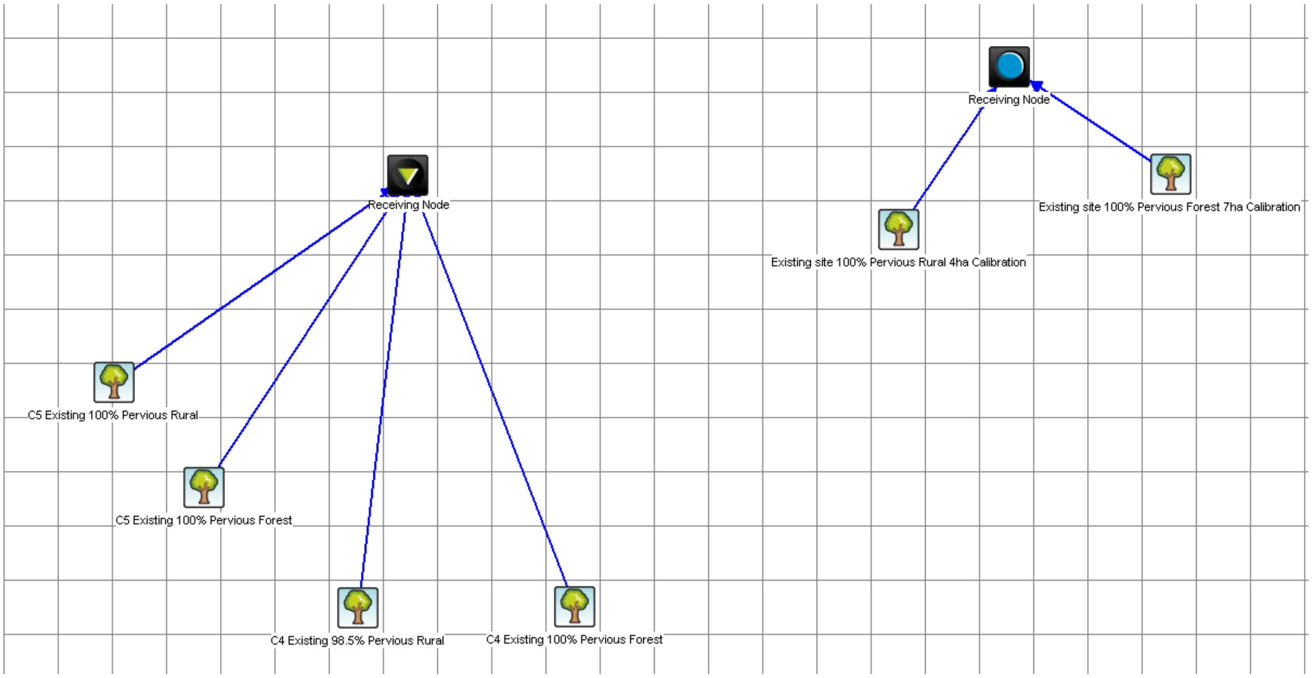


Figure 3: Pre-developed site

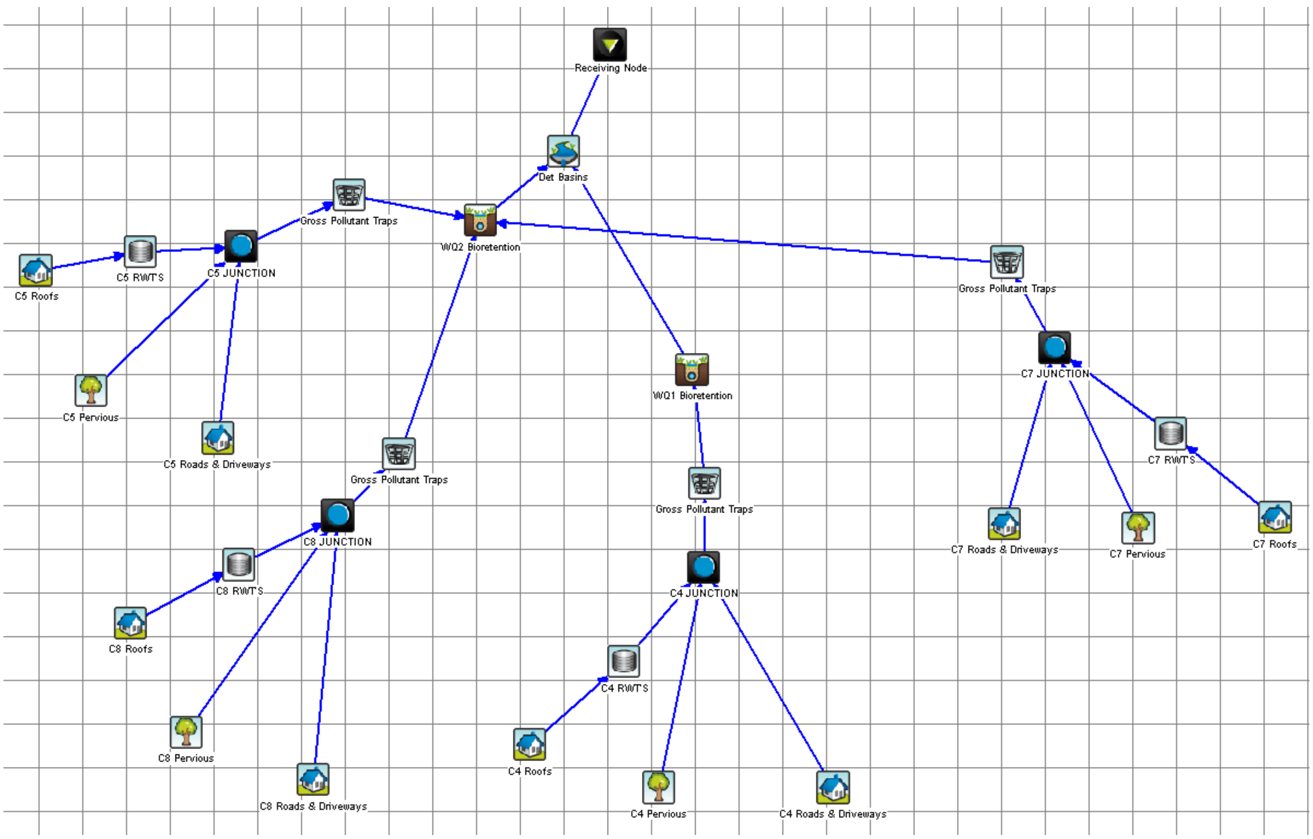


Figure 4: Post-developed site with treatment
(see Appendix B.2 for more detail)

5.8 Model Results

Table 6 presents the average annual pollutant export loads at the downstream extent of the entire subject site under the pre and post developed conditions (with and without treatment).

Table 6 - Annual Average Pollutant Export Loads

Pollutant	Proposed Development Catchment			
	Existing Site Load (kg/yr)	**Developed Site Load (without treatment) (kg/yr)**	**Developed Site Load (with treatment) (kg/yr)**	**% Reduction**
Gross Pollutants	12.4	1440	0.01	**100**
TSS	1430	11900	1050	**91.2**
TP	3.34	24.1	6.60	**72.6**
TN	34.8	161	88.3	**45.1**

The results in Table 6 indicate that the proposed stormwater management strategy would meet or exceed the water quality objectives for the site, which were:

- Post development loads of Gross Pollutants, TSS, TN and TP are to be reduced by 70%, 80%, 45% and 45% respectively compared to the untreated post developed pollutant loads.

The MUSIC output files are attached in Appendix B.

As a side note, the 3kL rainwater tanks meet approximately 50% of the re-use demand for individual households (i.e. potable water use still required).

Refer to the Stormwater Strategy Plan for the locality, size and details of the proposed stormwater treatment measures.

5.9 Construction Stage

Water quality during the construction stage will be addressed by a Stormwater Management plan prepared in accordance with NSW Department of Housing “Blue Book” 2004, and form part of the final detailed civil engineering drawings.

5.10 Maintenance

An Operations and Maintenance Manual is to be prepared for the stormwater quality devices proposed for the development. This document will be prepared at the construction certificate stage in accordance with final DA conditions.

6 SUMMARY

6.1 Stormwater Quantity Summary

6.1.1 Q_5 Peak Storm Event

This strategy has demonstrated that the criterion for stormwater runoff has been met. That is, to ensure that developed runoff from the site is less than or equal to the undeveloped flow from the site for the 5 yr ARI peak storm event.

The utilisation of detention in the detention basins and water quality raingardens will attenuate captured stormwater runoff equal to or less than to pre-developed conditions. The peak discharge from the 5 year ARI peak storm events satisfactorily complies to being equal to the pre-developed discharges (see Table 6).

Additionally, the modelling shows that for the 5 year ARI peak storm event, the peak water level reached in the detention pond will be RL5.32m AHD. This demonstrates that for the Q_5 peak storm event, stormwater will be contained within the detention basins without overtopping.

6.1.2 Q_{100} Peak Storm Event

This strategy has demonstrated that the criterion for stormwater runoff has been met. That is, to ensure that developed runoff from the site is less than or equal to the undeveloped flow from the site for the 100 yr ARI peak storm event.

The utilisation of detention in the detention basins and water quality raingardens will attenuate captured stormwater runoff equal to or less than to pre-developed conditions. The peak discharge from the 100 year ARI peak storm events are equal or less than the pre-developed discharges (see Table 6).

The summary table below sets out existing and post-developed flows for the subject development, for the peak 5 yr and 100 yr ARI storm events.

The modelling shows that for the 100 year ARI peak storm event, the peak water level reached within the site will be RL5.9m AHD. This demonstrates that for the Q_{100} peak storm event, stormwater will be contained within the site catchment without flooding adjacent properties.

This level also gives a freeboard of 0.5m to the lowest adjacent proposed property floor levels.

The summary table below sets out existing and post-developed flows for the subject development, as well as maximum water levels reached within the site for the peak 5 yr and 100 yr ARI storm events.

Table 7 – Summary of Stormwater Quantity

NODE	Q_5	Q_5	Q_5	Q_{100}	Q_{100}	Q_{100}
	Natural	**Developed**	**Detention**	**Natural**	**Developed**	**Detention**
		(No measures)	(Detention Basins)		(No measures)	(Detention Basins)
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
Outlet West (A)	1.91	3.83	1.88	3.83	6.23	3.76
Outlet East (B)	0.80	0.80	0.80	1.33	1.33	1.33
Total	**2.71**	**4.63**	**2.68**	**5.16**	**7.55**	**5.08**

Table 8 – Summary of Stormwater Measures

NODE	WQ1 (Bioretention Pond 1)		WQ2 (Bioretention Pond 2)	
Base RL (mAHD)	6.35		5.70	
Side Batters	1:3 (Fenced at Southern End)		1:3	
Pond Depth (m)	0.45 to Wall R.L6.80 (0.30 to Weir)		0.35 to Wall R.L6.05 (0.25 to Weir)	
Permanent Pool depth (m)	0		0	
Total Volume (m^3)	220 (to Wall)		214 (to Wall)	
Spillway Level RL (mAHD)	6.65		5.95	
Spillway Length (m)	6		18	
Spillway Depth (m)	0.15		0.1	
Pipe Slope (%)	Subsoil to Outlet based on 180mm/hr through media		Subsoil to Outlet based on 180mm/hr through media	
Pipe Length (m)	-		-	
Pipe Outlet (mm)	-		-	
ARI	Q_5	Q_{100}	Q_5	Q_{100}
Storm Event (mins)	120	120	120	120
Peak Water Depth (m)	0.37	0.37	0.33	0.33
Peak Water RL (mAHD)	6.72	6.72	6.03	6.03
Total Pond Outflow (m^3/s)	0.22	0.22	0.74	0.74
Pipe Discharge (m^3/s)	0.017 (Subsoil)	0.017 (Subsoil)	0.028 (Subsoil)	0.028 (Subsoil)
Weir Flow (m^3/s)	0.20	0.20	0.71	0.71
Weir Flow Depth (m)	0.07	0.07	0.08	0.08
Weir Velocity (m/s)	0.46	0.46	0.49	0.49
Vy Product (m^2/s)	0.03	0.03	0.04	0.04

NODE	DB (Detention Basin 1 & 2)		CP1 (Caravan Park Detention Basin)	
Base RL (mAHD)	4.60		5.60	
Side Batters	1:6		1:5	
Pond Depth (m)	1.25 to Wall R.L5.85 (1.08 to Weir)		0.60 to Wall R.L6.20 (0.45 to Weir)	
Permanent Pool depth (m)	0		0	
Total Volume (m^3)	3146 (to Wall)		300 (Above Perm. Pool Level to Wall)	
Spillway Level RL (mAHD)	5.68		6.05	
Spillway Length (m)	6 x 2		4	
Spillway Depth (m)	0.17		0.15	
Pipe Slope (%)	0.5		0.5	
Pipe Length (m)	15		15	
Pipe Outlet (mm)	1200 x 450 RCBC (Detention Basin 1)		3 x 450dia RCPs	
	1200 x 450 RCBC (Detention Basin 2)			
ARI	Q_5	Q_{100}	Q_5	Q_{100}
Storm Event (mins)	120	120	120	120
Peak Water Depth (m)	0.72	1.21	0.33	0.51
Peak Water RL (mAHD)	5.32	5.81	5.93	6.11
Total Pond Outflow (m^3/s)	1.88	3.76	0.33	0.62
Pipe Discharge (m^3/s)	1.88	2.76	0.33	0.53
Weir Flow (m^3/s)	-	1.00	-	0.09
Weir Flow Depth (m)	-	0.13	-	0.06
Weir Velocity (m/s)	-	0.62	-	0.41
Vy Product (m^2/s)	-	0.08	-	0.02

6.2 Stormwater Quality Summary

A combination of measures discussed above including rainwater tanks, gross pollutant traps, detention basins and water quality raingardens have been proposed to manage the discharge of nutrients and pollutants leaving the site.

Table 9 below summarises the MUSIC modelling, which shows that the post development loads of Gross Pollutants, TSS, TN and TP were to be reduced by 70%, 80%, 45% and 45% respectively compared to the untreated post developed pollutants has been met on the subject site.

An Operations and Maintenance Manual is to be prepared for the stormwater quality devices proposed for the development. This document will be prepared at the construction certificate stage in accordance with final DA conditions.

Table 9 - Annual Average Pollutant Export Loads

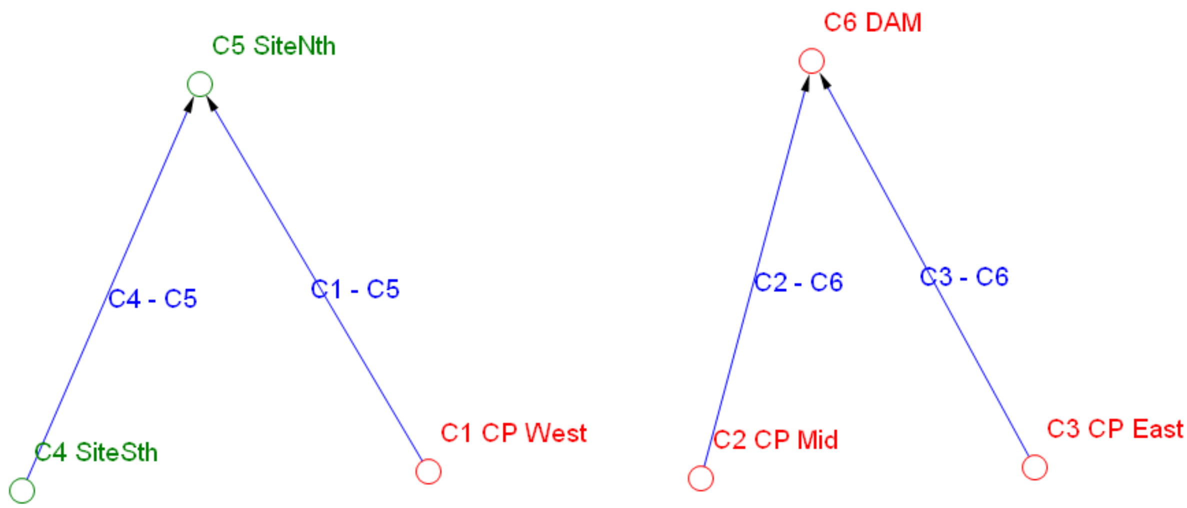
Pollutant	**Proposed Development Catchment**			
	Existing Site Load (kg/yr)	**Developed Site Load (without treatment) (kg/yr)**	**Developed Site Load (with treatment) (kg/yr)**	**% Reduction**
Gross Pollutants	12.4	1440	0.01	**100**
TSS	1430	11900	1050	**91.2**
TP	3.34	24.1	6.60	**72.6**
TN	34.8	161	88.3	**45.1**

PHILLIP J. LIDBURY

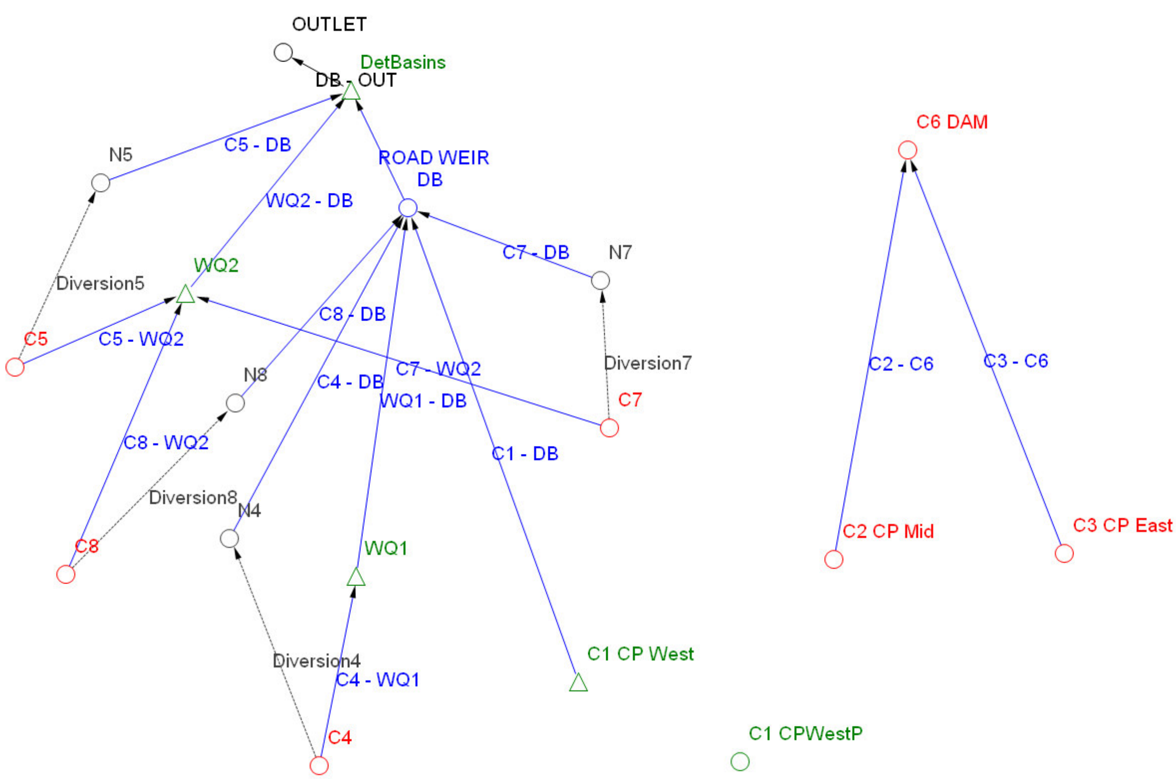
LIDBURY, SUMMERS & WHITEMAN

A HYDRAULIC OUTPUT FILES

A.1 XP-Rafts Schematic Layout (Existing)



A.1.1 Rafts Schematic Layout (Developed)



A.2 Catchment Summary

CATCHMENT DATA **EXISTING**

Node	Description	Area Total (ha)	Area Imp (ha)	Percentage Impervious (%)	Area Perv (ha)	Percentage Pervious (%)	Average Slope (%)
Existing							
Catch 01	Caravan Park West	1.577	0.700	44.4%	0.877	55.6%	3.5%
Catch 02	Caravan Park Mid	0.606	0.545	90.0%	0.061	10.0%	2.7%
Catch 03	Caravan Park East	1.430	0.850	59.4%	0.580	40.6%	1.5%
Catch 04	Site South	5.494	0.080	1.5%	5.414	98.5%	6.0%
Catch 05	Site North	5.506	0.000	0.0%	5.506	100.0%	6.3%
Catch 06	Site East Dam	1.072	0.000	0.0%	1.072	100.0%	1.0%
		15.685	**2.18**	**(13.9%)**	**13.51**	**(86.1%)**	

CATCHMENT DATA **POST DEVELOPED**

Node	Description	Area Total (ha)	Area Imp (ha)	Percentage Impervious (%)	Area Perv (ha)	Percentage Pervious (%)	Comments
Post Developed							
Catch 01	Caravan Park West	1.577	**0.000**	0.0%	1.577	100.0%	**As per Existing but with Det Basin to reduce to pervious only**
Catch 02	Caravan Park Mid	0.606	0.545	90.0%	0.061	10.0%	As per Existing
Catch 03	Caravan Park East	1.430	0.850	59.4%	0.580	40.6%	As per Existing
Catch 04	Site South Dev	2.409	1.154	47.9%	1.255	52.1%	Impervious only to C4
Catch 05	Site North West Dev	2.981	1.750	58.7%	1.231	41.3%	Pervious from C4 into C5
Catch 06	Site East Dam	1.072	0.000	0.0%	1.072	100.0%	As per Existing
Catch 07	Site North East Dev	1.337	1.023	76.5%	0.314	23.5%	Allow for Med Density
Catch 08	Site Middle	4.278	1.533	35.8%	2.746	64.2%	Pervious from part C5 into C8
		15.690	**6.86**	**(43.7%)**	**8.83**	**(56.3%)**	

A.3 Rafts-XP Output Summary

NODE	Q_5	Q_5	Q_5	Q_{100}	Q_{100}	Q_{100}
	Natural	**Developed**	**Detention**	**Natural**	**Developed**	**Detention**
		(No measures)	(Detention Basins)		(No measures)	(Detention Basins)
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
Outlet West (A)	1.91	3.83	1.88	3.83	6.23	3.76
Outlet East (B)	0.80	0.80	0.80	1.33	1.33	1.33
Total	**2.71**	**4.63**	**2.68**	**5.16**	**7.55**	**5.08**

NODE	WQ1 (Bioretention Pond 1)		WQ2 (Bioretention Pond 2)	
Base RL (mAHD)	6.35		5.70	
Side Batters	1:3 (Fenced at Southern End)		1:3	
Pond Depth (m)	0.45 to Wall R.L6.80 (0.30 to Weir)		0.35 to Wall R.L6.05 (0.25 to Weir)	
Permanent Pool depth (m)	0		0	
Total Volume (m^3)	220 (to Wall)		214 (to Wall)	
Spillway Level RL (mAHD)	6.65		5.95	
Spillway Length (m)	6		18	
Spillway Depth (m)	0.15		0.1	
Pipe Slope (%)	Subsoil to Outlet based on 180mm/hr through media		Subsoil to Outlet based on 180mm/hr through media	
Pipe Length (m)	-		-	
Pipe Outlet (mm)	-		-	
ARI	Q_5	Q_{100}	Q_5	Q_{100}
Storm Event (mins)	120	120	120	120
Peak Water Depth (m)	0.37	0.37	0.33	0.33
Peak Water RL (mAHD)	6.72	6.72	6.03	6.03
Total Pond Outflow (m^3/s)	0.22	0.22	0.74	0.74
Pipe Discharge (m^3/s)	0.017 (Subsoil)	0.017 (Subsoil)	0.028 (Subsoil)	0.028 (Subsoil)
Weir Flow (m^3/s)	0.20	0.20	0.71	0.71
Weir Flow Depth (m)	0.07	0.07	0.08	0.08
Weir Velocity (m/s)	0.46	0.46	0.49	0.49
Vy Product (m^2/s)	0.03	0.03	0.04	0.04

NODE	DB (Detention Basin 1 & 2)		CP1 (Caravan Park Detention Basin)	
Base RL (mAHD)	4.60		5.60	
Side Batters	1:6		1:5	
Pond Depth (m)	1.25 to Wall R.L5.85 (1.08 to Weir)		0.60 to Wall R.L6.20 (0.45 to Weir)	
Permanent Pool depth (m)	0		0	
Total Volume (m^3)	3146 (to Wall)		300 (Above Perm. Pool Level to Wall)	
Spillway Level RL (mAHD)	5.68		6.05	
Spillway Length (m)	6 x 2		4	
Spillway Depth (m)	0.17		0.15	
Pipe Slope (%)	0.5		0.5	
Pipe Length (m)	15		15	
Pipe Outlet (mm)	1200 x 450 RCBC (Detention Basin 1)		3 x 450dia RCPs	
	1200 x 450 RCBC (Detention Basin 2)			
ARI	Q_5	Q_{100}	Q_5	Q_{100}
Storm Event (mins)	120	120	120	120
Peak Water Depth (m)	0.72	1.21	0.33	0.51
Peak Water RL (mAHD)	5.32	5.81	5.93	6.11
Total Pond Outflow (m^3/s)	1.88	3.76	0.33	0.62
Pipe Discharge (m^3/s)	1.88	2.76	0.33	0.53
Weir Flow (m^3/s)	-	1.00	-	0.09
Weir Flow Depth (m)	-	0.13	-	0.06
Weir Velocity (m/s)	-	0.62	-	0.41
Vy Product (m^2/s)	-	0.08	-	0.02

A.4 Rafts Q5 Existing Discharge Output File (West)

```
 LINK C4 SiteSth        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                  2.620
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.81
 ESTIMATED TIME TO PEAK         (MINS) =               46.00

 LINK C1 CP West        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.8568
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.43
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK C5 SiteNth        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                  6.098
 ESTIMATED PEAK FLOW         (CUMECS) =                  1.9
 ESTIMATED TIME TO PEAK         (MINS) =               45.00

                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =       120.
                              RETURN PERIOD (YRS)      =         5.
                              BX                       =     1.0000
                              TOTAL OF FIRST SUB-AREAS  (ha) =       0.78
                              TOTAL OF SECOND SUB-AREAS (ha) =      11.80
                              TOTAL OF ALL SUB-AREAS (ha)    =      12.58

     SUMMARY OF CATCHMENT AND RAINFALL DATA
 Link       Catch. Area       Slope     % Impervious      Pern         B        Link
 Label       #1      #2      #1     #2       #1    #2      #1     #2     #1    #2      No.
            (ha)                (%)              (%)
C4 SiteSth0.0800  5.414  6.000 6.000  100.0 0.000  .015 .060  .0002 .0495  1.000
C1 CP West0.7000 0.8770  3.500 3.500  100.0 0.000  .015 .030  .0007 .0147  2.000
C5 SiteNth.00001  5.506  .0010 6.300  100.0 0.000  .025 .060  .0002 .0487  1.001


 Link     Average  Init. Loss   Cont. Loss     Excess Rain    Peak     Time    Link
 Label   Intensity  #1     #2     #1     #2       #1     #2     Inflow    to      Lag
          (mm/h)     ( mm )      (mm/h)         ( mm )      (m^3/s)   Peak    mins
C4 SiteSth31.477 1.500 10.00  0.000 2.500  61.455 48.788  0.8098  46.00 0.000
C1 CP West31.477 1.500 10.00  0.000 2.500  61.455 48.788  0.4324  35.00 0.000
C5 SiteNth31.477 1.500 10.00  0.000 2.500  61.455 48.788   1.908   45.00 0.000
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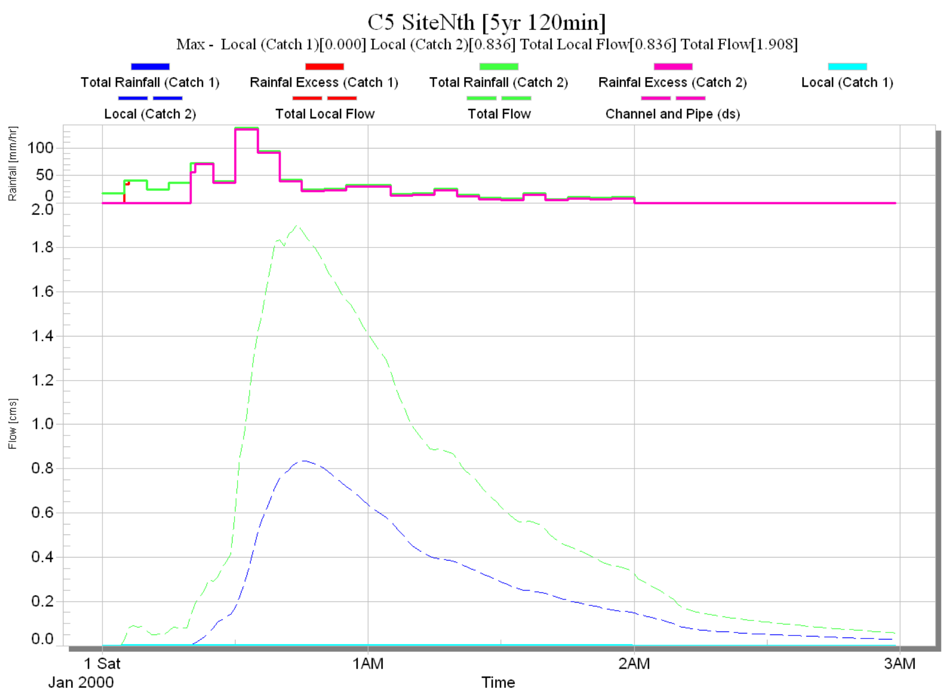


A.4.1 Rafts Q5 Existing Discharge Output File (East)

```
LINK C2 CP Mid          1.000

ESTIMATED VOLUME (CU METRES*10**3) =                 0.3236
ESTIMATED PEAK FLOW          (CUMECS) =                0.24
ESTIMATED TIME TO PEAK          (MINS) =              27.00

LINK C3 CP East         1.000

ESTIMATED VOLUME (CU METRES*10**3) =                 0.7072
ESTIMATED PEAK FLOW          (CUMECS) =                0.44
ESTIMATED TIME TO PEAK          (MINS) =              30.00

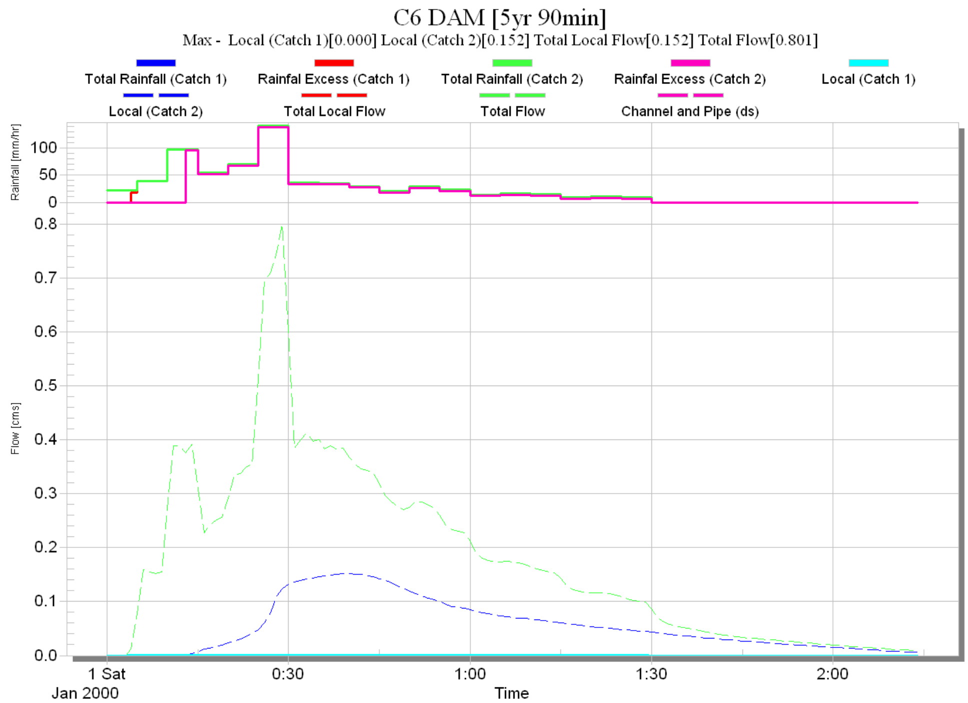
LINK C6 DAM             1.000

ESTIMATED VOLUME (CU METRES*10**3) =                  1.474
ESTIMATED PEAK FLOW          (CUMECS) =                0.80
ESTIMATED TIME TO PEAK          (MINS) =              30.00

                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =        90.
                              RETURN PERIOD (YRS)      =         5.
                              BX                       =     1.0000
                              TOTAL OF FIRST SUB-AREAS  (ha) =       1.40
                              TOTAL OF SECOND SUB-AREAS (ha) =       1.71
                              TOTAL OF ALL SUB-AREAS (ha)    =       3.11

    SUMMARY OF CATCHMENT AND RAINFALL DATA
Link      Catch. Area       Slope     % Impervious      Pern         B        Link
Label       #1      #2      #1     #2       #1    #2      #1     #2     #1    #2      No.
           (ha)                 (%)             (%)
C2 CP Mid 0.5450 0.0610  2.700 2.700  100.0 0.000  .015 .030  .0007 .0042  1.000
C3 CP East0.8500 0.5800  1.500 1.500  100.0 0.000  .015 .030  .0011 .0181  2.000
C6 DAM    .00001  1.072  .0010 1.000  100.0 0.000  .025 .030  .0002 .0305  1.001


Link     Average  Init. Loss   Cont. Loss     Excess Rain    Peak     Time    Link
Label   Intensity  #1     #2    #1     #2       #1     #2     Inflow    to      Lag
          (mm/h)     ( mm )      (mm/h)         ( mm )      (m^3/s)   Peak    mins
C2 CP Mid 37.394 1.500 10.00  0.000 2.500  54.591 42.864  0.2404  27.00 0.000
C3 CP East37.394 1.500 10.00  0.000 2.500  54.591 42.864  0.4439  30.00 0.000
C6 DAM    37.394 1.500 10.00  0.000 2.500  54.591 42.864  0.8012  30.00 0.000
```



A.5 Rafts Q100 Existing Discharge Output File (West)

```
LINK C4 SiteSth        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 4.855
 ESTIMATED PEAK FLOW         (CUMECS) =                 1.6
 ESTIMATED TIME TO PEAK         (MINS) =              43.00

 LINK C1 CP West        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 1.501
 ESTIMATED PEAK FLOW         (CUMECS) =                0.71
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

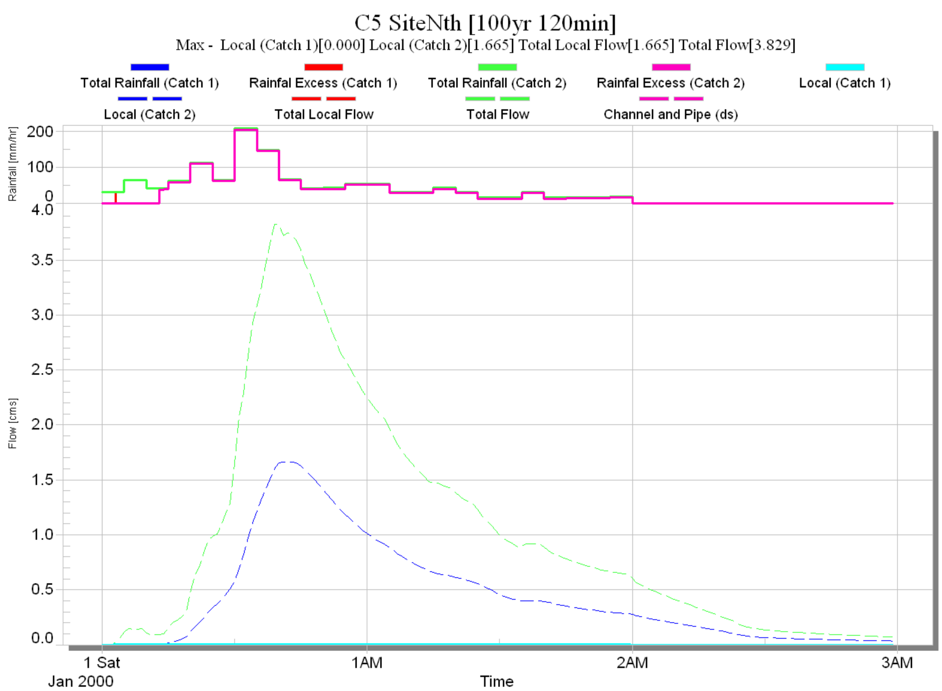
 LINK C5 SiteNth        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 11.21
 ESTIMATED PEAK FLOW         (CUMECS) =                 3.8
 ESTIMATED TIME TO PEAK         (MINS) =              40.00

                               ROUTING INCREMENT (MINS) =       1.00
                               STORM DURATION (MINS)    =       120.
                               RETURN PERIOD (YRS)      =       100.
                               BX                       =     1.0000
                               TOTAL OF FIRST SUB-AREAS  (ha) =       0.78
                               TOTAL OF SECOND SUB-AREAS (ha) =      11.80
                               TOTAL OF ALL SUB-AREAS (ha)    =      12.58

      SUMMARY OF CATCHMENT AND RAINFALL DATA
 Link      Catch. Area      Slope    % Impervious     Pern         B        Link
 Label       #1      #2     #1    #2      #1    #2     #1    #2     #1    #2      No.
            (ha)             (%)             (%)
C4 SiteSth0.0800  5.414  6.000 6.000  100.0 0.000  .015 .060  .0002 .0495  1.000
C1 CP West0.7000 0.8770  3.500 3.500  100.0 0.000  .015 .030  .0007 .0147  2.000
C5 SiteNth.00001  5.506  .0010 6.300  100.0 0.000  .025 .060  .0002 .0487  1.001


 Link    Average  Init. Loss  Cont. Loss    Excess Rain   Peak     Time   Link
 Label  Intensity  #1    #2    #1    #2      #1    #2    Inflow   to     Lag
          (mm/h)    ( mm )     (mm/h)        ( mm )     (m^3/s)  Peak   mins
C4 SiteSth51.978 1.500 10.00  0.000 2.500  102.46 89.497   1.627  43.00 0.000
C1 CP West51.978 1.500 10.00  0.000 2.500  102.46 89.497  0.7097  35.00 0.000
C5 SiteNth51.978 1.500 10.00  0.000 2.500  102.46 89.497   3.829  40.00 0.000
```



A.5.1 Rafts Q100 Existing Discharge Output File (East)

```
LINK C2 CP Mid         1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                0.5419
 ESTIMATED PEAK FLOW         (CUMECS) =                0.37
 ESTIMATED TIME TO PEAK         (MINS) =              27.00

 LINK C3 CP East        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 1.221
 ESTIMATED PEAK FLOW         (CUMECS) =                0.71
 ESTIMATED TIME TO PEAK         (MINS) =              30.00

 LINK C6 DAM            1.000

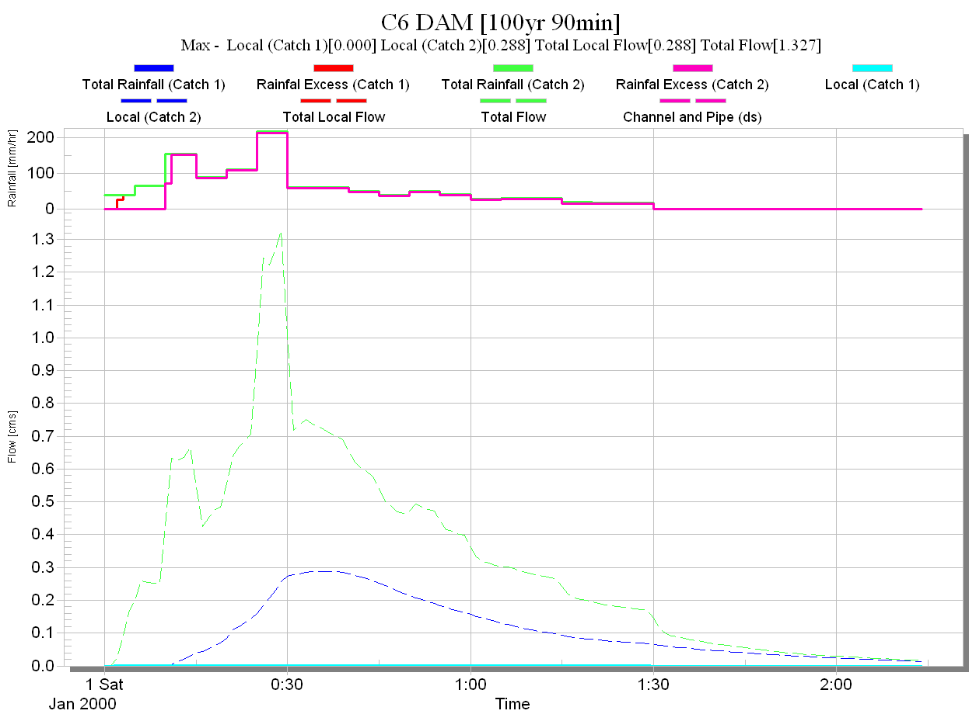
 ESTIMATED VOLUME (CU METRES*10**3) =                 2.589
 ESTIMATED PEAK FLOW         (CUMECS) =                 1.3
 ESTIMATED TIME TO PEAK         (MINS) =              30.00

                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =        90.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     1.0000
                              TOTAL OF FIRST SUB-AREAS  (ha) =       1.40
                              TOTAL OF SECOND SUB-AREAS (ha) =       1.71
                              TOTAL OF ALL SUB-AREAS (ha)    =       3.11
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1 (%)	#2	Pern #1	#2	B #1	#2	Link No.
C2 CP Mid	0.5450	0.0610	2.700	2.700	100.0	0.000	.015	.030	.0007	.0042	1.000
C3 CP East	0.8500	0.5800	1.500	1.500	100.0	0.000	.015	.030	.0011	.0181	2.000
C6 DAM	.00001	1.072	.0010	1.000	100.0	0.000	.025	.030	.0002	.0305	1.001

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	#2	Cont. Loss #1 (mm/h)	#2	Excess Rain #1 (mm)	#2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
C2 CP Mid	61.428	1.500	10.00	0.000	2.500	90.642	78.809	0.3733	27.00	0.000
C3 CP East	61.428	1.500	10.00	0.000	2.500	90.642	78.809	0.7129	30.00	0.000
C6 DAM	61.428	1.500	10.00	0.000	2.500	90.642	78.809	**1.327**	30.00	0.000



A.6 Rafts Q5 Developed Discharge Output File (West)

```
LINK C5                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                  1.674
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.94
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK C7                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.7783
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.41
 ESTIMATED TIME TO PEAK         (MINS) =               34.00

 LINK C8                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                  2.277
 ESTIMATED PEAK FLOW         (CUMECS) =                  1.1
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK WQ2                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                  3.461
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.74
 ESTIMATED TIME TO PEAK         (MINS) =               31.00

 LINK N5                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.4078
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.65
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK C1 CP West         1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.8568
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.43
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK N7                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.1537
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.28
 ESTIMATED TIME TO PEAK         (MINS) =               34.00

 LINK N8                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.7073
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.82
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK C4                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                  1.320
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.70
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK N4                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.3425
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.49
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK WQ1                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 0.9774
 ESTIMATED PEAK FLOW         (CUMECS) =                 0.22
 ESTIMATED TIME TO PEAK         (MINS) =               31.00

 LINK DB                 1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                  2.934
 ESTIMATED PEAK FLOW         (CUMECS) =                  2.0
 ESTIMATED TIME TO PEAK         (MINS) =               35.00

 LINK DetBasins          1.000
```

ESTIMATED VOLUME (CU METRES*10**3) = 6.682
ESTIMATED PEAK FLOW (CUMECS) = 3.4
ESTIMATED TIME TO PEAK (MINS) = 35.00

LINK OUTLET 1.000

ESTIMATED VOLUME (CU METRES*10**3) = 6.476
ESTIMATED PEAK FLOW (CUMECS) = 1.9
ESTIMATED TIME TO PEAK (MINS) = 46.00

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 5.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 6.16
TOTAL OF SECOND SUB-AREAS (ha) = 6.42
TOTAL OF ALL SUB-AREAS (ha) = 12.58

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
C5	1.750	1.231	6.300	6.300	100.0	0.000	.015	.030	.0008	.0131	1.000
C7	1.023	0.3140	.5000	.5000	100.0	0.000	.015	.030	.0021	.0228	2.000
C8	1.533	2.745	6.300	6.300	100.0	0.000	.015	.030	.0007	.0199	3.000
WQ2	.00001	0.000	6.300	0.000	0.000	0.000	.015	0.00	0.000	0.000	1.001
N5	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	4.000
C1 CP West	0.7000	0.8770	3.500	3.500	100.0	0.000	.015	.030	.0007	.0147	5.000
N7	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	6.000
N8	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	7.000
C4	1.154	1.255	6.000	6.000	100.0	0.000	.015	.030	.0007	.0136	8.000
N4	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.000
WQ1	.00001	0.000	6.000	0.000	100.0	0.000	.015	0.00	0.000	0.000	8.001
DB	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	5.001
DetBasins	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.002
OUTLET	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.003

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
C5	31.477	1.500	10.00	0.000	2.500	61.455	48.788	0.9424	35.00	0.000
C7	31.477	1.500	10.00	0.000	2.500	61.455	48.788	0.4114	34.00	0.000
C8	31.477	1.500	10.00	0.000	2.500	61.455	48.788	1.130	35.00	0.000
WQ2	31.477	1.500	0.000	0.000	0.000	61.455	0.000	0.7380	31.00	0.000
N5	31.477	10.00	0.000	2.500	0.000	48.788	0.000	0.6514	35.00	0.000
C1 CP West	31.477	1.500	10.00	0.000	2.500	61.455	48.788	0.4324	35.00	0.000
N7	31.477	1.500	0.000	0.000	0.000	61.455	0.000	0.2774	34.00	0.000
N8	31.477	10.00	0.000	2.500	0.000	48.788	0.000	0.8166	35.00	0.000
C4	31.477	1.500	10.00	0.000	2.500	61.455	48.788	0.7046	35.00	0.000
N4	31.477	10.00	0.000	2.500	0.000	48.788	0.000	0.4896	35.00	0.000
WQ1	31.477	1.500	0.000	0.000	0.000	61.455	0.000	0.2150	31.00	0.000
DB	31.477	10.00	0.000	2.500	0.000	48.788	0.000	2.035	35.00	0.000
DetBasins	31.477	10.00	0.000	2.500	0.000	48.788	0.000	3.425	35.00	0.000
OUTLET	31.477	10.00	0.000	2.500	0.000	48.788	0.000	**1.877**	46.00	0.000

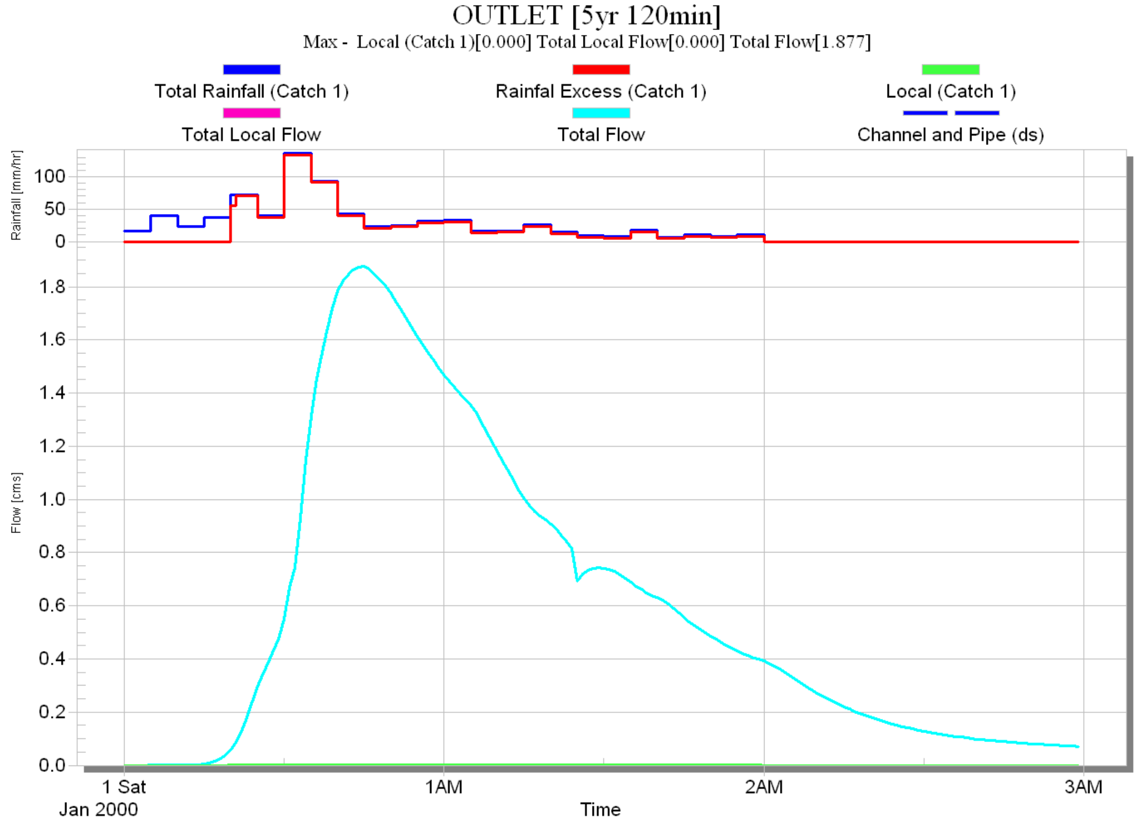
SUMMARY OF BASIN RESULTS

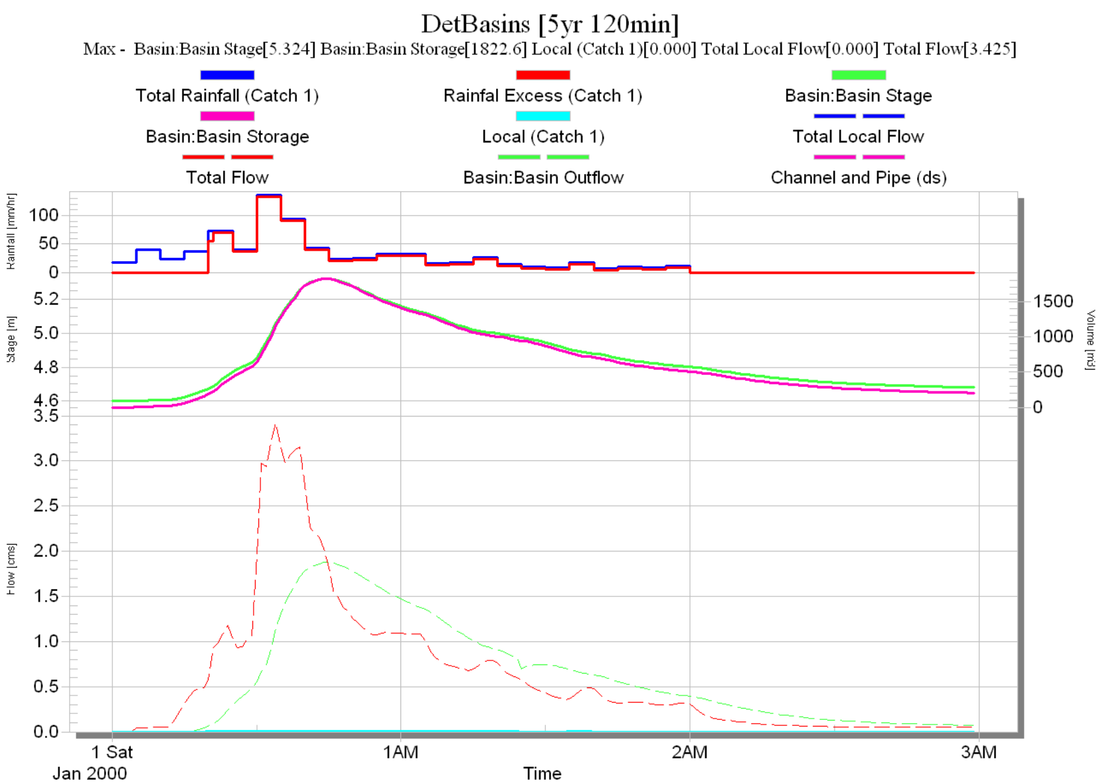
Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
WQ2	31.00	.7380	37.00	.7380	3460.7	0.0000	202.59	6.0314
C1 CP West	35.00	.4324	41.00	.3337	856.76	0.0000	165.59	5.9310
WQ1	31.00	.2150	46.00	.2150	977.35	0.0000	151.36	6.7222
DetBasins	35.00	3.424	46.00	**1.876**	6682.2	0.0000	1822.6	**5.3243**

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
WQ2	3.0	1.000		0.000	20.000	0.5000
C1 CP West	3.0		.4500	0.000	15.000	0.5000

```
WQ1        2.0     1.000          0.000     20.000  0.5000
DetBasins  9.0            .3750   0.000     15.000  0.5000
```





A.7 Rafts Q100 Developed Discharge Output File (West)

```
LINK C5                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 2.894
 ESTIMATED PEAK FLOW         (CUMECS) =                 1.5
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK C7                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 1.323
 ESTIMATED PEAK FLOW         (CUMECS) =                0.64
 ESTIMATED TIME TO PEAK         (MINS) =              33.00

 LINK C8                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 4.023
 ESTIMATED PEAK FLOW         (CUMECS) =                 1.9
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK WQ2               1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 4.599
 ESTIMATED PEAK FLOW         (CUMECS) =                0.74
 ESTIMATED TIME TO PEAK         (MINS) =              31.00

 LINK N5                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 1.165
 ESTIMATED PEAK FLOW         (CUMECS) =                 1.2
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK C1 CP West        1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 1.501
 ESTIMATED PEAK FLOW         (CUMECS) =                0.71
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK N7                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                0.4939
 ESTIMATED PEAK FLOW         (CUMECS) =                0.51
 ESTIMATED TIME TO PEAK         (MINS) =              33.00

 LINK N8                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 1.982
 ESTIMATED PEAK FLOW         (CUMECS) =                 1.6
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK C4                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 2.305
 ESTIMATED PEAK FLOW         (CUMECS) =                 1.2
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK N4                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                0.9894
 ESTIMATED PEAK FLOW         (CUMECS) =                0.96
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK WQ1               1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 1.315
 ESTIMATED PEAK FLOW         (CUMECS) =                0.22
 ESTIMATED TIME TO PEAK         (MINS) =              31.00

 LINK DB                1.000

 ESTIMATED VOLUME (CU METRES*10**3) =                 6.171
 ESTIMATED PEAK FLOW         (CUMECS) =                 3.7
 ESTIMATED TIME TO PEAK         (MINS) =              35.00

 LINK DetBasins         1.000
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```
ESTIMATED VOLUME (CU METRES*10**3) =                 11.81
ESTIMATED PEAK FLOW         (CUMECS) =                 5.7
ESTIMATED TIME TO PEAK         (MINS) =              35.00

iosd llkta         0         21
LINK OUTLET              1.000

ESTIMATED VOLUME (CU METRES*10**3) =                 11.58
ESTIMATED PEAK FLOW         (CUMECS) =                 3.8
ESTIMATED TIME TO PEAK         (MINS) =              42.00

                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =       120.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     1.0000
                              TOTAL OF FIRST SUB-AREAS  (ha) =       6.16
                              TOTAL OF SECOND SUB-AREAS (ha) =       6.42
                              TOTAL OF ALL SUB-AREAS (ha)    =      12.58
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2	Slope #1 (%)	Slope #2	% Impervious #1 (%)	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
C5	1.750	1.231	6.300	6.300	100.0	0.000	.015	.030	.0008	.0131	1.000
C7	1.023	0.3140	.5000	.5000	100.0	0.000	.015	.030	.0021	.0228	2.000
C8	1.533	2.745	6.300	6.300	100.0	0.000	.015	.030	.0007	.0199	3.000
WQ2	.00001	0.000	6.300	0.000	0.000	0.000	.015	0.00	0.000	0.000	1.001
N5	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	4.000
C1 CP West	0.7000	0.8770	3.500	3.500	100.0	0.000	.015	.030	.0007	.0147	5.000
N7	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	6.000
N8	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	7.000
C4	1.154	1.255	6.000	6.000	100.0	0.000	.015	.030	.0007	.0136	8.000
N4	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.000
WQ1	.00001	0.000	6.000	0.000	100.0	0.000	.015	0.00	0.000	0.000	8.001
DB	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	5.001
DetBasins	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.002
OUTLET	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.003

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
C5	51.978	1.500	10.00	0.000	2.500	102.46	89.497	1.519	35.00	0.000
C7	51.978	1.500	10.00	0.000	2.500	102.46	89.497	0.6425	33.00	0.000
C8	51.978	1.500	10.00	0.000	2.500	102.46	89.497	1.921	35.00	0.000
WQ2	51.978	1.500	0.000	0.000	0.000	102.46	0.000	0.7380	31.00	0.000
N5	51.978	10.00	0.000	2.500	0.000	89.497	0.000	1.228	35.00	0.000
C1 CP West	51.978	1.500	10.00	0.000	2.500	102.46	89.497	0.7097	35.00	0.000
N7	51.978	1.500	0.000	0.000	0.000	102.46	0.000	0.5085	33.00	0.000
N8	51.978	10.00	0.000	2.500	0.000	89.497	0.000	1.608	35.00	0.000
C4	51.978	1.500	10.00	0.000	2.500	102.46	89.497	1.177	35.00	0.000
N4	51.978	10.00	0.000	2.500	0.000	89.497	0.000	0.9624	35.00	0.000
WQ1	51.978	1.500	0.000	0.000	0.000	102.46	0.000	0.2150	31.00	0.000
DB	51.978	10.00	0.000	2.500	0.000	89.497	0.000	3.689	35.00	0.000
DetBasins	51.978	10.00	0.000	2.500	0.000	89.497	0.000	5.655	35.00	0.000
OUTLET	51.978	10.00	0.000	2.500	0.000	89.497	0.000	**3.757**	42.00	0.000

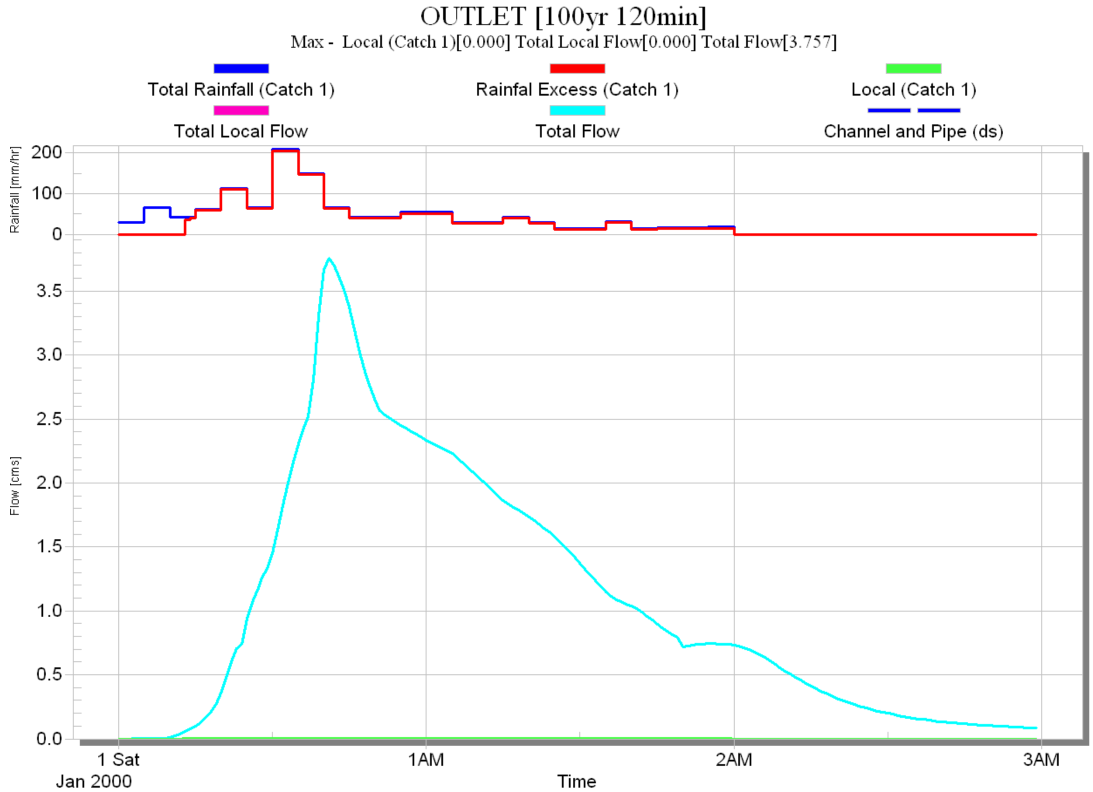
SUMMARY OF BASIN RESULTS

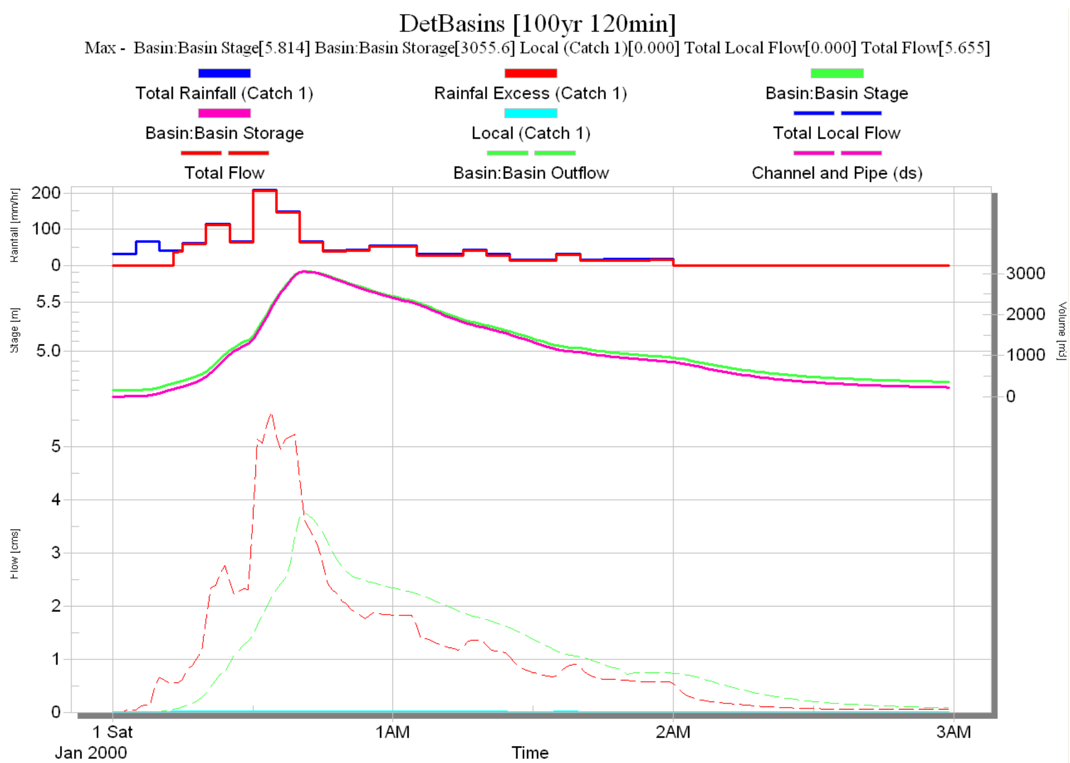
Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
WQ2	31.00	.7380	34.00	.7380	4598.7	0.0000	202.59	6.0314
C1 CP West	35.00	.7097	40.00	.6191	1501.5	0.0000	253.93	6.1078
WQ1	31.00	.2150	39.00	.2150	1315.2	0.0000	151.36	6.7222
DetBasins	35.00	5.654	42.00	**3.756**	11806.6	0.0000	3055.6	**5.8141**

SUMMARY OF BASIN OUTLET RESULTS

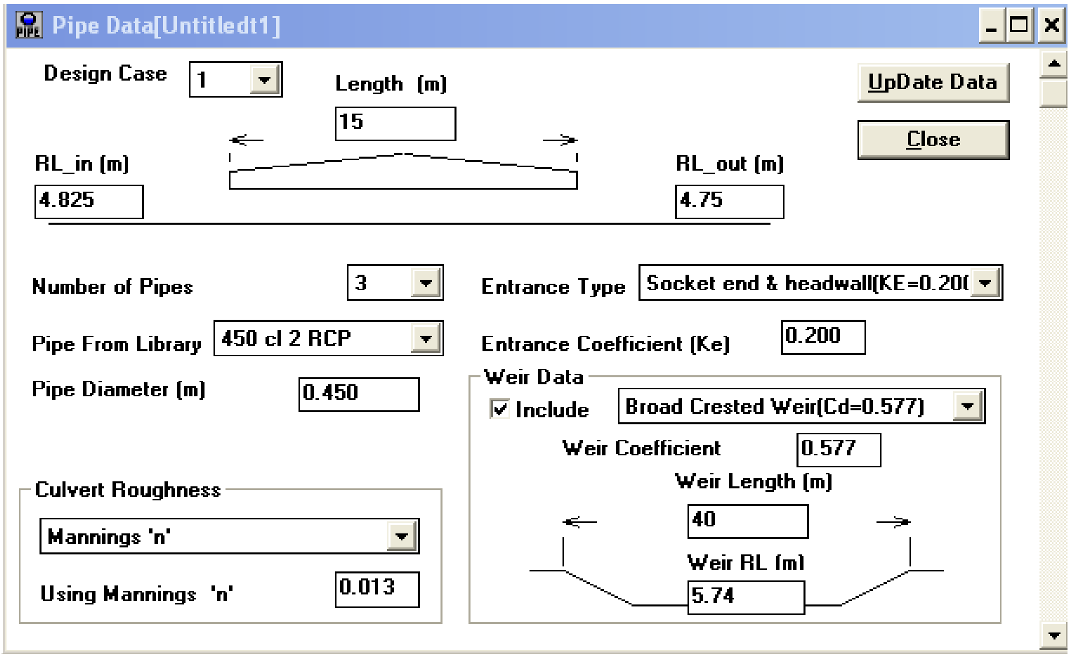
Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
WQ2	3.0	1.000		0.000	20.000	0.5000
C1 CP West	3.0		.4500	0.000	15.000	0.5000

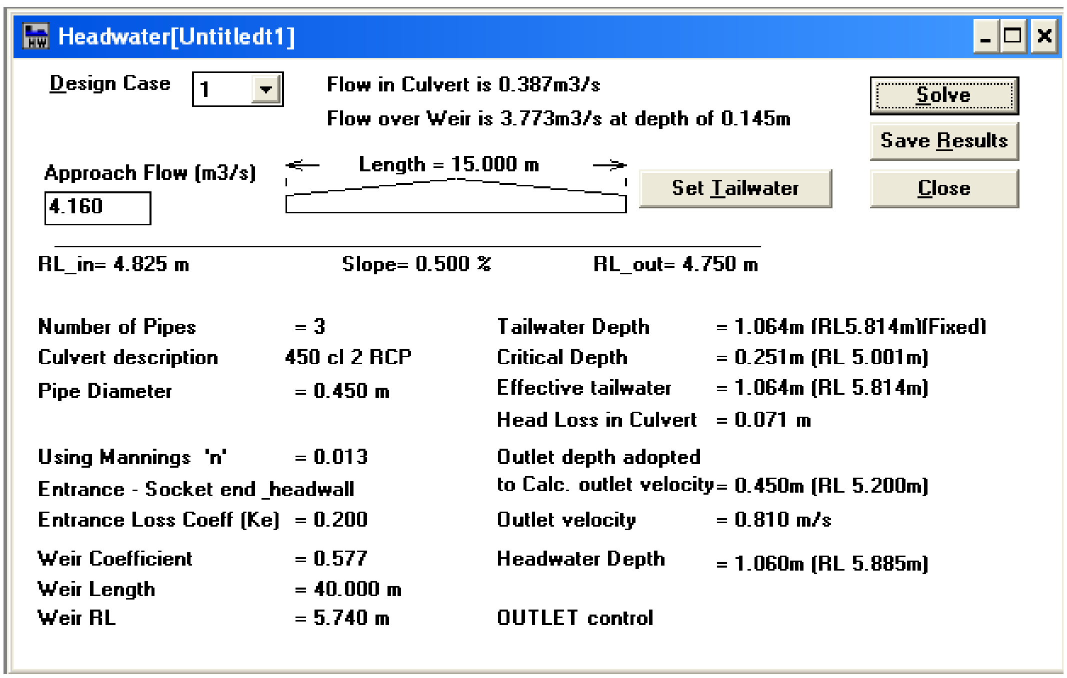
```
WQ1        2.0     1.000          0.000     20.000  0.5000
DetBasins  9.0             .3750  0.000     15.000  0.5000
```





A.8 Summary of Detention Basin Inflow Weirs Design



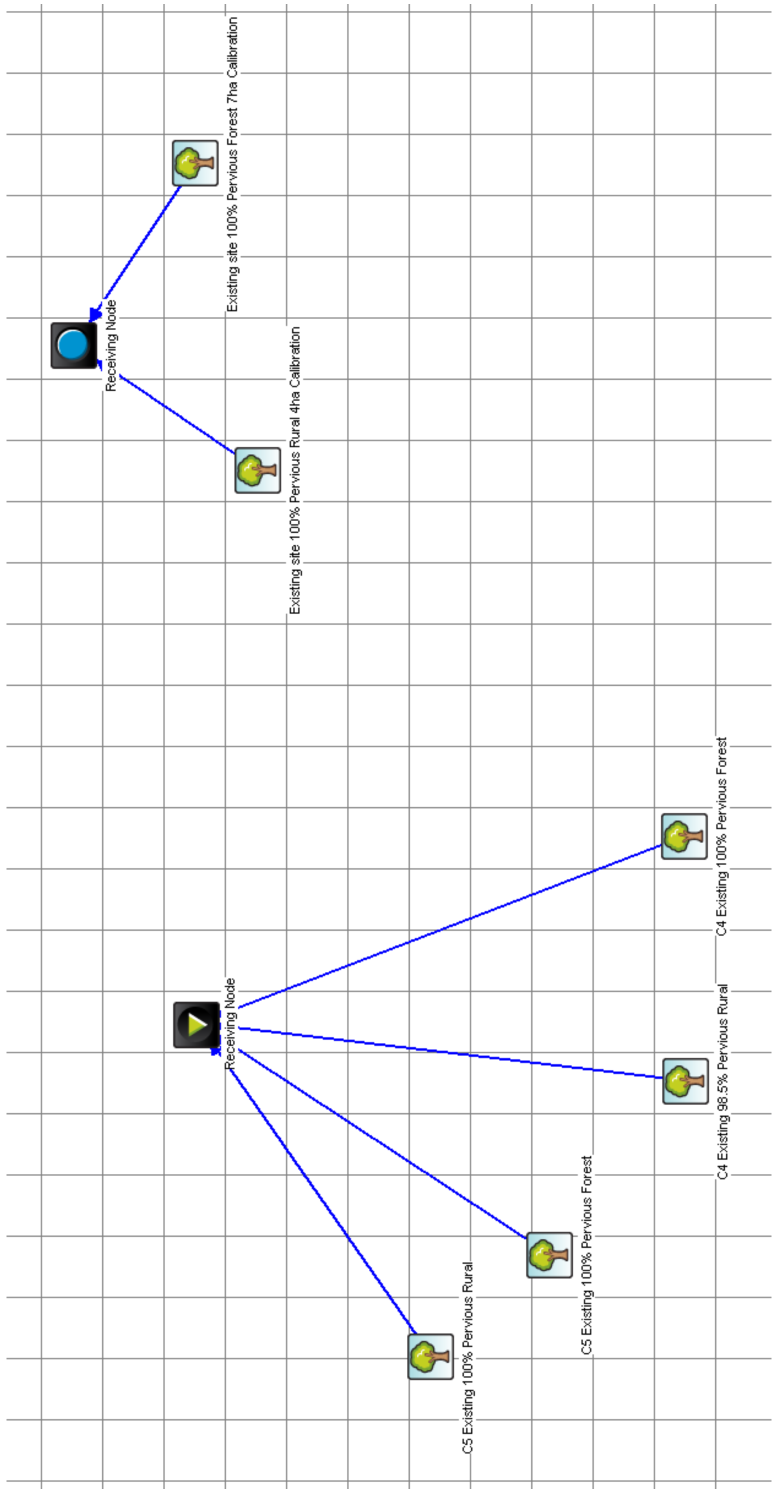


Conservative as modelled as flat weir and TWL R.L.5.814 in Detention Basins (peak TWL).
3 x 450Ø's chosen to represent 3 x 3.6m sag pits ponding (same capacity).

Ponding level will be lower than R.L.5.885 during final detailed design.
Over weir:
V = 0.65m/s
Vy = 0.094m^2/s

B MUSIC OUTPUT FILES

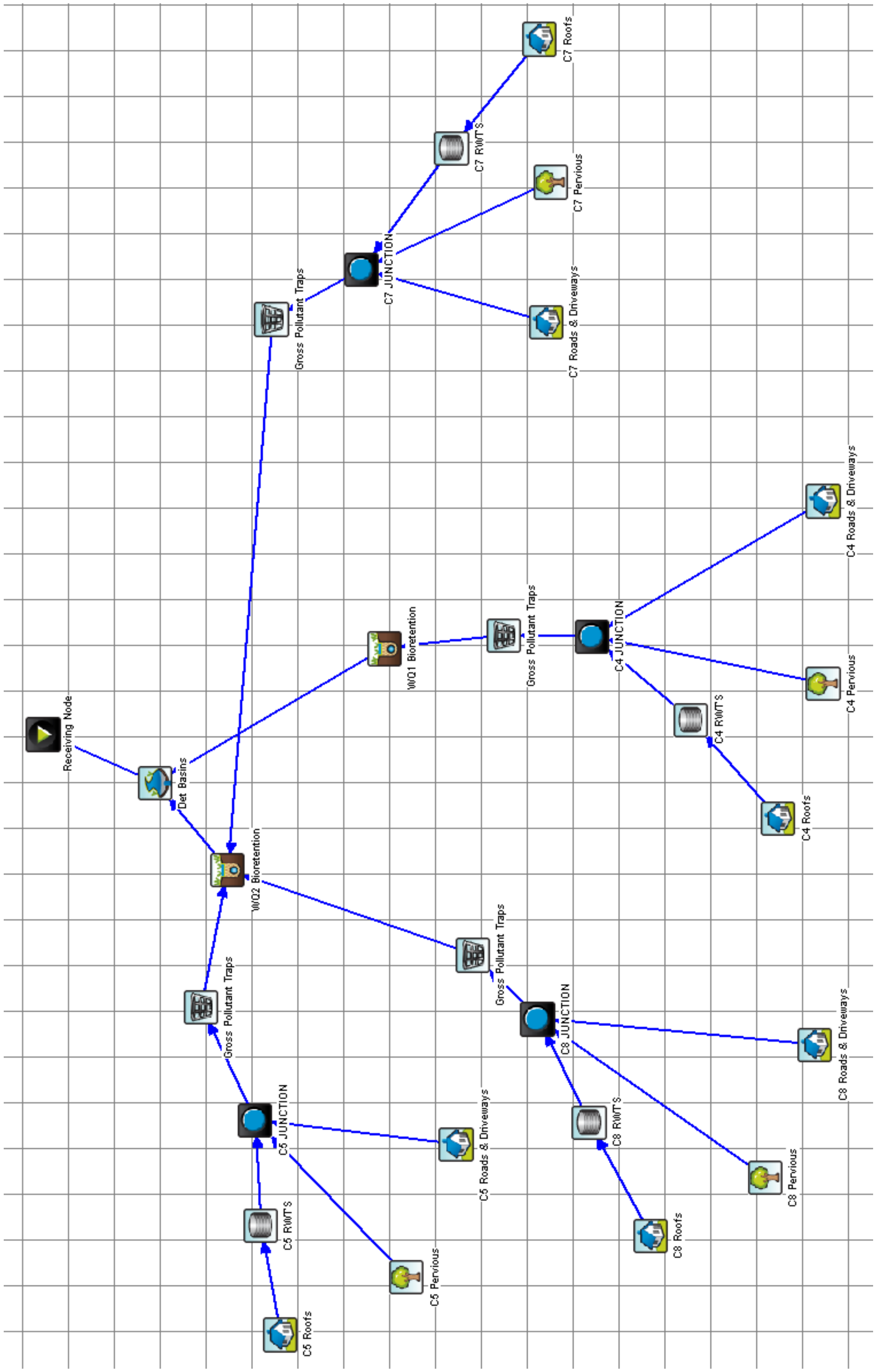
B.1 Pre-Development Music Model



Pre-Development Music Model

Source nodes						
Location	Existing site 100% Pervious Rural 4ha Calibration	Existing site 100% Pervious Forest 7ha Calibration	C4 Existing 98.5% Pervious Rural	C4 Existing 100% Pervious Forest	C5 Existing 100% Pervious Rural	C5 Existing 100% Pervious Forest
ID	2	3	5	6	7	8
Node Type	ForestSourceNode	ForestSourceNode	ForestSourceNode	ForestSourceNode	ForestSourceNode	ForestSourceNode
Total Area (ha)	4	7	2.414	3.08	1.526	3.98
Area Impervious (ha)	0	0	0.042962819	0	0	0
Area Pervious (ha)	4	7	2.371037181	3.08	1.526	3.98
Field Capacity (mm)	70	120	70	120	70	120
Pervious Area Infiltration Capacity coefficient - a	200	200	200	200	200	200
Pervious Area Infiltration Capacity exponent - b	1	1	1	1	1	1
Impervious Area Rainfall Threshold (mm/day)	1	1	1	1	1	1
Pervious Area Soil Storage Capacity (mm)	120	130	120	130	120	130
Pervious Area Soil Initial Storage (% of Capacity)	30	30	30	30	30	30
Groundwater Initial Depth (mm)	45	45	45	45	45	45
Groundwater Daily Recharge Rate (%)	25	25	25	25	25	25
Groundwater Daily Baseflow Rate (%)	5	5	5	5	5	5
Groundwater Daily Deep Seepage Rate (%)	0	0	0	0	0	0
Stormflow Total Suspended Solids Mean (log mg/L)	1.95	1.6	1.95	1.6	1.95	1.6
Stormflow Total Suspended Solids Standard Deviation (log mg/L)	0.32	0.2	0.32	0.2	0.32	0.2
Stormflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0
Stormflow Total Phosphorus Mean (log mg/L)	-0.66	-1.1	-0.66	-1.1	-0.66	-1.1
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.25	0.22	0.25	0.22	0.25	0.22
Stormflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Phosphorus Serial Correlation	0	0	0	0	0	0
Stormflow Total Nitrogen Mean (log mg/L)	0.3	-0.05	0.3	-0.05	0.3	-0.05
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.19	0.24	0.19	0.24	0.19	0.24
Stormflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Nitrogen Serial Correlation	0	0	0	0	0	0
Baseflow Total Suspended Solids Mean (log mg/L)	1.15	0.78	1.15	0.78	1.15	0.78
Baseflow Total Suspended Solids Standard Deviation (log mg/L)	0.17	0.13	0.17	0.13	0.17	0.13
Baseflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0
Baseflow Total Phosphorus Mean (log mg/L)	-1.22	-1.52	-1.22	-1.52	-1.22	-1.52
Baseflow Total Phosphorus Standard Deviation (log mg/L)	0.19	0.13	0.19	0.13	0.19	0.13
Baseflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Phosphorus Serial Correlation	0	0	0	0	0	0
Baseflow Total Nitrogen Mean (log mg/L)	-0.05	-0.52	-0.05	-0.52	-0.05	-0.52
Baseflow Total Nitrogen Standard Deviation (log mg/L)	0.12	0.13	0.12	0.13	0.12	0.13
Baseflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Nitrogen Serial Correlation	0	0	0	0	0	0
OUT - Mean Annual Flow (ML/yr)	12.5	15.9	7.92	7.02	4.78	9.07
OUT - TSS Mean Annual Load (kg/yr)	733	677	476	293	282	375
OUT - TP Mean Annual Load (kg/yr)	1.85	1.4	1.23	0.627	0.704	0.779
OUT - TN Mean Annual Load (kg/yr)	18.7	16	12.4	6.73	6.99	8.66
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0	0	12.4	0	0	0
Rain In (ML/yr)	45.7698	80.0971	27.622	35.2427	17.4611	45.5409
ET Loss (ML/yr)	33.5338	64.6882	19.8828	28.4628	12.7932	36.7795
Deep Seepage Loss (ML/yr)	0	0	0	0	0	0
Baseflow Out (ML/yr)	7.04481	1.09514	4.16651	0.481861	2.68759	0.622665
Imp. Stormflow Out (ML/yr)	0	0	0.502459	0	0	0
Perv. Stormflow Out (ML/yr)	5.4949	14.8495	3.24985	6.5338	2.09631	8.44303
Total Stormflow Out (ML/yr)	5.4949	14.8495	3.75231	6.5338	2.09631	8.44303
Total Outflow (ML/yr)	12.5397	15.9447	7.91882	7.01566	4.7839	9.0657
Change in Soil Storage (ML/yr)	-0.303761	-0.535527	-0.179653	-0.235632	-0.115885	-0.304486
TSS Baseflow Out (ML/yr)	107.413	6.89826	63.6341	3.03712	41.0358	3.93298
TSS Total Stormflow Out (ML/yr)	625.969	669.873	411.934	289.878	240.828	371.483
TSS Total Outflow (ML/yr)	733.382	676.771	475.568	292.916	281.863	375.416
TP Baseflow Out (ML/yr)	0.467076	0.0345626	0.27622	0.015248	0.178135	0.0196248
TP Total Stormflow Out (ML/yr)	1.38458	1.36567	0.956438	0.611397	0.526052	0.759469
TP Total Outflow (ML/yr)	1.85165	1.40023	1.23266	0.626645	0.704187	0.779094
TN Baseflow Out (ML/yr)	6.53206	0.346083	3.85834	0.152336	2.49119	0.196686
TN Total Stormflow Out (ML/yr)	12.1554	15.6909	8.52672	6.57642	4.50183	8.46506
TN Total Outflow (ML/yr)	18.6875	16.037	12.3851	6.72876	6.99302	8.66174
GP Total Outflow (ML/yr)	0	0	12.3986	0	0	0
No Imported Data Source nodes						
No USTM treatment nodes						
No Generic treatment nodes						
Other nodes						
Location	Receiving Node	Receiving Node				
ID	1	4				
Node Type	ReceivingNode	JunctionNode				
IN - Mean Annual Flow (ML/yr)	28.8	28.5				
IN - TSS Mean Annual Load (kg/yr)	1.43E+03	1.41E+03				
IN - TP Mean Annual Load (kg/yr)	3.34	3.25				
IN - TN Mean Annual Load (kg/yr)	34.8	34.7				
IN - Gross Pollutant Mean Annual Load (kg/yr)	12.4	0				
OUT - Mean Annual Flow (ML/yr)	0	**28.5**				
OUT - TSS Mean Annual Load (kg/yr)	0	**1.41E+03**				
OUT - TP Mean Annual Load (kg/yr)	0	**3.25**				
OUT - TN Mean Annual Load (kg/yr)	0	**34.7**				
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0	**0**				
Links						
Location	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link
Source node ID	2	3	5	6	7	8
Target node ID	4	4	1	1	1	1
Muskingum-Cunge Routing	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed
Muskingum K						
Muskingum theta						
IN - Mean Annual Flow (ML/yr)	12.5	15.9	7.92	7.02	4.78	9.07
IN - TSS Mean Annual Load (kg/yr)	733	677	476	293	282	375
IN - TP Mean Annual Load (kg/yr)	1.85	1.4	1.23	0.627	0.704	0.779
IN - TN Mean Annual Load (kg/yr)	18.7	16	12.4	6.73	6.99	8.66
IN - Gross Pollutant Mean Annual Load (kg/yr)	0	0	12.4	0	0	0
OUT - Mean Annual Flow (ML/yr)	12.5	15.9	7.92	7.02	4.78	9.07
OUT - TSS Mean Annual Load (kg/yr)	733	677	476	293	282	375
OUT - TP Mean Annual Load (kg/yr)	1.85	1.4	1.23	0.627	0.704	0.779
OUT - TN Mean Annual Load (kg/yr)	18.7	16	12.4	6.73	6.99	8.66
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0	0	12.4	0	0	0

B.2 Post-Development Music Model



7420 DEVELOPED CATCHMENT AREAS
16/04/2010

Single Roof Area	325	m2	**60% OF LOT IMPERVIOUS**	AVERAGE LOT SIZE = 710m2
Single Dway/Lot	100	m2	**60% OF LOT IMPERVIOUS**	

CATCHMENT	TOTAL AREA (m2)	TOTAL AREA (ha)	No of Roofs	Roof Area (to RWT) (ha)	No of driveways	Extra Imp Area (m2)	Total Dway/Imp Area (ha)	Total Roadway (m)	Road Area (ha)	Total Road & Dways/Imp (ha)	Pervious Area (ha)	Comments	% Pervious	% Impervious	Slope Perv	Slope Imp.
C1 CP WEST	15770	1.577	0	0	0	7000	0.7	0	0	0.7	0.877	NOTE: 0% IMPERVIOUS FOR XP-RAFTS	55.61	44.39	3.5	3.5
C2 CP MID	6060	0.606	0	0	0	5454	0.5454	0	0	0.5454	0.061		10.00	90.00	2.7	2.7
C3 CP EAST	14300	1.430	0	0	0	8500	0.85	0	0	0.85	0.580		40.56	59.44	1.5	1.5
C4 SITE STH	24090	2.409	21	0.6825	21	0	0.21	2620	0.262	0.472	1.255		52.08	47.92	6	6
C5 SITE NW	29810	2.981	33	1.0725	33		0.33	3478	0.3478	0.6778	1.231		41.28	58.72	6.3	6.3
C6 SITE EAST DAM	10720	1.072	0	0	0	0	0	0	0	0	1.072		100.00	0.00	1	1
C7 SITE NE	13365	1.337	8	0.26	8	6000	0.68	830	0.083	0.763	0.314		23.46	76.54	0.5	0.5
C8 SITE MID	42775	4.278	27	0.8775	27	0	0.27	3850	0.385	0.655	2.745		64.17	35.83	0.5	0.5
TOTALS	156890	15.689	89	2.8925	89	26954	3.5854	10778	1.0778	4.6632	8.1333					
									% IMP	48.16	51.84	% PER				

NOTE IMPERVIOUS ARE FOR LOTS 7-21 GOES TO C4. PERVIOUS AREA GOES TO C8

ALLOWED AN EXTRA 6000m2 FOR C7 (SITE NE - LARGER BLOCKS)
TO MAKE 75% OF LOT IMPERVIOUS FOR MEDIUM DENSITY SITE

AVERAGE LOT SIZE = 1375m2

Post-Development Music Model

Source nodes													
Location	C4 Roads & Driveways	C4 Roofs	C4 Pervious	C5 Roads & Driveways	C5 Roofs	C5 Pervious	C7 Roads & Driveways	C7 Roofs	C7 Pervious	C8 Roads & Driveways	C8 Roofs	C8 Pervious	
ID	2	4	8	9	11	15	16	18	21	23	25	28	
Node Type	UrbanSourceNode	UrbanSourceNode	ForestSourceNode	UrbanSourceNode	UrbanSourceNode	ForestSourceNode	UrbanSourceNode	UrbanSourceNode	ForestSourceNode	UrbanSourceNode	UrbanSourceNode	ForestSourceNode	
Total Area (ha)	0.472	0.683	1.255	0.678	1.073	1.231	0.763	0.26	0.314	0.655	0.878	2.745	
Area Impervious (ha)	0.472	0.683	0	0.678	1.073	0	0.763	0.26	0	0.655	0.878	0	
Area Pervious (ha)	0	0	1.255	0	0	1.231	0	0	0.314	0	0	2.745	
Field Capacity (mm)	80	80	70	80	80	70	80	80	70	80	80	70	
Pervious Area Infiltration Capacity coefficient - a	200	200	200	200	200	200	200	200	200	200	200	200	
Pervious Area Infiltration Capacity exponent - b	1	1	1	1	1	1	1	1	1	1	1	1	
Impervious Area Rainfall Threshold (mm/day)	1	1	1	1	1	1	1	1	1	1	1	1	
Pervious Area Soil Storage Capacity (mm)	120	120	120	120	120	120	120	120	120	120	120	120	
Pervious Area Soil Initial Storage (% of Capacity)	30	30	30	30	30	30	30	30	30	30	30	30	
Groundwater Initial Depth (mm)	50	50	45	50	50	45	50	50	45	50	50	45	
Groundwater Daily Recharge Rate (%)	25	25	25	25	25	25	25	25	25	25	25	25	
Groundwater Daily Baseflow Rate (%)	5	5	5	5	5	5	5	5	5	5	5	5	
Groundwater Daily Deep Seepage Rate (%)	0	0	0	0	0	0	0	0	0	0	0	0	
Stormflow Total Suspended Solids Mean (log mg/L)	2.43	1.3	2.15	2.43	1.3	2.15	2.43	1.3	2.15	2.43	1.3	2.15	
Stormflow Total Suspended Solids Standard Deviation (log mg/L)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	
Stormflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	
Stormflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0	0	0	0	0	0	0	
Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.89	-0.6	-0.3	-0.89	-0.6	-0.3	-0.89	-0.6	-0.3	-0.89	-0.6	
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Stormflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	
Stormflow Total Phosphorus Serial Correlation	0	0	0	0	0	0	0	0	0	0	0	0	
Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.3	0.3	0.34	0.3	0.3	0.34	0.3	0.3	0.34	0.3	0.3	
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	
Stormflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	
Stormflow Total Nitrogen Serial Correlation	0	0	0	0	0	0	0	0	0	0	0	0	
Baseflow Total Suspended Solids Mean (log mg/L)	1.2	0	1.2	1.2	0	1.2	1.2	0	1.2	1.2	0	1.2	
Baseflow Total Suspended Solids Standard Deviation (log mg/L)	0.17	0	0.17	0.17	0	0.17	0.17	0	0.17	0.17	0	0.17	
Baseflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	
Baseflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0	0	0	0	0	0	0	
Baseflow Total Phosphorus Mean (log mg/L)	-0.85	0	-0.85	-0.85	0	-0.85	-0.85	0	-0.85	-0.85	0	-0.85	
Baseflow Total Phosphorus Standard Deviation (log mg/L)	0.19	0	0.19	0.19	0	0.19	0.19	0	0.19	0.19	0	0.19	
Baseflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	
Baseflow Total Phosphorus Serial Correlation	0	0	0	0	0	0	0	0	0	0	0	0	
Baseflow Total Nitrogen Mean (log mg/L)	0.11	0	0.11	0.11	0	0.11	0.11	0	0.11	0.11	0	0.11	
Baseflow Total Nitrogen Standard Deviation (log mg/L)	0.12	0	0.12	0.12	0	0.12	0.12	0	0.12	0.12	0	0.12	
Baseflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	
Baseflow Total Nitrogen Serial Correlation	0	0	0	0	0	0	0	0	0	0	0	0	
OUT - Mean Annual Flow (ML/yr)	4.91	7.11	3.93	7.06	11.2	3.86	7.94	2.71	0.984	6.82	9.14	8.61	
OUT - TSS Mean Annual Load (kg/yr)	1.78E+03	184	359	2.52E+03	290	350	2.86E+03	69.9	91	2.40E+03	237	756	
OUT - TP Mean Annual Load (kg/yr)	2.9	1.07	0.845	4.18	1.7	0.827	4.74	0.407	0.208	4.02	1.36	1.88	
OUT - TN Mean Annual Load (kg/yr)	11.9	15.5	6.71	17.1	24.9	6.68	19.2	5.9	1.74	16.4	19.9	14.7	
OUT - Gross Pollutant Mean Annual Load (kg/yr)	124	180	0	178	282	0	201	68.3	0	172	231	0	
Rain In (ML/yr)	5.40083	7.81518	14.3603	7.75797	12.2777	14.0857	8.73057	2.97503	3.59293	7.4948	10.0465	31.4095	
ET Loss (ML/yr)	0.488641	0.707081	10.5212	0.701904	1.11083	10.32	0.789908	0.269167	2.63241	0.678097	0.908959	23.0126	
Deep Seepage Loss (ML/yr)	0	0	0	0	0	0	0	0	0	0	0	0	
Baseflow Out (ML/yr)	0	0	2.21031	0	0	2.16804	0	0	0.553017	0	0	4.8345	
Imp. Stormflow Out (ML/yr)	4.91219	7.1081	0	7.05607	11.1669	0	7.94067	2.70587	0	6.8167	9.13751	0	
Perv. Stormflow Out (ML/yr)	0	0	1.72403	0	0	1.69106	0	0	0.43135	0	0	3.77088	
Total Stormflow Out (ML/yr)	4.91219	7.1081	1.72403	7.05607	11.1669	1.69106	7.94067	2.70587	0.43135	6.8167	9.13751	3.77088	
Total Outflow (ML/yr)	4.91219	7.1081	3.93433	7.05607	11.1669	3.8591	7.94067	2.70587	0.984367	6.8167	9.13751	8.60538	
Change in Soil Storage (ML/yr)	0	0	-0.095305	0	0	-0.0934826	0	0	-0.0238452	0	0	-0.208456	
TSS Baseflow Out (ML/yr)	0	0	37.8012	0	0	37.0383	0	0	9.45284	0	0	82.7718	
TSS Total Stormflow Out (ML/yr)	1777.13	183.574	321.06	2518.32	290.304	312.861	2863.65	69.8873	81.5759	2404.95	237.026	673.692	
TSS Total Outflow (ML/yr)	1777.13	183.574	358.861	2518.32	290.304	349.899	2863.65	69.8873	91.0287	2404.95	237.026	756.464	
TP Baseflow Out (ML/yr)	0	0	0.342829	0	0	0.336306	0	0	0.085954	0	0	0.751886	
TP Total Stormflow Out (ML/yr)	2.89851	1.06775	0.501761	4.17666	1.70313	0.490653	4.74244	0.406829	0.12231	4.02167	1.36366	1.12657	
TP Total Outflow (ML/yr)	2.89851	1.06775	0.84459	4.17666	1.70313	0.826958	4.74244	0.406829	0.208264	4.02167	1.36366	1.87846	
TN Baseflow Out (ML/yr)	0	0	2.96197	0	0	2.90133	0	0	0.740596	0	0	6.47144	
TN Total Stormflow Out (ML/yr)	11.8823	15.4534	3.74644	17.0882	24.8645	3.77679	19.2211	5.90373	1.00351	16.4334	19.9346	8.20847	
TN Total Outflow (ML/yr)	11.8823	15.4534	6.70841	17.0882	24.8645	6.67812	19.2211	5.90373	1.74411	16.4334	19.9346	14.6799	
GP Total Outflow (ML/yr)	124.054	179.51	0	178.196	282.012	0	200.536	68.3347	0	172.151	230.761	0	
No Imported Data Source nodes													
USTM treatment nodes													
Location	C4 RWT'S	WQ1 Bioretention	C5 RWT'S	WQ2 Bioretention	C7 RWT'S	Det Basins	C8 RWT'S						
ID	5	7	12	14	19	22	26						
Node Type	RainWaterTankNode	BioRetentionNodeV4	RainWaterTankNode	BioRetentionNodeV4	RainWaterTankNode	PondNode	RainWaterTankNode						
Lo-flow bypass rate (cum/sec)	0	0	0	0	0	0.045	0						
Hi-flow bypass rate (cum/sec)	1	0.215	1	0.738	1	3.8	1						
Inlet pond volume	0		0		0	0	0						
Area (sqm)	35	406.5	55	612	13.3	2517	45						
Extended detention depth (m)	0.05	0.3	0.05	0.25	0.05	1.08	0.05						
Permanent pool volume (cum)	63		99		24	0	81						
Proportion vegetated	0		0		0	0.1	0						
Equivalent pipe diameter (mm)	412		517		255	1130	468						
Overflow weir width (m)	10	6	10	18	10	12	10						
Notional Detention Time (hrs)	5.50E-03		5.49E-03		5.45E-03	0.244	5.48E-03						
Orifice discharge coefficient	0.6		0.6		0.6	0.6	0.6						
Weir coefficient	1.7	1.7	1.7	1.7	1.7	1.7	1.7						
Number of CSTR cells	2	3	2	3	2	2	2						
Total Suspended Solids k (m/yr)	400	8000	400	8000	400	400	400						
Total Suspended Solids C* (mg/L)	12	20	12	20	12	12	12						
Total Suspended Solids C** (mg/L)	12		12		12	12	12						
Total Phosphorus k (m/yr)	300	6000	300	6000	300	300	300						
Total Phosphorus C* (mg/L)	0.13	0.13	0.13	0.13	0.13	0.09	0.13						
Total Phosphorus C** (mg/L)	0.13		0.13		0.13	0.09	0.13						
Total Nitrogen k (m/yr)	40	500	40	500	40	40	40						
Total Nitrogen C* (mg/L)	1.4	1.4	1.4	1.4	1.4	1	1.4						
Total Nitrogen C** (mg/L)	1.4		1.4		1.4	1	1.4						
Threshold hydraulic loading for C** (m/yr)	3500		3500		3500	3500	3500						
Horizontal Flow Coefficient		3		3									
Extraction for Re-use	On	Off	On	Off	On	Off	On						
Annual Re-use Demand - scaled by daily PET (ML)	0		0		0		0						
Annual Re-use Demand - scaled by daily PET - Rain (ML)	1.8396		2.8908		0.7008		2.3652						
Constant Daily Re-use Demand (kL)	5.586		8.778		2.128		7.182						
User-defined Annual Re-use Demand (ML)	0		0		0		0						
Percentage of User-defined Annual Re-use Demand Jan	17.37826217		17.37826217		17.37826217		17.37826217						
Percentage of User-defined Annual Re-use Demand Feb	8.95910409		8.95910409		8.95910409		8.95910409						
Percentage of User-defined Annual Re-use Demand Mar	6.219378062		6.219378062		6.219378062		6.219378062						
Percentage of User-defined Annual Re-use Demand Apr	1.089891011		1.089891011		1.089891011		1.089891011						
Percentage of User-defined Annual Re-use Demand May	0.149985001		0.149985001		0.149985001		0.149985001						
Percentage of User-defined Annual Re-use Demand Jun	0.149985001		0.149985001		0.149985001		0.149985001						
Percentage of User-defined Annual Re-use Demand Jul	0.149985001		0.149985001		0.149985001		0.149985001						
Percentage of User-defined Annual Re-use Demand Aug	4.679532047		4.679532047		4.679532047		4.679532047						
Percentage of User-defined Annual Re-use Demand Sep	10.75892411		10.75892411		10.75892411		10.75892411						
Percentage of User-defined Annual Re-use Demand Oct	13.79862014		13.79862014		13.79862014		13.79862014						
Percentage of User-defined Annual Re-use Demand Nov	15.81841816		15.81841816		15.81841816		15.81841816						
Percentage of User-defined Annual Re-use Demand Dec	20.84791521				20.84791521				20.84791521				20.84791521

Post-Development Music Model (continued)

User-defined Re-use File								
Filter area (sqm)		333		558				
Filter perimeter (m)		0.1		0.1				
Filter depth (m)		0.4		0.4				
Filter median particle diameter (mm)								
Saturated hydraulic conductivity (mm/hr)		180		180				
Infiltration Media Porosity		0.35		0.35				
Length (m)								
Bed slope								
Base Width (m)								
Top width (m)								
Vegetation height (m)								
Vegetation Type		Vegetated with Effective Nutrient Removal Plants		Vegetated with Effective Nutrient Removal Plants				
Total Nitrogen Content in Filter (mg/kg)		800		800				
Proportion of Organic Material in Filter (%)		<5		<5				
Orthophosphate Content in Filter (mg/kg)		<55		<55				
Is Base Lined?		Yes		Yes				
Is Underdrain Present?		Yes		Yes				
Is Submerged Zone Present?		No		No				
Submerged Zone Depth (m)	-9999		-9999		-9999		-9999	
B for Media Soil Texture		13		13		-9999		
Proportion of upstream impervious area treated	0		0		0		0	
Exfiltration Rate (mm/hr)	0	0	0	0	0	0	0	
Evap Loss as proportion of PET						1		
Depth in metres below the drain pipe								
TSS A Coefficient								
TSS B Coefficient								
TP A Coefficient								
TP B Coefficient								
TN A Coefficient								
TN B Coefficient								
Sfc		0.37		0.37				
S*		0.22		0.22				
Sw		0.11		0.11				
Sh		0.05		0.05				
Emax (m/day)		0.008		0.008				
Ew (m/day)	7.11	0.001	11.2	0.001	2.71		9.14	
IN - Mean Annual Flow (ML/yr)	184	14	290	52.1	69.9	63.8	237	
IN - TSS Mean Annual Load (kg/yr)	1.07	1.13E+03	1.7	4.70E+03	0.407	1.15E+03	1.36	
IN - TP Mean Annual Load (kg/yr)	15.5	4.07	24.9	16.5	5.9	6.91	19.9	
IN - TN Mean Annual Load (kg/yr)	180	27.4	282	104	68.3	88.8	231	
IN - Gross Pollutant Mean Annual Load (kg/yr)	5.19	12.4	8.16	55.1	1.98	0.263	6.67	
OUT - Mean Annual Flow (ML/yr)	123	13.2	193	50.6	46.7	63.7	158	
OUT - TSS Mean Annual Load (kg/yr)	0.768	122	1.22	1.03E+03	0.293	1.05E+03	0.977	
OUT - TP Mean Annual Load (kg/yr)	11.2	1.01	18	5.9	4.27	6.6	14.5	
OUT - TN Mean Annual Load (kg/yr)	0	15.9	0	72.9	0	88.3	0	
OUT - Gross Pollutant Mean Annual Load (kg/yr)	7.10831	4.00E-02	11.1671	0.223	2.70586	1.25E-02	9.13704	
Flow In (ML/yr)	0	14.0325	0	52.0498	0	63.7547	0	
ET Loss (ML/yr)	0	0.84321	0	1.48415	0	0.0319874	0	
Infiltration Loss (ML/yr)	0	0	0	0	0	0	0	
Low Flow Bypass Out (ML/yr)	0	0	0	0	0	43.2104	0	
High Flow Bypass Out (ML/yr)	5.11445	0.118956	8.04527	0.507034	1.9427	0	6.57976	
Orifice / Filter Out (ML/yr)	0.0770856	10.5401	0.109999	29.1331	0.0331372	20.5184	0.093665	
Weir Out (ML/yr)	0	2.53288	0	20.9305	0	0	0	
Transfer Function Out (ML/yr)	1.92903	0	3.03008	0	0.735085	0	2.47875	
Reuse Supplied (ML/yr)	3.87785	0	6.09152	0	1.47711	0	4.98706	
Reuse Requested (ML/yr)	49.7447	0	49.7426	0	49.765	0	49.7035	
% Reuse Demand Met	26.9653	0	26.9709	0	26.9794	0	26.963	
% Load Reduction	183.574	5.98971	290.304	2.84162	69.887	0.0405482	237.026	
TSS Flow In (kg/yr)	0	1129.73	0	4692.59	0	1153.66	0	
TSS ET Loss (kg/yr)	0	0	0	0	0	0	0	
TSS Infiltration Loss (kg/yr)	0	0	0	0	0	0	0	
TSS Low Flow Bypass Out (kg/yr)	0	0	0	0	0	316.643	0	
TSS High Flow Bypass Out (kg/yr)	121.014	8.68587	189.683	48.865	45.9543	0	154.916	
TSS Orifice / Filter Out (kg/yr)	1.75129	21.0803	3.40827	58.2663	0.731511	729.437	2.825	
TSS Weir Out (kg/yr)	0	92.6312	0	924.656	0	0	0	
TSS Transfer Function Out (kg/yr)	29.0271	0	46.0081	0	11.0665	0	37.6085	
TSS Reuse Supplied (kg/yr)	0	0	0	0	0	0	0	
TSS Reuse Requested (kg/yr)	0	0	0	0	0	0	0	
TSS % Reuse Demand Met	33.125	0	33.4865	0	33.1981	0	33.4498	
TSS % Load Reduction	1.06775	89.1658	1.70313	78.0124	0.40683	9.32528	1.36366	
TP Flow In (kg/yr)	0	4.06344	0	16.5208	0	6.91063	0	
TP ET Loss (kg/yr)	0	0	0	0	0	0	0	
TP Infiltration Loss (kg/yr)	0	0	0	0	0	0	0	
TP Low Flow Bypass Out (kg/yr)	0	0	0	0	0	3.0852	0	
TP High Flow Bypass Out (kg/yr)	0.757113	0.0303772	1.19999	0.164	0.288036	0	0.964586	
TP Orifice / Filter Out (kg/yr)	0.0109912	0.534927	0.0173358	1.47858	0.0045914	3.51708	0.0125596	
TP Weir Out (kg/yr)	0	0.446731	0	4.2574	0	0	0	
TP Transfer Function Out (kg/yr)	0.261716	0	0.413474	0	0.099579	0	0.336078	
TP Reuse Supplied (kg/yr)	0	0	0	0	0	0	0	
TP Reuse Requested (kg/yr)	0	0	0	0	0	0	0	
TP % Reuse Demand Met	28.0631	0	28.5243	0	28.0712	0	28.3437	
TP % Load Reduction	15.4534	75.0941	24.8645	64.2876	5.90373	4.46204	19.9345	
TN Flow In (kg/yr)	0	27.4283	0	103.808	0	88.72	0	
TN ET Loss (kg/yr)	0	0	0	0	0	0	0	
TN Infiltration Loss (kg/yr)	0	0	0	0	0	0	0	
TN Low Flow Bypass Out (kg/yr)	0	0	0	0	0	50.3627	0	
TN High Flow Bypass Out (kg/yr)	11.0028	0.254078	17.7044	1.12302	4.20269	0	14.3064	
TN Orifice / Filter Out (kg/yr)	0.162517	10.6654	0.285198	29.4856	0.0668246	37.9157	0.193523	
TN Weir Out (kg/yr)	0	4.9371	0	42.2743	0	0	0	
TN Transfer Function Out (kg/yr)	3.83076	0	6.10061	0	1.45857	0	4.87723	
TN Reuse Supplied (kg/yr)	0	0	0	0	0	0	0	
TN Reuse Requested (kg/yr)	0	0	0	0	0	0	0	
TN % Reuse Demand Met	27.7489	0	27.6497	0	27.681	0	27.262	
TN % Load Reduction	179.509	42.1887	282.012	29.7908	68.3347	0.497775	230.758	
GP Flow In (kg/yr)	0	12.4054	0	55.0884	0	0.262981	0	
GP ET Loss (kg/yr)	0	0	0	0	0	0	0	
GP Infiltration Loss (kg/yr)	0	0	0	0	0	0	0	
GP Low Flow Bypass Out (kg/yr)	0	0	0	0	0	0.0125058	0	
GP High Flow Bypass Out (kg/yr)	0	0.0400412	0	0.22294	0	0	0	
GP Orifice / Filter Out (kg/yr)	0	0	0	0	0	0	0	
GP Weir Out (kg/yr)	0	0	0	0	0	0	0	
GP Transfer Function Out (kg/yr)	0	0	0	0	0	0	0	
GP Reuse Supplied (kg/yr)	0	0	0	0	0	0	0	
GP Reuse Requested (kg/yr)	0	0	0	0	0	0	0	
GP % Reuse Demand Met	100	0	100	0	100	0	100	
GP % Load Reduction	99.6772	99.5953	95.2446					

Post-Development Music Model (continued)

Generic treatment nodes				
Location	Gross Pollutant Traps	Gross Pollutant Traps	Gross Pollutant Traps	Gross Pollutant Traps
ID	6	13	20	27
Node Type	GPTNode	GPTNode	GPTNode	GPTNode
Lo-flow bypass rate (cum/sec)	0	0	0	0
Hi-flow bypass rate (cum/sec)	1	1	1	1
Flow Transfer Function				
Input (cum/sec)	0	0	0	0
Output (cum/sec)	0	0	0	0
Input (cum/sec)	10	10	10	10
Output (cum/sec)	10	10	10	10
Input (cum/sec)				
Output (cum/sec)				
Input (cum/sec)				
Output (cum/sec)				
Input (cum/sec)				
Output (cum/sec)				
Input (cum/sec)				
Output (cum/sec)				
Input (cum/sec)				
Output (cum/sec)				
Input (cum/sec)				
Output (cum/sec)				
Input (cum/sec)				
Output (cum/sec)				
Input (cum/sec)				
Output (cum/sec)				
Gross Pollutant Transfer Function				
Input (kg/ML)	0	0	0	0
Output (kg/ML)	0	0	0	0
Input (kg/ML)	100	100	100	100
Output (kg/ML)	10	10	10	10
Input (kg/ML)				
Output (kg/ML)				
Input (kg/ML)				
Output (kg/ML)				
Input (kg/ML)				
Output (kg/ML)				
Input (kg/ML)				
Output (kg/ML)				
Input (kg/ML)				
Output (kg/ML)				
Input (kg/ML)				
Output (kg/ML)				
Input (kg/ML)				
Output (kg/ML)				
Input (kg/ML)				
Output (kg/ML)				
Total Nitrogen Transfer Function				
Input (mg/L)	0	0	0	0
Output (mg/L)	0	0	0	0
Input (mg/L)	49.99754139	49.99754139	49.99754139	49.99754139
Output (mg/L)	46.11063217	46.11063217	46.11063217	46.11063217
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Total Phosphorus Transfer Function				
Input (mg/L)	0	0	0	0
Output (mg/L)	0	0	0	0
Input (mg/L)	4.997035585	4.997035585	4.997035585	4.997035585
Output (mg/L)	4.503253217	4.503253217	4.503253217	4.503253217
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Total Suspended Solids Transfer Function				
Input (mg/L)	0	0	0	0
Output (mg/L)	0	0	0	0
Input (mg/L)	999.82784	999.82784	999.82784	999.82784
Output (mg/L)	500.3640523	500.3640523	500.3640523	500.3640523
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
Input (mg/L)				
Output (mg/L)				
IN - Mean Annual Flow (ML/yr)	14	19.1	10.9	22.1
IN - TSS Mean Annual Load (kg/yr)	2.26E+03	3.06E+03	3.00E+03	3.32E+03
IN - TP Mean Annual Load (kg/yr)	4.51	6.22	5.24	6.88
IN - TN Mean Annual Load (kg/yr)	29.8	41.8	25.2	45.6
IN - Gross Pollutant Mean Annual Load (kg/yr)	124	178	201	172
OUT - Mean Annual Flow (ML/yr)	14	19.1	10.9	22.1
OUT - TSS Mean Annual Load (kg/yr)	1.13E+03	1.53E+03	1.50E+03	1.66E+03
OUT - TP Mean Annual Load (kg/yr)	4.07	5.61	4.73	6.2
OUT - TN Mean Annual Load (kg/yr)	27.4	38.5	23.3	42.1
OUT - Gross Pollutant Mean Annual Load (kg/yr)	12.4	17.8	20.1	17.2
Flow In (ML/yr)	14.0323	19.0641	10.8957	22.0875
ET Loss (ML/yr)	0	0	0	0
Infiltration Loss (ML/yr)	0	0	0	0
Low Flow Bypass Out (ML/yr)	0	0	0	0
High Flow Bypass Out (ML/yr)	0	0	0	0
Orifice / Filter Out (ML/yr)	0	0	0	0
Weir Out (ML/yr)	0	0	0	0
Transfer Function Out (ML/yr)	14.0323	19.0641	10.8957	22.0875
Reuse Supplied (ML/yr)	0	0	0	0
Reuse Requested (ML/yr)	0	0	0	0
% Reuse Demand Met	0	0	0	0
% Load Reduction	0	0	0	0
TSS Flow In (kg/yr)	2257.41	3059.76	2998.68	3317.62
TSS ET Loss (kg/yr)	0	0	0	0
TSS Infiltration Loss (kg/yr)	0	0	0	0
TSS Low Flow Bypass Out (kg/yr)	0	0	0	0
TSS High Flow Bypass Out (kg/yr)	0	0	0	0
TSS Orifice / Filter Out (kg/yr)	0	0	0	0
TSS Weir Out (kg/yr)	0	0	0	0
TSS Transfer Function Out (kg/yr)	1129.73	1531.26	1500.69	1660.3
TSS Reuse Supplied (kg/yr)	0	0	0	0
TSS Reuse Requested (kg/yr)	0	0	0	0
TSS % Reuse Demand Met	0	0	0	0
TSS % Load Reduction	49.9547	49.955	49.9549	49.9551
TP Flow In (kg/yr)	4.50924	6.21792	5.24064	6.87385
TP ET Loss (kg/yr)	0	0	0	0
TP Infiltration Loss (kg/yr)	0	0	0	0
TP Low Flow Bypass Out (kg/yr)	0	0	0	0
TP High Flow Bypass Out (kg/yr)	0	0	0	0
TP Orifice / Filter Out (kg/yr)	0	0	0	0
TP Weir Out (kg/yr)	0	0	0	0
TP Transfer Function Out (kg/yr)	4.06344	5.60365	4.72272	6.19505
TP Reuse Supplied (kg/yr)	0	0	0	0
TP Reuse Requested (kg/yr)	0	0	0	0
TP % Reuse Demand Met	0	0	0	0
TP % Load Reduction	9.88638	9.87895	9.88277	9.87511
TN Flow In (kg/yr)	29.7404	41.7373	25.2233	45.5981
TN ET Loss (kg/yr)	0	0	0	0
TN Infiltration Loss (kg/yr)	0	0	0	0
TN Low Flow Bypass Out (kg/yr)	0	0	0	0
TN High Flow Bypass Out (kg/yr)	0	0	0	0
TN Orifice / Filter Out (kg/yr)	0	0	0	0
TN Weir Out (kg/yr)	0	0	0	0
TN Transfer Function Out (kg/yr)	27.4283	38.4937	23.262	42.0564
TN Reuse Supplied (kg/yr)	0	0	0	0
TN Reuse Requested (kg/yr)	0	0	0	0
TN % Reuse Demand Met	0	0	0	0
TN % Load Reduction	7.77447	7.77148	7.77601	7.76718
GP Flow In (kg/yr)	124.056	178.197	200.535	172.155
GP ET Loss (kg/yr)	0	0	0	0
GP Infiltration Loss (kg/yr)	0	0	0	0
GP Low Flow Bypass Out (kg/yr)	0	0	0	0
GP High Flow Bypass Out (kg/yr)	0	0	0	0
GP Orifice / Filter Out (kg/yr)	0	0	0	0
GP Weir Out (kg/yr)	0	0	0	0
GP Transfer Function Out (kg/yr)	12.4054	17.8196	20.0536	17.2151
GP Reuse Supplied (kg/yr)	0	0	0	0
GP Reuse Requested (kg/yr)	0	0	0	0
GP % Reuse Demand Met	0	0	0	0
GP % Load Reduction	100	100	100	100

Other nodes					
Location	Receiving Node	C4 JUNCTION	C5 JUNCTION	C7 JUNCTION	C8 JUNCTION
ID	1	3	10	17	24
Node Type	ReceivingNode	JunctionNode	JunctionNode	JunctionNode	JunctionNode
IN - Mean Annual Flow (ML/yr)	**63.7**	14	19.1	10.9	22.1
IN - TSS Mean Annual Load (kg/yr)	**1.05E+03**	2.26E+03	3.06E+03	3.00E+03	3.32E+03
IN - TP Mean Annual Load (kg/yr)	**6.6**	4.51	6.22	5.24	6.88
IN - TN Mean Annual Load (kg/yr)	**88.3**	29.8	41.8	25.2	45.6
IN - Gross Pollutant Mean Annual Load (kg/yr)	**1.25E-02**	124	178	201	172
OUT - Mean Annual Flow (ML/yr)	0	14	19.1	10.9	22.1
OUT - TSS Mean Annual Load (kg/yr)	0	2.26E+03	3.06E+03	3.00E+03	3.32E+03
OUT - TP Mean Annual Load (kg/yr)	0	4.51	6.22	5.24	6.88
OUT - TN Mean Annual Load (kg/yr)	0	29.8	41.8	25.2	45.6
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0	124	178	201	172

Links																											
Location	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link
Source node ID	2	4	6	5	3	8	10	11	15	12	9	17	19	18	16	21	13	14	22	23	28	25	26	24	27	20	7
Target node ID	3	5	7	3	6	3	13	12	10	10	10	20	17	19	17	17	14	22	1	24	24	26	24	27	14	14	22
Muskingum-Cunge Routing	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed
Muskingum K																											
Muskingum theta																											
IN - Mean Annual Flow (ML/yr)	4.91	7.11	14	5.19	14	3.93	19.1	11.2	3.86	8.16	7.06	10.9	1.98	2.71	7.94	0.984	19.1	50.6	63.7	6.82	8.61	9.14	6.67	22.1	22.1	10.9	13.2
IN - TSS Mean Annual Load (kg/yr)	1.78E+03	184	1.13E+03	123	2.26E+03	359	3.06E+03	290	350	193	2.52E+03	3.00E+03	46.7	69.9	2.86E+03	91	1.53E+03	1.03E+03	1.05E+03	2.40E+03	756	237	158	3.32E+03	1.66E+03	1.50E+03	122
IN - TP Mean Annual Load (kg/yr)	2.9	1.07	4.07	0.768	4.51	0.845	6.22	1.7	0.827	1.22	4.18	5.24	0.293	0.407	4.74	0.208	5.61	5.9	6.6	4.02	1.88	1.36	0.977	6.88	6.2	4.73	1.01
IN - TN Mean Annual Load (kg/yr)	11.9	15.5	27.4	11.2	29.8	6.71	41.8	24.9	6.68	18	17.1	25.2	4.27	5.9	19.2	1.74	38.5	72.9	88.3	16.4	14.7	19.9	14.5	45.6	42.1	23.3	15.9
IN - Gross Pollutant Mean Annual Load (kg/yr)	124	180	12.4	0	124	0	178	282	0	0	178	201	0	68.3	201	0	17.8	0.223	1.25E-02	172	0	231	0	172	17.2	20.1	4.00E-02
OUT - Mean Annual Flow (ML/yr)	4.91	7.11	14	5.19	14	3.93	19.1	11.2	3.86	8.16	7.06	10.9	1.98	2.71	7.94	0.984	19.1	50.6	63.7	6.82	8.61	9.14	6.67	22.1	22.1	10.9	13.2
OUT - TSS Mean Annual Load (kg/yr)	1.78E+03	184	1.13E+03	123	2.26E+03	359	3.06E+03	290	350	193	2.52E+03	3.00E+03	46.7	69.9	2.86E+03	91	1.53E+03	1.03E+03	1.05E+03	2.40E+03	756	237	158	3.32E+03	1.66E+03	1.50E+03	122
OUT - TP Mean Annual Load (kg/yr)	2.9	1.07	4.07	0.768	4.51	0.845	6.22	1.7	0.827	1.22	4.18	5.24	0.293	0.407	4.74	0.208	5.61	5.9	6.6	4.02	1.88	1.36	0.977	6.88	6.2	4.73	1.01
OUT - TN Mean Annual Load (kg/yr)	11.9	15.5	27.4	11.2	29.8	6.71	41.8	24.9	6.68	18	17.1	25.2	4.27	5.9	19.2	1.74	38.5	72.9	88.3	16.4	14.7	19.9	14.5	45.6	42.1	23.3	15.9
OUT - Gross Pollutant Mean Annual Load (kg/yr)	124	180	12.4	0	124	0	178	282	0	0	178	201	0	68.3	201	0	17.8	0.223	1.25E-02	172	0	231	0	172	17.2	20.1	4.00E-02

C Pre-Developed Catchment Plan

Developed Catchment Plan

Stormwater Strategy Plan