LSW
SURVEYORS, PLANNERS & ENGINEERS

LSW SURVEYORS
P & J LIDBURY & ASSOCIATES PTY. LTD
Established 1981
A.B.N. 17 619 183 309
P.O. BOX 510, FORSTER
FIRST FLOOR
3 WHARF STREET
FORSTER NSW 2428
Phone: (02) 6554 7988
consult@lswsurveyors.com.au
www.lswsurveyors.com.au

Registered Surveyors
P. J. Lidbury B.Surv.(Hons.) B.Civ.Eng.(Hons.) M.I.S. MIEAust
R. J. Lidbury B.Eng (Surveying) M.I.S.

Civil Engineers
P. J. Lidbury B.Surv.(Hons.) B.Civ.Eng.(Hons.) M.I.S. MIEAust.

Your Ref:
Our Ref: 3997
Document Ref: 3997 SW Strategy
Date: 30th November 2024

STORMWATER STRATEGY FOR

© Nearmap 2024

PROPOSED ALTERATIONS & ADDITIONS TO FORSTER BOWLING CLUB PART LOT 2 DP1033666 No.2 STRAND STREET, FORSTER

November 2024
Issue 1

Prepared for:

Forster Bowling Club

Prepared by:

Phillip J. Lidbury
Registered Surveyor
B.Surv. (Hons.) B.Civ. Eng. (Hons.) MIS MIEAUST

LSW SURVEYORS
Consulting Surveyors, Planners & Engineers

ABN: 17 619 183 309

P.O. BOX 510, FORSTER
First Floor
3 Wharf Street
FORSTER NSW 2428

Website: www.lswsurveyors.com.au
Email: consult@lswsurveyors.com.au
Phone: (02) 6554 7988

This report has been prepared on behalf of and for the exclusive use of the above mentioned. LSW Surveyors accept no liability or responsibility whatsoever for it in respect of any use or reliance upon this report by any third party.

LSW Surveyors A.B.N. 17 619 183 309. All rights reserved. This work covered by all copyright and cannot be reproduced or copied in any form or by any means (graphic, electronic or mechanical including photocopy) without the written permission of LSW Surveyors. Any license, express or implied, to use this document for any purpose what so ever is restricted to the terms of the written agreement between LSW Surveyors and the instructing party.

Liability limited by a scheme approved under Professional Standards Legislation.

1 INTRODUCTION

This document has been prepared to address stormwater quality and quantity management for proposed alterations and additions to Forster Bowling Club on part Lot 2 DP1033666, No.2 Strand Street, Forster. This strategy will conceptually size stormwater water quality measures to comply with Mid-Coast Council's stormwater quality management objectives. Stormwater will be treated by a combination of traditional drainage measures, as well as water sensitive urban design (WSUD) techniques.

The 11,078m2 site is located on the corner of Macintosh Street and Strand Street, Forster on the NSW Mid North Coast. The proposed development consists of an alteration and addition to part of the existing bowling club (being 1518m2), being a partial development of an existing outdoor bowling green and curtilage. The bowling green is quite flat with elevations ranging from 2.6m to 2.5m AHD, grading to the south-west corner of the site, prior to discharging into an existing adjacent Council drainage channel.

The soils on the site are expected to generally consist of Silty Sand (adjoining geotechnical information and eSpade soil profile in nearby Cross St).

This strategy is subject to final detailed design in accordance with final conditions of consent.

1.1 STORMWATER MANAGEMENT PERFORMANCE TARGETS

The objectives for water quality adopted for this Water Sensitive Design Strategy are based on *Great Lakes Council's* DCP Chapter 11 *Water Sensitive Design (September 2017).* As the existing impervious on the overall site is greater than 10%, the targets are:

- Post development loads of Gross Pollutants, TSS, TP and TN are to be reduced by 90%, 80%, 60% and 45% respectively compared to the untreated post developed pollutant loads.

Additionally, the objectives for water quantity are based on Mid-Coast Council's *Site Stormwater Design Guidelines (February 2024)*:

- Attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 1% AEP rainfall event.

1.2 PROPOSED STORMWATER QUALITY MANAGEMENT STRATEGY

This Water Sensitive Design 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 meet the objectives proposed above. These measures will also assist in reducing the post-developed peak flows exiting the site.

It is proposed that the majority of the new roofs will divert captured stormwater to a 100kL Rainwater Tank (100% of captured roof area, utilising a sealed downpipe system as required) which will be utilised for part re-use and stormwater detention. Any overtopping of this captured roof water, as well as other bypassing roof areas, impervious areas and remaining pervious areas will discharge through an outlet pit and enter the Council stormwater network.

The soils on the site are expected to generally consist of Silty Sand (adjoining geotechnical information and eSpade soil profile in nearby Cross St). Infiltration measures are not proposed.

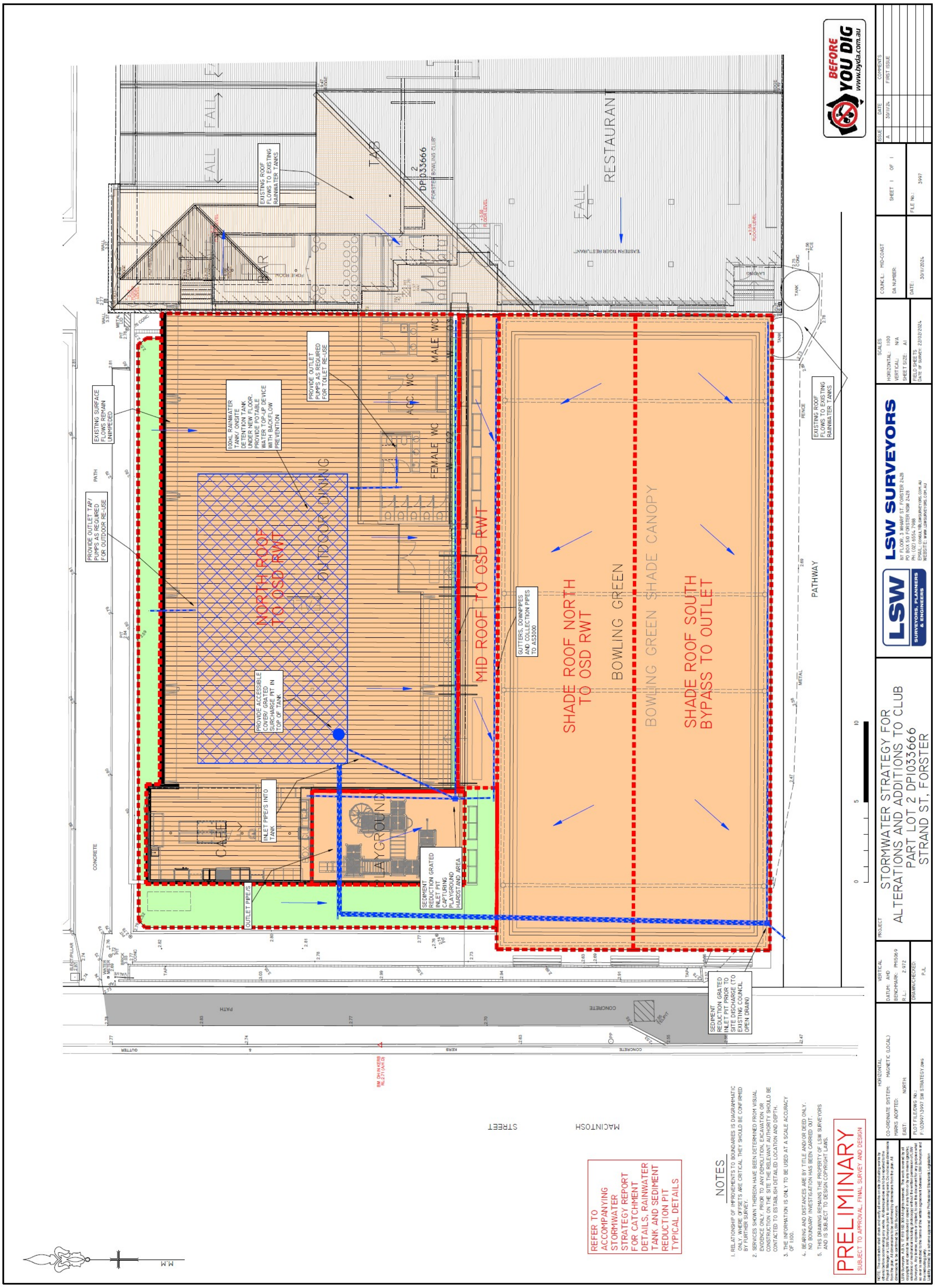


Figure 1 – Proposed Development

2 MUSIC WATER QUALITY MODEL

MUSIC (Model for Stormwater Improvement Conceptualisation) Version 6.4 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 post development scenario. The results from the post development scenario (with and without water quality treatment measures) modelling were compared to assess the performance of the proposed stormwater quality controls to meet the water quality objectives stated above.

2.1 RAINFALL AND EVAPORATION

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

Bureau of Meteorology records from the nearest Station 60013 (Forster Tuncurry Marine Rescue) were reviewed to determine that the average annual rainfall depth is approximately 1,217mm. *Bureau of Meteorology* records at this station provide complete 6 -minute pluviograph data. A 9-year consecutive period of data was required which included both wet and dry years with an average annual rainfall over the period being close to the historic average. Mid-Coast Council have provided a rainfall template to be adopted within the LGA with an average of 1,326mm rainfall.

A 6-minute rainfall time step was considered necessary to more accurately model the performance of rainwater tanks and biofiltration devices. It should be noted that this water quality modelling exercise is a comparative assessment (i.e. post-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.

Areal potential evapotranspiration values have also been provided in the template to be adopted within the LGA.

2.2 SOIL DATA AND MODEL CALIBRATION

A rainfall-runoff calibration was undertaken to match the predicted runoff to expected values. The model was calibrated in accordance with the *Guidelines for Water Sensitive Design Strategies - Mid-Coast Council October 2019* for a Soil Hydrologic Group 'A', which broadly corresponds to a Sandy soil. The adopted parameters are summarised below;

Table 1 – MUSIC Rainfall-Runoff parameters

Impervious Properties	Pervious properties	Groundwater Properties
Rainfall threshold: 1mm (roofs with first flush) and 1.5mm (roads and Impervious areas) Pervious areas 1mm	Soil storage:155 Initial Storage:25 Field Capacity: 75 Infiltration coefficient A: 360 Infiltration coefficient B: 0.5	Initial Depth: 10mm Daily recharge rate: 100% Daily baseflow rate: 50% Daily deep seepage rate: 0%

2.3 POLLUTANT CONCENTRATIONS

The pollutant concentrations adopted for existing-state and developed state modelling are shown in Table 2. The event mean concentrations (EMC's) for each of these land uses were derived from *Fletcher et al (2004)* and *Draft NSW MUSIC Modelling Guidelines.*

Table 2 – 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/l
Roofs				
Suspended Solids	1.30	0.32	-	-
Total Phosphorous	-0.89	0.25	-	-
Total Nitrogen	0.30	0.19	-	-
Impervious				
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

2.4 CATCHMENT DEFINITION

For the purpose of the water quality modelling, the site was separated into Roof Area and Impervious (Playground) areas.

Existing external areas and existing remaining bowling green areas either do not enter any treatment measures or are the same in both pre and post developed scenarios and as such have not been modelled.

Table 3 – Contributing Catchment Details

POST-DEVELOPED Sub-Catchment	Area (m^2)	% Imperviousness
1 Proposed Roof North+Mid+Shade North to RWT (Roof)	1016	100%
2 Proposed Roof Shade South Bypass (Roof)	335	100%
3 Playground area hardstand (Urban)	55	100%
TOTAL	**1406**	**100%**

2.5 MODELLING STORMWATER MANAGEMENT CONTROLS

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

2.5.1 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.

It is proposed that the majority of the new roofs will divert captured stormwater to a 100kL Rainwater Tank (100% of captured roof area, utilising a sealed downpipe system as required) which will be utilised for part re-use and stormwater detention. Any overtopping of this captured roof water, as well as other bypassing roof areas, impervious areas and remaining pervious areas will discharge through an outlet pit and enter the Council stormwater network.

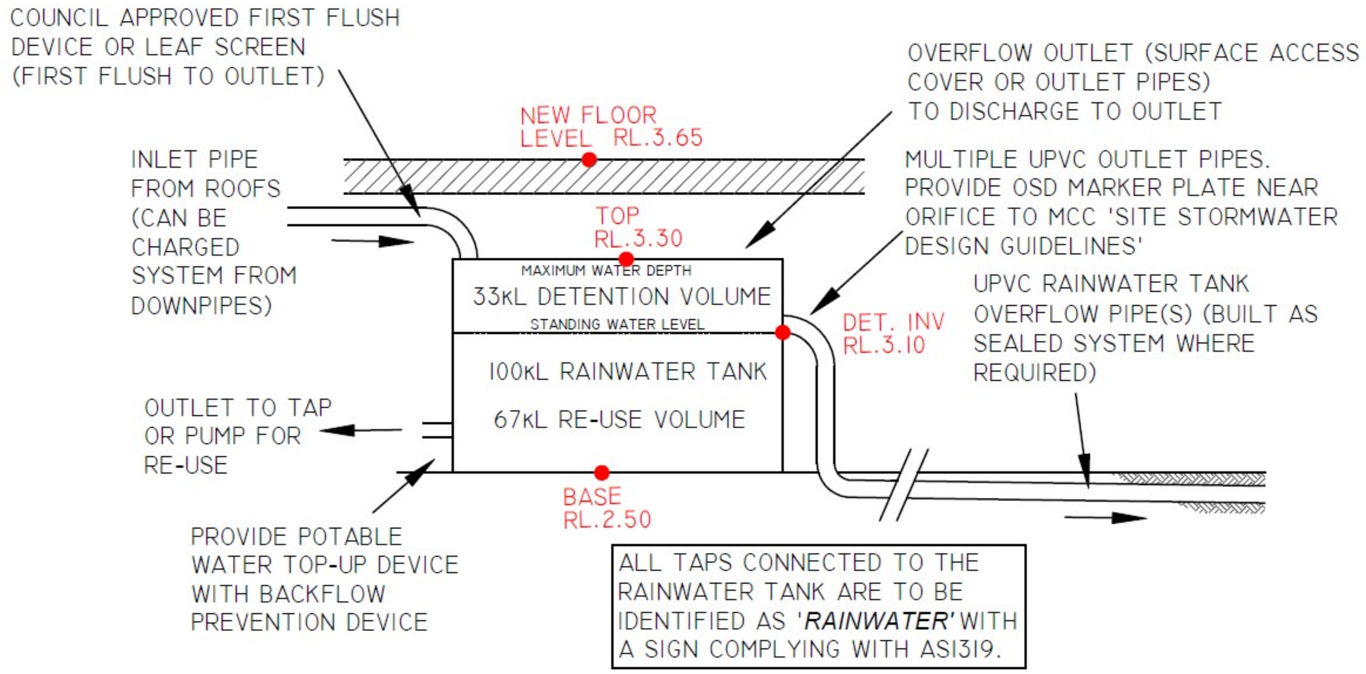
This tank will require a council approved first flush stormwater filter device, prior to water entering the unit. To ensure the tank will always contain water for indoor re-use, a potable water top-up device with backflow prevention device is to be fitted to the tank. All taps connected to the rainwater tanks are to be identified as *'Rainwater'* with a sign complying with AS1319.

Re-use of the collected stormwater runoff is to be used for non-potable indoor and outdoor purposes only including toilet flushing and outdoor irrigation.

For MUSIC modelling, the following parameters were used:

- 100kL tank per dwelling for re-use capturing the majority of the new roof area (100% capture). 67kL reserved for re-use, 33kL for detention. Only 67kL has been modelled in MUSIC.
- Outdoor re-use has been estimated based on the publication *'Best Practice Guidelines for water efficiency in clubs (Sydney Water, 2009)'* which suggests a recommended irrigation rate of 0.18kL/m2/year for Bowling Greens. We have allowed for the adjacent full sized green and covered half green to be irrigated (1870m2) which provides an annual re-use demand of 336kL/year.
- Toilet flushing demands for the new toilets proposed to be connected to the tank has been estimated based on the publication *'Best Practice Guidelines for water efficiency in clubs (Sydney Water, 2009)'* which suggests an average usage of 27L/customer/day of which 30% is estimated as toilet amenities, being 8L/customer/day. The design plans nominate the new toilets account for 50% of the total toilets in the club, for a total patronage of 1732 customers. As such there is an

estimated 866 customers attributed to these connected toilets, which provides a daily re-use demand of 6.93kL/day.
- 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).



TYPICAL RAINWATER TANK DETAIL
NOT TO SCALE

2.5.2 Sediment Reduction (GPT) Pits

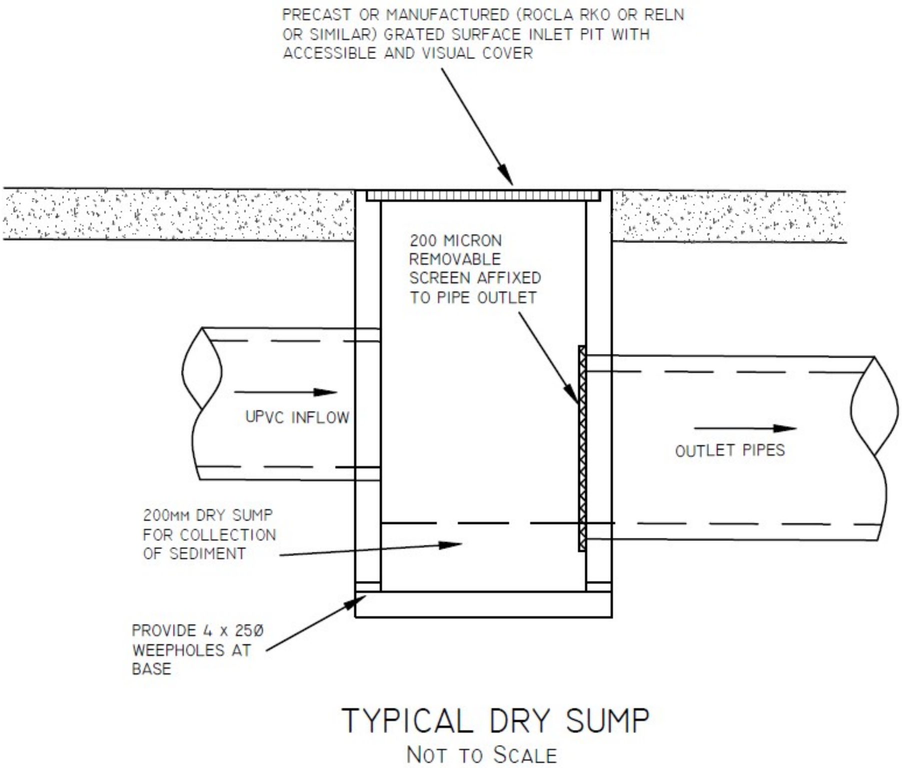
Sediment reduction/pre-filter pits are a type of at source *Gross Pollutant Trap (GPT)* and is a stormwater treatment *Best Management Practice* device designed to capture coarse sediment, trash and vegetation matter. *GPT's* play an important role in stormwater quality management as pre-treatment for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

It is proposed to provide a Sediment Reduction Pit in the final surface inlet pit required prior to entry into the OSD Rainwater Tank (expected playground catchment) and also the final pit collecting the bypassing half of the shade structure prior to outlet.

These pits will contain a 200micron filter screen (or similar) with a dry sump and will act as gross pollutant traps and will capture coarse sediment, trash and vegetation matter, and screen finer particulates. The pit grates shall be removable for access and maintenance.

It was assumed that the Sediment Reduction Pits had the following pollutant removal efficiencies:
- 100% to 075mg/L, 65% to 1000mg/L Total Suspended Solids removal*
- 0% Total Phosphorus Removal (per *MCC Guidelines for Water Sensitive Strategies*)
- 0% Nitrogen Removal (per *MCC Guidelines for Water Sensitive Strategies*)
- 90% Gross Pollutant Removal*

*Based on Draft *NSW MUSIC Modelling Guidelines – August 2010*



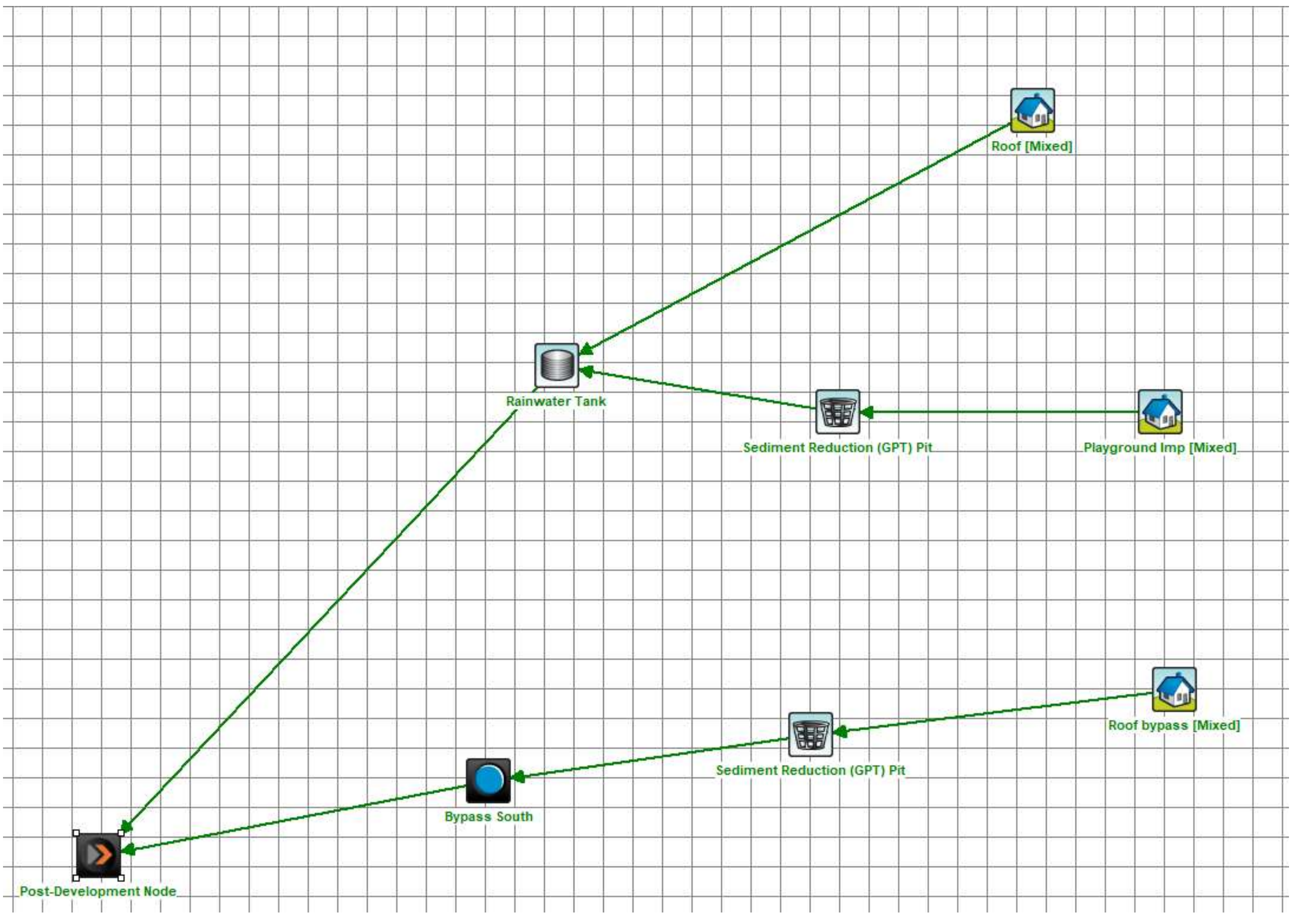


Figure 2: Post-Developed MUSIC model

2.6 MODEL RESULTS

Table 4 presents the average annual pollutant export loads at the downstream extent of the contributing catchment under post developed conditions (with and without treatment).

Table 4 - Annual Average Pollutant Export Loads

	Proposed Development Catchment		
Pollutant	**Developed Site Load (without treatment) (kg/yr)**	**Developed Site Load (with treatment) (kg/yr)**	**% Reduction**
Gross Pollutants	39.1	0.94	**97.4**
TSS	53.1	15.6	**70.6***
TP	0.258	0.103	**60.1**
TN	3.45	1.45	**57.8**

The results in Table 4 indicate that the proposed Water Sensitive Design Strategy would meet or exceed the water quality objectives for the site, which were:

- Post development loads of Gross Pollutants, TSS*, TP and TN are to be reduced by 90%, 80%, 60% and 45% respectively compared to the untreated post developed pollutant loads.

*Note that the Total Suspended Solids (TSS) reductions was slightly less than the target of 80% (by approximately 4kg/yr). This cannot be practically reduced further without substantial treatment as the site is effectively being penalised by having a low post-development Event Mean Concentration (primarily roofs) which means to reduce the TSS by 80% requires over treatment. As a comparison, the pre-developed TSS loadings for this site (pervious bowling green) are 30.4kg/yr. The treated site has reduced post-developed loadings to 15.6kg/yr, being effectively 50% of the pre-developed TSS loadings. As such we consider the objective of TSS has been achieved in a practical manner.

2.7 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. Construction methods will be detailed in designs for the construction certificate.

2.8 Maintenance

An Operations and Maintenance Manual is to be prepared for the future rainwater tank and associated sediment reduction pits and will be prepared for the construction certificate.

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

3 HYDROLOGIC ANALYSIS

The peak flow modelling criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 1% AEP peak rainfall event.

Hydrological modelling for this strategy has been undertaken using DRAINS software, incorporating an IL-CL model.

3.1 DRAINS Parameters

The pre and post-developed DRAINS models are unsteady IL-CL hydrological models representing the proposed developed catchments.

The following parameters were adopted for the DRAINS IL-CL catchments:

Table 5 – IL-CL Model Parameters

	Pervious Areas	Impervious Areas
Initial Loss (IL)	29 mm	1 mm
Continuing Loss (CL)	0.92 mm/hr*	0 mm/hr

*reduced by 60% based on NSW OEH guidance

3.1.1 Rainfall Data

Rainfall inputs were entered using IFD relationships from BOM for Forster and temporal patterns/ ensembles and pre-burst rainfall depths from ARR2019 Data Hub.

An Antecedent Moisture Condition of 3 has been adopted, after reviewing previous rainfall records for the area.

3.2 Catchment Definition

Existing external areas and existing roof areas either do not enter any treatment measures or are the same in both pre and post developed scenarios and as such have not been modelled.

Table 6 – Contributing Catchment Details

PRE-DEVELOPED Sub-Catchments	Area (m^2)	% Imperviousness
1 Existing Pervious (Bowling Green and curtilage) Tc = 5min	1518	0%
TOTAL	**1518**	**0%**

POST-DEVELOPED Sub-Catchment	Area (m^2)	% Imperviousness
1 Proposed Roof North+Mid+Shade North to RWT	1016	100%
2 Proposed Roof Shade South Bypass	335	100%
3 Playground area hardstand	55	100%
4 Bowling Green and curtilage Remaining Pervious	112	0%
TOTAL	**1518**	**92.6%**

3.3 Post-Development Flows

As mentioned previously, it is proposed that the majority of the new roofs will divert captured stormwater to a 100kL Rainwater Tank (100% of captured roof area, utilising a sealed downpipe system as required) which will be utilised for part re-use and stormwater detention. Any overtopping of this captured roof water, as well as other bypassing roof areas, impervious areas and remaining pervious areas will discharge through an outlet pit and enter the Council stormwater network.

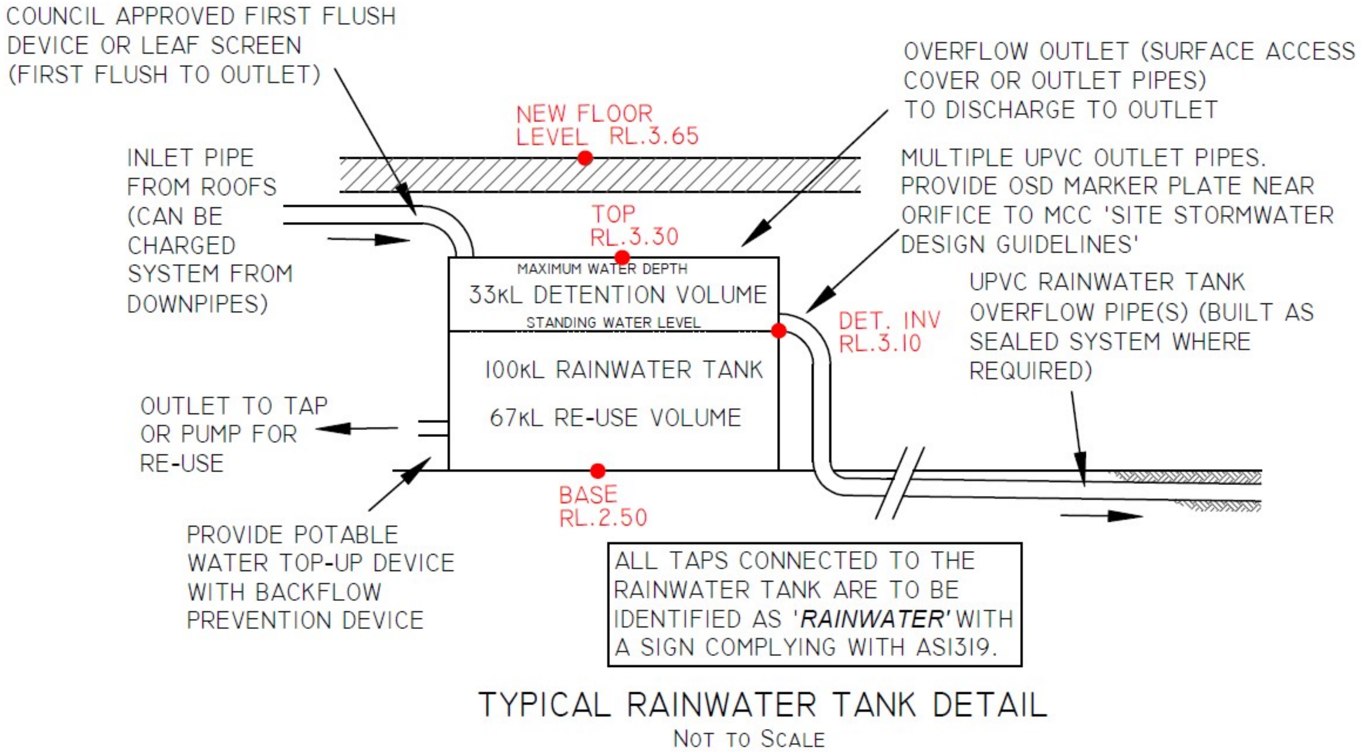


Figure 3 – Rainwater Tank Details

Table 7 – Detention Basin Storage Volume

Catchment	Storage Volume (m^3)	Peak Water Level
Onsite Detention (Tank)	33m3 (R.L.3.1 outlet invert to R.L.3.3 top)	R.L.3.26 (1% AEP)

33kL of the tank has been modelled for detention (the re-use component has not been modelled). Multiple outlet pipes at the outlet of the detention volume is proposed to be nominated.

The flows exceeding the approximate roof 5% AEP flows into the rainwater tank has also been conservatively diverted from the tank (given that roof gutters only require capacity to the 5% AEP under AS3500).

The total peak discharges from the 20%, 10%, 5% and 1% AEP events (for durations 5mins – 2hours) for the catchment has been reduced to less than the pre-developed. Refer to Table 7 below for a summary of pre and post developed discharges.

Table 8 – Summary of Stormwater Quantity

	20% AEP (m3/s)	10% AEP (m3/s)	5% AEP (m3/s)	1% AEP (m3/s)
Pre-Developed	0.052	0.070	0.084	0.113
Post-Developed with OSD	0.037	0.045	0.054	0.085

Note the above peak flows are (total) summed for the development where there are multiple outlets. The peak flows produced by DRAINS are the result for the highest upper median value for all durations in the AEP for each catchment (which is the highest of the upper median (critical) peak flow from all of the duration storm ensembles and therefore the most 'representative' storm as per ARR2019)

3.4 Flooding

The proposed floor level of the addition is above Great Lakes Council's Flood Planning Level, which incorporates the 1% AEP for 2100 and an additional 500mm freeboard. Any inundation of the outdoor bowling green is as per existing and has suitable overflow opportunities into the adjoining Council open drain. As such the development has considered potential flooding impacts.

4 SUMMARY

4.1 Stormwater Quality Summary

A combination of measures discussed above including rainwater tanks and sediment reduction pits have been proposed to manage the discharge of nutrients and pollutants leaving the site. The modelling shows that the water quality objective of "treatment train effectiveness" can be achieved for the proposed development.

4.2 Stormwater Quantity Summary

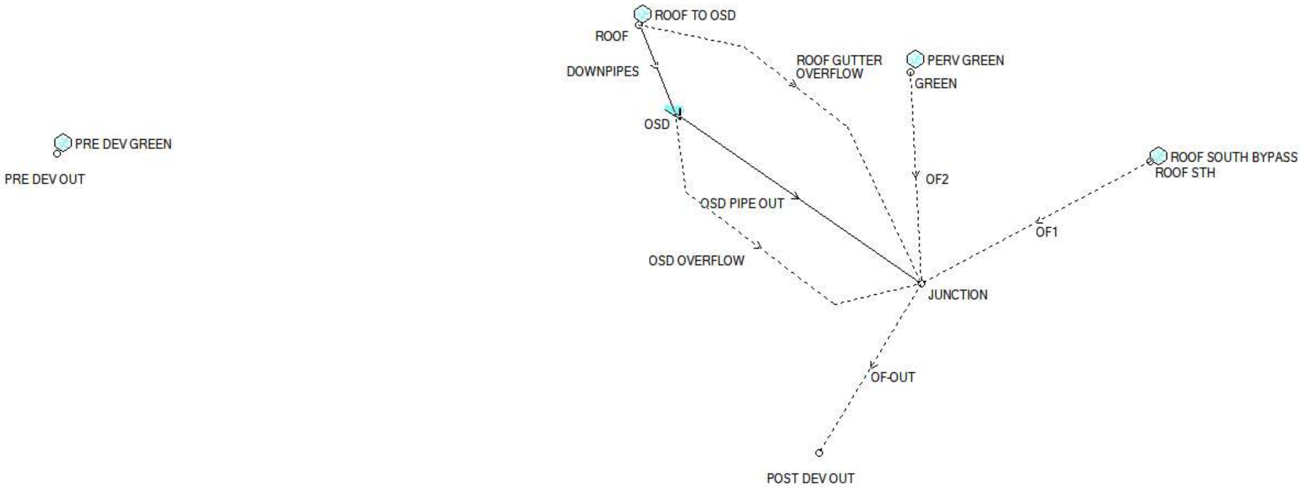
The utilisation of detention in the Rainwater Tank will attenuate captured stormwater runoff. The criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 1% AEP rainfall event.

The modelling shows that the total peak discharges from the 20%, 10%, 5% and 1% AEP events (for durations 5mins – 2hours) for the development has been reduced to less than the pre-developed.

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

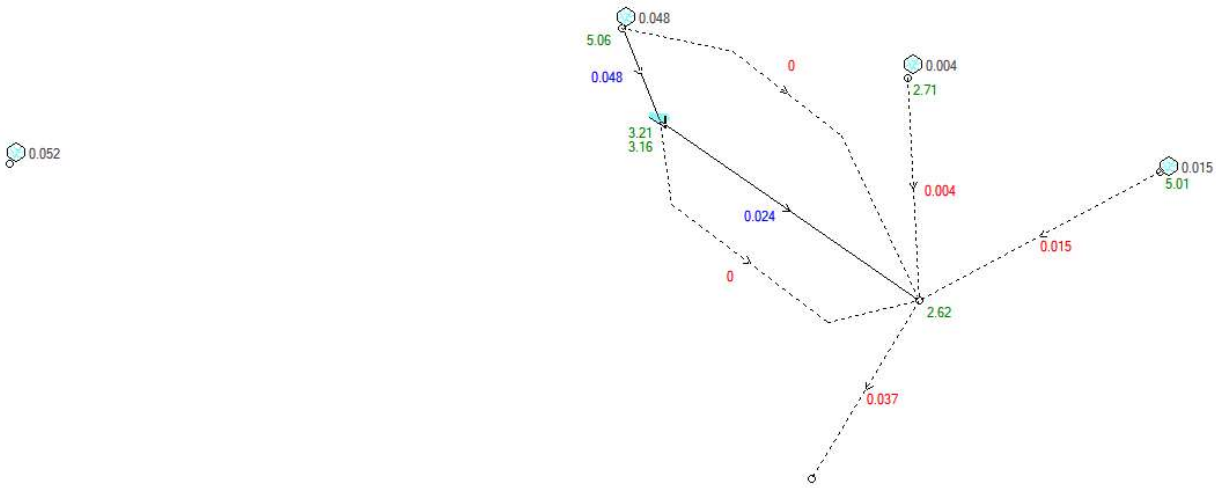
A HYDRAULIC OUTPUT FILES

A.1 DRAINS Pre and Post-Developed Model Schematic Layout

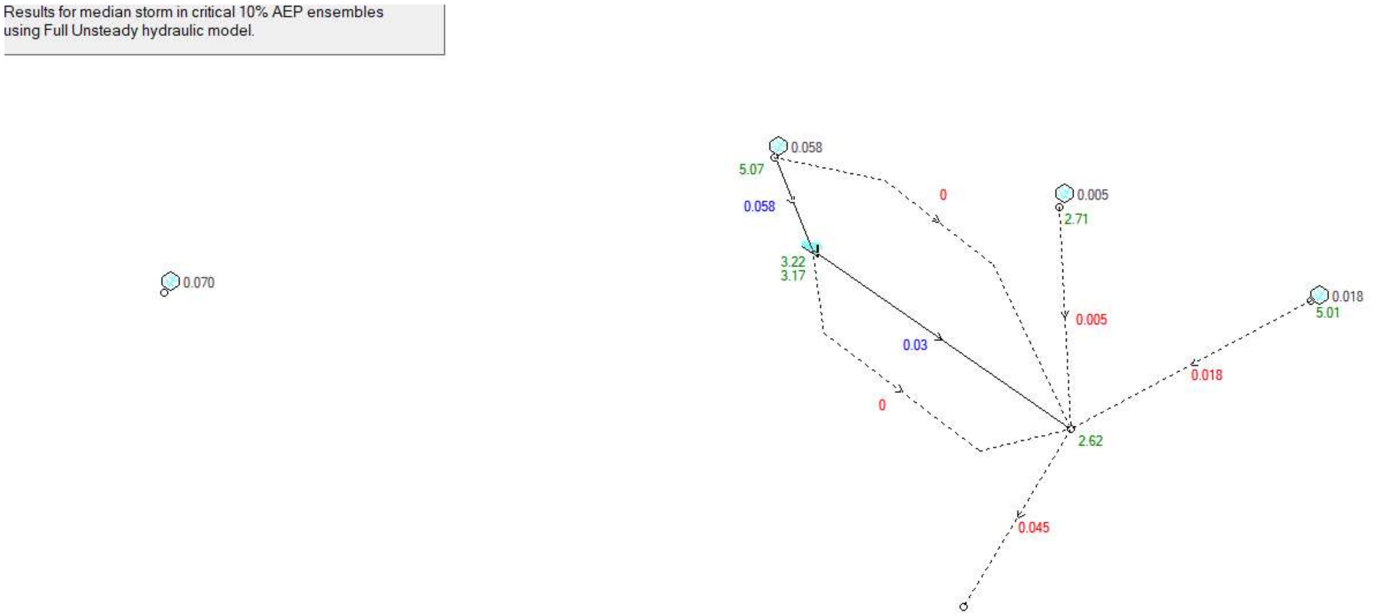


A.2 DRAINS Pre and Post-Developed Model (20% AEP Peak Flows)

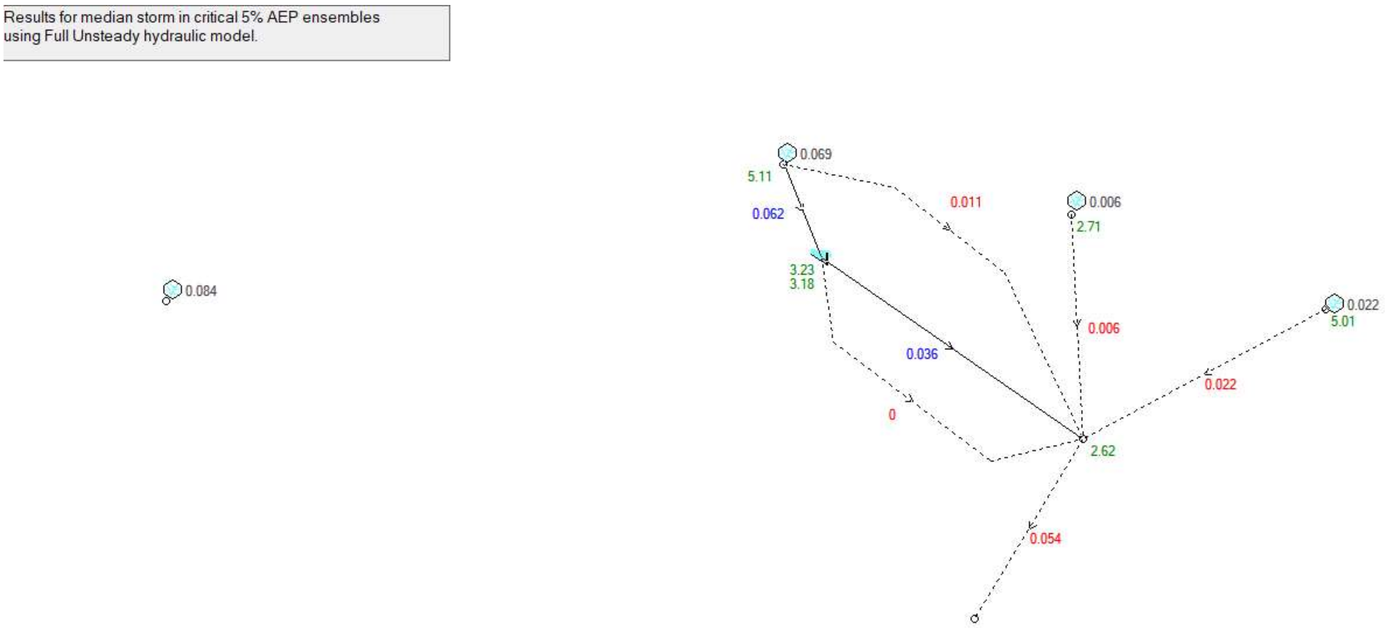
Results for median storm in critical 20% AEP ensembles
using Full Unsteady hydraulic model.



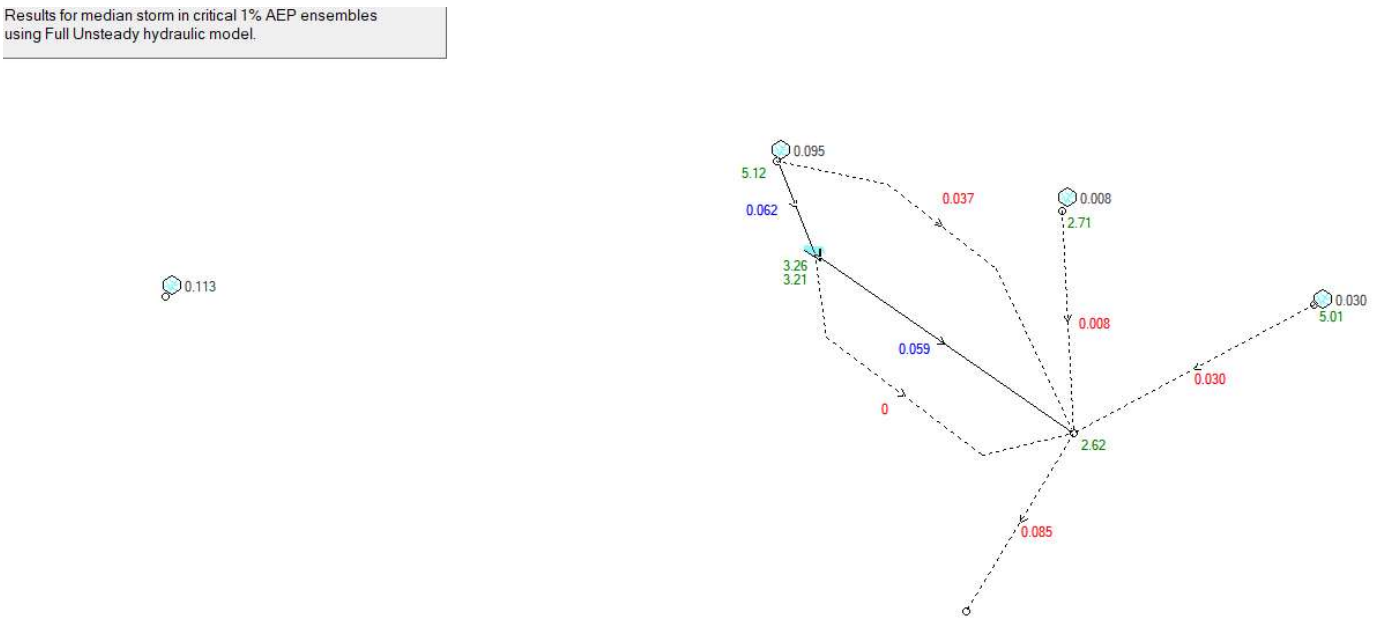
A.3 DRAINS Pre and Post-Developed Model (10% AEP Peak Flows)



A.4 DRAINS Pre and Post-Developed Model (5% AEP Peak Flows)



A.5 DRAINS Pre and Post-Developed Model (1% AEP Peak Flows)



B Stormwater Strategy Plan