STORMWATER MANAGEMENT PLAN

FOR

BUNNINGS WAREHOUSE

357-373 WARRINGAH RD, FRENCHS FOREST

REPORT NO. R02240-SWMP

Revision B

MAY 2020

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PROJECT DETAILS

Property Address: 357-373 Warringah Rd, Frenchs Forest

Development Proposal: Bunnings Warehouse

REPORT CERTIFICATION

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DOCUMENT CONTROL

REVISION	ISSUE DATE	ISSUED TO	ISSUED FOR
A	MARCH 2020	Bunnings Group Ltd	Information
B	MAY 2020	Bunnings Group Ltd	Information
		Council	Approval

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1 INTRODUCTION

1.1 General

This Stormwater Management Plan has been prepared in accordance with the Northern Beaches Council DCP to support the development application (DA) for the proposed Bunnings Warehouse, Frenchs Forest.

The scope of this report includes a comprehensive assessment of the stormwater management requirements for the proposed development. Accordingly, this report includes findings of the assessment and proposes a best practice stormwater management strategy.

The report describes the principles and operation of the proposed stormwater systems as well as the primary components of the drainage system. As the assessment is required under the conditions of consent, the final stormwater system layout may need to be revised in the future during the application for a Construction Certificate.

The following information and documents were utilised in this investigation:

- Concept Civil Engineering Drawings for the Development Application submission prepared by C&M Consulting Engineers;
- Architectural Plans by Michael Carr Architects;
- Warringah Council DCP (2011);
- "Australian Runoff Quality – A Guide to Water Sensitive Urban Design", Engineers Australia (2006);
- "Australian Rainfall and Runoff – A Guide to Flood Estimation", Institute of Engineers, Australia (2016).

The increase in impervious areas and alteration of the natural topography due to land development has the potential to increase and concentrate peak storm flows. This has the potential to impact on flow regimes and cause erosion of the downstream drainage network and associated waterways.

To avoid any adverse impact on the downstream drainage systems, the site's stormwater management system must be designed to ensure the safe conveyance of flows throughout the site and within the capacity of the downstream trunk drainage systems in a healthy environmental state for Ecological Sustainable Development.

1.2 The Site

The site is located at 357-373 Warringah Rd, Frenchs Forest. It is bound by Warringah Road to the North & West and Rodborough Rd to the South. There are currently commercial buildings on the property (Refer to Figure 1).

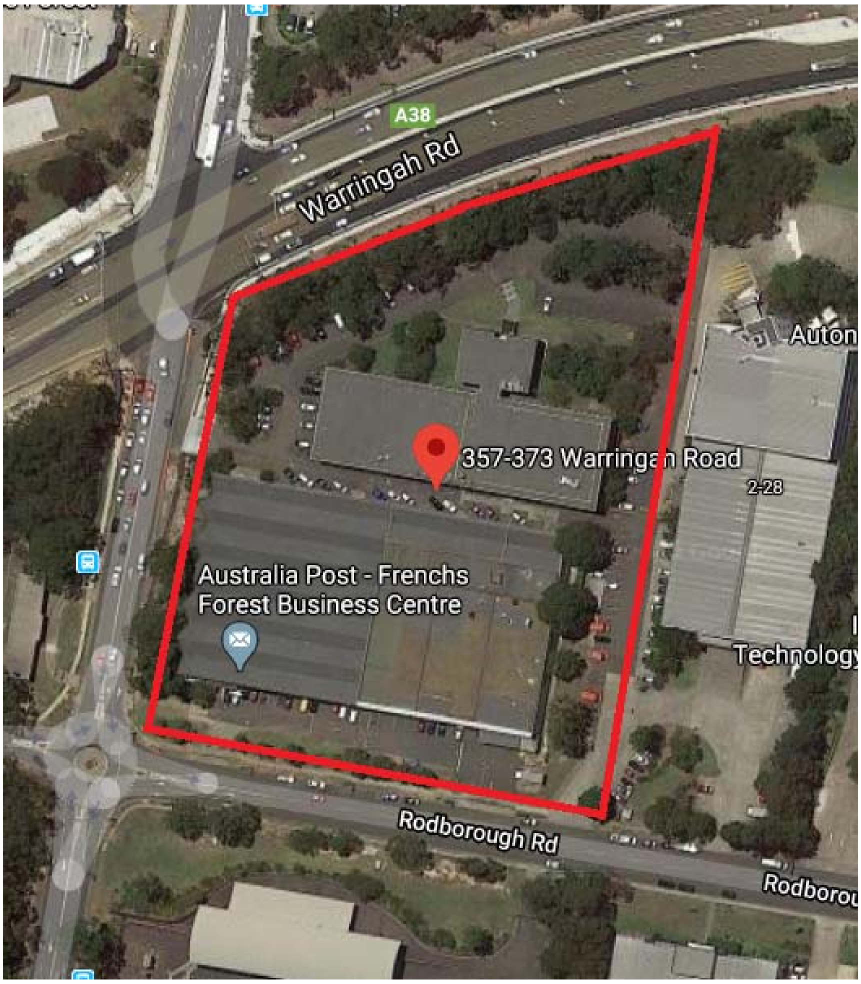


Figure 1 - Site Location
(Source: google.maps.com)

The land falls gradually towards the Northern end of the Site. The proposed development includes the demolition of the existing infrastructure and the construction of a Bunnings Warehouse including basement parking, driveways, car parking, stormwater drainage infrastructure and utility services.

1.3 Key Issues

The key issues and the mitigating measures to be employed within the proposed development site are:

- **Water Quantity** - Increased impervious surfaces (such as roofs, driveways, etc) have the potential to increase the storm water flows from the site during storm events. To avoid impacting on the downstream drainage system, the site storm water system has been planned to safely convey the flows through the site and within the capacity of the downstream system.

- **Water Quality** - Urban developments have the potential to increase gross pollutants, sediments and nutrient concentrations in storm water runoff. To limit impact on the downstream water quality, pollution control measures will be provided at each storm water outlet prior to discharging to the existing drainage system.

2 RELEVANT GUIDELINES

2.1 Design Guidelines

The site based stormwater management and planning elements are to be designed and constructed in accordance with the following:

Water Quantity

Guidelines: Warringah Council – On-site Stormwater Detention Technical Specification (1998)

The proposed development increases the total impervious area of the existing site and therefore may increase the discharge rate to the downstream drainage network and waterways. The main objective is to achieve a natural water balance which seeks to approximate the pre-development site conditions to maintain existing conditions as well as controlling erosion and sediment removal.

Water Quality

Guidelines: Warringah Council – Water Management Policy (2011)

The main objective for stormwater quality is to ensure that the effectiveness of the proposed stormwater quality improvement devices (SQIDs) must achieve the minimum reductions as summarised in Table 2.

Table 1 - Water Quality Reduction Targets

PARAMETERS	CRITERIA
Gross Pollutants	90% reduction of the average annual load
Suspended Solids	85% reduction of the average annual load
Total Phosphorus	65% reduction of the average annual load
Total Nitrogen	45% reduction of the average annual load

2.1.1 Objectives and Targets

The objective is to provide stormwater controls that ensure that the proposed development does not adversely impact on the quantity or quality of stormwater flows within, adjacent and downstream of the site.

Compatible with the legislation, policy and requirements, the objectives and targets for stormwater management are as provided in Table 2.

Table 2 - Stormwater Management Objectives

Stormwater Management	Objectives	Target
Quantity	▪ The existing runoff flow regimes for the full storm events should be maintained, and provide safe conveyance system for the major storm events.	▪ Maintain existing runoff from development: – Provide a stormwater drainage and stormwater detention system – Ensure no adverse impact on downstream properties or receiving waters
Quality	▪ The full range of typical urban stormwater pollutants shall meet Council requirements.	▪ Provide controls to meet the Council requirements.

3 STORMWATER QUANTITY CONTROL

3.1 Introduction

The main criterion for the stormwater quantity control is to ensure that the post-developed peak flows do not cause detriment to the downstream waterways and Council's existing drainage network.

3.2 Proposed Drainage System

The drainage system for the proposed development will be designed to collect the majority of concentrated flows from impermeable surfaces such as access ways, parking areas and buildings. Where possible (and practical), runoff from pervious areas will also be collected.

The proposed stormwater management system for the development includes:

- A pit and pipe network to collect minor storm runoff from areas;
- Overland flow paths to carry major storms through the site;
- A below ground OSD tank with orifice and weir control;
- A below ground rainwater reuse tank.

3.3 On-Site Stormwater Detention Requirements

The OSD was modelled using the runoff routing software DRAINS. A pre vs post development model was set up within DRAINS with the assumption that the predevelopment condition was fully pervious. The permissible site discharge was then limited to the pre-development flow rates for all storm events from the 20%AEP (1 in 5 Year ARI) up to and including the 1% AEP (1 in 100 Year ARI) storm event.

The DRAINS model data and results can be found attached to this report as Appendix A. The model will be made available upon request.

For the proposed development, it is recommended that OSD be provided in the form of a below ground tank with a discharge control pit, orifice and weir control. It is currently proposed to provide a minimum OSD storage volume of 701m^3.

3.4 Rainwater Reuse

This Section of the Report summarises the performance of the proposed rainwater tank by water balance simulation using historical recorded rainfalls.

Bunnings Warehouse adopts Water Sensitive Urban Design (WSUD) strategy in their development to reduce the loading placed on water and wastewater infrastructure. This strategy will give opportunities to reduce demand on potable water and to reduce wastewater exported from the site.

Bunnings has its own policy to replace a minimum of 90% of potable water for use within the outdoor nursery and for toilet flushing.

3.4.1 Water Demands

Based on a comparable observation on other Bunnings stores, the water usage for the outdoor nursery is between 0.5mm and 1.5mm per day based on season. For the modelling purpose, 1.5mm per day for the whole nursery area is used.

Although there are public toilets in Bunnings, the majority of users are staff. A total of 12 WCs each fitted with 6/3L flushing system having an average of 15 flushes per day per WC would account for about 0.9 kl/day.

For the nursery area of 1258m^2 the maximum daily demand used in the modelling is therefore 1.887kl/day.

3.4.2 Water Balance Model

Water balance modelling has been undertaken to determine the most effective rainwater tank capacity and estimate the potable water savings based on the demands.

The capacity of the rainwater tanks is a function of the local rainfall data, the catchment areas, and the water demand placed upon the tanks. The rainfall data, which encompasses daily rainfall for a period of 10 years from 1983 to 1992, was obtained from the Sydney Station recorded by the Bureau of Meteorology.

The model is a daily urban water balance model developed in-house to simulate the water cycle as an integrated whole and provide a tool for investigating the use of locally generated stormwater as a substitute for potable water.

The model allows for seasonal variation and element factors like wet/dry days that regulate the irrigation.

PROJECT:	**02246 - BUNNINGS FRENCHS FOREST**
RAINFALL DATA:	**SYDNEY FROM 1983 TO 1992**
DESIGNER	**PO**
DATE:	

ROOF AREA (Ha)	0.3	
NON-ROOF AREA (Ha)	0	
FRACTION IMPERVIOUS	0	
PERVIOUS LOSS COEFF	0.3	30% lost
Max Tank/pond Capacity (m3)	28	
Average Surface Area (m2)	0	
Pond base area (m2)	0	
Average Infiltration rate (mm/hr)	0	
Porosity of soil (%)	5%	
Usage:		
Total Number of occupants	30	
Toilet Flushing (l/d/person)	30	
Laundary (l/d/person)	0	
Other usage (l/d/person)	0	
Total Domestic Usage (m	0.90	
Irrigation Area (m2)	1258	
Max Irrigation Rate (mm/day)	1.5	<= Summer
No irrigation if rainfall > (mm)	1	
Max Irrigation Usage (m3/	1.887	
Daily Infiltration (m3)	0.00	
% Irrigation water re-collected	0	

SUMMARY RESULTS

Average Annual Rainfall (mm)		1450
Total No. Days:		3653
Total # days with empty tank		258
	Percentage:	7.1%
Total # days with overflow/full tank		922
	Percentage:	25.2%
Total Annual Runoff Collected (KL)		4351
Average Annual Rainwater Usage (KL)		552
% Reuse		12.7%
Total Average Annual Water Demand (KL)		613
Average Annual Potable Water Required (KL)		61
Potable Water Usage (%)		9.9%

roof	size
0.1	55
0.2	34
0.3	**28**
0.4	26
0.5	24
0.6	23

Figure 2 - Water Balance Model & Results

The model shows the optimum configuration is met with 3000m^2 of roof area draining to a 28kL rainwater tank.

3.4.3 Rainwater Tank Requirements

- Roof catchment for the tanks shall be protected from pipe bleeding from roof mounted appliances such as air conditioners, hot water services and any other appliances that may cause pipe bleeding.
- The tank(s) shall be fitted with a first flush filter system and the overflow provision connected to the stormwater drainage system.
- The tank shall be fully enclosed and all openings sealed to prevent mosquito breeding.
- The tank shall have a minimum of 15% air gap.
- Potable water backup system shall be provided to the Water Authority's requirement and their standard. This backup system shall be operational in the event of a power failure.
- The tank(s) shall be plumbed to toilets and nursery areas to the requirements of Bunnings and of local authorities.
- The associated piping shall be labelled 'Rainwater – Not for Drinking' in accordance with local authority's requirement.

4 WATER QUALITY CONTROL

4.1 Introduction

The quality of runoff from a catchment depends upon many factors such as land use, degree of urbanisation, population density, sanitation, waste disposal practices, landform, soil types, and climate. Pollutants typically transported by runoff include litter, sediment, nutrients, oil, grease, and heavy metals. Whilst these pollutants have a deterious impact on the receiving water quality, suspended solids and nutrients cause the highest detrimental impact to the environment. Litter, oils, and other surfactants have an aesthetic impact.

Activity within a catchment during urbanisation includes the disturbance of vegetation, removal of topsoil, land shaping, road construction, installation of services, and building works. It is during this phase that the sediment movement is greatest and is estimated that the sediment production levels may be up to 6 times higher than under the existing conditions. However, once development is completed, the sediment loading may return to the existing level or remain at a higher level depending on land management practices.

As with all development projects, soil erosion during the construction phase presents a potential risk to water quality. The primary risk occurs while soils are exposed during earthworks when suspended sediment and associated pollutants can be washed into downstream watercourses.

This section of the report addresses the long term impacts of the development on water quality. For short term effects (i.e. during the construction phase) water quality control is achieved by implementing the measures in the Sedimentation & Erosion Control Plans to be included with future Construction Certificate submissions.

4.2 Water Quality Control Measures

There are a number of measures that can reduce pollutant loadings, varying in effectiveness depending on land use type, topography and the control target.

The measures proposed for the redevelopment are summarised in Table 3.

Table 3 - Water Quality Control Measures

MEASURES	DESCRIPTIONS
Gross Pollutant Traps	▪ An *EnviroPod* is a catch basin insert installed inside inlet pits. It is effective in removing trash, debris and other pollutants from runoff. ▪ *EnviroPods* proposed for the project utilise a 200 micron filter system. These filter baskets will be installed in indicated pits for the proposed development.
Filter Cartridges	▪ StormFilter is a proprietary device containing multiple cartridge units in a single system thereby suitable for larger catchments ▪ One of the advantages of using StormFilter is that the cartridges come with various filtration media available to target site-specific pollutants ▪ Each cartridge consists of a PhosphoSorb media which is a lightweight media built from a Perlite base that removes total phosphorus (TP) by adsorbing dissolved-P and filtering particulate-P simultaneously. It not only removes phosphorous but is also designed to capture TSS, Oil and Grease, soluble metals, and nutrients. ▪ There will be total of 30 x 690mm PSORB Stormfilter Cartridges within a chamber of the OSD system as detailed in the engineering drawings.
Rainwater Tank	▪ Rainwater tanks are effective in the removal of pollutant loads at source. The pollutant removal process occurs by harvesting runoff for reuse, thereby limiting the nutrients that are discharged into the waterways. ▪ Harvested rainwater will be plumbed to each unit for external taps and toilet flushing. ▪ A total of 12 WCs each fitted with 6/3L flushing system having an average of 15 flushes per day per WC would account for about 0.9 kL/day ▪ It is proposed to provide a rainwater reuse tank with a minimum effective volume of 28kL plumbed for toilet flushing and nursery irrigation.

In addition to the above measures for pollutant control, natural vegetated buffers will be maintained along the edges of roads, accesses, and areas of activity, which will further reduce pollutants to meet reduction targets. This added benefit has not been included in the modelling hence contributing to the conservative nature of the modelling and assessment.

4.3 Strategy Effectiveness

The effectiveness of the proposed water quality measures have been assessed using numerical modelling. The results were assessed against the established Council requirements to determine the effectiveness of the proposed strategy.

4.4 Water Quality Modelling

4.4.1 MUSIC Program

The water quality model adopted for this project is the MUSIC (Model for Urban Stormwater Improvement Conceptualisation version 6) water quality numerical model developed by the MUSIC Development Team of the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC is an event basis model, and will simulate the performance of a group of stormwater management measures, configured in series or in parallel to form a “treatment train”.

The MUSIC User Manual suggests that the time-step should not be greater than the time of concentration of the smallest sub-catchment, but consideration should also be given to the smallest detention time of treatment nodes in the system. To accurately model the performance of the treatment nodes, a 6-minute time step was chosen.

The MUSIC model was generated using the historical 6-minute rainfall and monthly evapotranspiration data for Sydney (Rainfall Station 66062) for a period of 10 years from 1959 to 1969 was utilised.

Catchment characteristics were defined using a combination of roof areas and non-roof catchments with varying imperviousness ratios to replicate the catchment for the development condition. The respective catchment areas are shown in Table 6.

The MUSIC model layout and results are shown in Appendix B of this report.

4.4.2 Event Mean Concentration

MUSIC uses different event mean concentrations (EMC) to determine the pollutant loads generated by different land uses. The standard EMCs adopted within MUSIC were based on research undertaken by Duncan (1999) through the CRCCH and the results are reproduced in Australian Runoff Quality – A Guide to Water Sensitive Urban Design (ARQ). Table 4 summarises the parameters used for the development site.

Table 4 - EMC Parameters

LAND USE	MEAN BASE FLOW CONCENTRATION PARAMETERS Log_{10} (mg/L)			MEAN STORM FLOW CONCENTRATION PARAMETERS Log_{10} (mg/L)		
	TSS	TP	TN	TSS	TP	TN
Roof Areas	Not Applicable*Note 1			1.300	-0.890	0.300

Impervious Areas	1.100	-0.820	0.320	2.200	-0.450	0.420
Pervious Areas	1.100	-0.820	0.320	2.200	-0.450	0.420

*Note 1 – Roof areas consists of 100% impervious area so there is no base flow generated from this area.

4.4.3 Configuration

Table 5 and Table 6 provide the treatment configurations used in the MUSIC model.

Table 5 - Catchment Areas

LAND USE	DEVELOPED CONDITIONS		LAND USE CATCHMENTS (%)
	AREA (m^2)	IMPERVIOUSNESS (%)	
Other Impervious	3532	100	19
Roof	7643	100	40
Pervious	4135	0	20
Bypass Pervious	4100	0	21
Totals	19410	59	100

Table 6 - Stormwater Quality Improvement Devices (SQID)

STORMWATER QUALITY IMPROVEMENT DEVICE (SQID)	QUANTITY OF SQID
Enviropods	10 x 200micron
Stormfilter	30 x 690mm PSORB
Rainwater Tank	28kL

4.4.4 Results

The results of the MUSIC modelling are summarised in Table 7. The total pollutant loads from the development are expressed in kilograms per year. The reduction rate is expressed as a percentage and compares the pollution from the post developed site to that of the existing developed state of the site.

Table 7 - Summary of Music Model Results

PARA-METER	EXISTING SITE LOADS (KG/YR)	POST DEVELOPMENT WITH TREATMENT (KG/YR)	REDUCTION %	TARGET ACHIEVED
GP	364	0	100	Yes
TSS	1560	206	87	Yes
TP	4.72	1.63	65	Yes
TN	45	24	46	Yes

GP = Gross Pollutants
TSS = Total Suspended Solids
TP = Total Phosphorus
TN = Total Nitrogen

In all instances, the proposed water quality control measures enabled the reduction targets to be achieved for all key stormwater pollutants. Therefore, by implementing the proposed treatment train measures within the proposed development there will be no detrimental effect on the quality of stormwater running off from the site.

5 CONCLUSIONS

The proposed development of the subject site could potentially lead to significant changes in water quantity as well as quality if a water sensitive urban design approach is not adopted as part of the development strategy. The traditional stormwater management and investigation that only considers impacts of flooding and flood mitigation is a thing of the past. Stormwater management practices must now also consider water quality, aquatic habitats, riparian vegetation, recreation, aesthetic and economic issues.

The key strategies to be adopted for this development include the following:

Water Quantity

- A pipe network system to collect minor storm runoff from surface areas which will minimise nuisance flooding;
- A below ground OSD tank with orifice and weir control with a storage capacity of 701m3 to maintain peak flows at the 'state of nature' flow for all storm events up to and including a 1% AEP event;
- 28kL Rainwater harvesting and retention system to allow rainwater reuse while at the same time providing improvement to the quality of stormwater runoff from the site and also providing some level of stormwater detention;
- Overland flow paths to carry major storms through the site without causing damage to property from flooding;

Water Quality

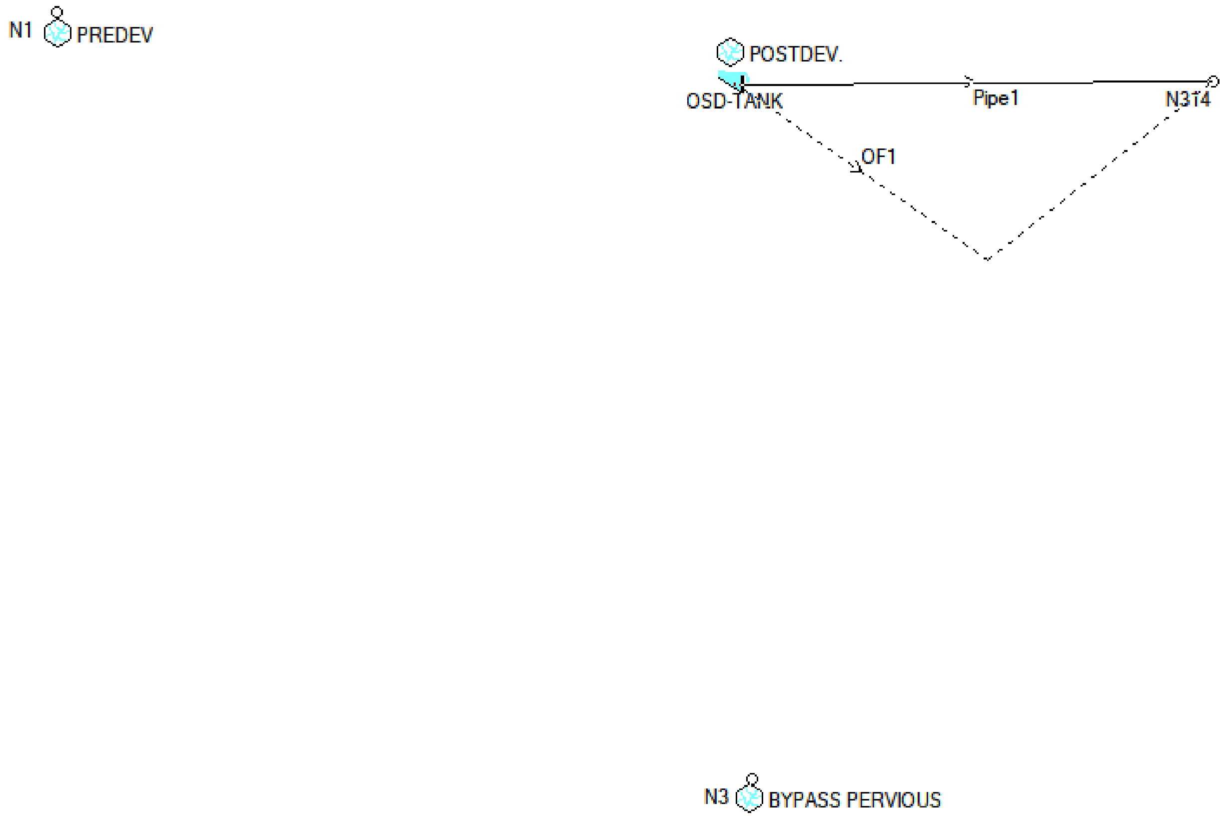
- 10 x STW360 EnviroPods in nominated inlet pits will form part of the water quality treatment train, removing gross pollutants.
- 30 x 690mm PSORB stormfilter cartridges (STW360) fitted in a StormFilter chamber within the OSD tank to treat the water by removing suspended solid, sediments and nutrients prior to it leaving the site.

The results from the investigations and modelling for this project that have been summarised in this report indicate that the development with the proposed WSUD strategy and management can provide a safe and ecologically sustainable environment.

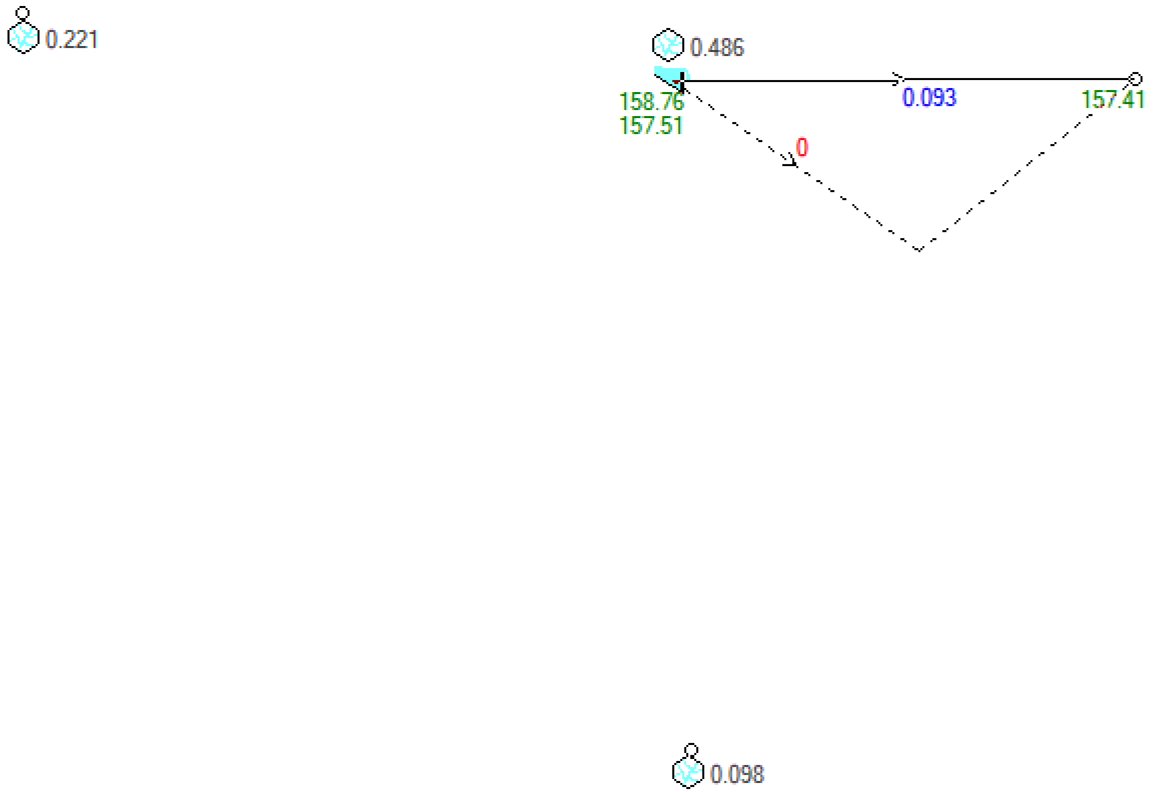
APPENDIX A

DRAINS OSD MODEL LAYOUT & RESULTS

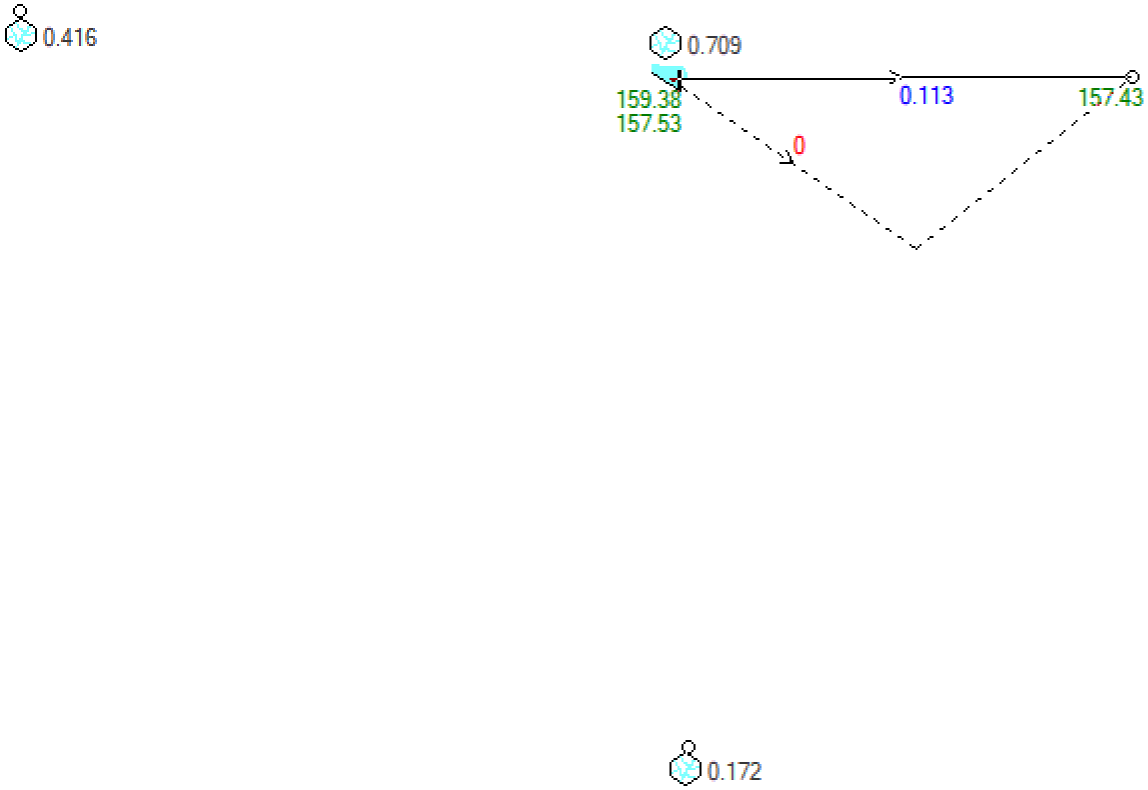
DRAINS OSD LAYOUT



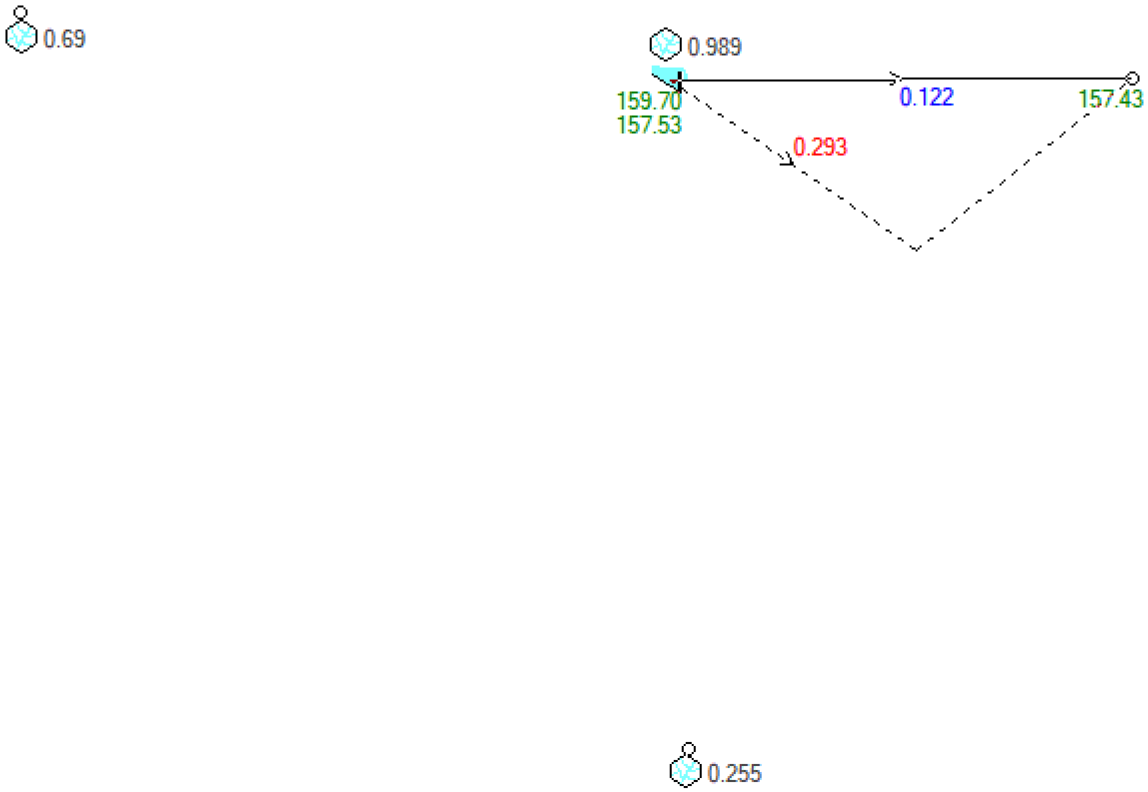
DRAINS OSD RESULTS: 1 IN 5 YEAR ARI (20% AEP)



DRAINS OSD RESULTS: 1 IN 20 YEAR ARI (5% AEP)



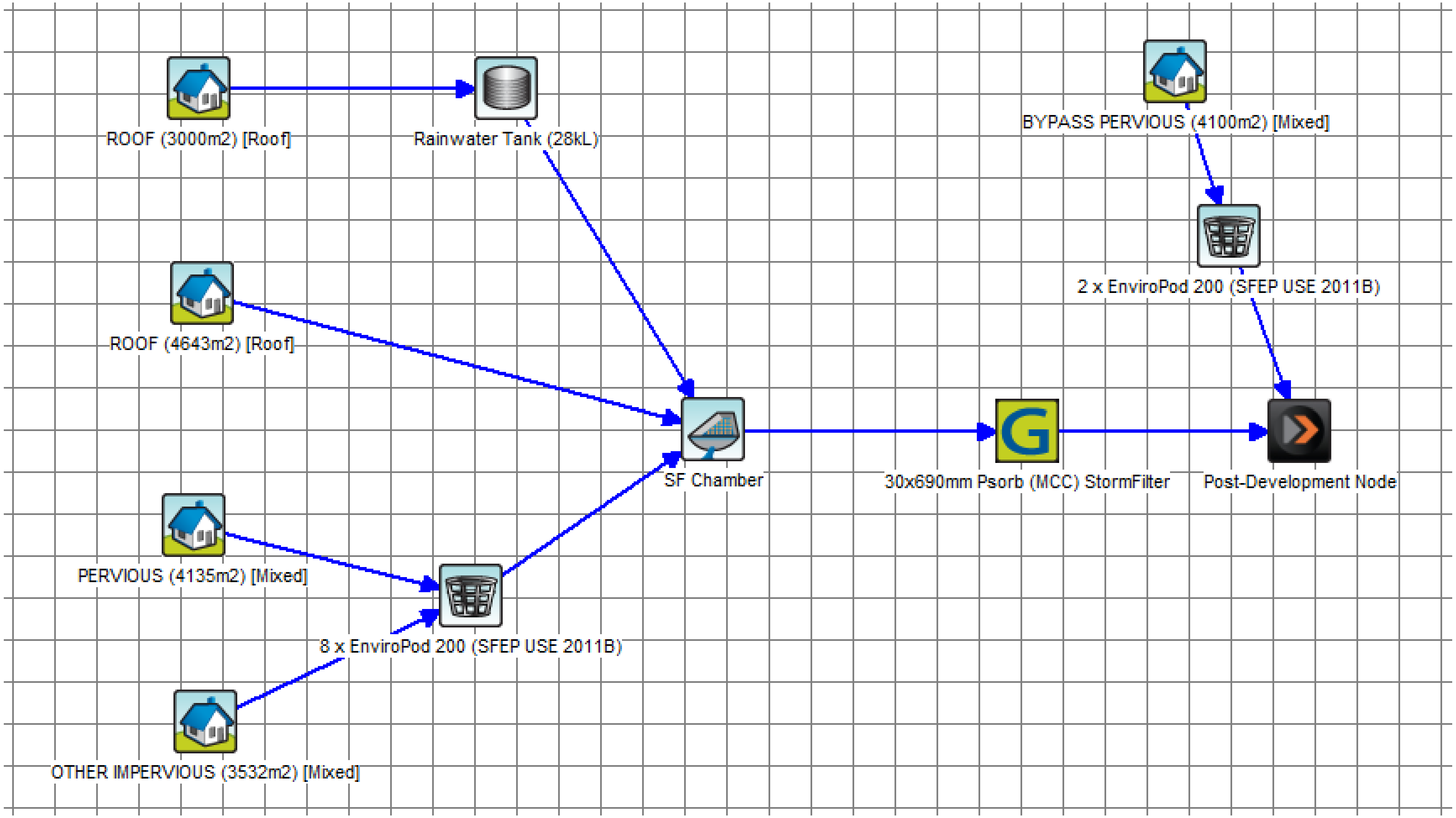
DRAINS OSD RESULTS: 1 IN 100 YEAR ARI (1% AEP)



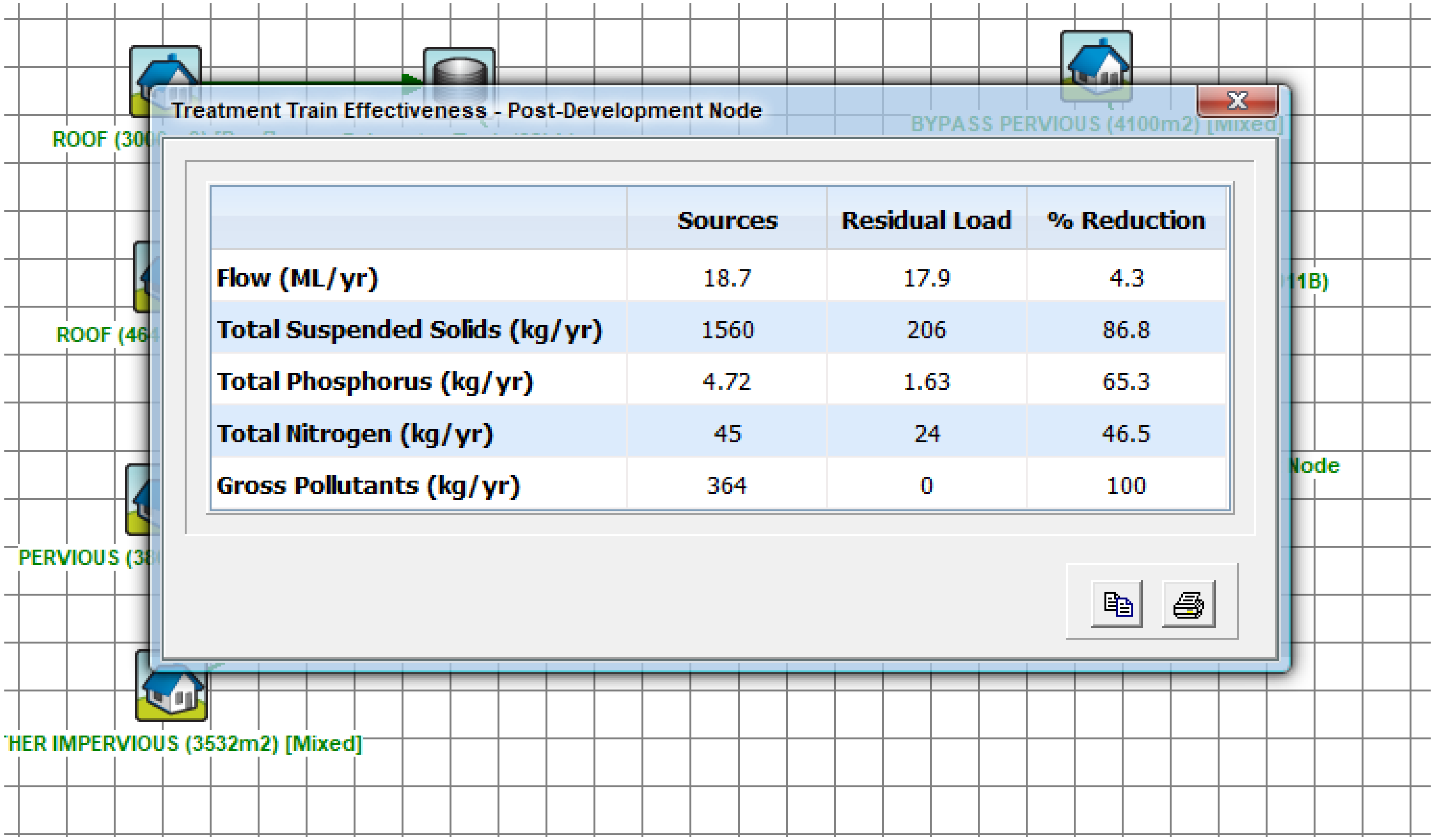
APPENDIX B

MUSIC MODEL LAYOUT & RESULTS

MUSIC MODEL LAYOUT



MUSIC MODEL RESULTS



	Sources	Residual Load	% Reduction
Flow (ML/yr)	18.7	17.9	4.3
Total Suspended Solids (kg/yr)	1560	206	86.8
Total Phosphorus (kg/yr)	4.72	1.63	65.3
Total Nitrogen (kg/yr)	45	24	46.5
Gross Pollutants (kg/yr)	364	0	100