DONOVAN
ASSOCIATES

PH/ 02 9806 3000 FAX/ 02 9891 2806
E/ email@donovanassociates.com W/ donovanassociates.com

15 PARKES ST PARRAMATTA NSW 2150
INCORPORATED ENGSURVEY PTY LTD ABN: 84 134 616 078

WATER SENSITVE URBAN DESIGN STRATEGY

No. 21-25 WOODRIFF STREET, PENRITH

PREPARED BY: YOUSSEF RIAD

CHECKED BY: SCOTT SHARMA

BE(Civil) MIEAust

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JOB REFERENCE: E286341

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PH/ 02 9806 3000 FAX/ 02 9891 2806
E/ email@donovanassociates.com W/ donovanassociates.com
15 PARKES ST PARRAMATTA NSW 2150
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INTRODUCTION

Donovan Associates has been engaged to prepare a Water Sensitive Urban Design (WSUD) Design Strategy to support the Development Application of the **Proposed Residential Apartments** at **No.21-25 Woodriff Street, Penrith**.

The scope of this report includes an overview of the WSUD model and targets that have been addressed by this development, as well as an outline of the quality and quantity of stormwater runoff and water conservation strategies for the proposed development.

The report identifies the WSUD principals of the proposed stormwater system as well as the objectives fulfilled by each component of the drainage system. The proposed measures may have to be revisited and refined in conjunction with any modifications to the final form of layout and along with other commitments from Council during its assessment.

The following information and documents were used for this investigation:

- ***Architectural Drawings prepared by Morson Group***
- ***Stormwater Management Plans prepared by Donovan Associates***
- ***Penrith City Council – Stormwater Drainage for Building Developments***
- ***Penrith City Council – C3 Water Management***
- ***Penrith City Council - Water Sensitive Urban Design (WSUD) Policy***
- ***Penrith City Council - WSUD Technical Guidelines***

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PROPOSED DEVELOPMENT

THE SITE

The site is situated at the corner of Woodriff Street and Union Lane. The neighbouring properties are generally commercial nature, with a multistorey car park adjacent the proposed development. The pre-development site is currently a paved car park (see Figure 1 below) and the total development area is approximately 2,732m^2 in area.

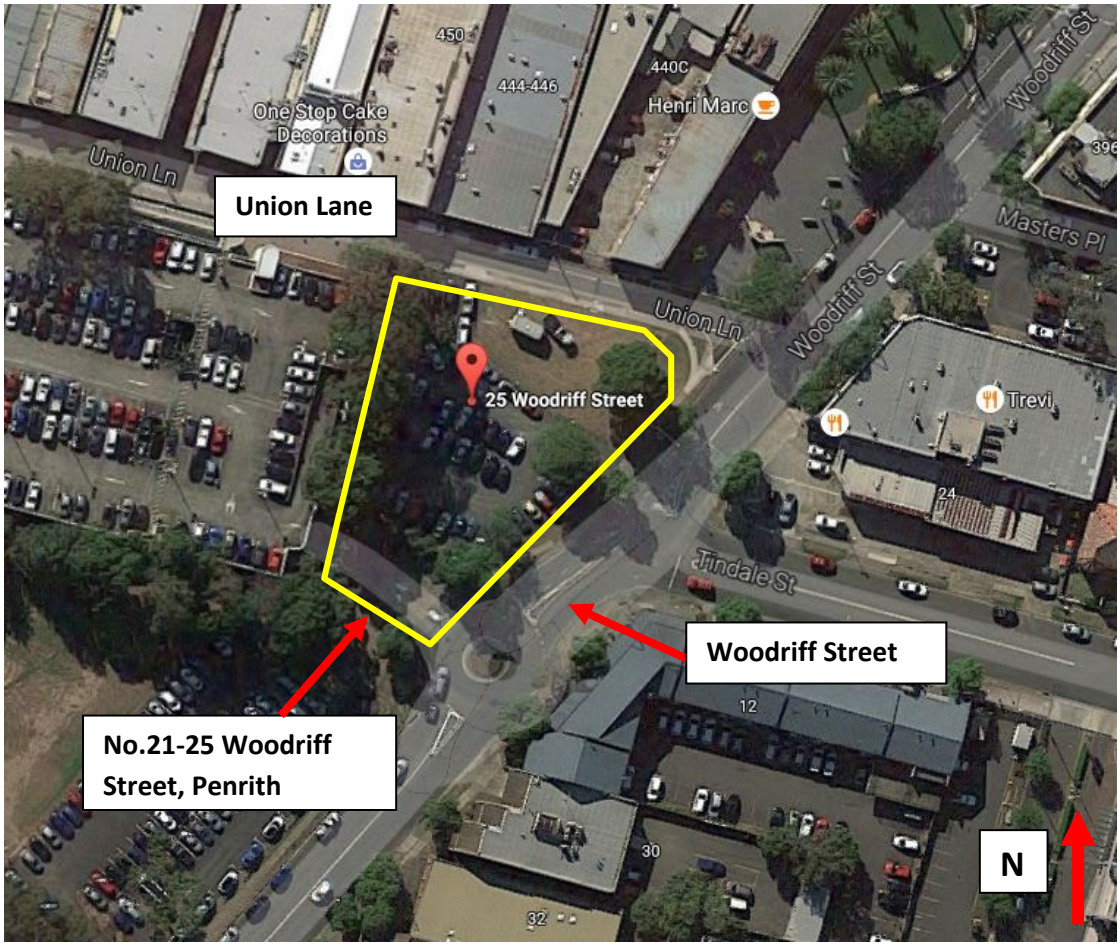

Figure 1: Pre-development site No.21-25 Woodriff Street, Penrith

The proposed development involves the construction of an eight storey mixed use residential and commercial development (not including two basement levels).

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WSUD Objectives

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

- ***Penrith City Council - Water Sensitive Urban Design (WSUD) Policy***
- ***Penrith City Council - WSUD Technical Guidelines***

Penrith City Council WSUD Policy, **section 3.1: Water Conservation**, outlines objectives 'to reduce consumption of potable water for all development types' and 'to harvest rainwater... where appropriate.'

As outlined in Penrith City Council WSUD Policy, **section 3.2: Stormwater Quality**, the main objective for the stormwater quality is to reduce stormwater pollution and the effects on the receiving environment. The guidelines outline objectives and goals for all types of development outlined in Penrith City Council WSUD Policy.

Table 1 below outlines these performance criteria for water quality.

PARAMETERS	CRITERIA
GROSS POLLUTANTS	**90% reduction in the post development mean annual load of Gross Pollutants (greater than 5mm)**
SUSPENDED SOLIDS	**85% reduction in the post development mean annual load of Total Suspended Solids (TSS)**
TOTAL PHOSPHORUS	**60% reduction in the post development mean annual load of Total Phosphorus (TP)**
TOTAL NITROGEN	**45% reduction in the post development mean annual load of Total Nitrogen (TN)**

Table 1: Water quality targets as outlined in Penrith City Council WSUD Policy

Water Conservation

Performance criteria pertaining to water conservation in Penrith City Council WSUD Policy, **section 3.1: Water Conservation**, state that all developments outlined must install rainwater tanks to meet 80% of non-potable demand including toilets and irrigation.

As outlined in Penrith City Council WSUD Technical Guidelines, **Section 4.5: Non-Potable Reuse rates for Modelling Rainwater Tanks in MUSIC**, the following rates have been provided for MUSIC modelling purposes for industrial and commercial developments;

For irrigation of landscaped areas; 0.4 KL/year per m^2 for sprinkler systems and 0.3 KL/year per m^2 for subsurface irrigation.

The proposed development includes approximately 390m^2 of landscaped area that may require irrigation. The landscaped area has been considered to be subsurface irrigated, requiring 0.3 KL/year per m^2. The total yearly water demand for the proposed development has thus been calculated to be approximately 117 KL per year. As outlined in Figure 2, the yearly water demand of proposed

development has incorporated the 'MUSIC' model in the parameters of the proposed 3,000L of rainwater tank.

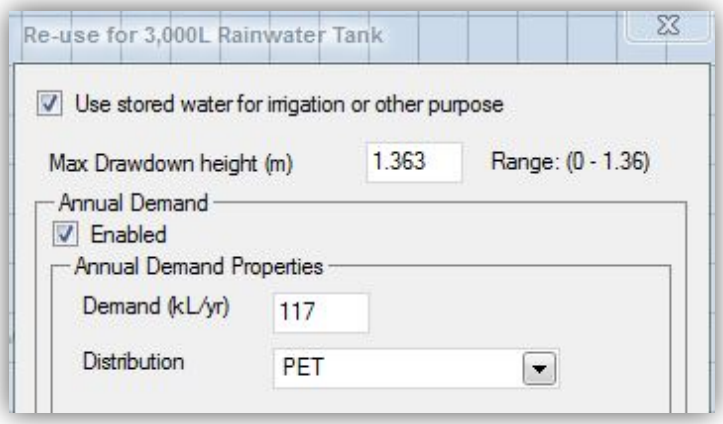

Figure 2: MUSIC Rainwater Re-use Node Parameters

Node Water Balance - 3,000L Rainwater Tank

	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	0.53	13.83	0.08	1.17	14.91
ET Loss	0.00	0.00	0.00	0.00	0.00
Infiltration Loss	0.00	0.00	0.00	0.00	0.00
Low Flow Bypass Out	0.00	0.00	0.00	0.00	0.00
High Flow Bypass Out	0.00	0.00	0.00	0.00	0.00
Pipe Out	0.45	10.96	0.07	0.99	0.00
Weir Out	0.00	0.09	0.00	0.01	0.00
Transfer Function Out	0.00	0.00	0.00	0.00	0.00
Reuse Supplied	0.07	1.10	0.01	0.14	0.00
Reuse Requested	0.12	0.00	0.00	0.00	0.00
% Reuse Demand Met	63.52	0.00	0.00	0.00	0.00
% Load Reduction	13.98	20.08	15.33	14.86	100.00

Figure 3: MUSIC Rainwater Re-use Node Water Balance

Figure 3 identifies that a reuse demand of 63.52% has been achieved, as 63.52% of the sites non-potable water needs have been met by the rainwater re-use tanks. This falls below Penrith City Council's requirement of 80% of all non-potable re-use to be met by rainwater reuse volume. Due to the sheer number of residential units within the development, rainwater reticulation to the toilets/laundries within each unit is impractical, and this may impact the water conservation targets.

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STORMWATER QUALITY

INTRODUCTION

The quality of runoff from a catchment depends upon many factors such as land use, degree of urbanisation, population density, sanitation & waste disposal practises, landform, soil types, and climate. Pollutants typically transported by runoff include litter, sediment, nutrients, oil, grease, and heavy metals. Whilst these pollutants have negative impact on receiving water quality, the suspended solids and nutrients are the most detrimental impact on 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 six 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 and Erosion Control Plans.

WATER SENSITIVE URBAN DESIGN (WSUD)

Donovan Associates have prepared the **Stormwater Management Plans -** and this report must be read in conjunction with these plans to achieve aforementioned WSUD objectives.

STRATEGY	DESCRIPTION
SHORT TERM STRATEGIES – CONSTRUCTION	Short term strategies generally refer to control of soil and water erosion control during the construction phase. The primary risk occurs while soils are exposed during construction works when suspended sediment and associated pollutants can be washed into downstream waterways. The strategies to prevent this potential degradation include adequate provision of sediment and erosion control measures that should be documented prior to commencement of the works in a Soil and Water Management Plan (SWMP). The controls will limit movement of sediment in disturbed areas, and will be designed to remove sediment from runoff prior to discharge from site.
LONG TERM STATEGIES - OPERATIONAL	Long term strategies to maintain stormwater quality discharged from the site include utilisation of a number of permanent treatment measures to remove litter, suspended solids, and nutrients effectively. The main measures to be implemented include *StormFilter*, *Rainwater Tanks* and *Enviropods*.

Table 2: Short Term and Long Term Water Quality Strategies

This report addresses the long term impacts of the development. For short term effects (i.e. during the construction phase) water quality control is achieved by implementing the measures in the Sediment and Erosion control Plans to be included with the Construction Certificate Application.

WATER QUALITY CONTROL MEASURES

There are a number of measures that can reduce pollutant loadings. However, each different type has its own effectiveness in reducing pollutant loadings that depends on land use type, topography and the target controls.

The proposed 'treatment train' will provide the most efficient and manageable measures, suited to the subject development's physical limitations. Table 3 summaries the water quality products and the intended purpose of the each product and how it has been considered for the proposed development.

MEASURES	DESCRIPTIONS
Rainwater Tank	• *Rainwater tanks* are effective in the removal of pollutant loads at source. The pollutant removal process is by harvesting runoff for reuse, thereby limiting the nutrients discharging to the waterways. • The tanks also reduce stormwater runoff quality and flooding
Enviropod	• *Enviropod* is a catch basin insert installed in inlet pits. It is effective in removing trash, debris, and other pollutants from runoff. • It is an effective pre-treatment device in the 'treatment train' • There are two types of *Enviropods*. One with GPT bag and one with a 200 micron filter. • *Enviropods* used in the project are the 200 micron filter system. These filters will be installed in specific locations within the drainage system, as shown in Stormwater Management Plans prepared by Donovan Associates.
StormFilter	• A StormFilter is a device consisting of a cartridge with various filtration media • Multiple cartridges units can be contained in a below ground chamber, suitable for a site with limited area for bioretention • Storm water is directed to the StormFilter chamber basin where it is treated by a number of physical and chemical processes • The proposed development will require 1 chamber with 2 x 460mm High proprietary cartridges by 'Stormwater 360'

Table 3: Water Quality Devices and Summary

MUSIC Model

The water quality model adopted for this project is 'MUSIC' (Model for Urban Stormwater Improvement Conceptualisation) water quality numerical model developed by the MUSIC Development Team of the Cooperative Research Centre for Catchment Hydrology. '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'.

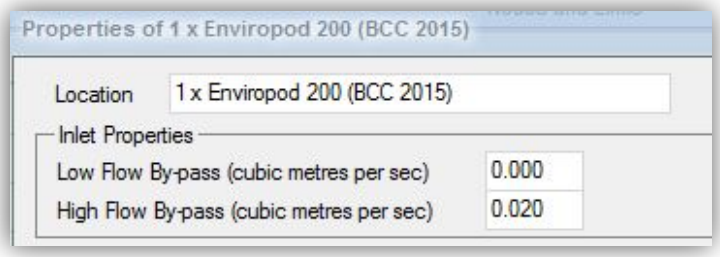

Figure 4: Stormwater360 1 x Enviropod Parameters

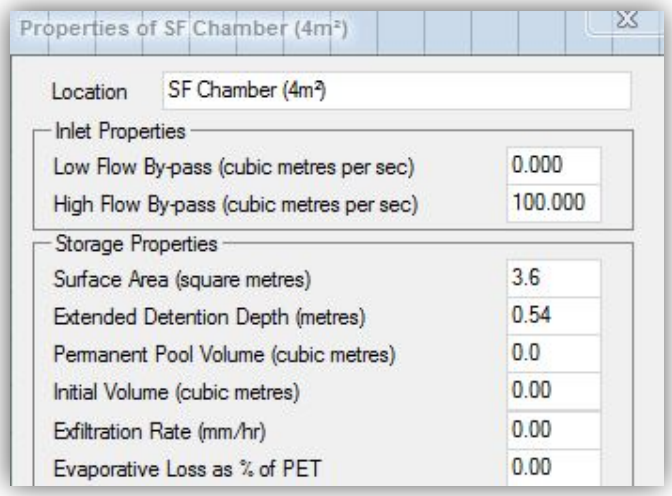

Figure 5: Stormfilter Chamber Parameters

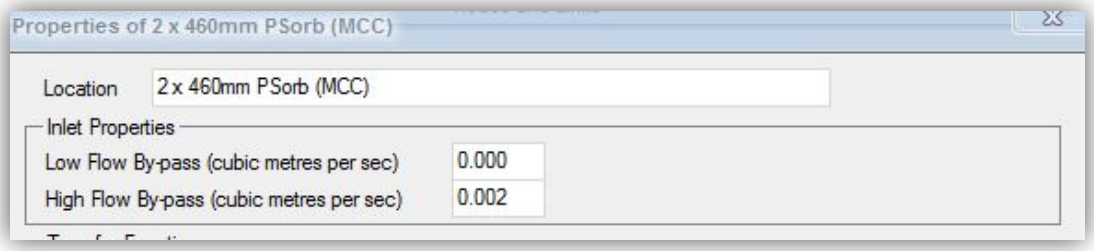

Figure 6: Stormfilter Cartridge Parameters

Figures 4, 5 and 6 outline the parameters entered into the 'MUSIC' Model for the Enviropod, Stormfilter Chamber and StormFilter Cartridges respectively, which comprise the water quality control devices in the 'treatment train' of the proposed development.

As shown in Figure 8 (MUSIC Model), the entirety of the proposed development roof area is to be taken to the 3,000L rainwater re-use storage. An Enviropod will collect and treat water from the roof

area, balconies and the first floor podium level, as well as Surface water on the northern side of the site. Water treated by this Enviropod are to be directed to the StormFilter Chamber.

Paved, driveway and (ground floor) landscaped surfaces on the southern side of the site will be directed to another Enviropod which will bypass the StormFilter chamber.

Treated water from the WSUD system will then be discharged to an existing kerb inlet pit on Woodriff Street where it will enter council's below ground stormwater system.

The 'MUSIC' model was generated using the historical 6-minute rainfall and monthly evapo-transpiration data for the area as supplied by the 'MUSIC' model. Catchment characteristics were defined using a combination of roof areas and non-roof (urban) catchments with varying imperviousness ratios to replicate the catchment for the development condition. A post-development scenario with a proposed treatment train was modelled to estimate the pollutant loads from the site as well as assess the effectiveness in percentage reduction of the treatment train.

The following key pollutants associated with stormwater runoff have been assessed:

- ***Gross Pollutants (GP)***
- ***Total Suspended Solids (TSS)***
- ***Total Phosphorus (TP)***
- ***Total Nitrogen (TN)***

RESULTS

The results were assessed against the water quality targets shown in Table 1 of this report to determine the effectiveness of the proposed strategy.

The total pollutant loads from the development are expressed in kilograms per year. The reduction rate is expressed as a percentage and compares the resulting pollution where treatment measures are provided versus a situation where no treatment is provided (i.e. comparing the development without controls versus development with controls).

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	1.36	1.29	5.5
Total Suspended Solids (kg/yr)	186	25.3	86.4
Total Phosphorus (kg/yr)	0.362	0.137	62
Total Nitrogen (kg/yr)	3	1.56	47.9
Gross Pollutants (kg/yr)	36.8	0	100

Figure 7: Stormwater360 'MUSIC' model results

The results of the modelling (Figure 7) show that the proposed 'treatment train' system will ensure that the required Council Stormwater Water Quality targets (as per Table 1) are met.

PH/ 02 9806 3000 FAX/ 02 9891 2806
E/ email@donovanassociates.com W/ donovanassociates.com

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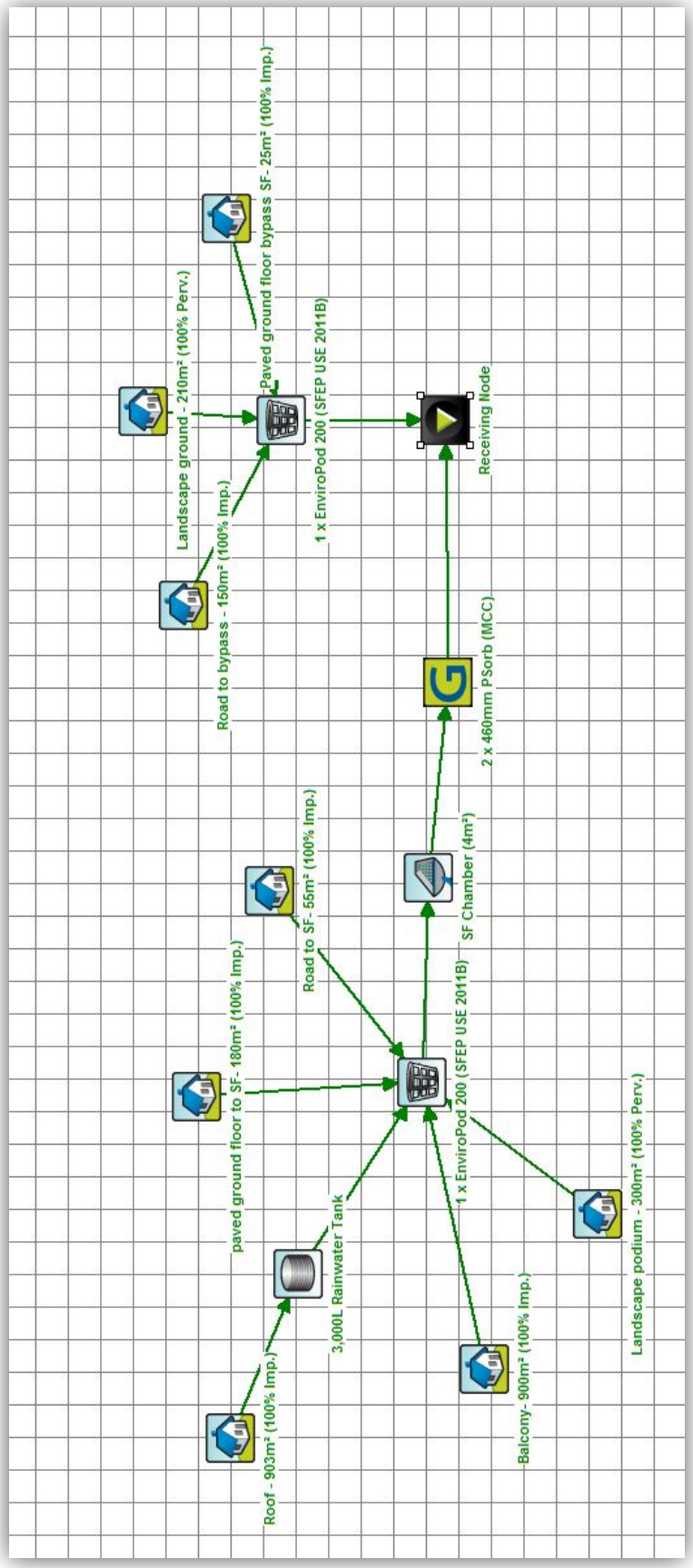

Figure 8: 'MUSIC' model

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COST

The 'MUSIC' model output (Figures 7 & 8) reveal that the quality targets set by council have been met.

The products that are required include:

- ***2 x Enviropod200 Catch Pit Inserts***
- ***2 x 460mm high StormFilter Cartridges***

Please note the above is for the modelling of Stormwater360 products ***only*** and if another product is intended for use then this recommendation is invalid. Further analysis will be required.

A budget estimate for the cost of the required devices can be obtained from Stormwater360 at www.stormwater360.com.au.

MAINTENANCE

The use of the above mentioned products will require on-going maintenance to ensure that the devices work effectively. It is intended that access to the Enviropods will be relatively easy as they will be located in the car parking area. Maintenance of the Stormfilters can be undertaken by 'Stormwater 360' or by dedicated landscaping/general maintenance personnel operating at the proposed development. A Draft Site Specific Operations and Maintenance Manual has been prepared by **Donovan Associates**.

CONCLUSIONS

The proposed development of the subject site could potentially lead to significant changes in water quality if a Water Sensitive Urban Design approach is not adopted as part of the development strategy.

The key strategies (as shown on the plans prepared by **Donovan Associates: Stormwater Management Plans - Job No. 286341)** to be adopted for this development include the following:

1. The use of Rainwater Re-use Tank, intended to store water for reuse on the site and reduce site runoff.

2. 2 x Eviropod200 (provided by Stormwater 360) are to be installed as shown on the plans prepared by Donovan Associates**.**

3. 2 x 460mm high StormFilter Cartridges (provided by Stormwater 360) are to be provided in a below ground chamber as shown on the plans prepared by Donovan Associates**.**

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