DRAFT
MUSIC modelling guidelines

Ku-ring-gai Council

2010

Appendix A of report “*Review of Ku-ring-gai Council’s On Site Detention Policy*”, prepared by Ecological Engineering (EDAW) 2007

Appendix A - MUSIC Modelling Guidelines

1 Introduction

Recent developments in urban stormwater quality modelling software have resulted in a significant advancement in the ability to simulate the pollutant removal efficiency of a range of stormwater treatment devices configured to form stormwater treatment trains. Specifically, MUSIC (Model for Urban Stormwater Improvement Conceptualisation) developed by the Cooperative Research Centre for Catchment Hydrology (CRC-CH) now provides stormwater practitioners with a state of the art model that is available for a nominal fee and can be used to demonstrate compliance with Council's stormwater quality treatment standards set out in DCP 47 (Chapter 8).

In the context of Ku-ring-gai LGA, MUSIC will be used by designers, consultants, developers and Council to undertake conceptual design (size, configuration, depths) of stormwater treatment elements. To ensure consistent and uniform application of MUSIC within Ku-ring-gai LGA, MUSIC Modelling Guidelines have been developed in this document. These guidelines are provided to allow designers, consultants, developers and Council to conceptualise stormwater treatment systems. These guidelines provide specific guidance on rainfall and evaporation inputs, source node selection, rainfall runoff parameters, pollutant generation parameters and stormwater treatment nodes. Guidance is also provided on modelling rainwater tanks for reuse. These guidelines should be read in combination with the MUSIC User Guide, which outlines all the definitions, assumptions and methodologies provided within the MUSIC package. Technical information and training support can be found on the following websites: www.ewatercrc.com.au and www.toolkit.net.au.

The MUSIC guidelines should be referred to when developing or assessing any designs for water quality treatment requirements in Ku-ring-gai. Any MUSIC models that are not consistent with the MUSIC guidelines should justify the differences from the default parameters.

2 MUSIC Model Setup

There are several steps to be undertaken prior to running a MUSIC model network as summarised in Figure 1. These steps include:

- Selection of appropriate meteorological data (rainfall and evaporation inputs);
- Defining catchment areas (source nodes) to be incorporated into the model;
- Input of soil properties (rainfall runoff properties); and
- Input of pollutant generation characteristics for selected source nodes.

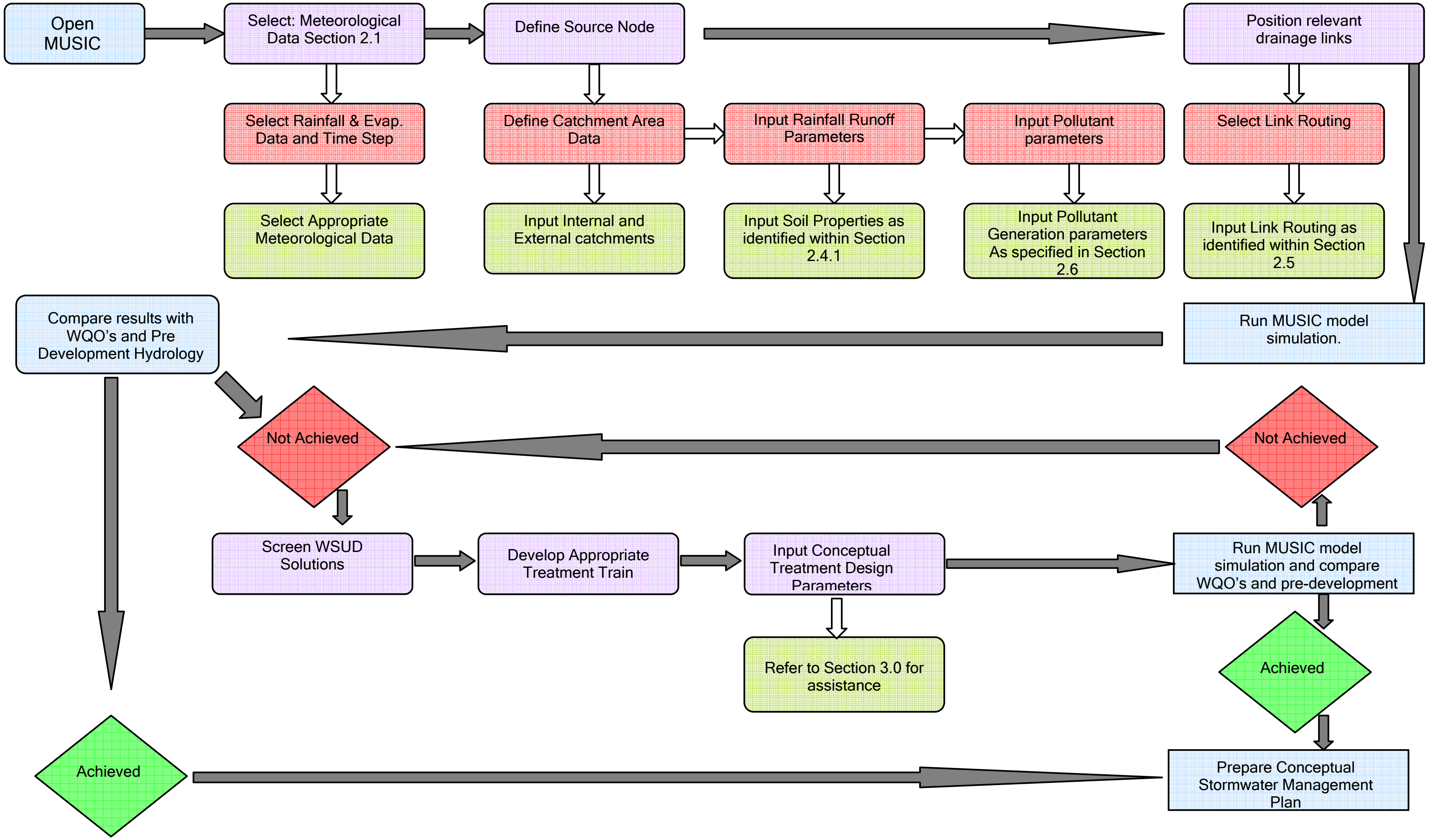


Figure 18 Schematic of MUSIC Modelling Process

2.1 Rainfall & Evaporation Inputs

Stormwater runoff (represented as surface runoff and baseflow) is generated in MUSIC through the interaction of rainfall, evapotranspiration and the MUSIC Rainfall-Runoff Model (see MUSIC User Manual for full description of Rainfall-Runoff Model). Relevant issues for the use of MUSIC for projects in Ku-ring-gai LGA are addressed below.

2.1.1 Rainfall Data for Water Quality Modelling

The following approach to rainfall simulation is recommended for water quality modelling:

- Continuous simulation of a minimum of 10 years should be used; and
- A six (6) minute time step is to be utilised as this allows for the appropriate definition of storm hydrograph movement through small-scale stormwater treatment processes such as vegetated swales and bioretention systems.

To provide a consistent approach to stormwater modelling, it is recommended that rainfall data is sourced from the same rainfall station, for consistent time periods, for all modelling exercises. The Sydney Observatory Hill rainfall station (066062) is the recommended gauge and 1 January 1963 – 31 December 1993 is the recommended period. This period is representative of the long-term average for the station.

It should be noted that there are two other 6 minute BOM pluviograph stations in the vicinity of Ku-ring-gai LGA:

- 66142 (Duffys Forest) 1987-2006
- 66063 (Wahroonga Reservoir) 1949-1973

Sydney Observatory Hill was selected as the preferred station because:

- It has a long record available.
- Data from this station is available with the MUSIC model.
- A simple MUSIC modelling assessment undertaken using data from Duffys Forest, Wahroonga Reservoir and Observatory Hill indicated that the gauge used would have some influence on the water quality results. However the treatment system sizing for a typical residential development would be similar for each gauge. Observatory Hill results were in between those for the other two gauges.

When undertaking a site-specific assessment in Ku-ring-gai LGA, it would be possible to use gauge data other than the recommended Sydney Observatory Hill 1963 -1993 period, as long as the data selection is justified for the site. It should be demonstrated that the chosen data is representative of typical rainfall conditions (average annual rainfall and number of rain days) for the site, by comparing with nearby daily rainfall gauging.

2.1.2 Evapotranspiration Data

MUSIC requires the use of potential evapotranspiration (PET) data. There is no daily PET data from BOM for Sydney. Monthly PET data are available and this is preferable to using pan evaporation data and using a percentage coefficient to obtain PET. This is due to the difficulty of specifying a single correlation between PET and pan evaporation data.

Monthly PET values for Sydney are shown in Table 7.

Table 7: Monthly Potential Evapotranspiration for Sydney Region

Month	J	F	M	A	M	J	J	A	S	O	N	D
Evapotranspiration (mm)	180	135	128	85	58	43	43	58	88	127	152	163

2.2 Node Selection

Once the meteorological data has been input into the model the user must then define the source nodes to reflect the details (i.e. area, landuse) of the contributing catchments. MUSIC Version 3 currently has five land uses, these being:

- Forest;
- Agricultural;
- Urban;
- User Defined; and
- Imported Data.

Source Nodes for Ku-ring-gai LGA are defined as follows:

- The Urban Source Node in MUSIC is used to describe low to high density residential, retail, and commercial areas. These areas comprise private allotments together with all associated facilities, such as roads, parks, school grounds, etc.
- The Forested Source Node is to be used for natural bushland areas. This node is to be utilised in areas where canopy densities are greater than 50%.

2.3 Area

Each individual Source Node, with the exception of the Imported Data Node, requires the total area and impervious percentage of the site to be defined. See the following section for an overview of how to set the impervious percentage.

2.4 Rainfall Runoff Parameters

As outlined in Section 2.1, stormwater runoff (represented as storm flow and baseflow) is generated in MUSIC through the interaction of rainfall, evapotranspiration and the MUSIC Rainfall-Runoff Model. A full description of the MUSIC Rainfall-Runoff Model is provided in the MUSIC User Manual. If the reader of this document has no MUSIC modelling experience they should review Appendix A of the User Manual before reading below.

MUSIC ideally should be calibrated to streamflow data. Currently Ku-ring-gai Council are undertaking flow monitoring within the LGA and intend to develop rainfall runoff parameters for MUSIC. The parameters provided in the current guidelines are preliminary values.

2.4.1 Rainfall Runoff Parameters

The steps for setting up the rainfall runoff parameters are described below.

Step 1: Set Soil Properties – Regardless of the type of source node (urban/forested) the following soil characteristics shown in Table 8 should be adopted.

Table 8: Soil Characteristics

Parameter	Recommended value
Rainfall Threshold (mm/day)	1.5
Soil Capacity (mm)	300
Initial Storage (%)	20
Field Capacity	172
Infiltration Capacity Coefficient a	200
Infiltration Capacity Coefficient b	1
Initial Depth (mm)	1
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	5
Daily Deep Seepage Rate (%)	4

Step 2: Set % Impervious – An initial estimate of % impervious for the particular landuse should be made. The impervious area should be based on building density controls developed by council as well as the development's urban planners and architects. The building density controls that are of relevance include minimum soft landscaping area, maximum building envelopes, floor space ratios and road design guidelines. These estimates should also be compared to aerial photos of similar recent developments in Ku-ring-gai LGA. Where differences between the estimates and the on ground impervious area are significant then estimates should be revised or the differences justified.

2.4.2 Land Type Split

When the modeller intends to model a single allotment (including commercial and industrial), the influence of rainwater tanks or a single street (including allotments) then the urban node must be split into the various land types (i.e. road reserve, roof, ground level pervious and impervious). When utilising this approach:

- Roof areas are to be modelled as 100% impervious;
- Road reserve areas include the road and adjacent landscaping and footpaths contained within the road reserve. Imperviousness of this node should be approximately 30-70 % depending on the road reserve configuration; and
- The Ground Level node which can be further split into pervious and impervious when required. Where the area is accommodated into a single node then the % impervious should typically be 30%.

2.5 Link Routing

The modeller may choose not to apply routing to reduce the complexity of the generated model, however, it is noted that this will result in the performance of the treatment devices being underestimated as peak inflows into the treatment nodes will increase. For all MUSIC model simulations it is recommended that the channel routing options in MUSIC be used to reflect the travel time for flood wave propagation through the catchment. The user is referred to the MUSIC User Manual for further details.

2.6 Pollutant Generation

As outlined in the MUSIC User Manual, a comprehensive review of stormwater quality in urban catchments was undertaken by Duncan (1999) and this review forms the basis for the default values of event mean concentrations in MUSIC for TSS, TP and TN. More recently, Fletcher et al (2004) has updated the values provided in Duncan (1999) and specifically provides guidance on appropriate land type breakdown. Table 9 presents the recommended model defaults for various land use categories. Note that TN is consistent across each urban land use as TN is dominated by atmospheric deposition.

The data in Table 9 is presented in terms of the base 10 logarithm of pollutant concentrations in milligrams per litre. MUSIC requires the mean and standard deviation values to be entered as the base 10 logarithm, e.g. Log_{10}[mean] and Log_{10}[st. dev.].

Pollutant concentration data is required for both base flow and storm flow conditions.

Table 9: Pollutant concentration details for entry into MUSIC

Land-use category		Log_{10} TSS (mg/L)		Log_{10} TP (mg/L)		Log_{10} TN (mg/L)	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
General Urban	Mean	2.2	1.1	-0.45	-0.82	0.42	0.32
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Roads	Mean	2.38	1.1	-0.6	-0.82	0.42	0.32
	Std Dev	0.4	0.17	0.5	0.19	0.19	0.12
Roofs	Mean	1.55	1.1	-0.92	-0.82	0.42	0.32
	Std Dev	0.39	0.17	0.29	0.19	0.19	0.12
Forest	Mean	1.90	0.9	-1.10	-1.5	-0.075	-0.14
	Std Dev	0.20	0.13	0.22	0.13	0.24	0.13

Note: For all simulations the MUSIC model must be run with pollutant export estimation method set to “stochastically generated”.

3 Stormwater Quality Treatment Nodes

Following the determination of the site's water quality objectives the user (if required) is to develop an appropriate treatment train for the development dependent on site constraints and opportunities.

Within the current version of MUSIC (3.01) the user has several treatment options available:

- Wetland;
- Pond;
- Sedimentation Basin;
- Infiltration Basin;
- Gross Pollutant Trap;
- Buffer;
- Bio-Retention;
- Swale;
- Rainwater Tank; and
- Generic Node.

The default parameters in MUSIC for the first order decay K c* model used to define the treatment efficiency of each treatment device should be used unless local relevant treatment performance monitoring can be used as reasonable justification for modification of the default parameters. Reference should be made to the MUSIC User Manual.

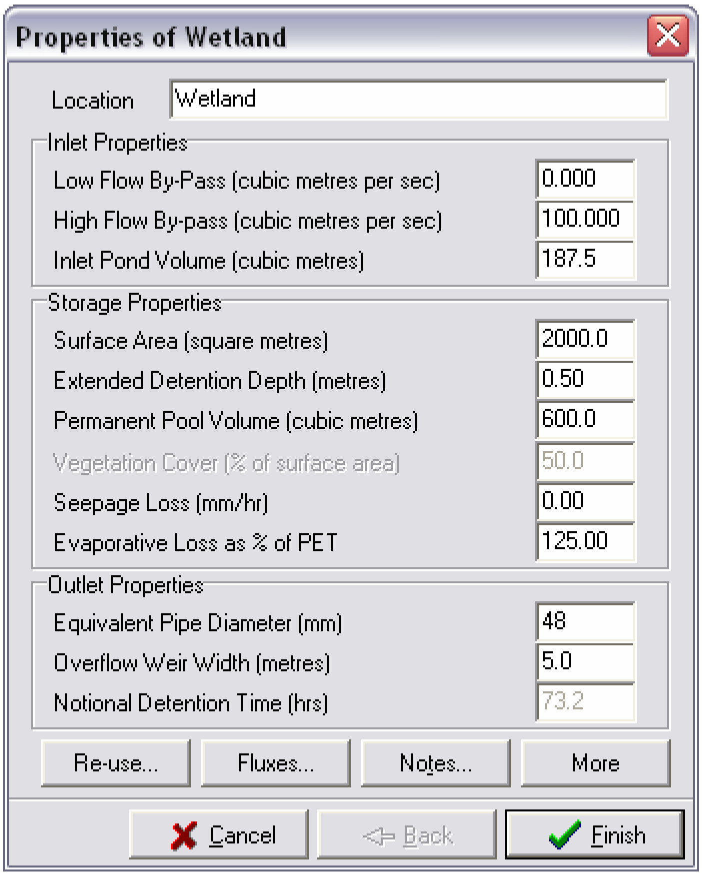
Note: The following devices are not to be modelled within the MUSIC program: Natural waterways, Natural wetlands, Naturalised channel systems, Environmental buffers and Lake/Pond systems.

In order to reduce the confusion of conflicting aspects of treatment node implementation, the following sections include advice for modelling stormwater treatment measures and rainwater tanks within Ku-ring-gai LGA.

3.1 Wetland

Constructed wetland systems use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater. Constructed wetland systems consist of an inlet zone (sediment basin to remove coarse sediments), a macrophyte zone (a shallow heavily vegetated area to remove fine particulates and allow uptake of soluble pollutants) and a high flow bypass channel (to protect the macrophyte zone).

Input Parameters



Properties of Wetland

Location: Wetland

Inlet Properties
Low Flow By-Pass (cubic metres per sec): 0.000
High Flow By-pass (cubic metres per sec): 100.000
Inlet Pond Volume (cubic metres): 187.5

Storage Properties
Surface Area (square metres): 2000.0
Extended Detention Depth (metres): 0.50
Permanent Pool Volume (cubic metres): 600.0
Vegetation Cover (% of surface area): 50.0
Seepage Loss (mm/hr): 0.00
Evaporative Loss as % of PET: 125.00

Outlet Properties
Equivalent Pipe Diameter (mm): 48
Overflow Weir Width (metres): 5.0
Notional Detention Time (hrs): 73.2

- Input the appropriate bypass characteristics to reduce the impacts on macrophytes within the wetland;

- Proposed surface area of wetland macrophyte zone;

- Estimate the inlet pond volume by multiplying the surface area by 0.2

- Set extended detention depth of between 0.25-0.75m. Note that any flood storage above the extended detention depth must not be included in the extended detention depth;

- The volume of water permanently submerging macrophytes. Set by multiplying the average depth (typically 0.25m to 0.4m) by the surface area;

- Water lost from the device into the surrounding soil (assume 0mm/hr in the absence of soil information);

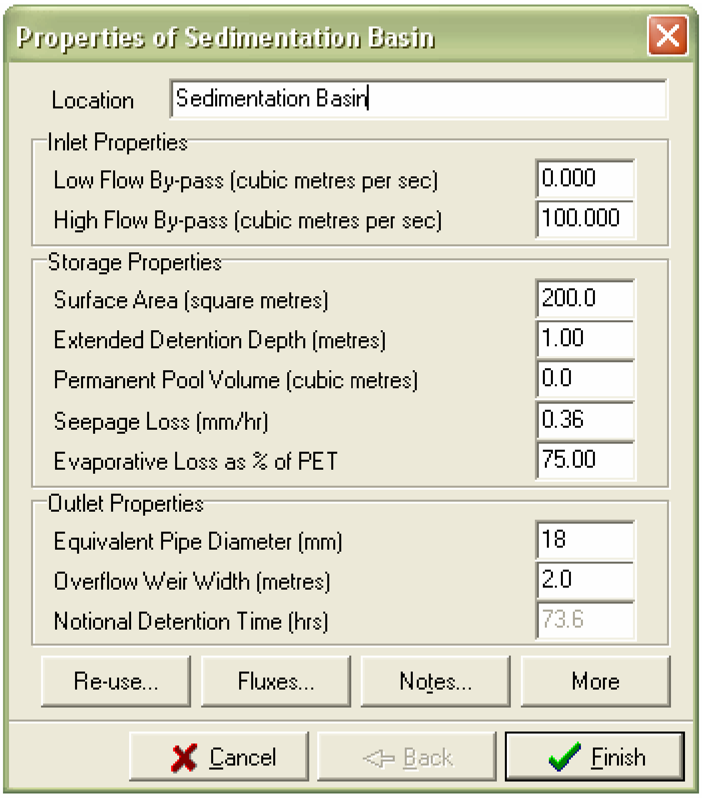
- Adjust the pipe diameter to ensure the device has a notional detention time of approximately 72 hrs.

3.2 Sedimentation Basin

Sediment basins are used to retain coarse sediments from runoff. They operate by reducing flow velocities and encouraging sediments to settle out of the water column.

They are frequently used for trapping sediment in runoff during construction activities and for pre-treatment to measures such as wetlands (eg. an inlet pond). They can drain during periods without rainfall and then fill during runoff events. They are sized according to the design storm discharge and the target particle size for trapping (generally 125 µm).

Input Parameters



Location: Sedimentation Basin

Inlet Properties
Low Flow By-pass (cubic metres per sec): 0.000
High Flow By-pass (cubic metres per sec): 100.000

Storage Properties
Surface Area (square metres): 200.0
Extended Detention Depth (metres): 1.00
Permanent Pool Volume (cubic metres): 0.0
Seepage Loss (mm/hr): 0.36
Evaporative Loss as % of PET: 75.00

Outlet Properties
Equivalent Pipe Diameter (mm): 18
Overflow Weir Width (metres): 2.0
Notional Detention Time (hrs): 73.6

- Identify any high flow or low flow bypasses proposed for the device;
- Input the surface area of the basin;
- Identify the depth between the top of the permanent pool (or ground if no permanent pool) and the lip of the overflow weir;
- Calculate the permanent volume of water within the device;
- Apply a seepage loss if confirmed via a geotechnical report or soil percolation testing; and
- Modify the discharge pipe diameter to ensure a detention time of approximately 48 – 72 hrs.

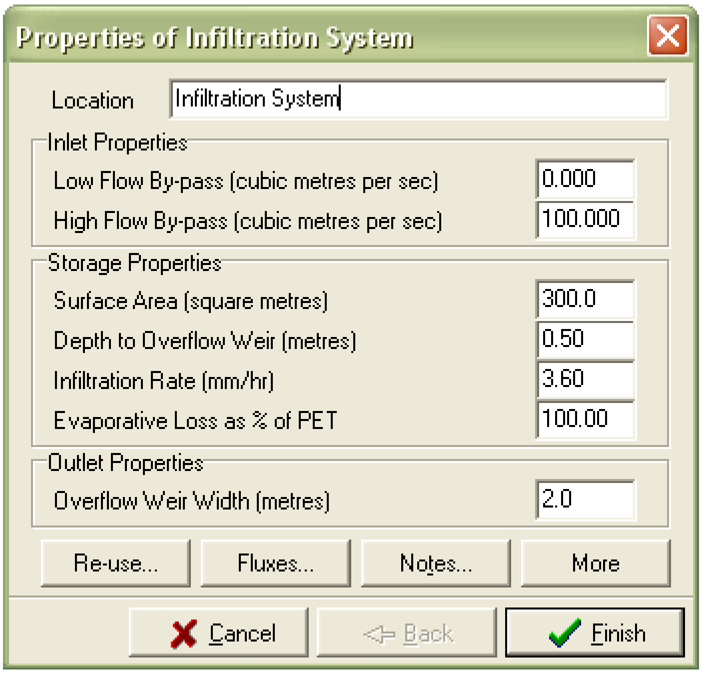
Note: These devices can be utilised as pre-treatment devices upstream of bioretention devices to allow for a diversion of flows above recommended scour velocities.

3.3 Infiltration Basin

Infiltration measures encourage stormwater to infiltrate into surrounding soils. Infiltration measures are highly dependent on local soil characteristics and are best suited to sandy and sandy clay soils with deep groundwater. This allows adequate filtration of stormwater through the soil before reaching the groundwater body. Any infiltration strategy will require an appropriate site and soil evaluation study. Note that infiltration measures are generally not treatment systems and suitable pre-treatment of stormwater is required prior to entering the infiltration measure.

Input Parameters

- Identify surface area of the device;
- Calculate the depth to the overflow weir of the proposed device; and
- Establish the infiltration rate based on findings from a geotechnical engineering report of soil percolation test to determine the likely infiltration rate from the device to the surrounding soils.



Properties of Infiltration System

Location: Infiltration System

Inlet Properties
Low Flow By-pass (cubic metres per sec): 0.000
High Flow By-pass (cubic metres per sec): 100.000

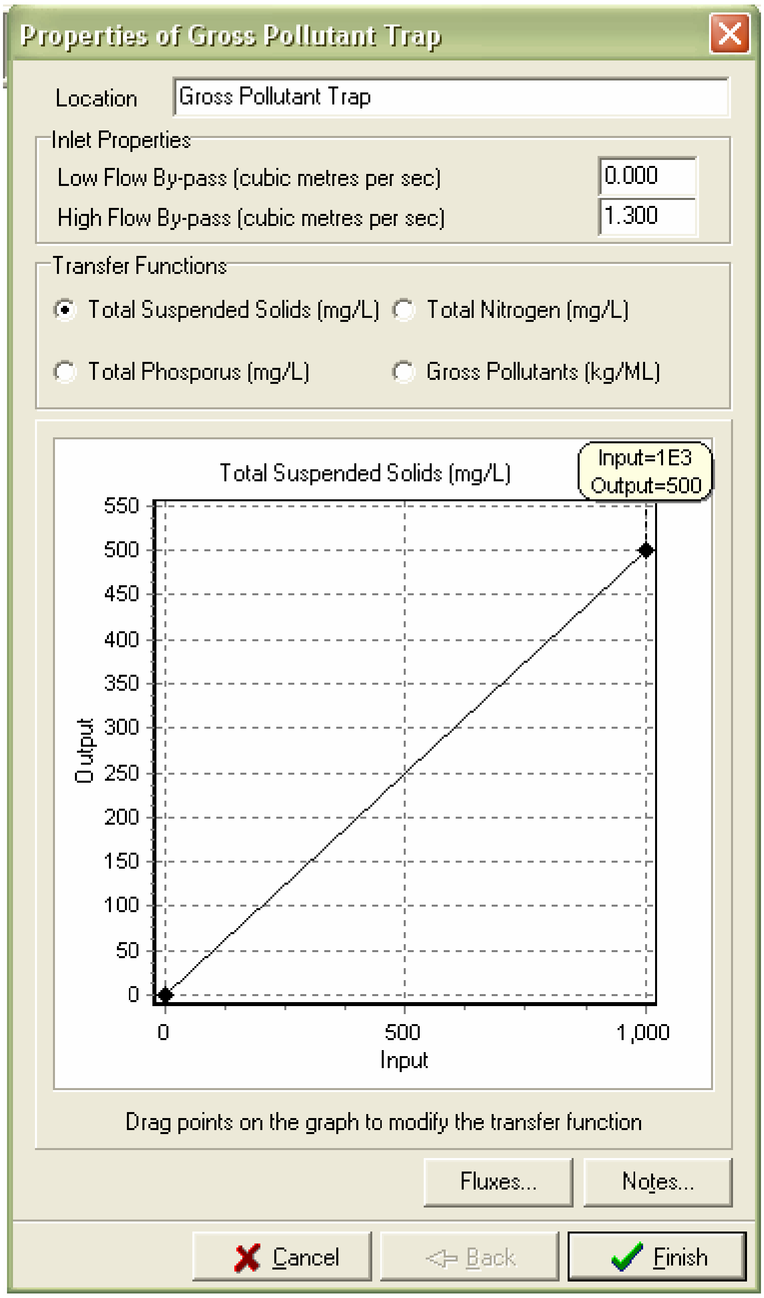
Storage Properties
Surface Area (square metres): 300.0
Depth to Overflow Weir (metres): 0.50
Infiltration Rate (mm/hr): 3.60
Evaporative Loss as % of PET: 100.00

Outlet Properties
Overflow Weir Width (metres): 2.0

Note: Provide all supporting information with regard to soil percolation within the Stormwater Management Plan (i.e. Undertake a Site and Soil Evaluation).

3.4 Gross Pollutant Trap

GPTs typically remove rubbish and coarse sediment from stormwater runoff. Some GPTs also have features to trap hydrocarbons. These devices can be very effective at removal of solids conveyed within stormwater which are typically larger than 5mm in size.



Properties of Gross Pollutant Trap

Location: Gross Pollutant Trap

Inlet Properties

Low Flow By-pass (cubic metres per sec): 0.000

High Flow By-pass (cubic metres per sec): 1.300

Transfer Functions

● Total Suspended Solids (mg/L) ○ Total Nitrogen (mg/L)

○ Total Phosporus (mg/L) ○ Gross Pollutants (kg/ML)

Drag points on the graph to modify the transfer function

Input Parameters

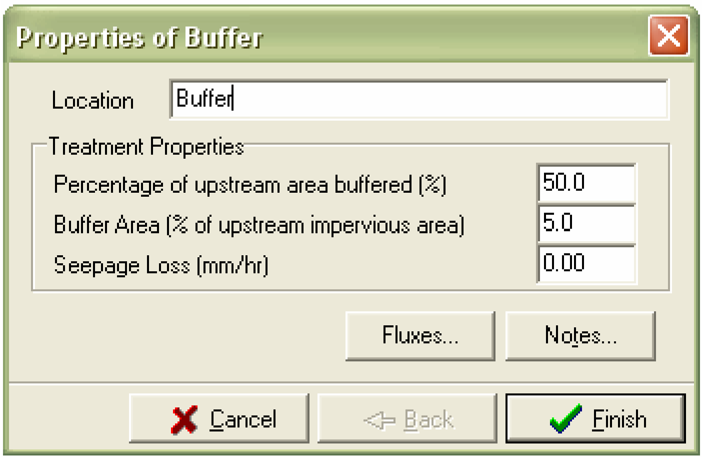
- Calculate the required high flow bypass for the device. (typically the 3-month ARI peak flow);
- Choose the required pollutant to apply a pollutant reduction to;
- Modify input and output parameters of chosen pollutant.

Information on pollutant removal efficiencies which are supported for GPTs can be found in the MUSIC User Guide. While GPTs can be effective for coarse sediment removal, they are not able to remove significant loads of fine sediment or nutrients.

Note: Council should only accept nutrient removal within the GPT from an independent assessment of the chosen device following continuous monitoring of the product for a time frame of three months after an initial storm event. This three month period is to include various documented design events (and include typical stormwater runoff from the chosen land use) to determine whether the device contributes to pollutants discharging from the product due to the potential anaerobic conditions created within the storage sump of the device. No pollutants are to be removed from the device during the assessment of the device to mimic the actual maintenance regime of many devices within the Kur-ring-gai LGA.

3.5 Buffer

Buffer or filter strips, in the context of urban stormwater, are grassed or vegetated areas over which stormwater runoff from adjoining impervious catchments traverses enroute to the stormwater drainage system or receiving environment. Buffer strips are intended to provide discontinuity between impervious surfaces and the drainage system. They take water from impervious surfaces in a distributed manner, promote even flows and filter sediments and coarse pollutants entrained in the runoff. The key to their operation is an even shallow flow over a wide vegetated area. The low hydraulic loading over the vegetation allows flows to filter through the vegetation and pollutants to settle out. They also provide a detention role to slow flows down.



Properties of Buffer

Location: Buffer

Treatment Properties

Percentage of upstream area buffered (%): 50.0

Buffer Area (% of upstream impervious area): 5.0

Seepage Loss (mm/hr): 0.00

Input Parameters

- Calculate the percentage of upstream area that shall actually pass over buffer;
- Calculate the size of the proposed buffer area as a percentage of the upstream catchments impervious area; and
- A seepage loss may be applied on some soil types. If losses are proposed, then a qualified geotechnical engineer is to determine the likely infiltration rate from the device to the surrounding soils.

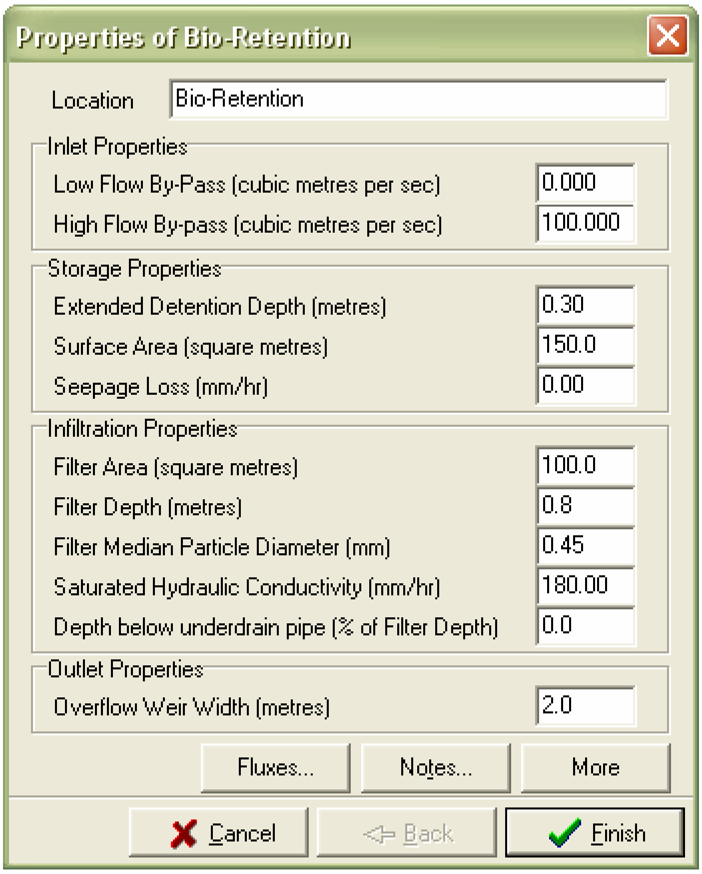
Note: Utilise buffer devices upstream of other treatment devices to assist in sediment drop out prior to stormwater entering secondary treatment devices i.e. swales.

3.6 Bioretention

Bioretention systems (also known as biofiltration trenches) are a combination of vegetation and filter substrate that provides treatment of stormwater through filtration, extended detention and some biological uptake.

The systems are designed to accept stormwater runoff and allow it to percolate through the filtration media and then discharge within a drainage layer comprising a system of perforated pipes to ensure the devices are drained adequately. The bioretention systems are to be densely planted out with endemic ground cover, shrubs and plants to promote the feeling of a landscaped form/feature and ensure the conductivity of the filter media is not compromised.

Input Parameters



Location: Bio-Retention
Low Flow By-Pass (cubic metres per sec): 0.000
High Flow By-pass (cubic metres per sec): 100.000
Extended Detention Depth (metres): 0.30
Surface Area (square metres): 150.0
Seepage Loss (mm/hr): 0.00
Filter Area (square metres): 100.0
Filter Depth (metres): 0.8
Filter Median Particle Diameter (mm): 0.45
Saturated Hydraulic Conductivity (mm/hr): 180.00
Depth below underdrain pipe (% of Filter Depth): 0.0
Overflow Weir Width (metres): 2.0

- Identify whether a bypass structure shall be included within or upstream of the device to control flows;
- Identify the ponding depth of stormwater runoff prior to its overflowing the control weir of the device. Depths greater than 0.4 m are not recommended with 0.1-0.3m recommended for plant sustainability and adequate draining times;
- Provide the estimated surface area of the device based upon site constraints and opportunities;
- Only apply a seepage loss if the storage area of the device is larger than the filter area. The parameter chosen is to be supported by an appropriate percolation assessment;
- Input the surface area of the filter media within the device;
- Provide the proposed depth of filter media within the device. The following depths are recommended as a minimum within the device: > 0.4 m for rushes and shrubs and > 0.8 m for tree species proposed to ensure adequate area for root growth are provided within the device. This depth does not include the drainage layer;
- Identify the type of filter media proposed based upon particle size and hydraulic conductivity. A sandy-loam mixture is recommended to provide adequate organic material for vegetation/root yet still has sufficient drainage characteristics;
- Seepage loss may be applied on some soil types. If losses are proposed then a qualified geotechnical engineer is to determine the likely infiltration rate from the

device to the surrounding soils. The depth of the pipe location is a function of the percent of filter below the slotted drainage pipe;

- The default kC* values for the bioretention system must not be adjusted without appropriate confirmation from Council.

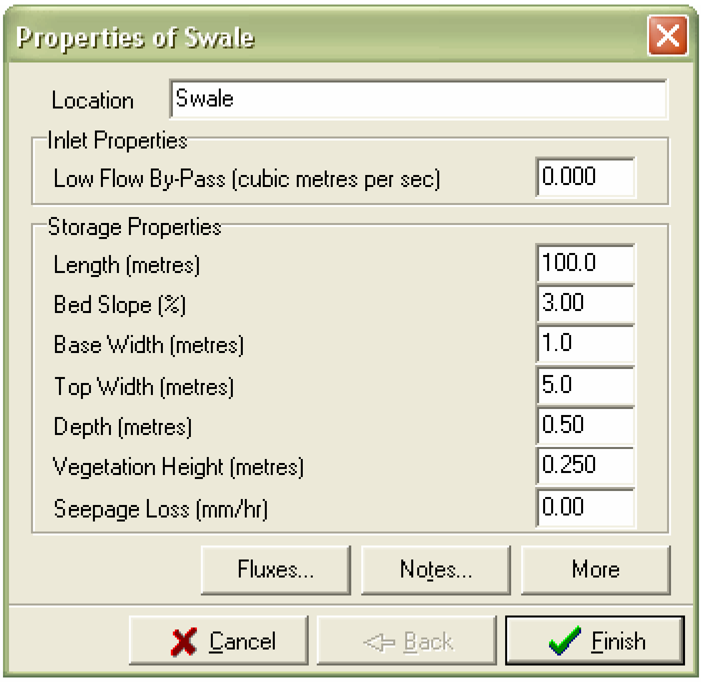
Note: When locating bioretention devices ensure the ability of the devices to drain adequately has been assessed. Also ensure the device has sufficient pre treatment bypass flows or contains structures to ensure flows within the device are kept below the scour velocity of the chosen filter media.

3.7 Swale

Vegetated swales are open vegetated channels that can be used as an alternative stormwater conveyance system to conventional kerb and channel along roads and associated underground pipe. The interaction of surface flows with the vegetation in a swale facilitates an even distribution and slowing of flows thus encouraging particulate pollutant settlement. Swales can be incorporated into streetscape designs and can add to the aesthetic character of an area.

Input Parameters

- Identify the length of the swale based upon location and site constraints;
- Determine the slope of the swale. Swales are most effective on slopes of 1-4%. Swales with bed slopes > 5% can be used if designed with rock check dams to slow velocities and prevent scour and erosion. Swales with bed slopes < 1% are to incorporate a drainage line within the base of the device, to prevent waterlogging;



Properties of Swale

Location: Swale

Inlet Properties

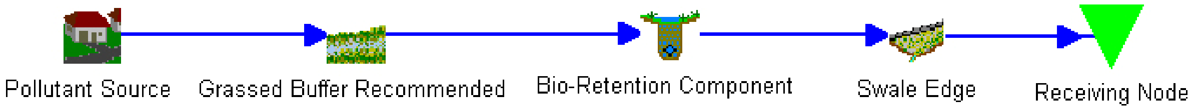
Low Flow By-Pass (cubic metres per sec)	0.000

Storage Properties

Length (metres)	100.0
Bed Slope (%)	3.00
Base Width (metres)	1.0
Top Width (metres)	5.0
Depth (metres)	0.50
Vegetation Height (metres)	0.250
Seepage Loss (mm/hr)	0.00

- Provide dimensions for the base and top width of the swale;
- Calculate the depth of the device based upon the base and top width characteristics and identify the height of vegetation within the device; and
- Seepage loss may be applied on some soil types. If losses are proposed then a qualified geotechnical engineer is to determine the likely infiltration rate from the device to the surrounding soils.

3.7.1 Bioretention Swales



In order to model the proposed treatment efficiency of a bioretention swale within a treatment train, it is recommended that the modeller separate the device into its various components. These are the bioretention filter surface and battered slopes of the grassed channel. The image above depicts a standard layout for incorporating a bioretention swale within a treatment train.

Input Parameters

Bioretention Component:

The device should have no extended detention depth as runoff is anticipated to be conveyed through the device and not ponded to a design depth;

No seepage loss is to occur as treated flows shall discharge the device via a underdrain pipe; and

The filter media reflect a sandy-loam material to ensure vegetation can establish on the surface of the filter media.

All other parameters are dependant on the design of the device. The user should consult the MUSIC manual for an explanation of each parameter.

Grassed Swale Component:

The low flow bypass into the device is to be calculated. This is undertaken by the following formulae:

Bypass = SA x ksat / 1000 x 3600

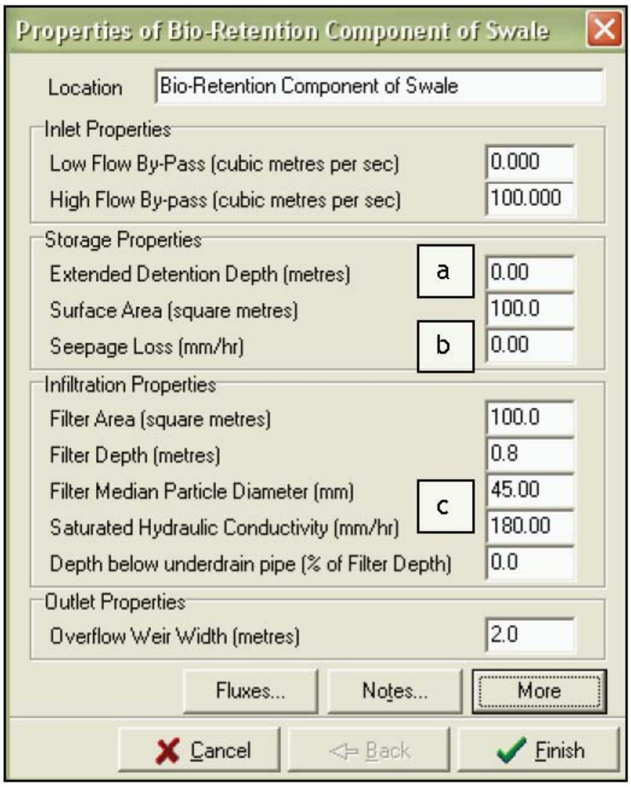
Where:

SA = Bioretention surface area

Ksat / 1000 x 3600 = Hydraulic conductivity of filter media in metres per second

Ensure that the bed slope of the swale does not exceed 5%;

Seepage loss may be applied on some soil types. If losses are proposed then a qualified geotechnical engineer is to determine the likely infiltration rate from the device to the surrounding soils.



Properties of Bio-Retention Component of Swale

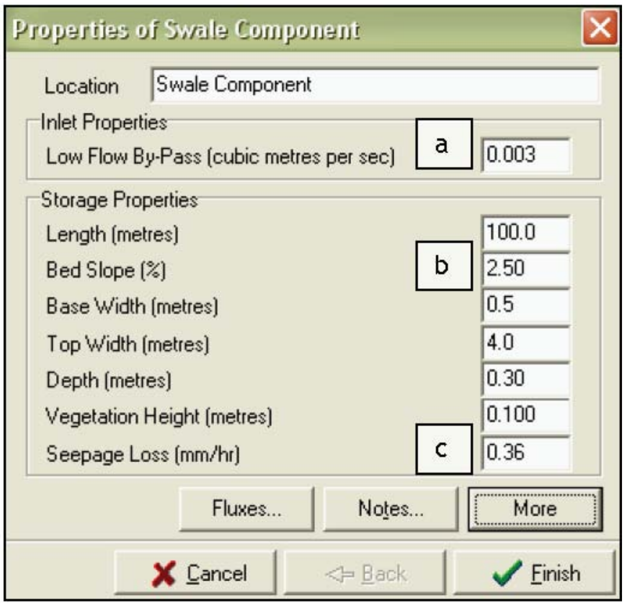
Location: Bio-Retention Component of Swale

Inlet Properties
Low Flow By-Pass (cubic metres per sec): 0.000
High Flow By-pass (cubic metres per sec): 100.000

Storage Properties
Extended Detention Depth (metres): 0.00
Surface Area (square metres): 100.0
Seepage Loss (mm/hr): 0.00

Infiltration Properties
Filter Area (square metres): 100.0
Filter Depth (metres): 0.8
Filter Median Particle Diameter (mm): 45.00
Saturated Hydraulic Conductivity (mm/hr): 180.00
Depth below underdrain pipe (% of Filter Depth): 0.0

Outlet Properties
Overflow Weir Width (metres): 2.0



Properties of Swale Component

Location: Swale Component

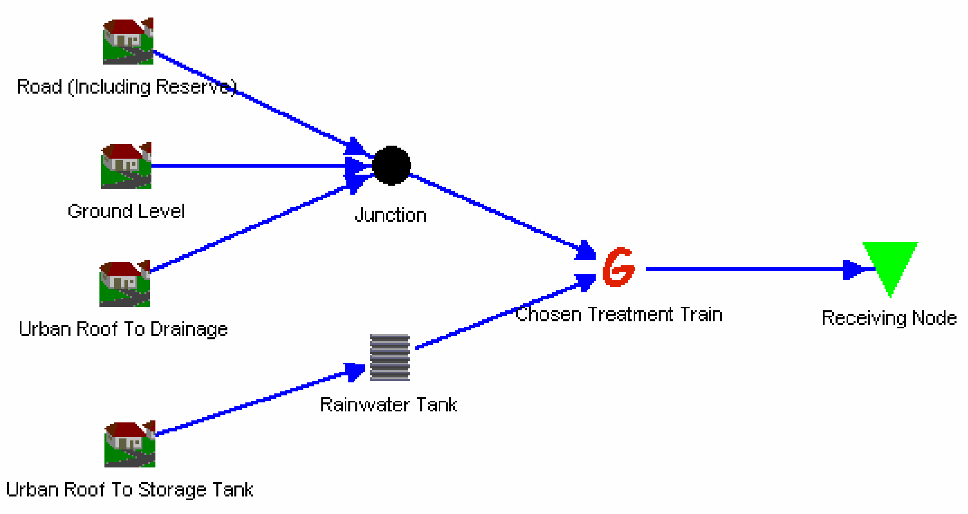
Inlet Properties
Low Flow By-Pass (cubic metres per sec): 0.003

Storage Properties
Length (metres): 100.0
Bed Slope (%): 2.50
Base Width (metres): 0.5
Top Width (metres): 4.0
Depth (metres): 0.30
Vegetation Height (metres): 0.100
Seepage Loss (mm/hr): 0.36

3.8 Rainwater Tank

Guidance on modelling rainwater tanks for reuse is included in Section 4. This section includes guidance on modelling the treatment performance of rainwater tanks. In order to appropriately model the treatment efficiency of a rainwater tank within an urban development proposal it is recommended that the following methodology be utilised:

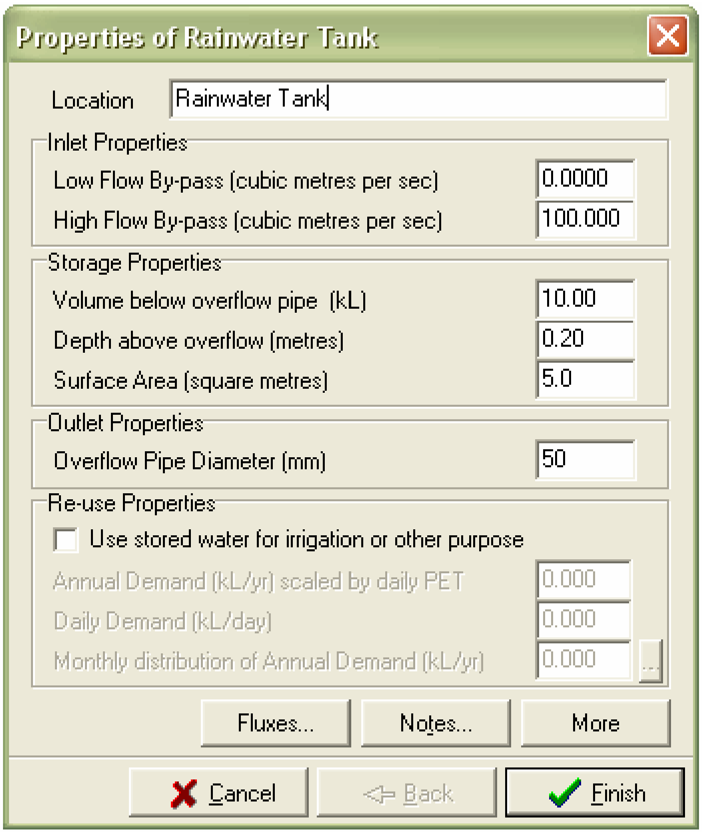
- The rainwater tank that is entered into MUSIC must comply with any BASIX certificate for that residential site.
- It is recommended that the modeller develop a treatment train utilising the rainwater tank node in the following manner:



Input Parameters

Storage outlet properties shall be designed as the modeller feels appropriate for the site. Ensure that the volumes and surface areas of the proposed tanks are included within the Stormwater Management Plan to justify modelling assumptions.

With regard to re-use ensure that the Use stored water for irrigation or other purpose box is checked. Demands should be verified with demands from BASIX calculated water demands.



Properties of Rainwater Tank

Location: Rainwater Tank

Inlet Properties
Low Flow By-pass (cubic metres per sec): 0.0000
High Flow By-pass (cubic metres per sec): 100.000

Storage Properties
Volume below overflow pipe (kL): 10.00
Depth above overflow (metres): 0.20
Surface Area (square metres): 5.0

Outlet Properties
Overflow Pipe Diameter (mm): 50

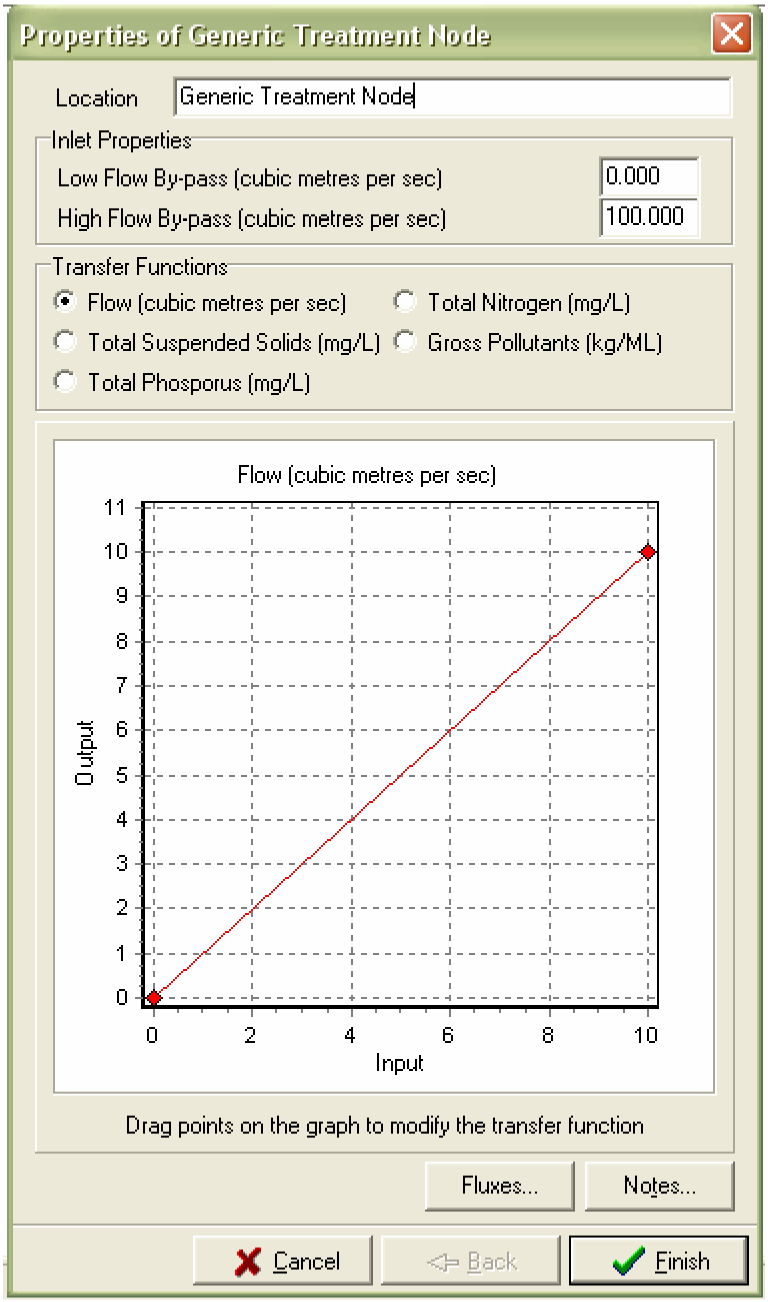
Re-use Properties
☐ Use stored water for irrigation or other purpose
Annual Demand (kL/yr) scaled by daily PET: 0.000
Daily Demand (kL/day): 0.000
Monthly distribution of Annual Demand (kL/yr): 0.000

3.9 Generic Node

This node allows the user to simulate the treatment performance of devices not listed within the default parameters.

This use of this device is similar to the processes identified for a Gross Pollutant Trap with the exception of a Flow transfer function to replicate any flow attenuation produced by the proposed device.

Note: The use of the Generic Node should only be permitted if sufficient justification can be provided and where Council Officers support this information. If this node is utilised the user is to identify the proposed treatment efficiency along with any additional supporting information to Councils requirements.



Properties of Generic Treatment Node

Location: Generic Treatment Node

Inlet Properties

Low Flow By-pass (cubic metres per sec): 0.000

High Flow By-pass (cubic metres per sec): 100.000

Transfer Functions

● Flow (cubic metres per sec)
○ Total Nitrogen (mg/L)
○ Total Suspended Solids (mg/L)
○ Gross Pollutants (kg/ML)
○ Total Phosporus (mg/L)

Drag points on the graph to modify the transfer function

4 Rainwater Tanks for Reuse

When modelling rainwater tanks for reuse, the following considerations apply:

- Average household water demand in Ku-ring-gai LGA was 402 kL/year before water restrictions came into force. This demand can typically be broken down as outlined in Table 10.

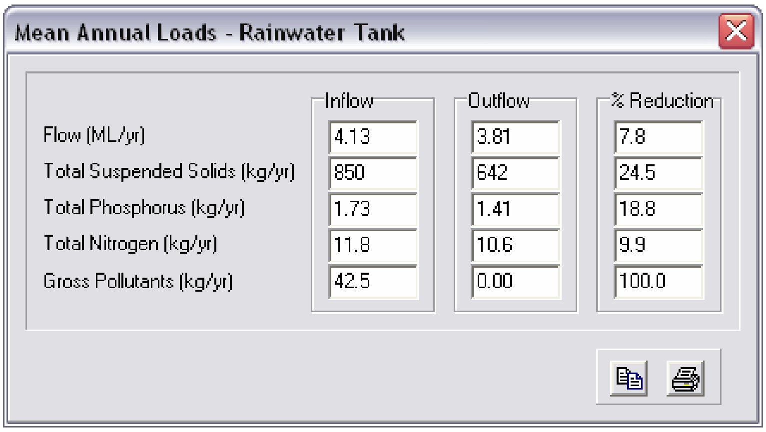
Table 10: Typical household water demands

Type of water use	Percentage of total demand	Demand Type	Demand kL/yr
Outdoor	25%	Seasonal	100
Shower	23%	Daily	92
Laundry	20%	Daily	80
Toilet	19%	Daily	76
Kitchen and basins	13%	Daily	52

- Indoor demands are best represented in MUSIC as an average “Daily Demand” in kL/day.
- Outdoor demands are best represented in MUSIC as an average “Annual Demand scaled by PET” in kL/year. This modelling approach will account for seasonal variation in irrigation and other outdoor demands.
- If a user-defined “Monthly distribution of Annual Demand” is provided, this should be accompanied by justification of the approach used.

MUSIC can be used to estimate how effective a rainwater tank will be at meeting the anticipated demands. The following steps should be followed:

- The model should be run at a daily time step for a period of at least 50 years.
- After running the model, right-click on the rainwater tank and select Statistics, then Mean Annual Loads.



Mean Annual Loads - Rainwater Tank

	Inflow	Outflow	% Reduction
Flow (ML/yr)	4.13	3.81	7.8
Total Suspended Solids (kg/yr)	850	642	24.5
Total Phosphorus (kg/yr)	1.73	1.41	18.8
Total Nitrogen (kg/yr)	11.8	10.6	9.9
Gross Pollutants (kg/yr)	42.5	0.00	100.0

- Total rainwater used in one year (ML) = Inflow (ML/yr) - Outflow (ML/yr)
- Efficiency in meeting demands = Total rainwater used / Total demand
- The results also show how effective the rainwater tank is for pollutant removal