MUSIC Parameters for use within the City of Greater Geelong

Introduction

The following MUSIC Guidelines have been developed by Parsons Brinckerhoff (PB) for the City of Greater Geelong for use in modelling stormwater treatment and stormwater reuse systems. MUSIC (Model for Urban Stormwater Improvement Conceptualisation) is a commonly used conceptual design tool for stormwater systems.

This document aims to provide information to developers, consultants and reviewers on the use of the MUSIC software, including appropriate input parameters to adopt for stormwater treatment and reuse systems within the City of Greater Geelong.
A meteorological data template was created for the City of Greater Geelong using rainfall and evapotranspiration data for Geelong.

Rainfall

The Geelong Salines (Moolap) rainfall station (station 87023) data was used to determine the reference year for the City of Greater Geelong. This station was chosen given it has a rainfall data record from 1/4/1897 to 31/3/2009. The analysis of the data for this period determined that the year of 1985 most accurately represents the long-term meteorological records for Geelong.

The meteorological data template for Geelong was created from the Geelong North pluviograph data, as no pluviograph data was available for Geelong Salines. Analysis of the data from the two rainfall stations ensured that the data for Geelong North accurately represented the Geelong Salines rainfall data. Table 1 outlines the information from the chosen rainfall station.

Table 1 Adopted rainfall station for the City of Greater Geelong

Station name	Station number	Reference year	Mean Annual Rainfall
Geelong North	87133	1985	513 mm

Evapotranspiration

Monthly evapotranspiration values have been estimated from average potential evapotranspiration contour maps for Victoria (Hydrological Recipes Estimation Techniques in Australian Hydrology, 2004). Average monthly potential evapotranspiration values for Geelong are shown in Table 2.

Table 2: Average monthly potential evapo-transpiration for Geelong

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Average potential evapotranspiration (mm)	169	143	102	56	32	21	24	42	70	107	133	160

(Source: Hydrological Recipes Estimation Techniques in Australian Hydrology, 2004)

Pollutant Reduction Targets

Port Phillip Bay, Corio Bay and Bass Strait Targets

The Best Practice Environmental Management Guidelines (BPEMG) outline pollution reduction targets for urban stormwater discharge into Port Phillip Bay (refer to Table 3). These targets are also relevant to urban stormwater discharges to Corio Bay and Bass Strait.

Table 3: Stormwater pollutant reduction targets (BPMEG, 1999)

Pollutant	Total Suspended Solids (TSS)	Total Nitrogen (TN)	Total Phosphorous (TP)	Gross Pollutants (GP)
Reduction	80%	45%	45%	70%

Other receiving waters

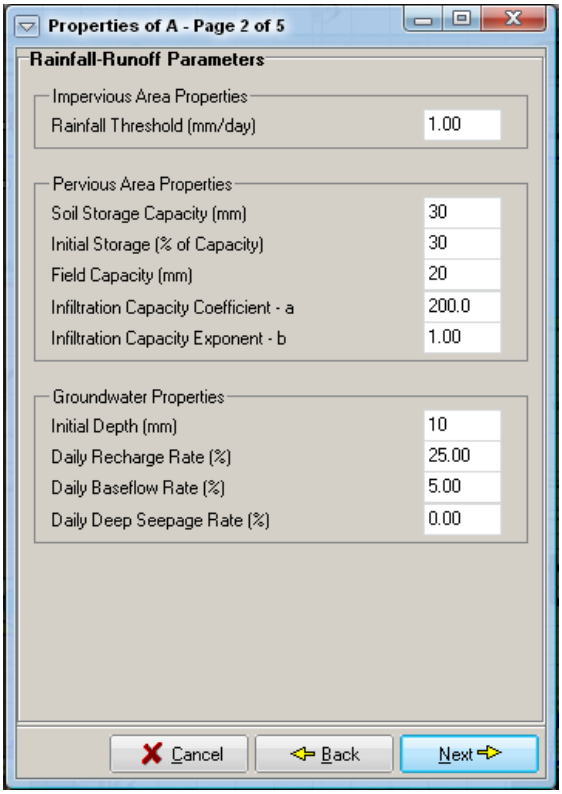
The City of Greater Geelong would like to maintain strict regulation of urban stormwater discharge into other wetlands and waterways. Geelong City Council should be contacted for guidance on pollution reduction targets for proposed development that discharge to other receiving waters.

Default MUSIC Parameters

Rainfall-runoff parameters

Rainfall-runoff parameters are outlined in the MUSIC User Manual (CRC for Catchment Hydrology, 2005) (see Table 4).

Table 4: Rainfall-runoff default parameters for Melbourne (MUSIC User Manual, 2005)



Pollution Concentration data

The default parameters for the pollution concentration data (total nitrogen, total phosphorus and total suspended solids) should be used for identified land uses (MUSIC Input Parameters, 2004).

Simulation Timestep

Water treatment

The timestep for water treatment modelling is defined in the MUSIC Input Parameters guideline (Melbourne Water, 2004) as being equal to or less than:

- The Time of Concentration of the smallest sub-catchment, and
- The shortest detention time (under design flows) of the treatment measures being modelled

The MUSIC Input Parameters guidelines also note that if these times are less than 6 minutes, the 6 minute time step should be used.

Stormwater reuse

The MUSIC software can be used to model stormwater reuse systems, and to estimate harvested volumes and security of supply. The systems can be modelled using the pond, wetland or rainwater tank treatment nodes in MUSIC.

The modelling period from 1982 to 2005 should be adopted for stormwater water reuse models using the Geelong North rainfall. The City of Greater Geelong should be contacted for this information.

The time step adopted for the water reuse model is dependent on the proposed mechanism of stormwater extraction. For proposed stormwater extractions involving the use of pumps or buffer storages, an hourly time step should be adopted as a minimum. This sub-daily time step allows for a more accurate representation of peak flows generated by MUSIC and more accurate harvesting volume estimates.

In determining the security of supply and harvested volume of a scheme, the MUSIC flux files should be used, adopting the water release and water demand figures over the simulation period.

Demands

Non potable water demands for stormwater reuse schemes include open space irrigation and toilet flushing. Typical values for total annual water demands and monthly use are outlined below.

Open Space Irrigation

Annual Volume Requirements

Typical annual application rates for grass irrigation are outlined below:

- Drought tolerant grasses – 350 mm/m²
- Non drought tolerant grasses – 500 mm/m²

Site specific application rates for grass irrigation should be adopted where available.

Application rates applied for tree irrigation should be considered on a species specific basis.

Monthly Proportion requirements

Demand profile for open space irrigation needs to be estimated from similar facilities and usage patterns. Where these usage patterns are not available, Table 5 can be used to allocate annual demand over each month of the year.

Table 5: Monthly Proportion of Annual Rainfall Volumes

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
22%	17%	16%	4%	0%	0%	0%	0%	2%	8%	12%	19%

Other non potable uses

In estimating the total annual demand for non potable uses, recorded data should be applied where available. Melbourne Water WSUD Engineering Procedures (2005) should be adopted where practical to calculate these demands in the absence of recorded data. In distributing this total demand for each month of the year, consideration should be given to potential use of non potable water. Considerations include sports seasons for sports club rooms, typical school days for school use etc.

Fraction Impervious

Typical fraction impervious values for the various land use types are outlined in the MUSIC Guidelines (Melbourne Water, 2010). These values are shown in Appendix A. In residential areas, the "Typical Value" to be adopted shall be as per the allotment size.

Aerial photographs and the Victorian Planning Scheme maps for Geelong can be useful tools for determining the fraction impervious of a particular property or catchment. The recommended values are consistent with the Geelong Housing Diversity Strategy (2007).

Submission of MUSIC modelling reports

The submission of MUSIC models to the City of Greater Geelong should be supplemented by brief report that outlines assumptions adopted. The submitted information should include the following:

Input Parameters

- Description of the function and intent of the treatment system
- Description of how fraction impervious was calculated (what figures were used for different zonings)
- Description of and documentation for any departure from these guidelines.

Summary of Performance

- Mean annual load reduction for TSS, TP, TN and GP
- Percentage of pollutant reduction achieved for each device within the treatment train
- Percentage pollutant reduction achieved for the total treatment train
- Average annual volume of stormwater diverted from source for reuse (if applicable)
- Reliability of the preferred stormwater harvesting option based on an annual and summer security of supply (if applicable).

MUSIC Model Data

- Sqr or Sqz model of catchment with treatment devices
- Sqr or Sqz model of catchment without treatment devices
- Use of reference rainfall year (1985) for stormwater quality modelling
- Use of reference rainfall years (1982 – 2005) for stormwater reuse modelling
- Use of recommended evapotranspiration data in Table 2-2
- Flux file for any stormwater harvesting options from ponds, wetlands or closed storages (rainwater tank).

If available, an electronic copy of the catchment and subcatchments used in ArcView or other approved format. If an electronic copy is not available, a hard copy is acceptable.

REFERENCES

- Bureau of Meteorology
- CRC for Catchment Hydrology, 2005, MUSIC User Manual
- CSIRO, 1999, Urban Stormwater: Best Practice Environmental Management Guidelines
- Grayson R.B., Argent R.M., Nathan R.J., McMahon T.A., Mein R.G., 2004, Hydrological Recipes – Estimation Techniques in Australian Hydrology
- Greater Geelong City Council, 2007, Geelong Housing Diversity Strategy
- Melbourne Water, 2005 WSUD Engineering Procedures: Stormwater
- Melbourne Water, 2004, MUSIC Input Parameters
- MUSIC GUIDELINES – Recommended input parameters and modelling approaches for MUSIC users – Melbourne Water 2010

Other reference documents

- Geelong Healthy Waterways Program (Greater Geelong City Council)
- Victoria Planning Provisions – Clause 56.07-4 and Standard C25
- Victoria Planning Schemes Online (http://www.dse.vic.gov.au/PlanningSchemes/) (Department of Planning and Community Development**)**

APPENDIX - A
FRACTION IMPERVIOUS

Fraction Impervious for residential areas shall be the "Typical Value" for the appropriate lot size

Zone	Zone Code	Brief Description/Examples	Normal Range	Typical Value
Residential Zones:				
Residential 1 & 2 Zone	R1Z	Moderate range of densities. (Allotment size 800m² – 4000m²)	0.40 - 0.50	0.45
	R2Z	Normal densities. (Allotment size 500m² – 800m²)	0.50 - 0.70	0.60
		Medium densities. (Allotment size 350m² – 500m²)	0.70 - 0.80	0.75
		High densities. (Allotment size <350m²)	0.80 - 0.95	0.85
Low Density Residential Zone	LDRZ	Low densities (0.4 ha min.)	0.10 - 0.30	0.20
Mixed Use Zone	MUZ	Mix of residential, commercial, industrial and hospitals.	0.60 - 0.90	0.70
Township Zone	TZ	Small townships with no specific zoning structures.	0.40 - 0.70	0.55
Industrial Zones:				
Industrial 1 Zone	IN1Z	Main zone to be applied in most industrial areas.	0.70 - 0.95	0.90
Industrial 2 Zone	IN2Z	Large industrial zones away from residential areas.	0.70 - 0.95	0.90
Industrial 3 Zone	IN3Z	Buffer between Zone 1 and Zone 3.	0.70 - 0.95	0.90
		• for garden supplies/nurseries.	0.30 - 0.60	0.50
		• for quarries.	0.10 - 0.30	0.20
Business Zones:				
Business 1 Zone	B1Z	Main zone to be applied in most commercial areas.	0.70 - 0.95	0.90
Business 2 Zone	B2Z	Offices and associated commercial uses.	0.70 - 0.95	0.90
Business 3 Zone	B3Z	Offices, manufacturing industries and associated uses.	0.70 - 0.95	0.90
Business 4 Zone	B4Z	Mix of bulky goods retailing and manufacturing industries.	0.70 - 0.95	0.90
Business 5 Zone	B5Z	Mix of offices and multi-dwelling units.	0.70 - 0.95	0.90
Rural Zones:				
Rural Zone	RUZ	Main zone to be applied in most rural areas.	0.05 - 0.20	0.10
Environmental Rural Zone	ERZ	Rural areas with specific environmental considerations.	0.05 - 0.20	0.10
Rural Living Zone	RLZ	Predominantly residential use in rural environment.	0.10 - 0.30	0.20

APPENDIX - A – CONT.D
FRACTION IMPERVIOUS

Zone	Zone Code	Brief Description/Examples	Normal Range	Typical Value
Public Land Zones:				
Public Use Zone		Use of land for public purposes		
• Service and Utility	PU1Z	• power lines, pipe tracks and retarding basins.	0.00 - 0.10	0.05
		• reservoirs.	0.40 - 0.60	0.50
• Education	PU2Z	• schools and universities.	0.60 - 0.80	0.70
• Health and Community	PU3Z	• hospitals.	0.90 - 0.80	0.70
• Transport	PU4Z	• railways and tramways.	0.60 - 0.80	0.70
• Cemetery / Crematorium	PU5Z	• cemeteries and crematoriums.	0.50 - 0.70	0.60
• Local Government	PU6Z	• libraries, sports complexes and offices/depots.	0.50 - 0.90	0.70
• Other Public Use	PU7Z	• museums.	0.50 - 0.80	0.60
Public Park and Recreation Zone	PPRZ	Main zone for public open space, incl golf courses.	0.00 - 0.20	0.10
Public Conservation and Resource Zone	PCRZ	Protection of natural environment or resources.	0.00 - 0.05	0.00
Road Zone – Category 1	RDZ1	Major roads and freeways.	0.60 - 0.90	0.70
Road Zone – Category 2	RDZ1	Secondary and local roads.	0.50 - 0.80	0.60
Special Purpose Zones:				
Special Use Zone	SUZn	Development for specific purposes.	0.50 - 0.80	0.60
Comprehensive Development Zone	CDZn	Large and complex developments – residential.	0.40 - 0.80	0.50
Urban Floodway Zone	UFZ	Land identified as part of an active floodway.	0.00 - 0.05	0.00
Capital City Zone	CCZn	Special Use Zone for land in Melbourne's central city.	0.70 - 0.90	0.80
Docklands Zone	DZn	Special Use Zone for land in Docklands area.	0.70 - 0.90	0.80
Commonwealth Land:				
Commonwealth Land	CA	Army barracks, CSIRO.	0.50 - 0.80	0.60

Note: Values included in this table relate only to the average imperviousness of a land-use type. They are not runoff coefficients and should not be used as runoff coefficients. Refer to the Australian Rainfall and Runoff (Engineers Australia, 2001) for the difference between fraction impervious and runoff coefficients.

Source – "MUSIC GUIDELINES – Recommended input parameters and modelling approaches for MUSIC users" – Melbourne Water - 2010