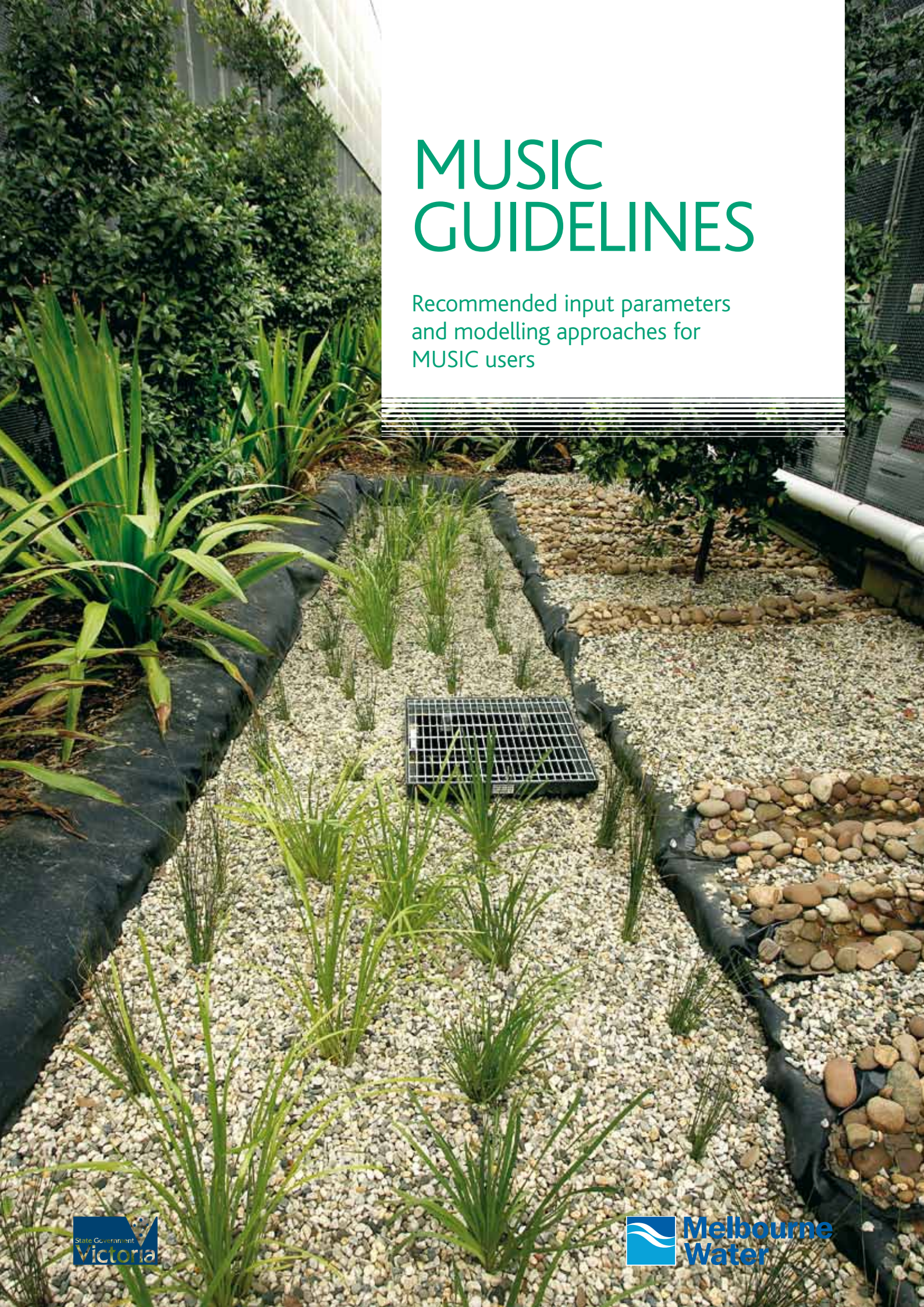


MUSIC GUIDELINES

Recommended input parameters and modelling approaches for MUSIC users

State Government Victoria

Melbourne Water

INTRODUCTION

Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was developed by eWater. MUSIC is a conceptual design tool. The program can be used to estimate pollutant generation from a catchment and to demonstrate the performance of stormwater quality improvement systems.

Generally Melbourne Water requires treatment of stormwater so that annual pollutant loads achieve targets set out in the Best Practice Environmental Management Guidelines (BPEMG), these are:

- 45% reduction in Total Nitrogen (TN) from typical urban loads
- 45% reduction in Total Phosphorus (TP) from typical urban loads
- 80 % reduction in Total Suspended Solids (TSS) from typical urban loads
- 70% reduction in Litter from typical urban loads
- Maintain discharges for the 1.5 year ARI event at pre-development levels

There are however many cases where individual treatment measures will have different targets, for instance if the receiving aquatic ecosystem is identified as being of very high value, then Melbourne Water may require a higher treatment level.

The design intent for any treatment system must be clearly documented and discussed with Melbourne Water early in the conceptual design stage. Melbourne Water uses MUSIC to assess the impacts of proposed development against performance targets. If alternative methods or models are used, the developer must demonstrate to Melbourne Water's satisfaction that performance targets can be achieved.

This document provides guidance on input parameters and modelling approaches for MUSIC that are recommended by Melbourne Water.

PURPOSE OF THIS DOCUMENT

This document is aimed at supporting those submitting MUSIC models to Melbourne Water.
The objectives are to:

- Ensure a consistent scientifically based approach is applied to MUSIC models
- Provide guidance on methods specific to the Melbourne region without inhibiting innovative modelling approaches.
- Reduce the time taken by Melbourne Water in assessing models.

This document should be read in conjunction with the MUSIC Users Manual. Users of these guidelines are expected to know how to use MUSIC software and are sufficiently trained in the use of MUSIC software.

This document is not a design guideline and should be read in conjunction with appropriate design guidelines, eg. *WSUD Engineering Procedures: Stormwater* (Melbourne Water, 2005).

1. RAINFALL DATA & EVAPOTRANSPIRATION

Use of meteorological data within MUSIC is a balance between accurate representation and computing time. Testing has shown that the use of rainfall data from an appropriately selected year of rainfall data can represent the long-term metrological record. Six rainfall stations across Melbourne have been selected to reflect the rainfall gradient shown in Figure 1 below. The Representative years were selected as the best match of long-term records in terms of mean annual rainfall, distribution of rainfall and 90th percentile of rainfall. Melbourne Water recommends that results obtained by the "reference year" method be compared with long term rainfall records as a final check.

The rainfall distribution map can be used to determine the appropriate weather station, in order to better determine which station is appropriate; a large-scale version of the map is also available at the Melbourne Water website.

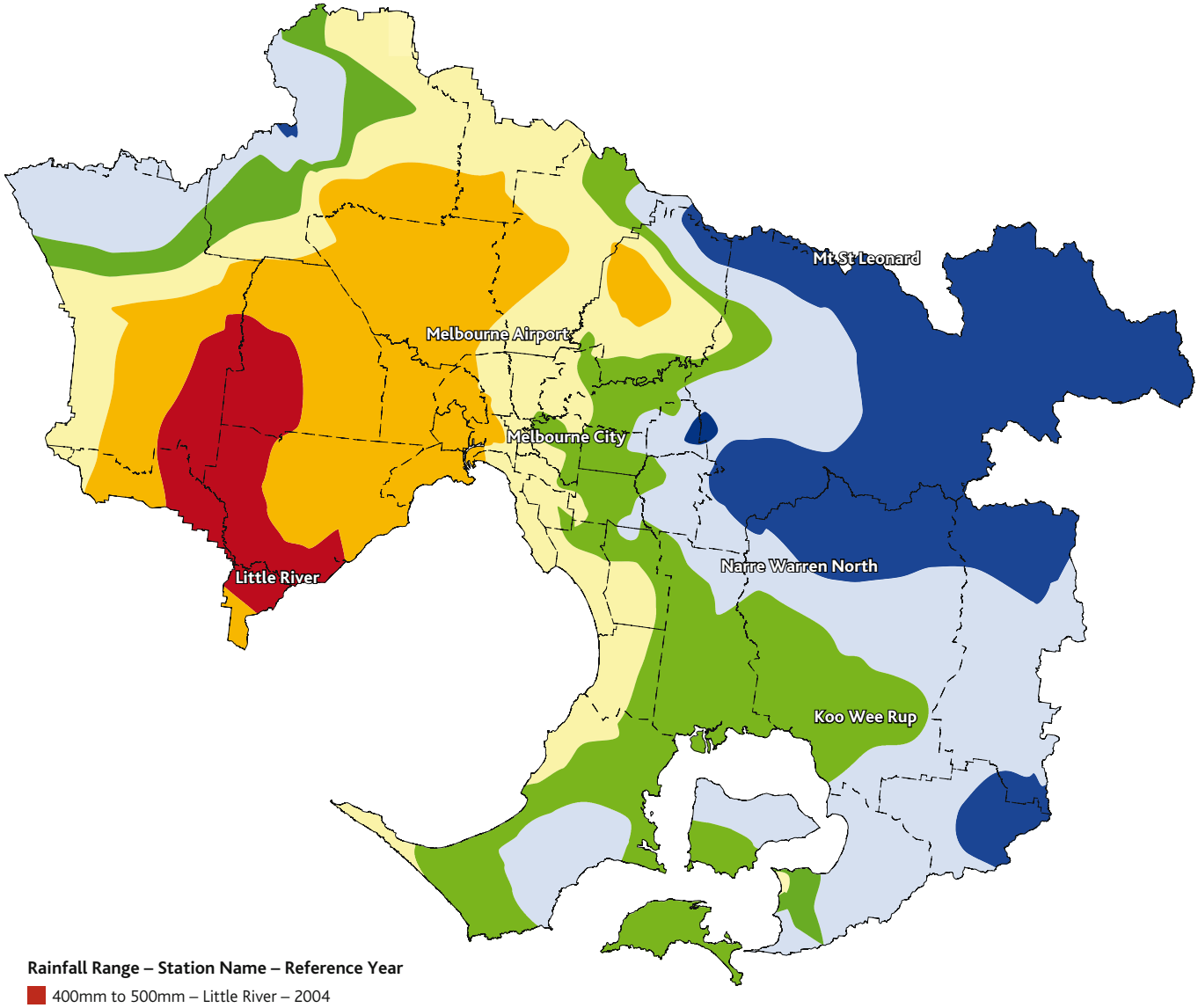
Rainfall data is available from the Bureau of Meteorology www.bom.gov.au. Templates for the six rainfall stations selected to reflect the rainfall gradient across metropolitan Melbourne are available at melbournewater.com.au.

All models created from January 2011 onwards must use either Melbourne Water's recommended rainfall templates or appropriate local rainfall. Use of alternative rainfall data is permitted if it can be demonstrated that the selected rainfall data is high quality and representative of the area to which it is being applied.

Table 1. Weather station, Mean Annual Rainfall range, reference year

Weather Station	Mean Annual Rainfall (mm) range	Reference year
Little River	400 - 500	2004
Melbourne Airport	500 - 650	1996
Melbourne City	650 - 750	1966
Koo Wee Rup	750 - 850	2004
Narre Warren North	850 - 1100	1998
Mt St Leonard	1100 - 2100	1998

RAINFALL DISTRIBUTION – GREATER MELBOURNE



Rainfall Range – Station Name – Reference Year

- 400mm to 500mm – Little River – 2004
- 500mm to 650mm – Melbourne Airport – 1996
- 650mm to 750mm – Melbourne City – 1966
- 750mm to 850mm – Koo Wee Rup – 2004
- 850mm to 1100mm – Narre Warren North – 1998
- 1100mm to 2100mm – Mount St Leonard – 1998

2. TIMESTEP

The timestep must be equal to or less than:
i. the Time of Concentration of the smallest Sub-Catchment, and
ii. the shortest detention time (under design flows) of the treatment measures being modelled.

Where either of these would be less than 6 minutes, the model should be run using a 6 minute interval.

3. HYDROLOGIC ROUTING

Hydrologic routing should be used where appropriate to reflect the Time of Concentration of the Catchment as calculated using a recognised procedure. The applicant may choose not to apply routing to reduce the complexity of the model. Generally this will result in the performance of treatment systems being underestimated.

4. SOILS

In MUSIC the pervious area properties default to Brisbane properties. These will need to be altered to reflect Melbourne properties as documented in the MUSIC User Manual. Any deviation from the Melbourne parameters listed in the MUSIC User Manual should be described in the report provided with the model. Supporting evidence should also be provided.

The MUSIC User Manual lists the following pervious area properties for Melbourne:

Soil Store Capacity = 30mm Field Capacity = 20mm

5. LOSSES FROM THE SYSTEM

The exfiltration rate specified in treatment nodes relates to the seepage rate in mm/hr of the soil surrounding the treatment systems. This does not refer to the hydraulic conductivity of any of the soils contained within the actual treatment systems. The exfiltration rate adopted in any treatment nodes that is more than 0mm/hr must be supported by a geotechnical report.

6. POLLUTION CONCENTRATION DATA

The default values for TSS, TP and TN are to be used, unless additional data is available. Any new data must be published and demonstrate that there is a significance difference between the new data and the default data. Changes to default pollutant concentrations must be confirmed by Melbourne Water in writing.

The Serial Correlation (R squared) is to be set to zero for TSS, TP and TN if using a single reference year of rainfall data. This applies to MUSIC Version 4 models only.

7. FRACTION IMPERVIOUS

Ideally models should be calibrated using local flow data. However in most cases information is not available to achieve this. Where the model cannot be calibrated using local flow data, the following table indicating the fraction impervious for different land uses can be used as a guide. Consideration should be given to the catchment modelled and where it fits within the range provided. This table may not be applicable to all catchments.

It should be noted that these figure are total fraction impervious whereas MUSIC requires the effective fraction impervious. Use of these figures may result in overestimation of more frequent flows in some cases.

Any significant deviation from these figures must be supported by relevant information (i.e. long term flow data that enables calibration of the model)

Zone	Zone Code	Brief Description/Examples	Normal Range	Typical Value
Residential Zones:				
Residential 1 & 2 Zone	R1Z	Moderate range of densities. (Allotment size 800m^2 – 4000m^2)	0.40 - 0.50	0.45
	R2Z	Normal densities. (Allotment size 500m^2 – 800m^2)	0.50 - 0.70	0.60
		Medium densities. (Allotment size 350m^2 – 500m^2)	0.70 - 0.80	0.75
		High densities. (Allotment size <350m^2)	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

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.

8. STOCHASTIC VERSUS MEAN GENERATED DATA

Stochastically generated data is always to be used, except where there is a requirement to examine behaviour for a particular storm event or set of operating conditions.

9. SOURCE NODES

Any Agricultural & Forest nodes must be submitted as independent subcatchments, parkland within an urban development will usually be modelled as an urban node. The uncertainties associated with the defaults used for agricultural nodes are significantly higher than those for urban nodes. In most cases the use of urban nodes, with low fraction impervious, will be preferable to the use of agricultural nodes.

10. K, C*, C**

Melbourne Water must approve any changes to these parameters in writing. Any data used to modify these parameters must be published data, and be appropriate for the circumstances being modelled.

11. INSTREAM WORKS

Any works within receiving waters (such as pool and riffle systems) shall not be included into any treatment train models. Waterways in Development Services Schemes shall not be included into any treatment models.

Online wetland treatment trains are acceptable if they comply with Melbourne Water's Constructed Wetland Guidelines.

12. GPT'S

No treatment should be attributed to a GPT unless it is supported by reliable studies. Nitrogen reductions from GPT's shall not be included in the overall performance of the treatment train.

13. WETLANDS

To access design guidelines for constructed wetland systems please refer to the Melbourne Water publication 'Constructed Wetlands Guidelines' (Melbourne Water, 2010). This document is available as a PDF download from Melbourne Water's web page.

A minimum of 80% coverage of emergent macrophytes is required within the normal water level surface area of the wetland.

The extended detention depth can vary up to a maximum of 500mm, unless otherwise approved.

The detention time in the macrophyte extended detention zone is recommended to be 72 hours, with not less than a 48 hour detention time.

Additional requirements for wetlands can be found in Melbourne Water's Constructed Wetland Guidelines, http://www.melbournewater.com.au/content/planning_and_building/information_for_developers/guidelines_for_developers.asp

14. LAKES

MUSIC is not a suitable model for in-lake processes, other than water balance assessments. Guidance on this topic can be found in the Melbourne Water publication "*Constructed Shallow Lake Systems for Developers*". This document is available as a PDF download from Melbourne Water's web page.

15. REUSE

A reuse master plan must be provided which is to be signed off by all relevant authorities (Local Government, Melbourne Water). Calculations should be provided to support reuse volumes.

Reuse used to contribute to treatment train performance must have demands that are reliable, eg. toilet flushing. Irrigation of a residential block is encouraged, however will not be accepted as demand for reuse in a model due to the high variability of this demand.

For reuse to be accepted as part of a MUSIC model there needs to be a suitable agreement between the relevant stakeholders relating to the reuse.

Use of reuse to contribute to treatment performance should be modelled in accordance with the "Rainfall Data & Evapotranspiration" and "Timestep" sections of these guidelines. Use of a different timestep and a number of consecutive rainfall years should be considered when determining the optimum size of the storage unit.

16. SWALES

Suggested vegetation heights

- **Grass swale** (mowed) height range: 10 – 100mm
- **Vegetation** (not mowed): 100 – 400mm

In the case where unmown vegetation is being used, the proponent should identify what type of vegetation is proposed, and how it will be managed within the landscape and maintenance requirements of the development. Waterways within developments cannot be deemed as swales and shall not be included in the treatment train model.

17. BIORETENTION SYSTEMS

Bioretention systems used in models must be supported by a specification of the filter media for the system included in the design. The specification should comply with the specification requirements listed in the *"Stormwater Biofiltration Systems: Adoption Guidelines"* (FAWB, 2009)

The hydraulic conductivity of the filter media used in the model should match the specification. An acceptable range of the hydraulic conductivity of a bioretention system is 100mm/hr – 400mm/hr. A geotechnical report may be required to support the selection of the exfiltration rate if the system is not lined.

If using MUSIC Version 3 or the media filtration system node in MUSIC Version 4, the median particle diameter size should match the specification. The filter media depth should not include the transition layer and the drainage layer.

If using MUSIC Version 4, the portion of organic material in the filter, the TN content of filter media and the Orthophosphate content of the filter media should also match the specification provided with the model. If the system is to be vegetated with effective nutrient removal plants, a vegetation specification is to be provided with the design. The filter media depth should not include the transition layer and the drainage layer unless there is a submerged zone. The porosity of the filter media and a submerged zone, if present, should represent the materials listed in the specification.

Consideration should be given to the extended detention depth selected for bioretention systems. The depth should be safe for construction, operation and maintenance of the system. If the system has a longitudinal slope, it will not have a uniform extended detention depth and an average should be selected.

18. PERMEABLE PAVEMENT

Permeable pavement should be modelled as per the manufacturer's guidelines. Documentation supporting the modelling must be submitted for review.

19. IMPORTED DATA NODES

Supporting documentation will be required to demonstrate the use of any imported data nodes in models.

20. GENERIC TREATMENT NODES

Generic treatment nodes should not be used unless supported by supplementary models or if modelling as per a treatment manufacturer's guidelines with supporting documentation.

Generic treatment nodes can be used to simulate the splitting of flows. Appropriate documentation must be provided to justify the split of flows if used to simulate this.

SUBMISSION REQUIREMENTS

The functional design report for the project should incorporate the following information for systems modelled with MUSIC:

Summary

- Summary of treatment performance in terms of:
  1. Mean annual load reduction for TSS, TP and TN
  2. % reduction of each treatment device
  3. % reduction of total treatment system
- Description of the function and intent of the treatment system.
- Catchment details.
- Description of how fraction impervious was calculated (what figures were used for different zonings).
- Description of and documentation for any departure from the Melbourne Water "MUSIC Inputs" document.
- A plan to an identifiable scale clearly depicting the catchment / s contributing to the treatment systems.
- Drawings depicting the design of the system.
- Specification for the treatment systems.
- Vegetation specification for bioretention systems.

Model

- Sqz model of catchment with treatment measures.
- Sqz model of catchment without treatment measures.
- Description of rainfall/ET data used (should be one of MW's reference years)
- If available an electronic copy of the catchment and subcatchment used in MapInfo or other approved format. If an electronic copy is not available a hard copy is acceptable.

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