

1.2 Introduction

MUSIC is the Model for Urban Stormwater Improvement Conceptualisation, developed by the MUSIC Development Team of the CRC for Catchment Hydrology.

MUSIC provides the ability to simulate both quantity and quality of runoff from catchments ranging from a single house block up to many square kilometres, and the effect of a wide range of treatment facilities on the quantity and quality of runoff downstream.

1.3 Background

Many organisations, from governments to catchment management groups, have introduced initiatives to protect the aquatic environment of urban areas. Often these initiatives have focussed on point sources of pollution, such as sewage discharge and industrial effluent. Building on the success of these initiatives, organisations are now turning their attention to diffuse sources of pollution, such as urban stormwater. Indeed, stormwater runoff is recognised as a major carrier of urban pollutants.

It is difficult to prevent stormwater from polluting creeks because runoff can be contaminated almost anywhere rain falls. Consequently, successful initiatives to manage stormwater will adopt a *catchment-wide* approach. The diffuse sources of stormwater pollution also demand a *multi-disciplinary* approach. Successful initiatives may need to integrate a range of urban planning and design disciplines, including urban hydrology, land-use planning, landscape design and asset life-cycle economics. Unfortunately, at the moment, progress has been hampered because organisations have insufficient knowledge or expertise in relevant disciplines, or are unable to fully integrate the various disciplines.

The Cooperative Research Centre for Catchment Hydrology (CRC) is addressing these deficiencies through its Urban Stormwater Quality Research Program. The program's research has culminated in MUSIC (the Model for Urban Stormwater Improvement Conceptualisation). As an aid to decision-making, MUSIC predicts the performance of stormwater quality management systems. It is intended to help organisations plan and design (at a conceptual level) appropriate urban stormwater management systems for their catchments.

A pilot version of MUSIC was released in March 2001 for beta testing by Melbourne Water, Brisbane City Council and associated consultants. Following the eight-month testing period, MUSIC Version 1 was released to the stormwater industry at large. MUSIC Version 2 (December 2003) extended the capabilities of the original program through additional calculation and presentation features, greater ability to export data for external analysis, and substantially smaller saved files. MUSIC Version 3 introduces the Life Cycle Costing module, provides two additional treatment nodes (rainwater tanks and infiltration basins), and offers further options to import and export model data.

The model's algorithms are based on the known performance characteristics of common stormwater quality improvement measures. These data, derived from research undertaken by CRCCH and other organisations, represent the most reliable information currently available in our industry. Nonetheless, knowledge gaps remain. MUSIC will evolve as the CRCCH, and the stormwater industry generally, conducts further research into:

- the catchment factors influencing the generation of stormwater pollutants and the characteristics of these pollutants;

- various physical, chemical and biological processes influencing the performance of stormwater quality improvement facilities; and
- how aquatic ecosystems respond to the intermittent and stochastic loading of stormwater-based pollutants.

1.4 Modelling Philosophy and Appropriate Application of MUSIC

MUSIC is an aid to decision-making. It enables users to evaluate conceptual designs of stormwater management systems to ensure they are appropriate for their catchments.

By simulating the performance of stormwater quality improvement measures, MUSIC determines if proposed systems can meet specified water quality objectives.

MUSIC will simulate the performance of a group of stormwater management measures, configured in series or in parallel to form a "treatment train". MUSIC runs on an event or continuous basis, allowing rigorous analysis of the merit of proposed strategies over the short-term and long-term.

The adoption of a continuous simulation approach is recommended in water quality modelling. This stems from the fact that impacts of poor stormwater quality on aquatic ecosystem health are associated with cumulative pollutant loads and frequency of aquatic ecosystem "exposure" to poor water quality. Pollutant loads delivered to receiving waters from many of the small storm events (e.g. of magnitude less than the 3 month ARI peak discharge) can make up in excess of 90% of the annual loads discharged from the catchment.

The evaluation of the effectiveness of a stormwater management system is based on a risk-based approach associated with examination of (i) the long-term frequency in which the receiving aquatic ecosystem is subjected to exposure of pollutant concentrations above a pre-specified threshold level and/or (ii) the long-term mean annual pollutant load delivered to the receiving waters.

MUSIC is designed to simulate stormwater systems in urban catchments and to operate at a range of temporal and spatial scales suitable for catchment areas from 0.01 km² to 100 km². Modelling time steps can range from 6 minutes to 24 hours to match the range of spatial scale.

Here we must sound two cautionary notes about appropriate application. Firstly, MUSIC is **not** a detailed design tool; it does not contain the algorithms necessary for detailed sizing of structural stormwater quantity and/or quality facilities. MUSIC should be viewed as a conceptual design tool.

Secondly, MUSIC should be only one of several tools used in Water Sensitive Urban Design because factors other than stormwater quality (e.g. land and soil characteristics, amenity, passive recreation, and landscape design) also influence Water Sensitive Urban Design. MUSIC does not currently incorporate all aspects of stormwater management that decision-makers must consider. Hydraulic analysis for stormwater drainage, indicators of ecosystem health, and the integration of urban stormwater management facilities into the urban landscape are currently omitted from the model.