

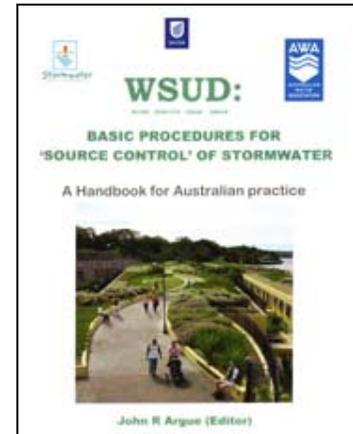
Water Sensitive Urban Design: Basic Procedures for 'Source Control' of Stormwater A Handbook for Australian Practice

Edited by John Argue, University of South Australia

Published in 2004

John Argue of Adelaide, Australia has specialised in the field of urban hydraulics and hydrology since 1976. His book "Storm drainage design in small urban catchments - a handbook for Australian practice" published in 1986 is still widely used by municipal engineers and consultants across the nation. The recently published Handbook on source controls incorporates theory development and practical lessons learned by Urban Water Resources Centre staff at the University of South Australia through research for, design and monitoring of over 30 successful stormwater management field installations in South Australia and New South Wales.

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Executive Summary

INTRODUCTION

Water-sensitive Urban Design (WSUD) is a term coined by a multi-disciplinary group of practitioners and academics in Perth, Western Australia, in the early 1990s, to describe the 'new thinking' then emerging about sustainable water cycle management in the urban landscape in Australia. The Handbook meets the needs of Australian practitioners in developing designs of (stormwater) installations that are water-sensitive. It presents design information under five climate 'bands' ranging from tropical to semi-arid. The Handbook comprises nine chapters:

- **Chapters 1 – 4:** introductory material – basic concepts, descriptions of devices and systems, data on soil types and characteristics, geology, essential theory, strategic planning;

- **Chapter 5:** four design procedures on stormwater quantity control using a *modified* design storm method applied to six different types of devices/installations; seven detailed design illustrations;
- **Chapters 6 and 7:** detailed information on Australian water quality criteria (relating to stormwater); four design procedures based on continuous simulation modelling providing dimensions for pollution control sub-structures and 'filter strip' swales (for pollution control); six detailed design illustrations
- **Chapter 8:** two design procedures based on continuous simulation modelling providing dimensions of storm runoff harvesting installations (rainwater tanks, etc); an exploration of the consequences for minor system flood control of using rainwater tanks.
- **Chapter 9:** Concluding Discussion.

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The Handbook's most important issues and contributions are:

1. 'CONTINUOUS SIMULATION', DESIGN STORM METHOD, DETENTION-RETENTION ISSUES

Australian stormwater management practice has adopted **detention** technology and the 'design storm' method as the main techniques for mitigating floods in urban catchments. These (techniques) have been questioned in recent years by those who advocate 'continuous simulation' modelling as a superior design method, and stormwater **retention** practices as better technology for controlling urban storm drainage.

The Handbook reviews 'continuous simulation' modelling in the context of contemporary stormwater management practice, leading to the introduction of a *modified* design storm procedure to overcome the problem of part-emptying of on-site storages which occurs during successions of closely spaced (in time) storms.

The Handbook proposes that successful urban catchment flood control is achieved by designing for equality of 'before and after' (development) runoff **volumes** from component areas, and not the 'before and after' peak flows of detention practice. 'Continuous simulation' modelling is employed in the Handbook in the domains of pollution control and stormwater harvesting (dimensioning of installations, see below).

2. STORMWATER RETENTION IN EXPANSIVE CLAY SOILS

An issue of great importance in developing urban catchments is that of "clearance distances" which must be provided between in-ground stormwater retention installations and nearby building footings, particularly those associated with domestic structures. The Handbook offers information in this connection on four soil classes – sand, sandy clay, medium clay and heavy clay: "clearance distance" for the latter – the most reactive – is 5 m (distance to point where soil 'heave' is barely perceptible).

3. FOUR CATEGORIES OF INSTALLATIONS

The Handbook identifies four classes of installations :

Category 1 : installations whose primary role is in **flood control**;

Category 2 : installations whose primary role is in **pollution control**;

Category 3 : installations whose primary role is in **stormwater harvesting**; and,

Category 4 : installations with multi-objective roles spread fairly evenly across flood control, pollution control, stormwater harvesting and/or amenity.

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4. SOME STRATEGIC DIRECTIONS FOR URBAN STORMWATER MANAGEMENT

The Handbook introduces three retention-based strategies for managing stormwater runoff in developing catchments. The important strategic role of municipal agencies is emphasised.

- **yield-maximum** : all storm runoff available in the catchment is collected and conveyed to a wetland or similar facility where it is cleansed prior to injection into an aquifer as part of an ASR scheme. The potential for flooding in the wetland vicinity must be recognised and steps taken such as use of stormwater detention techniques to ensure acceptable performance;
- **regime-in-balance** : this strategy is implemented by providing, on each development site, a stormwater retention facility with storage capacity equal to the **difference** between the developed site runoff volume and its pre-development equivalent in the (design) Y-years storm of (catchment) critical duration; similarly for re-development sites;
- **yield-minimum** : this strategy is implemented by providing, on each development site, a stormwater retention facility with storage capacity equal to the runoff volume generated on that site in the (design) Y-years storm of (catchment) critical duration; similarly for re-development sites.

5. DESIGN PROCEDURES – ALL CATEGORIES

Procedure 1 : design formulae which enable the plan area required for an infiltration surface to be determined, matched to the 'peak (design) flow' generated in a contributing catchment.

Procedure 2 : design formulae which enable the dimensions of in-ground stormwater retention devices to be determined, matched to the (design) runoff volume generated in a contributing catchment.

Procedure 3 : design formula which enables the dimensions (plan area) of infiltration or 'dry' ponds to be determined, matched to the (design) runoff volumes generated in contributing catchments.

Procedure 4 : a three-step process which is a continuation of Procedures 2 and 3, above, to be applied in cases where a design fails to meet a required emptying time criterion.

Procedures 5 & 6 : a multi-step process (Procedure 5) using graphs based on 'continuous simulation' modelling which enables the dimensions of in-ground "soakaway" reservoirs storing cleansed stormwater runoff to be determined. A multi-step continuation is applied in cases where a Procedure 5 design fails to meet a required emptying time criterion.

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Procedures 7 & 8 : a multi-step process (Procedure 7) using graphs based on 'continuous simulation' modelling which enables the dimensions of 'filter strip' swales to be determined. A multi-step continuation is applied in cases where a Procedure 7 design fails to meet a required emptying time criterion.

Procedure 9 & 10 : Two multi-step procedures (one graphical) using 'continuous simulation' modelling to determine rainwater tank capacities for domestic or industrial roof catchments yielding related water demands.

6. ILLUSTRATIVE EXAMPLES AND TUTORIAL PROBLEMS

Each of the three main category areas – quantity control, pollution control and harvesting – is followed by a generous set of 'worked examples'. The examples are, for the most part, based on existing, successful projects. Appendix F contains a set of tutorial problems suitable for students or for learning by novice practitioners.

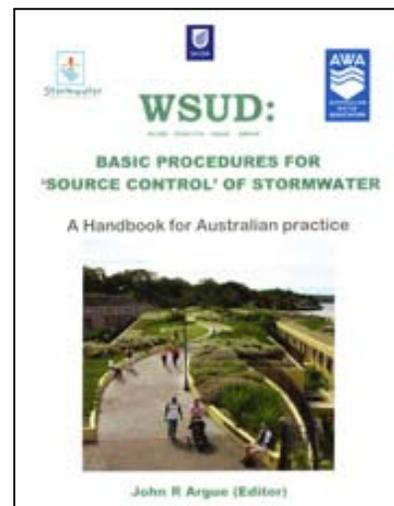
CONCLUSION

The Handbook has been developed for use by Australian practitioners and is intended to fill the perceived 'gap' which exists between the many excellent guideline documents presently available and the realisation of their guidance in dimensioned installations. The important strategic role of local government agencies is emphasised. The Handbook includes illustrative examples and

case studies covering the five climate zones into which Australia may be divided. The design procedures are presented, in the main, in 'step-by-step' format. It is hoped that use of the document will lead to deeper penetration of sustainable stormwater management practices across the nation.

How to Purchase the Handbook:

The cost of the Handbook is Aus \$ 165.00, which in mid January 2005 was equal to about US \$127, Can \$154 or Euro €97.



The Handbook can be obtained from Diane Wiesner at the Australian Water Association Bookshop at

AWA Bookshop
PO Box 388
Artarmon NSW 1570, Australia
Telephone +61 (02) 9413 1288
E-mail: bookshop@awa.asn.au

or from the Urban Water Resources Centre at the University of South Australia by contacting Ms. Carolyn Bellamy at carolyn.bellamy@unisa.edu.au