CATCHMENT SCALE MODELLING OF WATER QUALITY AND QUANTITY

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December 2002

A thesis submitted for the degree of Doctor of Philosophy of

The Australian National University

This thesis is my own work. Some of the work presented in Chapter 4 has been published in Newham *et al.* (2000) and Croke *et al.* (2001b). Parts of Chapter 5 have been published in Croke *et al.* (2000) and Newham *et al.* (2001b). The research presented in Chapter 6 is based on the publication of Newham *et al.* (2001c). Part of the research presented in Chapter 8 has been published in Croke *et al.* (2002). The contributions made by the various co-authors are indicated in the text.

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Acknowledgments

I am sincerely grateful for the assistance provided by all members of my supervisory panel. The panel consisted of Professor Anthony Jakeman (Chair), Dr Barry Croke, Dr Ian Prosser, Professor John Norton and Professor Bob Wasson. I am particularly grateful to Barry Croke who provided me with much valued technical assistance, always showing considerable patience. I would also like to acknowledge the excellent guidance, encouragement and advice provided by Professor Anthony Jakeman.

I was fortunate to have assistance and guidance from several other advisers who were particularly helpful early in the project. They include Dr Mark Littleboy, Greg Keen, Bill Watson and Chris Buller. Andrew Hughes also assisted greatly with application of the SedNet model.

This research was supported by an ARC Linkage Grant. I am most grateful for the support of both the industry partners - New South Wales Department of Land and Water Conservation and Environment ACT.

I would like to thank the staff and students of the Centre for Resource and Environmental Studies and the Integrated Catchment Assessment and Management Centre for their assistance over the course of the project. In particular I would like to thank fellow students Rebecca Letcher, Wendy Merritt and Juliet Gilmour and staff members Susan Kelo and Susan Cuddy whom assisted greatly by providing much valued guidance and encouragement.

Finally, I would like to acknowledge the boundless support of Jenny and my family.

Abstract

Appropriately constructed pollutant export models can help set management priorities for catchments, identify critical pollutant source areas, and are important tools for developing and evaluating economically viable ways of minimising surface water pollution.

This thesis presents a comparison, an evaluation and an integration of models for predicting the export of environmental pollutants, in particular sediment, through river systems. A review of the capabilities and limitations of current water quality modelling approaches is made. Several water quality and quantity modelling approaches are applied and evaluated in the catchment of the upper Murrumbidgee River.

The IHACRES rainfall-runoff model and a simple hydrologic routing model are applied with the aim of developing a capacity to predict streamflow at various catchment scales and to enable integration with other pollutant load estimation techniques. Methods for calculating pollutant loads from observed pollutant concentration and modelled streamflow data are also investigated. Sediment export is estimated using these methods over a 10-year period for two case study subcatchments. Approaches for water quality sampling are discussed and a novel monitoring program using rising stage siphon samplers is presented.

Results from a refinement of the Sediment River Network model in the upper Murrumbidgee catchment (SedNet-UM) are presented. The model provides a capacity to quantify sediment source, transport and to simulate the effects of management change in the catchment. The investigation of the model includes rigorous examination of the behaviour of the model through sensitivity assessment and comparison with other sediment modelling studies. The major conclusion reached through sensitivity assessment was that the outputs of the model are most sensitive to perturbation of the hydrologic parameters of the model.

The SedNet-UM application demonstrates that it is possible to construct stream pollutant models that assist in prioritising management across catchment scales. It can be concluded that SedNet and similar variants have much potential to address common resource management issues requiring the identification of the source, propagation and fate of environmental pollutants. In addition, incorporating the strengths of a conceptual rainfall-runoff model and the semi-distributed SedNet model has been identified as very useful for the future prediction of environmental pollutant export.

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