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Using multiple lines of evidence to guide the management of catchment water quality

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Abstract: Natural resource management (NRM) actions need to be implemented in the most appropriate locations to be cost effective and efficient. To adequately target water quality investment we need to understand 'how catchments work' with respect to sediment and nutrient delivery into rivers. Which nutrients or sediments contribute to water quality problems? What is their origin? Where in the catchment are their source areas? Along which hydrological pathways are the materials transported to the waterways? And when? Effectively this requires a spatial catchment 'diagnosis'.

The impacts of NRM actions also need to be assessed. Government seeks to be able to determine the extent to which outputs (e.g. meters of fence line installed or hectares of riparian zones or wetlands) contribute to outcomes such as improved river health. The spatial catchment diagnosis can inform efficient monitoring programs. For example, if the catchment diagnosis suggests that ammonium from fertiliser application moves via surface runoff into waterways then one should measure ammonium (not just total N) to identify the result of specific fertiliser management interventions.

Although catchment management is increasingly based on catchment science, the catchment diagnosis and management strategies often rely on only a subset of potentially available information. In this paper we show that each type of monitoring information or analysis has different value and some types complement or are dependent on others. No single type of information or analysis is adequate on its own; hence multiple lines of evidence are required to develop an adequate catchment diagnosis that can inform both management and monitoring design.

We draw on work in progress[1] that applies the concept of multiple lines of evidence to determine key sources and flow paths of nutrients in the Duck River catchment in North-Western Tasmania. The relative value of several lines of evidence are evaluated: (a) new high temporal frequency (5 min to hourly time scale) water quality measurement which yields detailed patterns of stream nutrient dynamics; (b) longitudinal stream sampling (sampling along the length of the river and its tributaries); (c) a spatial, index-based approach of assessing critical source areas (source areas with connectivity to the stream) using readily available GIS data layers and terrain analysis; (d) targeted, spatial modelling analyses; and (e) isotope analyses to provide information about the origin of nutrients. Spatial conceptual modelling is used as a precursor, and then to bring together the different lines of evidence (spatial and temporal) into a catchment diagnosis.

The research experience in the Duck River catchment is used to develop 'Guidelines for spatial catchment diagnosis and design of supporting water quality monitoring'. To ensure these are fit-for-purpose, catchment management organisations are involved with their development. The guidelines are organised to reflect a multiple lines of evidence approach, addressing for example: nutrient species, origin, source area, pathway and/or timing. The guidelines identify the strengths and weaknesses of different methods, as well as powerful combinations, and provide methods to reflect the catchment diagnosis in simple, spatial conceptual models. It is anticipated that this will support catchment management organisations in making sound evidence-based investment decisions and demonstrating the environmental outcomes from NRM actions.

Keywords: *catchment management, high frequency monitoring, critical source area, spatial conceptual model, weight-of-evidence, nutrients, sediments*

Abstract only

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[1] Project 5 within Landscape Logic, a research hub under the Commonwealth Environmental Research Facilities scheme, managed by the Department of Environment, Water, Heritage and the Arts. http://www.landscapelogic.org.au/