Robust and sensitive indicators of groundwater health and biodiversity

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Certificate of Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

Investigations into eastern Australian groundwater ecology significantly lag those of Europe, USA and other regions of Australia. Despite this, this region has potential to contain significant biodiversity. This thesis provides the first ecological study within the semi-arid region of northwest New South Wales (NW NSW), Australia. The study region lies within the Murray Darling Basin, the most significant inland water source in Australia. This catchment is facing increased pressure from not only agricultural and potable usage, but also from mineral and coal seam gas explorations. The primary aim of this thesis was to identify biological indicators of groundwater ecosystem health to enable the monitoring of these ecosystems as required by Federal and State legislation and policy.

This thesis confirms speculation that significant biodiversity is present in aquifers of eastern Australia. The two adjacent aquifers studied, (i.e. the Gwydir and Namoi River shallow alluvial aquifers), have significant biodiversity with 21 and 14 taxa inhabiting these aquifers respectively. The poor taxonomic knowledge of stygofauna within the region, coupled with the potential for cryptic species may uncover a greater diversity.

The relationship between the stygofauna and microbial distribution, environmental variables and human influences was investigated. Biota within the adjacent aquifers was found to respond to similar environmental variables with stygofauna distribution most greatly influenced by habitat and site attributes, and microbes responding greatest to climate and water quality attributes. Impacts of irrigation activities were evident on biotic communities in both catchments. Distinct differences in groundwater biotic communities between catchments were noted, whilst the ecosystems retained similar functional assemblages of biota. It is speculated that this was the result of evolutionary processes.

Finally, this thesis synthesizes the above findings with generic knowledge of groundwater ecosystems to provide a multimetric tiered framework to assess groundwater health based on land use. The framework provides a range of assessment techniques at two levels of assessment, allowing a coarse and inexpensive assessment

based on worldwide generic indicators of health (Tier 1), and a more detailed assessment based on locally set benchmarks (Tier 2). The assessment methods have proven to be robust, allowing adjacent catchments with similar environmental and geological history to be assessed utilising one set of benchmarks, and may be applicable in other regions of Australia and indeed globally. Ultimately it is hoped that the framework will enable land and water managers to assess groundwater health and be incorporated into an integrated surface and groundwater monitoring program.

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