From catchment to consumer: safeguarding potable water supply through understanding contamination risks in source water catchments.

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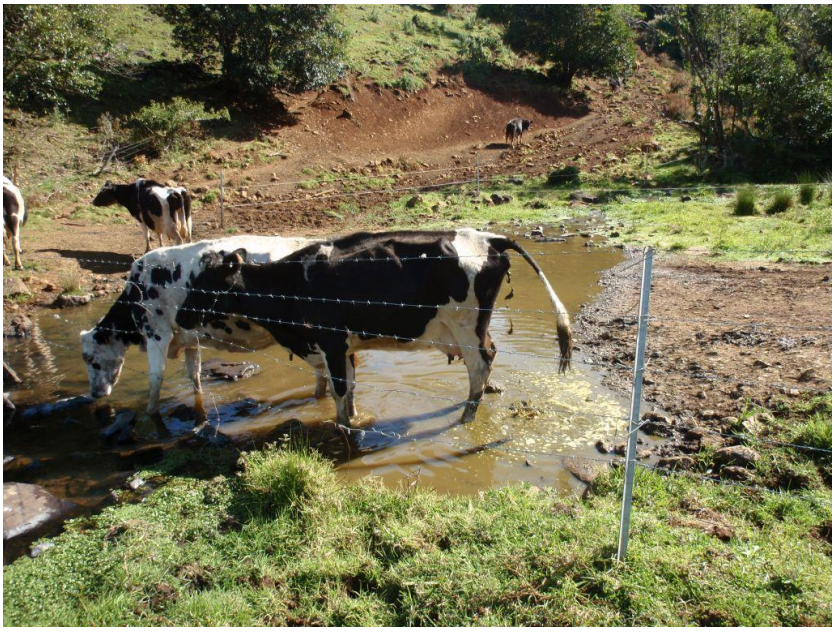

A dissertation submitted for the degree of master of resource science of the University of New England.

March 2015

Declaration

I certify that the substance of this dissertation has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this dissertation and all sources used have been acknowledged in this dissertation.

Signature

Acknowledgements

I am very grateful to many people and organisations for their help and support throughout my postgraduate journey.

Firstly, I thank my supervisors Darren Ryder and Karl Vernes for all their time, patience encouragement, and mentorship. It is difficult to imagine me completing this dissertation without the support, flexibility, insight, brainpower and coffee provided by Darren. I am also very thankful for the support, encouragement, time and sanity-checks given by Andrew Watkinson – in many ways Andrew has been an unofficial academic supervisor.

This work would not have been possible without the strong support and practical assistance given by Kate Smolders and Rob Rolls, both of whom tirelessly and selflessly helped kick ideas around, improve drafts, run stats and listened to me whinge. Mark Amos from the Lake Baroon Catchment Care Group was instrumental in setting up the stream crossing project, and provided valuable knowledge and assistance in the field. I am also grateful to Sean Kadel, Tim Odgers and Mark Mackenzie who gave their expert opinions to the research, help with data provided and valuable assistance with field work without (much) complaint.

Thank you to The Kopyrite Liberation Front and dandelion tea for getting me through the last late-night leg of the journey.

Finally, huge thanks to my wonderful family for their patience and support. Dear Nick, Sandi, Morgan, Zarah and Vanessa - I couldn't have done this without you all!

Abstract

The Australian Drinking Water Guidelines (ADWG) Framework for the Management of Drinking Water Quality (NHMRC, NRMMC 2011) promotes a structured and systematic preventative management approach to assure safety of drinking water at point of supply. Central to the ADWG Framework are 12 Elements considered good practice by which to manage drinking water supply from catchment to tap. Application of key ADWG Elements to the treatment and distribution components of a water supply system tends to be relatively straightforward, but less so to the source water catchments and raw water reservoirs components. This can lead to a breakdown in the integrated approach for managing water contamination risks across all stages of water supply. Accordingly, the leading aim of this study was to practically demonstrate how Element 2 (*Assessment of the drinking water supply system*) of the ADWG framework can be applied to a source water catchment to improve recognition and knowledge of water quality at this key juncture in the water supply system. The second aim was to demonstrate how investigative studies and research monitoring, as per Element 9 (*Research and development*) of the ADWG, can be applied to fill gaps in knowledge and enable the level of risk to raw water quality to be better quantified. The third aim was to employ Element 9 to quantify improvements to source water quality achieved by applying an in-catchment intervention designed to mitigate a source of contamination, and assess the effectiveness of the intervention as barrier against microbial hazards. The outcome of applying the principles of Element 2 to a demonstration source water catchment shows that the catchment contains many water quality hazards, pathogenic bacteria, protozoa and viruses pose a high to extreme risk to water quality, there is a high level of uncertainty around the risk ratings for certain water quality hazards and hazardous processes, and there is a lack of clarity regarding the effectiveness of in-catchment preventative measures to mitigate livestock-derived microbial pollution. The application of Element 9 principles enables the

level of risk posed by little black cormorants (*Phalocrocorax sulcirostris*) roosting on dam intake structures to be more fully quantified, showing no significant relationship between cormorant numbers and water column concentrations of *Escherichia coli* (*E. coli*), highlighting that inputs from across the broader catchment dominated microbial pollution and inputs compared with inputs from roosting cormorants. The application of Element 9 to quantify the effectiveness of in-catchment preventative measures to mitigate livestock-derived microbial pollution shows that while the installation of a stream bridging structure in a source water catchment was effective in reducing cattle-derived point source pollution, cattle-derived diffuse source pollution is not ameliorated by this intervention alone. This thesis re-emphasises the authentic links between the condition of the catchment and the condition of drinking water, and clearly demonstrates how key Elements of the ADWG Framework can be applied as a structured, systematic and adaptive approach to managing water quality across the supply system.

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