Healthy Rivers, Healthy Communities

Presenting current research in the Goulburn Broken Catchment

Protocols for the optimal measurement and estimation of nutrient loads in the Goulburn-Broken Catchment

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Abstract:

A difficulty that has been encountered in the Goulburn-Broken region and elsewhere in Australia is the inconsistency in sampling and estimation methodologies. Without some numerical measure of uncertainty, it is impossible to rigorously evaluate the success of nutrient reduction strategies for sediment and nutrient loads. Total nutrient loads are important determinants of water quality. Accordingly, many measures of environmental improvement and many aspirational objectives are now couched in terms of nutrient load reduction. In the Goulburn-Broken catchment, load targets are a critical component of the Water Quality Strategy and yet the errors and uncertainties have not been quantified. This project is studying the effectiveness of various sampling strategies for estimating nutrient loads, and additionally is developing a new, robust protocol for calculating loads and associated uncertainty measures.

Key Findings:

- Traditional nutrient load estimation techniques have been shown to exhibit bias since typically, high flow events (which contribute relatively large proportions of nutrient loads) are underrepresented in many sampling schemes. This finding enables two innovations in load estimation: to improve the precision of load estimates over time by applying bias correction factors and the application of probabilistic sampling techniques to reduce the bias and potentially improve precision of future load estimates (Fox, 2004). This research has demonstrated that the flow behaviour of irrigation drains in Shepparton can be accurately represented as a mixture of three log-normal distributions which enables the calculation of an appropriate bias correction factor based on similar findings in other Victorian Irrigation Districts. These findings can also be used to give an estimate of the magnitude of uncertainty in traditional load estimation techniques.

Implications:

- A defensible basis on which to assess the attainment of nutrient reduction targets including quantification of current levels of uncertainty
- Maximise effectiveness of water quality data through increased awareness of the role proper statistical design and analysis plays in the determination of load estimates
- Better understanding of the performance characteristics of various sampling techniques to estimate sediment and nutrient loads
- Understanding the utility of different sampling protocols

Summary:

- This project is characterising important statistical attributes of bias and precision for a range of common load estimation techniques using Monte Carlo simulation, analytical, and in-situ methods
- This project is investigating new size-biased sampling strategies that have the potential to reduce current monitoring levels while producing load estimates of acceptable precision

Further Reading:

- Fox, D. (2003). "Analysis of Southern Rural Water's Drain Monitoring Data." 01/03, Centre for Environmnetal Applied Hydrology. The University of Melbourne, CSIRO, Melbourne University Private Limited, Melbourne.
- Fox, D. (2004). "Statistical considerations for the modelling and analysis of flows and loads: Draft." Australian Centre for Environmetrics, The University of Melbourne, CSIRO, Melbourne University Private Limited, Melbourne.
- Sinclair Knight Merz. (2003). "Nutrients in irrigation drains in the Shepparton irrigation region." C806 A&B Shepparton Drain Nutrients, Goulburn-Murray Water, Tatura, Vic.