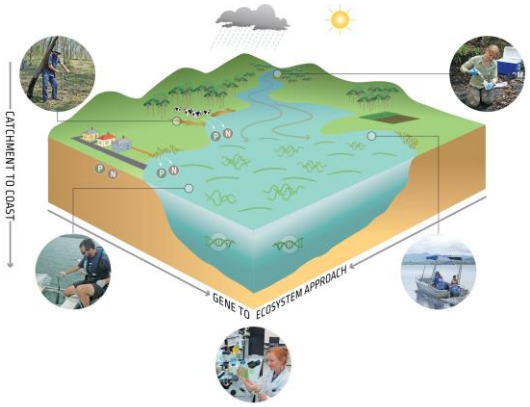
How do we manage water quality risks to our drinking water supplies?



Project team

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Timeframe

2003-2017

Project description

Poor water quality impacts on humans and the environment. It is a growing concern as the world's population puts more pressure on water resources. In Australia, poor water quality results in higher treatment costs for drinking water, reduced access to waterways for recreational activities, loss of visual amenity and impacts on the plants and animals that live in our aquatic systems.

One of the key water quality issues is harmful algal blooms, and in Australian freshwaters this is principally cyanobacteria, also known as blue-green algae. A number of the bloom forming species are toxic and in water supplies this requires constant monitoring and sufficient water treatment processes to keep toxins at safe levels.

Reducing the scale and frequency of algal blooms requires an understanding of the causes and the impacts. Our research has focussed on unravelling the cause-effect relationships for algal blooms and other water quality issues that are a risk to our water supplies.

Outcomes

One of the key water quality issues in reservoirs is blooms of toxic cyanobacteria, with the species *Cylindrospermopsis raciborskii* being one of the most prevalent. Historically, water authorities monitor the number of *C. raciborskii* cells in reservoirs as a trigger for concern, after which they start measuring levels of the toxin, cylindrospermopsin. This is important to ensure that treatment procedures are adequate and recreational use of water is controlled. However we now know that an important driver of toxin levels is strain dominance, i.e. the proportion of strains producing higher or lower toxin levels. Our findings have been incorporated into Seqwater's Cyanobacterial Management Plan (toxin alert level framework). They have also used to revise the monitoring program at Seqwater (southeast Queensland water authority). Monitoring is now based on toxin analysis during periods of risk, rather than cell counts. This has substantially reduced the costs of monitoring and analysis. It has also meant less recreational closure time for reservoirs.

Our work has also shown that the nutrients, nitrogen and phosphorus, need to be managed in catchments in order to reduce algal blooms. However, there is evidence that phosphorus is the nutrient that stimulates toxin production by shifting the *C. raciborskii* population to more toxic strains, meaning that phosphorus management is particularly important. Our studies provide key information quantifying nitrogen and phosphorus impacts on algal growth. This provides critical information to inform models of the effect of changing nutrient loads from catchments. The information was used to inform baseline trends in raw water quality potential from three of Seqwater's major surface water supply storages (Wivenhoe, Samsonvale and Advancetown) over the next 30 years. Additionally the information was used to determine likely algal responses if purified recycled water were added into Wivenhoe reservoir in the future.

Both reservoir and catchment characteristics contribute to poor water quality in reservoirs. Analyses have revealed which factors are most critical and these were used to develop a vulnerability index that ranks the vulnerability of the Seqwater's reservoirs to algal blooms. Wivenhoe reservoir, the most important water supply in southeast Queensland, was ranked most vulnerable to algal bloom measures.

A predictive model of total nitrogen, phosphorus and suspended solids concentrations in Wivenhoe and Somerset reservoirs has been developed. It shows that the bulk of phosphorus, nitrogen and sediment loads are delivered to the reservoirs during large inflow events, and that monitoring in reservoirs should be focussed around rainfall events. During periods of low inflow, regular monitoring could be reduced as there is little variation in concentrations. This information has been used for reviews of the source water monitoring program.

Destratification is a commonly used strategy to control algal blooms by forcing mixing of cells deeper into the water column, reducing light availability. However, the destratification unit in Samsonvale reservoir was ineffective at controlling blooms of *C. raciborskii*. Our studies have demonstrated that this is because *C. raciborskii* has a lower light requirement than other well studied cyanobacterial species, deeper mixing is actually beneficial. Therefore the recommended management action was to turn off the destratification unit at North Pine for algal management however it is still used to assist with manganese levels, another water quality issue.

Water levels in reservoirs are affected by water use as well as drought and rainfall events. Our work has shown the critical nature of managing water levels to ensure good water quality. In particular our work has shown how aquatic plants can reduce algal blooms, but on the flipside when they die due to water level drops, they negatively impact on water quality.

Funding

ARC Linkage, Seqwater, Sydney Catchment Authority, Melbourne Water.

Partners

University of New South Wales, University of Melbourne, University of Waikato, Monash University, University of Newcastle

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Publications

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