Project Description

		Provide Comments
Title	**Characterising the drivers of cyanotoxin production to embed into a Cyanobacteria risk management framework**	
Project Type	☐State-of-knowledge ☐Problem Definition ☒Knowledge Generation ☒Knowledge Transfer ☐ Knowledge Adoption ☐Benefit Realisation	
Problem	Several cyanobacteria species are well known for their potential to produce cyanotoxins. However, not all genotypes of known toxin producing species produce cyanotoxins and of these there is significant variation in the spatial and temporal dynamics of toxin production. The water industry currently relies of observational measurement of the presence of 'potentially toxic species', toxin gene and toxin presence to inform management of cyanobacteria blooms in water supply storages. Predictive tools and preventative management are limited by a lack of simple environmental predictors to predict toxin production events. Understanding the drivers for toxin production that inform risk management frameworks would be of great benefit to water supply managers and to inform alternate management options. These tools would enable better responses to bloom events and allowing for the establishment of pre-emptive measures to minimize cyanotoxin production by targeted manipulation of environmental drivers.	
Background/ Description:	There are many potential environmental and ecological drivers (e.g. predation, competition, nutrient ratios, osmotic stress, water temperature) that, solely or via complex interactions, lead to toxin production. There may even be some treatment processes that initiate toxin production. Due to the complexity of factors that may contribute to toxin production, a combination of controlled laboratory experiments and field studies that couple cyanobacteria metabolism information with current water quality monitoring data, microbial signal measurements and environmental physiochemical parameters is needed. This detailed "systems biology" approach will provide an avenue for establishing the environmental covariates that are linked to toxin production. The systems biology approach will provide water supply managers the information needed to identify and pre-empt adverse bloom events from occurring.	

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Objectives:	Identify key cyanobacteria metabolic functions (i.e. organism specific biochemical metabolism events/expressed pathways) and environmental covariates that identify when toxin production is 'switched on' in cyanobacteria species and strains that are known toxin producers and quantify their environmental drivers to improve decision frameworks.	
Scope/ Deliverables:	1. Review the literature to identify current knowledge and information gaps about: a. Genetic factors that may influence toxin production in cyanobacteria, such as regulatory genes, promotor sequences and toxin gene sequences. b. the known toxin producing species and strains and prioritise those that are significant in the water supplies of project partners. c. the likely drivers for toxin production. 2. Design and undertake experiments to investigate the potential drivers for toxin production under laboratory conditions using multi-omics based approaches (i.e., measuring genes, proteins, lipids and metabolites) coupled with real time bioenergetics (measuring organism glycolysis and respiration) under a range of pseudo environmental conditions that establish biochemical metabolic toxin-production pathways. 3. Conduct field research to test laboratory-based hypothesis in-situ and establish covariates for toxin production within a project partner water supply catchment (i.e., an exemplar case study that links current monitoring data, hydraulic/hydrodynamic models, and biochemical metabolic toxin pathway data). 4. Construct a short term, operationally relevant cyanobacteria toxic bloom forecasting tool for potential adoption by project partners that includes utility tacit knowledge (captured via an industry workshop with CSIRO). 5. Report on the outcomes of the literature review and experimental investigations. This will be delivered via a project research report and a knowledge transfer workshop.	

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Benefits	1. Provide a better understanding of the environmental covariates that trigger toxin production. 2. Enhance risk management frameworks. 3. Guide both source and treatment operational responses to the presence of known toxin producing cyanobacteria. 4. Identify potential alternative monitoring technology based on detecting biochemical lead signals of toxin production. 5. Potential to modify or manage source environmental conditions to prevent toxin production.	
Investigative or Research approach	Research approach to be used: Tailored collaboration with the CSIRO	
Indicative Funding required:	☐Small (<$100k) ☒Medium ($100-$500k) ☐Large (>$500k) • Seeking $25k/yr for 3 years from minimum 6 utilities; CSIRO to provide a co-investment contribution.	
Duration/Start	☐Short (<6 months) ☐Medium (6-18 months) ☒Long (>18 months) **Start:** 01/2022	

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