

PART B - SERVICES REQUIREMENTS

B1. TECHNICAL SPECIFICATIONS

Background

The Board of the SCA has commissioned the Science and Research unit of the SCA to develop and deliver the Warragamba Blue Green Algal Research Plan (WBGARP) from early 2007 for up to four years. A draft research plan has been developed and incorporated into the SCA's Warragamba Blue Green Algal Action Plan (WBGAAP). The Action Plan also incorporates operational responses to manage the drinking water catchment and the bulk water supply to minimise the risk to public health and adverse aesthetic impacts from cyanobacterial growth in Sydney's drinking water supply. It is anticipated that the Action Plan will be presented to Premier and Cabinet in April 2008.

It is currently expected that the Research Plan and the Action Plan will continue to approximately June 2012, subject to six monthly reviews.

The SCA Board has requested that the plan be developed as a series of staged deliverables with regular peer and Board review with identified Go – No Go decision points based on progress against desired outcomes.

The SCA is seeking a Project Manager for the SCA's WBGARP. In the first instance the SCA would like a project manager on a full-time basis or as near to full-time as possible for one year. Should the submitted list of costs for the position to be filled full-time exceed the SCA's budget for the position, it will be negotiated as part-time, with a minimum of three days per week.

Reporting lines

The WBGARP Project Manager will report to the SCA's Manager of Science and Research.

Description of services

The Project Manager will initially consult with the SCA Science Manager and SCA Action Plan Manager and other relevant staff to understand the Research Plan and its interactions with the Action Plan.

The Project Manager will become familiar with the elements of the research plan that are of high immediate priority and assist the Science Manager to ensure their timely delivery to the SCA Board and thence to Premier and Cabinet. The short term deliverables of the plan include an initial review of the water quality and algal changes on Lake Burragorang from July 2007 to the present, an assessment of the likely causes of the bloom, an assessment of the likelihood of a recurrence of the bloom and advice on appropriate monitoring for early warning of the recurrence of a large bloom.

The Project Manager will develop the research deliverables in consultation with senior SCA Science staff and the SCA Action Plan Manager and develop individual research projects and strategies to deliver the required outcomes in a timely fashion based on robust, internationally defensible science.

The Project Manager will be responsible for leading the development of the Research Plan into a series of staged projects using Australian and, where necessary, international research and review expertise to deliver the medium term

outcomes required by the Research Plan. Opportunities to leverage funds from external sources such as the Australian Research Council grants should be explored.

The Project Manager will be responsible for the ongoing delivery of the Research plan on time, to budget and specifications.

The progress of the delivery of the Research Plan will be reviewed every six months by the SCA's Board with advice from the SCA's Manager of Science and Research and the SCA Executive. The Research Plan Project Manager's position will be reviewed six monthly but can be terminated by the Board at any time for failure to deliver on key agreed outcomes. The position will require annual Board approval for renewal.

Essential criteria

1. Record of delivery of the development of and delivery of major research projects with a preference for projects in blue green algae (cyanobacteria) or closely related fields of research.
2. Proven record in the management of teams of scientists for delivery of major research projects.
3. Access to a network of expertise in cyanobacteria to facilitate the delivery of high quality, peer reviewed reports, presentations and scientific papers on the research deliverables of the Research Plan.
4. Ability to synthesise and present reports to the SCA Executive and Board and key stakeholders with assistance from SCA senior Science staff.

Ability to be based at the SCA Head Office at Penrith a minimum of three days per week to facilitate the delivery of the outcomes of the Research Plan.

ADDITIONAL INFORMATION

WARRAGAMBA DAM BLUE GREEN ALGAE MANAGEMENT

ALGAE ACTION PLAN

The SCA and Sydney Water, with technical review by the Department of Water and Energy (DWE), will bring forward the *Warragamba Dam Blue Green Algae Action Plan* to the Premier. It addresses how future blue green algal blooms may be avoided, reduced and/or managed. The plan will include the following areas.

Current investigations

Sydney Water and SCA routinely review their “catchment-to-tap” risk assessment, which seeks to identify and rank the risk to the quantity, quality and continuity of the water supply. As a priority, they have brought forward the review to November 2007 to assess the risks in light of the current incident.

The SCA has acquired a field probe to obtain immediate algal measurements at various depths and locations in Warragamba Dam to identify the extent of the algal bloom, its concentration at various levels and its behaviour over time. It is also investigating the availability of a field sampling method/technology for toxicity that can provide immediate results in terms of whether the algal bloom is toxic. The SCA is also conducting a review of recent algae and nutrient sample data (including phosphorus and nitrogen) in the upper reaches of Warragamba Dam in order to attempt to clarify the cause of the current bloom and identify the possibility of secondary blooms.

Treatment plant options

Sydney Water has conducted tests on the effectiveness of chlorination processes in filtered water for the degradation of toxins. The tests show that in excess of 92 per cent of toxins are removed; Sydney Water has also conducted tests to enable selection of the best performing type of powdered activated carbon to use at its water filtration plants.

Powdered activated carbon has been installed at Warragamba and Orchard Hills water filtration plants.

Research and investigations

In response to the Warragamba Dam algal bloom, the SCA and Sydney Water have developed science and research programs (Appendix B) to: understand the cause of the current bloom and enhance the prediction of any future potential blooms in Warragamba Dam (and other SCA dams); review catchment and reservoir management approaches in relation to algae; and ensure the drinking water delivered to customers continues to meet the *Australian Drinking Water Guidelines* (2004); and consider future monitoring and analytical requirements. The Plan uses the catchment-to-tap approach of the *Framework for Management of Drinking Water Quality* included in the guidelines.

The program recognises existing SCA and Sydney Water strategic alliances with external research agencies, including the Cooperative Research Centre for Water Quality and Treatment and the American Water Works Association Research Foundation, both of whom have active research programs on algae.

The program includes immediate actions, as well as medium and longer term research, to underpin prediction and management of future blooms and targeted catchment and reservoir management responses. Specific matters for early research include: hydrodynamics of the reservoirs; water chemistry; nutrient loads; climate and temperature effects; rainfall patterns in the catchments; and biodiversity of the Warragamba Dam, including blue green algae species; and development and release of toxins and taste and odour compounds in algae.

Medium and longer term research aims to underpin prediction and management of future algal blooms, including targeted catchment and reservoir management responses. The research program will also examine treatment options for blue green algae, toxins and taste and odour compounds in water treatment plants.

The science program will be subject to review and input from the Department of Water and Energy, in recognition of the synergies with research on algal blooms in other water systems around the state. The program will also be subject to peer review. The SCA's early estimate of the additional cost to it of the science program is \$7 million. Funding for this program has not been sourced, as it is outside the SCA's operational expenditure approved in the SCA's current price determination.

Review and implement revised or new catchment health and reservoir management strategies

To identify actions which will help prevent, reduce or manage any future blooms, the SCA will review its water quality management programs. These programs include strategies under the *Drinking Water Catchments Regional Environmental Plan No. 1* and the SCA's Healthy Catchments Program, including: Accelerated Sewerage Program; Catchment Protection Scheme; Riparian Management Assistance Program; Catchment Protection and Improvement Grants Program; and on-site sewage management grants. The plan also draws on existing strategies and expertise in DWE, the Regional Algal Coordinating Committee, SCA and external experts on algal management.

The plan will establish priority actions to achieve early, medium and long-term improvement, accelerate, amplify or modify existing programs within the SCA and other agencies including Sydney Water, Department of Water and Energy, local government and with land owners. The plan will consider and implement any additional monitoring and analytical requirements. The costs of these additional works cannot be established at this stage.

LONGER TERM ISSUES

Prospect Water Filtration Plant

The need for additions to Prospect water filtration plant to treat algal related compounds is contingent on a better assessment of the longer term risk of algal blooms occurring again in Warragamba dam and their impact on the health of the community. The above science program, as a priority in the first six months, will advise on whether additional treatment processes should be added to Prospect water filtration plant. The ability to supply from variable levels in Warragamba dam and from alternative sources, plus the likely frequency, intensity and type of algae, will be important considerations.

Sydney Water and Australian Water Services have commenced scoping investigation work to determine possible options for supplementary treatment at the plant. This plant has a high design filtration rate and uses coarse sand in its filters. Pilot plant work will be necessary to determine if powdered activated carbon is a practical supplementary process or if other options are required. Some process modifications to the plant may also be necessary if Prospect Reservoir is to be used more frequently as a primary raw water source.

Future alternative water supplies

The completion in 2007 of the SCA's raw water pumping station at Prospect Reservoir increased its capacity to provide a temporary water supply should water from Warragamba Dam be unavailable or unsuitable. Under its 2006 Metropolitan Water Plan, the Government has two actions that will improve future management of such incidents by adding two further alternative water supplies to Warragamba Dam. From 2010, the Kurnell desalination plant can provide up to 250 megalitres per day as an alternative to supplies from the Prospect water filtration plant delivery system. The SCA is completing early investigations into groundwater supplies at Leonay and Wallacia. If accessed, these supplies could be fed into the Orchard Hills water filtration plant.

SCA's Upper Canal

The SCA's Upper Canal is integral to its raw water supply system. The canal is the sole means of transferring water from Nepean, Cordeaux and Cataract dams to the Macarthur (servicing 250,000 people) and Prospect water filtration plants, and also plays a significant role in the transfer of water from the SCA's Shoalhaven Scheme. Constructed over 120 years ago, the canal consists of 64 kilometres of weirs, tunnels, aqueducts and open sandstone canals transferring up to 600 megalitres of water per day and supplying some twenty per cent of Sydney's drinking water.

As a consequence of its age and other compounding factors, such as adjacent land use changes and mining impacts, the canal poses constraints and risks. The quality of water transferred in the canal is affected by the catchments draining into it downstream of the Upper Nepean dams. The canal's open sections are also vulnerable to stormwater runoff, giving rise to increased turbidity, organics and pathogens in the raw water.

The SCA has started detailed early investigations into replacing the Upper Canal, which would increase the capability of the Upper Nepean dams and the Shoalhaven System to provide an alternate water supply to Prospect water filtration plant. The SCA will report to Government on the outcomes of its investigations in mid 2008.

SYDNEY CATCHMENT AUTHORITY AND SYDNEY WATER
INTEGRATED SCIENCE ACTION PLAN: KEY RESEARCH AREAS

Scientific research efforts will focus on the following areas:

Understanding the current algal bloom

Elucidating the causes will define the key water quality parameters that need to be monitored in future.

- What were the key causes of the Warragamba bloom of 2007?
- How long will it last, based on the assessment of its cause? What conditions would lead to a similar bloom?
- Can the bloom be fingerprinted to identify potential sites of seeding or inoculum, for example, the upper reaches and sediments of Warragamba Dam?

Enhanced prediction of bloom events

Understanding the likely behaviour of blooms informs short-term operational responses. Understanding reservoir ecology will allow the medium- to long-term prediction of the return of blooms, as well as their potential to become significantly toxic or generate substantial amounts of taste and odour compounds. Improving computer models will allow scenario testing in advance of bloom development.

- What could cause other blooms in Warragamba Dam?
- What will make a bloom die off?
- What could make a bloom produce significant amount of toxins?
- What could make a bloom cause significant taste and odour problems in the water supply?
- Could existing hydrodynamic – ecological computer models have predicted the 2007 bloom?

Management of catchments and reservoirs

- What are the major sources of blue green algae seeding populations for blooms: farm dams or upstream shallows or lake sediments?
- How important are nutrient loads and what are the major types and sources of nutrients that cause a population to bloom?
- Do inter-basin water transfers influence the potential for blooms or bloom characteristics?
- How important is natural biodegradation and natural predators such as zooplankton in maintaining the biological balance, the breaking down of cells, toxins and taste and odour compounds in catchments and reservoirs.
- What are suitable options for in-reservoir treatment to either prevent or control bloom (e.g., destratification, algaecides or others).

Water treatment

- What range of options is available and appropriate for water treatment plants, for treatment of algae, toxins and taste and odour compounds?

Monitoring & analysis

- What data are needed for early warnings of blooms and their management?
- What is the optimal design of a sampling program in terms of spatial and temporal coverage and analytes?
- What measurements can be made in the field or remotely, and are improved laboratory techniques required?

A: Characterise and investigate the cause of 2007 bloom (lead agency – Sydney Catchment Authority)						
Research outcome	Management outcome	Research activity	Term	Duration	2007/10	2007/10
Improved understanding of the physical-chemical, biological and nutrient conditions that led to cyanobacteria bloom in Lake Burragorang 2007	Knowledge to inform the management, prediction and amelioration of potential future blooms	a. Collect and store appropriate water, <i>Cyanobacteria</i> and sediment samples from the current bloom for investigative analysis; review current testing methods and sites and hydrometric monitoring (see D) (Contractors required)	Immediate	Current - Jul08	50	0.5
		b. Detailed examination of SCA's water quality database for relevant locations for last 3 years. Determine trends and changes in nutrients and other parameters to assess their influences on cyanobacterial dynamics (Consultancy and agency hire involved)	Short	Apr08 - Dec08	200	1.0
		c. Literature review and lab analysis to characterise the microbial community and their interactions in Warragamba reservoir and inflow streams, including identification of potential cyanobacterial sources that may have inoculated the bloom as well as natural predators of bloom species (supplementary short-term external resources required).	Short	Jun08 - Dec08	200	0.4
		d. Preliminary analysis to investigate the influence of Shoalhaven transfers on nutrient balance and subsequent bloom development	Immediate	Dec07 - Jun08	55	0.3

B: Enhanced prediction of bloom behaviour (lead agency – Sydney Catchment Authority)

Research outcome	Management outcome	Research activity	Term	Duration	'000 2007/10	FTE 2007/10
I. Enhanced understanding of the dynamics of blooms in SCA's reservoirs and the reasons for bloom die-off	Early warning and prediction of bloom type and potential to release toxic or T&O compounds for forward planning (catchment, reservoir and water treatment plants)	1. Preliminary study of sediment, nutrient and cyanobacterial content in Lake Burragorang. Collate and review data on all previous algal events in SCA storages and compare with the 2007 bloom	Short	Apr08 - Mar09	100	0.5
		2. Study impact of combinations of nutrient, light and temperature on cyanobacteria as well as the relative role of stratification and major inflow events	Long	Apr08 - Dec10	250	0.8
		3. Investigate and trial remote sensing/GIS tools to map cyanobacterial micro-organism within lakes	Medium	Apr08 - Mar10	150	0.6
II. Understanding the potential for blooms to become toxic and / or produce T&O compounds		4a. Literature review to investigate the changes in dominant cyanobacteria species and their behaviour; describe the impacts of changes in nutrient levels and other environmental factors (light, wind, other biota, etc) on species domination. Identify key knowledge gaps to enable scoping of a future research project.	Medium	Apr08 - Dec08	340	0.2
		4b. Investigate gene exchange and development of toxic species. Study toxin and T&O compound production in source waters: Preliminary literature review (July 08) to inform planning of scope of research to begin in 08/09	Medium	Jan08 - Mar10	340	0.6

B: Enhanced prediction of bloom behaviour (lead agency – Sydney Catchment Authority) – contd.

Research outcome	Management outcome	Research activity	Term	Duration	'000 2007/10	FTE 2007/10
II. Understanding the potential for blooms to become toxic and / or produce T&O compounds	Early warning and prediction of bloom type and potential to release toxic or T&O compounds for forward planning (catchment, reservoir and water treatment plants)	4c. Identify degraders of toxins and T&O compounds in reservoirs, and the degradation kinetics (literature review and laboratory investigations) to inform the scoping of a longer term research project.	Immediate	Dec07 - Dec10	100	0.4
		5. Undertake genetic studies on cyanobacteria and toxins from streams, reservoir and lake sediment samples	Long	Jun08 - Dec10	350	1.0
		6. Literature review and field data to enhance knowledge on T&O causing algae and bacteria to inform the scoping of a long-term research project that includes a lake survey of T&O causing microorganisms.	Medium	Apr08 - Dec08	50	0.4
		7. Literature review on the effectiveness of physical, chemical and biological conditions to alter the nature of cyanobacteria	Medium	Apr08 - Mar10	350	0.2
		8a. Incorporate a phytoplankton module in SCA's Reservoir Management System (SCARMS); 8b. Extend SCARMS to Shoalhaven storages; and 8c. Scenario testing of nutrient input and different species Note: Included on the understanding that this work is already planned and budgeted for in the advanced Bulk Water Division budget	Long	Jun08 - Dec10	0	0

C: Management of catchments and reservoirs (lead agency – Sydney Catchment Authority)						
Research outcome	Management outcome	Research activity	Term	Duration	'000 2007/10	FTE 2007/10
I. Catchment activities prioritised to reduce the probability of cyanobacteria blooms	I. Prioritised catchment management programs, including Healthy Catchment Program, Rectification Action Plan Decision Support System, and Catchment Risk Assessment Framework	1a. Continued improvement and revision of Rectification Action Plan Decision Support System) to identify nutrient sources and other influencing factors.	Ongoing	Dec07 - Dec09	150	0.2
		1b. Review the nutrient load estimates (such as from SedNet, HSPF) to inform potential sources of nutrients	Medium	Current - Dec08	20.0	0.4
		2a. Evaluate methods for quantifying transport and fate of nutrients through catchment stream network.	Medium	Jul08 - Jul09	60	0.2
		2b. Develop methods for evaluating the effectiveness of catchment interventions designed to reduce nutrient loads (as part of the normal operations)	Long	Jun08 - Dec10	0	0
		2c. Development and trialling of stream flow and nutrient model	Long	Dec07- Dec09	250	1.1

C: Management of catchments and reservoirs (lead agency – Sydney Catchment Authority) – contd.

Research outcome	Management outcome	Research activity	Term	Duration	'000 2007/10	FTE 2007/10
II. Appropriate reservoir management priorities set for a) Pre-bloom prevention, and b) Bloom management (deep water, cell / toxin management, storage treatments)	II. Pre-bloom prevention measures put in place. Staged bloom management measures adopted	3a. Undertake a detailed assessment of options for key SCA reservoir to reduce risks and impacts of imminent algal blooms, and the presence of cyanobacteria and toxins, including the review of potential implications	Short	Mar08 - Dec08	50	0.3
		3b. Science input to trial of reservoir management options as appropriate	Medium	Dec08 - Apr10	0	0.3
		4. Review and evaluate the hydrodynamic influence of water supply outlets in SCA reservoirs (as part of the normal operations)	Short	Jul08 - Jun09	0	0

D: Monitoring and analysis (lead agency – Sydney Catchment Authority)						
Research outcome	Management outcome	Research activity	Term	Duration	'000 2007/10	FTE 2007/10
Robust data and improved analytic techniques to inform modelling and prediction	Targeted, timely monitoring program for the prediction and management of blooms	1. Review and gap analysis of current monitoring program and modify SCA algal monitoring program, water quality monitoring program and Bulk Raw Water Incident Response Plan as appropriate (as part of the normal operations).	Short	Current - Dec 08	0	0
		2a. Review SCA field and laboratory techniques, eg ELISA and the rapid testing techniques for toxins and T&O compounds and implement changes to monitoring as appropriate	Medium	Jan08 - Dec09	180	0.4
		2b. Investigate and implement options for on-line and early warning systems (measurements) and other early indicators	Short	Apr08 - Mar09	75	0.4

E: Water treatment (lead agency – Sydney Water)						
Research outcome	Management outcome	Research activity	Term	Duration	'000 2007/10	FTE 2007/10
<p>Ensure meet ADWG for toxins at the customers' taps.</p> <ul style="list-style-type: none"> - Avoid T&O events and minimise customer complaints. - Ensure robust last barrier to the contaminants of concern 	<p>Appropriate treatment options in place; high confidence of consumers in safety of drinking water supplies</p>	1. Undertake an application research work with Veolia and Australian Water Services (Prospect water filtration plant) under contractual arrangements	Short	Current - Jun08	0	0
		2. Undertake studies to ensure that disinfection practices employed at water filtration plants can significantly remove toxins	Medium	Jan08 - Jun09	0	0
		3. Undertake a research project through an <i>AusIndustry</i> grant to University of Adelaide and WSAA on biofiltration for removal of trace organics including algal toxins	Long	Jun08 - Dec10	0	0
		4. Fast track the in-house study to manage return sludge from filter-backwash	Medium	Jan08 - Dec08	0	0
		5. Undertake performance assessment of various treatment units in a University of Melbourne Linkage Grant Project with United Utilities	Long	Jun08 - Dec10	0	0
		6. Literature review and data analysis of T&O compounds by an SCA & Sydney Water joint project on T&O compounds	Short	Current - Jun08	0	0
Total Resource Commitment					3450	12.4