



CRC for Water Quality and Treatment Research Themes

Presentation to Drinking Water Regulatory
Unit Seminar – Measurement and Research

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CRC for Water Quality and Treatment

- Established in 1995 under the Federal Government's Cooperative Research Centres Scheme
- A collaboration of 29 contributing parties and 20 Associates, including 11 research and 18 industry organisations
- Mission is "to assist the Australian water industry produce high quality water at an affordable price"!
- Centre commenced operations in 1995 and received a second round of funding in 2001. Currently funded until June, 2008





CRC for Water Quality and Treatment Research Programs

1A – Epidemiology

1B – Toxicology

1C – People's Perspectives

2A – Catchments

2B – Reservoirs

2C – Measurement

2D – Water Treatment

2E – Distribution Systems

2F – Sustainable Water Sources





CRC for Water Quality and Treatment Research Programs

3A – Strategic Directions

3B – Policy and Regulation

3C – Rural & Regional Water Supplies


3D – Education and Training





CRC for Water Quality and Treatment Research Themes

- Cyanobacteria
 - Pathogens
 - Natural Organic Matter
 - Aesthetics
 - Micropollutants
 - Sustainability
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Cyanobacteria

Major Research Outcomes for Epidemiology

Key Research Objective

Assess evidence of illness due to exposure to cyanobacteria.

- ***No evidence found of an association between exposure to cyanobacteria in drinking water supplies and the incidence of cancers and pregnancy outcomes.***
- Recreational exposures causes skin irritation occurs in sensitive individuals.
- Outcomes incorporated in to the national guidelines for managing risks in recreational waters.





Cyanobacteria

Major Research Outcomes for Toxicology

Key Research Objective

Provide information for the development of guidelines.

- ***Microcystin demonstrated tumour promoter.***
 - ***Cylindrospermopsin is genotoxic, potentially carcinogenic and disruptive to human reproduction.***
 - Cyanobacterial lipopolysaccharides have low toxicity.
 - ***Results were critical to the formulation of water quality guidelines for drinking and recreational waters.***
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Cyanobacteria

Major Research Outcomes for Reservoirs

Key Research Objective

Determination of the factors influencing cyanobacterial growth and develop monitoring methods.

- ***Predictive model developed for cyanobacterial in the River Murray - Has been used to provide management options.***
- ***Predictive model developed for the impact of artificial mixing on cyanobacterial growth in reservoirs –In use by SA Water and NSW Dept of Commerce.***
- The CWR model with the additions made by the CRC is now used in 59 countries.
- Model developed for toxin and geosmin production and degradation.
- Toxin degrading organism identified.
- Semi-automated image analysis program developed – in use at AWQC.





Cyanobacteria

Major Research Outcomes for Water Treatment

Key Research Objective

Removal of toxins and off-flavours in treatment.

- ***Detailed understanding and a predictive model developed to explain the absorption of toxins and off flavours by activated carbon – Model is in use at United Water.***
 - ***Comparative tests developed to select GAC and have been applied by SA Water and United Water.***
 - Biodegradatin effective in removing cyanotoxins in GAC filters.
 - Degrading organisms identified.
 - The Global Water Research Coalition have commissioned an operators guideline for the management of algal toxins.
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Cyanobacteria

Major Research Outcomes for Measurement

Key Research Objective

Development of analytical methods and monitoring techniques for toxins and off-flavours.

- Analytical methods and QA/QC developed for all the common toxins and QA/QC protocols under development.
- methods adopted by AWQC and Sydney Water
- PCR probes for microcystin and cylindrospermosin – In use by AWQC to assess cyanobacterial blooms.



Pathogens

Major Outcomes for Catchments

Key Research Objective

Identification of pathogen sources, predictive models and source tracing tools.


- ***Extensive data base on pathogen numbers in streams and various pathogen sources established.***
- ***Die off during transport across land and on soils quantified.***
- Juvenile cattle and pigs and juvenile and adult sheep the major sources of Cryptosporidium.
- Cryptosporidium inactivated by heat.
- Riparian vegetation very effective in removing Cryptosporidium.
- New method for genotyping Cryptosporidium.
- Predictive models under development.



Pathogens

Major Outcomes for Catchments (cont)

Industry Uptake

- Data base on pathogen numbers used by Melbourne Water, SEQ Water, Sydney Catchment Authority, Water Corporation and SA Water to develop pathogen models.
 - Melbourne Water, Barwon Water and Central Highlands Water have used the results to demonstrate the value of catchment protection.
 - Early versions of the pathogen model has been used by Melbourne Water and SEQ Water.
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Pathogens

Major Outcomes for Reservoirs

Key Research Objective

Determination of the factors influencing pathogen distribution and survival.

- ***Model for the prediction of pathogen behaviour in reservoirs developed and verified. Complex model plus simple web based version. The model has been used by SA Water to minimise sampling and to avoid harvesting contaminated water.***
- Cell based infectivity method developed –Is in use at AWQC and has been transferred to Sydney Water.
- High temperature depletes ATP stores and reduces infectivity. Results have been incorporated into the model



Pathogens

Major Outcomes for Distribution

Key Research Objectives

Control of opportunistic entry of pathogens and improvement of disinfection.

- New method for determining ammonia oxidising bacteria developed and in use by SA Water.
- Disinfection management tools developed to optimise disinfection.



Pathogens

Major Outcomes for Epidemiology

Key Research Objective

Assess evidence for water related disease.

- ***Drinking water in Melbourne and Adelaide is not a significant source of Cryptosporidium.***
- ***Melbourne water not a significant source of illness.***
- Both results decreased the pressure for further expenditure on water treatment.
- 12 element framework developed for a risk-based management of water supplies.
- Results have provided the data for evidence based decisions on risks from a range of pathogens.




Pathogens

Major Outcomes for Sustainable Water Sources

Key Research Objective

Identification and treatment of sources of pathogens in rain water tanks.

- Project will provide base line data for urban rain water tanks.
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NOM

Major Research Outcomes for Water Treatment

Key Research Objective

Develop a better understanding of the role of NOM in water treatment.

- ***Particular fractions of NOM which contribute most to membrane fouling and DBP formation have been identified and processes for their removal developed.***
- ***Fundamental processes controlling adsorption of NOM and taste & odour compounds on activated carbon understood.***
- Use of polyelectrolytes in water treatment well understood.
- Novel, cheap process for non-thermal regeneration of activated carbon developed and tested.
- Model to rapidly and accurately predict coagulant and pH reagent dosing for optimal performance developed and successfully trialed.




NOM

Major Research Outcomes for Measurement

Key Research Objective

Develop advanced methods for characterising
NOM.

- Complimentary HPSEC-DOC systems are available at both Curtin and AWQC.
 - Better understanding has been achieved of both the variability and behaviour of source water NOM in different Australian water systems.
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NOM

Major Research Outcomes for Catchments

Key Research Objective

Provide tools to assist catchment managers to prioritise their activity in managing NOM and organic pollutants.

- A software package that predicts NOM in streams at the river basin scale has been incorporated into the CRCCH catchment toolkit.
- Techniques for tracing the origin of faecal and organic pollution are being made available to industry through two case studies.




NOM

Major Research Outcomes for Reservoirs

Key Research Objective

Determine the nature of changes in NOM in reservoirs & the factors influencing those changes.

- Exposure to UVB can make NOM more biodegradable, thus exacerbating biofilm growth.
 - Application of gypsum can reduce NOM movement through soils and into the reservoir.
 - Destratification can reduce the biodegradable component of NOM in a reservoir.
 - Runoff from urban catchments can contribute significant levels of BOD.
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Aesthetics

Major Research Outcomes for Distribution

Key Research Objective

Understand the fundamental processes that control water quality deterioration and develop appropriate management tools.

- ***A particle sedimentation and chlorine decay model have been incorporated into a common software platform & tested in industry***
 - A DSS with a toolbox approach to managing discoloured water is being trialled in Australia and the Netherlands
 - Improved predictive tools for managing taste & odour development due to Geosmin & MIB are available
 - A risk management framework based on HACCP principles to manage discoloured water and taste and odour risks has been developed
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Aesthetics

Major Research Outcomes for Water Treatment

Key Research Objective

Develop simple, cost-effective technology for biological Mn removal.

- Biological removal of Mn to <0.01 mg/l successfully demonstrated in pilot plant trials
- Sodium hypochlorite identified as best oxidant under conditions of limited detention time
- Particulate Mn easily removed by 5 micron POU filter
- Process design parameters can be accurately estimated via specific pilot plant trials



Aesthetics

Major Research Outcomes for Reservoirs

Key Research Objective

Control of Fe and Mn release from sediments.

- Improved understanding of Fe and Mn generation and transformation in reservoirs
- Optimal strategies for artificial destratification and selection of water withdrawal points
- Appropriate use of oxidising agents




Aesthetics

Major Research Outcomes for Measurement

Key Research Objective

Detection of specific taste and odour compounds.

- Guidance on ways to avoid bromophenol formation in drinking water.
 - Techniques available for analysis of volatile halophenols at nanogram /litre levels.
 - The effect of various trace components in natural waters on bromination rates of organics better understood.
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Micropollutants

Major Outcomes for Epidemiology

Key Research Objective

Evidence of health effects from exposure to DBPs.

- No association between THM levels and genetic damage.
- TCAA a potential biomarker for DBP exposure.
- Fluoridation not associated with adverse health effects.



Micropollutants

Major Outcomes for Toxicology

Key Research Objective

Assist health risk assessment by provision of toxicological data.

- Triclosan detection limit reduced.
- Sensitive method developed for NDMA.
- Antiscaling agent (sodium hexametaphosphate) not likely to be linked with skin rashes.




Micropollutants

Major Outcomes for Measurement

Key Research Objective

Characterisation of by-products.

- Improved understanding of chloraminated DBP formation.
- Field method for detection of pesticides.



Micropollutants

Major Outcomes for Water Treatment

Key Research Objective

Optimisation of removal of NOM and micropollutants.

- Method for tagging polymers developed which has allowed improved assessment of potential health effects.
- Analytical methods developed for ozonation DBPs and in use by SA Water.
- Advanced coagulation may not remove recalcitrant NOM or DBP precursors.
- MIEX decreases disinfection demand and DBP formation potential.



Micropollutants

Major Outcomes for Distribution

Key Research Objective

Control of DBPs by minimising chlorine doses.

- Neural net works used to improve disinfection control.
- HACCP risk based approach applied to two case studies.
- Modelling tools for distribution system management developed.




Micropollutants

Major Outcomes for Sustainable Water Sources

Key Research Objective

Identification of micropollutants in rainwater tanks and assessment of the importance of endocrine disruptive compounds.

- Surveys being conducted of rainwater tanks.
 - Bioassays being developed for estrogenicity.
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Sustainability

Major Research Outcomes for Sustainable Water Sources

Key Research Objective

Reduce barriers to implementation of sustainable urban systems.

- Understanding of stakeholders & institutional barriers to new system implementation.
 - A database on alternative system developments to facilitate optimal planning and design of future systems.
 - Guidance on installation and management of rainwater tanks in urban and rural environments.
 - Best practice cost analysis methodologies for sustainable urban water systems.
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Sustainability

Major Research Outcomes for Catchments

Key Research Objectives

Develop guidance and best practice on key catchment sustainability issues.

- A decision making framework and DSS can be applied to the management of recreational access to reservoir catchments.
 - Guidance developed for a catchment risk management program to identify and assess risks to raw water quality.
 - A natural asset valuation system that is robust before a pricing regulator and informs natural asset investors is being developed.
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Sustainability

Major Research Outcomes for Water Treatment


Key Research Objective

Develop treatment options which are more sustainable.

- Develop pretreatment options for RO, which significantly reduce fouling and lead to overall reductions in energy and material consumption.
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People's Perspectives A Special Case

- National survey touched on many issues relevant to all themes.
 - Hence, hard to categorise projects into a particular theme.
 - New project on attitudes water conservation and reuse fits largely into Sustainability theme, but will still canvass a broad spectrum of issues.
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Policy and Regulation

- The CRC has had significant influence on the ADWG (and WHO)
- The Framework is being implemented by most utilities and is part of the regulatory system in Victoria
- The Framework has been adapted for use in current national water recycling guidelines review
- Ongoing review of the ADWG is required

Technology Transfer Initiatives

- Research outputs framed around application of the Drinking Water Quality Management Framework
- Research Reports – some in hard copy, all as PDF documents
- Technology Transfer Workshops – 1 location and 1 time only!
- Case studies undertaken by industry participants – you have to be in it to win it!
- Roadshows supported by specially written documentation

