July 2007

South Australian Murray-Darling Basin Natural Resources Management Board

PROSPECTUS FOR RESEARCH & DEVELOPMENT

Government of South Australia

South Australian Murray-Darling Basin
Natural Resources Management Board

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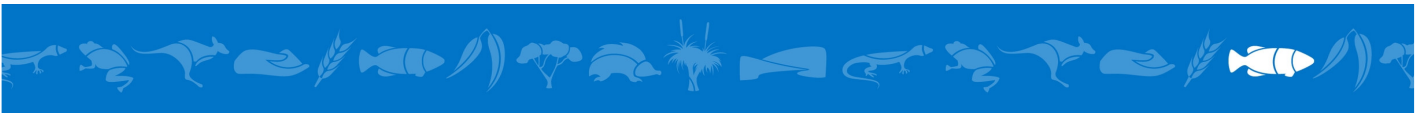
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Table of Abbreviations

ABRS	Australian Biological Resources Survey
AEON	Australian Ecosystem Observation Network
ARC	Australian Research Council
AWI	Australian Wool Innovation
BRS	Bureau of Rural Sciences
CERF	Commonwealth Environmental Research Facility
CMA	Catchment Management Authority
CNRM	Centre for Natural Resource Management
CoAG	Council of Australian Governments
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DEH	Department for Environment and Heritage (South Australia)
DEWR	Department of Environment and Water Resources
DPI	Department of Primary Industry (Victoria)
DRDC	Dairy Research and Development Corporation
DWLBC	Department of Water, Land and Biodiversity Conservation (in South Australia)
EPA	Environment Protection Authority (South Australia)
GWRDC	Grape and Wine Research and Development Corporation
HAL	Horticulture Australia Ltd
I&PC	Investment and Program Committee of the Board
ICE WaRM	International Centre of Excellence in Water Resource Management
IP	Intellectual Property
INRM	Integrated Natural Resource Management
LWA	Land and Water Australia
MDBC	Murray Darling Basin Commission
MECG	National NRM Monitoring and Evaluation Coordination Group
NAP	National Action Plan for Salinity and Water Quality
NRM	Natural Resources Management

NWI	National Water Initiative
PIRSA	Primary Industries and Resources South Australia
R&D	Research and Development
RIRDC	Rural Industries Research & Development Corporation
SARDI	South Australian Research and Development Institute
SAMDB	South Australian Murray Darling Basin Region
SECWMB	South East Catchment and Water Management Board
STI10	SA State Governments Science, Technology and Innovation Strategic Plan

1. Executive Summary

The Purpose of this Prospectus is to inform stakeholders in NRM research of the research topics that will enable the Board to better manage the resources under it's jurisdiction.

The SAMDB NRM Board hopes to attract the interest of the scientific community to undertake research within the region on topics of greatest priority for the Board and to identify research topics the Board would like to see funding directed towards.

The SAMDB NRM region has natural resources that are strategically important for Australia and South Australia and has ecological assets of national and international significance. The SAMDB NRM Board is responsible, under the State Natural Resources Management Act (2004), for the management of these ecological assets and natural resources.

To manage the natural resources it is responsible for most effectively, the SAMDB NRM Board supports scientific endeavour that results in new knowledge to underpin the management of natural resources in the region. The Board has undertaken a systematic process of identifying existing research and research capability in the region and working with key researchers, government technical advisors and Board staff to identify research that will assist the Board in making better management and investment decisions in the future. An online database has been developed to facilitate access to publications of research undertaken in the region. A Research Plan has been developed that identifies the research interests and priorities of the Board. This Prospectus builds on the Research Plan and Research Database to outline in more detail very highest priority research topics identified in the Research Plan.

The Prospectus was developed in consultation with key researchers, government technical advisors and Board staff through a series of workshops. The Prospectus identifies for each of the priority research topics:

- A description of the research required;
- The purpose of the research;
- Existing research already undertaken;
- Possible co-investors;
- The relative level of priority and urgency of the research identified;
- Key contacts for further information.

Thirteen high priority research topics have been identified in this Prospectus. The numbers in square brackets relate to research priorities identified in the Research Plan.

5.1   [T2] Inventory of biological and ecological assets

5.2   [D8] Biology, tolerance and adaptation of native species to environmental extremes

5.3   [T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management

5.4   [D9] Ecological restoration techniques/works

5.5   [T4] Strategic placement of vegetation within an experimental adaptive management framework

5.6   [R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis

5.7   [D2 & D3] Ecological impacts of different water management strategies in the Eastern MLR

5.8   [R11] Integrated salt and water balance in the riverine corridor

5.9   [R6 & R18] Smart use of water to gain maximum overall value and increase robustness of systems that rely on water

5.10   [D11] More robust production systems

5.11   [R29] Integrated landscape Scale Modelling and Scenario Testing

5.12   [S3,S8 & S13] Holistic Regional Economic Evaluation of NRM Investment

5.13   [S9 & S10] Extended Evaluation of Market Based Instruments

A number of priority research topics identified in the Research Plan have not been included in this Prospectus but will be developed further for inclusion in the revised Prospectus in 2008.

There are significant opportunities to gain greater value from the research if the information and activity from each research domain can feed into other research activities. A mechanism that has been identified to enable this coordination is the establishment of a number of Research Coordinating Committees under the Technical Advisory Group of the Centre for Natural Resource Management. The role of the Research Coordinating Committees would be to coordinate research priorities, activities and communication across the region. They would potentially report to the Technical Advisory Group who may use an independent reviewer to review the research activities of research from time to time to ensure high scientific standards are maintained.
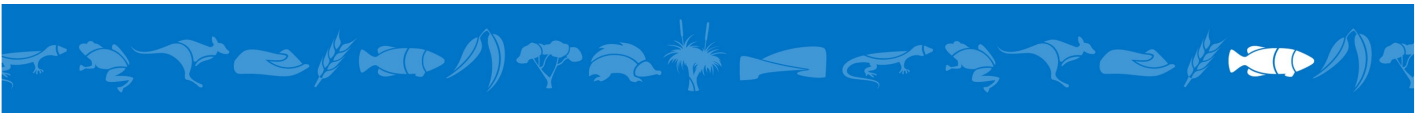
2. Background

Good Reasons to Invest in Research in the SAMDB NRM Region

1. Nationally important and unique environment with strategically valuable natural resources

The SAMDB Region has particular national importance because it includes the lower end of the River Murray, which is the water source for Adelaide and regional areas in South Australia, and:

- The wetlands of the River Murray floodplain and the complex aquatic systems of the Coorong, Lower Lakes and Murray Mouth are nationally and internationally important ecosystems;
- The irrigated horticulture and viticulture areas along the River Murray and the Mallee farming areas are important contributors to the economy of South Australia;
- The River Murray in this region is the subject of national efforts to improve water quality for environmental and socio-economic purposes;
- The River Murray tributary creeks and streams of the eastern Mt Lofty Ranges are under pressure from land use change and development, and include some rare and threatened communities and species, including native fish species.

South Australia's Murray-Darling Basin has been identified as one of Australia's 21 priority salinity and water quality regions under the National Action Plan for Salinity and Water Quality. The region also includes large reserves of Australia's unique mallee ecosystem.

Fig. 1. Map of SAMDB NRM Region (orange shaded area)
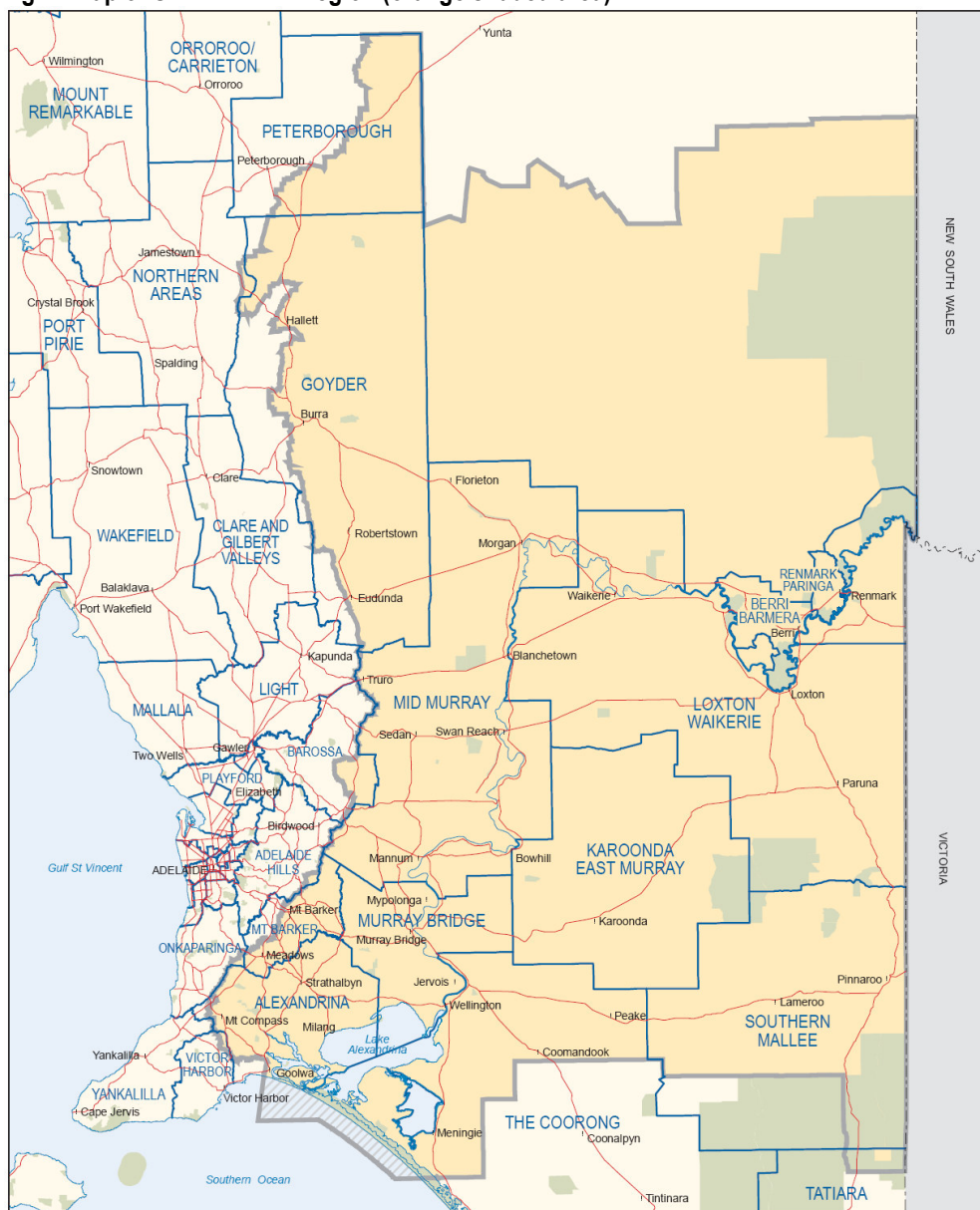
2. A Track Record in the Support of Scientific Study to Underpin its Investments in NRM

The SA MDB NRM Board was established under the South Australian Natural Resources Management Act, 2004. The Board's vision is '*A healthy living landscape meeting the social, environmental and economic needs of the community and ensuring the rights and wellbeing of future generations'*, and, as such, the Board focuses on the delivery of direct on-ground works and capacity building programs that address essential natural resources management. Major projects outlined in the SA MDB NRM Plan include the rehabilitation of the Lower Murray Irrigation Areas, Salt Interception Scheme projects to combat salinisation of soil and water resources, projects to improve water use efficiency and land management, revegetate cleared land and protect and enhance remnant habitat, and capacity building. The SAMDB NRM Board also works closely with all tiers of government on the development and implementation of NRM-related policy.

The SAMDB NRM Board is one of the leading organisations of its kind in Australia in the promotion and investment in successful, high quality and innovative science projects such as:

- It has been a strong supporter of the Lower Murray Landscape Futures project, the first project of its type in Australia to analyse the implications of reaching targets set in regional, state and national plans within the Lower Murray region of the Murray Darling Basin. This project has funding support from the National Action Plan for Salinity and Water Quality in SA and Victoria and from CSIRO Water for a Healthy Country;
- The Board formally supported the Coorong, Lower Lakes and Murray Mouth research project to develop an integrated hydrodynamic and ecological model of this region (which was funded by CSIRO Water for a Healthy Country);
- The Mallee Sustainable Farming Systems project has identified the key drivers for sustainability and productivity in the mallee farming region of the SAMDB NRM region, Mallee CMA region in Victoria and Lower Murray Darling CMA region in NSW.
- State Grain and Graze Project;
- SARDI Mallee Lucerne Project.
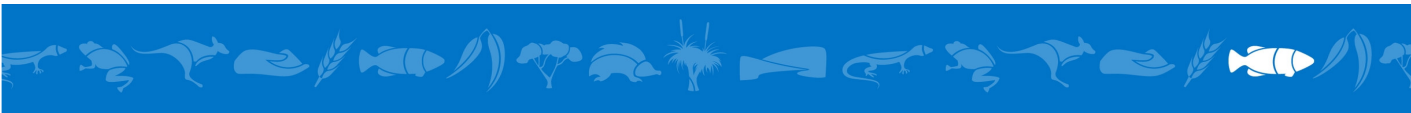
The SAMDB NRM Board recognizes the importance of basing investment and management decisions on a strong scientific foundation. To ensure the scientific foundation is strong and strongly supported, the Board has invested in a systematic process to develop research priorities (Fig. 2) which have been developed to form this Prospectus.

Fig 2. Process to Identify Research Priorities

| Collation of research publications undertaken In SAMDB region | Enter data into online database | Use database to identify active researchers in the region and invite them to workshops to identify research priorities | Preparation of Research Plan | Preparation of Prospectus |
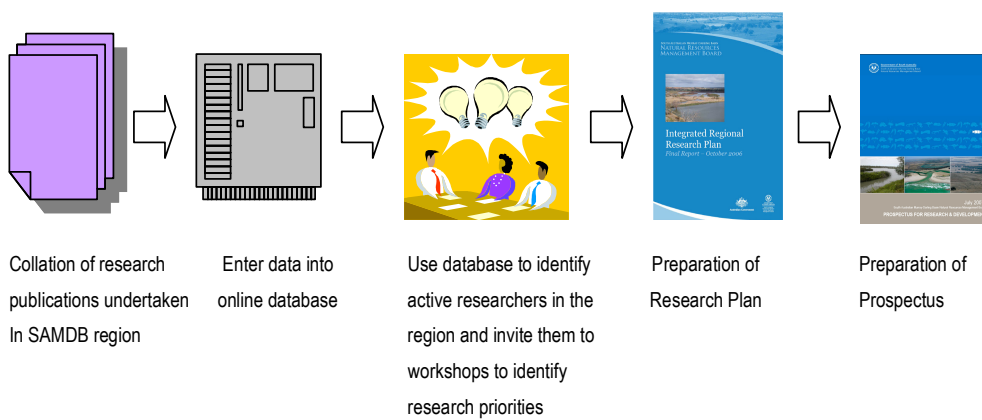
The Board has collated information on research undertaken in the region and identified research capability, particularly in South Australian research institutions with experience in publishing research undertaken in the region. An online database of publications arising from research undertaken in the region between 1995 and 2005 has been established[1].

Leading researchers and technical advisors who were active in the region were invited to participate in a process of developing a Research Plan for the region. The Research Plan is available online at the Board's website[2]. The Research Plan:

- Addresses the key strategic objectives of the Board's NRM Plan and Investment Strategies, and is consistent with the State NRM Plan, State Strategic Plan and State's STI10 Science, technology and innovation vision;

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[1] http://www.dwlbc.sa.gov.au/subs/research/search.php
[2] http://www.samdbnrm.sa.gov.au/assets/files/SAMDB_Research_Plan.pdf

- Offers strategic direction to the Board by providing an overview of regional research and development (R&D), results of a gap analysis of current and past R&D, recommendations on future priority R&D and the role of the Board in future R&D activities;
- Identifies opportunities for co-investment and partnerships, issues of resourcing and budgetary implications, and the role of monitoring and evaluation.

The Research Plan was developed following a process of consultation with researchers, key advisors from the state government and staff from the SAMDB NRM Board. It identifies areas of research that would address information gaps and improve the Board's ability to make investments in NRM based on sound science. The Plan identifies over 100 of these research topics, and assigns a level of priority to each.

The Research Plan also identifies how the areas of research identified fit within broader state and national planning frameworks for research. The relationship between the research themes identified by the Board and the research priorities identified in the State NRM Plan and in the National Research Priorities is shown in Fig. 3.
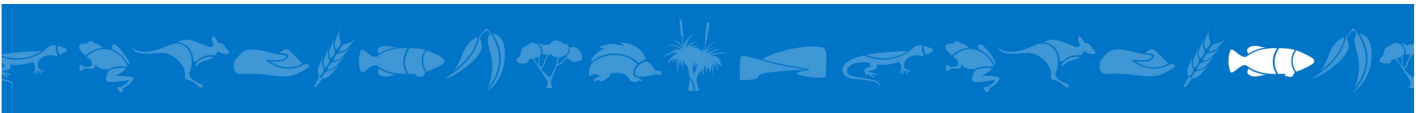
Fig. 3. Relationship between SAMDB NRM Board research themes and other state and national research planning documents
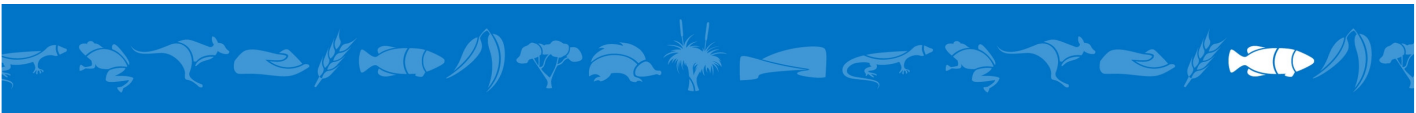
National Research Priorities	State NRM Plan	SAMDB NRM Plan
Overcoming soil loss, salinity and acidity Sustainable use of Australia's biodiversity Water, a critical resource	Ecosystem processes (understanding causes of problems and resource limits)	Marine and Estuarine Futures Hydrological and Salinity Processes
Sustainable use of Australia's biodiversity	Natural resource repair technologies (lessening symptoms, fixing problems)	Biodiversity Conservation and Restoration
Transforming existing industries Sustainable use of Australia's biodiversity	Financially viable and ecologically sustainable natural resource-based industries	New Industries
	Social and economic issues regarding the use and protection of natural resources	Social and Economic Research
Responding to climate change and variability	Landscape and climate futures	Landscape and Climate Futures
Water – a critical resource	Water and irrigation futures	Water and Irrigation Futures Hydrological and Salinity Processes
	Indicators and evaluation tools to underpin the adaptive management framework required by the Act.	
Reducing and capturing emissions in transport and energy generation		
Developing deep earth resources		

The Research Plan identifies 18 priority areas of research. This Prospectus presents research briefs all but two of these priority areas, with more detailed information on exactly what research would be required to address the priority areas, where research capability is available, and what the likely quantum of investment and time is required to generate information through research that can be used by the Board to improve its operations and investment decisions. . Refer to Appendix B to view the link between the 18 priority areas identified in the Research Plan and the research briefs documented in this Prospectus.

Comment [PD1]: Why did the number of priorities drop?

The Prospectus forms the basis for negotiation with research organisations on the development of and investment in research projects required by the SAMDB NRM Board. The Prospectus documents regional research priorities for advice to the South Australian and Australian Governments as they consider their investment in the NRM and related research. The Prospectus also provides researchers with documented regional support for the relevance of their research and will assist in demonstrating research priorities to research funding bodies.

3. Purpose of Prospectus

The Purpose of the Prospectus is to provide stakeholders in NRM research with an interest in the SAMDB NRM region with a guide as to the research themes and priorities that will enable the Board to better manage the natural resources over which it has management jurisdiction.

For Researchers

The SAMDB NRM Board hopes to attract the interests of the scientific community to undertake research within the region on topics of greatest interest to the Board. The Prospectus outlines those areas of research that will add greatest value to the Board's activities. Researchers are welcome to cite the Prospectus to funding agencies to demonstrate the value and priority of research being undertaken in the region. A number of key contacts are provided for each research topic to assist researchers find out more about what is required by the Board. While the Board does not have a large budget to co-invest cash into research projects, researchers are encouraged to develop well thought out proposals for funding and present these to the nominated Board contacts to determine if co-investment is available from the Board.

For Investors in Research

For research funding organisations, the Board wishes to identify the areas of research it would like to see funding directed towards. The Prospectus can be used by funding bodies to determine whether research proposed for the region is prioritised by the Board. It is hoped that funding bodies will choose to invest in the research topics identified in this Prospectus, where they coincide with the priorities and interests of research funding bodies.

4. Development of the Prospectus

The Prospectus was developed through discussion and consultation at a number of workshops held to:

- Scope out in more detail the research required to address the research priorities listed;
- Prioritise ideas based on which are likely to provide the best value to the SAMDB NRM Board;
- Identify possible funding sources;
- Seek interested researchers, technical advisors and interested parties from the NRM region to participate in writing team to develop detailed research briefs.

Some workshops were invitation only events organized specifically for the SAMDB NRM region (Ecological Processes, Production Irrigation and Hydrology). For these events, researchers and technical experts were invited based on their demonstrated experienced in the research topic within the region(based on information from the research database) and/or their responsibilities as SAMDB NRM Board staff.

A number of additional workshops were organized as part of the Living Laboratories Program co-sponsored by DWLBC and ICE WaRM (International Centre of Excellence in Water Resources Management) to address research issues identified in the SAMDB NRM Research Plan, Rather than hold parallel workshops, it was decided to work in partnership with the organizers of the Living Laboratories workshops to scope out research topics. The issues raised at the Living Laboratories workshops were relevant to all regions in SA, not just the SAMDB NRM region. The Living Laboratories workshops also canvassed a range of research themes for monitoring and evaluation which had not been highlighted in the development of the SAMDB NRM Board Plan. The Workshop on Community Values on 13th June was initiated by Sally Pederick from the SAMDB NRM Board.

Ecological Processes Workshop – 23 May 2007

Priority themes discussed were:

Basic ecology

- Inventory of biological/ecological assets

- Biology, tolerance and adaptation of native species to extreme temperature, trends in temperature changes and salinity of water/soil

- Basic ecological processes in terrestrial ecosystems to refine our conceptual models of how terrestrial ecosystems function and respond to pressure

Terrestrial ecology and restoration

- Ecological restoration techniques/works including riparian, Strategic placement of vegetation

- Risk identification and management for ecological assets in terrestrial ecosystems

- Key threatening processes to land resources, what we need to manage in the rangelands

Riverine processes and management

- Ecological impacts of different water management strategies in the EMLR

- Better understanding of groundwater/surface water processes to assist in water allocation planning, particularly fractured rock in EMLR.

- Understanding of the links between water management, ecosystem management and biodiversity: threatened and iconic species.

- Tools for trade-off analysis between alternative ecological outcomes and water quality

Attendees are listed in Appendix A

Production, irrigation and hydrology along the River Murray – 25 May 2007

Priority themes discussed were:

- Reuse of drainage water: Bioaccumulation, saline production of crops and fodder
- Biology, tolerance and adaptation of established and new crop and animal species to extreme temperature, trends in temperature changes and salinity of water/soil
- Feasibility study for multiple use of water: environment, irrigation, and aquaculture.
- Siting and design of irrigation systems to reduce water use, salt damage, and robustness to climate conditions, soil conditions
- Matching cropping systems to perceived changes in the supply of water: Research and products to support adaptation to higher salt and lower water availability and higher cost scenarios for both high and low value crops.
- Tools for improved salt and water balance models for SA Murray

Attendees are listed in Appendix A

Living Laboratories: Monitoring and Evaluation of NRM Workshop – 31 May 2007
http://www.icewarm.com.au and click on Living Laboratories

Priority themes discussed were:

- Explore real NRM monitoring and evaluation problems and challenges, identified by the people who have the imperative to solve them
- Discuss these challenges and problems with a diverse range of researchers with relevant research interests and expertise
- Apply research expertise in novel ways, outside traditional areas of application
- Identify research required to fill the knowledge gaps and scope funding opportunities to pursue them

Attendees are listed in Appendix A

Living Laboratories: Emerging Tools to Respond to and Influence Community Values in Natural Resource Management – 13th June

http://www.icewarm.com.au and click on Living Laboratories "Invisible Hands, Quick Fingers, Mapping Minds"

Priority themes discussed were:

- Share ideas on recent research and activity in trialing new social and economic instruments to encourage changing practice in NRM;
- Discuss the challenges and problems associated with these instruments with a diverse range of researchers with relevant research interests and expertise and policy makers applying the instruments;
- Identify research required to fill the knowledge gaps and develop research briefs;
- Provide an opportunity for people to hear new ideas and meet new people.

Attendees are listed in Appendix A
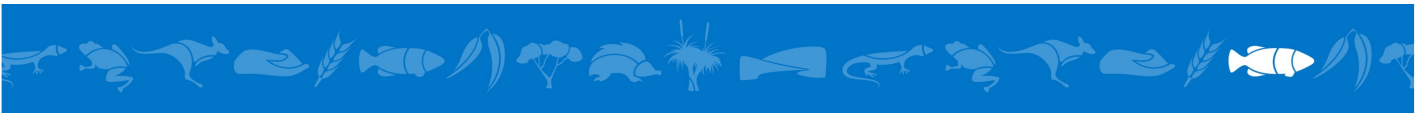
5. Research Topics of Interest

In this Section, areas of research interest to the Board documented in the Research Plan are listed. In some cases, several research topics have been combined, or the title of the research topic has changed following discussion at the workshops. Numbers in square brackets indicate the original research topic(s) identified in the Research Plan. For each research topic, the research and its purpose are described. Research capability and possible co-investors are identified. A relative ranking for each research topic is given for Priority (impact of research on the Boards investment outcomes) and Urgency (how soon the information is required). Individuals who can be contacted to discuss these topics in more detail are identified.

Urgency

The level of urgency ascribed to a research topic is based on the importance of having the information within a certain period of time to be of use to the Board. A relative scale has been developed and is described below:

1. Because this information is not currently available, it is probable that the Board is either causing damage to the environment and community or is much less effective in achieving improvements

2. If this information is not available within the next seven years, the Board will potentially cause damage to the environment and community or be much less effective in achieving improvements in resource condition

3. This research is important to continue to build our understanding of natural/social processes within the region

Priority

The level of priority ascribed to a research topic is based on the likely impact the information will have on the effectiveness of the Board's investments. A relative scale has been developed and is described below:

1. Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

2. Without the research, the Board will be much less effective at protecting ecological assets in the region

3. The research is required to improve our understanding of processes in the region and reduce the uncertainty surrounding the ability of the Board to effectively invest in protecting the ecological assets of the region.

Geographic scale of research

Research topics are relevant at different jurisdictional scales. In this Prospectus, the Board identifies research topics of interest, whether they are best coordinated and resourced at a local, regional, state or national level. The SAMDB NRM Board will focus its own investment on research relevant at a regional or local level, and may decide to co-invest with other regions. However, the Prospectus also identifies research issues that can best be coordinated and resourced at a state and national level to develop generic tools that would be useful at a regional level in other jurisdictions.

Co-Investors

Potential co-investors in research are identified in the Prospectus. This list is not intended to be an exhaustive list of potential co-investors, nor does it imply that these organisations have any interest in or made any commitment to the research topic.

Gaps in the List that Require Further Development

There are some topics for research that were identified as high priorities in the Research Plan but which have not bee included in the Prospectus. The description of research required and purpose could not be agreed to during the timeframe of the development of this Prospectus, and thse topics have been put aside for further development. These topics include:

- Risk identification and management for ecological assets in terrestrial ecosystems
- Key threatening processes to land resources, what we need to manage in the rangelands
- Siting and design of irrigation systems
- Biosaline agriculture
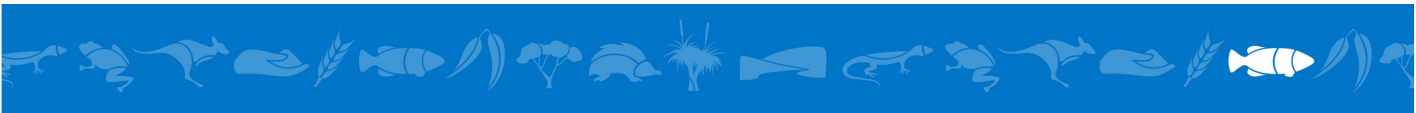
Furthermore, the Prospectus is currently strongly focused on water related issues and under-represents the knowledge required for sustainable dryland agricultural systems and social/economic research. These research topics will be developed and refined in more detail for the next version of the Prospectus, planned for release in July 2008.

Links Between Projects

Many of the project topics have links to others. This is partly due to the nature of integrated natural resource management, and partly a result of arbitrary boundaries between ideas set during the workshop process. The table below shows where the author believes that there are strong links between projects, and where information from one is likely to be of use in another.

	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	5.10	5.11	5.12	5.13
5.1													
5.2	▓												
5.3	▓	▓											
5.4	▓												
5.5				▓									
5.6		▓											
5.7						▓							
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5.10													
5.11		▓	▓		▓	▓		▓	▓	▓			
5.12											▓		
5.13												▓	

5.1 Inventory of biological and ecological assets [T2]

Description

Basic knowledge of biological and ecological assets in the region is considered insufficient to make evidence-based decisions with confidence. While there are some areas of the SAMDB NRM region that are under-represented in existing datasets (such as the rangelands sub-region), the highest priority for the SAMDB NRM Board in the first instance is to collate and make available existing data. There is currently a process within the state Department for Environment and Heritage (DEH) to transfer their biological survey data to a new, online database by October 2007. The SAMDB NRM Board is keen to see this task complete as soon as possible. The Board recommends to the Department for Environment and Heritage (DEH) that the capability of the new database is increased over time to be able to include data from the "grey" literature (unpublished reports).

It is the view of the SAMDB NRM Board that the collection, storage and collation of information relating to biological and ecological assets are primarily the responsibility of the state agency; DEH. It is the understanding of the Board that this information will be made accessible to the Board for its planning purposes. The Board is interested in discussing with DEH and other relevant agencies about how the Board staff and the regional community could be involved in building upon the core dataset of which DEH is the custodian especially where an increase in knowledge is required to assist the Board with its decision making.

Once the collation of existing data on biological and ecological assets from existing records is complete, the next steps will be:
1) In partnership with DEH and other relevant agencies, undertake a gap analysis of available knowledge (based on the information needs identified by the Board);
2) If required, establish a program of knowledge collection at a range of identified scales in partnership with DEH and other relevant agencies;
3) Develop tools and techniques for analyzing this information and present it is a manner that can be used by non-expert planners and policy makers in the Board as a basis for deciding on priorities for investment and action by the Board.

The information is foundational and supports other research, in particular projects 5.2, 5.3 and 5.4.

Purpose of Research

To inform planning for asset protection and to underpin other research on biological and ecological processes.

Existing information and research

- Department for Environment and Heritage (DEH) Biological Survey data
- Published scientific studies (eg. University of Adelaide reports on ecological health of Coorong)
- The proposed Australian Ecosystem Observation Network (AEON) aims to improve methodologies for the capture, storage, retrieval and analysis of ecological data. The SAMDB NRM Board fully supports the AEON proposal at a national level and also strongly supports the proposal from a southern Australia consortium for an AEON hub to be based along the Chowilla Floodplain and connected ecosystems.

Possible Funding Sources

- Australian Biological Resources Survey (ABRS)
- Australian Research Council (ARC)
- Commonwealth Environmental Research Facilities (CERF)
- Australian Armed Forces
- DEH Biological Survey & Monitoring
- Department of Environment and Water Resources (DEWR)
- SA Museum & Herbarium (in-kind expertise and information and specimen management)
- SAMDB NRM Board (gap analysis)
- Mining and Industry
- DWLBC (Pastoral Branch collections in rangelands)
- Transport SA (road and rail reserve data)
- Universities (in-kind expertise and students)

Urgency: If this information is not available within the next seven years, the Board will potentially cause damage to the environment and community or be much less effective in achieving improvements in resource condition

Priority: Without the research, the Board will be much less effective at protecting ecological assets in the region

Primary contact(s) for further information

Peter Waanders (SAMDB NRM Board); Andy Lowe (DEH – also see Jeff Foulkes & Nigel Willoughby); Qifeng Ye (SARDI)

5.2 Biology, tolerance and adaptation of native species to environmental extremes [D8]

Description

Current understanding of the ecophysiology of species and their tolerances to changes in climate and available water undermine efforts to manage species and populations in the face of environmental changes.[3] Changes in environmental conditions include shifts in climatic conditions, changes in landuse and management techniques as well as changes in water quality and flows in rivers and streams. In terrestrial systems, the fragmentation of native habitats means that individual animals and plants may be isolated and unable to move themselves or propagation materials to sites where conditions are better suited to their ecophysiology.

The SAMDB NRM Board in particular requires an understanding of the ecophysicological tolerances of threatened and keystone species. Threatened species are potentially most vulnerable to changes in environmental conditions, and the Board requires an understanding of these for conservation planning in partnership with key agencies, such as the Department for Environment and Heritage.

Currently, there is no agreed list of "keystone" species that the Board could use to inform its planning and management. The Board would be interested in research that identified important ecological processes and individual species that require management attention from the Board to ensure the maintenance of ecological function of native ecosystems.

Project 5.1 informs this project, which in turn can provide information to underpin research in project 5.3. It will provide information of use to Project *5.11 Integrated Landscape Scale Modelling and Scenario Testing.*

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[3] Current efforts to model bioclimatic envelopes is limited due to insufficient knowledge of the ecophysiology of species of interest.

Purpose of Research

To improve predictions of the impact of environmental changes to inform management decisions for conservation planning.

Possible Funding Sources

- Australian Research Council (ARC)
- Land & Water Australia (LWA)
- Commonwealth Environmental Research Facilities (CERF)
- Centre for Natural Resource Management (CNRM)
- DEH Biological Survey and Monitoring
- Forestry SA
- Universities & Museums
- Department of Environment and Water Resources (DEWR)
- SAMDB NRM Board

Urgency: Because this information is not currently available, it is probable that the Board is either causing damage to the environment and community or is much less effective in achieving improvements

Priority: Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

Primary contact(s) for further information
Peter Waanders (SAMDB NRM Board); Andy Lowe & Jeff Foulkes (DEH); David Paton (University of Adelaide); Dale McNeil and Victor Sadras (SARDI)

5.3 Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management [T5]

Description

Ecological processes underpinning the integrity of species and ecosystems in the region are not well understood. The ability of managers to respond to pressures from threatening processes is subsequently weakened but could be improved with improved knowledge and refined conceptual models. Processes of interest effect ecosystems at the level of structure, function and composition. Key processes of interest include:

- Fire
- Fragmentation/connectivity
- Recruitment (including competition and invasion)
- Dispersal
- Mortality (including predation)

This is supported by projects 5.1 and 5.2. It will provide information of use to Project *5.11 Integrated Landscape Scale Modelling and Scenario Testing.*

Purpose of Research

To inform and direct restoration and management activities

Existing information and research

There is a significant body of ecological theory and experience published in the scientific literature on this issue. There is much less information on specific ecological processes within the SAMDB NRM region.

- David Paton and his students have undertaken research on the impact of fire regimes on bird populations in Ngarkat National Park.

Possible Funding Sources

This is an information gap to be addressed largely at a national and state level. The NRM Board strongly supports research which creates greater understanding of Australian ecological processes, particularly for ecosystems within the SAMDB NRM region.

- Australian Research Council (ARC)
- Australian Ecosystem Observation Network (AEON)
- Murray Darling Basin Commission (MDBC)
- Department for Environment and Heritage (Fire program & seed bank)
- Commonwealth Environmental Research Facility (CERF) projects
- Centre for Natural Resource Management (CNRM)
- Universities (in-kind expertise and students)

Urgency

- Because information on understanding of specific processes relevant to management of assets within the SAMDB NRM region is not currently available, it is probable that the Board is either causing damage to the environment and community or is much less effective in achieving improvements
- Building an understanding of general ecological theory is important to continue to build for the region

Priority: Without the research, the Board will be much less effective at protecting ecological assets in the region

Primary contact(s) for further information

Peter Waanders and Bernadette Lawson (SAMDB NRM Board), Meredith Henderson [fire], Phil Ainsley [seed biology], Peter Cale & Andy Lowe [ecological processes] (DEH)
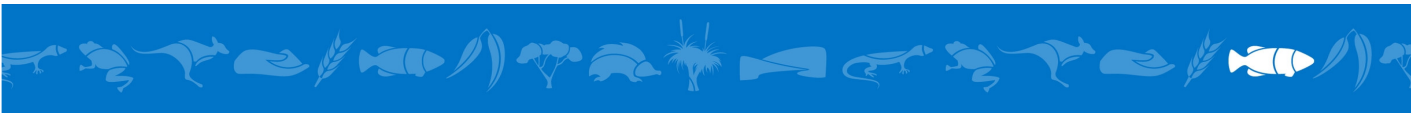
5.4 Ecological restoration techniques/works [D9]

Description

A program of experimentation is sought on large scale revegetation/restoration projects. Research is required to identify optimal restoration/revegetation approaches to achieve a range of conservation outcomes. The SAMDB NRM Board encourages research that:

- Is large scale and ongoing (50+ years). Small scale, short term projects will not provide the information that is required by the Board. It takes many years of vegetation growth to produce the diversity of niches that natural habitats provide (e.g. A range of vegetation heights, hollows in trees, plant leaf litter)

- Of sufficient size to allow valid statistical analysis. Demonstrations of habitat restoration techniques are far less valuable than scientifically designed experiments that allow statistical comparisons of different restoration options. This requires the establishment of replicated, multi-factorial experiments.

- Includes an analysis of cost of works and ecological outcomes. The Board seeks to achieve the greatest ecological benefit from the limited resources it has at its discretion. It is therefore particularly interested in the inclusion of a robust accounting of the costs associated with restoration and the ecological benefits that accrue as a result.

- Include treatments such as:
  o plant density (planting, direct seeding or regrowth)
  o patch heterogeneity (clumped/even)
  o landscape placement effects
  o species mix (high/low diversity)

- Include measures such as:
  o genetic level contribution to ecological outcomes from restoration (i.e. provenance and seed source)
  o collateral effects (e.g. effect of large scale revegetation on water-dependent ecosystems)
  o successional processes within restored habitat
  o success of propagation techniques

This topic is related to topic *5.5 Strategic placement of vegetation within an experimental adaptive management framework* which identifies where the greatest value can be gained by placing new habitat within a landscape context.

Purpose of Research

The conservation of native species is under threat as a result of past clearing of native habitat. Ecological theory suggests that the current area of native habitat can support a much lower abundance of species than is currently found in these habitats. Anecdotal evidence suggests that the populations of some native species are declining rapidly, and many ecologists expect that many hundreds of native species will become extinct in the future as a result. To slow down or halt this rate of extinction, new habitat will need to be created. Existing areas of degraded native habitat will need to be restored.

The principal purpose of this research is to find optimal techniques for cost-effective habitat restoration, to increase the extent and connectivity of vegetation and reduce the chance of species scarcity leading to extinctions.

Existing information and research

- MDBC is funding a project to evaluate the effectiveness of riparian restoration (contact: Paul Reich, Monash University).

Possible Funding Sources

- River Murray Forest (DEH/DWLBC)
- Centre for Natural Resource Management (CNRM)
- Philanthropic foundations (e.g. Potter Foundation)
- Land & Water Australia
- Mining / Industry
- Department for Environment and Heritage
- Carbon traders/brokers (emergent source)
- Australian Greenhouse Office
- Community Groups (Local Action Planning Groups etc)
- Non-government organisations (e.g. Trees for Life, Greening Australia)

Urgency: Because this information is not currently available, it is probable that the Board is either causing damage to the environment and community or is much less effective in achieving improvements

Priority: Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

Primary contact(s) for further information

Sarah Lance (SAMDB NRM Board); Andy Lowe and Brenton Grear (DEH); Damien Pearce (DWLBC); David Paton (University of Adelaide)

5.5 Strategic placement of vegetation within an experimental adaptive management framework [T4]

Description

There is a significant body of research in the scientific literature on the ecological value of different patch sizes and their connectivity. There is also an increasing amount of research that uses modeling to identify where revegetation may have benefits in terms of reduced wind erosion and reduced recharge of water to groundwater systems. This research informs the Board in understanding the value of revegetation depending on:

- The scale of revegetation (what are optimal sizes for priority conservation objectives)
- The placement of vegetation to achieve optimal outcomes
- Trade-offs for alternate land uses
- Complementarities / diversity at the landscape scale

To achieve various functions in the landscape (habitat for species, reduced groundwater recharge, reduced wind erosion, economic returns).

The Board seeks a consolidation and review of this information to provide business rules for the Board in making investment decisions and to identify gaps in the knowledge base that could be improved through further research. The Board considers that this research is best undertaken nationally, but is willing to make its programs in revegetation, particularly large scale programs, available for research and data collection to ground-truth knowledge and ideas generated through theoretical modelling.

This topic is related to topic *5.4 Ecological restoration techniques/works* which aims to identify how to re-establish native species to create native habitats. It will provide information of use to Project *5.11 Integrated Landscape Scale Modelling and Scenario Testing.*

Purpose of Research

To improve the cost-effectiveness of restoration and revegetation investment

Existing information and research

There is a significant body of ecological theory and experience published in the scientific literature on the relative value of vegetation patch size and distribution within a landscape.

The last five years has seen numerous attempts to use GIS-based modeling to identify the value of revegetation on various landscape values (salinity, biodiversity, erosion, economic productivity) depending on its geographical placement:

- Florasearch project (CRC Plant Based Management of Dryland Salinity)
- Lower Murray Landscape Futures (CSIRO and DPI Victoria)
- Mallee Futures project (CSIRO and DWLBC)
- Recharge in the Bremer catchment of the Eastern Mt Lofty Ranges (Rural Solutions)

Possible Funding Sources

- River Murray Forest (DEH / DWLBC)
- Department for Environment and Heritage (Biological Survey & Monitoring)
- Universities (in-kind and students)
- DWLBC
- MDBC
- Community groups (Local Action Planning Groups)
- Non-government organisations (eg. Trees for Life, Greening Australia)

Urgency: If this information is not available within the next seven years, the Board will potentially cause damage to the environment and community or be much less effective in achieving improvements in resource condition

Priority: Without the research, the Board will be much less effective at protecting ecological assets in the region

Primary contact(s) for further information

Peter Waanders (SAMDB NRM Board); Mark Lethbridge (Flinders University); Andy Lowe and Jeff Foulkes (DEH); Janet Kuys (Rural Solutions)

5.6 Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analyses [R3 & R10]

Description

The Board needs a scientific framework to pull together information on the function and requirements of ecological assets in the River Murray system so it can be ready to respond to a changing water management environment. An ability to bring together data and models that already exist is required to create an integrated understanding of water management, ecosystem management and biodiversity conservation. The Board can then make informed decisions about the trade-offs between alternative ecological outcomes.

This will deliver information and be informed by research undertaken in projects 5.7, 5.8 and 5.9. It will provide information of use to Project *5.11 Integrated Landscape Scale Modelling and Scenario Testing.*

This work should build upon existing research being undertaken to develop more integrated models of ecological function in the region including:

- Coorong, Lower Lakes and Murray Mouth project (CSIRO Water for a Healthy Country, University of Adelaide, SARDI, Flinders University, SA Water, DWLBC)
- Lower Murray Landscape Futures (Land Technologies Alliance, CSIRO, DPI Victoria, University of Adelaide, DWLBC)
- CSIRO Water for a Healthy Country

Purpose of Research

The framework developed would enable the Board to undertake scenario modeling to identify what the region's aquatic systems will look like under different management regimes. The development of an integrated modeling framework and subsequent scenario testing would also help identify knowledge gaps.

Some specific questions the Board is interested in answering include:

- What are the services that floodplains provide to the river system?
- What are the consequences of disconnection between floodplain and river and consequences of connection or more infrequent basis (flow vs flood)
- Do the same ecological responses emerge from manipulated inundation events as natural floods?

- What is the role of hydrology vs other measures such as revegetation in restoration of floodplains?
- Are the icon sites enough to protect ecological systems and species?
- What is the value of longitudinal connectivity between the top and bottom of the river?

Existing information and research

- CSIRO already has a project to develop such a mechanism, so SAMDB investment could add value to this framework to plug the gaps.
- The Lower Murray Landscape Futures project has developed a modeling framework for the relationship between hydrology and salt loads in the River
- The Coorong, Lower Lakes and Murray Mouth project is developing such a framework for its particular area of interest

Possible Funding Sources

- CSIRO Water for a Healthy Country
- Murray Darling Basin Commission (MDBC)
- Australian Research Council (ARC)

- National Water Initiative (NWI)
- Australian Government
- Department for Environment and Heritage

Urgency: If this information is not available within the next seven years, the Board will potentially cause damage to the environment and community or be much less effective in achieving improvements in resource condition

Priority: Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

Primary contact(s) for further information

Peter Waanders (SAMDB NRM Board), Rod Oliver, Sebastien Lamontagne (CSIRO), Dale McNeil (SARDI), Brenton Grear (DEH)

5.7 Ecological impacts of different water management strategies in the Eastern Mt Lofty Ranges [D2 & D3]

Description

The highest priority is to collate existing information on

- Surface- and ground-water drivers and processes, including interactions
- What are the stresses and contributors to water regimes
- What are the impacts of different water regimes on biota
- What evidence exists on effective restoration techniques for aquatic and riverine habitat, e.g. low flow bypass

Much of this work is being carried out as part of the current water allocation planning process in the EMLR, including development of conceptual models of environmental water requirements for different types of habitats.

Once this information is collated, the next priority is to use the information and new experimentation to test existing ecosystem response models to identify ecological limits and thresholds. The priority for this work is processes and management relating to refuge pools and low flow preservation and connectivity.

The Board is also interested in continuing to refine and develop surface- and ground-water models and understanding of interactions between surface- and ground-water, and to integrate these with each other and with ecological models of the systems they affect.

This project could be seen as a sub-set of project *5.6 Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analyses*, but is particularly focused on the eastern Mt Lofty Ranges and aims to inform the development of a Water Allocation Plan for the region.

Purpose of Research

Better understand the impact of water regimes (flow volumes, timing, and quality) on water-dependent ecological systems within the Eastern Mount Lofty Ranges (EMLR), to improve the effectiveness of environmental water provisions and the scientific foundation of a Water Allocation Plan for the sub-region.

Of particular interest to the SAMDB NRM Board is to identify what flow regimes are required to ensure the integrity and survival of refuge sites and provision of appropriate connectivity within the creeks and rivers of the EMLR.

Existing research

- Understand surface hydrology (this is being done by DWLBC & NRM)
- Understand groundwater and surface water – ground-water interactions (this is being undertaken by DWLBC and part-funded through NWI)
- Basic fish and longer term monitoring (this is being undertaken by Mike Hammer)
- Process related plant ecology (this has been undertaken by Brian Deegan)

Possible Funding Sources

- CSIRO Water for a Healthy Country – interest in co-investment for large, integrated projects
- Centre for Natural Resource Management (CNRM)
- NWI – projects of national application
- MDBC – Lower Lakes, Living Murray
- Australian Government – integrated research
- Department for Environment and Heritage

Urgency: If this information is not available within the next seven years, the Board will potentially cause damage to the environment and community or be much less effective in achieving improvements in resource condition

Priority: Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

Contacts

Mardi van der Wielen (SAMDB), Michelle Bald (DWLBC), Mike Hammer (University of Adelaide), Adrian Stokes (DEH)
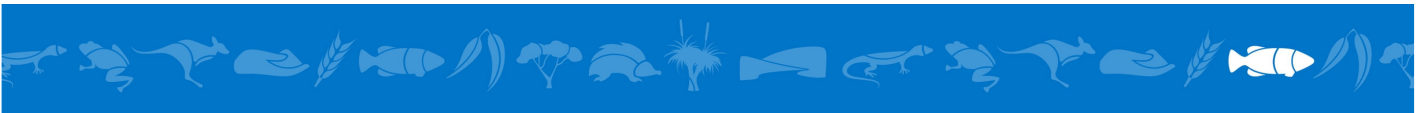
5.8 Integrated salt and water balance in the riverine corridor [R11]

Description

Over the last decade considerable investment has been made in the SA MDB NRM Board region on developing robust salinity modelling tools (i.e. SIMPACT/SIMRAT, various MODFLOW models etc.) to predict the impact that irrigation development and other land use changes will have in increasing inflows of saline groundwater to the riverine corridor (i.e. the river, floodplain and wetlands) of the River Murray. Much less attention has been directed toward understanding and modelling the movement of this salt through the floodplain and its wetlands, and the role that floodplain, wetland and river management have on the spatial and temporal delivery of salt to the River Murray. While there has been some research and model development (i.e. the regional scale Floodplain Risk Methodology (FRM), and WAVES and WINDS modelling on the Chowilla floodplain) on salt accumulation in floodplain soils, this has been focused on just the floodplain ecological consequences, rather than river salinity outcomes.

We know from past floods at Chowilla that very large salt loads to the river are generated after flooding, and so it is not unreasonable to expect that any initiatives to improve the flow regime of the floodplains and wetlands (i.e. Living Murray actions and other watering initiatives of the River Murray Environmental Manager) could potentially lead to increased salt loads to the river which would need to be managed accordingly. We also know from the recent drought that once pools levels drop below entitlement increased flows saline groundwater into the wetlands and river occurs, however we have little understanding of the location and magnitude of these impacts. Integrated modelling of floodplain/wetland salt storage and movement is fundamental to South Australia meeting its obligations and targets under the MDBC Basin Salinity Management Strategy and Living Murray and other initiatives.

The aim of this research is to develop a regional scale (SA/NSW/Vic Border to Lower Lakes) integrated (river-floodplains-wetlands-highland) model of salt storage and movement within the riverine corridor. The model will build upon existing spatial floodplain hydrology and salinity models that have been developed for South Australia (Flood Inundation Model (FIM), WINDS, Floodplain Risk Methodology (FRM) etc.). Even with these tools as a starting point, the project poses a very significant challenge because of the geomorphological, hydrological and hydrogeological complexity of the riverine corridor, and the paucity of data, particularly in relation to the spatial distribution of soil types, groundwater depths and salinities, floodplain elevations, and wetland water depths and salinities. For this reason, the project would need to involve the collection of these fundamental data and/or surrogates. Preliminary results from a recent

airborne EM survey of the Chowilla floodplain are demonstrating that this approach can, with appropriate field validation through drilling programs, provide very good spatial information on the floodplain hydrogeology, particularly in identifying areas of high/low salt storage, and groundwater depths and salinities. Moreover, collection of spatial LIDAR (Light Detection and Ranging) data for Chowilla has allowed the development of high resolution elevation maps and hydrodynamic models for the floodplain and wetlands which can be used to identify areas and depths of inundation at different river flows, and how these may change with the operation of new flow regulation structures. Extension of both of these airborne surveys to the remaining areas of the riverine corridor (including around the Lower Lakes), including field validation, would be an essential first component of this project. It is important to note that both of these data sets would be of value to other SA MDB NRM Board projects beyond just this particular application.

The information will be of use to project *5.6 Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analyses.* It will provide information of use to Project *5.11 Integrated Landscape Scale Modelling and Scenario Testing.*

Purpose of Research

The integrated modelling proposed here is fundamental for designing scenarios to maintain neutral salt and water balances in the riverine corridor so as to meet South Australia's obligations under the MDBC Basin Salinity Management Strategy and Living Murray initiatives. The modelling will thus enable regional scale salt accounting in the riverine corridor. The proposed approach involves the development of salt storage and movement models for the floodplain and wetlands, and their integration with the river flow models (such as BIGMOD and its replacement) and the highland land use impact models (SIMPACT/SIMRAT, MODFLOW etc). This will allow the development of regional-scale management scenarios in which the river salinity impacts (both positive and negative) of long-term land use change, flow and wetland management, and salt interception schemes can be predicted. This will clearly guide the prioritisation of investment in salinity management within the riverine corridor so as to optimise both the river salinity and ecological benefits. The Board fully supports this research that it believes should be resourced and coordinated through existing multi-lateral processes at a Basin scale.

Possible Funding Sources

- DWLBC
- Centre for Natural Resource Management (CNRM)
- Murray Darling Basin Commission (MDBC)
- National Water Initiative (NWI)

Urgency: If this information is not available within the next seven years, the Board will potentially cause damage to the environment and community or be much less effective in achieving improvements in resource condition

Priority: Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

Primary contact(s) for further information

Ian Jolly and Glen Walker (CSIRO Water for a Healthy Country Flagship), Judy Goode and Peter Waanders (SAMDB NRM Board), Phil Cole (DWLBC)

5.9 Smart use of water to gain maximum overall value and increase robustness of systems that rely on water [R6&R18]

Description of Research

Information is required to improve the ability of the SAMDB NRM Board to allocate water to get greatest environmental and economic outcomes from the water supply. More information is required to understand how water flows between assets and through systems within the Murray River Basin. Some of the research and development required includes:

- Process flow and the development of optimization models that account for economic and environment benefits
- Continued improvements salt and water balance models, particularly on the floodplain
- Revising and redefining leaching requirements for irrigated horticulture along the River

This project has a strong link to project *5.6 Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analyses*. It will provide information of use to Project *5.11 Integrated Landscape Scale Modelling and Scenario Testing.*

Purpose of Research

The primary purpose of the research is to provide information that can be used by the SAMDB NRM Board to allocate water to get greatest environmental and economic outcomes from the water supply that is available. The information will be used when making decisions on investing in infrastructure or undertaking policy reform. The research should sit within the context of research being undertaken across the whole Basin and is best managed and resourced at a state and national level.

Existing Information and research

- CSIRO modeling
- Tony Herbert (DWLBC)
- DWLBC hydrological modeling
- CRC eWater – River Manager model
- Justin Brookes (University of Adelaide) and Mike Burch (SA Water) – Water quality modeling
- Fish studies – McNeil and Qifeng Ye (SARDI)
- DWLBC – EMLR environmental water requirements
- Holger Maier – confidence limits on ModFlow and resource optimization framework in SE

Possible Funding Sources

- Murray Darling Basin Commission (MDBC)
- DWLBC
- PIRSA

- National Water Initiative (NWI)
- National Action Plan for Salinity and Water Quality (NAP)

Urgency: Because this information is not currently available, it is probable that the Board is either causing damage to the environment and community or is much less effective in achieving improvements

Priority : Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

Key Contacts: Gerrit Schrale (SARDI), Holger Maier/Graeme Dandy (University of Adelaide) and Phil Cole (DWLBC)

5.10   More robust production systems [D11]

Description of Research

- Research on the biology, tolerance and adaptation of established and new production systems to enable improved coping regimes in response to more extreme temperature, salinity, water supply and water security
- Strategic research to identify what adaptations production systems will have to undergo to cope with higher costs for water and other inputs

Purpose of Research

The Board would like to have a better understanding of the risks to sustainable agricultural production in the region from changing environmental conditions such as high temperatures, lower/higher rainfall, lower/higher river flow, lower/higher salt loads into the river. The Board also encourages the development and improvement of production systems that are more resilient to changes in environmental conditions to ensure the continued sustainability of agriculture and horticulture within the region.

Ideally, the Board seeks an ability to carry out scenario analyses to identify what the likely stresses will be on existing production systems and what the potential responses (biophysical & economic stresses/responses) may be. Such scenario analyses should ideally be undertaken in consultation with industry in the region to determine the scenarios. Scenario outputs will identify risks to and opportunities for agriculture and horticulture in the future, and will identify areas where information for effective planning is lacking and requires further research.

The Board supports research in this area, which it believes should be funded and coordinated at a state and national level. It will provide information of use to Project *5.11 Integrated Landscape Scale Modelling and Scenario Testing.*

Existing Information/Work

- Heat stress impact on yield and quality (Sadras and Major growers)

- Charactierising climate in Clare and Riverland (Uday)

- Boron and salt tolerance of vines (Rob Stevens)

- Using saline water in potatoes and onions (Rob Stevens)

- Water use efficiency at the micro-scale (Julie Styles – Loxton)

- Rootzone salinity (Tapas)

- I.R.E.S. (ICMS)

- Lower Murray Landscape Futures (Connor & Bryan)

- Quality aspects of wine (CSIRO Food – Simon Robinson)

- Advanced fertigation systems for citrus (Schrale)

- SARDI Mallee Lucerne Project (Kobelt)

Possible Funding Sources

- Australian Research Council (ARC)
- Horticulture Australia Ltd (HAL)
- Land & Water Australia (LWA)
- Murray Darling Basin Commission (MDBC)
- National Water Initiative (NWI)
- Grape and Wine Research & Development Corporation (GWRDC)

- PIRSA
- Dairy Research & Development Corporation (DRDC)
- Meat & Livestock Australia (MLA)
- Council of Australian Governments (CoAG)
- Riverland Irrigation Trust
- Central Irrigation Trust

Urgency: Because this information is not currently available, it is probable that the Board is either causing damage to the environment and community or is much less effective in achieving improvements

Priority: Without the research, the Board will be unable to protect important ecological assets of the region, and they will be irreversibly degraded or become extinct

Key Contacts: Victor Sadras (SARDI) and Dan Meldrum (SAMDB NRM Board)

5.11   Integrated landscape Scale Modeling and Scenario Testing [R29]

Description of Research

This research would bring together much of the research described in all of the other research topics in this Prospectus. Integrated modeling of regional processes is important because it enables the Board to understand the relationship between different parts of the system. Much of the research described to this point in the Prospectus aims to better understand individual components of the system. This is very important and is a fundamental requirement of being able to undertake integrated modeling. Regional Scale Integrated Modeling brings together the knowledge from this more fundamental research to establish modeling frameworks which can then be used to run different "scenarios" of management and future conditions to determine what the overall impact in the region would look like.

An important component of integrated modeling is to include economic impacts and influences in the modeling framework. This will enable the Board to undertake regional economic studies of achievement through NRM Investment Strategies and Plans. It will be able to estimate the net economic outcome of its investments that takes into account the costs of implementation, changes in agricultural output and value, development of new industries and flow-on economic benefits and environmental services delivered.

Purpose of Research

The purpose of the research is to enable the Board to assess the impact of its investment, the collective actions of landholders and external influences such as climate change, on the economic, social and environmental outcomes for the region. This information can be used to develop plans that are underpinned by the best available science, will inform the setting of resource condition targets and the design of monitoring programs and also identify where our current knowledge is inadequate to make properly informed investment decisions in NRM. This research needs to be undertaken and coordinated at a regional scale.

Existing information and research

- Lower Murray Landscape Futures
- Coorong, Lower Lakes and Murray Mouth
- Australian Ecosystem Observation Network (under development)
- Resource Optimisation Framework in the Upper South East
- Department for Environment and Heritage

Possible Funding Sources:

- CSIRO
- Murray Darling Basin Commission (MDBC)
- Australian Research Council (ARC)
- DWLBC
- Department for Environment and Heritage (DEH)
- Centre for Natural Resource Management (CNRM)
- National Water Initiative (NWI)
- Department of Environment and Water Resources (DEWR)
- Department of Employment, Science Technology (DEST)

Urgency: This research is important to continue to build our understanding of natural/social processes within the region

Priority: Without the research, the Board will be much less effective at protecting ecological assets in the region

Key contact: Wayne Meyer (University of Adelaide), Brett Bryan & Jeff Connor (CSIRO), Andy Lowe and Jeff Foulkes (DEH)

5.12   Holistic Regional Economic Evaluation of NRM Investment [S3, S8 & S13]

Description of Research

While this is an area of research that can be included in the integrated modeling described above, it is also an area that could be developed discretely. Currently, investment in NRM activities are made with negligible assessment of their economic impact. Where these analyses have existed in the past, they have assessed only the impact of the investment on loss in agricultural production. However, the full economic cost or benefit must also take into account the cost of implementing any actions (including opportunity costs), the growth in new industries (nurseries for growing trees, fencing contractors, weed control operators etc) and the delivery of ecosystem services (eg. Carbon storage, reduced salt loads). Such research will require more than just a straight economic analysis of inputs and outputs but will require the use of regional economic impact models.

The SAMDB NRM Board is also of the view that it would be preferable to include non-market values in this analysis.

Purpose of Research

The purpose of the research is to develop methodologies and tools to calculate the net economic outcome of NRM investment that takes into account the costs of implementation, changes in agricultural output and value, development of new industries and flow-on economic benefits and environmental services delivered. This can lead to a holistic assessment of the relative public and private value of various management changes which can then be compared and tested with the perceptions of the community about of the relative economic value of actions to them and the broader community. This information could be used to inform the design of incentive programs. The Board believes that this research is best coordinated and resourced at a national level.

Existing information and research
- Lower Murray Landscape Futures

Possible Funding Sources:

- Department of Environment and Water Resources (DEWR)
- DWLBC
- Department for Environment and Heritage (DEH)
- Centre for Natural Resource Management (CNRM)

- Murray Darling Basin Commission (MDBC)
- Department of Agriculture, Fisheries and Forestry (DAFF)
- National Water Initiative (NWI)

Urgency: This research is important to continue to build our understanding of natural/social processes within the region

Priority: Without the research, the Board will be much less effective at protecting ecological assets in the region

Key contact: Jeff Connor (CSIRO), Denise Fowles (SA MDB NRM Board)

5.13 Extended Evaluation of Market Based Instruments [S9 & S10]

Description of Research

Market Based Instruments are currently being tested across Australia for their efficiency and effectiveness at encouraging and resourcing improvements in the management and condition of natural resources. This information needs to be consolidated and reviewed to identify the lessons learned to date.

The SAMDB NRM Board is also supportive extending this research to determine if these instruments can also be used with groups as well as individuals. The Board would be particularly interested in instruments that pay for services delivered at a catchment scale rather than inputs at a local scale.

The Board is particularly interested and supportive of mechanisms that require less administration and logistics from the Board, freeing up resources for on-ground action.

Purpose of Research

To improve the effectiveness and efficiency of the Board's operations and investment in on-ground activities in natural resource management

Existing information and research

- Policy and Economic Research Unit, CSIRO Land and Water – Catchment Care Incentive Schemes
- O'Connor NRM – BushBids Biodiversity Stewardship Initiative
- DWLBC, South Australian Biodiversity Assessment Tool
- Chris Raymond, SAMDB – Community Values Assessment Tool
- DWLBC currently have a project funded by the National Water Initiative to review salinity credit trading schemes
- WaterFind Environmental Trust

Possible Funding Sources

- Australian Government
- State Government

Urgency: This research is important to continue to build our understanding of natural/social processes within the region

Priority: Without the research, the Board will be much less effective at protecting ecological assets in the region

Key contact: Jeff Connor (CSIRO), Denise Fowles (SA MDB NRM Board)
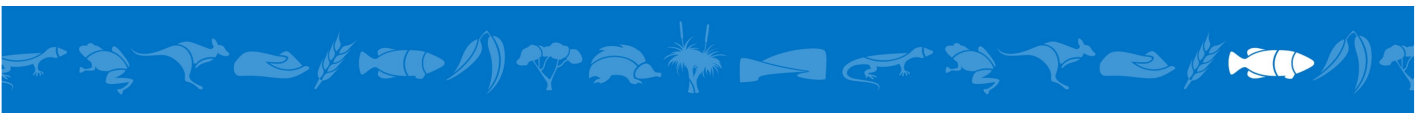
6. Proposed Next Steps

The workshop participants will have an opportunity to review these notes and provide feedback. The revised notes will be discussed with staff from the SAMDB NRM Board in late June and a final Prospectus will be submitted to the Board at the end of June.

The participants at some of the workshops identified the need to coordinate research across the research priorities, given the links between them (See Fig. 4). There are significant opportunities to gain greater value from the research if the information and activity from each can feed into other research activities. A mechanism to enable this coordination to happen is to establish a number of Research Coordinating Committees under the Technical Working Group of the Centre for Natural Resource Management. The role of the Research Coordinating Committees would be to coordinate research across the region. They would potentially report to the Technical Working Group who may use an independent reviewer to review the activities of research from time to time to ensure high scientific standards are maintained. These groups could also be asked to develop the areas of research to be included in the 2008 Prospectus that were not included in the 2007 Prospectus. A proposed list of participants in these Committees are listed on the next page.

The Board has contracted a Research Manager, Paul Dalby from In Fusion Consulting, to assist in the coordination and promotion of the Board's research interests. As well as ensuring the functions of the Research Coordinating Committees identified above are being carried out, he also has the responsibility of integrating research and development into planning processes, facilitating the development of stronger ties between the Board, its staff and the research community and in building strong links between the Board and the Centre for Natural Resource Management. Some of the activities planned are a Regional Science Conference and presentations by researchers to the Board and its staff.

Possible Research Coordinating Committee – Ecological Systems in SAMDB

- Peter Waanders (SAMDB NRM Board)
- Mardi van der Wielen (SAMDB NRM Board)
- Andy Lowe (Department for Environment and Heritage/University of Adelaide)
- Michelle Bald (DWLBC)
- Dale McNeil (SARDI)
- Peter Cale (Department for Environment and Heritage)
- David Paton (University of Adelaide)
- Rod Oliver (CSIRO)
- Sebastien Lamontagne (CSIRO)

Possible Research Coordinating Committee – Production and Hydrology in SAMDB

- Dan Meldrum (SAMDB NRM Board)
- Bernadette Lawson (SAMDB NRM Board)
- Wayne Meyer (University of Adelaide)
- Rob Thomas (SARDI)
- Gerrit Schrale (SARDI)
- Phil Cole (DWLBC)
- A person from CSIRO hydrology team
- A representative who can report to Tri-State Forum
- A representative from MDBC

Possible Research Coordinating Committee – Economics, Social value and Integrated Modelling in the SAMDB

- Sarah Lance (SAMDB NRM Board)
- Planning Manager for SAMDB NRM Board (to be appointed)
- Wayne Meyer (University of Adelaide)
- Jeff Connor (CSIRO)
- Brett Bryan (CSIRO)

Appendix A. Attendees at Workshops

<u>*Attendees – Ecological Processes Workshop, 23 May 2007*</u>

- Andy Lowe – University of Adelaide and DEH
- Dale McNeil – SARDI
- David Paton – University of Adelaide
- Jason Nicol – SARDI
- Jason Higham – SARDI
- Mardi van der Wielen – SAMDB NRM Board
- Michelle Bald – SAMDB NRM Board
- Mike Hammer – University of Adelaide
- Peter Cale – DEH
- Rod Oliver – CSIRO
- Sarah Kuchel – SAMDB NRM Board
- Sebastien Lamontagne – CSIRO
- Lisa Stribley – SAMDB NRM Board
- Stephanie Williams – CNRM/DWLBC

<u>*Attendees of Production, Irrigation and Hydrology Workshop, 25 May 2007*</u>
- Fred Leaney – CSIRO
- Gerrit Schrale – SARDI
- Graham Green - DWLBC
- Ian Jolly – CSIRO
- Rob Stevens - SARDI
- Rob Thomas – SARDI
- Victor Sadras - SARDI
- Wayne Meyer – University of Adelaide

Attendees of Living Laboratories Workshop on M&E, 31 May 2007

Speakers
- Andrew Johnson – DWLBC
- Patrick O'Connor – O'Connor NRM
- Neville Crossman – CSIRO
- Christine Maher – Flinders University
- Paul Dalby – ICE WaRM
- Tony Meisner – DWLBC

Organising Committee
- Andrea Cast – DWLBC/CSIRO
- Patrick O'Connor – O'Connor NRM
- Paul Dalby – ICE WaRM
- Karen Parry – DWLBC
- Sophie Hastwell – ICE WaRM
- Stephanie Williams - CNRM

Participants
  NRM Board Staff
- Keith Smith – AMLR NRM Board
- Steven Gatti – AMLR NRM Board
- Naomi Scholz – EP NRM Board
- Grant Flanagan – KI NRM Board
- Sandy Gunter – SAAL NRM Board
- Barry Lincoln – SAAL NRM Board
- Lucy Schapel – SAMDB NRM Board
- Peter Waanders – SAMDB NRM Board
- Cameron Welsh – SAMDB NRM Board
- Tracey Steggles – SAMDB NRM Board
- Callie Nickolai – SAMDB NRM Board
- Rebecca Turner – SAMDB NRM Board

  Research providers
- Neville Crossman – CSIRO
- Peter Boxall – CSIRO (visiting from USA)
- Agnas Gandgirard – CSIRO (visiting from France)
- Christine Maher – Flinders University
- Erin Parham – Flinders University
- Duncan Mackay – Flinders University
- Dale McNeil - SARDI
- Megan Lewis – University of Adelaide
- Wayne Meyer – University of Adelaide
- Mike Geddes – University of Adelaide
- Kala Saravan – University of New England, NSW
- Beverley Coombes – UniSA

  State Government Agencies (excluding NRM Boards)

- Stephanie Williams – CNRM/DWLBC
- Tony Meisner – DWLBC
- Andrea Cast – DWLBC/CSIRO
- Anna Dutkiewicz - DWLBC
- Lissa Fountaine - DWLBC
- John McConachie – DWLBC
- Wendy Harris - DWLBC
- Simon Goodhand - DAFF
- Phil Pisanu – DEH
- Doug Fotheringham - DEH
- Patricia von Baumgarten - DEH
- Andrew Solomon - EPA
- Carmel Schmidt - PIRSA

Other Organisations
- Jane Corin – Conservation Council of SA
- Paul Dalby – ICE WaRM
- Tim Milne – Nature Conservation Society of SA
- Janet Pedler – Nature Conservation Society of SA
- Patrick O'Connor – O'Connor NRM

Attendees of Living Laboratories Workshop on Emerging Tools to Respond to and Influence Community Values in Natural Resource Management – 13th June

Speakers
- Mike Young - University of Adelaide
- Merv Lewis - NY NRM Board
- Sally Pederick - SAMDB NRM Board
- Patrick O'Connor – O'Connor NRM
- Tim Dendy - DWLBC
- Darren Willis - DWLBC
- Chris Rawlinson - Helpful Partners Pty Ltd
- John Leake - Land Repair Australia
- Mike Seyfang - mikeseyfang.com
- Brett Bryan – CSIRO Land and Water
- John Ward - CSIRO Land and Water

Organising Committee
- Paul Dalby – ICE WaRM
- Wendy Harris – DWLBC
- Andrea Cast – DWLBC/CSIRO
- Christine Maher – Flinders University
- Stephanie Williams – CNRM/DWLBC
- Sophie Hastwell – ICE WaRM

Participants
  Research Organisations
- Darran King - CSIRO Land and Water
- John Ward - CSIRO Land and Water
- Noel Richards - Flinders University
- Jonathan Sobels - Flinders University
- Jennifer McKay – UniSA
- Mike Young - University of Adelaide
- Brett Bryan – CSIRO
- Jeff Connor – CSIRO

  NRM Boards
- Sandy Gunter - Arid Lands NRM Board
- Merv Lewis - NY NRM Board
- Mardi van der Wielen - SAMDB NRM Board
- Sarah Kuchel - SAMDB NRM Board
- Peter Waanders - SAMDB NRM Board
- Jan Whittle - SAMDB NRM Board
- Simon Sherriff - SAMDB NRM Board
- Sally Pederick - SAMDB NRM Board
- Bianca Lewis - SAMDB NRM Board
- Tumi Bjornsson - SAMDB NRM Board

Government Agencies (excluding NRM Boards)
- Kate Zealand - DEH
- Russell Seaman - DEH
- Lee Heard - DEH
- Stephanie Williams - DWLBC
- Michael Good - DWLBC
- Wendy Harris - DWLBC
- Pikusa, Edward - DWLBC
- Andrew Fisher - DWLBC
- Tim Dendy - DWLBC
- Darren Willis - DWLBC
- Chris Raymond - DWLBC
- Carmel Schmidt - PIRSA
- Jacqueline Frizenschaf - SA Water

Other Organisations
- Julian James - City of Onkaparinga
- Bruce Munday - Clear Communications
- Chris Rawlinson - Helpful Partners Pty Ltd
- Paul Dalby - ICE WaRM
- John Leake - Land Repair Australia
- Mike Seyfang - mikeseyfang.com
- Patrick O'Connor - O'Connor NRM
- Dr Nigel Long - SAFF
- Andrew Lothian - Scenic Solutions
- Nicholas Newland – Newland Solutions
- Bianca Lewis
- Tian Shi - PIRSA

Appendix B. Linking the Prospectus to the Research Plan Priorities

Research Plan High Priorities	Prospectus Projects
T2. Inventory of biological/ecological assets	Inventory of biological and ecological assets
D9. & T4 Ecological restoration techniques/works including riparian, Strategic placement of vegetation	Ecological restoration techniques/works Strategic placement of vegetation within an experimental adaptive management framework
D2. Ecological impacts of different water management strategies in the EMLR	Ecological impacts of different water management strategies in the Eastern MLR
T1. Monitoring tools for adaptive management	Delayed
R11. Tools for improved salt and water balance models for SA Murray	Integrated salt and water balance in the riverine corridor
R10. Reuse of drainage water: Bioaccumulation, saline production of crops and fodder	Delayed
D11. Biology, tolerance and adaptation of established and new crop and animal species to extreme temperature, trends in temperature changes and salinity of water/soil	More robust production systems
D8. Biology, tolerance and adaptation of native species to extreme temperature, trends in temperature changes and salinity of water/soil	Biology, tolerance and adaptation of native species to environmental extremes
R18. Feasibility study for multiple use of water: environment, irrigation, and aquaculture.	Smart use of water to gain maximum overall value and increase robustness of systems that rely on water
R29. Scenario analysis of the likely future conditions of the NRM region	Integrated landscape Scale Modelling and Scenario Testing
D3.Better understanding of groundwater/surface water processes to assist in water allocation planning, particularly fractured rock in EMLR	Ecological impacts of different water management strategies in the Eastern MLR

Research Plan High Priorities	Prospectus Projects
T3. Risk identification and management for ecological assets in terrestrial ecosystems	Delayed
R5. Siting and design of irrigation systems to reduce water use, salt damage, and robustness to climate conditions, soil conditions	Delayed
R3. Understanding of the links between water management, ecosystem management and biodiversity: threatened and iconic species. R10. Tools for trade-off analysis between alternative ecological outcomes and water quality	Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis
R6. Matching cropping systems to perceived changes in the supply of water: Research and products to support adaptation to higher salt and lower water availability and higher cost scenarios for both high and low value crops.	Smart use of water to gain maximum overall value and increase robustness of systems that rely on water
T5.Basic ecological processes in terrestrial ecosystems to refine our conceptual models of how terrestrial ecosystems function and respond to pressure	Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management
D6. Key threatening processes to land resources, what we need to manage in the rangelands	Delayed
S3,S8 & S13. What other economic tools can replace Benefit:Cost Analysis, which are strongly influenced by time for benefit to emerge and the discount rate used. Non-Market Based Instruments for influencing behaviour change	[S3,S8 & S13] Holistic Regional Economic Evaluation of NRM Investment

Research Plan High Priorities	Prospectus Projects
S9. What could encourage private investment from outside the region to bring about landscape change? S10. What are the handful of approaches for coordinating biophysical, social and economic systems?	[S9 & S10] Extended Evaluation of Market Based Instruments

Appendix C. Linking the Prospectus to Resource Condition Targets

Resource Condition Target	Prospectus Research Topic	
1. Maintain and improve the extent and condition of 65% of current floodplain vegetation communities in areas of high priority by 2020	5.1	[T2] Inventory of biological and ecological assets
	5.2	[D8] Biology, tolerance and adaptation of native species to environmental extremes
	5.3	[T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management
	5.5	[T4] Strategic placement of vegetation within an experimental adaptive management framework
	5.6	[R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis
	5.8	[R11] Integrated salt and water balance in the riverine corridor
	5.9	[R6 & R18] Smart use of water to gain maximum overall value and increase robustness of systems that rely on water
	5.11	[R29] Integrated landscape Scale Modelling and Scenario Testing
2. By 2020, a 30% reduction in priority areas of floodplain currently affected by salinity from groundwater discharge	5.8	[R11] Integrated salt and water balance in the riverine corridor
3. Maintain and improve the condition and connectedness of 60% of wetlands of high priority by 2020	5.1	[T2] Inventory of biological and ecological assets
	5.2	[D8] Biology, tolerance and adaptation of native species to environmental extremes
	5.3	[T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management
	5.6	[R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis
	5.8	[R11] Integrated salt and water balance in the riverine corridor
	5.9	[R6 & R18] Smart use of water to gain maximum overall value and increase robustness of systems that rely on water
	5.11	[R29] Integrated landscape Scale Modelling and Scenario Testing
4. Maintain and improve the condition of 60% of the littoral zone of high priority and high significance by 2020	5.1	[T2] Inventory of biological and ecological assets
	5.2	[D8] Biology, tolerance and adaptation of native species to environmental extremes
	5.3	[T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management
	5.6	[R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis
	5.8	[R11] Integrated salt and water balance in the riverine corridor
	5.9	[R6 & R18] Smart use of water to gain maximum overall value and increase robustness of systems that rely on water
	5.11	[R29] Integrated landscape Scale Modelling and Scenario Testing

Resource Condition Target	Prospectus Research Topic
5. By 2020, improve the habitat in all waters to permit successful recruitment of native fish, particularly Murray Cod, resulting from natural or manipulated flows	5.1 [T2] Inventory of biological and ecological assets 5.2 [D8] Biology, tolerance and adaptation of native species to environmental extremes 5.3 [T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management 5.6 [R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis 5.7 [D2 & D3] Ecological impacts of different water management strategies in the Eastern MLR 5.8 [R11] Integrated salt and water balance in the riverine corridor 5.9 [R6 & R18] Smart use of water to gain maximum overall value and increase robustness of systems that rely on water
6. Recover 30% of water dependent ecosystems from pest infestation and minimize any further infestations by 2020	5.3 [T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management 5.4 [D9] Ecological restoration techniques/works 5.6 [R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis 5.7 [D2 & D3] Ecological impacts of different water management strategies in the Eastern MLR 5.13 Extended Evaluation of Market Based Instruments
7. By 2020, to have salinity of water in the River Murray less than 800EC for 95% of the time at Morgan to ensure drinking water standards	5.8 [R11] Integrated salt and water balance in the riverine corridor
8. By 2020, to have salinity of water in the River Murray less than 543EC for 80% of the time at Berri Irrigation Pump Station to ensure drinking water standards	5.8 [R11] Integrated salt and water balance in the riverine corridor
9. By 2020, to have salinity of water in the River Murray less than 770EC for 80% of the time at Murray Bridge Pump Station to ensure drinking water standards	5.8 [R11] Integrated salt and water balance in the riverine corridor
10. The phosphorous concentration in the River Murray is to be less than or equal to 0.05mg/L 90% of the time by 2020	
11. The nitrogen concentration in the River Murray is to be less than or equal to 1.0mg/L 90% of the time by 2020	

Resource Condition Target	Prospectus Research Topic
12. The turbidity level in the River Murray is to be equal or less than 80 NTU 90% of the time by 2020	
13. Maintain blue green algal levels below the national standard threshold level for all sections of the River Murray and the Lower Lakes by 2020	5.3 [T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management 5.6 [R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis 5.9 [R6 & R18] Smart use of water to gain maximum overall value and increase robustness of systems that rely on water 5.11 [R29] Integrated landscape Scale Modelling and Scenario Testing
14. Maintain and improve the stability of river banks, lake edges, sand dunes and cliffs by 2020	
15. The Murray mouth open 100% of the time through fresh water outflows with adequate tidal variation to meet the needs of Coorong ecosystems	
16. 30% of flow maintained in watercourses of EMLR to sustain ecosystem function by 2020	5.7 [D2 & D3] Ecological impacts of different water management strategies in the Eastern MLR
17. By 2020 to have constrained the area of salt affected land within the region to 120,000 ha	
18. By 2020, reduce the area of agricultural land at risk of wind erosion during June each year by 40%	5.10 [D11] More robust production systems
19. Reduce recharge by improving dryland water use efficiency to 70% across the region by 2020	5.10 [D11] More robust production systems
20. To have an increasing trend in Soil carbon levels in cropping soils leading to improved soil health by 2020	5.10 [D11] More robust production systems
21. Recover 30 % of quality native vegetation, habitat and agricultural production areas from pest infestation and minimize any further infestations by 2020	5.3 [T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management

Resource Condition Target	Prospectus Research Topic	
22. By 2020 improve or maintain condition of terrestrial native vegetation focusing on identified priority areas and improve condition of 50% of remnant vegetation on private land as well as increasing vegetation cover by 1% in the agricultural region	5.1	[T2] Inventory of biological and ecological assets
	5.2	[D8] Biology, tolerance and adaptation of native species to environmental extremes
	5.3	[T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management
	5.4	[D9] Ecological restoration techniques/works
	5.5	[T4] Strategic placement of vegetation within an experimental adaptive management framework
	5.11	[R29] Integrated landscape Scale Modelling and Scenario Testing
23. Maintain and improve the conservation status of all threatened National and State listed species and regionally threatened communities and species by 2020	5.1	[T2] Inventory of biological and ecological assets
	5.2	[D8] Biology, tolerance and adaptation of native species to environmental extremes
	5.3	[T5] Basic ecological processes to refine our conceptual models of how ecosystems function and respond to pressure and management
	5.4	[D9] Ecological restoration techniques/works
	5.5	[T4] Strategic placement of vegetation within an experimental adaptive management framework
	5.6	[R3 & R10] Understanding the links between water management, ecosystem management & biodiversity and the development of tools for trade-off analysis
	5.7	[D2 & D3] Ecological impacts of different water management strategies in the Eastern MLR
	5.8	[R11] Integrated salt and water balance in the riverine corridor
	5.9	[R6 & R18] Smart use of water to gain maximum overall value and increase robustness of systems that rely on water
	5.11	[R29] Integrated landscape Scale Modelling and Scenario Testing
	5.13	Extended Evaluation of Market Based Instruments
24. By 2020 groundwater resources will not have salinity impacts on land condition and will meet the needs of dependent ecosystems	5.7	[D2 & D3] Ecological impacts of different water management strategies in the Eastern MLR
	5.10	[D11] More robust production systems
25. By 2006 to have developed a RCT relative to irrigated and waterlogged land		
26. The *E.coli* count in the River Murray is to be less than or equal to 150 EC/100mL for 90% of the time by 2020		