SOUTH AUSTRALIA'S 2010-11 REPORT TO THE BASIN SALINITY MANAGEMENT STRATEGY

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CONTENTS

1. EXECUTIVE SUMMARY X
Key Achievements xi
Significant Work xi
Future Work xii
Context for 2010-11 xiii
2. INTRODUCTION 1
3. NINE ELEMENTS OF THE BASIN SALINITY MANAGEMENT STRATEGY 3
3.1. Developing Capacity to Implement the Strategy 4
3.1.1. Young Irrigator Group 4
3.1.2. South Australian MDB Sustainable Irrigation Steering Committee 6
3.1.3. Case Study Groups 6
3.1.4. How Efficient Are We? A Report on Water Use Efficiency 7
3.1.5. Irrigator Annual Reporting 7
3.1.6. Goyder Institute 8
3.1.7. Coping with Irrigation Drought 9
3.2. Identifying Values and Assets at Risk 11
3.2.1. Salinity Risks from Floodplains 11
3.2.2. Environmental Watering Actions 13
3.2.3. Determining Long-term Accountable Salinity Impacts Associated with Environmental Watering Actions 15
3.3. Setting Salinity Targets 19
3.3.1. Salinity Targets 19
3.4. Managing Trade-offs with the Available Within-Valley Options 25
3.4.1. Operational Strategies and Actions 25
3.4.2. Reuse of Salt Interception Scheme Water 29
3.4.3. South Australian Weir Pool Manipulation Program 29
3.4.4. New Schedules to the Murray-Darling Basin Agreement 30
3.4.5. Water for the Future 30
3.5. Implementing Salinity and Catchment Management Plans 33
3.5.1. State Plans and Strategies 33
3.5.2. Regional Plans and Strategies 36
3.6. Redesigning Farming Systems 43
3.6.1. Water for the Future 43
3.6.2. On-Ground Support to Achieve Irrigation Efficiency 43
3.6.3. Future Farm Industries Cooperative Research Centre 44
3.6.4. High Input Fertigation Management 45

3.7. Targeting Reforestation and Vegetation Management 47
3.7.1. Revegetation and Restoration Activities 47
3.7.2. The River Murray Forest 48
3.8. Constructing Salt Interception Works 49
3.8.1. Waikerie SIS 50
3.8.2. Woolpunda SIS 50
3.8.3. Loxton SIS 50
3.8.4. Bookpurnong SIS 51
3.8.5. Qualco-Sunlands Groundwater Control Scheme 51
3.8.6. Murtho SIS 51
3.8.7. Pike SIS 52
3.8.8. Riverland Salt Disposal Management Plan 52
3.9. Ensuring Basin-Wide Accountability: Monitoring, Evaluating and Reporting 54
3.9.1. Monitoring 54
3.9.2. Evaluating 61
3.9.3. Reporting 64
4. VALLEY REPORTS 72
4.1. End of Valley Report Card 72
4.2. Summary of monitoring sites 74
4.2.1. Border (A4261022) 74
4.2.2. Berri (A4260537) 75
4.2.3. Morgan (A4260554) 75
4.2.4. Murray Bridge (A4261162) 76
5. RESPONSE TO INDEPENDENT AUDIT GROUP 77
5.1. High Priority Recommendations 77
5.2. Normal Priority Recommendations 82
6. REFERENCES 85

LIST OF FIGURES

Figure 1 - South Australian Murray-Darling Basin 2
Figure 2 - Soil moisture monitoring (Woolpunda) 5
Figure 3 - Soil moisture monitoring (Qualco) 5
Figure 4 - IRES survey results 6
Figure 5 - Canopy reduction in citrus as a tool to manage the impact of reduced irrigation. 10
Figure 6 - Key statistics of salinity and salt load targets (Source- Pollino et al.) 22
Figure 7 - Salinity non-exceedance curves for Morgan (Source- Pollino et al.) 22
Figure 8 - Average annual salt loads (million tonnes/y) through the barrages for rolling 10-year periods (Source- Pollino et al.) 23
Figure 9 - Graph of South Australia's salinity register balance based on the November 2010 Salinity Register 34
Figure 10 - Monarto Salt Bush Research Site 45
Figure 11 - EC in South Australia during 2010-11 54
Figure 12 - Total salt load at Morgan 2008-09, 2009-10 and 2010-11 55
Figure 13 - Salt load SA Border and Morgan 2010-11 55
Figure 14 - Comparison of 2010-11 salt loads with past high flow event salt loads 56
Figure 15 - Community Stream sampling sites across the SA Murray-Darling Basin Natural Resources Management Board Region 58
Figure 16 - Community Stream Sampling Program. 59
Figure 17 - Goolwa Channel salinity gradient in May 2011 59
Figure 18 - February salinity comparisons of consecutive years at selected sites in the lower reaches of the SA MDB NRM Board Region 60
Figure 19 - Location of South Australia's Numerical Groundwater Models 61
Figure 20 - Project site map and model domain 63
Figure 21 - Monitoring pontoon during high flows 74
Figure 22 - Fouling of monitoring station 76

LIST OF TABLES

Table 1 - Operating SIS within South Australia 49
Table 2 - Total salt load at SA Border and Morgan for high flow events 56
Table 3 - Status of South Australia's numerical groundwater models 62
Table 4 - Summary of MODFLOW impact for 1988 – 2003 irrigation development 66
Table 5 - Variations to Site Use Approvals due to temporary trade, 2009-10 68
Table 6 - Variations to Site Use Approvals due to temporary trade, 2010-11 68
Table 7 - Prior Commitment Claims (claimed) 69
Table 8 - Summary of variations to Site Use Approval due to adjustments for existing plantings, 2009-10 to 2010-11 69
Table 9 - SARMSS monitoring sites 72
Table 10 - End-of-valley summary report card 73

LIST OF ABBREVIATIONS

ABIMZ	Angas Bremer Irrigation Management Zone
ABWMC	Angas Bremer Water Management Committee
ADCP	Acoustic Doppler Current Profiler
AHD	Australian Height Datum
BSMS	Basin Salinity Management Strategy
CLLMM	Coorong, Lower Lakes and Murray Mouth
CDS	Comprehensive Drainage Scheme
CEWH	Commonwealth Environmental Water Holder
COAG	Council of Australian Governments
CMC	Catchment Management Consulting
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DENR	Department of Environment and Natural Resources
DFW	Department for Water
DWLBC	Department of Water, Land and Biodiversity Conservation
EC	Electrical Conductivity - µS cm^{-1} EC
ELMA	Environmental Land Management Allocation
EOI	Expressions of Interest
EPBC Act	Environment Protection and Biodiversity Conservation Act, 1999 (Commonwealth)
EPP	Environmental Protection (Water Quality) Policy, 2003 (Commonwealth)
FAE	Field Application Efficiency
FFI CRC	Future Farm Industries Cooperative Research Centre
GIS	Geographic Information System
GL	Gigalitre (1 000 000 000 litres)
IAG	Independent Audit Group
IGA	Inter-Governmental Agreement
IIEP	Improving Irrigation Efficiency Project
IQQM	Integrated Quantity and Quality Model

IRES	Irrigation Recording Evaluation System
LAPs	Local Action Planning Associations
LMIMZ	Lower Murray Irrigation Management Zone
LWMP	Land and Water Management Plan(ning)
MAT	Management Action Target
MBI	Market Based Instruments
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority
MERI	Monitoring, Evaluation, Reporting and Improvements
ML	Megalitre (1 000 000 litres)
NAP	National Action Plan for Salinity and Water Quality
NHT	Natural Heritage Trust
NRM	Natural Resources Management
OFIEP	On-Farm Irrigation Efficiency Program
RAP	River Analysis Package
RMIMZ	River Murray Irrigation Management Zone
RSDMP	Riverland Salt Disposal Management Plan
SA MDB	South Australian Murray-Darling Basin
SA MDB NRM Board	South Australian Murray-Darling Basin Natural Resources Management Board
SARMSS	South Australian River Murray Salinity Strategy
SARDI	South Australian Research and Development Institute
SASP	South Australia's Strategic Plan
SIS	Salt Interception Scheme
SKM	Sinclair Knight Mertz
SUTRA	Saturated Unsaturated TRAnsport (finite element) model
t	Tonne
TDS	Total Dissolved Solids
TLM	The Living Murray
USE	Upper South East
VI	Velocity Index
WAP	Water Allocation Plan
WUE	Water Use Efficiency

1. EXECUTIVE SUMMARY

Management of River Murray salinity remains a key priority for South Australia due to its location on the lower reach of the River Murray; the natural geological structure of the Murray-Darling Basin in which the River Murray acts as a drain for salt out of the landscape; the influence of human development in mobilising salt to the River, and the ultimate implications of salinity in terms of water quality for all uses, including critical human water needs.

South Australia is committed to delivering salinity management obligations under the Murray-Darling Basin Authority (MDBA) Basin Salinity Management Strategy (BSMS) Schedule B of the Murray-Darling Basin Agreement (Schedule 1 of the *Water Act, 2007* (Cth)) and also recognises the importance of salinity management through key State level strategies and plans. These include:

- Water for Good (Action 56): Maintain a positive balance on the MDBA's Salinity Register, and continue to implement strategies and actions to ensure the real time management of salinity in the lower reaches of the River Murray so that water quality remains at levels suitable for human consumption;
- South Australia's Strategic Plan (SASP) Target (T.77): River Murray Salinity – South Australia maintains a positive balance on the MDBA's Salinity Register;
- Objectives in the *River Murray Act 2003*; and
- Management Action Targets in the South Australian Murray-Darling Basin Natural Resources Management Plan.

Salinity management will require continued investment from South Australia to manage the risk of increased salt loads to the River Murray into the future, partly due to past actions (the legacy of history) and continued irrigation development, but also due to increased mobilisation of salt that may result from higher flows and environmental watering.

A new Salinity Program has been developed to ensure that South Australia can address these risks and continue to meet its BSMS obligations, the SASP target 77 and deliver against the related Action 56 in Water for Good. Importantly, the new program is cognisant of requirements under the *Water Act* 2007 (Cth) and proposed Basin Plan. In terms of directions for managing salinity within this program, South Australia has been guided by previous recommendations of the Independent Audit Group – Salinity and the recommendations of the BSMS Mid-term Review.

The Department for Water continues to work across programs internally and collaborate with key external stakeholders including the MDBA to maximise the value of investment across programs to continue to manage salinity within the Murray-Darling Basin.

Key Achievements

Key salinity management achievements in 2010-11 include:

- South Australia's balance on the BSMS Salinity Registers remains in positive credit, following endorsement of the 2010 Salinity Registers by Murray-Darling Basin Ministerial Council (26 May 2011);
- Research, review, analysis and provision of advice on the water quality and salinity chapter of the draft Guide to the proposed Basin Plan and draft Basin Plan legislative instrument, as well as significant input to the South Australian Basin Plan Science Review (with the Goyder Institute for Water Research) from a water quality and salinity perspective;
- Active engagement with the MDBA to develop policy guidelines for accounting for salinity impacts of environmental watering;
- Groundwater modelling to support annual update of entries on the BSMS Salinity Registers, including completion of peer review of a number of South Australia's models, enabling accreditation of the models and further update of BSMS Salinity Registers entries by November 2011;
- Completion of a project quantifying the local risk of floodplain salinity to the River Murray. This identified specific mitigation strategies that could be driven from within South Australia to ensure that water quality remains within target levels. This also enabled significant input to the MDBA project on the same issue (from a Basin perspective);
- Implementation of key recommendations of the Independent Audit Group- Salinity (IAG) December 2010 report was pursued; in particular, seeking opportunities to progress the Pike salt interception scheme beyond Stage 1;
- Completion of the draft report 'How efficient are we?' (documenting the historical improvement of water use efficiency in the South Australian Murray-Darling Basin); and
- Completion of an initial salinity assessment of the operation of the Chowilla environmental regulator (under construction), with further work occurring to update the groundwater model to inform a more reliable salinity assessment.

Significant Work

Significant effort was directed to:

- Revision of policy documents for the South Australian River Murray Salinity Zoning Policy to ensure the policy is consistent with the unbundled water licensing regime;
- Preparation of a draft Annual Water Use report on River Murray irrigation water use to understand current patterns in irrigation water use and hence future salinity impacts;
- Development of a proposal for a cross South Australian agency approach to crop data collection to support irrigation salinity assessments (currently undergoing internal review);
- Drafting of a discussion paper on land and water management planning to support future salinity management (also undergoing internal review) and significant input to

the development of the Pyap to Kingston Land and Water Management Plan to ensure it contains actions to deliver improved salinity outcomes;

- Development of a code of practice for irrigated agriculture (aimed at improving irrigation efficiencies with the benefit of minimising salinity impacts of irrigation) - a partnership project with the South Australian MDB Natural Resources Management Board (SA MDB NRM Board); and
- Investigation of options for cost recovery for salinity management.

Future Work

The forthcoming Water Quality and Salinity Management Plan (WQSMP) within the Basin Plan will continue to be a major focus for 2011-12. South Australia has been preparing for the release of the Basin Plan and will be formally responding to the Basin Plan documents during the corresponding consultation periods. At June 2011, South Australia was involved in significant intra and interstate consultation on the draft Basin Plan legislative instrument including Chapter 8 – the water quality and salinity chapter. It will be especially important for the Water Quality and Salinity Management Plan to build on the strength of the Basin Salinity Management Strategy successes and for effort to be directed to building an appropriate interface between the new Plan and the existing Strategy.

In 2011-12, significant effort will also be directed towards:

- Preparation of the Government of South Australia's response to the Basin Plan, evaluating salinity implications of the final WQSMP and translating into a plan implementation schedule (note that water quality aspects are not covered within the scope of the salinity program);
- Delivery of all Schedule B reporting requirements (BSMS Annual Report, updates to Salinity Registers entries and Audit) and providing significant input to the mandated review of Schedule B;
- Work with the Murray-Darling Basin Authority to develop the accounting framework for BSMS salinity registers assessment of the salinity impacts of environmental watering actions;
- Exploration of options for efficiencies in operation of salt interception scheme infrastructure;
- Working with the environmental watering program to ensure that operational plans for environmental regulators are established that are cognisant of salinity impacts and contain appropriate options for operational responses;
- Devising and implementing a simplified salinity assessment process for irrigation development to reduce time and resources required for assessments;
- Provision of policy input to the revision of the Water Allocation Plan for the River Murray Prescribed Watercourse (RM WAP) to ensure the RM WAP contains salinity management obligations that enable delivery of the Basin Plan WQSMP and existing BSMS outcomes;
- Review and consider the policy recommendations from the 'How efficient are we?' project; and

- Completing the 5 year review of the Morgan to Waikerie Groundwater Model.

Completion of these tasks in 2011-12 will ensure South Australia can continue to address the highest salinity risks to the River Murray system, meet its salinity management obligations under Schedule B, and be well placed to manage against any new targets and objectives in the Basin Plan.

Context for 2010-11

During 2010-11 South Australia received the highest peak flow in the river Murray since 1993, following persistent long periods of rainfall and flooding in the eastern states. This weather pattern resulted in a very long build-up to the peak flows entering South Australia, in February 2011. The extended slow recession of the high flows has enabled large salt loads to be flushed through the river system and out to sea. While the maximum salt load at Morgan in this period was approximately 470 000 t/month (March 2011), river salinity in South Australia has generally remained low, with higher flows diluting the large salt loads in the system. In contrast salinity levels in the Lower Lakes have remained above average during 2010-11 and additional flows will be required to improve water quality in the region.

Carryover and Water Allocations

In September 2010, River Murray water resource conditions rapidly improved and South Australia was guaranteed of receiving its full entitlement flow of 1 850 GL in 2010-11 and substantial unregulated flow. This provided a much improved basis on which to manage water quality and salinity within the system.

South Australia continued its annual drought carryover arrangements that were initially implemented in 2006-07 to supplement heavily restricted water allocations. These arrangements enabled licensed water users to carry over unused water from 2009-10 into 2010-11, thereby providing the opportunity to more effectively manage inter-seasonal risk and underpin their businesses during the drought. A total of 228 GL was allocated as carryover in 2010-11, more than twice the volume previously allocated.

From 1 October 2010 South Australian licensed water users were allocated 67 percent of their water access entitlement, which equated to 422 GL. This allocation, and the 228 GL already allocated as carryover, equalled the 650 GL maximum water allocation under the Water Allocation Plan for the River Murray Prescribed Watercourse. Consequently no further allocation announcements were made.

The annual drought carryover policy ended on 30 June 2011 and new carryover arrangements are being developed following the negotiation of long-term water storage arrangements by South Australia under Schedule G of the *Murray-Darling Basin Agreement 2008*. These storage arrangements provide the opportunity for South Australian water users to store water in upstream storages, as occurs in New South Wales and Victoria. The storage right will be an important tool for managing water supply to South Australia in drier periods, particularly in terms of ensuring water is available for critical human water needs. The stored water may be used for consumption or to assist in managing salinities by providing a dilution benefit.

Based on the Murray-Darling Basin Authority water resource availability forecast for 2011-12 provided in late May 2011, the South Australian Government announced that water

allocations for all River Murray licensed water users be 100 percent of water access entitlement from 1 July 2011, for the first time since 2005-06.

River Murray Drought Water Allocation Decision Framework

The 2010-11 River Murray Drought Water Allocation Decision Framework was developed to share and allocate the limited River Murray water resources received by South Australia, during the forecast period of ongoing low water availability.

The framework was designed to optimise the allocation and use of River Murray water as it became available to South Australia during 2010-11 and to support the long-term sustainability and viability of South Australian communities reliant on the River Murray.

The 2010-11 framework allocated water quite differently to previous frameworks by sharing water resource improvements between critical human water needs, general allocations (primarily irrigators) and the environment from the start of the water year. This ensured that the 201 GL required for critical human water needs in 2011-12 was accumulated from improvements during 2010-11 and that the South Australian Government's commitment to secure a 170 GL Lower Lakes Environmental Reserve for 2010-11 was achieved.

Due to significantly improved water resource conditions, South Australia had secured the 201 GL required for critical human water needs in 2011-12 by the end of August 2010.

Providing the additional 170 GL to the Lower Lakes assisted in mitigating the detrimental impacts of the historically low water levels below Lock 1 (at Blanchetown) on floodplains, riverbanks, levees and other structures, including the high salinities within the Lower Lakes. This allocation was further enhanced by substantial unregulated flow from September 2010. The higher flows have enabled large amounts of salt to be removed from the system via the Murray Mouth. It is fortunate that the higher flows have been sustained. This has allowed the large amounts of salt mobilised from floodplains through surface wash off processes to be diluted and flushed from the system. Had the high flows of the past year not been sustained, the in-river salinity outcomes could have been much worse. This highlights the need to continue to direct effort to the management of floodplain and wetland salt mobilisation, including managed watering events.

2. INTRODUCTION

This report documents South Australia's accountability and delivery against the MDBA Basin Salinity Management Strategy (BSMS) (Schedule B to Schedule 1, *Water Act, 2007* (Cth)).

The report is structured around a standard Table of Contents agreed to in 2008 by jurisdictions for BSMS reporting, as noted at Basin Salinity Management Advisory Panel Meeting #9, 15 July 2011.

Chapter three describes work undertaken in 2010-11, grouped against each of the nine elements of the BSMS, with an indication given to priority areas of focus for the coming year and beyond.

Chapter four provides a summary of flow and salinity observations and predictions at key locations within South Australia.

Chapter five summarises South Australia's response to the recommendations of the Independent Audit Group – Salinity from their most recent report.

This report has been compiled by Department for Water with significant contributions from other agencies and organisations, as noted in the acknowledgements section at the beginning of the report. This reflects that management of salinity in the South Australian Murray-Darling Basin (see Figure 1) involves a partnership approach across the community, State agencies, the MDBA and other jurisdictions.

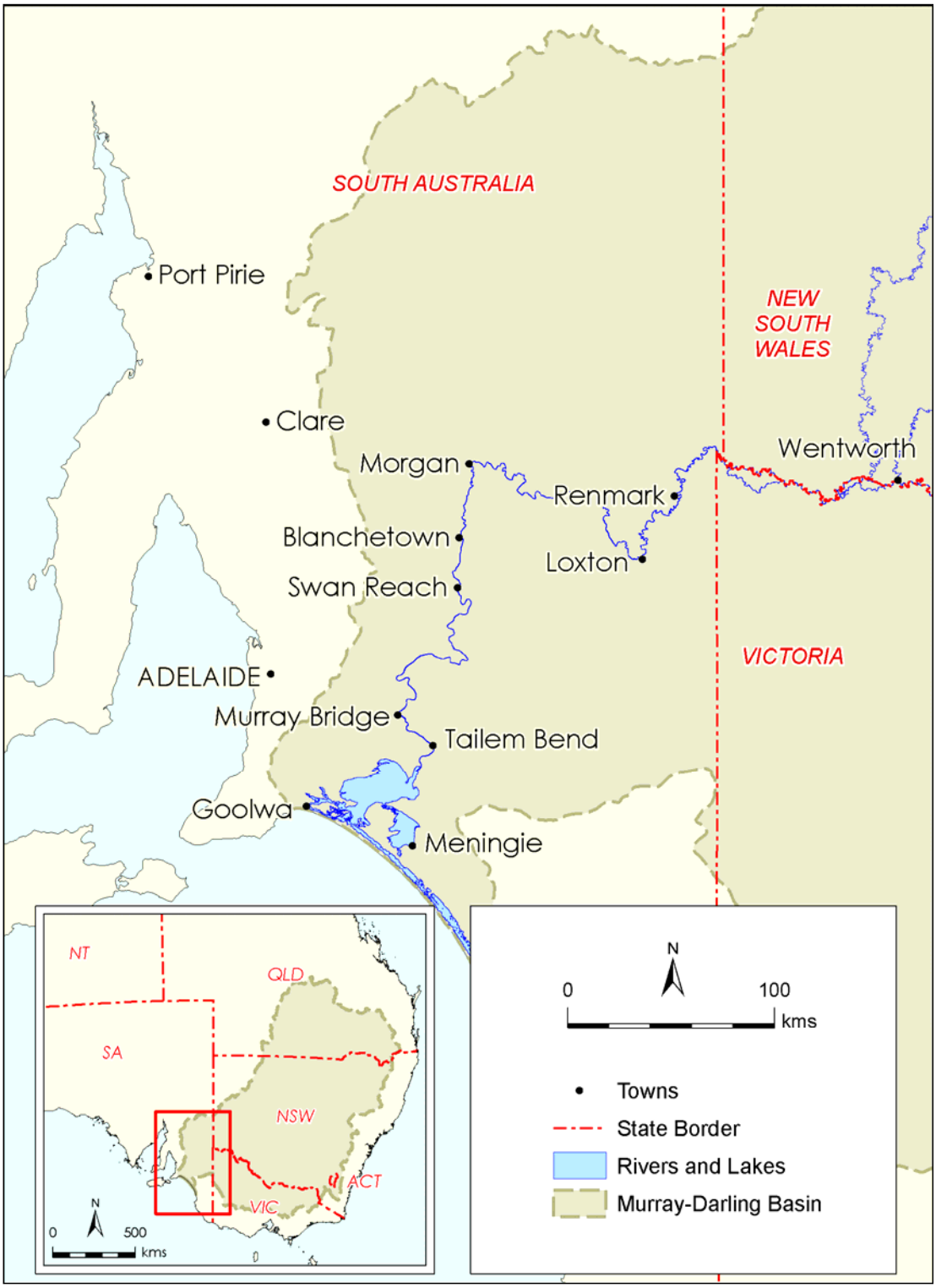

Figure 1 - South Australian Murray-Darling Basin

3. NINE ELEMENTS OF THE BASIN SALINITY MANAGEMENT STRATEGY

The following sections highlight actions taken within South Australia in 2010-11 to implement each of the nine elements of the BSMS:

1. ***Developing capacity to implement the Strategy***
2. ***Identifying values and assets at risk***
3. ***Setting salinity targets***
4. ***Managing trade-offs with the available within-valley options***
5. ***Implementing salinity and catchment management plans***
6. ***Redesigning farming systems***
7. ***Targeting reforestation and vegetation management***
8. ***Constructing salt interception works***
9. ***Ensuring Basin-wide accountability: monitoring, evaluating and reporting***

3.1. DEVELOPING CAPACITY TO IMPLEMENT THE STRATEGY

The Commission and partner Governments will administer a comprehensive 'knowledge generation' program to support Basin and within valley planning and implementation.

The partner Governments will assist catchment communities to implement national, Basin and State initiatives by improving access to and use of the knowledge and decision tools generated by investigations and salinity research and development. This process will be supported by further capacity building for catchment planning, including communication and education.

(BSMS 2001–2015)

Various initiatives are undertaken in South Australia to develop and maintain capacity to implement the BSMS. Developing capacity occurs at different levels including within local communities and groups focussed towards on ground actions, within South Australian government agencies, and in terms of the ongoing interface between South Australia, Commonwealth agencies such as the MDBA and other jurisdictions that are party to the Murray-Darling Basin Agreement.

3.1.1. Young Irrigator Group

The Young Irrigator Group (YIG) comprises approximately 26 irrigators under 35 years of age. The project is focused on undertaking a mixture of capacity building and on farm trial works to boost grower awareness of key issues, and to demonstrate the value of innovative approaches to irrigation management, including irrigated depth and accumulation of soil salinity. Other activities include crop walks, tours, monthly group meetings, presentations and training.

The second phase of the Young Irrigator Group project was implemented in 2010-11 in the regions around Waikerie, including Taylorville, Woolpunda, Qualco, Ramco and Cadell. Outcomes gained through 2010-11 trial works include:

- improved understanding of the effects of irrigation decisions on irrigated depth;
- improved knowledge of soil properties through estimation of soil moisture holding capacity;
- soil nutrition testing and the identification of key soil constraints; and
- limited soil solute analysis to assess the salinity values of soil water.

Throughout the 2010-11 phase of the project, trial works were extended to a further three properties. Snapshots of the data captured in the capacitance probe trials are provided below. This phase was funded by the State Natural Resources Management Program Community Grants with in-kind assistance from DFW and the SA MDB NRM Board.

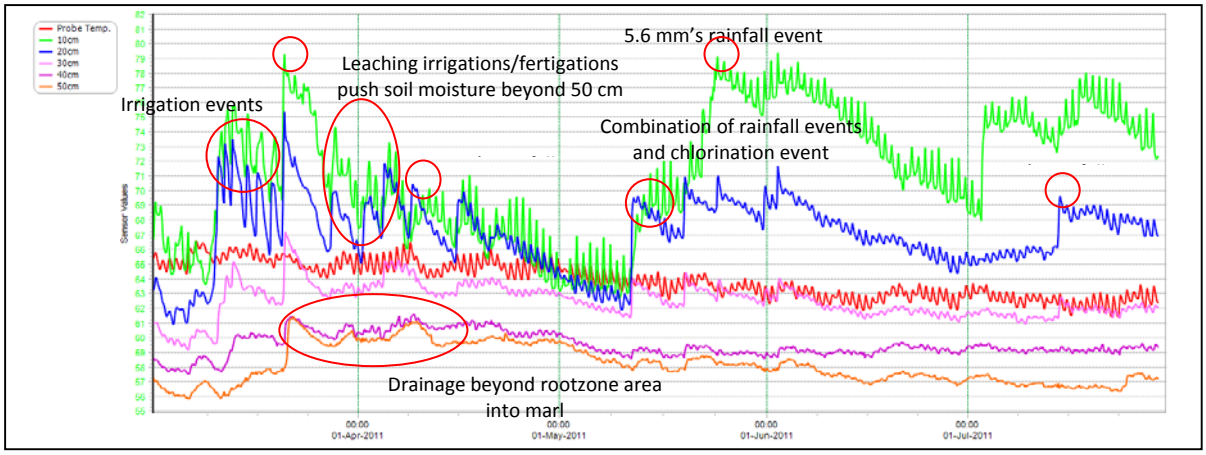

Figure 2 - Soil moisture monitoring (Woolpunda)

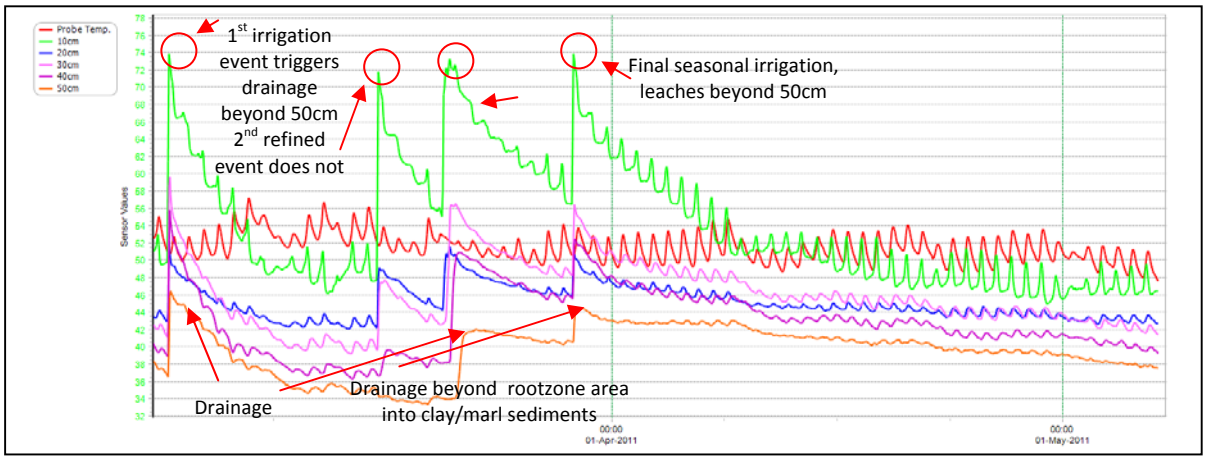

Figure 3 - Soil moisture monitoring (Qualco)

Figure 2 and Figure 3 show some of the results from soil moisture monitoring trials in Woolpunda and Qualco districts. Initial indications from these trials over the past two years have shown that irrigation practices are generally of a high standard and that equipment installed has considerably enhanced growers skills in adminstering efficient irrigation events.

Due to variations in irrigation records kept by individual irrigators, it is not possible to directly quantify water savings in terms of volume (ML) applied, but the capacitance probe readings do provide some indication of where irrigation exceeds the crop root zone. This makes it a valuable tool in refining irrigation scheduling into the future.

As well as collecting data in 2011-12 the YIG project will also begin to assess grower attitude towards data collection and the use of other forms of irrigation system and practice assessment.

A third year grant for the YIG is currently being assessed.

3.1.2. South Australian MDB Sustainable Irrigation Steering Committee

The cross government agency South Australian Murray-Darling Basin (MDB) Sustainable Irrigation Steering Committee (SISC) was formed in 2010, and comprises representatives from the SA MDB NRM Board, DFW and Primary Industries and Resources SA (PIRSA).

The broad role of the SISC is to provide effective coordination and collaboration across irrigation and salinity management programs in key state government agencies to deliver natural resource management outcomes. The committee met on four occasions during 2010-11 and has proven to be an effective forum to discuss key water management issues in the South Australian MDB.

3.1.3. Case Study Groups

The Bookpurnong to Lock 4 district provides a valuable case study area for benchmarking property and district scale irrigation efficiency using a computerised event based recording system.

The Irrigation Reporting and Evaluation System (IRES™) is an intelligent data entry and analysis system utilised by irrigators in this district to better understand water applications and water use efficiency. It enables accurate forecasting of future scheduling, particularly when used in combination with soil moisture monitoring. The system also helps to refine the calculation of crop water use through improving the accuracy of crop coefficient values.

The on-going focus of work in this district is to allow comparison of drought and post drought irrigation efficiency and water applications, to assist irrigators in adjusting to post drought impacts, including soil salinity build up. The data collected also enables on-going estimations of deep drainage.

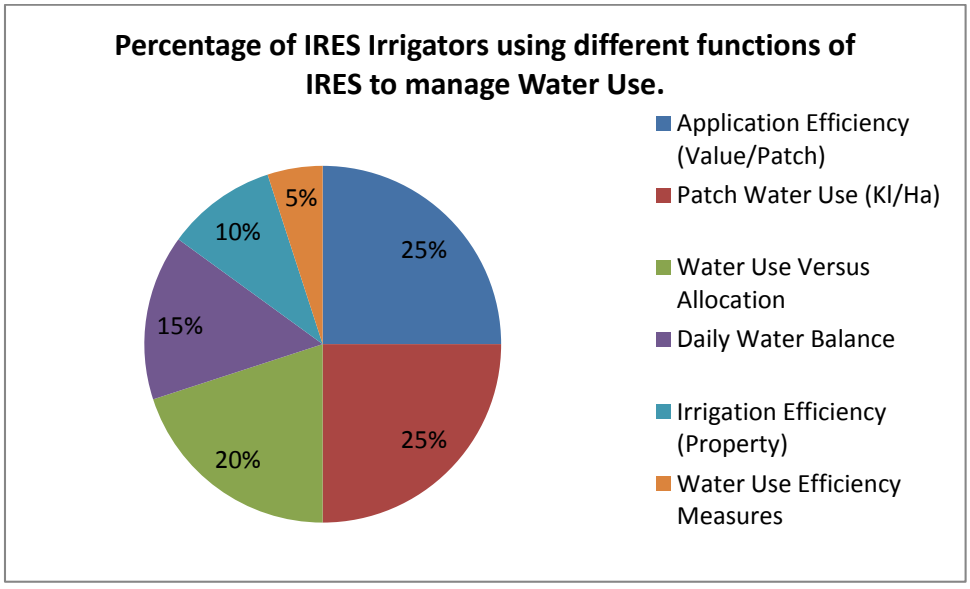

Figure 4 - IRES survey results

In 2010-11 irrigators using IRES™ were surveyed to gain a better understanding of how they are using the system. Figure 4 shows the survey results. The survey found that the majority of irrigators used IRES™ to calculate field application efficiency and monitor water use relative to available water allocation. Half of the irrigators used the daily water balance

function in IRES™ to assist with planning irrigation management and irrigation schedules. A third used the broader production indicator and water use efficiency functions in IRES™.

This facilitates:

- accurate record keeping;
- review of irrigation management within and between irrigation seasons to assist planning and general irrigation management;
- daily irrigation scheduling and tracking of water distribution across the property; and
- understanding of whether the irrigation system is performing according to the design specifications.

3.1.4. How Efficient Are We? A Report on Water Use Efficiency

Maintaining and improving irrigation water use efficiency remain key methods of managing salt loads to river. During 2010-11 the draft report titled *How Efficient Are We*? *A report on Water Use Efficiency in the South Australian Murray-Darling Basin* was completed. At the time of writing the report was under review. There were three objectives in commissioning the report:

- Document major improvements in water use efficiency in the South Australian Murray-Darling Basin and the drivers and enablers for those improvements between 1960 and 2009 (the information was sourced from interviews, literature reviews and data reviews to identify the best sources of information available within the timeframe and budget of the project);
- Develop a preferred suite of definitions of water use efficiency or irrigation efficiency and identify datasets that can be used quickly and efficiently to determine water use efficiency; and
- Provide a benchmark report on irrigation efficiency in South Australia that identifies areas of high, medium, and low performance using the preferred indicators.

The first two objectives were met. The third objective was unable to be met due to a lack of integration between consumption and crop information databases. Such a task required more time and resources than allowed for within this project. Instead, recommendations have been provided as to how to progress this work. These will be considered in the context of salinity management and water allocation planning in the next twelve months.

3.1.5. Irrigator Annual Reporting

Irrigator Annual Reporting for the River Murray Irrigation Management Zone

A draft annual water use report for the River Murray Prescribed Watercourse was produced in 2010-11. The report combines annual water use information collected by DFW with crop survey information contributed by individual irrigators for the 2009-10 water use year. A database has now been set up to enable rapid data entry and analyses in the future.

Through the use of the database and other contextual information, the following measures were calculated at a property and district scale:

- crop types and areas;

- annual water use compared to approved site use approval volumes;
- irrigation intensity - including at a crop type level;
- water use efficiency index - a measure of water use efficiency based on estimates of crop water use and annual water use and precipitation; and
- estimates of deep drainage based on recent findings of a MDBA report.

Anecdotal evidence of improvements in irrigation efficiency including uptake of on-farm and off-farm irrigation efficiency programs is also included.

The report helps identify priority areas for minimising the risk of deep drainage from irrigation water application and hence has immediate management value. The report has highlighted the need to improve the process of data collection and also the measures of irrigation efficiency. A critical future requirement is to determine the most reliable and cost effective method of collecting crop information for use in efficiency calculations. Advances have been made to resolve this issue through cross agency collaboration.

A number of recommendations have been formulated which draw from the results of the irrigation annual report and the *How Efficient Are We?* report to improve the process in future years, and to make more information available to the public.

Ideally the monitoring of irrigation efficiency should be as uniform as possible across the Murray-Darling Basin, to assist in clear and transparent monitoring and reporting of salinity impacts that result from deep drainage.

Irrigator Reporting for the Angas Bremer Irrigation Management Zone

The 2009-10 Irrigation Annual Report for the Angas Bremer Irrigation Management Zone (ABIMZ) was generated during 2010-11 and is available at: http://www.angasbremerwater.org.au/annual_reporting.php

The 2009-10 Angas Bremer Irrigation Annual Report indicated that the average water use across the regions 6578ha of irrigated crops was 2.47ML/ha.

The Angas Bremer Water Management Committee (ABWMC) will be moving to an on-line irrigation annual reporting system for the development of the 2010-11 district report which will enable the report to be generated in a more efficient manner.

The ABWMC is also planning to update the region's Irrigation Code of Practice during 2011-12 which was developed by the local water management committee to assist irrigators in complying with the innovative land and water management policies adopted in the ABIMZ.

3.1.6. Goyder Institute

The Goyder Institute for Water Research was established in July 2010.

It brings together leading scientists and researchers from across Australia to enhance the Government of South Australia's capacity to develop and deliver science-based policy solutions in water management.

The Institute is a collaborative effort between the Government of South Australia through DFW, the CSIRO as Australia's national research institution, and three of South Australia's universities – Flinders University, the University of Adelaide and the University of South Australia.

The Institute will help improve the State Government's ability to forecast threats to water security and develop an integrated approach to water management challenges.

Basin Plan Science Review

In 2010-11, the Goyder Institute for Water Research conducted a high-level scientific review of implications for South Australia of the Guide to the proposed Basin Plan.

The review was carried out by the CSIRO as a member of the Goyder Institute, in collaboration with scientists, technical and policy staff from the Institute's partners.

The review was confined to the South Australian portion of the River Murray and considered the objectives and associated environmental water requirements for two internationally recognised environmental assets: the Riverland – Chowilla Floodplain and the Coorong, Lower Lakes and Murray Mouth. These are key basin health indicator sites - if their environmental water requirements are met, those of other river and floodplain environments in South Australia (and indeed the Basin) are also likely to be met.

Through peer-reviewed, critical scientific assessment, the Goyder Institute investigated:

- whether the environmental water requirements of these two assets, both as identified in the Guide and as determined by the South Australian Government, could be delivered under the three proposed Guide scenarios (3000 GL, 3500 GL and 4000 GL average annual reductions in total Basin water diversions);
- whether the MDBA and South Australian water quality and salinity targets could be met under the proposed Guide scenarios (refer to section 3.3 for more information);
- how best to manage river flows to meet the South Australian Government's environmental water requirements; and
- the socio-economic risks and benefits of the proposed Guide scenarios within South Australia.

The review was based on information in the Guide and the hydrological models that the MDBA developed to underpin it. The MDBA has since been reviewing its modelling and analysis; however, the Goyder science review has developed additional skills and tools that will make it easier to assess the scenarios contained in the proposed Basin Plan when it is released.

The Science Review Reports are available on the Goyder Institute for Water Research website http://www.goyderinstitute.org.

Information about the Goyder Institute Science Review of the Guide to the proposed Basin Plan, including the Synthesis Report, is available on the Goyder website: http://www.goyderinstitute.org/publications/2011/synthesis-science-review-Basin-plan.pdf

3.1.7. Coping with Irrigation Drought

The majority of irrigated cropping in the South Australian MDB is permanent horticultural crops, in particular citrus, almond and other fruit trees, and grape vines. Although 2010-11 represented a time of great relief from the recent drought, the impact of reduced irrigation allocations on these crops can be severe and long lasting. A series of trials and on-farm

monitoring programs have been utilised to collect data over the course of the recent drought, providing an insight into the resilience of some of these crops.

The work is assisting in understanding the relationship between water application and potential yield, which will assist growers with decision making during future drought events. Information about the tolerance of crops to salt in the soil profile, speed of recovery of yield under various degrees of drought, and the effectiveness of a variety of management options to moderate the impacts of drought on permanent horticultural plantings, will also assist in future decision making in regard to crop water requirements and salt leaching requirements, which will potentially improve irrigation efficiency and reduce deep drainage events, minimising salinity impact implications.

Figure 5 - Canopy reduction in citrus as a tool to manage the impact of reduced irrigation.

3.2. IDENTIFYING VALUES AND ASSETS AT RISK

The partner Governments will work with catchment communities to identify important values and assets throughout the Basin at risk of salinity, and the nature and timeframe of risk. This Strategy emphasises the triple-bottom-line approach, requiring a balance between economic, environmental and social values. It necessarily recognizes that living with salinity is the only choice in some situations.

(BSMS 2001–2015)

South Australia recognises that managing environmental watering at a Basin scale is a balancing act and that management and approval of environmental watering events will require a coordinated whole-of-Basin approach. This is to take into account the need to meet environmental water requirements for system assets and remove salt from floodplains while maintaining river salinity within acceptable salinity levels for all water users, including other downstream assets such as the Coorong and Lower Lakes. In assessing which sites to water, the potential scale of the cumulative salinity impacts and in-stream flow and salinity conditions, both current and future (i.e. future water availability for dilution) need to be considered.

3.2.1. Salinity Risks from Floodplains

Floodplain salinity poses one of the single biggest risks to meeting River Murray salinity management objectives in South Australia. On average, about 2 million tonnes of salt per year reaches the sea via the river. River regulation and greatly reduced flows, particularly in the last decade, resulted in little discharge of salt to the sea for a long period, at least until the breaking of the drought in 2010. Although the recent, extended higher flows have enabled wash off of surface salt, dilution and discharge from the River system via the Murray Mouth, the risk of the volume of salt present in the groundwater systems of the floodplains along the lower parts of the River Murray remains relatively unquantified.

There has been significant concern that this salt will become mobilised when these floodplains are watered as a result of natural flooding and/or through planned environmental watering events (e.g. utilising infrastructure such as the Chowilla environmental regulator currently under construction).

South Australia has recognised that it needs to act to assess this risk and identify what options are available for addressing this issue. As a first step, South Australia initiated a project late in 2009-10 to:

- assess what tools are available to quantify floodplain salt loads;
- conduct a broad assessment of the risk;
- explore river system operational response options to mitigate the salinity affects following a flood; and
- identify areas for further work.

This project was completed in September 2010 and the draft findings were reported in South Australia's 2009-10 Report to the BSMS. The final report did not alter the draft findings and the report has informed South Australia's input to the MDBA project on the same issue.

Phase 1 of the MDBA project was largely completed during the first half of 2011. South Australia believes the MDBA project has been successful as a first cut analysis to assemble a conceptual model of floodplain salt mobilisation and to identify possible mitigation strategies. The report is only a broad assessment; however, it has significant implications in terms of further work. It is important to recognise that the report is based on regional scale data only, in that it groups data into long time blocks and broad geographic units for analysis and assesses the significance of salinity impact against a single indicator site (where the Basin Salinity Target (Morgan) was exceeded).

It should be recognised that salt peaks can occur elsewhere in the system, both above and below Morgan with significant implications for water users. The report frames the highest risk areas as being within the Riverland. While it is true that in relative terms these are the higher risk areas, in absolute terms the upstream areas are also a key salt source – that is, the net salt contribution of the Basin landscape outside of the South Australian section of the Basin remains significant.

South Australia is of the view that more work is needed on this issue, including unpacking detailed data to give a better understanding of trends and system responses. This work is required to look past the broad regional trends before moving to development of operational strategies. South Australia understands that BIGMOD could assist in this task.

South Australia continues to support phase 2 of the project that will look to develop principles for operational and mitigation responses. South Australia believes that this will require refinement of the understanding of historical sources of salt loads (over that provided in the report) and engagement with river operators, environmental watering programs at the start of the project. South Australia will undertake to do this within its jurisdiction but this also needs to occur at the Basin scale, led by the MDBA.

There will be a need to examine what management actions have worked in the past and under what circumstances (i.e. actions that can realistically be undertaken to mitigate post flood salt), while identifying possible other mitigation actions (i.e. possible actions/those not yet trialled).

There is a general understanding in South Australia that it is not the role of the MDBA BSMS program to develop operational strategies (as BSMS does not hold detailed knowledge of all other programs that influence operations). However, there is a clear role for this program to determine high level principles for salinity management to feed into operational planning.

It is understood that the MDBA will be doing further work in the coming year to progress these issues. In doing this, it will be important to examine the linkages between the conceptual model developed in the report, and its applicability to managed watering events that generate salt, given these are likely to occur more regularly than natural floods.

At this stage, it does appear that dilution flow is one of the few genuinely effective management options. There is a need to make a best estimate for dilution water required before a managed or unmanaged flooding event occurs, as a safety net. Dilution volumes could be needed for long periods (more than 12 months) in some cases.

3.2.2. Environmental Watering Actions

Salinity Risks

Prior to river regulation, salt was regularly mobilised out of the River Murray floodplain in response to frequent flood inundation of the adjacent floodplains. While the salt content of the Basin has not changed under river regulation, factors such as reduced water availability, lack of regular high flow events, river regulation and land management practices have all resulted in changes in the timing of the discharge of salt from the Basin groundwater systems, wetlands and floodplains.

Most notably, salt has concentrated in floodplains and wetlands due to changes in the timing of wetting, drying and release cycles. This has impacted on the health of these systems. Broad scale environmental watering measures (including those under the The Living Murray program) have been initiated to reinstate (or at least mimic) the natural wetting, drying and salt release cycles in these systems and larger volumes of environmental allocations are intended to be delivered to such systems in future.

Delivery of environmental water therefore plays a vital role in supporting the future health of South Australia's River Murray, its floodplains and wetlands. Over the past five years environmental watering has ensured the maintenance of drought refuges, prevented the loss of species and habitat, and enabled re-colonisation and re-establishment of species and ecosystem functions when higher flows returned. The environmental watering undertaken in the years prior to the 2010-11, although limited in scale, has provided an important foundation for the recovery process.

Significant investment is currently being made by Basin States, the Commonwealth and the MDBA in environmental water and infrastructure. The intention is to improve the ecological condition of high priority sites throughout the Basin such as the Chowilla floodplain.

This will be beneficial to the health of such systems but also has the potential to mobilise significant volumes of salt to the river; resulting in accountable salinity impacts under Schedule B of the Murray-Darling Basin Agreement. The local real-time (short term) salinity impacts are likely to be particularly significant and will warrant real-time decision-making during the course of managed events to ensure salinities do not exceed agreed salinity targets. South Australia supports the inclusion of such actions on the BSMS Salinity Registers; however the real time impacts need to be given serious consideration.

The delivery of environmental water therefore needs to be appropriately managed to ensure an effective balance between restoring the health of wetland, floodplain systems and managing the potential salinity risk. This highlights the need for a real-time salinity management framework to ensure salinity risk can be assessed across all sites and watering events are managed accordingly.

There are existing operational strategies that can be employed to mitigate these salt loads, including the use of dilution flows and restriction of backflow from high salinity wetlands. Early warning systems can also be used to inform affected water diverters of likely salinity levels.

It is therefore essential that partner jurisdictions recognise the importance of managing real-time salinity impacts at all sites that may result in such impacts, and that an allowance

of dilution water is made available in addition to the allocation required to achieve the ecological objectives at the respective sites.

Findings from salinity investigations show that there is high risk that there will be a real-time salinity event in response to an environmental watering action at both the Chowilla floodplain and the Koondrook-Perricoota Forest (specifically the Wakool system). The risk arises when floods mobilise floodplain-stored salts or when stratified saline pools are flushed back into the river.

South Australia proposes that the operational plans (schedules to the Environmental Water Management Plans) address real-time salinity through plans for operational responses to ensure unacceptable salinity impacts to other water users are minimised and or mitigated. South Australia is also of the view that environmental watering actions are managed collectively to ensure the potential cumulative salinity impacts of multi-site watering can be appropriately managed. South Australia is keen to continue to work with the MDBA and the Commonwealth Environmental Water Holder (CEWH) to address this issue.

Environmental water delivery

Environmental water bids for 2010-11 were developed and submitted to the MDBA, The Living Murray Program (TLM) and the CEWH. These proposals were based upon a site selection and prioritisation process undertaken in late 2009-10, prior to the drought breaking. A workshop with ecologists and wetland managers identified priority assets for watering. The criteria used to prioritise 2010-11 watering sites built on the knowledge, experience and monitoring information from previous watering actions.

As 2010-11 progressed, flows in South Australia reached levels not seen since the early 1990s, resulting in the natural reconnection of the floodplain and wetlands to the main river channel. With the return of high flows, the importance of the previous environmental watering effort to provide drought refuge and preserve species and habitat was reinforced. The improving river conditions required revision of the environmental watering program with priorities changing as higher flows resulted in floodplain inundation and the natural filling of many wetlands.

During 2010-11, South Australia received 305 511 ML of environmental water for River Murray wetlands, floodplains and the Lower Lakes. This included water received from the following sources:

- the MDBA TLM Program (157 347 ML) which consisted of 137 ML delivered to wetlands within the Chowilla floodplain and 157 210 delivered to the Lower Lakes;
- the Commonwealth Environmental Water Holder (139 191 ML) which consisted of 154 ML for Carpark Lagoons on the Katarapko floodplain and 139 037 ML delivered to the Lower Lakes;
- private donations of 100 ML for watering priority wetland sites on the Pike Floodplain; and
- return flows of 8 873 ML resulting from Victorian environmental watering actions.

Approximately 92 000 ML was delivered into Lake Alexandrina and Lake Albert from the South Australian Drought Water Allocation Decision Framework Lower Lakes Environmental Reserve.

South Australia also received significant volumes of “unregulated flow" that inundated the majority of the South Australian River Murray wetlands and some parts of the floodplain. A significant volume of the unregulated flow went to the Lower Lakes, Coorong and Murray Mouth icon site.

Environmental water provided during 2010-11 was used to extend the benefits of the natural high flow event which has provided a critical opportunity to mobilise and flush significant volumes of salt from the Basin. Additional environmental water also increased the volumes released through the barrages from Lake Alexandrina to the Murray Mouth and Coorong estuary, thereby increasing connectivity, increasing the estuarine area and decreasing salinity levels in the Coorong. It also provided the opportunity for continued barrage fishway releases through winter of 2011, a critical time for the adult female Congolli to move from Lake Alexandrina to the estuary and ocean to breed.

During early 2011 extensive work was undertaken on the development of environmental water proposals to the CEWH and TLM for proposed watering activities in 2011-12. These bids were submitted in May 2011 for the coming year. The focus of the next round of proposed environmental watering actions is to build on and consolidate the benefits of the 2010-11 high flow event.

With increasing volumes of environmental water holdings available, the work of allocating, managing and delivering environmental water from the various sources is becoming increasingly complex. The Department for Water, in collaboration with a range of stakeholders, continues to put significant effort into the preparation of detailed watering proposals underpinned by robust science and monitoring. In addition to the development and implementation of watering actions, the Department will continue to monitor and adapt to emerging river conditions to ensure that available environmental water is used efficiently and effectively, cognisant of in river flow and salinities.

3.2.3. Determining Long-term Accountable Salinity Impacts Associated with Environmental Watering Actions

Chowilla Floodplain Icon Site

The Chowilla floodplain is underlain by a shallow highly saline aquifer and is well documented as a source of saline groundwater discharge into the River Murray. It is recognised that managed inundation of the floodplain via operation of the Chowilla environmental regulator will reduce soil salinity, thereby improving vegetation health and providing environmental benefit to the Chowilla region. However, it is understood that the inundation will also result in an increased discharge of salt into the Chowilla Creek and ultimately to the River Murray.

Initial assessment of the long term salinity impact from operation of the regulator was undertaken by the then Department of Water, Land and Biodiversity Conservation (DWLBC) in 2007 and identified an interim salinity impact assessment of 4.6 EC. This assessment also indicated that operation of the Chowilla Creek environmental regulator could result in the addition of approximately 450 t/day of salt post-flooding at full operating height. The salinity impact at Renmark (immediately downstream of Chowilla) of an additional 450 t/day was considered to be in the order of 160 EC at flows of 5000 ML per day and 80 EC at 10 000 ML per day.

The Chowilla Regulator construction approval advice from MDBA requested further work to better assess both short term (real time) and long term salinity impacts of regulator operation to inform development of an appropriate operational strategy, prior to operational approvals being granted.

The salinity impact assessment undertaken by DWLBC (2007) was independently reviewed by an MDBA appointed peer reviewer (Salient Solutions, 2008). The reviewer provided recommendations for further model development and assessment. The Department for Water also sought further external review of the suitability of the model and has been advised (Aquaterra, 2010) that the model is suitable for the purpose of predicting post flood salt loads but that further development would improve confidence in the output.

In January 2010, Sinclair Knight Mertz (SKM) was engaged to assess the real time salinity impacts of regulator operation in more detail, including consideration of salt from both groundwater and surface water sources under a range of operating scenarios. Salinity impacts were assessed as predicted peak incremental EC increase in the River Murray downstream of the Chowilla Creek confluence.

Under the worst case scenario, a peak increase of 191 EC in the River Murray (at a location downstream of the Chowilla Creek confluence) was predicted. An increase of this scale may be problematic if river salinity is already high. In such situations, additional water for dilution will be necessary. The required volume of dilution water, if required, will be identified as part of any environmental watering proposal.

These findings are informing the development of the operational plan for the Chowilla regulator and the development of Basin and local level environmental watering management plans.

The estimate of the interim salinity impact of Chowilla Creek regulator operation was determined using the existing Chowilla groundwater model. This model is currently unaccredited and the register entry considered provisional. The model is currently undergoing an upgrade based on the findings of the 2008 peer review. Model upgrade and revised salinity impact assessment will be completed by late 2011. It is likely that the provisional entry (4.6 EC debit) at Morgan will increase following the upgrade of the groundwater model.

Following upgrade, the model outputs in combination with the findings of the SKM assessment are expected to provide sufficient information to support approval by the MDBA for operation of the Chowilla environmental regulator.

Pike and Katarapko Floodplains

Significant investment in environmental water and infrastructure for broad-scale inundation is proposed to be undertaken at the Pike and Katarapko sites, under the Murray Futures Riverine Recovery project (as reported in Section 3.4.5). Prior to operation of the structures for environmental watering it is likely that an investigation will be required to quantify the salinity impact to satisfy BSMS accountability obligations, and to assess what operational actions, such as dilution flow, may be required.

Advice from the MDBA has suggested that it will be necessary to construct a comprehensive numerical groundwater model for Pike and Katarapko similar to that used for Chowilla. The

Chowilla model has involved substantial effort over an extended period and builds on numerous years of investigation and data acquisition.

Currently there is inadequate information available for a similarly comprehensive and accurate floodplain groundwater model at the Pike and Katarapko floodplains. There is neither sufficient spatial hydrogeologic data to construct a groundwater model, nor sufficient spatial hydrologic data to validate the model in terms of salt mobilisation. However, there remains a need to ensure an adequate assessment of salinity risk has been completed prior to broadscale watering actions occurring.

Given these issues, Catchment Management Consulting (CMC) were engaged by DFW in January 2011 to investigate whether a groundwater model coupled to a surface water numerical model, would produce an adequate representation of the salinity risk associated with the proposed management actions at sites such as Pike and Katarapko, consistent with the salinity assessment requirements within the BSMS Operational Protocols. As part of the investigation, CMC were also required to propose possible alternative approaches. The intention of the project was to put the salinity risks associated with proposed surface water management actions at Pike and Katarapko into context, and to identify what further effort would be required to satisfy BSMS modelling requirements.

The spatial variability of groundwater attributes combined with a lack of precision relating to the operating regime for floodplain environmental works generates considerable uncertainty in relation to salinity impact assessments. In the case of Pike, there is inadequate site specific data to undertake a sophisticated impact assessment approach. However, the actual impacts from any large watering actions will be measurable soon after the action; this is in contrast to irrigation actions for which there is generally a long lag time between action and impact. Provisional salinity register entries could be established for Pike based on preliminary estimates using the information that is currently available. These estimates could then be improved following detailed measurement of the impacts during and post environmental watering actions.

Based on these findings, DFW has been considering a process for modelling salinity impacts of environmental watering actions where data is lacking; e.g. Pike floodplain. It is proposing that in these cases:

- a historical analysis is undertaken (including use of expert opinion) to estimate the impact;
- a data collection strategy is developed and implemented;
- infrastructure is operated with caution and used to aid collection of further data; and
- if warranted, a more comprehensive modelling platform is developed (groundwater and surface water model) to better estimate the potential/actual impacts.

Similar to the Chowilla regulator operations, the local real-time (short term) impacts are likely to be particularly significant and will warrant real-time decision-making during the course of managed events (estimating local real time impacts associated with a range of operational scenarios can similarly be undertaken prior to operation by understanding salt loads associated with historic natural events, coupled with expert panel opinion). The assessment of the dilution water required to support operations (to ensure river salinities

remain within accepted targets) is likely to be the most critical issue and this will warrant further investigation and discussion in 2011-12.

3.3. SETTING SALINITY TARGETS

The Ministerial Council will adopt end-of-valley targets to protect values and assets while providing for targets to be revised, as new information becomes available. The partner Governments will empower catchment management organisations to advise on end-of valley targets and determine within-valley targets and monitoring arrangements, under salinity and catchment management plans.

(BSMS 2001–2015)

In light of the Water Act, 2007 (Cth) requirements for salinity objectives and targets in the Basin Plan, South Australia has directed effort in 2010-11 to reviewing the proposed salinity targets in the Guide to the Proposed Basin Plan, and supporting the inclusion of these targets to complement the existing Basin Salinity Target.

3.3.1. Salinity Targets

Setting salinity targets

The existing Basin Salinity Target at Morgan in South Australia (while supported by South Australia as key component of the BSMS) does not adequately provide for management of River Murray salinity below Lock 1 in South Australia.

The Basin Plan provides a critical opportunity to set salinity targets for high risk areas of the Basin, including the River Murray below Morgan, to guide management actions.

The Guide to the Proposed Basin Plan included operational salinity targets which resulted in the Independent Audit Group - Salinity (IAG) removing their recommendation on this issue in their 2009-10 report, on the basis that the recommendation had been addressed.

Setting salinity targets below Morgan is consistent with:

- Water Act provisions for critical human needs (S86A);
- Water Act provisions for salinity target setting (Part 2, Division 1, Section 25 (1) (b));
- IAG recommendations (2009, rec 4); and
- BSMS Mid Term Review recommendations (2007).

The development of operational salinity targets is a critical MDB management issue, especially for South Australia given the location of key water supply off-takes for Adelaide and country towns well below Morgan, at Mannum and Murray Bridge. The recent drought showed it is possible to meet the Basin Salinity Target but have high salinities below Lock 1.

South Australia continues to actively support setting such targets within the Basin Plan to provide a basis to guide operational management actions, including the management of environmental water delivery. Not including such targets in the Basin Plan provides little more for salinity management below Morgan than the existing BSMS. It would be extremely unfavourable to have completed such an extensive MDB policy and legislative reform process and have in place a new instrument that is effectively the same as the existing Schedule, given a key premise of the Water Act is improved Basin management

arrangements; addressing issues with current strategies and management frameworks; and not accepting the status quo as best practice.

Science Review of the Basin Plan Water Quality and Salinity Management Plan

As part of the Science Review of the Guide to the proposed Basin Plan, water quality, salinity and salt load targets proposed by the Government of South Australia and the MDBA were reviewed by the Goyder Institute (Pollino et al. (2011)).

South Australian salinity targets were developed to inform the State's input to the development of the Basin Plan. While the South Australian salinity targets have support across government agencies, they are not currently formal Government policy.

Information on the MDBA's targets was extracted from the Guide to the proposed Basin Plan (the Guide) (MDBA, 2010a and 2010b). The review relied on water flow, water level and salinity results from BigMod modelling provided by the MDBA for the five scenarios – baseline, without-development and the three Guide scenarios (3000, 3500 and 4000).

The following criteria were selected for assessing salinity impacts:

- "working" salinity targets proposed by the Government of South Australia for the border, Berri, Morgan, Murray Bridge, Tailem Bend and Lake Alexandrina (Milang) – prescribed as EC thresholds for a percentage of time;
- South Australia's management target of 800 EC and emergency response threshold and 1400 EC (the point beyond which water is no longer considered suitable for Critical Human Water Needs);
- MDBA's Basin Salinity Management Strategy (BSMS) EC and salt load targets at Morgan; and
- MDBA's operational salinity targets at the border, Berri and Murray Bridge (as set in the Guide to the proposed Basin Plan).

Statistical analyses of the salinity results from BigMod were undertaken using the eWater River Analysis Package (RAP) available from the eWater Toolkit (<www.toolkit.net.au>), supplemented with graphs and some additional statistics extracted using the Integrated Quantity and Quality Model (IQQM) graphics package and Excel.

Achievability of MDBA's proposed salt load export target of a minimum of 2 million tonnes per year through the barrages on a 10-year rolling average basis (i.e. 20 million tonnes in any 10 year period) was also investigated. This entailed calculating daily salt loads through the barrages and using these to calculate 10-year rolling averages of salt loads, with the first period starting on 1 July 1975 and following periods starting progressively one year later through to 1 July 1999.

Scenario salinity results were compared with South Australia's proposed salinity targets and MDBA's BSMS targets at the South Australian border (upstream Lock 6), Berri (MDBA target location), Morgan, Murray Bridge, Tailem Bend (surrogate for Wellington) and Lake Alexandrina (Milang). Results are presented in Figure 6, expressed in the percentage of time the target is achieved under modelled conditions.

Risks and caveats

The following risks and caveats were identified during the project:

- Salinity results are a by-product of flow modelling and not the results of a salinity modelling project, but the results are the best available at present; and
- Water quality and salinity results can be expected to be sensitive to the sequencing and period of historical data, to assumptions made about delivery of environmental water under the Guide scenarios and, in the case of salinity, to assumptions made in modelling salinity.

Findings

Water quality is generally improved and salinity reduced under the Guide scenarios compared to baseline conditions. There is relatively little difference between the Guide scenarios in terms of their effects on water quality and salinity.

- South Australia's salinity targets for Lake Alexandrina are met under all three Guide scenarios (Figure 6), but are not met under baseline conditions;
- South Australia's salinity targets and the MDBA Basin Salinity Target at Morgan are met under all three Guide scenarios (Figure 7) and the without-development scenario. However they are not met under baseline conditions;
- The MDBA operational salinity target at the border, Berri and Murray Bridge, as defined in the Guide to the Proposed Basin Plan, are not met under any of the scenarios. However, the MDBA planning targets at Berri and Murray Bridge are met under all three Guide scenarios. The MDBA planning target at Murray Bridge is also met under baseline conditions;
- Due to the high probability of salt mobilisation from environmental watering events, achieving the salinity targets may be sensitive to the particular application of environmental flow delivery rules;
- The MDBA's BSMS basin salt load target of an average 1.76 million tonnes/year at Morgan, is met under all three Guide scenarios; and
- MDBA's salt load export target of a minimum of 2 million tonnes/year through the barrages on a ten-year rolling average basis (i.e. 20 million tonnes in any ten-year period) is not met except during persisting wet conditions under the baseline scenario or any of the three Guide scenarios (Figure 8).

Scenario	baseline	3000	3500	4000	without development
SA border					
SA: < 400 EC 99.7% of the time (in a rolling 12-month period).	69	70	72	74	83
MDBA: < 412 EC 80% of the time (from *Water Act 2007*)	72	73	74	76	***84***
MDBA operational target: 310 mg/L (496 EC)	90	88	89	89	*91.5
Berri					
MDBA: < 543 EC 80% of the time (from *Water Act 2007*)	79	***83***	***85***	***86***	***88***
MDBA operational target: 390 mg/L (624 EC)	91	93	94	92	92
Morgan					
SA and MDBA: < 800 EC 95% of the time (Basin Salinity Target)	90	***96***	***98***	***97***	92
MDBA operational target: 500 mg/L (800 EC)	90	***96***	***98***	***97***	92
Murray Bridge					
SA: < 900 EC 99.7% of the time (in a rolling 12 month period)	94	98	98	98	96
MDBA: < 770 EC 80% of the time (from *Water Act 2007*)	***83***	***93***	***95***	***95***	***94***
MDBA operational target: 500 mg/L (800 EC)	86	94	96	96	95
Tailem Bend					
SA: < 900 EC 99.7% of the time (in a rolling 12 month period) **at Wellington**	93	97	*98.5	98	96
Lake Alexandrina					
SA: < 1000 EC 95% of the time	85	95	***96***	***98***	85
SA: < 1500 EC 100% of the time	95	***100***	***100***	***100***	87

Note: non-exceedance percentiles (green cells with numbers in italics indicate a percentile equalling or better than the target value)
* - interpolated

Figure 6 - Key statistics of salinity and salt load targets at key locations under without-development, baseline and Guide scenarios (Source- Pollino et al.)

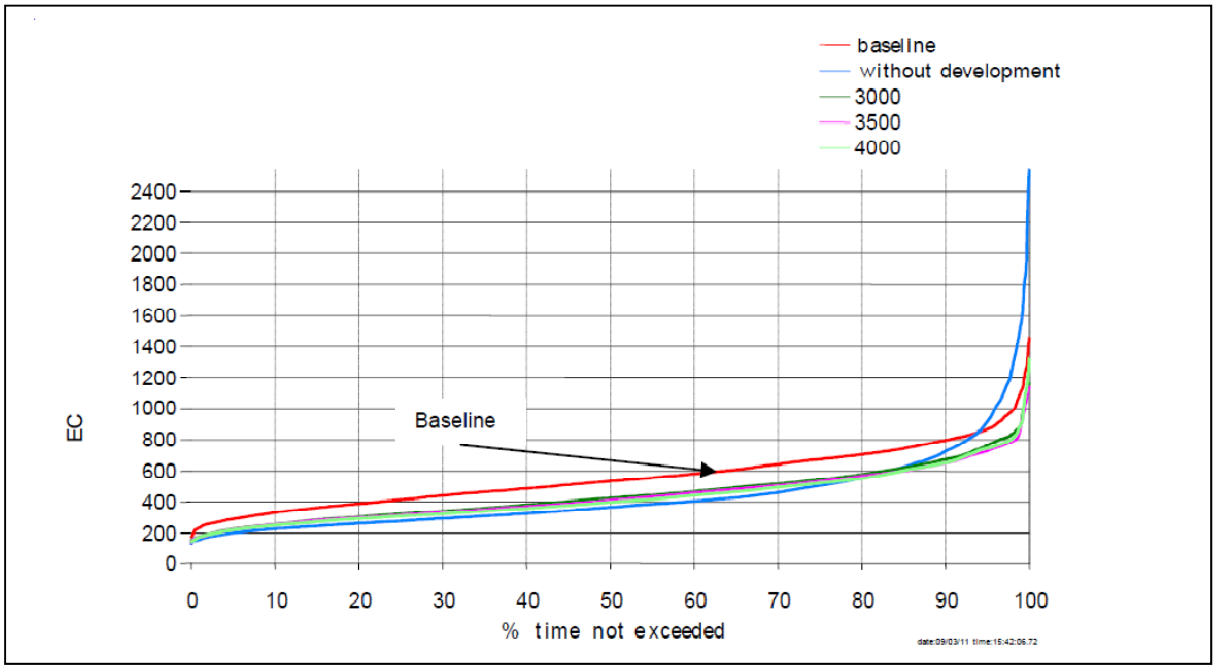

Figure 7 - Salinity non-exceedance curves for Morgan over the full period of salinity modelling (1/1/1975–30/6/2009) under the baseline, without-development and Guide scenarios (Source- Pollino et al.)

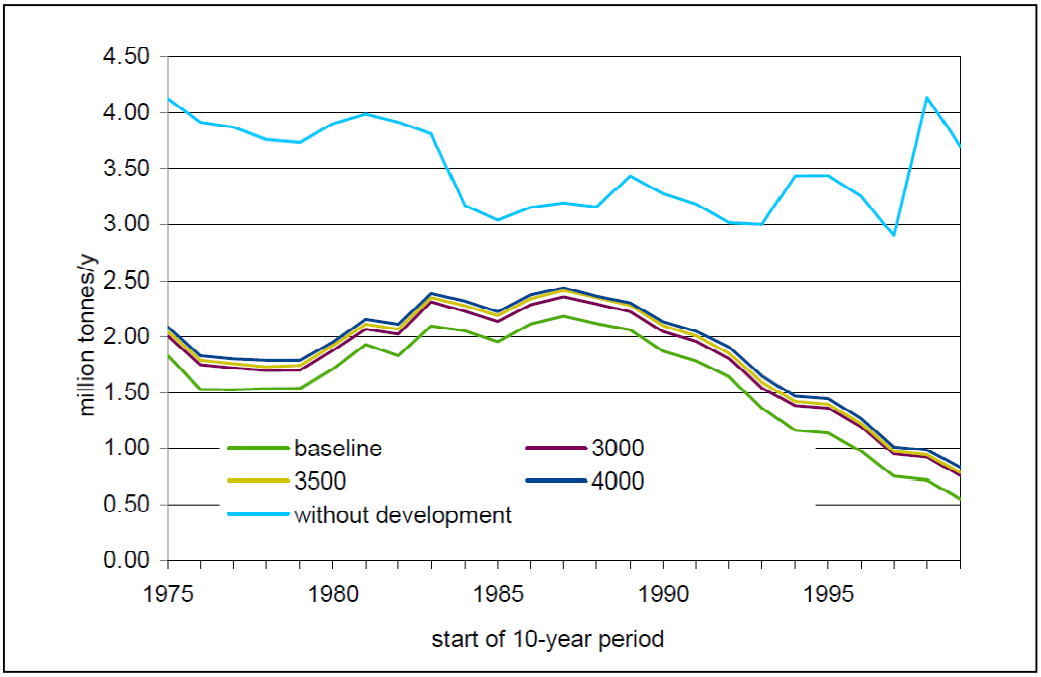

Figure 8 - Average annual salt loads (million tonnes/y) through the barrages for rolling 10-year periods over all complete years in the salinity modelling period (i.e. 1/7/1975–30/6/2009) under the without-development, baseline and Guide scenarios (Source- Pollino et al.)

Salinity Targets for the Coorong and Lower Lakes

The Coorong, Lower Lakes and Murray Mouth (CLLMM) region is one of Australia's largest wetland systems. The region is of international ecological significance and is one of the MDBA's Living Murray icon sites. The region hosts an economy based on agriculture, fisheries and tourism, and is the traditional country of the Ngarrindjeri people. Modifications to the flow regime, lack of inflows from the Murray-Darling Basin, infrastructure, management and rising salinity have degraded the wetlands and significantly changed the ecology of the region. Indeed, salinity management is one of the key issues for this region.

The long-term plan for the CLLMM region (reported in 2009-10) was prepared to ensure the region and its people have a healthy, viable and sustainable future in the context of variable climatic conditions and water resources. A key element of the overall strategy is the determination of the site's environmental water requirements. The process undertaken to determine environmental water requirement for the CLLMM region was reported in Lester et al. (2011), and has been summarised below.

In developing a recommended environmental water regime for the CLLMM region, hydrological, hydrodynamic and ecological response modelling was used. Heneker (2010) outlines the hydrological modelling which showed that salinity in Lake Alexandrina was the variable of the lakes flow regime that required the most flow to support in the long term, compared with the maintenance of water levels or connectivity with the Coorong. Thus, if flows were sufficient to meet the salinity targets for Lake Alexandrina, other targets for the lakes, such as those associated with water levels or barrage outflows, should also be met.

Flow sequences into Lake Alexandrina were explored to develop rules for the amount of additional flow needed to maintain salinities at or below the thresholds likely to result in harmful effects to the sites ecology. An assessment of the effect of large inflows showed

that the 'memory' of the system regarding flows was quite short; approximately three years. That is, large flows had the ability to lower the salinity of the lakes for up to three years, after which salinities began to rise again significantly. This allowed a determination of a regime required to support the ecology of the Lower Lakes.

Lester et al (2011) details the hydrodynamic and ecological response modelling of the Coorong. This modelling was undertaken on the resultant barrage outflows required to support the salinity targets in Lake Alexandrina and indicated that the outflows required to support salinity targets in Lake Alexandrina, affected the maximum salinity within the Coorong. Analysis using the ecosystem states model demonstrated that flows of this magnitude maintain the Murray Mouth sufficiently open to allow for ecologically-meaningful connectivity between the Coorong and the ocean.

Alterations to the flow delivery regime had a substantial impact on both the hydrodynamics and ecosystem states of the Coorong, meaning that any improvements in ecological condition were likely to be dependent on the manner in which flows were delivered to the Coorong, as well as the volume that was delivered. This is a significant issue for the future delivery of environmental water to the Coorong.

An additional investigation of the low-flow requirements for the Coorong demonstrated that the volumes sufficient to meet the target of 1000 EC in Lake Alexandrina (or lower) were sufficient to limit ecological degradation in the Coorong. These flow rules were sufficient to maintain Coorong hydrodynamics and ecosystem states, even under climate change. Flows to meet the 1500 EC target were not sufficient in very dry periods to prevent ecological degradation.

A similar analysis of high-flow requirements, however, showed that these were not satisfied by any of the proposed sets of minimum-flow delivery rules. Instead higher, 'natural' barrage outflows (i.e. not environmental releases but minor 'floods') of 6000 and 10 000 GL year were required to supplement the flows to support the Lake Alexandrina salinity target. In the absence of better data on which to recommend the frequency with which these flows are required, it was recommended that these flows be maintained at their current frequency (of every three and seven years, respectively).

Modelling showed that meeting the targets set for Lake Alexandrina (i.e. the long-term average of 700 EC with a maximum of 1000 EC in 95 percent of years) in combination with the higher flows historically received by the site would be sufficient to provide for the site's environmental water requirements.

In order to meet the target of 1000 EC in Lake Alexandrina, minimum flows over the barrages in any given year should be the maximum of:

- 650 GL
- 4000 GL - F_{X-1}
- 6000 GL - F_{X-1} - F^*_{X-2}

where F_{X-1} is the flow volume from the previous year and F^*_{X-2} is maximum of the flow volume from two years previous or 2000 GL.

Reports outlining the findings in greater detail including the independent peer review, the author's response and a shorter summary of the work can be found at www.environment.sa.gov.au/cllmm

3.4. MANAGING TRADE-OFFS WITH THE AVAILABLE WITHIN-VALLEY OPTIONS

The States will analyse and review the best mix of land management, engineering, river flow, and living with salt options to achieve salinity targets while meeting other catchment health targets and social and economic needs. The States will assist communities to understand and agree the options with affected groups, industries and people through best practice planning processes.

(BSMS 2001-2015)

The Government of South Australia is working with local communities, scientists, technical experts and engineers to address drought recovery issues and develop long-term sustainable solutions.

3.4.1. Operational Strategies and Actions

Significant improvements to water availability early in 2010-11 enabled the South Australian Government to shift focus from managing drought impacts, to recovery from drought. Many of the drought response projects reported in 2009-10 were concluded early in 2010-11 to focus on ensuring that the maximum benefits could be gained from the high flows.

South Australia's River Murray Operating Strategy

South Australia is developing its own River Murray Operating Strategy, currently in-draft. This Strategy will provide an overarching strategic framework for transparent and coordinated operations of the River Murray system from the border to the Murray Mouth, and will take into account a range of potential flow scenarios and the competing needs of all water users. The Strategy underpins South Australia's River Murray Annual Operating Plan (the Annual Operating Plan) that describes the range of actions that may be undertaken under certain high and low flow situations to achieve desired outcomes. The Strategy is being designed to be current until 2014 but will be updated as required.

The Strategy and the Annual Operating Plan have been developed to inform the River Murray System Annual Operating Plan developed under the Murray-Darling Basin Agreement.

In particular, the Strategy will:

- highlight the key strategic environmental, economic and social outcomes sought through management and use of the River Murray in South Australia based on existing and proposed documents and plans;
- establish clear operational objectives (including salinity objectives) taking account of a range of water resource and river conditions and flow history;
- specify the outcomes sought from the storage and delivery of deferred water for critical human water needs and private carryover;
- specify the communication mechanism that outlines the changing risk associated with the transfer or substitution of water stored as carryover to the relevant holders of water allocations through monthly variations made via the Annual Operating Plan;

- specify the outcomes sought from the delivery and application of held environmental water secured from the Commonwealth Environmental Water Holder, The Living Murray, or any other source;
- specify priorities for the use and management of unregulated flow should they become available;
- establish agreed broad rules and parameters within which river management actions should be undertaken such as minimum and maximum regulated weir pool levels and barrage operation; and
- identify and provide a mechanism to address unresolved management and policy issues.

This Strategy will guide the Annual Operating Plan and is prepared for the benefit of all stakeholders associated with the River Murray System in South Australia.

Water quality and salinity targets are a key component of this strategy and will be established to be consistent with South Australia's previous advice (in the context of the Basin Plan Water Quality and Salinity Management Plan) to the MDBA on water quality and salinity issues. The salinity targets proposed for this strategy will include targets for the River Murray in South Australia, the Lower Lakes and the Coorong.

Opening of disposal basins and creeks

As a result of the significantly improved flows in 2010-11 compared to the previous ten years, several creeks and drainage disposal basins which were previously closed due to low flows were opened.

In late September Bookmark Creek at Renmark was opened. This was the first time in a decade that the Riverland creek had been flushed. The opening of the creek provided significant salinity management benefits by helping to remove the salt in the creek and to freshen up the local environment. Prior to the opening of the creek local support assisted in removing assorted rubbish which had accumulated in the creek bed over the past decade.

In early December the Cobdogla and Berri basins were opened for the first time in a decade. In the past these basins were important irrigation drainage basins for the region, but with improved irrigation practices and the drought, they dried up over the past decade. With increased inflow from upstream to the River Murray system, the basins were able to be filled, offering significant salinity management benefits.

Initially the water was allowed to pool in the basins. As the season progressed significant improvements to inflow allowed the basins' banks to be opened to enable water to flush through to connecting creeks. The benefit to the local ecology from reopening Cobdogla Basin and Berri Basin was enormous with significant and speedy environmental and ecological responses to the fresh water, including a return of wildlife. Importantly, the high River flows enabled salt to be diluted, thereby mitigating any potential impacts downstream.

Murray Mouth Sand Pumping Project

In May 2002, a large volume of sand flowed into the Murray Mouth during two storms causing constriction of the Murray Mouth and channels. All available evidence indicated

that the Murray Mouth would close if no action was taken. As a result, the Murray Mouth Sand Pumping Project commenced dredging operations in October 2002.

Initially dredges were in operation around the clock to ensure that the Murray Mouth remained open, however following the release of water from barrages in the Lower Lakes in 2010-11 the dredging hours at the Murray Mouth, Tauwitchere and Goolwa Channels were halved to 12 hours a day in October 2010. Dredging was halted in December 2010 with the return of higher flows and projections of a significant amount of water in early 2011.

Over the eight years of dredging operations, more than 6.5 million tonnes of sand were removed at a cost of around $32 million, ensuring an exchange of water between the ocean and the Coorong. The dredging was a joint project of the MDBA, DFW and SA Water. The dredging has been critical in enabling some connectivity between the River system and the sea, enabling export of salt from the basin (flow permitting).

Removal of Emergency Drought Structures

The combined effects of the prolonged drought together with past management practices throughout the MDB resulted in water levels in the River Murray below Lock 1 falling to critically low levels from 2008 to 2010. This resulted in elevated salinity levels and the development of acid sulfate soils in the region below Lock 1.

A number of agencies within the Government of South Australia worked tirelessly throughout the drought to address immediate issues and plan for worst-case scenarios. Emergency drought projects dealt with the urgent issues associated with low water levels including reduced flows, rising salinities and acidification of exposed soils.

The return of more favourable conditions and high flows to the Lower Murray in 2010-11, has enabled the commencement of removal of several of the temporary structures constructed during the drought.

Narrung Bund

The bund between Lake Alexandrina and Lake Albert was constructed at the peak of the drought in April 2008, when record low inflows saw the water level in the Lower Lakes and Goolwa Channel plunge to around a metre below sea level. The bund allowed the water level in Lake Albert to be managed independently through pumping water from Lake Alexandrina, keeping the high-risk acid sulfate soils at the centre of Lake Albert under water.

Lake Alexandrina and Lake Albert were reconnected in September 2010, with the removal of a 100 metre section of the embankment enabling water to flow naturally from Lake Alexandrina to Lake Albert for the first time since April 2008. The initial reconnection of the lakes was designed to allow reinstating of the embankment if conditions deteriorated again.

The embankment was entirely removed by July 2011, fully reconnecting Lake Albert and Lake Alexandrina for the first time in three years. At the peak of the drought salinity levels reached approximately 20 000 EC in Lake Albert. Following the reconnection of Lake Alexandrina and Lake Albert salinity levels in Lake Albert have decreased to approximately 5000 EC by June 2011, with water levels recovering to 0.75m AHD by October 2010.

Goolwa Channel temporary Flow Regulators

As an emergency response to prevent the impacts of acid sulfate soils on the Goolwa Channel and its tributaries, the Government of South Australia built two temporary structures to regulate the flow of water and raise water levels. The Goolwa Channel flow regulator was completed in August 2009, while the regulator at the mouth of Currency Creek was completed in September 2009.

The Goolwa Channel regulator was partially removed in October 2010 to enable up to 15 000 ML of water to flow each day from Lake Alexandrina, down the Goolwa Channel and out through Goolwa Barrage into the Coorong estuary.

The removal of a section (135m) of the regulator enabled water to flow between Lake Alexandrina and the Goolwa channel for the first time in more than a year. The partial removal of the regulator and provision of additional flows has drastically reduced salinity levels in the channel.

The remainder of the structure will be removed by 30 June 2012. This timeframe is a worst case scenario.

The Currency Creek regulator is still in place as it was designed and constructed to allow water to flow over the top of the structure during times of high flows. Planned commencement of removal of this structure is mid 2012.

Lake Bonney Regulator

The Lake Bonney regulator was constructed in 2007 to ensure that critical human needs could be met during the record low inflows during the prolonged drought along the Murray-Darling Basin.

Following improvements in flows the trigger for the removal of the regulator was met and the structure was removed in early December 2010. The decision to remove the regulator was made after considering a request from the Berri Barmera Council and the views of the local community.

The removal of the regulator has allowed more water to flow between Lake Bonney and the River Murray, and has significantly improved water quality in the Lake.

Barrage Operations and Water Levels in the Lower Lakes

From late December 2010 the water levels in Lake Alexandrina, Lake Albert and the Goolwa Channel have been managed to enable the freshening of the Lower Lakes and to remove accumulated salt.

Water levels in the lakes have been drawn down to around 0.5m AHD on several occasions by increasing barrage discharges and providing higher flows into the Coorong. The lakes have then been re-filled by the fresher water flowing down the River Murray.

The water levels in the lakes have generally been managed between 0.5m to 0.8m AHD during the events and this has further contributed to the success of current investments in revegetation and acid sulfate soil mitigation around the lakes.

A number of seawater backflow events occurred during May and June 2011 due to king tide events. These seawater backflow events caused elevated salinity levels upstream of each of the barrages for a few days after each event, with the saline water dissipating rapidly when

releases into the Coorong resumed. In some locations the elevated salinity levels have lasted slightly longer; however, the potential for these events has been reduced by opening a lower number of barrage gates.

3.4.2. Reuse of Salt Interception Scheme Water

The saline groundwater extracted by Salt Interception Schemes (SIS) along the River Murray in South Australia has been identified as a potential resource for economic development. Some examples of the commercial uses of saline groundwater across Australia include:

- inland aquaculture;
- salt harvesting;
- chemical extraction; and
- energy production.

The Government of South Australia has previously released an Information Memorandum seeking expressions of interest to access and use saline water from the Woolpunda Salt Interception Scheme (SIS) for commercial application. There was minimal interest received from commercial enterprises during the official response period; however, the Information Memorandum remains open should any other parties approach the Government in the future.

Opportunities to attract an economically viable industry to the Riverland region continue to be investigated by the Government of South Australia. In 2010-11 the DFW developed an evaluation report on the expression of interest process. As part of the evaluation report alternative uses for saline water have been identified, along with strategies to promote the use of the resource within the Riverland region.

3.4.3. South Australian Weir Pool Manipulation Program

No targeted weir pool manipulation events for environmental outcomes were undertaken during 2010-11 due to the initial low flow conditions and then the rapid return of high flows across the MDB system. Lock and weir operations in South Australia did include some small scale raising and lowering in order to manage the increasing flows and protect construction activity underway at a number of sites, until flows exceeded the levels at which the weir structures could remain operable.

With the recent improvement of flows into South Australia, opportunities to commence implementation of the South Australian River Murray Weir Operating Strategy (Lloyd, et al, 2010) have been considered. This Strategy was developed to guide the implementation of weir pool manipulation events aimed at maximising potential ecological outcomes within the existing constraints.

There may be an opportunity to undertake weir pool manipulation (raising) in conjunction with the delivery of environmental water to South Australia during the spring of 2011. This opportunity is currently limited to weir pool raising in the Lock one to two reach. A range of activities and constraints including construction activity at Chowilla and at Locks two and four will prevent any manipulation of other weirs during 2011-12. Planning is in progress to prepare for implementation of the proposed weir raising at Lock one.

Projects to further progress the weir pool manipulation program in South Australia have been incorporated into the Riverine Recovery project of the Murray Futures program. This includes a range of investigations to fill knowledge gaps and support planning, risk management and progressive implementation of the South Australian River Murray Weir Operating Strategy. The investigations to be undertaken during 2011-12 include building further understanding of potential salinity risks of implementing the Operating Strategy and how these risks can be mitigated. No new salinity investigations relating to weir pool management have been undertaken in 2010-11.

3.4.4. New Schedules to the Murray-Darling Basin Agreement

Clauses 130 and 135 of the Murray-Darling Basin Agreement required the MDBA to prepare draft schedules to account for South Australia's Storage Right (Schedule G) and a draft Schedule for Water Sharing (Schedule H). Basin jurisdictions, through the River Murray System Operations Review Steering Committee and the Operations Review Working Group, finalised the schedules in 2011.

Schedule G (the storage schedule) is an important management tool to assist South Australia to store water in relatively wet times, to manage during periods of low inflows and during drought conditions (which are likely to become more prevalent in future). This storage schedule may be of particular benefit in terms of providing opportunities for South Australia to manage critical human water need requirements and local salinity impacts within the State by having access to water in the upstream storages for release during periods of low water availability – for example, to provide for dilution flow.

Following the endorsement of Schedule G, the Government of South Australia is now in the process of establishing a new long-term water carryover policy for all water users by the end of 2011. If approved the new policy will become operational to provide for the carryover of unused water from 2011-12 to the 2012-13 water year.

3.4.5. Water for the Future

At the 3 July 2008 meeting of the Council of Australian Governments (COAG), Basin States signed an Inter-Governmental Agreement (IGA) on Murray-Darling Basin Reform that established new governance arrangements for the Basin.

The IGA included $530 million for South Australia's priority project, Murray Futures – an integrated package to sustain, support and reinvigorate communities and industries within the Murray-Darling Basin in South Australia. A further $80 million was made available for the purchase of water entitlements from willing sellers, with water to be held by the Commonwealth Environmental Water Holder (CEWH).

The Murray Futures program aims to secure future water supplies, renew irrigation industries and communities, and secure improvements to the river's health by providing flexibility in how the system is managed in the future.

The 10-year $610 million Murray Futures program includes:

- $120 million Lower Lakes Pipelines;
- $200 million Lower Lakes and Coorong Recovery;
- $110 million River Industry Renewal;

- $100 million Riverine Recovery; and
- $80 million Water Buy Back.

Riverine Recovery

The Riverine Recovery Project is a component of Murray Futures program that aims to achieve measurable long- term improvements in the health of the riverine environment between Wellington and the South Australian border.

The project aims to improve ecological outcomes for floodplains and wetlands, use environmental water more effectively and efficiently, provide social benefits, and deliver up to 15 GL of water savings to the Commonwealth to help protect or restore environmental assets in the MDB.

The Riverine Recovery Project is one of the first of its type aimed at improving the efficiency of environmental water use and re-allocating these water savings for the benefit of the environment. As part of the project there is a key opportunity to build-in operational strategies to manage salinity impacts, both on the sites being watered and in terms of management of potentially saline return flows from these sites.

Completion of the project will assist South Australia to effectively implement the Basin Plan. The project builds on the Living Murray First Step Decision to optimise environmental water delivery and maximise environmental outcomes while minimising impacts to other users. A significant part of the project will be to manage the impact of salinity on wetlands, and the downstream salinity impact of environmental watering events on other water users.

The funding will be used to undertake activities across a suite of project elements. One such element is the improvement of floodplains through the provision of critical infrastructure for enhanced environmental flows, fish passage and habitat, and connectivity of the floodplain and the river channel. Such activities will be aimed at reversing the effects of degradation (including salinisation) and restore the ecological health of two significant floodplain sites: Pike floodplain and Katfish Reach.

In addition, river operations will be enhanced by varying the timing and delivery of environmental water and, where appropriate, adjusting the height of weirs. These activities will aim to make the most of available water resources, while ensuring sufficient flow of water for dilution benefit to minimise downstream salinity impacts.

Finally, information management will be improved to support decision making. This means that various indicators of wetlands and floodplains including wildlife, vegetation and water quality will be monitored and the results will be used to better inform the management of environmental water, in order to maximise positive ecological outcomes with the available water resources.

Lower Lakes and Coorong Recovery

Following on from the development of the Long Term Plan for the Coorong, Lower Lakes and Murray Mouth reported in 2010-11 a further $118 million of funding has been approved by the Australian Government to ensure a healthy and sustainable future for South Australia's Coorong, Lower Lakes and Murray Mouth region. The funding agreement to support the projects and actions outlined in the State Government's Long-Term Plan for the

region will include a contribution from the South Australian Government as per the funding agreement.

The Long-Term Plan envisages that the Lower Lakes will remain a freshwater system and operate at variable water levels, the Murray Mouth remains open, salinity in the Coorong is reduced, the region's ecology is protected and there is enough water to sustain local communities.

3.5. IMPLEMENTING SALINITY AND CATCHMENT MANAGEMENT PLANS

This Strategy acknowledges gains made by existing plans, but requires that actions in existing and new plans, or the plans themselves, will need to be assessed and reported against the end of-valley and Basin targets and recorded on Salinity Registers.

The partner Governments will continue and enhance support for land and water management plans (LWMPs) in irrigation regions.

The partner Governments will enhance support for development and implementation of ICM Policy-compliant salinity and catchment management plans in dryland regions.

(BSMS, 2001-2015)

The significance of River Murray salinity as an issue for South Australia is reflected in it being recognised through key State level strategies and plans. The aim is to facilitate management action within South Australia that contributes to improved salinity outcomes locally and thus assists in meeting BSMS objectives.

3.5.1. State Plans and Strategies

South Australia's Strategic Plan

It is valuable to continue to have salinity recognised in the South Australian Strategic Plan as the specific salinity target: River Murray Salinity – South Australia maintains a positive balance on the MDBA's Salinity Register (T.77, formerly T3.11).

An implementation plan and fact sheet for this target were released in 2007-08. The graph from this fact sheet is updated periodically to reflect updates to South Australia's balance on the Salinity Registers, and project the State's salinity credit balance over time. Due to the delayed salinity impacts of past actions, South Australia's balance is predicted to ultimately reach zero. The graph provides a forward estimate of the timeframe for that to occur; this informs future policy directions and guides further investment and management actions to delay this. Reporting of progress against this target must be based on published data (as the graph and fact sheet become public information).

The graph from this fact sheet was last updated in 2010 to reflect the approved 2009 Salinity Register. Since the November 2010 BSMS Salinity Registers had not been approved by Ministerial Council at the last South Australian Strategic Plan reporting period, South Australia has not yet updated the graph on the published fact sheet. However, the updated graph has been drafted to reflect the November 2010 data and is included in this report at Figure 9. The graph will be included in an updated fact sheet for the next reporting period.

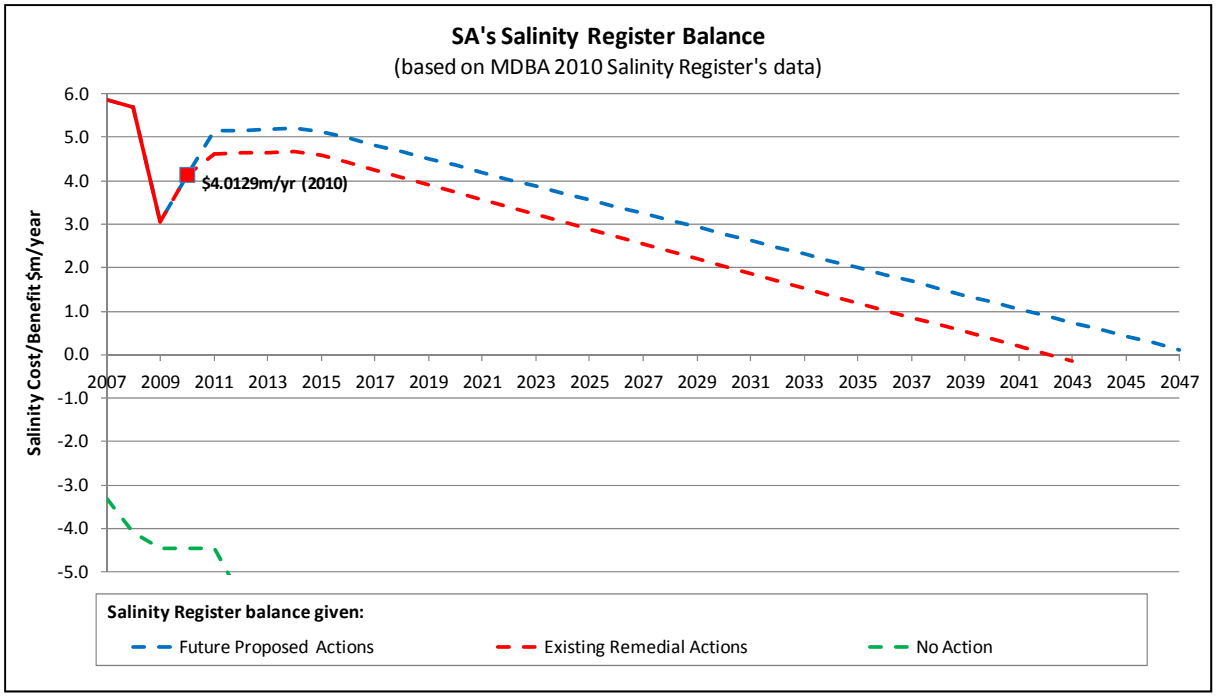

Figure 9 - Graph of South Australia's salinity register balance based on the November 2010 Salinity Register

Fact sheets relating to SASP targets can be downloaded at: http://www.saplan.org.au/

DFW is of the view that South Australia needs to continue to recognise River Murray salinity as a priority issue in its own right within high level State plans like SASP to facilitate ongoing investment in management actions. In implementing SASP, the BSMS Salinity Registers provide an existing framework for quantifying long term salinity impacts, thereby supporting ongoing SASP salinity target reporting.

Water for Good

The objective to remain in credit on the BSMS Salinity Registers remains an important action within a key State level strategy, Water for Good. The relevant Water for Good action (Action 56) is to "Maintain a positive balance on the MDBA's Salinity Register, and continue to implement strategies and actions to ensure the real time management of salinity in the lower reaches of the River Murray so that water quality remains at levels suitable for human consumption".

The desired outcome is that the entire length of the River Murray is a healthy, working waterway that continues to provide critical human water needs for Adelaide and regional South Australia, irrigation requirements and water for the environment. Key performance indicators include measurement of salinity and water quality levels in the Lower Murray. South Australia reports quarterly in terms of progress against this action. Progress in 2010-11 is clearly aligned with progress in BSMS implementation and reflects the key milestones as identified in the Executive Summary of this report.

Water for Good also contains an action regarding re-use of saline water: Action 42 – "Explore the economic and environmental feasibility of using saline water produced in salinity management schemes" discussed under managing trade-offs. This action is now complete.

South Australian River Murray Salinity Strategy

The fifteen-year vision of the South Australian River Murray Salinity Strategy (2001) is to maintain salinity in the River Murray in South Australia at current levels (i.e. when the Strategy commenced). The strategy is now dated. South Australia is awaiting the launch of the Basin Plan (including the Water Quality and Salinity Management Plan) to ensure the this Strategy is revised and updated to be consistent with the current and future Basin salinity management priorities. This will ensure that the Strategy is aligned with the Basin Plan. It is possible that a specific South Australian River Murray Salinity Strategy is not developed and salinity provisions will instead become embedded in a broader South Australian River Murray management strategy, to reflect an integrated management approach.

River Murray Act

The *River Murray Act 2003* provides for the protection and enhancement of the River Murray and related areas and ecosystems. The *River Murray Act 2003* has two specific objectives which relate to the management of salinity in the river, these are:

- water quality within the River Murray system should be improved to a level that sustains the ecological processes, environmental values and productive capacity of the system; and
- the impact of salinity on the ecological processes and productive capacity of the River Murray system is to be minimised.

The *River Murray Act 2003* requires the Minister for the River Murray to prepare an Implementation Strategy to ensure that the objectives of the Act are achieved. The initial implementation strategy was finalised in 2006. The Implementation Strategy:

- sets out the priorities that the Minister will pursue in order to achieve the Objects of the Act and to further the implementation of the Objectives for a Healthy River Murray;
- sets out the strategies that the Minister intends to adopt to meet those priorities; and
- takes into account the State Natural Resources Management Plan and the Planning Strategy.

The implementation strategy has two key priorities that relate to salinity management within the South Australian MDB;

- preventing increases in salinity and working to reduce current salinity levels including the 'legacy of history'; and
- controlling clearance of endemic native vegetation, and encouraging re-vegetation.

The River Murray Act Implementation Strategy is currently under review. As part of this process DFW conducted an online survey in June 2011, to ensure the views of relevant organisations and members of the public are taken into account in the review. The strategy will be updated in 2011-12 and it is anticipated that salinity will remain as one of the key priority areas for action.

Salinity Zoning Policy Review

The Salinity Zoning Policy is designed to maximise irrigation development potential by allocating salinity credits available to South Australia to irrigation development behind salt interception schemes and in the low impact zone, subject to available credits. Credits have not been allocated to high impact zones to date, as a policy decision was made to not permit further development in these zones. However, salinity credits have been allocated in the high salinity impact zone where significant commitments to the development prior to 30 June 2003 exist.

Since the development and implementation of the salinity zoning policy in 2005 there have been several developments in water policy at both a State and National level. These changes include:

- implementation of the 2009 River Murray WAP;
- unbundling of water rights;
- transformation of water rights;
- Commonwealth water buyback and exit grants; and
- development of the Basin Plan.

These changes initiated an evaluation, review and update of the salinity zoning policies in 2010-11 to ensure that the objectives of the policy are being achieved. Some of the proposed amendments to the Salinity Zoning Policy include, updating of terminology to align with site use approval, updating of references to legislation, policies and plans, and removal of provisional credit assignment.

3.5.2. Regional Plans and Strategies

River Murray WAP

The SA MDB NRM Board, in accordance with the *Natural Resources Management Act 2004*, is responsible for developing Water Allocation Plans for the South Australian MDB region in partnership with DFW. A concept statement has been prepared which outlines the proposed content of the plan and the relevant consultation required.

The existing River Murray WAP includes principles directed at protecting the river from adverse salinity impacts of water use. Principles 19 and 20 of the River Murray WAP allow the use of water for irrigation in the River Murray Irrigation Management Zone notwithstanding that such use may detrimentally affect the quality of water in the river by increasing salinity, provided:

> *"the increase in salinity is offset by an agreement, undertaking or obligation for works, actions or practices to prevent increases in salinity (including drainage management infrastructure, salinity mitigation infrastructure or revegetation to control irrigation recharge)"*

To give effect to this, within the River Murray WAP under Principle 15, it states:

> *"Water shall only be transferred for irrigation where the use of that water will be required to achieve a water use efficiency of no less than 85 percent"*

Due to legislative requirements for salinity management (such as Schedule B - BSMS) and the salinity implications of irrigation water use, it is important to keep a measure for efficiency in the River Murray WAP and to continue to encourage irrigators to be efficient.

Based on the findings of the How Efficient Are We? Report, as reported in Section 3.1.4, it is suggested that the basis for calculation of the current measure of water use efficiency could be changed. Options will be investigated as to whether it would be more appropriate to have a basis for assessment built into the River Murray WAP that enables calculation via a range of indices, including a water use efficiency index and an irrigation intensity index.

It is also proposed as part of the River Murray WAP review that opportunities to incorporate parts of the South Australian Salinity Zoning Policy be considered. The inclusion of key principles of the Salinity Zoning Policy in the River Murray WAP will give the policy a stronger basis for operation, improve transparency in regard to site use approval application and approval process and enable effective delivery of South Australia's salinity management legislative obligations.

A cross agency project is currently underway to consider the above suggestions and to develop a detailed systems understanding of the environmental watering requirements of the ecological assets of the River Murray. The project will also examine the best way to provide for these requirements through the River Murray WAP. The River Murray WAP will be released in 2014 for adoption under the State NRM Act. The River Murray WAP will also require future accreditation under the *Water Act 2007*, to align with Basin Plan.

South Australian Murray-Darling Basin Natural Resources Management Plan

As detailed in South Australia's 2009-10 Report to the BSMS, the SA MDB NRM Board launched the South Australian Murray-Darling Basin Natural Resources Management Plan (the Regional NRM plan) in June 2009. The Regional NRM Plan builds upon previous plans and strategies and provides a plan to protect and improve the condition of the natural resources of the SA MDB NRM region. The plan came into full operation on 1 July 2009.

The Regional NRM Plan establishes a consolidated set of targets which provide for a much stronger foundation for associated Monitoring, Evaluation, Reporting and Improvement (MERI) activities. The plan includes key targets associated with irrigation efficiency and salinity management, including:

- W1: All water resources are managed sustainably by 2018; and
- W2: Improve water quality to achieve the regionally endorsed environmental values by 2030.

A number of related management action targets are also identified. In regard to W1, these relate mainly to managing the salinity impacts of irrigation and include:

- W1.4: Minimise impacts of irrigation induced saline groundwater flows to water or ecosystem assets;
- W1.5: Complete a Basin wide prioritisation process for the development of land and water management plans by 2012; and
- W1.6: 90 percent of the irrigated area achieving WUE as prescribed by the relevant WAP by 2014.

In regard to W2 the key management action target is:

- W2.1: Maintain South Australia's position on MDB Authority Salinity Register in balance by 2014.

Monitoring, Evaluation, Reporting and Improvement Achievements

In 2009, the Regional Monitoring, Evaluation, Reporting and Improvement Plan (MERI Plan) was completed for the SA MDB NRM region. One of the main features of the MERI Plan is a Schedule of Evaluation and Reports, ranging from monthly to five years. This schedule has been endorsed by the Board and supports key decision making needs. The schedule includes two important annual evaluations and reports: the Regional Outcomes Report and Hotspot Evaluations, which both commenced in the first half of 2010.

Regional Outcomes Report

Between February and August 2010 the SA MDB NRM Board initiated a process to produce the SA MDB NRM Board's first Regional Outcomes Report with a focus on addressing the question "what progress are we making against the MATs?" Individuals with relevant knowledge were brought together at a series of workshops to review a mix of evidence and make an assessment of target progress.

These expert panels included SA MDB NRM Board members and their staff, NRM Groups, Local Government, State Agencies and a number of non-government bodies particularly Local Action Planning Groups.

A snapshot report has been produced (MDB NRM Board 2010), which summarises the 2010 assessment of target progress. An overview of the assessment of targets that relate to the management of salinity impacts of irrigation is included below.

MAT W1.4 – Minimise impacts of irrigation induced saline groundwater flows to water or ecosystem assets

Achievement Score	Confidence Score	Explanatory Statement
LIMITED PROGRESS	MEDIUM	Evidence indicates that improvements in Water Use Efficiency (WUE) are occurring. However, the link between improved practices and effects of drought and/or water markets on the water or ecosystem assets is unclear.

This target reflects a need to ensure that irrigation practices do not result in groundwater mounds or flows, which negatively impact other aquatic habitats or water assets. The focus of this target is areas where salinity impacts, due to irrigation, present the greatest risk (SA MDB NRM Board 2008).

The SA MDB NRM Board helps to achieve this target by supporting the Regional Weather Station Network and the adoption of sustainable irrigation management tools. The Board also supports the implementation of the Irrigation Recording and Evaluation System (IRES^{TM}) and provides on-farm support for irrigators.

MAT W1.5 - Complete a basin wide prioritisation process for the development of Land and Water Management Plans by 2012

Achievement Score	Confidence Score	Explanatory Statement
NO PROGRESS	HIGH	Resource limitations have affected progress and the priority is implementing existing Land and Water Management Plans (LWMPs). Some uncertainty about parts of planning environment e.g. Basin Plan.

Land and Water Management Planning (LWMP) is a key tool used within the region to improve the practices of the irrigation industry, to limit impacts on soil and water resources and to support a more resilient and sustainable industry. Effective engagement is required from a sufficient number of landholders to adopt and implement these plans to decrease impacts on soil and water resources.

When this target was developed, it was considered that the SA MDB basin-wide prioritisation process would identify new areas for LWMP's and whether existing LWMP's required review. At that time, all existing LWMP's were within the River Murray Prescribed Watercourse and opportunities were thought to exist for LWMPs in other water resource areas, particularly where Water Allocation Plans already exist or were nearing completion (e.g. Mallee, and Eastern Mount Lofty Ranges).

The completion of the basin wide prioritisation process is dependent on the availability of funding.

MAT W1.6 – 90 percent of the irrigated area achieving average WUE as prescribed by the relevant WAP by 2014

Achievement Score	Confidence Score	Explanatory Statement
ON TRACK	MEDIUM	Evidence, mainly from one data rich sub-region, indicates progress. Lack of water availability and water markets have had a confounding effect on measuring trends and understanding drivers for improvement in WUE.

Water Use Efficiency (WUE) is a measure of crop production per unit of water applied with a focus on increasing WUE to make better use of scarce rainfall and/or irrigation water. Therefore, it is a tangible measure of how well the irrigation industry is improving its practices and, in doing so, decreasing its impacts on natural resources and becoming more sustainable in the long term (SA MDB NRM Board 2008).

The SA MDB NRM Board helps to achieve this target by supporting the Regional Weather Station Network and the adoption of sustainable irrigation management tools. The Board

also supports the implementation of the Irrigation Recording and Evaluation System (IRES) and provides on-farm support for irrigators.

MAT W2.1 - Maintain SA's position on MDBC Salinity Register in balance by 2014

Achievement Score	Confidence Score	Explanatory Statement
ON TRACK	HIGH	SA has on-going decline in credits with current projection of falling out of balance by around 2034. Measurement of this target is confounded by changes in data availability, modelling and conversion to dollar units.

This target presents a risk from a number of perspectives. It was established to be consistent with the South Australian Strategic Plan and Murray-Darling Basin Salinity Management Strategy, and will always present a picture of being "On-Track" over the life of this target. In reality there is a declining trend that needs to be communicated and acted upon.

Although this target is likely to be achieved by 2014, that is a credit balance is maintained on the Salinity Register, the rectification of the declining trend has high importance. In the short-term better data collection (and linkages between databases) for modelling and endorsement of information quality (to inform this target) is essential.

Hotspot Evaluations

Hotpot Evaluations are a new annual initiative of the SA MDB NRM Board. The purpose is to enable the Board and staff to take a more in-depth look at a particular component of the Board's business and activities. The intent, as with the Regional Outcomes Report is to build staff understanding and capacity to undertake evaluations.

The focus of the two 2010 Hotpot Evaluations were the Board's 'NRM Education Program' and 'Improving Irrigation Efficiency Program'. These are both important programs that have been operating for more than five years. The Board was interested to explore the achievements and contributions of these programs, what aspects are working well and where improvements could be made.

'Making every drop count' (SA MDB NRM Board 2010a) is an evaluation report of the Improving Irrigation Efficiency Project. The 'Improving Irrigation Efficiency Program' has been supporting irrigators across the region to adopt best management practices and improve irrigation water use efficiency for 10 years. These improvements, in turn, link to the desire to improve industry sustainability and reduce salinity impacts.

The evaluation process has included the collation of existing data and the gathering of additional qualitative information (through interviews and case studies) to bring together a picture of the achievements of the program. Early indications of the evaluation suggest that the program has been beneficial to the local community and:

- made a contribution to increased water use efficiency;
- assisted with some reduction in irrigation induced salinity across the region;

- increased awareness of water use efficiency including knowledge, skills and confidence of irrigators to manage water and salinity impacts; and
- contributed to on farm practice change.

Utilising an evolving set of activities, the program has responded to the changing context and the emerging issues and interests of the growers in the region. The number and type of irrigation courses have, for example shifted from basic scheduling, soil moisture monitoring and maintenance, to more advanced monitoring of soil salinity and application of results from recent irrigation research. This has enhanced awareness, capacity and adoption of best practice across different sections of the irrigation community. The project has also developed new tools such as the weather station network and the associated website which has a broad support base.

Updating Land and Water Management Plans

A major focus in 2010-11 in relation to Land and Water Management Planning (LWMP) has been to develop a revised framework for LWMP through the circulation and endorsement of a relevant discussion paper.

The discussion paper has recommended a new model for LWMP that strengthens the process through having:

- overarching direction through a technical advisory committee and a governance committee;
- a focus at an action plan level but with clear links to higher level strategic and investment frameworks including the BSMS and the SA MDB NRM Plan;
- a clearly articulated role for the community and the capacity building initiatives required;
- defined priority localities for action incorporating an integrated approach to the preservation of assets; and
- a defined consistent monitoring and evaluation framework for evaluating outcomes.

The new approach has received support and endorsement from a range of groups and government agencies including DFW, PIRSA, DENR, SA MDB NRM Board and community groups.

A draft Pyap to Kingston LWMP has been developed using the new approach and is being reviewed by community representatives and government agencies. After endorsement of the Pyap to Kingston LWMP, the approach can be rolled out to other priority LWMP regions.

Sustainable Irrigation Code of Practice

An Irrigation Code of Practice is recognised as an important risk mitigation tool for managing the future salinity risk/occurrence of deep drainage events. It tackles the problem from the source.

A draft Irrigation Code of Practice has been developed that identifies key points or risks in the irrigation enterprise, and identifies and proposes control actions to minimise these risks.

The code has been designed at three levels from a minimum level of competency to a high level. The code specifies management practice requirements and mandates standardised

data collection at a property level to inform both property and district scale performance. This includes basic crop survey and also computer based recording, scheduling and analysis.

Current work includes investigating the use of the Code of Practice as a compliance tool that is enabled when Site Use Approval (SUA) Holders do not meet a minimum licence condition (85 percent water efficiency), in high risk salinity regions. This then acts to minimise the future risk of deep drainage events.

In addition, the Code of Practice can be promoted as a voluntary code for irrigators who wish to gain recognition for their level of practice. This is particularly relevant if there is a specific market advantage for food produced with a higher level of water use efficiency.

Preliminary work has also commenced to trial the Irrigation Code of Practice with the Young Irrigators Group. South Australia urges the MDBA to support the concept of a code of practice, and integration of the code within compliance frameworks.

3.6. REDESIGNING FARMING SYSTEMS

The partner Governments will coordinate and enhance research and development into new farming and forestry systems that deliver improved control of groundwater recharge in the high rainfall grazing, winter rainfall cropping, and summer rainfall cropping zones. Over and above current programs the Commission will enhance research and development into new industries based on salinised resources, such as broadacre saltland agronomy, saline aquaculture, and salt harvesting.

(BSMS, 2001-2015)

Minimising the salinity impact of irrigation actions remains of critical importance. By applying the latest irrigation technology on farm, the long-term sustainability of irrigation developments is enhanced while minimising discharge of saline groundwater to the river, thus having significant salinity benefits for the River Murray.

Current BSMS Salinity Register projections indicate that salinity levels are likely to rise in the medium to long-term and that within South Australia there are limited opportunities for salt interception capacity to be increased. Improvements in irrigation water use efficiency are therefore essential for maximising the benefits from salt interception schemes and minimising salinity impacts of irrigation. Such improvements will also contribute towards meeting any new salinity objectives within the Basin Plan (Water Quality and Salinity Management Plan) as well as expected new Sustainable Diversion Limits for water extraction from the River Murray system.

3.6.1. Water for the Future

The Water for the Future program is covered at Section 3.4.4 above. Two projects relating to improving on farm irrigation efficiency will be implemented by the SA MDB NRM Board and are therefore reported here.

The SA MDB NRM Board signed a funding agreement with the Commonwealth Government in September 2010 relating to Round one of the *On-Farm Irrigation Efficiency Program* (OFIEP). This funding will support the undertaking of 21 on-farm irrigation efficiency projects in the SA MDB region which will yield approximately 0.7GL of water savings.

The SA MDB NRM Board has also been advised that additional funding through the Water for the Future initiative has been approved through Round two of both the On-Farm Irrigation Efficiency Program (OFIEP) and the Private Irrigation Infrastructure Program – South Australia *(*PIIPSA). Collectively in excess of $20 million of investment has been awarded to the SA MDB NRM Board which will enable in excess of 100 on-farm projects to commence in 2011-12 and deliver total combined water savings of approximately 6.5GL.

3.6.2. On-Ground Support to Achieve Irrigation Efficiency

Traditionally the large majority of on-ground irrigator support programs have been delivered through the *Improving Irrigation Efficiency Project* (IIEP) which has been in operation in the SA MDB region since 2001. An evaluation of the IIEP conducted during 2009-10 indicated that the activities of the IIEP would benefit from being better integrated

into the broader sustainable irrigation program initiatives, and that a more strategic approach to project delivery should be considered.

Key activities that continued during 2010-11 included the support of root-zone salinity trials across the SA MDB region. Funding was secured through the Caring for our Country Community Action Grant program to install additional root-zone salinity monitoring equipment at Langhorne Creek. This project will build on the extensive root-zone salinity monitoring that has been conducted in the region as part of the Angas Bremer Irrigation Code of Practice.

3.6.3. Future Farm Industries Cooperative Research Centre

In 2010-11, the Government of South Australia continued to be involved in the Future Farm Industries Cooperative Research Centre (FFI CRC) through DENR and SARDI, in collaboration with CSIRO and The University of Adelaide. The aim of the FFI CRC is to develop innovative farming systems and new regional industries through the incorporation and sustainable use of perennial plants in the broadacre farms of southern Australia. These plants and farming systems can reduce salinity impacts and provide other natural resource management benefits for soil protection and supporting biodiversity.

In 2010-11 DENR staff have been investigating carbon assessment methodologies and the carbon sequestration rates within woodlots, revegetation sites and remnant vegetation in Murray-Darling Basin, Mid North and Mount Lofty regions of the state in partnerships between FFI CRC, Department of Agriculture, Fisheries and Forestry (Forest Industries Climate Change Research Fund) and South Australian State NRM Program. Results from these surveys and analyses also contribute to the refinement of the National Carbon Accounting Toolbox, in a collaborative project with the Department of Climate Change and Energy Efficiency and CSIRO. Linked to these assessments of carbon sequestration in revegetation sites is the collaborative "Biodiverse Carbon" project (FFI CRC/SA State NRM Program) that is investigating the influence of woodlots and "bio-diverse" revegetation sites on bird species richness and diversity in the eastern Mount Lofty region.

The Government of South Australia continues to support FFI CRC new woody crop development research in the Murray-Darling Basin through ongoing activities at DENR's Monarto Research Site. Recent activities included the establishment of an experimental Oil Mallee (*Eucalyptus loxophleba*) provenance/family trial containing over 5000 plants. DENR also continues to support the development of viable native fodder shrubs (under the Enrich project) for the lower rainfall livestock/cropping zone of southern Australia such as the South Australian MDB region. Fodder shrub experiments and Oldman Saltbush plant breeding activities continued at the Monarto site and across the state. Fodder shrub researcher team presented their findings to primary producers at a forum in Waikerie in April. The researchers have found that fodder shrubs, established on 20 percent of farm land, can increase whole farm profits by providing out of season feed (during summer and autumn) while reducing groundwater recharge rates. However, using a single shrub species is not the 'silver bullet' solution but rather a mixture of shrub species provides the best nutrition and maximises natural resource management benefits. Furthermore, farmers can train sheep to eat new fodder shrub species.

Figure 10 - Monarto Salt Bush Research Site

SARDI continued the delivery of dryland salinity information through the FFI CRC-funded Saltland Knowledge Exchange project, which is the last major national extension project addressing dryland salinity management. As part of its management of the Saltland Genie website the project has added a new "Catchment Management Plans" section, which includes plans for the Lower Murray and Murray Plains regions that are relevant to the Murray-Darling Basin and make these more accessible to stakeholders and landholders in the regions.

Future Farm Industries CRC website:

http://www.futurefarmonline.com.au/

Saltland Genie website:

http:// www.saltlandgenie.org.au/resources/catchment-management-plans.htm

3.6.4. High Input Fertigation Management

In response to increasing input costs and reducing returns for product, many irrigated horticultural industries are turning to intensive management systems to optimise productivity. High input fertigation techniques are one popular example of this trend. However, these intensive production systems require higher management input to ensure success, and the consequences of poor management are much more severe than under lower intensity production systems.

Two recent projects have focussed on understanding the movement of nutrients through the rootzone and beyond in high input almond and citrus production systems. These projects have employed soil solution sampling (using SoluSAMPLER® solution extractors) to monitor nutrient and salinity levels at different depths in the soil. This provides an insight into nutrient movement, uptake and leaching, and in the case of almonds was conducted across the whole growing season.

As well as providing research data to allow assessment of appropriate fertigation management practices for specific crops, soil solution sampling also has a potential as a management tool for irrigators. As such soil solution monitoring can assist irrigators in monitoring their fertigation and salinity management, thus avoiding the potential for negative outcomes from poorly managed fertigation programs or accumulated salts in the root zone.

Information about appropriate timing and amounts of fertigation inputs across the growing season, as well as guidelines for using soil solution sampling for fertigation monitoring are being developed, and will be publicised across the irrigation industries in the Riverland.

3.7. TARGETING REFORESTATION AND VEGETATION MANAGEMENT

The partner Governments recognise the necessity for landscape change specifically targeted at salinity control. In order to facilitate such targeted change, where changed farming systems are not adequate, the Commission will further develop the concept of a vegetation bank to have the capacity to finance extension of forestry outside of traditional forestry areas.

The partner Governments will further consider the financing of native vegetation management, rehabilitation and land stewardship, and the commercialisation of short rotation tree crops, particularly for the wheatbelt.

(BSMS, 2001-2015)

Reforestation and vegetation management activities are significant in promoting overall catchment health and land management. Reforestation can also provide long-term benefits in terms of stabilising groundwater movement and thus discharge of saline groundwater to the river.

3.7.1. Revegetation and Restoration Activities

Large scale landscape programs such as Woodland BushBids, the Woorinen Recovery Project and the South Australian Multiple Ecological Communities Environmental Stewardship project are dramatically increasing the area of private land targeted for conservation management. The SA MDB NRM Board manages these and many other revegetation and restoration projects, that use market based approaches or traditional incentive programs to target key areas, be they geographical or based on priority species.

Woodland BushBids Round two is currently under assessment with an estimated additional 2500 hectares of remnant vegetation to be protected and improved under 5 year conservation contracts for 2011-12. This follows the previous 4700 hectares that was placed under 5 year management agreements during 2010-11.

The Woorinen Recovery Project (funded by the Native Vegetation Council) completed 100 hectares of revegetation and 350 hectares of remnant protection targeted at restoring and expanding the Triodia shrubby dunes of the Northern Murray Mallee, critical habitat for threatened Mallee birds.

During 2010-11 the South Australian Multiple Ecological Communities Project (part of the Australian Government's Environmental Stewardships program) has successfully contracted private land managers to protect and improve 4803 hectares of Peppermint Box grassy woodland and Iron Grass grassland, two priority threatened ecological communities.

Community groups and non-government organisations are important contributors to revegetation and conservation within the SA MDB. During the 2010-11 period Eastern Hills and Murray Plains Catchment Group, Goolwa to Wellington Local Action Planning Group, Murray Mallee Local Action Planning Association and the Coorong District Local Action Planning Association provided technical advice to 338 landholders and were responsible for the implementation of 117 hectares of revegetation and the protection of 1100 hectares of remnant vegetation.

Other groups such as the Threatened Plant Action Group, other Local Action Planning Groups, Conservation Volunteers Australia, Trees for Life, Greening Australia, Monarto Zoo, Aboriginal Learning of Country crews and local government have also undertaken revegetation works across the SA MDB during 2010-11.

3.7.2. The River Murray Forest

The River Murray Forest project aims to plant regionally native species along the River Murray in order to improve biodiversity and ensure carbon sequestration outcomes.

A total of 2450 hectares have been offered by landholders for planting through the tender process. These areas are now under contract. Plantings will be staged over several years to allow for seasonal conditions and seed supply. To date 1400 hectares of the contracted area has been planted. This project is managed by DENR and funded by the Government of South Australia.

3.8. CONSTRUCTING SALT INTERCEPTION WORKS

The Commission will construct and operate new joint (partner Government funded) salt interception works to protect Basin-wide assets and values, including the shared water resources of the Murray and Darling Rivers. This will provide protection beyond the benefits from simply meeting end-of valley targets, based upon agreed cost sharing and benefit allocation principles. The benefits will continue to include salt disposal entitlements to offset the impacts of future actions that aggravate salinity.

(BSMS, 2001-2015)

Salt interception remains a key salinity mitigation strategy for the River Murray. Salt interception has proven valuable in providing a reduction of saline groundwater flows to the River Murray, thereby reducing in-river salinity and protecting water quality for all water uses.

Within South Australia, all salt interception schemes except the Qualco Sunlands Scheme have been constructed through the Murray-Darling Basin Authority Salinity and Drainage Strategy or the Basin Salinity Management Strategy. Operating schemes in South Australia include Woolpunda, Qualco-Sunlands, Waikerie, Bookpurnong, and Loxton. A Salt Interception Scheme (SIS) is currently under construction at Murtho. An SIS has been proposed for Pike but has not been funded under the Murray-Darling Basin Authority (MDBA) joint works program.

The operating SIS continue to meet their operational targets and intercept large volumes of saline groundwater from entering the River Murray. Table 1 shows the effectiveness of the existing SIS within South Australia. In 2010-11, the program that oversees the development of new SIS within the Department for Water was largely completed. Murtho and Pike are the final SIS to be constructed within South Australia. Murtho SIS is expected to be commissioned in 2012 and at this point it is not known if the balance of the Pike SIS will be constructed as a joint work.

Table 1 - Operating SIS within South Australia

Scheme	Date Commissioned	Joint works vs. South Australia %		Construction Costs ($M)			Volume Pumped 10-11	Salt Load Intercepted 10-11	Average Salinity 10-11
		SA	Joint works	Total	SA	MDBA	ML	(t/yr)	EC
Woolpunda SIS	Dec. 1990	-	100	$25	-	$25	3825	74 916	31 800
Waikerie SIS	Stage 1: 1992 Stage 2: Sep. 2003	-	100	$15.6	-	$15.6	3179	69 926	35 300
	Oct. 2009	6	94	$4.4	$0.26	$4.19			
Bookpurnong SIS	Sep. 2006	30	70	$21.8	$6.5	$15.3	595	14 513	38 265
Loxton SIS	Stage 1: 2009 Stage 2: Nov. 2010	2	98	$19.5	$0.39	$19.1	1266	15 325	23 347

3.8.1. Waikerie SIS

Developed in 2 stages - Waikerie 1 (1992) and Waikerie 11A (2003)

Both stages were constructed as a joint works under the Murray-Darling Basin Commission Salinity and Drainage Strategy

Waikerie Stage 1 intercepts approximately 74 tonnes of salt per day and stage 11A an estimated 23 tonnes of salt per day

Provides a 12.8 EC benefit at Morgan

The scheme was designed to intercept a total of 39 tonnes of salt per day from entering the River Murray over a 30 year time period

In 2010-11, the Waikerie SIS continued to operate effectively with few operational problems. An optimisation study has enabled the flows from some bores to be reduced to save pumping costs while still maintaining the interception targets.

3.8.2. Woolpunda SIS

Constructed as a joint works under the Murray-Darling Basin Commission Salinity and Drainage Strategy

First section was commissioned in 1990; the balance in 1992

Intercepts a total of 150 tonnes of salt per day with a benefit of 47.4 EC, based on pre and post 1988 irrigation development

In 2010-11 an investigation into extending the Woolpunda SIS towards Lock 3 was undertaken to determine if the extension would be economically viable. The investigation determined that the scheme could be feasibly extended on both sides of the river towards Lock 3 and would intercept an additional 17 tonnes of salt per day with a benefit cost ratio of 1.31.

The scheme was conceptually designed to include 3 production bores, one located on the Overland Corner Floodplain and the other 2 located near Banrock Wetland. Disposal would be through the existing Woolpunda disposal main to Stockyard Plains Disposal Basin.

3.8.3. Loxton SIS

Designed to intercept a total of 70 tonnes of salt per day from entering the River Murray to provide an 11 EC benefit at Morgan over a 30 year time period

Constructed in two stages – floodplain and highland

The Floodplain section of the scheme became operational at the start of 2009 and is currently intercepting a total of 50 tonnes of salt per day. The floodplain section was completed early in 2011

Due to the complex hydro-geological conditions in the Loxton area, the design of the scheme had to be altered during construction. This resulted in delays to the completion of the scheme and a reduction in the amount of salt intercepted.

In April 2011 the Murray-Darling Basin Authority Chief Executive declared the Loxton SIS to be effective (Clause 64 of the Murray-Darling Basin Agreement) and that the agreed salinity credits are to be placed on the Salinity Registers in accordance with Clause 22 (1) of Schedule B to Schedule 1 of the Water Act 2007 (Cth.).

3.8.4. Bookpurnong SIS

Constructed as a shared works under the Murray-Darling Basin Commission Basin Salinity Management Strategy and commissioned in September 2006

Intercepts an estimated 50 tonnes of salt per day

Benefit of 21.8EC at Morgan over a 30 year time period

In 2010-11, the fifteen floodplain bores generally operated satisfactorily with no significant issues and with groundwater levels being held below their target levels. The seven highland bores likewise generally maintained groundwater levels below their target levels although some are suffering chemical clogging problems that are being addressed through some trial rehabilitation techniques.

A detailed investigation program was completed to better understand the aluminium oxide clogging problem in part of the area that has to date precluded extension of the scheme into the affected zone. The key objective of the study was to assess and understand the processes leading to the dissolution and re-precipitation of aluminium.

3.8.5. Qualco-Sunlands Groundwater Control Scheme

Commissioned in 2001

Reduces salt load to the river by 19 tonnes of salt per day with a 4.8EC benefit at Morgan

Operated by local irrigators through the Qualco-Sunlands Groundwater Control Trust, which was established under the *Groundwater (Qualco-Sunlands) Control act 2000*

The drought and severe restrictions on irrigation allocations has resulted in a considerable reduction in drainage to the groundwater mound. Under these conditions groundwater levels have essentially stabilised. The scheme is currently being operated on a care and maintenance basis with most pumps running for only two hours per day. The exception is the three bores adjacent the river that provide salt interception benefit; these continue to be operated to provide that benefit.

3.8.6. Murtho SIS

Approved for construction as a shared works by the MDBC BSMS at the end of 2007

Construction of the scheme is still underway and is expected to be completed in 2011-12

Conceptually designed to intercept a total of 99.4 tonnes of salt per day or a 20.2EC benefit at Morgan

Construction of the Murtho SIS was delayed in 2010-11 due to the high river level which occurred in October 2010. The high river level resulted in the inundation of the Disher Creek

Basin which prevented the construction of the pump station and the completion of the pump testing on the floodplain bores. River levels have now returned to normal pool level which has allowed work to commence. It is expected that work on the Murtho SIS will be completed by June 2012.

3.8.7. Pike SIS

Conceptually designed as a 59 highland SIS bore scheme with 28.5km of pipeline to intercept a total of 167 tonnes of salt per day or an EC benefit at Morgan of 35.4EC over the 30 year time period

Existing disposal infrastructure such as the Lyrup Surge vessel and the Disher Creek and Noora Gravity main pipelines will transfer the intercepted groundwater from the Pike SIS to the Noora Basin

The scheme has been conceptually costed at $25.321M

The South Australian Government reached an agreement with the MDBA to allow National Action Plan for Salinity and Water Quality Program One funds to be spent on constructing a component of the Pike SIS. Stage 1 of the Pike SIS comprises of 4 production bores along the Simarloo area and 2.7km of pipeline connecting into the Noora Disposal Main. Construction work was completed in June 2011 and the scheme was commissioned in September 2011.

3.8.8. Riverland Salt Disposal Management Plan

Saline groundwater intercepted by Salt Interception Schemes is disposed of to either one of the two disposal basins located within South Australia. The Bookpurnong, Loxton and Pike Stage 1 Salt Interception Schemes dispose to the Noora Disposal Basin (20km east of Loxton). Once constructed the Murtho Salt Interception Scheme will also dispose to the Noora Disposal Basin. The Woolpunda, Waikerie and Qualco-Sunlands Salt Interception Schemes dispose to Stockyard Plains Disposal Basin (15km southwest of Waikerie).

Stockyard Plains Disposal Basin

Located 15km southwest of Waikerie

Encompasses a number of natural shallow depressions with floor elevations as low as 24mAHD and has a design top water level of 31mAHD

The maximum available pond area is about 7km^2 and with the basin operated at 31mAHD the current design capacity is 300L/sec

Owned and operated by the MDBA

Schemes that dispose to the basin: Woolpunda – 165L/sec; Waikerie 103L/sec; Qualco-Sunlands – 35L/sec

Noora Disposal Basin

Located 20km east of Loxton and commissioned in 1982 with an estimated land size of 3600ha

Established to dispose of irrigation drainage water from the Comprehensive Drainage Schemes (CDS) stored at Berri Disher Creek Disposal, over time due to improved irrigation practices and prolonged drought conditions the volume of water disposed from the CDS has reduced from an estimated 119L/sec to 40L/sec

Receives water from the CDS and also from the Salt Interception Schemes

The current design capacity of the basin operating at 19.0m AHD is 435L/sec comprising a 100 year long-term average of 395L/sec from the SIS's and 40L/sec from the CDS

Owned and operated by the Government of South Australia

Schemes disposing to the Noora Basin are: Bookpurnong – currently 43L/sec, by 2100 54L/sec; Loxton – currently 57L/sec, by 2100 63L/sec; Murtho – proposed 50L/sec; Pike – proposed 93L/sec

During 2010-11 the Noora Disposal Basin Sustainability Project was completed. Land was successfully acquired to create a buffer zone between the Noora Disposal Basin and the neighbouring landowners. This buffer zone will ensure the sustainable long term use of the Noora Disposal Basin as the disposal point for intercepted saline groundwater from salt interceptions schemes into the future. A revegetation program for the buffer zone has also been completed to aid in reducing the impacts of salinity on the surrounding environment.

3.9. ENSURING BASIN-WIDE ACCOUNTABILITY: MONITORING, EVALUATING AND REPORTING

The partner Governments will demonstrate accountability by reporting to the Commission and Council through State end-of-valley Report Cards and Commission Salinity Registers that record the salinity effects of actions, including salt interception schemes and salinity and catchment management plans. The Council will receive audits every five years for each valley and Commission Register entry, assessing impacts on river salinity and progress towards targets, with the provision to require further action as necessary.

(BSMS, 2001-2015)

South Australia undertake programs of monitoring, evaluating and reporting for salinity at different organisational levels and for different purposes. These programs are of great value in enabling South Australia to meet long-term accountability requirements under Schedule B (BSMS Salinity Registers entries) as well as providing a basis for understanding the short-term variations in-river salinity to guide real-time management actions.

3.9.1. Monitoring

Significant Developments

During 2010-11 South Australia received the highest peak flows in the River Murray since 1993, following persistent long periods of rainfall and flooding in the eastern states. This weather pattern resulted in a very long term build-up to the peak flows entering South Australia, in February 2011. The extended slow recession has enabled large salt loads to be flushed through the river system and out to sea. The maximum salt load at Morgan in this period was approximately 470 000 t/month in March 2011. However, salinity in South Australia has generally remained low, with higher flows diluting the large salt loads in the system (Figure 11).

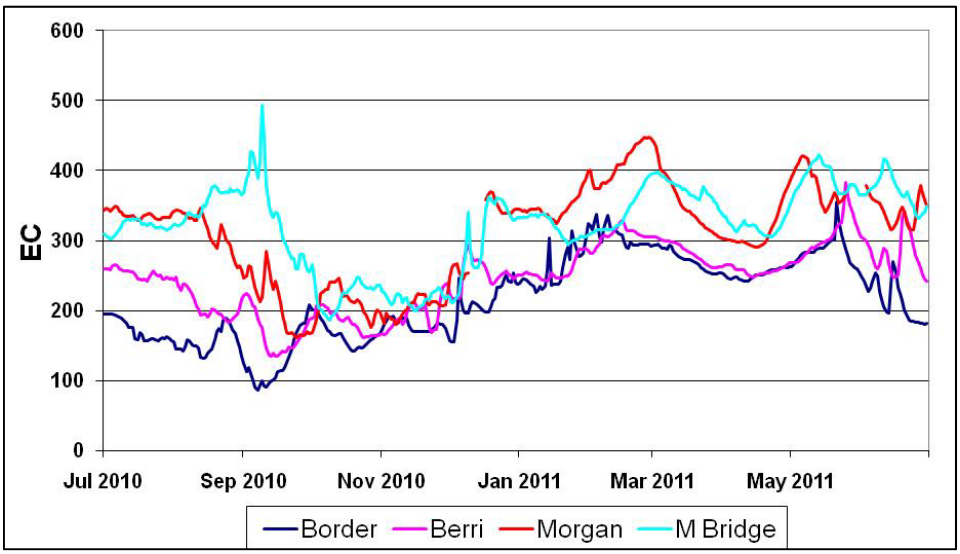

Figure 11 - EC in South Australia during 2010-11

Salt loads at the border and at Morgan increased dramatically in 2010-11, due to the increased flows, carrying large tonnages over the South Australian border. The border salt load increased from 178 000 t/year in 2009-10 to 2 008 000 t/year, and the Morgan load increased from 241 000 t/year in 2009-10 to 2 600 000 t/year (Figure 12).

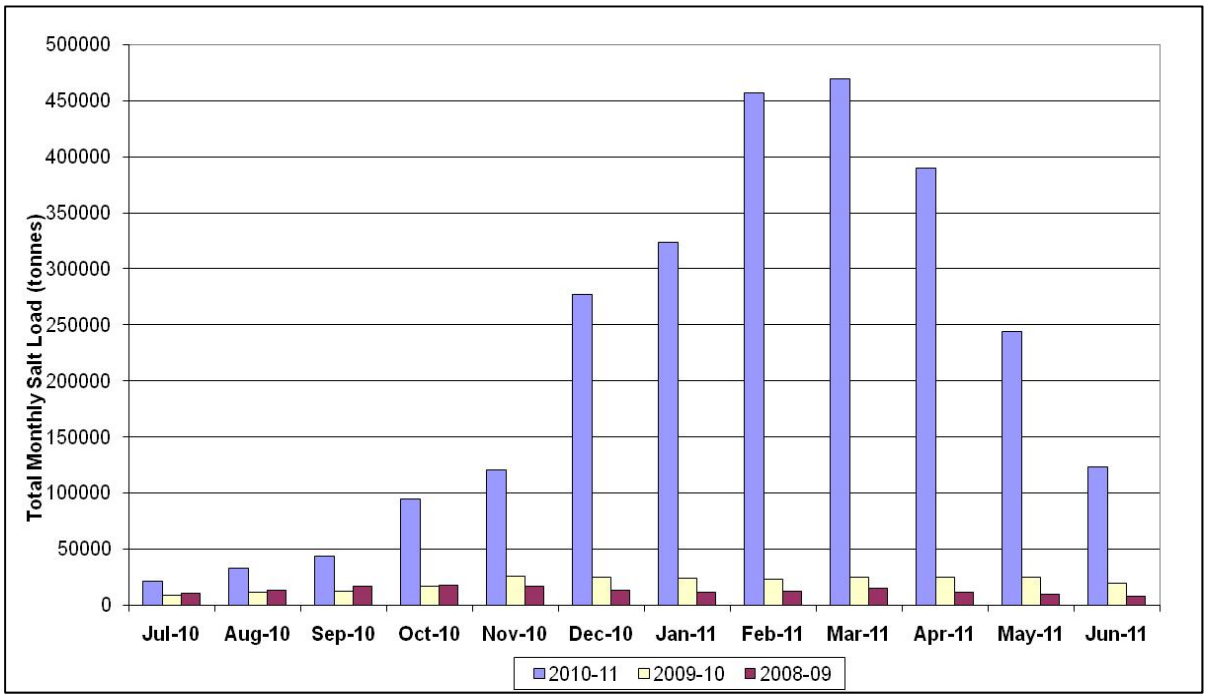

Figure 12 - Total salt load at Morgan 2008-09, 2009-10 and 2010-11

The largest South Australian salt load contribution in 2010-11 was during the early flood recession, when non flowthrough backwaters drained back into the main stream (Figure 13). An example of this is Lake Bonney at Barmera, where salt loads to the river were in excess of 6000 t/day in April/May 2011.

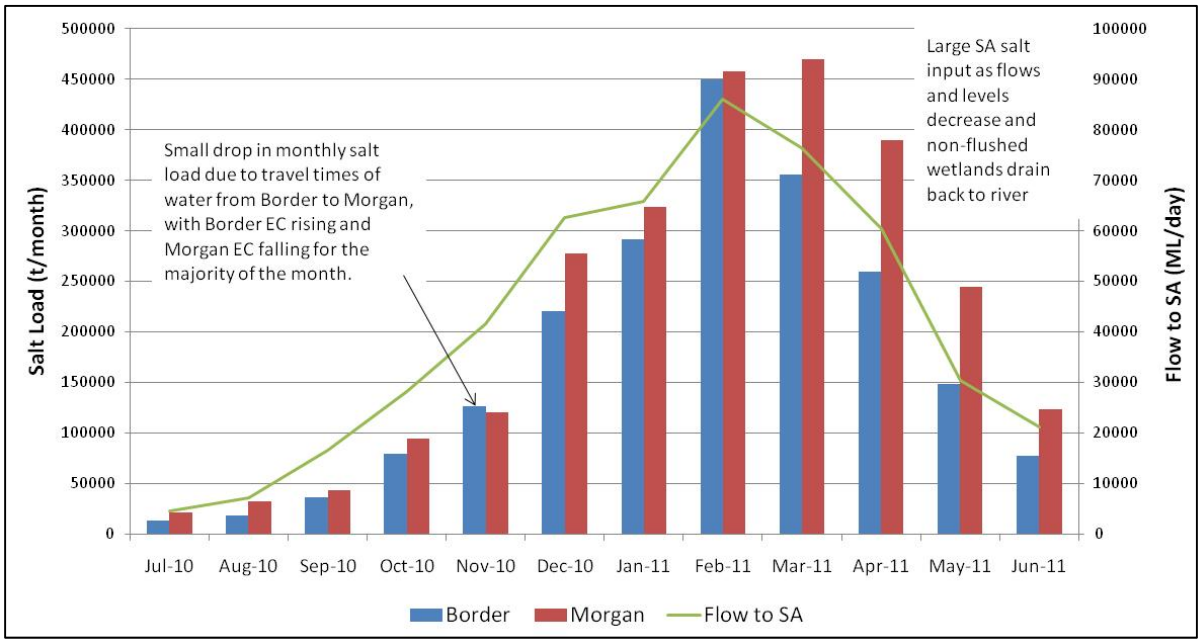

Figure 13 - Salt load SA Border and Morgan 2010-11

The high salt load recorded at the border and Morgan in 2010-11 is comparable to the salt loads recorded during similar magnitude flow events in the past. Figure 14 shows a comparison of the monthly salt load recorded at the border and Morgan along with the river flow to South Australia for 2010-11 and five other similar years. The 2010-11 graph shows that the salt load pattern recorded during the recent high flow event is similar to previous high flow events, with the majority of the salt load entering the river early during the flood recession.

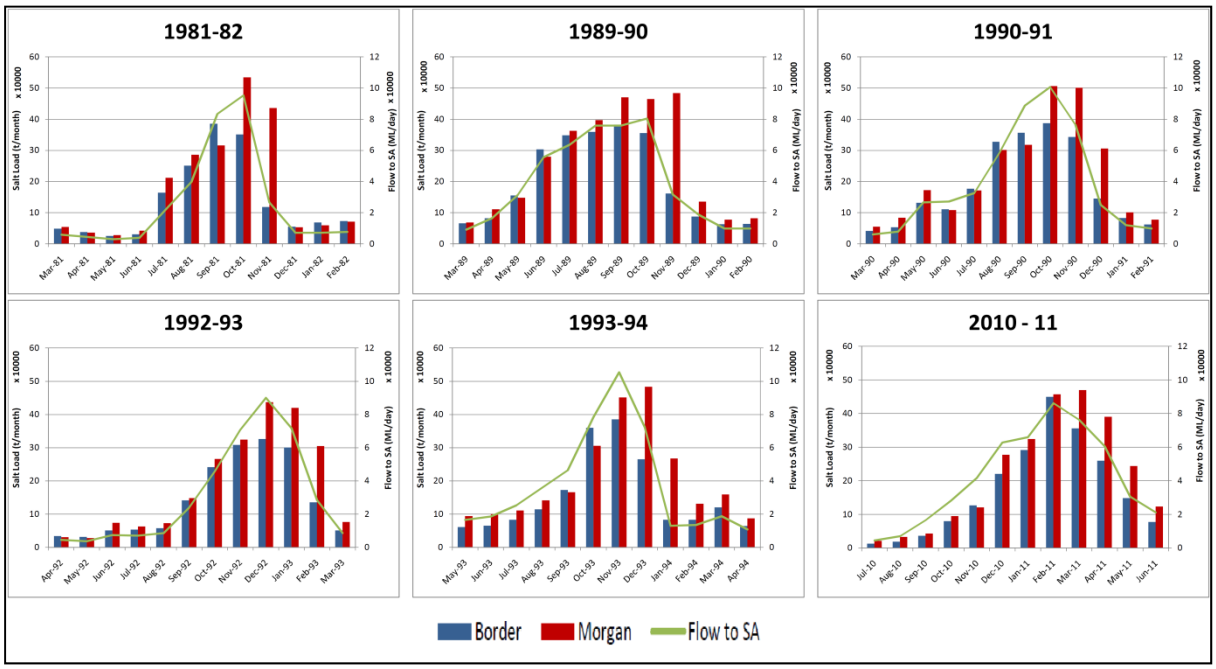

Figure 14 - Comparison of 2010-11 salt loads with past high flow event salt loads

The salt load data depicted in Figure 14 is also displayed in Table 2 as total salt load recorded during high flow events. The monitoring data shows that the extended period between high flow events has not had significant impact on the total salt load recorded at Morgan, or the South Australian salt accessions between the border and Morgan.

Table 2 - Total salt load at SA Border and Morgan for high flow events

Flood Year	Border Salt Load	Morgan Salt Load	SA Accessions	Max Flow to SA
1981	1,610,000	2,130,000	520,000	105,000
1989	2,430,000	3,080,000	650,000	85,000
1990	2,220,000	2,700,000	480,000	103,000
1992	1,730,000	2,240,000	510,000	96,000
1993	1,860,000	2,500,000	640,000	112,000
2010	2,080,000	2,600,000	520,000	94,000

The MDBA has worked with South Australia to facilitate provision of funds to enable the installation of upgraded salinity monitoring equipment with telemetry at several sites during 2010-11. This will enable more “real-time” observation of the expected high salinities after the flood recession, and will assist with the interpretation of the data presented above. All

telemetry sites have been upgraded for greater communications reliability to Internet Protocol addressed modems. This has enabled more efficient updating of web services.

Flow Monitoring

Increased flows in the River Murray in 2010-11 have resulted in increased high flow gaugings in South Australia. This work was carried out to confirm rating table validity and accuracy. As well as gaugings at Lyrup, Morgan and Lock 1 which are detailed in the respective target sites notes. Flow measurements were also carried out at the following locations:

- Overland Corner, A4260528;
- Pike River @ Lettons, A4260644; and
- Chowilla Creek, A4261091.

Overland Corner (A4260528) is the major high flow gauging station within South Australia. Twenty-seven flow measurements were taken and have been used to confirm the rating at this site. The maximum gauged flow was 71 670 ML per day on the 4 March 2011.

The Pike River is an anabranch of the River Murray, that starts above Lock 5 and rejoins the River Murray just upstream of Lyrup. During flood recessions it can carry large tonnages of salt. Six gaugings were carried out to increase the knowledge of bypass flows in these anabranches.

Chowilla Creek is the outfall of the Chowilla anabranch that also can carry large tonnages of salt into the River Murray. A continuous flow monitoring installation has been operating through the high river event and five gaugings were carried out to validate the higher flows in this system. Flows up to about 22 000 ML per day in Chowilla Creek appear to be valid, however water bypasses the continuous flow site above this level. The low flow Velocity Index rating will be extended to accommodate these new results.

Close Interval EC Surveys

No close spaced 3D EC surveys were carried out in 2010-11 due to the increased flows in the whole river system. However, some targeted surveys were requested for different wetland areas. This represented only a small amount of time and where no salinity effect was observed, processing of surveys was minimal.

Run of River Salinity Surveys

Run of River salinity surveys were not conducted in 2010-11 due to river flows being too high to provide the slower travel times needed for salt load calculations. Monthly monitoring of the Lower Lakes and Goolwa Channel have however been completed. These ceased in March 2011.

Community Stream Sampling in the SA MDB NRM Board Region

The Community Stream Sampling project supports more than 40 community groups across the South Australian MDB region. The project supports communities by providing them with the means to identify areas within their catchments that are at risk from salinity. The information obtained is used by groups to better understand their local water resources. In

addition, this local-scale monitoring is used to enhance the regional water resource picture. Salinity monitoring forms part of a broader community water monitoring program that also captures the following water testing parameters; nutrient, turbidity, pH, supporting field observations and biological monitoring.

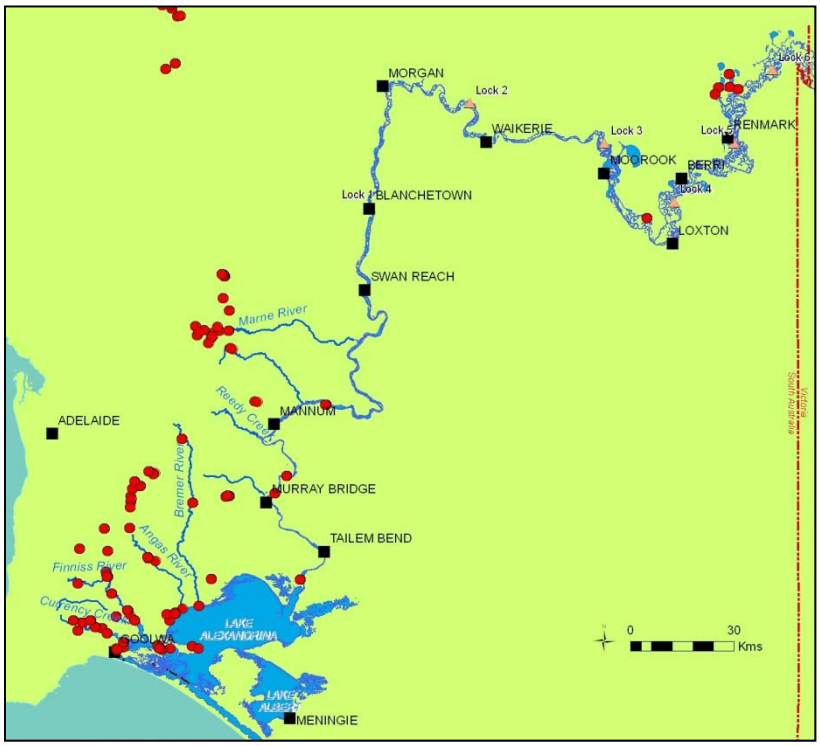

Figure 15 - Community Stream sampling sites across the SA Murray-Darling Basin Natural Resources Management Board Region

The community stream sampling program collects salinity readings from 143 sites over the South Australian MDB region. Some of these sites have been continually monitored since 1994, others are relatively recent, and some are inactive due to changes to the monitoring program

Information about the effect of a wet and cool summer period on local catchments was reported to the Community Stream Sampling Project over recent months. Over summer and autumn 100 plus sites were monitored for salinity, some on multiple occasions and some included macro-invertebrate monitoring.

Some towns in the Rangelands, Riverland and Mallee (Sedan, Mount Bryan, Pinnaroo, Swan Reach, Karoonda, Loxton) experienced their highest summer rainfall on record, with many eastern Mount Lofty Ranges towns recording their highest summer rainfall since the wet summer of 1968 (Milang, Mount Compass and Meadows).

(See: http://www.bom.gov.au/climate/).

The test results show that salinity remained the single most influential factor for healthy river systems in the South Australian MDB region over autumn. The highest reading was 47 200 EC at Vigars Road in the Marne Valley and 43 700 EC was recorded at site LGC-020 (Frayville Road west of Mannum), the median value for all sites was 2940 EC. Eleven sites were over 10 000 EC and 19 sites were under 2 000 EC.

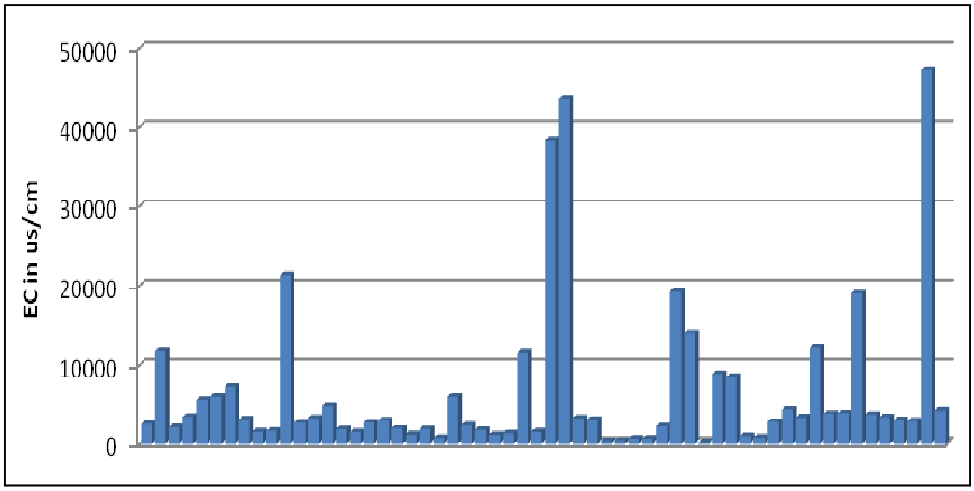

Figure 16 - Community Stream Sampling Program – All sites in the SA MDB NRM Board region where community stream sampling for has shown large spatial variation in salinity (EC) readings.

Salt incursions in the Goolwa Channel over autumn were picked up by community monitoring groups as well as the data loggers installed as part of the Lower Lakes management program. These salt incursions are largely due to wind driven estuarine water being pushed upstream through the open barrage gates.

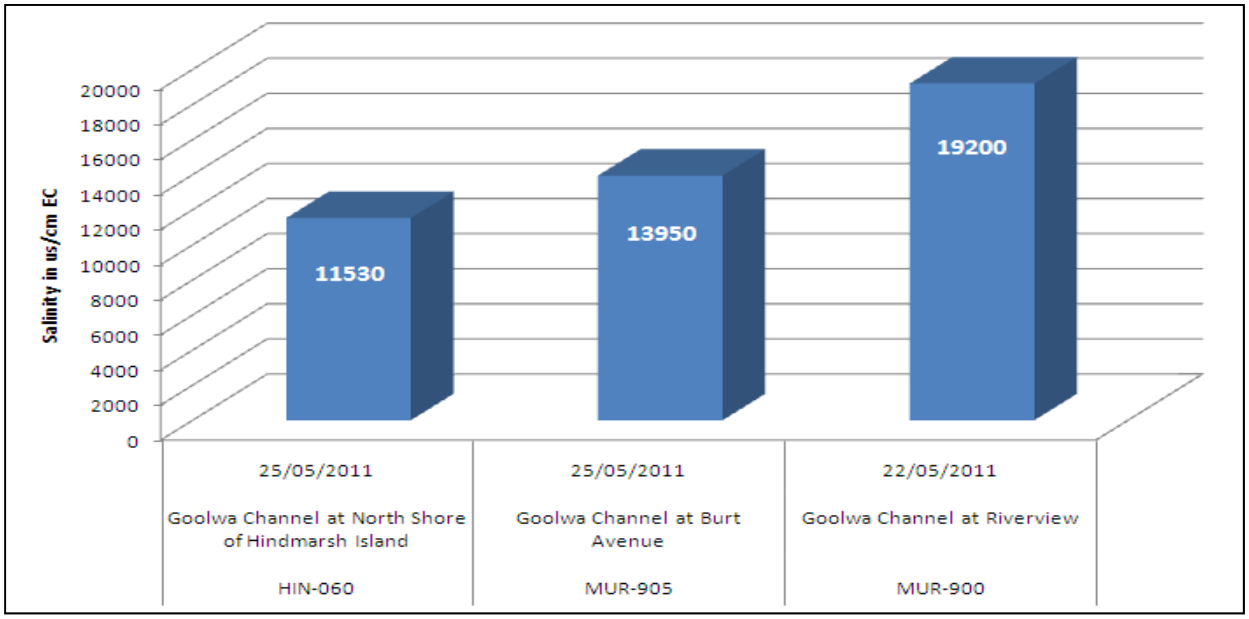

Figure 17 - Goolwa Channel salinity gradient in May 2011 (Source- Community Monitoring Database http://samdbnrm.sa.gov.au/CommunityMonitoringDatabase.aspx)

Monitoring in autumn recorded salinities of over 40 000 EC at the Goolwa Wharf, with elevated salinities on the northern shore of Hindmarsh Island and Clayton. One site in North Goolwa went from a salinity of 600 EC on 20 April to 19 200 EC on 22 May.

The Community Monitoring Online Database for the SA MDB region became operational in June 2010 and allows for:

- Direct entry of community surface water data;
- Information about surface water groups and contacts;

- Public access to the collected data;
- Greater uptake and use of data collected; and
- Use by individuals with limited computer experience.

By making information publicly available, communities can showcase how they are part of natural resource management in their region, while also adding data they have collected. The database includes metadata outlining a quality rating.

Last year the Community Stream Sampling Project reported that salinity levels have not changed significantly across many lower Murray 'feeder' streams sampled by the community in 2010 and 2011 (Figure 18). Some streams recorded a slight increase while others showed a slight reduction.

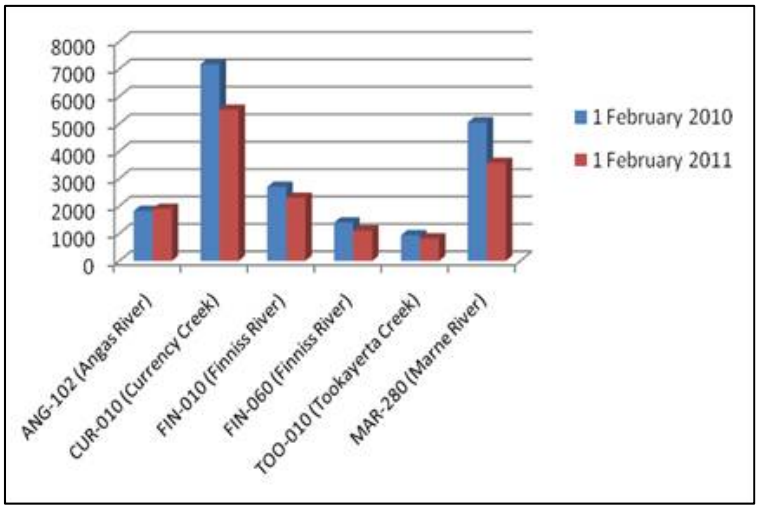

Figure 18 - February salinity comparisons of consecutive years at selected sites in the lower reaches of the SA MDB NRM Board Region

Dryland Salinity Monitoring

Within the South Australian Murray-Darling Basin, the State Government monitors groundwater trends in two catchments at risk of dryland salinity. The Eastern Mount Lofty Ranges and Coomandook sites are representative of the local and regional groundwater flow systems respectively. They provide a useful indication of groundwater levels and hence salinity trends in this part of the region. The catchment is part of a network of dryland salinity sites across the dryland agricultural regions of SA that are monitored by the State Government.

In 2010-11, groundwater levels in a selection of bores have shown a slight rise following the break of the drought. At Coomandook, the break of the drought has seen the resumption of the slow rise in the deeper regional groundwater levels that was evident prior to the drought.

A report on the decadal trends in depth to groundwater for dryland salinity areas of South Australia is available for download at: http://www.environment.sa.gov.au/Knowledge_Bank/Science_research/Monitoring_evaluation_analysis/Monitoring/Land_salinity_monitoring

Automatic Weather Monitoring network

A major upgrade of the South Australian MDB Regional Automatic Weather Monitoring Network was completed during 2010-11 with funding provided through the Commonwealth Government's *Modernisation and Extension of Hydrologic Monitoring Networks* program. The upgrade involved the development of an automated data quality assurance system along with a new website featuring enhanced end user functionality.

In 2011-12 it is planned to continue to refine the website to encourage increased adoption of the data to facilitate adaptive and sustainable land and water management practices in the South Australian MDB region.

3.9.2. Evaluating

Groundwater Models in South Australia

With the recent completion of the Morgan to Wellington model, submitted for accreditation in 2010, South Australia now has a complete set of groundwater models that span the full length of the River Murray in South Australia (Figure 19). The models all utilise a consistent set of scenarios to inform multiple accountable action entries on the BSMS Salinity Registers.

The models are an important salinity management tool that predict salt loads entering the River Murray from accountable actions, and inform Salinity Register entries representing mallee clearance, past, present and future irrigation development, rehabilitation of infrastructure, improvements to irrigation efficiency and SIS (where relevant). The current status of these models is shown at Table 3.

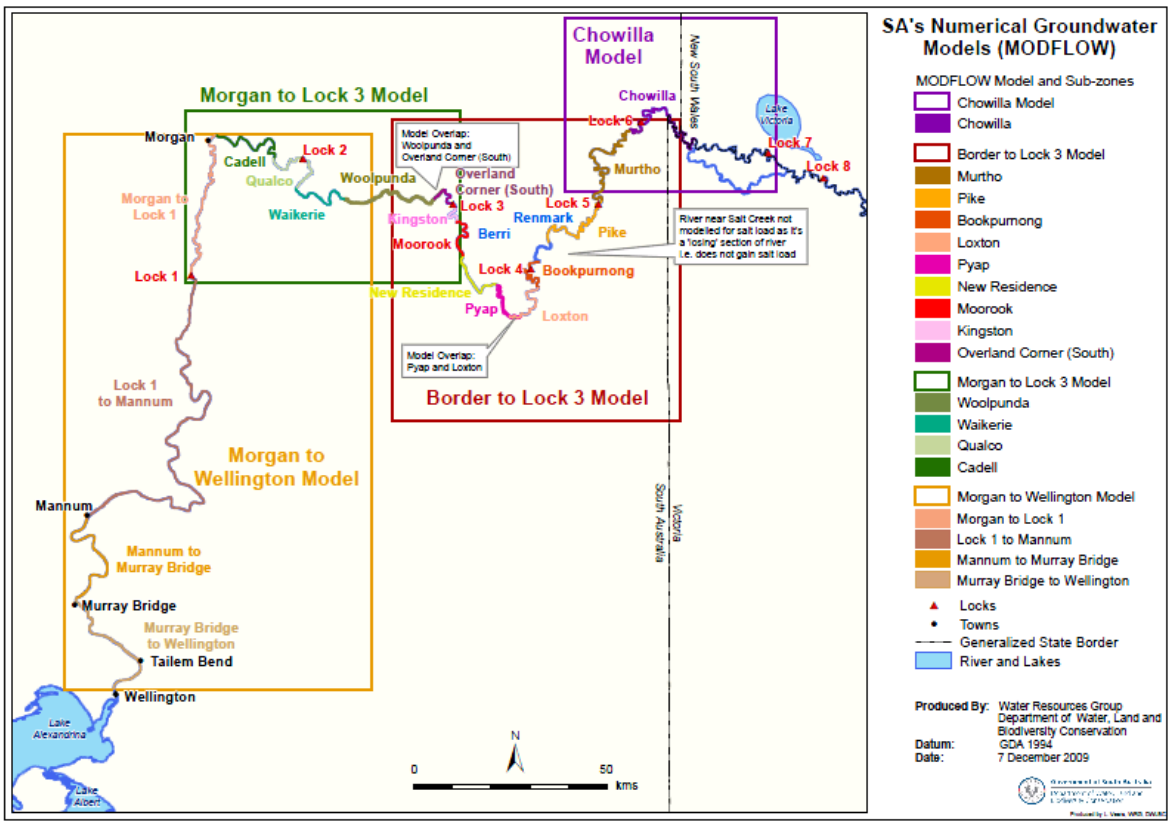

Figure 19 - Location of South Australia's Numerical Groundwater Models

Table 3 - Status of South Australia's numerical groundwater models

Regional Model	Sub-zones	Completed	Accredited	Report Reference	Additional Runs	5-7 Year Model Review Due	Status
Border to Lock 3	Loxton Bookpurnong	2004 2011	2005 2011	DWLBC Report 2005/17 DFW Report XX/2011	Bookpurnong: Scenarios rerun in 2008 for Aluminium clogging area Loxton: Scenarios run in 2009 for as constructed scheme	2010-12	5 Year Review modelling completed in June 2011, model accredited in September 2011, Registers to be updated in 2012 following approval of SIS 5 Year Review (includes operations review, model review and register entry review)
	Pike Murtho	2006	2006	DWLBC Report 2006/26	Scenarios run in 2008 for Pike SIS submission report Pike: need to rerun for as constructed (State) scheme (2011) Murtho: need to rerun for as constructed scheme once completed (2012)	2011-13	5 Year Review scheduled for 2013-14
	Renmark Berri	2007	2011	DWLBC Report 2007/30		2016-18	
	Pyap New Residence Moorook Kingston	2008	2011	DWLBC Report 2008/19		2016-18	
Lock 3 to Morgan	Woolpunda	2005	2005	Aquaterra (August 2005) Aquaterra (June 2007)	Rerun standard defined scenarios in 2007	2010-12	SIS Operations and Hydrogeological 5 Year Review in 2011, preliminary model by June 2012, final model update for accreditation by June 2013
	Waikerie Qualco Sunlands Cadell	2005	2005	Aquaterra (August 2005) Aquaterra (June 2007)	Rerun standard defined scenarios in 2007	2010-12	SIS Operations and Hydrogeological 5 Year Review in 2011, preliminary model completed June 2011, final model update for accreditation by June 2012
Morgan to Wellington	Morgan to Lock 1 Lock 1 to Mannum Mannum to Murray Bridge Murray Bridge to Wellington	2006 2010	2006 2011	PIRSA Report 2000/45 DWLBC Report 2006/08 DWLBC Report 2010/09		2016-18	Accepted by MDBC in 2006 without irrigation scenarios (Morgan to Tailem Bend) 5 Year Review modelling completed in 2010 - Morgan to Wellington model and includes irrigation scenarios

As the suite of groundwater models were accredited over the period 2005 to 2011, South Australia has now entered the initial 5 year review phase for these models, as per Section 24 (1) and Section 39 (1) of Schedule B of the Murray-Darling Basin Agreement, commencing with the Loxton-Bookpurnong area in 2010-11.

The Border to Lock 3 model for the Loxton – Bookpurnong area (referred as to the Loxton – Bookpurnong model, Figure 20) was developed in 2004 and accredited by the MDBA in 2005. This model was used to assist in estimating Salinity Register entries and to support the SIS design for Loxton and Bookpurnong.

The Loxton – Bookpurnong groundwater model is the first model to undergo the review process. The review was conducted early to align with the 5 year review of Salinity Register entries and to assist with the staggering of model reviews over the next few years. The model has been upgraded significantly from its predecessor, including:

- Groundwater recharge is a key system driver but it has high uncertainty due to the lack of data. Laroona Environmetrics was engaged to collate, summarise and verify irrigation data for Loxton and Bookpurnong. This has led to a much higher confidence in the recharge applied in the model;
- Lag time (time elapsed for irrigation water to reach the water table) was not well understood in the past. Hence DFW engaged Lisdon Associates to undertake a detailed Saturated Unsaturated Transport (SUTRA) modelling to examine the lag time for irrigation drainage. The outcome is important for understanding of the recharge process and developing assumptions for scenarios;

- Evapotranspiration controls the hydraulic heads in the floodplains, and the heads in the floodplains control the groundwater flux and hence salt load entering the River Murray. As evapotranspiration is a critical parameter it has been reviewed in this model upgrade process based on latest CSIRO research findings;
- As mentioned above, the heads in the floodplains are crucial, but the floodplain condition was a large unknown and hence floodplain calibration was impossible in the Loxton – Bookpurnong area in the past. The newly collected pumping rate and groundwater level observation data from the constructed SIS have provided invaluable information for floodplain calibration, which has significantly improved the accuracy of salt load estimation;
- The thickness of the Loxton Sands and Loxton Clay – Bookpurnong Formation aquitard is critical in controlling the thickness of the aquifer and vertical leakage to the Loxton Sands aquifer. DFW engaged Australian Water Environments (AWE) to review the structural contours and thickness of the aquifer and aquitard which has resulted in a better simulation of the lateral and vertical flux to the river; and
- A great amount of effort has been spent on model re-calibration with the newly collected observation data and best knowledge. Consequently there is a significant improvement in model calibration compared to the previous version of the model and this has increased the confidence in the model outputs considerably.

The details of the upgraded Loxton – Bookpurnong model and the modelled salt loads for Salinity Registers scenarios are documented in a DFW report titled “Loxton – Bookpurnong Numerical Groundwater Model 2011”. The report is currently undergoing an internal approval process and is expected to be published in 2011-12.

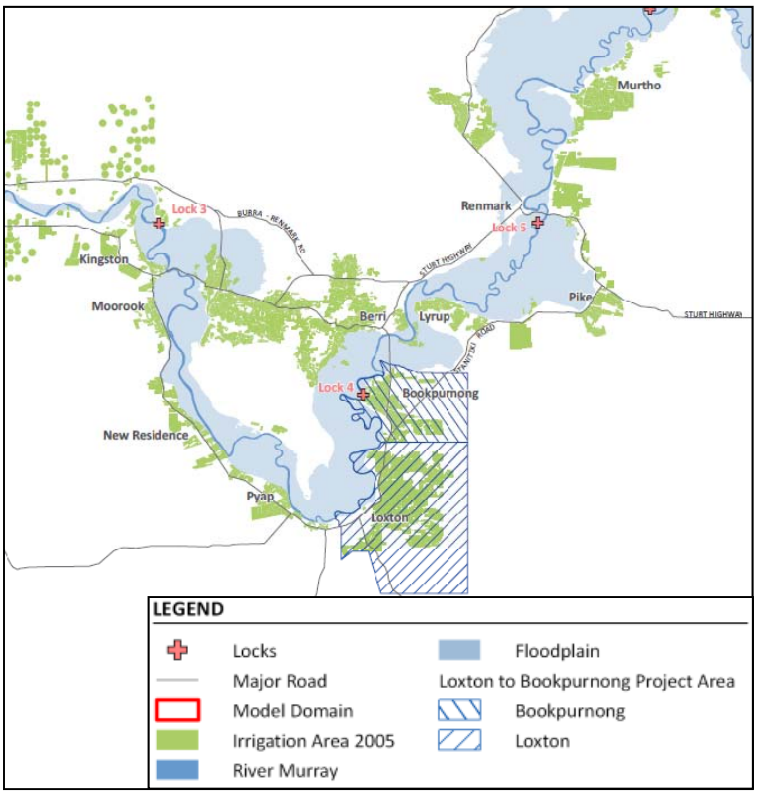

Figure 20 - Project site map and model domain

3.9.3. Reporting

Five Year Review of South Australia's BSMS Salinity Register Entries

Commencing in 2004, South Australia has progressively developed a suite of numerical groundwater models, based on the MODFLOW platform. The models utilise a series of modelling scenarios that are applied consistently to each MODFLOW model to derive South Australia's entries on the BSMS Salinity Registers. The scenarios allow the impact of actions such as irrigation development, SIS and improved irrigation practices to be assessed. With the accreditation of the Morgan to Wellington numerical model in 2011, South Australia has a full suite of numerical groundwater models for the entire River Murray in South Australia covering the region from the eastern Border to Wellington, see Figure 19.

It has always been South Australia's intention that the full range of accountable actions on the BSMS Salinity Registers be derived from outputs from the suite of MODFLOW models, once completed and accredited. To date, as these models have been accredited, the output related to each accountable action in that region has been added to the respective entry on the BSMS Salinity Registers. This includes the entries for:

- pre 1988 irrigation development;
- dryland clearing;
- improved irrigation practices; and
- rehabilitation of irrigation infrastructure.

Currently, the only South Australian entry not derived from the MODFLOW models is the post 1988 irrigation development entry. This is currently based on the accredited SIMRAT analytical model output and is considered to be an interim assessment until such time as it can be updated based on MODFLOW model output.

As the MODFLOW models have been developed and accredited at different times, with their outputs contributing to multiple entries on the BSMS Salinity Registers, the timing for the 5 year review of BSMS Salinity Register entries is not a single date. Rather, each entry will be updated as the individual MODFLOW models that contributed to the entry are updated.

For those BSMS Salinity Register entries that are based on a single MODFLOW model, e.g. South Australia's component of Loxton SIS or Qualco-Sunlands Groundwater Control Scheme, the BSMS Salinity Register entry will be reviewed along with the model as per its 5-7 year review timeframe.

Accountable Actions for 2011 BSMS Salinity Registers Update

South Australia's BSMS Salinity Register entries in 2011 are being updated for a number of reasons, including:

- Creating a separate entry "SA Irrigation Development 1988-2003" based on MODFLOW model output for the 1988-2003 (currently based on SIMRAT model output);
- Adjusting the existing entry for SIMRAT based assessments of permanent water trade 2003-04 to 2008-09 (remove 1988-2003);
- Creating a new entry for SIMRAT based assessments of Site Use Approvals since 1 July 2009;

- Updating entries based on a revised method for determination of South Australia's local component in SIS and irrigation development behind SIS;
- Combining the entries for improved irrigation practices and rehabilitation of irrigation infrastructure; and
- Updating entries with data from newly accredited MODFLOW models (Berri-Renmark, Pyap to Kingston and Morgan to Wellington).

A description of each of these changes is included in this section.

Creating a separate entry for "SA Irrigation Development 1988-2003 (MODFLOW)"

The BSMS Salinity Register entry representing post 1988 irrigation development is currently derived from permanent water trade assessed through the accredited SIMRAT model. In 2010-11, the MDBA independently appointed peer reviewer endorsed the MODFLOW model scenarios as an appropriate basis for the post 1988 irrigation development BSMS Salinity Registers entry. The MODFLOW model assessments are based on the area of irrigated land current to 2003.

Accordingly, in the 2011 BSMS Salinity Registers, South Australia will replace the SIMRAT derived entry for 1988 to 2003 to be based on MODFLOW model output covering all relevant model zones (i.e where there is irrigation) from the Border to Wellington. SIMRAT will continue to be used as the basis for an interim assessment for new irrigation development in years from 2003-04 to present and until the MODFLOW models are updated based data on area of irrigated land relating to a more recent year. That is, the entry for irrigation development from 2003-04 to 2010-11 will be based on SIMRAT model output until such time as the MODFLOW models are further updated to be representative of the current year. To clearly distinguish between the components of post 1988 irrigation development based on differing model platforms, it is proposed that separate lines be created on the 2011 BSMS Salinity Registers for these entries.

Table 4 shows the salt load impact of irrigation development for the period 1988-2003 in tonnes per year, derived from the series of MODFLOW numerical groundwater models.

Table 4 - Summary of MODFLOW impact for 1988 – 2003 irrigation development

Model Subzone	Net Impact of Irrigation 1988-2003 (tonnes/year)			
	2000	2015	2050	2100
Border to Lock 5				
Murtho	0.0	2.2	33.6	94.7
Lock 5 to Lock 4				
Pike	6.8	5.7	28.6	36.3
Renmark	1.5	1.4	1.4	1.6
Lock 4 to Lock 3				
Bookpurnong (2011)	0.0	9.1	36.0	41.6
Loxton (2011)	0.0	2.3	12.3	19.0
Berri	0.1	0.2	0.2	0.3
Pyap	0.0	0.1	3.3	5.1
New Residence	0.0	0.2	4.6	5.9
Moorook	0.0	0.0	1.6	1.7
Kingston	0.0	0.0	0.9	1.1
Lock 3 to Lock 2				
Woolpunda	0.0	0.0	27.9	61.6
Waikerie	0.0	0.7	7.8	9.4
Qualco	0.0	1.7	12.7	17.0
Lock 2 to Morgan				
Cadell	0.0	1.6	7.2	9.2
Morgan to Lock 1				
Morgan to Lock 1	0.0	0.0	7.1	8.4
Lock 1 to Murray Bridge				
Lock 1 to Mannum	0.0	0.0	13.5	20.1
Mannum to Murray Bridge	0.0	0.0	8.9	10.8
Murray Bridge to Mouth				
Muray Bridge to Wellington	0.0	0.0	12.6	14.8
TOTAL	8.5	25.2	178.1	304.3

Adjusting the existing entry for SIMRAT based assessments of permanent water trade

As described above, this is the existing entry which will have the SIMRAT based assessments of permanent water trade for 1988 to 2002-03 removed and retain the SIMRAT based assessments of permanent water trade for 2003-04 to 2008-09. These remaining assessments will ultimately be replaced by MODFLOW based assessments in the coming years once these areas are updated as per their 5 year review timeframes.

Creating a new entry for SIMRAT based assessments of Site Use Approvals since 1 July 2009

Prior to 2009-10, the salinity impact of new irrigation development was estimated from the volume of permanent trade of water entitlement entering the River Murray Prescribed Watercourse assessed through the accredited SIMRAT model. However, recent water reforms in South Australia mean that it is no longer possible to estimate salinity impacts based on traded water volumes.

On 1 July 2009, water entitlements in South Australia were unbundled. Unbundling allows water users to trade their water separately from land and divides the water rights into their component parts: Water Access Entitlement, Water Allocation, Water Resource Works Approval and a Site Use Approval (SUA).

The SUA represents the permission to use water at a particular site in a particular manner and has replaced traded water volumes as the basis for accounting for the salinity impacts of irrigation development using the SIMRAT model. Adopting the SUA as the accounting mechanism is a precautionary approach to accounting for salinity impacts. This is because the SUA represents the maximum amount of water that can be applied at a specific site. In assessing a salinity impact based on this volume, the maximum potential impact is therefore represented.

All applications to vary or to establish new SUAs since 1 July 2009 were assessed in 2009-10 and 2010-11. It is now proposed that these impacts are brought to the BSMS Salinity Registers as a separate entry from other post 1988 impacts to reflect the basis of their assessment; and be included on the BSMS Salinity Registers until such time as the MODFLOW models are updated based on area of irrigated land from a more recent year than 2003, as is currently the case.

In making the assessments, it was identified that there have been no new SUAs since 1 July 2009 that relate to new irrigation development. As such, all salinity assessments based on SUAs to be brought to the BSMS Salinity Registers in 2011 relate to variations to existing SUAs and fall into three categories: SUA variations due to previous temporary trade; SUA variations due to prior commitment; and SUA variations due to maturing plantings. Not all require the impact assessments to be brought to the Salinity Registers. A description of each follows.

SUA Variations due to previous temporary trade

The volume to be applied for irrigation on the SUA was calculated at the date of unbundling (1 July 2009) and based on the entitlement volume held by each irrigator at that time. As annual temporary trades cease on 30 June, in some cases the volume attributed to SUA did not reflect volumes that had been traded in on a temporary basis. This means that the salinity impacts of these volumes have not previously been assessed.

A process has been undertaken in 2010-11 to reconcile the volumes associated with these variations and assess the salinity impacts using SIMRAT. The bulk of SUA variations in 2009-10 and 2010-11 were due to irrigators increasing the volume on their SUA up to the level of previous annual temporary trade. As these volumes have not previously been assessed their impacts are to be entered on the BSMS Salinity Registers in 2011. A summary of the salinity impact of these variations for 2009-10 and 2010-11 are listed at Table 5 and Table 6 respectively.

Table 5 - Variations to Site Use Approvals due to temporary trade, 2009-10

Assessment Year	Reach	Total Volume (ML)	Impact @ 2010 Salt tonnes/day	Impact @ 2011 Salt tonnes/day	Impact @ 2012 Salt tonnes/day	Impact @ 2013 Salt tonnes/day	Impact @ 2014 Salt tonnes/day	Impact @ 2015 Salt tonnes/day	Impact @ 2050 Salt tonnes/day	Impact @ 2100 Salt tonnes/day
2009-10	Border to Lock 6	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009-10	Lock 6 to Lock 5	8,662.5	0.000	0.000	0.000	0.000	0.000	0.000	0.220	14.682
2009-10	Lock 5 to Lock 4	343.6	0.000	0.000	0.000	0.000	0.000	0.000	1.926	3.505
2009-10	Lock 4 to Lock 3	4,784.0	0.000	0.000	0.000	0.000	0.000	0.000	0.193	1.118
2009-10	Lock 3 to Lock 2	1,254.9	0.040	0.049	0.054	0.057	0.059	0.059	1.186	4.543
2009-10	Lock 2 to Morgan	775.8	0.000	0.000	0.000	0.000	0.000	0.000	2.582	4.559
2009-10	Morgan to Lock 1	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009-10	Lock 1 to Murray Bridge	8,393.7	0.000	0.000	0.000	0.000	0.000	0.000	0.695	2.941
2009-10	Murray Bridge to the Mouth	437.8	0.007	0.009	0.009	0.009	0.010	0.010	1.098	1.193
2009-10	Outside Reaches	1,521.0	-	-	-	-	-	-	-	-
	TOTAL 2009-10	**26,173.3**	**0.047**	**0.058**	**0.063**	**0.066**	**0.068**	**0.068**	**7.900**	**32.540**

Table 6 - Variations to Site Use Approvals due to temporary trade, 2010-11

Assessment Year	Reach	Total Volume (ML)	Impact @ 2010 Salt tonnes/day	Impact @ 2011 Salt tonnes/day	Impact @ 2012 Salt tonnes/day	Impact @ 2013 Salt tonnes/day	Impact @ 2014 Salt tonnes/day	Impact @ 2015 Salt tonnes/day	Impact @ 2050 Salt tonnes/day	Impact @ 2100 Salt tonnes/day
2010-11	Border to Lock 6	1010.7		0.000	0.000	0.000	0.000	0.000	0.515	8.876
2010-11	Lock 6 to Lock 5	3472.755		0.585	0.825	0.951	1.032	1.032	5.237	21.720
2010-11	Lock 5 to Lock 4	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010-11	Lock 4 to Lock 3	2,165.9	-	0.001	0.001	0.002	0.002	0.002	0.164	1.045
2010-11	Lock 3 to Lock 2	1,829.9	-	0.000	0.000	0.000	0.000	0.000	0.222	4.253
2010-11	Lock 2 to Morgan	-	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010-11	Morgan to Lock1	990.4	-	0.003	0.004	0.004	0.004	0.004	0.929	2.797
2010-11	Lock 1 to Murray Bridge	293.0	-	0.001	0.001	0.001	0.001	0.001	0.007	0.152
2010-11	Murray Bridge to Mouth	1,071.8	-	0.016	0.020	0.022	0.023	0.023	1.688	3.897
2010-11	Outside Reaches	938.1	-	-	-	-	-	-	-	-
	TOTAL 2010-11	**11,772.6**		**0.606**	**0.851**	**0.980**	**1.062**	**1.062**	**8.761**	**42.739**

SUA Variations due to Prior Commitment

The South Australian River Murray Salinity Zoning Policy establishes three salinity impact zones: high, low and high (salt interception). Subject to the availability of salinity credits and compliance with other principles in the River Murray Water Allocation Plan, new SUAs and variations to existing SUAs will be granted in the low salinity impact and the high salinity (salt interception) zones.

In the high salinity impact zone, new SUAs or variations to existing SUAs will only be granted if the applicant can prove that they were financially or legally committed to the development prior to 30 June 2003. This is referred to as Prior Commitment.

Prior Commitment clauses were included in the Salinity Zoning Policy as a transitional measure to ensure that entities with commitments to developments within the high salinity zone, prior to the implementation of the Salinity Zoning Policy in June 2003, were exempt from the restrictions to develop in the high salinity impact zone.

There have been 41 approved claims for Prior Commitment, totalling approximately 73 GL. To date, 13 of these claims have been taken up with a corresponding approximate salinity impact of an additional 25 tonnes per day at 2050. A summary of the salinity impacts of these claims is provided at Table 7 for inclusion in the 2011 BSMS Salinity Registers.

Uptake of the remaining Prior Commitments will be reported in South Australia's 2011-12 Report to the BSMS.

Table 7 - Prior Commitment Claims (claimed)

Reach Name	Total Volume (ML)	Impact @ 2011 Salt tonnes/day	Impact @ 2012 Salt tonnes/day	Impact @ 2013 Salt tonnes/day	Impact @ 2014 Salt tonnes/day	Impact @ 2015 Salt tonnes/day	Impact @ 2050 Salt tonnes/day	Impact @ 2100 Salt tonnes/day
Border to Lock 6	931.0	0	0	0	0	0	0.766	6.819
Lock 6 to Lock 5	13,527.0	0	0	0	0	0	7.653	73.577
Lock 5 to Lock 4	163.2	0.000	0.000	0.000	0.000	0.000	1.071	1.626
Lock 4 to Lock 3	1,315.8	0.080	0.089	0.097	0.103	0.103	2.342	4.447
Lock 3 to Lock 2	4,328.4	0.000	0.000	0.000	0.000	0.000	11.288	21.927
Lock 2 to Morgan	601.2	0.000	0.000	0.000	0.000	0.000	2.084	3.522
Morgan to Lock 1	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lock 1 to Murray Bridge	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Murray Bridge to Mouth	29.3	0.000	0.000	0.000	0.000	0.000	0.089	0.096
TOTAL	**20,895.8**	**0.080**	**0.089**	**0.097**	**0.103**	**0.103**	**25.295**	**112.014**

SUA Variations due to maturing plantings

As described previously, the South Australian River Murray Salinity Zoning Policy restricts the ability to apply additional volumes of water within the high salinity impact zone. When this policy was first implemented (1 July 2003) the water entitlement on many irrigator's licences only reflected the consumption needs of the crop at the time, i.e. it did not reflect the volume required to meet the mature crop's water requirements.

To ensure such irrigators would not be disadvantaged under the new policy, the Government of South Australia endorsed an exemption to the policy that allows irrigators located in the high salinity impact zone to increase the volume on their SUA up to the volume required to meet the mature crop water requirements, for crops planted before the zoning policy was implemented.

As the irrigated area of land related to these claims was in existence at 1 July 2003 and the MODFLOW models have assessed salinity impacts based on this land area, the cumulative impact of the mature crop variations are considered to have been assessed and included on the BSMS Salinity Registers. A summary of variations to SUA due to adjustments for existing plantings is listed at Table 8.

Table 8 - Summary of variations to Site Use Approval due to adjustments for existing plantings, 2009-10 to 2010-11

Reach	Volume (ML)
Lock 6 to Lock 5	19,252.3
Lock 5 to Lock 4	13,888.7
Lock 4 to Lock 3	7,024.0
Lock 3 to Lock 2	13,306.0
Lock 2 to Morgan	6,282.1
Morgan to Lock 1	1,364.1
Lock 1 to Murray Bridge	8,966.1
Murray Bridge to Mouth	1,803.2
	71,886.5

Revised method for determination of South Australia's local component in SIS and irrigation development behind SIS

Several of the SIS operated within South Australia are funded on a joint basis between the MDBA and the Basin States. These include the Loxton, Bookpurnong, Murtho and Waikerie Lock 2 SIS. This joint funding arrangement mean that both the credits generated by the SIS and the on-going costs of operation and maintenance are shared. South Australia holds both a share of the joint credit component and a State credit component in each SIS. The basis for sharing is based on the principles documented in the BSMS Operational Protocols and includes:

- A joint work or measure should have a primary (but not necessarily exclusive) purpose of addressing delayed salinity impacts (Legacy of History - LOH);
- The benefits arising from any new action should not erode the credits assigned to an existing joint work or measure on Register A or Register B without prior agreement by the Commission; and
- For a shared work or measure: the cost (capital, operations and maintenance and renewals) and the benefits gained would be in direct proportion to the split between the joint works component and State actions, or in any other proportion that the Commission may agree to from time to time.

The current method determines the joint component (credit) and the State action (debit) as the basis for the BSMS Salinity Register entries and cost sharing calculations. The issues with this method are:

- The total State debit is assumed to be offset by the State local component – this may not be the case; and
- There is potential for the total scheme benefit to be either under or over allocated, i.e. when summed, the joint component and the State action do not equal the total benefit of the scheme.

The current method to derive the BSMS Salinity Registers entries is applied at each of the key reporting dates (2000, 2015, 2050, 2100) and interpolated to the current year.

As the impacts of post 1988 irrigation increase over time, the credit allocated to offset the state component also increases over time while the joint component reduces. This directly contradicts the principle that "the benefits arising from any new action should not erode the credits assigned to an existing joint work".

Conversely, as the cost sharing is based on a 30 year average impact this remains a constant until the SIS and supporting model undergoes 5 year reviews.

As the joint benefit must not deteriorate due to a new action, a new method for determining the BSMS Salinity Registers entries has been devised in consultation with MDBA.

It is proposed to first determine the cost sharing ratio, based on 30 year averages, by calculating the total benefit of the scheme, then the joint component with the remainder allocated to the State component. These components are then used to determine the cost sharing ratio. To calculate Salinity Register entries the total benefit is determined at the key

reporting dates and the cost sharing ratio applied to determine the joint and State components. The current year is then interpolated from these calculations.

In this manner:

- The joint component does not deteriorate over time;
- The total benefit of the scheme is not under or over allocated (i.e. the joint component + State component = total benefit); and
- The local debit (post 1988 irrigation) is not assumed to be offset by the local component.

It is proposed that this method will apply to the 2011 BSMS Salinity Registers for entries related to the following salt interception schemes: Loxton, Bookpurnong and Waikerie Lock 2.

Combining improved irrigation practices (IIP) and rehabilitation of irrigation infrastructure (RH)

It has been identified during the development of previous MODFLOW groundwater models that it is difficult to accurately isolate the benefits of improved irrigation practices from rehabilitation of irrigation infrastructure as the two are closely linked. Therefore, in future model reviews there will no longer be separate model runs to separate the two. Currently the only claim for both IIP and RH are in the Loxton area, therefore it is proposed to combine these entries in the 2011 BSMS Salinity Register.

Updating entries with data from newly accredited MODFLOW models

During 2010-11, two of South Australia's MODFLOW numerical groundwater models have been subject to independent peer review and have been endorsed as fit for purpose as a basis for BSMS Salinity Registers entries. A further two models, in the first quarter of 2011-12, have been peer reviewed and endorsed as fit for purpose as a basis for BSMS Salinity Registers entries. However, until such time as the Salt Interception Scheme 5 Year Review is complete and endorsed for Loxton SIS and Bookpurnong SIS, the data from the 2005 model is to be used to update the associated SIS entries with the new method described at point 4. Once the SIS 5 Year Review has been endorsed the SIS entries can be updated from the 2010 model. The SIS 5 Year Review is likely to completed in the first half of 2011-12 and the SIS entries will be updated on the 2012 BSMS Salinity Registers.

The models recently accredited and the entries to be updated in the 2011 BSMS Salinity Registers include:

- Berri-Renmark (accredited in 2010-11): post 1988 irrigation development, improved irrigation practices and Mallee legacy of history (dryland and irrigation);
- Pyap to Kingston (accredited in 2010-11): post 1988 irrigation development, improved irrigation practices and Mallee legacy of history (dryland and irrigation); and
- Morgan to Wellington (accredited in 2011-12): post 1988 irrigation development, improved irrigation practices and rehabilitation of infrastructure, and Mallee legacy of history (dryland and irrigation).

Accordingly, the BSMS Salinity Registers entries listed above will be updated with the newly accredited groundwater models (Berri-Renmark, Pyap to Kingston and Morgan to Wellington).

4. VALLEY REPORTS

South Australia is committed to contributing towards meeting the existing Basin Salinity Target and has also adopted it as a State target under the South Australian River Murray Salinity Strategy 2001-2015 (SARMSS). South Australia is keen for new operational targets to be specified in the forthcoming Water Quality and Salinity Management Plan that facilitate actions to enable management of River Murray salinity below Morgan.

4.1. END OF VALLEY REPORT CARD

The Independent Audit Group - Salinity has previously acknowledged that the End-of-valley Summary Report Card is not entirely suitable for South Australia, as it does not make provision for downstream targets, actions or reporting. However, South Australia has completed the relevant fields of the End-of-valley Summary Report Card (Table 10).

Table 9 - SARMSS monitoring sites

Monitoring site	Target EC *	Description
Border (downstream of Rufus River)	412	This site near the SA/NSW border effectively provides the salinity of water entering South Australia
Berri (Irrigation Pump Station)	543	This site has good long-term data and a continuous data recorder
Murray Bridge (Pump Station)	770	This site is a major off-take, and is downstream of the major urban off-take. The installation of a continuous recorder will ensure data quality will be maintained.

*Target EC for 80 percent of the time

Table 10 - End-of-valley summary report card

Valley	Interim 2015 Target (% of 2000 Benchmark Conditions)			Valley Reporting Site	Assessed Baseline Conditions – 1/1/2000	"Do Nothing" Legacy of History Impact –2015 Effect	Agreed 2015 Target	Progress Given Actions To-Date
								Current Year 2010-11
	Salinity		Salt load	(Shared resource sites shown in italics)	End of Valley: Flow, Salinity, Salt Load			End of Valley: Salinity, Flow, Salt Load
South Australia	Median	95%ile	Average					
Lock 6 to Morgan	Tba	800 EC	Tba	Murray at Morgan			800 EC	447 EC (Max) 418 EC (95 %ile) 365 EC (80 %ile) 78 900 ML/Day Max Flow
Monitoring Sites	Median	80%ile	Average					
Below Morgan	Tba	770 EC	Tba	Murray at Murray Bridge			770 EC	493 EC (Max) 404 EC (95 %ile) 371 EC (80 %ile) No flow data available
SA Border	Tba	412 EC	Tba	Murray at SA Border			412 EC	355 EC (Max) 304 EC (95 %ile) 276 EC (80 %ile) 93 508 ML/Day Max Flow
Berri	Tba	543 EC	Tba	Murray at Berri			543 EC	383 EC (Max) 316 EC (95 %ile) 289 EC (80 %ile) 79 000 ML/Day Max Flow

4.2. SUMMARY OF MONITORING SITES

Most of the pontoon mounted salinity monitoring equipment installed in the main river channel in South Australia was removed during the high flow period to avoid equipment damage. The pontoons are at risk of being submerged due to debris in the water catching on the moorings when flows are over 60,000 ML/day. The dataloggers were reinstated as soon as the recession was underway and there was no risk to the structures. This represented a major investment of labour and resources, to reinstate most sites in time to capture recession salinity effects.

Figure 21 - Monitoring pontoon during high flows

4.2.1. Border (A4261022)

The pontoon-mounted salinity monitoring equipment located at the South Australian – Victorian Border generally provided reliable "good" coded data. However, due to removal of the EC equipment, four months of data collection was coded "not operating". The very small accessions between A4260200 and Lock 6 during this high flow period mean the A4260200 EC can be substituted for the Border EC to provide a continuous dataset for the year.

Flow records for this site are derived from a rating at A4260200 (Victorian Gauging station, River Murray downstream of Rufus River) and A4140211 (Victorian Gauging station, Mullaroo Creek).

During this period of high flows all flow data was derived from the rating tables developed for these sites. Maximum rated flow to South Australia was 93 508 ML/day on the 13 February 2011.

4.2.2. Berri (A4260537)

The salinity monitoring equipment located at the Berri Irrigation Pumping Station continued to operate reliably, with 100 percent of data being of "good" quality in 2010-11. Because this site is mounted on the pumping station above the events peak, this ensured no interruption to data collection.

Generally EC data was reasonably smooth due mainly to a regular monthly visiting regime which kept biofouling to a minimum.

Flows for this site are calculated at Lock 4 (A4260515, 8kms downstream of Berri), up to a stream-flow of 40 000 ML/day. Above 40 000 ML/day when the weir is "drowned" the high-flow gauging site at Lyrup (A4260663, 12km upstream of Berri) is used. Flows at Lock 4 were quality coded "good" for 100 percent of record below 40 000 ML/day for 2010-11.

The high flows enabled a further 14 flow gaugings to be carried out at Lyrup to improve the rating table for this site. As a consequence the rating table range from 40 000 ML/day to 100 000 ML/day is rated "good".

Consequently the flows used to calculate salt loads at Berri are a combination of low flows at Lock 4 and higher flows at Lyrup.

4.2.3. Morgan (A4260554)

The salinity monitoring equipment located at the Morgan Pumping Station pontoon operated reliably, with all data coded "good" quality in 2010-11 except for about 3 months of high flow period when the equipment was removed as detailed above. A new EC instrument was fitted to the Morgan flow site, 3.5 km downstream of the pumping station and this data enabled continuous Morgan EC to be collected during the high river. Ninety six percent of Morgan EC has been coded "good".

The new continuous flow station (A4261110), 3.5 km downstream of Morgan provided continuous flow data except for short periods when large amounts of floating weed fouled the sensors (Figure 22).

Ten flow gaugings were carried out to validate the velocity index rating, and all were within 5 percent of rated flows. When river flows reached approximately 50 000 ML/day, backwaters around the site started to flow and Morgan no longer reflected total stream flow. Above 50 000 ML/day, Lock 1 rated flow was used for salt load calculations at Morgan.

During the high flow period 11 flow gaugings were carried out at Lock 1 to validate the rating table. All high flow gaugings were within 5 percent of the rating.

Figure 22 - Fouling of monitoring station

4.2.4. Murray Bridge (A4261162)

The new water level and EC monitoring installation (A4261162) at Long Island (5 km downstream of the previous site) was not affected by the high flows and consequently all EC data has been coded “good”.

No flow measurements are currently possible at Murray Bridge, as previously reported.

5. RESPONSE TO INDEPENDENT AUDIT GROUP

South Australia values the process of annual audit by the Independent Audit Group – Salinity (IAG). The recommendations provided by the IAG in their annual reports promote action to address the high priority issues and highlight areas requiring additional investment. This is particularly valuable in a time of more limited resources for Murray-Darling Basin salinity management and a need to target key issues. South Australia's formal response to the IAG recommendations (as forwarded to the MDBA 28 January 2011) is provided below.

5.1. HIGH PRIORITY RECOMMENDATIONS

Recommendation 1: Flood recession salt risks

That the MDBA office proceed with its project to facilitate development of a conceptual model of flood recession salt mobilisation in the flood plains, and prepare operational response management plans in preparation for the next high flow event.

South Australia continues to support this recommendation.

Flood recession salt risks remain one of the most significant threats to water quality, especially for the lower River Murray.

South Australia has provided detailed input to the progress of the existing program of work MDBA has coordinated on this issue, including the project commissioned to Australian Water Environments in 2009-10. South Australia has expressed concern relating to the method of assessment used in the project (the broad risk assessment) and considers that further work on this issue will be needed before proceeding to develop appropriate operational management action plans. South Australia suggests that the next phase of work is to compare actual monitored data with historical management practises to inform the development of operational responses (i.e. what mitigation actions were successful in particular circumstances). Detailed analysis of the considerable volume of monitored data is required to ensure operational management responses and resources are targeted appropriately. Further effort needs to be directed to this issue, building on the good work commenced in 2009-10.

The current high river flows and water levels being experienced provide a timely opportunity to collect data on floodplain response to inundation and drying cycles. However, given that collecting and analysing such data to enable exploration of floodplain salt mobilisation dynamics remains a work in progress, the key mitigation action that can be taken at present is the use of water for dilution flow. South Australia understands it will be receiving additional dilution flows until the end of November 2011 that will assist in the mitigation of salinities arising from the current high flow event.

South Australia is also of the view that water committed for environmental purposes may be used for salinity dilution in flood recession circumstances when it is not required in that year for environmental watering.

Recommendation 2: Accountability for salt mobilisation by environmental watering

That the MDBA with advice from Basin Salinity Management Advisory Panel complete a framework for accountability for the salinity effects of environmental watering to enable such actions to be entered onto the salinity registers.

This is clearly linked to Recommendation 18. South Australia suggests that the real time aspects - including salt export from the Basin as referred to at Recommendation 18 - are equally important and should receive the same high priority rating. It is imperative that work across programs within MDBA (i.e. BSMS, River Operations, Environmental Watering) continues so that both the short term (real time) and the long term salinity accountability (salinity registers) risks are mitigated.

South Australia believes that the current salinity registers may not be the appropriate tool to manage or account for environmental watering salinity impacts as it cannot manage short term (real time) impacts. The salinity impact of environmental watering is a key issue for the review of Schedule B; therefore, the development of policy to account for environmental watering salinity impacts should not be limited by existing frameworks.

South Australia continues to advocate for a 'no borders approach' to the management of salinity impacts associated with environmental watering that aligns with the proposed Basin Plan approach. This acknowledges the creation of the salt problem is shared across the Basin and therefore the need for shared management solutions. Within the accountability framework, the salinity credits resultant from dilution flows associated with environmental watering should be quarantined for further environmental watering events. They should also be apportioned according to where the salinity risks exist and debits will arise, rather than providing them to individual jurisdictions to offset other actions.

The proposed Basin Plan should provide a framework for funding of the salinity accountability aspects of environmental watering.

Recommendation 3: Re-assessing salinity risk in the Basin

A comprehensive review of the currently projected salinity risk in the Basin for 2050 should be undertaken by the MDBA with advice from Basin Salinity Management Advisory Panel while the Basin Plan and the environmental watering plans are being developed as a first step in producing the next phase of salinity management. The review should take into account the re-assessment of salt loads from individual catchments, the water buyback, and climate change scenarios.

South Australia supports this recommendation.

South Australia is concerned that the overall register balance is predicted to decline and yet there is no further program of joint works and measures to mitigate this impact. South Australia is therefore keen to confirm whether the risks are as predicted (particularly given the proposed new management framework of the Basin Plan) so mitigation actions can be appropriately targeted. In the meantime, South Australia will continue to take a precautionary approach to salinity management, including pursuit of the adoption of the full Pike salt interception scheme as a joint work.

Recommendation 4: Prioritising catchments and sub-catchments for salinity management

The MDBA should facilitate assessment of currently available tools that prioritise catchments with high salinity outflows or salinity risk and allow the reduction in salinity outflows from the application of a range of recommended land and water management actions to be measured.

South Australia supports this recommendation.

South Australia will provide information on available tools to MDBA as required to facilitate this assessment.

Recommendation 5: Coal seam gas

(a) Queensland should formally document and provide to the MDBA the policy framework and processes it is using to manage coal seam gas developments to minimise salinity risks to the Basin.

(b) New South Wales should report to the MDBA on its policy framework for coal seam gas developments in New South Wales, identifying the processes that can be used to minimise any potential salinity risk in the Basin.

Not directed at South Australia; however, South Australia supports this recommendation.

Recommendation 6: Joint works and measures program Pike River

Pike River Salt Interception Scheme construction should be implemented as a precautionary approach to salinity management in the Basin given the predicted 2050 salinity outcome based on current models and the minimal credits available from retiring irrigated lands show that the probability of meeting the Morgan Basin salinity target into the future is low.

South Australia supports this recommendation.

South Australia continues to support a precautionary approach to salinity management. Investment in salt interception infrastructure continues to be a key strategy to achieve this outcome. Work is underway to commence construction of an initial component of the Pike salt interception scheme using existing funds. The significant long term benefits from completion of the Pike salt interception scheme are such that South Australia will continue to pursue to progress the scheme as a Joint Works program with the MDBA.

Recommendation 7: Outstanding reviews of register items

(a) Queensland outstanding reviews of registers A and B items need to be progressed

(b) All outstanding reviews of Victorian Register B items need be completed, in particular the Goulburn Broken and Loddon catchments legacy of history salinity impacts should be assessed using detailed modelling

(c) South Australia salinity groundwater modelling technical review be completed so it can be accepted by MDBA

(d) New South Wales formally submits to the MDBA each of the Register B valley five-year reviews so they can be finalised.

South Australia is already making progress on this item having submitted to the MDBA formal requests in December 2010-January 2011 for the following models:

- Berri/Renmark - independent peer review and accreditation of supplementary documentation;
- Pyap to Kingston - independent peer review and accreditation of supplementary documentation;
- Morgan to Wellington - independent peer review and accreditation of updated model;
- Chowilla - request for involvement of independent peer reviewer during model development;
- Loxton/Bookpurnong - request for involvement of independent peer reviewer during 5 year review upgrade; and
- Morgan to Lock 3 – request for involvement of independent peer reviewer during 5 year review upgrade.

South Australia has established a cross agency Project Team with representatives from DFW, SA Water and the MDBA to ensure the 5 yearly review of groundwater models reflects the policy requirements set out in Schedule B.

Recommendation 8: Resourcing of salinity in catchment plans

Funding for catchment plans to address salinity issues needs to be increased to ensure the skills, knowledge and actions built up during the first nine years of BSMS are not lost.

South Australia supports this recommendation.

Adequate funding for continued salinity management at the State and regional levels is essential to ensure a smooth transition to the proposed Basin Plan (including Water Quality and Salinity Management Plan) arrangements. Significant effort and resources will need to be sourced to ensure that State Water Resource Plans and regional Land and Water Management Plans can be developed and implemented to deliver against Water Quality and Salinity Management Plan objectives and outcomes. South Australia will continue to seek to partner with MDBA where appropriate to progress key issues and retain expertise.

Recommendation 9: Relationship between registers and the target at Morgan

The consistency between the credit and debit balances of the registers and the target at Morgan needs to be established, taking into account the likely effects of environmental watering and the Basin Plan, given that 2010 is the first year that the target at Morgan has been met while Register A has been in credit for each jurisdiction for some years.

South Australia supports this recommendation.

The fact that achieving the salinity registers balance does not necessarily mean the Basin Salinity Target has been met creates confusion and can be very difficult to explain to those not directly involved in the Basin Salinity Management Strategy program. Making the relationship between the registers and the target more consistent would therefore be most beneficial.

South Australia is also of the view that the salinity registers framework should be reviewed in preparation for the review of Schedule B. The BSMS salinity registers have provided a

solid basis for accountability of long term salinity impacts and demonstrate the value of partnerships in managing an environmental issue that does not heed institutional boundaries. The salinity registers are a tangible and effective example of a contemporary environmental accounting framework with its successes largely an outcome of an inter-jurisdictional partnership committed to addressing the problem. Notwithstanding the success of the current model, improvements are required over time. In particular, challenges include providing better representation of short term impacts as well as long term trends and balancing the drive for technical rigour in groundwater modelling with simplicity. This is in light of a more restricted funding environment – streamlined processes for model review, development and accreditation are needed to enable ongoing commitment by governments and other stakeholders.

Recommendation 10: Irrigation Salinity Accountability Framework

The MDBA, with advice from Basin Salinity Management Advisory Panel, facilitate the development of a consistent framework for the accountability of irrigation salinity impacts including improved knowledge of district-scale irrigation related groundwater recharge. MDBA should continue capturing the irrigation improvement measures and unbundling water from lands to inform this process. MDBA should promote irrigation as a special application case in revised groundwater modelling guidelines being prepared by the National Water Commission.

South Australia supports this recommendation.

There have been a number of changes to the water licensing environment since groundwater modelling was first undertaken for salinity and these need to be reflected in a new accountability framework. South Australia is keen to work with MDBA and partner jurisdictions to:

- enable the development of assumptions from work completed on district-scale irrigation related groundwater recharge for use in groundwater models; and
- promote the adoption of existing technologies developed and successfully trialled in South Australia (such as the IRES package to improve on-farm irrigation scheduling efficiency; and in-river monitoring techniques to detect areas of risk, such as the close interval EC surveys and acoustic flow monitoring).

Recommendation 11: Salinity expertise for the Commonwealth Environmental Water Holder

To facilitate appropriate salinity accounting and operating conditions for environmental watering activities, Commonwealth Environmental Water Holder should consider including skills in floodplain salt mobilisation on its Environmental Water Scientific Advisory Committee. Also increased collaboration is required with partner governments to incorporate the considerable existing knowledge and expertise available.

Not directed at South Australia; however, South Australia supports this recommendation.

The CEWH needs to progress active engagement with the States on the management of environmental water. If the water is not appropriately managed, there may be significant implications in terms of downstream salinity impacts. The States have much expertise and knowledge that they could share with the CEWH on this issue and South Australia has

nominated a suitable representative for the MDBA's Environmental Watering Salinity Accountability Task Force (EWSATF). It is envisaged that stronger links into both States expertise and the BSMS program can be established via the EWSATF and through ongoing engagement with the Basin Salinity Management Advisory Panel, both at regular meetings and out-of-session.

5.2. NORMAL PRIORITY RECOMMENDATIONS

Recommendation 12: Consistent Basin-wide land use databases

The MDBA should facilitate the development of a set of databases that describe land use at catchment scale across the Basin for use in prioritising dryland catchments for land management improvement.

South Australia supports this recommendation.

South Australia suggests that this needs to be extended to both dryland and irrigation regions – there is a need for consistency in land use databases basin wide; not just for the dryland areas. South Australia is engaging with MDBA on this issue, particularly in terms of the collection of consistent base datasets on extent of irrigated land as a data input to groundwater models that, in turn, inform salinity registers entries.

Recommendation 13: Science skills audit to support the salinity program

MDBA and the jurisdictions should review their sources of science expertise to support the BSMS and propose strategies to enable the program to be supported with ongoing appropriate skills into the future.

South Australia supports this recommendation.

South Australia has - and will continue to - promote a close link between policy officers involved in the Basin Salinity Management Strategy program, regional officers with expertise in irrigation management and environmental management and science officers with skills in groundwater modelling and monitoring. South Australia will make every effort to support a program of this nature with appropriate skills into the future and utilise alternative sources of skills and expertise (such as through the Goyder Institute) as appropriate.

Recommendation 14: Updating the valuations in the registers

That the registers reflect the current dollar value of the assets at risk and these be updated annually.

South Australia supports this recommendation.

South Australia is keen to see the salinity registers updated so they reflect both the actual cost of salinity and the relative costs incurred between different actions on the registers.

South Australia is concerned that the environmental costs of salinity are not currently represented within the cost functions that underpin the salinity registers. This needs to be addressed. One of the largest environmental assets of the Basin is the Coorong, Lower Lakes

and Murray Mouth region. The condition of this asset is a key indicator of overall system health and particularly downstream flow and salt export to sea. Including the cost of salinity to assets such as this in the cost functions will better reflect how Basin jurisdictions are collectively travelling in terms of salinity management, thus ensuring that the salinity registers more closely reflect reality.

Recommendation 15: Defining the uncertainty in the register items

Uncertainties in the registers need to be more transparent and the meaning of high, medium and low confidences defined.

South Australia supports this recommendation.

South Australia encourages MDBA to develop these ratings in consultation with the jurisdictions.

Recommendation 16: Recording the mitigation decisions required during the drought

That South Australia should document the recent actions taken (particularly below Lock 1) during the drought to mitigate the salinity issues and also the recent recovery within an ecosystem response and resilience context.

South Australia supports this recommendation.

All of the actions taken below Lock 1 during the drought to mitigate salinity and acidification issues have been documented and this process is continuing during the recovery from drought. A new South Australian River Murray Operations Coordinating Committee has oversight of future actions and the development of a longer term strategic operations plan and annual operating plans for the River Murray in South Australia.

Although there is currently much more water available within the system, South Australia is of the view that this should not be an excuse for complacency, particularly in terms of developing long term management strategies. The recent drought and low water availability resulted in extremely poor system health, especially below Lock 1. While the recent rains have provided a reprieve, droughts will always occur. The recent actions taken can inform improved approaches to future basin management in times of drought to avoid a repeat experience. It will be critical for the Basin Plan to be progressed to ensure the system can be managed to be more resilient in the future.

Recommendation 17: End-of-valley salinity-flow interpretations

That the MDBA facilitate a whole-of-basin analysis of salinity-flow hydrographs over the past wet season in order to provide insight into the natural processes that release salt to streams. This could involve synthetic models to demonstrate the key processes.

South Australia supports this recommendation.

South Australia suggests that the current wet period provides a critical opportunity to undertake on-ground analysis and data collection to further develop understanding of these processes. Consideration should be given to merging this task with the next stage of work

required to inform operational management action plans for floodplain salinity management, referred to in Recommendation 1.

Recommendation 18: Environmental water and salt export

In developing environmental watering guidelines, multiple objectives such as the export of salt from the Basin and ecological health of the Coorong and Lower Lakes should be considered.

South Australia supports this recommendation.

South Australia is of the view that salt export from the basin and ecological health of the Coorong and Lower Lakes are critical real time management issues that are equally important as completing a framework for environmental watering salinity accountability as per Recommendation 2. This recommendation is of equal high priority. Please refer to other comments at recommendation 2.

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