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MURRAY–DARLING BASIN AUTHORITY

Basin Salinity Management 2030

2018-19 Comprehensive report

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GPO Box 1801, Canberra ACT 2601
engagement@mdba.gov.au
1800 230 067
mdba.gov.au

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin
The Murray−Darling Basin Authority pays respect to the Traditional Owners and their Nations of the Murray−Darling Basin. We acknowledge their deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

The guidance and support received from the Murray Lower Darling Rivers Indigenous Nations, the Northern Basin Aboriginal Nations and our many Traditional Owner friends and colleagues is very much valued and appreciated.

Aboriginal people should be aware that this publication may contain images, names or quotations of deceased persons.

Contents

Foreword

I have pleasure in releasing the Murray-Darling Basin Authority's (MDBA) 2018-19 comprehensive report of the Basin Salinity Management 2030 (BSM2030) strategy, the second comprehensive report of the new strategy that came into effect in 2015.

The BSM2030 strategy continues to build on the successes of the former Basin Salinity Management Strategy (2001–2015) to deliver a strategic, cost-effective and streamlined program of coordinated salinity management.

For more than 30 years, basin salinity management strategies have contributed to the progressive reduction in river salinity. Investment in salt interception schemes and improved land and water management practices by partner governments have made a real contribution to the improved water quality in rivers and waterways of the basin, and wellbeing of the people who rely on them.

For each of the last 10 years, partner governments and the MDBA have worked together to meet the basin salinity target of maintaining the average daily salinity at Morgan, South Australia, at less than 800 EC for at least 95% of the time. This is a model-based measure of performance simulated over a period that represents both wet and dry climatic sequences and reflects the successful actions taken by partner governments and communities in managing salinity in the basin.

The Independent Audit Group for Salinity (IAG-Salinity) conducted their audit of the BSM2030 strategy in November 2019. The auditors reviewed the implementation of the strategy by MDBA and the partner governments in accordance with the amended Schedule B and associated procedures. The executive summary of the Report of the IAG-Salinity 2017-19, including their recommendations, is provided in this report.

The success of the BSM2030 strategy is only possible with the cooperation of partner governments and the dedication of the people involved. In particular, the commitment by partner governments to the delivery of salinity management activities in the valleys across the basin and the cooperation extended to the MDBA is commendable.

Although great progress has been made, managing salinity remains a challenge in the basin. The collective effort and commitment for salinity management through the BSM2030 strategy will take us through to 2030 and beyond. I look forward to continued achievement and further success with the partner governments working together to implement the BSM2030 strategy.

Phillip Glyde
Chief Executive
Murray–Darling Basin Authority

Abbreviations

AWRC	Australian Water Resources Council
BOC	Basin Officials Committee
BSMS	Basin Salinity Management Strategy
BSM2030	Basin Salinity Management 2030
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EC	electrical conductivity (measured as µS/cm)
EoVT	end-of-valley target
IAG–Salinity	Independent Audit Group for Salinity
LoH	Legacy of History
MDBA	Murray–Darling Basin Authority
MDBC	Murray–Darling Basin Commission
MSM–BigMod	daily flow and salinity model for the River Murray
SIS	Salt Interception Schemes
TLM	The Living Murray

Executive Summary

Basin Governments and the MDBA have been working together to implement strategies to manage salinity in the Basin for more than 30 years. To continue this collective effort, the Basin Salinity Management 2030 (BSM2030) strategy was adopted by Ministerial Council in November 2015 to guide basin-wide salinity management until 2030. The BSM2030 strategy focuses on continuing to ensure salinity is kept at levels appropriate to protect economic, environmental, cultural and social values.

This is the second comprehensive report prepared by the MDBA under the BSM2030 strategy highlighting progress in implementing basin-wide salinity management. The report provides an overview of outcomes and achievements against the key elements of the BSM2030 strategy and includes the executive summaries from the report prepared by each of the Basin States and the Australian Government.

Salinity accountability framework

The salinity registers remain a critical aspect of the salinity management accountability framework under the BSM2030 strategy. The 2019 salinity registers indicate that New South Wales, Victoria and South Australia (ACT and QLD do not have any register entries) continue to be in net credit positions as required under the BSM2030 strategy.

Under the BSM2030 strategy, the Basin salinity target continues to provide a key reference point for achievement in Basin salinity management. This target aims to maintain the average daily salinity at Morgan in South Australia at a simulated level of less than 800 EC for at least 95% of the time.

Comparing modelled salinity against the baseline, based on 2018–19 levels of land and water use, river salinity at Morgan was 778 EC for 95% of the time; hence the strategy is meeting the Basin salinity target.

This long-term modelled outcome is supported by measured salinity levels which have remained below 800 EC at Morgan in South Australia since 1998.

Management of Salt Interception Schemes (SIS)

Management of SIS continues to focus on varying the level of scheme operations in response to forecast salinity and flow conditions throughout 2018-19, in addition to addressing key knowledge gaps about system responses to the changing level of operations and minimising running costs where practical.

In 2018–19 about 474,201 tonnes of salt was diverted away from the river system and nearby landscapes. The amount of salt diverted over the past two years have been quite similar reflecting the similar operating conditions over this period.

Implementation of the trial of responsive management of SIS continued in 2018-19. Low salinity levels throughout the River Murray allowed for a reduction in the level of SIS operations in December 2018. An extension of the trial will be sought to allow for a more complete understanding of system responses to changed operations. The salinity outlook tool continued to be used to inform operational decisions in support of the trial of responsive management of SIS.

Salinity management

The BSM2030 strategy supports operational salinity management of flow management salinity targets at Lock 6, Morgan, Murray Bridge, Milang and Burtundy under the Basin Plan. Assessment of the salinity levels at the Basin Plan reporting sites found that the salinity target values were met (percentage of days above the target was less than 5% over the five-year reporting period) at all reporting sites except at Burtundy due to a lack of flow in the lower Darling River.

In general, salinity levels along the River Murray were relatively low during 2018–19. Operation of the SIS played a key role in maintaining river salinity at low levels. Over the three-year period from July 2016 – June 2019 an estimated annual average of 0.94 million tonnes of salt was exported over barrages in South Australia.

Under the BSM2030 strategy, jurisdictions continue to monitor flow and salinity for the nominated end-of-valley target sites. In the southern connected system, the 50th and 80th percentile salinities for 2017-18 and 2018-19 were generally comparable with or less than longer term statistics in most catchments. However, continuing drought conditions across the northern basin resulted in salinity levels, for some locations, that were much higher than the long-term statistics.

Efficient governance

A number of BSM2030 processes were progressed or completed through 2018-19. These included the process for amending Schedule B to give effect to the BSM2030 strategy which was completed in December 2018 when the amendment regulations were signed into law by the Governor General.

Preparation of Basin Salinity Management (BSM) procedures was also progressed through 2018-19. BSM procedures provide the detail and consistency to support BSM2030 strategy implementation, including for the obligations set out in Schedule B. These procedures are updating and replacing the Basin Salinity Management Strategy Operational Protocols. Twelve BSM procedures were endorsed by Basin Salinity Management Advisory Panel (BSMAP) throughout 2018-19, and the remaining six procedures are in preparation.

To seek improvements in reporting under the BSM2030 strategy, MDBA completed an evaluation of reporting. The evaluation identified changes to improve consistency in reporting, informed the continued development of the draft procedure for BSM2030 reporting, and guided the development of templates to support reporting. These changes were first applied to the reporting for 2017-18.

The MDBA also continued working towards adopting the SOURCE modelling platform as the MDBA river model for preparing the salinity registers. The MDBA and jurisdictions are in the final stages of verifying flow and salt loads prior to the re-estimation of baseline conditions.

The Review Plan tracking template also continued to be used to highlight the progress in undertaking reviews as set out in the Review Plan and to document any changes to the timing of reviews. The review of the Loxton-Bookpurnong joint SIS accountable action was progressed by the MDBA during 2018-19.

Strategic knowledge improvement

A number of projects to address the BSM2030 knowledge priorities were undertaken in 2018-19. These included:

- Development and testing of a series of transfer functions to improve recharge estimates for input to modelling across a range of Mallee landscape settings
- CSIRO and MDBA commenced a three year project to provide robust field data for vegetation evapotranspiration, aiming to improve the accuracy of evapotranspiration data used in numerical models
- MDBA supported the development of an ARC linkage proposal which, if successful, aims to improve the conceptualisation of how water and salt move within saline floodplains, including vegetation water use, flooding and environmental watering
- Investigations commenced or were continued at six locations along the River Murray to address a number of the key knowledge gaps associated with the trial of responsive management of SIS.

Community engagement and communication

In 2018-19, MDBA communicated salinity management outcomes and progress with implementing the BSM2030 strategy through its status and summary reporting to Ministerial Council. These reports were published on the MDBA website.

Priorities for future work

In 2019–20, priorities to be implemented through the BSM2030 strategy include:

- continuing the transition to the Source model for preparation of the Salinity Registers, including confirmation of salt loads and re-estimation of baseline conditions
- finalising the remaining Basin Salinity Management procedures
- continuing, and seeking to extend, the trial of responsive management of SIS and implementing knowledge gap investigations at the trial sites
- progressing projects related to the BSM2030 knowledge priorities
- undertaking reviews of register entries and models consistent with the Review Plan
- finalising nominations to, and implementing, the Basin-wide core salinity monitoring network
- undertaking other activities in line with the BSM2030 strategy implementation plan
- convening the second Basin salinity forum to promote discussion and collaboration between Basin salinity managers, river operators, environmental water managers and other government officials to share lessons learnt and to support BSM2030 implementation.

Introduction

Basin governments have been working together with their communities for more than 30 years to manage salinity in the rivers and catchments of the Murray–Darling Basin. To continue the ongoing collective efforts in salinity management, the Basin Salinity Management 2030 (BSM2030) strategy focuses on ensuring that salinity within the Murray-Darling Basin is maintained at appropriate levels to protect economic, environmental, cultural and social values.

Key elements of the BSM2030 strategy include:

- Maintaining the existing salinity accountability framework and incorporating new issues related to environmental water and flow management.
- Using risk-based approaches to improve the cost effectiveness of salinity management.
- Trialing different options to manage Salt Interception Schemes (SIS) so operations and costs can be reduced when river salinity is forecast to be low.
- Investing in knowledge priorities to reduce uncertainty around future salinity risks, which may assist in avoiding future capital investment in new works to manage salinity.

Reporting has been rationalised under the BSM2030 strategy. Given the progress in Basin salinity management over the period 2001 to 2015, and the maturity of the collaborative arrangements, BSM2030 reporting was able to be streamlined without risk to strategy implementation or achievement of strategy objectives.

This report is the second comprehensive report prepared by the MDBA under the BSM2030 strategy.

Salinity Accountability Framework

One of the key elements for the success of salinity management in the Basin is the commitment of all jurisdictions to a strong salinity accountability framework implemented through the salinity registers.

Status of the BSM2030 salinity registers

The salinity registers are a critical aspect of the BSM2030 strategy and are an effective environmental accountability framework that considers economic impacts as well. The registers provide the primary record of jurisdictional accountability for actions that affect river salinity.

The registers are an accounting tool that record the debit and credit balance of accountable actions that significantly affect[1] river salinity at Morgan in South Australia. This accounting system provides a transparent basis for making decisions on basin-wide trade-offs on salinity management actions and investments in joint works and measures.

Actions that reduce river salinity are recorded as credits, while actions likely to increase river salinity are recorded as debits. Actions such as constructing SIS and improvements in irrigation practices can generate a credit. Actions such as irrigation development may generate a debit because in some areas they may lead to increased salt loads to the River Murray. In addition, actions such as permanent water transfers in or out of an irrigation area may result in either a credit or a debit.

State and territory governments report annually to the MDBA, providing new or updated information on accountable actions. This information is collated and analysed to update the registers each year. This enables changes in river salinity impacts to be tracked over time. It also provides estimates of the economic costs and benefits arising from these salinity effects. The updated registers are audited biennially by independent auditors and published on the MDBA website.

There are two salinity registers, Register A and Register B:

- Register A records the impacts of each accountable action that occurred after the baseline date (1988 for New South Wales, Victoria and South Australia, 2000 for Queensland and the Australian Capital Territory) and includes jointly funded works and measures
- Register B accounts for delayed salinity impacts, which have an effect on salinity levels after 2000 but which are the result of actions taken before the respective baseline dates.

The success of past salinity strategies in delivering significant salinity improvements for the Basin stems from jurisdictional agreement both to be accountable for salinity debits and credits on the registers and to undertake collective actions that lead to material improvements in river salinity. Such collective actions include those jointly undertaken under MDBA–coordinated programs (joint

[1] A Significant Effect is:
(a) a change in average daily salinity at Morgan which the Authority estimates will be at least 0.1 E.C. by the year 2100; or
(b) a salinity impact which the Authority estimates will be significant.

works or measures) and those undertaken by two or more states independently of MDBA (shared state actions). 'Joint works or measures' and 'shared state actions' are shown separately on the salinity registers, with the benefits shared between states. They are distinguishable from individual state actions for which the particular state gains either a debit or a credit.

The registers were reviewed and amended as part of the development of the BSM2030 strategy. A summary of the amendments is provided in **Appendix B**. The updated 2019 salinity registers, including updated entries, are provided in **Appendix B** and summarised in Table 1.

The 2019 salinity registers indicate that the states of NSW, Victoria and South Australia are in a net credit positions as required under the BSM2030 strategy. ACT and QLD do not have any register entries.

Table 1: Summary of the 2019 salinity registers (excluding provisional entries)

Actions	NSW ($m/yr)	VIC ($m/yr)	SA ($m/yr)	QLD ($m/yr)	ACT ($m/yr)	Australian Government contribution (EC)
Joint works and measures	2.932	2.932	1.142	0	0	32.1
State shared works and measures	0.189	0.189	0	0	0	0
State actions	3.435	1.837	2.202	tbd	tbd	1.0
Total register A	6.555	4.908	3.535	tbd	tbd	33.1
Transfers to register B	0.861	0.687	1.994	0	0	0
Total register B[a]	0.494	-0.380	4.277	0	0	0
Balance — registers A and B	7.050	4.578	7.621	0	0	33.1

tbd to be determined

[a] *total includes transfers from Register A*

Proposed or new Accountable Actions

In 2018-19, there were no proposed or new joint works or measures.

Bridging the Gap dilution benefits

Dilution of river salinity due to the delivery of Basin Plan water (Commonwealth environmental water holdings or other environmental water held by a State to offset the reduction in the long-term average sustainable diversion limit set by the Basin Plan) is recorded as a provisional entry in the

register as *Bridging the Gap dilution benefits from water delivery*. Each year the provisional entry for *Bridging the Gap dilution benefits from water delivery* is updated based on the volume of recovered water that is available as a held environmental water entitlement.

The estimated salinity benefit at Morgan of a 2,800 GL water recovery scenario for 2015 compared to 2015 Basin Plan Baseline Diversion Limit (BP BDL) was 58 EC (MDBA 2014 [2]). It should be noted that this modelling provides indicative results of likely changes to long term salinity levels against the benchmark period given early assumptions about patterns of water recovery and delivery.

As at 30 June 2018, 1,918 GL of recovered water was held in environmental water entitlements. The 58 EC estimated salinity benefit based on the 2,800 GL water recovery scenario is adjusted using a pro rata approach to determine the salinity benefit from the delivery of water recovered at that time. This provisional entry was first included in Register A in 2016 (- 34.7 EC) and updated for 2019 (- 40.8 EC) based on the increased level of water recovered.

Salinity outcomes relative to Basin salinity target

Under the BSM2030 strategy and Schedule B to the Murray–Darling Basin Agreement, salinity targets have been established for the Basin in the River Murray at Morgan in South Australia and for major tributary valleys at end-of-valley target (EoVT) sites.

The Basin salinity target is to maintain the average daily salinity at Morgan at a simulated level of less than 800 EC for at least 95% of the time. This is modelled over the benchmark period (1975–2000) under the current land and water management regime. The benchmark period provides a mechanism for consistently assessing river salinity outcomes over a climatic sequence that includes both wet and dry periods.

Performance against the basin salinity target at Morgan

Long-term salinity levels are being maintained below the Basin salinity target. Table 2 indicates that, based on 2018–19 levels of development (including salinity mitigation), river salinity at Morgan was less than 800 EC for 96% of the time—hence, the strategy is achieving the target. As a comparison, under baseline conditions salinity would have been less than 800 EC for only 72% of the time. This demonstrates that under benchmark period flow and climate conditions the incidence of salinity exceedance of 800 EC at Morgan has substantially declined.

[2] General review of salinity management in the Murray–Darling Basin, MDBA 2014

Table 2: Simulated salinity (EC) summary statistics at Morgan, South Australia, for baseline and 2019 conditions over the 1975 to 2000 climatic period

Period	Time interval	Average	Median (EC)	95 percentile (EC)	% time greater than 800 EC	% time less than 800 EC
25 years	Modelled 1988 conditions 1975–2000	665	666	1058	28	72
25 years	Modelled 2019 conditions 1975-2000	490	466	778	4	96

Note: Baseline conditions are the conditions that influenced flow and salinity within the basin on 1 January 2000. For New South Wales, Victoria and South Australia, these baseline conditions include the Accountable Actions arising from development activities between 1988 and 2000.

Figure 1 further illustrates the success of current management interventions by showing the progressive reduction in modelled river salinity in response to changes in development and the implementation of mitigation works and measures over time. Reviews of accountable actions completed in 2017–18 resulted in an increase to the modelled 95 percentile salinity at Morgan in 2018. The increase was primarily due to new knowledge from improved information and monitoring. This improved understanding resulted in a reduction of the estimated salinity benefit provided by the Murtho, Waikerie Lock 2, and Waikerie Phase 2A schemes.

Achievement of the target in 2010, and the subsequent maintenance of that achievement, is a significant outcome. This provides a tangible demonstration of the benefits that have accrued through substantial and cooperative salinity mitigation investment in salinity management by the Australian, South Australian, Victorian and New South Wales governments.

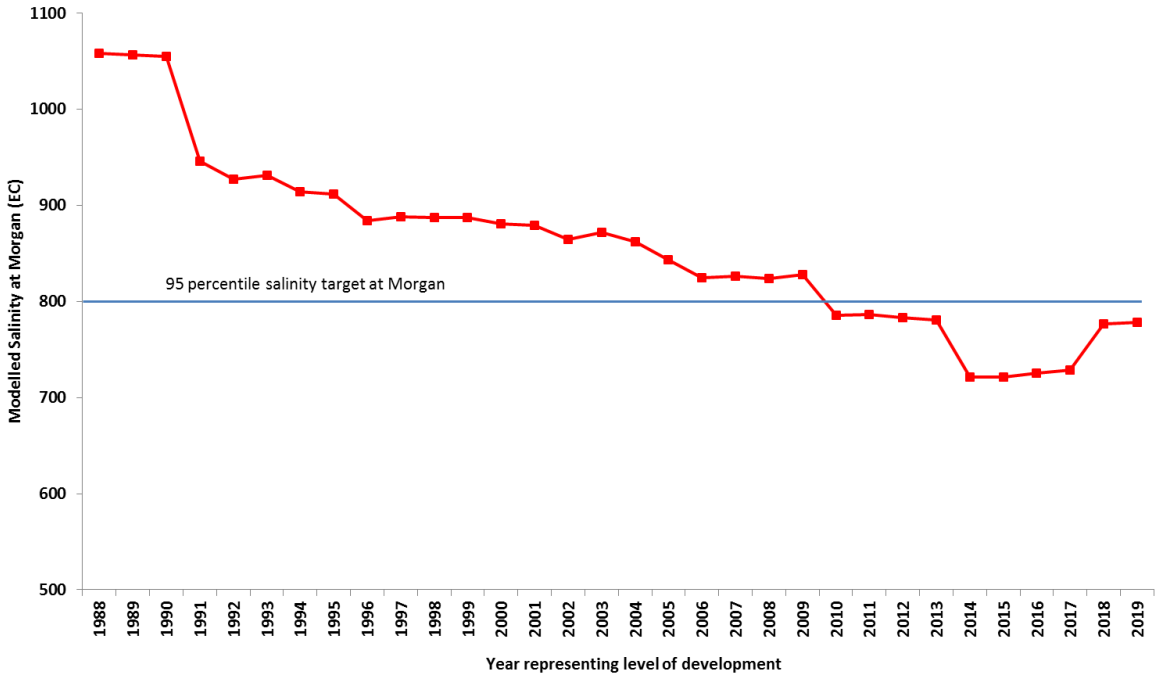


Figure 1. Modelled 95 percentile salinity over the 1975-2000 Benchmark period at Morgan in South Australia due to the implementation of salinity management programs from 1988 to 2019

Measured salinity levels

While progress against BSM2030 salinity targets is assessed based on modelled river salinity outcomes over the benchmark period, salinity management actions have also had a notable positive impact on measured river salinity. Measured river salinity showed that salinity at Morgan remained below 800 EC throughout 2018–19. The peak river salinity at Morgan has not exceeded 800 EC since 1998.

Table 3 provides statistics on salinity levels measured at Morgan over four time intervals (1, 5, 10 and 25 years) to June 2019 and enables a comparative assessment of average, median, 95 percentile and peak salinity outcomes for 2018–19.

The 2018–19 salinity statistics were lower compared to all other time intervals presented in Table 3. In fact, with the exception of 95 percentile and peak salinities in 2015-16, the 2018-19 salinity statistics are the lowest 1-year levels since reporting of these statistics began at the commencement of the BSMS in 2001-02. This outcome is a consequence of the prevailing climatic periods covered by the respective reporting periods and the progressive implementation of the salinity mitigation programs mentioned above.

Table 3: Summary of measured salinity levels (EC) at Morgan, South Australia

Period	Time interval	Average	Median	95 percentile	Peak	% time > 800 EC
1 year	July 2018 - June 2019	263	252	370	462	0%
5 years	July 2014 - June 2019	309	294	469	732	0%
10 years	July 2009 - June 2019	328	308	527	732	0%
25 years	July 1994 - June 2019	436	413	720	1087	2%

Impacts of salinity management actions

In addition to climatic factors and river conditions, the cumulative benefits of salinity mitigation works and measures, such as SIS and improvements in irrigation practices and delivery systems, have also contributed substantially to the low salinity levels summarised in Table 3. The SIS are highly beneficial to river salinity outcomes during extended periods of low flows.

Figure 2 presents mean daily salinity levels over the period from July 2017 to June 2019 recorded at Morgan and also the simulated (modelled) salinity levels representing a ‘no further intervention’ scenario for the same period. The ‘no further intervention’ scenario estimates the river salinity levels that would have occurred if post-1975 SIS and improved land and water management actions were not undertaken. The modelled data shown in figure 2 does not include the dilution benefits of delivering water recovered under either the Basin Plan or the Living Murray Initiative.

The word ‘further’ is used because a number of SIS were operating before 1975, so their effects are not included in the simulated salinity levels. The simulated no further intervention salinity levels are

derived from river model runs which can model historical salinity levels with and without intervention activities. The difference between the observed and the simulated no further intervention salinity levels are assumed to be the effect of management interventions.

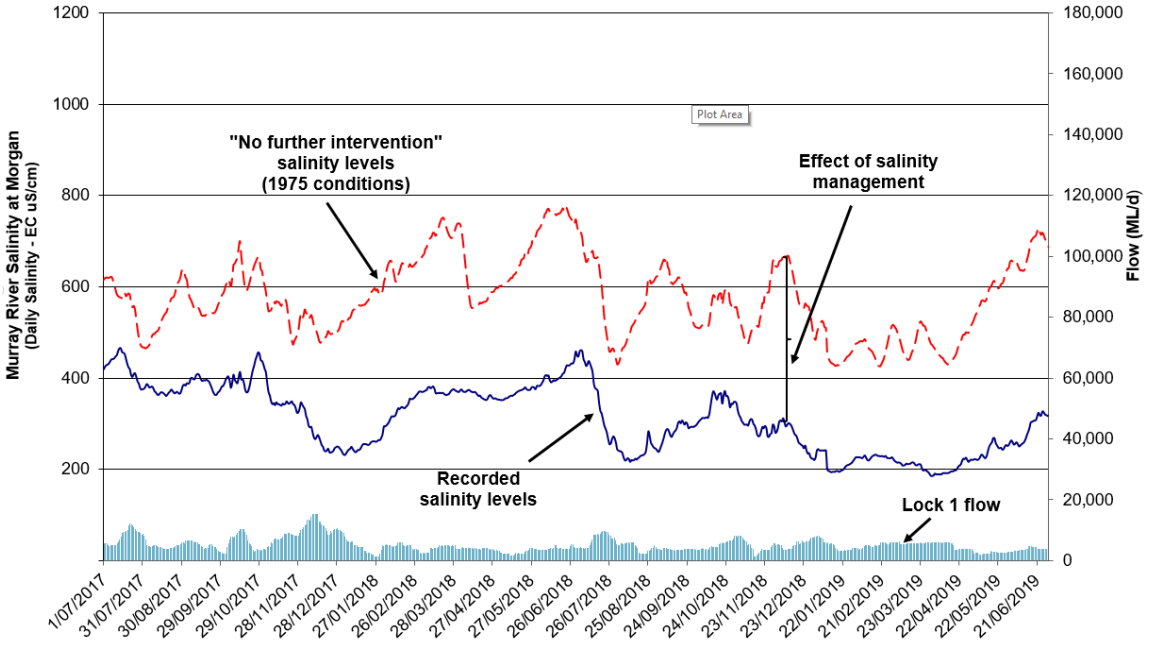


Figure 2. Comparison of mean daily recorded salinity levels at Morgan from July 2017 to June 2019 to modelled 1975 'no further intervention' salinity levels.

River salinity levels progressively increase downstream because of both natural groundwater discharge to the river and accelerated salt mobilisation caused by development activities. The cumulative effects of these factors result in higher salinity in the lower River Murray. Figure 3 demonstrates this progressive increase in salinity downstream with four datasets at specific reaches along the River Murray.

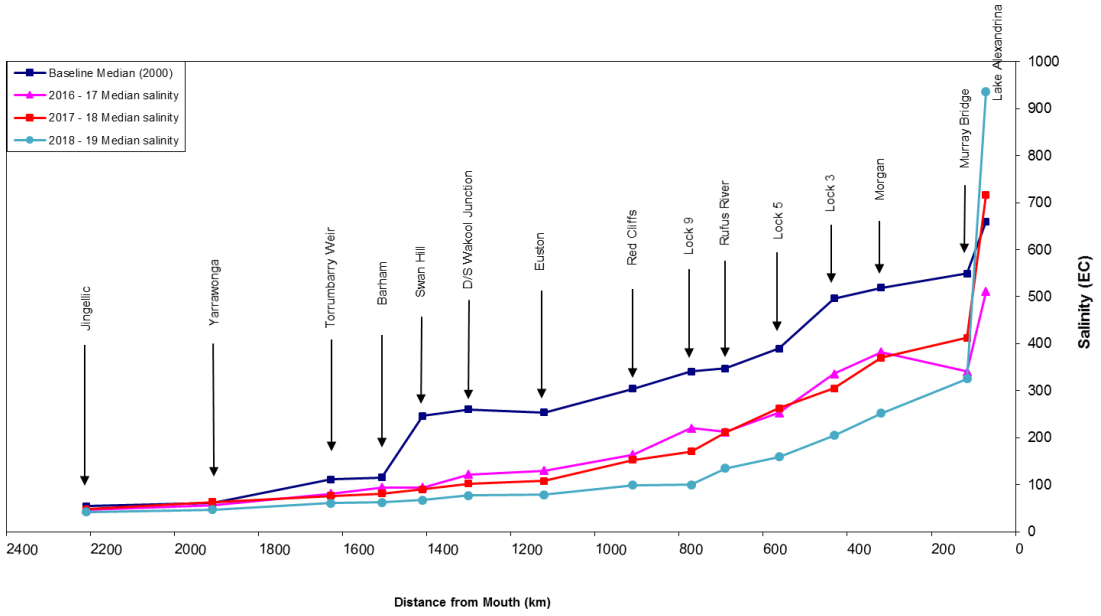


Figure 3. River Murray salinity profile: comparison of observed median salinity levels of 2018–19 with those of recent past years and the modelled baseline median salinity level for the benchmark period (1975–2000).

Management of Salt Interception Schemes

Operation of the authorised works or measures under Schedule B has focused on the ongoing efficient and effective management of SIS to maintain water quality in the River Murray for agriculture, environmental, urban, industrial and recreational uses.

Scheme operation and maintenance

New South Wales, Victoria and South Australia, together with the Australian Government, have constructed and now operate and maintain 13 SIS. Under the BSM2030 strategy, the focus is on optimising scheme operations and investing in learning and knowledge development for SIS operations.

Operation of the various SIS has continued to be highly successful in terms of in-river outcomes. During 2018-19, operation and maintenance of the existing joint SIS assets continued to focus on minimising running costs, in particular the energy costs associated with pumping.

Table 4 compares salt diverted over the past decade, while Table 5 below details the performance of the joint SIS in 2017-18 and 2018-19. Jointly managed schemes diverted about 484,586 tonnes and 474,201 tonnes of salt away from the River Murray and adjacent landscapes in 2017-18 and 2018-19 respectively.

Table 4: Total salt load diverted from the River Murray and adjacent landscapes from 2009-10 to 2018-19

Reporting year	Salt load diverted (tonnes/annum)
2018-19	474,201
2017-18	484,586
2016-17	395,388
2015-16	524,728
2014-15	432,454
2013-14	397,739
2012-13	322,686
2011-12	362,508
2010-11	324,164
2009-10	490,000

Table 5: Joint salt interception scheme performance report 2017-18 & 2018–19

Salt interception scheme	Year	Volume pumped (ML)	Salt load diverted (tonnes)	Average salinity (EC units)	Actual target achieved (% of time)	Power consumption (kWh)
Pyramid Creek	17/18	870	21,369	40,714	100	147,497
	18/19	515	12,684	40,786	100	155,560
Barr Creek	17/18	4,116	29,641	11,160	100	78,513
	18/19	1,458	8,034	12,263	100	25,822
Mildura-Merbein	17/18	1,085	45,118	79,322	51	179,582
	18/19	1,497	66,630	75,451	75	282,597
Mallee Cliffs	17/18	1,758	57,714	51,308	97	519,712
	18/19	1,942	64,847	52,130	100	591,575
Buronga	17/18	1,966	49,901	39,667	100	427,847
	18/19	2,129	56,493	41,750	100	489,492
Upper Darling	17/18	1,386	35,550	40,076	78	282,770
	18/19	1,477	42,888	45,225	78	302,449
Pike River	17/18	234	8,668	49,967	NA	72,692
	18/19	443	18,449	52,529	NA	141,328
Murtho	17/18	1,802	42,621	38,723	41	2,540,255
	18/19	1,498	36,069	38,214	60	2,022,438
Bookpurnong	17/18	896	23,238	39,087	89	342,638
	18/19	701	17,490	39,302	93	273,659
Loxton	17/18	1,245	21,775	27,187	89	492,605
	18/19	1,329	22,763	27,143	95	530,139
Woolpunda	17/18	4,701	91,859	30,557	95	2,848,914
	18/19	3,903	73,829	30,088	96	2,331,320
Waikerie	17/18	3,235	57,130	29,886	85	1,226,206
	18/19	3,140	53,877	29,175	84	1,201,281
Rufus River	17/18	0	0	42,478	100	3,739
	18/19	5	147	45,684	100	7,069
Totals	17/18	23,294	**484,586**			9,162,970
	18/19	20,036	**474,201**			8,354,731

Note: Operation of pumps varies from year to year based on operational advice from the MDBA due to budgets; operational and maintenance requirements; and loss of access and/or scheme operating rules during periods of high flow.

Responsive management of SIS

Under the BSM2030 strategy, responsive management of SIS seeks to reduce operating costs by reducing operation of salt interception bores during periods when flow and/or water source with low salinity provide adequate dilution, for in-river salinity to remain below the level at which water remains “fit for purpose”. It has the potential to provide an acceptable trade-off of operating cost against minimising actual river salinity.

The trial of responsive management of SIS commenced in July 2016 following the inaugural SIS Operators Workshop in May 2016. During the trial period a precautionary approach is being applied to ensure that to the extent reasonably and operationally possible, salinity is maintained at appropriate levels. Initially the trial period was set for a three-year period from 2016-2019. However, given delays in establishing knowledge gap investigations, primarily resulting from the 2016 high river event and associated allocation of resources during this time to re-establish scheme infrastructure, at the time of preparing this report, an extension of the trial to 2025 is being sought from the Basin Officials Committee (BOC). The extension will allow sufficient time to observe any system responses to changed operations at the trial sites. The effectiveness of the trial will be reviewed at the end of the trial period and the results of the trial will determine whether or not responsive management of SIS should continue and if so under what policy conditions.

SIS operations under responsive management are determined through an SIS Operators Workshop. Workshop participants include the SIS Managers from each State Constructing Authority, the MDBA Senior Assets Engineer and MDBA River Operators. Workshops are convened quarterly, and the meetings conducted throughout 2017-18 and 2018-19 are listed in Appendix F. The workshops provide a forum for SIS Managers to draw on a range of information, including the monthly salinity outlooks and operation and maintenance activities to recommend the level of SIS operations moving forward.

An overview of operational decisions made with consideration to responsive management of SIS and operations/maintenance activities over 2018–19 are provided in Table 6.

A high-level summary of the status of key tasks to be completed by the MDBA in conjunction with the SIS Managers from each State Constructing Authority, for the trial of responsive management of SIS is shown in Table 7.

Table 6: Decisions regarding SIS operations under the responsive management trial during 2018–19

Operational decisions	Change in operations
Workshop 10, 30 August 2018 – Considering planned maintenance activities during the forecast period, the current and forecast river conditions, forecast climatic outlook over the coming months and the time of year (i.e. heading into Spring/Summer period) it was agreed to continue to maintain full SIS operations to the extent possible (with the exception of key bores involved in responsive management trials) and that river and climatic conditions continue to be monitored over the Spring period.	No change to operations
Workshop 11, 12 December 2018 – Considering current and forecast river conditions, forecast climatic outlook over the coming months, SIS operational considerations and the 6 month salinity outlook, it was agreed to reduce operations of the Murtho SIS to previous responsive management operating levels. Key considerations in this decision were the opportunity to realise some cost savings and that the forecast salinity at Morgan was expected to remain well below the Morgan salinity target over the 6 month outlook period.	Operations reduced
Workshop 12, 7 May 2019 – Considering current and forecast river conditions, forecast climatic outlook over the coming months, SIS operational considerations and 6 month salinity outlook, it was agreed to maintain the current level of operations as per the outcome from Workshop 11, including continuing reduced operations of Murtho SIS. A key consideration was that the forecast salinity at Morgan was expected to continue to remain well below the Morgan salinity target over the 6 month outlook period.	No change to operations

Table 7: Summary of high level tasks, timing and status

Task	Date	Status
Responsive Management Trial Commence	July 2016	Complete
Knowledge Gap Investigation Commence	No later than July 2016	Ongoing
Salinity Risk Outlook Review	Every month to 3 months – ongoing (or higher frequency as required) Inaugural review to be in April 2016	Ongoing
Responsive Management Operation Decision	Every month to 3 months – ongoing (or higher frequency as required). Inaugural decision to be undertaken no later than 2 months prior to the commencement of the trial.	Ongoing
Preparation of Draft Knowledge Gap Investigation Implementation Plans	November 2015	Complete
Site Inspections and review of Draft Knowledge Gap Investigation Implementation Plans	December 2015	Ongoing - Site inspections completed. Some issues still being resolved
Preparation of Final Knowledge Gap Implementation Plans	December 2015	Ongoing
Finalisation of Triple Bottom Line Assessment Tool	March 2016	
BSMAP Updates	6-monthly	Ongoing
Review of Governance Arrangements	On completion of the trial and to be included within the trial review	Ongoing
Review of Bore Assessments	Ongoing	Ongoing
Review of salinity spikes and long term in-river salinity	On completion of the trial and to be included within the trial review	Ongoing
Review of Salinity Risk Outlook	Ongoing – to be a standing task at the Operators Forum to review previous operation decision making and salinity risk outlooks	Ongoing
Responsive Management Trial Report	No later than December 2019 (timing has made allowance for end of year data acquisition and initial processing by SCAs)	Ongoing – status report completed July 2019.

Six-monthly salinity outlook tool to support decision making

The MDBA modelling team has developed a Salinity Outlook Tool for the River Murray and lower Darling River. The salinity outlook provides a range of likely river salinities at four of the Basin Plan reporting sites for a variety of flow scenarios. This information can be used as an 'early warning tool' to enable the MDBA and Basin States to implement actions if needed (for example, modify SIS operations).

Table 8 provides an example of the outlook as of June 2019. Here, the tool summarises the maximum modelled salinity over the period from June to November 2019, compared to the Basin Plan salinity target at the four River Murray reporting sites, under each flow scenario.

SIS Operators draw on these outlooks to inform the level of SIS operations and responsive management decision making at SIS Operators Workshops, in addition to other considerations including planned maintenance activities during the forecast period and the current and forecast climactic and river conditions. When the outlook indicates that salinity at Morgan may rise above 600 EC, as far as operationally and practically possible, preparations can then be made to ensure adjustments to SIS operations such that the 600 EC at Morgan is not exceeded as a result of the trial of responsive management of SIS.

Table 8: Summary of maximum modelled salinity as at June 2019 for each flow scenario compared to the Basin Plan salinity targets for the River Murray reporting sites

Site	Basin Plan salinity target (EC for 95% of time)	Maximum modelled salinity (EC) for 50% AEP*	Maximum modelled salinity (EC) for 75% AEP	Maximum modelled salinity (EC) for 90% AEP	Maximum modelled salinity (EC) for 95% AEP	Number of days over Basin Plan salinity target for 75% AEP+ scenario
River Murray at Lock 6	580	170	170	170	171	0
River Murray at Morgan	800	347	347	347	351	0
River Murray at Murray Bridge	830	360	385	415	458	0
Lake Alexandrina at Milang	1000	954	966	1088	1124	0

* AEP is the annual exceedance percentage of river flows (higher AEP means lower river flows)

+ At the time of the June 2019 Outlook flows were tracking around the moderate (75% AEP) scenario

Salinity management

Flow-based management

The BSM2030 strategy aims to facilitate continuous improvement in flow management by periodically reviewing and providing advice on flow management practices, particularly in response to elevated salinity events in the shared water resources.

The inclusion of flow management provides the opportunity to look at the effectiveness of in-river salinity management and the collective outcome for the shared water resource from individual actions and accountabilities.

Outcomes for 2018–19

Salinity targets for managing flows

Salinity levels at the five Basin Plan reporting sites (Lock 6, Morgan, Murray Bridge, Milang and Burtundy) were monitored continuously over the five-year reporting period (July 2014 – June 2019). The targets at the reporting sites are deemed to have been met if the percentage of days above the target is less than 5%, or the salinity has been below the target 95% of the time over the five-year reporting period.

Over the reporting period (July 2014–June 2019), the assessment indicates the targets have been met at all reporting sites except Burtundy.

The target value at Burtundy is 830 EC. Over the reporting period, salinity levels at Burtundy were above the target for 46% of days. This is a 10% increase on last year's result which stems from recent drought conditions and record low inflows across much of the northern Basin. Salinity levels were consistently above the target value from late November 2018 through to early June 2019, peaking at 1,226 EC on 25 May 2019. Lack of flow from April to June 2019 also meant that salinity levels could not be recorded during these times.

The 2017 Basin Plan Evaluation recommended that the review of the water quality and salinity targets in the Basin Plan scheduled for 2020 should examine the appropriateness of salinity targets, particularly at Burtundy in light of progress on implementing protection of environmental water in the northern Basin.

Elevated salinity events

During 2018–19 there were no elevated salinity events that BSMAP determined warranted review. Notwithstanding the high salinity levels in the lower Darling River, BSMAP had reviewed an elevated salinity event in the lower Darling River in 2016-17. That review provided a number of important insights, especially about the recommencement of flows, which remain relevant in the current context and will be considered when managing the recommencement of flows.

The salt export objective

The Basin Plan includes a salt export objective which aims to ensure adequate flushing of salt from the River Murray system into the Southern Ocean. Achievement of the salt export objective is assessed each year by the MDBA. Over the three-year period July 2016 to June 2019, the annualised rate of salt export over the barrages was 0.94 million tonnes per year. This is less than the Basin Plan's indicative figure of two million tonnes per year.

Flushing salt from the river systems helps avoid salt accumulation and adverse impacts on water users. Flushing salt also supports healthy river and floodplain ecosystems. Salt interacts with in-stream biota (animals and plants), changing the ecological health of streams and estuaries.

Generally, more salt is flushed out to the ocean during wet years and less in dry years. The level of salt flushing in a year is also impacted by river regulation, irrigation diversions and current levels of development, including salt interception works.

The 2017 Basin Plan Evaluation recommended that the 2020 Basin Plan water quality targets review should examine the appropriateness of the salt export objective as an indicator of adequate flushing of salt from the river system in the context of a variable climate. The review could consider how salt export objectives can be varied to deal with periods of low flow.

End-of-valley outcomes

End-of-valley targets (EoVTs) for major tributary valleys were introduced under the BSMS to serve as indicators of catchment health and to help assess and manage the impacts of salt movement from the catchments to the shared water resources.

Under the BSM2030 strategy, the role of EoVTs changed to provide a valley scale context to the identification and management of salinity risks. While there is no longer a compliance requirement for these targets, continued monitoring at EoVT sites in all valleys will inform understanding of changes in salinity risk to shared water resources and within-valley assets.

The performance of catchment salt loads against EoVTs requires complex modelling over the benchmark period. Therefore, EoVT outcomes are reviewed periodically as set out under the Review Plan. However, monitoring and reporting are useful to provide an indication of actual salinity outcomes over the reporting year for each of the valley sites.

Variability in hydrological conditions in catchments from year to year is a typical characteristic of the Basin. This variability has significant impacts on the amount of salt mobilised annually into tributaries and river systems.

Schedule B requires all states and the Australian Capital Territory to undertake continuous flow and salinity monitoring at EoVT sites for which they are responsible. This monitoring supports reviews of targets and analysis of salinity risks arising from valleys.

Additional monitoring at 'interpretation sites' is highly useful in supporting an understanding of the salt mobilisation and salinity dynamics across the Basin.

Table 9 summarises progress in monitoring at EoVT sites over the period from 2000 to 2019. The second column provides the percentage of days for which salinity (EC) measurements have been monitored for each site. The third column provides an indication of flow and available EC and is expressed as a percentage of time that salt load can be calculated.

Table 10 is a summary report card of flow and salinity data for each EoVT site for the years 2017–18 and 2018–19. The full details of state and territory government valley outcomes are provided in the individual governments' reports.

Graphs of flow and salinity at EoVT sites are provided in Appendix D, while Appendix E compares salinity levels and salt loads over the 2017–18 and 2018-19 periods against long-term records. The length of the record varies from site to site. Owing to extended dry conditions across much of the Basin over the past two decades, there are some sites where river flows ceased for long periods. For those periods, measurements of salinity and flow are not accurate; therefore, salinity and salt load records may be incomplete.

Table 9: Availability of monitoring data for all BSM2030 strategy end-of-valley and interpretation monitoring sites, 2000 to 2019

Year	Aggregate % of days with EC records	Aggregate % of days with flow and EC records
2000	55	55
2001	57	57
2002	72	73
2003	75	76
2004	86	87
2005	81	83
2006	85	88
2007	72	74
2008	77	81
2009	76	79
2010	81	86
2011	85	88
2012	85	88
2013	78	82
2014	69	72
2015	69	62
2016	78	71
2017	85	78
2018	69	62
2019	64	56

Table 10: End-of-Valley summary report card 2017–18 & 2018–19

Site	AWRC No.	Year	No. of days with salinity records	No. of days with flow records	Days with flow above zero	Mean salinity (µS/cm)	Median salinity (µS/cm)	80%ile salinity (µS/cm)	Peak salinity (µS/cm)	Mean flow (ML/day)	Median flow (ML/day)	80%ile flow (ML/day)	Peak flow (ML/day)
All Partner Governments													
River Murray at Morgan [a]	426554	17/18	365	365	365	359	370	439	465	5,614	4,803	8,072	15,472
		18/19	357	365	365	262	253	367	459	4,812	4,483	6,007	9,734
South Australia													
SA border [b]	426200	17/18	365	365	365	227	229	262	301	7,397	6,618	10,041	17,840
		18/19	365	365	365	146	140	175	200	6,807	7,004	8,469	12,134
Lock 6 to Berri [c]	426514	17/18	365	365	365	293	297	324	389	6,646	5,621	9,129	16,690
		18/19	365	365	365	187	178	226	265	5,908	5,901	7,603	10,793
River Murray at Murray Bridge [d]	426522	17/18	365	NA	NA	410	415	466	589	NA	NA	NA	NA
		18/19	365	NA	NA	320	308	383	478	NA	NA	NA	NA
New South Wales													
Murrumbidgee at Balranald	410130	17/18	365	365	365	181	159	231	387	1,269	573	1,441	7,195
		18/19	365	365	365	129	120	165	242	733	622	1,132	1,892
Lachlan at Forbes	412004	17/18	365	365	365	407	332	456	1,047	1,228	1,187	1,615	7,049
		18/19	365	365	365	365	339	382	667	1,257	1,030	1,756	5,326

Site	AWRC No.	Year	No. of days with salinity records	No. of days with flow records	Days with flow above zero	Mean salinity (µS/cm)	Median salinity (µS/cm)	80%ile salinity (µS/cm)	Peak salinity (µS/cm)	Mean flow (ML/day)	Median flow (ML/day)	80%ile flow (ML/day)	Peak flow (ML/day)
Bogan at Gongolgon	421023	17/18	230	365	132	494	490	554	653	1	0	1	18
		18/19	115	365	62	491	483	501	806	5	0	0	63
Macquarie at Carinda	421012	17/18	272	365	223	617	614	744	921	42	2	98	284
		18/19	107	365	106	551	523	614	782	13	0	8	109
Castlereagh at Gungalman Bridge	420020	17/18	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA
		18/19	4	88	58	311	332	366	381	72	1	22	1,058
Namoi at Goangra	419026	17/18	237	365	236	531	436	756	919	36	12	57	326
		18/19	101	365	93	501	580	644	1,020	9	0	4	447
Mehi at Bronte	418058	17/18	365	365	324	401	335	546	813	67	10	88	731
		18/19	246	365	59	304	283	388	531	48	0	0	516
Barwon at Mungindi	416001	17/18	365	365	360	304	297	377	585	206	108	376	1,356
		18/19	325	365	187	299	300	327	366	21	0	22	294
Darling at Wilcannia	425008	17/18	203	365	270	434	377	459	1,257	142	57	325	769
		18/19	55	365	163	1,357	1,187	1,518	3,045	17	0	3	277
River Murray at Heywoods	409016	17/18	365	365	365	49	48	53	75	8,710	10,961	13,982	19,103
		18/19	365	365	365	46	42	48	96	9,424	10,369	14,011	19,605

Site	AWRC No.	Year	No. of days with salinity records	No. of days with flow records	Days with flow above zero	Mean salinity (µS/cm)	Median salinity (µS/cm)	80%ile salinity (µS/cm)	Peak salinity (µS/cm)	Mean flow (ML/day)	Median flow (ML/day)	80%ile flow (ML/day)	Peak flow (ML/day)
River Murray at Red Cliffs [e]	414204	17/18	52	NA	NA	149	153	177	237	NA	NA	NA	NA
		18/19	51	NA	NA	104	99	127	172	NA	NA	NA	NA
Flow to SA	426200	17/18	365	365	365	227	229	262	301	7,397	6,618	10,041	17,840
		18/19	365	365	365	146	140	175	200	6,807	7,004	8,469	12,134
Victoria													
Wimmera at Horsham Weir	415200D	17/18	365	365	365	1,210	1,235	1,475	2,285	48	33	64	537
		18/19	365	365	365	1,265	1,234	1,595	2,050	32	30	48	154
Avoca at Quambatook [f]	408203B	17/18	365	365	67	67	NA	NA	9,010	1	0	0	16
		18/19	365	365	37	272	1,343	1,789	2,188	3	0	0	146
Loddon at Laanecoorie	407203B	17/18	365	365	365	551	505	613	948	148	108	192	766
		18/19	365	365	365	627	651	691	1,213	104	73	119	614
Campaspe at Campaspe Weir [g]	406218A	17/18	365	365	365	447	446	457	790	259	185	344	1,582
		18/19	365	365	365	524	516	574	628	134	91	116	1,479
Goulburn at Goulburn Weir [h]	405259A	17/18	365	365	365	73	63	81	181	2,077	1,344	2,704	12,504
		18/19	365	365	365	60	56	64	123	2,080	1,452	2,970	8,997

Site	AWRC No.	Year	No. of days with salinity records	No. of days with flow records	Days with flow above zero	Mean salinity (µS/cm)	Median salinity (µS/cm)	80%ile salinity (µS/cm)	Peak salinity (µS/cm)	Mean flow (ML/day)	Median flow (ML/day)	80%ile flow (ML/day)	Peak flow (ML/day)
Broken at Casey's Weir [i]	404217B	17/18	365	365	365	140	140	153	174	12	11	14	25
		18/19	365	365	365	151	155	176	197	10	9	13	37
Ovens at Peechelba East	403241	17/18	365	365	365	57	59	65	93	2,615	1,328	3,768	27,793
		18/19	365	365	365	52	50	63	85	1,748	837	2,627	10,456
Kiewa at Bandiana	402205	17/18	365	365	365	36	36	42	74	1,402	1,052	2,228	6,973
		18/19	365	365	365	34	32	39	136	1,140	1,023	1,756	3,833
River Murray at Heywoods	409016	17/18	365	365	365	49	48	53	75	8,710	10,961	13,982	19,103
		18/19	365	365	365	46	42	48	96	9,424	10,369	14,011	19,605
River Murray at Swan Hill	409204	17/18	365	365	365	98	90	116	351	7,479	6,720	9,277	19,259
		18/19	365	365	365	87	67	90	364	7,360	6,780	9,665	15,273
Flow to SA	426200	17/18	365	365	365	227	229	262	301	7,397	6,618	10,041	17,840
		18/19	365	365	365	146	140	175	200	6,807	7,004	8,469	12,134
Queensland													
Barwon River at Mungindi	416001	17/18	365	365	360	305	297	379	585	205	108	376	1,356
		18/19	325	365	187	272	275	321	366	20	0	22	294

Site	AWRC No.	Year	No. of days with salinity records	No. of days with flow records	Days with flow above zero	Mean salinity (µS/cm)	Median salinity (µS/cm)	80%ile salinity (µS/cm)	Peak salinity (µS/cm)	Mean flow (ML/day)	Median flow (ML/day)	80%ile flow (ML/day)	Peak flow (ML/day)
Moonie at Fenton	417204A	17/18	82	365	81	138	142	149	178	25	0	0	1,779
		18/19	0	365	0	NA	NA	NA	NA	0	0	0	0
Ballandool at Hebel—Bollon Rd	422207A	17/18	107	365	107	163	160	187	220	8	0	0	134
		18/19	41	365	41	244	245	255	279	1	0	0	15
Bokhara at Hebel	422209A	17/18	56	365	56	139	122	162	162	14	0	0	217
		18/19	26	365	26	200	201	209	214	3	0	0	175
Briarie at Woolerbilla—Hebel Rd	422211A	17/18	8	365	8	79	71	79	162	0	0	0	2
		18/19	0	365	0	NA	NA	NA	NA	0	0	0	0
Culgoa at Brenda	422015	17/18	98	365	98	178	185	201	258	44	0	1	3,267
		18/19	47	365	47	196	196	201	207	9	0	0	381
Narran at New Angledool 2	422030	17/18	55	365	55	162	165	169	270	9	0	0	269
		18/19	0	365	0	NA	NA	NA	NA	0	0	0	0
Paroo at Caiwarro	424201A	17/18	95	365	95	63	62	72	98	65	0	8	2,189
		18/19	84	365	84	63	65	72	82	585	0	4	29,729

Site	AWRC No.	Year	No. of days with salinity records	No. of days with flow records	Days with flow above zero	Mean salinity (µS/cm)	Median salinity (µS/cm)	80%ile salinity (µS/cm)	Peak salinity (µS/cm)	Mean flow (ML/day)	Median flow (ML/day)	80%ile flow (ML/day)	Peak flow (ML/day)
Warrego at Barringun No 2	423004	17/18	77	365	77	150	159	176	186	37	0	0	1,711
		18/19	84	365	84	104	110	124	144	143	0	9	5,503
Cuttaburra at Turra	423005	17/18	44	365	44	185	151	260	268	29	0	0	3,175
		18/19	71	365	71	122	138	145	148	262	0	0	19,062
Australian Capital Territory													
Murrumbidgee at Hall's Crossing	410777	17/18	365	365	365	273	283	358	412	688	446	895	7,590
		18/19	365	365	365	336	336	360	554	324	260	353	4,494

a The 95%ile is reported here as the Basin salinity target at Morgan. Also note that flow data is measured at site 426902 (River Murray at Lock 1)

b Salinity measured at site A4261022 (Murray @ Old Custom House)

c Salinity measured at site 426537 (Berri pumping station)

d Flow is not measured at this site

e Flow data stops in October 1994

f Spot salinity data ends in Sep 2008 and continuous recording starts in Sep 2013

g Used flow data for 405200A (Campaspe at Rochester)

h Used flow data for 405200A (Goulburn River at Murchison

i Used salinity data for 404224B (Broken River at Gowangardie)

NA Data not available

Salt load is determined using the following calculation: salt load (t/d) = flow (ML/d) x salinity (EC) x 0.0006

Efficient governance

The governance of the salinity management program has been developed over 30 years and is now well understood and accepted. Given this mature status, the BSM2030 strategy has implemented a streamlined approach to that developed under BSMS by making it more risk-based and efficient.

The updated reporting, review and auditing arrangements will continue to ensure transparency and compliance with the agreed actions and accountabilities of BSM2030, while addressing the BSM2030 knowledge priorities will further improve the knowledge of future salinity risks.

Amendment of Schedule B

In November 2015, the Ministerial Council adopted the BSM2030 strategy. Amendments to Schedule B to the Murray-Darling Basin Agreement were therefore required to give effect to the changed obligations under the new strategy.

Elements of the BSM2030 strategy that placed additional individual or collective commitments, and created new or altered powers or duties for the Authority, were formalised by the amendments to Schedule B. The main elements of the BSM2030 strategy which led to proposed amendments to the Schedule were:

- accountability for salinity impacts of actions associated with the recovery, delivery and use of environmental water, and also for salinity impacts arising out of changes to operation of the salt interception schemes;
- no longer requiring State Contracting Governments to submit programs of actions relating to salinity management in catchments and valleys;
- changes to how often entries in the Registers and associated models are reviewed, so that the frequency of review reflects the risk associated with different entries and models;
- changes to monitoring obligations and reporting requirements;
- reduction in the frequency of audits but increase in the scope of audits; and
- the process for conducting a review of BSM2030, commencing by 2026.

Preparation of the amendment regulations took place over the period from February 2016 to June 2018. This included preparing drafting instructions in consultation with Contracting Governments and working with staff from the former Department of Agriculture and Water Resources and the Office of Parliamentary Counsel to draft the amendments. The amendment regulations were approved by Ministerial Council in June 2018, and the Governor General signed the amendments into

law in December 2018. The amended Schedule B is available on the federal register of legislative instruments as part of Schedule 1 (Murray-Darling Basin Agreement) to the *Water Act 2007*.

Evaluation of BSM2030 reporting

An evaluation of reporting was completed following two years of implementing the BSM2030 strategy. By that time, a full cycle of the new BSM2030 biennial reporting arrangements had been completed, including status reports for the 2015-16 reporting period and comprehensive reports for the 2016-17 period. The Commonwealth had also completed two annual reports over this timeframe.

The evaluation of BSM2030 reporting provided an opportunity to discuss the challenges that had been encountered when using the draft BSM2030 reporting procedure and to promote discussion about what worked and what didn't, and to discuss where improvements could be made. The evaluation highlighted the issues and challenges associated with the new BSM2030 reporting arrangements, identified changes to improve consistency in reporting, informed the continued development of the draft procedure for BSM2030 reporting, and guided the development of templates to support reporting. As a result of the evaluation, improvements were made to the draft BSM Reporting procedure, and these improvements were first implemented for the 2017-18 reporting period.

Preparation of BSM Procedures

BSM procedures are being developed, in consultation with Contracting Governments, to update and replace the Basin Salinity Management Strategy Operational Protocols. This process commenced in October 2017, and these practical guidelines provide the detail and consistency to support implementation of the BSM2030 strategy, including for the obligations set out in Schedule B.

Table 11 provides a summary of the BSM procedures and their status following BSMAP meeting 42. As at July 2019, twelve BSM procedures had been endorsed by BSMAP for application and testing, noting that they may be subject to further refinement if required. The remaining six procedures are in various stages of preparation. Once all of the BSM procedures are endorsed by BSMAP and after a suitable testing period, BOC approval of the BSM procedures will be sought. It is expected this will occur in the second half of 2020.

Table 11: Summary and status of the BSM procedures (as at July 2019)

BSM PROCEDURES	SUMMARY	STATUS	ACTION REQUIRED
Introduction	This procedure introduces the role of BSM procedures and prescribes arrangements for making, amending and revoking procedures under the BSM2030 strategy. It also includes a glossary of terms applicable to BSM procedures developed at the time of writing.	EARLY DRAFT	MDBA review before circulation to BSMAP
Introduction to the accountability framework	This procedure introduces the accountability framework including the evolution of the framework, key concepts and features. It is descriptive, rather than prescribing the specific arrangements for basin-wide salinity accountability under the BSM2030 strategy.	FINAL	Refinement as required (endorsed by BSMAP)
Register entries	This procedure sets out the rules for entering the salinity impacts of accountable actions and delayed salinity impacts on the Registers. These rules apply to new and revised assessments of accountable actions and underpin existing register entries. It also includes arrangements for removing or replacing a register entry.	FINAL	Refinement as required (endorsed by BSMAP)
Register operations	This procedure describes the arrangements for register operations including annual updates and adjustment processes.	FINAL	Refinement as required (endorsed by BSMAP)
Salinity impact assessment process	This procedure sets out the salinity impact assessment process under the BSM2030 strategy.	FINAL	Refinement as required (endorsed by BSMAP)
Conducting reviews and assessments	This procedure sets out the arrangements for conducting reviews and assessments of accountable actions and delayed salinity impacts. This includes reviews of new and existing models and/or methods. The procedure does not include assessment or review of MDBA models and/or methods as this is adequately covered in Schedule B.	FINAL	Refinement as required (endorsed by BSMAP)

BSM PROCEDURES	SUMMARY	STATUS	ACTION REQUIRED
Environmental water accountability	This procedure describes the accountability arrangements for the following environmental water actions: delivery of environmental water; recovery of environmental water; use of environmental water; operation of works or measures to support environmental watering; changes in river operations to support environmental watering. This includes actions associated with Basin Plan water, TLM water and some actions associated with non-Basin Plan water held by State Contracting Governments.	FINAL	Refinement as required (endorsed by BSMAP)
Authorised works or measures	This procedure provides context around authorised works or measures implemented under the S&DS and BSMS, and describes accountability, assessment and review arrangements for salinity impacts arising from authorised works or measures.	FINAL DRAFT	BSMAP endorsement
Review of elevated salinity events	This procedure defines an elevated salinity event and outlines a process for reviewing elevated salinity events including their causes and impacts, the effectiveness of management responses, opportunities for policy improvements, and for information sharing.	FINAL	Refinement as required (endorsed by BSMAP)
Catchment salinity	This procedure provides the approach for building an understanding of salinity trends and risks to the shared water resources arising from tributary catchments to inform adaptive management responsibilities.	DRAFT V2	NSW review
Monitoring	This procedure describes the key requirements for monitoring under the BSM2030 strategy including the Basin-wide Core Salinity Monitoring Network.	FINAL	Refinement as required (endorsed by BSMAP)
Developing the Review Plan	This procedure is intended to guide the development and annual review of the Review Plan. The Review Plan specifies the timing and responsibility for reviews of register entries, models and outcomes at End-of-Valley Target sites.	FINAL	Refinement as required (endorsed by BSMAP)

BSM PROCEDURES	SUMMARY	STATUS	ACTION REQUIRED
Reporting	This procedure describes the reporting requirements under the BSM2030 strategy, including the comprehensive and status reporting requirements for the MDBA and state contracting governments, the annual reporting requirements for the Commonwealth, and the requirements for summary report for Ministerial Council.	FINAL	Refinement as required (endorsed by BSMAP)
Independent audit and assessment	This procedure describes the arrangements for undertaking the independent audit and assessment.	FINAL	Refinement as required (endorsed by BSMAP)
Review of BSM2030 & Schedule B	This procedure describes the arrangements for the review of the BSM2030 strategy and operation of Schedule B.	FINAL	Refinement as required (endorsed by BSMAP)
Modelling	This procedure describes the modelling processes, scenarios and considerations specific to meeting the requirements of Schedule B.	DRAFT V2	Workshop to resolve outstanding issues
Governance	This procedure provides an overview of governance arrangements for BSM2030 including a current list of relevant committees, advisory panels and working groups. Specific details of roles and responsibilities are covered in Terms of Reference documents, Schedule B, BSM Procedures and Murray-Darling Basin Agreement.	EARLY DRAFT	MDBA update of BSMAP comments
Salt load data	A procedure for tracking and managing salt load data provided by jurisdictions. It is expected this will be progressed through an update to either the Salinity impact assessment procedure or the Conducting reviews and assessments procedure	EARLY DRAFT	Early stage of preparation

Improvements in modelling platforms and other technical elements

Salinity models

The MDBA's salinity registers are informed by a suite of models that assist in assessing progress against salinity targets and estimating the salinity impacts of register entries. These models require periodic review by states, an independent assessment and then accreditation by the Authority to ensure improvement in model predictions of the impacts of land and water management actions.

Basin states use surface water and groundwater models and other analytical models to estimate salinity, salt load and flow to the River Murray. Some of these models are used to determine the salinity, salt load and flow regimes at the EoVT sites and baseline conditions for the basin catchments have been established (see Appendix C – Baseline conditions). The MDBA uses the datasets generated by the models as input to MSM–BIGMOD (the River Murray model). MSM–BIGMOD is used in the assessment of all register entries. With the aid of cost functions, MDBA is also able to provide estimates of the relative salinity cost effect of progressive increases in salinity along the river. The costs appear in the salinity registers as credits and debits in $m/year for each entry and are used for determining the register balance for each of the jurisdictions.

MSM–BIGMOD model

The MSM–BIGMOD river model and its documentation was updated and peer reviewed in 2014 to include a number of policy changes and works and measures undertaken since 2003 when the model was last documented. The peer reviewer found that the basic structure and layout of the updated model is sound and is suitable for the development of baseline conditions and the assessment of various actions and impacts including environmental watering salinity impacts. However, the updated MSM–BIGMOD river model was not adopted for BSM2030 purposes as the MDBA and Basin governments are working on adopting a more contemporary SOURCE modelling platform for water resource and salinity management.

Transition to SOURCE model

An independent peer review of the SOURCE model for BSM2030 purposes, completed in 2016, found that the SOURCE model is "fit-for-purpose" to model flow and salt loads in the Murray. The independent peer reviewer endorsed the MDBA proposal to utilise SOURCE for the purposes of Schedule B and the BSM2030 strategy.

The MDBA and jurisdictions are in the final stages of verifying flow and salt loads prior to the re-estimation of baseline conditions. The verification of the salt load data series is essential to ensure the most up-to-date and verified data is used by the MDBA for the re-estimation of the salinity and salt loads under baseline conditions which underpins the salinity registers. The Technical Working Group for Salinity Modelling (TWGSM), comprising representatives from the jurisdictions, was established to provide technical advice about suitability of the SOURCE model for salinity accountability purposes under Schedule B. The TWGSM met on two occasions in 2016 to discuss implications and consequences of transitioning from MSM-BIGMOD to SOURCE. Further meetings in 2020 are planned after the completion of the verification of salt loads from the jurisdictions.

Other Basin Salinity Management 2030 strategy models

Review of the Mallee Legacy of History (Irrigation and Dryland) register entry for both New South Wales and Victoria has commenced and is due for completion in mid-2020. The objectives of this project are to estimate salt loads to the Murray River from pre-1988 irrigation and dryland clearance in NSW and Victorian Mallee region to support the determination of salinity register B entries. The review will upgrade the EM1.2 model using the latest advances in modelling software and will incorporate new data into the model.

The review of Loxton-Bookpurnong groundwater model has been completed. The review upgraded the Border to Lock 3 model in the Loxton-Bookpurnong area to reflect new knowledge such as land clearance, irrigation area development, changes in irrigation practice and the construction of salt interception schemes. The review also included changes in model software, and new data regarding Salt Interception Schemes (SIS) pumping rates and spatial extent of irrigation areas.

Basin-wide core salinity monitoring network

The BSM2030 strategy commits MDBA and partner governments to nominate key salinity monitoring sites for inclusion in the Basin-wide core salinity monitoring network. This network will be maintained for the life of the BSM2030 strategy. Monitoring sites will be reviewed at least every five years to ensure the network continues to provide a sound basis for salinity assessment in response to an improved knowledge of risk and uncertainty.

The sites for inclusion in the network will be those that MDBA and partner governments consider to be critical in providing information to support a range of activities under the BSM2030 strategy. The key salinity monitoring sites will be determined by partner governments and the MDBA as appropriate to their responsibilities and accountabilities.

Throughout 2018-19, MDBA continued to work with New South Wales to finalise their core salinity monitoring sites. Other Basin states previously nominated key monitoring sites for inclusion in the network.

Review Plan

The Review Plan sets out the frequency for the review of register entries, models and end-of-valley outcomes under the BSM2030 strategy. Consistent with the amended Schedule B:

- the Review Plan is reviewed annually and may be amended by the Authority on the advice of Contracting Governments, in order to alter the frequency or level of review of any item
- the independent auditors must assess the implementation of the Review Plan, including the appropriateness of review periods.

While Basin Officials Committee (BOC) endorsed the Review Plan in October 2016, at that time it was not able to be provided to the Authority for approval until the amendments to Schedule B were approved. Given the passage of time since the Review Plan was initially prepared (October 2016) and the completion of the amendments to Schedule B (December 2018), BSMAP agreed that an updated

version of the Review Plan will be provided to BOC again before seeking Authority approval. The revised version of the Review Plan will be provided to BOC in late 2019 for their consideration.

The Review Plan tracking template continues to be used to highlight the progress in undertaking reviews as set out in the Review Plan and to document any changes to the timing of reviews. The template is provided to each BSMAP meeting, allowing Contracting Governments and MDBA to provide updates on review progress and discuss any changes to timelines. Tracking progress of reviews and documenting the changes to the review frequency provides evidence as required for complying with Schedule B requirements.

Reviews progressed by MDBA in 2018-19

The Review Plan requires the Basin States and the MDBA to review register entries, models and outcomes at EoVT sites. The review of Loxton-Bookpurnong groundwater model was completed during 2018-19. A number of reviews of joint works or measures, however, were completed in 2017–18. This included updates to models underpinning the Waikerie (all stages), Woolpunda and Murtho schemes in South Australia and affected 16 register entries.

Details of reviews progressed by Basin States can be found in their respective BSM2030 comprehensive reports.

Contracting Governments' reported outcomes

Biennially the Contracting Governments provide a comprehensive report outlining progress made against BSMS2030 strategy objectives, whereas the Commonwealth provides an annual report to the MDBA. Executive summaries of the Contracting Governments reports are included in Appendix G.

Outcomes from the audit report

Schedule B requires that the Independent Audit Group for Salinity (IAG–Salinity) be appointed by the MDBA to carry out an audit and assessment. Auditing is an integral part of the BSM2030 strategy, ensuring a fair and accurate assessment of the Contracting Governments' and MDBA's performance against the provisions of Schedule B.

Outcomes of the IAG-Salinity audit for 2018–19 are provided in Appendix A.

Response to 2016–17 audit recommendations

The IAG–Salinity audit of 2016–17 was the first audit under the BSM2030 strategy. The audit report included an assessment of the Contracting Governments and the MDBA's implementation of the strategy and provided recommendations to support continuous improvement. Response to the audit recommendations were reported to the Ministerial Council in mid-2018.

During 2017–18 and 2018-19 the MDBA, with advice from the Basin Salinity Management Advisory Panel (BSMAP), progressed some of the key recommendations in the Report of the Independent Audit Group for Salinity 2016-17 (MDBA 2018). The audit recommendations that are applicable to the MDBA are itemised and progress is reported in Table 12.

Table 12: The MDBA's response and progress to the 2016–17 audit recommendations

IAG–Salinity recommendations	MDBA response to Ministerial Council	Progress
Recommendation 1: That MDBA work closely with South Australia, NSW and Victoria to finalise the reviews of the South Australian register entries derived from the Waikerie to Morgan, Woolpunda and Pike-Murtho ground water models and ensure the registers are adjusted in a principled and timely manner.	The MDBA supports this recommendation.	The MDBA developed a process and worked closely with SA, NSW and Victoria to finalise the outcomes of the review of accountable actions in SA river reaches (Waikerie-Morgan, Woolpunda and Pike-Murtho) to update the salinity register entries. The MDBA prepared a detailed report that utilised salt loads generated from the revised SA models and associated scenarios to resolve update of salinity register entries that were affected by the SA reviews. At BSMAP 37 (22 May 2018), MDBA proposed options for updating the register entries relating to the shared works or measures (Waikerie Lock 2 and Murtho SIS). Principles were established for making decisions about the credit/cost sharing ratio of shared works or measures. BSMAP (meeting 37 – 22 May 2018) agreed that the credit/cost sharing ratio between the Joint work and State Action components of the shared works or measures be maintained in accordance with the Ministerial Council decisions for Waikerie Lock 2 and Murtho SIS when the schemes were approved for construction. The outcomes from the review of accountable actions in SA river reaches (Waikerie-Morgan, Woolpunda and Pike-Murtho) were included on the 2018 salinity registers.
Recommendation 2: NSW as a matter of urgency should ensure it has the dedicated resourcing required to meet its obligations to conduct the reviews of salinity entries on the registers.	The MDBA supports this recommendation.	MDBA provided input, as requested, to the review of the NSW Basin Salinity Management Program completed by Jacobs in 2018. MDBA was also involved in the selection panel for the process to recruit a NSW Basin Salinity Program Manager to progress the NSW obligations under the BSM2030 strategy.

IAG–Salinity recommendations	MDBA response to Ministerial Council	Progress
Recommendation 3: BSMAP should work with the Commonwealth to determine how it can continue to be actively involved in BSMAP in an efficient and effective manner.	The MDBA supports this recommendation.	The MDBA has continued to seek Commonwealth involvement in relevant BSMAP activities to ensure that they are able to meet their obligations under the BSM2030 strategy and Schedule B. As part of preparing the BSM Reporting procedure MDBA, in consultation with the Commonwealth Environmental Water Office and the former Department of Agriculture and Water Resources, identified processes to assist the Commonwealth meet its Schedule B reporting obligations. This included identifying relevant information prepared for other reporting purposes by both the MDBA and the Commonwealth Environmental Water Office that could be used to support the preparation of the Commonwealth annual report.

IAG–Salinity recommendations	MDBA response to Ministerial Council	Progress
Recommendation 4: The MDBA and jurisdictions should learn from unexpected short term in-river salinity spikes from events such as occurred at Lake Bonney and the lower Darling, review where these may occur in the Basin in the future, and develop mitigation strategies to reduce the future risk of spikes occurring.	The MDBA supports this recommendation.	Flow management is a key element of the BSM2030 strategy. This element aims to facilitate continuous improvement in salinity management including by reviewing elevated salinity events and supports the obligations to have regard to the Basin Plan salinity targets for managing water flows. Outcomes from the review of the elevated salinity events at Lake Bonney and in the lower Darling River were presented and discussed at the Salinity Forum in Adelaide in November 2017. The final report on these elevated salinity events was made available to BSMAP members and circulated to both Water Liaison Working Group (WLWG) and the Southern Connected Basin Environmental Watering Committee (SCBEWC) to ensure that the outcomes and lessons learned were shared between the relevant practitioners. Consistent with the BSM2030 implementation plan, MDBA reviewed the process for conducting the review of elevated salinity events. A report on the outcomes from this review were provided to BSMAP (meeting 38 – 21 August 2018). BSMAP members (meeting 40 – 28 November 2018) endorsed the BSM procedure to guide the review of elevated salinity events. This BSM procedure underpins the salinity component of the guideline that was prepared under s9.13 of the Basin Plan to assist relevant entities to have regard to the flow management targets under s9.14 of the Basin Plan, which include the salinity targets at the five Basin Plan reporting sites.

IAG–Salinity recommendations	MDBA response to Ministerial Council	Progress
Recommendation 5: The MDBA, in conjunction with the jurisdictions, should develop a clear procedure setting out the roles and responsibilities of all parties for resolving the risks to river salinities associated with the cumulative impacts of environmental watering and other actions.	The MDBA supports this recommendation.	Partner governments and MDBA agreed to the accountability arrangements for the salinity impacts from environmental water and these were included in the BSM2030 strategy. BSMAP (meeting 40 – 28 November 2018) endorsed the BSM procedure for environmental water accountability. This procedure describes the accountability arrangements and responsibilities for the following environmental water actions: delivery of environmental water; recovery of environmental water; use of environmental water; operation of works or measures to support environmental watering; and changes in river operations to support environmental watering. This includes actions associated with Basin Plan water, TLM water and some actions associated with non-Basin Plan water held by State Contracting Governments Given the challenges with understanding cumulative salinity impacts from the system-scale use of environmental water at this early stage of implementing the Murray-Darling Basin water reforms, this is a knowledge priority under the BSM2030 strategy with a collective responsibility to progress the understanding of the issues. This work will be pursued through the environmental watering and floodplain knowledge priority. While developing the BSM2030 strategy, partner governments and the MDBA also documented current practices for how environmental water managers and river operators consider salinity risks across a range of scales when planning and delivering environmental water, including at the system scale. This information supported the development of the BSM procedure for the review of elevated salinity events which was endorsed by BSMAP at meeting 40 (28 November 2018). This procedure outlines the process for reviewing elevated salinity events including their causes and impacts, the effectiveness of management responses, opportunities for policy improvements, and the process for information sharing. Approval and implementation of the new River Murray model for preparing the salinity registers will enable the cumulative salinity impacts of environmental watering and other actions to be included in the salinity accountability framework.

IAG–Salinity recommendations	MDBA response to Ministerial Council	Progress
Recommendation 6: The work required to set the framework for introducing the SOURCE Model for BSM2030 purposes be progressed urgently so that the SOURCE Model can be introduced in 2018.	The MDBA supports this recommendation.	The adoption of SOURCE model for BSM2030 purposes will require consideration of many factors including satisfying specific requirements set out in Schedule B of the Murray Darling Basin Agreement. The MDBA will continue to work with Contracting Governments to complete the Schedule B requirements to introduce SOURCE model for the BSM2030 purposes. The MDBA has prepared a work plan outlining timelines for the critical tasks required to complete the transition to SOURCE model for preparation of the 2020 salinity registers and consideration by the IAG-Salinity. The key steps and progress against these are: 1. Salt load and flow data verification with the states (completed). 2. Re-estimation of the salinity and salt load under Baseline Conditions (in-progress). 3. TWGSM endorsement of the re-estimated salinity and salt load under Baseline Conditions (yet to commence). 4. Preparation of 2020 salinity registers for comparison purpose (yet to commence). 5. TWGSM and BSMAP consideration of the 2020 salinity registers and advise the MDBA (yet to commence). 6. MDBA prepares the 2020 salinity registers using SOURCE model (in-progress). 7. BSMAP reviews and endorses the 2020 salinity registers (yet to commence). 8. The 2020 salinity registers are provided to the IAG-Salinity for consideration and recommendations (yet to commence).

IAG–Salinity recommendations	MDBA response to Ministerial Council	Progress
Recommendation 7: Given the range of modelling issues that need to be resolved quickly and efficiently under the BSM2030 transition, there is a need for an expansion of the role of the Technical Working Group for Salinity Modelling or for similar committee(s) be set up to aid the facilitation of modelling issues in a planned way.	The MDBA supports this recommendation.	The primary role of the Technical Working Group for Salinity Modelling (TWGSM) is to provide technical advice regarding the introduction of SOURCE model for BSM2030 purposes. This is a significant task and therefore it is necessary that this primary role of the TWGSM remain unchanged until this task is completed. However, the MDBA in consultation with BSMAP will be developing a Basin Salinity Management procedure to provide clarity regarding the salinity modelling issues. The role of the TWGSM and/or the need for a similar group will be considered as part of the procedure development.
Recommendation 8: The MDBA and jurisdictions should consider the development of an approach to assessing the salinity impacts of irrigation that better represents actual water use; particularly in relation to the reduction in irrigation water use in some established irrigation areas in the southern basin.	The MDBA supports this recommendation.	The MDBA has supported Contracting Governments in developing approaches to assess the salinity impacts of irrigation through the preparation of BSM procedures. A set of high-level principles were included in the Conducting reviews and assessments procedure. To maintain a level of consistency, these high-level principles must be considered in the representation of irrigated area in assessments and reviews of accountable actions.

IAG–Salinity recommendations	MDBA response to Ministerial Council	Progress
Recommendation 9: The economic impacts of the salinity management program in the MDB should be reviewed and updated before 2026 as an input to the strategic review of the BSM2030.	The MDBA supports this recommendation.	A review of the cost functions is included in the BSM2030 implementation plan to be completed by 2025 to inform the strategic review of the BSM2030 strategy. BSMAP members (meetings 38 and 40) discussed this issue and requested that MDBA scope out an approach for the review of the cost functions. The scoping study is required to determine the purpose of the salinity cost functions review and how the outcomes may be implemented. The costs, along with the positive and negative aspects of the different options, need to be defined in greater detail. A review of the cost functions may be aligned with other activities such as a review of the Benchmark Period (1975 – 2000 climatic period) to ensure that disruption to the salinity registers is minimised.
Recommendation 10: The jurisdictions and the MDBA should develop a strategic approach to management and oversight of the BSM2030 implementation program, with a view to ensuring that all necessary actions can be delivered to support achievement of the strategy objectives, and to enable the 2026 review to be undertaken in an effective, timely manner.	The MDBA supports this recommendation.	The BSM2030 implementation plan is included as a standing agenda item for all BSMAP meetings. Progress against implementation activities is tracked via a spreadsheet that is updated prior to each BSMAP meeting. BSMAP members review the spreadsheet to ensure that critical issues and resourcing risks can be identified and addressed accordingly.

Strategic knowledge improvement

Knowledge is the key to salinity management in the Murray-Darling Basin. Steady improvements in knowledge about salinity processes have underpinned three decades of successful adaptive management.

The BSM2030 strategy continues that focus and aims to overcome critical information gaps and uncertainties to provide a solid basis for decision-making and future planning. Progress against key knowledge gaps will inform the 2026 review of the BSM2030 strategy and the development of future basin-wide salinity management strategies.

BSM2030 Knowledge Priorities

The key knowledge gaps identified in the BSM2030 strategy are:

- Mallee Legacy of History (LoH) – improved understanding of risk associated with the projected impacts of historic land clearing and water use in the Mallee regions of NSW, South Australia and Victoria will help to reduce the uncertainty surrounding the future magnitude and timing of salinity risks to the shared water resources
- improved understanding of environmental water management and watering practices will help to better assess the salinity impacts of environmental watering in the shared water resources including:
    i. environmental watering and floodplain dynamics – development of the next generation groundwater models to assess and predict potential salinity impacts from environmental watering
    ii. the cumulative, system-scale salinity impacts arising from environmental watering regimes (salinity accountability for environmental water management)
- predictive forecasting for in-river salinity – improved surface water models to support predictions and forecasting of salt loads and river salinities will help to reduce the risks associated with responsive SIS management and inform other management actions
- responsive SIS management – improved understanding of the salinity impacts associated with responsive SIS management, with particular focus on the floodplain and in-river responses will help the potential to further reduce operating costs and improve SIS operations.

Progress against the BSM2030 knowledge priorities is listed below.

Mallee Legacy of History salinity impacts

Following the initial knowledge priority workshop on Mallee legacy of history salinity impacts held in June 2016, projects to review the conceptualisation and assumptions regarding the timing and magnitude for both the dryland and irrigation Mallee legacy of history were completed.

The review highlighted some challenges and inconsistencies in how irrigation recharge is determined and noted some significant limitations in current approaches, namely:

- There is no direct modelling of the unsaturated zone to account for perching on clays. This is known to be widespread in the Mallee and influence the timing and magnitude of irrigation recharge and thus the timing and magnitude of salt loads to the river.
- There is inconsistent and insufficient use of agronomic data to constrain groundwater model calibrations and their outputs. In some cases, a forward (or deterministic) modelling approach is used. In other cases, an inverse modelling approach is used. Both the forward and inverse modelling approaches may lead to biases in salt load estimates due to irrigation and create uncertainty when linking on-ground actions (e.g. irrigation efficiency improvements) to salt loads in the river. The risk of biases can affect cost-sharing, rehabilitation and salinity planning.

To address these issues, the review recommended

- the development of a transfer function (a simple model capable of simulating the influence of perching behaviour within the unsaturated zone),
- the implementation of a 'hybrid' modelling approach that includes parameters from the agronomic water balance and the transfer function within model calibration, and also the use of agronomic data to constrain the calibration.

Further testing and development of the transfer function and hybrid modelling occurred in a pilot trial that used the Loxton-Bookpurnong salinity register model. This work validated the use of the transfer function and hybrid modelling as providing a robust and transparent approach for the treatment of irrigation recharge, with the major benefits being:

- The greater use of agronomic data (particularly information on irrigation drainage) to better constrain and calibrate estimates of irrigation recharge.
- The ability to simulate gross recharge and drainage explicitly, so that on-ground actions can be appropriately represented and instances where drainage rates may be derived from both root zone drainage and the interception of a groundwater mound (e.g. at Loxton) can be unpicked and simulated explicitly by the model.
- A methodology to calibrate irrigation efficiency estimates, providing greater confidence in the formulation of scenarios which are used to predict salinity impacts.

Overall, the method was shown to add significant value to salinity modelling and should only require marginally more resources if it is to be applied by future modelling applications.

Environmental watering and floodplain salinity dynamics

A report arising from the floodplain processes workshop, held in November 2017, outlined a work plan (Figure 4) to address a range of floodplain knowledge priorities. The report summarised the key floodplain processes knowledge priorities into five themes. These are:

- developing a floodplain processes body of knowledge
- salinity risk framework
- improving the conceptual understanding
- modelling
- data and monitoring.

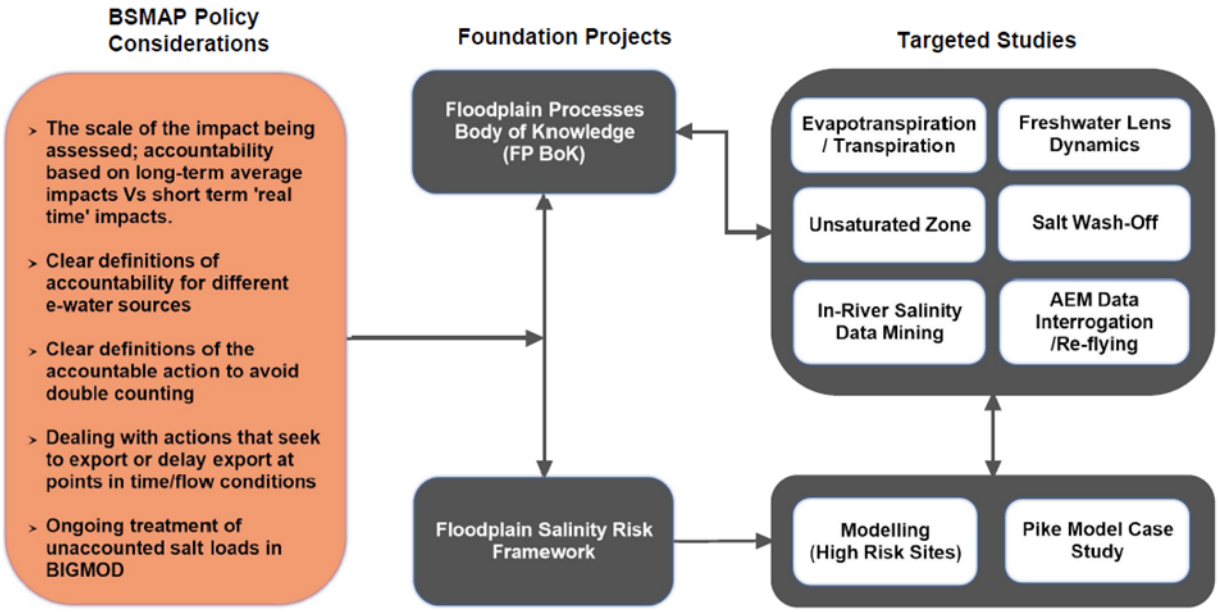


Figure 4. Floodplain knowledge priorities – work plan framework.

Improving the conceptual understanding

The most immediate need identified in the floodplain knowledge priority workshop was the collection of data to support improving the estimates of evapotranspiration. This is being progressed through two complementary processes.

In May 2019, the CSIRO and MDBA commenced a three-year project to quantify total water losses or evapotranspiration from key floodplain vegetation located over saline groundwater within the Murray-Darling Basin. Lack of vegetation evapotranspiration data has been identified as a significant knowledge gap in the ability to understand and model salt mobilisation in the lower Murray. The study aims to provide robust field data for vegetation evapotranspiration, to improve river and saline floodplain management and improve the accuracy of evapotranspiration data used in numerical models.

CSIRO installed equipment at two sites (Bookpurnong and Calperum) in South Australia in June 2019. Equipment will also be installed at two sites at Lindsay Island in Victoria. The field data will be used to

validate a model to provide robust evapotranspiration outputs for River Red Gum in saline groundwater locations. This work complements existing studies of black box communities at Mallee Cliffs in New South Wales being conducted in the trial of responsive management of SIS and by CSIRO at Calperum in South Australia, and earlier CSIRO studies at Yanga National Park in New South Wales.

Field locations were selected in areas where there are predicted management actions in the future. This includes salt interception scheme manipulation to vary the operation of these schemes as well the influence of environmental flow actions on floodplain vegetation evapotranspiration and hence tree community canopy condition and reduction of water stress.

MDBA has also supported Flinders University in preparing an Australian Research Council (ARC) linkage proposal which aims to improve the conceptualisation of how water and salt move within saline floodplains, including vegetation water use, flooding and environmental watering.

The proposal brings together researchers from Flinders University, Adelaide University and CSIRO, with support from MDBA and SA Department for Environment and Water. Figure 5 describes the relationship between the major tasks including evapotranspiration fieldwork.

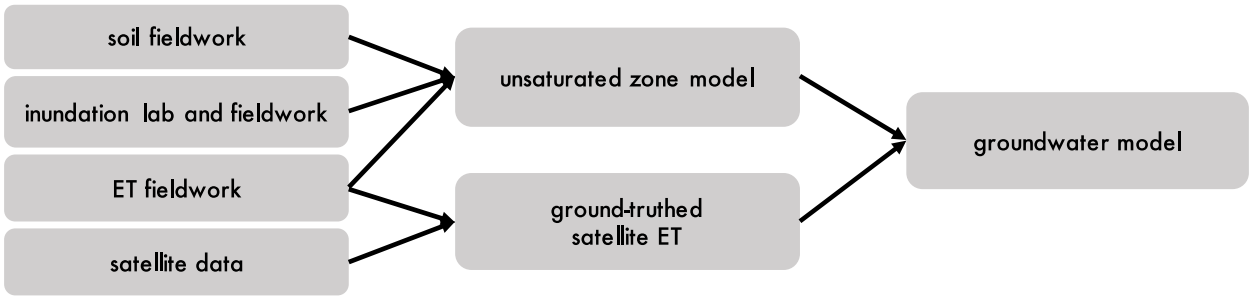


Figure 5. Relationship between the major project tasks.

Floodplain Processes Body of Knowledge

MDBA has also commenced the process for developing a floodplain processes body of knowledge. This process is at an early stage of conceptualisation with key progress to date being the selection of a preferred option of utilising data.gov.au and the equivalent state portals. The steps identified in developing the floodplain processes body of knowledge include establishing a working group, identifying relevant information for inclusion, and establishing a schema with an agreed vocabulary of search terms so that the published data is discoverable and accessible. While nominations for the working group were received, further work on developing the floodplain processes body of knowledge has been on hold while other priorities are being pursued.

Predictive forecasting for in-river salinity

A modelling tool was developed and the MDBA Source Murray Model has been configured to prepare six-month forecasts on salinity levels in the lower Murray. These forecasts are used to inform decisions around the level of SIS operations to support the trial of responsive management of SIS.

The modelling tool applies a number of flow scenarios at the SA border, based on the river operations annual operation plan and multi-history flow outlooks, to cover the range of possible flow conditions. For a given level of SIS operations, forecast salinity levels are provided for the four Basin Plan reporting sites in South Australia (Lock 6, Morgan, Murray Bridge, and the Lower Lakes at Milang).

The modelling tool is used each month to prepare the forecasts on salinity levels in the lower Murray that inform decisions around the level of SIS operations. While the modelling tool is regularly being refined through its application, other MDBA modelling priorities have limited further development to date.

System responses to changed salt interception scheme operations

Six trial sites were selected to address a number of the key knowledge gaps associated with the trial of responsive management of SIS, being the groundwater and salt inflow responses to changed operations, the relationship between pumped volumes and the extent of low salinity lenses, and the relationship between groundwater salinity and vegetation health. The trial sites are at Mallee Cliffs SIS, Mildura SIS, Western's Floodplain, Clark's Floodplain, Thiele's Floodplain and Ramco Floodplain.

Initial efforts focused on establishing baseline information, and a summary of the monitoring activities now underway at each of the trial sites associated with responsive management of SIS is provided in Table 13.

Table 13: Summary status of monitoring activities underway

Monitoring task	Western's	Clark's	Thiele's	Ramco	Mildura	Mallee Cliffs
Groundwater vertical salinity profiling	√	√	√	√	√	√
Groundwater level recording	√	√	√	√	√	√
Downhole geophysics						√
Surface geophysics	√	√	√	√		√
Soil push tube sampling	√	√	√	√		√
Vegetation photo points	√	√	√	√	√	√
Leaf water potential	√	√	√	√		√
Sap flow	√	√	√	√		√
Instream salinity recording	√			√		
Instream nanoTEM	√	√	√	√	√	√

Community engagement and communication

Community engagement and education

The responsibility for community engagement and communication rests with the Basin States who report on community engagement and communication activities undertaken through their salinity management programs as part of their comprehensive reports to Ministerial Council.

From time to time the MDBA provides specific engagement and education support.

Communication activities

It is important that communities understand that salinity risk has been reduced through past investment and environmental water recovery under the Basin Plan. Similarly, it is important that they understand that salinity risks remain and that river salinity levels still require careful management to ensure the Basin Salinity Target is achieved.

Throughout 2018-19, the MDBA released the following salinity related publications:

- Assessment of the salt export objective and salinity targets for flow management 2017-18
- BSM2030 2017-18 status report
- BSM2030 2017-18 summary report

Priorities for future work

In 2019–20, priorities to be implemented through the BSM2030 strategy include:

- continuing the transition to the Source model for preparation of the Salinity Registers, including confirmation of salt loads and re-estimation of the baseline
- finalising the remaining Basin Salinity Management procedures that will replace the existing Basin Salinity Management Strategy Operational Protocols
- continuing, and seeking to extend, the trial of responsive management of SIS and implementing knowledge gap investigations at the trial sites
- progressing projects related to the BSM2030 knowledge priorities
- undertaking reviews of register entries and models consistent with the Review Plan
- finalising nominations to, and implementing, the Basin-wide core salinity monitoring network
- undertaking other activities in line with the BSM2030 strategy implementation plan
- convening the second Basin salinity forum to promote discussion and collaboration between Basin salinity managers, river operators, environmental water managers and other government officials to share lessons learnt and to support BMS2030 implementation.

Appendix A – Extract from the Report of the IAG-Salinity 2017-19

Executive Summary and recommendations

Introduction

The Basin Salinity Management 2030 (BSM2030) strategy was agreed by the Murray-Darling Basin Ministerial Council (MDBMC) in 2015 and commits the partner governments to accept shared responsibility for continuing action to manage salinity in the shared water resources of the Basin. The strategy provides a framework to deliver a strategic, cost-effective and efficient program of coordinated salinity management from 2016 to 2030. The mandatory elements of BSM2030 have been incorporated into Schedule B to the Murray-Darling Basin Agreement (Schedule 1 to the *Water Act 2007* (Commonwealth)). Clause 34 of Schedule B specifies that the Authority must appoint independent auditors to carry out an audit.

Under the BSM2030 strategy, audit and reporting has been streamlined now that the program has matured. Commencing in 2017, auditing will now occur biennially to align with the comprehensive reporting by jurisdictions and the Murray-Darling Basin Authority (MDBA). This process ensures a fair and accurate assessment of the Contracting Governments' and Authority's performance against Schedule B. The auditors are called the Independent Audit Group for Salinity (IAG-Salinity).

This report presents the consensus view that the IAG-Salinity has reached covering the 2017-18 and 2018-19 financial years. The State Contracting Governments, and the MDBA submitted reports on their activities, outcomes at end-of-valley target sites, the status of the register entry reviews and BSM2030 Salinity Register entries or adjustments. The Australian Government also submitted a brief report related to environmental watering activities.

The audit process adopted by the IAG-Salinity included a review of the jurisdiction and MDBA reports and the Salinity Registers. This was followed by a face to face meeting with each jurisdiction and the MDBA to discuss their report and consider any future needs of the program. Jurisdictions and the MDBA were given an opportunity to comment on the draft text of the audit report containing the recommendations and their suggestions have been considered and included, where appropriate.

The 2018-19 context for BSM2030 implementation

This is the tenth year in a row that the modelled river salinity at Morgan has been below 800 EC. This is consistent with the Basin salinity target, as set out in Schedule B, that is, to maintain the average daily salinity at Morgan at a simulated level of less than 800 EC for at least 95% of the time. The Basin Plan (Section 9.14) flow management target of actual measured salinity over a 5-year rolling period being below 800 EC 95% of the time at Morgan, as set out in the Basin Plan (Section 9.14) was also met.

In 2018-19 low rainfall across the basin has once again resulted in very low or no water flows from the northern Basin and the River Murray flows are again relying on water storages to deliver water. Environmental water flows from up-stream watering events that ended up over the barrages exported an estimated 240,722 tonnes of salt out of the Basin in 2017-18 and assisted in managing salinity levels of the Coorong and maintaining an open Murray Mouth. The Murrumbidgee and the Barwon rivers were provided with environmental flows to improve the water quality and reduce salinity. The Basin Plan salinity target at Milang of 1000 EC has been exceeded during the audit period but it is currently below this level following environmental water reaching the lakes.

There are some short-term salinity risks facing the River operators when the Darling River needs to be reconnected to River Murray and if there is a high flow, inflows of salt to the River Murray from Lake Bonney. These occurred in the previous Audit period. When the Darling was reconnected it put high salt loads into the Murray River that were fortunately diluted by a high Murray River flow. Lake Bonney caused a problem on the flood recession when water from Lake Bonney entered the Murray River and river salinity reached 775 EC at Morgan. While the learnings from both events were documented, there were no clear protocols presented to the Auditors for managing these short-term risks in the future.

The water trade between industries and locations has been extensive in the past two years including about 3,500 hectares of new irrigation development coming on line in Sunraysia area of NSW. The IAG-Salinity was informed that 400 dairy farmers in Victoria left the industry in 2018/19 and that the irrigation area is changing with bigger farms using a more intensive production system leaving large areas of previously irrigated land unused. The market for water has led to a more dynamic system with water moving to the Sunraysia area. The impact of the significant shifts will be a challenge to accounting for the salinity impact in the future. This has led to the need to assess the actual area irrigated and crop type each year so that the salinity risk can be understood and based on the actual areas that are irrigated.

The Audit raised the issue two years ago; that NSW did not have sufficient resources to adequately manage its responsibilities under BSM2030. While a plan has been established as a way forward, and some new resources made available to progress some register reviews and improve the management of the SIS, there is still much to do. The rapid expansion of irrigation in the NSW component of Sunraysia without a salinity policy framework and with many register reviews outstanding is a concern for both those investing in the permanent plantings and for the health of the rivers in the basin. Already 5,800 ha has been developed with approximately a 6 EC debit that is not on the registers. There is a potential for another 3,500 ha to be developed with a potential for another 3.7 EC debit. While the Auditors appreciate that NSW has had many water resource plans to submit to the MDBA and demands for resources to manage drought, we understand that it may take two more years before a further increase in funding is available to commence work on the salinity impact assessments. NSW is already in breach of the Schedule B and any further delay will put both the investors and the health of the River Murray at risk. It is essential that NSW immediately provide the resources to meet its obligations under the Murray-Darling Basin Agreement and the *Water Act (2007).*

The BSM2030 is predicated on taking a risk management approach so the effort is commensurate with risk. While risk is being considered in the individual projects and assessments, the risks at the program level have not been assessed. The review leading up to the current BSM2030 did assess

salinity risks but not the program risks. It is timely that a risk assessment of program risks be made to determine the business opportunities and direct the investment in the program.

The salinity credits associated with the use of Basin Plan environmental water have been included as a provisional entry on the registers but the debits that occur from short term watering actions have not. Each jurisdiction is working with environmental water holders to examine the risk. SA reported that they have looked for a simple modelling system to predict the impacts down the length of the River from the accumulative watering of environmental assets but it has not worked. Consequently, models are required for each site and then the accumulative impacts from all the watering sites can be assessed. This is a maturing science and the Commonwealth reported that it expects the accumulated salinity debits from the 36 Sustainable Diversion Limit (SDL) adjustment project sites to be watered may be able to be assessed and added to the registers in the next two years.

A salinity risk in the northern Basin is from the brine ponds that are stored on the coal seam gas (CSG) fields in the headwaters of the Basin in Queensland. The IAG-Salinity wrote to the Queensland Government during the previous Audit and were provided with advice that 26 brine ponds existed with a combined capacity of 18 GL. The IAG-Salinity met the regulators during the current audit and were assured that when the mining is finished the brine ponds will need to be removed legally. There is research being undertaken to find a use for the salt, mainly sodium carbonate, but none has been found to date. Not all the brine ponds are near rivers, but the risk of the brine ponds to water quality does need to be quantified, including the decommissioning process.

The review date for the BSM2030 is in 2026 and it is essential that the knowledge needed to make decisions about the next strategy be developed. The modelling undertaken in the lead up to the BSM2030 shows that, with environmental water, the credits run out by 2080 so it is important that the knowledge about salinity be continuously improved.[3] The IAG-Salinity considered that some of the important issues to develop the context for the revision are:

1. The impact of climate change on salinity is not easy to predict, for example (i) it has been well established that salinity and groundwater impacts in the Shepparton irrigation district are rainfall dependent, whereas (ii) the removal of salt from the basin is reliant on flow;

2. The economic impact of salinity on the agricultural, tourism, value adding industries in the basin and the communities that rely on the water for their well-being needs to be determined and communicated. There is a general community view that the salinity issues have been fixed. The returns from the investment in BSM2030 and the investment opportunities that it has provided need to be quantified to ensure that appropriate investment in salinity management continues;

3. The register framework including the cost functions needs to be reviewed. The cost functions are based on an economic assessment in 2005, are out-of-date and do not provide a sense of the value of ensuring water is managed to below 800 EC at Morgan;

[3] General review of salinity management in the Murray–Darling Basin, MDBA 2014
https://www.mdba.gov.au/publications/mdba-reports/general-review-salinity-management

4. The end-of-valley targets assessed annually need to be reviewed as they do not currently provide the feed-back to the catchment communities that would bring them to action when there is an issue. Trend data and mid-valley targets in at-risk catchments may give the communities more ownership of the water quality in their catchment; and

5. The legacy of history register items in the B register predict a high level of salt movement to the River over time and the loss of salinity credits by most jurisdictions by 2080, so certainty of this prediction needs to be refined as it will have an influence on investment decisions in the next salinity strategy.

The IAG-Salinity is of the overall view that the program is tracking well against the BSM2030 but with NSW needing to increase its effort to meet its obligations. The IAG-Salinity considers that the BSM2030 and its predecessors, the BSMS and S&DS to be one of the best examples of a successful, long-term natural resource management program in the world. The MDBA has produced a video and information on the success of the program to date but the public does need to be reminded from time to time that there is a salinity risk and that it is currently being well managed and needs ongoing resources.

Figure A1 demonstrates that the program has lowered the salinity levels at Morgan which on three occasions would have approached the 800 EC target if no action had been taken. Over the last two years there has been a steady low flow of water down the River Murray. Figure A2 shows that with a medium flow of up to 80,000 ML/d the salinity levels following the recession of the flow do spike in real time. With higher flows it may exceed 800 EC.

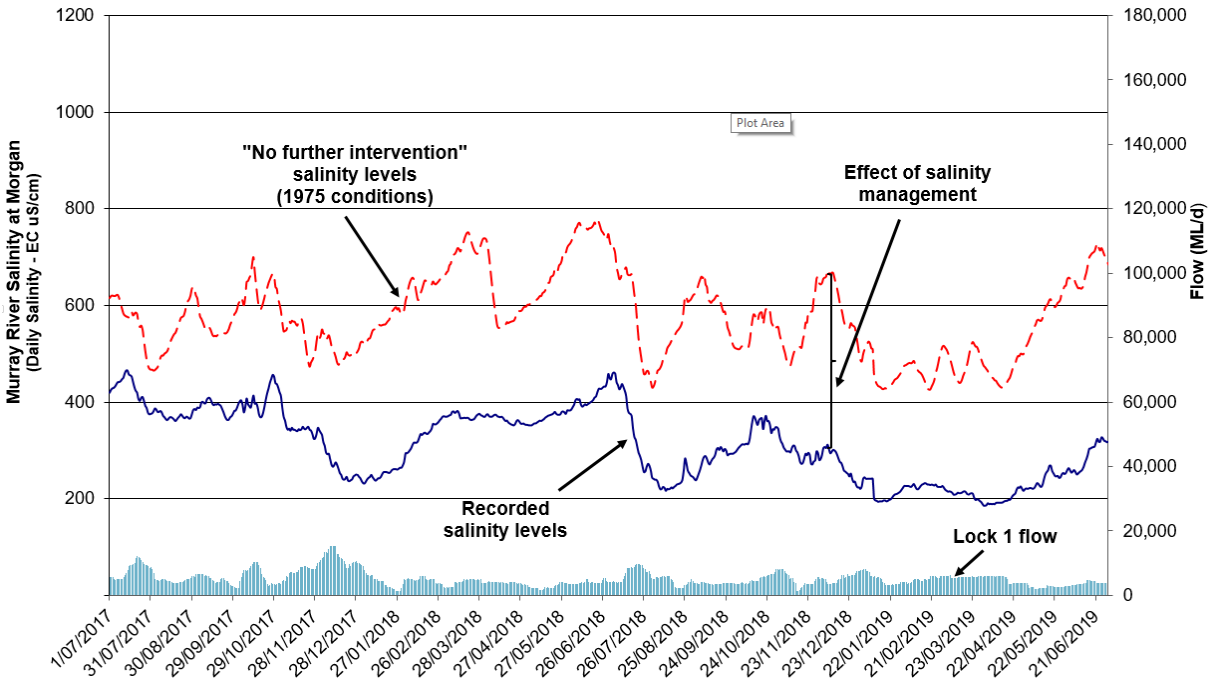


Figure A1. Comparison of mean daily-recorded salinity levels at Morgan from July 2017 to June 2019 to the modelled 1975 'no further intervention' salinity levels.

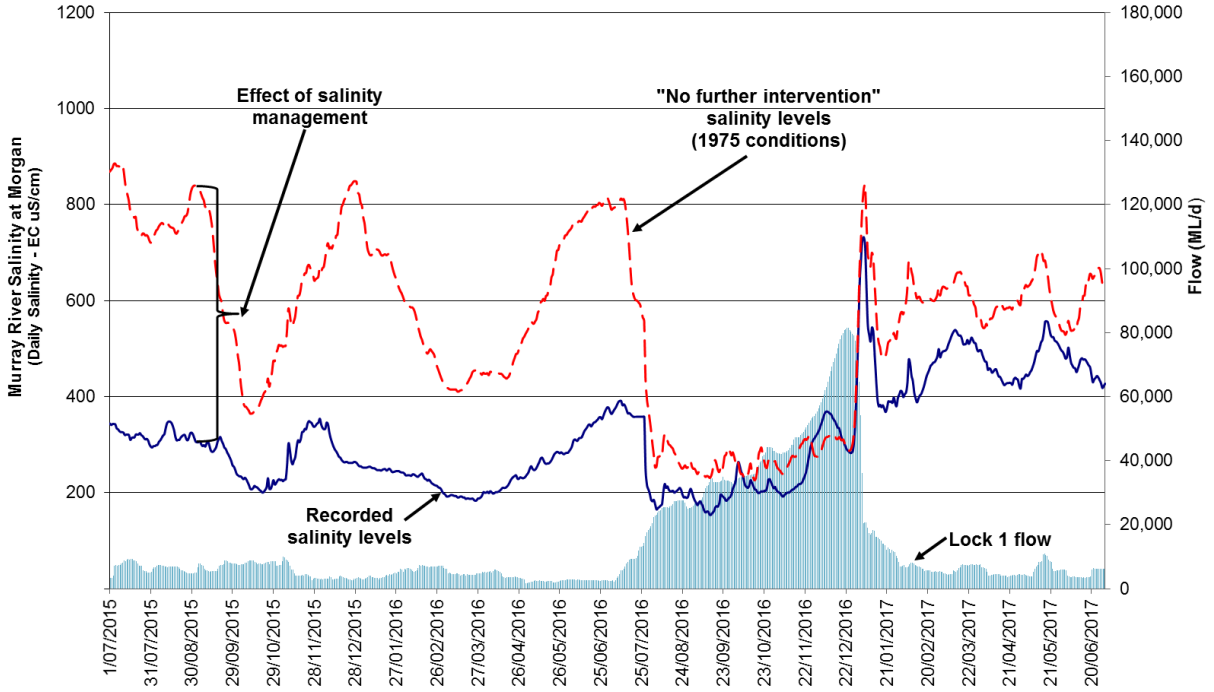


Figure A2. Comparison of mean daily-recorded salinity levels at Morgan from July 2015 to June 2017 to the modelled 1975 'no further intervention' salinity levels.

Figure A3 demonstrates that the program, which commenced in 1988, has managed to reduce the salinity risk and meet the Morgan target 95% of the time. The debits from new developments in the NSW Sunraysia, the Salt Interception Scheme (SIS) trial and environmental watering and the credits from The Living Murray program (TLM) and environmental water recovery have not been included in the modelling. If they were it is expected to adjust the line but still keep it well below 800 EC at Morgan.

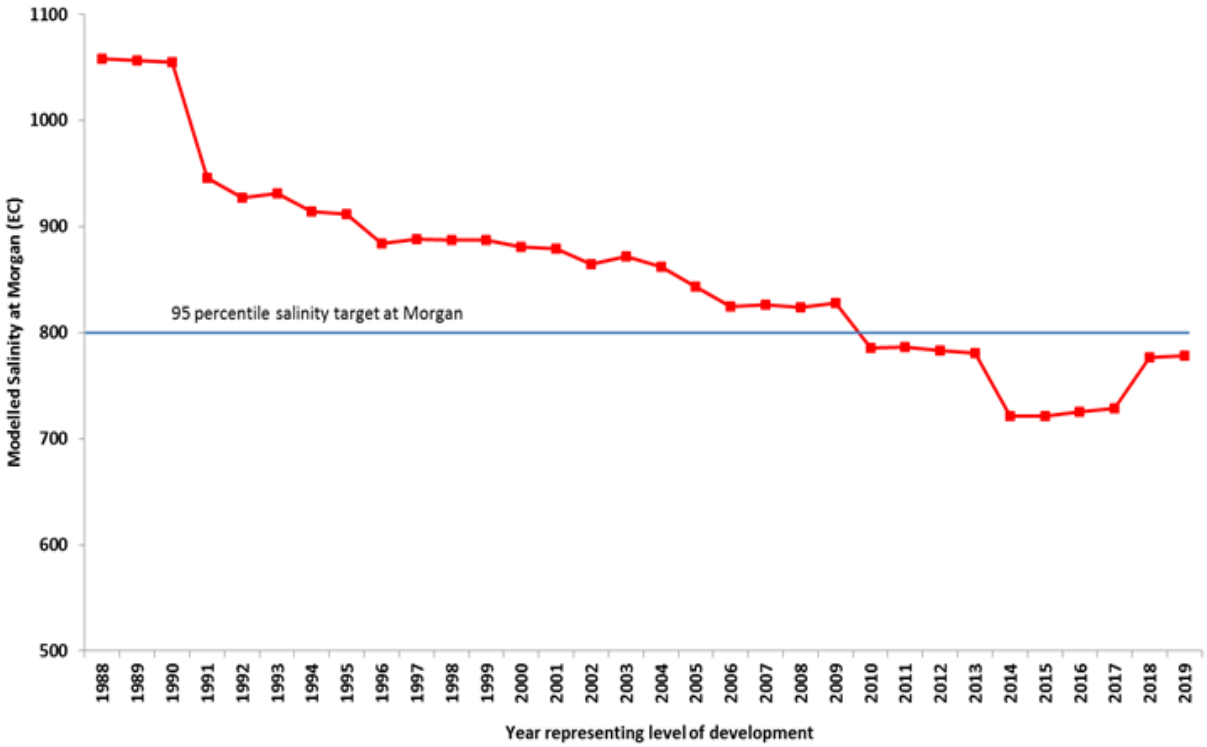


Figure A3. Modelled 95 percentile salinity over the 1975-2000 Benchmark period at Morgan in South Australia due to the implementation of salinity management programs from 1988 to 2019

Statement on Register entries

The IAG–Salinity's opinion on the balance of salinity credits and debits for each state as at 30 June 2019 (see below).

Schedule B, Clause 16 (1) provides as follows:

16(1) A State Contracting Government must take whatever action may be necessary (a) to keep the total of any salinity credits in excess of or equal to the total of any salinity debits attributable to it in Register A; and (b) to keep the cumulative total of all salinity credits in excess of, or equal to, the cumulative total of all salinity debits attributed to it in both Register A and Register B.

Register A currently shows NSW, Victoria and South Australia to be in net credit, while Register B shows NSW and South Australia to be in net credit with Victoria slightly in debit but close to neutral. For the combined registers, all three States are in credit. Queensland and the ACT do not have register entries.

Opinion on register balances

The IAG–Salinity has examined the register as provided for this audit and has come to the opinion that NSW, Victoria and South Australia are in a net credit position. However, the register entries for NSW are not comprehensive, which therefore presents an inaccurate picture for the NSW position. The NSW entries need to be updated with a provisional debit of 6 EC for the post 2006 irrigation development in the NSW Sunraysia region.

Opinion on MDBA's accuracy in maintaining the registers

The IAG-Salinity found no inaccuracies in MDBA's maintenance of the registers and the lack of comprehensive coverage is attributed to the NSW not informing the MDBA of the impacts of 5,800 ha of development since 2006 and not completing the outstanding register entry and model reviews due from NSW.

The Auditors found that NSW needs to urgently update its register entries and provide resources to immediately update its models and provide surety about the new irrigation developments in Sunraysia both for salinity management in the basin and for the irrigation investor confidence in the system.

South Australia did raise the issue of the post 1988 credits for irrigation improvements being accounted for in Register B on the advice of the IAG-Salinity in 2005-06. The Audit in 2005-06 suggested that the credits from improved irrigation practice were distorting the true balances in both registers and suggested that credits and debits be split between the A and B registers. While there are adequate credits in the registers at the moment, as we move towards 2050, SA register A will be in debit. This issue needs to be considered in the lead up to the 2026 review of the BSM2030 as there needs to be a consideration of whether the way the register A and B are currently constructed may lead in the long term to capital expenditure in the Basin which may not be warranted.

IAG-Salinity recommendations

The IAG-Salinity make the following recommendations:

Recommendation 1: The MDBA immediately add a provisional register entry of 6 EC debit to account for the 5,800 ha of irrigation development in the NSW Sunraysia region as this is an accountable action under Schedule B of the MDB Agreement (Water Act (2007)).

Recommendation 2: NSW urgently increase resources to meet the BSM2030 Schedule B contractual agreement to complete the register entry and model reviews and reduce the uncertainty of the salinity impacts from the expected new development in the high salinity risk areas of Sunraysia.

Recommendation 3: The MDBA and Contracting Governments develop a common risk assessment and management framework that is consistent with AS ISO 31000 and develop a risk profile for the basin-wide program.

Recommendation 4: The Commonwealth and State Contracting Governments continue to work with environmental water holders to understand the basin-wide salinity risk and the cumulative debit impacts from environmental watering of sites.

Recommendation 5: The Queensland Government assess the risk to basin rivers from the brine ponds constructed by the CSG industry.

Recommendation 6: In the lead up to the 2026 review of the BSM2030 strategy the following knowledge gaps be explored:

1. The impact of climate change on the salinity in the shared water resources;

2. The economic impacts and opportunities provided to the basin industries and communities from salinity mitigation;

3. Revisit the cost function framework of the registers;

4. The usefulness of end-of-valley targets for management decisions and consideration be given to other indicators such as trend analysis and mid-valley targets; and

5. Review key entries in the registers to reduce uncertainty and provide improved certainty in relation to available credits by 2080.

IAG-Salinity recommendations from 2015-17 still relevant

Recommendation 4: The MDBA and jurisdictions should learn from unexpected short term in-river salinity spikes from events such as occurred at Lake Bonney and the lower Darling, review where these may occur in the Basin in the future, and develop mitigation strategies to reduce the future risk of spikes occurring

Recommendation 7: Given the range of modelling issues that need to be resolved quickly and efficiently under the BSM2030 transition, there is a need for an expansion of the role of the Technical Working Group for Salinity Modelling or for similar committee(s) be set up to aid the facilitation of modelling issues in a planned way.

Recommendation 8: The MDBA and jurisdictions should consider the development of an approach to assessing the salinity impacts of irrigation, that better represents actual water use; particularly in relation to the reduction in irrigation water use in some established irrigation areas in the southern basin.

Appendix B – Salinity registers

The BSM2030 salinity registers present individual accountable actions as credits and debits expressed both in EC impacts and as cost effects in dollar values.

Register A includes accountable actions taken after the baseline date (1988 for New South Wales, Victoria and South Australia; 2000 for Queensland and the Australian Capital Territory) and joint-funded authorised works or measures. Accountable actions that are predicted to cause increases in salinity are referred to as salinity debits and are shown in as a positive number. Accountable actions that result in a decrease in salinity levels are referred to as salinity credits and are shown as a negative number. Salinity debits can be offset by credits arising from authorised works or measures and other credit generating actions, such as improved land and water management practices.

Register B records delayed salinity impacts or the 'Legacy of History' due to actions taken before the baseline date applicable to each state (the 'legacy of history' for which the Contracting Governments accept joint responsibility). It also contains details of the predicted future salinity impacts of actions aimed at addressing delayed salinity impacts, including contributions from authorised works or measures, and their salinity cost effects. Delayed salinity impacts are salinity impacts that result from a pre-1988 action but for which the impact does not begin to occur until after 1 January 2000. That part of the impact which occurs before 1 January 2000 is incorporated into baseline conditions. Salinity and cost effects of relevant management actions that are nominated by Contracting Governments as specifically for offsetting 'Legacy of History' salinity impacts after 1 January 2000 are also entered in Register B.

Changes to the registers to accommodate the new requirements under BSM2030

The flow regime of the Murray–Darling Basin is changing as a result of environmental water recovery, delivery and use under the Basin Plan. Environmental watering is estimated to have a net long-term salinity benefit for the shared water resources due to the substantial dilution benefits from delivering the water. However there may also be some environmental watering actions that mobilise salt into the river system.

The expected salinity impacts (both positive and negative) from environmental water are accountable actions under Schedule B to the Murray–Darling Basin Agreement and as such are included on the BSM2030 Salinity Register(s).

The design of the salinity registers was changed in 2016 to accommodate the new requirements under BSM2030. The BSM2030 salinity accountability arrangements for environmental water require changes to the design of Register A. Changes include new Commonwealth and Collective columns to indicate the salinity cost effect. The amendments to Schedule B also include a requirement to forecast the salinity effect (EC at Morgan) at the year 2030 for all register entries to coincide with the end of the BSM2030. This change requires a new 2030 column for both Register A and Register B.

A new section for Register A has been created to group actions arising from BSM2030 including those associated with Bridging the Gap water (Basin Plan water) and the changed operation of SIS under the trial of responsive management.

Other changes under the BSM2030 include that the Basin States have agreed to pool the credits associated with their other environmental water holdings (including the net balance of The Living Murray (TLM), Register A salinity credits not required to offset TLM debits) in the Collective column of Register A. Basin States will be able to access their share of the collectively held credits for their individual use if required. These do not necessitate further changes to the design of Register A other than those already outlined above.

The Commonwealth credits from the dilution benefits associated with delivering Bridging the Gap water will offset the debits from any accountable actions associated with the recovery of Bridging the Gap water, Sustainable Diversion Limits (SDL) adjustment works and measures, the use of environmental water (excluding TLM), and any changes to river operations (that are not part of the SDL adjustment mechanism), and in addition the trial of salt interception scheme responsive management. This is done through the inclusion of an additional row to show the offsets provided by the Commonwealth, and the offsets are also shown in the total of the Commonwealth column.

Explanation of the BSM2030 salinity registers

Table 1 provides a summary of the BSM2030 salinity registers for 2019. Table 14 and Table 15 are the actual salinity registers, which provide more detail on the credits and debits of specific actions. This section explains the broad groups of register entries.

Joint works and measures

The first line summarises the economic benefits in the river arising from joint works and measures for each state and the Australian Government.

Joint works and measures refer to SIS constructed as part of the Salinity and Drainage Strategy (MDBC 1989) and those developed under the BSMS and BSM2030. The registers demonstrate the benefits of the shared schemes between the investing states. The Australian Government has provided significant financial input to the schemes, which is reflected in the right-hand column showing a salinity benefit equivalent to that contribution. A proportion of credits generated by the joint works and measures program is assigned to individual states to offset the debts recorded in Register B. In the registers summary (Table 1), these transfers are shown as ‘Transfers to Register B’.

Shared state actions

Some states have carried out actions together, such as adopting targeted river operating rules that provide downstream salinity benefits. These benefits are shown as ‘shared state actions’ in the salinity registers.

State actions

The individual state actions reflect the land and water use salinity costs and benefits to the river. Typical examples of activities that increase salinity costs include new irrigation developments, the construction of new drainage schemes that mobilise salt to the river and wetland flushing. Offsetting activities include improved irrigation efficiencies and improved river operations.

Total Registers A and B

The overall cumulative accountability for salinity impacts on the river in 2016–17 is summarised in the 'Total Register A' and 'Total Register B' rows. Register A maintains accountability for actions after 1 January 1988 for New South Wales, Victoria and South Australia, and after 1 January 2000 for Queensland and the Australian Capital Territory. The 'Total for Register A' reflects the sum of the salinity cost of the state actions offset by 'Joint works and measures' or 'State shared works and measures' shown in the preceding lines.

Register B accounts for actions that occurred before the baseline year but for which the impacts were not experienced until after the baseline year because of the slow movement of groundwater and salt to the river. There have been significant improvements in confidence ratings for Register A items in recent years; however, many of the Register B items continue to have medium or low confidence ratings. This suggests relatively wide uncertainty bands around the Register B totals compared with Register A totals.

Balance Register A and B

The register balance provides an overall assessment of whether each basin partner is in net credit or debit. This balance needs to be interpreted in the light of the different levels of confidence in individual register entries provided by Register B. Uncertainty bands associated with the lower confidence in the Register B entries are incorporated into the overall balance for Register A and Register B items.

Table 14: 2019 salinity register A

	AUTHORITY REGISTER A (Accountable Actions)	Type	Date Effective	Provisional Salinity Credit ($m/yr)	Current Impact on Morgan 95%ile Salinity (EC)	Impact on Flow at Mouth (GL/y)	Salinity Effect^ (EC at Morgan)						Salinity Credits# (Interpolation to Current Year Benefits $m/year)									Commonwealth Contribution (EC)	Reviews (BSM2030 review plan)	
							2000	2015	2030	2050	2100	Modelled Current Conditions (Interpolation to Current Year)	NSW	Vic	SA	Qld	ACT	Collective Actions	Commonwealth	Total			Latest Review	Next Review
	JOINT WORKS & MEASURES																							
	Former Salinity & Drainage Works																							
1	Woolpunda SIS	SDS	Jan 1991		-74	0	-42.1	-43.5		-52.1	-59.1	-44.4	0.752	0.752						4.011	1	11.1	2018	2023
2	Improved Buronga and Mildura/Merbein IS	SDS	Jan 1991		-6	0	-3.0	-3.0		-3.0	-3.0	-3.0	0.140	0.140						0.748	2	0.8	2005	2021
3	New Operating Rules for Barr Creek Pumps	SDS	Jul 1991		-8	0	-4.9	-4.9		-4.9	-4.9	-4.9	0.225	0.225						1.198	3	1.2	2011	2019
4	Walkerie Stage 1 SIS	SDS	Dec 1992		-22	0	-16.1	-14.2		-13.5	-13.7	-14.1	0.236	0.236						1.260	4	3.5	2018	2024
5	Changed MDBC River Operations 1988 to 2000	SDS	Apr 1993		-1	4	-1.6	-1.6		-1.6	-1.6	-1.6	0.150	0.150						0.797	5	0.4	2005	2020
6	Mallee Cliffs SIS	SDS	Jul 1994		-17	0	-11.4	-11.3		-11.3	-11.3	-11.3	0.515	0.515						2.747	6	2.8	2013	2021
7	Changed Operation of Menindee and Lower Darling	SDS	Nov 1997		3	8	0.9	0.9		0.9	0.9	0.9	-0.146	-0.146						-0.776	7	-0.2	2005	2020
8	Walkerie Phase 2A SIS	SDS	Feb 2002		-7	0	-3.3	-3.3		-3.6	-3.7	-3.4	0.054	0.054						0.291	8	0.8	2018	2024
9	Changed MDBC River Operations 2000 to 2002	SDS	Feb 2002		-3	-1	-1.4	-1.4		-1.7	-1.9	-1.4	-0.136	-0.136						-0.728	9	0.4	2006	2020
	Sub Total - Former Salinity & Drainage Works				-136	11	-83.0	-82.3	0.0	-90.8	-98.4	-83.3	1.790	1.790	0.000	0.000	0.000	0.000	0.000	3.548		20.8		
	Basin Salinity Management Strategy																							
10	Changed MDBC River Operations after 2002	BSMS	Dec 2003		1	7	-0.2	-0.2		-0.4	-0.4	-0.3	0.022	0.022	0.022					0.135	10	0.1	2005	2020
11	Pyramid Ck GIS	BSMS	Mar 2006		-5	-3	-3.6	-3.5		-3.5	-3.4	-3.5	0.135	0.135	0.135					0.822	11	0.9	2016	2021
12	Bookpurnong SIS	BSMS	Mar 2006		-21	0	-8.2	-11.2		-16.0	-17.0	-11.8	0.219	0.219	0.219					1.334	12	2.9	2013	2019
13	Improved Buronga SIS	BSMS	Mar 2006		-1	0	-0.6	-0.5		-0.5	-0.5	-0.5	0.021	0.021	0.021					0.127	13	0.1	2006	2021
14	Loxton SIS	BSMS	Jun 2008		-17	0	-10.5	-10.8		-11.1	-12.0	-10.8	0.206	0.206	0.206					1.254	14	2.7	2013	2019
15	Walkerie Lock 2 SIS	BSMS	Jun 2010		-9	0	-5.9	-6.1		-6.1	-6.2	-6.1	0.068	0.068	0.068					0.416	15	1.5	2018	2024
16	Upper Darling SIS	BSMS	Jun 2014		-4	0	-4.5	-4.6		-4.5	-4.5	-4.6	0.241	0.241	0.241					1.471	16	1.1	2014	2019
17	Murtho SIS	BSMS	Jun 2014		-14	0	-5.8	-5.8		-20.9	-21.0	-7.5	0.231	0.231	0.231					1.408	17	1.9	2018	2022
	Sub Total Joint Works under BSMS				-69	4	-39.3	-42.7	0.0	-63.0	-65.0	-45.0	1.142	1.142	1.142	0.000	0.000	0.000	0.000	6.968		11.3		
	Joint Works Sub Total				-205	15	-122.3	-125.1	0.0	-153.8	-163.4	-128.3	2.932	2.932	1.142	0.000	0.000	0.000	0.000	16.516		32.1		
	The Living Murray Works and Measures and Water for Rivers**																							
18	TLM-RMIF 570 GL	TLM	Jun 2014	3.696	-47	346	-24.4	-24.4	-24.4	-24.4	-24.4	-24.4									18		2014	2020
19	TLM Works and Measures	TLM	Jun 2014	-0.902	5	0	4.6	4.6	4.6	4.6	4.6	4.6									19		2014	2020
	TLM Sub Total			2.794	-42	346	-19.8	-19.8	-19.8	-19.8	-19.8	-19.8												
	BSM2030																							
20	Responsive Management SIS	BSM2030	Jun 2015									12.0									20			
21	BIG Dilution benefits from delivery[A]	BSM2030	Jun 2015									-40.8									21			
	Sub Total under BSM2030				0	0	0.0	0.0	0.0	0.0	0.0	-28.8												
	BSM2030 and TLM Sub Total				-42	346	-19.8	-19.8	-19.8	-19.8	-19.8	-48.6												
	STATE WORKS & MEASURES																							
	Shared New South Wales and Victorian Measures																							
22	Permanent Trade Accounting Adjustment - NSW to Victoria	50N50V	Jun 2006		0	0	0.0	-0.1		-0.1	-0.1	-0.1	0.002	0.002						0.004	22	0	2006	2020
23	Barmah-Millewa Forest Operating Rules	50N50V	Mar 2002		-2	33	-1.9	-2.0		-1.9	-2.3	-2.0	0.187	0.187						0.373	23	0	2006	2020
	Shared Measures Sub Total				-2	33	-2.0	-2.1	0.0	-2.0	-2.3	-2.1	0.189	0.189	0.000	0.000	0.000	0.000	0.000	0.378		0		
	New South Wales																							
24	Boggabilla Weir	NSW	Dec 1991		0	0	-0.1	-0.1		-0.1	-0.1	-0.1	0.040							0.040	24	0	2007	2021
25	Pindari Dam Enlargement	NSW	Jul 1994		0	-17	0.7	0.7		0.7	0.7	0.7	-0.121							-0.121	25	0	2007	2021
26	Tandou pumps from Lower Darling	NSW	Sep 1994		2	-3	-0.1	-0.1		-0.1	-0.1	-0.1	0.034							0.034	26	0	2005	2020
27	NSW MIL LWMP's	NSW	Feb 1996		-4	57	-4.0	-4.0		-4.0	-4.0	-4.0	0.684							0.684	27	0	2010	2020
28	NSW Changes to Edward-Wakool and Escapes	NSW	Jan 1990		-2	4	-2.0	-2.1		-2.0	-2.0	-2.0	0.366							0.366	28	0	2005	2020
29	Permanent Trade Accounting Adjustment - NSW to SA	NSW	Jun 2006		-3	1	-0.5	-0.4		-0.4	-0.5	-0.4	0.109							0.109	29	0	2005	2020
30	NSW Sunraysia Irrigation Development 1997 to 2006	NSW	Jul 2003		2	0	0.0	0.0		4.5	6.1	1.3	-0.298							-0.298	30	0	2007	2021
31	RISI Stage 1	NSW	Jun 2010		-5	0	-2.7	-3.9		-4.1	-4.1	-3.9	0.853							0.853	31	0	2016	2021
32	RISI Stage 2	NSW	Jun 2014		-4	0	-3.6	-3.8		-3.9	-3.9	-3.8	0.858							0.858	32	0	2014	2021
33	NSW S&DS Commitment Adjustment	NSW	Nov 2002		0	0	0	0		0	0	0	0.910							0.910	33	0		2020
	New South Wales Works and Measures				-15	43	-12.4	-12.9	0.0	-9.4	-8.0	-12.5	3.435							3.435		0		
	Victoria																							
34	Barr Creek Catchment Strategy	Vic	Mar 1991		-12	0	-7.7	-7.7		-7.7	-7.7	-7.7		1.963						1.963	34	0	2013	2019
35	Tragowel Plains Drains at 2002 level	Vic	Mar 1991		1	1	0.2	0.2		0.2	0.2	0.2		-0.022						-0.022	35	0	2013	2019
36	Shepparton SMP 0.01 TWF	Vic	Mar 1991		8	-61	5.7	5.4		5.9	7.8	5.4		-1.064						-1.064	36	0	2018	2023
37	Nanqiloc-Colignan S.M.P.	Vic	Nov 1991		-1	1	0.4	0.4		0.4	0.4	0.4		-0.102						-0.102	37	0	2013	2023
38	Nyah to SA Border SMP - Irrigation Development	Vic	Jul 2003		26	0	17.7	17.6		17.5	17.6	17.6		-4.086						-4.086	38	0	2014	2019
39	Kerang Lakes/Swan Hill Salinity Management Plan	Vic	Jan 2000		1	4	1.1	1.6		1.1	0.9	1.6		-0.361						-0.361	39	0	2010	2020
40	Campaspe West SMP	Vic	Aug 1993		0	0	0.0	0.0		-0.1	0.0	0.0		-0.046						-0.046	40	0	2017	N/A
41	Psyche Bend	50V50C	Feb 1996		-4	0	-2.1	-2.1		-2.1	-2.1	-2.1		0.237						0.474	41	1	2017	2022
42	Permanent Trade Accounting Adjustment - Victoria to SA	Vic	Jun 2006		0	2	-0.7	-0.8		-0.8	-1.0	-0.8		0.183						0.183	42	0	2005	2020
43	Woorinen Irrigation District Excision	Vic	Sep 2003		-1	-2	1.3	0.8		1.0	1.2	0.8		-0.230						-0.230	43	0	2010	2020
44	Sunraysia Drains Drying up	Vic	Jun 2004		-2	-4	-2.1	-2.2		-2.1	-2.1	-2.2		0.640						0.640	44	0	2017	2022
45	Lamberts Swamp	Vic	Jun 2004		-5	0	-3.0	-3.0		-3.0	-3.0	-3.0		0.624						0.624	45	0	2017	2027
46	Church's Cut decommissioning	Vic	Mar 2006		0	0	-0.2	-0.3		-0.2	-0.2	-0.3		0.048						0.048	46	0	2016	2021
47	Mallee Drainage bore decommissioning	Vic	Jun 2008		-1	0	-0.1	-0.3		-0.3	-0.3	-0.3		0.065						0.065	47	0	2019	2029
48	RISI Stage 1	Vic	Jun 2010		-9	0	-2.0	-5.5		-6.8	-7.1	-5.7		1.327						1.327	48	0	2016	2021
49	RISI Stage 2	Vic	Jun 2014		-6	0	-4.4	-4.7		-5.0	-5.1	-4.8		1.073						1.073	49	0	2014	2021
50	Victorian S&DS Commitment Adjustment	Vic	Nov 2002		0	0	0	0		0	0	0		1.600						1.600	50	0		2020
	Victoria Works and Measures				-3	-59	4.1	-0.5	0.0	-2.0	-0.5	-0.7		1.837						2.074		1.0		
	South Australia																							
51	SA Irrigation Development Based on Footprint Data*	SA	Jul 2003		27	0	4.6	12.5		54.3	73.1	17.3			-1.881					-1.881	51	0	2015	2026
52	SA Irrigation Development Due to Water Trade	SA	Jun 2006		0	0	0.0	0.1		3.4	13.8	0.5			-0.169					-0.169	52	0	2014	2021
53	SA Irrigation Development Based on Site Use Approvals	SA	Jun 2010		2	0	-0.1	0.1		11.4	76.4	1.4			-0.207					-0.207	53	0	2014	2021
54	SA Component of Bookpurnong SIS	SA	Mar 2006		-7	0	-3.0	-4.1		-5.9	-6.3	-4.4			0.485					0.485	54	0	2013	2019
55	SA Component of Loxton SIS	SA	Jun 2008		-1	0	-0.8	-0.8		-0.8	-0.9	-0.8			0.095					0.095	55	0	2013	2019
56	SA component of Walkerie Lock 2 SIS	SA	Jun 2010		-1	0	-0.4	-0.4		-0.4	-0.4	-0.4			0.026					0.026	56	0	2018	2024
57	SA Improved Irrigation Efficiency and Scheme Rehabilitation Req A	SA	Jan 2000		-37	0	-10.8	-21.5		-24.3	-21.3	-21.9			2.950					2.950	57	0	2018	2026
58	Qualco Sunlands GWCS	SA	Sep 2004		-8	0	-5.0	-5.2		-7.8	-8.5	-5.5			0.382					0.382	58	0	2018	2024
59	Pike Stage 1 SIS	SA	Jan 2012		-5	0	-2.2	-3.0		-4.9	-5.4	-3.2			0.492					0.492	59	0	2018	2022
60	SA component of Murtho SIS	SA	Jun 2014		0	0	-0.1	-0.1		-0.4	-0.4	-0.2			0.029					0.029	60	0	2018	2022
	South Australia Subtotal				-30	0	-17.8	-22.5	0.0	24.5	120.0	-17.1			2.202					2.202		0		
	Balance - Register A				-254	31	-150.4	-163.0	0.0	-142.6	-54.2	-209.3	6.556	4.958	3.344	0.000	0.000	0.000	0.000	21.063		33.1		
						Factors for allocating transferred credits to Register B							0.243	0.184	0.563	0.000	0.000							

Table 15: 2019 salinity register B

	AUTHORITY REGISTER B (Delayed Salinity Impacts)	Type	Year of Predictions	Provisional Salinity Credit ($m/yr)	Current Impact on Morgan 95%ile Salinity (EC)	Impact on Flow at Mouth (GL/y)						Salinity Credits (Interpolation to Current Year Benefits $m/year)					
							2000	2015	2030	2050	2100	Modelled Current Conditions (Interpolation to Current Year)	NSW	Vic	SA	Qld	ACT	Total
	Transfers from Register A												0.861	0.687	1.994	0.000	0.000	3.542
	New South Wales																	
61	Darling Catchment Legacy of History - Macquarie	NSW	Jan 2000		0	0	0	0.1		0.3	0.4	0.1	-0.038					-0.038
62	Darling Catchment Legacy of History - Macintyre	NSW	Jan 2000		0	0	0	0.0		0.0	0.0	0	0.000					0.000
63	Darling Catchment Legacy of History - Gil Gil Ck	NSW	Jan 2000		0	0	0	0.0		0.0	0.0	0.0	-0.001					-0.001
64	Darling Catchment Legacy of History - Gwydir	NSW	Jan 2000		0	0	0	0.0		0.0	0.0	0.0	-0.002					-0.002
65	Darling Catchment Legacy of History - Namoi	NSW	Jan 2000		0	0	0	0.2		0.4	0.5	0.2	-0.056					-0.056
66	Darling Catchment Legacy of History - Castlereagh	NSW	Jan 2000		0	0	0	0.0		0.0	0.1	0.0	-0.001					-0.001
67	Darling Catchment Legacy of History - Bogan	NSW	Jan 2000		0	0	0	0.1		0.2	0.3	0.1	-0.028					-0.028
68	Lachlan Legacy of History	NSW	Jan 2000		0	0	0	0.0		0.0	0.0	0	0.000					0.000
69	Murrumbidgee Catchment Legacy of History	NSW	Jan 2000		0	0	0	0.1		0.2	0.2	0.1	-0.020					-0.020
70	NSW Mallee - dryland	NSW	Jan 2000		0	0	0	0.3		1.3	3.6	0.4	-0.096					-0.096
71	NSW Mallee - Pre 88 irrigation	NSW	Jan 2000		0	0	0	0.4		1.2	2.3	0.5	-0.120					-0.120
	Victoria																	
72	Campaspe Catchment Legacy of History	Vic	Jan 2000		0	0	0	0.1		0.2	0.3	0.1		-0.028				-0.028
73	Goulburn Catchment Legacy of History	Vic	Jan 2000		1	-5	0	0.5		1.1	1.6	0.6		-0.131				-0.131
74	Loddon Catchment Legacy of History	Vic	Jan 2000		1	-1	0	1.0		1.5	2.3	1.0		-0.260				-0.260
75	Kiewa Catchment Legacy of History	Vic	Jan 2000		0	0	0	0.1		0.0	0.0	0.1		-0.033				-0.033
76	Ovens Catchment Legacy of History	Vic	Jan 2000		0	0	0	0.0		0.6	1.3	0		-0.017				-0.017
77	Victorian Mallee - dryland	Vic	Jan 2000		1	0	0	0.6		2.2	5.9	0.8		-0.181				-0.181
78	Victorian Mallee - Pre 88 irrigation	Vic	Jan 2000		3	0	0	1.4		4.7	8.3	1.7		-0.416				-0.416
	South Australia																	
79	SA Mallee Legacy of History - Dryland	SA	Jan 2000		3	0	0	1.2		5.4	15.1	1.7			-0.251			-0.251
80	SA Mallee Legacy of History - Irrigation	SA	Jan 2000		40	0	0	14.7		36.1	42.0	17.0			-2.739			-2.739
81	SA Improved Irrigation Efficiency and Scheme Rehabilitation Reg B	SA	Jan 2000		-74	0	0	-36.4		-52.0	-59.2	-38.2			5.273			5.273
	Queensland																	
82	Queensland Legacy of History	Qld	Jan 2000	TBA														
83	Queensland Irrigation Development pre 1 Jan 2000	Qld	Jan 2000	TBA														
	Balance - Register B			0.000	-23	-6	0.0	-15.6	0.0	2.4	25.1	-13.6	0.494	-0.380	4.277	0.000	0.000	4.390
	Balance - Registers A & B				-277	26	-150.4	-178.6	0.0	-140.2	-29.1	-222.8	7.050	4.578	7.621	0.000	0.000	25.453
	Modelled Current Status				778	4,944	515	487		525	637	492						

Registers Explanatory Notes
TBA - To be advised
^Salinity Effect - Increase or decrease in average salinity at Morgan in EC
#Salinity Credits - Unit of account of Salinity and Drainage Strategy = Reduction in Salinity Costs ($m/year March 2005 values)
* These entries are comprised of multiple MODFLOW model outputs accredited at various times. As such they are not reviewed and updated in their entirety in one year but the component models are updated in line with the BSM2030 review plan. The review year reflects the latest model review.
Some of the totals are affected by rounding
** Assessments based on preliminary reports. Further work is required on how these assessments are presented in the register. Salinity impacts not included in the totals.
[A] Based on 1819 GL representing the LTDLE volume of all HEW entitlements
Total Register A of $21.188 m/yr excludes transfers to Register B

Appendix C – Baseline conditions

The BSM2030 baseline conditions are the agreed suite of conditions in place within the catchments and rivers of the basin on 1 January 2000. They include land use (level of development); water use (level of diversions); land and water management policies and practices (including the Murray–Darling Basin cap agreements); river operating regimes; SIS; run-off generation; salt mobilisation processes; and groundwater status and condition.

The baseline conditions have been set for all end-of-valley target sites as shown in Table 16.

Table 16: Basin Salinity Management Strategy end-of-valley baseline conditions

Valley	Salinity (EC) mean (50%ile)	Salinity (EC) peak (80%ile)	Salt load (t/y) mean	Valley reporting site	AWRC site number
All partner governments					
Murray–Darling Basin	570	920 (95%ile)	1,600,000	Murray R at Morgan (Salinity)	426554
				Murray R at Lock 1 (Flow)	426902
South Australia					
SA Border	380	470	1,300,000	Flow to SA	426200
Lock 6 to Berri	450	600	1,500,000	Murray R at Lock 4 (Flow)	426514
Below Morgan	600	820	1,600,000	Murray R at Murray Bridge	426522
New South Wales					
Murrumbidgee	150	230	160,000	Murrumbidgee R d/s Balranald Weir	410130
Lachlan	430	660	250,000	Lachlan R at Forbes (Cottons Weir)	412004
Bogan	440	490	27,000	Bogan R at Gongolgon	421023
Macquarie	480	610	23,000	Macquarie R at Carinda (Bells Bridge)	421012
Castlereagh	350	390	9,000	Castlereagh R at Gungalman Bridge	420020
Namoi	440	650	110,000	Namoi R at Goangra	419026
Gwydir	400	540	7,000	Mehi R at Bronte	418058

Valley	Salinity (EC) mean (50%ile)	Salinity (EC) peak (80%ile)	Salt load (t/y) mean	Valley reporting site	AWRC site number
NSW Border Rivers	250	330	50,000	Barwon R at Mungindi	416001
Barwon–Darling	330	440	440,000	Darling R at Wilcannia Main Channel	425008
NSW Upper Murray	54	59	150,000	Murray R at Heywoods	409016
NSW Riverine Plains	310	390	1,100,000	Murray R at Red Cliffs	414204
NSW Mallee Zone	380	470	1,300,000	Flow to SA	426200
Victoria					
Wimmera	1,380	1,720	31,000	Wimmera R at Horsham Weir	415200
Avoca	2,060	5,290	37,000	Avoca R at Quambatook	408203
Loddon	750	1,090	88,000	Loddon R at Laanecoorie	407203
Campaspe	530	670	54,000	Campaspe R at Campaspe Weir	406218
Goulburn	100	150	166,000	Goulburn R at Goulburn Weir	405259
Broken	100	130	15,000	Broken Ck at Casey's Weir	404217
Ovens	72	100	54,000	Ovens R at Peechelba East	403241
Kiewa	47	55	19,000	Kiewa R at Bandiana	402205
Vic. Upper Murray	54	59	150,000	Murray R at Heywoods	409016
Vic. Riverine Plains	270	380	630,000	Murray R at Swan Hill	409204
Vic. Mallee Zone	380	470	1,300,000	Flow to SA	426200
Queensland					
Queensland Border Rivers	250	330	50,000	Barwon R at Mungindi	416001 [a]

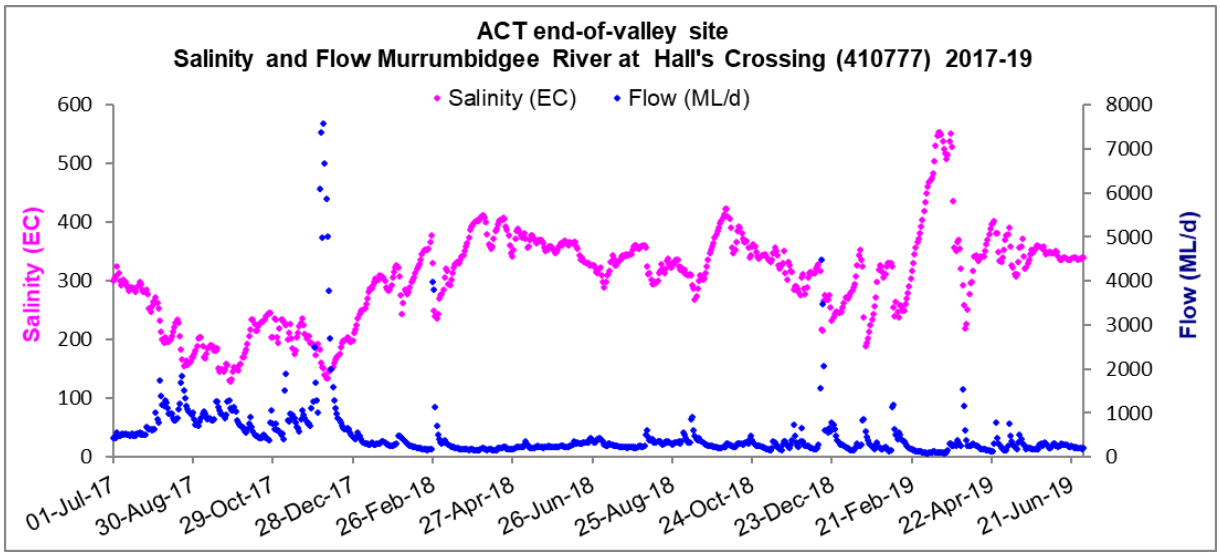
Valley	Salinity (EC) mean (50%ile)	Salinity (EC) peak (80%ile)	Salt load (t/y) mean	Valley reporting site	AWRC site number
Moonie	140	150	8,700	Moonie R at Fenton	417204A
Condamine–Balonne	170	210	4,200	Ballandool R at Hebel—Bollon Rd	422207A
	170	210	5,000	Bokhara R at Hebel	422209A
	150	280	6,500	Briarie Ck at Woolerbilla—Hebel Rd	422211A
	170	210	29,000	Culgoa R at Brenda	422015 [a]
	160	210	10,000	Narran R at New Angledool	422030 [a]
Paroo	90	100	24,000	Paroo R at Caiwarro	424201A
Warrego	101	110	4,800	Warrego R at Barringun No.2	423004 [a]
	100	130	5,500	Cuttaburra Ck at Turra	423005 [a]
Australian Capital Territory					
ACT	224	283	32,700	Murrumbidgee R at Hall's Crossing	410777

[a] *These sites are operated by New South Wales for Queensland*

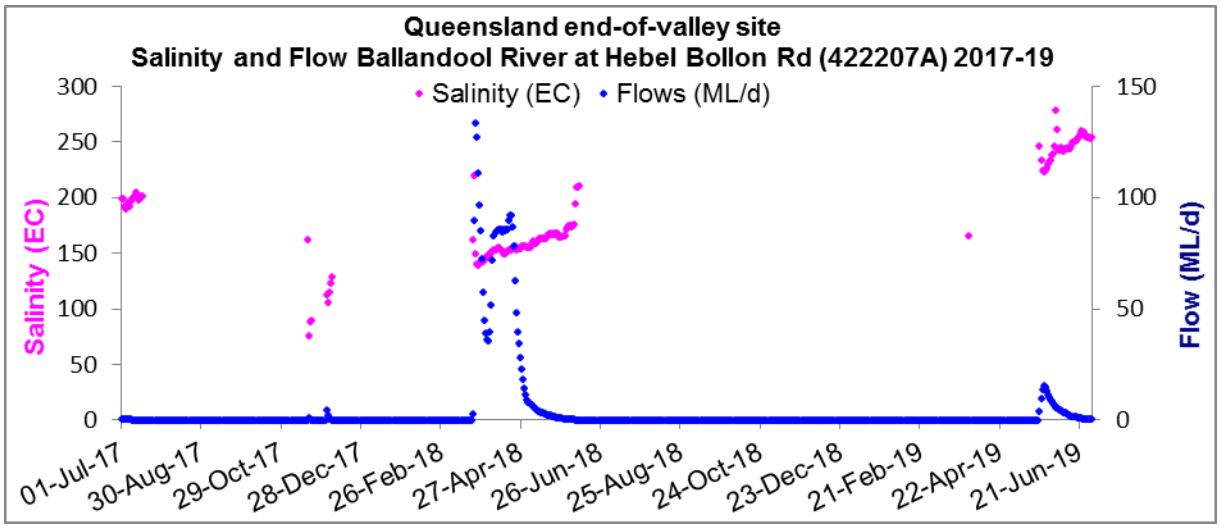
Appendix D – Flow and salinity for EoVT sites

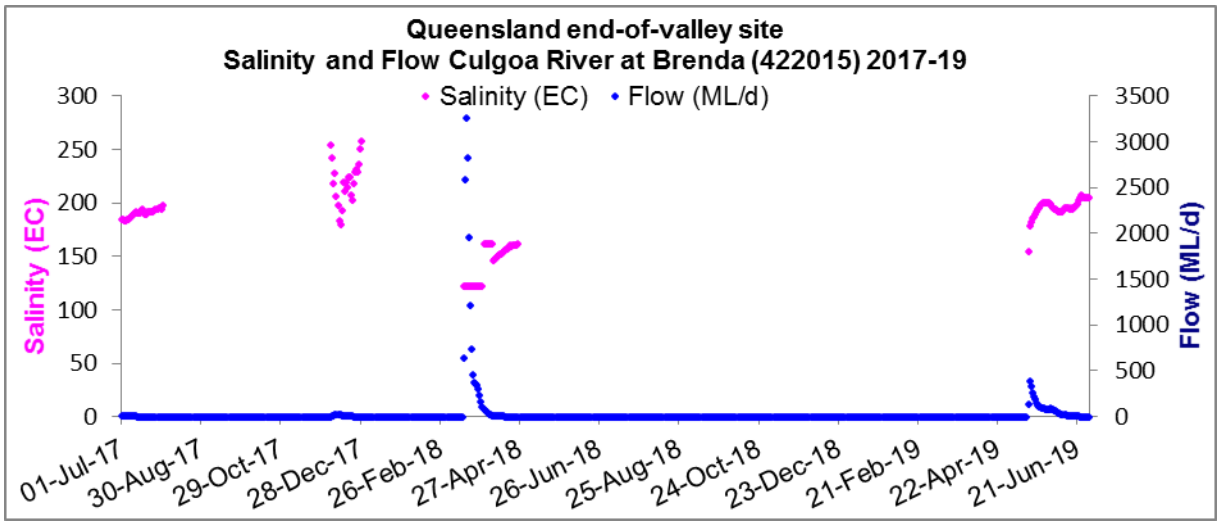
The graphs presented in Appendix D are related to the end-of-valley target sites and illustrate flow and salinity for the 2017–18 and 2018-19 period.

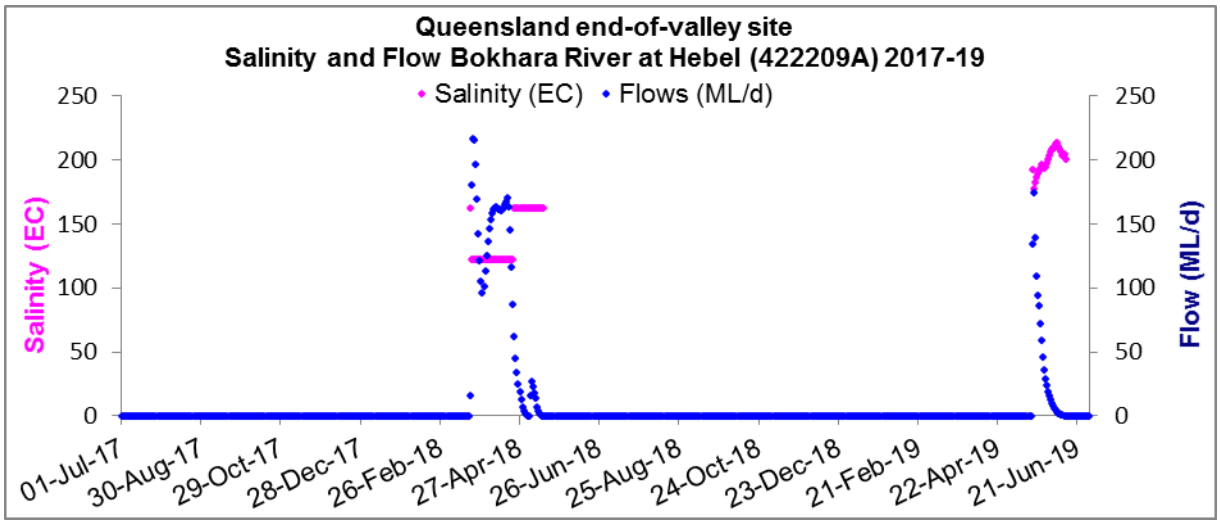
Australian Capital Territory

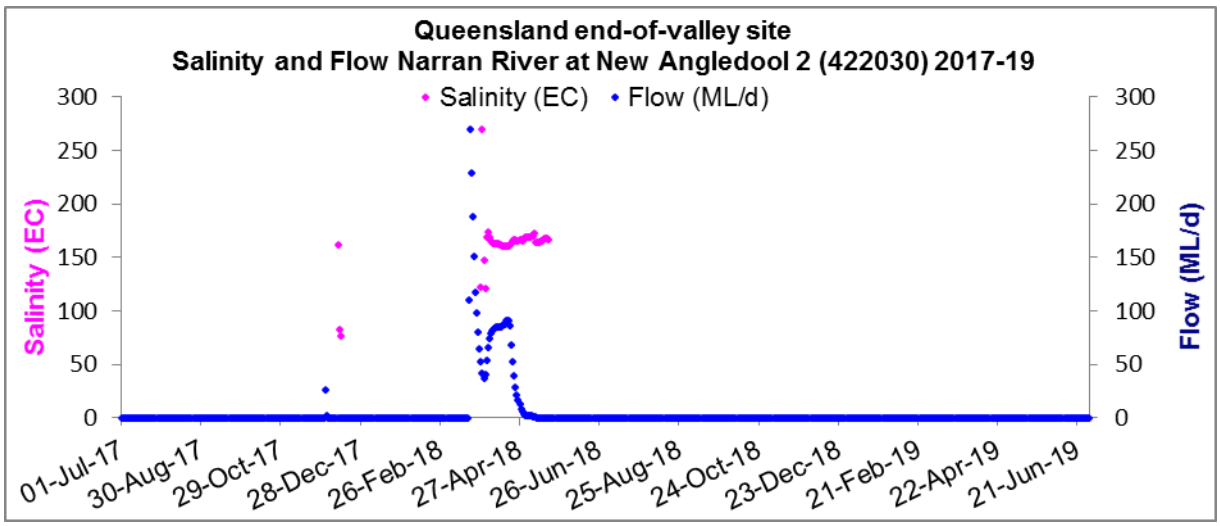


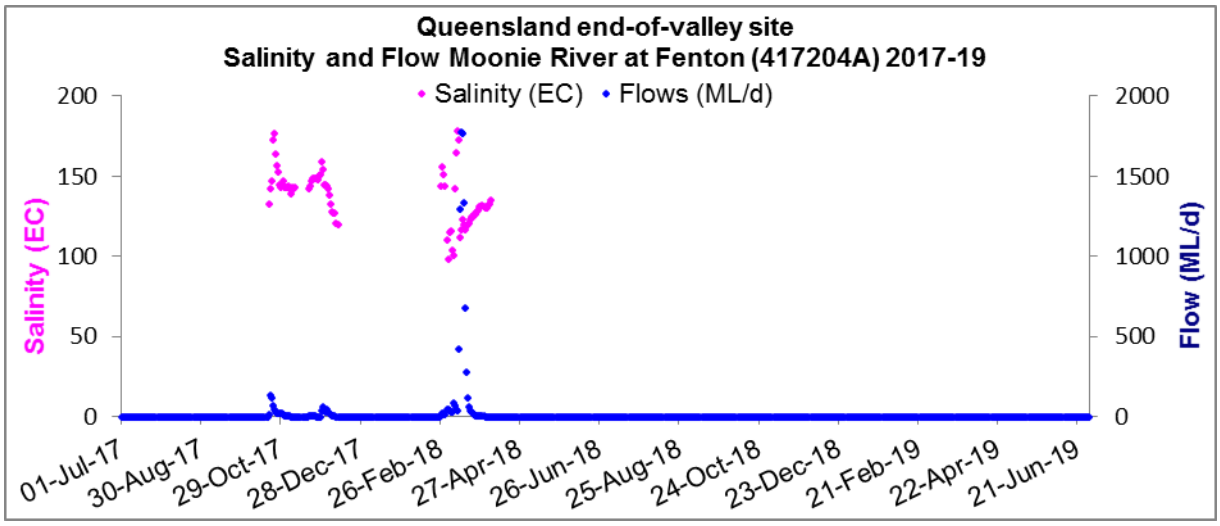
Queensland

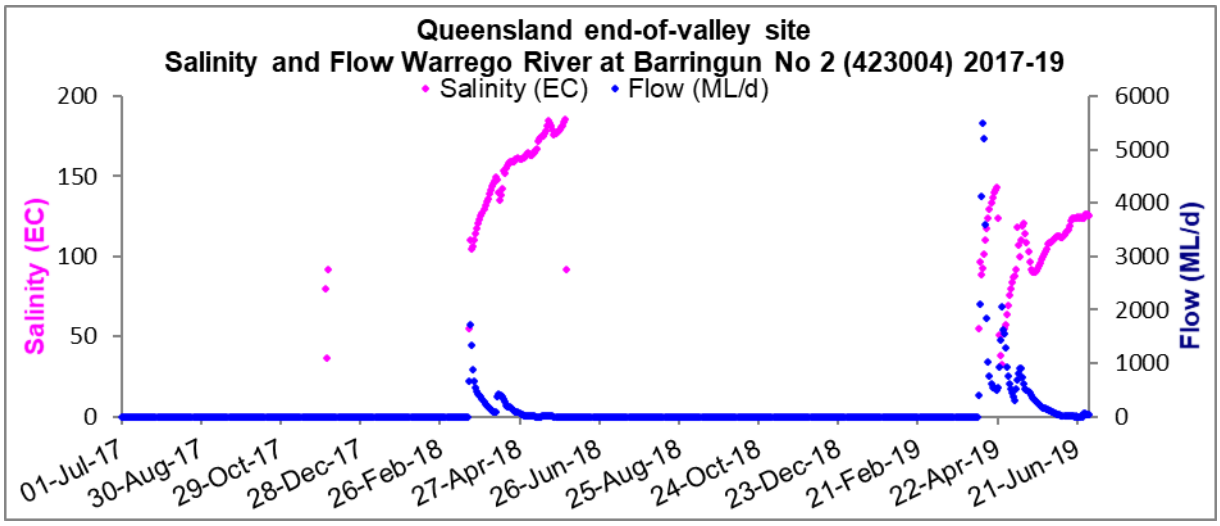


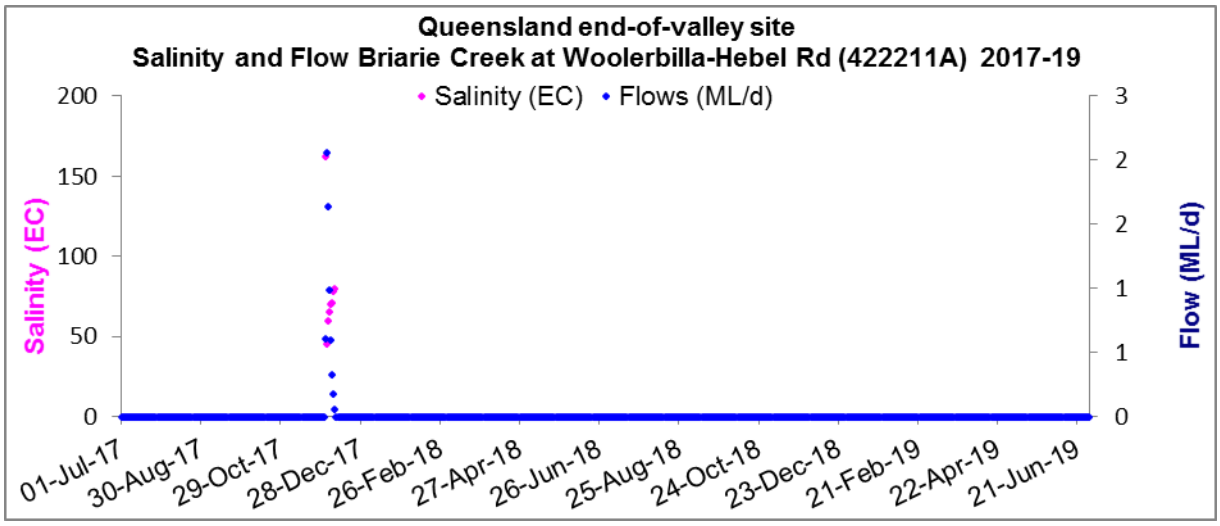

Queensland end-of-valley site
Salinity and Flow Culgoa River at Brenda (422015) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
300
250
200
150
100
50
0
3500
3000
2500
2000
1500
1000
500
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

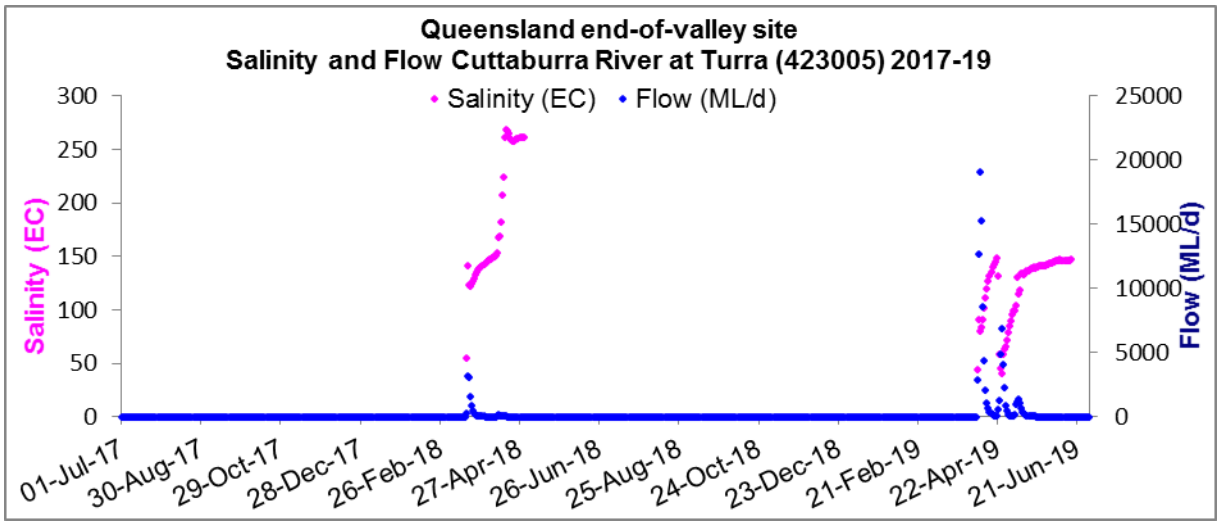

Queensland end-of-valley site
Salinity and Flow Bokhara River at Hebel (422209A) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
250
200
150
100
50
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

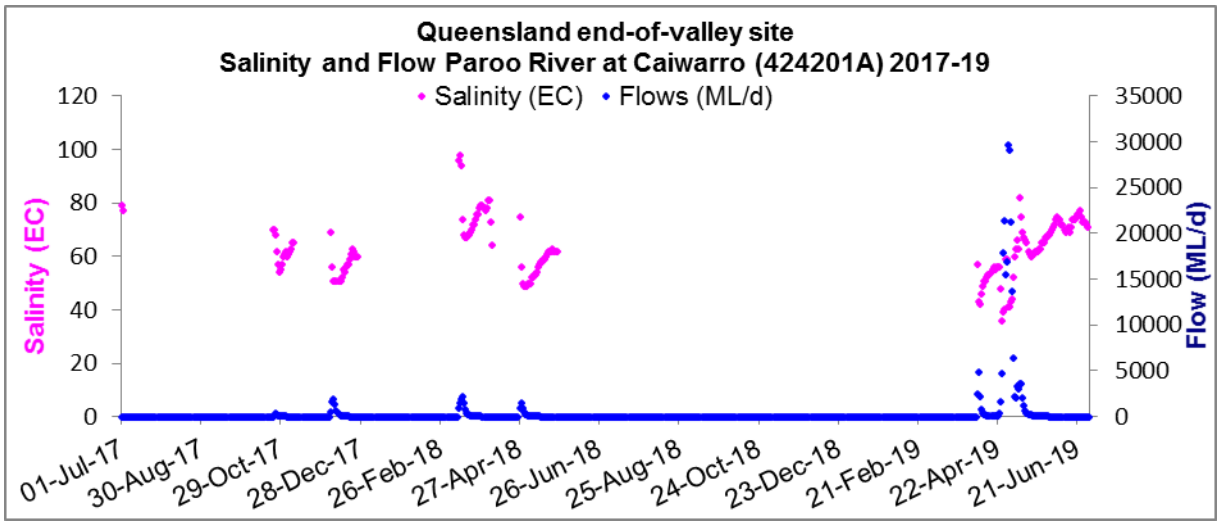

Queensland end-of-valley site
Salinity and Flow Narran River at New Angledool 2 (422030) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
300
250
200
150
100
50
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19


Queensland end-of-valley site
Salinity and Flow Moonie River at Fenton (417204A) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
200
150
100
50
0
2000
1500
1000
500
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

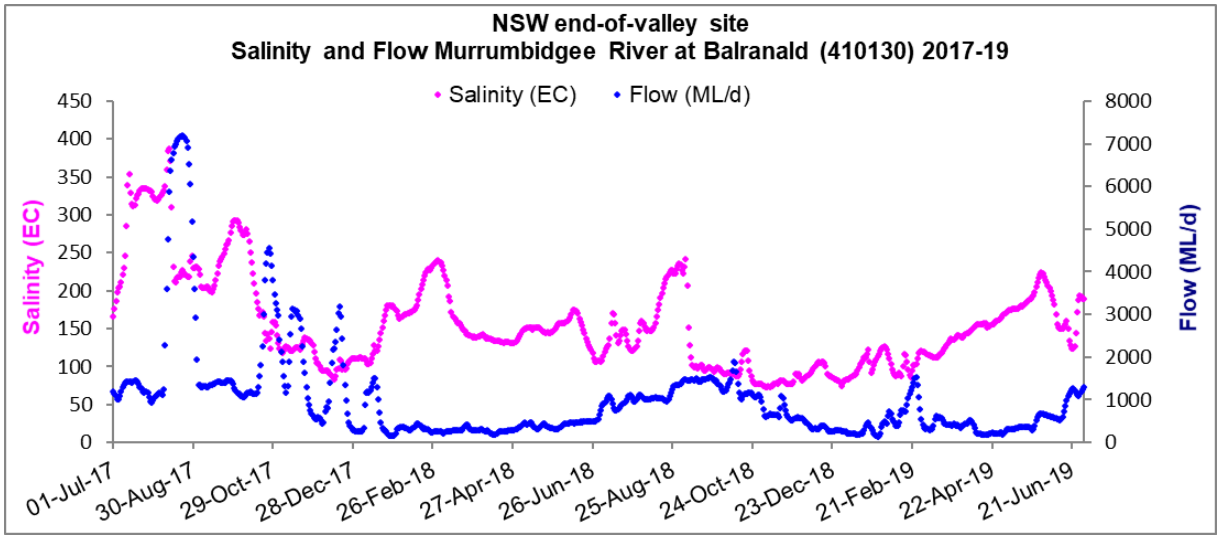

Queensland end-of-valley site
Salinity and Flow Warrego River at Barringun No 2 (423004) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
200
150
100
50
0
6000
5000
4000
3000
2000
1000
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

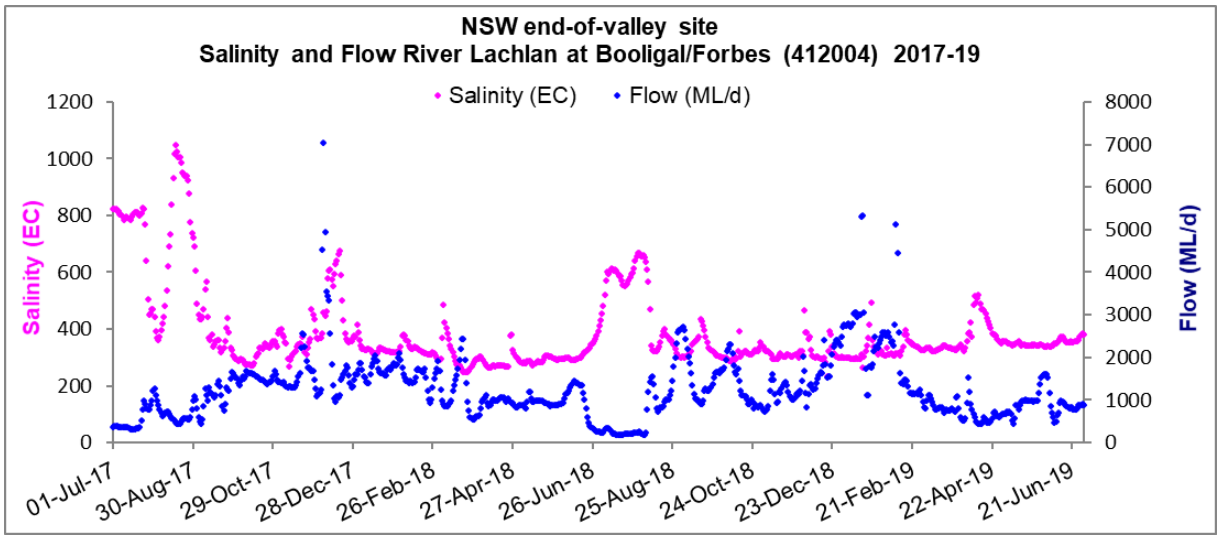

Queensland end-of-valley site
Salinity and Flow Briarie Creek at Woolerbilla-Hebel Rd (422211A) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
200
150
100
50
0
3
2
2
1
1
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

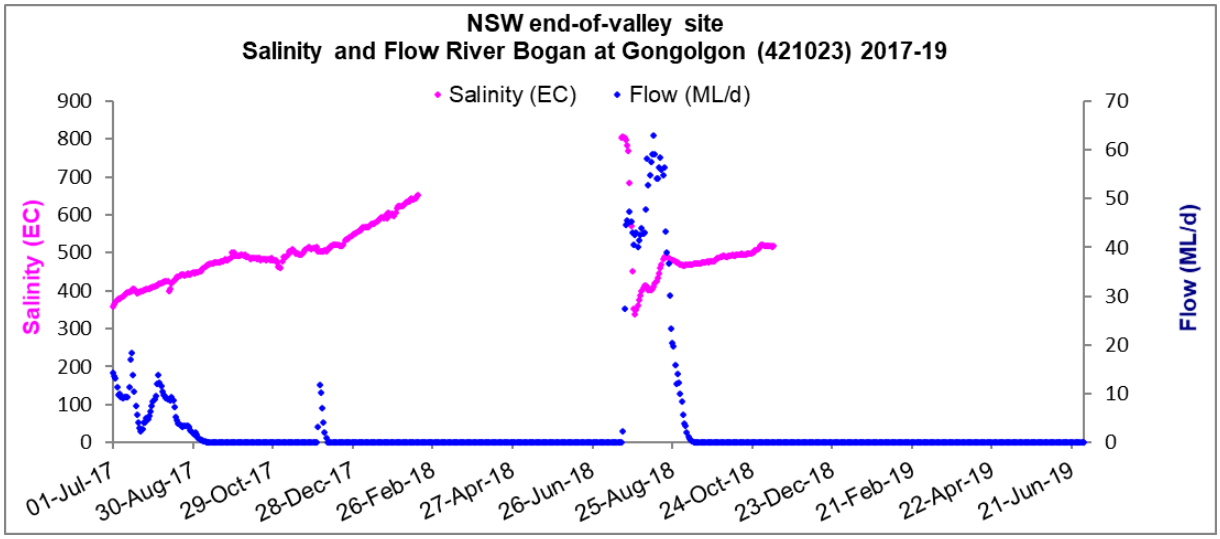


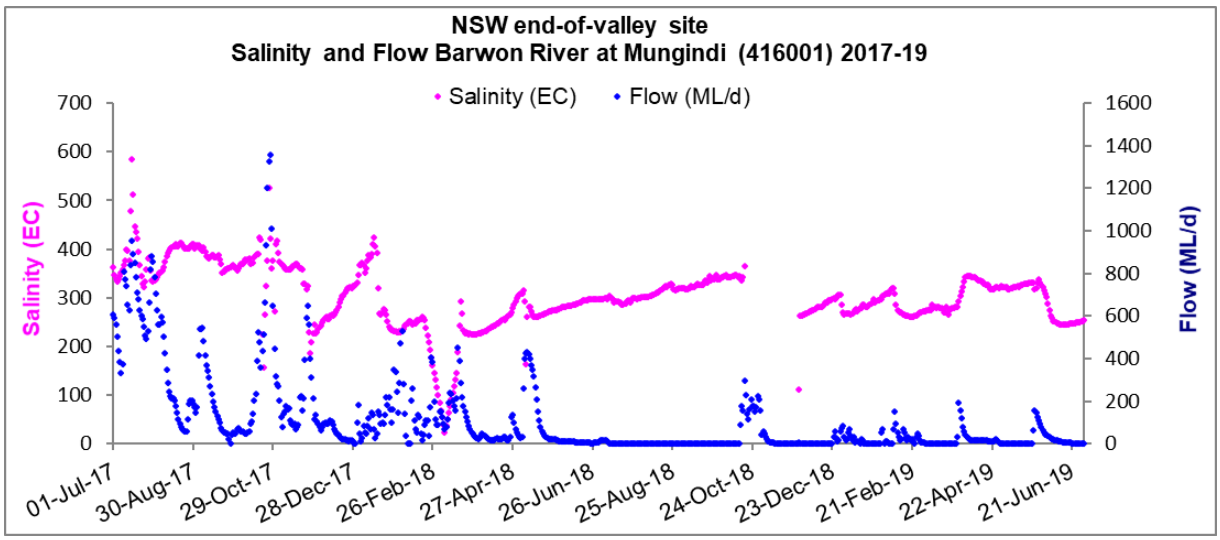


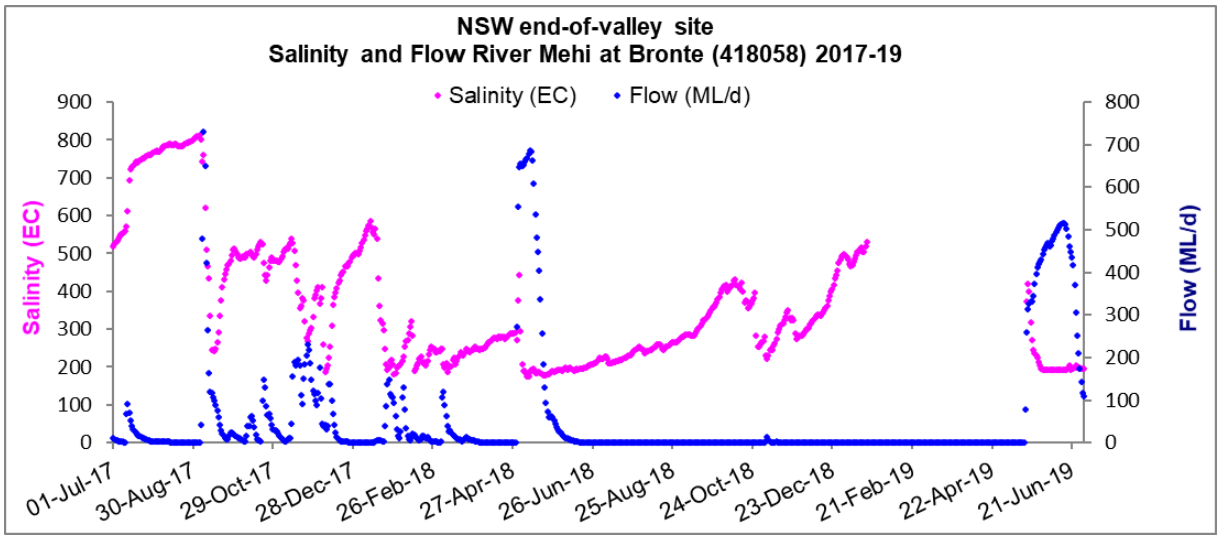
New South Wales

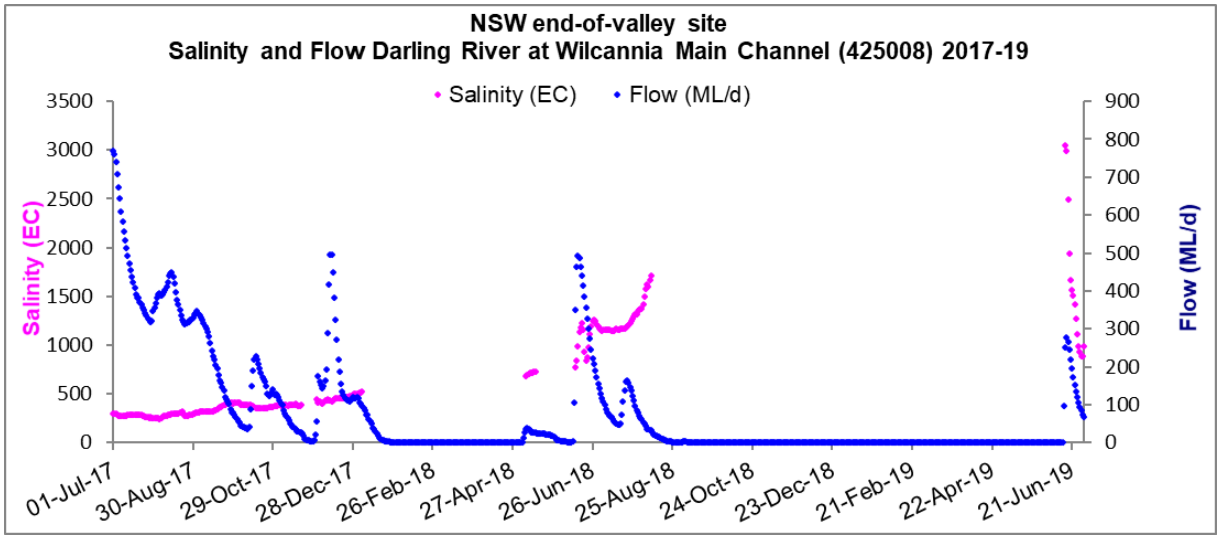


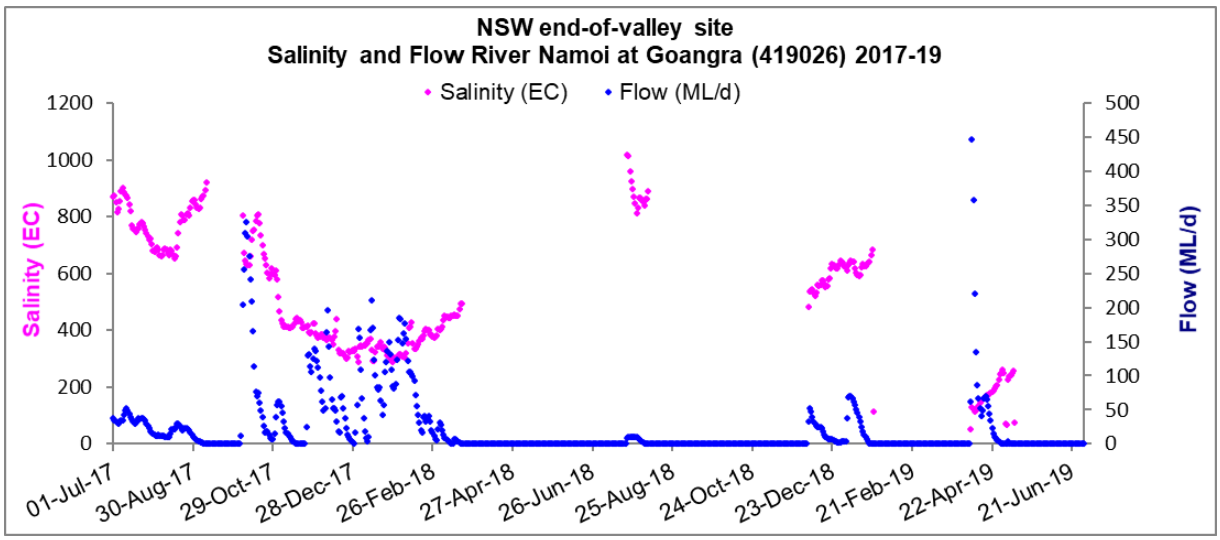

NSW end-of-valley site
Salinity and Flow River Lachlan at Booligal/Forbes (412004) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
1200
1000
800
600
400
200
0
8000
7000
6000
5000
4000
3000
2000
1000
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

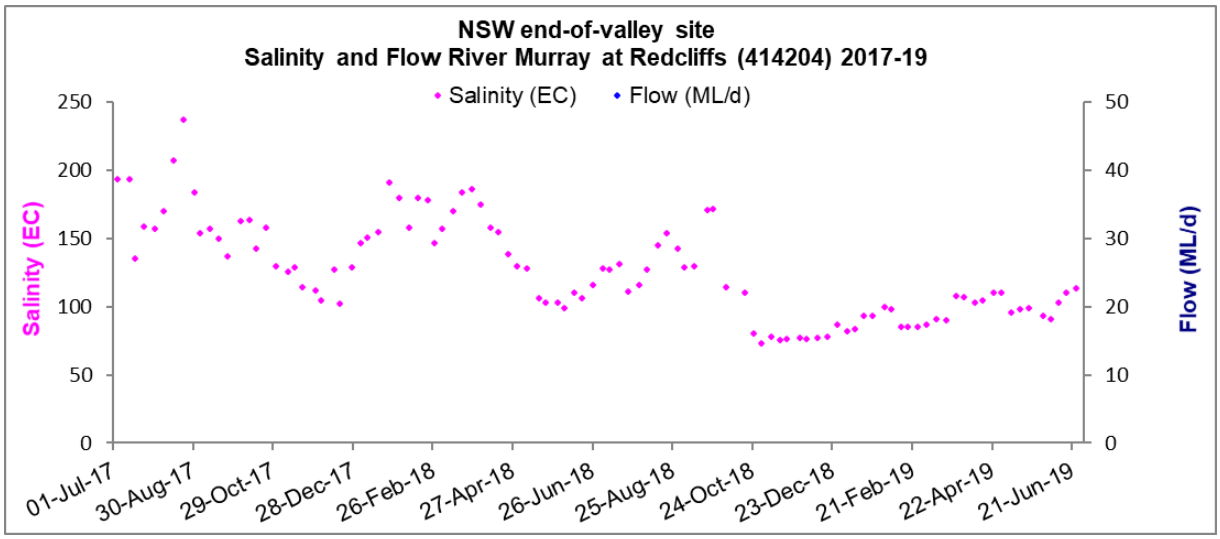

NSW end-of-valley site
Salinity and Flow River Bogan at Gongolgon (421023) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
900
800
700
600
500
400
300
200
100
0
70
60
50
40
30
20
10
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

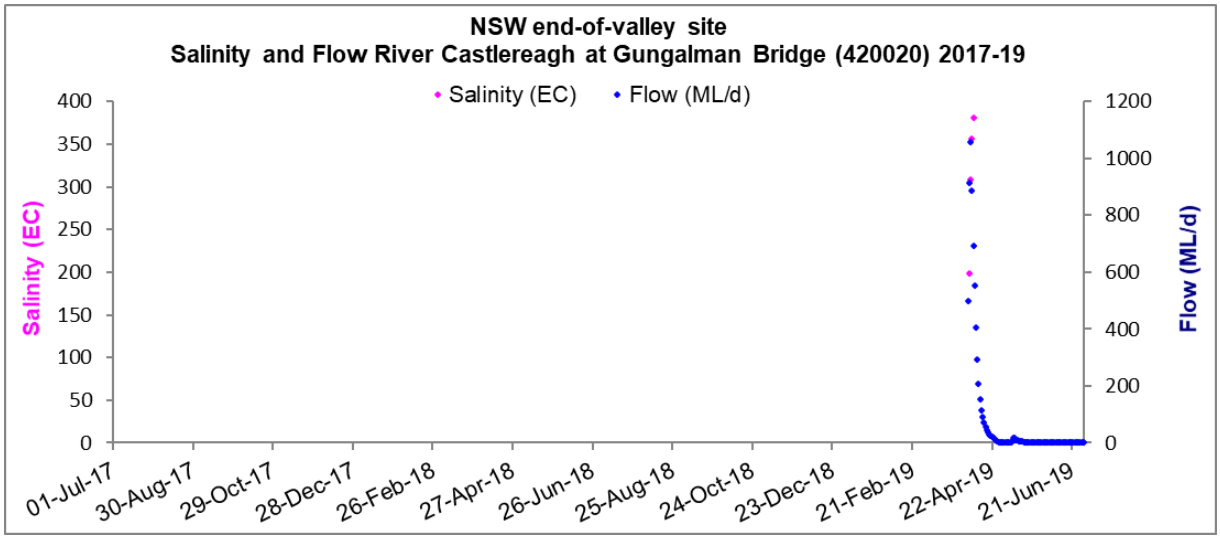

NSW end-of-valley site
Salinity and Flow Barwon River at Mungindi (416001) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
700
600
500
400
300
200
100
0
1600
1400
1200
1000
800
600
400
200
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

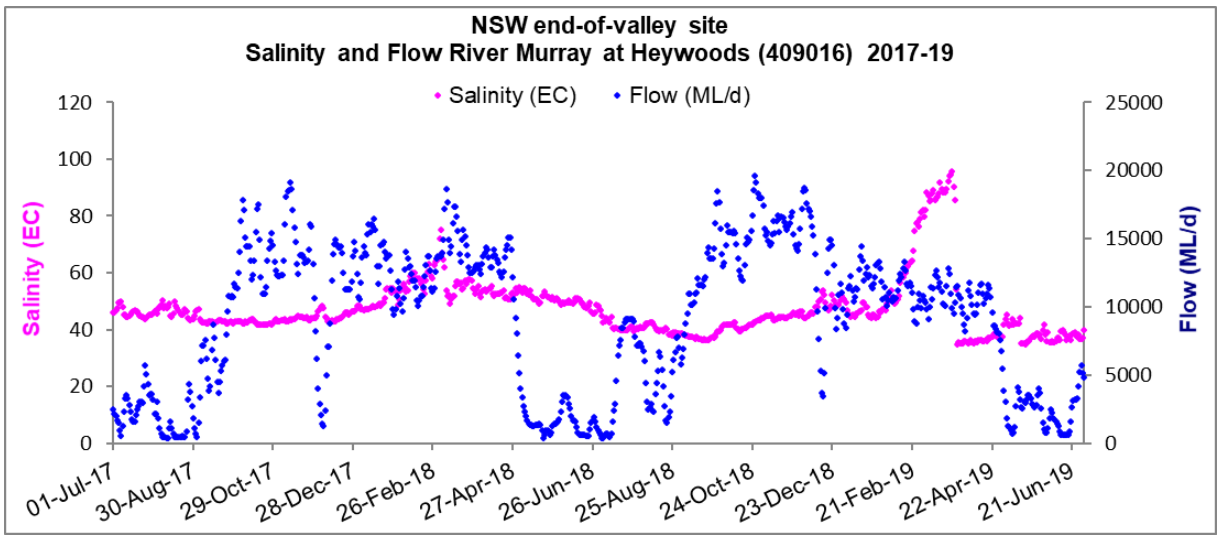

NSW end-of-valley site
Salinity and Flow River Mehi at Bronte (418058) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
900
800
700
600
500
400
300
200
100
0
800
700
600
500
400
300
200
100
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

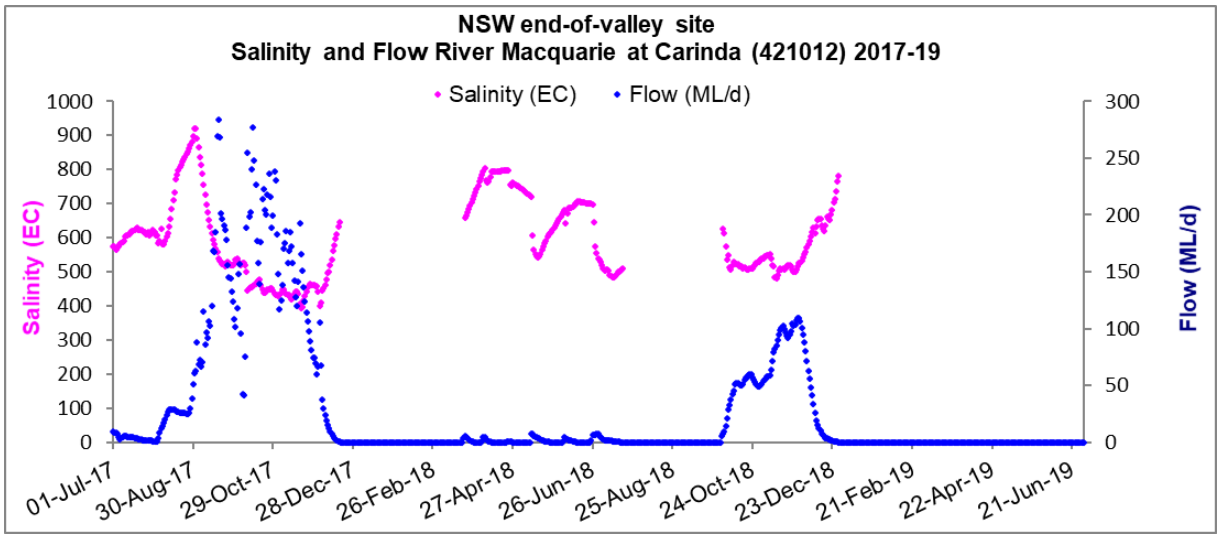

NSW end-of-valley site
Salinity and Flow Darling River at Wilcannia Main Channel (425008) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
3500
3000
2500
2000
1500
1000
500
0
900
800
700
600
500
400
300
200
100
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19


NSW end-of-valley site
Salinity and Flow River Namoi at Goangra (419026) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
1200
1000
800
600
400
200
0
500
450
400
350
300
250
200
150
100
50
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

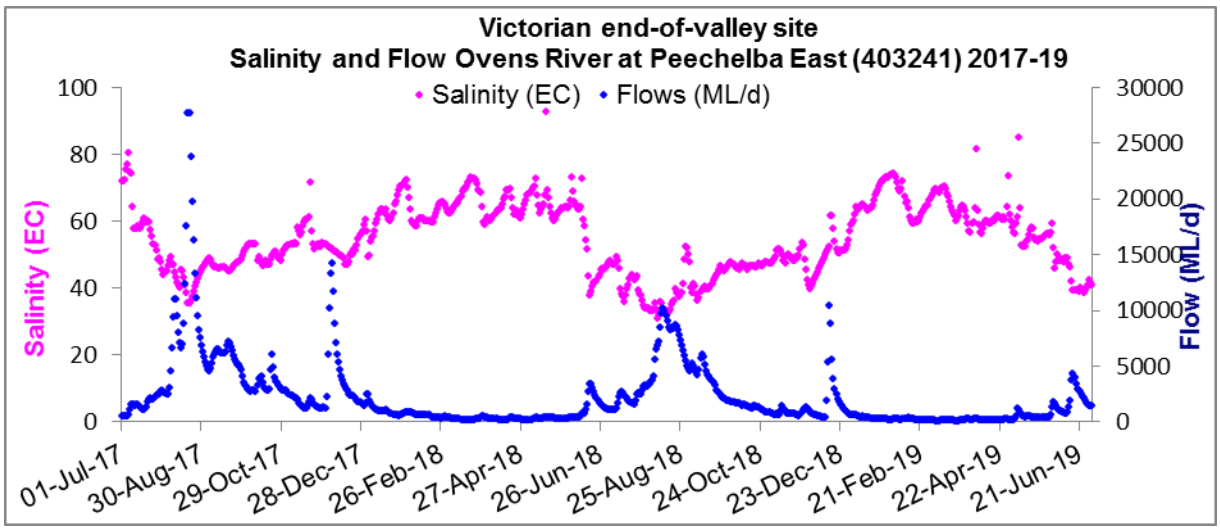

NSW end-of-valley site
Salinity and Flow River Murray at Redcliffs (414204) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
250
200
150
100
50
0
50
40
30
20
10
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

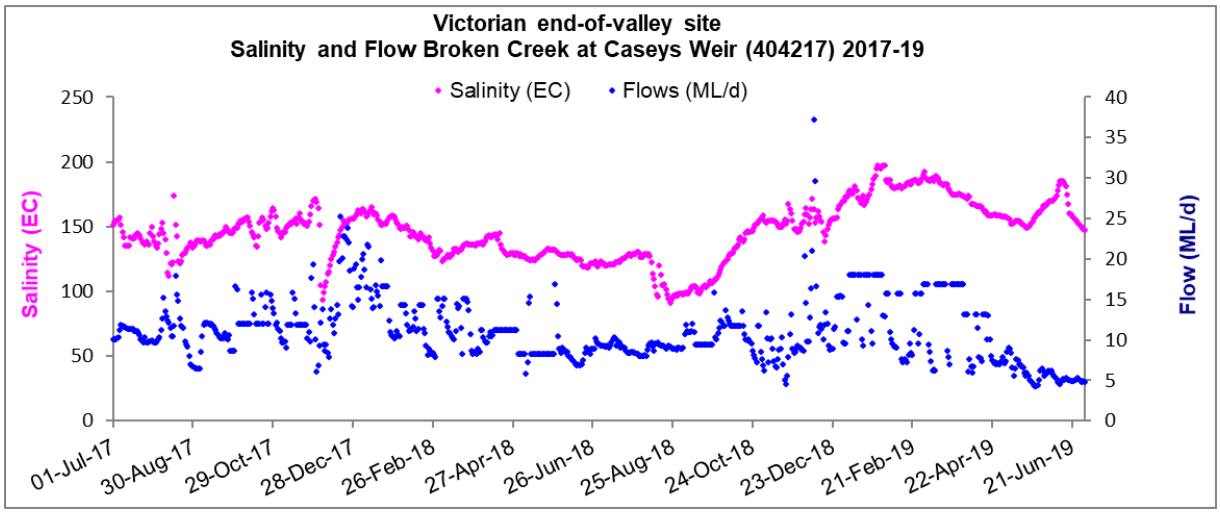

NSW end-of-valley site
Salinity and Flow River Castlereagh at Gungalman Bridge (420020) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
400
350
300
250
200
150
100
50
0
1200
1000
800
600
400
200
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

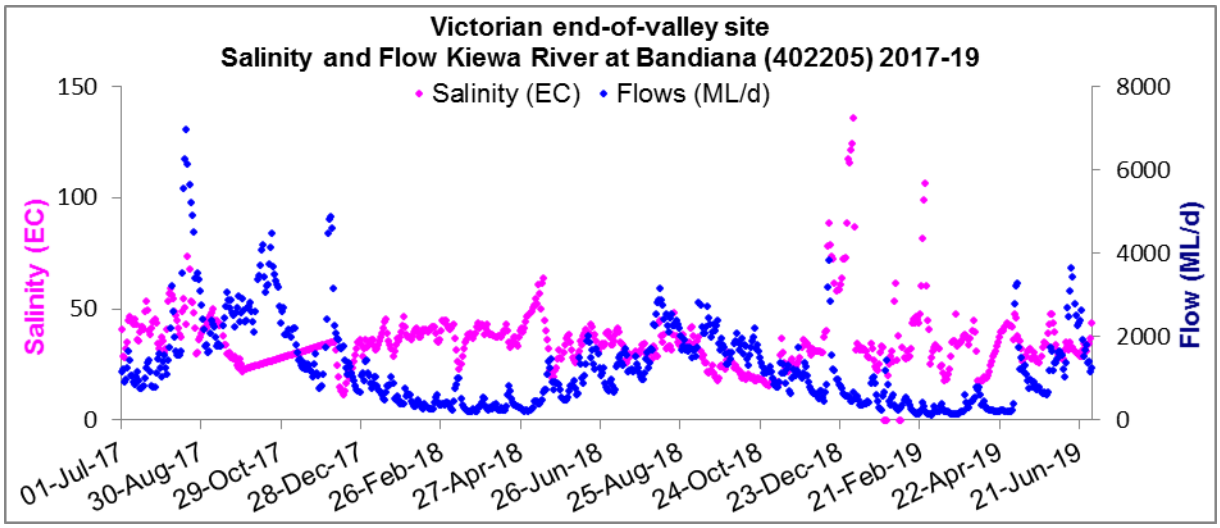

NSW end-of-valley site
Salinity and Flow River Murray at Heywoods (409016) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
120
100
80
60
40
20
0
25000
20000
15000
10000
5000
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

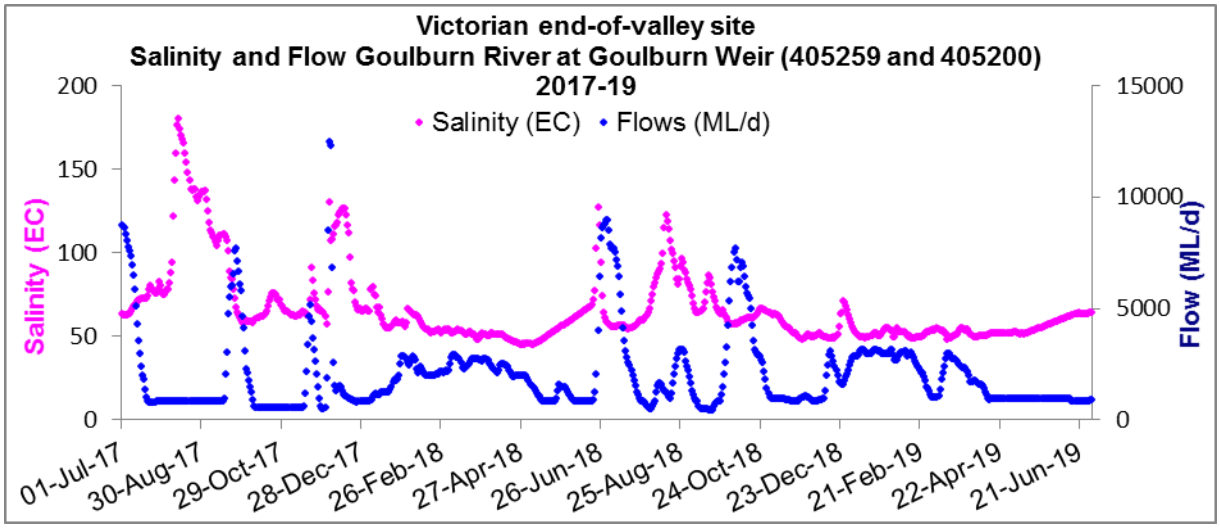

NSW end-of-valley site
Salinity and Flow River Macquarie at Carinda (421012) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
1000
900
800
700
600
500
400
300
200
100
0
300
250
200
150
100
50
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

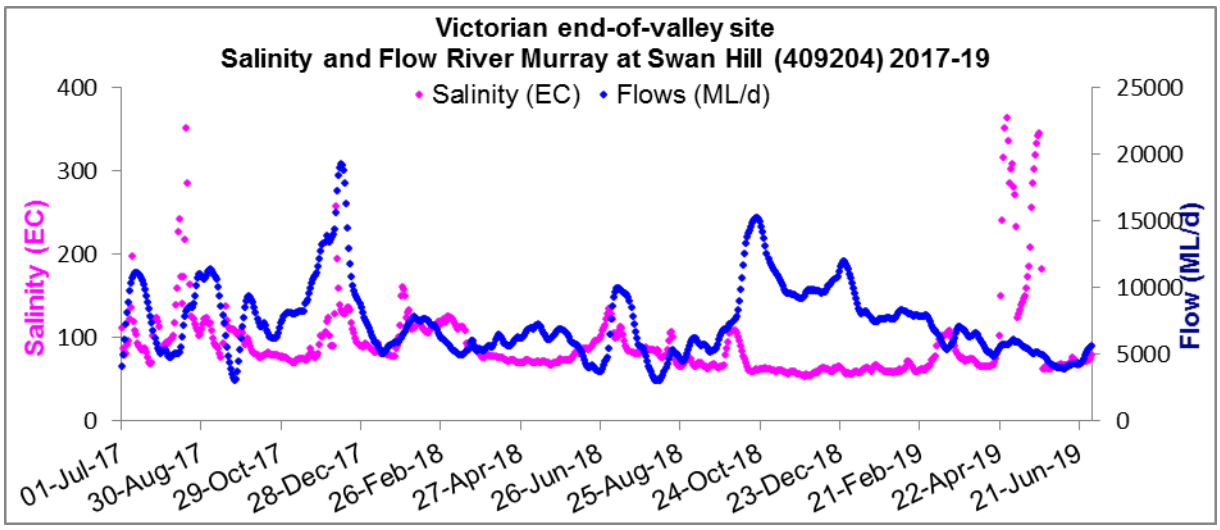
Victoria

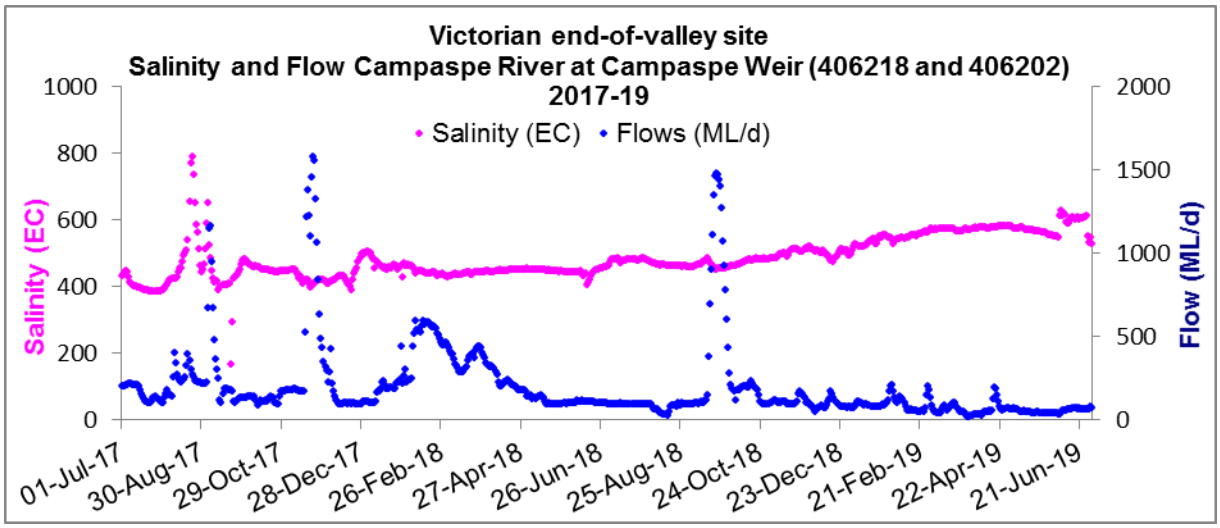

Victorian end-of-valley site
Salinity and Flow Ovens River at Peechelba East (403241) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
100
80
60
40
20
0
30000
25000
20000
15000
10000
5000
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

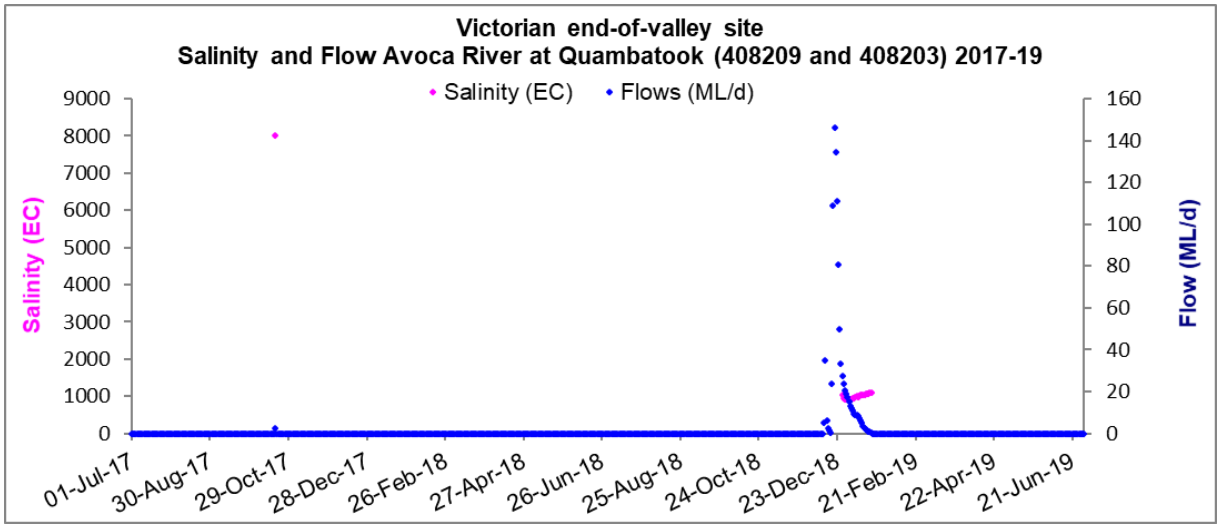

Victorian end-of-valley site
Salinity and Flow Broken Creek at Caseys Weir (404217) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
250
200
150
100
50
0
40
35
30
25
20
15
10
5
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19


Victorian end-of-valley site
Salinity and Flow Kiewa River at Bandiana (402205) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
150
100
50
0
8000
6000
4000
2000
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19


Victorian end-of-valley site
Salinity and Flow Goulburn River at Goulburn Weir (405259 and 405200) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
200
150
100
50
0
15000
10000
5000
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19


Victorian end-of-valley site
Salinity and Flow River Murray at Swan Hill (409204) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
400
300
200
100
0
25000
20000
15000
10000
5000
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19


Victorian end-of-valley site
Salinity and Flow Campaspe River at Campaspe Weir (406218 and 406202) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
1000
800
600
400
200
0
2000
1500
1000
500
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19


Victorian end-of-valley site
Salinity and Flow Avoca River at Quambatook (408209 and 408203) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
160
140
120
100
80
60
40
20
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
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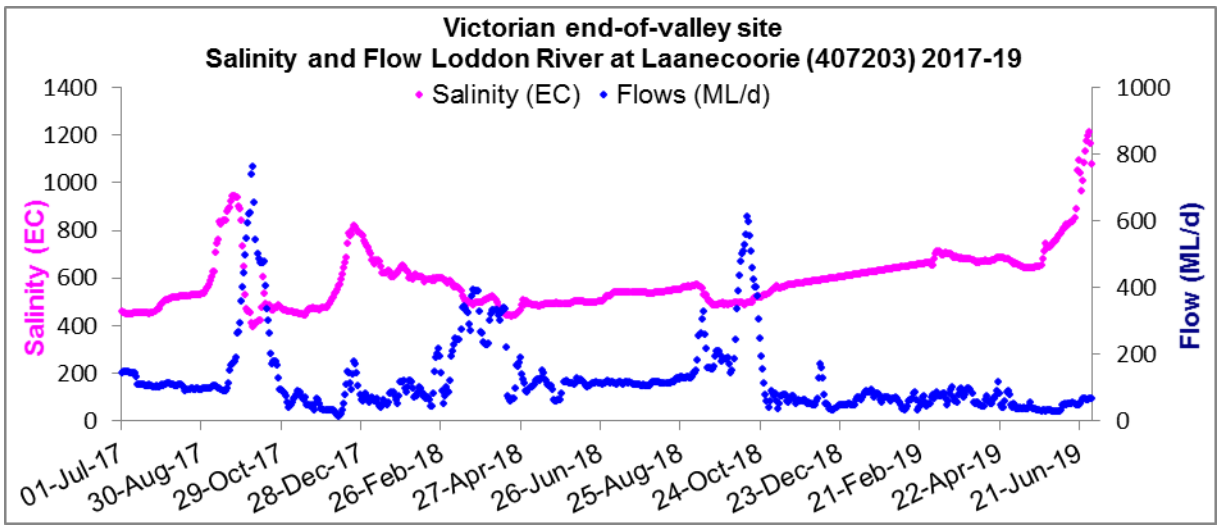
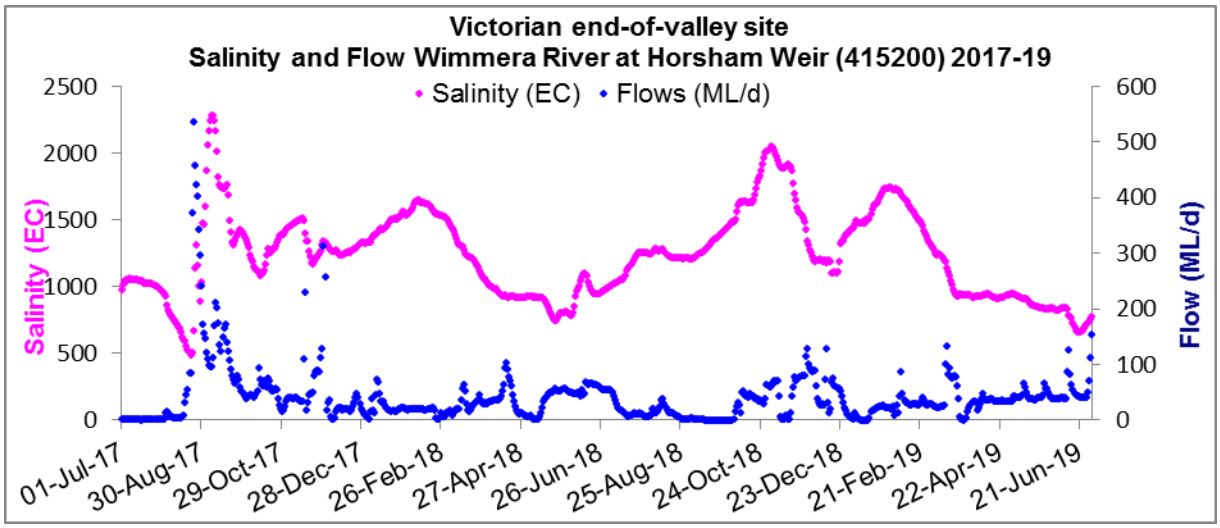
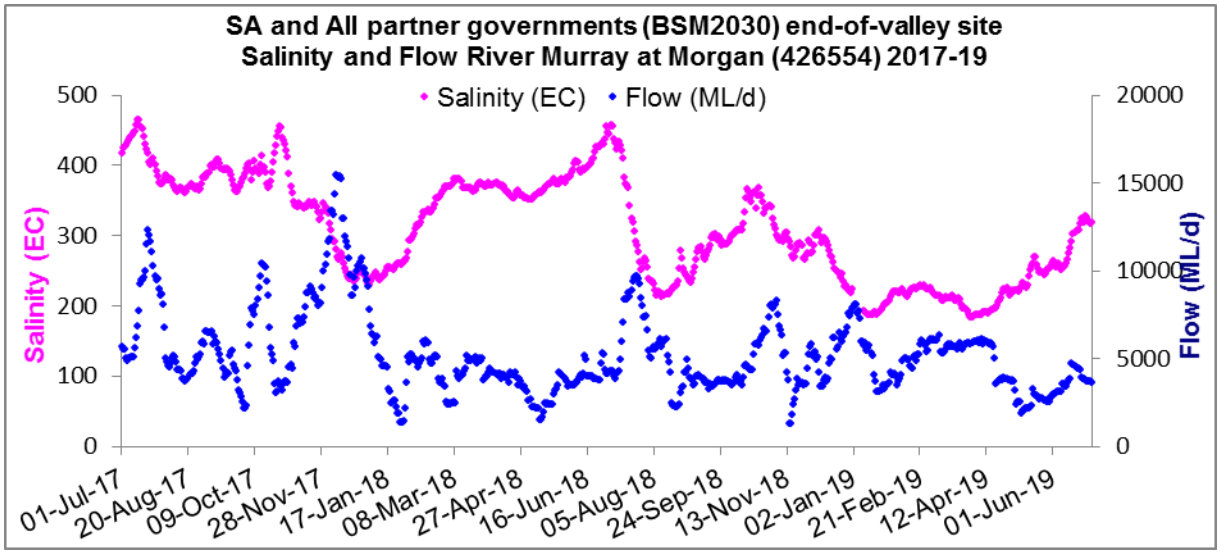
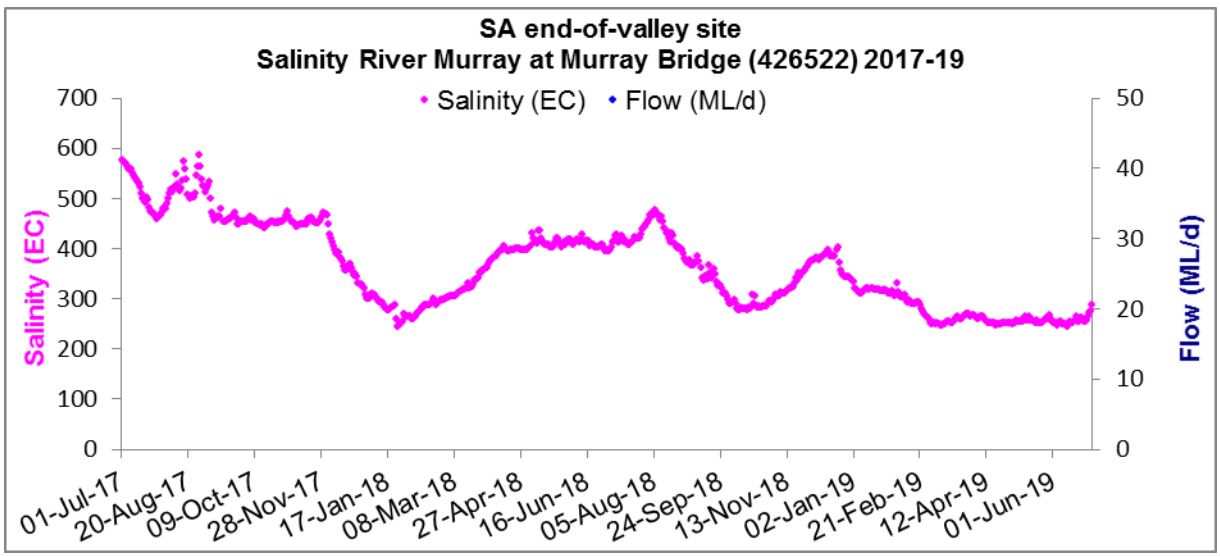
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

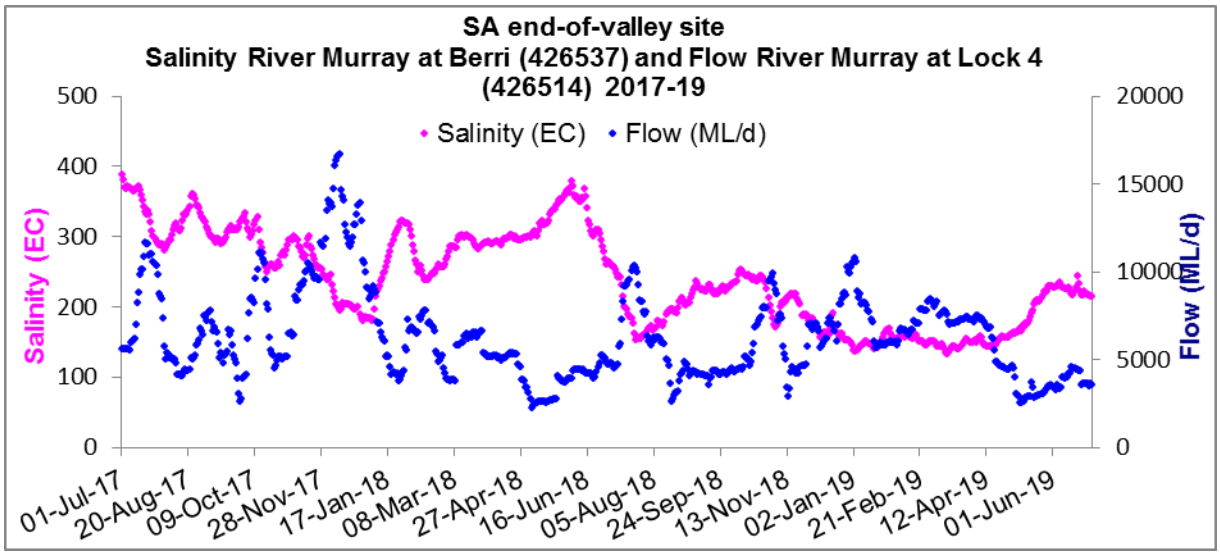

Victorian end-of-valley site
Salinity and Flow Loddon River at Laanecoorie (407203) 2017-19
Salinity (EC)
Flows (ML/d)
Salinity (EC)
Flow (ML/d)
1400
1200
1000
800
600
400
200
0
1000
800
600
400
200
0
01-Jul-17
30-Aug-17
29-Oct-17
28-Dec-17
26-Feb-18
27-Apr-18
26-Jun-18
25-Aug-18
24-Oct-18
23-Dec-18
21-Feb-19
22-Apr-19
21-Jun-19

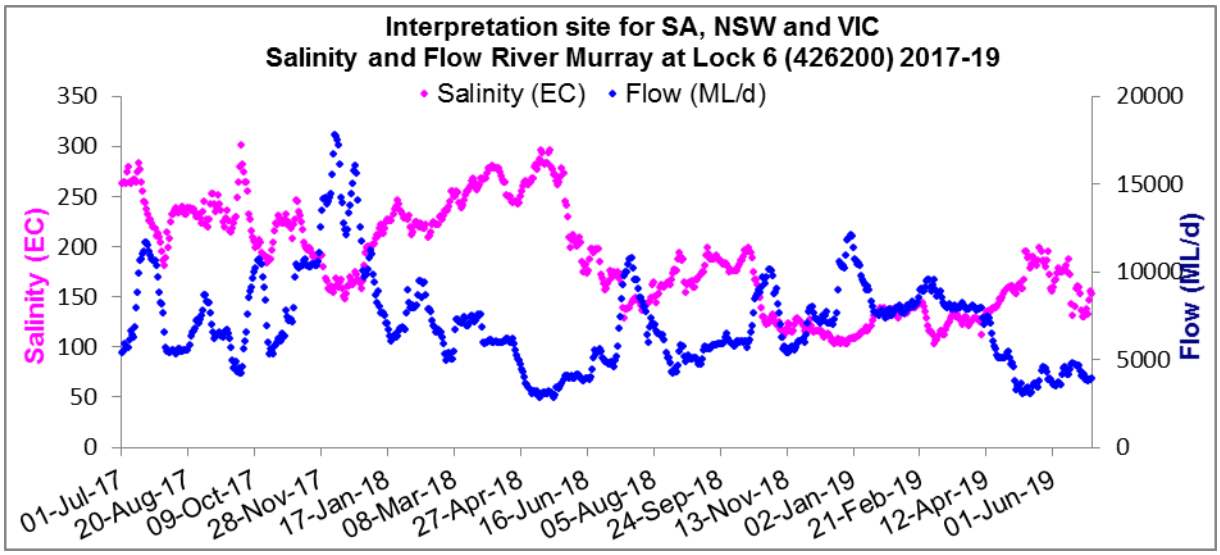


South Australia






SA end-of-valley site
Salinity River Murray at Berri (426537) and Flow River Murray at Lock 4 (426514) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
500
400
300
200
100
0
20000
15000
10000
5000
0
01-Jul-17
20-Aug-17
09-Oct-17
28-Nov-17
17-Jan-18
08-Mar-18
27-Apr-18
16-Jun-18
05-Aug-18
24-Sep-18
13-Nov-18
02-Jan-19
21-Feb-19
12-Apr-19
01-Jun-19


Interpretation site for SA, NSW and VIC
Salinity and Flow River Murray at Lock 6 (426200) 2017-19
Salinity (EC)
Flow (ML/d)
Salinity (EC)
Flow (ML/d)
350
300
250
200
150
100
50
0
20000
15000
10000
5000
0
01-Jul-17
20-Aug-17
09-Oct-17
28-Nov-17
17-Jan-18
08-Mar-18
27-Apr-18
16-Jun-18
05-Aug-18
24-Sep-18
13-Nov-18
02-Jan-19
21-Feb-19
12-Apr-19
01-Jun-19

Appendix E – Comparison of in-stream salinity outcomes with long-term trends at EoVT sites

Under the BSM2030 strategy there is a continued requirement to monitor EoVT sites, however there is no longer a compliance requirement associated with achieving targets at these sites. Jurisdictions monitor flow and salinity for the nominated EoVT sites and also, where applicable, for the interpretation sites (sites for shared rivers or valleys that cross state boundaries).

Table 17 summarises the in-stream EC at each monitored site in the Basin. Records indicate the 50th and 80th percentile for 2017-18 and 2018-19 respectively, as well as the long-term 50th and 80th percentile EC values against baseline values. The length of the long-term record is also indicated.

In the southern connected system, the 50th and 80th percentile salinities for 2017-18 and 2018-19 were generally comparable with or less than longer term statistics in most catchments. However, continuing dry conditions across the northern basin resulted in salinity levels, for some locations, that were much higher than the long term statistics. A full understanding of the variability in short-term salinity outcomes compared with longer term trends requires a detailed analysis for the specific catchment - a process undertaken as part of the review of end-of-valley outcomes.

Estimates of salt load were calculated for records having both EC and flow data. Table 18 compares mean annual salt loads for 2017-18 and 2018-2019, along with long-term mean annual loads against baseline values.

Salt load exports for 2017-18 across the Basin were generally lower than the long-term averages because of limited salt export during periods of low flows. Salt load exports for 2017-18 were generally also substantially lower than the baseline salt load values.

Salt load exports for 2018-19 across the Basin were generally much lower than the long-term averages, especially in the northern basin throughout NSW and Queensland due to drought conditions. However, a flow in the Paroo and Warrego rivers resulted in higher salt loads in 2018-19 compared with the long-term average.

Comparisons of 2018-19 salt load data against the baseline values generally followed a similar trend to that observed in the comparison against long term averages, again with the exception of the Paroo and Warrego rivers.

Table 17: Comparison of salinity data with long–term records for 2017–18 and 2018–19 (units: EC)

Site	AWRC Site Number	Length of record (years)	50%ile Baseline	80%ile Baseline	Year	50%ile All data	50%ile Year	80%ile All data	80%ile Year
Basin target site									
River Murray at Morgan [a]	426554	81	570	920	17/18	477	370	731	397
					18/19	473	252	729	302
South Australia									
Berri Pumping Station	426537	77	450	600	17/18	389	297	571	324
					18/19	386	178	569	226
River Murray at Murray Bridge [b]	426522	85	600	820	17/18	500	415	571	324
					18/19	496	308	569	226
NSW/Victoria shared									
River Murray at Lock 6 [c]	426510	57	380	470	17/18	328	229	444	262
					18/19	324	140	442	175
NSW									
Murrumbidgee R at Balranald Weir	410130	53	150	230	17/18	167	159	226	231
					18/19	166	120	225	165
Lachlan R at Forbes (Cottons Weir)	412004	20	430	660	17/18	433	332	598	456

Site	AWRC Site Number	Length of record (years)	50%ile Baseline	80%ile Baseline	Year	50%ile All data	50%ile Year	80%ile All data	80%ile Year
					18/19	427	339	591	382
Bogan R at Gongolgon	421023	19	440	490	17/18	371	490	550	554
					18/19 [g]	376	483	546	501
Macquarie R at Carinda (Bells Bridge)	421012	27	480	610	17/18	568	614	680	744
					18/19	566	523	679	614
Castlereagh R at Gungalman Bridge	420020	18	350	390	17/18 [g]	437	NA	836	NA
					18/19	436	332	836	366
Namoi R at Goangra	419026	27	440	650	17/18	377	436	535	756
					18/19	378	580	538	644
Mehi R at Bronte	418058	18	400	540	17/18	424	335	630	546
					18/19	417	283	624	388
Darling R at Wilcannia Main Channel	425008	54	330	440	17/18	386	377	556	459
					18/19	387	1,187	559	1,518
River Murray at Heywoods	409016	46	54	59	17/18	51	48	57	53
					18/19	51	42	57	48
River Murray at Red Cliffs	414204	52	310	390	17/18	280	153	372	177
					18/19	279	99	372	127

Site	AWRC Site Number	Length of record (years)	50%ile Baseline	80%ile Baseline	Year	50%ile All data	50%ile Year	80%ile All data	80%ile Year
Victoria									
Wimmera R at Horsham Weir	415200	27	1380	1720	17/18	1,170	1,235	1,579	1,475
					18/19	1,176	1,234	1,579	1,595
Avoca R at Quambatook [d]	408203	33	2060	5290	17/18	5403	NA	7,200	NA
					18/19	5000	1,343	5,649	1,789
Loddon R at Laanecoorie	407203	11	750	1090	17/18	727	505	1,049	613
					18/19	703	651	1,003	691
Campaspe R at Campaspe Weir	406218	29	530	670	17/18	572	446	776	457
					18/19	568	516	768	574
Goulburn R at Goulburn Weir	405259	30	100	150	17/18	70	63	116	81
					18/19	68	56	114	64
Broken Ck at Casey's Weir [e]	404217	27	100	130	17/18	173	140	236	153
					18/19	171	155	233	176
Ovens R at Peechelba East	403241	40	72	100	17/18	62	59	87	65
					18/19	62	50	86	63
Kiewa R at Bandiana	402205	46	47	55	17/18	42	36	51	42
					18/19	41	32	51	39

Site	AWRC Site Number	Length of record (years)	50%ile Baseline	80%ile Baseline	Year	50%ile All data	50%ile Year	80%ile All data	80%ile Year
River Murray at Heywoods	409016	46	54	59	17/18	51	48	57	53
					18/19	51	42	57	48
River Murray at Swan Hill	409204	52	270	380	17/18	211	90	333	116
					18/19	208	67	330	90
Queensland									
Barwon R at Mungindi [f]	416001	24	250	330	17/18	254	297	318	379
					18/19	257	275	320	321
Moonie R at Fenton	417204A	16	140	150	17/18	131	142	171	149
					18/19 [g]	131	NA	171	NA
Ballandool R at Hebel—Bollon Rd	422207A	17	170	210	17/18	195	160	296	187
					18/19	197	245	294	255
Bokhara R at Hebel	422209A	17	170	210	17/18	182	122	221	162
					18/19	182	201	220	209
Briarie Ck at Woolerbilla—Hebel Rd	422211A	16	150	280	17/18	230	71	305	79
					18/19 [g]	230	NA	305	NA
Culgoa R at Brenda [f]	422015	17	170	210	17/18	186	185	224	201
					18/19	187	196	224	201

Site	AWRC Site Number	Length of record (years)	50%ile Baseline	80%ile Baseline	Year	50%ile All data	50%ile Year	80%ile All data	80%ile Year
Narran R at New Angledool [f]	422030	17	160	210	17/18	179	165	232	169
					18/19 [g]	179	NA	232	NA
Paroo R at Caiwarro	424201A	15	90	100	17/18	79	62	107	72
					18/19	78	65	106	72
Warrego R at Barringun No.2 [f]	423004	18	101	110	17/18	138	159	202	176
					18/19	136	110	199	124
Cuttaburra Ck at Turra [f]	423005	18	100	130	17/18	130	151	203	260
					18/19	130	138	200	145
ACT									
Murrumbidgee R at Hall's Crossing	410777	29	224	283	17/18	234	283	234	358
					18/19	234	336	236	360

a 95 percentile for BSM2030 target at Morgan
b Flow is not measured at this site
c Salinity measured at site A4261022 (Murray @ Old Custom House)
d Spot salinity data ends in Sep 2008 and continuous starts in Sep 2013
e Used salinity data for 404224B (Broken River at Gowangardie)
f Operated by New South Wales on behalf of Queensland
g Zero flow
NA data not available

Table 18: Comparison of salt load data with long–term records for 2017–18 and 2018–19

Site	AWRC Site Number	Length of record (years)	Mean baseline salt load (t/y)	Year	Mean annual salt load (tonnes) All data	Mean annual salt load (tonnes)
Basin target site						
River Murray at Morgan	426554	52	1,600,000	17/18	1,410,400	432,500
				18/19	1,388,600	275,700
South Australia						
Berri Pumping Station	426537	25	1,500,000	17/18	528,900	409,200
				18/19	515,700	233,500
River Murray at Murray Bridge [a]	426522	NA	1,600,000	17/18	NA	NA
				18/19	NA	NA
NSW/Victoria shared						
River Murray at Lock 6	426200	57	1,300,000	17/18	1,138,000	354,700
				18/19	1,121,900	210,600
NSW						
Murrumbidgee R d/s Balranald Weir	410130	53	160,000	17/18	55,800	55,700
				18/19	119,000	20,900
Lachlan R at Forbes (Cottons Weir)	412004	20	250,000	17/18	130,800	100,500
				18/19	128,800	91,900

Site	AWRC Site Number	Length of record (years)	Mean baseline salt load (t/y)	Year	Mean annual salt load (tonnes) All data	Mean annual salt load (tonnes)
Bogan R at Gongolgon	421023	19	27,000	17/18	19,200	100
				18/19	18,800	500
Macquarie R at Carinda (Bells Bridge)	421012	27	23,000	17/18	22,500	4,700
				18/19	22,200	1,500
Castlereagh R at Gungalman Bridge	420020	18	9,000	17/18 [h]	35,700	0
				18/19	35,700	700
Namoi R at Goangra	419026	27	110,000	17/18	64,000	3,800
				18/19	63,200	600
Mehi R at Bronte	418058	18	7,000	17/18	7,100	4,700
				18/19	6,900	2,200
Darling R at Wilcannia Main Channel	425008	54	440,000	17/18	365,900	12,500
				18/19	364,900	5,300
River Murray at Heywoods	409016	46	150,000	17/18	130,200	93,800
				18/19	129,100	97,800
River Murray at Red Cliffs [b]	414204	36	1,100,000	17/18	1,236,400	NA
				18/19	1,236,400	NA

Site	AWRC Site Number	Length of record (years)	Mean baseline salt load (t/y)	Year	Mean annual salt load (tonnes) All data	Mean annual salt load (tonnes)
Victoria						
Wimmera R at Horsham Weir	415200	27	31,000	17/18	19,700	14,200
				18/19	19,200	9,200
Avoca R at Quambatook [c]	408203	33	37,000	17/18	32,300	0
				18/19	30,300	100
Loddon R at Laanecoorie	407203	11	88,000	17/18	32,300	18,600
				18/19	30,300	14,300
Campaspe R at Campaspe Weir [d]	406218	52	54,000	17/18	24,800	26,900
				18/19	24,500	15,600
Goulburn R at Goulburn Weir [e]	405259	30	166,000	17/18	49,700	34,500
				18/19	49,000	28,600
Broken R at Casey's Weir [f]	404217	27	15,000	17/18	1,600	400
				18/19	1,500	400
Ovens R at Peechelba East	403241	40	54,000	17/18	47,000	29,200
				18/19	45,800	17,500
Kiewa R at Bandiana	402205	46	19,000	17/18	16,700	11,600
				18/19	16,300	8,800

Site	AWRC Site Number	Length of record (years)	Mean baseline salt load (t/y)	Year	Mean annual salt load (tonnes) All data	Mean annual salt load (tonnes)
River Murray at Heywoods	409016	46	150,000	17/18	130,200	93,800
				18/19	129,100	97,800
River Murray at Swan Hill	409204	52	630,000	17/18	577,400	176,600
				18/19	568,300	140,000
Queensland						
Barwon R at Mungindi [g]	416001	24	50,000	17/18	44,900	16,800
				18/19	43,300	1,200
Moonie R at Fenton	417204A	16	8,700	17/18	14,000	800
				18/19 [h]	14,000	0
Ballandool R at Hebel—Bollon Rd	422207A	17	4,200	17/18	7,600	300
				18/19	7,500	29
Bokhara R at Hebel	422209A	17	5,000	17/18	9,800	400
				18/19	9,700	100
Briarie Ck at Woolerbilla—Hebel Rd	422211A	16	6,500	17/18	53,900	0.32
				18/19 [h]	53,900	0
Culgoa R at Brenda [g]	422015	17	29,000	17/18	56,400	1,300

Site	AWRC Site Number	Length of record (years)	Mean baseline salt load (t/y)	Year	Mean annual salt load (tonnes) All data	Mean annual salt load (tonnes)
				18/19	55,800	400
Narran R at New Angledool [g]	422030	17	10,000	17/18	19,900	400
				18/19 [h]	19,900	0
Paroo R at Caiwarro	424201A	15	24,000	17/18	28,800	1,100
				18/19	28,900	6,800
Warrego R at Barringun No.2 [g]	423004	18	4,800	17/18	30,900	1,100
				18/19	30,400	3,200
Cuttaburra Ck at Turra [g]	423005	18	5,500	17/18	27,100	900
				18/19	27,200	5,200
ACT						
Murrumbidgee R at Hall's Crossing	410777	29	32,700	17/18	73,900	32,900
				18/19	72,100	22,300

a Flow is not measured at this site
b Flow data stops in October 1994
c Spot salinity data ends in Sep 2008 and continuous starts in Sep 2013
d Used flow data for 405200A (Campaspe at Rochester)
e Used flow data for 405200A (Goulburn River at Murchison)
f Used salinity data for 404224B (Broken River at Gowangardie)

g Operated by New South Wales on behalf of Queensland
h Zero flow
NA = data not available
Salt load is determined using the following calculation: salt load (t/d) = flow (ML/d) x salinity (EC) x 0.0006 except Queensland where the factor EC/TDS varies for each site

Appendix F – Operational processes

Table 19: BSMAP meetings between July 2017 and July 2019

Meeting Number	Date	Location
33	20 July 2017	Sydney
34 (Registers)	28 September 2017	Teleconference
35	31 October 2017	Adelaide
36	22 February 2018	Melbourne
36a	10 April 2018	Teleconference
37	22 May 2018	Canberra
38	21 August 2018	Brisbane
39 (Registers)	16 October 2018	Teleconference
40	28 November 2018	Adelaide
41	21 February 2019	Melbourne
42	24 July 2019	Canberra

Table 20: BSMAP out-of-session papers

Out-of-session number	Title	Confirmation Date
22	Review of the Psyche Bend Lagoon, Lamberts swamp and Sunraysia Drying of Drains accountable actions	11 October 2017
23	Basin Salinity Management 2030 (BSM2030) Reporting 2017-18	30 July 2018

Table 21: Schedule B amendments consultation meetings

Location	Date
South Australia (Adelaide)	5 February 2018
New South Wales (Sydney)	6 February 2018
Victoria (Melbourne)	7 February 2018
Queensland (teleconference)	8 February 2018
MDBA (Canberra)	8 February 2018
ACT (Canberra)	9 February 2018

Location	Date
Commonwealth (Canberra)	9 February 2018

Table 22: Salt Interception Scheme Operators workshops

Meeting Number	Location	Date
Workshop 6	Buronga	5 September 2017
Workshop 7	Buronga	5 December 2017
Workshop 8	Buronga	6 March 2018
Workshop 9	Buronga	30 May 2018
Workshop 10	Buronga	29 August 2018
Workshop 11	Canberra	12 December 2018
Workshop 12	Buronga	7 May 2019
Workshop 13	Teleconference	29 August 2019

Table 23: BSM Procedures meetings / workshops

Meeting	Location	Date
Victoria bilateral meeting	Melbourne	14 November 2017
South Australia bilateral meeting	Adelaide	23 November 2017
New South Wales bilateral meeting	Sydney	13 December 2017
Workshop	Melbourne	15 March 2018
Workshop	Sydney	8 August 2018
Victoria bilateral meeting	Melbourne	22 May 2019
South Australia bilateral meeting	Adelaide	23 May 2019
Queensland bilateral meeting	Teleconference	28 May 2019
New South Wales bilateral meeting	Sydney	29 May 2019

Appendix G – Executive summaries from Contracting Government reports

Disclaimer: Information contained in Appendix G was provided to the MDBA by each of the Contracting Governments as part of their BSM2030 reporting obligations. The executive summary from each State Contracting Governments comprehensive report and the Australian Governments annual report was extracted for inclusion in this appendix and reformatted to meet MDBA styles for consistency. The MDBA does not hold responsibility for the accuracy of data and information contained within Appendix G.

Executive Summary: Victoria's BSM2030 comprehensive report 2018-19

This Comprehensive Report presents Victoria's accountability and achievements in implementing the *Basin Salinity Management 2030* (BSM2030) strategy in 2018/19, and includes highlights from 2017/18.

The Department of Environment, Land, Water and Planning (DELWP) takes the lead on reporting Victoria's compliance under BSM2030, with support from Goulburn Broken Catchment Management Authority (CMA), North Central CMA, North East CMA, Mallee CMA, Wimmera CMA, Goulburn-Murray Water and Department of Jobs, Precincts and Regions (Agriculture Victoria).

Salinity Accountability Framework

Victoria reconfirmed its commitment to salinity management in the Murray-Darling Basin through *Water for Victoria (https://www.water.vic.gov.au/water-for-victoria)* (2016). Water for Victoria is the State's strategic plan for managing its water resources. It sets a long-term direction for managing water resources in the context of climate change and a growing population.

Victoria remains compliant with Schedule B to the Murray-Darling Basin Agreement (Schedule 1 to the Water Act 2007). Victoria's net balance on the Murray-Darling Basin Salinity Register A as of 11 September 2019[4] is **-24.8 EC credits** or **$4.959 million/yr**.

There were two changes to Victoria's Register A balance in 2018/19;

- an increase in debit of **0.3 EC**[5] attributed to the Nyah to the South Australian Border Salinity Management Plan (SMP). This accounts for irrigation development in the Victorian Mallee region; and
- an increase in credit of **-0.3EC** attributed to the Mallee Drainage Bore Decommissioning accountable action, which was previously listed on the provisional register.

During the reporting period Victoria progressed work to assess new and existing accountable actions, including Victorian Mid-Murray Storages (VMMS) and Connections Project.

Environmental watering activities such as the Victorian Murray Floodplain Restoration Program (VMFRP) (previously Sustainable Diversion Limit offset projects) are being incorporated into Victoria's accountability framework as projects are approved and implemented. Preliminary salinity investigations indicate that two VMFRP may result in new accountable actions.

[4] Based on draft Register provided by MDBA

[5] The progressive total salinity impact for the Nyah to the South Australian Border SMP is estimated to be 17.6 EC according to MDBA's 2019 Draft Salinity Register

Management of Salt Interception Schemes (SIS)

The three Victorian salt interception schemes (SIS): Barr Creek Drainage Diversion Scheme, Mildura-Merbein Salt Interception Scheme and Pyramid Creek Groundwater Interception Scheme, continued to be operated in accordance with operating rules. Victoria also worked with the Murray-Darling Basin Authority (MDBA) to refine the operation of the SIS in response to forecast river flow and salinity conditions, as part of the trial of responsive SIS management implemented under BSM2030.

A total of 183,476 tonnes of salt was diverted from the Murray River over the reporting period.

Salinity Management

Victoria's five Basin CMAs continued to implement Land and Water Management Plans (LWMP) in their irrigation areas, which provide the strategic framework and key actions for natural resource management in Victoria. In addition, CMAs have developed over 61 long-term Environmental Water Management Plans (EWMP)s to guide environmental watering activities across the State. These EWMPs are developed under partnership arrangements with the community and government agencies, such as the Victorian and Commonwealth environmental water holders and MDBA and incorporate management of salinity impacts.

In the reporting period, CMAs delivered a wide range of on-farm planning and works, including irrigation and dryland whole farm plans, upgrades to irrigation systems for water use efficiency and salinity benefits, as well as protection of remnant vegetation and targeted re-vegetation activities.

Salinity and salt loads at End-of-Valley-Target (EoVT) sites were monitored and evaluated over the reporting period for each Victorian valley for which an EoVT has been set. Results are provided in this report for reference.

Efficient Governance

The Efficient Governance section of this report explores actions Victoria has taken to review its accountable actions, the ongoing status of its Core Salinity Monitoring Network, and Victoria's response to the 2016/17 Independent Audit Group recommendations.

In this reporting period Victoria has progressed ten register entry reviews, and investigations into areas of potential improvements to our assessments.

Victoria's CMAs continued to support efficient Basin-wide governance of BSM2030 through monitoring which helps to support the assessment of salinity impacts and periodic reviews of register entries. Victoria actively participates in the independent audit process, every second year, which tracks Basin-wide performance in implementing BSM2030 and identifies areas of improvement.

DELWP has worked closely with regional partners including CMAs, GMW and Agriculture Victoria to develop a draft Victorian contribution to the Basin-wide Core Salinity Monitoring Network which identified all surface and groundwater sites used to monitor and review Victorian Register Entries.

Strategic Knowledge Improvement

DELWP, Agriculture Victoria and the CMAs continued to increase state-wide capacity for managing salinity in the Murray-Darling Basin in the reporting period by progressing several research and investigation projects, including:

- The Goulburn Broken CMA and GMW are delivering a hybrid drainage program. Hybrid drainage relies on restoring flow in natural drainage courses, through improving linkages and removing artificial obstructions to flow. The Shepparton Irrigation Region (SIR) Public Pump Triggers Optimisation Project is continuing, and the SIR Shallow Groundwater Website was released following extensive consultation in late 2017.
- The Mallee CMA progressed the Mallee Model Refinement Project, which will replace the current analytical approach to modelling with an upgraded numerical approach to support more accurate reviews of accountable actions. The Satellite Based Estimation of Root Zone Drainage project continued, building knowledge and confidence in estimates of root zone drainage which are critical to quantifying the impacts of irrigation on Murray River salinity.
- The North Central CMA has identified the need to establish more rigorous models that afford improved approaches to the reporting and accounting of salinity, following on from the completion of the Barr Creek risk-based review in 2019.
- Agriculture Victoria Research participated in ongoing advice to CMA's, Landcare, community groups, rural water authorities and local governments on how to deal with dryland salinity and rising groundwater levels in their area.

Community Engagement and Communication

Community engagement, education and communication are central to the implementation of Victorian CMA Regional Catchment Strategies and subordinate strategies and plans, including Land and Water Management Plans and Waterway Strategies. Local ownership of the challenges and opportunities of salinity management has been a long-standing and successful approach in Victoria.

Many CMA boards use community-based advisory groups to gain community and expert input into projects and strategies, and to help inform communities, agencies and land managers about natural resource management in the region. These groups are central to effective management of salinity in Victoria, particularly in irrigation areas.

CMAs, GMW and Agriculture Victoria continued to engage with local communities on salinity management over the reporting period, with a focus on communicating key salinity threats and mitigation options through watertable maps, Landcare Groups and field days.

Priorities for Future Work

Victoria will continue to implement BSM2030 in co-operation with the MDBA and Basin states. Key projects include: finalising the Victorian Core Salinity Monitoring Network, reviewing the Nyah to the Border Salinity Management Plan accountable action, progressing strategic improvement of salinity assessments in the GMID and updating Victoria's manual for salinity management to support effective implementation of BSM2030. Victoria will also prioritise work on assessing new accountable

actions within the state, with a focus on environmental watering activities such as VMFRP, VMMS and the GMW Connections Project.

Implementation of these priorities will be supported by the delivery of key actions in *Water for Victoria*, including management of salinity and waterlogging, and improving the management of salinity in the Mallee. Regional partners will focus on reviews of strategies and plans to support salinity management, including the SIR LWMP and Loddon Campaspe Irrigation Region (LCIR) LWMP, as well as North Central CMA drainage reviews.

Victoria will continue to be a part of the trial for responsive management of the SIS and operate schemes within the state in accordance with the adaptive management approach until the conclusion of the trial 2025.

Executive Summary: Queensland's BSM2030 comprehensive report 2018-19

This report has been compiled by the Department of Natural Resources, Mines and Energy to report to the Murray-Darling Basin Ministerial Council on how Queensland is implementing Basin Salinity Management 2030 (BSM2030). It summarises Queensland's actions with respect to the key elements of BSM2030 and provides statistics of stream flow and salt load at Queensland's ten End-of-Valley (EoV) reporting sites. The Queensland Government has continued its commitment to implementing the objectives of BSM2030 and adhering to the guiding principles underpinning BSM2030.

The Queensland Murray-Darling Basin remains drought declared (and has so since March 2014), with the region receiving below average rainfall (some areas were the lowest on record) during the two year reporting period (2017–19). Three of the EoV sites reported no flow in 2018–19. Total flows for the other seven sites were all well below average annual flows. Salt loads were all well below targets across the region, except for the two EoV sites in the Warrego catchment in 2018–19 (loads were 67% and 95% of the target). Median EC generally exceeded targets across the region, except for the Paroo catchment [it is worth noting that the highest median EC reported at all sites was only 297 µS/cm (target of 250 µS/cm)]. The 80th percentile EC values were generally below targets across the region, except for the Warrego catchment. These results are to be expected, given the dry/low flow conditions.

A review of the Warrego EoV targets is suggested, in light of more recent data collected in the catchment. There is also a broader recommendation for all sites in the QMDB to develop low flow and high flow EC targets as this would better represent the high variability in the hydrology.

A project assessing salinity risk and likelihood of discharge to stream from an irrigation development in the Condamine catchment finished in October 2019.

Future priority work includes reviewing the status of groundwater in the Border Rivers alluvia, and project work to further develop the understanding of surface water/groundwater interaction in the Condamine-Balonne catchment.

Executive Summary: South Australia's BSM2030 comprehensive report 2018-19

Murray-Darling Basin governments renewed their commitment to manage salinity in 2015 through the adoption of the Basin Salinity Management 2030 (BSM2030) strategy. The BSM2030 strategy builds on previous investments in salinity management as part of the Salinity and Drainage Strategy (1988-2000) and the Basin Salinity Management Strategy (2001-2015). The BSM2030 strategy maintains the existing accountability framework and management arrangements, while addressing contemporary issues such as the effects of environmental watering and exploring ways to optimise the operation of salt interception schemes (SIS).

This is South Australia's second comprehensive report which covers implementation of the BSM2030 strategy in 2017-18 and 2018-19. South Australia's key achievements and outcomes over the past two years are outlined below against each of the key elements of the BSM2030 strategy.

Salinity accountability framework

- South Australia remains compliant with Schedule B of the Murray-Darling Basin Agreement with a Salinity Register net credit balance of $7.621 million.
- Initial results from salinity assessments for actions undertaken as part of the South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP) at Pike indicate that the combined impact of actions are likely to result in a net reduction in salt load to the River Murray averaged over 100 years.
- An audit of the Chowilla groundwater model was completed to compare modelled estimates of salinity impacts directly with observations collected during regulator operation. The audit confirmed that the Chowilla model is fit for purpose and can continue to be used for assessing potential salt load impacts from operation of the floodplain infrastructure.

Management of salt interception schemes

- SIS located in South Australia intercepted more than 467,768 tonnes of salt over the past two years.
- Tranche 1 of the Pike groundwater management scheme designed to enhance the ecological benefits of inundation of the Pike and Katarapko floodplains has been completed.

Flow management

- Salinity levels remained below the target levels in 2017-18 and 2018-19 at all South Australian End-of-Valley Target sites and Basin Plan reporting sites other than Milang which had a short exceedance above 1,000 EC.
- During 2017-18 and 2018-19 the Department for Environment and Water considered the salinity and water quality risks associated with 72 separate requests to undertake environmental watering and river operational actions as part of the approval process.
- Murray-Darling Basin Authority modelling estimates that salt export from the Murray-Darling Basin was 510,000 tonnes in 2017-18 and 360,000 tonnes in 2018-19.

- The Murray Mouth remained open 100 percent of the time due to dredging operations and delivery of environmental water.

Salinity management in catchments

- The South Australian Murray Region Water Resource Plan was submitted in 2018 and accredited by the Commonwealth Minister on 20 August 2019.
- The Eastern Mount Lofty Ranges and South Australian River Murray Water Resource Plans were submitted for accreditation in February 2019.
- The River Murray salinity zoning policy was revised and included in the Water Allocation Plan for the River Murray Prescribed Watercourse in February 2019 following a review of irrigation salinity management which was carried out in 2017.
- The South Australian River Murray Sustainability program and Commonwealth On-Farm Further Irrigation Efficiency program returned over 40 GL of water to the environment and reduced drainage and salt loads to the River Murray through improvements to irrigation efficiency.
- Construction of the South East Flows Restoration Project was completed in early 2019 to help manage salinity levels in the Coorong.

Efficient governance

- The Department for Environment and Water completed the nomination of South Australian sites for inclusion in the Basin-wide core monitoring network to quantify salinity register entries, evaluate trends at End-of-Valley Target sites, improve knowledge and support salt interception scheme and river operations.
- The Waikerie to Morgan, Woolpunda and Pike-Murtho groundwater models were accredited by the Murray- Darling Basin Authority for use in estimating salinity register entries for 16 accountable actions.
- A review of the Loxton-Bookpurnong numerical groundwater model and accountable actions commenced and was substantially completed in 2018-19.
- A Run of River survey between Lock 1 and Lock 7 was carried out in May 2018 in accordance with a methodology updated and improved in 2017.

Strategic knowledge improvement

- South Australia supported the development of the transfer function as part of the second stage of the Mallee legacy of history knowledge project, including the trial of the transfer function in the Loxton to Bookpurnong groundwater model.
- The development of complex groundwater models for high value floodplains such as Pike and Katarapko continued to provide valuable learnings that will assist with understanding the salinity impacts of environmental watering.

Community engagement and communication

- Extensive community engagement was undertaken in 2018 as part of the development of the Water Allocation Plan for the River Murray Prescribed Watercourse, which included revisions based on the outcomes from the South Australian review of irrigation salinity management.
- Significant community engagement has been carried out as part of the SARFIIP projects at Pike and Katarapko.

Executive Summary: New South Wales' BSM2030 comprehensive report 2018-19

Salinity remains an issue in New South Wales (NSW) and requires ongoing management. The MDBA Basin Salinity Management (BSM) Strategy Annual Audit (2014/15) made the following recommendation to Basin States, which is still relevant today:

> *The Independent Audit Group for Salinity (IAG-Salinity) recommends that, in transitioning to BSM2030, jurisdictions and the Murray Darling Basin Authority (MDBA) should clearly communicate the success of salinity management to date, emphasizing that,* ***whilst there is no longer an impending salinity crisis, it is an issue that requires careful, ongoing management and the maintenance of current management arrangements to ensure that it remains under control.***

NSW has continued to address the ongoing challenge of salinity through a variety of measures in 2017/18 and 2018/19. Outcomes and achievements for this period are listed in line with the eight key elements[6] of the Basin Salinity Management 2030 (BSM2030) Strategy.

The largest impediments to on-ground activity since the wetter period of 2016 has been the prolonged impact of drought, where salinity management is considered a lower priority for (dryland) landholders but high for irrigators and communities dependent on river water for town water supply. NSW continues to invest in salinity management via projects, programs and policy. However; land management programs overall have declined due to shifting priorities in State and Federal programs (for example: drought coordination and Basin Plan implementation).

The key focus for this reporting period has centered around increasing the Department of Planning, Industry and Environment's (DPIE) internal capacity and capability to deliver NSW BSM2030 obligations. This is in direct response to IAG-Salinity (2018) Recommendation 2: '*NSW, as a matter of urgency, should ensure it has the dedicated resourcing required to meet its obligations to conduct the reviews of salinity entries on the registers*'. Key actions undertaken to address this include:

- An external review of the NSW Basin Salinity Management Program completed (Jacobs, 2018) that provided guidance on the level of resources required to deliver NSW BSM2030 obligations;
- Recruitment of a dedicated full time position to manage NSW BSM2030 obligations (Basin Salinity Program Manager);
- Provision of full time Principal Salinity Officer and part time Senior Salinity Officer to provide technical support to the Basin Salinity Program Manager;
- Establishment of a formal Basin Salinity Management Program Steering Committee (BSM SC), with representation across all areas of DPIE who have responsibility for delivery of BSM2030 activity and actions;
- Development and endorsement of the project plan and workplan/schedule to implement BSM2030 obligations, including the delivery of Register reviews; and,

[6] Some key elements have been merged as per the Table of Contents provided in the draft BSM Procedure – Reporting.

- BSM2030 Review Plan updated with revised Register review schedule.

Salinity Accountability Framework

NSW maintained a net credit balance on the Salinity Register in 2017/18 and 2018/19, in a continued commitment to Schedule B of the Murray-Darling Basin Agreement (the Agreement). Based on the MDBA 2019 Salinity Register A (endorsed 11 September 2019), NSW has a salinity effect of **-36.4EC.**

During this reporting period there was a 9% reduction in NSW credits arising largely from the review of several South Australian joint works and measures in 2017/18, wherein the balance of Register A and B dropped from $7.769 million/year in 2017 to $7.054 million/year in 2018. There was no change in the estimated salinity impact from NSW accountable actions between July 2017 and June 2019.

There were no new or proposed Accountable Actions for NSW during this reporting period. However, some potential actions are currently being investigated such as new irrigation development in the Lower Murray-Darling region and Billabong Creek Salt Interception Scheme (SIS).

Delivery of water for the environment considers and manages salinity impacts of environmental watering events, with a particular emphasis on impacts to receiving streams and waterways. Where salinity issues are known (such as in the Edward-Wakool River system) dilution flows are supplied and are evaluated using a fit-for-purpose 'salinity calculator'. No environmental watering events were considered significant during this reporting period.

Salinity impacts have also been explicitly considered in initial risk assessments for all SDLAM projects and was found to be not significant. More detailed evaluation and modelling of salinity impacts will be undertaken as part of the pre-construction phase of the SDL works and measures projects.

Management of Salt Interception Schemes (SIS)

The NSW Salt Interception Scheme (SIS) program currently consists of four salt interception schemes: Mallee Cliffs SIS (MDBA Joint Venture); Buronga SIS (MDBA Joint Venture); Upper Darling SIS (MDBA Joint Venture); and, Billabong Creek SIS (State owned scheme). All schemes continued to operate in accordance with their Operating Protocols during the reporting period.

For the purposes of this report, only the Joint Venture SIS are included in scheme summary statistics. In total 307,393 tonnes of salt was diverted from the Murray and Darling River systems. All schemes generally operated in a full-time capacity throughout the reporting period. Retaining basin condition assessments were completed for both the Upper Darling and Mallee Cliffs SIS, with results indicating further work was required.

In NSW, the Mallee Cliffs SIS was selected as a site to participate in the trial and as a result a 'Mallee Cliffs Responsive Management Monitoring Plan' and 'Trigger Action Response Plan' was developed. In 2018, intensive monitoring was undertaken of vegetation and groundwater in the vicinity of the production bore field, with a 'fresh water lens' study also initiated. As part of the trial, the scheme must be shut down for a period of six months which is due to commence in October 2019.

Salinity Management

DPIE Water is the overarching body that manages in-stream salinity and is responsible for complying with accountability requirements as set out in Schedule B of the Agreement, with other government agencies supporting the delivery of BSM2030 tasks and objectives. Salinity management in catchments is supported by salinity information and products developed for the delivery of current NSW policy and intergovernmental agreement.

Modelling tools have been developed that support salinity management of environmental water by enabling an assessment of salinity regimes under a 'stationary' water management regime. This enables different management options to be explored and evaluated. In addition, agreements (for example, with Murray Irrigation Limited) are in place to ensure water is provided for dilution flows when drain salinity trigger values are reached.

A significant amount of work has been undertaken during this reporting period to manage dryland/catchment salinity, including:

- the *Hydrogeological Landscapes* (HGL) program - provides land management agencies, consultants and landholders the tools they need to ensure that land management actions can be spatially targeted and allows salinity priorities and risks in landscapes be defined.
- development of *Salinity Technical Reports* - informs Basin Plan Water Quality & Salinity Management Plans.
- *Catchment Action (CA)* NSW - the provision of on-ground projects and training, delivering a range of services that assist in the mitigation of salinity impacts within individual catchments such as implementation of sustainable grazing practices; revegetation and rehabilitation works; training and community capacity building programs; and, development of on-farm planning/property management plans.

Drought has had a major impact on flow, particularly in the Northern Basin, over the two year period. Maximum EC figures were elevated in 2018/19 in the Namoi River (1,020 EC) and Castlereagh River (1,085EC) and was particularly significant at the Darling River site @ Wilcannia with an EC of 3,045 recorded. The Darling River exceedance is caused, in large part, by mobilisation of saline groundwater upstream and evaporation acting on a low rate of flow. This explains the target exceedances for both 2017/18 and 2018/19. In contrast, the Lachlan River @ Forbes has had a notable reduction in maximum EC from 1,047 to 667EC during this reporting period. This is likely due to reduced high runoff flows (wash-off from saline sites) from the saline upper catchment streams of the Lachlan e.g. Boorowa River.

Efficient Governance

There has been significant progress during the reporting period to ensure NSW's obligations as set out in BSM2030 are met, with a particular focus on improving NSW BSM program governance. This has included the development of a project plan (and program logic) and the establishment of a BSM Steering Committee to provide program oversight. In addition, NSW has been an active member of the Basin Salinity Management Advisory Panel (BSMAP) and has provided assistance and support for the delivery of multiple interjurisdictional BSM2030 tasks.

As a key task of BSM2030, NSW is required to submit a list of key salinity monitoring sites (both groundwater and surface water) to MDBA for inclusion within the Basin-wide Core Salinity Monitoring Network. To date 321 surface water sites have been selected, with another 641 groundwater sites identified. In addition, a number of complementary projects are being undertaken that will further inform NSW and Basin-wide Core Salinity Monitoring Networks.

A revised BSM2030 Review Plan was submitted and endorsed by BSMAP (Meeting 43) in 2019, with the timing of Register reviews adjusted based on:

- the independent assessment of NSW BSM program (Jacobs, 2018);
- Basin Officials Committee (BOC) endorsed review frequencies;
- their inherent risk profile (i.e. modelling salinity effect);
- existing internal priorities; and,
- concurrent knowledge priority work.

As such, the Mallee Legacy of History (dryland clearing and pre-88 irrigation); Murray (MIL) Land and Water Management Plan (LWMP); and, the Upper Darling SIS reviews have commenced, with all Sunraysia related reviews to be completed in line with the (MDBA led) Sunraysia (EM2) model refinement project.

Strategic Knowledge Improvement

During this reporting period, NSW has pursued knowledge improvements with respect to landscape management, modelling adaptation; and, salinity dynamics and processes. Key projects and innovations include:

- *Hydrogeological Landscapes (HGL) program* - targeting high priority salinity catchments to identify appropriate land management activities that mitigate on-farm and catchment salinity impacts, whilst also meeting production and sustainability outcomes across NSW;
- *Polluter/Diluter Catchment Analysis* - research on the source, behaviour and trends of river salinity processes within sub-catchments for each of the inland river Murray-Darling Basin (MDB) valleys;
- *Salinity Technical Reports* - underpins the Basin Plan Water Quality and Salinity Management Plans (WQSMP). Uses both the HGL Framework and salinity modelling approaches.
- *Salinity Research Sites* - modelling and monitoring to inform state-wide hydrology research project;
- *Urban Salinity Programs* - uses HGL information to assess development applications, inform subdivision planning, provides advice to consultants and developers and used for strategic planning purposes (e.g. Local Environmental Plans);
- *Hydrologic Modelling Practice Notes* - a knowledge sharing project that developed an integrated online information sharing platform to facilitate a transparent, consistent and efficient implementation of the SOURCE modelling platform across the MDB; and,
- *NSW River Styles* - this database describes the geomorphic character, behaviour, condition and recovery of third and higher order rivers in NSW.

Community Engagement and Communication

Community engagement and communication activities continued during this reporting period, with a wide range of stakeholders participating in events. Salinity-related activities such as training, project support and field days were delivered across the state, supporting the knowledge and implementation of salinity management across NSW.

From January 2018 to June 2019 training was delivered by DPIE Water (Salinity Technical Unit) with a total of 602 community members and LLS & agency staff participating in events aimed at improving knowledge in salinity. Types of training included:

- *Hydrogeological Landscape* (HGL) frameworks for LLS and Landcare groups. In high demand, 1 - 3 day courses are targeted at local scale, sub-catchment and regional scales;
- *Farm planning* training with a focus on soil / salinity for community groups and industry groups.
- *Training of LLS staff* – Up-skilling new staff, particularly in minor district locations;
- '*Reading the Landscape*' and '*Salt of the Earth*' courses for catchment communities; and,
- '*Farmers teaching farmers*' programs have been supported and continue to be an effective interface with the community.

A major focus was to improve the awareness and understanding of salinity management works to Landcare networks and community groups who have an interest in salinity through training on effective grazing management on salt affected landscapes, saline pasture management, property management planning and landscape hydrology.

Future Priorities

Future priorities in NSW are focused on establishing further, and maintaining existing, resources and capacity to successfully implement and contribute to BSM2030 key tasks and objectives. Sourcing and securing appropriate staffing and funding will continue to be a key priority over the next 12-18 months.

Other key initiatives include:

- finalisation of the NSW Core Salinity Monitoring Network;
- establishing a New Irrigation Development policy framework;
- completion of current Register reviews and supporting the Sunraysia (EM2) model refinement project;
- completing model transitions to the SOURCE framework for all NSW river system models;
- undertake a NSW Upland Catchment Audit;
- integration of salinity information onto publicly accessible on-line platforms; and,
- salinity impact assessments of SDLAM progressed and/or completed, including the assessment of other environmental water initiatives (as required).

In addition, NSW will continue working with other Basin States and the MDBA on key priorities as required.

Executive Summary: Australian Capital Territory's BSM2030 comprehensive report 2018-19

The ACT government did not provide a BSM2030 comprehensive report for 2018-19.

Executive Summary: Australian Government's BSM2030 annual report 2018-19

Current Commonwealth interaction with BSM2030 occurs primarily through the Commonwealth Environmental Water Office (CEWO) and the interactions of delivery of environmental water. The Commonwealth continued to review the influence of Commonwealth environmental watering on salinity in the Murray-Darling Basin and quantified the benefit of the delivery of Commonwealth environmental water on salt export through the Murray Mouth.

As with previous years, Commonwealth environmental water also continued to be delivered to the Lower Murray, contributing to improving water quality and exportation of salt through the Murray Mouth. During 2018-19, Commonwealth environmental water contributed 100% of the flow through the South Australian barrages.

In reporting with relevance to flow management on salinity and the use of the Commonwealth held water, the CEWO undertakes reporting under:

- Annual Basin Plan Reporting for schedule 12 (excluding matter 9.3);
- Annual Environmental water accounting under Schedule 12 for matter 9.3;
- Commonwealth Environmental Water Holder (CEWH) annual reporting (required by the *Water Act 2007* section 114(1), referencing the Basin Plan's Environmental Watering Plan).
- Long Term Intervention Monitoring (LTIM) reporting, applying principles for monitoring and evaluating the effectiveness of environmental water (Basin Plan section 13.04 and Schedule 12, item 14).

While the Commonwealth has agreed to offset the salinity debits from a range of other environmental water related actions using the salinity credits from the delivery of Commonwealth environmental water, this will not occur until the salinity credits are able to be estimated confidently and at that time the provisional status of this register entry will be removed.

Office locations
Adelaide
Albury-Wodonga
Canberra
Goondiwindi
Griffith
Mildura
Murray Bridge
Toowoomba

mdba.gov.au 1800 230 067 engagement@mdba.gov.au