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MURRAY–DARLING BASIN AUTHORITY

Basin Salinity Management 2030

2019–20 Status report

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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.

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Introduction

To continue ongoing collective efforts in salinity management, partner governments and the Murray–Darling Basin Authority (MDBA) prepared the Basin Salinity Management 2030 (BSM2030) strategy, which was agreed by the Ministerial Council in November 2015. The BSM2030 strategy focuses on continuing to ensure 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.
- Trialling 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.

Under the BSM2030 strategy, every second year from 2016 the MDBA is required to prepare a BSM2030 status report for the Basin Officials Committee (BOC). This is the third BSM2030 status report prepared by the MDBA.

The information contained within this report and each of the partner governments' BSM2030 reports will be compiled into a summary brochure for Ministerial Council.

Overview of outcomes

Key achievements in 2019–20:

- The basin salinity target was met for the eleventh consecutive year. The target aims to maintain the average daily salinity at a simulated level of less than 800 EC[1] for at least 95% of the time at Morgan, South Australia.
- The SIS diverted about 471 thousand tonnes of salt away from the River Murray system and adjacent landscapes.
- The second BSM2030 strategy audit by the Independent Audit Group for Salinity (IAG-Salinity) was undertaken in November 2019 (IAG-Salinity, 2020).
- The 2nd Basin Salinity Forum was held in Mildura in November 2019, with 60 delegates sharing new knowledge and experience to continuously improve best management practices for river operations, environmental watering and salinity management.
- Knowledge priorities to reduce uncertainty around future salinity risks were progressed, including:
    - Continued development of transfer functions for use in groundwater models to calculate irrigation recharge to groundwater, including piloting the transfer functions in the review of the Loxton-Bookpurnong model.

[1] This status report presents salinity as electrical conductivity (EC) units, microsiemens per centimetre (µS/cm).

- Continuing investigations at trial sites to understand system responses to changed SIS operations.
- Conducting floodplain woody vegetation evapotranspiration studies to inform knowledge on saline groundwater movement in the lower Murray.
- Planning for floodplain salinity modelling projects to address knowledge gaps and improve river salinity management.

Summary of authorised works or measures

The BSM2030 strategy focuses on investing in learning and knowledge development for ongoing operations of existing SIS.

Scheme operation and maintenance

In 2019–20, operating and maintaining the existing River Murray Operations (RMO) SIS assets continued to focus on knowledge development. Minimising operating costs from power usage associated with pumping was of particular focus.

RMO SISs continued to be successful in diverting salt away from the River Murray and adjacent landscapes. About 471 thousand tonnes of salt was diverted in 2019–20 (Table 1). These results are similar to outcomes achieved in recent years. This reflects stable ongoing operations and maintenance following the floods in 2016-17.

Key planned maintenance activities undertaken in 2019–20 included:

- Goulburn-Murray Water completed replacement works of the three bridges identified in the Barr Creek Diversion Drainage Scheme Bridge Upgrade Strategy.
- NSW Department of Planning, Industry and Environment (DPIE) progressed Phase 1 of the Switchboard Replacement Program (3 bores) and installation of additional isolation valves and pressure meters at the Mallee Cliffs SIS (scheduled to be completed in Quarter 2 of 2020–21).
- SA Water completed switchboard replacement works at Woolpunda bores 8, 9 and 10.

Some maintenance activities planned from March 2020 were deferred due to coronavirus (COVID-19) pandemic restrictions and State border closures. This includes use of SA Water across the RMO SIS Program to undertake acid dosing, responsive management field investigations and various other supply chains for goods and services that were based interstate.

These impacts continue to be reviewed and appropriate management plans put in place. This includes monitoring and surveillance of schemes, and alternate arrangements for on-ground works.

Table 1: Joint salt interception scheme performance report 2019–20

Salt interception scheme	Volume pumped (ML)	Salt load diverted (Tonnes)	Average salinity (EC units)	Target achieved (% of time)	Power consumption (kWh)
Pyramid Creek	983	24,952	42,417	100%	148,206
Barr Creek	546	2,657	7,468	100%	11,711
Mildura-Merbein	1,680	79,088	75,400	81%	356,309
Mallee Cliffs	968	31,240	51,983	94%	317,009
Buronga	2,018	49,425	39,978	97%	461,733
Upper Darling	1,116	33,227	46,962	76%	194,433
Pike River	254	10,730	57,452	60%	92,047
Murtho	1,304	32,777	39,353	89%	1,771,581
Bookpurnong	774	17,996	36,077	93%	284,861
Loxton	808	9,589	23,431	94%	320,868
Woolpunda	5,083	102,748	32,230	98%	2,935,820
Waikerie	4,486	77,001	29,101	85%	1,660,615
Rufus River	1	41	44,810	100%	7,702
Totals	**20,021**	**471,471**			**8,562,895**

Notes: 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 salt interception schemes

As part of the trial of responsive management of SIS, each month throughout 2019–20 the MDBA continued to prepare six-month salinity outlooks. Workshops were held quarterly to review current and forecast in-river salinity conditions and to make decisions on the level of SIS operations. For the first three quarters in 2019–20, salinity levels at Morgan were forecast to remain below 400 EC, and the decision to continue reduced operation of Murtho SIS while maintaining full operation of other schemes to the extent possible was maintained.

To assist mitigating the salinity impacts forecast from the recommencement of flows in the lower Darling River, in April 2020 operations at Murtho SIS were increased to full capacity and bores at Mildura-Merbein which were off at the time for operation and maintenance reasons were temporarily restarted. However, the anticipated salinity impacts from the Darling River inflows were not realised, and as such, in quarter four, operations at Murtho SIS were reduced back to typical responsive management levels while other schemes were maintained at the same level of operations as previous quarters.

Over 2019–20, key activities for the knowledge gap investigations at the six trial sites included:

- Commencement of a "gap analysis" review of the monitoring activities at the four South Australian trial sites, expected to be finalised in the first half of 2020–21.
- Six-month shutdown of the Mallee Cliffs SIS to inform understanding of the low salinity lens dynamics to changes in operations.
- Preparation of a scope of works to engage expertise to assist with the implementation of vegetation monitoring activities at the Mildura-Merbein SIS.

At the time of reporting (September 2020) the majority of schemes were operating close to full time, with the exception of Murtho SIS which is currently operating at reduced levels and Mallee Cliffs SIS which was recently partially re-energised following the extended shutdown for knowledge gap investigations.

Additionally, in November 2019 the Basin Officials Committee agreed to extend the period of the trial of responsive management of SIS until 2025. This will inform the BSM2030 strategic review in 2026.

BSM2030 review plan

The BSM2030 Review Plan sets out the frequency for the review of register entries, models and end-of-valley outcomes under the BSM2030 strategy.

Since the Review Plan was first endorsed by BOC in October 2016, changes were proposed by State Contracting Governments through the Basin Salinity Management Advisory Panel (BSMAP). Consequently, the Review Plan has been updated and was resubmitted to BOC for endorsement in November 2019. The Authority subsequently approved the Review Plan in December 2019.

As part of the salinity audit, the IAG-Salinity assessed progress of reviews under the Review Plan. They recommended that the Authority include a provisional debit entry to account for new irrigation development in the NSW Sunraysia irrigation area. The assessment of salinity impacts from new irrigation development was completed by NSW, and the Authority has now added this provisional entry to the 2020 salinity register.

Reviews

The transition of the MDBA river model from BIGMOD to SOURCE has delayed a number of MDBA register entries reviews, for which the salinity impacts will be re-estimated using the new SOURCE model. The MDBA has estimated the salinity and salt loads under the baseline conditions using the SOURCE model and are finalising reporting on that modelling. When this report has been finalised, a meeting of the Technical Working Group for Salinity Modelling (TWGSM) will be scheduled to consider the re-estimated salinity and salt loads under baseline conditions. The transition to the SOURCE model will progress throughout 2020–21.

A number of reviews of authorised works or measures were completed in 2019–20, including the joint component of Loxton and Bookpurnong SIS and the Barr Creek Drainage Diversion Scheme. The Loxton-Bookpurnong model was found to be "fit-for-purpose" and the updated salt loads were used to revise the salinity register. This included various South Australian state actions and the joint component of the Loxton and Bookpurnong SIS. Assessment of salinity impacts following the review of Loxton-Bookpurnong groundwater model indicated a reduction in salinity benefits at Morgan of

9.4 EC for all related accountable actions. The joint works and measures component of Loxton SIS and Bookpurnong SIS reduced the salinity effect at Morgan by 11.5 EC.

The salinity register component of Barr Creek Drainage Diversion Scheme was assessed based on the extent to which pumps were operated in accordance with operating rules. The review recommended that the current salinity register entry (4.9 EC) should be retained.

Outcomes from reviews conducted by State Contracting Governments are provided in their respective status reports.

Summary of the 2020 salinity registers

Under the BSM2030 strategy, actions that increase or decrease average river salinity are accounted as debits and credits and recorded in the salinity registers. Actions such as new irrigation developments may generate a debit on the register if they increase salt loads to the River Murray. By comparison, actions such as operating SIS and improving irrigation practices may generate credits (a reduction in river salinity).

Each register entry covers salinity impacts on the river arising from recent accountable actions (Register A), as well as from major historical land and water use decisions (Register B). Each year, the Contracting Governments inform the MDBA about reviews of existing register entries and new activities that have significant salinity effects[2]. Reviews are submitted to the MDBA for independent peer assessment and then provided to BSMAP for endorsement. A summary of the 2020 salinity registers is provided in Table 2.

Table 2: Summary of the 2020 salinity registers

Actions	NSW ($m/year)	Vic ($m/year)	SA ($m/year)	Qld ($m/year)	ACT ($m/year)	Commonwealth contribution (EC) [b]
Authorised works or measures	2.743	2.743	0.948[#]	0	0	33.3
State shared works & measures	0.189	0.189	0	0	0	0
State actions	3.414	2.656	2.377	tbd	tbd	1.0
Total register A	6.346	5.588	3.325	tbd	tbd	33.3
Transfers to register B*	0.874	0.698	2.024	0	0	0
Total Register B	0.488	-0.267	4.109	0	0	0
Balance registers A & B	6.834	5.321	7.435	0	0	33.3

**Total includes Transfers from Register A; tbd = To be determined*

#South Australia decided to allocate its share of the credits from authorised works or measures constructed under the Salinity and Drainage Strategy to improve River Murray salinity

[2] 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.

Modelled salinity outcomes at Morgan, South Australia

For the eleventh consecutive year the basin salinity target was met (Figure 1). The modelled salinity outcome at Morgan, South Australia in 2020 was 786 EC for 95% of the time. This is below the basin salinity target that aims to maintain Morgan salinity at a simulated level of less than 800 EC for 95% of the time. Figure 1 illustrates the progressive change in modelled river salinity in response to changes in development, implementation of mitigation works and measures and the improved modelling knowledge over time.

Over recent years there has been an increase in the modelled 95 percentile salinity at Morgan which continued in 2020. These increases arise from the review of accountable actions and are primarily due to new knowledge from improved information and monitoring. In 2019–20, this improved understanding resulted in a reduction of the estimated salinity benefits provided by the Loxton and Bookpurnong schemes. This was balanced by a reduction of modelled salinity impacts from irrigation in the Nyah to South Australian border region of Victoria.

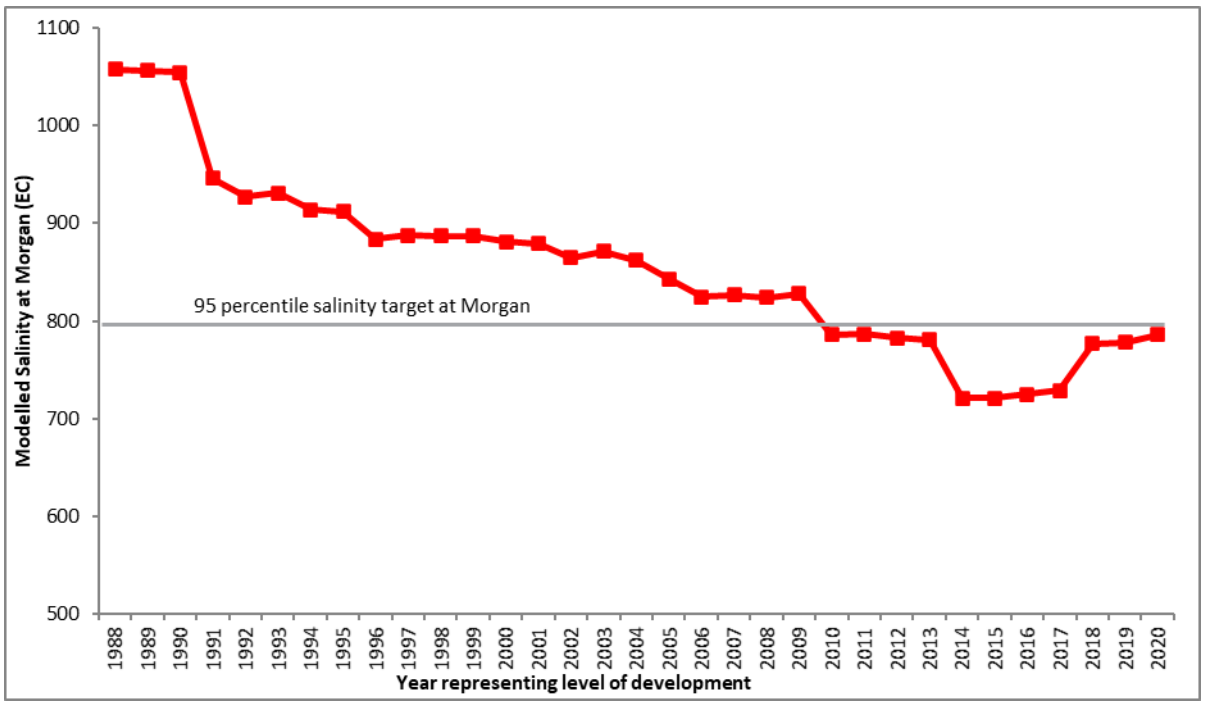

Figure 1: Modelled 95 percentile salinity over the 1975 to 2000 benchmark period at Morgan, South Australia, due to the implementation of salinity management programs from 1988 to 2018.

Note: The river model is capable of simulating median and average daily salinity levels with a higher level of confidence, when compared to the 95 percentile daily salinity level.

Improvements in salinity management to date can be assessed by modelling outcomes for baseline condition levels of development and salinity mitigation and comparing them with outcomes based on 2020 levels of development and salinity mitigation (over the 1975 to 2000 benchmark period). Table 3 demonstrates that under the defined variable climatic regime, the incidence of salinity exceedance of 800 EC at Morgan has substantially declined.

Table 3: Simulated salinity (EC) summary statistics at Morgan, South Australia, for baseline and 2020 conditions over the 1975 to 2000 climatic period

Period	Time interval	Average (EC)	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 2020 conditions 1975–2000	499	470	786	4	96

Note: Baseline conditions are set at 2000. However, salinity impacts arising from development activities between 1988 and 2000 in New South Wales, Victoria and South Australia are accountable under the Basin Salinity Management 2030 strategy and have been excluded from the baseline, so for New South Wales, Victoria and South Australia, the baseline represents 1988 conditions.

Observed salinity outcomes at Morgan, South Australia

A comparative assessment of average, median, 95 percentile and peak salinity levels measured at Morgan, South Australia over four time intervals (1, 5, 10 and 25 years) to June 2020 and for the 1975–2000 period is provided in Table 4.

The 2019–20 measured average and median salinity levels at Morgan were slightly lower than the 5-year statistics in Table 4. The 95 percentile and peak salinity statistics for 2019–20 were also lower than the other periods. The improvement in salinity statistics over time is most evident when comparing the longer term 25-year salinity statistics over the 1975–2000 and 1995–2020 periods, which indicates the effectiveness of the progressive implementation of the successive salinity management strategies.

Table 4: Summary of measured salinity levels (EC as µS/cm) at Morgan, South Australia.

Period	Time interval	Average (EC)	Median (EC)	95 percentile (EC)	Peak (EC)	% time more than 800 EC
1 year	July 2019 - June 2020	234	226	318	332	0%
5 years	July 2015 - June 2020	297	279	462	732	0%
10 years	July 2010 - June 2020	309	294	473	732	0%
25 years	July 1995 - June 2020	414	395	680	946	0%
25 years	July 1975 – June 2000	632	607	1063	1441	23%

The benefits that can be directly attributable to mitigation measures are demonstrated by Figure 2 using a combination of measured and modelled data. Figure 2 compares in-stream salinity outcomes at Morgan in South Australia with model predictions of the salinity outcome if no mitigation actions had been carried out since 1975. The results for the 2019–20 period demonstrate the effectiveness of all salinity mitigation works and measures since 1975 towards reducing salinity in the river.

Figure 2 also demonstrates the significant influence the flow regime has upon salinity and that the benefits of the actions are most obvious during low flow periods.

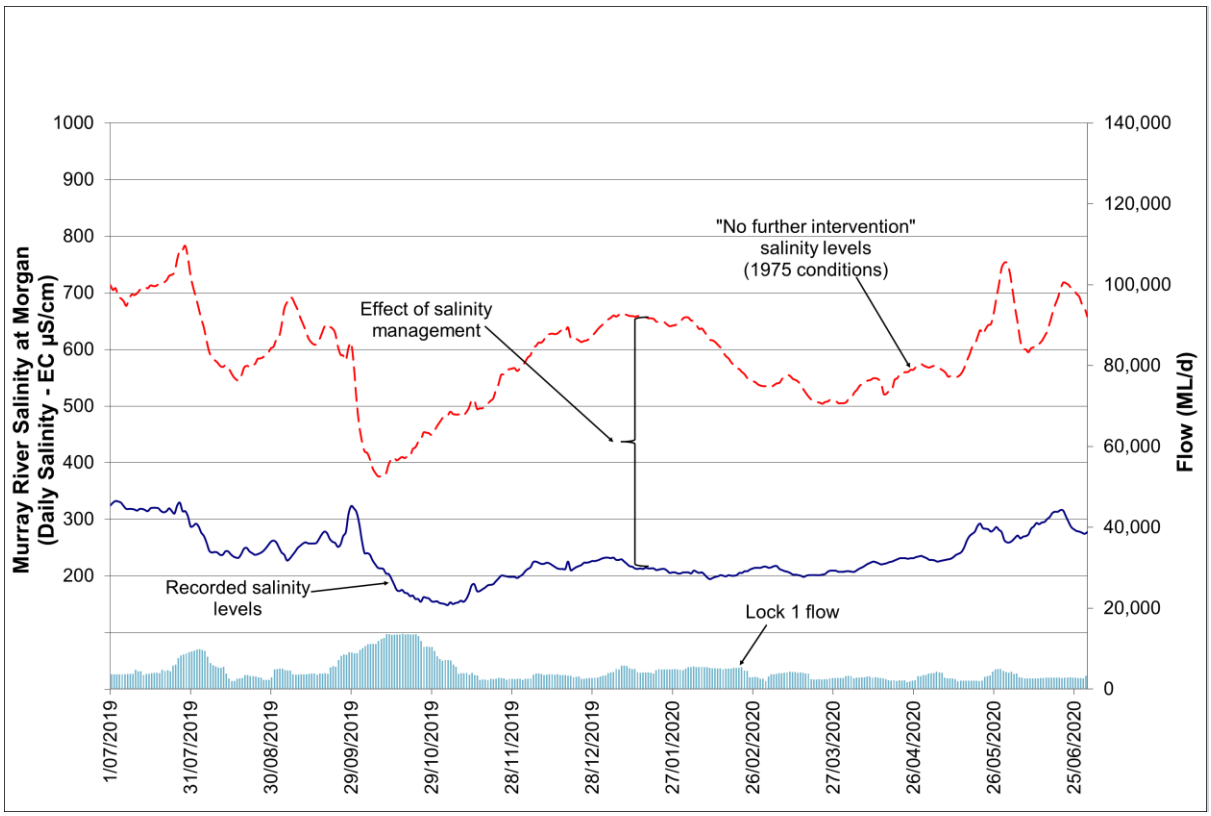

Figure 2: Comparison of modelled 'no further intervention' salinity levels' (1975 conditions) to mean daily recorded salinity levels at Morgan, South Australia, from July 2019 to June 2020.

Basin Plan reporting

The Basin Plan requires the MDBA to monitor salinity at five reporting sites on a daily basis and to assess, at the end of each water accounting period, whether the targets at the reporting sites have been met. The targets are deemed to have been met if the salinity levels have been below the target value for 95% of the time over the last five years. From July 2015 to the end of June 2020, the salinity target values were achieved at three of the five reporting sites – Murray Bridge, Morgan and Lock 6. However, the recorded salinity at the Burtundy site and the Milang site was above the target value 42.4% and 6.4% of the time, respectively.

In the previous 12 months (1 July 2019 to 30 June 2020), recorded salinity levels from the data loggers at Burtundy peaked at 1,267 EC on 31 August 2019. Low or no flows during this 12 month period stranded the data recorder above the waterline on five separate occasions so time-series

salinity levels could not be recorded at these times (1 July to 5 July, 7 July to 18 July, 6 August to 12 August, 25 August to 30 August, and 4 September to 11 April).

An increasing trend in salinity levels at Milang was first identified in last year's report (MDBA, 2020b). As forecast, the Milang target was not achieved in the current reporting period. In the previous 12 months (1 July 2019 to 30 June 2020), salinity at Milang peaked at 1,049 EC on 5 July 2019.

The Basin Plan includes a salt export objective to ensure salt is flushed at a sufficient rate from the River Murray system into the Southern Ocean. The objective is expected to be achieved by discharging an average of two million tonnes of salt per year over a three-year period.

The estimated annualised rate of salt export over the barrages was 0.43 million tonnes during the three-year assessment period (June 2017 – July 2020). This is less than the Basin Plan's indicative figure of 2 million tonnes per year.

A range of factors can influence how much salt is exported each year. These factors include river regulation, changed land management practices, complex groundwater systems and the highly variable nature of the hydrological conditions in the Basin. It may not be possible to flush 2 million tonnes of salt consistently to ensure salt concentration or salinity levels in the river remain at acceptable levels.

During periods of low flow, such as 2017–20, preventing salt entering the river through the operation of SIS is more important than exporting salt out to the ocean. In 2019–20, the operation of SIS helped protect the river from salinity by diverting about 471 thousand tonnes of salt away from the river and riverine landscapes.

Elevated salinity events

After record rainfall deficiencies particularly across the northern basin from 2017 to 2020, a band of above average rainfall extending across the Basin brought relief in March 2020. This recommenced flows from the Darling River to the Murray River on 14 April 2020 (Bureau of Meteorology 2020a, 2020b and MDBA 2020a).

Initial releases from Weir 32 in 2020 by WaterNSW to recommence flow in the lower Darling River were maintained at higher levels compared to 2016 recommencement. Water quality was monitored in the lower Darling River and the Murray River as the higher flows progressed downstream. Salinity levels from grab samples peaked at Burtundy on the Darling River at an elevated concentration of 3,949 µS/cm on 31 March 2020, which reduced to 247 µS/cm on 14 April 2020. Maintenance of the high initial flow rate was a key factor for managing salinity when the lower Darling River restarted flowing.

First flows from the lower Darling River to the Murray River peaked briefly one week later at 600 µS/cm in the Wentworth Weir pool. However, the Murray River downstream of Wentworth Weir remained below 200 µS/cm. Salinity impacts to the Murray River were minor and this result reflected the planning and joint management actions taken in anticipation of this reconnection event.

In planning for the recommencement of flows, the arrival of a slug of elevated salinity water from the lower Darling River at the Murray River junction was anticipated. MDBA in conjunction with WaterNSW and supported by the Water Liaison Working Group worked to manage potential water quality impacts to the Murray River from the forecast elevated salinity event.

This included partial drawdown of the Wentworth Weir pool. Weir pool drawdown was triggered for commencement with the arrival of Darling flows at the Burtundy gauge. This measure, first taken in the 2016 re-connection event, proved to be effective at mobilising and diluting saline water at the Murray–Darling junction. The Euston Weir Pool was lowered and timed to provide additional delivery of flow to dilute the higher salinity Darling River water. The effectiveness of this step was recorded as a valuable mechanism for such reconnection events to manage flows and elevated salinity (MDBA 2020).

Following this peak salinity event, BSMAP determined the recommencement of flows in the lower Darling River and associated elevated salinity levels warranted review. Information will be compiled, shared and analysed ahead of a discussion forum between salinity managers, river operators and environmental water managers. This work will be undertaken throughout the second half of 2020.

Core salinity monitoring network

Nominations to the basin-wide core salinity monitoring network are now largely finalised. In December 2019, NSW nominated their critical salinity monitoring sites to the network.

MDBA will continue to work with the State Contracting Governments to ensure the network of salinity monitoring sites remains current. MDBA have initiated working towards a data repository to store the core salinity monitoring network sites. MDBA will continue to develop the data repository in 2020–21.

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