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Assessment of the salt export objective and salinity targets for flow management 2022–23

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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.

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Basin salinity management

Salinity management across the Murray–Darling Basin is a significant challenge with a range of strategic policy and intervention measures implemented to manage the ongoing salinity problem. Since 1988, Basin governments have implemented 3 consecutive strategies to manage salinity, the most recent being the Basin Salinity Management 2030 strategy.

If not managed well, salinity poses an ongoing threat with risks to the Basin's land and water resources. While salt occurs naturally in the Basin's landscape, activities such as irrigation development and land clearing can cause salt to concentrate in certain places presenting management challenges and impacting agricultural production and, in some cases, potable water supplies, particularly during extreme low flow periods.

Water flowing through the River Murray system and out to the Southern Ocean through the Murray Mouth is the main natural process by which salt can be completely exported from the Basin. Salt interception schemes divert saline groundwater away from the river, however this salt doesn't leave the Basin as the saline groundwater is pumped to regional disposal basins where the water evaporates.

In order to maintain good salinity levels in the River Murray system, the Basin Plan includes an objective to flush out salt through the Murray Mouth and there are salinity targets for flow management at 5 sites. One of these sites is located on the lower Darling River and the remaining 4 sites are located on the River Murray in South Australia.

Generally, more salt is flushed out to the Southern Ocean during higher flow years and less in lower flow years. Discharge of salt is augmented by the delivery of environmental water recovered under the Basin Plan as it increases end of system flows. The provision of environmental water in dry years is often the primary driver of barrage flows and salt export. The amount of salt export is also impacted by river regulation, irrigation diversions and current levels of development, including salt interception works. The achievement of the salt export objective should therefore be viewed in the wider context of overall salinity management, including all the measures implemented in the Basin over the last 3 decades.

Unregulated flows increase the volume of salt mobilised when they are sufficiently high to engage the floodplains, wetlands and numerous creeks along the River Murray system. These flows provide an opportunity for the mass export of salt and nutrients from the River Murray system into the Southern Ocean and they also provide other significant benefits including the freshening of groundwater lenses.

The minimum annual discharge through the barrages required to achieve (95% of the time) a salinity target of less than 1,000 EC in Lake Alexandrina is a minimum of 650 gigalitres (GL) in any year to be achieved for 95% of years. This does depend on the starting salinity position in the Lower Lakes and 650 GL following a period of low to no barrage releases (such as during extreme drought) is likely to be insufficient to reset salinity levels. The 650 GL of flow also provides many additional benefits to the River Murray system when enroute to South Australia and may be provided in the form of return flows from watering actions and directed releases from the headwater storages to meet a demand at the South Australian border.

Salt export objective

The Basin Plan includes a salt export objective which aims to ensure adequate flushing of salt from the River Murray system. Achievement of the salt export objective is assessed each year by the MDBA.[1]

Over the 3-year assessment period from July 2020 to June 2023, the annualised rate of salt export at the barrages was 2.38 million tonnes per year (Figure 1). This is more than the Basin Plan's indicative figure of 2 million tonnes per year. In 2022–23, due to higher flows, the estimated amount of salt exported was 4.57 million tonnes (Figure 1).

The amount of salt exported is a function of flow across the border and within South Australia, flow over the barrages and Lower Lakes salinity levels. The total flow across the South Australian border was estimated at approximately 22,994 GL in 2022–23 which was up from 9,090 GL in the previous year. This is significantly above the normal regulated entitlement flow of 1,850 GL plus environmental water flows which are on average up to 1,000 GL per year.

The high flow in 2022–23 led to substantial floodplain inundation and watering of areas which had not been inundated since the 1970's. Significant volumes of salt can accumulate in the lower River Murray floodplains and this flow event would have led to the most substantial mobilisation of salt since the 1970's, albeit with a significant dilution impact. Flow at the South Australian border peaked at an estimated volume of approximately 185 GL on 21 December 2022. This flow led to a substantial volume of sand being scoured from the Murray Mouth, which increased the depth and width of the Mouth. This scouring provided for greater tidal exchange which benefits the ecology of the Coorong through improved connectivity with the Southern Ocean.

Flushing salt from the river system helps reduce salt accumulation and adverse impacts on water users. Flushing salt also supports healthy river and floodplain ecosystems including the environment of the Coorong, which substantially benefits from high flows reducing salinity levels. Salt interacts with instream biota (animals and plants), changing the ecological health of streams and estuaries, and reduced salinity levels helps to build ecological resilience coming into droughts and low flow periods when flushing opportunities may be reduced.

It is noted that the salt export objective is being reviewed in 2023–24 as part of the Basin Plan Review and this review will consider potential options for improvement.

[1] A detailed description of the methodology is provided in the following report: MDBA 2013, Approach for estimating salt export from the River Murray System to the Southern Ocean, Murray–Darling Basin Authority, Technical Report 2013/09.

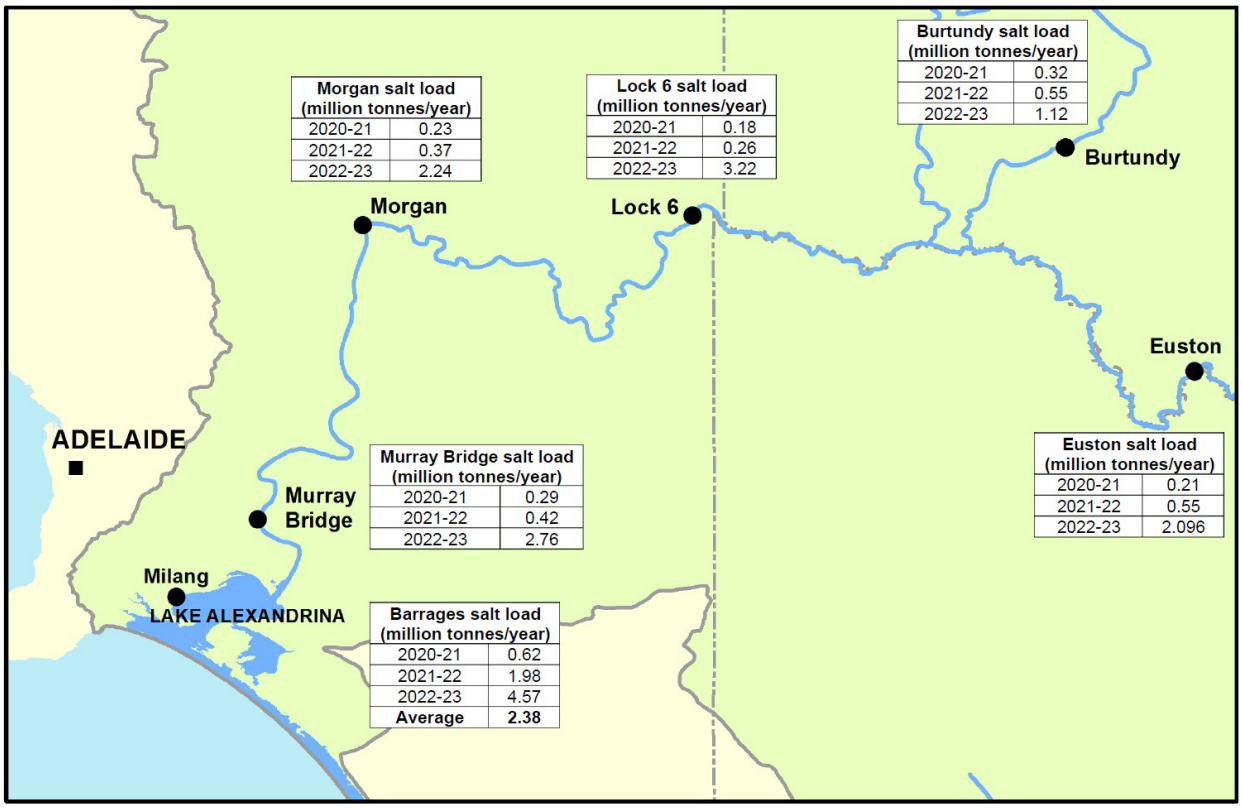

Figure 1 Salt loads at key locations in the Murray–Darling Basin.

*Note that due to the extensive flooding in South Australia, data is missing for the Lock 1 flow for a period of 58 days. The salt load calculations for Morgan and Murray Bridge are impacted by this missing data and the salt loads are therefore underestimated when comparing the values to those observed at Lock 6 (Figure 1).

Table 1 Estimated salt export over the barrages and salt diverted away from the river system by salt interception schemes.

Variable	2020–21 (million tonnes/year)	2021–22 (million tonnes/year)	2022-23 (million tonnes/year)
Salt diverted away from the river and adjacent landscapes through operation of SIS	0.45	0.37	0.28
Estimated salt export through the lower lake barrages (annualised average over the 3 preceding years)	0.47	0.98	2.38

Salinity targets for flow management

The Basin Plan also includes salinity targets for flow management (operational targets) at 5 reporting sites between Burtundy (lower Darling River) and Milang at Lake Alexandrina. These targets seek to ensure River Murray water is suitable for drinking, agriculture, recreation and the environment. Salinity levels will vary significantly between years and are linked to both flow conditions at the reporting site and upstream conditions. For example, low to no flow periods on the lower Darling River can result in

elevated salinity levels at Burtundy due to the absence of suitable flushing events to mobilise salt from the Lower Darling River.

Salt can accumulate in Lake Alexandrina when sufficient water isn't flowing down the River Murray during hot-dry and low water availability years. The ability to discharge into the Coorong is also impacted by the downstream water levels and when water levels are high in the Coorong (often driven by a combination of wind and high tides) the barrages can be closed to partially mitigate the upstream estuarine intrusion. There are also regional groundwater influences around the Lower Lakes which can impact salinity levels when water levels reduce in the Lower Lakes.

Salinity levels at the 5 reporting sites listed in the Water Quality and Salinity Management Plan of the Basin Plan in *Section 9.14 Targets for managing water flows* (Lock 6, Morgan, Murray Bridge, Milang and Burtundy) were monitored near continuously over the 5-year reporting period (2018– 2023). At Morgan and Murray Bridge there is some missing salinity data in 2022–23 due to the removal of the telemetry stations during the peak flooding period. This impacted the salt load calculations as the missing data coincided with the highest flows along the River Murray during December 2022 and January 2023.

The salinity targets 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 reporting period (July 2018 to June 2023), the assessment indicates that the targets have been met at 3 of the 5 reporting sites, being Lock 6, Morgan and Murray Bridge.

The target value at Burtundy is 830 EC and the target was not achieved over the 5-year reporting period. Salinity levels at Burtundy were above the target for 13% of days over the reporting period. Following an extended period of low or no flow conditions, the lower Darling River re-commenced to flow at Burtundy in April 2020 with flows being maintained between normal operating releases to meet downstream demands and flood operations. Over the 12-month period from 1 July 2022 to 30 June 2023, recorded salinity levels at Burtundy remained below target and peaked at 528 EC on 31 January 2023.

The target value for Milang is 1,000 EC. This target was not achieved over the 5-year reporting period as salinity levels were less than 1,010 EC 95% of the time, which is just above the target. This is a function of salt contributions from the River Murray, regional groundwater inputs and reverse flow through the barrages. Salinity levels for the reporting period exceeded the target for 7.1% of days. In the 12-month period from 1 July 2022 to 30 June 2023 salinity levels remained relatively low, due to the significant volume of unregulated flow arriving predominantly over spring and summer. The lowest salinity value was recorded as 278 EC on 4 November 2022 prior to the flood peak which arrived at Lake Alexandrina in late December 2022 to early January 2023.

The Milang site can also be influenced by reverse flows through and over the barrages from the Coorong with saline water intruding into Lake Alexandrina. The Department for Environment and Water instructs SA Water to leave barrages open at times to allow for improved fish passage in addition to the fishways. This action results in increased salinity levels inside Lake Alexandrina and depending on the local weather conditions can influence monitoring sites at significant distances from the barrages.

The salinity target values at both the Burtundy and Milang sites will be reviewed in 2023–24 as part of the Basin Plan Review.

Table 2 Salinity levels at the reporting sites over the 5-year period from 1 July 2018 to 30 June 2023, compared to the target values in Basin Plan (Section 9.14).

Reporting site	Target value (EC*) (µS/cm)	Non-exceedance salinity at 95% of the time (µS/cm)**	% of days above the target value
River Murray at Murray Bridge	**830**	356	0
River Murray at Morgan	**800**	319	0
River Murray at Lock 6	**580**	264	0
Darling River downstream of Menindee Lakes at Burtundy	**830**	1073	13.3
Lower Lakes at Milang	**1,000**	1,010	7.1

* EC is an electrical conductivity unit commonly used to indicate salt concentration or the salinity of water. As a guide, EC > 800 µS/cm is marginal for drinking, EC > 1,600 µS/cm is brackish, EC > 4,800 µS/cm is saline.

** Salinity values are compiled from best available data (daily mean values derived from continuously logged data).

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