APPENDIX 1

Legislative and policy context

A range of international agreements and Commonwealth and state legislation and policies govern the management of the CLLMM site. An overview of these is presented in **Table 7**. A discussion of some of the most important of these follows.

International agreements

The Ramsar Convention on Wetlands of International Importance underpins the management requirements for the Coorong, Lakes Alexandrina and Albert Ramsar site. The central tenet of the Ramsar Convention is the wise use of wetlands, which is defined as:

> *'the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development.'*[77]

The history of over-allocation of water from the Murray-Darling Basin is a history of development that is not sustainable and has resulted in a continuing loss of ecological character. Meeting Australia's commitments under the Ramsar Convention requires a reversal of long-term trends across the Basin, rather than maintenance of the status quo. There is also a requirement to take into account Indigenous cultural values in the management of Ramsar wetlands.

Australia's commitment under Article 3.1 of the Ramsar Convention as a Contracting Party is to:

> *'formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory.'*[78]

Three agreements on migratory birds place related obligations on signatory governments.

- The Japan-Australia Migratory Bird Agreement states that 'each Government shall endeavour to take appropriate measures to preserve and enhance the environment of birds protected under this Agreement'.[79]
- The China-Australia Migratory Bird Agreement states that each government will 'take appropriate measures to preserve and enhance the environment of migratory birds.'[80]
- The Republic of Korea-Australia Migratory Bird Agreement similarly requires each government to take 'appropriate measures to conserve and improve the environment of birds protected under Article 1 of this Agreement.'[81]

International agreements	Ramsar Convention on Wetlands of International Importance Convention on the Conservation of Migratory Species of Wild Animals Japan-Australia Migratory Bird Agreement China-Australia Migratory Bird Agreement Republic of Korea-Australia Migratory Bird Agreement
Commonwealth legislation, policies and programs	*Environment Protection and Biodiversity Conservation Act 1999* *Water Act 2007* *Native Title Act 1993* *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* Water for the Future (2008) National Water Quality Management Strategy
Multi-jurisdictional strategies and plans	Intergovernmental Agreement on Murray-Darling Basin Reform (2008) Water Management Partnership Agreement (2009) The Living Murray (2002) The Lower Lakes, Coorong, and Murray Mouth Icon Site Environmental Management Plan (2006-2007) The Murray-Darling Basin Plan Commonwealth Wetlands Policy (1997) Ngarrindjeri Regional Partnership Agreement (2008) Closing the Gap
State legislation	*Waterworks Act 1932* *National Parks and Wildlife Act 1972* *Coast Protection Act 1972* *Native Vegetation Act 1991* *Environment Protection Act 1993* *Development Act 1993* *Water Resources Act 1997* *Aboriginal Heritage Act 1988* *River Murray Act 2003* *Natural Resources Management Act 2004* *Fisheries Management Act 2007* *Marine Parks Act 2007* *Climate Change and Greenhouse Emissions Reduction Act 2007* *Water (Commonwealth Powers) Act 2008* *Murray-Darling Basin Act 2008*
Relevant state strategies, plans and agreements	Coorong, and Lakes Alexandrina and Albert Ramsar Management Plan (2000) Wetlands Strategy for South Australia (2003) Living Coast Strategy for South Australia (2004) State Natural Resources Management (NRM) Plan (2006) South Australia's Strategic Plan (2007) No Species Loss (2007) Tackling Climate Change: South Australia's Greenhouse Strategy (2007-2020) Murray Futures (2008) South Australian Murray-Darling Basin Natural Resource Management Board Regional NRM Plan (2009-2019) Water for Good (2009) Kungun Ngarrindjeri Yunnan Agreement (2009) Ngarrindjeri Nation Yarluwar-Ruwe Plan (2007) Coorong National Park Management Plan (1990) Management Plan for the South Australian Lakes and Coorong Fishery (2005)

Table 7. International agreements and Commonwealth and state legislation governing the management of the CLLMM site.

Commonwealth legislation, policies and programs

The EPBC Act provides a legal framework for protecting the environment, in particular matters of National Environmental Significance, including Ramsar wetlands, listed migratory and threatened species, listed threatened communities and heritage sites. It outlines requirements for approval of activities that might have a significant impact on Ramsar wetlands, mechanisms for declaring and designating Ramsar wetlands, management planning obligations and principles, and allows for funding and other assistance to be provided by the Commonwealth for the protection and conservation of Ramsar sites.

The *Water Act 2007* established the Murray-Darling Basin Authority whose main function is to address over-allocation and protect, restore and provide for the ecological values and ecosystem services of the Murray-Darling Basin. This will be achieved through a Basin Plan, to commence in 2011. Among other things, it will specify:

- Limits on the amount of water (both surface water and groundwater) that can be taken from Basin water resources on a sustainable basis
- An environmental watering plan to optimise environmental outcomes for the Basin
- Rules about trading water rights in relation to Basin water resources.

The Basin Plan must give effect to relevant international agreements under the *Water Act 2007.* Among other things, the Basin Plan must also promote the conservation of declared Ramsar Wetlands. The *Water Act 2007* also sets out in Schedule 1 the water-sharing agreements between New South Wales, South Australia and Victoria.

The Australian Government's Water for the Future strategy is a national framework that integrates rural and urban water issues. Buying back water to restore the environment is one of the priorities of Water for the Future. The Australian Government is investing $3.1 billion in buying back water in the Murray-Darling Basin over 10 years. The water must be used to protect and restore environmental assets.

A component of Water for the Future is the 10-year, $5.8 billion Sustainable Rural Water Use and Infrastructure program. State-priority Murray Futures projects will be funded from the program. South Australia will receive up to $610 million for activities including the purchase of water entitlements from willing sellers, with water to be held by the Commonwealth Environmental Water Holder. As part of the South Australian Priority Project activities, the Australian Government is providing up to $200 million to support an enduring response to the environmental problems facing the CLLMM site. This includes a $10 million feasibility study of the long-term options for the management of the site, which has produced this document. In addition, up to $120 million is being provided by the Australian Government for the Lower Lakes Integrated Pipeline Project.

The Australian Government has committed $10 million to the South Australian Department for Environment and Heritage for bioremediation and revegetation in newly identified suitable sites in and around the Lower Lakes. This initiative builds on the outcomes of smaller-scale bioremediation trials undertaken by the South Australian Government on the shores of Lake Albert and seeks to engage and involve the community.

Multi-jurisdictional strategies and plans

The Living Murray initiative was established in 2002 in response to concerns about the declining health of the River Murray system. A major focus of The Living Murray initiative is on improving the environment at six designated Icon Sites. The program's first step was to recover by 30 June 2009 500 GL of water, which can be deployed for environmental purposes at the six Icon Sites into the future. (South Australia has achieved its target share by recovering its 35 GL.)

The Living Murray Icon Site Environmental Management Plan for the CLLMM site has recognised that the site's social, cultural and economic values are under threat due to diminished flows. The plan establishes three ecological objectives for the site:

- An open Murray Mouth
- Enhanced migratory water bird habitat in the Lower Lakes and Coorong
- More frequent estuarine fish spawning and recruitment.

The National Water Quality Management Strategy (NWQMS) is a national approach to improving water quality in Australia and New Zealand. The NWQMS is endorsed by the Environment Protection and Heritage Ministerial Council, the Natural Resource Management Ministerial Council and the National Health and Medical Research Council. The NWQMS aims to protect and enhance the nation's water resources by improving water quality and reducing pollution while supporting the businesses, industry, environment, and communities that depend on water for their continued development.

Closing the Gap is a strategy that aims to reduce indigenous disadvantage with respect to life expectancy, child mortality, access to early childhood education, educational achievement and employment outcomes.

State legislation, plans and strategies

Three particularly relevant South Australian Acts are the *River Murray Act 2003*, the *Murray-Darling Basin Act 2008* and the *Aboriginal Heritage Act 1988*. The *River Murray Act 2003* specifies a number of objectives for a healthy River Murray, which include:

- The protection of key habitat features, ecological processes, high value floodplains, wetlands of international and national significance and native species
- Ecologically significant natural flow regimes, fish passage areas and connectivity between and within environments within the River Murray system
- Overall improvement of water quality (including salinity, nutrient levels and pollutants) within the River Murray system to sustain ecological processes, environmental values and productive capacity
- Human dimensions such as community interests, community knowledge and the importance of a healthy river to the economic, social and cultural prosperity of communities.

The *Murray-Darling Basin Act 2008* specifies that the Murray-Darling Basin Authority must be informed of any proposal that may significantly affect the flow, use, control or quality of any water in the River Murray in South Australia.

The authority's approval is required to carry out any work (for example, a temporary weir) not already provided for under the agreement. In considering an authorisation, the Murray-Darling Basin Authority must assess any possible effects on the water, land or other natural resources within the Murray-Darling Basin.

The *Aboriginal Heritage Act 1988* provides protection for Aboriginal sites, cultural traditions, objectives and human remains.

Murray Futures (2008)

Murray Futures is South Australia's priority project to secure the future for Murray-Darling Basin industries and communities reliant on the environment. Murray Futures positions South Australia to respond to the threats and challenges facing the River Murray in a future of reduced water availability and climate change.

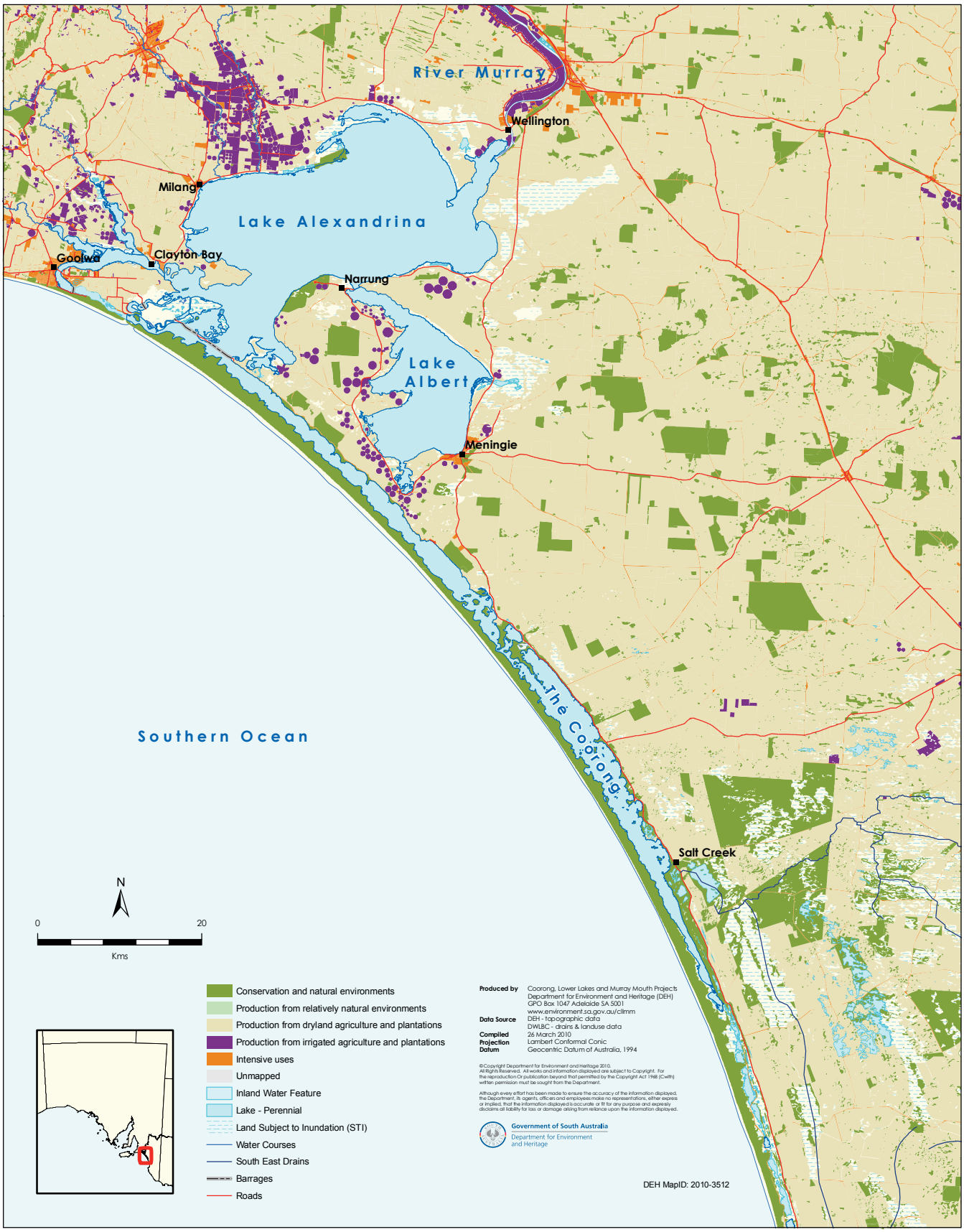
The 10-year integrated package aims to ensure that South Australia will respond proactively to climate change by adopting flexible, adaptive environmental management practices that foster long-term community, industry and environmental outcomes. It aims to maximise the use of existing environmental water and target water to key priority sites, while providing environmental water savings. It is designed to ensure the river system and its communities are more 'climate ready'.

Importantly, Murray Futures, which is supported by the Australian Government through Water for the Future, also supports national and Murray-Darling Basin initiatives, in recognition of the shared responsibilities to:

- Address over-allocation
- Address the immediate and worsening crisis in the CLLMM region
- Develop a 'one river' approach
- Set and meet a sustainable target for end-of-system flows into the future.

APPENDIX 2

Land use map



Appendix 2. Map showing land use in the CLLMM region before the current conditions.

APPENDIX 3

Indicative ecological response to declining water levels and quality

Lake level (metres AHD)	Total volume (GL) (Lakes Alexandrina and Albert combined)	Total surface area (hectares)	Average annual net loss (GL)	Measured / modelled Lake Alexandrina salinity (EC)	Ecological and management implications
0.8	1 924	82 171	802	400 – 2 300	Lower Lakes surcharge level under pre-drought conditions.
0.75	1 883	82 014	800	400 – 2 300	Lower Lakes full supply level.
0.7	1 842	81 857	799	400 – 2 300	
0.6	1 761	81 669	797	400 – 2 300	
0.5	1 679	80 976	790	400 – 2 300	Lower Lakes preferred minimum level under pre-drought conditions. Barrage opening not possible below this level under current operational arrangements. Therefore: • fish that require both marine and freshwater habitats are unable to migrate between sea and Lower Lakes and are therefore unable to complete their life cycles (fish ways allow flows and fish passage through at lower water levels) • water level and salinity targets for the Coorong are not met due to inadequate freshwater flows. Therefore all Coorong biota (aquatic plants, mudflat invertebrates, fish, shorebirds, fish-eating birds, waterfowl) are impacted • dredging required to maintain an open mouth. Murray Mouth closure leads to: - salinisation of estuary and exacerbation of inappropriate salinity and water levels in Coorong - all Murray estuary biota threatened.
0.4	1 599	79 899	779	400 – 3 000	
0.3	1 519	78 820	769	400 – 3 000	Likely exposure of all fringing submerged and emergent aquatic vegetation around the shoreline of the Lower Lakes and tributary wetlands. Therefore: • loss of fringing vegetation, unless exposure is temporary • likely loss of many freshwater fish and waterbird species.
0.2	1 441	77 754	759	400 – 3 000	
0.1	1 364	76 664	748	400 – 3 000	
0	1 288	75 349	735	400 – 3 000	
-0.1	1 213	73 919	721	3 000	
-0.2	1 140	72 414	706		
-0.3	1 068	70 972	692	3 250	Lakes Alexandrina and Albert become disconnected at this level. Therefore: fish communities in each lake become isolated.

(continued)

Lake level (metres AHD)	Total volume (GL) (Lakes Alexandrina and Albert combined)	Total surface area (hectares)	Average annual net loss (GL)	Measured / modelled Lake Alexandrina salinity (EC)	Ecological and management implications
-0.4	998	69 405	677	3 500	
-0.5	930	67 787	661	4 000	
-0.6	863	66 106	645		
-0.7	797	64 278	627	4 500	Acidification of Lake Albert is predicted to occur at this level (-0.75 m AHD) and lower. Therefore: • all biota in Lake Albert threatened • salinity in Lake Alexandrina exceeds threshold for most freshwater fish • likely loss of freshwater fish from Lake Alexandrina and tributary wetlands.
-0.8	734	62 456	610	5 000	Loveday Bay and Boggy Lake at risk from acidification.
-0.9	673	60 614	592	5 500	Acidity releases from upper Finniss River.
-1	613	58 471	571	5 750	Currency Creek dry with acidified soils.
-1.1	556	55 356	541	6 250	
-1.2	502	52 858	514	6 700	Goolwa Channel and Lake Alexandrina start to disconnect.
-1.3	451	49 771	486	7 000	
-1.4	403	45 715	447	7 500	
-1.5	359	42 391	414	7 800	
-1.6	318	40 347	395	8 000	
-1.7	278	38 598	377	8 300	Acidification of Lake Alexandrina is predicted to occur at this level (-1.75 m AHD) and lower Therefore: • all biota in Lake Alexandrina and tributary wetlands (estuarine fish, waterfowl, fish-eating birds) threatened.
-1.8	241	36 996	362	8 700	
-1.9	205	3 4830	341	8 900	
-2	171	32 676	320		
-2.1	140	29 770	291		
-2.2	112	26 217	256		
-2.3	87	22 545	220		
-2.4	66	19 431	190		
-2.5	48	16 827	165		
-2.6	33	13 044	128		
-2.7	22	10 176	99		
-2.8	13	7 251	71		
-2.9	7	4 759	47		
-3	3	2 978	29		

APPENDIX 4

Alternatives considered but not recommended

The South Australian Government appreciates the many submissions and proposals received during the development of this plan. Some options were suggested by several contributors. However, not all have been included as recommended actions. This section provides a preliminary response as to why those proposals are not supported.

Piping water from northern Australia

There were many suggestions that water could be piped from locations such as the Ord River from far northern Western Australia or from north-east Queensland. Calculated costs of these proposals demonstrate that moving large volumes of water long distances rapidly becomes very expensive. Depending on the source, the cost of water brought from northern Australia would range between $6 and $9 per kilolitre.[82] At these rates, it would cost a minimum of $4.2 billion per annum just to cover the evaporative losses from the Lower Lakes. This is not affordable.

Desalination

Desalination is a component of providing water security for urban communities in South Australia. However, the volumes of water required for human water security and the volumes of water required for a healthy CLLMM are of different orders of magnitude. The desalination plant being constructed at Port Stanvac for Adelaide's water supply will produce 100 GL per year. This is very significant in terms of urban water security (200 GL a year) and is affordable for that purpose. But it is not a significant amount of water in relation to the needs of the CLLMM region. While it is much cheaper than bringing water from northern Australia, it would still cost about $1 billion a year just to cover evaporative losses from the Lower Lakes.

Marine lakes including barrage removal

There were a number of proposals suggesting that, either in total or in part, the Lower Lakes should be allowed to become marine in nature. These proposals require either a permanent weir on the lower River Murray to prevent seawater moving up the river or a large internal bund within Lake Alexandrina to separate the freshwater from the seawater.

There is no doubt that there were occasional incursions of seawater well into the Lower Lakes and lower reaches of the River Murray before the development of the Murray-Darling Basin. However, there is solid evidence that the Lower Lakes were predominantly freshwater, and the established ecological character reflects that history.

If the barrages were opened without adequate freshwater flows, the evaporation of water from the surface of the lakes, coupled with the limited mixing of water that can take place through the Murray Mouth, mean that there would be an increasing concentration of salt, leading to extremely saline conditions. Modelling indicates that if seawater were to enter Lake Alexandrina in sufficient volume, then, in the absence of adequate freshwater flows, the great majority of the lake would become hypersaline within two years.[42] Without adequate freshwater flows, letting seawater enter Lake Alexandrina will lead to an increasingly degraded hypersaline ecosystem, not a healthy estuarine or marine system.

Removal of the barrages would also make the Lower Lakes more vulnerable to projected sea level rise.

Increased stormwater harvesting, greywater recycling, aquifer recharge, rainwater tanks

These are components of urban water security, as described in the Water for Good plan. However, the quantities of water available through these methods are not significant relative to the minimum requirements for a healthy Coorong and Lower Lakes with an open Murray Mouth. They are, however, significant in relation to the quantities of water required for water security for urban purposes and are being pursued accordingly.

Cloud seeding

There have been successful examples of cloud seeding in various locations around the world. However, it is not believed to be practical to conduct cloud seeding on such a scale that it could have a significant impact on end-of-system flows for the Murray-Darling Basin.

Even if such large-scale cloud seeding were practical, it would mean that enhanced rainfall over the Murray-Darling Basin may well be at the cost of reduced rainfall elsewhere. This would have negative impacts on the ecological and economic values of areas outside the Murray-Darling Basin.

Additional outlets to the sea for the Lower Lakes and/or the Coorong

The Murray Mouth has only been kept open in recent years through constant dredging. In the absence of adequate end-of-system flows of freshwater, any additional openings to the sea will rapidly be blocked by sand movement without continual dredging, and will have the effect of filling the Coorong with sand, while the rate of closure of the current Murray Mouth will accelerate.

Modelling has shown that the current dredging program that has been in place since 2002 is by far the most effective means of keeping the Coorong and estuary connected to the sea until end-of-system flows improve.[83] Resetting the salinity of the South Lagoon through pumping out hypersaline water, diverting freshwater from the South-East, and the return of end-of-system flows are more feasible ways of contributing to a healthy Coorong.

Constructing a channel between Lake Albert and the North Lagoon of the Coorong

Connecting Lake Albert to the Coorong in the absence of adequate flows of freshwater would result in saline water from the Coorong replacing the evaporative losses from Lake Albert. This would not refresh Lake Albert, but result in hypersaline conditions.

River mouth training walls

River mouth training walls were considered to prevent sand from being transported into the Murray Mouth and also to provide shelter to the inner parts of the entrance from wave action, creating a permanently open Murray Mouth. Due to the way that sand is transported in and around the Murray Mouth, it is expected that sand would still build up within the Murray Mouth during times of low river flows. Therefore dredging would still need to occur in the Murray Mouth and the inner mouth areas.

Assessments of the different options for maintaining an open Murray Mouth were made based on effectiveness, contribution to ecosystem health and cost. Dredging without construction of permanent training walls was considered a better option.

APPENDIX 5

Adaptive management for salinity in the South Lagoon

Increases in salinity in the South Lagoon of the Coorong have had serious impacts on keystone species such as tuberous tassel, small-mouthed hardyhead and chironomids. All of these species are food sources for various bird species that historically occupied the South Lagoon and their loss can be linked to reduced bird numbers in the South Lagoon.

Conceptual models of the ecology of the South Lagoon, and the species associated with the ecology, indicate that by reducing salinity and maintaining appropriate water levels, adaptive management of the South Lagoon should result in improved water quality. This would allow the recolonisation of tassel from the North Lagoon. This in turn would facilitate the future recovery of historical aquatic habitat by recolonisation of other food species.

Historically the maximum salinity in the South Lagoon was approximately 160,000 EC, but summer salinity in the South Lagoon is now higher than 280,000 EC and has at times exceeded 310,000 EC. Such high salinities place the South Lagoon beyond the limits of acceptable change for tassel, based on the 1985-2006 ecological character description.

The adaptive management process proposed for the site would include the following steps (based on the process outlined in Section 11):

Step 1: Develop a plan of management actions

Identify the problems

The key problems for the South Lagoon are increasing salinity and decreased water levels during summer each year. Conceptual models of ecology and hydrology indicate this is principally caused by reduced freshwater inflows, resulting in the loss of tuberous tassel as a food source for waterbirds, including black swans. This, combined with the salinity increase, has resulted in the loss of small-mouthed hardyhead and chironomids as a food source for other bird species.

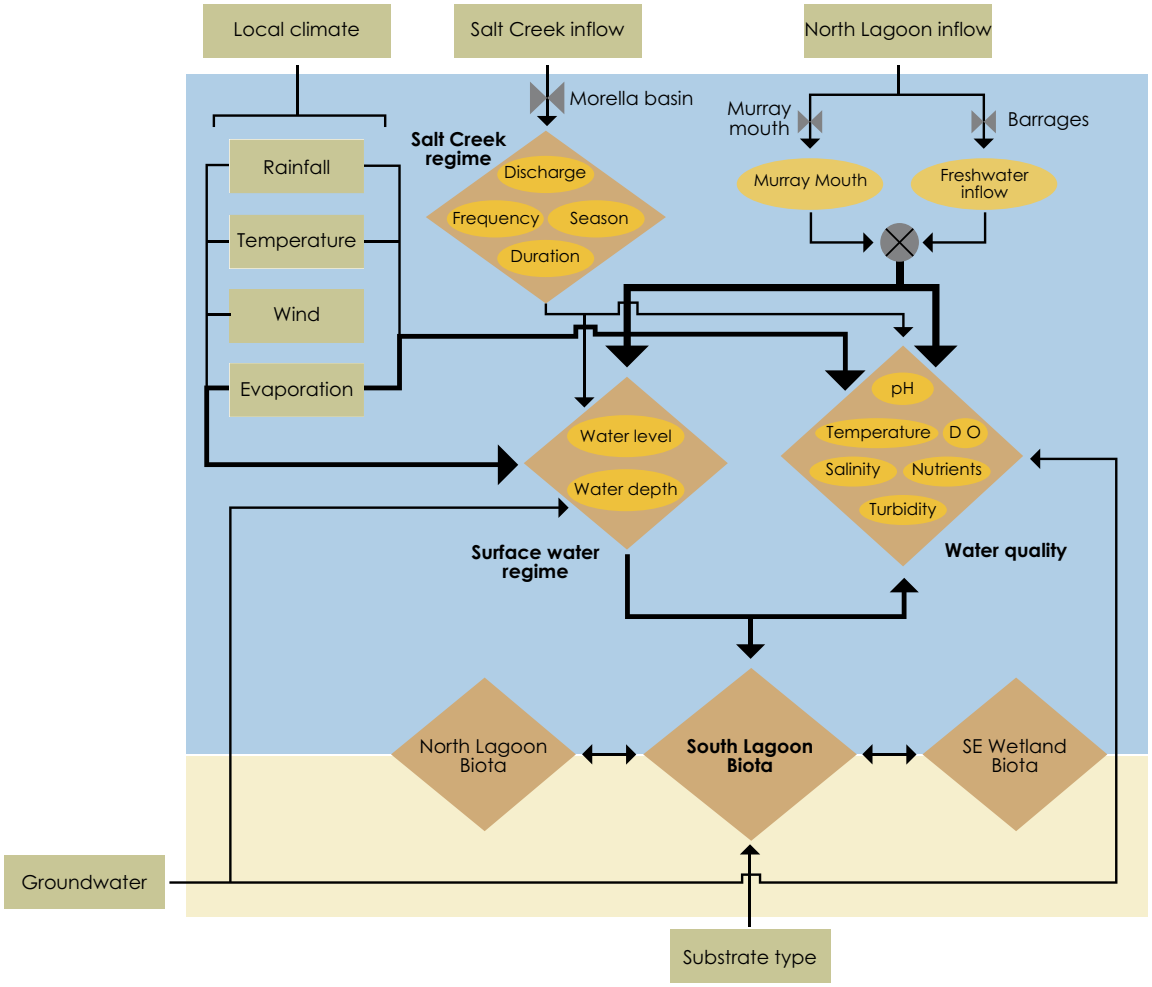


Figure 13. Conceptual model of the South Lagoon.[84]

Scope actions

Based on a conceptual model of the South Lagoon, two management actions were identified as ways to reduce salinity in the South Lagoon:

- Increasing freshwater outflow across the barrages
- Increasing freshwater inflow from the Upper South-East Drainage Scheme.

It was determined that insufficient freshwater was available to achieve these actions within a suitable timeframe to avoid the risk of ecological collapse.

Additional actions which were proposed for the South Lagoon included:

- Construction of a regulator at Parnka Point
- Dredging the constriction at Parnka Point
- Pumping hypersaline water from the Coorong into the Southern Ocean.

The potential impacts of these various actions on water level, salinity and ecosystem states were examined using modelling products developed during CLLAMMecology (CLLMM futures modelling and the CSIRO one-dimensional hydrodynamic models).

Select actions

The outcomes, timeliness and cost of the various actions were assessed. The best action to implement was pumping saline water from the South Lagoon to the Southern Ocean. The benefit would be greater when combined with dredging at Parnka Point to minimise the adverse impacts of pumping on water levels during summer.

Additional modelling was then conducted using a more detailed hydrodynamic model to determine:

- Pumping rates
- Impacts on water quality
- Dredging impacts at Parnka Point
- Timing for commencement.

The next steps were to progress:

- Implementation of a pumping program to reduce salinity in the South Lagoon, including preparation of all necessary permits and approvals
- Investigation of impacts on fauna at discharge point
- Investigations into the redirection of additional freshwater inflows from the south-east of South Australia.

A process or results chain was then developed to outline the expected results from the management action.

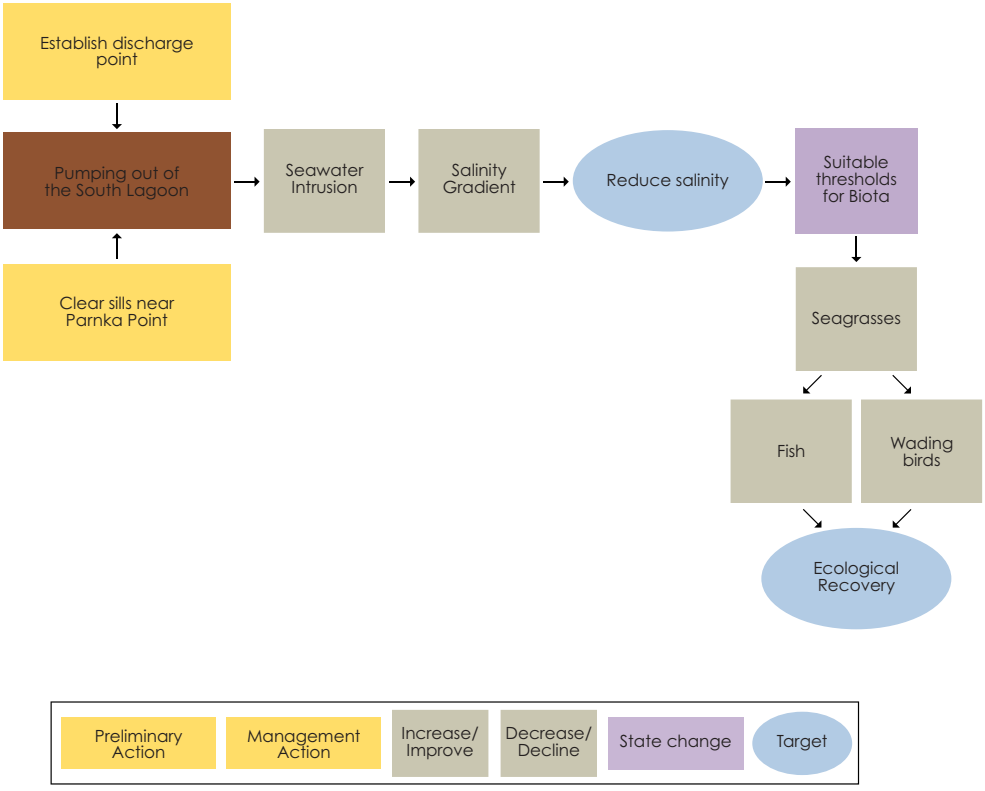


Figure 14. Process chain for pumping hypersaline water from the South Lagoon.

Develop implementation plan

The implementation plan outlines the logistics, necessary approvals, risk assessment and management responses. The plan also includes triggers for reviewing the action, based on modelled performance at specific pumping rates, to achieve the target water quality based on the tolerances of the target species.

Outline objectives and targets

The objective is to restore severely degraded habitat in the South Lagoon of the Coorong by reducing the extremely high salinity levels. Targets for the site are shown in the following table.

Water Quality Targets	Ecological Targets
Maximum salinity of 160,000 EC for summer and 90,000 EC for winter Water level targets also set for summer and winter.	Recovery of tuberous tassel in the South Lagoon to 80 per cent of the historical distribution by 2016 Recovery of wader habitat, such that birds occupy 80 per cent of available habitat by 2016 Recovery of hardyhead distribution to include a presence at 50 per cent of sites sampled by 2016.

Set timeframe

Assuming implementation of the action no later than August 2010, pumping is expected to take at least 18 months to achieve the target salinities. Interim targets or trigger points are expected at the times shown.

2010	2011	2012
December		December
	March	March
	June	June
	September	September

Develop monitoring program

A monitoring plan has been prepared to determine that the action is achieving the interim targets, and to gauge if the action is having unexpected consequences. The plan outlines monitoring of:

- The physical environment, especially salinity and water levels, at relevant locations in the South Lagoon
- The physical environment near the outfall
- Ecological responses of keystone species and bird populations
- Species interactions, as determined by a risk assessment carried out during the preparation of a referral to the Australian Government under the EPBC Act.

Re-establishment of keystone species is expected to occur from Coorong North Lagoon refuges, but tuberous tassel may need a revegetation program to ensure recovery occurs. Triggers are still to be established for the implementation of this action, although a feasibility study has been undertaken to demonstrate it is possible and it has been costed for inclusion in the Long-Term Plan.

Beyond achieving the desired salinity, continuing monitoring will be required to determine if pumping is required in the future to keep salinity near target levels. This would require the setting of a trigger salinity level for re-starting pumping.

Specify triggers and limits of acceptable change

The tolerances of key species are:

- Tuberous tassel tolerates approximately 160,000 EC, plus needs adequate water levels, which are dropping
- Chironomids tolerate up to approximately 190,000 EC
- Small-mouthed hardyhead fish tolerate up to approximately 190,000 EC.

These salinity tolerances establish important benchmarks for management action to ensure the restoration of ecological character in this part of the CLLMM site.

Step 2: Implement the plan

Implementing the plan involves undertaking the action in the manner and timeframe specified in Step 1. Similarly, any research or predictive modelling is implemented as planned.

Step 3: Monitor the activities

The ecological monitoring is coordinated around pumping saline water from the South Lagoon. This monitoring complements the regular condition monitoring that already occurs. Implementation summaries will be regularly provided to the CLLMM Board via the CLLMM Technical Advisory Group as briefings. The findings will be entered into a decision support system; a computer system that will help guide decisions in managing the site. In this way, the monitoring program allows managers to assess the success of the action.

Step 4: Analyse outcomes against expectations

At quarterly intervals, results of the action will be compared with the water quality expectations from the implementation plan. At this time, questions such as 'Did the action achieve the desired water quality as predicted for this period?' will be answered by examining water quality changes against the interim targets. If the desired salinity targets are achieved outside the expected timeframe (early or late), an investigation will be initiated to determine the reasons. If required, models used for water quality will be altered to reflect the changes.

Following achievement of the desired water quality objectives and ecological outcomes, the success of each action or decision will be evaluated. Questions may include: 'Did the action solve the problem?' or 'Did other factors affect the success of the action (e.g. drought)?'

Step 5: Review and adapt the actions

Based on the information gained from Step 4, one of the following recommendations will be made to the CLLMM Board:

- *Continue action*: if water quality is within the range of expected results within an expected timeframe
- *Cease action*: if the targets for salinity and water levels have been achieved within an expected timeframe
- *Review causes:* if water quality is not within the range of expected results.

Following this review, a further recommendation will be made to either:

- Proceed with the action if the issues can be resolved. Models and targets will be reviewed and updated, and timelines will be extended
- Suspend the action until uncertainty or identified issues are addressed
- Terminate the action.

A decision support system will be used to document decisions and supporting evidence.

Step 6: Learn from the activities

Key findings from Step 5 are used to evaluate the conceptual and qualitative models of the site. These revised models are then used to develop future management objectives and targets, so that knowledge gained from past actions improves future decision-making.

APPENDIX 6

Implementation schedule

			2010			
Location	**Program**	**Activity**	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec
Murray Mouth	Maintaining an open Murray Mouth	Dredging the Murray Mouth as per existing strategy	•	•	•	•
Coorong	Coorong salinity reduction	Design work on restoring flows from the Upper South-East to the Coorong	•	•	•	•
		Diverting water from the South-East to the Coorong (first stage)				•
		Pumping out about 300 GL of hypersaline water from the South Lagoon	•	•	•	•
		Dredging of sills at Parnka Point				
	Vegetation	Revegetation – tubestock		•		
		Weed control		•		•
		Vermin control		•		•
	Tassel (*Ruppia* sp.) translocation	Translocation of large-fruit and tuberous tassel				
Lake Alexandrina	Managing acid sulfate soils	Limestone dosing		•	•	
		Environmental Impact Statement studies on impacts of seawater	•	•		
	Vegetation	Revegetation – tubestock		•		
		Revegetation – aerial seeding		•	•	
		Cropping to stabilise soils		•		
		Weed control		•		•
		Vermin control		•		•
		Fencing		•	•	•
	Fishways	Construct/install fishways				•
	Protecting critical environmental assets	Conservation of threatened species	•	•	•	•
		Maintenance of refuge habitats	•	•	•	•

2011				2012				2013				2014			
Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
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			2010			
Location	**Program**	Activity	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec
Lake Albert	Managing acid sulfate soils	Construction of artificial wetland		•	•	
		Limestone dosing		•	•	
		Installation of sub-surface barriers in the lakebed	•			•
	Vegetation	Revegetation – tubestock		•		
		Revegetation – aerial seeding		•	•	
		Weed control	•			•
		Vermin control	•			•
		Fencing		•	•	•
		Cropping to stabilise soils		•		
	Lake Albert water level management	Install a siphon at Narrung bund for one way water flow from Lake Alexandrina				TBD
		Pumping water from Lake Alexandrina to keep lake centre inundated	•	•		
Goolwa Channel and tributaries	Managing acid sulfate soils	Construction of temporary flow regulators: Clayton and across Currency Creek	•	•	•	•
		Limestone dosing		•	•	
	Vegetation	Revegetation – tubestock		•		
		Revegetation – aerial seeding		•	•	
		Weed control	•			•
		Vermin control	•			•
		Fencing		•	•	•
	Protecting critical environmental assets	Off-site conservation of threatened species for re-introduction	•	•	•	•
		Maintenance of refuge habitats	•	•		
Entire site	Adaptive management	Monitoring and adaptive management program	•	•	•	•
		Research program	•	•	•	•
	Community engagement	Community engagement and communications	•	•	•	•
	Ngarrindjeri engagement	Ngarrindjeri partnerships and involvement	•	•	•	•
	All programs	Direction, governance and planning	•	•	•	•

2011				2012				2013				2014			
Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sept	Oct – Dec
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APPENDIX 7

How the mix of management actions may change depending upon climate scenario

Program	Activity	Climate Scenario			
		Extreme-Dry	Dry	Median	Wet
Maintaining an open Murray Mouth	Dredging the Murray Mouth as per existing strategy	✓	✓	↓	X
Coorong salinity reduction	Design work on restoring flows from the Upper South-East to the Coorong	✓	✓	↑	↑
	Diverting water from the South-East to the Coorong (first stage)	✓	✓	↑	↑
	Pumping out about 300 GL of hypersaline water from the South Lagoon	✓	✓	↓	X
	Dredging of sills at Parnka Point	✓	✓	↓	X
Tassel translocation	Translocation of large-fruit (*Ruppia megacarpa*) and tuberous tassel (*Ruppia tuberosa*)	✓	✓	✓	✓
Managing acid sulfate soils	Limestone dosing	✓	↑	X	X
	Installation of sub-surface barriers in the lakebed	✓	↑	X	X
	Studies on impacts of seawater	✓	↓	X	X
	Lakefront habitat restoration	✓	✓	↓	X
Vegetation	Revegetation – tubestock on lake edge	✓	↑	↑	↑
	Revegetation – aerial seeding of exposed lakebed	✓	✓	✓	↓
	Cropping to stabilise soils	✓	✓	↓	X
	Weed control	✓	↑	↑	↑
	Vermin control	✓	✓	↑	↑
	Fencing	✓	✓	↓	X
Fishways	Construct/install fishways	✓	✓	↓	X
Protecting critical environmental assets	Conservation of threatened species	✓	✓	↑	↑

(continued)

Program	Activity	Climate Scenario			
		Extreme-Dry	Dry	Median	Wet
	Maintenance of refuge habitats	✓	✓	✓	✓
Lake Albert water level management	Pumping water from Lake Alexandrina to keep lake centre inundated	✓	✓	↓	X
Adaptive management	Monitoring and adaptive management program	✓	✓	✓	✓
	Research program	✓	✓	✓	✓
Community engagement	Community engagement and communications	✓	✓	✓	✓
Ngarrindjeri engagement	Ngarrindjeri partnerships and involvement	✓	✓	✓	✓
All programs	Direction, governance and planning	✓	✓	✓	✓

✓ = Action is appropriate under these conditions

↑ = Action becomes more important under these conditions, compared to extreme-dry conditions

↓ = Action becomes less important under these conditions, compared to extreme-dry conditions

X = Action is not required under these conditions

List of scientific names

Common name	Scientific name
Chestnut teal	*Anas castanea*
Austral seablite	*Suaeda australis*
Australasian bittern	*Botaurus poiciloptilus*
Banded stilt	*Cladorhynchus leucocephalus*
Beaded samphire, beaded glasswort, glasswort or samphire	*Sarcocornia quinqueflora*
Big-bellied seahorse	*Hippocampus abdominalis*
Black swan	*Cygnus atratus*
Bony herring	*Nematalosa erebi*
Brine shrimp	*Parartemia zietziana*
Cape Barren goose	*Cereopsis novaehollandiae*
Chironomid	*Tanytarsus barbitarsus*
Common galaxias	*Galaxias maculatus*
Common reed	*Phragmites australis*
Congolli	*Pseudaphritis urvillii*
Curlew sandpiper	*Calidris ferruginea*
Dune fanflower	*Scaevola calendulacea*
Dwarf grass-wrack	*Zostera muelleri var.*
Dwarf flat-headed gudgeon	*Philypnodon macrostomus*
Eastern curlew	*Numenius madagascariensis*
Eastern gambusia	*Gambusia holbrooki*
Estuary perch	*Macquaria colonorum*
Fairy tern	*Sternula nereis*
Freshwater eel-tailed catfish	*Tandanus tandanus*
Golden perch	*Macquaria ambigua ambigua*
Hooded plover	*Charadrius rubricollis*
Large-fruit tassel	*Ruppia megacarpa*
Latham's snipe	*Gallinago hardwickii*
Lewin's rail	*Rallus pectoralis*
Little tern	*Sterna albifrons*
Long-fruit water-mat	*Lepilaena cylindrocarpa*

Common name	Scientific name
Metallic sun-orchid	*Thelymitra epipactoides*
Milfoils	*Myriophyllum spp.*
Mount Lofty Ranges southern emu-wren	*Stipiturus malachurus intermedius*
Murray cod	*Maccullochella peelii peeli*
Murray hardyhead	*Craterocephalus fluviatilis*
Orange-bellied parrot	*Neophema chrysogaster*
Pondweeds	*Potamogeton spp.*
Pouched lamprey	*Geotria australis*
Redfin perch	*Perca fluviatilis*
Red-necked avocet	*Recurvirostra novaehollandiae*
Ribbon weed	*Vallisneria americana*
River blackfish	*Gadopsis mormoratus*
Rushes	*Juncus spp.*
Sandhill greenhood	*Pterostylis arenicola*
Scarlet grevillea	*Grevillea treueriana*
Sea heath	*Frankenia pauciflora*
Sharp-tailed sandpiper	*Calidris acuminata*
Short-finned eel	*Anguilla australis*
Short-headed lamprey	*Mordacia mordax*
Shrubby glasswort	*Tecticornia arbuscula*
Silver daisy-bush	*Olearia pannosa*
Silver perch	*Bidyanus bidyanus*
Small-mouthed hardyhead	*Atherinosoma microstoma*
Southern bell frog	*Litoria raniformis*
Southern pygmy perch	*Nannoperca australis*
Swamp paperbark	*Melaleuca halmaturorum*
Tamar goby	*Afurcagobius tamarensis*
Tuberous tassel	*Ruppia tuberosa*
Tubeworms	*Ficopomatus enigmaticus*
Water ribbons	*Triglochin procerum*
Yarra pygmy perch	*Nannoperca obscura*
Yellow swainson-pea	*Swainsona pyrophila*
Bullrush	*Typha sp.*

Glossary

Aquatic	Consisting of, relating to, or being in water; living or growing in, on or near the water. An organism that lives in, on, or by the water.
Acid sulfate soils	Sulfate rich soils, common in low lying coastal regions, that have been exposed to oxygen (e.g. exposed to air through lowering of water levels) and produce sulfuric acid (the same acid as in a car battery).
Adaptation measures	Measures that allow the site to function under stable but altered conditions. The purpose of adaptation measures is to develop long-term sustainable solutions for the site.
Adaptive management	A process of "learning by doing", where learning is fully incorporated into future decision-making (Holling 1978). Adaptive management allows decisions to be made using the best available knowledge at the time, rather than requiring complete understanding of all possible consequences.
AHD	Australian Height Datum – national survey datum corresponding approximately to average sea level.
Alkalinity	An expression of the ability of a solution to neutralise acids, measured as the milliequivalents of hydrogen ions neutralised by a litre of water (expressed as $CaCO_3$ in mg/L).
Anadromous	Living primarily at sea but migrating up rivers to spawn.
Anthropogenic	Of or relating to human activity. An anthropogenic action or effect is one brought about by humans.
Barrages	A series of five structures that separate the fresh waters of the River Murray and Lake Alexandrina from the more saline waters of the Murray Mouth estuary and Coorong lagoons. These barrages, Goolwa, Mundoo, Boundary Creek, Ewe Island and Tauwitchere, were constructed between the mainland and Hindmarsh, Mundoo, Ewe and Tauwitchere Islands. Work on the barrages began in 1935 and was completed in 1940.
Basin Plan	A plan to be prepared by the Murray-Darling Basin Authority in consultation with Basin states, Indigenous groups and local communities, that will specify limits on the amount of water that can be taken from Basin waters on an environmentally sustainable basis. It will also include an environmental watering plan to optimise environmental outcomes and implement a management plan for water quality and salinity and rules about the trading of water rights.
Benthic	The deepest part of a water body (e.g. the bottom of a lake).
Biodiversity	The variety of different species, the genetic variability of each species, and the variety of different ecosystems that they form.

Bioregion	A territory defined by a combination of biological, social and geographical criteria rather than by geopolitical considerations; generally, a system of related interconnected ecosystems.
Bioremediation	Promoting naturally occurring bacteria to return contaminated environments to a healthy state. 'Sulfate reducing' bacteria in the soil can reverse the process of acid sulfate soils forming sulfuric acid. They use sulfate in the acid as well as iron and organic matter to do this, so making sure these are available is an important part of bioremediation. Growing plants (revegetation) can create more organic matter and iron, but it is only one part of the longer-term bioremediation process.
Biosequestration	The conversion of a compound through biological processes to a form that is chemically or physically isolated (e.g. living organisms, such as plants, capturing and storing carbon, removing it from the atmosphere).
Biota	All living organisms of a region.
Calcareous	A sediment, sedimentary rock, or soil type which contains a high proportion of calcium carbonate.
Catadromous species	Fish species that spawn at sea but use freshwater environments during their juvenile and sub-adult life stages.
Colloidal	Very fine particles evenly dispersed in a substance (e.g. water) so they are not easily filtered or readily settle out of the substance.
Commonwealth Environmental Water Holder	Commonwealth Environmental Water Holder was established by the *Water Act 2007* to manage water entitlements acquired by the Commonwealth through water entitlement purchasing and water savings through investment in improved infrastructure.
Coorong	The Coorong is a long, shallow saline lagoon that stretches more than 100 km and is separated from the Southern Ocean by a narrow sand dune peninsula.
CSIRO Murray-Darling Basin Sustainable Yields Project	A series of studies and reports which assess the current and future water availability in the Murray-Darling Basin.
Diadromous species	Species that require access to both marine and freshwater environments to complete their lifecycle.
Diatoms	Microscopic single-celled algae with a hard outer shell that are deposited in the sediments, including in the Lower Lakes and Coorong.
Dredging (Murray Mouth)	The process of sand pumping to maintain an open Murray Mouth to the Southern Ocean.

EC	Electrical conductivity – a measure of water's ability to conduct electricity. EC units (measured in µS/cm – microsiemens per centimetre) are used to express salinity levels in soil and water. When salt is dissolved in water the conductivity increases, hence higher salinities are directly related to higher EC values. Drinking water should be under approximately 1,000 EC units and seawater is approximately 60,000 EC units.
Ecological character	The combination of the ecosystem components, processes, and benefits and services that characterise the wetland at a given point in time. Within this context, ecosystem benefits are defined in accordance with the variety of benefits to people (ecosystem services).
Ecological communities	Any naturally occurring group of species inhabiting a common environment, interacting with each other especially through food relationships and relatively independent of other groups. In the EPBC Act they are defined as assemblages of native species that inhabit particular areas in nature.
Ecosystem	A dynamic assemblage of plant, animal, fungal and micro–organism communities and the associated non–living environment interacting as an ecological unit.
Ecosystem services	The benefits provided by ecosystems to people. They include provisioning services such as water for irrigation and drinking supply; regulating services such as water purification and climate regulation; cultural services such as tourism and recreation; and supporting services such as nutrient cycling and providing habitat. These services will generally have an indirect benefit to humans or a direct benefit in the long-term.
Emergent vegetation	Protruding from the water (e.g. growing out of the lake water surface).
End-of-system flows	The volume of water that flows through the Murray Mouth.
Endangered	An ecological community is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria outlined in the EPBCAct.
Environmental Impact Statement (EIS)	Outlines the potential impacts on matters of National Environmental Significance (including threatened species, Ramsar wetlands and national heritage sites) defined under EPBC Act.
Ephemeral (water course)	A watercourse or body (such as a river or lake) that exists for only a short time following substantial rainfall.

Erosion	The continuing process of landscape development as a smoothing or levelling of the earth's surface by removal of weathered material. Natural erosion is due only to the forces of nature such as wind and water movement; accelerated erosion occurs as a result of human activities. In each case, the same processes operate and the distinction is often only a matter of degree and rate.
Estuarine	Conditions encountered in an estuary. Estuaries are generally characterised by higher salinities and high biological diversity. (NB: The term estuarine may be used to describe raised salinity in an environment which is naturally non-estuarine; in such a case it does not necessarily imply high biological diversity).
Estuary	The area where river water meets and dilutes salt water of the sea. The zone where a river mixes with the sea.
Eutrophication	Process by which an increase in the concentration of chemical nutrients in a water body result in negative environmental impacts including rapid growth of algae and cyanobacteria and the depletion of oxygen.
Evaporative losses	The amount of water that is lost to the atmosphere via evaporation.
Ex-situ	Not in its original location e.g. ex-situ conservation measures include captive breeding programs at a different site from an animal's natural habitat.
Fauna	Animal species, especially the animals of a particular region or period, considered as a group.
Federation drought	Period of drought from 1895 to 1902.
Fishway	Engineered structure on or around artificial barriers to facilitate the natural migration of fish.
Flora	Plant species, especially the plants of a particular region or period, considered as a group.
Geomorphology	General term referring to the description of topography (form or geometry of the land surface, including elevation, slope angle, relative relief, contour configuration and profile form), and an assessment of the past and present factors that shape it. Includes determining the influence of rock materials and structures and past and present tectonic, climatic and biological processes.
GL	Gigalitre – 1 billion litres or approximately 444 Olympic sized swimming pools.

Goolwa Channel Water Level Management Project	A project being implemented by the South Australian Government as an emergency response required to avert the acidification of the Goolwa Channel and its tributaries (including Finniss River and Currency Creek). The project has seen the construction of two temporary flow regulators – one in the Goolwa Channel and one in Currency Creek. Construction of a third temporary flow regulator for Finniss River has been put on hold.
Groundwater	Water that is below the surface, generally occupying the pores and crevices of rock and soil.
Habitat	The place in which an organism lives; comprising its physical structure, such as reef, sediments or water column properties, as well as biological structures, such as the dominant plant types. Specific place where a plant or animal lives.
Hydraulic head	Water level gradient. Water flows in a direction of high to low hydraulic head.
Heavy metals	A very dense metal such as lead, cadmium or mercury or metalloid (a non-metal that behaves like a metal) such as arsenic. Because they cannot be degraded or destroyed, heavy metals are persistent in all parts of the environment.
Hydrodynamic	Relating to forces in, or motions of water.
Hydrology	The science dealing with surface waters and ground waters; their occurrence, circulation and distribution; their chemical and physical properties; and their reaction with the environment.
Hypersaline	Water that is extremely saline and saltier than the sea.
Icon Site Management Plan	The Living Murray Icon Site Environmental Management Plan for the Coorong, Lower Lakes and Murray Mouth has recognised that the site's social, cultural and economic values are under threat due to diminished flows. The plan establishes three ecological objectives for the site: • An open Murray Mouth • Enhanced migratory water bird habitat in the Lower Lakes and Coorong • More frequent estuarine fish spawning and recruitment.
Keystone species	A species that has a disproportionate effect on other organisms within an ecosystem. Such species affect many other organisms in an ecosystem and help to determine the composition and abundance of various others species in a community.
Levee banks	Levee banks were originally constructed along both sides of the River Murray to allow floodplains and wetlands along the river to be used for agricultural purposes. They also prevent flooding when river levels are high. As well as providing access to properties, the levee banks provide for recreational uses such as walking, cycling and fishing.

Limestone dosing	Adding of finely ground limestone and/or limestone slurry (dry limestone mixed with water) to the lakebed and water to keep the water's pH high enough to neutralise acid released from the exposed acid sulfate soils in the region.
The Living Murray	Initiative established in 2002 in response to concerns about the declining health of the River Murray system. It is a partnership of the Australian, New South Wales, Victorian, South Australian and Australian Capital Territory governments. A major focus of The Living Murray initiative is on improving the environment at six designated Icon Sites. The program's first step was to recover 500 GL of water by 30 June 2009 which can be deployed for environmental purposes at the six Icon Sites into the future (South Australia has achieved its target share by recovering its 35 GL).
Lower Lakes	Lake Alexandrina and Lake Albert form the Lower Lakes of the River Murray.
Metres AHD	Unit of elevation measurement used to describe the height (altitude) above the Australian Height Datum (AHD) (i.e. given in metres AHD). The mean sea level for 1966 – 1968 was assigned the value of zero at multiple tide gauges around Australia.
Macro invertebrate	Invertebrates (animals without a backbone such as insects) visible to the naked eye.
Migratory species	Migratory species are those animals that travel to different regions each year. A number of migratory species travel to and within Australia and its external territories, or pass though or over Australian waters during their annual migrations. Examples of migratory species are birds (e.g. albatrosses and petrels), mammals (e.g. whales) and reptiles (e.g. leatherback turtles). Migratory species listed in the EPBC Act also include any native species identified in an international agreement approved by the Minister.
(The) Minister	Minister for Environment and Conservation, the River Murray, and Water.
Mitigation measures	Measures designed to reduce impacts resulting from continued low or non-existent end-of-system flows. They are implemented to prevent continued ecological degradation until conditions improve. Some are of a temporary nature to deal with immediate challenges and not suitable for long-term application.
Mono-sulfidic black ooze	Gelatinous soil that consists of iron sulfide; formed under anoxic and often increased saline conditions; once disturbed can rapidly remove oxygen from overlying waters and react with the oxygen to form sulfuric acid.

Murray Futures	Funded by the Australian Government's Water for the Future program, Murray Futures is South Australia's priority project to secure the future for Murray-Darling Basin industries and communities reliant on the environment. Murray Futures positions South Australia to respond to the threats and challenges facing the River Murray in a future of reduced water availability and climate change. The ten-year integrated package aims to ensure that South Australia will respond proactively to climate change by adopting flexible, adaptive environmental management practices to achieve long-term community, industry and environmental outcomes. It aims to maximise the use of existing environmental water and target water to key priority sites, while also providing environmental water savings. It is designed to ensure the river system and its communities are more 'climate ready'.
Murray Mouth	The terminus of Australia's largest river system and the only site where water contaminants such as silt, salt and nutrients can be exported from the Murray-Darling Basin to the ocean.
Narrung Narrows	A narrow channel near Port Malcolm connecting Lake Albert and Lake Alexandrina.
Narrung Narrows regulator/bund	Structure that separates the waters of Lakes Alexandrina and Albert and allows the lakes to be managed independently of each other while the current water crisis continues.
North Lagoon	North Lagoon of the Coorong, defined as the lagoonal area between Parnka Point and Pelican Point.
Oxidation	A chemical reaction where a substance combines with oxygen (e.g. iron reacts with oxygen to form rust and sulfidic soils react with oxygen to form sulfuric acid).
pH	A measure of the acidity or alkalinity, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The pH scale commonly in use ranges from 0 to 14.
Primary Determinants	Ecosystem components central to maintaining ecological character.
Pyritic	Relating to the common mineral pyrites (iron disulfide).
Ramsar	The Convention on Wetlands of International Importance Especially for Waterbird Habitat, commonly known as the Ramsar Convention, was initially adopted in Ramsar, Iran, in 1971. Australia is a signatory and currently has 65 Wetlands of International Importance, commonly known as Ramsar wetlands. The Coorong, Lakes Alexandrina and Albert, was designated a Wetland of International Importance in 1985.

Ramsar Management Plan	The Environment Protection and Biodiversity Conservation Regulations 2000 require that at least one management plan be prepared for each Australian declared Ramsar wetland, which outlines the principles for managing the site in accordance with the regulations.
Red List	The International Union for Conservation of Nature Red List aims to identify and document those species most in need of conservation attention to reduce global extinction rates and to provide a global index of the state of change of biodiversity.
Regulator	Structure to regulate the flow of water, raise water levels and keep acid sulfate soils saturated. In doing so, acidic soils will remain wet and limit the formation of acid that would otherwise be generated.
Resilience (ecosystem)	The capacity of an ecosystem to cope with disturbances without shifting into a qualitatively different state.
River Murray Environmental Manager	The primary decision maker on environmental water within South Australia. They have a key advocacy role in Murray-Darling Basin forums and coordinate all environmental watering activities within the South Australian River Murray, including the delivery, allocation and management of environmental water and Living Murray Icon Site management. They also facilitate environmental water donations and encourage community involvement in flow management.
River Regulation	Anthropogenic modifications to the flow regime, channel shape or immediate floodplain to control a river for human needs.
Salinity	Salinity is a measure of the salt concentration of water. Higher salinity means more dissolved salts. Electrical Conductivity (EC) is the measurement of salinity. Dissolved salt in soil or water creates a stronger electrical current, so the more salt in the soil or water, the higher the EC units will be.
Sediment	Solid material (predominantly small particles of sand, silt, rock and vegetable material) that have been transported by water and deposited or settled out of suspension. Unless otherwise specified, sediments are generally assumed to be inorganic.
South Lagoon	South Lagoon of the Coorong, defined as the lagoonal area between Parnka Point and 42 Mile Crossing.
Submerged	Existing beneath the surface of the water.
Sub-surface barrier	Sub-surface barriers typically include the excavation of trenches which are then filled with a control material that assists with the retention of sub-surface groundwater. Sub-surface barriers are designed to manage areas of high acid sulfate soils risk by increasing soil moisture. This limits the oxidation of pyritic soils and prevents acidity moving to the remaining water body.

Sulfidic soils	Submerged or waterlogged soils that contain sulfur in the absence of oxygen. They are generally referred to as 'potential' acid sulfate soils or sulfidic sediments. They have soil acidity levels ranging between pH 4 and pH 9 and on exposure to oxygen have the potential to form sulfuric acid.
Sulfuric	When sulfidic materials are exposed to oxygen they can become acidic (pH <4) through the oxidation of sulfides to form sulfuric acid. Sulfidic soils that oxidise to form sulfuric acid are then referred to as 'actual' acid sulfate soils.
Surface waters	All waters whose surface is naturally exposed to the atmosphere, for example, rivers, lakes, reservoirs, streams, seas, estuaries, etc., and all springs, wells, or other collectors directly influenced by surface water.
Sustainable	An activity able to be carried out without damaging the long-term health and integrity of natural and cultural environments.
Swamps of the Fleurieu Peninsula	Important habitat for the endangered Mount Lofty Ranges southern emu-wren. Areas defined as Fleurieu Peninsula Swamps occur at the junction of Lake Alexandrina and Tookayerta Creek, Currency Creek and the Finniss River.
Technical feasibility	Technical feasibility assessments provide detailed analyses of the objective, rationale, critical assumptions and costings of implementing an action or intervention.
Terrestrial	Relating to living or growing on land (as distinct from aquatic).
Threatened species	Any species that is likely to become endangered within the foreseeable future, throughout all or a significant part of its range. A species of wildlife or plants listed as 'threatened' in a specific Act. The EPBC Act lists threatened native species in the following categories: extinct; extinct in the wild; critically endangered; endangered; vulnerable; conservation dependent.
Threatened ecological communities	The EPBC Act lists threatened ecological communities as: critically endangered; endangered; or vulnerable (also see 'ecological community').
Tributary	A stream or other body of water (surface or underground) that contributes its water, even though intermittently and in small quantities, to another and larger stream or body of water.
Turbidity	The muddiness, cloudiness or milkiness of water. Related to the amount of suspended sediment in the water. Generally measured in Nephelometric Turbidity Units (NTU).

Turion	A young, scaly shoot budded off from underground stems or a detachable winter bud used for overwintering in many aquatic plants.
Vulnerable species	A threatened species. Native vulnerable species are listed in the EPBC Act. They are not critically endangered or endangered but face a high risk of extinction in the wild in the medium–term future.
Water allocation	Amount of water that can be diverted from a watercourse.
Water for Good	South Australia's plan to secure sustainable water supplies for our health, our way of life, our economy and our environment - both now and in the future and reduce South Australia's reliance upon the River Murray.
Water for the Future	The Australian Government Water for the Future strategy is a long-term national framework to secure the water supply of all Australians. Buying back water to restore the environment is one of the priorities of Water for the Future. The Australian Government is investing $12.9 billion over ten years through Water for the Future to address four key priorities: • Using water wisely • Supporting healthy rivers • Taking action on climate change • Securing water supplies
Water quality	The condition of water in the context of one or more beneficial uses. Usually described in terms of water quality indicators (such as pH, temperature and concentrations of nutrients or contaminants).
Weir pool	The body of water immediately upstream of a weir structure. In a relatively steep river or stream, a weir pool is expected to be more obvious while in a less steep river (such as the River Murray below Lock 1) a weir pool is expected to appear similar to the river in its natural state if the weir spillway height is not higher than the natural river level.
Wetland of International Importance	See 'Ramsar'.
Wetlands	Inland, standing, shallow bodies of water that may be permanent or temporary, fresh or saline. Areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. A low–lying area of land that is saturated with moisture, especially when regarded as the natural habitat of wildlife. Marshes, swamps, and bogs are examples of wetlands.
Wind seiche	The term for the movement of water by wind energy.

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