

Healthy Coorong, Healthy Basin

Coorong Restoration Roadmap



Australian Government



Government
of South Australia

Department for
Environment and Water

Foreword

The Coorong is a wetland of local, national and international importance, and one of the most significant waterbird habitats in the Murray-Darling system. The condition and value of the Coorong has suffered long-term decline and was further substantially damaged by the Millennium Drought. The long-term accumulation of salt and nutrients, combined with low annual water levels through late spring and summer, have prohibited the recovery of the system to a recognisable healthy state.

In recognition of the Coorong South Lagoon's declining condition and the Ramsar-listed wetland's importance to the health of the Murray-Darling Basin and the Basin Plan's success, *Healthy Coorong, Healthy Basin* (HCHB) is working to improve the ecology, knowledge and management of the Coorong.

In 2019, the Government of South Australia released the *Healthy Coorong, Healthy Basin Action Plan*, which outlined the short, medium and long-term activities required from the program to get the Coorong back on track for a healthy future. Activities included on-ground works, scientific trials and investigations, management tools and infrastructure solutions.

Since the release of the Action Plan, HCHB has completed an unprecedented science program, which has directly informed concurrent feasibility investigations into long-term management options for the site.

Guided by the *International Principles and Standards for the Practice of Ecological Restoration*, the HCHB Coorong Restoration Roadmap (the Roadmap) presents how the program will use key findings and partner with scientists, communities and First Nations to implement a strategic restoration program for the Coorong.

Restoring a healthy Coorong is critical for the environment, First Nations, local communities, the South Australian tourism industry, the overall health of the Murray-Darling Basin and the success of the Basin Plan.

WARNING: Aboriginal readers are warned that this document may contain images of deceased persons.





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Ngarrindjeri and First Nations of the South East

First Nations of the South East and Ngarrindjeri are the Traditional Owners of the Coorong, its connected lands and waters. These lands and waters have sustained unique First Nations cultures since the time of Creation. Ngarrindjeri and First Nations of the South East's spiritual, social, cultural, and economic practices come from the lands and waters, and continue to maintain their cultural heritage, economies, languages and Lores, which are of ongoing importance.

Ngarrindjeri

Ngarrindjeri vision

Our Lands, Our Waters, Our People, All Living Things are connected. We implore people to respect our Ruwe (Country) as it was created in the Kaldowinyeri (the Creation). We long for sparkling, clean waters, healthy land and people and all living things. We long for the Yarlularu-Ruwe (Sea Country) of our ancestors. Our vision is all people Caring, Sharing, Knowing and Respecting the lands, the waters and all living things.

Ngarrindjeri goals

- For our people, children and descendants to be healthy and to enjoy our healthy lands and waters. To see our lands and waters healthy and spiritually alive
- For all our people to benefit from our equity in our lands and waters
- To see our closest friends - our Ngartjis (special animals) - healthy and spiritually alive.
- For our people to continue to occupy and benefit from our lands and waters
- To see all people respecting our laws and living in harmony with our lands and waters (*Ngarrindjeri Nation Yarlularu Ruwe Plan 2006*)

Tapatauwi

Ngarrindjeri cultural values are protected and enhanced in planning and implementation of management actions.

Water is available to support Ngarrindjeri culture and wellbeing.

Ruwe

Ngarrindjeri speak for, care for and exercise cultural responsibility for Ruwe/Ruwar.

Ngartjis

Provide a habitat for our Ngartjis to be healthy and spiritually alive.



Ngarrindjeri Aboriginal Corporation (NAC) members at Raukkan.

Acknowledgement of Country

Aboriginal people are the First Peoples and Nations of South Australia. The Coorong connected waters and surrounding lands have sustained unique First Nations cultures since time immemorial. The *Healthy Coorong, Healthy Basin* program acknowledges the range of Ngarrindjeri and First Nations of the South East rights, interests and obligations for the Coorong and connected waterways and the cultural connections that exist between Ngarrindjeri and First Nations of the South East across the region, and seeks to support their equitable engagement. Ngarrindjeri and First Nations of the South East spiritual, social, cultural and economic practices come from their lands and waters, and they continue to maintain their lore, cultural heritage, economies and languages, which are of ongoing importance.

First Nations of the South East

First Nations of the South East vision

In the spirit of our ancestors, with the wisdom of our Elders, and for the future of our children, our vision is for the preservation of Country and effective management of our natural resources.

First Nations of the South East will maintain and respect the natural resources of Mambuwang (Great Ancestral Spirit) and protect our Burt (Boort- totem) and surrounding waters to establish sustainable resources for everyone.

First Nations of the South East goals

- Utilise the Lartara-wirkeri governance framework to undertake all business
- Maintain and grow culture and language, support healing, and increase Community connections through culturally safe and appropriate programs
- Demonstrate effective leadership in relation to heritage and environmental protection

Ceremony and Talk

Finding common ground and shared purpose to determine specific expectations and responsibilities with First Nations voices at the centre.

Hunt and Gather

Develop agreed pathways to progress common goals ensuring economic, employment and skill development opportunities are available for First Nations people.

Song and Dance

Utilise meaningful evaluation processes to celebrate the success and community collaboration that has occurred to reach a desired outcome.



South East Aboriginal Focus Group (SEAFG) members at Hacks Lagoon.

The Coorong

The Coorong is an estuarine wetland of local, national and international prominence, forming a major component of the Coorong and Lakes Alexandrina and Albert Wetland of International Importance under the *Convention on Wetlands (Ramsar 1971)*. It is also widely regarded to be one of the most significant waterbird habitats in the Murray-Darling system.

It is a coastal lagoon system that spans approximately 140 km, including the North Lagoon and South Lagoon, which are separated by a narrow constriction at Parnka Point. Salinity generally increases with distance from the mouth from marine, ranging from ~35 parts per thousand (ppt) at the Murray Mouth to hypersaline (>60 ppt) in the South Lagoon. The site supports extensive and diverse waterbird, fish and plant assemblages as well as threatened ecological communities and species.

The condition and value of the Coorong is largely reliant upon its hydrology, which is driven by releases of freshwater flows from the River Murray through the Lower Lakes barrages. Long-term declines in these freshwater flows were exacerbated by the Millennium Drought (2001 to 2010), which contributed to an absence of barrage water releases between 2007 and 2010. These changes to the system's hydrology led to an accumulation of salt and nutrients in unfavourable forms and while the Coorong has partially recovered since the return to flows in 2010-11, further action is required to secure its long-term health.

While many of South Australia's wetlands have been lost or significantly damaged due to large-scale water use and drainage, restoring wetlands within broader landscape networks contributes to the resilience of Coorong species populations and also strengthens the First Nations cultures and communities linked to them.



The Basin Plan and Ramsar

The Government of South Australia is committed to implementing the Basin Plan in full and ensuring the state has a sustainable, healthy working river for future generations.

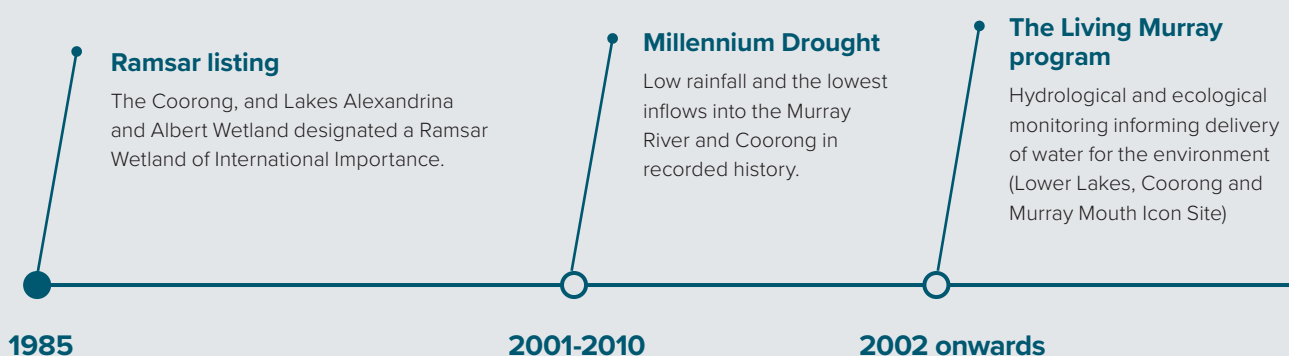
One purpose of the Basin Plan, as described in the *Water Act 2007*, is to provide for the integrated management of basin water resources, while also giving effect to relevant international agreements such as the Convention on Wetlands (Ramsar 1971).

The Basin Plan also aims to promote:

- **sustainable use** of the Murray-Darling Basin's water resources to protect and restore the ecosystems, natural habitats and species that are reliant on them, and to conserve biodiversity
- **wise use of** all Murray-Darling Basin **water resources**
- **conservation of declared Ramsar wetlands** in the Murray-Darling Basin.

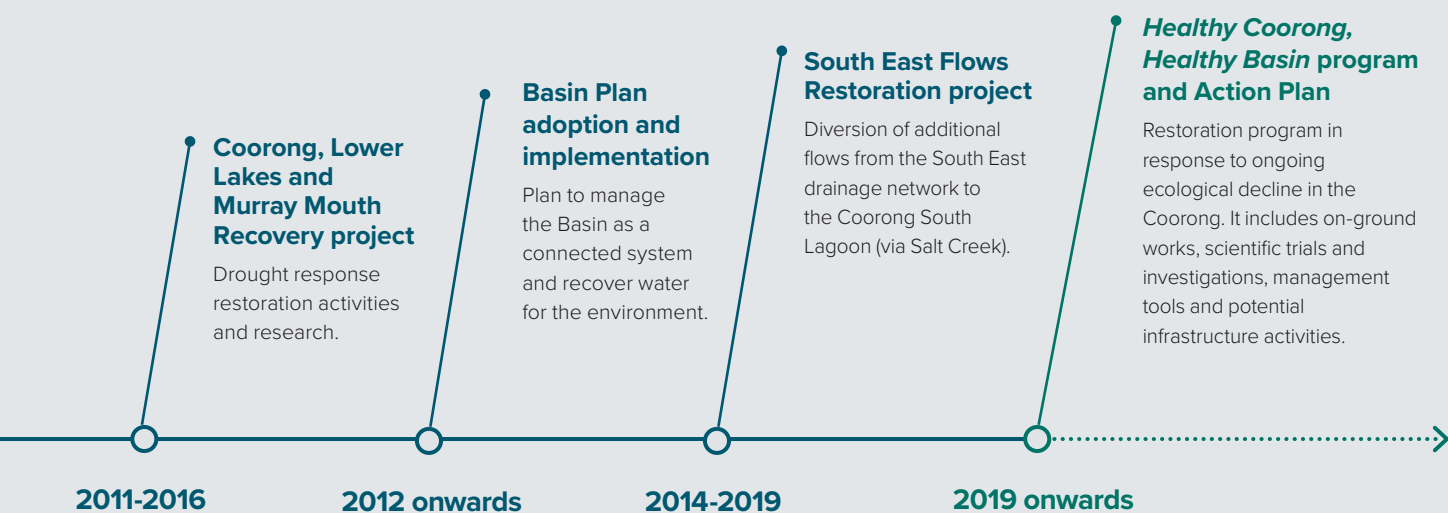
Continued optimisation of the delivery of water for the environment will be critical in achieving the Basin Plan's objectives for Ramsar wetlands and habitat restoration, and ensuring that sites such as the Coorong and Lakes Alexandrina and Albert Wetland, maintain their ecological character and are resilient to climate change and other threats.

Coorong policy and program history





Coorong and Lakes Alexandrina and Albert



Healthy Coorong, Healthy Basin

Restoring a healthy Coorong is critical for the environment, First Nations, local communities, agricultural and fishing industries, the South Australian tourism industry and the overall health of the Murray-Darling Basin.

The HCHB program will contribute to managing the Coorong's ecological health, and therefore support the Coorong and Lakes Alexandrina and Albert Wetland Ramsar site to be a healthy, productive and resilient wetland system that maintains its international significance.

Why is the Coorong important?

The Murray-Darling Basin is one of the most important social, environmental, economic and cultural systems in Australia. River systems die from the mouth up, which is why the Coorong's health is important for the whole of Australia, not just the Murray-Darling Basin.

Approximately 28,000 people live in the Coorong, Lower Lakes and Murray Mouth region and mainly work in agriculture, viticulture, fishing, manufacturing and tourism, with the majority of the region's industries relying on a healthy wetland system to thrive.

The Coorong's significance in supporting threatened wildlife, rare plants and endangered migratory waterbirds from around the world is internationally recognised in the Coorong and Lakes Alexandrina and Albert Wetland's inclusion as a Wetland of International Importance (*Ramsar 1971*). The value of the wetland is also recognised in international migratory bird agreements.

The Ramsar site provides significant economic and social value to both the region and South Australia, supporting a thriving tourism industry, commercial fishing, recreation, Traditional Owner uses and other social activities.

The health of the Coorong and its connected lands and waters are central to the culture and beliefs of the Ngarrindjeri and the First Nations of the South East, who are the Traditional Owners of the region. The waters are part of Country and provide the basis for the livelihoods of families and communities, while also containing many sacred and spiritually significant places. The water itself is believed to be a living body that was formed during the Creation, and the Traditional Owners are part of its existence, with the freshwater flows being the lifeblood of these Nations.

The Traditional Owners of the Coorong have cultures based on an interconnectedness with Country, including its wetlands and water. Their ways of life, cultural expressions and value systems are deeply connected to those ecosystems.

The Coorong National Park not only plays an important role in conserving this precious environment for First Nations, it also offers a wide range of beautiful wilderness for visitor activities, from birdwatching and canoeing to fishing, camping and 4-wheel driving.

The local community is active in advocating for improved management and conservation of the region, and during the Millennium Drought, participated in site management, including setting up community nurseries to propagate plants for local revegetation programs, planting vegetation to manage acid sulphate soils, monitoring acid sulphate soils and water quality, and installing fencing and planting native sedges to protect the lakes' shoreline. This resulted in the community feeling empowered and taking ownership of the program, becoming advocates in the broader community.

The Government of South Australia is committed to ensuring the environmental features of the Coorong that make it internationally significant, its ecological character, are maintained. It's vital that this important wetland is looked after for future generations to benefit plants and wildlife, First Nations cultures, local communities, fishing and agriculture industries, the state's economy and for the enjoyment of visitors from across the world.

That is why the South Australian and Australian governments are taking action to restore the health of the Coorong and get this important wetland back on track for the future.

The Coorong at a glance



Population

Approximately **28,000** people live in the Coorong, Lower Lakes and Murray Mouth region.



Murray-Darling Basin

Located **at the end of Australia's largest river system**, the Coorong is a critical part of the Murray-Darling Basin.



River Murray water

River Murray water flows through the barrages and into the Coorong and Southern Ocean (via the Murray Mouth).

Average 3,415 gigalitres/year (1990-2020)



NGARRINDJERI
ABORIGINAL
CORPORATION

Ngarrindjeri



First Nations of
the South East

First Nations

Traditional Owners of the Coorong, its connected lands and waters.



Internationally significant

Listed as a '**Wetland of International Importance**' in 1985. It supports **11** threatened species, **6** threatened migratory waterbird species and **2** threatened ecological communities.



South East Flows

Freshwater flows from the South East enter the Coorong's South Lagoon via a regulator at Salt Creek.

Average 11.43 gigalitres/year (1990-2020)



Tourism

Average **annual tourism expenditure of \$130 million** from 779,000 domestic day trips and 335,000 overnight visitors per year (2021).



Significant waterbird habitats

Regularly **supports more than 100,000 waterbirds annually**, including more than 30,000 migratory shorebirds each summer.



Marine exchange (Murray Mouth)

Inflows of tidal marine waters flow through the Murray Mouth into the Coorong.



Commercial fishing

The Lakes and Coorong Fishery provides **\$8-13 million annually**. Key species are pipis, yellow-eye mullet and mullet. Freshwater flows increase food sources and trigger breeding and recruitment for Coorong fish.



Over-extraction

Murray-Darling Basin flows have reduced due to over extraction in combination with a changing climate. These impacts were exacerbated during the Millennium Drought (2001-2010).



Groundwater

Groundwater enters the Coorong lagoons via active seeps.

People and industry need a healthy Coorong wetland system to thrive.



Key HCHB program achievements

In 2019, the Government of South Australia released the *Healthy Coorong, Healthy Basin* Action Plan, which outlined the short, medium and long-term on-ground works, scientific trials and investigations, management tools and infrastructure activities required from the program to get the Coorong back on track for a healthy future.

Key achievements to date from the implementation of the Action Plan include:

On Ground Works

- Completed feasibility investigations across 5 sites to restore more than 3,000 hectares of **priority wetlands** in the Lower Lakes and South East.
- **Partnered with Ngarrindjeri and First Nations of the South East** to identify priority species and wetlands for restoration.
- Gained approval for **small-scale wetland restoration works** to improve the quality and availability of waterbird habitat throughout the Coorong, Lower Lakes and South East.

Scientific Trials and Investigations

- **Unprecedented investment** in scientific research to fill **key knowledge** gaps regarding crucial Coorong ecosystem functions, to inform the development of targeted and effective management actions.
- Ngarrindjeri Aboriginal Corporation led a **cultural knowledge project** and developed tools for cultural health assessments.
- Developed and applied an **integrated hydrodynamic, ecological, and biogeochemical model** to optimise environmental water delivery decisions and inform feasibility of long-term operational infrastructure in the Coorong.
- Supported **early career researchers** to build science capacity in South Australia.

Water Resource Optimisation

- **Four new continuous monitoring stations** placed in the Coorong to measure salinity, organic matter, dissolved oxygen, turbidity and pH.
- **Two new meteorological (weather) stations** placed in the Coorong to measure wind speed and direction, temperature, rainfall and solar radiation.
- The **Coorong Water Quality Monitoring program** collected and analysed more than 1,200 water samples between 2019 and 2022.
- **Data will be publicly available** at [Data.sa.gov.au](https://data.sa.gov.au)



Long-term Operational Infrastructure Investigations

- Reviewed **20 international case studies** to identify learnings and outcomes that may be transferable to the Coorong.
- Consulted with scientists, managers, communities and First Nations to identify and **shortlist infrastructure options** to facilitate hydrological remediation of the Coorong.
- Used the **best available science and technology** to predict ecological benefits that proposed infrastructure could deliver to the Coorong South Lagoon, including hydrodynamic, ecological and biogeochemical.
- Completed multiple large-scale **cultural heritage surveys** with representatives and Elders from Ngarrindjeri and First Nations of the South East to identify optimal locations for potential infrastructure and management solutions.
- **Developed 13 infrastructure engineering concept designs**, reflecting the single largest investigation undertaken to improve the health of the Coorong.
- Determined that variants of a **connection between the Coorong South Lagoon and Southern Ocean** (with or without targeted dredging as a complementary action) have **the most potential for improving the health of the Coorong South Lagoon** and should be investigated further in a design and approvals stage.

First Nations Partnerships

- Followed a **best practice engagement** format, partnering with Ngarrindjeri and First Nations of the South East community members to contribute to a strong First Nations voice across the program. The program collaborated with board members, Elders and young people, and supported people on Country through working/focus groups and yarning circles.
- Employment of **community-based First Nations project officers** to facilitate First Nations voices being incorporated into HCHB planning and implementation.
- Delivery of **cultural awareness training** to facilitate deeper understanding of First Nations' cultural values and their connection to Country.
- Employment of **Coorong National Park Cultural rangers** to work with scientific researchers and be at the forefront of the Coorong National Park management.
- Contribution from Ngarrindjeri and First Nations of the South East to content for the **Ramsar Management Plan**: the Coorong and Lakes Alexandrina and Albert Wetland.



Raukkan community members.

Community Partnerships

- **Extensive community consultation** processes, including meetings, discussion forums, webinars and surveys.
- Established and consulted with the ministerially appointed **Coorong Partnership**, which included community representation across conservation, recreation, science, agriculture, local government, tourism, fishing, heritage and First Nations.
- **Annual science forums and regular community E-newsletters.**
- Successful **Coorong BioBlitz** event in 2021 to engage community in on-ground activities.
- Developed the **Science and Citizens of the Coorong video** with the Murraylands and Riverland Landscape Board, that was shown as part of the Scinema International Film Festival and globally accessible online.





A large proportion of submissions emphasised the importance of considering the impact of climate change on the region's health, as well as the restorative requirement for increased water for the environment and intermittent high flows. There was also an overarching desire from respondents for ongoing engagement with communities and maximising the use of First Nations knowledge regarding the Coorong and water management.

3,211

community members were engaged in the shaping of the Coorong Restoration Roadmap



91

community members completed surveys



12+

workshops, meetings, and drop-ins were held



1,768

views of social media articles

256

People attended workshops and meetings



604

Consultation newsletters were read



91%+

of respondents supported the Roadmap's desired state, key principles, actions and strategies

Restoration principles

Purpose of the Roadmap

Guided by *International Principles and Standards for the Practice of Ecological Restoration*, the Roadmap sets out key processes and principles to restore the Coorong from its current state. It will guide the development of an integrated restoration program to improve ecological function and support the ecological character of the site for many years to come.

In line with these key principles, the Department for Environment and Water (DEW) will continue its commitment to involve local communities, First Nations and key stakeholders in the development and implementation of key restoration actions outlined in this Roadmap.

Ecological restoration

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Society for Ecological Restoration international primer on ecological restoration, 2004).

HCHB aims to implement actions and interventions that seek to reinstate target ecological processes and functions in the Coorong, rather than achieve 'full restoration' to a historical state. Options being investigated include long-term infrastructure and ecological restoration actions, monitoring activities and engagement.



Key principles:

Restoration of the Coorong will be underpinned by national and international standards for the practice of ecological restoration:



Informed by **natural reference systems** while considering environmental change.



Engage people.



Support **ecosystem recovery** processes by repairing, rehabilitating and/or restoring ecological function.



Draw on many types of **knowledge**.



Include activities that form part of a **restorative continuum** and gain cumulative value when applied at large scales.



Use clear **targets, goals, objectives** and measurable indicators.



Include activities that seek the highest level of **recovery** possible.

The Coorong Restoration Roadmap key principles are adapted from:

- International Science & Policy Working Group SER (2019). *International Principles and Standards for the Practice of Ecological Restoration, 2nd Edition*. Society for Ecological Restoration. Available from www.ser.org
- Standards Reference Group SERA (2021) *National Standards for the Practice of Ecological Restoration in Australia, Edition 2.2*. Society for Ecological Restoration Australasia. Available from www.seraustralasia.org

Terry Hartman monitoring Coorong freshwater soaks.





Engage people

We acknowledge the interests and contributions of diverse stakeholders. Restoration activities will give consideration to both conservation and socio-economic values (including cultural values).

Community engagement

The future health and sustainability of the Coorong relies on community advocacy and ongoing involvement in the long-term management of the Coorong, as well as a broader understanding of the Coorong across the wider Murray-Darling Basin and its importance to the whole system.

Ongoing foundational engagement activities involve:

- informing the community through updates and communication of significant milestones throughout the program
- involving communities and stakeholders ahead of major decision points
- consulting communities and stakeholders ahead of final decisions, through facilitating workshops, meetings and online consultations
- flexibility in our willingness to adapt to stakeholder needs.

Future engagement in Coorong Restoration activities will focus on:

- how proposed restoration and long-term management options will ultimately support Basin Plan outcomes and benefits for communities, First Nations and broader stakeholders in the Coorong and across the Murray-Darling Basin
- building closer relationships with key stakeholders who are potentially impacted by proposed restoration and management activities
- building awareness and knowledge of HCHB across broader Murray-Darling Basin communities, ahead of any significant investment decisions.

“The unique ecology of the Coorong, with its international Ramsar reputation, is at serious risk of collapse. Its restoration, based on sound science and with community support, must now be our priority.”

**HON DEAN BROWN AO
COORONG PARTNERSHIP CHAIR**



Nathan Hartman & Gerald Rigney.

First Nations partnerships

First Nations of the South East and Ngarrindjeri are the Traditional Owners of the Coorong, its connected lands and waters. The health of the Coorong is intrinsically linked to the health of these First Nations communities, and they have historical and ongoing rights, interests and cultural obligations in the region.

Ngarrindjeri people have occupied, enjoyed, managed and used their inherited lands and waters within the area of the River Murray (Murrundi), Lower Lakes, Coorong (Kurangk) and adjacent areas since the Kaldowinyeri (Ngarrindjeri Creation).

DEW will continue First Nations partnerships to:

- protect and promote Traditional Owner culture and heritage, and their unique relationship with and responsibilities for their Country
- improve ecological outcomes through the respectful application of Cultural Knowledge to site decision-making (including co-designing actions and initiatives)
- facilitate Ngarrindjeri and First Nations of the South East economic and skill development through employment opportunities involving looking after the health of their Country.

The HCHB First Nations Partnerships project's focus on building strong and capable Aboriginal communities is a recognised action under the Premier's *Aboriginal Affairs Action Plan 2021-2022*. Importantly, this partnership continues to build on meaningful relationships with Ngarrindjeri and First Nations of the South East, as well as between the 2 communities.

First Nations project partners

“The First Nations Partnership project has been a crucial part of building positive partnership and ongoing relationships between DEW and Ngarrindjeri Aboriginal Corporation. The Partnership has enabled the Ngarrindjeri people to meet their cultural obligation to care for and manage Country. The HCHB First Nations Partnership project has been extremely effective and we have encouraged our new partners to follow a similar process.”

Tim Hartman
CEO Ngarrindjeri Aboriginal Corporation

“The South East Aboriginal Focus Group was established in 2004 to represent the interests of the First Nations of the South East. The First Nations Partnership project has helped strengthen links between the department and First Nations of the South East and allowed for genuine partnership. This has been integral in building trust between First Nations and the HCHB project team.”

Robyn Campbell
Former HCHB Project Officer and Burrandies CEO



Kezrah and Shanesia Varcoe: lakes fish monitoring. Photo: S. Wedderburn.

Draw on many types of knowledge

Coorong restoration activities will continue to be informed by a strong scientific evidence base, Ngarrindjeri and First Nations of the South East knowledge, practitioner knowledge (land, water and restoration managers) and local knowledge.

First Nations research projects, cultural heritage assessments and First Nations project officers have been funded and supported by HCHB to ensure that Ngarrindjeri and First Nations of the South East knowledge is incorporated into restoration planning and implementation. The HCHB First Nations Partnerships project will continue to seek both cultural and program outcomes through two-way knowledge sharing between Ngarrindjeri and First Nations of the South East and Coorong restoration project teams on Country.

The program will also continue to draw on a wide range of knowledge and experience to underpin decision making, including working with existing and emerging community reference groups, landscape boards, scientific reference groups and expert panels. We will continue to demonstrate flexibility in our approach and adapt to community needs and values for the site.

Science informing restoration

In 2018, the Goyder Institute for Water Research Expert Panel reviewed the current condition of the Coorong South Lagoon and determined that the key ecological features that make this system unique and valuable are still in place, including the north-south salinity gradient, the large areas of mudflat habitat and the species of plants, invertebrates, fish and birds. However, the concentration, abundance and distribution of many parameters and species have dramatically altered. The Expert Panel determined that the system is now in a vulnerable state, with little capacity to absorb continued and cumulative environmental stress.

In response, HCHB delivered an unprecedented investment in targeted scientific research (2019-2022) to inform restoration and future management of the Coorong. This work was delivered with significant collaboration with the Goyder Institute for Water

Research, including partners from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Flinders University of Adelaide and the South Australian Research and Development Institute (SARDI), and a long-term partnership with the University of Western Australia. The Ngarrindjeri Aboriginal Corporation was the key partner leading the Ngarrindjeri Knowledge Research project.

HCHB's Scientific Trials and Investigations project (2019-2022) included more than 70 researchers and 20 government scientists, with a strong focus on early career researchers to build capacity in SA. The project has facilitated innovative science to help solve complex problems in the Coorong, with research including interdisciplinary expertise across hydrology, biogeochemistry, aquatic ecology, quantitative modelling, First Peoples knowledge and social science.

A Ngarrindjeri-led research project ensured that Cultural Knowledge of the Kurangk (Coorong) was documented and shared in an accessible and culturally appropriate way to support Ngarrindjeri engagement and input into current and future environmental research/management projects. Cultural risk assessment processes, including the Ngarrindjeri Yarluwar-Ruwe Assessment technique, will continue to be developed and applied within the program to aid restoration.

Key outcomes include:

- ensuring that management decisions are informed by the best available science
- ensuring that Ngarrindjeri and First Nations of the South East knowledge contributes to joint decision-making and cultural values are protected
- identification of knowledge gaps, collection of data, and the synthesis and translation into management decisions.



Case for action

State of the Coorong

The latest scientific understanding of the state of the Coorong draws on 2 decades of research, from The Living Murray program (since 2002), Coorong, Lower Lakes and Murray Mouth Recovery project (2011-2016) and HCHB (from 2019).

The science is clear that the Southern Coorong (central Coorong and South Lagoon) has suffered long-term decline and is currently in a degraded state characterised by:

Hyper-eutrophic (high nutrient) conditions

- High phytoplankton and filamentous algal blooms, chlorophyll a, nitrogen and phosphorous levels.
- Repeated and rapid internal transfer/recycling of nutrients between the sediment and algae.
- Limited conversion of nutrients into a form that can be released into the atmosphere.

Limited connectivity and flushing

- Reduced water flows have led to build-up of sand and sediments, causing a restriction of flows at the Murray Mouth (which then require dredging) and Parnka Point (constriction point between the North Lagoon and South Lagoon).
- Reduced flushing of the Coorong has led to a long-term accumulation of salt and nutrients in the system.

Poor habitat quality

- The quality of water and sediments has declined as healthy nutrient cycling processes are inhibited by extreme organic and nutrient loads.
- Algal blooms are prevalent in spring and summer, exacerbating high nutrient conditions, and interfering with waterbird foraging and reproduction of aquatic plants.

- Monosulfidic black oozes are organic and sulfide rich sediments that have formed over large areas of the southern Coorong, causing sediments to become uninhabitable for aquatic plants and macroinvertebrates.
- The abundance and/or distribution of some invertebrate, plant, fish and waterbird species has declined in response to reduced habitat quality.

Impacts to Ngarrindjeri and First Nations of the South East

- Reduced access and connection to Country.
- Barriers to transfer of Cultural Knowledge and practice within the community (and across generations).
- Reduced ability to care for Ngartjis and Burt (totems).
- Reduced wellbeing.

Changes to the Coorong: 2022-23 River Murray flood event

- The 2022-23 River Murray flood event is the largest flood recorded in South Australia since 1956 and occurred as a result of heavy upstream rainfall. Short-term impacts of the flood due to increased freshwater flows to the Coorong included flushing effects, higher water levels, reduced salinities and improved South Lagoon water quality.
- While the flood provided a much-needed boost to the Coorong, it must be sustained into the future through sufficient environmental flows, including through the full delivery of the Basin Plan and further investigation of management options to improve the site's resilience.



Use clear targets, goals, objectives and measurable indicators

Restoring ecological function will be facilitated through the identification of clear targets, goals, objectives and measurable indicators.

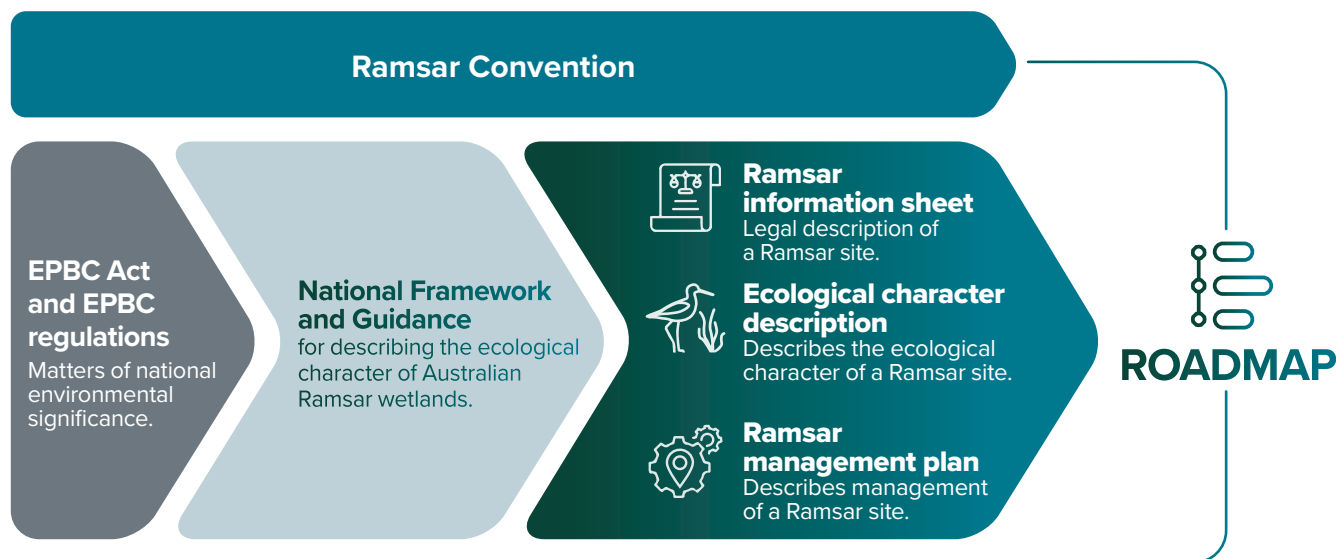
Basin Plan and Ramsar targets

The Roadmap will be implemented in alignment with *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) requirements to protect and maintain the ecological character of Ramsar-listed wetlands. Specifically, the Roadmap will focus on the restoration of ecological function to support ecological character of the site, which also assumes continued optimisation of environmental water delivery in line with the Basin Plan.

Restoration activity under the HCHB program is aligned to clear targets and objectives of the Basin Plan and Ramsar Management Plan: Coorong and Lakes Alexandrina and Albert Wetland, including those for:

- surface water salinity
- barrage flows
- a functioning and resilient foodweb, including plants, macroinvertebrates, fish and waterbirds.

A monitoring and evaluation plan will be developed to monitor progress using restoration targets.





Monitoring and evaluation

Monitoring and evaluating condition and ecological responses in the Coorong is critical for detecting changes, both positive and negative. In turn, this improves the ability to:

- respond quickly and appropriately if change is detected
- support adaptive site management, including the management of water for the environment
- evaluate program outcomes.

Monitoring activities will complement existing long-term data collected through The Living Murray, and will ensure that high priority baseline data is available to assess the future impacts and benefits of potential infrastructure and ecological restoration actions, including:

- continued on-ground water quality monitoring
- critical on-ground ecological monitoring, including measures of habitat quality, baseline data for cultural and impact assessments and measuring responses of native species to management interventions
- Ngarrindjeri and First Nations of the South East monitoring and evaluation methodologies such as Yarluwar Ruwe Assessment tool and the South East 6 seasons calendar.

The restoration of the Coorong is critical to achieving Basin Plan outcomes and DEW will continue to support full implementation of the Basin Plan by working with partners and water holders to coordinate the effective delivery of water for the environment.

Yarluwar Ruwe assessment

The Ngarrindjeri Yarluwar Ruwe assessment is a tool used to enable a holistic approach to Caring for Country. The assessment tool aims to understand the cultural health of an area by incorporating Ngarrindjeri knowledge and cultural values, taking into account Ngartijis, the surrounding environments and the site's ecology, as experienced by Ngarrindjeri people.

Ngarrindjeri Yarluwar Ruwe assessments will inform the design and implementation of key program activities and effective management of associated risks, while ensuring Ngarrindjeri values, traditions and heritage are protected, enhanced and managed during current and future on-ground works in the Coorong.



Scotte Wedderburn (photo) Whitney Rickett, Gerald Rigney and Tyreen Gollan, Lakes Thukabi monitoring.



Informed by natural reference systems while considering environmental change

The Coorong is a unique, diverse and dynamic coastal ecosystem that has been impacted by long-term environmental change. The Roadmap's Coorong reference system is based on a 'Target State' conceptual model and will also refer to additional case studies.

What the Roadmap trying to achieve

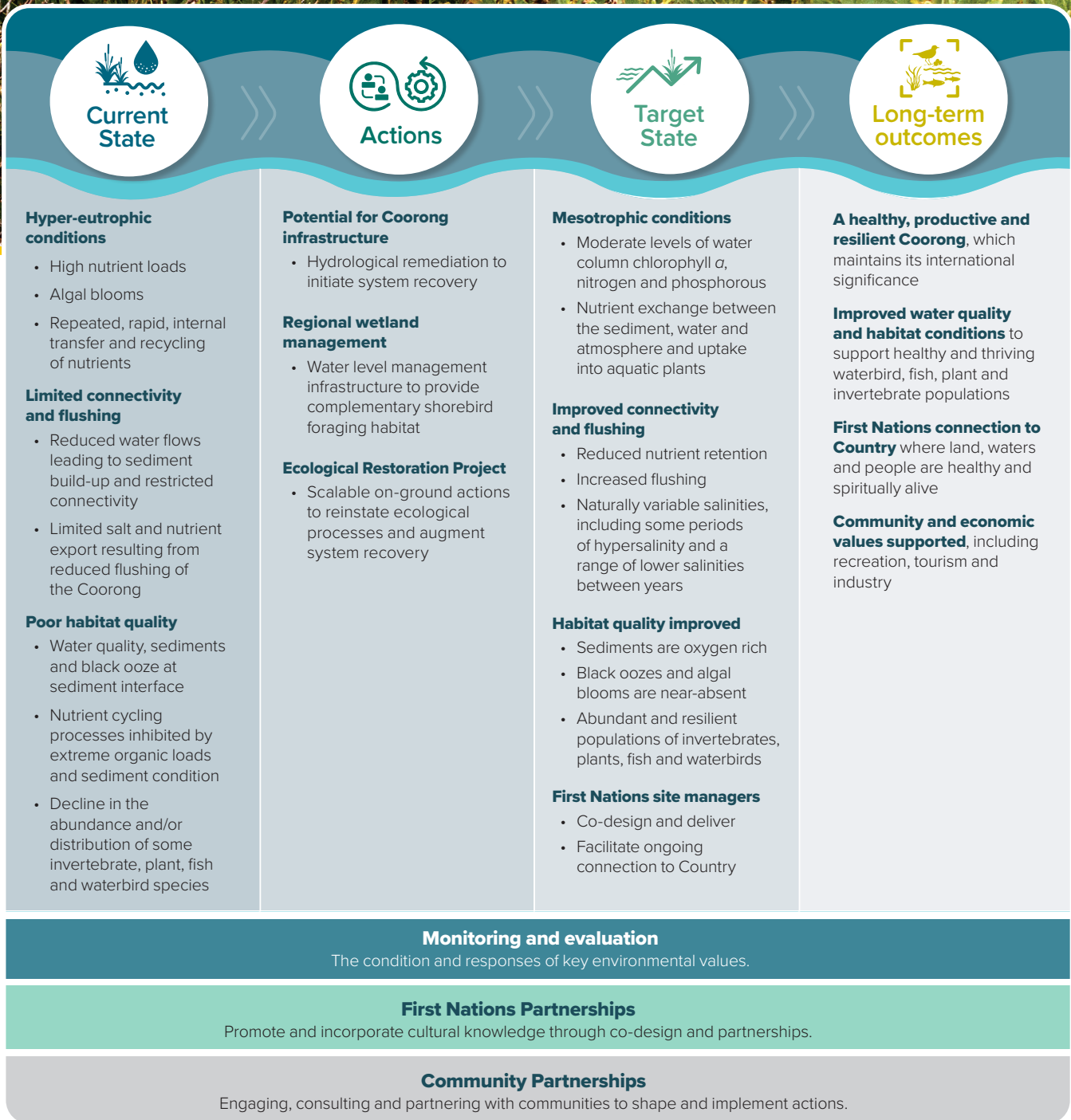
In 2020, leading scientists and environmental managers came together to build a shared understanding of the existing and emerging scientific knowledge of the southern Coorong. Following these discussions, and drawing on various scientific reports, the State of the Coorong - discussion paper was produced to communicate an up-to-date, scientific analysis of the target state of the southern Coorong. It describes the current and target states for the ecosystem and details why the long-term management options being explored through HCHB are needed.

The target state for the southern Coorong is a resilient and naturally variable system, which provides habitat to support waterbird, fish, plants and invertebrate populations.

To reach the target state, management strategies to improve ecological function are needed. These strategies need to:

- regularly export salt and nutrients from the system
- result in only short periods of restricted connectivity and hypersalinity
- promote functional food webs that are complex and resilient and include high-value aquatic plants, invertebrates, fish and waterbirds. .

HCHB is developing and implementing a range of restoration actions that will begin the process of recovery of ecological function and resilience in the Coorong, helping to restore it to a more desired state that could be achieved under current and future water availability scenarios.





Support ecosystem recovery processes by repairing, rehabilitating and/or restoring ecological function

Restoration will include a range of activities that contribute to overall restoration goals and are implemented with consideration to ecological, social and financial conditions at appropriate spatial and temporal scales. Restoration activities will be developed with regard to ecosystem processes that function at site, regional and broader landscape scales where possible.

The initial phase of HCHB (2019-2022) has focused on filling scientific knowledge gaps and conducting early feasibility assessments for infrastructure to achieve desired outcomes in the Coorong and regional wetlands. These works have delivered a clearer understanding of the current environmental problems and potential actions needed to take to establish a pathway to recovery for the Coorong.

HCHB is actively refining existing tools and operations to **improve site management**, and the Government of South Australia is working to further investigate and implement an integrated suite of management interventions to help **repair ecosystem functions** in the Coorong.

Initiating recovery of fundamental hydrological processes in the Coorong will help rehabilitate the site by exporting salt, nutrients and organic matter and promoting healthy nutrient cycling. This step will set the system on a trajectory to **partial or full recovery** of key ecological functions so that the Coorong continues to provide important habitat for native species.



Nutrient problems in the Coorong

Nutrients enter the Coorong ecosystem through water flowing from multiple sources. These nutrients are incorporated into the Coorong's ecological cycle through interactions between water, sediment, microbes, plants and animals.

We now know that nutrient levels and cycling processes in the southern Coorong are in an unhealthy, hyper-eutrophic state (i.e. contain high nutrient and organic matter loads). Nutrients remain trapped within the South Lagoon, as there is insufficient flushing of water and nutrients out to the North Lagoon and ocean via the Murray Mouth. Narrow constrictions and expansive shallow areas (particularly in spring and summer) reduce connectivity and water flow between the lagoons, causing excess nutrients to accumulate, promoting the growth of phytoplankton and filamentous algal blooms, which break down on the sediment surface and increase sediment nutrient and organic carbon loads. Organic matter is then decomposed by bacteria that consume oxygen and create anoxic (no oxygen) sediments. These processes have led to the formation of black, organic and sulfide-rich sediments called 'monosulfidic black ooze', which are now predominant over large areas of both the south and north lagoons. These monosulfidic black oozes and hypersaline (high salinity) conditions are toxic to macroinvertebrates and aquatic plants.

The most effective way to reduce monosulfidic black ooze is to minimise organic matter (e.g. algal) accumulation and promote water flows that export salt and nutrients. Enhanced lagoon flushing, via increased seawater exchange or facilitated export of South Lagoon water to the ocean, would decrease organic matter availability for sulphate reducing bacteria, reducing anoxic conditions and monosulfidic black oozes.

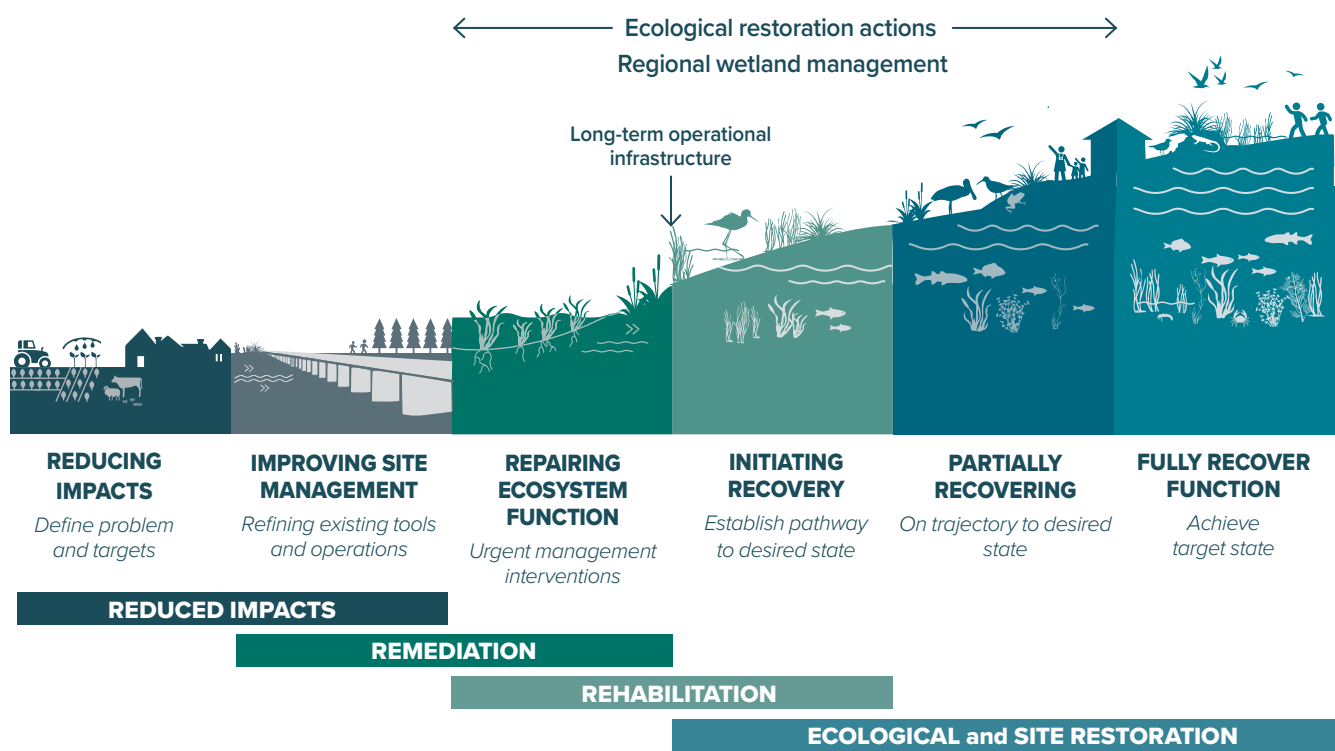
Reduced salinities (<60 ppt) and nutrient loads will further enhance system recovery by promoting native seagrass and benthic macroinvertebrate recolonisation. Sediments are oxygenated by the burrowing of native worms and bivalves (macroinvertebrates) and the roots of native aquatic plants, which further facilitates exchange of nutrients back into the atmosphere.

HCHB is investigating options to improve flushing and export of organic matter, algae and nutrients from the Coorong. The Roadmap includes a range of restoration activities that will work together to recover ecological function, including healthy nutrient cycling processes, in the Coorong.



Include activities that form part of a restorative continuum and gain cumulative value when applied at large scales

HCHB restoration actions will include a range of management interventions that collectively contribute to the recovery of ecological function along a restorative continuum.



The restorative continuum illustrates how the implementation of restorative activities at all levels can optimise broad scale ecological and social outcomes (adapted from International Science and Policy Working Group SER (2019). *International Principles and Standards for the Practice of Ecological Restoration*, 2nd Edition. Society for Ecological Restoration.)



Restoration activities in the HCHB program are being investigated and developed to support the recovery of ecosystem values that have been lost or degraded. A range of restorative activities will allow successful progress through the stages of the restorative continuum, and contribute to ecological recovery. The restorative continuum provides a context for the staged progression of restorative activities to maximise their success.





Include activities that seek the highest level of recovery possible

Ecological restoration aims for the highest practicable level of recovery possible, even if outcomes have long timeframes or require various interventions.

Key HCHB activities will contribute to ecological recovery through:

- **Regional wetland management** that will provide regional-scale complementary shorebird foraging habitat in the Lower Lakes and South East while restoration is underway in the Coorong
- **Potential long-term operational infrastructure** to provide broad-scale hydrological remediation of the Coorong by exporting excess salt and nutrients and initiate system recovery
- **Ecological Restoration Project actions**, including local-scale nutrient management, sediment remediation and facilitating restoration of aquatic plants and macroinvertebrates to augment active ecosystem recovery.

The long-term impacts of water over-allocation across the Murray-Darling Basin, exacerbated by the Millennium Drought, have degraded the Coorong to the point where it is at risk of losing some of the elements that make it an iconic wetland of local, national and international importance.

Recovery of complex ecosystems, such as the Coorong, from long-term and cumulative change requires iterative restoration actions and longer-term recovery timelines. This Roadmap includes actions appropriate to the different stages of desired long-term outcomes.

The functional designs of all restoration activities (including potential infrastructure) are being optimised to achieve the highest possible level of ecological recovery in the Coorong.



Regional wetland management



Long-term operational infrastructure



Ecological Restoration Project actions

Regional wetland restoration

Waterbirds move within and between networks of wetlands in their search for food and habitat, as the condition of individual wetlands varies across seasons, largely in response to water availability. Recent HCHB research has tracked waterbirds moving between habitats along the Coorong and into regional wetlands, including those in the Lower Lakes and South East of South Australia.

HCHB has commenced regional wetland restoration activities to ensure that habitats exist within the broader regional landscape at critical times for key Coorong South Lagoon waterbird species.

These activities aim to improve the availability and quality of habitat for migratory and non-migratory shorebirds outside of the Coorong in the short to medium-term, while broader restoration of the Coorong is underway. Small-scale wetland management infrastructure will be constructed at priority wetland sites within proximity of the Coorong to manage water at levels that improves the extent, quality and duration of inundation.

Expected benefits of regional wetland restoration include:

- increased availability and quality of shallow water foraging habitat for Australian and migratory shorebirds
- improved access tracks for birdwatching and recreational activities
- supporting restoration of wetlands that have significant cultural and ecological value to Ngarrindjeri and First Nations of the South East
- supporting key community restoration priorities.

Shorebirds are waterbirds that feed by wading in shallow water or probing in mudflats. Shorebirds are usually found in intertidal habitats or inland wetlands in Australia.



Long-term operational infrastructure

The latest science emphasises the need for increased system-scale flushing (frequency and magnitude) to reduce and support reversal of eutrophic conditions in the Coorong South Lagoon. This flushing will help to:

- export nutrients, algae and organic matter, therefore reducing water column and sediment nutrient loads and allowing light penetration for native aquatic plant growth
- reduce hypersaline conditions, facilitating re-establishment of benthic macroinvertebrates
- reduce formation of hypersaline, sulfide-rich sediments that are toxic and uninhabitable for native species.

Operators currently have very few tools to manage flows efficiently and effectively within the Coorong, in particular the South Lagoon. The current management levers available to manipulate flows and water levels in the South Lagoon include:

- River Murray flow (including water for the environment)
- barrage operations
- Murray Mouth dredging
- flows from the South East.

The efficacy of current management levers is limited by freshwater flows, meaning that in times of drought and lower water availability, desired water levels and quality cannot be achieved. Long-term, large scale infrastructure could deliver the required system flushing at scale by introducing:

- a new water source that is available across all climatic and water availability conditions
- an alternate management lever that enables efficient and effective management.

Since 2020, the Coorong Infrastructure Investigations Project has engaged with communities, First Nations and stakeholders through options, investigations and feasibility stages to develop a significant evidence base regarding long-term management solutions. The current status of this project is described in more detail within the Coorong Infrastructure Investigations Feasibility and Future Directions document.

Feasibility investigations identified that 3 variants of a connection between the Coorong South Lagoon and Southern Ocean (with or without targeted dredging as a complementary action) have the most potential for improving the health of the Coorong South Lagoon. All 3 infrastructure variants export salt and nutrients from the Coorong.



Circulation

Pump in at one location and out at another, with lower visual impact discharge.

Provides the best ecological outcomes for the Coorong South Lagoon.

Bidirectional

Pump in or out at one location, with separate pumping stations.

Provides the 'next best' ecological outcome for the Coorong South Lagoon.

Pump out

Lower visual impact discharge, with dredging.

Included in the event that further investigations of the other options prove prohibitive.

These options will be considered by the project, with and without dredging, as a complementary action, with concepts refined as required.

These 3 infrastructure concepts will progress through further investigations, design and approvals. This remains an investigations project and no decision has been made to proceed with any particular option. Community, First Nations and stakeholder consultation will continue throughout the project and before final decisions are made to proceed with any particular option.

Should a suitable long-term management option for the Coorong South Lagoon be identified, appropriate approvals will be obtained and a decision made by the relevant governments to proceed with its construction.

In addition to investigating potential HCHB program restoration activities, the Government of South Australia continues to support the full implementation of the Basin Plan.

Integrated operations

The Roadmap's long-term vision includes Coorong management levers being guided by an integrated operations approach to coordinating large-scale environmental watering and associated site infrastructure operation.

An integrated operations approach will allow greater risk management while achieving site-scale and cumulative benefits across the Coorong.



Ecological restoration actions

The southern Coorong requires an integrated management approach to recover biogeochemical and ecological functions. Operation of long-term, large-scale infrastructure will support the repair of ecosystem function through the export of excess salt and nutrients. While desired hydrological and salinity regimes can be achieved under infrastructure operation, additional strategies are needed to repair the natural ecosystem functions that reduce nutrient loads and improve foodweb functioning.

Ecological restoration actions under investigation include:

- short-term removal of algae accumulating on shorelines to reduce localised organic matter and nutrient deposition, and improve shorebird access to food in mudflats
- restoration of benthic macroinvertebrate and aquatic plant communities, encouraging oxygenation of sediments to reduce sediment nutrient loads
- re-establish food sources for fish and waterbirds.

Feasible ecological restoration activities will generally be targeted to more localised areas, where extra effort is needed to repair poor conditions. This will kick-start native species restoration by establishing source populations of aquatic plants and macroinvertebrates in strategic locations and/or add further value to larger scale hydrological remediation.

Ecological restoration actions will fit within a staged plan, with some actions required before, during and/or after the potential hydrological remediation via Coorong infrastructure. All ecological restoration actions will be designed and implemented to reduce impact on the surrounding environment and foster partnerships with First Nations and the community.

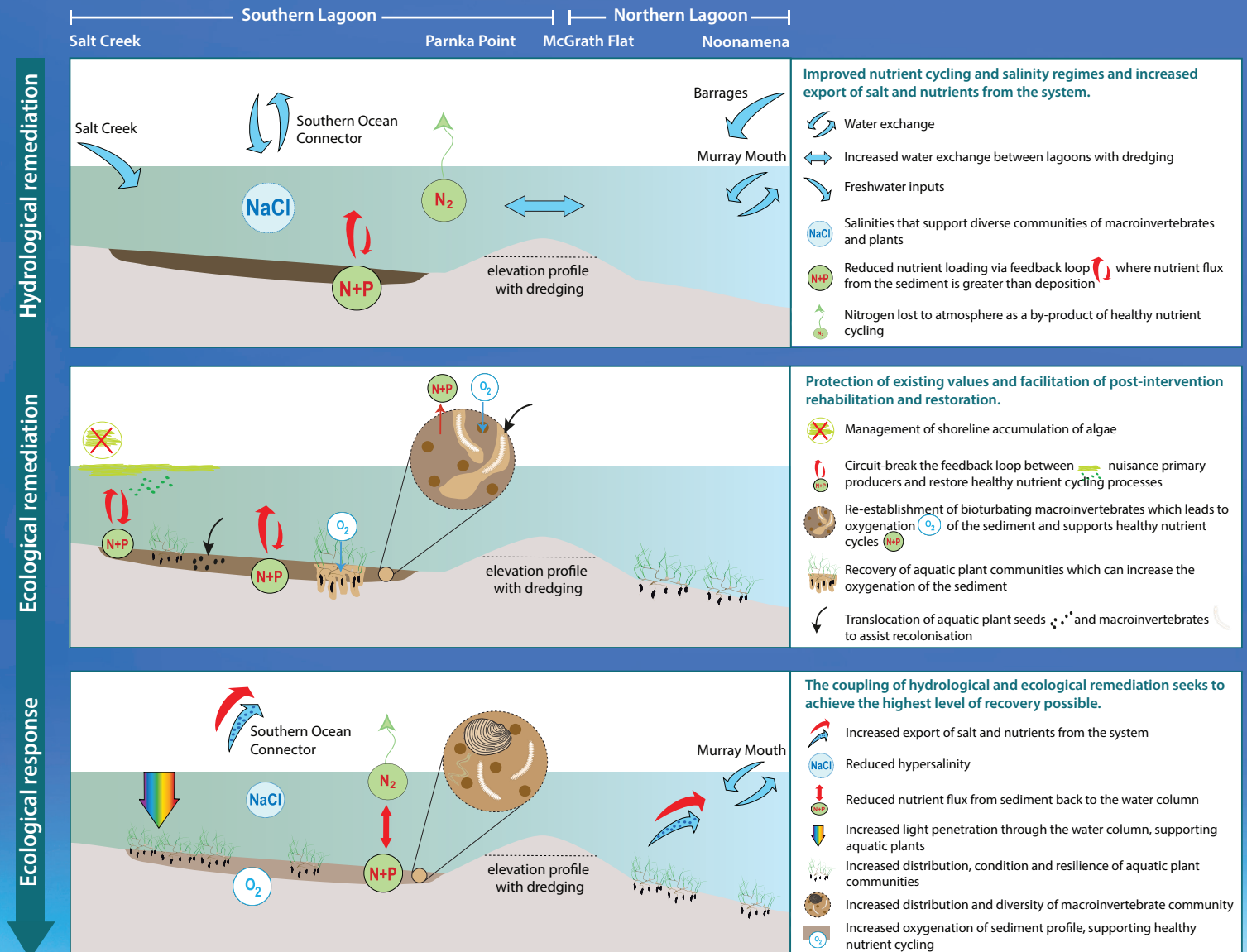
Combining local ecological restoration actions with system-scale restoration activities couples the benefits of hydrological remediation with ecological remediation to hasten and improve ecological restoration outcomes (refer to conceptual diagram).



Case study: Coorong aquatic plant restoration

Native aquatic plants (*Ruppia*) were successfully translocated to the Coorong as a restoration action under the Coorong, Lower Lakes and Murray Mouth Recovery project, in partnership with Ngarrindjeri. Seed-laden sediments were translocated from Lake Cantara to 5 restoration sites in the Coorong between 2012-2014. Eight years later, these 5 sites show significant improvement in aquatic plant biomass, seed bank and the number of turions (underground reproductive structures) produced. As a result of this previous work, we can utilise tried and tested methodologies as part of an aquatic plant restoration strategy in the Coorong.

Conceptual diagram of the linkages between hydrological remediation (infrastructure), ecological remediation (ecological restoration activities) and ecological restoration outcomes.



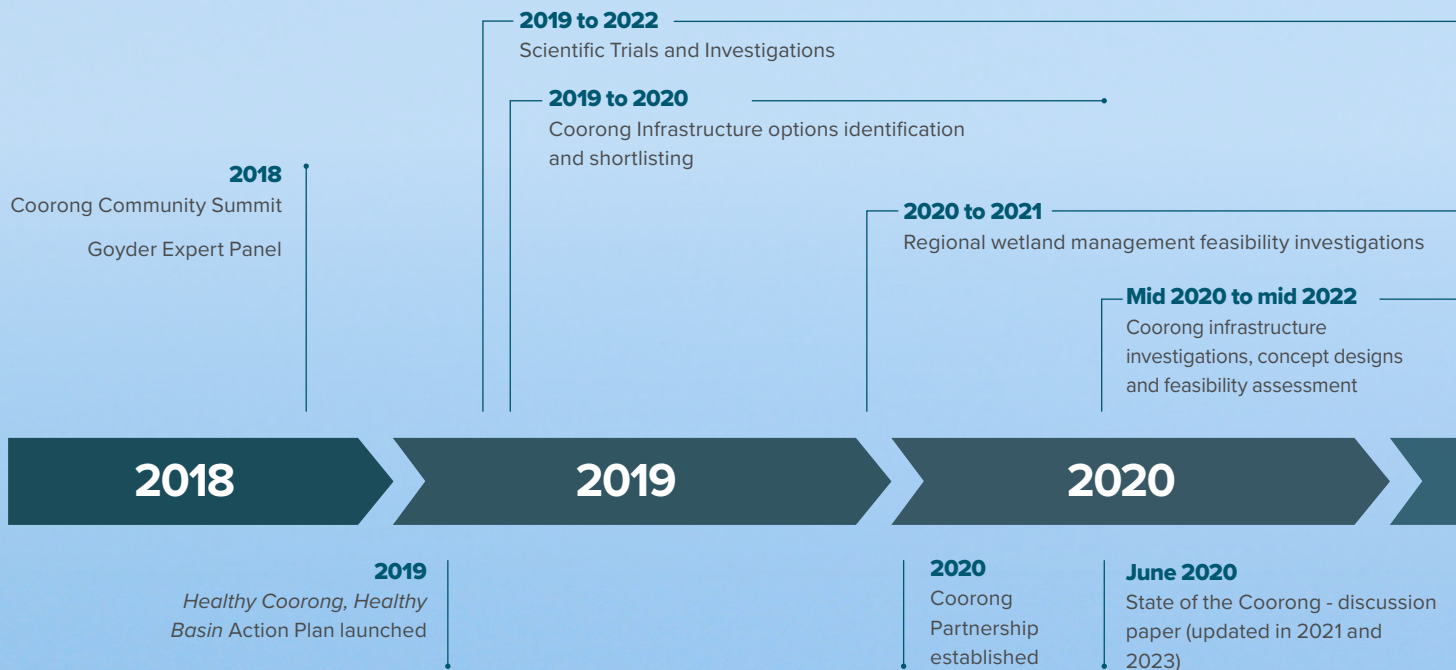
Proposed *Healthy Coorong, Healthy Basin* restoration activities form an integrated package that work, at a regional and local-scale, to seek the highest level of recovery possible in the Coorong.

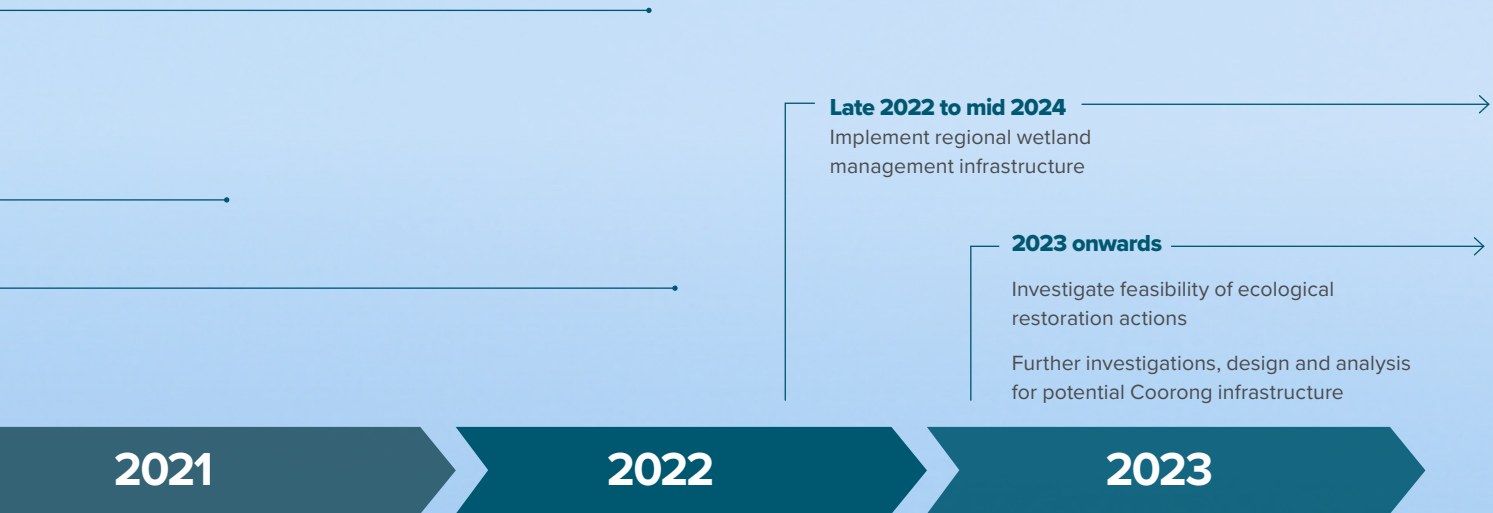


HCHB activity timeline

First Nations partnerships and community engagement are foundational and ongoing activities throughout the program.

Water quality and nutrient monitoring is a continuous and ongoing activity throughout the program.





More information

For *Healthy Coorong*, *Healthy Basin* news or to subscribe for updates on opportunities, including citizen science activities, events and community consultations, scan the QR code or visit environment.sa.gov.au/HCHB-news



If you have any questions or comments, please let us know at Healthy.Coorong@sa.gov.au

environment.sa.gov.au/healthy-coorong



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