3

Water and biodiversity in South Australia

3.1 As the driest state in the driest inhabited continent in the world,[1] South Australia received considerable attention at the height of the drought experienced by southeastern Australia from 1997 to 2009, the worst drought in the 110-year instrumental record.[2] The impact on the Coorong, Lower Lakes and Murray Mouth (CLLMM) region, in particular, was a major focal point. Located at the downstream end of the Murray–Darling River system, there was concern that the drought, combined with the over-allocation of water resources upstream, had severely compromised the region's internationally significant biodiversity.

3.2 Some of the environmental impacts of the drought have abated since 2009. However, many of the challenges for the region remain, and these were part of the focus of the Committee's site inspections in the CLLMM region on 16 May 2012.

3.3 Apart from this focus, the Committee was interested to see the development of innovative practices for the sustainable use of water resources and the protection of biodiversity assets. On 17 May 2012, the Committee inspected the constructed Greenfields Wetlands, which contribute to addressing concerns about the availability of water from the River Murray and the potential ecological impacts of stormwater run-off on marine ecosystems.

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1 Government of South Australia, 'Importance of water', <http://www.sa.gov.au/subject/Water,+energy+and+environment/Water/Water+resources+in+SA/Importance+of+water> viewed 9 October 2012.

2 B Timbal, 'The continuing decline in South-East Australian rainfall: update to May 2009' in PA Sandery, T Leeuwenburg, G Wang and AJ Hollis (eds), *CAWCR Research Letters*, issue 2, July 2009, Centre for Australian Weather and Climate Research, Melbourne, 2009, pp. 4–11, <http://www.cawcr.gov.au/publications/researchletters/CAWCR_Research_Letters_2.pdf> viewed 16 October 2012.

3.4 Over these two days, the Committee's site inspection program in South Australia addressed matters relating to freshwater, marine and terrestrial biodiversity; impacts of biodiversity loss on human populations; the sustainable use of natural resources; and community engagement.

Committee activities

The Coorong, Lower Lakes and Murray Mouth region

3.5 The CLLMM region is approximately 142 500 hectares in size and contains a diverse range of freshwater, estuarine and marine habitats.[3] The region is a Ramsar site, known as the Coorong and Lakes Alexandrina and Albert (Lower Lakes) Wetland of International Importance. It is an area of high biodiversity value, and home to many endemic plant and animal species. The Coorong and Lower Lakes have been recognised by BirdLife International as Important Bird Areas, given their significance for resident waterbird, migratory shorebird, and orange-bellied parrot populations.[4] The Coorong also acts as an important refuge for animals during times of drought.

3.6 The Ramsar site covering the region is currently used for several purposes, including conservation, recreation, water storage and extraction, grazing and cropping, and urban and residential development. Local employment is mainly in the agriculture, viticulture, fishing, manufacturing, and tourism industries.[5]

3.7 Years of drought and over-use of water had left these 'internationally significant wetlands dry, the lakes disconnected, communities and industries under significant stress,' and native species threatened.[6]

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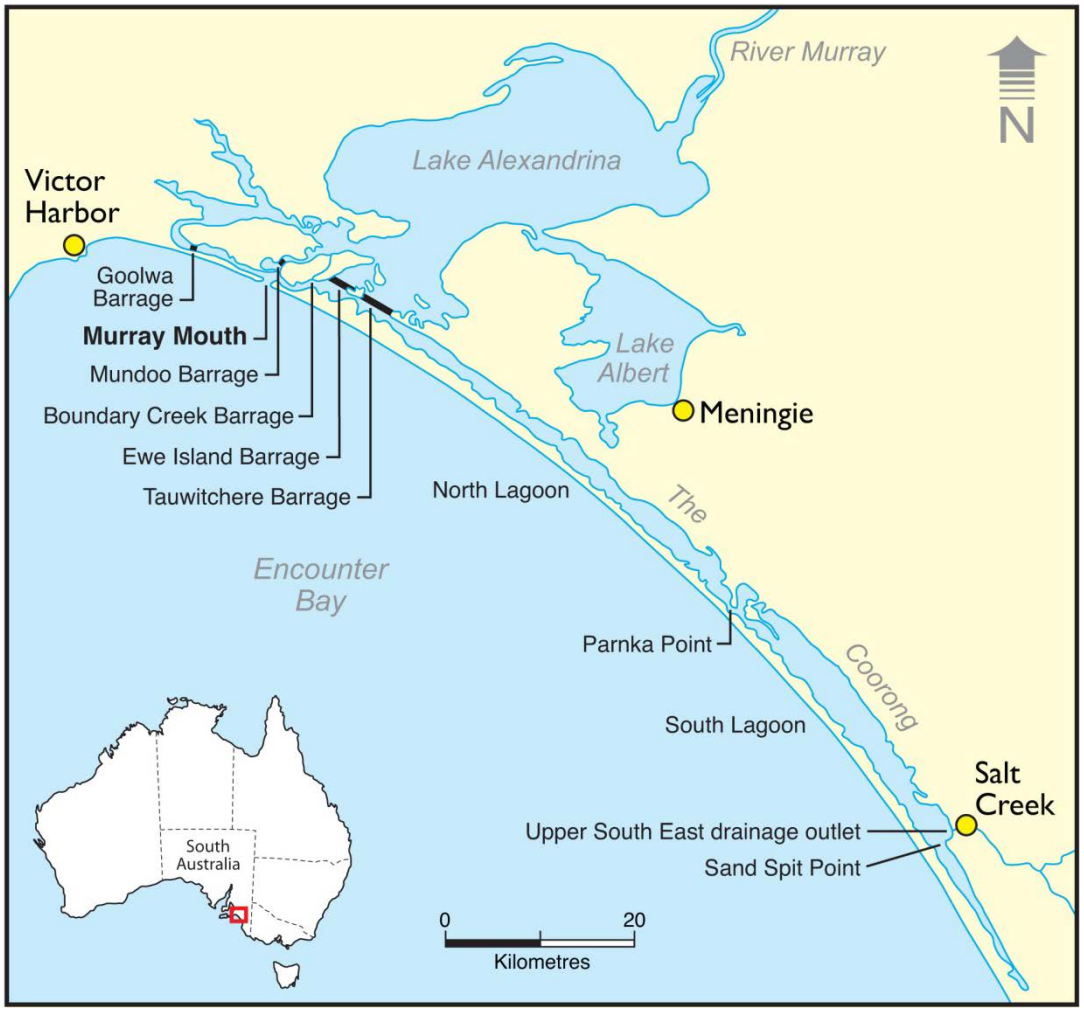
3 South Australian Department of Environment, Water and Natural Resources (DEWNR), 'Coorong, Lower Lakes and Murray Mouth region', <http://www.environment.sa.gov.au/conservation/rivers_wetlands/coorong_lower_lakes_murray_mouth> viewed 16 October 2012.

4 G Dutson, S Garnett and C Gole, *Australia's Important Bird Areas: Key Sites for Bird Conservation*, Birds Australia (RAOU) Conservation Statement No. 15, October 2009, pp. 32–3.

5 DEWNR, 'Coorong, Lower Lakes and Murray Mouth region', <http://www.environment.sa.gov.au/conservation/rivers_wetlands/coorong_lower_lakes_murray_mouth> viewed 16 October 2012.

6 Department for Environment and Heritage (DEH), *Securing the future: a long-term plan for the Coorong, Lower Lakes and Murray Mouth*, Government of South Australia, Adelaide, 2010.

Figure 3.1 Location of the Coorong, Lower Lakes, Murray Mouth, and Barrages



Source *Modified from: S Lamontagne, K McEwan, I Webster, P Ford, F Leaney and G Walker,* Coorong, Lower Lakes and Murray Mouth: knowledge gaps and knowledge needs for delivering better ecological outcomes, *Water for a Healthy Country National Research Flagship, CSIRO, Canberra, 2004, fig. 1, p. 3*

3.8 The Committee visited six distinct sites in the CLLMM region—which are briefly described below—and gained an insight into some of the complexities associated with natural resource management in the region. Throughout the site inspection program, the Committee was accompanied by Mr Russell Seaman, Environmental Advisor with the South Australian Department of Environment, Water and Natural Resources (DEWNR).[7] At each site, Mr Seaman provided briefings which focused on: the region's biodiversity values; ongoing and climate change-related threats to biodiversity; DEWNR initiatives; and the importance of community engagement in natural resource management.

7 On 1 July 2012, the South Australian Department of Environment and Natural Resources became the Department of Environment, Water and Natural Resources (DEWNR). For consistency, the latter title is used throughout this report.

3.9 During the inspections, the Committee received the following documents from the DEWNR:

- *BushBids Murray Plains and Rangelands: Woodland*, South Australian Murray–Darling Basin Natural Resources Management Board.
- *Applying a climate change adaptation decision framework for the Adelaide–Mt Lofty Ranges Natural Resource Management Board*, South Australian Department of Water, Land and Biodiversity Conservation.

Lakes Alexandrina and Albert

3.10 The River Murray, Australia's longest river, terminates in South Australia at the Southern Ocean, having passed through Lake Alexandrina, the Murray estuary and, finally, the Murray Mouth. Lake Albert is a terminal lake connected to Lake Alexandrina by a narrow channel. Lakes Alexandrina and Albert, collectively referred to as the Lower Lakes, are comprised of fresh to brackish and saline waters, and support significant biodiversity, including threatened bird species such as the orange-bellied parrot, Australasian bittern, and fairy tern.[8]

3.11 During the site inspections of the Lower Lakes, the Committee was briefed on local biodiversity values, threats to biodiversity including land use and climate change, and some of the DEWNR's relevant climate adaptation measures.

Clayton Bay and Dunn's Lagoon

3.12 Clayton Bay is located on the Lower Murray River. Dunn's Lagoon (also known as Clayton Wetland) is a back basin of Lake Alexandrina and located on the east side of the township of Clayton. It is a large, open, permanent wetland, and is relatively shallow in most parts. The wetland has three main connections with Lake Alexandrina. These broad, shallow inlets incorporate three islands including Goose Island to the west and Goat Island to the east. Water levels in the wetland fluctuate in accordance with water levels in Lake Alexandrina.

3.13 Dunn's Lagoon spans several land tenures including private and council land. The wetland is managed by a stakeholder group and is a popular place for recreational pursuits such as boating. The private land surrounding the wetland is used primarily for grazing.

8 BirdLife Australia, 'Birdata—Important Bird Area: Lakes Alexandrina & Albert', <http://www.birdata.com.au/iba.vm> viewed 27 September 2012.

3.14 During the inspection of Dunn's Lagoon, the Committee heard that the area is one of the top five ecologically important sites in the CLLMM region. Indeed, areas such as Dunn's Lagoon are considered the drivers of the ecology of Lakes Alexandrina and Albert.

Milang Lakes Hub

3.15 The Lakes Hubs at Milang and Meningie were established in 2009 and 2010 respectively, to help disseminate information and provide collaborative links between government and local communities. The Hubs provide a conduit between government and community members to deliver environmental restoration projects in the region.

3.16 The Lakes Hub at Milang is an initiative of the Milang and District Community Association and is part of the South Australian Government's Murray Futures program, funded by the Australian Government's Water for the Future initiative. The Committee visited the Milang Lakes Hub and received briefings from:

- Ms Karyn Bradford, Lakes Hub Executive;
- Ms Carole Richardson, Local Action Planning Coordinator; and
- Ms Gemma Cunningham, Community Engagement Manager, DEWNR.

3.17 At the Milang Lakes Hub, the Committee received the following documents:

- *Seeds to reeds: Lower Lakes Community Nurseries Newsletter*, 10th edition, Lakes Hub, March 2012.
- *Weekly Bulletin*, No. 96, Lakes Hub, 7 May 2012.
- *Local people, local issues, local action*, Goolwa to Wellington Local Action Planning Board Inc.
- *Development and implementation of a community engagement strategy for the Lower Lakes bioremediation and revegetation project, 2009–2011: Final report*, Milang & District Community Association Inc.

Wyndgate, Hindmarsh Island

3.18 Hindmarsh Island is located on the Lower Murray River, near the town of Goolwa. It is a popular tourist destination, and much of the land on the island is used for agricultural purposes.

3.19 The Committee visited the DEWNR office at Wyndgate on Hindmarsh Island, which is one of the sites from which Coorong National Park is currently managed, and received briefings from:

- Mr Tim Hartman, Ngarrindjeri Regional Authority; and
- Mr Lachlan Sutherland, Ngarrindjeri Partnerships Coordinator, DEWNR.

3.20 At Wyndgate, the Committee received briefings on the natural and cultural values of the area, impacts of recent droughts and related management responses, and programs to engage Indigenous communities in biodiversity conservation and the co-management of national parks.

Goolwa Barrages

3.21 Hindmarsh Island has freshwater on its northern shore and saltwater on the southern shores. The waters are separated by a series of barrages, constructed between 1935 and 1940, which are intended to maintain a consistent water level in the lakes and to protect agricultural areas from exposure to saltwater.

3.22 The five barrages—often collectively referred to as the Goolwa Barrages—span the Goolwa, Mundoo, Boundary Creek, Ewe Island and Tauwitchere channels. The Committee travelled over some of the barrages and received briefings on the design of the structures, the importance of fishways and water flow to the ocean, and the state of the Coorong and Murray Mouth.

The Coorong and Murray Mouth

3.23 The Coorong is a long, shallow, brackish to hypersaline lagoon more than 100 kilometres long. It is separated from the Southern Ocean by a narrow sand dune peninsula. The Coorong has been one of Australia's most important sites for shorebirds, but decreased environmental flows in recent decades have led to declines in many species.[9] Nevertheless, BirdLife International identifies more than a dozen globally-important bird species supported by the Coorong, including threatened species such as the orange-bellied parrot, fairy tern, Australasian bittern, and hooded plover.[10]

9 BirdLife Australia, 'Birdata—Important Bird Area: Coorong', <http://www.birdata.com.au/iba.vm> viewed 27 September 2012.

10 BirdLife Australia, 'Birdata—Important Bird Area: Coorong', <http://www.birdata.com.au/iba.vm> viewed 27 September 2012.

3.24 During its inspections of the Coorong and Murray Mouth, the Committee received briefings on the biodiversity values of the area, water management policies, and the effects of drought.

Figure 3.2 Committee members at one of the Goolwa Barrages

Photograph courtesy of committee secretariat

Greenfields Wetlands, Adelaide

3.25 The City of Salisbury is located on the northern fringes of Adelaide and, with approximately 130 000 residents, is the second largest local government community in South Australia. The City has experienced rapid residential and commercial growth and is South Australia's most productive manufacturing region.[11]

3.26 The City of Salisbury has established a stormwater recycling program that provides business and community customers with non-potable water. This has contributed to reducing Adelaide's overall reliance on the River Murray to meet its water requirements, and has delivered biodiversity benefits for the area and for adjacent marine ecosystems.

3.27 Greenfields Wetlands, which the Committee inspected on 17 May 2012, is one of over 50 constructed wetlands that help the City manage its water supply and improve water quality. During its inspection, the Committee

11 City of Salisbury, *Salisbury city plan 2020: sustainable futures*, City of Salisbury, Salisbury, South Australia, September 2008, p. 7.

was briefed by Mr Colin Pitman, General Manager, City Projects, City of Salisbury. The Committee received the following documents:

- City of Salisbury, *Water fact sheets:*
  - ⇒ *The Salisbury Wetlands*.
  - ⇒ *The Benefits of Our Wetlands*.
  - ⇒ *Frogs and Froglets*.
  - ⇒ *Little Wetland Critters*.
  - ⇒ *Managing Mosquitoes*.
  - ⇒ *Stormwater Treatment*.
  - ⇒ *Harvesting Our Stormwater*.
  - ⇒ *Monitoring Water Quality*.

3.28 During the inspection, the Committee heard about: the contribution of constructed wetlands to the sustainable use of natural resources; connectivity between ecosystems; and building resilience in ecosystems.

Issues explored in South Australia

3.29 As noted earlier, the Committee's inspections in South Australia included a focus on freshwater biodiversity and sustainable natural resource use, and the impacts of these on human communities. The Committee received extensive briefings on: the threats to the biodiversity of the CLLMM region and how resilience is being built into the region's ecosystems and associated human communities; natural resource management in a complex governance framework; and the benefits of constructed wetlands in an urban environment.

Threats to biodiversity in the CLLMM region

3.30 During its site inspection program, the Committee was informed that there had been record low river flows to the CLLMM region, particularly due to water management practices throughout the Murray–Darling Basin. The Committee heard that the levels of water extraction for human use throughout the basin had left insufficient water for the environment.

3.31 More recently, extended drought and the early impacts of climate change had added to the site's ecological stress. The drought had exacerbated the results of years of land clearing and intensive agricultural use in the region.

3.32 In addition, climate changes—particularly higher temperatures, less autumn and winter rainfall, and higher levels of atmospheric carbon dioxide potentially affecting the water consumption of plants—are expected to result in reduced run-off in the Murray–Darling Basin, leading to lower environmental flows in the CLLMM region.

3.33 Together, the existing threatening processes in the region have resulted in a range of biodiversity impacts, including habitat loss through the drying out of wetlands, competition from pest species, and exposure of acid sulfate soils. These were the focus of briefings the Committee received during site inspections in the region.

3.34 The Committee heard that falling lake levels and lack of flow over the barrages into the Coorong lagoon have resulted in reductions in vegetation, the disconnection and drying out of wetlands, reductions in threatened fish species numbers, and significant decreases in shorebird numbers.

3.35 The Committee inspected Dunn's Lagoon, which featured in news reports in 2009, when the wetland dried out completely. Water flow was restored in April 2010. In the interim, however, marine worms had moved into the area and colonised any available hard substrate. They encrusted the shells of eastern long-necked turtles, resulting in the death and injury of many turtles. The worms also moved into plumbing and water supply systems, blocking and damaging pipes and resulting in significant public infrastructure costs.

3.36 The Committee examined and received briefings on sulfuric soils in the region. Although such soils are a naturally occurring phenomenon, their exposure to oxygen can produce sulfuric acid, which can have detrimental effects on wetlands. When many parts of the CLLMM system dried out during the recent drought, acid sulfate soils were exposed to the air and there were concerns about the potentially devastating effect this could have on the region's biodiversity. Indeed, the Committee heard that, had the drought continued for another one or two summers, the entire region's ecosystems would have been on the verge of collapse.

Committee comment

3.37 The Committee notes the high biodiversity values of the CLLMM region. It appreciates there are challenges posed by periods of drought and the pressures from human water use requirements, and recognises the likelihood of climate change exacerbating existing threats to the region's biodiversity. As climate change introduces more uncertainty, effective

water management and biodiversity conservation policies will be essential for responding quickly to the region's needs.

3.38 Although river flows have increased in recent years, resulting in higher water levels reaching the CLLMM region, the Committee heard that many of the issues affecting the region remain. If these are not remedied or managed effectively, there could be serious and irreversible environmental impacts. It is likely that appropriate intervention and management will be even more pressing considerations in light of projected climate changes.

Enhancing the resilience of ecosystems

3.39 During its site inspections, the Committee heard about the complex hydrodynamics of the CLLMM system. The environmental management of the region is further complicated by the mosaic of ecosystems within and surrounding the region, including: mallee ecosystems; woodlands, including grassy and open woodlands; peat swamp forests; freshwater, estuarine, coastal, and marine ecosystems; and riverine ecosystems. The diverse range of ecosystem types necessitates distinct management plans for each segment of the system.

3.40 It was noted that there is very little ecological resilience in the CLLMM system, and that management strategies have therefore focused on increasing this resilience to prepare for fluctuating levels of water availability. The Committee heard about the South Australian Government's Coorong Lower Lakes Restoration Project, which also receives funding through the federal government's Water for the Future program. One of the goals of the restoration project is to enhance the resilience of the region through extensive, community-based revegetation programs. In 2012 the project will require 350 000 plants from 130 different local native species—including one nationally endangered.[12] As the Committee travelled around the region, it had the opportunity to see some of these revegetation sites.

3.41 The aims of the extensive revegetation program are to reduce evaporation and lower soil temperature, increase soil moisture, and remediate metals in the soil. The program also helps ensure there is adequate, connected habitat to act as refugia for local species during times of drought. Extensive planting programs increase the organic carbon inputs into the

12 This was an increase compared to previous years: 120 000 plants from approximately 15 species planted in 2010, and 240 000 plants from approximately 90 species planted in 2011.

system, encouraging the activity of sulfate-reducing bacteria, thereby reducing acidity.

3.42 The Committee was informed that the DEWNR also treated acid sulfate soils by applying limestone to neutralise some of the acidity. Engineering solutions, such as reinforcing barrages, also help prevent saltwater inundation, which would have profoundly negative effects on the ecosystems of the CLLMM region.

3.43 The Committee also heard about localised interventions, such as those employed when the creek at Wyndgate dried out and Murray hardyhead and Yarra pygmy perch fish species declined. These species were captured, bred, and released back into the repaired ecosystem. The Committee heard that these were locally endemic species—biodiversity that would have been lost, had intervention not occurred.

Committee comment

3.44 The Committee notes the complexities associated with environmental management in the CLLMM region, and commends the extensive efforts to increase the resilience of the system to future disturbances. The building of ecological resilience is a worthy goal, given that the region is subject to variations in weather and hydrological patterns, which are expected to be heightened by future climate change.

3.45 Examples of direct, urgent interventions to conserve biodiversity at particular sites highlighted the importance of natural resource managers being aware of the tipping points of species and ecosystems, and being prepared to act quickly when needed. The Committee understands that such awareness requires adequate resources for research and monitoring.

Community resilience through engagement and empowerment

3.46 The economic, social and cultural values in the CLLMM region depend on a healthy and functioning wetland environment. In addition to enhancing ecological resilience, as discussed above, the Committee heard about the importance of building the resilience of local human communities. In the CLLMM region, initiatives have improved communication and collaboration between government and the local community, built environmental management capacity, and encouraged citizen science.

3.47 As noted earlier, the Lakes Hubs at Milang and Meningie were established to enhance collaboration between government and community members on environmental restoration projects in the CLLMM region. The Committee heard that the activities of the Hubs were very important,

particularly at the height of the drought, because they allowed members of the local communities to be active participants in making decisions.

3.48 The Committee heard that there were some strong Landcare groups based in the region, and that the local community was very supportive of revegetation initiatives. The Lakes Hubs brought the communities and government agencies closer together and enhanced two-way communication, making use of the local community's expertise.

3.49 The Committee was advised that resilience was also built by increasing the community's capacity to engage in environmental management programs. The Community Advisory Panel (CAP) focuses on building the community's resilience to future drought episodes. Its membership is a broad range of 15 community leaders, who are involved in strategic level planning, disseminating information, and voicing community concerns. One of the outcomes of the CAP is to build community ownership of environmental programs so that communities carry on doing good work beyond the conclusion of government initiatives.

3.50 Programs carried out through the Lakes Hubs also helped create opportunities to improve the economy of the region, particularly through job creation and the provision of environmental management training. The native plant species used in the extensive revegetation programs discussed above are propagated and supplied by the Community Nurseries Network—a group of commercial nurseries in the CLLMM region. Local non-government organisations and community members have also been employed to deliver the revegetation programs. In addition, funds have been invested in conservation and land management training to increase natural resource management capacity in the region. Many of the students from these training courses have subsequently been employed by the Community Nurseries Network.

3.51 The Committee was informed that, in this region, the DEWNR had moved away from the traditionally volunteer-based, government-owned approach to natural resource management, and had instead redeployed many members of the community who had lost their jobs in the local viticulture and dairy industries as a result of environmental changes. These programs therefore delivered environmental benefits, while also stimulating and transforming the local economy, building resilience in the community, and ensuring local ownership of environmental programs.

3.52 The Committee heard briefly about a successful citizen science program run in the area, also through the Lakes Hubs. A program to monitor acid sulfate soils, overseen by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), provided the opportunity for

100 volunteers to be trained to collect soil samples over a period of time, from various sites in the region. The data were then fed back into the CSIRO's data collection for ongoing research.

Committee comment

3.53 The Committee commends the approach taken by the DEWNR in the CLLMM region, and notes the benefits of enhancing community resilience alongside ecological restoration. Evidence received from community members suggested that being part of the decision-making and implementation process had helped to empower the community.

3.54 The Committee considers the Lakes Hubs a model for a successful cooperative arrangement between government and the local community on issues of biodiversity conservation, delivering ecological outcomes while improving community resilience to future changes in the region.

Engaging Indigenous communities in biodiversity management

3.55 The CLLMM region and surrounding areas are the main homelands of the Ngarrindjeri people, and are central to the culture and spiritual beliefs of these Indigenous communities. Freshwater flows down the Murray-Darling system are seen as the lifeblood of the River Murray, Lower Lakes and Coorong, the health of which is linked to the wellbeing of the Ngarrindjeri people. The impacts of the drought were therefore significant for the Ngarrindjeri.

3.56 The Ngarrindjeri are committed to their country and have made significant efforts over the years to be part of managing the region's environment. During inspections, the Committee heard about the DEWNR's various environmental management programs, delivered in conjunction with the Ngarrindjeri community. Through engagement with the DEWNR, the Ngarrindjeri have had input into ecological decisions. Such decisions may include ensuring culturally appropriate plants are used in revegetation programs, for example, using plants that attract totemic animals or are used in cultural practices.

3.57 The Committee was briefed on the Ngarrindjeri Regional Authority's (NRA) governance arrangements, put in place in 2007 to bring together the community, voice the Ngarrindjeri's concerns, and more effectively engage and negotiate with other bodies. Cooperation between the NRA and State government is guided by a whole-of-government Kungun

Ngarrindjeri Yunnan Agreement (KNYA), made in 2009, which translates to 'listening to Ngarrindjeri people talking agreement'.[13]

3.58 The KNYA supports the full participation of the Ngarrindjeri in government-led environmental management projects in the region. It also sets out the rights and responsibilities of both parties to the agreement, and ensures that the Ngarrindjeri's cultural beliefs are considered in the formulation of government programs in the region.

3.59 The Committee heard about some of the complexities associated with intellectual property and copyright issues that came about during the negotiation of the KNYA. Cultural knowledge clauses in the agreement have built trust between the NRA and the government, and have given the Ngarrindjeri confidence that Indigenous knowledge shared with government is not used inappropriately.

3.60 One of the key outcomes of the KNYA has been the establishment of the Ngarrindjeri Partnerships Project by the DEWNR and NRA.[14] The project seeks to support participation in natural and cultural resource management in the CLLMM region, and pledges long-term funding for regional environmental programs in which the local Ngarrindjeri people will play a central role.

3.61 The Committee heard about a taskforce, established by the NRA and South Australian Government, to build core capacities in the Ngarrindjeri community through: training and skills development initiatives; increasing employment; and encouraging effective engagement with government planning processes on land and water management.

3.62 The NRA has established companies that employ members of the Ngarrindjeri community. Such enterprise structures have enabled the Ngarrindjeri to successfully tender for natural resource management contracts. In turn, engaging in these initiatives provides training, knowledge and experience to members of the community, and builds confidence in individuals to engage in paid employment outside these structures.

13 DEWNR and NRA, *KNYA taskforce report 2010–11*, Government of South Australia, 2012, p. 8.

14 DEWNR, 'Ngarrindjeri engagement', <http://www.environment.sa.gov.au/Conservation/Rivers_wetlands/Coorong_Lower_Lakes_Murray_Mouth/Ngarrindjeri_engagement> viewed 4 October 2012.

Committee comment

3.63 The Committee was pleased to hear about the benefits of incorporating Indigenous cultural considerations into environmental programs and policies. As advised by DEWNR officers, meeting cultural considerations will always satisfy environmental considerations as well, while an environmental approach alone will not necessarily fulfil cultural requirements.

3.64 The Committee commends the DEWNR for building a cultural heritage perspective into environmental programs, and for incorporating the expertise of Traditional Owners in formulating biodiversity management initiatives.

Governance arrangements

3.65 The complexity of governance arrangements across state borders and between various organisations was highlighted during the Committee's inspections of the CLLMM region. The Committee heard that the South Australian Government had developed a long-term plan for the region, incorporating input from community, scientists, industry, and other government stakeholders. The long-term plan is part of the $610 million Murray Futures program, funded by the Australian Government's Water for the Future strategy.[15] It aims to secure a future for the region as a productive and resilient wetland system of international importance, supporting the local economy and communities that depend on a healthy environment.[16]

3.66 However, the DEWNR's plans for the region do not exist in isolation. Commonwealth legislation, international agreements, the Murray–Darling Basin Plan, and activities upstream in other states present challenges for the governance framework supporting the environmental management of the CLLMM region.

3.67 Taking into account the unpredictable future climatic conditions and the complex governance framework, the South Australian Government's long-term plan for the region proposes an adaptive approach to

15 DEWNR, 'Lower Lakes and Coorong recovery plan', <http://www.environment.sa.gov.au/Conservation/Rivers_wetlands/Coorong_Lower_Lakes_Murray_Mouth/Lower_Lakes_Coorong_recovery_plan> viewed 4 October 2012.

16 DEH, *Securing the future: a long-term plan for the Coorong, Lower Lakes and Murray Mouth*, Government of South Australia, Adelaide, 2010.

management.[17] The aim is to develop strategies that can respond to changing conditions, as well as building ecological resilience into the region's ecosystems. It is intended that management strategies be informed by the best available science, and that the outcomes of interventions be closely monitored.

Committee comment

3.68 Noting the complexities involved with natural resource management in the CLLMM region, the Committee is pleased to note that there are plans in place to address the region's long-term needs. The South Australian Government's adoption of an adaptive approach to managing the ecosystems of the CLLMM region supports evidence the Committee has heard elsewhere: that such an approach to biodiversity management can deliver many benefits, particularly in the presence of uncertainty. The Committee considers that an adaptive approach may be relevant in many other parts of Australia, particularly as future climate scenarios introduce elements of uncertainty into the complex ecosystems being managed across the country.

Benefits of constructed wetlands in an urban environment

3.69 As noted earlier, the City of Salisbury's Greenfields Wetlands project is one of over 50 constructed wetlands within the local government area. During its inspection, the Committee heard about the relevance of the wetlands to key inquiry considerations, such as the sustainable use of resources, connectivity between ecosystems, and promoting resilience in ecosystems.

3.70 The Greenfields Wetlands are located approximately one kilometre inland from the sea, on a site that previously consisted of hypersaline soils. The area is slightly below high tide level, which has historically made residential and industrial development in the area problematic. Overdrawing from aquifers in the area had also resulted in depleted reserves, risking saltwater intrusion into aquifers.

17 DEH, *Securing the future: a long-term plan for the Coorong, Lower Lakes and Murray Mouth*, Government of South Australia, Adelaide, 2010.

Figure 3.3 Part of the Greenfields Wetlands, City of Salisbury

Photograph courtesy of committee secretariat

3.71 Constructed wetlands are a significant part of the City's stormwater recycling program. Urban stormwater run-off is treated in constructed wetlands through a range of natural processes, including the filtering of larger particles by riparian vegetation, aquatic plants and animals absorbing nutrients and organic matter, the effect of sunlight and oxygen on bacteria, and suspended clay particles settling on the bottom of the wetland. The Committee heard that horizontal flow wetlands such as the Greenfields Wetlands are able to remove approximately 90 per cent of pollutants and nutrients within a 24 hour period.

3.72 Treated stormwater is then either distributed throughout the City, mainly to government and industry consumers for irrigation and non-potable commercial use, or stored in depleted underground aquifers during the wet season for later use during the dry season.

3.73 The Committee was informed that one of the benefits of this system of wetlands is the reduced demand on the River Murray and Mount Lofty Ranges catchments. Wetlands also contribute to the City's water sensitive urban design, and deliver flood-mitigation services to local developments.

3.74 The Committee's inspections highlighted the degree of connectivity between terrestrial environments of the surrounding city, the freshwater

ecosystems of the wetlands, and the nearby estuarine and marine ecosystems. In the past, untreated stormwater entering the Gulf St Vincent had resulted in large meadows of seagrass dying off. These seagrass meadows had provided habitat for important marine species and helped buffer the shoreline from tidal activity.

3.75 Despite efforts to capture and re-use stormwater, most stormwater run-off is still discharged into the Gulf St Vincent. To avoid damage to the nearby marine ecosystem and important fish breeding habitats, the City of Salisbury has therefore adopted a policy to clean all stormwater run-off before it is released into the Barker Inlet, an estuary of the Gulf St Vincent. The City's key strategy in this regard is the use of wetlands to clean stormwater before it is released into the Barker Inlet.

3.76 The inspections of the Greenfields Wetlands also underscored the importance of constructed wetlands for increasing ecological resilience through the provision of habitats for native plant and animal species. The Committee heard about the many biodiversity benefits delivered by the wetlands, and the careful planning that went into their design. For example, the inclusion of 'beaches' and hollow logs into the design of the wetlands has created habitats for a range of bird populations. The City's wetlands provide habitat for many animal species, including numerous frog species, and aquatic macroinvertebrates such as insects, crustaceans and worms.

Committee comment

3.77 Having inspected the CLLMM region the previous day, and having heard about the stresses on the Murray–Darling system and the resultant adverse impacts on the local environment and community, the Committee was mindful of the need for sustainable water use and biodiversity conservation practices, particularly in the context of a changing climate. During its inspection of the Greenfields Wetlands, the Committee was pleased to hear about how urban stormwater—traditionally regarded as a problem—can be managed and harnessed through constructed wetlands. The Committee notes that such wetlands can contribute to the sustainable use of water resources, enhance urban design, deliver biodiversity benefits, and through the provision of recreational areas, help engage the community on issues of biodiversity conservation.

3.78 The Committee notes that, since the time of its visit to South Australia, the federal government has announced its support for other sustainable

stormwater harvesting and re-use projects around the country.[18] The Committee commends programs that seek to use natural resources in a sustainable manner while supporting positive biodiversity outcomes.

Concluding remarks

3.79 The Committee's site inspections in South Australia focused on freshwater biodiversity and underlined the impacts of biodiversity loss on human populations. The inspections also provided a worthwhile opportunity to witness the benefits of communication, consultation and cooperation between governments and local communities, engaging the public on issues of biodiversity conservation, and utilising local expertise and insights. The Committee benefited from seeing firsthand projects that provide simultaneously for the sustainable use of natural resources and biodiversity conservation outcomes.

3.80 The Committee wishes to record its thanks to all the individuals it met with during its site inspections in South Australia. The Committee extends its appreciation to the South Australian Department of Environment, Water and Natural Resources for its assistance, and in particular to Mr Russell Seaman for facilitating the Committee's visit and for his extensive briefings throughout the site inspections in the CLLMM region. The Committee also expresses its appreciation to Mr Colin Pitman from the City of Salisbury for providing briefings and assisting with the Committee's inspection of the Greenfields Wetlands.

18 Senator the Hon. Don Farrell (Parliamentary Secretary for Sustainability and Urban Water) and Mr Nick Champion MP (Member for Wakefield), *$42.5 million for stormwater and reuse projects*, media release, Parliament House, Canberra, 8 August 2012.