

Environment Protection Authority

Adelaide Coastal Water Quality Improvement Plan (ACWQIP)



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Adelaide Coastal Water Quality Improvement Plan (ACWQIP)

A plan that covers the issues, challenges and a way forward for water quality improvement for Adelaide's coastal waters

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Acknowledgments: We are grateful for the valuable input provided by individuals from the following groups to develop the ACWQIP: Adelaide Coastal Waters Steering Group members, Eco Management Services Pty Ltd and Strategic Matters; and Environment Protection Authority staff, particularly those in the Water Quality Branch and the extra efforts of Sam Gaylard, Shiloh Gerrity, Darren Green, Stephen Packer, Andrew Solomon, Trixie Tan, Amanda Gaetjens and Ruth Ward in final completion and editing of the documents.

Some of the materials in this report are drawn from project work completed through Arup Pty Ltd undertaken by Eco Management Services Pty Ltd and Strategic Matters.

Cover pictures – *Posidonia sinuosa* with fruits, photo provided with permission of Simon Bryars

Funding and resources for this project were provided by the Australian Government.

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ISBN 978-1-921495-17-5

July 2013

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Abbreviations

ABS	Australian Bureau of Statistics
ACWQIP	Adelaide Coastal Water Quality Improvement Plan
ACWS	Adelaide Coastal Waters Study
AMLR	Adelaide and Mount Lofty Ranges
AMLR NRM Board	Adelaide and Mount Lofty Ranges Natural Resources Management Board
ANZECC	Australian and New Zealand Environment and Conservation Council
CDOM	coloured dissolved organic matter
COAG	Council of Australian Governments
CPB	Coast Protection Board
Cu	copper
DEH	Department for Environment and Heritage (up to 30 June 2010)
DENR	Department of Environment and Natural Resources (from 1 July 2010 to 30 June 2012)
DEWNR	Department of Environment, Water and Natural Resources (from 1 July 2012)
DFW	Department for Water
DH	Department of Health
DPLG	Department for Planning and Local Government
DPTI	Department for Planning, Transport and Infrastructure
EIP	environment improvement program
EP Act	Environment Protection Act 1993
EPA	South Australian Environment Protection Authority
EV	environmental value
EWR	environmental water requirement
EWP	environmental water provision
ICLEI	International Council for Local Environmental Initiatives
ISQG	interim sediment quality guidelines

LGA	Local Government Association
MAT	management action target
MBI	market based instrument
MERF	monitoring, evaluation and reporting framework
MOSS	Metropolitan Open Space Strategy
NRM	natural resources management
NTU	nephelometric turbidity units
NWQMS	National Water Quality Management Strategy
OWS	Office for Water Security
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PIRSA	Department of Primary Industries and Regions South Australia
PCB	polychlorinated biphenyl
PEHMP	Public and Environmental Health Management Plan
PWWQIP	Port Waterways Water Quality Improvement Plan
SEWPaC	(Australian Government) Department of Sustainability, Environment, Water, Population and Communities
SMA	Stormwater Management Authority
SoE Reporting	State of Environment Reporting
TBT	tributyltin
TPH	total petroleum hydrocarbon
WQ Policy	Environment Protection (Water Quality) Policy 2003
WPA	Water Proofing Adelaide
WQIP	water quality improvement plan
WQO	water quality objective
WSUD	water sensitive urban design
WWTP	wastewater treatment plant
Zn	Zinc

Glossary

catchment to coast	Provides a framework for understanding the land to coastal connection as a whole, including the transportation of material (by flowing surface water) that is ultimately deposited at the coast.
chlorophyll	A green pigment found in most plants.
coloured dissolved organic matter (CDOM)	When plant material (eg leaves, grasses) decays, organic materials such as tannins are released and they dissolve in water, giving it a green, yellow-green or brown colour.
dissolved oxygen	Dissolved oxygen is a measure of the amount of gaseous oxygen dissolved in water.
ecosystem services	Natural assets such as water, plants, sediments, air and animals that are of value to humans for the ecological services they provide that have an environmental, social and or economic benefit.
environmental flows	The amount of water needed in a watercourse to maintain healthy aquatic ecosystems.
environmental value (EV)	<p>Anything a community agrees a body of water should be protected for. This might include ecosystems, industry, agriculture, recreation and/or spiritual and cultural recognition.</p> <p>EVs help prioritise the uses for a local body of water and how it should be protected. They are set following consultation with the community and are a concise way of describing the things that are important for specific bodies of water.</p>
environmental water provisions (EWP)	The water conditions that are provided as a result of the water allocation decision-making process, taking into account ecological, social and economic impacts. They aim to meet in part or in full, the environmental water requirements.
environmental water requirement (EWR)	Also called ecological water requirements. A description of the water regimes needed to maintain ecological values of water dependent ecosystems at a low level of risk.
estuary	The body of water where water from the land, rivers, creeks and streams mixes with seawater.
faecal micro-organisms	Bacteria which are found in the intestinal tracts of mammals.
inshore/nearshore	Adelaide's coastal waters from the shore to a depth of five metres.
metals	Elements such as iron, manganese, copper, lead and zinc which occur naturally as part of the earth's crust. Through many industrial activities metals can become concentrated and end up in the coastal environment through stormwater, wastewater or industrial discharges.
natural cycles	The seasonal and climatic cyclic conditions that may occur with changes in environmental quality that occur over spring, summer, autumn and winter or from periods of drought to wetter periods that may occur on a 2–5 year pattern over 10–20 year timeframes. These are not part of longer-term trends in changing climatic conditions that develop over a number of decades or hundreds of years.
neap tide	A neap tide occurs when the difference between high tide and low tide is the least, resulting in the smallest rise and fall in tidal level. Neap tides come twice a month in the first and third quarters of the moon when the sun, moon and earth form a right angle and the gravitational pull of the sun counteracts the pull of the moon.
nutrients	Chemicals (particularly nitrogen and ammonia) which have a negative impact on water quality when present in large amounts.
offshore	Adelaide's coastal waters from five metres depth to the centre of Gulf St Vincent.
subtidal	The marine zone which remains submerged at low tide.
suspended solids/particulate matter	The small particles (eg sediments) contained in water which are small enough not to fall to the sea floor.
toxics	These are poisons and can include metals, pesticides and other man-made chemicals.
turbidity	A measure of how light is scattered through a water body, measured by assessing how much light travels through the water (ie how cloudy or murky the water is).
water quality objectives	Measurable targets to protect environmental values and therefore, water quality. They include physical measures (eg turbidity), chemical measures (eg salinity) and/or biological measures (eg bacteria).

Community agreed vision:

Healthy aquatic ecosystems where environmental, social and economic values are considered in equal and high regard in a balanced management approach that aims to see the return of the 'blue line of seagrass' closer to shore by 2050.

Executive summary

Adelaide's coast is an iconic feature of the western boundary of the City of Adelaide and is highly valued by South Australians for its natural and cultural features that are of scenic, cultural, economic, ecological and recreational importance.

Adelaide's coastal communities call for 'Healthy aquatic ecosystems where environmental, social and economic values are considered in equal and high regard in a balanced management approach that aims to see the return of the 'blue line of seagrass'¹ closer to shore by 2050.' (Community vision for the ACWQIP)

The ACWQIP presents a vehicle to realise this exciting vision and implement strategies for the management of a healthy coastal system.

The issues of poor water quality, loss of seagrass, declining reef health and sediment instability were noticed by the Adelaide community, environmental managers and researchers as early as 60 years ago. Now the Adelaide Coastal Water Quality Improvement Plan (ACWQIP) provides a long-term strategy that is consistent with community expectations to achieve and sustain water quality improvement for Adelaide's coastal waters and create conditions to see the return of seagrass along the Adelaide coastline. Developed by the South Australian Environment Protection Authority (EPA) in partnership with key stakeholders and the community, the strategies and actions within the ACWQIP present a path forward that aligns with community agreed values for water quality improvements to Adelaide's coastal waters over the next 20 to 40 years.

The impetus for the Plan has been the decline in health of seagrass beds and reefs off the Adelaide coastline and change in quality of water caused by an increase in nutrients (primarily nitrogen), suspended solids (or sediments) and coloured dissolved organic matter (CDOM) from discharges to the coast. Over time, industrial discharges, waste water treatment plants and stormwater have promoted the growth of epiphytes and reduced light levels for seagrass which destroys the ecosystems and alters the integral structure of the coastal waters and habitats.

Central to the Plan is the 'value' of the coast, coastal waters and seagrass meadows for the ecosystem services they provide and the concept of the 'catchment to coast connection' (refer to [Figure 1](#)) where activities occurring on the land impact on coastal water quality and the coastal environment. The coastal waters and coastline have an important economic value for South Australia's tourism, commercial activity, fishing, land values and coastal and marine-based recreation. The area also encompasses social and environmental values including a high aesthetic and scenic value, a carbon storage value associated with the seagrass beds and a high ecological value borne from the estuarine and marine systems that form part of the broader bio-region of Gulf St Vincent. The coastline and the coastal waters of Adelaide have cultural and spiritual connections for both Aboriginal and non-Aboriginal peoples.

Extending the length of the Adelaide metropolitan coast, the ACWQIP project area covers an approximate 70-km stretch of coastline from Port Gawler in the north, to Sellicks Beach in the south, including the catchments that drain into these waters (refer to [Figure 1](#)). Geographically the coast and coastline holds spiritual and cultural significance for the traditional owners. The study area is home of the *Kaurna* and *Ramindjeri* Aboriginal peoples.

The management zone of the ACWQIP encompasses the shore to a few kilometres offshore, rather than the 20 km offshore that is identified in the Adelaide Coastal Waters Study (ACWS) [Fox *et al* 2007]. The ACWQIP divides the study area into four management areas: Northern coastal waters, Port waterways, Metropolitan coastal waters and Southern coastal waters.

¹ The blue line of seagrass refers to the observable colour of the ocean against the darker area of the seagrass.

The ACWQIP draws heavily from the accepted scientific findings of the ACWS (Fox *et al* 2007). The study established that nitrogen and sediment inputs from discharges from wastewater treatment plants, Penrice Soda Products discharge to the Port River and stormwater and catchments were the main contributors to issues impacting on Adelaide's coastal water quality and seagrass health. Care has been taken to ensure that the ACWQIP also aligns well with major relevant national and state plans, and contemporary reports being prepared by the EPA.

Extending over a five-year period, consultation, communication and engagement with stakeholders have been central to the development of the ACWQIP. Consultation with agency, scientific and community 'experts' (including traditional landowners) has deliberately encouraged community engagement in the decision-making process to increase the 'ownership' of the project outcomes. Significantly, the consultation resulted in a community-owned vision for Adelaide's coastal waters that guides the ACWQIP.

The ACWQIP is a facilitating document that provides a common vision and expects input from all partners to achieve successful outcomes. Through consultation, the ACWQIP has established community agreed environmental values (EVs²) and a range of water quality objectives (WQOs³) that inform management strategies and provide a structure against which to benchmark and monitor changes in the coastal waters.

The ACWQIP embraces the notion of ecosystem services, advocates the application of water sensitive urban design (WSUD) and promotes the catchment to coast philosophy. These initiatives combined advocate that activities occurring on the land impact on the coastal waters, and require appropriate management.

The ACWQIP culminates in eight strategies, as presented in [Table 1](#), which complement and encompass the 14 recommendations in the ACWS. The ACWQIP strategies connect with a series of detailed actions, designed to sustain and reinvigorate the beaches, coastal waters, seagrass and reef systems of Adelaide (refer to section 8.3, [Table 19](#)).

Table 1: Strategies for improvement in water quality and recovery of seagrass for Adelaide coastal waters

Strategy No. 1	Reduce nutrient, sediment and coloured dissolved organic matter (CDOM) discharges
Strategy No. 2	Promote integrated use of wastewater and stormwater across Adelaide
Strategy No. 3	Further investigate sources and volumes of sediment and CDOM
Strategy No. 4	Integrate monitoring for cumulative impact assessment across the Adelaide region
Strategy No. 5	Model and evaluate the impacts of climate change, new human impacts and population growth implications for Adelaide's coastal waters
Strategy No. 6	Establish planning and funding priorities for water initiatives for Adelaide's coastal waters
Strategy No. 7	Undertake seagrass mapping and rehabilitation work
Strategy No. 8	Build community capacity to take action to improve coastal water quality

The ACWQIP promotes the highest level of protection for each of the sections of Adelaide's coastal waters. This includes a reduction in nitrogen loads to around 600 tonnes per year, a reduction in sediment loads of 50% from 2003 levels and that steps should be taken to reduce the amount of coloured dissolved organic matter (CDOM) in waters discharged by rivers, creeks and stormwater drains.

The ACWQIP provides a high degree of certainty that the total targets provided by the ACWQIP are acceptable targets upon which to plan pollution reduction strategies in Adelaide's coastal waters.

² An EV is anything a community agrees a body of water should be protected for.

³ A WQO is a measurable target developed to protect the environmental value(s) and consequently, water quality.

Importantly, the ACWQIP provides a framework of sustainable targets for the Adelaide coast, against which the community can judge progress and against which regulatory agencies such as the EPA can assess improvement in performance of dischargers.

The ACWQIP contains 11 sections including:

- stakeholder and community input
- links with other plans
- water quality and ecosystem condition
- estuarine environmental flows
- current partner commitments and actions
- ACWQIP vision, environmental values (EVs) and water quality objectives (WQOs)
- strategies and implementation.

The information in the ACWQIP is currently the best available and to ensure success, suitable management tools need to be agreed on and implemented across government. The ACWQIP will be implemented adaptively so that as more is learnt about the coastal system, strategies and actions will be reassessed and further refinement of solutions can occur.

It is important to note that ACWQIP is only the first step in achieving water quality objectives for Adelaide's coastline and coastal waters, but it is an exciting step and it is achievable.

The ACWQIP is an invitation for all South Australians to care for their coast. As stated in the words of the Traditional Owners:

Healthy lands, sea and waterways equate to healthy people.

1 Introduction

The Adelaide Coastal Water Quality Improvement Plan (ACWQIP) is a facilitating document that provides a common vision for the coastal waters of Adelaide. The Plan advocates that Adelaide's coast and marine environment be managed as part of a larger integrated catchment system.

Central to the ACWQIP are the environmental values (EVs) and corresponding water quality objectives (WQOs) that strategically link to other scientific findings in the study area, including the Adelaide Coastal Water Study (ACWS).

1.1 Catchment to coast focus

The South Australian Environment Authority (EPA) is a lead agency in monitoring coastal, estuarine and marine water quality off the Adelaide coastline and for Gulf St Vincent. Although many agencies also have various roles relating to management and conservation of coast, estuarine and marine environments in South Australia and the Adelaide region, the EPA has a key role in ensuring water quality of this area is 'fit for purpose'. This role of regulating and influencing for good water quality is why the EPA has developed the ACWQIP in consultation with key stakeholders and the community to improve Adelaide's coastal water quality.

Underpinning the ACWQIP is the notion of 'catchment to coast' that acknowledges activities occurring on the land impact on our coastal waters and need to be appropriately managed. This means that if the 'catchment' (the foothills and the Adelaide Plains) is managed well, the urban and coastal environment benefit.

This 'catchment' approach is consistent with the final recommendation of the Adelaide Coastal Waters Study (ACWS):

Adelaide's coastal marine environment must be managed as a component of a system that integrates catchment management, urban and rural land use, demographics, urban and industrial development, climate change/climate variability and water use.

The catchment to coast system is illustrated in [Figure 1](#).

Due to the north–south tidal regime and littoral process in operation along the Adelaide coastline there is limited offshore movement of suspended solid loads from major land-based discharges, rivers and creeks. This means that suspended sediments and nutrients do not readily move offshore but stay in the nearshore zone moving backwards and forwards along the coast for some time before they are dispersed. If polluted stormwater enters the nearshore zone it is influenced by the coastal processes operating along the coastline. This causes coloured and turbid water to remain in the nearshore zone, resulting in reduced light availability for seagrass. These processes are also illustrated in [Figure 1](#).

1.2 Current condition

The coastal waters of South Australia including metropolitan Adelaide's coastal waters ([Figure 2](#)) were, prior to European settlement, naturally low in nutrients and relatively clear with low turbidity levels. Over many thousands of years the plants and animals in a variety of estuarine and marine habitats had adapted to these ecosystem conditions and developed unique coast and marine systems suited to the environmental conditions of southern Australia. Adelaide's coastal waters are part of the Gulf St Vincent bio-region which has significant areas of seagrass (Bryars *et al* 2008) and reef habitat (Turner and Collins 2008) unique to southern Australia.

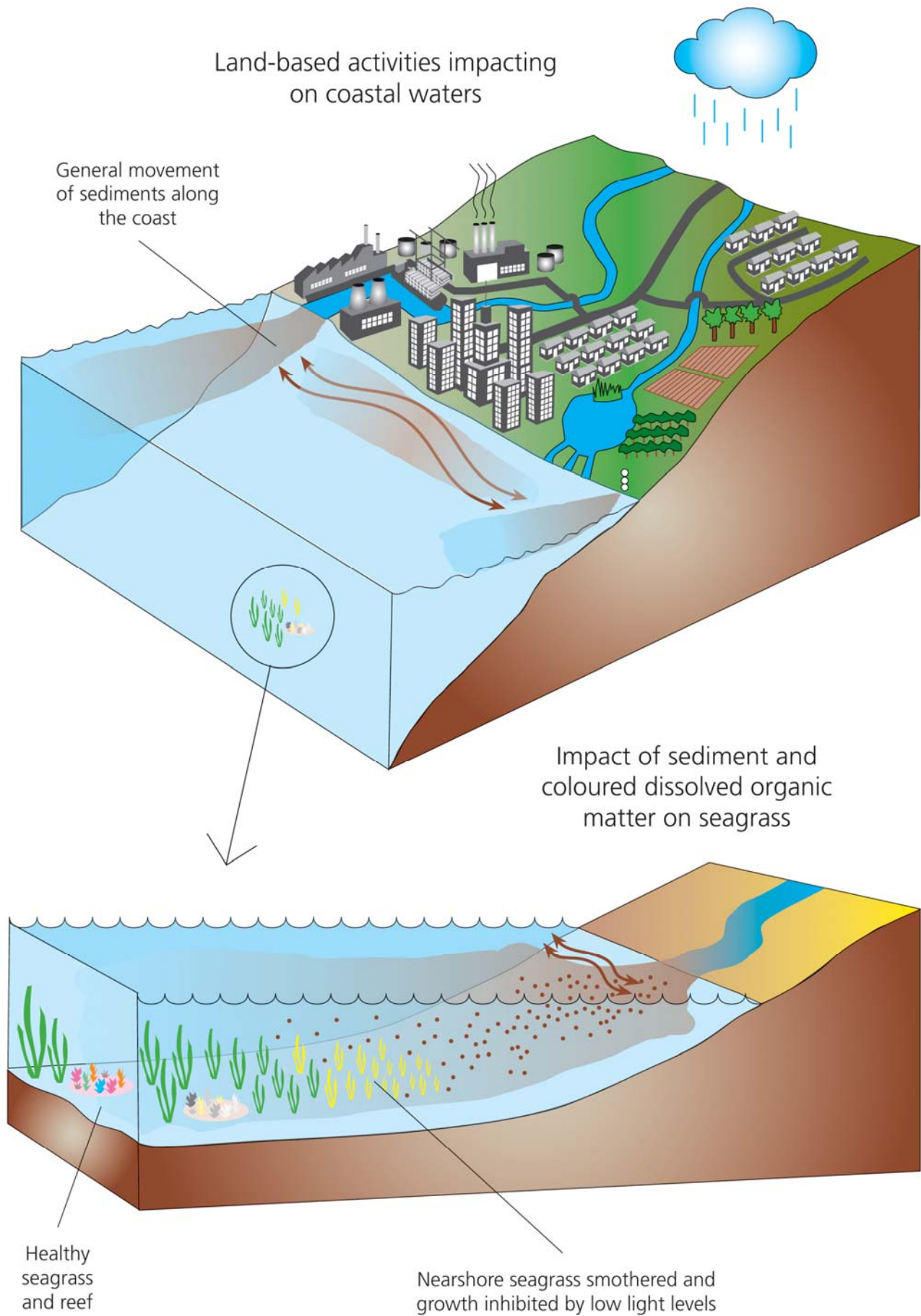


Figure 1: Catchment to coast diagram for Adelaide region showing impacts on the nearshore

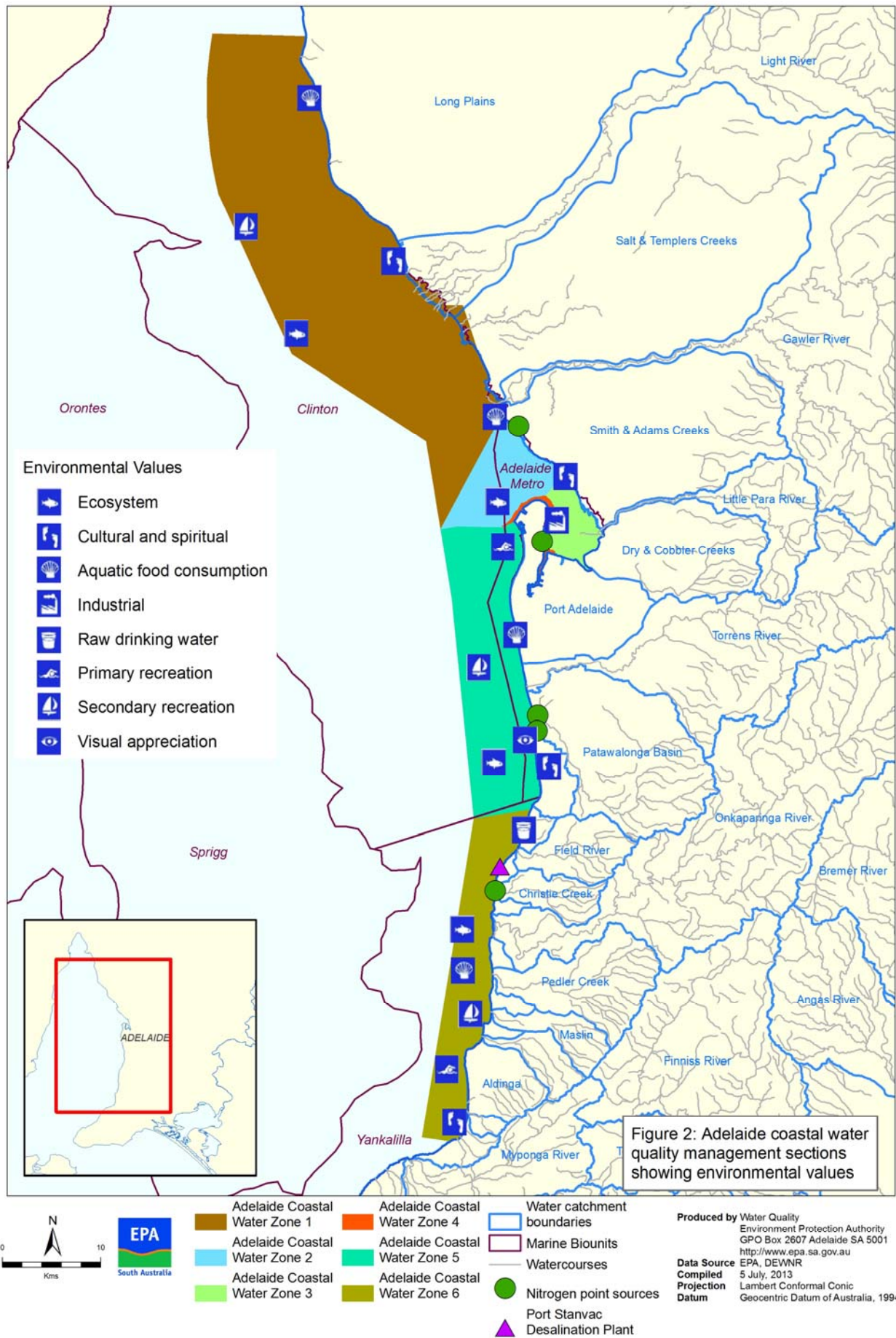


Figure 2: Adelaide coastal water quality management sections showing environmental values

Seagrass loss and declining reef health are indicators of poor ecosystem condition. The seagrass beds (Fox *et al* 2007) and reefs (Gaylard 2003) off the Adelaide coastline have been in a state of poor health for many decades. The problems of poor water quality, loss of seagrass, declining reef health and sediment instability were noticed by the Adelaide community, environmental managers and researchers over the last 60 years. Considerable knowledge now exists regarding the reasons for seagrass loss and declining reef health and what broadscale action should be taken as a result of the findings of the ACWS and other more recent research undertaken by a number of organisations in the early 2000s.

Water from the following waterways enters the Adelaide coastal waters ([Figure 2](#)) Northern Adelaide and Barossa creeks and rivers, Port River, River Torrens, Patawalonga River, Field River, Christies Creek, Onkaparinga River and the southern coastal catchments in the Aldinga area. Discharge from sediment and suspended material can result in the loss of seagrass. Visually this moves the blue line of seagrass further offshore.

The impacts of high loads of nutrients and sediments discharged to the coast from industrial discharges, wastewater treatment plants (WWTPs) and stormwater have promoted the growth of epiphytes and reduced light levels for seagrass. This has led to the loss of over 5,000 hectares of seagrass off the Adelaide coastline prior to the commencement of the ACWS research in 2001. Reef health has also been adversely impacted by elevated levels of nutrients and sediments. Increased nutrient levels result in greater macroalgal growth that smothers the reef systems. Increased loads of sediment are also known to affect reef systems.

The ACWQIP recognises that the significant infrastructure changes across the Adelaide plains have impacted on catchment flows since European settlement. The Plan advocates changes in the flow regimes of urban catchments; namely advocating that they revert to flow patterns similar to those before European settlement in order to enhance receiving waters.

In providing an assessment of water quality condition for Adelaide's coastal waters, the ACWQIP presents information on the condition of the main habitat areas alongside traditional physical and chemical water quality information. This reinforces the updated EPA approach of reporting water quality information as part of ecosystem condition assessment for both the newly developed Aquatic Ecosystem Condition Reports (AECRs) for marine waters (EPA 2013a) and the preparation of information for the State of Environment Report 2013 (EPA 2013b in prep).

1.3 ACWQIP aim

Findings of the ACWS combined with the work of the ACWQIP present the SA community with a challenge and an opportunity, to re-create a healthy coast and coastline. The document contains eight key strategies that focus on reductions in nutrient and sediment loads. The ACWQIP strategies connect with a series of detailed actions, designed to sustain and reinvigorate the beaches, coastal waters, seagrass and reef systems of Adelaide.

The ACWQIP promotes the highest level of protection for each of the sections of Adelaide's coastal waters. More specifically, the ACWS indicates that a reduction in nitrogen loads to around 600 tonnes per year is needed to halt current seagrass loss and create the conditions which support seagrass recovery. Further to this, the ACWQIP recommends a reduction in sediment loads of 50% from 2003 levels to allow sufficient light levels for seagrass to grow. It is also recommended that steps should be taken to reduce the amount of coloured dissolved organic matter (CDOM) in waters discharged by rivers, creeks and stormwater drains.

Importantly, the ACWQIP provides a framework of sustainable targets for the Adelaide coast, against which the community can judge progress and against which regulatory agencies such as the EPA can assess improvement in performance of dischargers. Based on research findings from the ACWS and experience in other parts of the world, studies have indicated that if nutrient and sediment loads can be reduced then water quality will improve which will assist in creating the conditions for the recovery of seagrass and reef systems.

The ACWQIP promotes a high degree of confidence in the ability to reduce nitrogen loads over the medium and longer terms. Such reductions will promote water quality conditions where seagrass can be protected and lost areas of seagrass may recover. The outlook for suspended solids and other stormwater sourced inputs is less clear. While improvements in these may take longer, initial work is likely to lead to improved amenity of Adelaide's coastal waters.

The ACWQIP utilises the term 'ecosystem services'; the concept that a set of natural assets such as water, plants, sediments, air and animals are of value to humans for the ecological services they provide that have an environmental, social and/or economic benefit.

The ACWQIP adopts a holistic approach to coastal management for the whole Adelaide coastline. It advocates the application of water sensitive urban design (WSUD) to reduce stormwater flows and sediment inputs to the coast from greenfield sites, infill development sites and the replacement of urban infrastructure. The ACWQIP promotes the catchment to coast philosophy which acknowledges that activities occurring on the land impact on our coastal waters and need to be appropriately managed.

1.4 Development of the ACWQIP

Much of the ACWQIP draws findings from the ACWS which was a large-scale scientific study undertaken from 2001 to 2007 for Adelaide's coastal waters investigating seagrass loss, declines in water quality and sea floor instability. It included the production of 20 technical reports and a final report containing 14 recommendations released in February 2008 (Fox *et al* 2007).

Building on the ACWS findings (which established that nitrogen and sediment inputs were the main contributors to issues impacting on Adelaide's coastal water quality and seagrass health), the ACWQIP targets reductions in nitrogen and sediment loads to coastal waters.

The ACWQIP has been developed in a manner consistent with the National Water Quality Management Strategy (NWQMS)—a system that has been used with success to resolve difficult water quality management issues across Australia. The NWQMS is endorsed in South Australia through the *Environment Protection (Water Quality) Policy 2003* (WQ Policy) under the *Environment Protection Act 1993* (EP Act) and links to work being undertaken in the area of water quality improvement in regional natural resources management (NRM) plans.

The ACWQIP applies information from contemporary reports being prepared by the EPA and links strategically with many state Government agendas, including South Australia's Strategic Plan 2011. The timeframes for implementation of the ACWQIP are compatible with the Water for Good (Office of Water Security 2009) focus to 2050 and the 30-Year Plan for Greater Adelaide (DPLG 2010) that extends to the year 2030.

The ACWQIP provides information about sections of the Adelaide coastal waters and Port waterways. The management sections ([Figure 2](#)) divide the study area into four management areas: Northern coastal waters, Port waterways, Metropolitan coastal waters and Southern coastal waters. These sections are mentioned further in the ACWQIP, particularly in Chapter 4.

The decline in Adelaide's coastal waters has taken place over many years with many actions, often well-intentioned by different individuals playing their part. In recent years steps have been taken to reverse this trend and much has been done of which the community can be proud. Within this context, the recovery of Adelaide's degraded seagrass areas and reef environments is likely to take decades, so both short to medium-term and longer-term strategies for water quality and ecosystem improvement are needed. Further to this, it is likely that there will be a time lag between effort and result for which patience, enthusiasm and persistence, especially at a community level, will be required.









1.5 Environmental values and water quality objectives

An environmental value (EV) is anything a body of water should be protected for as agreed by the community. This may include an ecosystem, industry, agriculture, recreation and areas of spiritual and cultural importance. Development of the EVs entailed the community identifying uses of the Adelaide coastal waters that were important to them and that required specific water quality conditions (eg primary recreational uses such as swimming must have suitable water quality to maintain public health).

The ACWQIP EVs were first identified through the 2007 community workshops undertaken as part of the development of the ACWQIP and confirmed through targeted workshops in 2008. The EVs were reviewed in discussions with Steering Group members in 2009 and then commented on by community groups, individuals, business and government agencies and local government in the public comment consultation during spring 2011.

The EVs were developed in conjunction with the vision for Adelaide's coastline and coastal waters. Over the life of the consultation the focus of the vision remained consistent. There was only minor change following public comment in spring 2011. The following are the confirmed EVs for Adelaide's coastal waters:

Table 2: Eight environmental values of the ACWQIP

 Aquatic ecosystems (protection of)	 Cultural and spiritual
 Visual appreciation	 Human consumption (aquatic foods)
 Primary recreation (eg swimming and snorkelling)	 Drinking water supply–desalination
 Secondary recreation (eg fishing and boating)	 Industrial use

Given the high level of community input to the development of the EVs, the EPA will also use the EVs to guide the management of authorisations for discharges that may affect Adelaide's coastal water quality under the EP Act. Further to this, the EPA will seek to have the EVs added to Schedule 1 of the *Environment Protection (Water Quality) Policy 2003*.

A water quality objective (WQO) is a measurable target designed to protect EVs and therefore, water quality. They include physical measures (eg turbidity), chemical measures (eg salinity) and/or biological measures (eg bacteria).

During the development of the ACWQIP, WQOs were set for Adelaide's coastal waters. They establish a guideline for water quality (eg turbidity level and level of nutrients) that assists in achieving the EVs. They also provide general advice about coastal water quality for monitoring and for comparative purposes for the management of discharges.

The details of the EVs and WQOs specific to each management section of Adelaide's coastal waters are discussed in Chapter 4 on water quality and the full details of the WQOs are presented in [Appendix 1](#).

1.6 Value of partnerships

The behavioural, policy and onground changes required to return the Adelaide coastline and coast to a healthy environment are achievable. Underpinning the success of the ACWQIP is the need for dynamic, informed and 'can-do' partnerships. It is envisaged that these will cover the full range of stakeholders as everyone has a role to play. The ACWQIP provides strategies that demonstrate how the South Australian community, including government agencies and industry, can work together to achieve and sustain a quality coastal ecosystem that is close to our city.

The quality and condition of the Adelaide coast and marine environment has relevance to all South Australians—whether for aesthetic and cultural values, recreational use, valuing the ecology and its ecosystem services, or for economic incentives, including coastal protection and other associated commercial and economic activities that occur at the coast. It is only through developing and maintaining partnerships that the implementation of the ACWQIP will achieve the strategies presented in this document.

1.7 Project process

Spanning over six years, the development of the ACWQIP involved a range of tasks including research, consultation, analysis, modelling and the development of strategies. The process adopted a 'planning cycle approach' that was conceptually consistent with the approach promoted in the State NRM Plan for regional NRM planning (refer to section 3.6 for more information).

The ACWQIP applies the precautionary principle. This means that a lack of knowledge will not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage. Instead the focus will be on applying the best practice available at any point in time. The ACWQIP is operating within an adaptive management framework that asserts that as new information and knowledge becomes available and monitoring results are known, management approaches can be reviewed and adapted accordingly.

The ACWQIP recognises that to date, management of Adelaide's coastline and coastal waters has been occurring largely on a piecemeal basis. Within this context, the ACWQIP adopts and promotes a holistic approach of catchment to coast management that is also in line with community expectations and the final recommendations of the ACWS (Fox *et al* 2007).

The ACWQIP involved the following eight core tasks.

Table 3: Eight core tasks of the ACWQIP undertaken from 2007–12

1	•Desktop Research
2	•Consultation Part A: Initial consultation to develop EVs
3	•Review of ACWS Findings and Scientific Analysis
4	•Consultation Part B: Stakeholder and community consultation to develop strategies
5	•Research and Modelling
6	•Development of Strategies, Targets and Actions
7	•Development of Monitoring Plan
8	•Consultation Part C: Period for public comment

Stated in more detail, the ACWQIP undertook the following:

- 1 *Desktop Research*: the findings of the ACWS were reviewed and where appropriate utilised.
- 2 *Consultation Part A*: the views of the Adelaide community were sought, to obtain community aspirations for the coast and develop draft EVs. These were developed by identifying those uses of the coastal waters that are important to the community and require specific water quality conditions.
- 3 *Review of ACWS Findings and Scientific Analysis*: the community agreed EV information was compared with water quality standards to develop a working paper, *Environmental Values, Water Quality Objectives, Pollution Reduction Targets and Environmental Flows* which was then referred to experts for review.
- 4 *Consultation Part B*: a process of stakeholder consultation and research was then undertaken to identify the long-term targets for water quality improvement for Adelaide's coastal waters and identify actions required to achieve the set targets.
- 5 *Research and Modelling*: further research and modelling work was undertaken where uncertainty exists for issues such as climate change and population growth.
- 6 *Development of Strategies, Targets and Actions*: long-term strategies for bridging gaps were developed together with some indication of their likely success.
- 7 *Development of Monitoring Plan*: a monitoring plan was developed to integrate all of the information that we need to assess whether we are being successful in implementing the ACWQIP.
- 8 *Consultation Part C: Period for public comment on the ACWQIP (spring 2011).*

Using an adaptive management approach, the ACWQIP will be regularly reviewed and strategies updated as monitoring is undertaken and new scientific information becomes available. [Background information on the ACWQIP](#), including documents developed in the process of the project is available on the EPA website.

2 Stakeholder and community input

Consultation, communication and engagement with stakeholders has been central to the development of the ACWQIP. Development of the ACWQIP undertook significant engagement with Adelaide's community, industry and government. Through this process, agreed EVs and required water quality objectives and improvement targets have been established.

2.1 Overview

The intent throughout the development of the ACWQIP has been to ensure the management of the Adelaide coastal water body is carried out in a transparent manner, incorporates the best available science and focuses attention on the maintenance of publicly agreed designated uses and values.

Involving the community has been fundamental to the effectiveness of the process for several reasons, including seeking a clear understanding of the community's knowledge, expectations and costs associated with managing specific water bodies; ensuring any management strategies are appropriately targeted; and gaining a shared ownership and commitment to implement the actions needed to protect and rehabilitate Adelaide's coast.

The coastal portion of these catchments is within the ancestral and traditional lands of the Kaurna, the Aboriginal people of the Adelaide Plains and the Ramindjeri Nation. Current Kaurna Nation people were included in targeted consultation for the preparation this ACWQIP, including the vision and EVs.

The broader Adelaide community including: community groups, local government, natural resources management (NRM) groups, government agencies, business and industry as well individuals from across metropolitan Adelaide, provided input to establish a collectively owned vision and agreed EVs for Adelaide's coastal waters. This occurred throughout the development of the ACWQIP and through the public comment process in spring 2011.

2.2 Adelaide Coastal Waters Steering Group

The ACWS Steering Group was established in 2008 to support the development and implementation of the ACWQIP. Its membership consists of representatives from the following organisations and groups:

- Department of Sustainability, Environment, Water, Population and Communities (formerly Australian Department of the Environment, Water, Heritage and the Arts)
- Adelaide and Mount Lofty Ranges (AMLR) NRM Board
- Coast Protection Board
- Conservation Council of SA
- Department of Environment, Water and Natural Resources (formerly DEH and DENR, now includes Department for Water)
- Department of Planning, Transport and Infrastructure (merger of former Department of Transport, Energy and Infrastructure and Department of Planning and Local Government)
- Department of the Premier and Cabinet
- Department of Treasury and Finance
- Environment Protection Authority
- Local Government Association
- Penrice Soda Holdings
- Primary Industries and Regions SA (formerly Primary Industries and Resources SA)
- SA Water
- South Australian Recreational Fishing Advisory Council
- Stormwater Management Authority.

The Steering Group has provided comment and feedback on the development of the ACWQIP at various stages including during the period of public comment on the ACWQIP.

2.3 Adelaide's coastal community

Community and stakeholder consultation was undertaken in 2007 and 2008 to establish EVs and WQOs for Adelaide's coastal waters and to link with existing strategies, plans and actions. Stakeholders at the meetings were representative of federal, state and local governments, associations, community groups and individuals. Input from the stakeholders was sought through public meetings, workshops and targeted discussions.

In 2007 public workshops were held to develop draft EVs and WQOs for Adelaide's coastal waters. In 2008 targeted stakeholder discussions were held with staff from the AMLR NRM Board, SA Water, Penrice Soda Holdings, Stormwater Management Authority, local government and state government agencies. Focus groups were held with business, industry, state and local government and community representatives to confirm the EVs identified by the community in 2007 and to define targets for improvement for Adelaide's coastal waters. The reports on these community consultation workshops are provided in [Report 1](#) on the EPA website.

Community vision for Adelaide's coastal waters

Healthy aquatic ecosystems where environmental, social and economic values are considered in equal and high regard in a balanced management approach that aims to see the return of the 'blue line of seagrass' closer to shore by 2050.

This vision was developed through Steering Group discussions based on community and stakeholder quotes (see [Report 1](#) on the EPA website). Some of these quotes included:

- | | |
|--|--|
| <ul style="list-style-type: none"> • go swimming and see my feet in afternoon sea waters • observe the sea floor • ability to see the blue line closer to shore • healthy reefs • coastal waters being free of stormwater discharge and nutrient rich outflows in the future • no species loss due to water quality issues | <ul style="list-style-type: none"> • creative solutions to capture, clean and reuse stormwater • recreational activities including swimming, boating, walking and fishing to be enjoyed anywhere along the coastline • coliform levels are consistent with natural levels and cycles. |
|--|--|









EVs and the community vision were subsequently added to in discussions with Steering Group members in 2009 and then commented on by community groups, individuals, business and government agencies and local government in the public comment process in spring 2011.

There are eight EVs for Adelaide's coastal waters. Each of the EVs is associated with one of the elements of the triple bottom line (TBL) that it is perceived predominantly as an 'environmental' value, a 'social' value or an 'economic' value, as illustrated in [Table 4](#).

After the public comment phase in 2011, the draft EV for 'potential aquaculture' was removed as it was deemed not to be relevant to Adelaide's coastal waters based on a request from PIRSA Aquaculture. The EVs for 'industrial use' and 'raw drinking water' (through desalination) remain in the list of confirmed EVs as they are current uses for Adelaide's coastal waters.

In the public comment phase of the project, some members of the community suggested that the 'industrial use' and 'raw drinking water' (through desalination) EVs were not as important as other EVs for Adelaide's coastal waters. However, at this stage these EVs have been retained as part of the EVs for the ACWQIP.

Table 4: Community agreed environmental values for Adelaide's coastal waters

ENVIRONMENTAL values	SOCIAL values	ECONOMIC values
Ecological	Aesthetic	Commercial (current and future)
 Protection of aquatic ecosystems	 Visual appreciation	 Human consumption (aquatic foods)
	Recreation	 Drinking water supply–desalination
	 Primary recreation (eg swimming and snorkelling)	Industrial
	 Secondary recreation (eg fishing and boating)	
	Cultural and spiritual	
	 Cultural heritage (Aboriginal and non-Aboriginal)	 Industrial use

The list of confirmed EVs for Adelaide's coastal waters can be used when an update of the Environment Protection (Water Quality) Policy occurs. It is intended that any updates to the Water Quality Policy will include the community agreed EVs for specific waterways (in this case Adelaide's coastal waters), rather than the current generic default EVs and Water quality objective (WQOs).

Following the establishment of EVs, the level of environmental quality (or water quality) necessary to maintain each value was determined by appointing corresponding management goals for nutrients and suspended solids in Adelaide's coastal waters.

A WQO is a measurable target to protect EVs and therefore, water quality. They include physical measures (eg turbidity), chemical measures (eg salinity) and or biological measures (eg bacteria). The WQOs provide general advice about coastal water quality for monitoring and for comparative purposes for managers of stormwater dischargers and beach users. The ACWQIP provides targets for load reduction that should result in the improvement of water quality based on the findings and recommendations of the ACWS (Fox *et al* 2007) and other more recent research undertaken by the EPA and others.

The details of the EVs and WQOs specific to each management section of Adelaide's coastal waters are discussed in more detail in Chapter 8.

2.4 Aboriginal groups

As part of the development of the ACWQIP, information has been sought via workshops from Traditional Land Owners on the Aboriginal vision and aspirations for Adelaide's coastal waters. The Four Nation NRM Governance Group produced two documents that contain information relevant to determining the Aboriginal vision, aspirations and environmental values for Adelaide's coastal waters.

2.4.1 Four Nations Natural Resources Management Governance Group Strategic Plan 2006–2010

The following aspirations from the Four Nations' NRM Governance Group Strategic Plan 2006–2010 (pg 18) are of particular significance when determining the vision, aspirations and EVs for Adelaide's coastal waters:

- lands, sea and waterways protected from pollution and from other damaging impacts, with past damage rehabilitated and natural environment restored
- healthy lands, sea and waterways equate to healthy people
- cultural awareness about land, sea and waterways and the cultural heritage significance of lands and waters protected.

Since the ACWQIP work commenced, the Four Nations Group has ceased to operate under the AMLR NRM Board umbrella and the Ramindjeri people have asked to also be recognised as a traditional group within the bounds of the AMLR NRM region.

The ACWQIP deals with a part of the AMLR NRM Board region that includes the traditional lands of the Kaurna and Ramindjeri Nations. Consultation undertaken with the Kaurna Nation as part of the development of this ACWQIP was undertaken consistent with the Four Nations NRM Governance Group Strategic Plan. Note that knowledge of the Ramindjeri Nation identifying themselves as a separate Aboriginal group to be consulted with for the Adelaide Plains only became known to the EPA at the end of the process of developing the ACWQIP.

2.4.2 Kaurna Nation

As part of the community and broad stakeholder consultation, a specific consultation process was undertaken in June 2008 with Kaurna Nation representatives to seek Aboriginal input into the development of the ACWQIP. Information on the ACWQIP was also presented at the Four Nations NRM Governance Group. Members of the Kaurna community were invited to attend a focus group to provide input into determining EVs for Adelaide's coastal waters. For the full report on the workshop refer to information provided in [Report 1](#) on the EPA website.

Kaurna workshop key messages

- Aboriginal people cannot separate cultural and ecological values—they are the essence of the landscape
- the coast is an integral part of the overall system and landscape for Aboriginal people and cannot be assessed and/or managed in isolation
- the coastline is dying through a lack of respect for the integration of systems
- many small projects do not equate to a healthy overall system
- all of the coast has cultural and ecological significance and cannot easily be simplified to a range of geographical locations.

A comment made at the workshop prospectively sums up the intent of the Kaurna vision and aspirations for Adelaide's coastal waters:

We want to leave a legacy to people and places.... Leave a deed to the people.

The key messages from the workshop highlight the interconnection of all aspects of the coastal system with the broader landscape and cultural and spiritual values. Cultural heritage and spiritual connections have been identified as important EVs for the Kaurna people.

2.5 Community and stakeholder feedback (spring 2011)

The EPA sought comment from Adelaide's broader community on the ACWQIP through a period of public comment in spring 2011. Comment was specifically sought on the vision and EVs contained within the ACWQIP and some community members and stakeholders also provided comment on the eight strategies presented in the document.

The EPA received 105 comments from individual community members, community groups and government agencies. Overall the comments were supportive of the vision, EVs and strategies in the ACWQIP. Many of the community and stakeholder submissions provided statements that confirmed significant support for the vision and EVs. Some of the more detailed submissions clarified activities being undertaken by key stakeholders in support of the implementation of the plan and the eight strategy areas (eg refer to information in [Appendix 2](#) on the City of Onkaparinga). [Appendix 3](#) includes a summary of the range of comments from the period of public comment and information on how some of the comments were addressed in finalising the ACWQIP and in planning for the implementation of the ACWQIP.

Significant support from the community and key stakeholders for the ACWQIP was indicated in feedback. The document provides a positive future for Adelaide's coastline by highlighting how coordinated action in partnership with community organisations, local government, state government agencies, industry and local business could improve Adelaide's coastal water quality and create the conditions to see the recovery of seagrass and reef systems within our lifetimes and those of our children or grandchildren.

After the period for public comment concluded, feedback was responded to either via e-mail or letters and the document was finalised in 2013. While the draft was being updated implementation of some of the ACWQIP strategies was undertaken and other strategies will be more significantly implemented from 2013 onwards.

3 Links with other plans

The ACWQIP builds on scientific and consultation knowledge about the current condition of Adelaide's coast and coastal waters. Care has been taken to ensure that the ACWQIP aligns well with major relevant national and state plans.

3.1 Overview

The ACWQIP defines WQOs and long-term pollutant reduction targets needed for nutrients and suspended solids to enable Adelaide's coastal waters to achieve both these objectives and a water quality condition which is consistent with community expectations.

The ACWQIP has been developed in accordance or with direct regard to the following national, state and local strategies and plans including:

- Adelaide Coastal Waters Study (Fox *et al* 2007)
- National Water Quality Management Strategy (ARMCaNZ and ANZECC 2000)
- South Australia's Strategic Plan 2011 (Government of South Australia 2011) and Action Agenda 2012–2014
- Environment Protection Authority Strategic Plan 2012–2015 (EPA 2012)
- Our Place Our Future State Natural Resources Management Plan SA 2012–2017 (Government of South Australia 2012)
- Water for Good – A plan to secure our water future to 2050 (Office for Water Security 2009)
- Stormwater Strategy – The Future of Stormwater Management (DFW 2011)
- The 30-Year Plan for Greater Adelaide (DPLG 2010b)
- Adelaide and Mount Lofty Ranges (AMLR) NRM Regional Plan (AMLR NRM Board 2008a)
- Four Nations NRM Governance Group Strategic Plan and Consultation and Engagement Protocols (Four Nations Governance Group 2007)
- Living Coast Strategy (DEH 2004)
- Adelaide's Living Beaches Strategy (DEH 2005a)
- Adelaide Dolphin Sanctuary Management Plan (DEH 2008)
- Port Waterways Water Quality Improvement Plan (EPA 2008a).

3.2 Adelaide Coastal Waters Study

The ACWQIP has built on the key findings of the Adelaide Coastal Water Study (ACWS). The ACWS was a large-scale scientific study undertaken from 2001 to 2007 on Adelaide's coastal waters investigating seagrass loss, decline in water quality and sea floor instability. The ACWS included the production of 20 technical reports and a final report. The final report containing 14 recommendations was released in February 2008 (Fox *et al* 2007).

Action to address the 14 ACWS recommendations is incumbent on the whole community across Adelaide's catchments to improve water quality at the coast. Strategy 1 of the ACWQIP: *Reduce nutrient, sediment and coloured dissolved organic matter (CDOM) discharges* directly connects with and addresses the first five of the 14 recommendations of the ACWS. A summary of the 14 ACWS recommendations is provided in [Table 5](#).

Table 5: Summary of the 14 ACWS recommendations for quick reference

1	Reduce wastewater, stormwater and industrial inputs to marine environment
2	Reduce annual nitrogen discharged to marine environment to around 600 tonnes
3	Reduce loads of particulate matter discharged to marine environment by approximately 50% from 2003 levels
4	Reduce the amount of CDOM discharged by rivers, creeks and stormwater drains
5	Continue to reduce and monitor toxicant levels discharged to marine environment
6	Develop and implement a comprehensive and integrated environmental monitoring program
7	Maintain and develop the comprehensive database of historical inputs generated by this study
8	Implement a long-term monitoring program to assess seagrass quality
9	Implement a long-term monitoring program of the outer depth margin of <i>Posidonia</i> meadows in Holdfast Bay
10	Implement a long-term monitoring program of seagrass meadow fragmentation in Holdfast Bay
11	Undertake detailed mapping of the distribution of <i>Amphibolis</i> across the Adelaide metropolitan area
12	Undertake a spatially intensive nitrogen stable isotope survey
13	Undertake an audit of key environmental assets in the southern metropolitan coastal region
14	Manage Adelaide's coastal marine environment as a component of an integrated system

The ACWS identified nutrients and suspended solids as the primary cause behind the loss of thousands of hectares of seagrasses along the Adelaide metropolitan coastline. The main areas for water quality improvement require a reduction in nutrient and sediment loads to the coast from both wastewater sources and stormwater.

The ACWQIP has incorporated additional issues outside the scope of the ACWS such as the health of sub-tidal reefs and community views. Nitrogen reduction targets set in the Port Waterways Water Quality Improvement Plan (PWWQIP) [EPA 2008a], which covers the Port River–Barker Inlet system, have also been included into the ACWQIP. The targets for nutrient and suspended solid reductions in the ACWQIP seek to prevent further seagrass loss and support conditions for seagrass rehabilitation. These reductions in nutrients and sediment loads will create conditions suitable for improved health of seagrass and seagrass recovery and also will in turn enhance marine biodiversity off the metropolitan coastline and the broader area of Gulf St Vincent.

3.3 National Water Quality Management Strategy

The preparation of the ACWQIP is consistent with the National Water Quality Management Strategy (NWQMS). The NWQMS includes nationally agreed policies, processes and guidelines [part of the Council of Australian Governments' (COAG) Water Reform Agenda–COAG 1994] that provide the information and tools for communities to plan for the sustainable management of their water resources (refer [Figure 3](#)). The NWQMS aims to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development (ARMCaNZ and ANZECC 2000).

The NWQMS requires the involvement of the community; who are central to the effectiveness of the process. Consultation throughout the development of a water quality improvement plan (WQIP) ensures the final strategies have been accepted and adopted by the community.

The community and stakeholder engagement approach that was used for the development of the ACWQIP was consistent with the NWQMS strategy. This included extensive community consultation for the development of EVs and WQOs and the period of public comment on the draft.

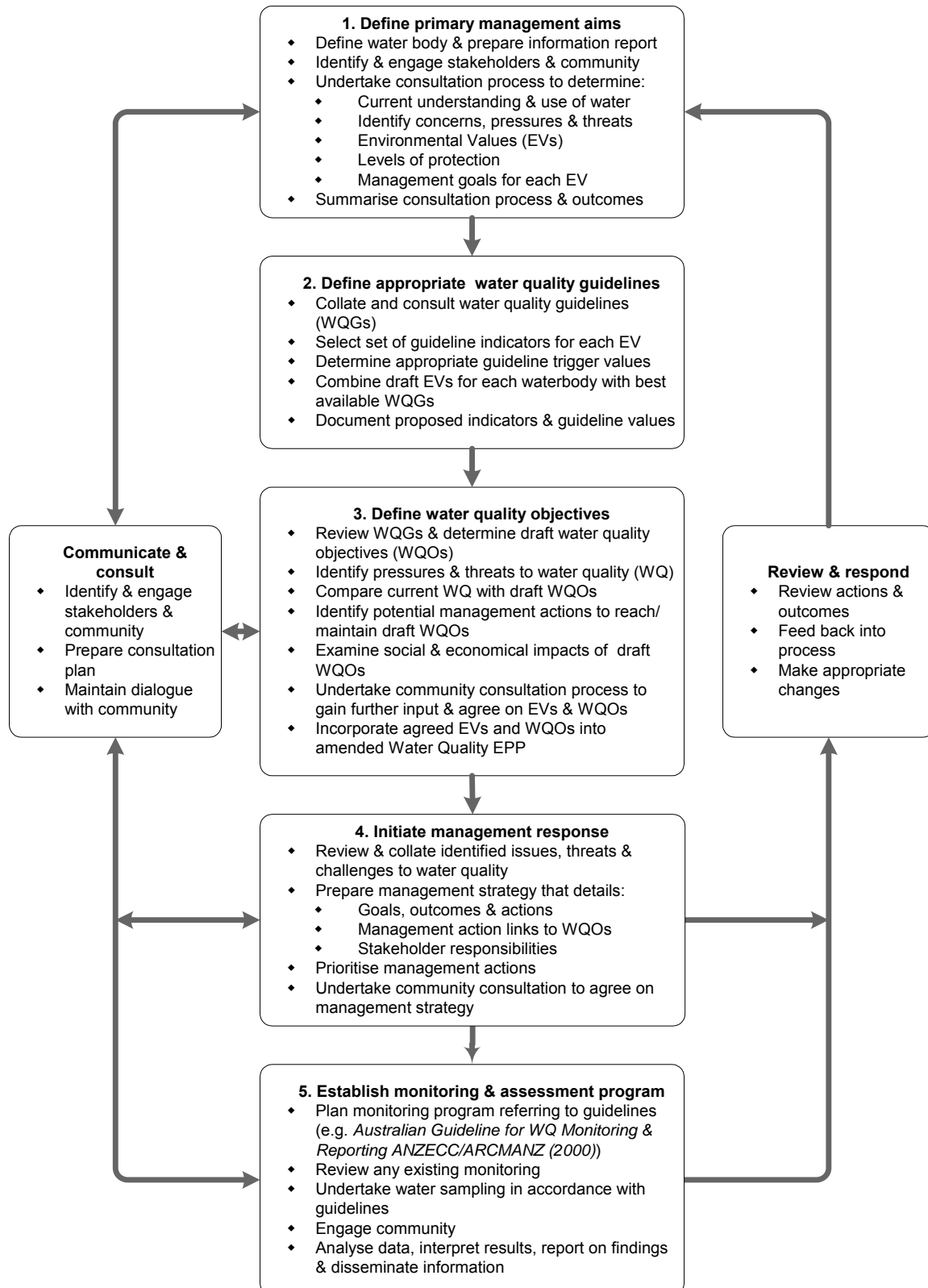


Figure 3: National Water Quality Management Strategy (NWQMS) Water Quality Management Framework as applied in South Australia

3.4 South Australia's Strategic Plan 2011 and Action Agenda 2012–2014

The South Australia Strategic Plan (SASP) reflects the input of communities throughout the state and their aspirations for continued prosperity within a context of balancing economic, social and environmental aspirations.

The ACWQIP is aligned with six objectives of SASP as follows:

- 1 **Growing prosperity:** economic benefits from fishing and other recreational activities and enhancement of the socio-economic status of coastal residential properties and commercial activities through proximity to a protected high quality coastal environment.
- 2 **Improving well-being:** public safety while swimming enhanced and the social benefits of recreational use of Adelaide's coastal waters protected.
- 3 **Attaining sustainability:** residential, commercial and industrial impacts on coastal waters managed.
- 4 **Fostering creativity and innovation:** stormwater and treated effluent reuse technologies developed, improved and disseminated.
- 5 **Building communities:** all Adelaide residents and users of coastal waters encouraged and supported to work together to protect our marine environment.
- 6 **Expanding opportunities:** large-scale reuse of treated effluent offering substantial opportunities for expansion of irrigated horticulture.

Under the Environment section of the SASP 2011 there are two vision statements (two goals) and four targets that are particularly relevant to the ACWQIP.

VISION: We look after our natural environment

GOAL: We look after our oceans, coasts and marine environments

- *Target 69:* Lose no species – a range of marine species may be compromised by water quality and loss of reef or seagrass habitat
- *Target 71:* Marine biodiversity – maintain the health and diversity of South Australia's unique marine environments.

VISION: We value and protect our water resources

GOAL: South Australia has reliable and sustainable water resources and is a leader in wastewater, irrigation, stormwater and groundwater management

- *Target 73:* Recycled stormwater – South Australia has the system capacity to harvest up to 35 GL of stormwater per annum by 2025
- *Target 74:* Recycled wastewater – South Australia has the system capacity to recycle up to 50 GL of wastewater per annum by 2050.

Greater reuse of wastewater and stormwater across metropolitan Adelaide should lead to better water quality for the marine environment. This process will support the ACWQIP to achieve improved water quality for Adelaide's coastal waters. A greater focus on reuse of wastewater and stormwater will assist in marine waters being managed within sustainable limits to support aquatic ecosystems, fisheries and recreation.

In 2012 the South Australian government released seven new strategic priorities for the state. These are embedded in the Strategic Plan. The strategic priorities of direct relevance to the ACWQIP are:

- creating a vibrant city
- safe communities, healthy neighbourhoods
- an affordable place to live
- premium food and wine from our clean environment.

3.5 Environment Protection Authority Strategic Plan 2012–2015

The EPA's role is to influence and regulate human activities to protect and restore our environment and reduce risk of environmental harm.

The ACWQIP supports the EPA Strategic Plan Goal 2 'Good Quality Water' and the existing EPA committed actions of Action 49 and 63 in Water for Good. In Water for Good, Action 49 focuses on the development of water quality improvement plans for the Mount Lofty Ranges and other critical catchments across the state and Action 63 focuses on setting of EVs for priority waters across the state.

The EPA Strategic Plan 2012–2015 focuses on protecting the environment for all South Australians. The most relevant goal for the ACWQIP is Goal 2: *Good quality water* with the other four environmental goals addressing air, land, noise and radiation. Goal 2 (Good quality water) states the following: Protect the quality of surface, ground, coastal and marine waters from pollution by monitoring water quality, advising and regulating industry and supporting water quality improvement projects.

The implementation of the ACWQIP will provide significant progress toward Goal 2 for Adelaide's coastal waters and involve work under the following strategic priority areas of the EPA including: robust regulation, sound science, strategic influence and partnerships and genuine engagement.

The Water Quality Policy under the *Environment Protection Act 1993* is South Australia's principal legislation for the protection of water quality. It is linked to the NWQMS through the setting of default EVs and water quality criteria. The Water Quality Policy can be amended to include specific EVs and water quality criteria for particular bodies of water. The work of the PWWQIP, ACWQIP and Healthy Waters projects will work towards having the Water Quality Policy updated to include the community agreed EVs for specific waterways (in this case Adelaide's coastal waters), rather than the current generic default EVs and WQOs. This will enable the EPA to use the EVs as a legislative tool to guide appropriate development and use of waters so impacts to waters are better managed.

3.6 Our Place Our Future State Natural Resources Management Plan SA 2012–2017

The development of the ACWQIP is consistent with the management system and continuous improvement cycle presented in this NRM Plan. The Plan is focused on a framework for NRM for the whole state with relevant targets and guiding targets, whereas the ACWQIP is focused on the catchment to coast aspect of NRM in the Adelaide region with the purpose of water quality improvement for Adelaide's coastal waters.

The approach that has been used to develop the ACWQIP is a 'planning cycle approach' that shares similarities with that presented in the State NRM Plan for regional NRM planning. The key steps were:

- assessing the state and condition of resources
- setting community derived targets
- determining strategies and actions for investment to improve condition
- detailing how condition will be monitored and measured
- applying continuous improvement.

The State Natural Resources Management Plan (NRM) SA, 2012–2017, entitled 'Our Place, Our Future' (Government of South Australia 2012) contains the vision 'We care for the land, water, air and sea that sustains us' and the following three interconnected goals:

GOAL 1: People taking responsibility for natural resources and making informed decisions

- Individuals, communities, industry and all levels of government working together, able and willing to manage our natural resources.

GOAL 2: Sustainable management and productive use of land, water, air and sea

- We all use resources productively, respecting limits and balancing economic, social and environmental sustainability, for the long-term.

GOAL 3: Improved condition and resilience of natural systems

- We care for natural systems to ensure that they can sustain us in the long-term.

The State NRM Plan includes a number of strategic level guiding targets that are of relevance to the ACWQIP including targets 5, 6, 9 and 10. Targets 5 and 6 are components of Goal 2 – *Sustainable management and productive use of land, water, air and sea* with these targets being of a general nature that 'All NRM Planning and investment decisions take into account ecological, social and production considerations' and 'Maintain the productive capacity of our natural resources' which takes into consideration 'trends in stormwater captured and wastewater recycled'. Guiding targets 9 and 10 are respectively 'improve condition of terrestrial aquatic ecosystems' and 'improve condition of coastal and marine ecosystems'. These two targets are two of 13 guiding targets that are designed to guide NRM effort across South Australia.

The EPA has been identified in the State NRM Plan as an 'assisting agency' for guiding targets 6, 9 and 10 in cross-government and NRM consultative processes for reporting on the condition of natural resources. Further to this, the EPA has been nominated to implement the NWQMS in South Australia via the *Environmental Protection (Water quality) Policy 2003*. This includes community agreed EVs and WQOs, establishing management strategies (and in some cases developing water quality improvement planning) and facilitating ongoing monitoring and reporting frameworks for waters across South Australia (including freshwater, groundwater and marine waters).

The State NRM Plan also identifies a range of pressures on our resource assets. The three pressures of particular relevance for Adelaide's coastal waters are 'climate change', 'land-use change and intensification' and 'pollution and nutrient enrichment' (SA Government 2012, pg 9). The State NRM Plan also details 10 priorities to strengthen the NRM Management System that is outlined in the document. These priorities focus on issues ranging from engagement of communities to developing NRM reporting frameworks to working in partnerships with stakeholders. These 10 priorities are also guiding priorities for the ACWQIP (SA Government 2012, pg 20).

There is overlap with the ACWQIP in that the State NRM Plan will play a role in the delivery of a number of the broad NRM related targets in South Australia's Strategic Plan that are applicable to the broader Adelaide and Mount Lofty Ranges NRM region and Adelaide's coastal waters including:

- *Target 62: Climate change adaption*
- *Target 69: Lose no species*
- *Target 70: Sustainable land management*
- *Target 71: Marine biodiversity*
- *Target 72: Nature conservation*
- *Target 73: Recycled stormwater*
- *Target 74: Recycled wastewater.*

More details on the most relevant SA State Strategic Plan targets to the ACWQIP are provided in section 3.4.

3.7 Water for Good – A plan to ensure our water future to 2050

Water for Good (Office for Water Security 2009) is a much broader plan than the ACWQIP in that it is a comprehensive plan to ensure there will always be enough water in South Australia, but the overlap between the documents relate to promoting the integrated use of stormwater and wastewater within the Adelaide region.

The approach of setting EVs and WQOs and then developing regional water quality improvement plans is also highlighted as a priority for the Adelaide and Mount Lofty Ranges (AMLR) NRM region and other high priority areas of South Australia.

Some of the relevant actions to the ACWQIP from Water for Good include:

- *Action 12:* update state water recycling guidelines to reflect the Australian Guidelines for Water Recycling and include stormwater by 2010
- *Action 16:* develop a master plan for effectively managing stormwater in Adelaide
- *Action 18:* develop state guidelines for grey water recycling, consistent with Australian Guidelines for Water Recycling, by 2010
- *Action 19:* develop a master plan for effectively managing wastewater in Adelaide, in concert with the stormwater recycling master plan, to ensure optimum use of both water sources
- *Action 22:* complete wastewater recycling projects, including Glenelg to Parklands (open space irrigation), Blakeview (housing development), Southern Urban Recycling Project (housing development), by 2013
- *Action 46:* increase regularity of statewide data collation, assessment and reporting, where required
- *Action 49:* develop water quality improvement plans for the Mount Lofty Ranges (MLR) Watershed by 2011 and other critical water catchments across the state by 2017
- *Action 63:* the EPA will develop environmental values for priority water bodies across the state by 2014
- *Action 67:* develop and implement the best regulatory approach for South Australia to mandate WSUD, dovetailing with The 30-Year Plan for Greater Adelaide by 2013
- *Action 68:* introduce WSUD targets by 2010.

The ACWQIP is one of the water quality improvement plans being developed under Action 49 for critical waters across the state and its development has involved setting EVs for the priority waters off the Adelaide coast according to Action 63.

The Department for Environment, Water and Natural Resources (DEWNR) is the agency responsible for the overall coordination of the actions listed in Water for Good. The responsible agencies listed in Water for Good against different actions regularly report to DEWNR on the progress of actions. The EPA Water Quality Branch reports against work undertaken for Actions 49 and 63.

3.8 Stormwater Strategy – The Future of Stormwater Management

The ACWQIP interacts with the Stormwater Strategy and subsequent Blueprint for Urban Water Management (being developed by DEWNR) in that it provides a clear water quality improvement focus and strategies for broader stormwater management.

The Stormwater Strategy (DFW 2011) is a 'road map' for achieving the stormwater harvesting target of 60 GL per annum by 2050.

The Stormwater Strategy commits the SA Government and other key stakeholders to a number of actions. These include Action 1 *the development of the blueprint for urban water*, which will be a comprehensive integrated plan for managing urban water resources. This action links with Action 16 and 18 in Water for Good as it relates to integrating reuse of stormwater and wastewater. A blueprint for urban water management is currently being developed to support the implementation components of Action 16 and 18 in Water for Good.

- *Action 2:* addresses the establishment of targets for WSUD within the Adelaide region. A WSUD consultation statement was released in early 2012 for public input. This document is currently in the process of being updated taking into account the comments provided
- *Action 3:* by 2015, identify what changes are required to stormwater infrastructure to improve water quality outcomes in line with the ACWQIP and the Torrens Taskforce. This initiative is particularly relevant to the implementation of the ACWQIP and the EPA has been identified as needing to lead this action.

Implementation of the ACWQIP relates to furthering Action 3 in the Stormwater Strategy.

3.9 The 30-Year Plan for Greater Adelaide

Over the coming 30 years it is projected that the population will grow by up to 560,000 people. With the increased number of people it follows that there will in all likelihood be increased pressure on Adelaide coastline and coastal waters and seagrasses. Within this context, any increase in population and the development footprint of Adelaide needs to be carefully managed.

The 30-Year Plan for Greater Adelaide (DPLG 2010) is a component of for the SA Planning Strategy. It will be used statutorily by the state government to guide the planning and delivery of services and infrastructure, such as transport, health, schools and community facilities.

The main aim of the plan is to outline how the government proposes to balance population and economic growth with the need to preserve the environment and the need to protect the heritage, history and character of Greater Adelaide.

Expansion of Adelaide's urban footprint through population growth would normally be expected to result in an increase in the amount of stormwater runoff and associated pollution. Attention to incorporate WSUD and other stormwater reuse principles in greenfields, infill developments and infrastructure upgrades across Adelaide will be required to achieve the growth Adelaide needs without compromising the economic, social and environmental capacity of the city.

The biodiversity theme of the plan recognises the environmental, social and economic value of seagrass as a unique habitat adjacent to Adelaide's metropolitan area, including Target E:

- *Target E:* minimise the discharge of stormwater, pollution and nutrients to freshwaters, coastal and marine environments through the adoption of appropriate water sensitive urban design (WSUD) and Adelaide coastal water quality improvement plan policies and targets into development plans.

The EPA will work with the DEWNR and DPTI and other relevant agencies to ensure this is undertaken. Both DEWNR and DPTI have responsibility for delivering outcomes to implement WSUD and the EPA is supportive of this work to improve stormwater quality and water quality for Adelaide's coastal waters in partnership with the work being undertaken by the AMLR NRM Board and local governments.

3.10 Adelaide and Mount Lofty Ranges Natural Resource Management (NRM) Regional Plan

The Adelaide and Mount Lofty Ranges (AMLR) NRM Regional Plan is focussed on the management of all natural resources within the Adelaide and Mount Lofty Ranges region. The focus of the ACWQIP is more 'catchment' (below reservoirs) and 'stormwater systems' specific. The ACWQIP also concentrates on the actual impacts of urban water quality on the seagrass and reef systems and overall ecosystem of Adelaide's coastal waters.

The AMLR NRM Board has developed a regional plan based on a long-term vision for the future of the region, titled *Thriving communities – caring for our hills, plains and seas* (AMLR NRM Board 2008a). It also outlines what the stakeholders in the region (local, state and federal government, industry groups, non-government organisations and the community) are aiming to achieve in the next 20 years.

The Regional Plan is a statutory plan under the *Natural Resources Management Act 2004* and the NRM Board is required to maintain a Regional NRM Plan for its region in consultation with stakeholders and the community. This plan links to the State NRM Plan and South Australia's Strategic Plan, and sets out the long-term NRM vision for the region. The Plan provides strategic direction for all NRM partners who invest in the region. This includes the establishment of long-term goals, clearly defined outcomes and targets.

The AMLR NRM Plan has information under the following themes that relate to the ACWQIP implementation:

- *Seascape Strategy Objectives*: these strategies will work towards protecting reefs, seagrasses and estuaries from land-based pollution impacts, managing coastal habitats across the region, protecting habitats for migratory shorebirds and marine species, encouraging sustainable use of marine resources and increasing the knowledge and awareness of the community about the coast and marine environment. Technical advice, research and financial support to protect and improve the coast and marine environment are key components of achieving the targets identified in the plan
- *Urban Watercourses Strategy Objectives*: these strategies aim to protect against further degradation of waterways and marine water quality from urban land uses, and to retain, and where possible return, indigenous biodiversity values. As part of improving water quality and managing flood risk, strategies aim to better manage stormwater runoff through WSUD, and to be better prepared for potentially damaging flooding events
- *Water for Life Strategy Objectives*: strategies aim to develop and implement plans to sustainably manage both surface water and groundwater, and to develop opportunities for reuse of treated wastewater discharged by treatment plants, as well as stormwater which runs off urban areas in volumes in excess of natural rates. Importantly, it also aims to protect marine, fresh and groundwater from potentially contaminating practices in urban and rural areas.

The AMLR NRM Regional Plan has a number of regional targets that are relevant to the ACWQIP as follows:

- *Regional Target T1: By 2028, the region will have the system capacity to harvest up to 35 GL of stormwater and 50GL of wastewater per annum.*
- *Regional Target T2: Aquatic ecosystems and groundwater condition is maintained or improved.*
- *Regional Target T10: Land-based impacts on coast, estuarine and marine areas – impacts on coastal waters from sediment loads from catchments and pollutant loads from stormwater to be reduced.*
- *Regional Targets T12: Coastal, estuarine and marine water quality – all water quality for marine waters to meet defined environmental values.*

For further details on relevant actions being undertaken by the AMLR NRM Board refer to section 7.3.4.

The initial AMLR NRM Regional Plan contained the Management Action Target 18, from 1 July 2008 to 30 June 2011—three WQIPs developed and being implemented including this ACWQIP. Since mid-2011 the AMLR NRM Board has put in place intermediate targets (iTargets) for the NRM Plan for 2011–16. The ACWQIP outlines the AMLR NRM Board's proposed investment over a three-year period. The following iTargets are now relevant to the implementation of the ACWQIP:

- *iTarget 4*: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achieved
- *iTarget 5*: stormwater management plans have been developed for 40% of the urban area
- *iTarget 6*: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchments
- *iTarget 7*: 2,000 ha of land managed for water quality improvement
- *iTarget 10*: existing native ecosystems being actively improved across 20% of their area (to meet pre-determined biodiversity conservation goals) – relates to seagrass and reef areas off the Adelaide coastline too.

The AMLR NRM Plan strategically links with some of the actions in the ACWQIP; especially those that focus on reducing stormwater sediment and nutrient loads and promote greater use of stormwater and wastewater.

The ACWQIP has the opportunity to complement the AMLR NRM Board's programs and activities with an integrated catchment to coast approach for the Adelaide region that is focused on water quality.

3.11 Four Nations NRM Governance Group Strategic Plan and Protocol

The Four Nations NRM Governance Group with elected members from the Kaurna, Ngadjuri, Ngarrindjeri and Peramangk people, were the initial group that was approached by the EPA regarding clarification on the best way to include broader Aboriginal input into the development of the ACWQIP. The advice from the Four Nations NRM Governance Group was that the EPA should work directly with the Kaurna people, the local people of the Adelaide plains and this was done for the development of the EVs for the ACWQIP.

The Four Nations NRM Governance Group was initially established to work together to support each other's NRM aspirations. The relationships shared by the groups stretched beyond NRM work and was inherently linked to the deep spiritual and cultural values Aboriginal people in the broader AMLR NRM region share.

The Four Nations NRM Governance Group developed a strategic plan and also a document, *Consultation and Engagement Protocols* (Four Nations Governance Group 2007), as a 'one-stop shop' to negotiate with all groups of interest to achieve NRM and employment outcomes that provide social and economic equity, encourage and support youth, through to senior Aboriginal people to fulfill cultural obligations to country.

The group supported the integration of NRM in the region and their objectives included achieving culturally appropriate outcomes for soils, water resources, geological features and landscapes, native vegetation, native animals, other native organisms and ecosystems.

The future goals for the Four Nations Ancestral or Traditional Lands are:

- to be acknowledged and respected by everyone
- lands, sea and waterways protected from pollution and from other damaging impacts, with past damage rehabilitated and natural environment restored
- healthy lands, sea and waterways = healthy people
- cultural awareness about land, sea and waterways and the cultural heritage significance of lands and waters protected
- good relationships with non-Aboriginal people and government
- a strong network of Aboriginal landholders working and supporting each other
- increased resources for Aboriginal Traditional Owners for the ongoing joint management of their lands, sea and waterways, including resources which can make good the damage from the past unjust treatment of Aboriginal peoples, their land and waterways
- community members, especially young people well trained in environmental care and natural resource management, who understand both Aboriginal and non-Aboriginal knowledge about natural resources and who have real opportunity for real jobs and good careers
- a strong role for Aboriginal people in making decisions about all land and water management, employment, monitoring and recommending sustainable use of land, sea and waterways biodiversity
- cultural security for our grandchildren and future generations.

The ACWQIP was developed in accordance with the Four Nations NRM Governance Consultation and Engagement Protocols (Four Nations Group 2007) and Strategic Plan 2006–2010. However, since this work commenced the Four

Nations Group no longer is in operation under the AMLR NRM umbrella and the Ramindjeri people have asked to also be recognised as a traditional group within the bounds of the AMLR NRM region.

The current AMLR NRM Board approach is to deal with each of the nation groups individually and this approach will also be emulated by the EPA in any follow-up work relating to the ACWQIP. The ACWQIP deals with a part of the AMLR NRM Board region that includes the traditional lands of the Kaurna and Ramindjeri Nations. Consultation undertaken with the Kaurna Nation as part of the development of this ACWQIP was undertaken consistent with the Four Nations NRM Governance Group Strategic Plan.

3.12 Living Coast Strategy

The Living Coast Strategy (DEH 2004) is a five year strategy (2004–09) that provides direction for the conservation, management and protection of the state's coast and marine environments. It sets out the policy directions that the state government have taken to help protect and manage South Australia's coastal areas, estuaries and marine ecosystems. The directions are also shaped by a number of state and national strategies and policies, as well as international agreements and conventions referred to in the Living Coast Strategy. These programs are implemented in partnership with the Coast Protection Board, regional NRM boards, local government, community and industry.

The development of the ACWQIP supports the following objectives of the Living Coast Strategy:

- *Objective 3:* to control pollution of our coastal, estuarine and marine environments by providing for nitrogen, suspended solids and CDOM to be reduced to and remain at sustainable loads
- *Objective 4:* to protect our coastal, estuarine and marine assets by protecting Adelaide's coastal seagrass and allowing for its natural recovery over time
- *Objective 5:* to improve understanding of coastal, estuarine and marine environments this has been supported through the ACWS being undertaken. The implementation strategies in the ACWQIP provide support for this objective through the better understanding of the fate and transport of suspended solids and CDOM to and along Adelaide's coast (Strategy 3) and the support for further work to undertake seagrass mapping and rehabilitation work (Strategy 7).

The ACWQIP intersects with the Living Coast Strategy through a shared focus on controlling pollution of coast, estuarine and marine environments and a need to protect coastal, estuarine and marine assets, including coastal seagrass. While the Living Coast Strategy has a statewide focus, the ACWQIP concentrates on Adelaide's catchments and coastal waters.

3.13 Adelaide Living Beaches Strategy

Adelaide Living Beaches Strategy (DEH 2005a) is a document that aims to maintain sand on Adelaide's beaches while reducing the amount of sand carting that has been taking place. The work of the ACWQIP is not inconsistent with the Adelaide Living Beaches Strategy in that by improving water quality and creating the conditions for the return of seagrass, enhanced sand stability is likely to occur along the coastline. This will assist in maintaining Adelaide's beaches. Further to this, the ACWQIP's focus on improved water quality is consistent with less long-term disturbance of Adelaide's beaches than currently occurs in the form of dredging operations for sand replenishment.

The Coast Protection Board and the Department of Environment, Water and Natural Resources (DEWNR) have been managing Adelaide's beaches for over 30 years in response to sand erosion and sand movement north along the coast. The main strategies for the future management of Adelaide's beaches from 2005 to 2025 are as follows:

- continue beach replenishment
- recycle sand more effectively using sand slurry pumping and pipelines
- add coarse sand from external sources
- build coastal structures in critical locations
- integrate sand bypassing of harbours with beach management.

Sand movement, pumping and pipeline works have the potential to adversely impact on the water quality of Adelaide's coastal waters and these activities need to be appropriately managed.

3.14 Adelaide Dolphin Sanctuary Management Plan

The water quality improvement plans for Adelaide's coastal waters and the Port waterways both overlap with the water quality improvement focus of Objective 3 of the Adelaide Dolphin Sanctuary Management Plan which is focused on improving water quality in the Port River estuary and Barker Inlet.

The Adelaide Dolphin Sanctuary (ADS) Management Plan (DEH 2008) is a statutory plan under the Adelaide Dolphin Sanctuary Management Act 2005. The plan has six objectives with Objective 3 relating to water quality in the Port waterways—water quality within the Port Adelaide River estuary and Barker Inlet should be improved to a level that sustains the ecological processes, environmental values and productive capacity of the Port River estuary and Barker Inlet.

The EPA has responsibilities under the four issues listed for Objective 3 and has been asked to report against this objective to the ADS Advisory Board. The four issues cover reduction of nutrients, reduction of pollutants, management of ballast waters and management of toxicants (DEH 2008).

The EP Act is a related operational act to the ADS Management Act and also the obligations with regards to the ADS Act's general duty of care (Part 5–32 of the ADS Act) relate to EPA business, 'A person must take all reasonable measures to prevent or minimise any harm to the Sanctuary through his or her actions or activities'. This indicates that preventing and minimising harm to the ADS should be considered in making decisions about the impacts of actions or activities on water quality of the Port waterways region. Maintaining water quality at a level that supports the use of the environment by dolphins has been considered in setting EVs, WQOs and appropriate levels of protection for the Port waterways (EPA 2008a).

Under Part 2, section 10A of the *Environment Protection Act 1993*, should an administrator of the Act take action within the boundaries of the sanctuary they must take into account the provisions of the (ADS) Management Plan.

3.15 Port Waterways Water Quality Improvement Plan (PWWQIP)

Information in the PWWQIP is consistent with the findings of the ACWS, with regard to nutrients being a key issue for ecosystem decline and seagrass loss. This focus on nutrients and strategies for reducing discharges (by working with SA Water and Penrice Soda Holdings) has been incorporated into the ACWQIP. The ACWQIP has a broader focus on water quality improvement for the whole Adelaide coastal waters, than the PWWQIP which is focused on water quality improvement in the Port waterways.

The PWWQIP (EPA 2008a) is a document that details targets to protect environmental values for water quality improvement, primarily with respect to nutrients in the Port waterways. The PWWQIP identifies the input of nutrients in the form of nitrogen (N) and phosphorous (P) as the key issues for water quality in the Port River. Two main point sources—the Bolivar Wastewater Treatment Plant and the discharge from Penrice Soda Products into the Port River—currently contribute the largest loads of nutrients to the Port waterways. The PWWQIP enabled initial stakeholder agreement on desired outcomes for improving water quality in the Port waterways and the processes for achieving reductions in nutrient loads. Information contained in the PWWQIP on targets for water quality improvement has been incorporated into the improvement of water quality for the broader area of Adelaide's coastal waters.

4 Water quality and ecosystem condition

The ACWQIP describes the overall picture of the broad environmental condition of Adelaide's coastal waters. It draws from the scientific findings of the Adelaide Coastal Waters Study, detailed monitoring information that was used in preparation of the 2013 State of Environment Report (EPA 2013b) and data used for the preparation of the EPA Aquatic Ecosystem Condition Reports for marine waters (EPA 2013a).

4.1 Overview

This section provides an overall statement about Adelaide's coastal water quality and the key issues for water quality.

The template for presenting the information is in accordance with each of Adelaide Coastal Water Zones as listed on [Figure 2](#):

- Northern coastal Waters (Adelaide Coastal Water Zone 1)
- Port waterways (Adelaide Coastal Water Zone 2, 3 and 4)
- Metropolitan coastal Waters (Adelaide Coastal Water Zone 5)
- Southern coastal Waters (Adelaide Coastal Water Zone 6).

The section combines traditional physical and chemical water quality data with habitat condition information to present a comprehensive water quality assessment. It also focuses on the array of valuable and important ecosystem services in the coastal waters and along the Adelaide coast. These include the estuarine environments, seagrass, sediment and reefs.

The water quality parameters of relevance to Adelaide's coastal waters include nutrients, suspended solids, turbidity and colour and faecal micro-organisms. Measures of temperature and dissolved oxygen are not as relevant for the open waters of Adelaide's coast as they are for the Port waterways, due to the better mixing of waters along the open coast as opposed to the more estuarine environment of the Port waterways.

For each of the sections of Adelaide's coastal waters, the highest level of protection is appropriate, considering:

- the importance placed on the coast for its ecosystems, recreational use, commercial use (tourism) and amenity
- the need to facilitate ecosystem recovery (seagrass, reef communities) where damage has occurred. Even though there has been a considerable loss of seagrass and recovery would be very slow, disturbed areas can still be of high conservation value.

4.2 Summary of study area

In preparation of the ACWQIP, the Adelaide coastal waters have been divided into water quality management sections to include information that has been collected as part of the development of the PWWQIP in 2008, the ACWS (Fox *et al* 2007) and more recent work undertaken by the EPA and others in monitoring coast, estuarine and marine condition along the Adelaide coastline.

Consistent with the PWWQIP, the water quality management sections for the Port waterways that were defined with community input have been included into the management sections for the Adelaide Coastal Water Zones ([Figure 2](#)). The PWWQIP management sections were based on the degree of modification from their natural condition by development, the extent and condition of natural ecosystems, amenity and recreational use, conservation status and information from the modelling on water circulation patterns in the waterways.

Similarly, water quality management sections defined in the ACWS, were generally accepted by the stakeholders and community and have been included into the ACWQIP. These ACWS zones have been integrated with the sections defined in the PWWQIP and adjusted to reflect the AMLR NRM Board northern boundary as shown on [Figure 2](#) and described in [Table 6](#). These water quality management sections also overlap with the boundary of the biounits presented in Figure 2 that are used as reporting boundaries in the recently released EPA Aquatic Ecosystem Condition Reports (EPA 2013a).

Table 6: Listing of Adelaide coastal water quality management sections for ACWQIP

Water quality management sections	Description	Adelaide coastal water zones
Northern Coastal Waters	<i>Northern:</i> Offshore Gawler River, to the northern AMLR NRM Board boundary	1
Port waterways	<i>North Barker Inlet:</i> Barker Inlet from St Kilda to Gawler River	2
	<i>Central Barker Inlet:</i> Torrens Island Bridge to St Kilda	3
	<i>Port River:</i> West Lakes to end of Outer Harbor breakwater	4
Metropolitan Coastal Waters	<i>Central Metropolitan:</i> Outer Harbor to Marino	5
Southern Coastal Waters	<i>Southern:</i> All remaining discharges from Marino to Sellicks Creek	6

Note: Modified from Fox *et al* 2007 and the Port waterways WQIP (EPA 2008a)

4.3 Condition of Adelaide's coastal waters

The recently released EPA Aquatic Ecosystem Condition Reports or AECRS (EPA 2013a) for marine waters show that Gulf St Vincent is in a reasonable condition in terms of water quality and ecosystem health. However, there are water quality issues and degradation of habitat, particularly in areas of seagrass and reefs in close proximity to coastal development or other human interaction. The AECRs relevant to Adelaide coastal waters management sections (refer to [Figure 2](#)) indicate that the northern Adelaide coastal waters in the Clinton Biunit are in a very good condition, the water quality for the metropolitan Adelaide coast is bordering on fair to good for the condition assessment, and the southern coastal areas in the Yankalilla Biunit are in poor condition.

Seagrass in areas of the lower end of the Clinton Biunit, Adelaide metropolitan nearshore and Yankalilla Biunits is very patchy or lost in the nearshore zone, but is generally present and healthy in deeper waters and at sites away from urban areas. This is consistent with information derived from both the ACWS and more recent studies of nutrient enrichment. These consistently show that nutrient enrichment in areas that experience discharges from wastewater and/or runoff from urban stormwater leads to elevated epiphyte loads on seagrass.

The metropolitan and southern areas also experience spikes of high turbidity leading to periods of poor water clarity after rain events. This results in conditions where waters may not be suitable for recreational bathing along parts of the Adelaide coastline down to the Yankalilla Biunit. Recent studies have also shown that reef areas have been impacted by sedimentation and excess nutrients along the coastline. This impact is noted in the Yankalilla Biunit (EPA 2013a).

Historically, the Port waterways (EPA 2008a) have been the most adversely impacted waters in the study area (due to wastewater, industrial discharge, development and shipping activities). However, the adjacent Northern coastal waters that are included in the southern portion of the Clinton Biunit (EPA 2013a) are generally considered to be in very good condition, as they have been less impacted by urban development and activities in the past than other areas of Adelaide's coast. Some of the nutrient impacts from the Bolivar WWTP and Penrice Soda Products discharge in the Port River have impacted on seagrass health with increased epiphyte growth in the southern end of the Clinton Biunit due to a predominate northward movement of water and sediments from these discharge sites in the Port waterways.

The Metropolitan coastal waters have also been adversely impacted from discharges from urban and industrial development and WWTPs. As a result, these waters have experienced the most loss of seagrass. Implementation of more recent water quality improvement measures in both the Port waterways and along the Metropolitan coastal waters appear to be leading to improvements in the condition of water quality and remnant seagrass. The Metropolitan coastal

waters are currently rated on the border between a fair and good assessment. Meanwhile the Southern coastal waters have in the past been in a good condition, but ongoing pressures from development and increasing population in the southern area resulting in increased urban areas, and discharges from WWTPs are now threatening these waters with the current assessment indicating poor condition for these southern waters.

EPA monitoring of areas of the nearshore along the Adelaide coast in recent years have found some sites that are totally bare of seagrass and other sites where seagrass is found it is patchy and in a degraded condition. In deeper waters offshore seagrass condition is better with good site coverage. This is consistent with modelling undertaken for the ACWS which showed that pollution in the nearshore moved along the coastline in a north–south direction with limited dispersion into deeper waters, and the impact of nutrient and sediment rich discharges are mostly concentrated in the nearshore zone. Seagrass has been progressively lost along its shoreward edge to the present extent due to discharges from WWTPs, industry and stormwater as urban Adelaide continued to develop without an understanding of these issues over the latter half of the 1900s.

Adelaide's coastal waters have had a history of a decline to poor water quality, but the recent AECRs for the Metropolitan coastal waters have indicated an improvement in ecosystem condition for both 2010 and 2011. As reported in information being prepared for the 2013 SoE Report (EPA 2013b), recent data have indicated the re-establishment of seagrass is occurring in some areas along Adelaide's coastline. During the time that the ACWS and ACWQIP have been developed, the EPA has worked with industry, SA Water and other stakeholders to improve water quality in some of the ACWQIP study area. However, more still needs to be done particularly with regard to stormwater and catchment management. The decline in seagrass condition in the southern part of the coast is of concern.

4.4 Detailed analysis of study area

4.4.1 Northern coastal waters

EPA assessment in the AECRs of marine areas north of the Port waterways, in the Clinton Biunit (EPA 2013a) that are less than 15 metres depth, indicates that water quality is generally in a good state with good seagrass cover, but there are some signs of nutrient enrichment that may lead to seagrass loss in the future in the southern section of the Clinton Biunit (refer to [Figure 2](#)). Sandy mudflats dominate the nearshore in the upper portion of Gulf St Vincent from Port Adelaide to the northern boundary of the AMLR NRM Board. Mudflats on the eastern side of Gulf St Vincent are associated with coastal mangrove, samphire habitats and seagrasses, and these areas are of ecological importance for waders and shorebirds of national and international importance. Of the 25 sites assessed in this area in the AECRs, 85% of the sites had good seagrass coverage. Overall seagrass cover is good for this area, but there are some signs of nutrient enrichment occurring in the southern area.

4.4.2 Port waterways

There is a considerable body of general water quality information on the status for the Port waterways (EPA 2008a) and southern estuaries, based on ambient water quality monitoring and this is summarised in [Figure 4](#). For the EVs (ecosystem protection, harvesting of food for human consumption and recreation), defined by the EPA (EPA 2000b, 2004), the key parameters examined included nutrients, metals, turbidity, chlorophyll 'a' and microbiological indicators.

Historically, the EPA classified water quality based on a monthly ambient water chemistry monitoring program where results were categorised as good, moderate or poor. In 2008, the EPA commenced a review of its water quality monitoring programs. This review led to alterations to the coastal water quality monitoring program to include a significant amount of biological data and a more statistically robust sampling strategy as part of the AECRs. However, the EPA is now no longer undertaking intensive water quality monitoring in the Port waterways.

The EPA commenced the revised program in 2009 and has since assessed over 70 sites in Gulf St Vincent and along the Adelaide metropolitan coast up to 2011. At the time of the development of the ACWQIP there were few sites in the Port waterways zone (defined as a subregion in the monitoring program). Therefore, only the information recorded under the previous monitoring program is presented here for the Port waterways.

Water quality for the Port waterways is defined under the previous EPA classification system as good, moderate or poor while for water quality for Adelaide's coastal waters a written description is provided based on recent water quality results from monitoring undertaken by the EPA as part of the AECRs.

In the Port waterways, as shown on [Figure 4](#), ambient monitoring of concentrations of metals, nutrients, turbidity and chlorophyll 'a' has led to the water quality being classified as moderate to poor in most locations. This is to be expected with the extent of industrial, commercial, urban and port activities, Bolivar WWTP industrial discharges and stormwater runoff found in the vicinity. The waterways also receive heated cooling water from a number of power stations.

The southern Barker Inlet, North Arm and North Arm Creek often have oxygen concentrations well below recommended levels. During low tide conditions, very low oxygen conditions occur in some areas for 1–2 days. Apart from the direct adverse impact this can have on aquatic fauna, these variables also produce conditions conducive to the re-mobilisation of contaminants (eg metals and nutrients) from sediments. This situation is largely due to the shallow sheltered nature of the area.

Periodic toxic dinoflagellate blooms (red tides) occur in the Port waterways, which are also a very important factor in determining water quality status with respect to recreation and potential human consumption of seafood. High levels of nutrients support algal blooms ([Figure 5](#)), including occasional toxic algal blooms (red tides), the largest stretching some 30 km northward from the inlet. The blooms are of concern because of the health risk and the ecological impacts, including fish kills (Cannon 1991). Algal blooms can also result in aesthetic problems in unsightly discolouration of the water and unpleasant odours.

Within the Port waterways there is the potential for impacts of endocrine disrupting chemicals (EDC) from the WWTPs. The CSIRO have raised concerns nationally over EDCs contained in pharmaceuticals and personal care products (PPCPs) which may enter aquatic environments in sewage or reclaimed water. Impacts in the AMLR NRM region are relatively unknown which has led to further investigations in Barker Inlet in relation to EDCs and triclosan in sediments. This work showed that while some products were detected they were presently at levels accepted as below those that might cause environmental effects (refer to Fernandes *et al* 2008b, 2010).

The Port River–Barker Inlet system shows signs of environmental stress and ecosystem decline (EPA 2008a). While nitrogen is the most significant problem, there are a range of water quality issues and contaminants. Nutrient enrichment and the proliferation of undesirable algal growth especially *Ulva* sp., is the principal factor in the large-scale loss of intertidal and subtidal seagrass meadows and the decline in mangroves ([Figure 6](#)), with adverse effects on associated fauna, biodiversity and fisheries. The extensive occurrence of *Ulva* also results in conditions which are unsightly and produces offensive odours when the vegetation is decaying.

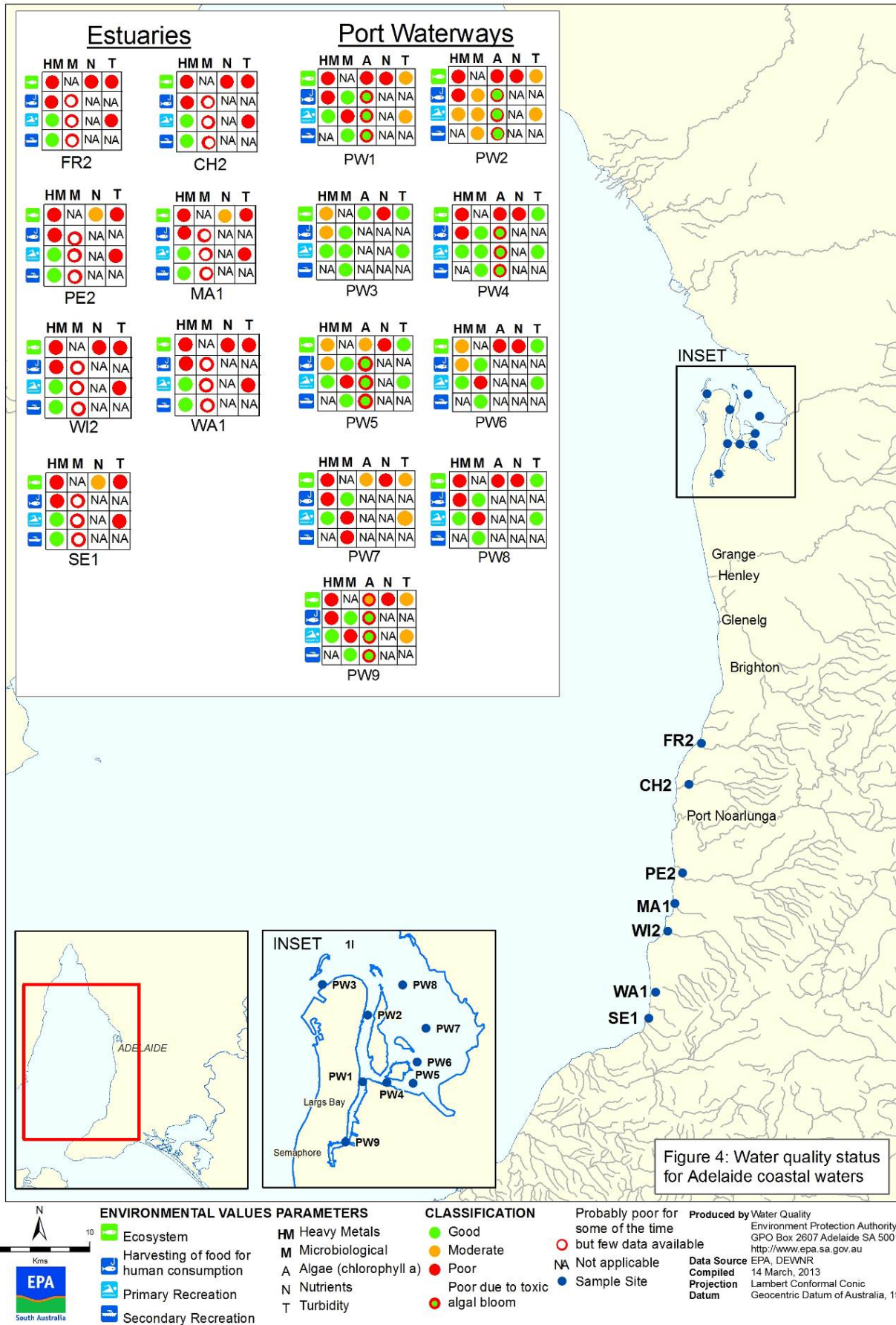


Figure 4: Water quality status for Adelaide coastal waters

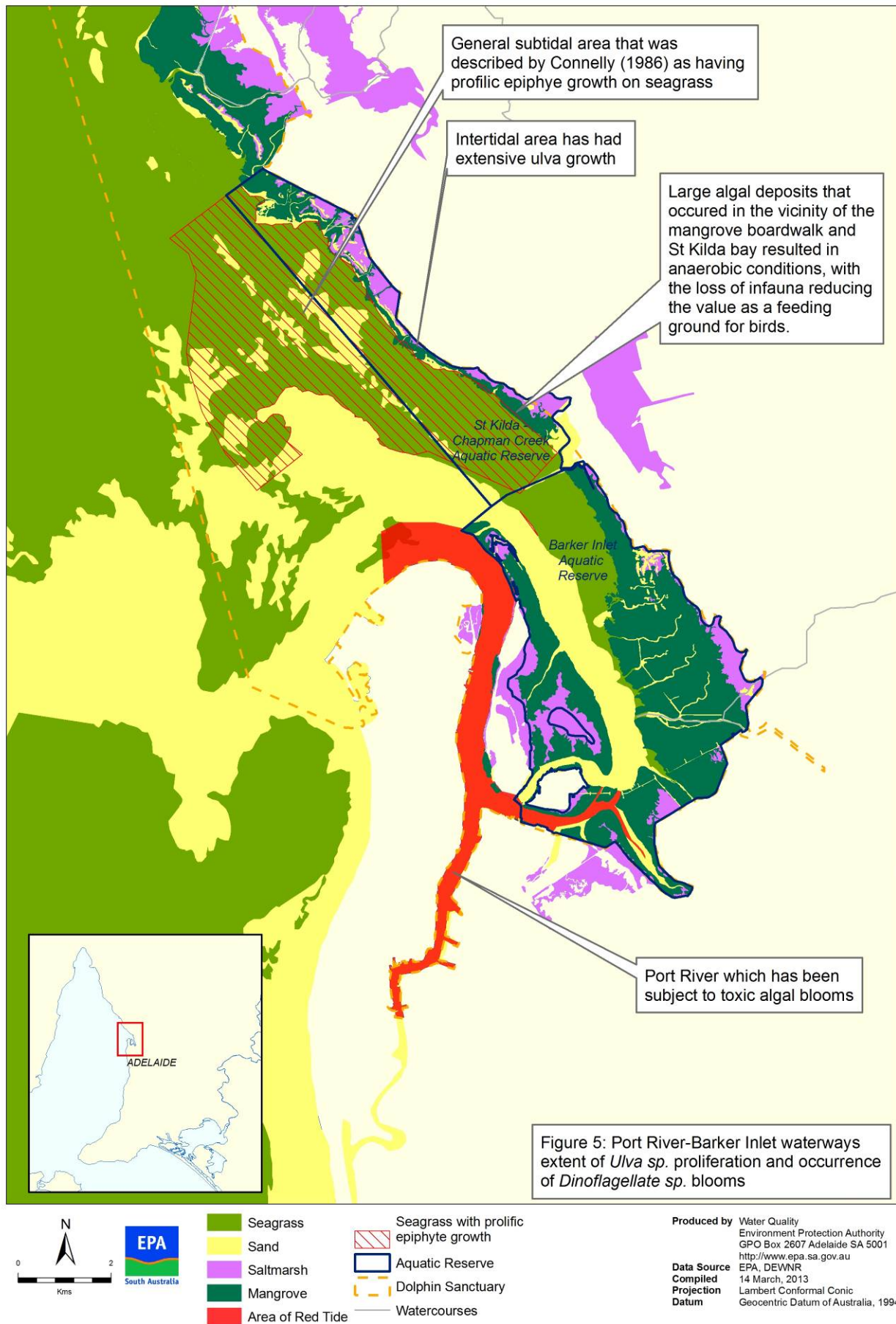


Figure 5: Port River-Barker Inlet waterways extent of *Ulva* sp. proliferation and occurrence of *Dinoflagellate* sp. Blooms

4.4.3 Metropolitan coastal waters

Water quality along the Adelaide Metropolitan coastline (refer to [Figure 2](#)) was assessed as part of the EPA's mid-year release of the AECRs for 2010 and 2011 (EPA 2013a), and Adelaide's waters were assessed to be on the border between fair and good in terms of ecosystem condition. Water quality along Adelaide's coast is impacted by discharges from industry, the three WWTPs and also from catchment and stormwater drainage as indicated in [Figure 7](#). Water quality monitoring results show nutrients (nitrogen) and chlorophyll 'a', an indicator of plant biomass in aquatic ecosystems, to be generally elevated. The most significant difference in water quality between these sites and those in other parts of Gulf St Vincent is in terms of elevated nutrients, turbidity and suspended solids.

Along the metropolitan coast, water quality is usually highly variable, depending on storm activity and inputs from rivers, number and location of stormwater outlets and whether coastal dredging is being undertaken. In summer, a daily cycle is common where turbidity is low during calm conditions in the morning, then increases during the day particularly when weather conditions allow the development of a sea breeze. Most outflows occur in the winter months when approximately 80% of the annual flows discharge.

Occasional large catchment storm events can deliver large pollutant loads and result in turbid waters along the coast, extending for up to one kilometre offshore. Such an event may last for 1–2 weeks. This persistence is due to water movement patterns which predominantly move in a north–south direction with little movement off shore and mixing along the coast. Modelling of salinity gradients undertaken as part of the ACWS showed that freshwater discharges dispersed along the coast, predominantly in a northerly direction, rather than out to sea (as shown in the salinity gradients presented in [Figure 8](#)) but this trend is not as strong in the summer months and can reverse seasonally at times.

Metals measured in translocated mussels (Gaylard *et al* 2011) showed patterns in metal concentrations correlated to the level of adjacent development ranging from industrial, to urban and rural land uses. In many cases the results are reflecting anthropogenic sources of metals either historically or recently discharged into the nearshore environment. However, there are also natural sources of some metals that either enter the coastal environment from erosion of terrestrial sediments and rocks containing metals or are within the underlying marine geology.

In addition to its impacts on EVs, turbidity is a significant water quality problem, affecting both amenity and safety due to reduced visibility during contact recreation. While turbidity is derived from storm events and outflows as described earlier, there is frequently an opaqueness, which occurs due to wave action re-suspending material. This has increased with the loss of inshore seagrass meadows. Studies (Corbin and Gaylard 2005) have shown that with respect to microbiology (faecal micro-organisms), Adelaide's coastal waters are generally safe for swimming three days after heavy rainfall events. Invariably discharges after heavy rainfall result in poor water clarity for Adelaide's coastal waters. The Department of Health recommends the public avoids swimming in the vicinity of discoloured water.

In 2013 the EPA and AMLR NRM Board launched a joint website alert system to caution the public after rain events when water quality is not suitable for swimming. Findings are generally based on predicted faecal micro-organisms levels and turbidity levels after rain events⁴.

⁴ Refer to the following for more information:

www.epa.sa.gov.au/environmental_info/water_quality/adelaides_coastal_waters/beach_water_advice

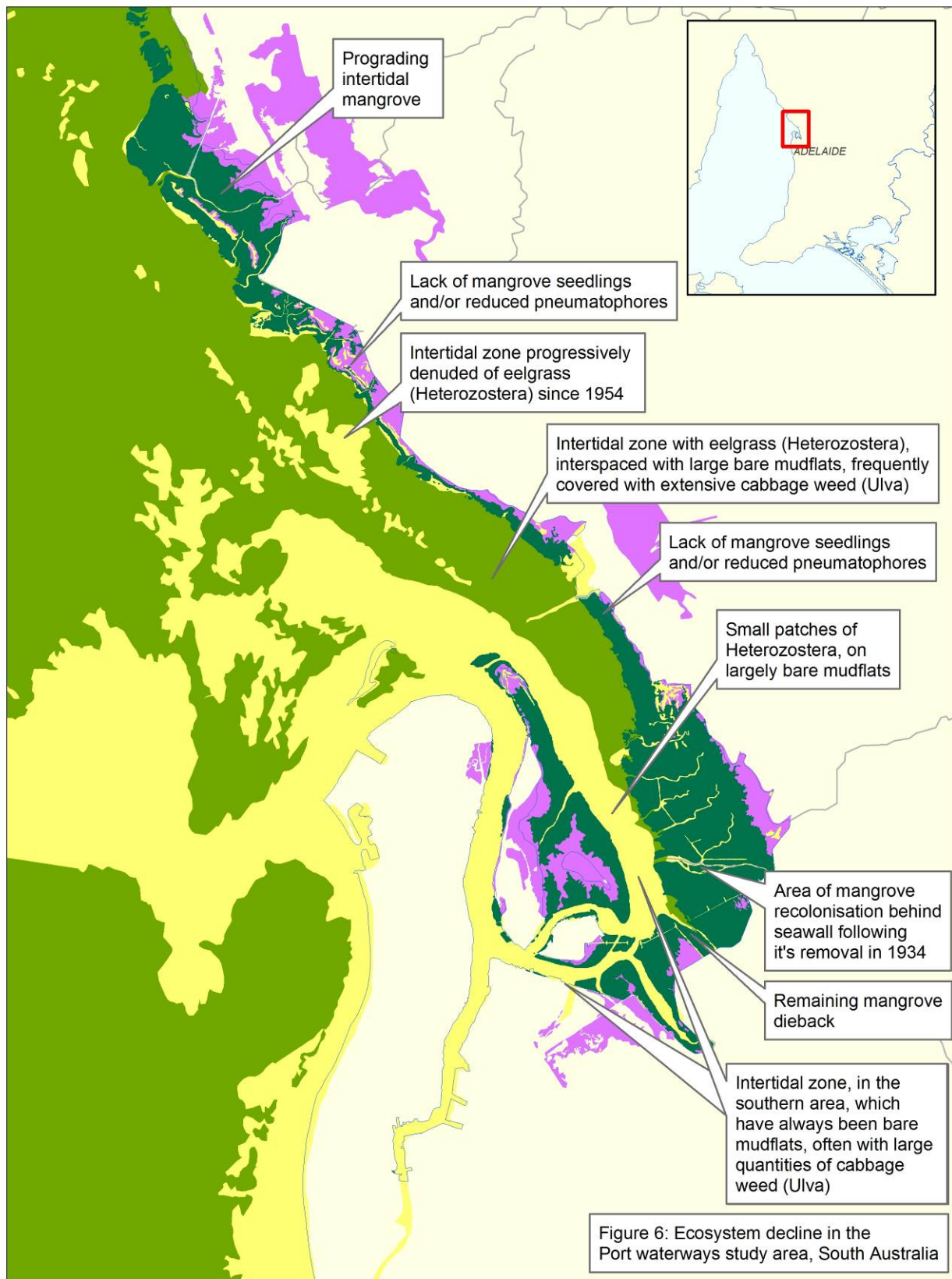


Figure 6: Ecosystem decline in the Port waterways study area, South Australia

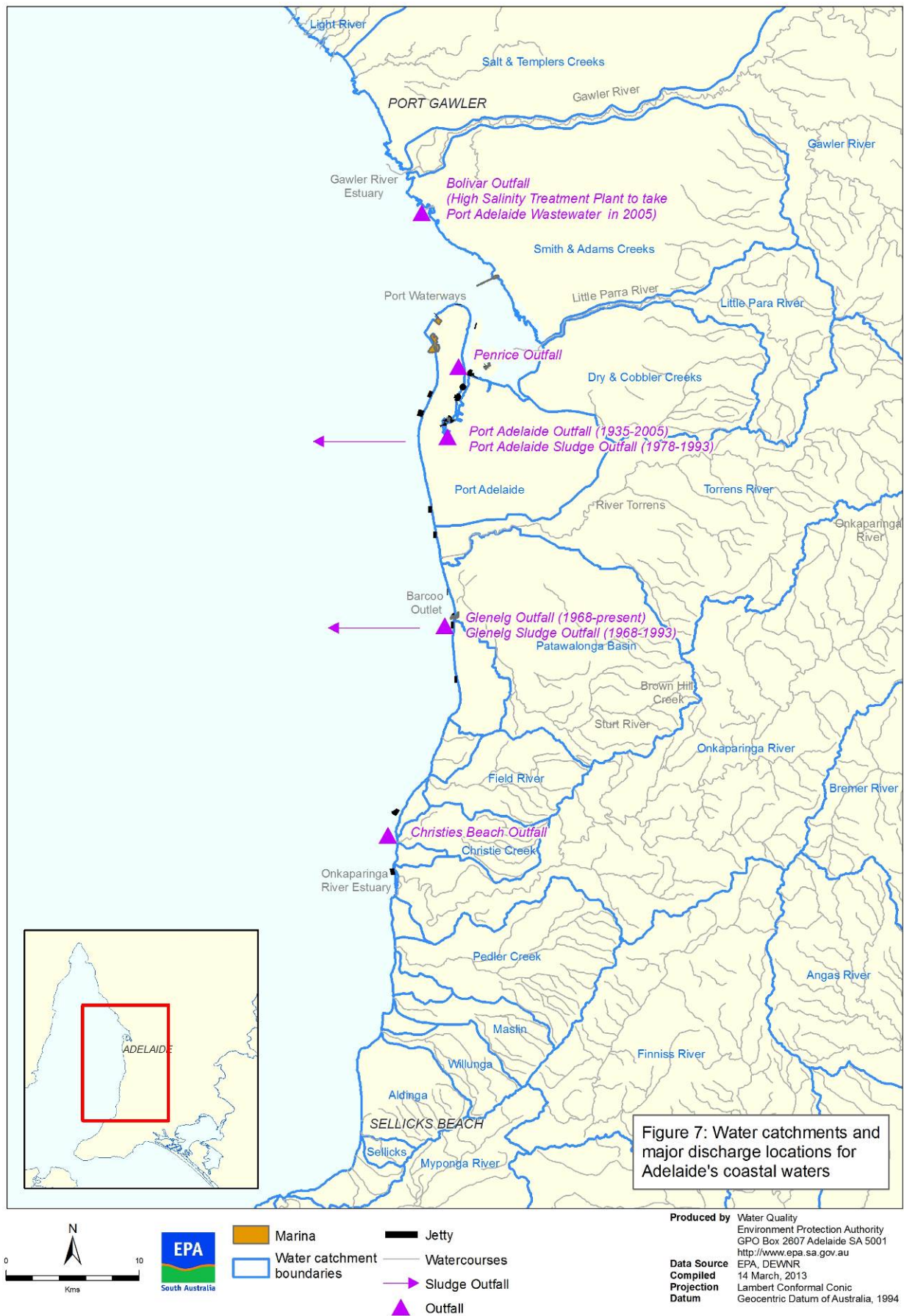


Figure 7: Water catchments and major discharge locations for Adelaide's coastal waters

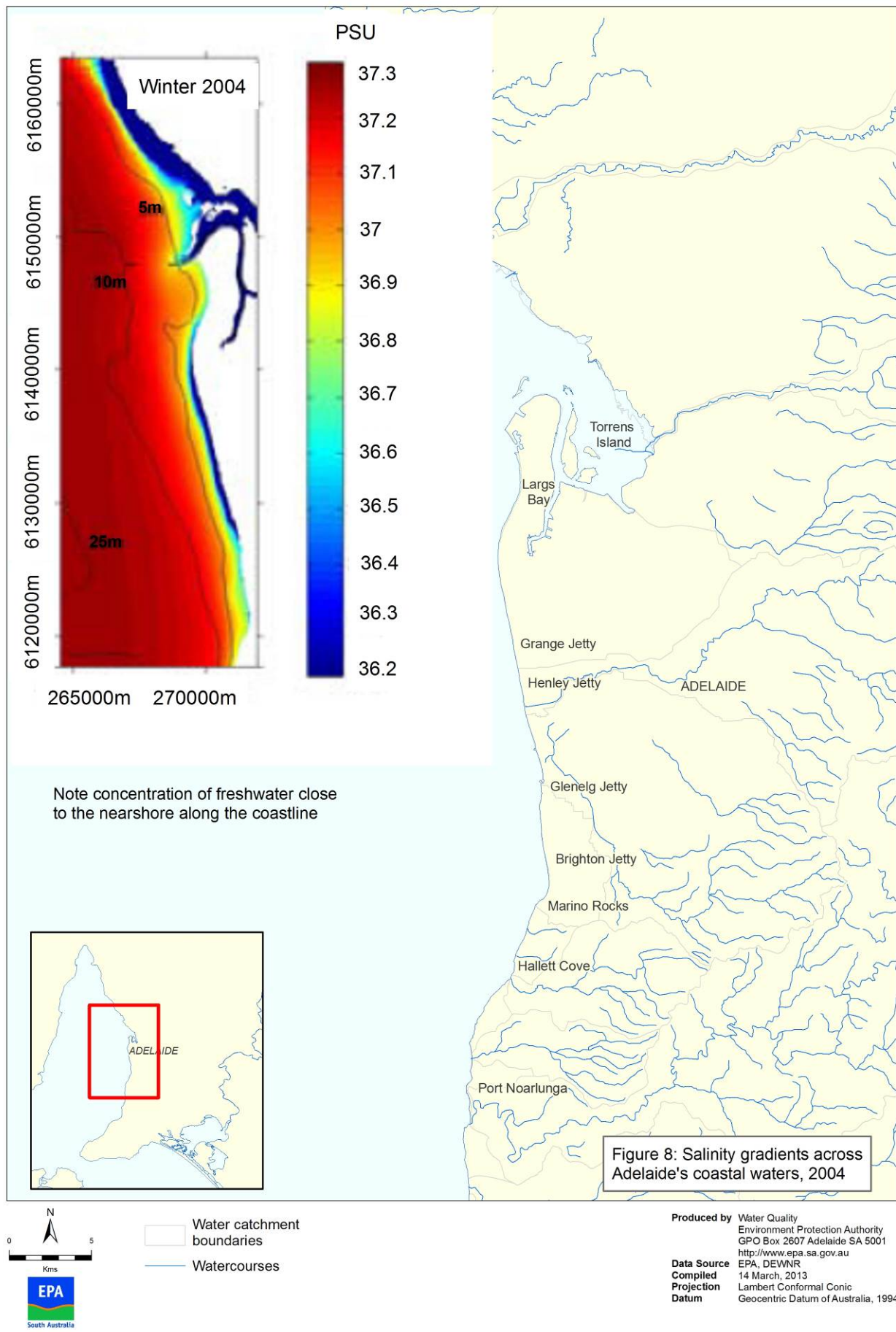


Figure 8: Salinity gradients across Adelaide's coastal waters, 2004

4.4.4 Southern coastal waters

In recent EPA assessment of the sites in the Yankalilla Biounit (EPA 2013a) including area between Marino and Sellicks Beach (refer to Figure 2), the ecological condition of the waters less than 15 metres deep is considered to be poor, as seagrasses were found to be patchy and there was evidence of nutrient enrichment. In the past reef and seagrass areas in this southern area were in a healthier state than those in the central metropolitan area, but the impacts of ongoing development with nutrient and sediment impacts are continuing to degrade coastal water quality and condition of seagrass and reef habitat in this area. Also refer to information on seagrass (section 4.6.3) and reef health (section 4.6.4, Figure 13) for the southern Adelaide area.

4.5 Ecosystem services

The coastal habitats within Adelaide's coastal waters provide an array of valuable and important ecosystem services for Adelaide and South Australia. These include:

- estuarine environments
- seagrass
- sediment
- reefs.

Ecosystem services is the concept that a set of natural assets such as water, plants, sediments, air and animals are of value to humans for the services they provide to humans in ecological terms which have an environmental, social and or economic benefit. For example, some of the ecosystem service values for estuaries that are provided to humans include breeding areas for species that are fished (both recreational and commercially) and water quality improvement values for settling of pollutants into sediments or filtering through estuarine wetland areas so water quality at the coast is improved.

The aquatic ecosystem value of Adelaide's coastal waters relate to the ecological significance of the coastal, estuarine and marine systems they support within the broader bio-region of Gulf St Vincent. In addition the ecosystem encompass the carbon storage value of seagrass beds that is many times greater than the equivalent sized terrestrial based carbon stored in areas such as rainforest and woodland.

Explored in greater detail, the following assets perform the associated ecosystem services:

Estuaries provide:

- carbon storage
- biodiversity benefits for the fishing industry, tourism and recreational users of the coast
- wetlands that assist in dissipating pollutants
- improved water quality
- habitats for juvenile fish
- habitats for international bird species.

Sediment supports:

- dune systems that offer recreational and aesthetical value
- stabilisation for the beach
- habitat and feeding areas both in the intertidal areas and below the high watermark.

Seagrass provide:

- habitat for species that are fished by commercial and recreational fishers
- carbon storage that is many times greater than the equivalent sized terrestrial-based carbon stored in areas such as rainforest and woodland
- a stabilising service for the ocean floor
- protection for the shore coastline.

Reefs provide:

- habitat for species that are fished by commercial and recreational fishers
- protection for the shore coastline
- opportunity for recreation and tourism.

4.6 Condition of marine and estuarine habitats

The *State of the Region Report 2008 (AMLR NRM Board 2008a)*, broadly describes the marine and estuarine habitats and the services which provide direct benefits to the community. These include the provision of food (recreational and commercial fisheries), cultural and recreational benefits, nutrient cycling and coastal protection. The habitats include:

- pelagic (open, deeper waters offshore) habitat
- submerged or subtidal habitats:
 - subtidal reefs
 - seagrass meadows
 - soft and sandy bottoms.
- intertidal habitats:
 - mangrove forests
 - salt marshes
 - intertidal rocky reefs
 - sandy and muddy beaches.
- estuaries.

These habitats, their ecosystems, fauna and flora are impacted to varying degrees by over-exploitation, visitor pressure, development and the loss of habitat and water pollution. The habitats are broadly indicated in [Figure 9](#) based on Bryars 2003).

While these habitats are directly affected by water quality impairment, those that provide indicators of the overall health of the marine ecosystem are seagrass, mangroves and reefs. Examples of the impacts on these habitats of reduced water quality include the large-scale loss of offshore seagrass meadows and extent of *Ulva* (cabbage weed) in the Port River–Barker Inlet system and the poor condition of many subtidal reefs.

This next section details information on estuaries, sediments, loss of seagrass and reef health.

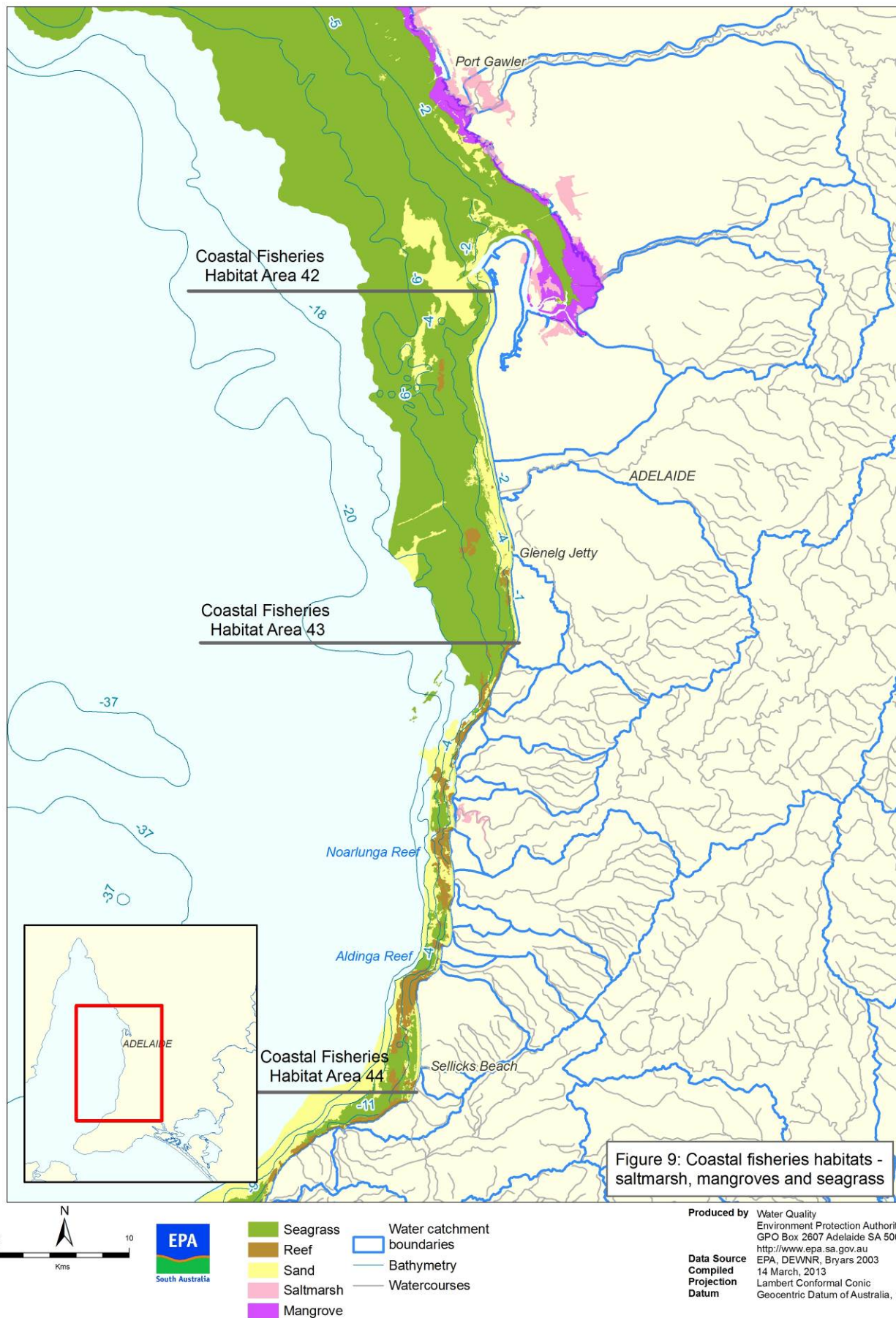


Figure 9: Coastal fisheries habitats – saltmarsh, mangroves and seagrass

4.6.1 Estuaries

Water bodies defined as estuaries include the Gawler River, Port River–Barker Inlet system, River Torrens outlet, West Lakes system, Patawalonga Basin, Field River, Onkaparinga estuary, Christies Creek, Maslin Creek, Willunga Creek, Sellicks Creek and the Washpool as identified in the draft State Estuaries Policy and Action Plan (DEH 2005b) and discussed in AMLR NRM Regional Plan (2008a).

The Patawalonga Basin, Torrens River outlet and West Lakes were described as being highly modified, artificial estuarine environments. Their current biodiversity values are considered to be limited, although they are regionally important for some marine species (AMLR NRM Board 2008a).

In the PWWQIP, it was considered more appropriate to consider the majority of Port River–Barker Inlet system as a bay rather than an estuary (EPA 2008a). Four of the wetlands are listed in the Directory of Important Wetlands in Australia namely Gawler River estuary (Port Gawler and Buckland Park Lake), Port River–Barker Inlet (Barker Inlet and St Kilda), Onkaparinga estuary and the Washpool lagoon (DEH 2007). The importance of these wetlands derives partly from the function of the estuarine areas for the use of migratory birds and is subject to a range of international agreements. The Draft State Estuaries Policy and Action Plan (DEH 2005b) also identify Pedlar Creek as an estuary.

Except for the large Port River–Barker Inlet system, where direct discharges of significant loads of nitrogen occur, specific water quality objectives have not been defined for estuaries along the Adelaide metropolitan coast. Work to define EVs for these estuaries will be undertaken over time and this will offer the opportunity to nominate WQOs specific to each. In the meantime the reduction in catchment-sourced pollutant loads to assist in achieving the WQOs presented in [Appendix 1](#) will improve water quality in these estuaries.

All of the estuaries are either highly modified and/or have agricultural/urban catchments. They are impacted by a range of pollutants, notably nutrients, turbidity/suspended solids, toxicants (metals) and faecal micro-organisms. This is reflected in the ambient water quality monitoring data available for some of the smaller southern estuaries presented in [Figure 4](#).

Similar to marine waters, occasional high flow events occur in the estuarine reaches, resulting in high suspended solid concentrations and frequently relatively high concentrations of pollutants associated with particulate matter, such as metals. Much of this material can remain in the estuarine sediments for many years.

The water quality of estuaries is defined under the previous EPA classification system as good, moderate or poor as indicated in Figure 4. Chapter 5 includes information on environmental flows for estuaries. Comments from the AMLR NRM Board provided in feedback on the ACWQIP indicated there is a need to discuss environmental flows to maintain the EVs within the region's estuaries.

Establishing EVs for estuaries should be undertaken as a separate process to the EVs for the ACWQIP and the catchments of the AMLR NRM region in the Healthy Waters project (undertaken by the EPA from 2008 to 2012). It is noted that EVs for estuaries were not established during either of these projects.

It is possible that setting EVs for estuaries could be considered in the framework for setting of EVs for priority waters across SA (according to Action 63 in Water for Good). The Water for Good action aims to establish a system for EVs for priority waters in SA by 2014.

4.6.2 Sediment

The location of sediment sampling sites along the coast and in the Port waterways are shown in [Figures 10 and 11](#). The sites have been classified as good, slightly impacted, moderately impacted or severely impacted. This classification is consistent with the Interim Sediment Quality Guidelines or ISQG (ANZECC 2000) which are also discussed in the Handbook for Sediment Quality Assessment (Simpson *et al* 2005). The ISQG are presented as trigger levels and are not intended to definitively indicate a problem exists. Nevertheless, the higher the concentrations the greater will be the potential for ecological impact, particularly from manufactured chemicals.

Examining Figures 10 and 11, it can be seen that the majority of sediment sampling has focused on the Port River and North Arm areas of the Port waterways in high-risk locations associated with stormwater drains and other expected sources of toxicants.

These sites were typically contaminated with a range of toxicants, including metals, organic materials (eg polychlorinated biphenyl or PCBs, organochlorine pesticides) and antifouling agents (eg tributyltin—tin or TBT). It could be expected with the scale of existing activities, sheltered waters, fine-grained sediments/mangrove muds and history of activities, there would be some areas of contamination. It is also important to note that many of the sites which were classified as poor or moderate (investigated by EPA in the survey of the Port River for heavy metals and PCBs in dolphins, sediment and fish (EPA 2000a) were targeted sites, being the most likely locations for contamination. Therefore, the existing record of samples should not be considered representative of the wider Port waterways region.

Other estuarine environments examined include the Onkaparinga estuary and Patawalonga Basin. Sediment analysis has been undertaken for copper (Cu), lead (Pb) and zinc (Zn) at over 60 locations throughout the Onkaparinga estuary. Virtually all concentrations were less than the ISQG low-level trigger values.

It is well documented that the Patawalonga Basin previously acted as a detention basin for upstream catchment flows, resulting in pollutant retention (metals and nutrients). As part of the project to divert stormwater from Patawalonga Basin direct to the Adelaide coast via the constructed Barcoo Outlet in the late 1990s, the lake was dredged to remove accumulated silt. This diversion of flows up to the 1-in-2 year average recurrence interval (ARI) events has returned the lake to a condition allowing for the recreational use for which it was intended, as well as establishing a healthier aquatic ecosystem. The implementation of the catchment works to date has resulted in a pollutant load reduction in the lake through the regular removal of accumulated silt from upstream structures.

Along the coastline, analysis of sediment for metals has been undertaken at the SA Yacht Club basin, Outer Harbor channel, North Haven Marina, Largs Bay and Port Stanvac. At the 10 ACWS monitoring sites, which included locations on the River Torrens and Barcoo Outlet, analysis included a focus on metals, organochlorine and organophosphate pesticides, triazine herbicides, glyphosphate, polycyclic aromatic hydrocarbon (PAHs) and total petroleum hydrocarbons (TPHs). The organic compounds in the ACWS were all below detectable limits and all metals were below ISQG low-level trigger levels. Consequently sediments are classified as good.

For sediment reduction work, any investment in catchment remediation and engineering structures needs to be properly targeted to know what fraction of the sediment load is being addressed and which methods will have the greatest beneficial impact on Adelaide's coastal waters.

To date the AMLR NRM Board has designed sediment basins to remove 50% of the total sediment load, but it is uncertain if the right sediment fraction has been targeted. It is a challenge to engineer any reduction in the fine sediment loadings using standard engineering design approaches. However, more recent findings from investigative research indicate that stormwater management approaches that collect, store and re-use low flows result in the removal of fine sediment.

The AMLR NRM Board commissioned research with Fernandes *et al* (2008a) and Fernandes (2008) to investigate the sedimentation impacts on reefs to try and provide better information with regards to prioritising catchments to manage potential sediment impacts to reefs. This research found that although some sedimentation is related to stormwater discharges from catchments in other areas erosion of coastal cliffs (particularly along Adelaide's southern beaches) is contributing up to 30% of sedimentation found on reefs along the Adelaide coastline.

Understanding the contribution of both inputs from catchment activities and also natural erosion of the coast is vital to ensure funds are targeted to directly manage problems related to sedimentation from stormwater in the most appropriate manner.

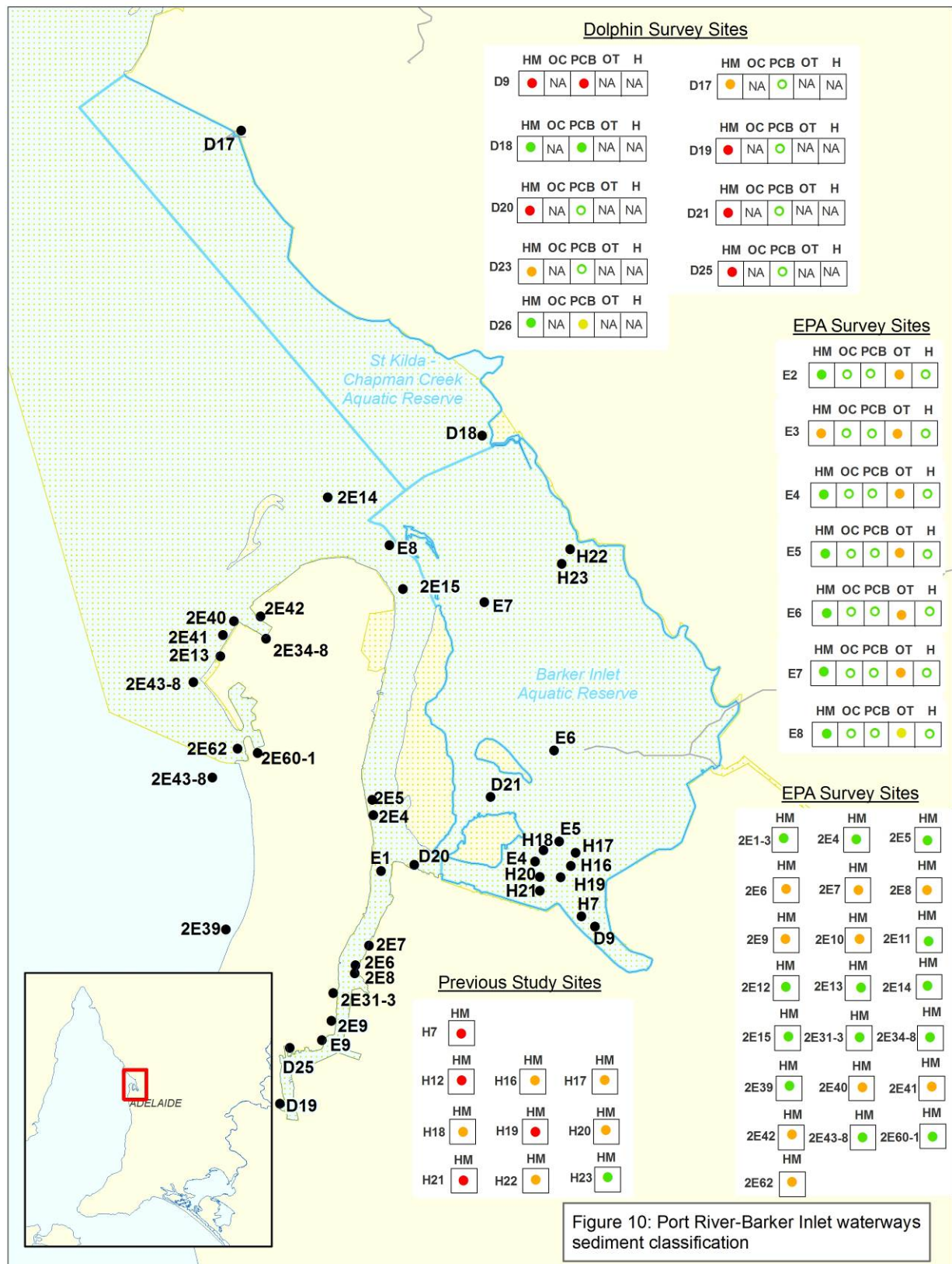


Figure 10: Port River-Barker Inlet waterways sediment classification

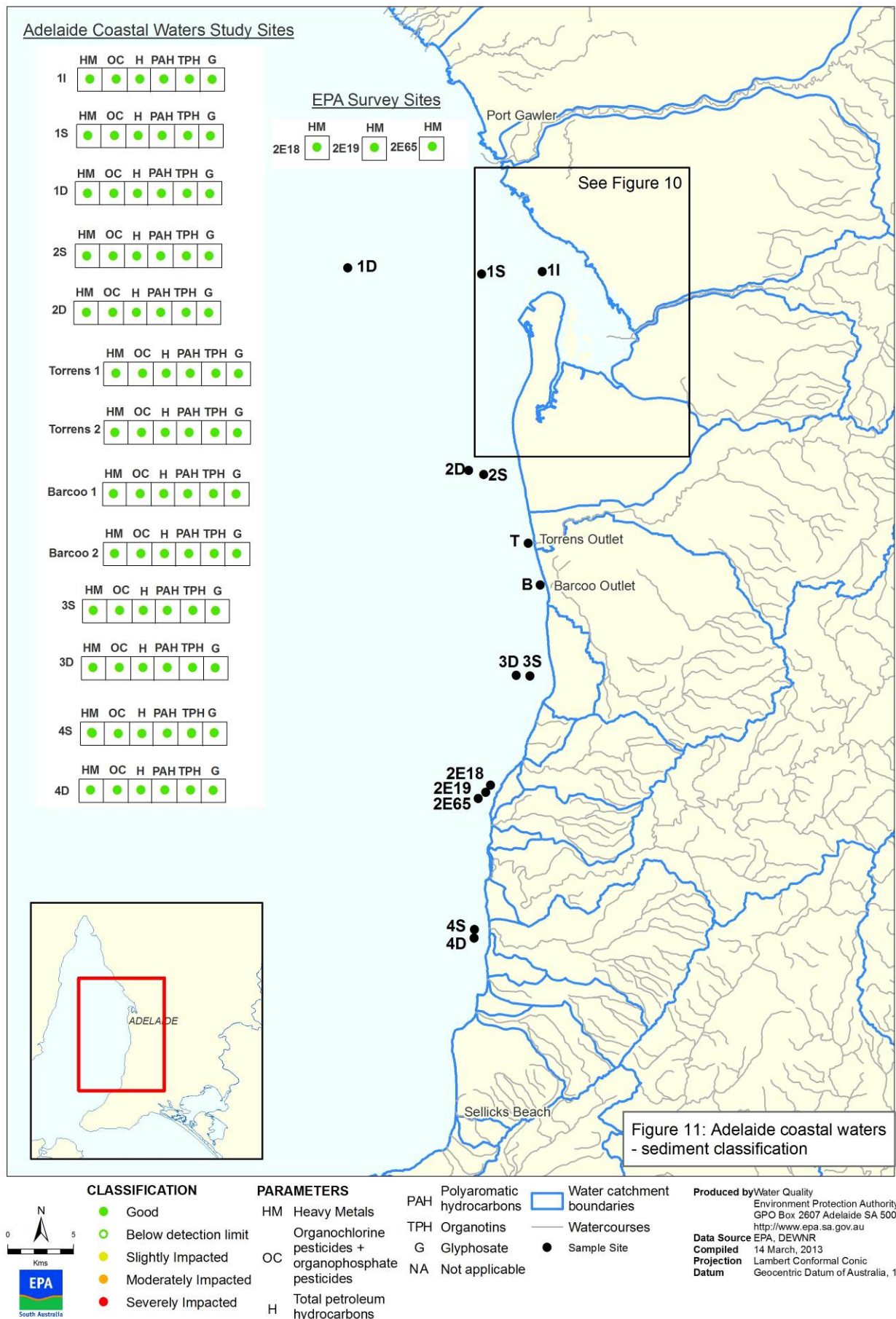


Figure 11: Adelaide coastal waters – sediment classification

4.6.3 Seagrass

In the ACWS, it was identified that many years of near-continuous inputs of nutrient-rich, turbid and coloured water and wastewater have long been implicated in the loss of over 5,000 hectares of seagrasses. The ultimate source of these discharges has been the development of the Adelaide urban area and associated stormwater, wastewater and industrial discharges (Westphalen *et al* 2004). Note that Westphalen *et al* includes a map of historic seagrass loss along the Adelaide coastline that clearly shows the impact of the wastewater treatment plant sludge outfalls on seagrass loss alongside and near to the sludge pipelines. These sludge discharges no longer occur along the Adelaide coastline as they were discontinued after it was shown that they caused the loss of significant areas of offshore seagrass.

The ACWS, which had three focus points (water quality, seagrasses and sediments), has indicated that all the evidence points to a key role of nitrogen loads in seagrass decline. Increased turbidity levels, resulting in reduced light penetration have also been a factor for seagrass loss in what is now called the inshore zone.

The extent of changes in seagrass coverage from 1995 to 2007 is shown in Figure 12. This DEWNR seagrass map shows the blue line of seagrass being approximately 1 km offshore. In some locations regrowth of seagrass is occurring in areas where water quality has improved. However, further work is needed in updating information on seagrass loss and regrowth in implementing the strategies of the ACWQIP to effectively monitor the response of seagrass to improvements in water quality off the Adelaide coastline within the last decade.

Sediment movement inside the current line of seagrass offshore may be sufficient to prevent regrowth of seagrasses in many locations even if excess nutrients were not an overriding problem. As nutrient and sediment levels decrease, it is likely that episodes of recovery will occur in years where winter storms are less intense. More research is needed to determine the most likely locations where sediment conditions and water quality improvement would allow the recovery of seagrass towards shore.

A natural seed bank is available to support future recovery if conditions are conducive to recruitment and subsequent growth. The ACWS describes timeframes for the regrowth of seagrass in other parts of the world as 20 years or more once suitable conditions were re-established, with a return to a seagrass dominated system of local species potentially taking over 100 years. Intervention in key areas with re-establishment of seedlings may potentially assist this process. This recovery can commence when substantial reductions in nutrient and sediment discharges are achieved and light conditions for seagrass are improved with lower turbidity nearshore.

In the early 2000s DEWNR had been working with research organisations and other government agencies to commence research and investigative work that will help prepare seagrass ready maps to identify locations best suited to the assisted recovery of seagrass. This work is currently supported by the AMLR NRM Board, SA Water and an Australian Government ARC Linkage Grant in collaboration with Flinders University, SARDI and DEWNR. The project is called *Enhancing seagrass restoration: Improving low cost techniques for facilitating natural recruitment* and involves trials to facilitate natural recruitment of seagrass seedlings in situ via biodegradable hessian bag substrates that anchor seedlings and facilitate growth. The project is also assessing the influence of wastewater discharges on seagrass recruits and providing more information on seagrass biology and ecology to assist rehabilitation.

In summary seagrass work needs further support to continue for a long enough period to inform and then monitor seagrass recovery efforts and feed into the five yearly State of Environment Reporting. Seagrass recovery is likely to take decades in many areas of Adelaide's coastal waters once water quality conditions are suitable for re-establishment of seagrass.

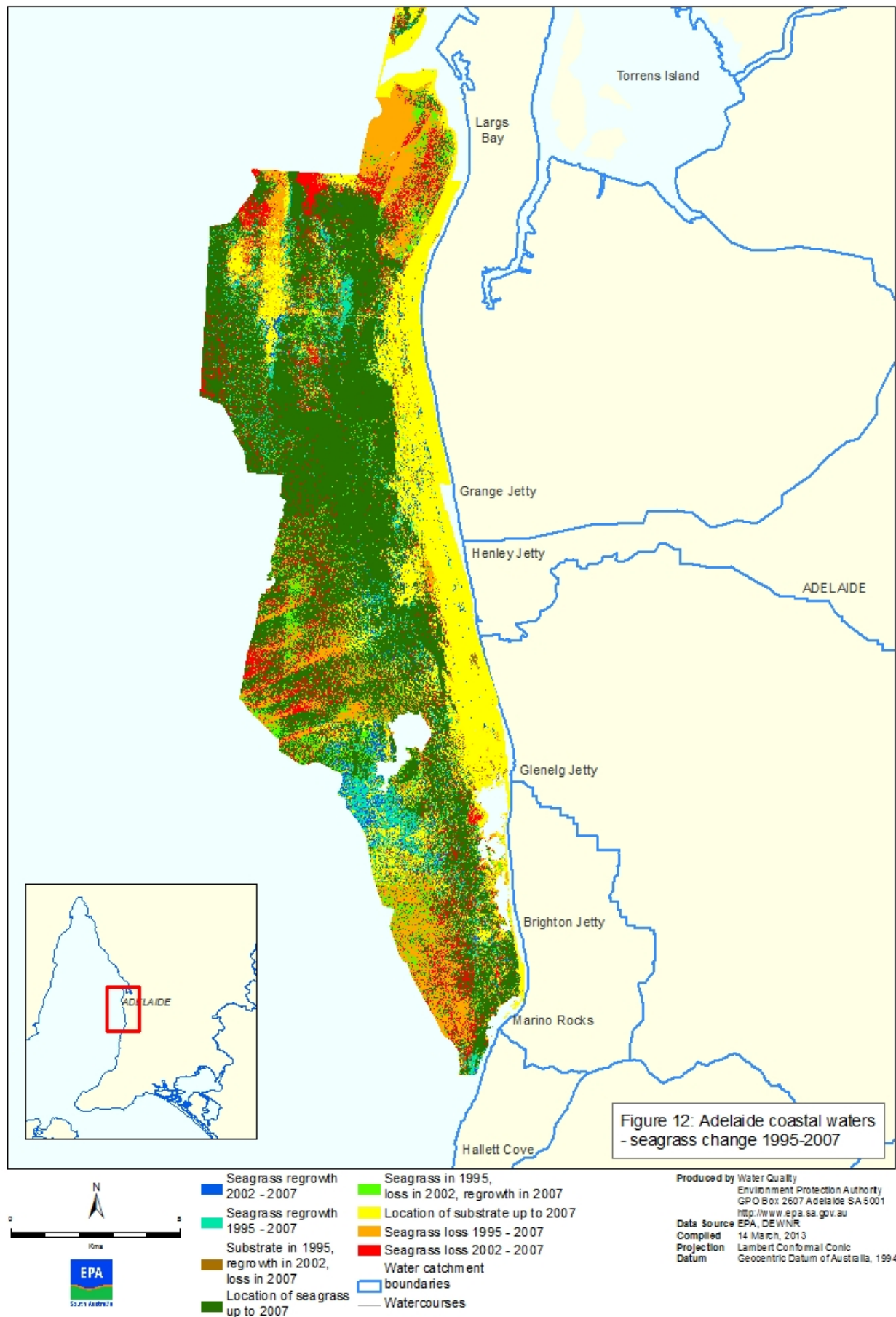


Figure 12: Adelaide coastal waters – seagrass change 1995–2007

Importance of seagrass

Overview

Seagrasses play an important role in marine ecosystems. They oxygenate the water, recycle nutrients and provide shelter for marine animals as well as food for fish and other species. Seagrasses are flowering plants that grow underwater in marine environments. They are quite different to seaweed which is an alga. Unlike seaweed they have a large root system which is needed to anchor them to the sand. Some nutrients are taken up by the roots, but seagrasses get the majority of their nutrients via absorption through the leaves. Seagrasses can form beds or meadows comprising many individual plants. Seagrass meadows support around 40 times more animals than the adjacent bare sand.

Fifteen species of seagrass are known to occur in South Australia covering an estimated area of 9,620 km². They are generally found growing on sandy or muddy areas in estuaries, coastal lagoons, gulfs and sheltered bays. The most extensive seagrass meadows occur in Spencer Gulf and Gulf St Vincent.

It is estimated that seagrasses cover 5,000 km (Bryars *et al* 2008) of the sheltered waters of Gulf St Vincent. The dominant seagrasses are known as ribbon-weed or tape-weed (*Posidonia* spp.) and wire-weed (*Amphibolis* spp.) and in the shallower regions, paddle-weed (*Halophila* spp.) and eel grass (*Zostera* and *Heterozostera* spp.).

Seagrasses in marine ecosystems

Seagrasses host a diverse range of small organisms called epiphytes (plants) and epifauna (animals) living in microhabitats and grazing on the leaves, stems and root systems. These organisms are important contributors to the overall productivity of seagrass meadows. Excess nutrients however can cause prolific epiphyte growth and lead to seagrass loss. Because of this, seagrasses can be useful indicators of the nutrient loading in the water column. Refer to Adelaide Coastal Waters Information Sheet No.2 *Seagrass Health* (EPA 2009) for more detailed information on seagrass loss. Seagrasses also provide a nursery habitat for fish (eg juvenile whiting and flathead) and habitat for many other species, including juvenile crustaceans.

Seagrass leaf litter (known as detritus) makes up a major food source for many marine species. Seagrass detritus found on beaches can be a seed source for seagrass re-colonisation and provides habitat for insects, birds and reptiles. A healthy beach environment is one with seagrass detritus on the beach. The value of seagrasses and seagrass mats as a carbon sink is also beginning to be recognised, for which the economic carbon storage value can be significant. The loss of approximately 260 km² of seagrass in the southern temperate waters of Australia is estimated to be worth \$500 million (Moore & Westphalen 2007).

Seagrasses as sediment stabilisers

Seagrasses trap and hold sediment on the sea floor and play an important role in the marine ecosystem. They accumulate fine sediment at the rate of about 1 cm every 100 years. Most of the seagrass beds in Gulf St Vincent have trapped at least one metre of sediment. This implies that Gulf St Vincent seagrass meadows have existed in their current form for at least 10,000 years. The seagrass sediment that has built up as a platform is an important protective buffer from waves for beaches and the shoreline.

4.6.4 Reefs

The health of subtidal reefs along Adelaide's coastline has been assessed on several occasions in recent years using the Reef Health Survey approach (Turner *et al* 2007), an analysis of Reef Watch data (Westphalen 2009, 2010), community-based reef monitoring programs currently underway including Reef Watch (explained below) and the Reef Life Survey. Connell *et al* (2008), present evidence of wholesale loss of canopy-forming algae (up to 70%) on parts of the Adelaide metropolitan coastline since urbanisation.

The causal mechanisms for reef degradation are difficult to pinpoint, as reef health is likely to be the product of a range of both direct and indirect influences similar to those posing threats to local seagrass systems (Westphalen *et al* 2004). However, nutrients, sediments and turbidity are known to be implicated in the loss of large canopy brown algae, with increases in turf-forming species. Turf-forming algae pose a serious threat to the biodiversity of coastal ecosystems, due to their ability to inhibit the recruitment of the larger canopy forming algae. A study conducted within South Australian waters has found turf-forming algae create more extensive habitat on subtidal rock adjacent to urban areas than in non-urban coastal areas (Gorgula and Connell 2004).

The current health of metropolitan reefs is summarised in [Figure 13](#) from information presented in Westphalen (2009, 2010) and Turner *et al* (2007) based on several reef health surveys undertaken from 2005 to 2010. The reef health ratings presented in [Figure 13](#) refer to the most recent assessments available for specific sites. Some sites have not had repeat surveys to update their ratings since the information was presented. Note that there has been some variability in ratings between seasons as indicated by Westphalen and the most recent reef health survey work has found that the Hallett Cove reef that was previously considered to be in 'good' condition now has a 'caution' rating and has been overtaken by a rapid expansion of mussels as reported by Westphalen (2010).

However, there is a distinct south to north trend, with the southern reefs considered to be healthier, being dominated by the large brown (Phaeophyceae) macroalgae and the northern reefs composed of the smaller foliaceous and turfing red (Rhodophyceae) algae. The healthier reefs have macroalgal community structures similar to those found on the Fleurieu and Yorke Peninsulas. However, many of the southern reefs that appear healthy when considering macroalgal composition still received a low rating because of low fish numbers, sedimentation levels and/or bare substrate.

It is notable that Horseshoe Reef has declined substantially in health since an earlier survey in 1999, with a change from a mussel/robust brown community to a reef comprising 60% bare substrate. Horseshoe Reef was subsequently rated as the poorest site in the 2005 survey. This reef is relatively close to the dredging site offshore Port Stanvac ([Figure 13](#)) and Christies Creek, which has been identified as a sediment source as a result of erosion (AMLR NRM Board 2006a).

Up until recently, understanding of subtidal reefs has been insufficient to establish sustainable nitrogen, suspended solids or coloured dissolved organic matter (CDOM) loads. It is therefore important to monitor subtidal reefs while pollutant loads are reduced to ensure these reductions are sufficient to protect these ecosystems and allow for recovery. The AMLR NRM Board commissioned research with Fernandes *et al* (2008a) and Fernandes (2008) to investigate sedimentation impacts on reefs to try and provide better information with regard to prioritising catchments to manage potential sediment impacts to reefs. This research found that sedimentation rates and impacts on reef areas are greatest in the southern Adelaide catchments where the most intensive residential development is currently occurring.

To reduce the continuation of the current overall trend of poor water quality, seagrass loss and declines in reef health condition along Adelaide's coastal waters, the ACWQIP advocates the application of water sensitive urban design (WSUD) to all new and infill development. Further to this, the ACWQIP notes that WSUD principles and practices need to be applied in the design and operation of other urban areas, such as streetscapes and open spaces as well as infrastructure upgrades (and maintenance) to reduce sediment and nutrient loads from stormwater.

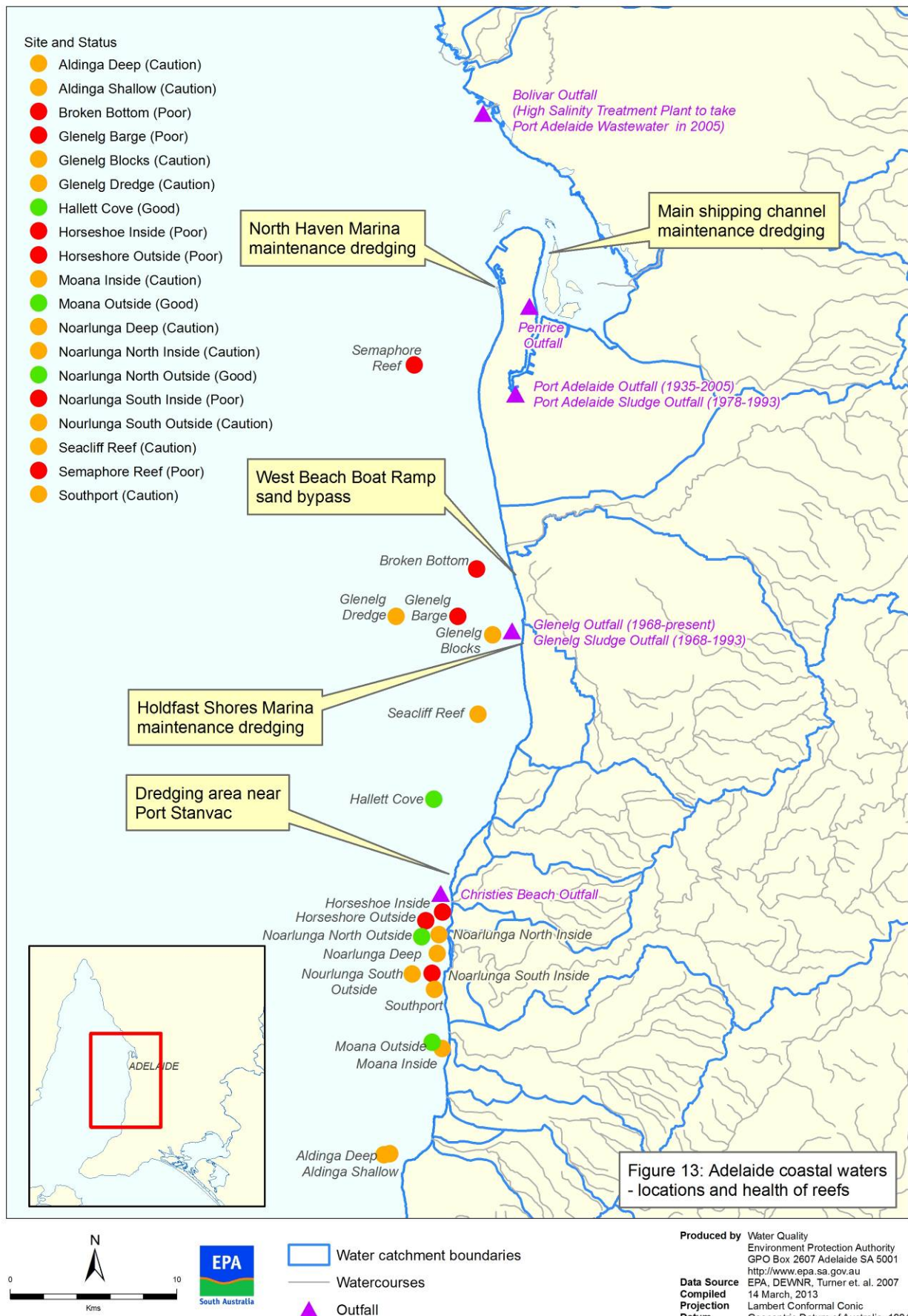


Figure 13: Adelaide coastal waters – locations and health of reefs

How does Reef Watch describe the health of Adelaide's subtidal reefs?

Reef Watch is an environmental monitoring program managed by the Conservation Council of South Australia and funded mainly by the AMLR NRM Board. The Reef Watch training program provides recreational scuba divers and snorkelers with the necessary skills to gather valuable information about the marine environment. The data will contribute to a growing body of information enabling better management.

With the aid of many of South Australia's top marine scientists and educators, Reef Watch has developed survey methods that are easy to use, providing useful data that is comparable with those collected by scientists. With the help of hundreds of volunteers, Reef Watch is able to gather, collate and disseminate quality information on the status of our marine environment. This information is made available to the general community, schools, government bodies and research institutions.

In order to establish a ranking for each site, all survey information is averaged to produce a single composite score, ranging between zero and 100. This score provides a relative measure of health. Reef health is set at three break points:

- poor condition (0–34)
- caution recommended (35–65)
- good condition (66–100).

The 'caution recommended' classification highlights reefs that may be in a state of flux, but should not necessarily be allocated to the 'poor condition' category. Instead such reefs should be the focus of further monitoring and research.

Refer to [Figure 13](#) in terms of how the rating system is used for the classification of Adelaide's reefs.

4.7 Risks to water quality for Adelaide's coastal waters

In 2009, the EPA produced a report, *A risk assessment to threats to water quality in Gulf St Vincent* (Gaylard 2009) that summarises the status of threats to water quality for various environmental values for Gulf St Vincent. This report encompasses the area of Adelaide's coastal waters concerning the eastern section of Gulf St Vincent and the following information regarding the status of threats to water quality (Gaylard, 2009, pp 20–28):

- WWTP effluent to be high risk to ecosystem values, for aquaculture and shellfish harvesting
- WWTP effluent to be a moderate risk to aesthetic and recreational values
- stormwater to be a high risk to ecosystem values
- stormwater to be a moderate risk to recreational and aesthetic values
- discharge from Penrice Soda Products present a high risk to ecosystem values and aquaculture values
- dredging activities in the eastern region are a high risk to ecosystem values
- dredging to be a moderate risk to recreational and aesthetic values
- discharge from AGL Torrens Island Power Station is a high risk to ecosystem and aquaculture values
- risk to ecosystem values from commercial fishing and wharves to be moderate, but the risk to aquaculture and aesthetic values is low
- recreational users of water are a moderate risk to recreational values
- bathers are a low risk to aquaculture values as no significant recreational activity in aquaculture regions
- risk to ecosystem values from trace metals from slipways to be moderate
- trace metals from slipways are a low risk as there are no aquaculture facilities in close proximity to the slipways.

The risk assessment for Gulf St Vincent focuses on assessing risks to water quality, but there is information on significant risk areas to environmental values that focus more on impacts and activities along the coast rather specifically on water quality. These potential threats include prawn trawling, marine pests, desalination plants and climate change impacts.

Awareness, investigation, research and management of other threats to coastal, estuarine and marine ecosystems apart from water quality decline are managed through a number of other state and local government agencies and groups including DEWNR, PIRSA, AMRL NRM Board, DPTI, Local Government Association, coastal local governments and the Conservation Council of SA. Largely local government interests concerning the threats to coastal and marine ecosystems relate to planning and development particularly in the context of climate change and sea level fluctuations. Much of the recent research, awareness and work on the threats to coastal, estuarine and marine ecosystems have been undertaken primarily through the AMRL NRM Board and DEWNR coast and marine programs. Examples of the range of broader coastal, estuarine and marine threats applicable to Adelaide's coastal waters and Gulf St Vincent that have been investigated include:

- issues relating to the management of competing uses and activities
- the impacts of climate change and sea-level rise on coastal, estuarine and marine habitats as well as development and infrastructure
- ongoing management of the impacts of historic and current development along the coastline
- management of coastal and marine pest plants and animals
- emergency spill management
- impacts of climate change and population growth.

Stormwater—what is the problem?

Coast and marine ecosystems and recreational amenity are the two main aspects of coastal water quality that are impacted by pollutants in Adelaide's stormwater. Specific Adelaide coastal waters environmental values (EVs) that are affected by stormwater include aesthetic, cultural and spiritual, ecological and recreational values. In the development of the ACWQIP, the Adelaide coastal community has expressed a desire for action to be undertaken to reduce the volume and improve the quality of stormwater inputs to Adelaide's coastal waters.

Loads of suspended solids and coloured dissolved organic matter (CDOM) in stormwater and catchment flows are generally consistent with amounts of rainfall. For example, low stormwater flows carry lower loads (although these can be disproportionately high for CDOM at different times of the year) and the high flows from the occasional very high rainfall events scour stream banks and mobilise sediments that are retained in weir structures adding disproportionately to the loads carried by these very high flows.

While most of the suspended solids and CDOM generated across the Adelaide region enters coastal waters and eventually impacts on seagrass, ACWS modelling has shown that it is retained for long periods close to shore, mostly inside the seagrass line. In this location along the coast, it causes little direct ecosystem harm at present, but has consistently contributed and will contribute in the future to the poor water quality that has characterised Adelaide beaches over the past few decades. The high flow/load events that occur every few years exclude light from seagrass, particularly nearer to shore. Healthy seagrass is better able to cope with this effect if it only lasts for up to a week or so and does not add to an existing pattern of generalised low light (as is often now the case).

While further work is required to effectively understand the way that suspended solids and CDOM disperse along the coast, our current understanding of the dynamics of Gulf St Vincent leads us to expect that this material travels north over time and contributes to the general filling of the gulf. The only effective way to improve swimming water quality along Adelaide's beaches is to remove the regular discharges of fine sediment and organic matter from stormwater sources.

5 Estuarine environmental flows

Since European settlement, significant infrastructure changes across Adelaide's plains have impacted on estuarine environmental flows. Creeks and outlets that once required large rainfall events to cut through the dune system to the coast now flow with even relatively small rain events, resulting in more regular additional sediments and nutrient outputs to the coast.

Changes in the flow regimes of urban catchments that revert flow patterns to those that were in place prior to European settlement are likely to enhance receiving waters.

5.1 Overview

Significant changes have occurred across the Adelaide Plains to modify coastal and estuarine flows and the operation of estuarine systems at the coast since initial European development and more recent infill urbanisation in the mid to late 1900s. Creeks and outlets that once flowed periodically to the coast in the largest rain events cutting through the dune systems now flow with even relatively small 10 mm to 30 mm rain events bringing additional sediments and nutrients to the coast more regularly. Some of these smaller creeks and outlets are also now diverted through concrete drains and the stormwater system either directly to the coast or to larger permanent outlets or estuarine-like areas such as the Port waterways, Torrens Outlet, Patawalonga Basin and Barcoo Outlet and the Onkaparinga River system.

Further to this, as a result of agricultural and urban development in the coastal catchments, natural flow patterns have been considerably altered, impacting on estuarine aquatic ecosystems. Environmental flows is not an issue for the marine environment for Gulf St Vincent, as originally there was little or no flow to the coast. However, environmental flows may be an issue in some of the estuaries, particularly for areas where there were more regular winter freshwater inputs, such as the Onkaparinga estuary.

Some research work has been undertaken for the estuaries that are within the study area. For example, work has been undertaken for the Onkaparinga and Gawler Rivers and a program of environmental water trials for the Western Mount Lofty Ranges has been undertaken to meet environmental water requirements (EWRs) for catchments such as Gawler River (NABCWMB 2000) and the Onkaparinga River (Sinclair Knight Merz 2003) in the AMLR NRM region. After the surface watercourses and underground waters of the western Mount Lofty Ranges were prescribed in 2005, a water allocation plan was prepared under the provision of the *Natural Resources Management Act 2004*. Environmental flows were allocated to estuaries as part of water allocation plan development.

The need to provide water for the environment has been recognised by state and federal governments and under the Council of Australian Governments agreement (COAG 1994), the environment is recognised as a legitimate water user. An awareness of the issue is important so that strategies adopted to minimise pollution do not inadvertently impact on natural estuarine flow regimes. Environmental flows are briefly discussed for each of the key estuary systems. In general, changes in the flow regimes of urban catchments that move flow patterns toward those that were in place prior to European management are likely to enhance receiving environments.

5.2 Port waterways

The Port waterways are a marine estuarine system dominated by tidal flows. Prior to European settlement, freshwater inflows from the south, including the River Torrens system, were intercepted by extensive freshwater/brackish wetlands, which 'dampened' the effect of major storm flows. These wetlands no longer exist and the area is now urbanised. The River Torrens was the major stream, discharging into the Port waterways and wetlands. It was diverted into Gulf St Vincent via a channel cut through the dune system at West Beach as part of flood mitigation works in 1938.

To the north, on the eastern side, are Dry Creek, Little Para River and Smith Creek. These were formerly ephemeral in nature, with high flows to the coast only during major flood events and in particular for Smith Creek and Dry Creek and

spreading out into the former extensive saltmarsh areas around Barker Inlet. The lower part of Dry Creek is now an artificial drain, allowing the rapid passage of floodwaters (and sediments) from its urbanised catchment.

To the north, on the eastern side of the coastline, Dry Creek, Little Para River and Smith Creek can be found. These were formerly ephemeral in nature, with high flows to the coast only during major flood events and in particular for Smith Creek and Dry Creek, spreading out into the former extensive saltmarsh areas. The lower part of Dry Creek is now an artificial drain, allowing the rapid passage of floodwaters (and sediments) from its urbanised catchment.

As described in the PWWQIP (EPA 2008a), large areas of the Port waterways and virtually the entire natural freshwater wetlands have been lost to development. Given the Port waterways' estuarine nature and the characteristics of catchment drainage to the waterways, environmental flows are considered in relation to:

- interruptions to, or improvements in, tidal flows and the effects of sea level change due to greenhouse impacts
- the development of constructed freshwater wetlands and fish passage opportunities
- flows in the Dry Creek, Little Para and Smith Creek catchments.

5.2.1 Interruptions in tidal flows

Tidal flows have been interrupted by:

- urban and industrial development which has prevented inland tidal flows resulting in the loss of saltmarsh and mangrove habitats
- the construction of levee banks, further alienating areas that had been previously inundated by high tides
- the construction of easements (transmission line easement across to Torrens Island Power Station)
- the modification of flow patterns in Angas Inlet, as a result of cooling water needs for the power station.

Significant actions taken in recent years to re-establish 'natural flows' have improved flows or had some compensatory benefits. For example:

- the transmission line easement across southern Barker Inlet formerly interrupted flows, resulting in the loss of large mangrove areas. A culvert has since been constructed on the tidal channel resulting in mangrove recolonisation
- Imperial Chemical Industries (ICI), who developed the Penrice saltfields, removed a seawall in 1954 when the saltfields were constructed, resulting in the large-scale re-establishment of mangroves (EPA 2008a)
- the construction of the 170-hectare Barker Inlet Wetland includes a marine intertidal wetland area of approximately 50 hectares for saltmarsh/mangrove colonisation
- a management plan has been prepared for the Mutton Cove Conservation Park. This aims to improve tidal exchange within the cove by modifying the inlet structure (Coleman and Cook 2003).

These modifications to flow are intended to benefit the biological communities of the cove and the removal of the tide gates at the mouth of Dry Creek would have some benefits for fish passage.

The need for saltmarsh and mangrove regrowth areas in the event of sea level rise should be seen as a general planning issue (and benefit) for the region. For example, if land is available behind the levee banks on the eastern side (Penrice saltfields, Bolivar WWTP lagoon area), environmental needs should be considered rather than seeing this area as land only for new development. With any sea level rise, there may be impacts on mangroves and saltmarsh but the extent of the impacts will depend upon the rate of change. Saltmarsh and mangroves trap sediments and will adjust to the changes, but if flows are restricted and changes occur too quickly for species to adapt and move landward; then mangrove areas will be at risk along with remaining saltmarsh areas.

5.2.2 Constructed wetlands and fish passage opportunities

Within the vicinity of the Port waterways a number of large freshwater wetland systems have been developed, which include:

- Greenfields Wetlands, Stages I, II and III
- Barker Inlet Wetland
- Magazine Creek Wetland
- Range Wetland.

Collectively, these represent a substantial area, which goes part of the way to replacing some of what has been lost. The wetlands were developed with the following broad objectives:

- to improve stormwater quality and protect downstream ecosystems (Port waterways)
- to improve landscape amenity and provide passive recreational opportunities
- to provide improved habitat for fauna and flora
- to provide opportunities for the harvesting and reuse of stormwater and in some instances, flood control.

A small detention basin was also developed on the LeFevre Peninsula at Snowdens Beach, but was never completed to become a functioning wetland system.

Greenfields, Barker Inlet, Magazine Creek and Range Wetlands have achieved their objectives and the Barker Inlet and Greenfields Wetlands are now part of the Metropolitan Open Space System (MOSS). Although only created in the early 1990s, the Barker Inlet Wetland has developed significant conservation value and has been listed as a wetland of national importance. Due to the proximity of these wetlands to the Port waterways, fish movement from the estuary into the wetlands was a significant achievement for the wetland ecosystem and the fish that breed there.

A fish ladder was constructed at the Torrens River Breakout Creek weir outlet at Henley Beach South. This promotes the movement of freshwater fish that spawn in the sea back to freshwater habitats for breeding and vice versa for species that have a marine stage to move into the catchments for their freshwater stage. Four fish species which congregate at the weir are most likely to use the ladder – pouched lamprey (*Geotria australis*), shorthead lamprey (*Mordacia mordax*), common jollytail (*Galaxias maculatus*) and climbing galaxias (*Galaxias brevipinnis*). Several other species are likely to use the fish ladder as casual visitors to the lower reaches of the Torrens, including yellow-eyed mullet (*Aldrichetta forsteri*), congolli (*Pseusaphrirtis urvilli*), blue spot goby (*Pseudogobius olorum*) and black bream (*Acanthopagrus butcheri*). While Breakout Creek is an artificial opening to the sea, a wide variety of fish use it for passage as it is now the only location where this part of their breeding cycle can occur.

5.2.3 Flows in Smith Creek, Dry Creek and Little Para River

Although Smith and Dry Creeks may be seen as artificial drains, there are opportunities for fish passage, linking with the upstream constructed wetlands, including greenfields. These opportunities should be considered in:

- future wetland design and even revisiting existing wetland outlet structures
- future design and landscaping of the drains.

Little Para River is now developing as an urban catchment with a water supply reservoir in its headwaters. It has a modified flow regime, but still remains largely an ephemeral system that flows in the winter and spring and is often dry through summer and autumn, (except for some small pools of water).

The Urban Biodiversity Unit (UBU) of DEWNR has undertaken remediation works in an area adjacent to the estuary of the Little Para, in order to provide an area of saltmarsh retreat. This has occurred due to relative sea level changes (a

combination of actual sea level change and land subsidence) in the Barker Inlet area that has caused landward progradation of mangrove across saltmarsh communities. In early 2000s the levee on the northern side of the river was removed and an area of land reshaped to allow floodwater detention and tidal ingress. In 2005 two events occurred – SEAGas laid a pipeline through the area south of the river and the southern river levee was removed to allow the area to be used for stormwater detention as a saltmarsh retreat zone. This area may be further modified with development of the proposed Northern Interconnector.

5.3 Gawler River estuary

Gawler River forms a significant, long, narrow estuary with delta creeks at Port Gawler. The estuary is classified as a tide dominated creek in a Northern Adelaide and Barossa Catchment Water Management Board study (NABCWMB 2000). The extensive tidal flats consist of shelly silts, clays and sands supporting significant low mangrove woodland. Small areas of samphire shrubland sit at the mouth of the Gawler River. Of the 65 coastal bird species recorded in the region, 16 species at Buckland Park and 12 species at Port Gawler are listed under treaties. As indicated earlier, the Gawler estuary including Port Gawler and Buckland Park Lake are listed in the *Directory of Important Wetlands*. The Port Gawler Conservation Park also preserve one of the larger areas of mangrove and samphire in the state and is listed in the *Register of the National Estate*; a list of natural, Indigenous and historic heritage places throughout Australia administered by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

Even though the estuary still retains considerable ecological value, Gawler River is a highly modified system, with approximately 56% of the natural flow diverted for consumption purposes. Total volumes, durations, frequencies and seasonality of flows have all been affected. Flow is heavily regulated due to dams, weirs and diversion from Gawler River tributaries.

The NABCWMB (2000) study defined the environmental water requirements (EWRs) of the section between the coast (at Buckland Park) and the town of Gawler. EWRs are also known as ecological water requirements and are a description of the water regimes needed to maintain ecological values of water dependent ecosystems at a low level of risk. The EWRs of this section (referred to as the meandering zone), are summarised in [Table 7](#). A reach of the Gawler River system, Barossa Diversion Weir to Gawler (South Para), is included in the AMLR NRM Board's environmental trials.

Table 7: Environmental water requirements of the lower Gawler River (coast to town of Gawler)

Flow band	Peak flow (m ³ /s)	Daily flow (ML)	Average frequency	Duration (Time)	Importance	Seasonality
Pool connection	6–10	420–700	Once every 3 years as a minimum, but every year is far more beneficial.	Minimum 2–3 months	Water quality for pools. Riffle habitat available. Recharge habitat for aquifers. Paratya (freshwater shrimp) migration. Fish reproduction and migration flows.	Autumn and spring for fish migration
Mid-flow	10	350	Yearly	Minimum 2–3 months	Connection and recharge to Buckland Park (BP). BP would require water flowing into the lake for 2–3 months per year. Sediment transport.	Winter to spring
Bank-full	<300	20,300	Once every 10–20 years	Hours	Sediment and organic matter transport. Channel maintenance.	N/A
Over-bank	300+	20,300+	Once every 10–20 years	Hours	Floodplain maintenance and organic inputs to channel.	N/A

Source: Northern Adelaide and Barossa Catchment Water Management Board 2000

5.4 River Torrens

Annual natural flows in the lower River Torrens have decreased by approximately 34% over recent decades (Eco Management Services 2000). The use of River Torrens (and other catchments) for public water supply purposes by the construction of reservoirs, the diversion of the River Murray and use of part of the river as an aqueduct, has progressively modified the flows to the lower urban reaches which now receive urban stormwater runoff. The natural pattern of low or no flow in summer–autumn with flows in winter–spring has now been replaced in the lower reaches with a flow after any rainfall event of significance and winter–spring flows reduced by reservoir storages.

The current Breakout Creek channel and outlet weir were completed in 1939. Prior to this there was no major freshwater inflow to the gulf at this location. This in itself has been a major alteration in natural flows. The lower river, below the city weir to the coast at Henley Beach has become a major community asset. It is part of the Torrens Linear Park with significant recreational and amenity value as well as valuable biodiversity values. Due to the weir at the constructed mouth of the River Torrens it is described as an artificial estuary. The weir prevents saltwater intrusion upstream as would occur in a natural estuarine system. Marine species do migrate into it and this has recently been assisted by the AMLR NRM Board with the construction of a fish ladder.

EVs developed for Adelaide's coastal waters and associated WQOs for primary and secondary recreation and aesthetics could be achieved with mainly surplus winter and spring flows in the River Torrens and summer flows being retained as much as possible for reuse or natural infiltration into groundwater. For future water allocation planning for streams that discharge to Adelaide's coastal waters, planners should accept this as a preferred option and clearly state economic, social and ecosystem values where this condition cannot be achieved. For example in areas where concrete drains are the only option due to the nature of historical urban development that has taken place limiting opportunities to retain, filter and reuse water.

The AMLR NRM Board (2006b) has developed environmental flow trials for four priority reaches (including two in the River Torrens):

- Barossa Diversion Weir to Gawler (South Para)
- Gumeracha Weir to Kangaroo Creek Reservoir (River Torrens)
- Gorge Weir to Torrens Lake (River Torrens)
- Clarendon Weir to estuary (Onkaparinga estuary).

The trials were put on hold for some time because of the long drought conditions, but have continued as planned following good rainfall in the winter of 2010. Water for environmental flows was released in spring 2010. These trials are intended to last three years, with the aim of testing the benefits of returning environmental flows, providing information that can be applied elsewhere as well as improving ecosystem function to these high priority reaches.

A detailed monitoring program has also been developed to assist with evaluating the results of the trial. The monitoring program comprises ecological surveys linked to flow monitoring in order that ecological responses to the environment water requirements (EWRs) can be evaluated. The program is being implemented by a consortium comprising scientists from the Australian Water Quality Centre and the University of Adelaide.

A consultation program for the environmental flow trials is included as part of the Western Mount Lofty Ranges Water Allocation Plan.

5.5 Onkaparinga River estuary

Similar to River Torrens, the use of Onkaparinga River for public water supply has changed flows. Since European settlement, it is estimated that approximately 75% of flow has been extracted prior to entering the Onkaparinga estuary. Only the largest flows (ie flood events) in Onkaparinga River move downstream to the estuary and at most times there is no flow directly below Clarendon Weir (OCWMB 2000). Water is held in the Mount Bold Reservoir before reaching Clarendon Weir. From the weir, water is diverted to Happy Valley Reservoir.

During the wetter winter months with inflow from the upstream catchment, the estuary is generally freshwater down to approximately Saltfleet Bridge near the original Port Noarlunga village. During the dry summer months, with little or no flow from the catchment, it is saline (seawater salinity) up to the Old Noarlunga township.

The EWRs of Onkaparinga River have been determined by the former Onkaparinga Catchment Water Management Board (OCWMB), through a study commissioned in 2000 (Sinclair Knight Merz, 2003). This report identified EWRs for the Onkaparinga River at Old Noarlunga. This is the most downstream reference point provided along the river and specifies the requirements of part of the upper estuary. The three-year environmental flow trial for the Onkaparinga River below Clarendon Weir is based on the EWRs developed in 2003. The flow was intended to deliver environmental benefit to the river within the lower reaches and gorge; however there might be some ecological benefit to the lower estuary from the trial, although this was not part of the objectives.

As indicated in the information for River Torrens, the environmental flow trials were put on hold for some time because of the drought conditions. They have now continued as planned following good rainfall in the winters of 2009 and 2010. Water for environmental flows was released in spring 2009 and 2010 from the Clarendon Weir. As discussed in the AMLR NRM Board document (2006b), these trials are intended to last three years, from 2009 - 2012, with the aim of testing the benefits of returning environmental flows, providing information that can be applied elsewhere as well as improving ecosystem function to these high priority reaches.

Reduced environmental flows with drought and not having environmental flow releases are having considerable impact on the salinity levels on the Onkaparinga River estuary. Estuary monitoring data show that there has been a distinct and possible permanent change in the isohaline pattern of the estuary, which has been previously described as having average salinities less than that of seawater (DEH 2005b). The overall average conductivity of the estuary between the mouth and site 12, over the entire monitoring period was 45.3 mS/cm² (Coleman 2011).

The EWR environmental releases at Clarendon Weir to downstream are included in [Table 8](#).

Table 8: Environmental water requirements below Clarendon Weir

Season	Magnitude	Frequency	Duration
Low flow (January–May)	>10 ML/day	Low flow period	Entire period
	>20 ML/day	2 annually	10 days
High flow (July–November)	>30 ML/day	High flow period	Entire period
	>100 ML/day	2 annually	5 days
	>650 ML/day	2 annually	2 days

Source: Sinclair Knight Merz 2003

It is important to note for the Onkaparinga River system that sedimentation from the mouth is rare, due to a lack of flow in the lower Onkaparinga system. This information is based on ongoing monitoring undertaken by the AMLR NRM Board (reported in Cook and Coleman 2010a).

There has only been one large turbidity slug in last three years and small flows are more important for maintaining the lower Onkaparinga River and estuary in a more natural condition. Cook and Coleman (2010b) have also reported a recent occurrence of mangroves in the Onkaparinga estuary as a result of the completely unnatural flows that the river system has experienced in recent decades.

Table 9: Summary of trial environmental water provisions for Onkaparinga river

System	Low flows (ML/yr)	Fresh flows (ML)	Flush flows (ML)	Total volume (ML/yr)	Comment on timing of flows
Onkaparinga River– Clarendon Weir to estuary	4,260	1,080	3,900	9,240	<ul style="list-style-type: none"> • Low flows (Jan to Oct) • Fresh flows (Mar, May, July and Sep) • Flush flows (Jun, Aug and Oct)

Source: Sinclair Knight Merz 2003

Within each of the flow bands, the intent is as follows:

- summer low flows: maintain shallow water habitat for macro-invertebrates and improve water quality in pools
- summer freshes: flush pools to improve water quality and increase habitat value
- winter low flows: create surface water flow sufficient to fill low flow channels and provide migration opportunities for fish and macro-invertebrates. These flows will not significantly impact the depth of pools
- winter freshes: provide longitudinal connection between pools and allow migration for fish and macro-invertebrates. These will not be sufficient to scour biofilms or sediment
- large winter pulses: reset habitat and ecosystem processes by scouring sediments and biofilms. These will also aid in controlling vegetation.

The overall ecological objectives are summarised as follows:

- to provide longitudinal connection for fish and macro-invertebrate migration
- to maintain and improve water quality
- to maintain self-sustaining fish populations
- to maintain and restore habitat diversity for macro-invertebrates
- to control terrestrial vegetation encroachment of the river
- to reset aquatic habitat.

The need for improved flushing of the lower section of the Onkaparinga estuary is important in terms of benefits to aquatic ecosystems, movement of in-stream silt and reducing community concerns regarding stagnant water and aesthetic issues. However, the changed water regime since European settlement together with upstream land-use activities have increased sedimentation in the upper estuary, particularly with the reduced frequency of larger flows and velocities reducing the transport of sediment downstream. Conversely, with large flow events, sedimentation on the nearby Onkaparinga reef is also an issue of concern where changes in flow patterns result in increased sediment loads, particularly during the period of recruitment of reef species (July – December).

5.6 Other small estuaries

Although small, the southern coastal estuaries, including Christies, Willunga, Maslins, Field and Pedler Creeks are still regionally important for recreation as well as their ecological habitats and function. There is little information to quantify changes, but similarly to the major catchments, as a result of agricultural development and increasing urban developments, flow patterns have changed.

It is important that the environmental water requirements for these estuaries are recognised as the water allocation plan is developed.

6 Integrating the ACWS and ACWQIP

The ACWQIP draws heavily from the accepted findings of the Adelaide Coastal Waters Study (ACWS) and complements and builds on the findings along with more recent research undertaken by the EPA and others. The role of the ACWQIP is to provide a template to implement the 14 ACWS recommendations in the process of developing a way forward for water quality improvement for Adelaide's coastal waters.

6.1 ACWQIP strategies and ACWS recommendations

The ACWQIP draws heavily from the accepted findings of the Adelaide Coastal Waters Study or ACWS (Fox *et al* 2007) which is based on data used in modelling work up to 2003. The ACWS established that nitrogen and sediment inputs were the main contributors to issues impacting on Adelaide's coastal water quality and seagrass health. Further work since the release of the ACWS shows the effect of these inputs as also causing degradation of subtidal reefs (not included in the ACWS). Accordingly, the key forward planning feature of the ACWQIP is establishing long-term targets for nutrients and suspended solids, based on the EVs and WQOs agreed through community and stakeholder input.

The ACWQIP supports the ACWS' aim of a reduction in nitrogen loads. Since 2003 (the date of the latest data used in the ACWS - that was used for setting targets) some improvements have occurred, resulting in improved water quality. However, significant improvements are still required. It is anticipated that by 2020, committed nitrogen reduction and reuse projects cited in the ACWQIP will result in nitrogen load reductions for Adelaide's coastal waters of about 50% from 2003 levels.

The ACWS recommends a reduction in sediment loads of 50% from 2003 levels to allow sufficient light levels for seagrass to grow and it also advises that steps should be taken to reduce the amount of coloured dissolved organic matter (CDOM) in waters discharged by rivers, creeks and stormwater drains. The ACWQIP has adopted these ACWS recommendations and also promotes the application of WSUD to reduce stormwater flows and sediment inputs to the coast from greenfields, infill development sites and urban infrastructure upgrades and replacement projects.

Within the ACWQIP, strategies for nutrient and suspended solid reductions (to achieve water quality improvement) and the WQOs have been derived from the ACWS, PWWQIP and the community and stakeholder consultation work undertaken by the EPA in 2007 and 2008 (refer to the supporting ACWQIP supporting reports on the EPA website).

As illustrated in [Table 10](#), the ACWQIP complements and builds on the ACWS. The eight ACWQIP strategies link with the 14 ACWS recommendations. Strategy 1 of the ACWQIP, *Reduce nutrient, sediment and coloured dissolved organic matter discharges (CDOM)* directly connects with and addresses the first five of the 14 recommendations of the ACWS.

6.1.1 Options for load reduction targets

In the ACWS Final Report (Fox *et al* 2007), 14 recommendations were listed ([Table 11](#)) and five of these focused on obtaining reductions in the volumes of stormwater, wastewater, nutrient loads, sediment loads, CDOM and toxicants. These recommendations aimed not only at arresting further decline, but assisting in system recovery.

For the purposes of the ACWQIP, the nutrient and sediment reduction targets to avoid environmental harm have been derived from a simple apportionment of the relevant final ACWS recommendations to have a nitrogen target of around 600 tonnes per year and a sediment target of around 5,000 tonnes for Adelaide's coastal waters.

Table 10: ACWQIP strategies for implementation cross referenced against the 14 ACWS recommendations

ACWQIP Strategy	Links with ACWS recommendations *													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Reduce nutrient, sediment and CDOM discharge	♦	♦	♦	♦	♦									
2 Integrate reuse of wastewater and stormwater	♦	♦	♦	♦										♦
3 Further investigate sources and volumes of sediment and CDOM			♦	♦		♦								
4 Integrate monitoring for cumulative impact assessment					♦	♦	♦	♦	♦	♦	♦	♦	♦	
5 Model the impacts of climate change, new human impacts and population growth implications	♦	♦	♦	♦		♦								
6 Establish planning and funding priorities for water initiatives	♦	♦	♦	♦										♦
7 Undertake seagrass mapping and rehabilitation work						♦	♦	♦	♦	♦	♦	♦	♦	
8 Build community capacity to take action	♦	♦	♦	♦	♦									♦

Given the time needed to fully implement the considerable discharge reductions required, the current levels of uncertainties about localised effects is no impediment to adopting a proportional approach to the total targets included in the ACWQIP in 2013. Consequently, the ACWS recommended targets have been adopted as the targets to 2030. These could be revised should an adaptive management approach be adopted for the ACWQIP.

There can be a high degree of certainty that the total targets provided by the ACWQIP (informed by the ACWS) are acceptable targets upon which to plan pollution reduction strategies and to continue their implementation at this point in time. Adjustment of individual targets to around 600 tonnes and 5,000 tonnes respective targets for nitrogen and sediments can be expected in the longer term based on location-specific studies and applying the principle of adaptive management to review the ACWQIP.

The ACWS recommendations are examined in more detail in [Table 11](#).

Table 11: Fourteen recommendations and topics covered by the Adelaide Coastal Waters Study

Strategy	ACWS recommendations
<i>Recommendation 1: Reduce wastewater, stormwater and industrial inputs to marine environment</i>	
Inputs of wastewater, stormwater & industrial inputs	As a matter of priority, steps must be taken to reduce the volumes of wastewater, stormwater and industrial inputs into Adelaide's coastal environment. This should be done within the context of an overarching strategy designed to remediate and protect the metropolitan coastal ecosystem.
<i>Recommendation 2: Reduce annual nitrogen discharged to marine environment to around 600 tonnes</i>	
Nitrogen inputs	The total load of nitrogen discharged to the marine environment should be reduced to around 600 tonnes (representing a 75% reduction from the 2003 value of 2,400 tonnes).
<i>Recommendation 3: Reduce loads of particulate matter discharged to marine environment by approximately 50% from 2003 levels</i>	
Sediment inputs	Commensurate with efforts to reduce the nitrogen load, steps should be taken to progressively reduce the load of particulate matter discharged to the marine environment. A 50% load reduction (from 2003 levels) would be sufficient to maintain adequate light levels above seagrass beds for most of the time. The reduced sediment load will also contribute to improved water quality and aesthetics.
<i>Recommendation 4: Reduce the amount of CDOM discharged by rivers, creeks and stormwater drains</i>	
CDOM inputs	To assist in the improvement of the optical qualities of Adelaide's coastal waters, steps should be taken to reduce the amount of CDOM in waters discharged by rivers, creeks and stormwater drains.
<i>Recommendation 5: Continue to reduce and monitor toxicant levels discharged to marine environment</i>	
Toxicant inputs	While the available data suggests that toxicant levels in Adelaide's coastal waters pose no significant environmental risk, loads from point sources such as the Port River, WWTPs and drains should continue to be reduced. Routine monitoring of toxicant loads and concentrations should be undertaken every 3–5 years.
<i>Recommendation 6: Develop and implement a comprehensive and integrated environmental monitoring program</i>	
Monitoring	Develop and implement a comprehensive and integrated environmental monitoring program that will enable natural resource managers and all stakeholders to evaluate changes in the coastal marine environment over time and at various spatial scales.
<i>Recommendation 7: Maintain and develop the comprehensive database of historical inputs generated by this study</i>	
Monitoring	Maintain and develop the comprehensive database of historical inputs generated by this study. It is suggested a single entity be created to oversee the administrative functions associated with data collection, storage/retrieval, analysis and reporting. This entity should also assume responsibility for the ongoing maintenance and application of the various models produced by ACWS to ensure they remain both relevant and accessible. Consideration should also be given for the establishment of a research/monitoring coordination body. A primary function of this body would be to prioritise ongoing and future research activities and to seek and allocate funding according to those priorities.
<i>Recommendation 8: Implement a long-term monitoring program to assess seagrass quality</i>	
Monitoring	Implement a long-term monitoring program to assess seagrass quality (or health) at sites adjacent to land-based discharges and at suitable reference sites.
<i>Recommendation 9: Implement a long-term monitoring program of the outer depth margin of Posidonia meadows in Holdfast Bay</i>	
Monitoring	Implement a long-term monitoring program of the outer depth margin of Posidonia meadows in Holdfast Bay.
<i>Recommendation 10: Implement a long-term monitoring program of seagrass meadow fragmentation in Holdfast Bay</i>	
Monitoring	Implement a long-term monitoring program of seagrass meadow fragmentation at a range of sites in Holdfast Bay.
<i>Recommendation 11: Undertake detailed mapping of the distribution of Amphibolis across the Adelaide metropolitan area</i>	
Monitoring	Undertake detailed mapping of the distribution of <i>Amphibolis</i> across the Adelaide metropolitan area, determine the lower depth limit of seagrasses in Holdfast Bay and map seagrasses in the southern metropolitan area between Seacliff and Sellicks Beach.
<i>Recommendation 12: Undertake a spatially intensive nitrogen stable isotope survey</i>	
Monitoring	Undertake a spatially intensive nitrogen stable isotope survey to determine the offshore and northern extents of nitrogen influence from WWTP and industrial outfalls along the Adelaide metropolitan coastline and also characterise nitrogen stable isotope signatures of potential nitrogen sources.
<i>Recommendation 13: Undertake an audit of key environmental assets in the southern metropolitan coastal region</i>	
Integrated management	Undertake an audit of key environmental assets in the southern metropolitan coastal region; identify risks to those assets and develop an integrated management plan to mitigate the risks. The applicability of management actions developed in response to the findings of this study to halt and reverse ecosystem degradation in the northern regions should be investigated with a view to adopting it (possibly with modification) in the southern region. (Note risk assessment done by Gaylard 2009, does contribute towards a risk assessment process for this action for water quality for Gulf St Vincent).
<i>Recommendation 14: Manage Adelaide's coastal marine environment as a component of an integrated system</i>	
Integrated management	Adelaide's coastal marine environment must be managed as a component of a system that integrates catchment management, urban and rural land use, demographics, urban and industrial development, climate change/climate variability and water reuse.

Recommendation 2 states that the total load of nitrogen should be reduced to about 600 tonnes, which is a 75% reduction of the estimated 2003 load of 2,400 tonnes. Nitrogen is the key nutrient that needs to be reduced in marine environments as the phosphorus levels are generally relatively low. A local exception to this potentially exists in the southern Barker Inlet where modelling undertaken with the PWWQIP (EPA 2008a) indicates the nitrogen loads from Penrice Soda Holdings combined with wind-driven phosphorus from the Bolivar WWTP have the potential to cause algal blooms from time to time that allows this area to be a source of nuisance macro-algae *Ulva lactuca* and marine pest organisms *Caulerpa taxifolia*.

Recommendation 3 states that a general 50% reduction target of suspended solids should occur. Meeting this target would result in a major reduction in other pollutants usually associated with particulate matter such as metals and improve amenity and recreational safety.

Adelaide's coastal waters cover a large area and include about 70 km of coastline. The recommendations of the ACWS with respect to the loads of key pollutants—nitrogen, suspended solids and CDOM inevitably carry a degree of scientific uncertainty. It should be noted that the ACWS wording of 'around' is used with care by the report authors, indicating that there are a number of uncertainties involved in the calculation of the appropriate nitrogen load and uncertainty is also implicit in the recommended load for suspended solids. There was sufficient uncertainty in the required load for CDOM that the authors did not feel justified in nominating an acceptable load. The required nitrogen and suspended solid loads may be somewhat smaller or larger and the loads for the different parts of Adelaide's coastal waters are not specified.

The approach to these areas of uncertainty in other water quality improvement plans is often to derive quanta for the level of uncertainty in the recommended long-term loads and apply this as a margin of safety—typically 5 to 10% and reduce the target loads accordingly. While this approach has not been undertaken in the ACWQIP, managers of discharges such as Penrice Soda Holdings and SA Water recognise that long-term targets for the nitrogen content of their discharges will be based on local effects as well as the more diffuse effects of their discharges over a large area. The quality of the monitoring of these discharges will be very important in confirming long-term targets for each discharge.

There will be costs associated with the reduction of pollutant loads. These are not well defined at present and the ACWQIP has not developed early estimates as they may be misleading. While these are not high on a per capita basis - particularly when implemented over time, the community may choose not to pay and accept that the way that we manage our coastal discharges into the future will cause harm. The consultation undertaken as part of the development of the ACWQIP has shown a firm resolve on the part of the community to achieve the return of seagrass and have the Adelaide coast as a high value recreation area into the future.

However, as costs are attached to improvement of the coast over the coming years, the community will have opportunity to re-think this through successive reviews of the ACWQIP at five-yearly intervals. These reviews will provide an opportunity to set different long-term targets for community derived WQOs to those presented in [Appendix 1](#). This would require a consensus that the EVs and WQOs currently presented in Appendix 1 are not achievable in the future at a reasonable cost. This may be the case in specific locations adjacent to major stormwater drains at times of discharge, eg the Torrens River outfall. However, at the time of stakeholder and community input, views about the required water quality of Adelaide's coast and the return of seagrass emerged as a consistent theme in consultations (Report 1) and feedback on the ACWQIP in 2011.

Currently, many options are available for the improved management and reuse of both wastewater and stormwater. In order for Adelaide's community to settle for a lower water quality in the long term, there would need to be a general understanding that all available improvements in wastewater and stormwater quantity and quality had been implemented.

6.1.2 Reducing nitrogen loads

The major sources of nitrogen discharges to Adelaide's coastal waters (94%) are derived from single sources of industrial or wastewater treatment activities ([Table 13](#)) all of which are subject to licences under the EP Act.

Licensing of discharges to the marine environment began in 1990, focusing considerable attention on SA Water WWTPs and industrial sites (eg Penrice Soda Holdings). As a result of the regulation of major dischargers, there have been

significant reductions in both the number of discharges and the loads discharged to the waterways. Relevant examples include:

- the significant reduction of suspended solids (about 100,000 tonnes per year) discharge from Penrice Soda Holdings at Osborne into the Port River
- the Glenelg to Adelaide Parklands Recycled Water Project which has the capacity to produce 5.5 GL of high-quality recycled water annually. The project provides up to 1.3 billion litres each year to irrigate the Adelaide Park Lands and presents opportunities for the development of additional recycled water initiatives
- the upgrade to the Christies Beach WWTP which will effectively achieve the ACWS recommended target of 75% reduction in nitrogen through a cost-effective combination of capital works and improved reuse in the Willunga Basin (reducing draw down issues in the Willunga Basin)
- the investment of over \$200 million by the SA Government through SA Water to relocate the Port Adelaide WWTP to Bolivar and the associated redevelopment of the Bolivar WWTP. This has reduced SA Water's contribution to the nutrient load to the Port waterways by over 1,200 tonnes of nitrogen (70% of total nitrogen contribution to Port waterways) and 60 tonnes of phosphorus (17% of total phosphorus contribution to Port waterways).

Building on the ACWS recommendations, the ACWQIP illustrates in [Table 12](#) the targets for nitrogen discharges to Adelaide's coastal waters. These include the change from 2003 loads and anticipated factors associated with population growth across the Adelaide metropolitan area from 1.14 to 1.5 million by 2036 (DPLG 2011). This information includes the expected results of all projects to reduce nitrogen loads with a high degree of certainty, ie projects or targets agreed to and/or very likely to be funded and completed.

Table 12: ACWQIP targets for nitrogen reduction (tonnes/year)

Source	1975–85 loads	2003 (ACWS)	2012	Forecast 2028 including pop growth	ACWQIP target	Notes
Penrice	1,300	1,000	550	300	250	2011 Penrice Environment Improvement Program (approved February 2011) shows commitment to reductions of 15 tonnes of ammonia per year for next 5 years*
Wastewater treatment plants (WWTPs)	2,279	1,136	911 (reduction from reuse was 352.3 t)	761 (factoring increased reuse volumes)	300	Although increases in reuse will occur overtime, this will be variable from year to year due to impacts of climate on demand
Potential reuse options in GL - wastewater			24 GL	50 GL of wastewater		Based on Target 1 of AMLR NRM Regional Plan
Stormwater and catchments	639	357	150	50	50	Forecasts for 2028 include current population growth estimates are correct and assume achievement of ACWS recommendations for load discharges.
Potential reuse options in GL - stormwater			8.6 GL	35 GL of stormwater		Based on Target 1 of AMLR NRM Regional Plan
Totals	4,218	2,493	1,611	1,111	600	

* In early 2013, Penrice indicated that they will cease soda ash production in mid-year 2013, but at this stage Penrice will retain the existing EIP to 2016 and the ACWQIP retains the longer term target for the Penrice discharge to be less than 250 tonnes of nitrogen per year. In a future revision of the ACWQIP the longer term target may be updated as part of the adaptive management and review process of the ACWQIP.

Additionally Penrice Soda Holdings Ltd and SA Water could work with the EPA to pursue options where these respective companies invest in activities that will reduce nitrogen and/or sediment loads from stormwater discharges (eg contribution to catchment-based WSUD efforts along with other partners where appropriate). Discussion about the management strategies and specific actions, of different organisations are detailed in [Figure 14](#) (Summary of management strategies and actions aimed at nutrient load reduction for key stakeholders, located in Chapter 7).

6.1.3 Reducing sediment loads

[Table 13](#) summarises the outlook for reductions in suspended solids over the period of the ACWQIP. It is assumed that flow and loads of suspended solids and CDOM are closely related (eg a drop in flows will result in a corresponding drop in suspended solids and CDOM). Discussion about the management strategies and specific actions, of different organisations are detailed in [Table 14](#) (Summary of management strategies and actions aimed at reducing stormwater flows, suspended solids and coloured dissolved organic matter, located in Chapter 7), with further information in [Report 3](#).

Stormwater is now being recognised as an important additional source of water for South Australia. In the *SA State of the Environment Report 2008*, one of the key findings was that there was still only a small percentage of stormwater being captured for reuse. Recommendation for Action 2.3 of the SOE was to ‘double the capture and reuse of stormwater and waste water by 2012’ (EPA 2008b). The harvest, treatment where necessary and reuse of stormwater will increase over the next few years under Water for Good Actions to 35 GL per year by 2025 and 60 GL per year by 2050 (Office for Water Security 2009).

The projects to achieve these targets have received some preliminary assessment through the Urban Stormwater Harvesting Options Study undertaken by the Stormwater Management Authority in 2009. Further development and prioritisation of projects will be carried out through the development of a stormwater and wastewater master plan, successive AMLR NRM Board business plans and also on a case-by-case basis as funding and market opportunities arise.

For the purposes of the ACWQIP, it has been assumed that key targets agreed by the community in formulating the AMLR NRM Board Plan (AMLR NRM Board 2008a) will eventually be substantially achieved. While the reuse of stormwater to meet the water needs of the Adelaide community is a current focus, the management of stormwater to reduce the current environmental harm that it causes to our coast is likely to include a wide range of initiatives—many of which will improve the quality of stormwater prior to discharge to the coast.

Within this wider context, the development of the Water for Good Stormwater Master Plan is needed to ensure that the AMLR NRM Board and other organisations such as local government are able to coordinate the delivery of a stormwater discharge regime to Adelaide’s coast that can meet the environmental, social and economic needs of the community.

It is important to understand that the intent of particulate matter reduction is to achieve a particular water quality status as defined in the ambient WQOs in Appendix 1 from an ecological perspective, the intent is to create a light climate which facilitates the health of existing seagrass meadows and allows recovery in denuded areas. In the relevant ACWS recommendation, the intent is to maintain adequate light levels for most of the time.

There is a limit to what can be achieved in particulate matter reduction and this will vary from catchment to catchment, particularly following large storm events. The ambient WQOs along Adelaide’s coast for turbidity 200 metres from shore is for the 90th percentile value to be <1 NTU. This allows for low levels for 90% of the time, but higher levels for 10% of the time as a result of offshore storm activity and large catchment storm events. Monitoring should focus on the ecological indicators and the achievement of satisfactory water quality as defined in the ambient WQOs, rather than on a sediment or CDOM load reduction target as an end in itself.

Table 13: ACWQIP targets for suspended solid reductions (tonnes/year)

Source	1975–85 loads	2003 (ACWS)	2008	Forecast 2028 including pop growth	ACWQIP target	Notes
Penrice	100,000	1,780	810	810	890	
Wastewater treatment plants (WWTPs)						
• Sewage sludge to sea	4,410	0	0	0	0	Sludge discharges ceased 1993 Based on flow reduction expectations
• other	2,595					
SA Water subtotal	7,005	1,580	1,060	675	760	
Stormwater from Adelaide's catchment Northern region						
• Gawler River	2,690	2,330	2,040	585	1,165	
• Barker Inlet	2,790	1,460	1,460	365	730	
Central region	2,690	1,920	1,680	480	960	Includes Torrens, Patawalonga and stormwater system
Southern region	990	1,150	1,000	290	575	Comprises Field River, Onkaparinga River, Christies Creek and Southern catchments
Subtotal	9,160	6,860	6,180	1,720	3,430	
Total sediment	116,165	10,220	8,050	3,205	5,080	

6.1.4 Adelaide coastal waters (northern and metropolitan waters only)

Turbidity discharges following storm events from catchments (rivers, creeks and storm drains) are an aesthetic problem as well as a potential health problem. Acknowledging the practical limits of what can be achieved, the intent is to reduce the frequency, extent and duration of turbid condition and coloured water to a level that is acceptable to the community. This can be done by effectively reducing the total amount and regular input of fine sediment into nearshore waters following light rainfall events by using this flow in an appropriate mixture of both large and local sized stormwater schemes.

This is also reflected in the current ambient WQOs, for a 90th percentile value of <25 NTU for turbidity in the swimming area adjacent to the shore, which would again mean that this value could be exceeded for 10% of the time and that good conditions would occur for 90% of the time. Outside of this, 200 m from the shore, a low-level 90th percentile value of <1 NTU for turbidity should be maintained to protect and encourage seagrass meadows. For Adelaide's southern coastal waters turbidity and sedimentation may also be related to coastal cliff erosion as covered in Fernandes *et al* (2008a) and Fernandes (2008).

6.1.5 Port waterways

The 50% suspended solids target is also adopted as an interim target for the Port waterways. Sources of metals and other pollutants occur from stormwater runoff, riverine flows (Dry Creek, North Para River, etc) and remobilisation from sediments. However, as discussed in the PWWQIP Stage 1 Technical Report (EPA 2005), most metals entering the waterways now are in stormwater runoff. While a 50% total reduction is defined, there should be an 80% reduction in stormwater sources. This localised target is based on the practicability of stormwater treatment initiatives such as Gillman and Greenfields wetlands to achieve this level of suspended solids reduction in the discharges to the Port waterways if these systems are appropriately managed and maintained. It recognises the strength of commitment by local government and the AMLR NRM Board to treat and reuse this resource. Longer-term monitoring will provide feedback to ensure that these measures remain effective. The load reductions targets for suspended solids are given in [Table 13](#).

6.1.6 Southern Adelaide coast

Some southern reef communities, such as Horseshoe Reef, have been severely impacted by suspended solids and many others are under threat so there is a need to improve the quality of stormwater as soon as possible. In response to this, projects undertaken by the local councils and the AMLR NRM Board in Christies Creek and other southern catchments seek to manage suspended solids and reuse stormwater through systems that provide water for irrigation and (potentially) industrial uses. While southern metropolitan urban development is also intensifying, current technology also provides opportunities to deal with water quality pressures by incorporating WSUD approaches.

Reduced flows in the Onkaparinga estuary have probably limited recent sedimentation, but erosion of coastal cliff sediments and re-suspension may also be of concern. A strong focus on adherence to WSUD targets at the land division, planning approval and building stages of development needs to be integrated with the development of stormwater retention and harvesting infrastructure. Failure to implement these targets is likely to result in long-term damage to the southern area's prime attraction - its coastal environment. The part that key contributing organisations have in implementing the ACWQIP and in achieving the pollutant load reduction targets and WQOs to protect EVs is nominated in their own forward planning. Information from these plans that is particularly relevant to water quality is summarised in section 7.5.5.

6.1.7 Early progress to reducing loads

The major sources of nutrient and suspended solid inputs, including discharges from WWTPs, industry and stormwater (catchments) shown in [Table 12](#) indicates the reduction of the 2003 loads of metals (copper, lead, zinc), suspended solids and nitrogen for the period 1975–85. There have been major reductions in these loads in the northern and central regions of Adelaide's coastal waters, in contrast with the southern region where there have been some increases. The northern and central reductions have occurred due to considerable work undertaken by SA Water, Penrice Soda Holdings, the former catchment water management boards (now incorporated into the AMLR NRM Board), councils, EPA and the general community. The rise in the southern region's nutrient and suspended solids is due to population growth which has increased the volume of wastewater and loads of suspended solids and CDOM in the stormwater produced by this area.

Most of the damage to offshore seagrasses occurred in the northern and central areas when discharges were greater than they are now (Fox *et al* 2007) and concentrated mainly in the Port River (EPA 2008a). While seagrass loss is continuing and further load reductions are required, it is important to recognise the considerable effort and progress to date that has been made by SA Water, Penrice Soda Holdings and the AMLR NRM Board. This also highlights the need to manage the southern area of Adelaide's coastal waters in a way that minimises the potential for considerable losses to seagrass, reef habitat and amenity. [Figure 14](#) indicates the proximity to the WWTPs, industrial discharge from Penrice and stormwater from catchments to the areas of seagrass along the Adelaide coastline, which form a link in marine habitats between the Upper Gulf St Vincent Marine Park and the Encounter Marine Park.

Following many years of the development of the sewerage reticulation system where treated wastewater and sewage sludge were discharged to the Adelaide coast, loss of seagrass and other environmental problems were noted. Through the implementation of the environment improvement programmes (EIPs) for its WWTPs SA Water has already made considerable progress in reducing nutrient loads to the Port River–Barker Inlet system and the metropolitan coastal waters. Since the 1975–85 period, when most damage was done to the aquatic ecosystems, the load of nitrogen discharged from the WWTPs has reduced by approximately 48%. This has involved considerable planning and investment and included the cessation of discharges from Port Adelaide and Glenelg sludge outfalls and the relocation of the Port Adelaide WWTP discharge to Bolivar. The upgrades of the WWTPs has resulted in reduced loads in discharges and improved quality for use of reclaimed water, particularly at the Virginia horticultural area.

Now that the ACWS has provided some clear ecosystem nitrogen load targets, SA Water is seeking to further reduce loads from its wastewater discharges in a sustainable manner that optimises the value to the SA community. Individual strategies for its metropolitan WWTPs are currently being developed to include innovative approaches to plant optimisation and reuse and research to align with SA Water's broad strategy on research and development. The work of SA Water in developing and implementing improvements to its WWTPs is also informed by 'Actions' in the Water for Good plan. This work is taking place in partnership with others, particularly the AMLR NRM Board, DEWNR and EPA.

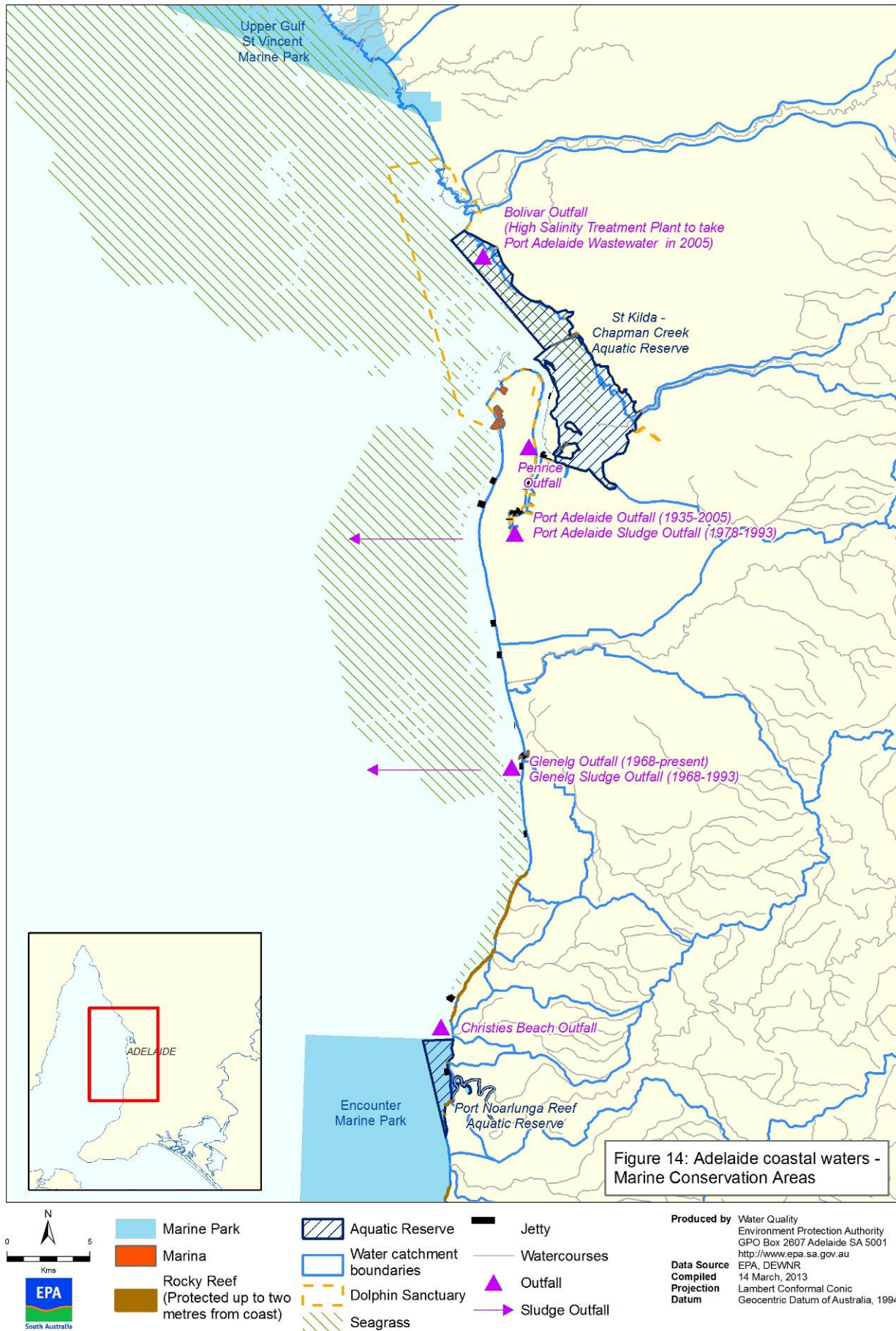


Figure 14: Adelaide coastal waters – Marine Conservation Areas

7 Current partner commitments and actions

The success of nutrient and sediment reduction in Adelaide's coastal waters is reliant on a collective and integrated effort from a range of partners. While efforts over recent years are to be commended and many state and local governments are working towards improvements, further effort and greater coordination is required.

7.1 Overview

Underpinning the success of the ACWQIP is the need for dynamic, informed and 'can-do' partnerships. It is envisaged that these will cover the full range of stakeholders as everyone has a positive role to play. The Plan provides strategies that demonstrate how the South Australian community, including government agencies and industry, can work together to achieve and sustain a quality coastal ecosystem that is close to our city.

In the formation of the ACWQIP, community and stakeholder consultation was undertaken in 2007 and 2008 to establish EVs and WQOs for Adelaide's coastal waters and to link with existing strategies, plans and actions. Public workshops were held to develop EVs and WQOs for Adelaide's coastal waters in 2007 and during 2008 targeted stakeholder discussions were held with state and local governments, associations, community groups and individuals.

Significant feedback from community groups, individuals, local government and state government agencies was provided in the period of public comment in spring 2011. Much of the stakeholder feedback, (particularly from key partners for implementing the ACWQIP, such as the AMLR NRM Board, SA Water and local governments), provided detail comment on actions they are already undertaking or are intending to take that will support the successful implementation of the ACWQIP. The following chapter provides detail on activities of some of the key groups and organisations in support of the focus of the eight strategies in the ACWQIP.

7.2 Community group activities that link with the ACWQIP

The activities of the following groups and organisations relate to raising community awareness and building capacity of the broader community to understand catchment, coast and marine issues across the Adelaide region. These range from groups operating under the banner of AMLR NRM Board and peak community groups of the SA Recreational Fishing Advisory Committee and Conservation Council of SA, to local interest groups including Friends of Gulf St Vincent and the Western Adelaide Coastal Residents Association.

The ACWQIP provides a real opportunity for capacity building and regional NRM activities that relate to improving components of catchments and coastal areas, to join together to focus on the catchment to coast connection for improving water quality at the coast. Many different groups currently engage in projects and activities that assist in promoting a 'caring for our catchments and coast' message.

Capacity building as indicated in the National NRM Capacity Building Framework (Australian Government), relates to a range of activities which individuals, groups and organisations do to improve their ability to achieve sustainable natural resources management. 'Capacity' in the context of the framework includes promoting awareness, skills, knowledge, motivation, commitment and confidence. These activities are not restricted to community groups, but include various elements of broader community and stakeholder engagement processes (including tools such as website promotion, training or provision of information on a variety of issues or projects) that are addressed or undertaken by state agencies such as DEWNR, EPA, PIRSA Fisheries and the AMLR NRM Board as well as local government.

7.2.1 AMLR NRM Board community engagement

The AMLR NRM Board partakes in community and stakeholder engagement activities that span the four regions of the Board: the northern, central and southern and Fleurieu regions. Activities range from catchment and terrestrial issues to those relating to the coast, estuarine and marine environment.

The catchment and biodiversity focused activities of the AMLR NRM Board link with numerous local government, community groups and 'Friends of Groups' who undertake local level catchment and biodiversity improvement activities in both rural and urban settings. There are specific programs for training and support for these groups in their activities run by AMLR NRM Board staff. A current focus of the AMLR NRM Board is to advance capacity building in the promotion of a greater uptake of WSUD across the Adelaide region.

The coast and marine activities of the AMLR NRM Board include working with many community groups along the coast to undertake activities that are consistent with the *Metropolitan Adelaide and Northern Coastal Action Plan 2009* (AMLR NRM Board 2009). Some of these activities relate to improving coast and marine environments that result in improvements to water quality. The AMLR NRM Board also implemented the 'Coastal Ambassador' program to train people to undertake activities that improve and monitor coast and marine habitats.

Furthermore, the Board also supports an NRM education program that specifically works with schools and community groups across the region to raise awareness on NRM issues. Topics covered range from biodiversity to catchment activities to coast, estuarine and marine activities.

7.2.2 SA Recreational Fishing Advisory Council Inc

The South Australian Recreational Fishing Advisory Council Inc is the recognised peak body that represents the interests of and advocates on behalf of over 230,000 recreational fishers in SA. The council has provided input to the development of the ACWQIP, through membership on the Adelaide Coastal Waters Steering Group. The vision and EVs of the ACWQIP are not seen to be inconsistent with the focus of recreational fishing interests that promote healthy marine habitat for the benefit of fisheries.

7.2.3 Conservation Council of SA

The Conservation Council of SA has also provided input to the development of the ACWQIP through membership on the Steering Group, as a peak body that represents the interests of many other environmental groups operating across South Australia focused on catchment, terrestrial and biodiversity issues as well as coast, estuarine and marine issues. The Conservation Council also runs some of its own coast and marine capacity building and citizen science programs such as Reef Watch (refer to section 4.6.4) and the 'feral or peril' program. These programs train snorkelers and divers in the assessment of reef environments and the identification of species that are endangered, threatened or vulnerable or that are marine pests. Other more localised groups are member groups of the Conservation Council such as the Friends of Gulf St Vincent.

7.2.4 Friends of Gulf St Vincent

The Friends Group was formed in 2003 to provide a coordinated approach for the coastal community to promote the protection and conservation of Gulf St Vincent. Objectives of the group include acting as advocates for the conservation of marine and coastal environments, protection of key habitats in the Gulf and the sustainable use of resources. The Friends of Gulf St Vincent is a member group of Friends of Parks Inc.

The Friends of Gulf St Vincent play a role in raising community awareness on issues impacting the Gulf through their activities including community forums, site visits and tours, information on their website, publication of the *Blue Swimmer* newsletter and other publications including the *Natural History of Gulf St Vincent* (Shepherd *et al* 2008), *Gulf St Vincent a precious asset* (Friends of Gulf St Vincent 2009) and their most recent activities including secchi depth monitoring in partnership with the AMLR NRM Board.

7.2.5 Western Adelaide Coastal Residents Association Inc

The Western Adelaide Coastal Residents Association has the following objectives:

- encourage, represent and advocate for residents to build and maintain a healthy, safe, joyous and equitable community
- protect our residential character and cultural heritage
- promote the protection of our biological diversity and the maintenance of indigenous species
- work cooperatively with governments, other resident associations, groups and park organisations to protect, enhance and conserve our environment.

This community group works in a similar way to the Friends of Gulf St Vincent and promote coastal issues through forums, newsletters, a website and other publications. They also prepare submissions to raise awareness of coastal issues that are important to the local community.

7.3 Reductions in nitrogen

7.3.1 Environment Protection Authority

The EPA licenses both SA Water and Penrice Soda Holdings under the EP Act to discharge to Adelaide's coastal waters. The provisions of the Act require the EPA to ensure environmental harm is minimised by these licensees using all reasonable and practicable measures.

The licences for SA Water cover the discharges from the Bolivar WWTP, Glenelg WWTP and Christies WWTP separately and the licence for Penrice Soda Holdings is for their discharge into the Port River at Osborne. Licence conditions can include development of individual environmental improvement plans (EIPs) for major discharges. This mechanism has been used in the past for both upgrades to the WWTPs and also for ongoing licence coordination for Penrice Soda Holdings.

The ACWQIP uses the ACWS as an authoritative source of information that has defined the discharge loads of nitrogen required to ensure environmental harm is reduced to a more sustainable level for Adelaide's coastal waters. This information provides guidance to the EPA when reviewing license conditions. It also assists the EPA to plan for reducing nitrogen loads in discharges to 'acceptable levels' over time.

The ACWQIP nitrogen load reduction targets provide a mechanism that ensures the relevant licensees can undertake their activities with a high degree of confidence, provided that they can prove that their nitrogen discharges are being reduced as quickly as is practically possible to loads consistent with the recommendations of the ACWS. As the ACWQIP is implemented and as work is undertaken that may review the targets of the ACWS, then an adaptive management approach will be taken and as new information is made available, the targets for nitrogen load reduction may be refined.

The other outcome of the findings of the ACWS is that it is now clear that current loads of nitrogen, suspended solids and CDOM are well above levels that cause environmental harm to Adelaide's coast. The EPA is therefore likely to oppose proposals for development that involve loads of these materials reaching Adelaide's coast or waterways.

In addition the EPA provides advice and/or direction to ensure appropriate management of activities of environmental significance. This advice draws from the findings of the ACWS and Environment Protection WQ Policy (eg large urban residential developments, major construction activities). The EPA is also leading Action 3 in the Stormwater Strategy; informing how stormwater infrastructure can be best designed to improve coastal water quality. The EPA is also providing input to the development of the 'Blueprint for Urban Water for Greater Adelaide' based on the findings of the ACWS and the strategies in the ACWQIP.

7.3.2 Penrice Soda Holdings

Penrice has made the following commitment to working towards achieving improvements in water quality for Adelaide's coastal waters:

Penrice Soda Holdings is committed to reducing its ammonia load to the Port River, consistent with the intent of the Adelaide Coastal Water Quality Improvement Plan (ACWQIP).

Penrice endorses the ACWQIP and its targeted reduction of a 75% nitrogen reduction against 2003 levels for all polluters. The PWWQIP identified that Penrice should ultimately reduce its nitrogen load to 250 tonnes and Penrice will use all reasonable and practicable means to achieve this target.

The ammonia reduction achieved over the previous five years has been substantial; a 42% nitrogen reduction against 2003 levels was achieved through the ongoing implementation of identified best practice methodologies. Penrice Soda Holdings successfully achieved the environment improvement program (EIP) in 2005–2010 with its commitment to reduce the nitrogen load to 575 tonnes by 2010. The current Penrice EIP (approved by the EPA February 2011) commits to a further reduction of 15 tonnes of ammonia per year over five years.

Penrice has accepted the ACWQIP target for 2030, the achievement of this target requires investigations into technological solutions that will achieve a significant step change in performance. Substantial ammonia reduction solutions are capital intensive and land intensive. For Penrice to achieve this target, it is anticipated that a level of co-investment and cooperation will be needed from key stakeholders.

In early 2013, Penrice indicated that they will cease soda ash production in mid-year 2013, but at this stage Penrice will retain the existing EIP to 2016 and the ACWQIP retains the longer term target for the Penrice discharge to be less than 250 tonnes of nitrogen per year. In a future revision of the ACWQIP the longer term target may be updated as part of the adaptive management and review process of the ACWQIP.

7.3.3 SA Water

SA Water has made the following statement in relation to findings of the ACWS and the ACWQIP:

SA Water has been keen to ensure that any environmental impacts caused by its wastewater treatment plants (WWTPs) are identified and strategies developed to address these. With this in mind, SA Water provided financial and material support for the ACWS.

The ACWS establishes targets for reducing the pollutant loads to Adelaide's coast. SA Water accepts these targets and has already delivered significant reductions in the loads from its discharges. This includes an 85% reduction in ammonia loads from coastal WWTPs since 2003. The achievement of these targets is subject to the availability of finance, the feasibility of further large-scale reuse schemes and agreement on timing. It will also take into account the results of current and future research and the availability of emerging technology.

Consistent with the commitments in the Water for Good initiative which targets 50 GL of reuse, SA Water is seeking to further reduce loads from its wastewater discharges in a sustainable manner that optimises the value to the SA community. Individual strategies for its metropolitan WWTPs will be further developed over the next 12 months and will include innovative approaches to reuse, underpinned by SA Water's significant commitment in research and development.

The recommended targets in the ACWS cover the whole of Adelaide's coast. While a proportional approach has been adopted in the major division of discharges by Penrice Soda Holdings and SA Water, individual long-term targets for each of SA Water's wastewater plants have not been derived as part of the development of this WQIP. Long-term discharges from each wastewater discharge will need to be agreed with the EPA as the licensing authority. These will need to take into account the effect that each discharge might have on the adjacent receiving waters, along with the more widespread effect of each discharge as it

is transported along the coast. Through an adaptive management strategy, SA Water will use ongoing monitoring and localised studies to assess the impact of previous load reductions and to develop these load targets for individual WWTPs. The studies include support for research into restoration of seagrasses. This research aims to provide direct evidence of the extent of the impact of the WWTP discharges.

SA Water will seek support from the SA Government to enable any required WWTP modifications in the future.

The SA community invests in the provision of safe and reliable water supplies and the disposal of wastewater in a safe and environmentally sustainable manner through SA Water by payment of water rates for both supply of water and treatment of wastewater.

The data in [Table 12](#) (ACWQIP targets for nitrogen reduction, located in section 6.1.2) shows that even with the inclusion of projects yet to be implemented; population growth indicates that the current outlook is that long-term nitrogen discharges of about 1,000 tonnes will still be approaching twice the 600-tonne target for Adelaide's coast.

Discussion about the management strategies and specific actions of different organisations aimed at reducing nitrogen loads are detailed in [Table 14](#), with further information provided in to [Report 3](#) of the supporting technical reports on the EPA website.

7.3.4 Adelaide Mount Lofty Ranges (AMLR) NRM Board

The AMLR NRM Board has been very active in the area of stormwater management and has an aspirational target for 75% reduction of stormwater in the AMLR NRM Regional Plan which is consistent with the first five recommendations of the ACWS. Achieving a 75% reduction in stormwater through stormwater use projects and broadscale support of water sensitive urban design (WSUD) will result in reductions to nutrients and sediments in stormwater, but the exact targets for these reductions in stormwater are still being established through WSUD targets.

When progressing stormwater management outcomes, the AMLR NRM Board works in partnership with many others including the EPA, DEWNR, local government and the Stormwater Industry Association. An example of a recent AMLR NRM Board supported WSUD project is the stormwater management system that is in place on Peacock Road that has been a partnership project between the AMLR NRM Board and the City of Adelaide. Projects like these do result in positive nutrient, sediment and CDOM reductions for waters entering the Torrens system that then flow out to Adelaide's coast.

7.4 Reductions in sediment and CDOM

7.4.1 Environment Protection Authority

The EPA has a key role in the reduction of both point source and diffuse source pollution loads to Adelaide's coast that further the objects of the EP Act. In undertaking this role, the EPA administers the WQ Policy under the EP Act. There are a range of activities relating to management of both point and diffuse sources of sediment and CDOM pollution (including stormwater). The full details are summarised in [Report 3](#) of the supporting technical reports on the EPA website and monitoring for Adelaide's coastal waters is discussed.

Management of point sources include the licensing activities for SA Water and Penrice Soda Holdings according to the recommendations of the ACWS, as well as licensing dredging activities and licensing of desalination plants. Details on management of diffuse sources are listed below in the section entitled *Activities to reduce nutrient and sediment loads from catchments and stormwater*.

Table 14: Summary of management strategies and actions aimed at nutrient reductions for key stakeholders

Agency	Management strategies and/or action
Penrice Soda Holdings	<p>The current Penrice Soda Holdings EIP (approved by the EPA in February 2011) commits to a further reduction of 15 tonnes of ammonia per year over five years. Although Penrice Soda Holdings face uncertainties with respect to technology, cost and land availability in achieving their target of 250 tonnes target by 2030, this proposed improvement is assumed to be in place for the purposes of this ACWQIP. It is expected that further agreements between the EPA and Penrice Soda Holdings about load reduction actions will result in future EIP targets being met with a high degree of certainty and that this process will continue until Penrice's discharge load allows for ACWS load targets and agreed EVs for the Port River to be achieved.</p> <p>In early 2013, Penrice Soda Holdings indicated that they will cease soda ash production in mid year 2013, but at this stage Penrice Soda Holdings will retain the existing EIP to 2016 and the ACWQIP retains the longer term target for the Penrice Soda Holdings discharge to be less than 250 tonnes of nitrogen per year. In a future revision of the ACWQIP the longer term target may be updated as part of the adaptive management and review process of the ACWQIP.</p>
SA Water–Bolivar WWTP	<p>Following the redevelopment of the Bolivar WWTP and the incorporation of flows from the former Port Adelaide WWTP in 2004, significant reuse of the resultant wastewater has occurred. Currently over 30% of the wastewater from the Bolivar WWTP is reused over the year with greater reuse in the summer months and less in the winter months. At the time of the Bolivar upgrade, SA Water recognised that further treatment might be required from the upgraded site if at least 50% reuse of effluent was not achieved. With the findings of the ACWS now available, SA Water is developing practical and cost-effective strategies.</p> <p>An example of this is where a major expansions of wastewater reuse is being investigated that incorporates the development of managed aquifer recharge (MAR) of presently under-utilised winter wastewater to provide source water for horticultural expansion. An inter-agency framework to allow these options to be explored is provided by SA Water's commitments to Actions 16 and 19 in the Water for Good Plan.</p>
SA Water–Glenelg to Parklands reuse scheme	<p>The diversion of up to 5.5 GL of wastewater for reuse has been included in the outlook for nutrient reductions. Modelling used to develop the ACWS showed that the Glenelg WWTP discharge impacts on seagrass in southern Holdfast Bay. Further reduction in this discharge is required to avoid further seagrass losses in this area.</p>
SA Water–Christies Beach WWTP	<p>SA Water is constructing an upgraded WWTP at Christies Beach. The aim of this plant will be to treat increasing volumes of wastewater (generated by the expansion of the southern suburbs) to a high level and support an increase in the reuse of this wastewater in the Willunga basin. This combined approach is cost effective and provides a high certainty of meeting the ACWS recommended reductions from this source in the long-term.</p>
SA Water and Department of Environment, Water and Natural Resources	<p>The current ranges of projects described above are contained within the Water for Good plan. Their combined result will be a flow reduction of 7.4 GL from metropolitan WWTPs, corresponding to a nitrogen load reduction of about 270 tonnes with present treatment methods. This is a significant contribution to the ACWQIP target reductions that SA Water is supporting. Integrating actions 16 and 19 in Water for Good are particularly relevant to achieving the ACWQIP targets through the implementation of the Stormwater Strategy.</p>
AMLR NRM Board regional targets for stormwater and local government activities	<p>The current AMLR NRM Regional Plan has identified a 20-year target of 75% of stormwater to be reused. The Board is currently developing a range of projects with local government and other stakeholders that aim to capture stormwater, focusing on rainfall events up to the 1 in 5–10 ARI storm events. Stormwater accounted for 6% of nitrogen but is the main source of suspended solids and CDOM that reached Adelaide's coastal waters in 2003. As these projects also focus on the reuse of stormwater, or directing water to well-planned wetlands, this reuse target for stormwater will effectively reduce nutrients in stormwater.</p> <p>The adoption of WSUD features (DPLG 2009) into land development offers the opportunity to minimise the entry of further pollutants including nitrogen and sediment into Adelaide's coastal waters if adopted for all new land developments and will support pollution load reductions if retro-fitted during urban consolidation. Action 68 in Water for Good includes the introduction of targets for WSUD and if based on ACWS recommendations could greatly assist in reducing nutrient and sediment loads to Adelaide's coastal waters.</p>

Licensing dredging activities

The EPA licenses dredging activities for both major capital investment projects, such as coastal developments of marinas and also ongoing periodic dredging, such as for maintaining channel openings or in the past for activities like dredging for sand replenishment on beaches. Dredging in marine waters applies to the waters of South Australia only; these waters generally extend 3 nautical miles from the coast and include the gulfs. The EPA has guidelines for how applicants should go about such dredging operations in order to comply with the WQ Policy.

The EP Act promotes the principles of ecologically sustainable development (ESD); in particular, section 25 of the Act imposes the general environmental duty on all persons undertaking an activity that may pollute to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm. Environmental harm is defined in section 5 of the Act and further specified in clause 12 of the WQ Policy. Some commercial activities of a size or type more likely to result in environmental harm are designated 'prescribed activities of environmental significance' and are listed in Schedule 1 of the Act. Schedule 1 prescribes both dredging and earthworks drainage as activities of environmental significance, requiring specific licences under the Act.

Licensing conditions are set to minimise the environmental impacts from dredging. The disposal of spoil ashore is strongly favoured, and the environmental performance of the operation must be monitored. In preparing an application for a licence to dredge, a development approval should be obtained from the relevant planning authority—either local council or the Development Assessment Commission—before a licence application can be considered and plans need to be made for the management of the environmental performance of the project.

Licensing of the Adelaide desalination plant

The Adelaide desalination plant at Port Stanvac was developed from 2009 to 2012 to diversify Adelaide's water supply. The desalination process involves taking seawater from Gulf St Vincent just off the coastline from Port Stanvac and then processing the water to produce freshwater to contribute to Adelaide's water supply. The desalination process results in a by-product of concentrated brine which is then discharged back to the sea. The EPA licenses such discharges to the coastal waters to ensure impacts on coastal water quality are minimised. In the context of the key issues for Adelaide's coastal water quality and impacts on loss of seagrass, inputs of nitrogen and sediments to the coast from discharge of concentrated brine is not considered to have negative impacts in terms of the larger issue of Adelaide's coastal water quality and health of seagrass.

Activities to reduce nutrient and sediment loads from catchments and stormwater include:

- setting of community agreed EVs and WQOs for Adelaide's coastal Waters and the Port waterways
- development of the PWWQIP
- coordinating the ACWS and preparing the ACWQIP
- development and planning assessment
- preparation of codes of practice including wharfing activities, marinas, industrial, retail and commercial stormwater and aquifer storage and recovery
- provision of advice and/or direction to ensure appropriate management of activities of environmental significance taking into account the findings of the ACWS and WQ Policy (eg large urban residential developments, major construction activities)
- leading Action 3 in the Stormwater Strategy to undertake work to inform stormwater infrastructure
- input to the development of the 'Blueprint for Urban Water for Greater Adelaide'
- monitoring overall condition of Gulf St Vincent and Adelaide's coastal waters.

[Table 13](#) summarises the actions for reductions in suspended solids over the period of the ACWQIP. It is assumed that flow and loads of suspended solids and CDOM are closely related (eg a drop in flows will result in a corresponding drop in suspended solids and CDOM). Discussion about the management strategies and specific actions, of different organisations are detailed in [Table 15](#) with further information in [Report 3](#).

It is important to understand that the intent of particulate matter reduction is to achieve a particular water quality status as defined in the ambient WQOs in Appendix 1. From an ecological perspective, the intent is to create a light (ie more transparent) climate that facilitates the health of existing seagrass meadows and allows recovery in denuded areas. In the relevant ACWS recommendation, the intent is to maintain adequate light levels for most of the time.

There is a limit to what can be achieved in particulate matter reduction and this will vary from catchment to catchment, particularly following large storm events. The ambient WQOs along Adelaide's coast for turbidity 200 metres from shore is set at the target of the 90th percentile value to be <1 NTU. This allows for low levels for 90% of the time, but higher levels for 10% of the time as a result of offshore storm activity and large catchment storm events. Monitoring should focus on the ecological indicators and the achievement of satisfactory water quality as defined in the ambient WQOs, rather than on a load reduction target as an end in itself.

High flow and low flow – different parts of the problem

For the Adelaide coast, there is a large difference in effect between the regular low to medium flows that discharge to and remain along, our swimming areas and the occasional episodes of high flow that discharge over the remains of our seagrass meadows.

High flow episodes are such that they currently (and will most likely always) overwhelm any engineering system designed to capture stormwater. There are usually some years between these events and at these times it is important that we maintain a stormwater network that continues to minimise the risk of property damage from flooding. Existing and proposed stormwater harvesting schemes will have little measurable effect on these flows. A recent example of this was the stormwater flows noted in the ACWS in October 2005. In this rare event, water spilled from Kangaroo Creek reservoir and travelled at a high velocity from the dam, picking up large loads of sediment as it eroded stream banks.

These episodes are consistent with the pattern of flow to the Adelaide coast in pre-European times and there is growing evidence that these flows were of little harm to otherwise healthy seagrass meadows. It is also likely that they were an important source of nutrients and a trigger to the breeding and life cycles of fish and other elements of the local marine ecosystem.

Low flows to the coast (except for the Onkaparinga River system – refer to section 5.5) on the other hand, are unlikely to have been a feature of Adelaide's coast in pre-European times as the coastal dune system probably held and absorbed most of them. With the development of a stormwater system to protect properties from flooding and the low rainfall events that characterise Adelaide's climate, these low flows are no longer intercepted by the dune system. This has also resulted in flows and associated pollutants impacting our seagrass and impairing the quality of our swimming beaches.

Current and future stormwater harvesting approaches focus on what is reasonably achievable in terms of flow volumes, ie the low to medium flows. This approach is likely to be consistent with improving beach amenity and supporting a slow shoreward progression of seagrass meadows, particularly in the context of the ecosystem improvements that will occur as we move toward sustainable nutrient loads to the Adelaide coast in the coming years.

At a local level, the inclusion of WSUD features into all greenfield developments and particularly in redeveloping existing urban areas will assist these processes over time. WSUD techniques can include the retention of more of these flows on site and allow the progressive release of filtered, higher quality stormwater over the following days and weeks. While the diligent application of these measures will take time, the results should include pleasant, green urban landscapes in the face of water supply shortages, increased amounts of high quality stormwater able to be harvested, less requirement to upgrade the capacity of urban stormwater systems, improved beach amenity and protection and contribution towards the re-establishment of seagrass off Adelaide's metropolitan coastline.

Note that although Water for Good proposes mandating WSUD by 2013, this will not be achieved solely through the planning system. What is required is extensive support for WSUD implementation from residents, local government, investors, developers and state government agencies for all new development and re-development as well as retrofitting existing urban areas. This work needs to be supported through a well-developed WSUD capacity building program.

7.4.2 Promoting integrated stormwater management and greater use of stormwater

Integrating stormwater management and promoting greater use of stormwater across the catchments of Adelaide involves many partners working together including the AMLR NRM Board, SA Water, DEWNR, EPA, DPTI, local governments from inland catchment areas to the coast and the Stormwater Management Authority. Details of activities that many of these partners are doing in terms of promoting integrated management of stormwater and greater use of stormwater are presented in [Table 15](#).

Stormwater is now being recognised as an important additional source of water for South Australia. In the SA State of the Environment (SoE) Report 2008, one of the key findings was that there was still only a small percentage of stormwater being captured for reuse.

Recommendation for Action 2.3 of the SoE was to 'double the capture and reuse of stormwater and waste water by 2012' (EPA 2008b). The harvest, treatment where necessary and reuse of stormwater will increase over the next few years under Water for Good Actions to 35 GL per year by 2025 and 60 GL per year by 2050 (Office for Water Security 2009). The projects to achieve these targets have received some preliminary assessment through the Urban Stormwater Harvesting Options Study undertaken by the Stormwater Management Authority in 2009. Further development and prioritisation of projects will be carried out through the development of a Stormwater Management Strategy and the Blueprint for the Urban Stormwater Management Plan, successive AMLR NRM Board business plans and on a case-by-case basis as funding and market opportunities arise.

The AMLR NRM Board has been working collaboratively with other stormwater management stakeholders to scope and develop a WSUD capacity building program to promote local government, state agencies, developers and stormwater industry people all working together and sharing information on what has worked and how to best implement WSUD across the Adelaide region.

This capacity building program will provide a regular forum for stormwater management practitioners and others to share ideas and information on WSUD, be provided with up-to-date training and promote collaboration on projects across the Adelaide region. This capacity building work and the actual projects that result from such linking of people, sharing ideas and upskilling people in WSUD will benefit the implementation of the ACWQIP in terms of promoting sediment and nutrient reductions from stormwater through application of WSUD to all greenfield, infill and urban infrastructure upgrades and replacement projects.

For the purposes of the ACWQIP, it has been assumed that key targets agreed by the community in formulating the AMLR NRM Board Plan (AMLR NRM Board 2008a) will eventually be substantially achieved. While the reuse of stormwater to meet the water needs of the Adelaide community is a current focus, the management of stormwater to reduce the current environmental harm that it causes to our coast is likely to include a wide range of initiatives—many of which will improve the quality of stormwater prior to discharge to the coast. Within this wider context, the development of the Stormwater Management Strategy and the Blueprint for Urban Stormwater Management Plan is needed to ensure that the AMLR NRM Board and other organisations are able to coordinate the delivery of a stormwater discharge regime to Adelaide's coast that can meet the environmental, social and economic needs of the community.

Further details on the actions of these individual stakeholders are listed in section 7.5. Further to this, a summary of some of the local government activities are provided in the table at the end of section 7.6.

Table 15: Summary of management strategies and actions aimed at stormwater flows, suspended solids and coloured dissolved organic matter

Agency	Management strategies and/or action
Penrice Soda Holdings	A large reduction in the loads of suspended solids travelling to Adelaide's coast occurred when Penrice Soda Holdings developed ponds in 2002 to remove this prior to discharge. Much of this remained in the Port River where it was discharged (eventually impeding the passage of shipping). Some of it, particularly the finer fractions travelled to Adelaide's coast. Historically, Penrice used to dredge this material every few years and discharge it directly into Adelaide's coastal waters near Outer Harbor. This practice has ceased with the last sea dumping of this material in 1993.
SA Water–Bolivar WWTP	Increased reuse of wastewater that is processed by the Bolivar WWTP will also remove further sediment from the marine outfall. There is a high likelihood that reuse projects will achieve the ACWS recommended outcome compared with their 2003 loads; however the 2028 loads are only estimates and dependent on numerous variables such as population growth projections, water use and uptake of recycling.
SA Water–Glenelg WWTP	Increased reuse of wastewater diverted by the Glenelg to Parklands reuse scheme will remove further sediment from the marine outfall. There is a high likelihood that reuse projects will achieve the ACWS recommended outcome compared with their 2003 loads; however the 2028 loads are only estimates and are dependent on numerous variables such as population growth projections, water use and uptake of recycling.
SA Water–Christies Beach WWTP	Increased reuse of wastewater for horticultural production and for domestic 'third pipe' systems in developing suburbs will remove further sediment from the marine outfall. Additionally, the former sewage sludge lagoons that received sediment are being rehabilitated and used as a wetland to minimise suspended solids and other pollutants from urban stormwater presently discharged to the Onkaparinga estuary. There is a high likelihood that reuse projects will achieve the ACWS recommended outcome compared with their 2003 loads; however the 2028 loads are only estimates and are dependent on numerous variables such as population growth projections, water use and uptake of recycling.
SA Water and DEWNR	The current range of projects including the Glenelg to Parklands scheme, the Blakeview housing development and the Southern Urban recycling project under Water for Good will result in a flow reduction of up to 7.4 GL from WWTPs. Also Water for Good Actions 16 and 19 will contribute to further water quality improvement for Adelaide's coastal waters in reducing sediment discharges from WWTPs and stormwater.
Local government/ Stormwater Management Authority and DEWNR	Actions 16 and 68 in Water for Good are particularly relevant to developing options for greater reuse of stormwater and use of WSUD. Report 3 in the EPA website lists the range of actions currently being undertaken by organisations that will result in suspended solid and CDOM load reductions to Adelaide's coast. Refer to section 7.5.5 for details on some local government activities from both inland and coastal councils. The major contributions of both coastal and inland councils to these load reductions will be of increasing importance in future years.
AMLR NRM Board regional targets for stormwater and local government activities	<p>The current AMLR NRM Regional Plan has identified a 20-year target of 75% of stormwater to be reused. The Board is currently developing a range of projects with local government and other stakeholders that aim to capture stormwater, focusing on rainfall events up to the 1 in 5–10 ARI storm events. Stormwater is the main source of suspended solids and CDOM that reached Adelaide's coastal waters in 2003.</p> <p>The AMLR NRM Board has been working collaboratively with other stormwater management stakeholders to scope and then develop a water sensitive urban design (WSUD) capacity building program to promote local government, state agencies, developers and stormwater industry people all working together and sharing information on what has worked and how to best implement WSUD across the Adelaide region.</p> <p>The adoption of WSUD features (DPLG 2009) into land development offers the opportunity to minimise the entry of further pollutants including nitrogen and sediment into Adelaide's coastal waters if adopted for all new land developments and will support pollution load reductions if retro-fitted during urban consolidation. Action 68 in Water for Good includes the introduction of targets for WSUD and if based on ACWS recommendations, could greatly assist in reducing nutrient and sediment loads to Adelaide's coastal waters.</p> <p>An aspirational target of 75% reduction of stormwater has been adopted by the AMLR NRM Board which is consistent with the ACWS recommendations. Measurable change would be achieved by virtue of the many stormwater harvesting schemes that have or are coming on line since 2008.</p> <p>Note that determining meaningful loads for nitrogen (and suspended solids) is difficult during drought conditions, but</p>

Agency	Management strategies and/or action
	<p>over a three to five-year period including a range of drier to wetter years, an estimation of annual loads could be more meaningfully established. Determining if reductions have been achieved that meet the recommendations of the ACWS will require ongoing monitoring and review of stormwater discharges from watercourses and stormwater drains. Given the increased understanding of the potential for the reuse of stormwater, it is expected that the 75% reuse target will be achieved over time for low to medium flows.</p> <p>The EPA and AMLR NRM Board have recently launched a website alert system in December 2012 to caution the public after rain events when water quality is not suitable for swimming (generally based on predicted faecal micro-organisms levels and turbidity levels after rain events).</p>

7.5 Summary of organisations' activities from catchment to coast

7.5.1 AMLR NRM Board

As indicated in section 3.10 of the ACWQIP, the AMLR NRM Board has developed a regional plan based on a long-term vision for the future of the region, which is 'Thriving communities caring for our hills, plains and seas' (AMLR NRM Board 2008a). It also outlines what the stakeholders in the region (namely local, state and federal government, industry groups, non-government organisations and the community) are aiming to achieve in the next 20 years.

For the AMLR NRM Regional Plan 'regional targets' were developed describing the desired condition of natural resources in 20 years for various 'themes', which include seascapes, urban watercourses and water for life (water resources). These targets need to be achieved for the longer-term regional vision to be met in 50 years. In this sense, 20-year regional targets will assist with evaluating the region's collective performance towards achieving the shared vision over the long-term.

The AMLR NRM regional targets link to targets set out in South Australia's Strategic Plan 2011 and State Natural Resources Management Plan 2012–2017. For the themes, the Board has developed a range of strategies and actions that it believes are an important part of achieving the 20-year regional targets. To measure its success in undertaking those actions, a series of shorter-term management action targets (MATs) were initially defined for July 2008 to 30 June 2011, but now intermediate targets (iTargets) have been set for the AMLR NRM plan from 2011–16.

For all themes in the plan, there is a diverse and complex program of strategies and actions, which will collectively achieve the Board's vision for the region, including the coastal waters. Although many aspects of the plan are relevant to the ACWQIP to some degree, the longer-term targets/strategies and now the iTargets are of more direct relevance to achieving particular ACWQIP strategies.

The AMLR NRM Regional Plan has information under the following themes that relate to the ACWQIP implementation:

- *Seascape Strategy Objectives:* these strategies will work towards protecting reefs, seagrasses and estuaries from land-based pollution impacts, managing coastal habitats across the region, protecting habitats for migratory shore birds and marine species, encouraging sustainable use of marine resources and increasing the knowledge and awareness of the community about the coast and marine environment. Technical advice, research and financial support to protect and improve the coast and marine environment are key components of achieving the targets identified in the plan.
- *Urban Watercourses Strategy Objectives:* these strategies aim to protect against further degradation of waterways and marine water quality from urban land uses and to retain and where possible return, indigenous biodiversity values. As part of improving water quality and managing flood risk, strategies aim to better manage stormwater runoff through WSUD and to be better prepared for potentially damaging flood events.
- *Water for Life Strategy Objectives:* these strategies aim to develop and implement plans to sustainably manage both surface and ground water and to develop opportunities for reuse of treated wastewater discharged by treatment

plants, as well as urban stormwater runoff in volumes in excess of natural rates. Importantly, they also aim to protect marine, fresh and ground water from potentially contaminating practices in urban and rural areas.

The AMLR NRM Regional Plan has a number of regional targets that are relevant to the ACWQIP:

- *Regional Target T1: By 2028, the region will have the system capacity to harvest up to 35 GL of stormwater and 50GL of wastewater per annum.*
- *Regional Target T2: Aquatic ecosystems and groundwater condition is maintained or improved.*
- *Regional Target T10: Land-based impacts on coast, estuarine and marine areas – impacts on coastal waters from sediment loads from catchments and pollutant loads from stormwater to be reduced*
- *Regional Targets T12: Coastal, estuarine and marine water quality – all water quality for marine waters to meet defined environmental values.*

The initial AMLR NRM Regional Plan included MAT 18, from 1 July 2008 to 30 June 2011—three WQIPs developed and being implemented including this ACWQIP. Since mid-2011 the AMLR NRM Board has put in place iTargets for the NRM Plan for 2011–16. The following iTargets are relevant to the implementation of the ACWQIP:

- *iTarget 4: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achieved*
- *iTarget 5: stormwater management plans have been developed for 40% of the urban area*
- *iTarget 6: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchments*
- *iTarget 7: 2,000 ha of land managed for water quality improvement*
- *iTarget 10: Existing native ecosystems being actively improved across 20% of their area (to meet pre-determined biodiversity conservation goals).*

Continued investigations, technical advice, financial support and ongoing monitoring and evaluation undertaken by the AMLR NRM Board relating to the themes, regional targets and iTargets identified above will contribute towards the implementation of the ACWQIP. Work of the AMLR NRM Board in water allocation planning, catchment management and stormwater planning is critical to protecting water resources through the allocation of water to productive and environmental uses and to minimise the impact of stormwater and wastewater on the degradation of urban, coast and marine environments.

Furthermore in implementing the AMLR NRM Plan the AMLR NRM Board is actively involved in stormwater management planning with local councils and also a key supporter with SA Water of seagrass rehabilitation research and reef and seagrass condition monitoring. In addition to this, the launch of a [website alert system](#) in December 2012 to caution community members after rain events when water quality is not suitable for swimming has been undertaken by the EPA and AMLR NRM Board.

7.5.2 Department for Environment, Water and Natural Resources (DEWNR): Stormwater

DEWNR is playing a lead role in partnership with others across state government, particularly the AMLR NRM Board, the EPA and SA Water to progress implementation of Water for Good, the Stormwater Strategy and development and implementation of the Blueprint for Urban Stormwater Management. Although primarily focused on addressing water security a number of the actions listed in Water for Good (refer to section 3.7) will have multiple benefits. Included in the benefits are improved water quality in Adelaide's water supply catchments and healthier rivers, waterways, catchments and marine environments. These are likely to be achieved through the provision of environmental flows and a reduction in effluent and stormwater discharges (provided that these are sufficient to allow improvement).

Progression of actions from *Water for Good* has led to the development of the *Stormwater Strategy – The Future of Stormwater Management* (DFW 2011) released in 2011. The *Stormwater Strategy* recognises that stormwater cannot be managed independently from wastewater and seeks to integrate management of these urban water resources.

Action 1 of the *Stormwater Strategy* is to develop an integrated blueprint for urban water incorporating Action 16 and 19 of *Water for Good*. The Urban Blueprint for Water Management is currently being developed.

Action 2 in the *Stormwater Strategy* focuses on establishing targets for WSUD for the Adelaide region. A consultation statement was released in early 2012 for public input. This document is currently in the process of being updated taking into account the comments provided.

Action 3 in the *Stormwater Strategy* states that by 2015, identification of what changes are required to stormwater infrastructure to improve water quality outcomes in line with the ACWQIP and the Torrens Taskforce. This initiative is particularly relevant to the implementation of the ACWQIP and the EPA has been identified as needing to lead this action.

Large-scale application of WSUD across the Adelaide region should result in coastal water quality improvements. In recognition of the importance of WSUD, *Water for Good*, *The 30-Year Plan for Greater Adelaide* and *Stormwater Strategy* all have actions or targets to further the implementation of WSUD. A WSUD consultation statement was released in early 2012 for public input. This document is currently in the process of being updated taking into account the comments provided. A business case for a WSUD Capacity building Program (supported by a number of agencies including DEWNR, AML NRM the EPA and the Stormwater Industry Association), was completed in late 2012. The objectives of the business case were to outline the benefits to South Australia of implementing a capacity building program and assess the need for, structure of and implementation plan for a WSUD capacity building program.

DEWNR and the AML NRM Board are playing a key facilitating role in promoting projects that address greater re-use of wastewater and stormwater. Since November 2009, a number of new stormwater harvesting and re-use projects in the Adelaide region have been announced and underway that will help to reduce stormwater pollutant loads entering receiving waters in addition to providing treated stormwater fit for purpose use. The Glenelg to Adelaide Park Lands Recycled Water Project and a number of other initiatives also assist in reducing wastewater-related pollutant loads.

The ACWS provides a specific focus for stormwater and wastewater projects in terms of reducing sediment and nutrient loads to Adelaide's coastal waters. However, to sufficiently improve water quality to create the overall conditions suitable for the recovery of seagrass along the Adelaide metropolitan coastline in the longer term, further opportunities need to be developed in the area of reducing sediment and nutrient loads to Adelaide's coastal waters beyond the current stormwater and wastewater projects underway and actions indicated in *Water for Good*, *The 30-Year Plan for Greater Adelaide* and *Stormwater Strategy*.

The reuse of wastewater has the potential to provide sustainable reductions in nitrogen loads to Adelaide's coast from WWTPs which can be a cheaper option than upgrading of infrastructure and processes. However, the proposed actions in *Water for Good* would not be enough alone to provide the necessary scale of reductions in nitrogen loads required in the ACWS Final Report.

Completion of Actions 16 and 19 in *Water for Good* of integrated strategies for greater use of stormwater and wastewater, through the development of the Urban Blueprint for water management have the potential to maximise the economic, social and environmental return to the community from reuse of both wastewater and stormwater runoff. Further to this, their benefits may extend to ensuring that the water needs can be met at the same time as achieving environmental benefits sought by the community for Adelaide's coastal waters.

7.5.3 Department for Environment, Water and Natural Resources (DEWNR): Coast and Marine

The DEWNR role in urban stormwater management is discussed in section 7.5.2, so the following section is primarily about the coast and marine work of DEWNR that relates to Adelaide's coastal waters.

The Living Coast Strategy (DEH 2004) sets out the state government's environmental policy commitments for coastal, estuarine and marine environments. It encompasses a range of environmental initiatives and programs and sets out the policy direction that the state government has continued to take to protect and manage South Australia's coastal areas, estuaries and marine ecosystems for their conservation and sustainable use. It defines the principles considered necessary for their sustainable use.

The Living Coast Strategy also identifies and addresses six key objectives for our coastal, estuarine and marine environments. A number of actions for state government and lead agencies are also identified. The objectives and actions are set out in [Report 3](#) of the supporting technical reports on the EPA website.

The Coast Protection Board (CPB) operates under the *Coast Protection Act 1972*, but also implements some of the recommendations of the Living Coast Strategy. The CPB is also tasked with the management of sand along Adelaide's beaches, including beach protection measures and the maintenance of navigable channels along the coast. This work often involves dredging or pumping sand which includes a small portion of fine materials derived from stormwater flows and beach transport. When this is being undertaken, there is a degradation of water quality for amenity purposes over an area that varies with wind and tide. There is considerable scope to minimise this effect by dredging at times that the community avoids beach use (eg night time, winter).

In 2000, the CPB initiated a review of the management of Adelaide's metropolitan beaches. Based on examination of the benefits and costs of a range of strategies, along with the results of a series of modelling and feasibility studies and input from the community, an innovative strategy for managing Adelaide's beaches called *Adelaide's Living Beaches: A Strategy for 2005–2025* (DEH 2005a) was developed.

The strategy consists of five main components and supports a number of aims related to the ACWQIP. Within the strategy, the Adelaide metropolitan coast is divided into seven management cells, with some interconnectivity between them. The components and aims are listed in [Report 3](#) of the supporting technical reports on the EPA website.

Other coastal and marine work that links to or supports the achievement of improved water quality for Adelaide's coastal waters includes work on the implementation of the South Australian marine parks network and management of the Adelaide Dolphin Sanctuary (ADS). DEWNR has the lead role of implementing 19 marine parks across the state. The two marine parks, which would benefit from water quality improvements, are the Encounter Marine Park and The Upper Gulf St Vincent Marine Park.

The Encounter Marine Park boundary extends up to Port Noarlunga reef (to Gulf View Road) and includes sanctuary zones for the Port Noarlunga Aquatic Reserve and Aldinga Aquatic Reserve that are in the southern region of Adelaide's coastal waters. This park includes a range of most popularly visited marine environments such as beaches and reef areas south of Adelaide, Fleurieu Peninsula, coastal areas of Kangaroo Island and the Coorong.

The Upper Gulf St Vincent Marine Park includes a sanctuary zone immediately south west of Port Gawler just above the northern boundary of Adelaide's coastal waters at Port Gawler. The park includes areas on both the eastern and upper western sides of Gulf St Vincent as well the entire upper region north of Port Wakefield.

The zoning of both marine parks are about preserving representative habitats from the Gulf St Vincent bioregion. Areas of both reef and seagrass habitat are more comprehensively represented in these and the other two marine parks of southern Yorke Peninsula than in marine parks for other bioregions in South Australia.

The area of seagrass and reef environments along Adelaide's coastal waters, although often referred to as in poor condition and being mostly outside the area covered by marine parks are still areas of conservation significance in terms of connecting habitat areas between the Upper Gulf St Vincent Marine Park and Encounter Marine Park ([Figure 14](#)) particularly for seagrass habitat. If water quality for Adelaide's coastal waters continues to improve and seagrass areas adjacent to Adelaide's coastline can recover to be closer to shore and in healthy condition and reef health is also improved in this area, then this will benefit the marine parks on either side of Adelaide's coastal waters.

The Adelaide Dolphin Sanctuary (ADS) Management Plan (DEH 2008) is a statutory plan under the Adelaide Dolphin Sanctuary Management Act 2005. The plan has six objectives with Objective 3 relating to water quality in the Port waterways. The EPA has responsibilities under the four issues listed for Objective 3 and has been asked to report against this objective to the ADS Advisory Board. The four issues cover reduction of nutrients, reduction of pollutants, management of ballast waters and management of toxicants (DEH 2008).

DEWNR work on the ADS includes:

- compliance activities
- research into the effects of excess nutrients and thermal pollution on prey species, vegetation health and pest species
- providing information on best practice methods for any new dredging and other sediment disturbance
- studying discharged pathogens and their impact on the ADS dolphin population.

7.5.4 Stormwater Management Authority

In May 2005, the *Urban Stormwater Management Policy* for South Australia was released. The document focuses on improving the way stormwater is managed. This policy was adopted following negotiation between the state government and the Local Government Association (LGA).

In February 2006 both parties (above) entered into a stormwater management agreement that provided an improved framework for stormwater management on a catchment-wide basis throughout the state. The Stormwater Management Authority (SMA) was established under the *Local Government Act 1999 (Stormwater Management Amendment 2007)* which came into effect on 1 July 2007. The Authority, which is responsible for implementation of the Stormwater Management Agreement, provides funding towards the cost of floodplain mapping, preparation of stormwater management plans and priority stormwater infrastructure works.

Stormwater projects must demonstrate a significant flood mitigation component as well as addressing, wherever practicable, value adding opportunities such as stormwater reuse and water quality enhancements to be eligible for funding from the Stormwater Management Fund.

The Urban Stormwater Management Policy identifies the following goals for collaborative and forward-looking stormwater management:

- apply a risk management framework for hazards/flooding based on catchment characteristics and rigorous data collection
- facilitate more productive use of stormwater
- manage the environmental impacts of stormwater as a conveyer of pollution
- manage stormwater as part of the urban water cycle recognising natural watercourses and ecosystems where feasible
- achieve responsible stormwater management locally by making better use of the statutory development planning system
- gain innovative stormwater policy outcomes through the most effective funding and procurement arrangements.

Stormwater management plans are required to set catchment-specific objectives, identifying clearly how the above goals can be achieved and measured.

Since September 2006, 46 projects have been approved. Some of the major projects include:

- Gawler River Flood Mitigation Scheme
- Port Road Catchment Stormwater Management Plan

- Brownhill and Keswick Creeks Catchment Stormwater Management Plan
- City of Norwood Payneham and St Peters First Creek Flood Mitigation Works
- City of Holdfast Bay and City of Marion Stormwater Management Plan.

In the future, stormwater management plans will contribute to achieving important water quality outcomes necessary for delivering the ACWIP stormwater targets. The ACWS has informed the development of both short-term (three-year MATs and iTargets) and long-term targets by the AMLR NRM Board who reviews stormwater management plans. With the incorporation of the AMLR NRM Board Plan into the ACWQIP, those preparing stormwater management plans will now have a consistent set of long-term targets to provide context and focus. Water quality improvement plans for other watercourses as proposed in the current AMLR NRM Board Plan will similarly also provide in-stream targets to assist in defining plan goals.

7.5.5 Local government

Local government is very active in natural resource and stormwater management across metropolitan Adelaide—in many cases in direct partnership with the AMLR NRM Board, SMA and other state government agencies. Local government is working with the AMLR NRM Board and state agencies to develop and implement stormwater management plans. Local government was also represented on the Adelaide Coastal Waters Steering Group through the Local Government Association (LGA) and also (either collectively or individually) already works extensively with many of the key environment and planning state government stakeholder agencies (eg DEWNR, DPTI and EPA) who are involved in the development of the ACWQIP.

The following section provides a sample of the various activities being undertaken at a local government level that are supporting or continue to support the implementation of the ACWQIP. These activities are based on information collated in the development stage of the ACWQIP, from comments provided during spring 2011 and a recent review of available information from each of the local governments on the topic of stormwater management and WSUD. The main local coastal council areas adjacent to Adelaide's coastal waters (from south to north) include the City of Onkaparinga, City of Marion, City of Holdfast Bay, City of West Torrens, City of Charles Sturt, City of Port Adelaide–Enfield, City of Salisbury, City of Playford and District Council of Mallala. Council boundaries are illustrated on [Figure 15](#).

Below, information is provided on the key projects and activities that a number of councils are engaging in to improve stormwater quality and implementation of WSUD features that will result in improvements to water quality for Adelaide's coastal waters. The information on inland catchment areas (found in the cities of Mitcham, Unley and West Torrens) provide examples of some of the activities being undertaken in Adelaide to address stormwater management issues in an urban setting.

In an effort to promote a greater uptake of WSUD across Adelaide, ideally, for the ongoing implementation of the ACWQIP, a steering group or coordinating group could be established to link closely with local government via the AMLR NRM Board and other state agencies.

There is a need to ensure that a strong catchment to coast perspective is adopted in the implementation of the ACWQIP. This could focus on local government and local communities' work that promotes activities to improve water quality across Adelaide. Examples of the catchment to coast commitment of the ACWQIP, is expressed via a listing of coastal or inland councils (which will contribute directly or indirectly to the implementation) in [Report 3](#) of the supporting technical reports on the EPA website. Information on some of the councils with extensive programs along the coast is included in the following text.

7.6 A snapshot of coastal council activities

City of Onkaparinga provided substantial comment on the ACWQIP indicating where work they are already doing aligns with and supports the implementation of the eight strategies of the ACWQIP. This information is provided in detail in [Appendix 2](#), but the following comments below are taken directly from the comments provided by the City of Onkaparinga.

Our approach to water management is reflected in our Water Futures Strategy 2008–2013 which seeks to ‘achieve the sustainable management of water resources and security of supply’.

As a council we will continue to work in collaboration with the EPA, AMLR NRM Board, SA Water, SMA and others agencies to reduce the amount of pollutants entering coastal waters.

The City of Onkaparinga region has 31 km of coastline—nearly half of the 70 km covered by ACWQIP. Extensive works have been undertaken to improve water quality in our region beyond the general environmental duties required under the EP Act and Natural Resources Management Act 2004. Local government acts widely to improve the quality of water that drains to the coast through the development of wetlands, the recycling of wastewater and stormwater and through cliff and creek erosion works and these projects are often implemented in partnership with other agencies. However, the projects often require collaboration by councils, or are initiated and managed by councils and involve significant expenditure.

The City of Onkaparinga has been active in implementing WSUD in council-owned streetscapes and parks and continues to encourage its incorporation into greenfield development including through a standard Development Condition and a Water Quality Levy. However, there are limits to how much WSUD can be mandated and there are particular challenges for achieving WSUD outcomes in existing built-up areas.

In terms of climate change and population growth impacts on coastal water quality, the City of Onkaparinga highlighted that there are two local government projects about to commence being funded by state, federal and local government and that when combined, cover the full length of the Adelaide coastline. It has joined with the cities of Holdfast Bay and Marion as part of the *Resilient South—the Southern Adelaide Region Integrated Vulnerability Assessment and Adaptation Action Plan* which will assess the climate change impacts—sea level rise and extreme weather events (including storms, flooding, heatwaves and bushfires) that pose a risk to property, infrastructure, business and industry, human health and the environment. This work will build on the work the Southern Region Councils have already undertaken in climate change risk assessments and adaptation plans for their corporate activities. A similar project is being undertaken by the Western Region of Councils of Cities of Charles Sturt, West Torrens and Port Adelaide Enfield.

City of Holdfast Bay (CHB) indicated they are contributing to the improvement of quality of Adelaide's coastal waters through the following actions:

- the development of the CHB and City of Marion combined Stormwater Management Plan
- reuse of A-Class water from the Glenelg WWTP to water street trees and reserves
- integrating WSUD policy into council's planning and development
- installation and maintenance of seven gross pollutant traps (GPTs) in the city. The cost is shared with City of Marion for four of these GPTs
- implementation of remedial works to reduce erosion, such as at Barton Gully (south of Kingston Park) resulting from stormwater flows through the gully. The work was undertaken during October and November 2011 and will reduce sediment and pollution loads entering the sea. CHB has spent \$40,000 on this project and will be allocating further funds towards revegetation with riparian species. CHB environmental volunteers also contribute significantly to this sites maintenance through weed control and revegetation.

The above actions are identified in the council's *Sustainable Futures Direction Plan* (SFDP) and are in line with ACWQIP recommendations. Please refer to the following link for further actions highlighted in Objective 3 'Water Preservation' of Council's SFDP⁵.

⁵ <www.holdfast.sa.gov.au/webdata/resources/files/Sustainable_Futures_Directions_Plan_2009-12_-_Final_Copy.pdf>

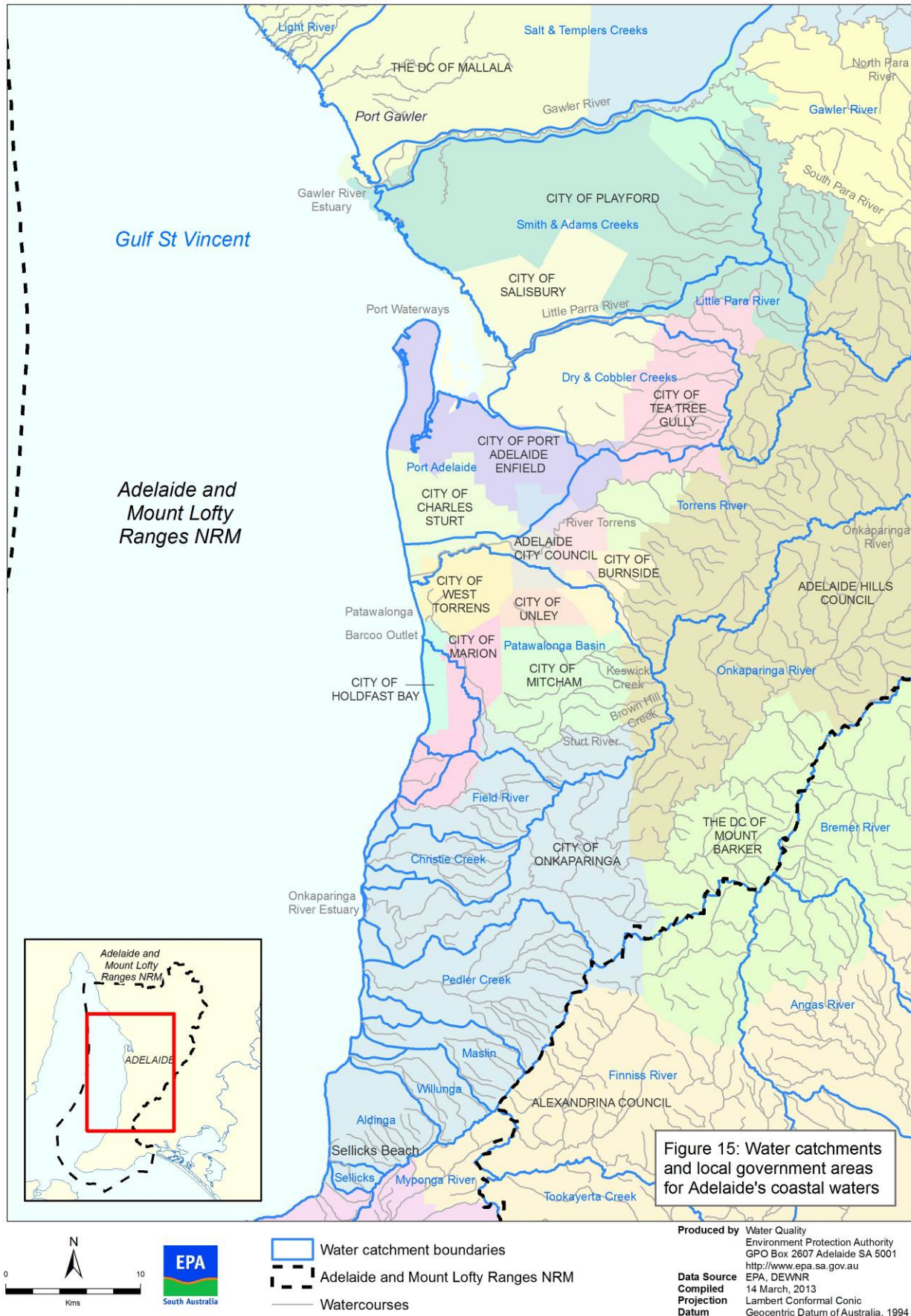


Figure 15: Water catchments and local government areas for Adelaide coastal waters

In addition, the CHB comments indicate that in the future they may be interested in collaborating with the EPA and other relevant agencies regarding the following:

- building on and expanding the current use of A-Class water throughout the City
- investigating the possibility of monitoring the effectiveness of GPTs with regard to the amount of sediment being 'trapped' versus the amount entering the sea as well as investigating methods of improving sediment trapping
- the Plan states that 'studies (Corbin & Gaylard 2005) have shown that micro-biologically (faecal micro-organisms), Adelaide's coastal waters are generally safe for swimming three days after heavy rainfall events. Invariably discharges after heavy rainfall are highly coloured.' It also states that 'the DH recommends the public avoids swimming in the vicinity of discoloured water'. It may be an advantageous project for public health purposes to collaborate with a range of key agencies to develop consistent signage across the CHB and metropolitan coastline which reflects the above message.

Note that the AMLR NRM Board and EPA have partially followed up on this action with the development of a joint [website alert system](#) to caution community members after rain events when water quality is not suitable for swimming refer to for more information.

City of Charles Sturt indicated that they are involved in undertaking the largest stormwater harvesting project in the history of the western suburbs of Adelaide, *Water Proofing the West* which will result in a significant reduction of stormwater discharged to the sea.

Stage 1 is the first component of a broader region-wide system which will harvest, treat and store stormwater in specific locations and then distribute the recycled stormwater through to demand areas in parts of the City of Charles Sturt. The project has five key elements with the following components:

- Old Port Road; with wetlands and aquifer storage and recovery (or ASR) which comprises a multi-objective stormwater scheme with water reuse, water quality improvement, environmental enhancements and reducing flood risk
- Cooke Reserve and Riverside Golf Course; with wetlands and ASR components
- Cheltenham wetlands; which will provide treated stormwater for ASRs and irrigation to the site's open space and urban development via a recycled water supply system
- a linking and distribution mains; joining Cheltenham wetlands, Old Port Road and Cooke Reserve/Riverside projects and a distribution mains to supply the recycled stormwater to parts of the council area
- a River Torrens diversion system; to divert river water to supply additional water for harvesting to all the wetlands.

In broad figures the *Water Proofing the West* scheme will harvest 2,400 ML per annum, with reflected reductions in discharge to the coast presented in the modelling and targets.

For the implementation of the ACWQIP the City of Charles Sturt recommended that stormwater pollution prevention projects are reintroduced to reduce non-point source pollution for non-licensed operations. Significant discharges are controlled by an EPA managed licensing system bearing in mind that some operators are not licensed, eg small to medium size enterprises.

To address this gap, stormwater pollution prevention projects began in SA in 1995 when the Patawalonga Catchment Board initiated a joint venture with the cities of Marion and Mitcham to improve stormwater practices of businesses in the Edwardstown and Melrose Park. Since that time, the number of projects has increased in the Patawalonga catchment, as well as extending into the former Torrens, Onkaparinga and Northern Adelaide and Barossa Catchment Board areas.

Several reviews of the effectiveness of individual projects have been undertaken since their inception. These reviews have all indicated that the individual projects are having an impact by raising the awareness of businesses and councils

to best management practices relating to stormwater. The results of these local reviews coincide with similar reviews interstate and overseas.

City of Salisbury contributed to workshops relating to the development of the draft ACWQIP as a recognised leader in the area of water conservation and management. It aims for ecologically sustainable development, as outlined in its *Salisbury, Sustaining Our Environment—an Environmental and Climate Change Strategy 2007*. The protection of the coastal environment and marine water quality are key environmental objectives of the council.

The City of Salisbury is looking to implement Australia's first totally integrated water management plan to efficiently harvest and manage systems for rain, storm and ground water, recycled wastewater and potable water. This plan is an integral part of the *Waterproofing Northern Adelaide* which received significant funding from the Australian Government in 2006. The project also has a sustained focus on broadening community awareness and action about conserving water and innovative ways to use this natural resource.

7.7 A snapshot of council activities in the Brownhill–Keswick Creek catchments

City of Mitcham was chosen as a representative upstream council to identify the range of activities undertaken by local government, which will have a major role in the implementation of the ACWQIP. Its *2008–2012 Strategic Plan* outlines the medium-term strategic directions for achieving the long-term vision for the area. The strategic plan establishes four broad goal areas (objectives) with an emphasis on contributing to long-term sustainability.

The strategies (actions) guide the council's annual business plan and budget as well as guiding its long-term financial plan. With regard to the ACWQIP, the environmental sustainability goal is relevant and is outlined in [Report 3](#) of the supporting technical reports on the EPA website. The council's *Public and Environmental Health Management Plan* was produced in 1997 and identified several strategies to sustain the health of catchments within the Mitcham Council area.

The City of Mitcham's **Water Management Plan 2004–2009** outlines a strategic direction and an implementation schedule for water-related actions. The plan has been prepared using the International Council for Local Environmental Initiatives (ICLEI) Water Campaign™ Framework. ICLEI is an international not-for-profit non-government membership organisation of local governments and their associations.

City of Unley has an *Environment Sustainability Plan 2010–2013*, which has a specific water action plan that has paved the way for the city to take a lead role in waterproofing the east of Adelaide in terms implementing the following:

- WSUD features across the public land in Unley
- use of permeable paving and nature strips in all public infrastructure upgrades
- plumbed rainwater tanks for public toilets
- tree water wells on public streets
- biodiversity gardens
- promotion of stormwater harvesting and reuse
- rainwater tank rebates
- use of recycled water from the Glenelg–Adelaide Recycled Water Pipeline.

The City of Unley has also been working alongside the cities of Adelaide, Mitcham, Burnside and West Torrens and the AMLR NRM Board to develop the Brownhill–Keswick Creek Stormwater Management Plan (Worley and Parsons 2012). The primary focus of their *Environment Sustainability Plan* has been on flood mitigation, but there is potential for the management of low flow events across catchments as already being demonstrated within the City of Unley to improve water quality and also the volume of low flow stormwater reaching the coast.

City of West Torrens has been the downstream inland to coast local government partner involved in the Brownhill–Keswick Creek Stormwater Management Plan and is also taking significant action within their own council area for management of stormwater and implementation WSUD approaches across both public and private land.

The City of West Torrens has been part of the Water Campaign™ program of the International Council for Local Environmental Initiatives (ICLEI). This international water management program helps local councils address water issues such as stormwater pollution and freshwater conservation through practical action at the local level. The overall aim is to reduce council's and the community's water use and improve the quality of stormwater runoff that ends up in the local waterways. The implementation of the water campaign has involved the development of a water management action plan, local level action with WSUD rain gardens on local streets and development of tips to improve development applications that include information for developers on WSUD.

The key catchment to coast strategies and actions being undertaken by relevant councils are described below.

Many local governments across the Adelaide region (including those listed above) are collectively undertaking numerous activities that support the day-to-day and longer-term implementation of the ACWQIP for sediment, nutrient and CDOM reduction to Adelaide's coastal waters. These activities range from routine expenditure of councils on street sweeping activities to implementation of WSUD for roadways and council public infrastructure upgrades, to involvement in *Waterproofing the South, East, North and West* projects. Other councils are actively planning and modelling for nutrient, sediment and CDOM monitoring in stormwater management planning (as is the case in the City of Holdfast Bay and City of Marion Stormwater Management Plan).

Local government is a key partner in promoting the implementation of WSUD across the Adelaide region, along with state government agencies and developers. As such, local government is likely to benefit greatly from the delivery of the WSUD capacity building program that has been scoped (and is planned to be delivered) by the AMLR NRM Board in partnership with other stormwater management stakeholders including DEWNR and EPA.

Table 16: Key catchment to coast strategies and actions being undertaken by relevant councils

Local government authority	Key catchment to coast strategies/actions
City of Charles Sturt	<ul style="list-style-type: none"> • Undertaking the largest stormwater harvesting project in the history of the western suburbs of Adelaide—Water Proofing the West—which will result in a significant reduction of stormwater discharged to the sea. • Water Proofing the West Stage 1 is the first component of a broader region-wide system which will harvest, treat and store stormwater in specific locations and then distribute the recycled stormwater through parts of the City of Charles Sturt area. In broad figures the scheme will harvest 2,400 ML per annum, with reflected reductions in discharge to the coast included in the modelling and targets.
City of Holdfast Bay	<ul style="list-style-type: none"> • City of Holdfast Bay and City of Marion Stormwater Management Plan. • Reuse of A-Class water from the Glenelg WWTP to water street trees and reserves. • Integrating WSUD policy into council's planning and development. • Installation and maintenance of seven Gross Pollutant Traps (GPTs) in the city. The cost is shared with City of Marion for four of these GPTs. • Implementation of remedial works to reduce erosion, such as at Barton Gully (south of Kingston Park) resulting from stormwater flows through the gully.
City of Mitcham	<ul style="list-style-type: none"> • Its strategic plan environmental sustainability goal is relevant and is outlined in Report 3 of the supporting technical reports on the EPA website. • The council's Public and Environmental Health Management Plan (PEHMP) were produced in 1997 and identified several strategies to sustain the health of catchments. • Its Water Management Plan 2004–2009 outlines strategic direction and an implementation schedule for water-related actions. The plan has been prepared using the International Council for Local Environmental Initiatives (ICLEI) Water Campaign™ Framework.

Local government authority	Key catchment to coast strategies/actions
City of Onkaparinga	<ul style="list-style-type: none"> • Extensive works have been undertaken to improve water quality beyond the general environmental duties required under the EP Act and Natural Resources Management Act 2004. This has been supported through funding from the Australian Government as part of waterproofing the South. • Active in implementing WSUD in Council-owned streetscapes and parks and continues to encourage its incorporation into greenfield development including through a standard Development Condition and a Water Quality Levy. • Council has joined with the cities of Holdfast Bay and Marion as part of the Resilient South—the Southern Adelaide Region Integrated Vulnerability Assessment and Adaptation Action Plan which will assess the climate change impacts—sea level rise and extreme weather events (including storms, flooding, heatwaves and bushfires) that pose a risk to property, infrastructure, business and industry, human health and the environment. <p>Note: the City of Onkaparinga provided extensive information as part of the feedback on the ACWQIP. This information is provided in Appendix 2: City of Onkaparinga activities supporting ACWQIP.</p>
City of Salisbury	<ul style="list-style-type: none"> • The council is looking to implement Australia's first totally integrated water management plan to efficiently harvest and manage systems for rain, storm and ground water, recycled wastewater and potable water. This plan is an integral part of the Waterproofing Northern Adelaide project and has a sustained focus on broadening community awareness and action about conserving water and innovative ways to use this natural resource.
City of Unley	<ul style="list-style-type: none"> • Its Environment Sustainability Plan 2010–2013, has a specific water action plan assisting council to adopt a lead role in waterproofing the east of Adelaide in terms implementing the following: <ul style="list-style-type: none"> – WSUD features across the public land of Unley – use of permeable paving and nature strips in all public infrastructure upgrades – biodiversity gardens – promotion of stormwater harvesting and reuse – rainwater tank rebates – use of recycled water from the Glenelg–Adelaide Recycled Water Pipeline. • The City of Unley has also been working with the cities of Adelaide, Mitcham, Burnside and West Torrens and the AMLR NRM Board to develop the Brownhill–Keswick Creek Stormwater Management Plan.
City of West Torrens	<ul style="list-style-type: none"> • The council has been part of the Water Campaign™ program of the International Council for Local Environmental Initiatives (ICLEI). This international water management program helps local councils address water issues such as stormwater pollution and freshwater conservation through practical action at the local level. The overall aim is to reduce council's and the community's water use and improve the quality of stormwater runoff that ends up in the local waterways • It is involved in the Brownhill–Keswick Creek Stormwater Management Plan and is also taking significant action within their own council area for management of stormwater and implementation WSUD approaches across both public and private land within the council area.

8 ACWQIP vision, EVs and WQOs

Underpinning the ACWQIP is the inspirational community agreed vision, the environmental values and the water quality objectives for Adelaide's coastline. Collectively these have established the 30-year framework for the management of the coast and coastal waters of Adelaide.

The ACWQIP strategies and actions, and reporting and monitoring requirements of the Plan are presented in detail in Chapter 8.

8.1 Environmental values (EVs)









To achieve the community agreed vision of:

Healthy aquatic ecosystems where environmental, social and economic values are considered in equal and high regard in a balanced management approach that aims to see the return of the 'blue line of seagrass' closer to shore by 2050.

The community of Adelaide has also agreed to environmental values (EVs) that are relevant to its coastal waters. These eight EVs are grouped into those relating to the environmental, social and economic uses of Adelaide's coastal waters (Table 4 reproduced as [Table 17](#) below). These EVs then set the scene for the level of water quality objectives (WQOs) that are being aimed for, to take the vision for Adelaide's coastal waters from an inspirational vision statement, to apply to the current condition and turn the vision into reality.

[Table 17](#) displays the community agreed EVs according to the relevant social, environmental and economic groupings and includes both current and potential future uses identified for Adelaide's coastal waters. [Figure 1](#) indicates the range of EVs for Adelaide's coastal waters that includes the different management segments.

Table 17: Community agreed environmental values for Adelaide's coastal waters

ENVIRONMENTAL values		SOCIAL values		ECONOMIC values	
Ecological		Aesthetic		Commercial (current and future)	
	Protection of aquatic ecosystems		Visual appreciation		Human consumption (aquatic foods)
		Recreation			Drinking water supply–desalination
			Primary recreation (eg swimming and snorkelling)	Industrial	
			Secondary recreation (eg fishing and boating)		
		Cultural and spiritual			
			Cultural heritage (Aboriginal and non-Aboriginal)		Industrial use

Some values are only relevant for certain segments of the Adelaide coastal waters (ie industrial use in the Port waterways). Other values, such as protection of aquatic ecosystems and cultural and spiritual values, relate to the whole coastline.

After the public comment phase in 2011, the draft EV for potential aquaculture was removed as not being relevant to Adelaide's coastal waters based on a request from PIRSA Aquaculture. The EVs for industrial and commercial use and raw drinking water (through desalination) remain in the list of confirmed EVs as these are current uses for Adelaide's coastal waters. This list may be used in updating the WQ Policy to revise the current list of default EVs as part of a process of review of the policy.

The EVs of the coastal waters and Port waterways have been defined in a number of previous studies, in particular the earlier Torrens, Patawalonga and Onkaparinga Catchment Water Management Plans. Appropriate EVs from these studies include:

- the protection and maintenance of aquatic ecosystems (ecological)
- primary industries (industrial and commercial), in this case aquaculture/human consumption of aquatic foods
- recreation and aesthetics.

In addition, there is the EV of industrial use of water (such as cooling water for power stations and industrial processes) for the Port waterways. Cultural and spiritual values have also been identified as important EVs by the Adelaide coastal community including the Kaurna people (see [Report 1](#) of the supporting technical reports on the EPA website).

While the values are generally applicable throughout the study area, differences in emphasis are to be expected for the different water quality management sections in the Port waterways and Adelaide coastal waters. For example, it would not be appropriate to have EVs of primary water contact (swimming) adjacent to discharges of wastewater from wastewater treatment plants (WWTPs) or industry. Signage provided by local and/or state government for specific locations may indicate where certain EVs are not appropriate.

Signage may also be used to indicate certain times when the water quality is not suitable for certain EVs and activities (eg after rain events, water in the vicinity of stormwater drains and catchment outflows may not be considered safe for swimming). In December 2012 the EPA and AMLR NRM Board jointly launched a website alert system to caution the public after rain events when water quality is not suitable for swimming (generally based on predicted faecal micro-organisms levels and turbidity levels after rain events)⁶.

An essential part of the development of the ACWQIP was the community and stakeholder consultation program undertaken during 2007 and 2008 to assist in defining EVs and identifying community issues. The executive summary report from this consultation is included in [Report 1](#) of the supporting technical reports on the EPA website. Information on the public comment process from spring 2011 is included in tables provided in [Appendix 3](#) within this document and also on the EPA website.

8.2 Setting water quality objectives (WQOs)

Water quality objectives were also set for Adelaide's coastal waters. They establish a guideline for water quality (eg turbidity level and level of nutrients) that assist in achieving the EVs. They also provide general advice about coastal water quality for monitoring, and for comparative purposes, for the management of discharges.

Targeted community and stakeholder input to the development of the ACWQIP has been valuable in defining the level of protection that is appropriate in developing WQOs. Further input was sought and confirmed through public comment on the ACWQIP. The full details on the WQOs for Adelaide's coastal waters are presented in [Appendix 1](#) within this document and a summary of the EVs and WQOs are presented in [Table 20](#).

For the coastal waters, it was very apparent that equal importance is given to all locations along the coast by the community. Residents in the Port Adelaide area, for example, valued the amenity and habitats of the southern region as well as the nearby Port waterways. Not only was the coastline considered to be an important community asset, a clean functional environment is seen as part of their heritage. Another very clear message that came through in all community

⁶ <www.epa.sa.gov.au/environmental_info/water_quality/adelaides_coastal_waters/beach_water_advice>

discussions was the need to allow for the recovery of seagrass along the Adelaide coastline even though this may take some decades to achieve.

Levels of protection for the different water quality management sections, to achieve the WQOs presented in [Appendix 1](#) were derived from the EVs set by the community. These levels of protection are described below for each management section.

The Australian and New Zealand Environmental and Conservation Council defines varying water quality criteria (trigger levels) for a range of water quality parameters, depending on the percentage of species expected to be protected, 99%–very high, 95%–high, 90%–moderate, and 80%–low (ANZECC 2000).

Table 18: Australian and New Zealand Environmental and Conservation Council (ANZECC 2000) water quality parameters

Level of protection	Percentage of species expected to be protected
Very high	99%
High	95%
Moderate	90%
Low	80%

The term 'level of protection' is given as a percentage (eg 99%). This means that the indicated percentage is considered achievable for the protection of aquatic ecosystems and the species that live within that ecosystem, for that percentage of time.

For example, for the high level of protection of 95% for the Port waterways, this means that for 95% of the time the Port waterways and the animals and other aquatic species (that are dependent on the waterways) are not impacted by poor water quality, but on occasions (such as in summer with low oxygen levels in the estuarine areas or after very heavy rain events that result in larger loads of nutrients and sediments entering the Port waterways) the water quality may be at a level where events may occur that are considered indicators of poor water quality. An event with poor water quality may result in adverse impacts or consequences such as fish kills or algal blooms.

However, for the majority of the time (95%) the listed WQOs (such as total N <200 ug/L (90th percentile)) presented in [Appendix 1](#) and summarised in [Table 20](#) should be considered achievable.

8.2.1 Port waterways

This section details the levels of protection that are considered appropriate for different water quality parameters for the Port waterways. These parameters include nutrients, toxicants, suspended solids, turbidity and colour, temperature, dissolved oxygen and faecal micro-organisms. These groupings of water quality parameters are often used for assessment of water quality in estuarine environments. Nutrients, suspended solids, turbidity and colour are standard measures for water quality. Levels of toxicants are important to measure in areas such as ports that have been impacted by historical activities where metal contamination and other contamination of sediments may occur (eg chemicals used in processing or hormones in wastewater).

Measures for temperature and dissolved oxygen are important parameters to consider in estuarine areas, as they can indicate when the water column is likely to become layered in such a way that oxygen levels plummet at the surface of the water and stress and death may occur for some species at these levels. Some species, including fish, can only tolerate certain ranges for temperature and dissolved oxygen before the water quality can become toxic for them to keep living in that environment. These events that result in fish kills and algal blooms are less likely to occur in the open water along Adelaide's coast which is well mixed and experiences greater wave energy that also results in better mixing of the water column.

Measures of faecal micro-organisms are important to consider in enclosed waters in terms of the waters being suitable for human contact for primary recreation activities such as swimming.

The Port waterways are included in the area covered by the Adelaide Dolphin Sanctuary (ADS). Objective 3 of the ADS Management Plan (DEH 2008) is 'improved water quality' and as indicated in the Adelaide Dolphin Sanctuary Act s8(1)(c):

Water quality within the Port Adelaide River estuary and Barker Inlet should be improved to a level that sustains the ecological processes, environmental values and productive capacity of the Port River estuary and Barker Inlet.

Maintaining water quality at a level that supports the ecosystem values of the Port waterways and capacity of the area to support the use of the environment by dolphins needs to be considered in setting EVs and WQOs for the Port waterways and appropriate levels of protection for these areas.

Levels of protection of water quality EVs defined for the three sections of the Port waterways are as follows:

Northern section, north of St Kilda and Torrens Island

Although described as an area severely impacted by nutrients in the PWWQIP from the discharges from the Bolivar WWTP and Penrice Soda Holdings, this area is a high value conservation area and ecological system and a high level of protection is considered appropriate by the community.

Central Barker Inlet section, which includes south of St Kilda in Barker Inlet, Angas Inlet, North Arm and North Arm Creek

This area has been significantly impacted by poor water quality and development in the past and overall this section should be considered as moderately to highly disturbed. However, despite the historic impact, much of the natural aquatic ecosystem remains in a modified form. A high level of protection is required for this area if the natural aquatic ecosystem is to be protected and improved, but limitations associated with returning this area to its former condition need to be recognised in any restoration efforts.

Port River section: measures for water quality in the Port waterways

Due to the historic development of port facilities and industry in the Port River, this area has a history of being highly degraded. However, in recent years water quality has improved somewhat and is likely to further improve with the water quality improvements proposed in the ACWQIP. While this area has a lower ecological value compared to the northern or central sections, it nevertheless has important recreational value (eg boating, amenity, fishing, etc) and a reasonably high standard of water quality is needed to maintain these uses. The inner harbour section of the Port River is now being further developed as a residential area and consequently amenity and recreation (both contact and passive) are increasingly important. Therefore, there is continued pressure for water quality improvement in the Port River to ensure that the desired EVs are achieved.

1 Nutrients

The PWWQIP (EPA 2008) focused on nutrients, particularly nitrogen, as it was the most significant pollutant. With regard to the definition of WQOs for other parameters, it is important to recognise the differences between the more open coastal waters and the more enclosed waters of the Port waterways, reflected in habitat types, dispersion characteristics and sediment mobility.

Within some areas of the Port waterways, there is relatively limited sediment movement and due to historic uses and discharges into the Port River, sediment contamination still occurs at some sites. However, if sediments are not disturbed then this contamination is not an issue for water quality in the Port River. Within the Port waterways, there are current thermal and industrial discharges, issues with dissolved oxygen at certain times of the year and major economic activities relating to industry and port activities.

The Port waterways offer sustained environmental, economic and social value to South Australia. Important water quality aspects include the aquatic ecosystem (including habitat for dolphins), recreational uses, new urban development and amenity. Despite the high level of disturbances that have taken place in the past, providing a high level of protection to the waterways will reap substantial benefits and are well within the capacity of the community to achieve over time. The continued reduction of nutrients and impacts from other inputs and water quality parameters (eg toxicants, suspended solids, temperature and dissolved oxygen) will be required. Full details of WQOs are provided in [Appendix 1](#) for the Port waterways.

2 Levels of protection and water quality objectives for toxicants

As discussed in ANZECC, for slightly disturbed ecosystems it may be more appropriate to apply the 99% level of protection, and for moderately disturbed ecosystems the 95% level of protection as default values. ANZECC also considers a high level of protection (99%) should apply to the metals copper, lead, cadmium, chromium and zinc, which are included in the WQOs for this ACWQIP. High levels of protection are considered appropriate in reference to the following information regarding toxicants:

- potential chronic (sub-lethal) as well as acute (lethal) toxic effects, particularly for the more sensitive juvenile stages of most fauna
- potential bio-accumulation effects
- the potential for additive or synergistic effects with other toxicants and also the potential interaction with other pollutants (suspended solids) and conditions such as elevated temperatures or low dissolved oxygen.

Using the ANZECC criteria, a 99% level of protection is considered appropriate for the Port waterways northern and central sections and for the Port River section a 95% level of protection is considered appropriate. The higher value for the northern and central sections reflect the community-driven environmental values.

3 Suspended solids, turbidity and colour

Suspended solids, turbidity and coloured dissolved organic matter (CDOM) in the water column impact on aquatic ecosystems and amenity/recreation. They are principally derived from stormwater and riverine sources, with suspended solids also being a transport mechanism for other pollutants.

For suspended solids and turbidity, the seasonal nature of the sources is recognised and the ambient water quality objectives take this into account by defining a target for the 90th percentile of results (ie they will be exceeded in about 10% of cases).

4 Temperature

Within the Port River section, there are three cooling water discharges, the main one being the Torrens Island Power Station that discharges heated cooling water into Angas Inlet. The others at Osborne and Pelican Point have minimal impact on the Port waterways. Monitoring of the effects of the cooling water on temperature indicates that (compared to studies undertaken in 1996) the overall impact has been reduced. The region of impact of the Torrens Island cooling water discharge was determined as part of an earlier Estuary and Lakes Hydraulic Flushing Model Study (Lord and Associates 1996).

In summary, it was concluded that the Port River segment is largely unaffected, except for a small area of North Arm which is impacted by an average elevated temperature of 10°C. This impacted area is west of the Grand Trunkway Bridge. The northern segment is not affected, however the lower part of the central Barker Inlet is affected, particularly Angas Inlet.

Previously, it was found that sites on the Port River (cooling water intake), Broad Creek in the lower part of Barker Inlet and the junction of Magazine Creek in North Arm have a common modal temperature (Coleman *et al* 2007). During the period of monitoring there was no statistical difference between these sites. Sites within Angas Inlet still showed distinct temperature increases. The immediate discharge area had increases of 2 degrees celsius for 96% of the time. Elsewhere in the inlet it reduced to 1 degree celsius 48% of the time. Refer to Coleman 2007a and 2007b for further information.

The higher temperatures may exacerbate the effects of toxicants, such as metals and ammonia. The lower dissolved oxygen with higher temperatures would also have adverse effects on water quality. Higher temperatures and a plentiful supply of nutrients are conducive to the growth of 'nuisance' algae and may give a competitive advantage to particular species. While no WQOs for temperature have been provided, further thermal inputs should only occur after review of project-specific information.

5 **Dissolved oxygen**

Occasionally low oxygen conditions occur, particularly at night during neap tides when waters are shallow with little movement. Low oxygen is the result of plant respiration–photosynthesis, higher temperatures, fauna respiration, microbial decay of accumulated plant debris, sediment oxygen demand, dissolved organic matter and biological oxygen demand.

While some natural dissolved oxygen variation is to be expected, pollutant loads may increase the extent and frequency to the point that aquatic biota are adversely affected. The reduction of plant biomass that occurs as a result of reducing nutrient pollutant loads will decrease the occurrence and extent of low oxygen levels. While it is uncertain to what extent this will affect levels, an interim working target of a minimum 25% saturation during neap tide conditions over 24 hours in the summer is suggested. Monitoring to be undertaken as part of the implementation of the ACWQIP will provide data to define a long-term objective.

6 **Faecal micro-organisms**

In all sections, a Category A classification is given (95th percentile for intestinal enterococci/100 mL). It is acknowledged that there are conflicts in uses, as primary contact in this area is not advisable, but secondary contact does occur along with the discharge from the Bolivar WWTP.

8.2.2 **Northern, Metropolitan and Southern coastal waters**

The water quality management sections defined in the ACWS are used in this ACWQIP (refer to [Figure 1](#)). The draft WQOs for Adelaide's coastal waters, suggested water quality improvement performance indicators and notes on the key water quality issues are included [Report 2](#) of the supporting technical reports on the EPA website.

Summarised briefly below, the water quality parameters of relevance to Adelaide's coastal waters include nutrients, suspended solids, turbidity and colour and faecal micro-organisms. Measures of temperature and dissolved oxygen are not as relevant for the open waters of Adelaide's coast as they are for the Port waterways, due to the better mixing of waters along the open coast as opposed to the more estuarine environment of the Port waterways.

For each section of Adelaide's coastal waters, the highest level of protection is appropriate, considering:

- the importance placed on the coast for its ecosystems, recreational use, commercial use (tourism) and amenity
- the need to facilitate ecosystem recovery (seagrass, reef communities), where damage has occurred. Even though there has been a considerable loss of seagrass and recovery would be very slow, disturbed areas should not be written off.

While many locations of concern were noted, the adoption of this level of protection was seen as consistent with the guidance for individual improvement projects.

1 **Nutrients**

Short- and medium-term (5–10 year) objectives are suggested for nitrogen improvement, at which time they should be evaluated. The longer-term target for reduction in nitrogen loads has been taken from the ACWS recommendation to reduce nitrogen loads by 75% from 2003 values. This is the longer-term load reduction target that the ACWQIP strategies aim to achieve for discharges to the coast from industry, WWTPs and stormwater. The details on the specific WQOs for Adelaide's coastal waters are provided in [Appendix 1](#) and a summary of these in [Table 20](#).

2 **Suspended solids, turbidity and colour**

As with the Port waterways, the seasonal nature of the sources is recognised for suspended solids and turbidity. The longer-term targets for reduction in suspended solid loads and coloured dissolved organic matter (CDOM) have been taken from the ACWS recommendation to reduce loads by 50% from 2003 values. This is the longer-term load reduction target that the ACWQIP strategies aim to achieve for discharges to the coast from stormwater, industry and wastewater treatment plants. Stormwater is now the main source of sediment and CDOM to the coast and partnerships with multiple organisations are needed to address stormwater issues as indicated in Chapter 9 (refer to [Table 21](#)). The details on the specific WQOs for Adelaide's coastal waters are provided in [Appendix 1](#) and a summary in [Table 20](#).

3 **Faecal micro-organisms**

In all sections, a Category A classification is given (95th percentile for intestinal enterococci/100 mL). However it is understood this is difficult to achieve during and immediately following storm events, particularly in close proximity to outlets. Consequently, as indicated earlier, the Department of Health has signage advising of the need to avoid coloured water.

The recommendations of the ACWS have been incorporated into planning for the eight strategies in the ACWQIP ([Table 19](#)) and prior to that setting the WQOs and suggested targets for water quality improvement as summarised in [Table 20](#) and outlined in more detail in [Appendix 1](#) of the supporting technical reports on the EPA website. These ACWS recommendations and WQOs have been considered in setting the water quality improvement targets and developing management strategies outlined in Chapter 9 (refer to [Table 21](#)).

The EPA and AMLR NRM Board have launched a joint [website alert system](#) to caution the public after rain events when water quality is not suitable for swimming.

8.3 **ACWQIP strategies and associated actions**

The strategies and associated actions of the ACWQIP have been developed through community and stakeholder consultation. The ACWQIP strategies also assist with the implementation of the ACWS recommendations. [Table 19](#) contains specific actions to directly progress the eight strategies of the ACWQIP (and indirectly some of the recommendations of the ACWS).



Table 19: ACWQIP Strategies and details of specific actions





Strategies	Details of specific actions required
Strategy No. 1: Reduce nutrient, sediment and CDOM discharges	1.1 EPA to continue to work with SA Water and Penrice Soda Holdings to reduce nutrient and sediment loads. 1.2 Encourage practical action for sediment reductions. 1.3 Encourage uptake and implementation of WSUD across Adelaide region.
Strategy No. 2: Promote integrated use of wastewater and stormwater across Adelaide	2.1 Undertake further investigative work regarding options to facilitate greater integrated reuse of stormwater and wastewater (links to Actions 1, 2 and 3 in the Stormwater Strategy). 2.2 Develop pilot or regional area projects for integrated use of stormwater and wastewater.
Strategy No. 3: Further investigate sources and volumes of sediment and CDOM	3.1 Further investigate sources of CDOM and sediments for catchment modelling. 3.2 Identify practical and prioritised action that can be taken for reductions in CDOM and sediments from catchments.
Strategy No. 4: Integrate monitoring for cumulative impact assessment across Adelaide region	4.1 Facilitate integrated monitoring of cumulative impacts and emerging issues across agencies for Adelaide's coastal waters. 4.2 Investigate and coordinate gap and operational funding for monitoring that needs to be done to meet recommendations of ACWS. 4.3 Support ongoing monitoring of reef and seagrass condition to integrate with other monitoring activities.
Strategy No. 5: Model and evaluate the impacts of climate change, new human impacts and population growth implications for Adelaide's coastal waters	5.1 Information from CDOM and sediment investigations and integrated monitoring activities to be fed into future modelling work. 5.2 Model projection of wastewater treatment plant (WWTP) inputs and outflows as a result of population change.
Strategy No. 6: Establish planning and funding priorities for water initiatives for Adelaide's coastal waters	6.1 Identify priority funding areas for projects with multiple benefits (incorporate triple bottom line accounting into project planning). 6.2 Trial investigations for storage and use of water normally discharged to coast in winter months.
Strategy No. 7: Undertake seagrass mapping and rehabilitation work	7.1 Develop and update 'seagrass ready' maps that integrate water quality and sediment information. 7.2 Further support for seagrass rehabilitation work.
Strategy No. 8: Build community capacity to take action to improve coastal water quality	8.1 Use existing Healthy Waters networks and other local government contacts to get messages across to community regarding how it can take local action for water quality improvement. 8.2 Further develop linkages with Kaurna and Ramindjeri people regarding community water quality messages.













Further to this, [Table 20](#) demonstrates the multifaceted linkages of all the key elements of the ACWQIP including the strategies, EVs, WQOs and 20-year ACWS recommendations, together with shorter-term partner-based initiatives. Importantly, partnership support from key stakeholders and the broader Adelaide community are paramount to the success of the ACWQIP.




It is envisaged that dynamic, informed and 'can-do' partnerships will underpin the ACWQIP; as everyone has a positive role to play and the community at large will benefit from the environmental, economic, social and cultural outcomes brought about by a healthy coast.

Table 20: Summary of environmental values and water quality objectives for Adelaide's coastal waters, 2013–50

Water quality issue	Relevant ACWQIP Strategies	Relevant environmental values (EVs)	Outcomes—quotes from the ACWQIP Stage 1 Executive Summary	Water quality objectives (WQOs) and performance indicators	Long-term water quality targets (20+ years)	Shorter-term targets/outcomes (1–5 years)
Nutrients–Nitrogen	1	 	<ul style="list-style-type: none"> Coastal waters being free of stormwater discharge and nutrient rich outflows in the future No species loss due to water quality issues Ability to see the blue line closer to shore 	<ul style="list-style-type: none"> Nitrogen Total N <200 ug/L (90th percentile) Ammonia <10 ug/L (90th percentile) Commercial Nitrate and Nitrite N 10 ug/L Ammonia 10 ug/L: <ul style="list-style-type: none"> reduced frequency, extent and duration of algal blooms ammonia concentrations largely reduced below 200 ug/L in the Port River channel minimal or no odours from decaying algae reduction in the amount of epiphytic algae on seagrass no further seagrass loss healthy mangrove recruitment. 	<p>ACWS</p> <p>Recommendation 2: the total load of nitrogen discharged to the marine environment should be reduced to around 600 tonnes per annum (representing a 75% reduction from the 2003 value of 2,400 tonnes).</p> <p>AMLR NRM Board Plan target:</p> <p>T1: 75% of stormwater reused, 100% of wastewater reused.</p> <p>Penrice</p> <p>Reduce nitrogen discharge to less than 250 tonnes by 2015.</p> <p>Water for Good</p> <p>Action 16: aims to provide 60 GL/annum of recycled stormwater in Greater Adelaide by 2050</p>	<p>SA Water overall target about 300 tonnes for the 3 WWTPs</p> <ul style="list-style-type: none"> Bolivar WWTP 2008—less than 493 tonnes (2003 load 1464 tonnes) (including the Port Adelaide WWTP discharge – moved to Bolivar in 2004) Glenelg WWTP 2008—less than 213 tonnes (2003 load 471 tonnes) Christie Beach WWTP 2008—less than 115 tonnes (2003 load 178 tonnes) Upgrade under construction and reuse to meet ACWS targets. <p>AMLR NRM Regional Plan</p> <ul style="list-style-type: none"> <i>iTarget 5:</i> Stormwater management plans have been developed for 40% of the urban area. <p>Penrice</p> <p>Reduce nitrogen loads were reduced to less than 575 tonnes by 2010 (2003 load 1,000 tonnes).</p>
	2					
	4					
	5					
	6					
	7					
	8					

Water quality issue	Relevant ACWQIP Strategies	Relevant environmental values (EVs)	Outcomes—quotes from the ACWQIP Stage 1 Executive Summary	Water quality objectives (WQOs) and performance indicators	Long-term water quality targets (20+ years)	Shorter-term targets/outcomes (1–5 years)
Sediments/suspended solids	1		<ul style="list-style-type: none"> Go swimming and see my feet in afternoon sea waters 	<ul style="list-style-type: none"> Suspended solids <3 mg/L (90th percentile) 	<p>ACWS</p> <p>Recommendation 3: a 50% load reduction (from 2003 levels) would be sufficient to maintain adequate light levels above seagrass beds for most of the time. The reduced sediment load would contribute to improved water quality and aesthetic.</p> <p>AMLR NRM Regional Plan targets:</p> <p>T1, T2, T8, T9, T10, T11 & T12</p> <p>Water for Good</p> <p>Action 16: aims to provide 60 GL/ annum of recycled stormwater in Greater Adelaide by 2050</p>	<p>AMLR NRM Regional Plan</p> <ul style="list-style-type: none"> <i>iTarget 5:</i> Stormwater management plans have been developed for 40% of the urban area. <i>iTarget 6:</i> Stormwater quality control devices capture silt and debris from 25,000ha of urban and semi-rural catchments. Adelaide Living Beaches Strategy – reduced impact of dredging to suspended solids in ACWS.
	2		<ul style="list-style-type: none"> Observe the sea floor 	<ul style="list-style-type: none"> Ecological/aesthetic/cultural 		
	3		<ul style="list-style-type: none"> Ability to see the blue line closer to shore 	<ul style="list-style-type: none"> turbidity <1 NTU (90th percentile) >200 m offshore 		
	4		<ul style="list-style-type: none"> Healthy reefs 	<ul style="list-style-type: none"> Recreational 		
	5			<ul style="list-style-type: none"> <25 NTU (90th percentile): 		
	6			<ul style="list-style-type: none"> – reduction in light penetration affecting photosynthesis 		
	7			<ul style="list-style-type: none"> – ambient water quality objectives achieved. 		
	8					

Water quality issue	Relevant ACWQIP Strategies	Relevant environmental values (EVs)	Outcomes—quotes from the ACWQIP Stage 1 Executive Summary	Water quality objectives (WQOs) and performance indicators	Long-term water quality targets (20+ years)	Shorter-term targets/outcomes (1–5 years)
Coloured dissolved organic matter (CDOM)	1 2 3 4 5 6 7 8	     	<ul style="list-style-type: none"> Go swimming and see my feet in afternoon sea waters Observe the sea floor Ability to see the blue line closer to shore Healthy reefs 	<ul style="list-style-type: none"> Colour – <15 Hazen Units (90th percentile) Reduction in light penetration affecting photosynthesis 	<p>ACWS</p> <p>Recommendation 4: to assist in the improvement of the optical qualities of Adelaide's coastal waters, steps should be taken to reduce the amount of CDOM (coloured dissolved organic matter) in waters discharged by rivers, creeks and stormwater drains.</p> <p>AMLR NRM Regional Plan targets:</p> <p>T1, T2, T8, T9, T10, T11 & T12</p> <p>Water for Good</p> <p>Action 16: aims to provide 60 GL/ annum of recycled stormwater in Greater Adelaide by 2050</p>	<p>AMLR NRM Regional Plan</p> <ul style="list-style-type: none"> <i>iTarget 5:</i> Stormwater management plans have been developed for 40% of the urban area. <i>iTarget 7:</i> 2000 ha of land managed for water quality improvement. <i>iTarget 4:</i> Investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achieved.
Pathogens	2 4 5 8	     	<ul style="list-style-type: none"> Creative solutions to capture, clean and reuse stormwater Recreational activities including swimming, boating, walking and fishing to be enjoyed anywhere along the coastline Coliform levels be consistent with natural levels and cycles 	<p>Enterococci – <200 orgs/100 ml</p> <p>EPA have defined these waters as low risk and this risk level has been taken from Guidelines for Managing Risks in Recreational Water (National Health and Medical Research Council 2006):</p> <ul style="list-style-type: none"> ambient water quality objectives achieved there is no contamination of human food species. 	<p>ACWS</p> <p>Recommendation 14: Adelaide's coastal marine environment must be managed as a component of a system that integrates catchment management, urban and rural land use, demographics, urban and industrial development, climate change/climate variability and water reuse.</p> <p>AMLR NRM Board Plan targets:</p> <p>T1, T2, T10, & T12</p>	<p>AMLR NRM Regional Plan</p> <ul style="list-style-type: none"> <i>iTarget 5:</i> Stormwater management plans have been developed for 40% of the urban area.

Water quality issue	Relevant ACWQIP Strategies	Relevant environmental values (EVs)	Outcomes—quotes from the ACWQIP Stage 1 Executive Summary	Water quality objectives (WQOs) and performance indicators	Long-term water quality targets (20+ years)	Shorter-term targets/outcomes (1–5 years)
Salinity	4 5	  	No species loss due to water quality reduction	<ul style="list-style-type: none"> • Low salinity not a major stressor to healthy seagrass • impacts of high salinity can be site specific and should be addressed for individual sites 	<p>Saline discharges need to be undertaken in a manner that does not cause environmental harm.</p> <p>AMLR NRM Regional Plan target: T2</p>	Achieve long-term target

9 Strategies and implementation

The ACWQIP marries eight strategies with the programs and activities being undertaken by a number of agencies, and the Plan's monitoring and assessment activities to create a strategic implementation framework for stakeholders. In this way the ACWQIP draws on a wide range of relevant information and practices, and builds on them to inform the management of the coastline of Adelaide. The success of the ACWQIP is dependent on multiple parties working together, sharing information, agreeing on process and employing an adaptive management framework. This means that new research and findings will be constantly used to review and update the document, ultimately improving outcomes and the transfer of knowledge.

Progress of the Plan will be reported annually with proposed five-yearly reviews. The strategies and actions contained within focus on a shorter implementation timeframe of 2–5 years.

9.1 Overview

To reduce harm to Adelaide's coastal waters, all levels of government, industry, developers and Adelaide's broader community, need to work together to improve catchment to coast water quality. The ACWS established that harm caused to Adelaide's coastal waters from inputs of nitrogen and suspended solids, results in seagrass loss. The ACWQIP is a guiding document that promotes nitrogen load reductions for Adelaide's coast and links with the load reductions proposed in the recommendations of the ACWS.

The EPA is strategically positioned to license for nitrogen and sediment load reductions from industry and is also a key authority who can work with other agencies to achieve both improvements to water quality from catchments and sediment and CDOM reductions from stormwater and catchments. The long-term vision of the ACWQIP of 'having the blue line of seagrass return closer to shore' is achievable if everyone involved embraces the implementation of the eight strategies outlined in the ACWQIP.

The EPA is a lead agency in monitoring coastal, estuarine and marine water quality off the Adelaide coastline and for Gulf St Vincent. Although many agencies also have various roles relating to management and conservation of coast, estuarine and marine environments in South Australia and the Adelaide region, the EPA has a key role in ensuring water quality of this area is 'fit for purpose'.

While the EPA has been the lead agency involved in progressing the development of the ACWS and following up recommendations for implementation (regarding improving water quality for Adelaide's coastal waters), the authority has also undertaken a number of other water quality projects concurrently. These include projects undertaken by its marine science team that confirm the need to follow up on the findings of the ACWS and strengthen the strategic management directions and actions within the ACWQIP.

In addition to the EPA's work, there are a wide range of programs and activities being undertaken by a number of agencies, which will reduce nutrient and sediment loads and improve water quality. While the outcomes of the programs being implemented to reduce nutrients from the major point sources can be clearly determined in terms of pollutant load reduction, this is not the case for the pollutants from diffuse sources. At present, it is somewhat uncertain what the effects of diverse catchment programs would be on loads of suspended solids, CDOM, turbidity, metals, nutrients and faecal micro-organisms. What is required is an integrated monitoring approach that will provide timely information to managers regarding whether the various water quality objectives, targets and longer-term goals are being achieved.

Data from monitoring of both water quality and the condition of ecosystems is necessary to inform the ongoing investment in the programs so that they are efficient, effective and adaptive to change. This information should be reported to the South Australian community in a clear and easily understandable manner. Currently, the AMLR NRM Board and EPA are reviewing and developing revised monitoring approaches.

9.2 Strategies

Findings and recommendations from the ACWS and the community and stakeholder input into the development of the ACWQIP have collectively influenced the development of the eight ACWQIP strategies ([Table 21](#)).

The details of the strategies have been designed to meet the water quality improvement targets established in the ACWS and achieve the community vision for the ACWQIP to see the return of the 'blue line of seagrass closer to shore'. These strategies have been developed through discussions with stakeholders after revision of draft versions of the ACWQIP by the Adelaide Coastal Waters Steering Committee in 2008 and 2009. [Table 21](#) indicates the relevant agencies which are nominated as 'leading' on the different strategies.

[Table 21](#) presents detailed information on the eight strategies of the ACWQIP. Information is categorised into 'current actions' and 'medium' and 'longer-term' gaps that need to be considered in terms of capability. The majority of the strategies are intended for implementation over the next 1 - 5 years, from 2013 onwards and for some strategies longer-term gaps are evident. These 'gaps' require additional dialogue and planning between agencies in order to improve coastal water quality and create the conditions where seagrass is no longer absent, but can be re-established closer to shore, bringing 'the blue line of seagrass' landward.

9.3 Operating context of ACWQIP

9.3.1 Adaptive management

[Figure 16](#) outlines the components of the adaptive management approach being used in the implementation and review of the ACWQIP. Many of the recommendations adopted from the ACWS and strategies presented for implementation in the ACWQIP convey the need to undertake further investigative work and test different approaches to address water quality issues and seagrass health.

An adaptive management framework has been applied to the ACWQIP as it presents a systematic process for continually improving management policies and practices through learning from the outcomes of the project. In this way, monitoring, review and assessment are undertaken of any actions and the review process assesses the relevant costs and benefits of continuing such actions on a longer-term basis. The process and timing of review of the ACWQIP are strongly linked to the adaptive management approach.

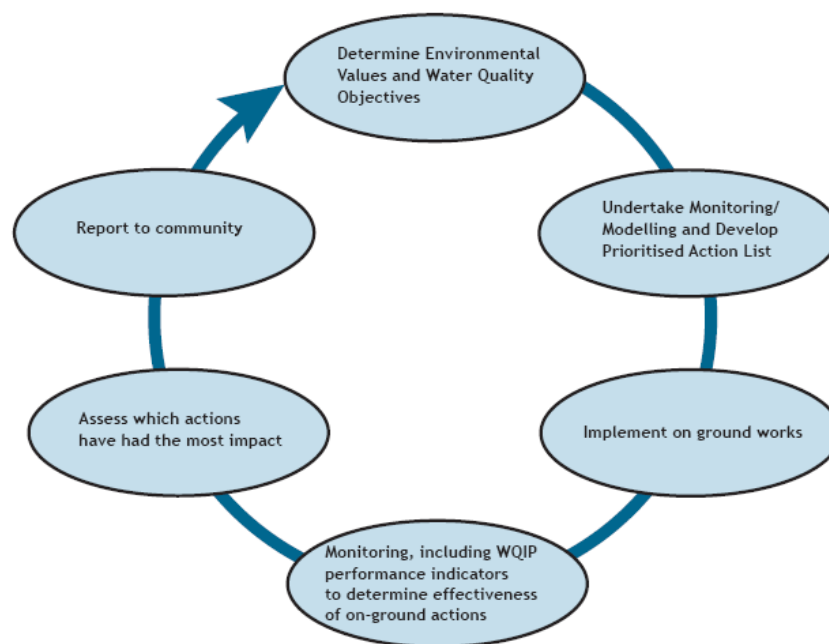


Figure 16: Adaptive management framework as it applies to implementation of the ACWQIP

Table 21: Current and future actions for the eight ACWQIP Strategies for Adelaide's coastal waters, 2013**Medium-term action needed (M) in next 1-5 years and Longer-term action needed (L) 5-10+ yrs.**

ACWQIP strategies	Sub-strategy	Current actions	Who is involved or will be involved?	Who is the lead?	Where are the gaps in the future?	Potential funding sources/resources
1. Reduce nutrient, sediment and coloured dissolved organic matter (CDOM) discharges (based on recommendations 1 to 5 in ACWS Final Report	1.1 EPA continues to work with SA Water and Penrice Soda Holdings to reduce nutrient and sediment loads	<ul style="list-style-type: none"> EPA licenses SA Water and Penrice for discharges of wastewater and regularly reviews licence conditions and monitoring requirements in updates of environment improvement programmes (EIPs) with both companies 	<ul style="list-style-type: none"> Nutrients in form of nitrogen (N) – EPA, SA Water, Penrice Soda Holdings Sediments as suspended solids (SS)- EPA, SA Water and Penrice Soda Holdings. See sub-strategy 1.2 for stormwater focus activities 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (<u>M</u>) No gaps in short term for Penrice and SA Water who have current EPA licences and are on track for short-term reductions (<u>L</u>) SA Water not likely to meet reduction targets without costly investment in capital upgrades (<u>L</u>) Approx. 75% or reuse is needed to achieve the N reductions without capital upgrades (<u>L</u>) Penrice would need to upgrade existing plant to reduce N loss or acquire more land to further reduce N discharges to Port River if continue to produce soda ash. 	<ul style="list-style-type: none"> (<u>L</u>) Whole-of-SA government approach needed to address upgrades or greater wastewater use options on large scale

ACWQIP strategies	Sub-strategy	Current actions	Who is involved or will be involved?	Who is the lead?	Where are the gaps in the future?	Potential funding sources/resources
	1.2 Encourage practical action for sediment and CDOM reductions	<ul style="list-style-type: none"> • AMLR NRM Board is working towards 75% reduction in stormwater discharge in partnership with local councils • Local government promoting better stormwater management with use of WSUD at local level, greater reuse options through work on Waterproofing the South, West, East and Northern Adelaide and also undertaking local activities such as street sweeping more often and in line with timing of leaf fall • Increased support for WSUD policy implementation according to Water for Good and The 30-Year Plan for Greater Adelaide through policy tools and greater emphasis on WSUD capacity building support 	<ul style="list-style-type: none"> • DEWNR, AMLR NRM Board, EPA, DPTI, local government and Stormwater Management Authority • WSUD to be adopted by all SA government agencies and metropolitan local governments for all new developments, existing development upgrades, in-fill development and urban infrastructure upgrades over a 20 to 30-year timeframe 	<ul style="list-style-type: none"> • EPA and DEWNR 	<ul style="list-style-type: none"> • (L) WSUD policy needs to be clearly in place so all stormwater activities and upgrades are focussed on capturing low flow stormwater and all stormwater infrastructure upgrades incorporate mandatory minimum WSUD features where possible • (M) EPA and local government to work together in a consistent manner to enforce meeting <i>Environment Protection (Water Quality) Policy 2003</i> for all development and construction sites across metro Adelaide 	<ul style="list-style-type: none"> • (M) Australian Government Caring for Country funding or biodiversity funding for WSUD capacity building and onground actions • (M) Stormwater Management Authority and AMLR NRM Board funding to have conditions for WSUD approaches to be essential for all stormwater and catchment projects • (M) EPA and local government funds needed to promote better practise for development and industry
	1.3 Encourage uptake and implementation of WSUD across Adelaide region	<ul style="list-style-type: none"> • Work on setting targets for WSUD has commenced under action 68 in Water for Good • Increased support for WSUD policy implementation according to Water for Good and The 30-Year Plan for Greater Adelaide through policy tools and greater emphasis on WSUD capacity building support • EPA and other key stormwater stakeholders on Steering Group for development of Blueprint for Urban Water Management 	<ul style="list-style-type: none"> • DEWNR, AMLR NRM Board, EPA, local government and Stormwater Management Authority • WSUD – adoption by SA government agencies and metropolitan local governments 	<ul style="list-style-type: none"> • AMLR NRM WSUD Capacity Building • DEWNR policy with EPA and DPTI 	<ul style="list-style-type: none"> • (L) WSUD policy needs to be clearly in place so all stormwater activities and upgrades are focussed on capturing low flow stormwater and all stormwater infrastructure upgrades incorporate mandatory minimum WSUD features where possible • (M) Support 3-year implementation of WSUD capacity building project for metropolitan Adelaide in partnership with local government • (M) EPA needs to do work that links to action 3 in Stormwater Strategy – by 2015 identify changes for stormwater infrastructure 	<ul style="list-style-type: none"> • (L) Developers, local government, AMLRNRM Board, SA government agencies for WSUD projects • (M) Australian Government Caring for Country or biodiversity funding and funds from AMLR NRM/SA government agencies • (M) EPA in partnership, DEWNR, DPTI and local government to identify changes for improvements in stormwater infrastructure

ACWQIP strategies	Sub-strategy	Current actions	Who is involved or will be involved?	Who is the lead?	Where are the gaps in the future?	Potential funding sources/resources
2. Promote integrated use of wastewater and stormwater across Adelaide	2.1 Undertake further investigative work regarding options to facilitate greater integrated reuse of stormwater and wastewater (links to Actions 16 and 19 in Water for Good)	<ul style="list-style-type: none"> Many localised projects are underway as part of Water Proofing the South, West, East and North Adelaide. Local government has played a major role in facilitating such projects especially the Cities of Onkaparinga, Charles Sturt, Unley and Salisbury for these respective waterproofing regional projects Other work is following on from Water for Good with the Stormwater Strategy and Blueprint for Urban Stormwater management 	<ul style="list-style-type: none"> DEWNR, SA Water, EPA, Local governments, Stormwater Management Authority and AMLR NRM Board 	<ul style="list-style-type: none"> DEWNR 	<ul style="list-style-type: none"> (M) Need to quantify what has already been achieved for wastewater and stormwater use in terms of actual water quality improvement with reduction of N and SS and compare to 2003 data from ACWS (L) Policy and infrastructure to keep pace with changes that need to be made to ensure Adelaide is a city of multiple water sources for people to tap into a mix of stormwater or wastewater for use in purple pipe systems across Adelaide 	<ul style="list-style-type: none"> (M) DEWNR, SA Water AMLR NRM Board, private enterprise, local government (L) Whole-of-SA-government approach needed to address integrated wastewater and stormwater use and options available on the larger scale
	2.2 Develop pilot or regional area projects for integrated use of stormwater and wastewater	<ul style="list-style-type: none"> Urban Stormwater Harvesting Options Study (2009) identifies potential to harvest up to 60 GL of stormwater by 2050, through large-scale schemes at sites across metropolitan Adelaide 	<ul style="list-style-type: none"> DEWNR, SA Water, EPA, local governments, Stormwater Management Authority and AMLR NRM Board 	<ul style="list-style-type: none"> DEWNR 	<ul style="list-style-type: none"> (M) to (L) Promote projects that match demand for water with supply of wastewater and stormwater, to ensure projects are cost effective and have social and environmental outcomes 	<ul style="list-style-type: none"> (M) to (L) DEWNR, SA Water, AMLR NRM Board, private enterprise, local government
		<ul style="list-style-type: none"> Water for Good Plan (2009) has targets of harvesting 60 GL of stormwater in Adelaide region by 2050 and 75 GL of wastewater across SA 		<ul style="list-style-type: none"> DEWNR 	<ul style="list-style-type: none"> (M) to (L) Provision of pool of funding or incentives schemes for develops pilot or regional area projects for integrated reuse of stormwater and wastewater across Adelaide 	<ul style="list-style-type: none"> (M) to (L) DEWNR, SA Water, AMLR NRM Board, private enterprise, local government
3. Further investigate sources and volumes of sediment and coloured dissolved organic matter (CDOM)	3.1 Further investigate sources of CDOM and sediments and quantify for input to catchment modelling	<ul style="list-style-type: none"> SARDI have previously sought funding for some work to be done on assessment of CDOM sources EPA have attempted to understand the low flow volumes of sediment and CDOM reaching the coast with monitoring that links to AMLR NRM Board network of composite samplers 	<ul style="list-style-type: none"> AMLR NRM Board, DEWNR, local government, Stormwater Management Authority, SA Water and EPA 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) to (L) Ongoing monitoring and modelling work is required to fill in gaps on sediment sources from different catchments and use this information in assessment of success of actions listed above for reducing N and SS and CDOM 	<ul style="list-style-type: none"> (M) Australian Government Caring for Country funding or biodiversity funding (M) to (L) AMLR NRM Board, DEWNR and EPA working together

ACWQIP strategies	Sub-strategy	Current actions	Who is involved or will be involved?	Who is the lead?	Where are the gaps in the future?	Potential funding sources/resources
	3.2 Identify practical and prioritised action that can be taken for reductions in CDOM and sediments from catchments	<ul style="list-style-type: none"> Sediment and CDOM generation and transport need to be identified to better inform infrastructure management practices and further work around best practice stormwater management 	<ul style="list-style-type: none"> AMLR NRM Board, DFW, local government, Stormwater Management Authority, SA Water and EPA 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) to (L) Monitoring of effectiveness of infrastructure to improve water quality linked to action 3 in Stormwater Strategy for EPA to identify changes for infrastructure to improve water quality 	<ul style="list-style-type: none"> (M) to (L) AMLR NRM Board, DEWNR and EPA working together
4. Integrate monitoring for cumulative impact assessment across Adelaide region	4.1 Facilitate integrated monitoring of cumulative impacts and emerging issues across agencies for Adelaide's coastal waters	<ul style="list-style-type: none"> EPA has undertaken a review of the ambient monitoring program for marine waters and produced a Gulf St Vincent risk assessment that will guide the development of future monitoring for meeting ACWS recommendations. AMLR NRM Board has a system of composite samplers across catchments and along coast that could feed into cumulative impact monitoring work 	<ul style="list-style-type: none"> Nutrients – EPA, SA Water, Penrice Soda Holdings Desalination – SA Water & contractors Sediments – AMLR NRM Board, local government, DEWNR and Stormwater Management Authority 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) to (L) More integration of monitoring information that is already been recorded needs to be incorporated in catchment to coast and modelling to determine both cumulative impacts on the coast and also benefits from actions taken for water quality improvement. This is monitoring beyond the Aquatic Ecosystem Condition Reports (AECRs) for marine waters of Gulf St Vincent 	<ul style="list-style-type: none"> (M) to (L) AMLR NRM Board, DEWNR and EPA working together
			<ul style="list-style-type: none"> Seagrass – DEWNR, SARDI and universities Reefs – EPA, Conservation Council of SA, DEWNR, SARDI 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) Seagrass coverage no longer fully monitored through work of DEWNR, so in future seagrass monitoring may be a gap area in SoE reporting (L) Seagrass and reef health information collated to give a more detailed report on condition of Adelaide's coastal waters beyond the AECRs for Gulf St Vincent 	<ul style="list-style-type: none"> (M) to (L) AMLR NRM Board, DEWNR and EPA working together

ACWQIP strategies	Sub-strategy	Current actions	Who is involved or will be involved?	Who is the lead?	Where are the gaps in the future?	Potential funding sources/resources
	4.2 Investigate and coordinate gap and operational funding for monitoring that needs to be done to meet ACWS recommendations	<ul style="list-style-type: none"> The EPA has undertaken a recent review of the ambient monitoring program for marine waters and produced a Gulf St Vincent risk assessment that will guide the development of future monitoring for meeting ACWS recommendations The AMLR NRM Board has already step up a system of composite samplers across the catchments of the Adelaide coast that could be used to feed into future modelling and gap monitoring work 	<ul style="list-style-type: none"> Nutrients – EPA, SA Water, Penrice Soda Holdings Desalination – SA Water & contractors Sediments – AMLR NRM Board, local government, OWS and Stormwater Seagrass – DENR, SARDI and universities Reefs – EPA, Conservation Council of SA, DENR, SARDI 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) Follow up on some of the monitoring and modelling work done for the ACWS in 2013 and every 5–10 years to see what is happening in terms of water quality improvement resulting from changes in management actions (M) Revisit design of monitoring framework for Adelaide's coast and implement monitoring or modelling for gap areas in consideration of AECRs to be released from marine waters of Gulf St Vincent 	<ul style="list-style-type: none"> (M) AMLR NRM Board, DEWNR and EPA working together
	4.3 Support ongoing monitoring of reef and seagrass condition to integrate with other monitoring activities	<ul style="list-style-type: none"> DEWNR have been involved in seagrass monitoring work, but this has been scaled back in recent years and AMLR NRM Board has undertaken more research work in recent years Conservation Council of SA has been involved in monitoring of reef habitats through the Reef Watch monitoring program 	<ul style="list-style-type: none"> Seagrass – DEWNR, SARDI and universities Reefs – EPA, Conservation Council of SA, DEWNR and SARDI 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) to (L) Need to fully understand nutrient, sediment and CDOM impacts on seagrass health and reef areas in order to advise for more detailed management action to improve seagrass and reef health 	<ul style="list-style-type: none"> (M) to (L) AMLR NRM Board, DEWNR and EPA working together
5. Model and evaluate the impacts of climate change, human impacts and population growth implications for Adelaide's coastal waters	5.1 Information from CDOM and sediment investigations and integrated monitoring activities to be fed into future modelling work	<ul style="list-style-type: none"> May link to other work that comes under Water for Good actions, the 30-Year Plan for Greater Adelaide and the Blueprint for Urban Water 	<ul style="list-style-type: none"> EPA, AMLR NRM Board, DEWNR, local government, Stormwater Management Authority and SA Water 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) Integration of monitoring and modelling information needed to be done for catchment to coast perspective 	<ul style="list-style-type: none"> (M) Australian Government Caring for Country funding (M) EPA, DEWNR, SA Water and AMLR NRM Board

ACWQIP strategies	Sub-strategy	Current actions	Who is involved or will be involved?	Who is the lead?	Where are the gaps in the future?	Potential funding sources/resources
	5.2 Model projection of WWTP inputs and outflows as a result of population change	<ul style="list-style-type: none"> Links to other work that comes under Water for Good actions, the 30-Year Plan for Greater Adelaide and the Blueprint for Urban Water Management 	<ul style="list-style-type: none"> SA Water and DPTI 	<ul style="list-style-type: none"> SA Water 	<ul style="list-style-type: none"> (M) Modelling of scenarios with different levels of wastewater reuse, population growth and urban form needed to adequately predict future WWTP outflows 	<ul style="list-style-type: none"> (M) SA Water, DPTI
6. Establish planning and funding priorities for water initiatives for Adelaide's coastal waters	6.1 Identify priority funding areas for projects with multiple benefits (incorporate triple bottom line accounting into project planning)	<ul style="list-style-type: none"> Needs link to other work that comes under Water for Good actions and The 30 Year Plan for Greater Adelaide, including the focus on greater use of stormwater and wastewater and the implementation of WSUD 	<ul style="list-style-type: none"> AMLR NRM Board, DEWNR, local government, Stormwater Management Authority, SA Water and EPA 	<ul style="list-style-type: none"> EPA 	<ul style="list-style-type: none"> (M) to (L) Promote projects that match demand for water with supply of wastewater and stormwater, to ensure projects are cost effective and have social and environmental outcomes 	<ul style="list-style-type: none"> (M) Australian Government Caring for Country funding (M) to (L) SA Water and AMLR NRM Board
	6.2 Trial investigations for storage and reuse of water normally discharged to coast in winter months	<ul style="list-style-type: none"> Research into the storage of winter wastewater discharges could be an example of such a project that has multiple benefits, including agricultural development 	<ul style="list-style-type: none"> AMLR NRM Board, DEWNR, local government, SA Water, EPA and DPTI 	<ul style="list-style-type: none"> SA Water 	<ul style="list-style-type: none"> (M) to (L) Promote projects that match demand for water with supply of wastewater and stormwater (ensure projects are cost effective and have social and environmental outcomes) 	<ul style="list-style-type: none"> (M) to (L) SA Water, local government and industry
7. Undertake seagrass mapping and rehabilitation work	7.1 Develop and update seagrass ready maps that integrate water quality and sediment information	<ul style="list-style-type: none"> DEWNR, SARDI and Flinders University have had an agreement for some early work to be done and AMLR NRM Board has undertaken more follow-up work regarding seagrass rehabilitation and impacts 	<ul style="list-style-type: none"> DEWNR, SARDI, EPA and Flinders University and AMLR NRM Board 	<ul style="list-style-type: none"> DEWNR 	<ul style="list-style-type: none"> (M) Data needed to understand links with impacts of discharges from WWTPs and Penrice Soda Holdings and stormwater to health of seagrass at specific locations (M) Collation of data for seagrass-ready maps 	<ul style="list-style-type: none"> (M) Australian Government - Biodiversity funding (M) EPA, AMLR NRM Board, DEWNR
	7.2 Further support for seagrass rehabilitation work	<ul style="list-style-type: none"> DEWNR, SARDI and Flinders University have an agreement for some work to be done on seagrass trials and AMLR NRM Board has funded additional work in this area 	<ul style="list-style-type: none"> DEWNR and AMLR NRM Board, SARDI and universities Possible role for SA Water, Penrice Soda Holdings and EPA 	<ul style="list-style-type: none"> DEWNR 	<ul style="list-style-type: none"> (M) Promote seagrass recovery and rehabilitation as a benefit for carbon off sets and carbon storage (M) to (L) Retaining existing areas of seagrass needs to be seen as economic, social and environmental benefit to the Adelaide coastline and the carbon storage and offset value of seagrass to be quantified 	<ul style="list-style-type: none"> (M) Australian Government biodiversity funding (M) to (L) EPA, AMLR NRM Board (M) to (L) Potential for SA Water and Penrice to fund work as carbon offsets

ACWQIP strategies	Sub-strategy	Current actions	Who is involved or will be involved?	Who is the lead?	Where are the gaps in the future?	Potential funding sources/resources
8. Build community capacity to take action for water quality improvement from catchments to the coast. Note: 'community' includes the whole spectrum of community in a catchment area from individual households through to developers, industry groups, educational institutions and local, state and national level government	8.1 Catchment to coast action for water quality improvement – use Healthy Waters networks and local government contacts to get messages across to local communities (including developers, industry and individual land holders) regarding how they can take action for water quality improvement	<ul style="list-style-type: none"> EPA updating stormwater information and codes of practice information through website update Stormwater and WSUD information pitched to different audiences on AMLR NRM Board, local government, university, industry websites and Waterwatch Adelaide website Current actions linked to stormwater and coast and marine education are linked to a number of AMLR NRM Board activities and a number of current Conservation Council of SA and their member group's actions and projects 	<ul style="list-style-type: none"> EPA, local government and AMLR NRM Board, DEWNR, Kaurna and Ramindjeri Nations and Conservation Council of SA Community level groups and educational centres such as the Marine Discovery Centre at Henley Beach, Regional NRM Centres and groups such as Friends of Gulf St Vincent and the Western Residents Association 	<ul style="list-style-type: none"> AMLR NRM Board/ DEWNR 	<ul style="list-style-type: none"> (M) to (L) Need for coordinated catchment to coast focus for actions people can take to improve water quality (eg at local level need project to work with developers to reduce sediment loads from building sites across whole of Adelaide) (M) to (L) Need for overall Adelaide focus on catchment to coast links for improving coastal water quality (note previously this area was more strongly supported through the regional catchment water management boards) 	<ul style="list-style-type: none"> (M) to (L) AMLRNRM Board, DEWNR, EPA, SA Water, local government, Australian Government and other partners as relevant eg Marine Discovery Centre and Regional NRM Centres
	8.2 Further develop linkages with Aboriginal peoples of the Adelaide region regarding community water quality messages	<ul style="list-style-type: none"> EPA has worked with local Aboriginal groups to have cultural and spiritual environmental values for waters included in the ACWQIP Some local governments eg City of Holdfast Bay have already been working closely with local Aboriginal groups to implement projects that build local capacity regarding knowledge of biodiversity. These types of projects could potentially be expanded to have a greater catchment to coast connection and links with improving water quality 	<ul style="list-style-type: none"> EPA, local government and AMLR NRM Board, DEWNR, Kaurna and Ramindjeri Nations and Conservation Council of SA 	<ul style="list-style-type: none"> EPA, SA Water, DEWNR 	<ul style="list-style-type: none"> (M) to (L) Integration between state and local government agencies could be improved for implementation of projects that benefit both local Aboriginal people and promote environmental/capacity building outcomes for water quality improvement 	<ul style="list-style-type: none"> (M) to (L) AMLR NRM Board, DEWNR, EPA, SA Water, local government, Australian Government and other partners as relevant

Note that use of the adaptive management approach does not mean doing nothing now and waiting to see what happens in the future; instead the focus is on implementing actions based on our current knowledge of any given situation. As new information and knowledge becomes available and monitoring results are known, management approaches can be reviewed and adapted accordingly. Many agencies such as SA Water, the AMLR NRM Board and DEWNR that will be involved in the implementation of the ACWQIP are already making use of adaptive management approaches and undertaking any action they can in the short to medium-term to reduce nutrient and sediment loads to Adelaide's coastal waters.

Since many of the initial strategies for implementation of the ACWQIP are projects involving investigative work and feasibility assessment for commitment to longer-term actions, a regular reporting and review process is essential to the long-term success of the ACWQIP. Reviews will be undertaken within an adaptive management framework ([Figure 16](#)) to allow for review of proposed actions after initial investigative work has been completed. It is also appropriate that the review process is synchronised with that of other agencies, particularly the AMLR NRM Board and the State of Environment (SoE) reporting process.

9.3.2 Reporting framework

Plans for realising the ACWQIP include the establishment of an implementation coordinating group who have the initial task of establishing an Implementation Plan for 2012 to 2017. This group will be made up of membership of the various agencies allocated responsibilities against the eight ACWQIP strategies. It would also be intended that linked to this group there is a specific monitoring, evaluation and reporting group that would coordinate monitoring and reporting on the implementation of the strategies as well as environmental response of Adelaide's coastal waters.

The ACWQIP proposed the following reporting framework:

- Annually (2013 to 2050) following the review of the monitoring needs of the ACWQIP and progress on implementation of strategies, annual monitoring reporting will continue, with data being regularly reviewed against environmental values, pollutant reduction targets and water quality objectives
- Five-yearly review (starting in 2017 to link to SoE reporting in 2018). The ACWQIP will be reviewed every five years and undertaken in a timeframe that will allow integration with SoE reporting. Reporting will include progress towards achieving the longer-term ecological goals, long-term reduction pollutant targets, ambient water quality objectives and resource allocation.

In addition to the annual and five-yearly review, reports will be provided to the EPA Board demonstrating progress on implementation of the ACWQIP. This will include reference to relevant EPA authorisations and any inter-agency issues that may impact on the progress of specific strategies.

Meetings of representatives from relevant stakeholder groups will be convened from time to time through focused forums and workshops. At these forums the EPA will present and facilitate discussions on the results of monitoring, assessments and possible trends in the management of water quality.

The development and implementation of the ACWQIP will be guided by an adaptive management framework that aims to:

- achieve continuous improvement in the health of Adelaide's coastal waters that allows for the recovery of seagrass
- identify key gaps in understanding of the system
- improve understanding of the ecosystem responses, thresholds and dynamics in order to adapt practices to fit changing social and economic values and ecological conditions
- gain reliable feedback about the effectiveness of alternative policies/practices
- encourage innovation and learning
- pass on information and knowledge gained through experience
- foster a management culture that emphasises learning and responsiveness.

9.4 ACWQIP catchment and monitoring plan

During the process of developing the ACWQIP the EPA has also developed a hydrological model of the whole of the metropolitan coastal catchments which can be used to assist in the implementation of both the AMLR NRM Board Plan and ACWQIP. Ultimately, however significant benefit will be achieved from linking the newly developed hydrological model with the Adelaide Coastal Waters modelling to create an integrated catchment to coast modelling system that can collate both catchment data and impacts with coastal data, outcomes for water quality, seagrass and reef health and sediment stability.

It is anticipated that modelling will be used interactively to guide the development of appropriate monitoring and to provide guidance about the types and/or intensity of management actions. For this reason, modelling has been considered along with monitoring, rather than as a separate task for the implementation of the ACWQIP.

9.4.1 Catchment model

The catchment model developed for the ACWQIP (refer to [Report 4](#) of the supporting technical reports on the EPA website) aims to provide sufficient information about proposed management strategies for Adelaide's coastal catchments to assist with the development of the ACWQIP. It enables the relative effects of different management strategies to be understood, eg use of WSUD.

There are many other models that have been used to provide information about flows and discharges from different parts of Adelaide's metropolitan catchments, but rather than replacing these, the Adelaide Catchment Model uses the flows and other information derived from these models. It enables integration of existing information across a much broader area than any of the other models produced so far. Where other models provide better information about specific areas, the information has been incorporated, eg the modelling undertaken for the Torrens Catchment Water Management Plan.

The EPA will initially use the model to understand the relative effects of different strategies on reducing or managing runoff as a means of decreasing nitrogen and suspended solids loads and CDOM levels. This level of sensitivity is sufficient for the present, as it enables the relative effect of different options to be understood in terms of how climate and population change may affect the discharges to Adelaide's coast. The EPA supports the use of the model to assist other organisations and agencies to gain insight into changes in the discharge of pollutants occurring as a result of proposed management changes.

The use of the model in a more quantitative manner is currently limited by a lack of monitoring data. Of primary importance is sufficient time series of relevant data for the major streams and stormwater systems across Adelaide. The AMLR NRM Board has put a monitoring strategy in place including 16 samplers at creeks and stormwater drains that discharge to Adelaide's coast. The Board may also include project-focused monitoring to assess the effectiveness of stormwater management projects across Adelaide. This monitoring data is likely to provide important information for initial modelling and enable subsequent monitoring and modelling within catchments to be undertaken effectively.

While the Adelaide Catchment Model will provide additional information about the effects of different water quality management strategies across Adelaide, there is a need to understand how these discharges affect the adjacent coastal water quality, particularly with respect to suspended solids and CDOM.

9.4.2 ACWQIP monitoring and assessment framework

The ACWQIP sets long-term targets for the improvement of water quality (specifically total nitrogen, total suspended solids and CDOM) for the Adelaide metropolitan coast. To assess progress towards these targets, a monitoring and assessment framework is required.

Some monitoring already occurs to assess the quality of Adelaide's coastal waters, its ecosystem and sediments. While this work is undertaken by different agencies, it is certainly the case that most agencies undertaking monitoring need to understand key information and much of this information is the same as that required to assess the effectiveness of the ACWQIP.

The ACWQIP monitoring and modelling plan strategically links with the findings of the ACWS and recommendations in the [ACWS Technical Report 19](#) (Henderson *et al* 2006). Technical Report 19 includes background information on what would be needed to achieve an integrated monitoring program for Adelaide's coastal waters; and preparation of a list of current monitoring undertaken. The document also promotes good communication across all agencies responsible for monitoring and obtaining feedback on priorities, capabilities and methodologies.

Use will be made of existing monitoring efforts undertaken by the EPA and others. Where further monitoring is needed, the aim will be to ensure that the work is undertaken by the agency best placed to undertake the monitoring in the most efficient manner.

It should be understood that monitoring can be expensive and monitoring programs can use a significant proportion of available resources. However, by using monitoring and modelling effectively to better focus management actions, a well-integrated monitoring program will collectively save money. As part of an adaptive management approach, the long-term targets and monitoring will be regularly reviewed and reassessed in terms of outcomes being achieved and value for money procured from management actions. Monitoring actions can then be modified as water quality improvement management strategies are successfully implemented.

As part of the assessment of monitoring of the ACWQIP, a stakeholder consultation workshop (refer to [Report 5](#) of the supporting technical reports on the EPA website) was held to confirm the nature (indicators, frequency and spatial distribution) of current and proposed sampling in the region. The comparison of current and proposed monitoring revealed several significant gaps in the sampling programs with regard to their capacity to fully inform the progress of the ACWQIP.

The following presents a condensed list of the indicators considered as critical to the progress of the targets of the ACWQIP:

- input water quality to the coast including stormwater, wastewater, industrial discharge, groundwater and atmospheric inputs
- coastal water quality
- sediment stability
- ecosystem health
- physical processes (tides, wind, currents).

The monitoring and assessment framework report (refer to [Report 5](#) of the supporting technical reports on the EPA website) recommends that the EPA take responsibility for coordinating and reporting on coastal water quality monitoring for the initial period of the implementation of the ACWQIP.

The EPA licenses the significant wastewater treatment and industrial discharges being delivered to the Adelaide coastal waters and monitoring of these discharges is covered under EPA licence conditions for SA Water and Penrice Soda Holdings. However, it is recommended that simple changes are made to these licence arrangements, so that 'end-of-pipe' monitoring reports pollutant loads and impacts on receiving waters, rather than concentrations.

SA Water currently undertakes some receiving waters monitoring near its discharges, but this monitoring needs to be considered in terms of the pollutant loads over different time scales. The EPA keeps these monitoring plans under regular review and is likely to change their monitoring approach in future in line with the findings of the ACWS. Future monitoring of the effects of their discharges on receiving waters may inform progress towards the targets of the ACWQIP. A recommended replacement for receiving waters sampling is a monitoring program designed to determine and track changes to the 'sphere of influence' of wastewater using stable nitrogen isotope signatures in seagrass meadows.

The ACWQIP monitoring and assessment framework also recommends the following:

- Given that groundwater discharge to coastal systems is considered to be low, there is arguably little need for targeted monitoring with respect to the ACWQIP for groundwater. Groundwater input monitoring undertaken by the AMLR NRM monitoring, evaluation and reporting framework (MERF) and licensing of aquifer recharge projects should provide a suitable level of information for informing the ACWQIP
- Atmospheric inputs (especially particulate matter dry fall) need to be estimated based on a modified sampling program already undertaken by the EPA.

The EPA has taken account of the ACWQIP monitoring and assessment framework in a comprehensive review of its ambient marine and coastal monitoring program. The program, which has received formal scientific review, enables the EPA to better evaluate water quality from an ecosystem-based approach. The implementation and ongoing review of the ACWQIP through the monitoring and assessment framework for Adelaide's coastal waters will be strengthened through the EPA process of updating the Aquatic Ecosystem Condition Reports (AECRs) for the marine waters of Gulf St Vincent (EPA in prep).

In this process a rating will be given to different areas of Gulf St Vincent including the different management sections of Adelaide's coastal waters. From this information reporting on the condition of the marine environment assessment can be made on how well the community agreed environmental values for Adelaide's coastal waters are being met by management actions. The information from the report cards will assist the review and evaluation of the ACWQIP, help determine how well the targets of the ACWQIP are being met and inform what management actions are required for the future.

For coastal monitoring by DEWNR there are only minor recommended changes to the existing sediment stability and sediment profiling sampling. This includes the suggestion of introducing a number of additional indicators to ensure that the existing program can better inform the ACWQIP. DEWNR has been undertaking beach profile monitoring work along the Adelaide coastline for over 40 years and the monitoring information from these beach profiles could feed into ACWQIP's monitoring. This may be applied to items including sediment stability, suitability of areas for rehabilitation or assisted regrowth of seagrass in the process of developing 'seagrass ready maps'. It is envisaged that the development of these maps would need to involve DEWNR, EPA, SA Water and the AMLR NRM Board.

Historically, ecosystem health condition parameters have not been quantified in a way that can reasonably inform progress on all the ACWS targets in a comprehensive manner. This situation is being improved in the revised sampling programs being undertaken by the EPA for reporting on aquatic ecosystem condition, SA Water's focus on developing a hydrodynamic model for Adelaide's coastal waters and the AMLR NRM Board's continued operation of the catchment and coastal based composite samplers, but still more needs to be done to integrate data together into the one interpretive framework. This needs to be done to be able to more accurately review progress against the ACWS recommendations and ACWS targets, especially with reference to seagrass and reef condition. Additional ideas on promoting greater integration of monitoring effort as part of the monitoring and assessment framework of the ACWQIP include:

- establishing monitoring governance with relevant scientific experience was identified as a way of ensuring integration of monitoring effort and developing a multi-agency funding bid for further monitoring and modelling for Adelaide's coastal waters
- there is a need to develop a seagrass health assessment framework that integrates the range of sampling tools identified by Henderson *et al* (2006) within a mutually supportive arrangement for spatial and temporal monitoring. The targeting of areas of particular concern needs to be established, which may include proximity to inputs as well as results of stable nitrogen isotope studies.

The ACWQIP monitoring and assessment framework highlights that the mechanism for sampling the health of reef systems needs to be identified in a similar fashion to that established for seagrass health. Sampling should follow the methodology and locations employed in earlier reef health assessments (Turner *et al* 2007).

However, the indices used to assess reef status need to be confirmed. While some existing indices are likely to remain relevant, other indices along the lines of those identified in Turner *et al* (2007) should be considered. Both seagrass and reef health assessments also need to be referenced against appropriate control locations. This suggestion is being taken into account in the review of EPA marine monitoring which is more focused on monitoring of ecosystem condition.

Stakeholders also highlighted the need to determine an appropriate proxy measurement for CDOM and determine what should constitute environmental flows from rivers, creek and streams in the Adelaide region.

Sediment stability investigations are recommended for sediment grain size, cliff stability and high-risk areas. The latter could potentially link to coastal water quality sampling, in particular event-based observations as well as telemetry. While it would assist in filling in gaps around issues that relate to integrating catchment and coastal system modelling, substantial funding would be required for this work to be undertaken.

The validity of employing commercial and recreational fisheries stock assessment data as another mechanism for ecosystem health assessment should also be investigated.

The availability of data and outputs from various mass balance water flow models for the Adelaide metropolitan coast as well as the Port waterways (particularly for projections relative to changes in management activity) should be examined with a view to determining their use in supporting ACWQIP objectives.

The principle outcome from the ACWQIP monitoring and assessment framework work is that a set of monitoring indices have been clearly identified and agreed to by relevant stakeholders and the responsibility for the monitoring of specific indicators has now been documented. The ACWQIP monitoring and assessment framework also fits well with the MERF implemented by AMLR NRM Board as discussed in Chapter 10.

9.5 Climate change and population growth impacts

The EPA commissioned a review of the implications of future population growth and climate change to provide an insight to how they may impact upon water quality within the Adelaide coastal waters. The aim of the work was not to consider how climate change may alter physical drivers of coastal processes such as sea level, patterns of storms and rainfall events, but to consider how established predicted changes from climate change will impact water quality for Adelaide and the ability to implement the eight strategies of the ACWQIP. The full report for this investigation is included as [Report 6](#) of the supporting technical reports on the EPA website.

While it is not possible to explicitly predict the nature and impact of either population or climate change, a broad understanding of potential changes and achieving the targets of the ACWQIP can be developed. Such understanding is important to support flexibility in planning and policy development, promoting management objectives that are realistic and achievable.

Likely scenarios for both climate change and population growth in the Adelaide region were derived from the DPLG forecasts that have originated from CSIRO published studies and Australian Bureau of Statistics (ABS) data. This information is used to develop a simple matrix of potential interactions for climate change and population growth based on several sets of scenarios: for low and high climate change and low, medium and high population growth by the year 2030. This time step was chosen as it is a point at which there are reasonable predictions available for both population and climate change and it is within a timeframe relevant to the development and management of policies to protect and enhance environmental values, such as the ACWQIP.

The following points summarise the potential climate change and population growth impacts for the Adelaide region and Adelaide's coastal waters based on the reports ([Report 6](#)) and a review of the literature when the report was written (but not from predictive modelling as there were problems in gaps in information in running the model):

- average mean annual temperatures and monthly average temperatures are likely to increase, the trend in mean annual temperatures from 1970–2008 has been for increases in SA of between 0.05 to 0.2° Celsius per 10 years over the four decades (this has been around 0.1° C for the Adelaide region)

- increased demands for water use (both for plant growth and human uses) due to impacts of increasing temperatures and impacts from increasing population pressures
- a decrease in rainfall across SA, the trend in mean annual rainfall from 1970–2008 has been for decreases of between 5 to 50 mm per 10 years over the last four decades (this has been around 10 mm for the Adelaide region)
- a decrease in soil moisture due both to the increased temperatures and evaporation rates and decrease in temperatures again placing more demand on water sources (eg groundwater, irrigation from dams for plant growth)
- fewer storm events over winter months and increased likelihood of summer storms

Overall these changes are likely to impact on catchment runoff and Adelaide's coastal waters in the following ways (note these are predicative changes, but were not able to be tested by modelling in the work undertaken for [Report 6](#)):

- continue current trends in increasing the portion of nutrients and sediments in any runoff to the coast
- continue to have loss of seagrass from discharges to the coast, especially with increases in population growth
- alter patterns of discharge to the coast so there may be fewer smaller rainfall events and long periods between events (eg months), but when events occur they are more likely to result in flow to the coast
- catchment activities are likely to capture more of the low flow events when they do occur, but larger events are likely to result in flooding of urban areas.

Note that as indicated in the report ([Report 6](#)) the above potential impacts on the Adelaide region and Adelaide's coastal waters could not be tested using the modelling approach due to too many gaps in data to undertake this piece of work in a comprehensive manner.

While population growth has been included in ACWQIP targets for nitrogen reduction the information available and the level of understanding of the likely effects of climate change were not sufficient to provide useful information with respect to other key pollutants. Developing a better understanding of the physical processes likely to ensue from climate change is the aim of proposed Strategy 5 of the ACWQIP.

In addition to this work there are two local government projects being funded by state, federal and local government and that when combined, cover the full length of the Adelaide coastline. The City of Onkaparinga has joined with the cities of Holdfast Bay and Marion as part of the 'Resilient South – the Southern Adelaide Region Integrated Vulnerability Assessment and Adaptation Action Plan' which will assess the climate change impacts – sea level rise and extreme weather events (including storms, flooding, heatwaves and bushfires) that pose a risk to property, infrastructure, business and industry, human health and the environment. This work will build on the work the Southern Region Councils have already undertaken in climate change risk assessments and adaptation plans for their corporate activities. A similar project is being undertaken by the western regional councils of the cities of Charles Sturt, West Torrens and Port Adelaide Enfield.

10 Supporting frameworks for ACWQIP

Effective plans cannot be prepared in isolation, but need to have regard to legislative, political, funding and best practice studies of other relevant organisations and groups aligned with the work of the plan. In addition to the high-level document linkage information presented in Chapter 3 of the ACWQIP, this chapter outlines a number of supporting strategic frameworks, studies and best practice methodologies relevant to the development of the Plan.

10.1 Overview

During its preparation, authors of the ACWQIP have taken into account a number of legislative, policy, funding and best practice frameworks. Much of the associational information on other plans and strategy information is presented in Chapter 3. This chapter outlines a number of supporting strategic frameworks, studies and best practice methodologies relevant to the development of the ACWQIP.

10.2 AMLR NRM Board monitoring evaluation and reporting framework

The AMLR NRM Board monitoring evaluation and reporting framework or MERF (AMLR NRM Board 2008b) provides the mechanism for determining the effectiveness of various programs in achieving the regional targets. It proposes a transition from the current approach of project-based monitoring at local scales towards investment in long-term monitoring of key environmental indicators at the regional scale that are directly related to the regional targets identified in the AMLR NRM Regional Plan.

The AMLR NRM Board MERF prepared for the regional NRM Plan, has been developed to focus the related regional activity by addressing the following three questions:

- To what extent has the region succeeded in implementing the NRM Plan (and supporting plans)?
- To what extent has the region progressed towards achieving the goals described in the Plan?
- Is the condition of the natural resources within the region getting better or worse?

This information will inform decisions concerning natural resource management, so that the management effort is efficient, effective and adaptive to change.

Significant progress towards these regional targets is unlikely to be detectable for very long time periods. Management action targets and now the intermediate targets (or iTargets) of the AMLR NRM Board, provide short to medium-term targets that are more directly attributable to the implementation of the AMLR NRM Regional Plan.

The Regional Plan has a number of regional targets that are relevant to the ACWQIP as follows:

- Regional Target T1: By 2028, the region will have the system capacity to harvest up to 35 GL of stormwater and 50GL of wastewater per annum.
- *Regional Target T2*: Aquatic ecosystems and groundwater condition is maintained or improved
- *Regional Target T10*: land-based impacts on coast, estuarine and marine areas – impacts on coastal waters from sediment loads from catchments and pollutant loads from stormwater to be reduced
- *Regional Target T12*: coastal, estuarine and marine water quality – all water quality for marine waters to meet defined environmental values.

Since mid-2011 the AMLR NRM Board has put in place iTargets for the NRM Plan for 2011–16. The following iTargets are relevant to the implementation of the ACWQIP:

- *iTarget 4*: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achieved
- *iTarget 5*: stormwater management plans have been developed for 40% of the urban area
- *iTarget 6*: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchments
- *iTarget 7*: 2,000 ha of land managed for water quality improvement
- *iTarget 10*: existing native ecosystems being actively improved across 20% of their area (to meet pre-determined biodiversity conservation goals).

Continued investigations, technical advice, financial support and ongoing monitoring and evaluation undertaken by the AMLR NRM Board relating to the themes, regional targets and iTargets identified above will contribute towards the implementation of the ACWQIP.

In addition to evaluation against the Regional Targets and iTargets, the AMLR NRM Board have identified core environmental indicators of change in the environment to be monitored, including environmental pressures, the condition (or state) of the environment and the consequent impacts. They were selected on the basis of being relevant, simple, measurable, accessible and timely. Those particularly relevant to the ACWQIP are listed in [Table 22](#).

Incorporating long-term ambient environmental monitoring into current MERF activity is a key challenge for the region, as is the development of a standard approach to program and project-based monitoring. Sustained investment in monitoring, evaluation and reporting is critical for the AMLR NRM Board to be able to effectively track performance of the plan and change in the region's natural resource base. Community involvement in the monitoring is seen as necessary for the successful implementation of NRM programs. Existing community monitoring style programs (also referred to as citizen science programs) include Waterwatch, Frog Census and Reef Watch.

Reporting on progress for the environmental indicators should be based on a five-yearly cycle, although there will be annual reporting on program implementation and resource allocation (management indicators). The AMLR NRM Board has established and maintains a comprehensive regional surface water monitoring program (composite sampler). This program includes monitoring of surface water flows (quantity and quality) to the marine environment at 16 sites along the coastline. This long-term program is important to monitor many of the environmental indicators illustrated in [Table 22](#) for the catchment model associated with the ACWQIP. All of the data from this monitoring program can be accessed on the Board's website⁷.

For effective achievement of the long-term targets, there should be an integration of monitoring undertaken by the AMLR NRM Board and that of other agencies. This includes the monitoring for Aquatic Ecosystem Condition Reports (AECRs) for marine waters undertaken by the EPA and monitoring of major point source impacts licensed by the EPA to Adelaide's coastal waters. This proposed integrated approach to monitoring Adelaide coastal waters will be a key focus of the implementation phase of the ACWQIP and should be strengthened through the ongoing process of updating the AECRs for the marine waters of Gulf St Vincent.

⁷ <www.amlrnrm.sa.gov.au/Monitoringandevaluation/Watermonitoring/Watermonitoringdata.aspx>

Table 22: AMLR NRM Board – monitoring, reporting and evaluation framework targets and environmental indicators

Target	Information required	Environmental indicator(s)	Relevant iTarget
Water			
T1 By 2028, the region will have the system capacity to harvest up to 35 GL of stormwater and 50GL of wastewater per annum.	Stormwater quantity	<ul style="list-style-type: none">Volume of stormwater generatedVolume of stormwater discharge to coast or marine systemsVolume of stormwater reused	<ul style="list-style-type: none">iTarget 4: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achievediTarget 5: stormwater management plans have been developed for 40% of the urban areaiTarget 6: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchmentsiTarget 7: 2,000 ha of land managed for water quality improvement
	Stormwater quality	Stormwater pollutant load	
T1 By 2028, the region will have the system capacity to harvest up to 35 GL of stormwater and 50GL of wastewater per annum.	Wastewater quantity	<ul style="list-style-type: none">Volume of wastewater generatedVolume of wastewater discharge to coast or marine systemsVolume of wastewater reused	<ul style="list-style-type: none">iTarget 4: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achievediTarget 5: stormwater management plans have been developed for 40% of the urban area
	Wastewater quality	Wastewater quality	
T2 Aquatic ecosystems and groundwater condition is maintained or improved	Surface water quality	<ul style="list-style-type: none">Exceedences of pH water quality triggers (surface water)Exceedences of salinity water quality triggers (surface water)	<ul style="list-style-type: none">iTarget 6: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchmentsiTarget 7: 2,000 ha of land managed for water quality improvement
T3 Sustainable management of water resources	Surface water use	<ul style="list-style-type: none">Surface water used for agriculture/irrigationSurface water used by industrySurface water used for urban/domestic	<ul style="list-style-type: none">iTarget 4: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achievediTarget 5: stormwater management plans have been developed for 40% of the urban areaiTarget 6: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchmentsiTarget 7: 2,000 ha of land managed for water quality improvement
		Total surface water required for the environment compared to that provided	
Biodiversity			
T8 Extent of functional ecosystems (coastal, estuarine, terrestrial, riparian)		Area of native vegetation	Mentions monitoring of seagrass condition and reef health condition under iTarget 10: Existing native ecosystems being actively improved across 20% of their area (to meet pre-determined biodiversity conservation goals)

Target	Information required	Environmental indicator(s)	Relevant iTarget
Marine			
T10 Land-based impacts on coastal, estuarine and marine processes	Catchment condition	Catchment sediment load	<ul style="list-style-type: none"> • <i>iTarget 4</i>: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achieved • <i>iTarget 5</i>: stormwater management plans have been developed for 40% of the urban area • <i>iTarget 6</i>: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchments • <i>iTarget 7</i>: 2,000 ha of land managed for water quality improvement
	Stormwater quality	Stormwater pollutant load	
	Stormwater quantity	Volume of stormwater discharge to coast or marine systems	
	Wastewater quantity	Volume of wastewater discharge to coast or marine systems	
T11 Seagrass, reef and other coast, estuarine and marine habitats	Coast, estuarine and marine ecosystems	Distribution and abundance of seagrass	Mentions monitoring of seagrass condition and reef health condition under <i>iTarget 10</i> : Existing native ecosystems being actively improved across 20% of their area (to meet pre-determined biodiversity conservation goals)
		<ul style="list-style-type: none"> • Condition of reefs • Condition of estuaries • Distribution and abundance of mangroves 	
T12 Coast, estuarine and marine water quality	Coast, estuarine and marine water quality	<ul style="list-style-type: none"> • Exceedences of heavy metals triggers (coastal, marine and estuarine waters) • Exceedences of marine Chlorophyll concentrations • Exceedences of marine nutrient concentrations • Exceedences of marine turbidity • Sea surface temperature 	<ul style="list-style-type: none"> • <i>iTarget 4</i>: investment in additional 2 GL of stormwater and wastewater harvesting capacity has been achieved • <i>iTarget 5</i>: stormwater management plans have been developed for 40% of the urban area • <i>iTarget 6</i>: stormwater quality control devices capture silt and debris from 25,000 ha of urban and semi-rural catchments • <i>iTarget 7</i>: 2,000 ha of land managed for water quality improvement

Source: AMLR NRM Board Monitoring, Evaluation and Reporting Framework 2008 (AMLR NRM Board 2008b) and 2011 Intermediate Targets for the NRM Plan 2011–2016.

10.3 Investigating market-based instruments for stormwater

In the development of the ACWQIP, the EPA engaged BDA Group and Econsearch to investigate potential market-based instruments (MBIs) to minimise the effect of stormwater on Adelaide's coastal water quality. While the primary purpose of this work was to consider improved water quality, the interactions between water quality and quantity were also examined. The report was provided to the EPA as a consultancy report from the BDA Group in early 2009.

Methods for improving the quality, or reducing volumes of stormwater discharged were considered, along with information on the costs and effectiveness of those measures. Proposed methods include common structural controls such as stormwater retention basins (and associated suggestions of water reuse), infiltration systems, conveyance systems, detention and pollution control. The report also briefly discusses key issues relevant to retrofitting existing urban areas.

MBIs used within and outside Australia to improve water quality were reviewed, as well as market-based approaches used for other objectives that may have relevance for stormwater management. Applications designed specifically to address stormwater runoff and pollution were also highlighted.

In the report, objectives of a stormwater MBI for Adelaide's coastal waters were stated and the suitability of MBIs to the stormwater pollution problem assessed. The relative merits of different types of MBIs that could be used to manage stormwater in the context of Adelaide's coastal waters were discussed.

This preliminary assessment suggested that the following types of MBIs would be most suited to improving stormwater quality and reducing impacts on Adelaide's coastal waters:

- stormwater quality charges
- subsidy program administered by competitive tender
- stormwater offset contribution scheme.

A review of conceptual framework and key design features for each of the shortlisted MBIs were outlined, along with the current legislative and institutional arrangements and policy settings relevant to the management of stormwater in SA.

Stakeholders indicated that there is interest in the concept of MBIs for improving water quality for Adelaide's coastal waters but further research is required to provide detail of how each of the potential systems may work for the Adelaide region. Research in this area would also need to consider the context of current work being undertaken to capture and use stormwater using systems at a scale driven by local government. In summary, more investigations on the practicality and suitability of MBIs for the Adelaide context is required and at this stage, there is no intention in the immediate future to implement MBIs across the Adelaide region for the purpose of improving coastal water quality.

10.4 Capacity to implement the ACWQIP

The statutory capacity of relevant agencies to implement the ACWQIP has been considered ([Report 7](#) in the EPA website); including the legislative framework for managing activities that can affect the water quality of the Adelaide coast. Legislation covers many aspects of businesses and individuals who interact with Adelaide's coast. Most of this has little or no direct bearing on Adelaide's water quality or related management and an exhaustive list is not provided.

The following legislation has aims consistent with the outcomes sought for Adelaide's coastal waters⁸:

- Adelaide Dolphin Sanctuary Act 2005
- Coast Protection Act 1972
- Development Act 1993
- Environment Protection Act 1993
- Local Government Act 1999
- Local Government (Stormwater Management) Amendment Act 2007
- Marine Parks Act 2007
- Natural Resources Management Act 2004
- Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987.

These Acts are listed with their full titles, objects and a summary of their statutory capacities with respect to the ACWQIP in [Report 7](#) of the supporting technical reports on the EPA website.

The effective management of activities to enable the recommendations of the ACWS to be achieved is within the scope of existing legislation. Changes to relevant schedules and tables of the WQ Policy where the EVs and WQOs developed for the ACWQIP are used to provide more focused targets will enhance the effectiveness of the EP Act.

⁸ All South Australian legislation can be accessed at <www.legislation.sa.gov.au/index.aspx>.

10.5 Reasonable Assurance Statement (RAS) for the ACWQIP

The Reasonable Assurance Statement (RAS), referred to in [Report 8](#) on the EPA website, seeks to provide stakeholders with a high degree of confidence that, if the ACWQIP is implemented, aiming for the ACWS nutrient and sediment load reduction targets, the water quality of Adelaide's coastal waters *will* improve and the likelihood of seagrass loss being halted and future seagrass return *will* be greater. This information is important to ensure that those investing resources in the implementation of the ACWQIP (such as state and Australian governments and businesses) can be confident of outcomes.

The RAS considers how certain we are about:

- our knowledge of the response of the system to pollutant loads
- the effectiveness of proposed interventions to achieve load reductions
- the adoption of proposed interventions, in terms of timing and extent. To account for uncertainty in the spirit of the precautionary principle this may require high levels of adoption of key interventions.

All key stakeholders accept that they need to manage Adelaide's coastal water quality in line with the recommendations of the ACWS and this provides a good level of confidence that the effective interventions will be developed and adopted to provide the necessary level of water quality improvement.

There is a high degree of confidence in the ability of the major dischargers—Penrice Soda Products and SA Water—to reduce nitrogen loads in the medium to longer term and that these reductions will allow for water quality conditions where seagrass can be protected and recover.

The outlook for suspended solids and other stormwater sourced inputs is less clear, mainly because there are multiple drivers for change in place and it is more difficult to measure progress. While improvements in these may take longer, initial work is likely to lead to improved amenity of Adelaide's coastal waters. The energetics of the nearshore, likely to inhibit regrowth of seagrass, means that recovery of seagrass in this area will be long-term—consistent with the long-term nature of likely improvements in total suspended solids and coloured dissolved organic matter (CDOM) loads.

11 Concluding remarks

Findings of the Adelaide Coastal Waters Study (ACWS) present the SA community with both a challenge and an opportunity, and the ACWQIP presents a vehicle to realise an exciting vision and implement strategies for the management of a healthy coastal system.

The ACWQIP provides a long-term strategy that is consistent with community expectations to achieve and sustain water quality improvement for Adelaide's coastal waters. Geographically the coast and coastline holds spiritual and cultural significance for the traditional owners. The study area is home of the Kaurna and Ramindjeri Aboriginal people who understand that healthy lands, sea and waterways equate to healthy people.

Consultation, communication and engagement with stakeholders has been central to the development of the ACWQIP. The Plan undertook significant engagement with the Adelaide's coastal waters' community (including traditional owners), industry and government. Findings indicate that Adelaide's coast is valued as an iconic feature of the City of Adelaide and for its natural and cultural features that are of scenic, cultural, economic, ecological and recreational importance to all South Australians.

The ACWQIP describes the overall picture of the broad environmental condition of Adelaide's coastal waters. It draws from the scientific findings of the ACWS and contemporary reports being prepared by the EPA. The ACWQIP recognises the decline in health of seagrass beds and reefs off the Adelaide coastline as a matter of significance. Building on the ACWS findings (which established that nitrogen and sediment inputs were the main contributors to issues impacting on Adelaide's coastal water quality and seagrass health), the ACWQIP targets reductions in nitrogen and sediment loads.

The catchment to coast philosophy infuses the Plan. This philosophy acknowledges that activities occurring on the land impact on our coastal waters and need to be appropriately managed. This means that if the catchment (the foothills and the Adelaide Plains) is managed well, the urban and coastal environment benefit. Improved management of wastewater and reductions in discharges, through initiatives such as water sensitive urban design (WSUD) features, will support the re-colonisation of seagrass on the bare sand: ultimately creating a healthier coastal system.

Central to the ACWQIP are the environment values (EVs) and corresponding water quality objectives (WQOs) that strategically link to both the ACWS and other scientific findings for the study area. The eight ACWQIP strategies complement the 14 recommendations in the ACWS and have been designed to sustain and reinvigorate the beaches, coastal waters, seagrass and reef systems of Adelaide. The ACWQIP provides a high degree of certainty that the targets provided by the ACWQIP are acceptable targets upon which to plan pollution reduction strategies in Adelaide's coastal waters.

The behavioural, policy and physical changes required to return the Adelaide coast to a healthy environment are achievable, provided people work together and resources for implementation can be pooled on similar projects. Underpinning the success of the ACWQIP is the need for dynamic, informed and 'can-do' partnerships. It is envisaged that the South Australian community, including government agencies and industry, will work together to achieve these outcomes both in the medium and longer term.

The ACWQIP provides a framework of sustainable targets for the Adelaide coast against which the community, government and traditional owners can judge progress and against which regulatory agencies such as the EPA can assess improvement in performance of dischargers. The ACWQIP is a facilitating document that provides a common vision for Adelaide's coastal waters and expects input from all partners to achieve successful outcomes for the eight strategies of the ACWQIP.

Findings of the ACWS together with the eight strategies of the ACWQIP present the SA community with a challenge and an opportunity, as the Plan presents a vehicle to create the exciting vision of:

Healthy aquatic ecosystems where environmental, social and economic values are considered in equal and high regard in a balanced management approach that aims to see the return of the 'blue line of seagrass' closer to shore by 2050 (Community vision for the ACWQIP).

Ultimately, the whole South Australian community will benefit from the increased environmental, economic, social and cultural value that a cared for coast will bring.

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APPENDICES

Appendix 1: ACWQIP water quality objectives

Information in the following table was prepared with input from Eco Management Services Pty Ltd for the preparation of the ACWQIP and has been adopted as the final water quality objectives for the updated ACWQIP in 2013.

PORT WATERWAYS		
PORT RIVER Section (Zone 4 on Part A, Figure 1)		
Water quality issues – pollutant indicators	Water quality objectives	WQIP performance indicators
NUTRIENTS		
<ul style="list-style-type: none"> High nutrient concentrations and algal blooms (occasionally toxic) Accumulation of toxins in shellfish Low oxygen conditions (contributor through plant respiration—diurnal rhythm) Occasional fish kills High ammonia levels and ammonia toxicity Discolouration Odours from decaying algae 	<p>Ambient concentration objectives:</p> <ul style="list-style-type: none"> Chlorophyll 'a' – 1 ug/L (90 percentile) <p>Phosphorus</p> <ul style="list-style-type: none"> Total 25 ug/L (90 percentile) FRP 10 ug/L (90 percentile) <p>Nitrogen</p> <ul style="list-style-type: none"> Total N 250 ug/L (90 percentile) Nitrate and Nitrate N 5 ug/L (90 percentile) Ammonia N 10 ug/L (90 percentile) <p>These are defined as interim objectives, based on the results of modelling undertaken as part of the Port Waterways Water Quality Improvement Plan (PWWQIP). Although modified from its former natural condition, low nutrient levels are still required to reduce or prevent algal blooms and protect existing environmental values.</p> <p>The 90 percentile allows for the objective values to be exceeded for 10% of the time, which may occur, for example, for short periods following larger rainfall events or ship movement re-suspending sediments.</p>	<ul style="list-style-type: none"> Reduced frequency, extent and duration of algal blooms Ammonia concentrations largely reduced, below 200 ug/L Minimal or no odours from decaying algae

Water quality issues – pollutant indicators	Water quality objectives	WQIP performance indicators
PHYSICAL PARAMETERS		
<p>Occasionally very high loads of suspended solids occur as a result of storm events, through turbulence, riverine inputs and stormwater inputs, resulting in:</p> <ul style="list-style-type: none"> • direct effects on biota (abrasion, smothering, loss of visibility, etc) • transport mechanism for toxicants and nutrients. <p>Increased turbidity and colour (coloured dissolved organic matter) affecting:</p> <ul style="list-style-type: none"> • reduction in light penetration and photosynthesis • recreational amenity and the suitability of waters for direct contact. 	<p>Ambient concentration objectives:</p> <ul style="list-style-type: none"> • Suspended solids – <3 mg/L (90 percentile) • Turbidity – <1 NTU>200 metres offshore (90 percentile) • Colour – <15 Hazen Units (90 percentile) <p>The 90 percentile allows for the objective values to be exceeded for 10% of the time, which may occur, for example, for short periods following larger rainfall events or ship movement re-suspending sediments.</p> <ul style="list-style-type: none"> • Dissolved oxygen – >6 mg/L or 100% saturation during daytime monitoring. During neap tides in summer >25% minimum saturation at any time over a 24-hour diurnal cycle <p>Temperature – < 20 over normal seasonal range</p> <p>pH – between 7.5–8.5</p>	<ul style="list-style-type: none"> • Ambient water quality objectives achieved
METALS		
<p>Metals occur in stormwater and industrial discharges. There is also the potential for remobilisation from sediments. As a consequence, concentrations in the water column can be elevated with:</p> <ul style="list-style-type: none"> • the potential for sub-lethal or lethal effects on biota • the potential for bio-concentration, bio-accumulation and bio-magnification • the potential to affect safety of fish and shellfish for human consumption • over time, increases in sediment concentrations as most metals are associated with particulate matter, which then may be remobilised. <p>Of the metals examined (Cu, Pb, Zn, Cd and Al), concentrations of copper and zinc are above the guideline trigger values.</p>	<p>Ambient concentration objectives (95% level of protection):</p> <ul style="list-style-type: none"> • Copper – 0.0013 mg/L (90 percentile) • Lead – 0.0044 mg/L (90 percentile) • Zinc – 0.015 mg/L (90 percentile) • Cadmium – 0.0055 mg/L (90 percentile) 	<ul style="list-style-type: none"> • Ambient water quality objectives achieved

Water quality issues – pollutant indicators	Water quality objectives	WQIP performance indicators
MICROBIOLOGICAL		
<p>Urban stormwater runoff typically can contain large numbers of faecal micro-organisms, used for many years as an indicator of the potential presence of pathogens. As a result, there is:</p> <ul style="list-style-type: none"> the potential for adverse effects on direct contact (eg swimming), passive recreation (eg boating) and from discharge, although depending on size these may be localised and transitory the potential for microbial contamination of food species, particularly shellfish, although at the present time there is a prohibition on the taking of shellfish for food in this area part of this segment, between the West Lakes outlet and North Arm, which is unsuitable for contact recreation because of the conflict with other uses, eg shipping and the historical condition of some of the waterways (rubble, glass, etc) 	<p>Primary contact recreation:</p> <p>Enterococci – <200 orgs/100 mL (95 percentile)</p> <ul style="list-style-type: none"> The 95 percentile allows for the objective value to be exceeded for 5% of the time which may occur, for example, for short periods following rainfall events causing stormwater discharges, particularly in the vicinity of the discharge points. For this reason the SA Health Commission has signage advising against contact recreation (bathing, swimming) in the vicinity when the water is coloured, which usually occurs with stormwater outflows. 	<ul style="list-style-type: none"> Ambient water quality objectives achieved There is no contamination of human food species
ORGANICS		
<p>There is no data for waters, however data for sediments would suggest contamination is episodic and localised. Traces of PCBs were found in North Arm Creek and traces of organotins found at a number of locations in sediments. Other organics examined, including herbicides and organochlorins, were not detected or below the limits of detection. Contamination by organics should be prevented because of:</p> <ul style="list-style-type: none"> the potential for sub-lethal or lethal effects on biota the potential for bio-concentration, bio-accumulation and bio-magnification the potential to affect safety or tainting of fish and shellfish for human consumption. 	<p>In waterways, all organic compounds listed in Table 3.4.1 in ANZECC (2000) should be below detection, except for:</p> <ul style="list-style-type: none"> Oils and petroleum hydrocarbons <1 mg/L (95 percentile) <p>In stormwater/discharges, all organic compounds listed in Table 3.4.1 in ANZECC (2000) should meet the criteria for the 95% level of protection identified in the table.</p>	<ul style="list-style-type: none"> Ambient water quality objectives achieved

CENTRAL BARKER INLET Section (Zone 3 on Part A, Figure 1)		
Water quality issues – pollutant indicators	Water quality objectives	WQIP performance indicators
NUTRIENTS		
<ul style="list-style-type: none"> • Ulva proliferation • Occasional fish kills • Odours from decaying algae • Low oxygen conditions and potential remobilisation of pollutants from sediments • High nutrient concentrations • Mangrove and seagrass loss 	<ul style="list-style-type: none"> • Chlorophyll 'a' – 1 ug/L <p>Phosphorus</p> <ul style="list-style-type: none"> • Total 25 ug/L • FRP 10 ug/L <p>Nitrogen</p> <ul style="list-style-type: none"> • Total N 250 ug/L • Nitrate and Nitrate N 5 ug/L • Ammonia N 10 ug/L 	<ul style="list-style-type: none"> • Ulva growth substantially reduced (by at least 60%) • No further seagrass loss • Healthy mangrove recruitment • Minimal or no odour from decaying algae • Reduction in the occurrence and extent of low oxygen conditions
PHYSICAL PARAMETERS		
<p>Occasionally very high loads of suspended solids occur as a result of storm events, through turbulence, riverine inputs and stormwater inputs, resulting in:</p> <ul style="list-style-type: none"> • direct effects on biota (abrasion, smothering, loss of visibility, etc) • transport mechanism for toxicants and nutrients. <p>Increased turbidity and colour (coloured dissolved organic matter) affecting:</p> <ul style="list-style-type: none"> • reduction in light penetration and photosynthesis. 	<p>Ambient concentrations objectives:</p> <ul style="list-style-type: none"> • Suspended solids – <3 mg/L (90 percentile) • Turbidity – <1 NTU>200 metres offshore (90 percentile) • Colour – <15 Hazen Units (90 percentile) <p>The 90 percentile allows for the objective values to be exceeded for 10% of the time, which may occur, for example, for short periods following larger rainfall events or storms.</p> <ul style="list-style-type: none"> • Dissolved oxygen – >6 mg/L or 100% saturation during daytime monitoring. During neap tides in summer >25% minimum saturation at any time over a 24 hrs diurnal cycle • Temperature – < 20 over normal seasonal range • pH – between 7.5–8.5 	<ul style="list-style-type: none"> • Ambient water quality objectives achieved

Water quality issues—pollutant indicators	Water quality objectives	WQIP performance indicators
METALS		
Concentrations of copper and zinc are elevated.	Ambient concentration objectives (99% level of protection): <ul style="list-style-type: none"> Copper – 0.0003 mg/L (90 percentile) Lead – 0.0022 mg/L (90 percentile) Zinc – 0.007 mg/L (90 percentile) Cadmium – 0.0055 mg/L (90 percentile) 	<ul style="list-style-type: none"> Ambient water quality objectives achieved
MICROBIOLOGICAL		
<p>Urban stormwater runoff typically can contain large numbers of faecal micro-organisms, used for many years as an indicator of the potential presence of pathogens. As a result, there is:</p> <ul style="list-style-type: none"> the potential for adverse effects on direct contact (eg swimming) and passive recreation (eg boating), from discharge, although depending on size these may be localised and transitory the potential for microbial contamination of food species, particularly shellfish. 	<p>Primary contact recreation:</p> <p>Enterococci – <200 orgs/100 mL (95 percentile)</p> <p>The 95 percentile allows for the objective value to be exceeded for 5% of the time, which may occur, for example, for short periods following rainfall events causing stormwater discharges, particularly in the vicinity of the discharge points. For this reason the SA Health Commission has signage advising against contact recreation (bathing, swimming) in the vicinity when the water is coloured, which usually occurs with stormwater outflows.</p> <p>Shellfishing</p> <ul style="list-style-type: none"> Faecal (thermotolerant) coliforms – median not exceeding 14 MPN orgs/100 mL, with no more than 10% of the samples exceeding 43 MPN/100 mL. Note that the standard for North Arm to Section Bank is currently under review 	<ul style="list-style-type: none"> Ambient water quality objectives achieved There is no contamination of human food species
ORGANICS		
<p>Although at present there is no information to indicate that there is currently any major concern, there remains:</p> <ul style="list-style-type: none"> the potential for sub-lethal or lethal effects on biota the potential for bio-concentration, bio-accumulation and bio-magnification the potential to affect safety or tainting of fish and shellfish for human consumption. 	<ul style="list-style-type: none"> In waterways, all organic compounds listed in Table 3.4.1 in ANZECC (2000) should be below detection, except for: Oils and petroleum hydrocarbons – <1 mg/L (95 percentile) In stormwater/discharges, all organic compounds listed in Table 3.4.1 in ANZECC (2000) should meet the criteria for the 95% level of protection identified in the table. 	<ul style="list-style-type: none"> Ambient water quality objectives achieved

Water quality issues—pollutant indicators	Water quality objectives	WQIP performance indicators
NORTHERN BARKER INLET (Zone 2 on Part A, Figure 1)		
NUTRIENTS		
<ul style="list-style-type: none"> • <i>Ulva</i> proliferation • High nutrient concentrations • Mangrove and seagrass loss 	<ul style="list-style-type: none"> • Chlorophyll 'a' – 1 ug/L <p>Phosphorus</p> <ul style="list-style-type: none"> • Total 25 ug/L • FRP 10 ug/L <p>Nitrogen</p> <ul style="list-style-type: none"> • Total N 250 ug/L • Nitrate and Nitrate N 5 ug/L • Ammonia N 10 ug/L 	<ul style="list-style-type: none"> • <i>Ulva</i> growth substantially reduced (by at least 60%) • No further seagrass loss • Healthy mangrove recruitment
PHYSICAL PARAMETERS		
<p>Occasionally very high loads of suspended solids occur as a result of storm events, through turbulence, riverine inputs and stormwater inputs, resulting in:</p> <ul style="list-style-type: none"> • direct effects on biota (abrasion, smothering, loss of visibility, etc) • transport mechanism for toxicants and nutrients. <p>Increased turbidity and colour (coloured dissolved organic matter) affecting:</p> <ul style="list-style-type: none"> • reduction in light penetration and photosynthesis. 	<p>Ambient concentrations objectives:</p> <ul style="list-style-type: none"> • Suspended solid – <3 mg/(90 percentile) • Turbidity – <1 NTU >200 metres offshore (90 percentile) • Colour – <15 Hazen Units (90 percentile) <p>The 90 percentile allows for the objective values to be exceeded for 10% of the time, which may occur, for example, for short periods following larger rainfall events or storms.</p> <ul style="list-style-type: none"> • Dissolved oxygen – >6 mg/L or 100% saturation during daytime monitoring • Temperature – < 20 over normal seasonal range • pH – between 7.5–8.5 	<ul style="list-style-type: none"> • Ambient water quality objectives achieved
METALS		
Concentrations of copper and zinc are elevated	<p>Ambient concentration objectives (99% level of protection):</p> <ul style="list-style-type: none"> • Copper – 0.0003 mg/L (90 percentile) • Lead – 0.0022 mg/L (90 percentile) • Zinc – 0.007 mg/L (90 percentile) • Cadmium – 0.0055 mg/L (90 percentile) 	<ul style="list-style-type: none"> • Ambient water quality objectives achieved

Water quality issues – pollutant indicators	Water quality objectives	WQIP performance indicators
MICROBIOLOGICAL		
<p>Urban stormwater runoff typically can contain large numbers of faecal micro-organisms, used for many years as an indicator of the potential presence of pathogens. As a result, there is:</p> <ul style="list-style-type: none"> the potential for adverse effects on direct contact (eg swimming) and passive recreation (eg boating), from discharge, although depending on size these may be localised and transitory the potential for microbial contamination of food species, particularly shellfish. 	<p>Primary contact recreation:</p> <ul style="list-style-type: none"> Enterococci – <200 orgs/100 mL (95 percentile) <p>The 95 percentile allows for the objective value to be exceeded for 5% of the time which may occur, for example, for short periods following rainfall events causing stormwater discharges, particularly in the vicinity of the discharge points. For this reason the SA Health Commission has signage advising against contact recreation (bathing, swimming) in the vicinity when the water is coloured, which usually occurs with stormwater outflows.</p> <p>Shellfishing</p> <p>Faecal (thermotolerant) coliforms – median not exceeding 14 MPN orgs/100 mL, with no more than 10% of the samples exceeding 43 MPN/100 mL.</p>	<ul style="list-style-type: none"> Ambient water quality objectives achieved There is no contamination of human food species
ORGANICS		
<ul style="list-style-type: none"> There is no data but contamination in this area is unlikely. 	<p>In waterways, all organic compounds listed in Table 3.4.1 in ANZECC (2000) should be below detection, except for:</p> <ul style="list-style-type: none"> Oils and petroleum hydrocarbons – <1 mg/L (95 percentile) 	<ul style="list-style-type: none"> Ambient water quality objectives achieved

METROPOLITAN COASTAL WATERS		
SECTION 1 NORTHERN-NEARSHORE (Zone 1 on Part A, Figure 1)		
Water quality issues – Pollutant indicators	Water quality objectives	WQIP performance indicators
NUTRIENTS		
<ul style="list-style-type: none"> High nutrient concentrations Mangrove and seagrass loss 	Ambient Concentration objectives: <ul style="list-style-type: none"> Chlorophyll 'a' – 1 ug/L (90 percentile) Phosphorus <ul style="list-style-type: none"> Total <25 ug/L (90 percentile) FRP <10 ug/L (90 percentile) Nitrogen – Total N <250 ug/L (90 percentile)	<ul style="list-style-type: none"> No further seagrass loss Healthy mangrove recruitment
PHYSICAL PARAMETERS		
Increased turbidity and colour (coloured dissolved organic matter), affecting: <ul style="list-style-type: none"> Reduction in light penetration affecting photosynthesis. 	Ambient concentration objectives: <ul style="list-style-type: none"> Suspended solids – <3 mg/L (90 percentile) Turbidity – <1 NTU >200 metres offshore (90 percentile) Colour – <15 Hazen Units (90 percentile) The 90 percentile allows for the objective values to be exceeded for 10% of the time, which may occur for example, for short periods following larger rainfall events or storms. Dissolved oxygen – 100% saturation during daytime monitoring Temperature – < 20 over normal seasonal range pH – between 7.5–8.5 	<ul style="list-style-type: none"> Ambient water quality objectives achieved
METALS		
	Ambient concentration objectives (99% level of protection): <ul style="list-style-type: none"> Copper – 0.0003 mg/L (90 percentile) Lead – 0.0022 mg/L (90 percentile) Zinc – 0.007 mg/L (90 percentile) Cadmium – 0.0055 mg/L (90 percentile) 	<ul style="list-style-type: none"> Ambient water quality objectives achieved

Water quality issues – pollutant indicators	Water quality objectives for metals	WQIP performance indicators
MICROBIOLOGICAL		
	<p>Primary contact recreation:</p> <ul style="list-style-type: none"> Enterococci – <200 orgs/100 mL (95 percentile) <p>The 95 percentile allows for the objective value to be exceeded for 5% of the time, which may occur, for example, for short periods following rainfall events causing stormwater discharges, particularly in the vicinity of the discharge points. For this reason the SA Health Commission has signage advising against contact recreation (bathing, swimming) in the vicinity when the water is coloured, which usually occurs with stormwater outflows.</p> <p>Shellfishing</p> <ul style="list-style-type: none"> Faecal (thermotolerant) coliforms – median not exceeding 14 MPN orgs/100 mL, with no more than 10% of the samples exceeding 43 MPN/100 mL. 	<ul style="list-style-type: none"> Ambient water quality objectives achieved There is no contamination of human food species
ORGANICS		
	<p>All organic compounds listed in Table 3.4.1 in ANZECC (2000) should be below detection, except for:</p> <ul style="list-style-type: none"> Oils and petroleum hydrocarbons – <1 mg/L (95 percentile) 	<ul style="list-style-type: none"> Ambient water quality objectives achieved

METROPOLITAN COASTAL WATERS		
ZONES 5 AND 6		
Water quality issues – pollutant indicators	Water quality objectives for nutrients	WQIP performance indicators
NUTRIENTS		
<ul style="list-style-type: none"> High nutrient concentrations Mangrove and seagrass loss 	Ambient concentration objectives: Chlorophyll 'a' – 1 ug/L (90 percentile) Phosphorus <ul style="list-style-type: none"> Total <25 ug/L (90 percentile) FRP <10 ug/L (90 percentile) Nitrogen <ul style="list-style-type: none"> Total N <250 ug/L (90 percentile) 	<ul style="list-style-type: none"> No further seagrass loss Healthy mangrove recruitment
PHYSICAL PARAMETERS		
Increased turbidity and colour (coloured dissolved organic matter) affecting: <ul style="list-style-type: none"> reduction in light penetration affecting photosynthesis. 	Ambient concentration objectives: <ul style="list-style-type: none"> Suspended solids – <2 mg/L (90 percentile) Turbidity – <2 NTU (90 percentile) Colour – <15 Hazen Units (90 percentile) The 90 percentile allows for the objective values to be exceeded for 10% of the time, which may occur, for example, for short periods following larger rainfall events or storms. <ul style="list-style-type: none"> Dissolved oxygen – 100% saturation during daytime monitoring Temperature – < 20 over normal seasonal range pH – between 7.5–8.5 	<ul style="list-style-type: none"> Ambient water quality objectives achieved
METALS		
	Ambient concentration objectives (99% level of protection): <ul style="list-style-type: none"> Copper – 0.0003 mg/L (90 percentile) Lead – 0.0022 mg/L (90 percentile) Zinc – 0.007 mg/L (90 percentile) Cadmium – 0.0055 mg/L (90 percentile) 	<ul style="list-style-type: none"> Ambient water quality objectives achieved

Water quality issues – pollutant indicators	Water quality objectives	WQIP performance indicators
MICROBIOLOGICAL		
	<p>Primary contact recreation: Enterococci – <200 orgs/100 mL (95 percentile)</p> <ul style="list-style-type: none"> The 95 percentile allows for the objective value to be exceeded for 5% of the time, which may occur, for example, for short periods following rainfall events causing stormwater discharges, particularly in the vicinity of the discharge points. For this reason the SA Health Commission has signage advising against contact recreation (bathing, swimming) in the vicinity when the water is coloured, which usually occurs with stormwater outflows. <p>Shellfishing</p> <ul style="list-style-type: none"> Faecal (thermotolerant) coliforms – median not exceeding 14 MPN orgs/100 mL, with no more than 10% of the samples exceeding 43 MPN/100 mL. 	<ul style="list-style-type: none"> Ambient water quality objectives achieved There is no contamination of human food species
ORGANICS		
	<p>All organic compounds listed in Table 3.4.1 in ANZECC (2000) should be below detection, except for:</p> <ul style="list-style-type: none"> Oils and petroleum hydrocarbons – <1 mg/L (95 percentile) 	<ul style="list-style-type: none"> Ambient water quality objectives achieved

Appendix 2: City of Onkaparinga activities supporting ACWQIP

Note that this information and tables indicating support of the ACWQIP was supplied in November 2011 as part of the City of Onkaparinga submission on the draft ACWQIP.

Support of the Adelaide Coastal Water Quality Improvement Plan

We are very supportive of the overall aims of ACWQIP which are to decrease the levels of nutrients, suspended solids and coloured dissolved organic matter entering our coastal waters.

Our approach to water management is reflected in our Water Futures Strategy 2008–2013 which seeks to:

Achieve the sustainable management of water resources and security of supply.

As a council we will continue to work in collaboration with the EPA, the Adelaide and Mt Lofty Ranges Natural Resources Management Board, SA Water, the Stormwater Management Authority and others agencies to reduce the amount of pollutants entering coastal waters.

Our main points are as follows:

1 The role and contribution of local government

The City of Onkaparinga region has 31km of coastline – nearly half of the 70km covered by ACWQIP. Extensive works have been undertaken to improve water quality in our region beyond the general environmental duties required under the Environmental Protection Act (1993) and Natural Resources Management Act (2004).

Local Government acts widely to improve the quality of water that drains to the coast through the development of wetlands, the recycling of wastewater and stormwater, and through cliff and creek erosion works. These projects are often implemented in partnership with other agencies. The projects listed often require collaboration by councils, or are initiated and managed by councils and involve significant expenditure.

Refer to Table 1 attached for a summary of the key projects initiated by the City of Onkaparinga in the period of the development of the ACWQIP that are contributing to the outcomes of the ACWQIP.

2 Water sensitive urban design – ACWQIP Strategy 1, Action 1.3

The City of Onkaparinga has been active in implementing WSUD in council-owned streetscapes and parks and continues to encourage its incorporation into Greenfield development including through a standard development condition and a water quality levy. There are limits to how much WSUD can be mandated, and there are particular challenges for achieving WSUD outcomes in existing built up areas. Our comments are provided in Table 2

3 Climate change and population growth impacts on coastal water quality – ACWQIP Strategy 5

It is noted that a technical report was undertaken by the EPA to assess the impact of Climate and Population change on stormwater input and coastal water quality for the Adelaide region. In addition Strategy 5 of ACWQIP is to:

Model and evaluate the impacts of climate change, human impacts and population growth implications for Adelaide's coastal waters.

There are two local government projects about to commence that the EPA should be aware of that are being funded by State, Federal and local government and that when combined, cover the full length of the Adelaide coastline.

The City of Onkaparinga has joined with the Cities of Holdfast Bay and Marion as part of the *Resilient South – the Southern Adelaide Region Integrated Vulnerability Assessment and Adaptation Action Plan* which will assess the climate change impacts – sea level rise and extreme weather events (including storms, flooding, heatwaves and bushfires) that pose a risk to property, infrastructure, business and industry, human health and the environment. This work will build on the work the Southern Region Councils have already undertaken in climate change risk assessments and adaptation plans for their corporate activities.

A similar project is being undertaken by the Western Region of Councils of the Cities of Charles Sturt, West Torrens and Port Adelaide Enfield.

Table 1: City of Onkaparinga projects and their contribution to ACWQIP Strategies

ACWQIP Reference: Strategy 1 – Reduce nutrient, sediment and coloured dissolved organic matter discharges		
Southern Urban Reuse Project As part of the City of Onkaparinga's Water Proofing the South Stage 1 Completed June 2011	Up to 1.6 billion litres of treated wastewater is being transferred each year from the Christies Beach Wastewater Treatment Plant to the Aldinga Wastewater Treatment Plant where it is being stored. The wastewater is then being further treated before being provided to up to 8000 new homes beginning with Seaford Meadows for use in dual reticulation systems. Works associated with the construction of the infrastructure included: <ul style="list-style-type: none"> • a pipeline from the Christies Beach Wastewater Treatment Plant to the Aldinga Wastewater Treatment Plant • a new storage basin, water polishing and disinfection plant, and a pipeline from the Aldinga Wastewater Treatment Plant to the new developments at Seaford. 	Project leader: SA Water \$15M Australian Government
City of Onkaparinga WSUD initiatives	Recent WSUD initiatives include construction of biofilters and installation of permeable paving in car parks, trialling of earth swales and biofilters in urban residential development, and watercourse restoration works. Several of these projects have also been recognised for their excellence through awards from the Public works, Landscape and building construction industry associations.	Project leader: City of Onkaparinga
City of Onkaparinga Water Resources Asset Management Plan and Resource Allocation Strategy	The City of Onkaparinga has won awards for excellence from both the Institute of Public Works Engineering Australia and the Stormwater Industry Association for our Water Resources Asset Management Plan and resource allocation strategy. The awards acknowledge Council's leadership and innovation through the introduction and implementing of service levels for water quality as well as flood protection as part of the water resources planning process. The service levels adopted are consistent with those applied to new development (see Table 2), and ensure that water resources projects (eg drainage upgrades, etc) have water quality outcomes in addition to the required flood protection outcomes.	Project leader: City of Onkaparinga
ACWQIP Reference: Strategy 1 – Reduce nutrient, sediment and coloured dissolved organic matter discharges		
The smaller southern estuaries are fairly typical in that they are 'highly modified due to their agricultural or urban catchments and are consequently being impacted by a range of pollutants, including nutrients, turbidity/suspended solids, toxicants (metals) and faecal micro-organisms. This has been reflected in the ambient water quality monitoring data available'.		
Morrow Road Sedimentation Basin, Christies Creek Completed	This sedimentation basin has been modelled to reduce sediments from the Christies Creek catchment by 50% in line with recommendation 3 of the ACWS.	Project leader: City of Onkaparinga Funding partners: Australian Government, AMLR NRM Board
Sellicks Creek	The Sellicks Creek wetland has won awards for its design and construction and aims to control erosion through the creation of a series of ponds, channels, weirs which extend approximately 700 metres upstream from the coast. The weirs and ponds slow down flows and protect the channel from erosion which over the years had created a gorge almost 1.5 kilometres long, 10 metres deep and up to 30 metres wide. A large basin allows sedimentation to settle prior to the waterway reaching the coast.	Project leader: City of Onkaparinga
Christie Creek Erosion Control works	An erosion audit completed in 2004 identified a number of erosion in issues in Christies Creek. In partnership with the AMLR NRM Board, all high and most medium priority works identified in the audit have now been completed, at an estimated cost of \$500,000. Further investment in medium priority sites is continuing as part of our watercourse management program.	AMLR NRM Board & City of Onkaparinga

ACWQIP Reference: Strategy 2 – Promote integrated use of wastewater and stormwater		
Water Proofing the South – Stage 1 Christie Creek	<p>Aims to harvest 850ML of stormwater for reuse, address flooding risks and improve water quality. These aims have been achieved through the construction of:</p> <ul style="list-style-type: none"> wetlands in Brodie Road reserve and Madiara Drive reserve to harvest and treat stormwater basins in Waverley Way and Woodcroft Drive reserves to slow high flows and address known flooding risks a storage dam within Wilfred Taylor reserve to store water for summer use plus a complementary aquifer storage scheme in the same area a 17-km distribution scheme to distribute collected stormwater for irrigation landscape and recreational amenity improvements including the construction of a linear trail through major areas, waterway health and biodiversity improvement and interpretative and interactive elements. 	<p>Project leader: City of Onkaparinga</p> <p>Funding partners: Australian Government, state government (Department for Planning and Local Government), AMLR NRM Board</p>
Water Proofing the South – Stage 2 Field River, Pedlar Creek and Hart Rd Wetland	<p>The City of Onkaparinga is currently working on projects that will have a significant impact on the overall reduction of sediments entering the Gulf.</p> <ul style="list-style-type: none"> enhancements to existing and new wetlands will each contribute towards the water harvest target of approximately 2.8 GL of stormwater, which will be stored below ground via MAR schemes for future recovery and reuse an extensive network of pipe transfer infrastructure will be constructed across the city to efficiently distribute harvested stormwater to service sports fields and ovals in close proximity to where water is harvested the modelling for the proposed Pedlar Creek wetland project result in reductions in sediment loads of approximately 51% Field River modelling from the proposed Byards/Reynella East wetland project result in reductions in sediment loads of approximately 85% 20% of the water harvested will be injected into the aquifer for environmental purposes (consistent with water allocation plans), resulting in an anticipated total reuse volume of 2.2 GL (2.2 billion litres) of stormwater to be available for reuse. 	<p>Project leader: City of Onkaparinga</p> <p>Funding partners: Australian Government, state government (Department for Water)</p>
Onkaparinga River estuary: environmental flows study Completed November 2010	<p>Though not a primary landholder, the City of Onkaparinga has taken a keen interest in the health of the Onkaparinga River:</p> <ul style="list-style-type: none"> the study aimed to establish the feasibility of delivering suitable, treated effluent and stormwater to the Onkaparinga River to achieve environmental flows researchers documented the potential effects of treated waste and stormwater on the health of the River in terms of water quality, human and environmental health, aquatic ecology and catchment characteristics that might influence river ecosystems. <p>The EPA was engaged throughout this project and the research brief stated that one of the aims was to avoid and/or reduce the discharge of treated wastewater into aquatic environments to avoid all potential deleterious effects.</p> <p>This message was reiterated by EPA participants during the development of the study through during our engagement activities.</p>	<p>Project leader: City of Onkaparinga</p> <p>Funding partners: Flinders University, Australian Government, SA Water, AMLR NRM Board</p>

ACWQIP Reference: Strategy 2 – Promote integrated use of wastewater and stormwater		
Willunga effluent reuse Completed June 2010	The installation of a distribution system to supply reclaimed water to irrigate the Willunga Township's open space facilities: <ul style="list-style-type: none"> • Willunga Golf Course • Willunga Recreation Park • Willunga Rose Garden • Willunga Waldorf School 	Project leader: City of Onkaparinga Funding partners: Australian Government
Willunga Balancing and Water Storage Completed June 2010	The Willunga balancing storage provides the necessary storage to enable water to be retained during winter (when demand is less than supply) and utilised at peak periods during summer, as well as providing essential network balance. The increase in storage volume proposed at Willunga (174 ML) will cater for increased demand in the Willunga Basin region.	Project leader: City of Onkaparinga Australian Government

Table 2: Water Sensitive Design (WSUD) Comments

<p>ACWQIP Reference: Strategy 1 - Reduce nutrient, sediment and coloured dissolved organic matter discharges through a range of measures including to:</p> <p>...encourage the uptake and implementation of Water Sensitive Urban Design across Adelaide region</p> <p>In addition within a discussion about 'reducing stormwater flows, suspended solids and coloured dissolved organic matter' on the Southern Adelaide Coast ACWQIP states:</p> <p>...the situation in the southern part of the metropolitan calls for a slightly different approach.... While southern metropolitan urban development is also intensifying, current technology also provides opportunities to deal with water quality pressures by incorporating WSUD approaches.</p> <p>A strong focus on adherence to WSUD targets at the land division, planning approval and building stages for development needs to be integrated with the development of stormwater retention and harvesting infrastructure.</p> <p>Failure to implement these targets is likely to result in long-term damage to the southern area's prime attraction – its coastal environment.</p>	
<p>City of Onkaparinga Development Plan</p>	<p>The City of Onkaparinga is currently able to encourage Water Sensitive Urban Design in new developments but is not able to require it to occur.</p> <p>There are a number of high level area wide objectives that promote WSUD principles in the Development Plan, and the 'Natural Resources' module of the Planning Policy Library contains a Water Sensitive Design section. This module will be incorporated into our development plan through a BDP and General Amendments DPA.</p> <p>We also apply a standard Development Condition to land divisions that requires pollutants to be trapped prior to exiting the site or entering the natural watercourse. A minimum standard of treatment is applied is to be able to remove the following percentages of pollutants from the typical annual urban load (Ref: CSIRO Urban Stormwater Best Practice Environmental Management Guidelines):</p> <ul style="list-style-type: none"> • Suspended solids 80% reduction • Total Phosphorus 45% reduction • Total Nitrogen 45% reduction • Litter 70% reduction
<p>Strong reliance on engineering approval rather than development approval to obtain stormwater quality outcomes</p>	<p>While land development approval can impose the above Development Condition, it is at the engineering design stage that the appropriate level of detail is given to be able to evaluate the true impact of the stormwater management design. The land division process does not require the submission of an engineering design.</p> <p>It is unlikely therefore that change to the Development Plan through the Natural Resources module will provide enough of a mechanism to determine the outcome of WSUD in greenfield developments.</p> <p>Although Regulation 9 of the Development Act gives powers for councils to determine requirements for drainage and easements at the land division stage, planners involved at this level may not have the capability to give clear advice or make a valid judgment on these requirements. This is particularly so without engineering drawings. Requiring developers to complete engineering drawings at land division stage is not seen favourably by applicants due to timing and cost issues.</p> <p>By the engineering design stage which occurs after land division, it is often too late to change the cadastral boundary which is a significant method to provide for many WSUD techniques.</p> <p>It is understood that there are groups working to improve planning outcomes in response to WSUD targets within the 30 Year Plan for Greater Adelaide. These include a Climate Change, Housing Affordability and Sustainable Neighbourhoods Task Force to advise on mandating WSUD for new developments by 2013 without compromising housing affordability; and the AMLR NRM Board is leading a process to establish a business case for a capacity building program for WSUD with the EPA, DPLG, Institute of Public Works Engineering Australia and the Stormwater Industry Association.</p> <p>The City of Onkaparinga is keen to be consulted by these groups to achieve stronger WSUD outcomes.</p>

ACWQIP Reference: Strategy 1 - Reduce nutrient, sediment and coloured dissolved organic matter discharges through a range of measures	
Water quality levy	<p>The EPA may be interested to know that the City of Onkaparinga has a Water Quality Levy which is applied when a developer negotiates an alternative to the provision of water quality outcomes as part of engineering approval.</p> <p>As discussed, the development conditions that are applied at development approval stage generally require water quality outcomes consistent with our service level which is given as a standard Development Condition.</p> <p>If the developer considers that these water quality outcomes cannot be met, then the levy is imposed as a charge under section 188 1c of the LG Act where Council undertakes to do work to meet the water quality objectives at the developer's cost. The levy is paid by the developer into a reserve, which is then used in the provision of strategic water quality improvement works. This work may be undertaken at this site, nearby, or at another site.</p>
<p>ACWQIP Reference:</p> <p>Adopting WSUD will reduce additional impacts from greenfield development has been assumed for all greenfield developments but this will not achieve any of the required improvements in water quality.</p> <p>However, WSUD techniques can also be applied to all infill development and redevelopment, together with improved practices and design/operation of public spaces, to further reduce the impacts of Adelaide's existing metropolitan area on coastal water quality.</p>	
WSUD in existing built-up areas	<p>It is the Development Regulations determined by the State Government that control site coverage, rather than the Development Plan. The regulations allow for 60% site coverage for complying developments, whereas 35-40% is commonplace in residential areas in much of Australia and New Zealand. In addition, the 60% limit only applies to complying development, and development applications assessed on merit can potentially result in developments which exceed 60% site coverage.</p> <p>Given that accessways and other paved areas typically take up to 20-25% of site area, development can potentially occur that is dominated by hard impermeable surfaces, with a minimal landscaped surface. This may limit WSUD techniques to relying on storage/detention facilities to address stormwater management, rather than on-site permeable/landscaped areas.</p>

Table 3: City of Onkaparinga projects requiring further support to contribute to ACWQIP Strategies

ACWQIP Reference: Strategy 1: Reduce nutrient discharges	
Effluent management in Sellicks Beach and Aldinga Beach south	<p>Wastewater treatment in the Sellicks Beach area is currently managed by a community wastewater management scheme and onsite waste control systems. A significant number of these systems are failing with consequences for both public health and the health of groundwater, surface water and coastal waters:</p> <ul style="list-style-type: none"> • in winter when the ground is saturated, the wastewater runs off during rain events into stormwater systems and out to sea • wastewater leaches into groundwater • surface run-off affects the local environment including the Aldinga Scrub Conservation Park • the installation of onsite systems in the Silver Sands area is hampered by the high water table. <p>There are also incidents of residents emptying their systems illegally into the stormwater system, Council land and privately owned land.</p> <p>The <i>Australian Guidelines for Water Recycling: Managing Health and Environmental Risks Phase 1</i> clearly outlines the risks associated with failing on-site effluent management systems:</p> <p style="padding-left: 40px;">Failing systems can have a significant impact on the environment as they can contaminate areas that hold surface water and can leak excessive nutrients and bacteria into stormwater systems and in turn, into coastal waters.</p> <p>Our response</p> <p>In July 2007, the City of Onkaparinga engaged Finders University to conduct a survey of on-site effluent disposal systems in Sellicks Beach and in the area of Aldinga Beach south of Norman Road. The failure rate in the survey area was high mainly attributed to the impermeable soils in the area, overloaded systems and/or site area constraints. Of the 926 properties surveyed, almost half (45%) of the on-site wastewater treatment systems were deemed to be 'non-complying' and thus to have failed.</p> <p>The current CWMS is at capacity and cannot be modified to accommodate more connections as there is no readily available additional disposal path.</p> <p>Proposed solution</p> <p>The City of Onkaparinga has been active over many years in seeking a resolution to this issue and has concluded that a centrally managed and maintained sewerage system for this area is a viable and long term solution.</p> <p>The responsibility for the sewerage of Sellicks Beach and Aldinga Beach (south) rests with SA Water as it is within the metropolitan Adelaide urban boundary and therefore within the SA Water service area. Sellicks Beach township is identified as an area that will accommodate new growth as part of the 30 Year Plan for Greater Adelaide. This is reinforced as part of the prohibition of urban development in the surrounding rural areas under the draft Character Preservation (McLaren Vale) Bill 2011. Growth is currently constrained however due to the absence of a sewer which is limiting the development of housing and associated infrastructure.</p> <p>In sewerage the area, the functional, environmental and public health issues related to on-site or on-land disposal of effluent in Sellicks Beach would be removed, including the ongoing management problems that exist with on-site systems given the soil conditions known to exist in the area.</p>

ACWQIP Reference:

...as being one of four wetlands listed in the Directory of Important Wetlands in Australia'

Adelaide Coastal Water Study Recommendation:

Undertake an audit of key environmental assets in the southern metropolitan coastal region; identify risks to those assets and develop an integrated management plan to mitigate the risks.

Washpool Lagoon Aldinga Beach

The Washpool Lagoon and environs covers an area of around 91 hectares and is one of the last remaining coastal lagoons of its type along the metropolitan Adelaide coastline. It is habitat to migratory birds that are listed under the Japan Australia and China Australia Migratory Bird Agreements, supports several rare and threatened plants and is a culturally significant site to the Kaurna people.

Our response

The City of Onkaparinga has completed or is undertaking in 2011/12 a number of projects that are contributing to the health of the Washpool and the outcomes of the ACWQIP:

- the Aldinga Drainage scheme comprises a series of wetlands, basins and flood control works to ensure stormwater from the developing area of Aldinga beach is cleaned to a suitable quality, with flows detained to pre-European flows, before discharging into the Aldinga Scrub and ultimately into the Washpool. The work completed to date associated with the scheme is estimated at over \$3.5 million
- construction of a sedimentation basin on the Washpool tributary crossing Cox Road to reduce sediment loads reaching the Washpool and have a minor effect in delaying flows into the lagoon
- floodplain mapping of the Washpool and Silver Sands area will map the likely extent of inundation due to sea level rise as well as major flood events within the Washpool catchment. Modelling to assess the possible impact on water levels on the adjacent Silver Sands settlement from changes in weir/outlet/levee configurations around the Washpool
- as part of Water Proofing the South - Stage 2 investigations, there is potential to utilise surplus stormwater harvested from the Aldinga Beach area to contribute to the environmental water requirements for the Washpool. This option is dependent on a further detailed investigation and endorsement of the use of harvested water for environmental flows in lieu of other alternative water supply uses
- we are investigating expanding the definition of 'coastal' to include the Washpool and Onkaparinga River. This will be investigated as part of a Port Stanvac and Miscellaneous Coastal DPA.

Despite owning only a small part of the site, Council has played a leading role in co-ordinating planning efforts. The Washpool Lagoon Restoration Action Plan (2008) was developed and provides a detailed consideration of the rationale, feasibility and cost of a number of actions however Council has not been able to gain commitment from the other agencies who own the land to jointly fund the recommendations which total approximately \$5.5m.

The next step toward restoration of the area is to undertake detailed engineering designs to guide the implementation of site works.

This will require considerable investment and extensive community and stakeholder engagement. As there has been no commitment to fund the on-ground works Council resolved at its meeting on 4 May 2010 to place this project on hold until such time as sufficient external funding is achieved for project implementation.

Appendix 3: Summary of feedback from public comment in 2011

Table A: Combined summary of written, e-mail and online comments on Adelaide Coastal Water Quality Improvement Plan (ACWQIP) Spring 2011

Comments were provided from both individuals and people representing a broad cross section of groups including state agencies, local governments, NRM networks, and peak community groups. Agreements with the ACWQIP vision, majority of the environmental values (EVs) and eight strategies were provided by over two thirds of people who commented. Note that potential EV for marine based aquaculture has been removed based on a request for this to be done by PIRSA Aquaculture.

Rank	Summary of main issues and area of comment	Who comment was from	What action is being taken by EPA in updating ACWQIP	No. of comments
1	Good support of the ACWQIP indicated (note general support was implied by all who responded - there was not any comments of no support for ACWQIP)	SA Water, Local gov, NRM, peak community groups and individuals	The EPA assumes that from the spring 2011 comments on the ACWQIP that there is overall community, stakeholder and government support for the ACWQIP including the vision, EVs and eight broad strategies.	88
2	Comments on specific environmental values	PIRSA, SA Water, Local gov, NRM, peak community groups and individuals	Clear agreement with majority of the environmental values (EVs) was provided by over two thirds of those who commented both online and via the website. PIRSA Aquaculture requested the removal of the marine EV for aquaculture and this has been done both in the text and on the maps of the revised ACWQIP.	73
3	Specific comments regarding the vision	Local government, community groups and individuals	Several written comments were provided with suggestions for specific changes to the vision to make it read better. Forty-four people supplied further information regarding the vision via the online feedback process. Overall there was no disagreement with the vision.	72
4	Sediments (S) – support for more to be done to reduce sediment (and stormwater) impacts on coast (issue links to Strategy 1 and 2)	SA Water, Local gov, NRM, peak community groups and individuals	The ACWQIP supports this action. In securing resources for implementation of the ACWQIP, the aim will be to promote partnership projects with others to address the issue of sediment reduction for Adelaide's coast, particularly from stormwater and catchment activities.	23
5	Nutrients – included comments regarding needing to do more to reduce Nitrogen loads (N) discharged to coast and issues regarding costs for Penrice and SA Water in making the required reductions (issue links to Strategy 1 and 2)	SA Water, Local gov, NRM, peak community groups and individuals	The ACWQIP supports further reductions in N loads to the coast of 75% reduction from 2003 levels as per recommendation two of the ACWS. In securing resources for implementation of the ACWQIP the aim will be to promote partnership projects to address the issue of reduction of nutrients to the coast from industry, wastewater and stormwater.	20
6	Strategy 1 in ACWQIP re reduction of N, S, and CDOM from industrial, wastewater and stormwater discharges and encourage uptake of WSUD	SA Water, Local gov, NRM, peak community groups and individuals	The EPA will be looking to promote the implementation of strategy one as a priority strategy for the first phase of implementation of the ACWQIP. Most comments supported timely implementation of this strategy.	15
7	Need for adequate resourcing and funding for implementation of ACWQIP strategies	SA Water, Local gov, NRM, peak community groups and individuals	The EPA is addressing this issue through the establishment of a high level briefing group to agree on commitment to resourcing and funding for the implementation of the ACWQIP.	13

Rank	Summary of main issues and area of comment	Who comment was from	What action is being taken by EPA in updating ACWQIP	No. of comments
8	Focus on WSUD implementation in both new development, re-developments and infrastructure upgrades across whole metro area (issue links to Strategy 1 and 2)	SA Water, Local gov, NRM, peak community groups and individuals	The updated ACWQIP includes more links to the SA Stormwater Strategy and efforts to promote WSUD for development, re-developments and infrastructure upgrades across whole metro area. Partnership projects are needed (eg Australian Government, developers, local industry, local gov, NRM, community groups, and state government agencies) to encourage the uptake of WSUD across the whole Adelaide metro area.	12
9	Seagrass restoration and conservation important focus for benefits to ecosystem condition and some specifically indicated for fish habitat.	SA Water, Local gov, NRM, peak community groups and individuals	The EPA recognises that improving water quality is a key mechanism for achieving recovery of seagrass ecosystems and this idea is central to the vision, EVs and aims and strategies of the ACWQIP. Improving water quality and seeing the return of seagrass to the Adelaide's coastline will promote a more vibrant Adelaide with benefits for our environment, society and economy. Comments also identified carbon storage benefits for conserving and restoring seagrass and this has been included the updated ACWQIP.	10
10	Strategy 7 – need for further seagrass mapping and restoration work	SA Water, Local gov, NRM, peak community groups and individuals	As indicated for priority comment nine the EPA recognises that the focus on seagrass conservation and restoration is central to the vision, EVs and aims and strategies of the ACWQIP. Refer to other comments above regarding seagrass restoration and conservation.	9
11	More local government input needed to implement ACWQIP	SA Water, Local gov, NRM, peak community groups and individuals	The EPA has recognised the input provided by local government in the area of stormwater management in updating the ACWQIP and will be seeking further local government input and partnerships in the implementation phase of the ACWQIP.	9
12	Strategy -4 re need for integrated monitoring across agencies who are undertaking monitoring activities in Adelaide's coastal waters	SA Water, Local gov, NRM, peak community groups and individuals	Comments highlight the need for integration of monitoring across agencies for Adelaide's coastal waters. As part of the implementation of the ACWQIP the EPA will seek to facilitate sharing of relevant data and information for a more integrated approach to monitoring accumulative impacts in Adelaide's coastal waters.	9
13	Beach management issues	Local gov, NRM, peak community groups and individuals	The EPA recognises the links between having improved water quality and healthy seagrass with the community fully supporting EVs that value sandy beaches and good water quality for water contact activities – Aquatic ecosystems, Primary recreation, Secondary recreation, Cultural and Spiritual and Visual appreciation.	8
14	Desalination plant impacts	SA Water, Local gov, NRM, peak community groups and individuals	A section has been included in the ACWQIP regarding desalination in context of the impacts considered in the Gulf St Vincent Risk Assessment and also the findings of the ACWS regarding N and S causing the most harm to seagrass health for Adelaide's coast.	8

Rank	Summary of main issues and area of comment	Who comment was from	What action is being taken by EPA in updating ACWQIP	No. of comments
15	Strategy 2 – promotion of reuse of water (also links to comments above concerning S and N and will assist in achieving priority focus of ACWQIP under Strategy 1)	SA Water, Local gov, NRM, peak community groups and individuals	The EPA recognises that upgrades to wastewater treatment plants are very expensive and that where possible options should be explored to use more wastewater and stormwater. These are actions that are being followed up in work under Water for Good, with the development of the Stormwater Strategy and Blueprint for Urban Stormwater Management.	7
16	Port Environment – further water quality info needed to follow up on issues in Port waterways WQIP and other comments around need to further reduce N loads and other contaminants Port waterways	Peak community groups, local government, and individuals	The updated ACWQIP now refers to more water quality information presented in the Port waterways WQIP.	6
17	Climate change impacts on Adelaide's coastal waters and interaction with ACWQIP in terms of impacts on the coast and issues for carbon reduction and/or emissions	SA Water, Local gov, NRM, peak community groups and individuals	The EPA has recognised that in implementing the ACWQIP the costs and benefits of climate change impacts and issues for carbon storage and/or emissions need to be taken into consideration. In planning for the implementation of the ACWQIP further work may need to be done to address these issues for some actions.	6
18	Past development impacts across the Adelaide metro area and along the coast impact on stormwater issues today	SA Water, Local gov, NRM, peak community groups and individuals	In updating the ACWQIP the EPA recognises that past development impacts across the Adelaide metro area and along the coast impact on stormwater issues today and this adds an element of complexity in aiming for Adelaide as a water sensitive city. WSUD not only needs to be applied to new development, but all re-developments and upgrades of existing infrastructure. However changing the current built environment of Adelaide to use more WSUD is likely to take 20-30yrs to achieve improvements in water quality to a level that we see the return of seagrass.	6
19	Marine Parks	Local gov, NRM, peak community groups and individuals	Updated information has been included in the revised ACWQIP regarding Marine Parks and the adjusted boundaries for the Encounter Marine Park which now extends into the southern region of Adelaide's coastal waters.	6
20	Environmental flow impacts in Onkaparinga River and Estuary	Local gov, NRM, peak community groups and individuals	The section in the ACWQIP relating to environmental flows for the Onkaparinga River and Estuary has been updated.	5
21	Aquaculture potential in Adelaide's coastal waters	PIRSA, community groups and individuals	PIRSA and some community members did not support marine aquaculture for Adelaide's coastal waters. The potential EV for marine based aquaculture has been removed from the ACWQIP document and maps.	5
22	Recreational and commercial fishing benefits re ACWQIP implementation	Community groups and individuals	A number of community groups and individuals stated that there would be benefits for improved fish stocks and fish habitat by implementing the ACWQIP.	5
23	Dredging impacts	Local government, community groups, SA Water	The updated ACWQIP includes information regarding dredging activities and their impacts on Adelaide's coastal waters in context of the impacts considered in the Gulf St Vincent Risk Assessment and also the findings of the ACWS regarding N and S causing the most harm to seagrass health for Adelaide's coast.	4

Rank	Summary of main issues and area of comment	Who comment was from	What action is being taken by EPA in updating ACWQIP	No. of comments
24	Reef health	NRM, local government and SA Water	More information has been included in the revised ACWQIP regarding reef health.	3
25	Barcoo water	Local government and community members	Local governments and community members indicated that they would like more monitoring data to be available regarding the impacts of the Barcoo Outlet on the Adelaide coast. This has been done in the updated ACWQIP.	3
26	Strategy 6 – Establish planning and funding priorities for water initiatives across the Adelaide region	SA Water, PIRSA and community groups	This strategy is one that the EPA will follow up with the high level briefing group in seeking final agency commitment to the implementation of the ACWQIP.	3
27	Strategy 8 – Build community capacity to take action	NRM and community groups	Under this strategy it is recognised by those providing the comments and also the EPA that building the capacity of people across Adelaide to promote the uptake of WSUD fits within this strategy area. Additionally provision of broader information for the general public on water quality issues and what action they can take to improve water quality for Adelaide's coast also fits within this strategy area, and is already being done by some groups as various scales.	2
28	Links to Adelaide Dolphin Sanctuary	NRM	The text in the revised ACWQIP has been updated regarding the links to the Adelaide Dolphin Sanctuary Objective 3 for Water Quality.	1
29	Strategy 3 – Further investigate sources and volumes of sediment and CDOM	Comment from Steering Group member	The updated ACWQIP includes EPA view that there is a need to integrate information so that this strategy can inform what action can be taken to reduce sediment and CDOM loads from stormwater under strategy 1 & 2 (also relates to EPA responsibilities under Stormwater Strategy).	1
30	Strategy 5 – modelling	Comment from Steering Group member	The updated ACWQIP indicates the EPA as the lead agency for promoting integration of information for this Strategy. This position has been included in the revised ACWQIP.	1
31	Endocrine disruptors – potential area for further investigation	NRM	Some information on endocrine disruptors and this potential area for further investigation has now been included in the revised ACWQIP.	1

Table B – Source of written comments on ACWQIP provided in spring 2011 with links to feedback information provided by EPA

Please contact the EPA (ph. 8204 2004) if you are interested in more detail about specific written comments on the ACWQIP.

No.	Agency/Group	Main topic of comment	Email – sent with feedback table	Letter – sent with feedback table
1	Department of Environment and Natural Resources	Reef health references	Yes – Response 1	
2	Port Adelaide and Enfield Council	Port River water quality		Yes – Response 2
3	EPA WQ Branch, Healthy Waters group	Need for simpler and clearer info in Exec summary and intro	Yes – Response 3	
4	EPA WQ Branch, Urban water catchments group	Update of links to relevant WSUD and stormwater strategy and planning info	Yes – Response 4	
5	Member of South Port Noarlunga Coastcare Group/South Port Surf Life Saving Club	Environmental flows in the Onkaparinga Estuary		Yes – Response 5
6	Port Adelaide Art Supplies	Port River water quality and impacts of development		Yes – Response 6
7	School of Earth and Environmental Sciences, Geology	Need to link to sediment and CDOM research in more detail		Yes – Response 7
8	Department of Environment and Natural Resources	Links of ACWQIP monitoring to beach profile monitoring that has been done	Yes – Response - 8	
9	Onkaparinga Estuary Water Quality Group	Environmental flows in the Onkaparinga Estuary		Yes – Response 9
10	PIRSA Fisheries and Aquaculture	Not supportive of potential environmental value of marine aquaculture for Adelaide Coastal Waters	Yes – Response 10	
11	Member of Friends of Gulf St Vincent	Supportive of ACWQIP, but would like to see more happening for water quality improvement in area of WSUD		Yes – Response 11
12	President of Western Adelaide Coastal Residents Association Inc.	Supportive of ACWQIP, but would like to see clear funding support for implementation		Yes – Response 12
13	Secretary SARFAC	Areas of concern included Adelaide Desalination Plant impacts and environmental impacts of Christies Beach Wastewater Treatment Plan		Yes – Response 13
14	City of Onkaparinga	Supportive of ACWQIP, but want to ensure linkages to relevant local government information and activities that relate to improving coastal water quality are included in updated ACWQIP		Yes – Response 14
15	Department of Sustainability, Environment, Water, Population and Communities	Specific information regarding update to information relating to National Water Quality Management Strategy and clarity on information and overlaps with Port waterways work.		Yes – Response 15
16	EPA Regulation and Compliance	Question regarding reporting on Nitrogen or Ammonia for Penrice discharge in ACWQIP	Yes – Response 16	

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17	SA Health	Request to remove incorrect information regarding Department of Health activities	Yes – Response 17	
18	Chief Executive, SA Water	Supportive of ACWQIP, but had identified a number of editing changes to be made		Yes – Response 18
19	Department for Water	Supportive of ACWQIP and keen to see group set up to support implementation		Yes – Response 19 combined into 26
20	Adelaide and Mount Lofty Ranges Natural Resources Management Board	Supportive of ACWQIP, but had identified a number of editing changes to be made		Yes – Response 20
21	Chief Executive, City of Charles Sturt	Supportive of ACWQIP, but had identified a number of editing changes to be made and put forward some recommendations regarding including more local government information		Yes – Response 21
22	PIRSA Fisheries and Aquaculture	Removal of marine aquaculture EV		Yes – Response 22
23	Port Adelaide Residents Environment Protection Group	Port River water quality and impacts of development		Yes – Response 23
24	Conservation Council of South Australia	Climate change impacts and costs relating to ACWQIP		Yes – Response 24
25	Local Resident in City of Victor Harbor	Need for greater use of stormwater and wastewater		Yes – Response 25
26	Chief Executive, Department of Environment and Natural Resources	Supportive of ACWQIP for seagrass ecosystem health, correction to be made content re Adelaide Living Beaches		Yes – Response 26
27	Department of Planning, Transport and Infrastructure (formerly DTEI)	CDOM and sediment monitoring information to link more to actual stormwater management at local level	Yes – Response 27	
28	Secretary, Friends of Gulf St Vincent	Resourcing for implementation of the ACWQIP and need for more integrated monitoring		Yes – Response 28
29	Department of Planning, Transport and Infrastructure (formerly DPLG)	Ensure that links to SA Strategic plan and relevant other planning information is updated		Yes – Response 29
30	Coast Protection Board	Supportive of ACWQIP for seagrass ecosystem health, correction to be made on content for Adelaide Living Beaches		Yes – Response 30
31	City of Holdfast Bay	Supportive of ACWQIP and put forward some recommendations regarding including more local government information and linking more with local government for water quality work		Yes – Response 31

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