



Lake Warden Catchment.

PHOTO: South Coast NRM.

SOUTHERN PROSPECTS 2011-2016

Water

WATER

This section describes the importance of our water based assets on the management of natural resources. The main components of the Water theme are described and factors affecting these assets are discussed. Aspirations (25+ years), Goals (10+ years) and Outcomes (one to five years) are outlined in a Program Logic Summary (See section 7.6).

ASPIRATION: *South Coast rivers, estuaries, wetlands and water resources are recognised as precious and are maintained, protected, and/or restored with social, cultural, economic and ecological values recognised and embraced.*

7.1 Principles

The principles which guide our approach to management of water resources are:

- sustainable and efficient use of water resources for community and the environment, with waste minimisation
- condition of rivers, estuaries and wetlands are maintained and/or improved through best management practices.

In this section, the issues related to management of water resources are described and goals and outcomes are outlined.

Water resources include waterways as well as resources for public and private water supplies. The term 'waterways' includes all rivers, tributaries, estuaries and wetlands. Marine waters are included in the Coastal and Marine theme. There are issues and actions that relate to the Biodiversity theme that will also be relevant for protection and management of water resources. Similarly, there are catchment management issues addressed under the Land theme that will contribute to the health of waterways and water supplies.

Liaison with stakeholders and reference to key documents have guided the preparation of the water theme chapter, including:

- Water Resources in the South Coast region. Background Paper 4 (Gunby et al., 2004)
- Ecological Values of Waterways in the South Coast Region, Western Australia (Cook et al., 2008)
- Southern Prospects Status Report - 2010 (South Coast NRM, 2010)
- Lower Great Southern Water Resource Development Strategy (Department of Water, 2010b)

- Western South Coast Water Resources Assessment (Department of Water, 2010a)
- various management plans for estuaries and wetlands.

7.2 What we know – values and threats

The South Coast NRM Region includes 107 rivers or major tributaries, 33 estuaries and more than 300 Conservation Category wetlands. Ground water resources are particularly significant as they perform essential ecological services and provide water for human consumption. It is likely that additional assets have been included in the region through boundary changes and increased knowledge of water resources.

Water resources have extremely significant ecological, social and economic value for the South Coast community as they provide water supply, recreational activities (including boating, commercial fishing, tourism and amenity). Agriculture contributes significantly to the economic wellbeing of the region and its continuation, growth and diversification is dependent on water availability (Gunby et al., 2004). The region's estuaries provide an important commercial fishery as well as opportunities for tourism and recreation. Other industries are dependent on water available from the coastal groundwater reserves and the expansion of industry is dependent on the future use of surface freshwater in the western part of the region (Gunby et al., 2004).

The natural water systems of the region are of central importance to Aboriginal spirituality, culture and identity, and all water sources have the same important value (Goode et al. 2008). Many



PHOTO: South Coast NRM.

Our knowledge of river values has increased significantly.

people value water resources because of its use for consumption or production or because of where it is its natural place for recreation, tourism, landscape, aesthetic, educational, scientific, heritage and historical social values.

A third of the 45 watercourses between the Deep River and Cheynes Bay streams were rated as having high social values when assessed as part of the Water Resource Assessment (Department of Water, 2010a) with the Frankland, Denmark, Kalgan and Waychinicup rivers scoring highly across multiple categories. Rivers with high social values tend to be large rivers in close proximity to a settlement, which are easily accessible and have historic significance and facilities for recreational use.

Our knowledge of the values of the rivers, tributaries, estuaries and wetlands of the region has significantly increased in the last five years, largely due to the identification of knowledge gaps in the previous NRM strategy and subsequent implementation of research, planning and implementation of projects.

Knowledge and base line information has been established through surveys of:

- wetlands, rivers and estuaries to classify their environmental, cultural and social values

- wetlands, rivers, estuaries and foreshores with generation of information regarding environmental condition and values. Determination of river habitat values (with habitat mapping) has provided a greater understanding of ecological values.
- estuaries (evaluation and mapping of sea grass, fish habitat and other fauna communities).

Monitoring programs (new and ongoing) in estuaries, wetlands, and rivers have provided information on species diversity and abundance, water chemistry, hydrology, nutrients and sedimentation.

7.2.1 Rivers

Two broad aquatic bioregions have been identified for river systems in the South Coast region:

- Western South Coast, from Gardner River in the west to Bluff River
- Eastern South Coast, from the Pallinup River through to the Thomas River in the east, based on a hierarchical classification using a comparative assessment of the ecological values of selected rivers across the region (Cook et al., 2008).

Rivers belonging to the eastern South Coast aquatic bioregion receive less rainfall, are significantly more

saline, slightly more alkaline, and have higher levels of total nitrogen than those belonging to the Western South Coast aquatic bioregion (Cook et al., 2008). Rivers of both aquatic bioregions have similar levels of turbidity, dissolved oxygen and total phosphorus levels.

The diverse river characteristics (e.g. hydrology, geomorphology, catchment size and vegetation cover) reflect the different management requirements across the region.

Hydrological flow and ambient water quality monitoring is undertaken at 55 river gauging stations on 40 river systems distributed across the South Coast region. Monitoring data are used for resource assessment and management, trend analysis, infrastructure design, floodplain mapping, model calibration, understanding catchment processes and detecting effects of changing climate. Several catchments are not monitored at present. Additional targeted resources and monitoring is required to calibrate and support catchment models, to understand water quality characteristics of water systems into the future and to determine if the condition of these resources is improving or deteriorating.

Additional physio-chemical water quality monitoring has focused on water systems in the Princess Royal and Oyster Harbours, Wilson Inlet and Torbay Inlet catchments (for nutrient monitoring) and the Kent and Denmark River catchments (for salinity monitoring). Information gathered is used to gain knowledge of the nutrient and salinity status within these catchments and to measure whether nutrient

and salinity reduction targets are being met in accordance with the catchment management plans.

A number of macro invertebrate species are considered to be characteristic of each of the two bioregions, with differences observed in the presence and abundance of particular species of amphipods, mayflies, stoneflies, caddis flies, dragonflies and damselflies (Cook et al., 2008). Average total macro invertebrate species richness is significantly higher in the western South Coast bioregion than the eastern South Coast bioregion, with the Frankland Gordon, Kent, Hay and Marbelup systems 'hotspots' in the western bioregion and Bremer and Phillips West Rivers 'hotspots' in the east (Cook et al., 2008). There are a number of taxa which can be used as 'indicators' for river health in western and eastern South Coast bioregions.

The South Coast region's waterways are home to number of endemic species found only in southern WA, including rare species that have narrow distribution ranges. Special macro invertebrate fauna include amphipods, freshwater crayfish, mayflies, stoneflies, caddis flies, dragonflies, freshwater mussels and fresh-water limpets. A number of new species have been identified (Cook et al., 2008), including four macro invertebrates (an amphipod, an isopod, a caddisfly and a bivalve). The known ranges of a number of species, such as the western swamp emerald dragonfly, and the koonac were extended.

Biological studies have been limited to snapshot surveys; there is no ongoing biological monitoring of rivers. Knowledge of aquatic flora is limited and additional macro invertebrate sampling is needed

The Denmark River catchment has been monitored for water quality, and its impact on Wilson Inlet.



PHOTO: Vennessa Sykes.



to clarify the delineation of the western and eastern bioregions between Bluff and Pallinup rivers (Cook et al., 2008). Key waterways including the Lort, Hamersley, King Creek, Angove River, King River and a number of smaller systems remain unsampled (Cook et al., 2008).

Ten species of native freshwater fish have been found in the South Coast region. The rarest include Western Trout (or Spotted) Minnow, Salamander fish, Balston's Pygmy Perch and a new undescribed species of Pygmy Perch from the Mitchell River near Denmark.

When river naturalness, diversity and rarity were considered together to obtain an overall assessment of ecological value, the top three in the western bioregion were the Shannon, Deep and Gardner Rivers and the top three in the eastern bioregion were the Bremer, Oldfield and Jerdacuttup Rivers (Cook et al., 2008).

A framework for prioritising waterways for management in WA is being developed to allow for a more detailed assessment of ecological values as undertaken in the study of South Coast river systems (Cook et al., 2008 and Department of Water, 2010b). A matrix plotting these ecological value scores against threatening processes for each river system is likely to be a useful tool for prioritising management responses.

The *Framework for the Assessment of River and Wetland Health* (FARWH) provides a standard approach for reporting health of rivers and wetlands nationally. The South West WA (SWWA) FARWH trials determined indicators within six ecological themes representing river health: catchment disturbance, physical form, fringing zone, hydrology, water quality and aquatic biota. The indicators reflect health status and have increased resource knowledge and scientific understanding of the ecology of SWWA aquatic systems. A robust river condition assessment tool has been developed to suit different Western Australian regions while still allowing assessment and comparisons at a national level.

7.2.2 Catchments and land use

There are 24 rivers with more than 89% of their catchments still under native vegetation cover. Three of these (Forth, Saint Mary and Dempster Rivers) have been identified as Priority One 'Wild Rivers'. Doggerup Creek, Blackwater Creek, Shannon River, Deep River and Inlet River have been assigned a Priority Two rating (Department of Water, 2009).

The upper catchments of three other rivers (the Oldfield, Young and Lort) are also substantially uncleared and have high environmental values. At the other end of the spectrum, 16 rivers have more than 80% of their catchments cleared, and as a consequence have very substantially modified hydrology, often associated with increased sedimentation, erosion and increased turbidity and nutrient levels in their estuaries.

Catchment clearing and altered land use resulting in changed hydrology and increased salinity levels are major threats to rivers in the region, and can be associated with increased erosion, sediment transportation, and altered turbidity and nutrient levels. Other threats include loss of riparian vegetation (including through unmanaged livestock access), nutrient enrichment, unmanaged recreational use, pollution from rural and urban land uses, over-extraction of limited freshwater and physical alteration to river banks, channels and floodplains, and inappropriate development in riverine and estuarine floodplain areas. Diversity, species richness and rarity scores are considered better predictors of total ecological value compared to measures of naturalness (e.g. native vegetation remaining) (Cook et al., 2008).

The way land is used affects the amount of water available and its quality. Hardwood plantations such as Blue Gums (*Eucalyptus globulus*) intercept precipitation, reduce soil moisture content and lower groundwater levels resulting in reduced streamflow and less recharge to groundwater systems compared to annual agricultural crops. Tree plantations also have beneficial effects on water levels especially in salt affected catchments. Computer modelling has predicted streamflow and salt load reductions under various land use regimes (including plantations) in the Denmark catchment under various future climate scenarios and monitoring data has confirmed the predicted salinity reductions (Department of Water, 2004). Farm dams and other infrastructure such as interception drains also reduce runoff and diminish streamflow. Understanding the influence and relative impact of tree crops and infrastructure on hydrology will allow for more informed land management and water planning.

7.2.3 Estuaries and inlets

Of the region's 33 estuaries and inlets, most are generally closed and only open to the Southern Ocean after heavy rainfall events or high seasonal water levels. Manual bar openings occur in some locations.

Only four small estuaries and their catchments occur entirely within national parks and can be considered 'pristine' (the Dempster and Saint Mary within the Fitzgerald River National Park, and Jordnee and Poison Creeks within the Cape Arid National Park).

Quarterly monitoring of physio-chemical status has been undertaken by Department of Water in eight estuaries including the Oldfield Estuary, Hamersley Inlet, Gordon Inlet, Wellstead Estuary, Beaufort Estuary, Wilson Inlet, Parry Inlet and Walpole/Nornalup Inlets since 1998. The suite of estuaries monitored was extended in 2006 to include five additional estuaries: Bandy Creek Harbour, Stokes Inlet, Culham Inlet, Princess Royal and Oyster harbours. Water quality monitoring enables the condition of the estuaries to be tracked. A matrix based on five water quality indicators; chlorophyll-a, dissolved oxygen, algae bloom events, fish kill events and catchment inputs of dissolved inorganic nitrogen is used to describe and compare the condition of the waterways.

Seagrass decline, algal growth and nutrient sources have been extensively studied for the Albany harbours, especially from 1988 to 1990. Seagrass mapping has been conducted in the Harbours approximately every four years between 1962 and 2006 and percentage cover of seagrass species has been compared. This is the first system in Australia to document increases in seagrass coverage.

Environmental Water Requirement (EWR) studies have been undertaken for the Wilson and Torbay Inlets, Lake Powell and Manurup Lagoon (Close & Donohue, 2008; Strehlow & Close, 2007a, 2007b). These studies have attempted to quantify the amount of water that could be harvested from these systems without unacceptable impacts on the environmental, social and economic values. Inclusion of estuaries in the EWR process is an Australian first.

Climate change scenarios predict a rise in height of wave-dominated estuary bars, less frequent openings, and shallower estuaries with greater sediment movement, less river flow and possibly more erratic delivery of flow, stronger salt wedge further upstream, increased low oxygen events, increased productivity therefore increased algae bloom events and fish kill events. Possible impacts of climate change need to be investigated as there are gaps in our understanding of implications of habitat modification and the likely impacts on diversity and fisheries (D'Souza et al., 2010).

7.2.4 Wetlands

Baseline and spatial information has been greatly increased across the regions for wetlands across the region, including:

- greater accuracy for location and boundaries of significant wetlands
- information about 15 previously unidentified wetlands
- development and implementation of wetland management plans for 8 Regionally significant wetlands suites
- flora and fauna lists for many wetlands
- development of indicator species for determining wetland health
- improved understanding of ecological functioning of wetlands
- datasets of wetland ecology and condition
- classification of wetlands based on improved assessment methodology of wetland values
- identification of the cultural significance of wetlands for Aboriginal people
- increased community awareness of the functions of wetlands and their susceptibility to environmental change
- increased protection of wetlands through impact assessment and management planning
- assessment of the conservation status of water assets (i.e. those poorly represented in the conservation reserve system).

Wetlands of International Significance (under the Ramsar Convention) in the region include lakes Gore and Warden and part of the Lake Muir system. Lake Warden is a Biodiversity Recovery Catchment and revegetation, monitoring and hydrology studies have been undertaken. An additional 11 wetlands systems are listed in the *Directory of Important Wetlands in Australia* (Environment Australia, 2001) and 15 systems are on the Register of the National Estate. About 300 wetland systems have been identified as being in the Conservation Category (as defined by the *Environmental Protection [South Coast Agricultural Zone] Policy 1997*) but only broad scale surveys and classifications have been undertaken.

The *South Coast Wetland Monitoring Program* has produced snapshot reports describing individual wetlands, their salinity, nutrient and macro-invertebrate characteristics (Calvert & Randall,

2008). The state of wetlands across the region is better understood and threatening processes have been more clearly identified (including secondary salinisation, increased runoff, hydrological changes and acidification). Monitoring has been an essential tool to assist with wetland and water resource planning to protect and conserve these assets.

Wetland mapping, classification, and evaluation of the condition of wetlands close to urban areas where development pressure and groundwater resources exist has been undertaken in priority areas of Albany, Hopetoun and Esperance. Definition of precise wetland boundaries and social and economic values has been used in guiding wetland management planning and future land use development planning. Bremer Bay is a growing community with potential future demands for water resources and development and this area would be the next priority for wetland mapping and classification.

Aquatic invertebrates are increasingly being recognised as critical indicators of wetland health due to their importance to processes such as sediment biochemistry, nutrient and carbon cycling and controlling phytoplankton. They also constitute the primary food resource for most of the migratory waterbirds that give wetlands international significance (Pinder et al., 2010). Aquatic invertebrate communities are being monitored in the Ramsar wetlands of Lake Warden and Gore system to guide responses to present and future management actions.

Changes to hydrology as a result of clearing and/or climate change are considered to be the most significant threats to the region's wetlands, which are compounded by increased salinity levels, clearing of the wetlands (e.g. grazing), inappropriate drainage, nutrient enrichment, invasion by weeds and over-extraction of water for supply purposes.

7.2.5 Water resources

In terms of water supply, the most significant resource issue is identifying and securing future public water sources for public drinking water supplies, industry and agriculture without detrimental impact on the environment. Demand for water is growing beyond the capacity of current resources, especially in light of declining rainfall in the western part of the region (Coffey Environments et al., 2009).

To make decisions about future water supplies, we need to have in depth understanding of water

resources (e.g. groundwater), social values, the ability of the source to sustain use, the extent of ecosystems dependent on the water resource and volumes of water likely to be required. This knowledge, with community consultation will provide a sound basis for public water planning for the short, medium and long-term.

The *Western South Coast Water Resources Assessment* (Department of Water, 2010b) has collated information on likely water sources in the western South Coast region, assessed their social, cultural and environmental values, and considered demand and impacts of climate change and land use. The region contains limited fresh groundwater, with the exception of coastal quaternary aquifers (sand dune aquifers), which provide critical supplies for Albany, Bremer Bay, Hopetoun and Esperance. In other areas, groundwater resources are either poorly known or are of limited extent and quality. Future planning and management needs to have a strong focus on management of wastewater discharge, water use and conservation (e.g. residential, agricultural and industrial) and management of increase in demand (especially for industrial uses).

Planning activities for sustainable water supply in the Lower Great Southern (Walpole, Denmark, Albany and Mt Barker) have included the publication of *Water Forever: Lower Great Southern* (Water Corporation, 2010) which seeks community and industry input about securing water services in the future. The challenge for the whole region is to provide water for people and the environment in an even drier climate, with twice as many people and with less environmental impact. To meet these challenges, government agencies need to work with

The challenge for the region is to provide water in a drying climate.



PHOTO: South Coast NRW.



PHOTO: Jenelle Carter.

Lake Warden, Esperance.

the community to reduce water use, increase water recycling and develop new water sources.

The *Lower Great Southern: Water Resource Development Strategy* (Department of Water, 2010b) explains the planning process and principles against which new water source proposals will be assessed. The objectives for water source planning are to assist responsible development, improve supply security and provide guidance for developing water sources. To complement this strategy, a *Great Southern Water Plan* is being developed for water resources.

Drinking water source protection plans have been prepared for most drinking water sources in the South Coast NRM Region with additional plans being produced annually.

The Kent and Denmark rivers were designated Public Water Supply Recovery Catchments under the WA Salinity Action Plan. Revegetation and high water use farming systems were implemented in these catchments with the aim of reducing salinity levels in the rivers. Results indicate that it is unlikely water quality will be improved in the Kent River in the medium term. However, salinity in the Denmark River is reduced and it is likely to be classified as fresh before 2020 (Bari et al., 2004; Department of Environment, 2004, Department of Water, 2010a).

Environmental Water Requirement studies have been undertaken in the Angove River (Water Corporation, 2010), Wilson and Torbay Inlets (Strehlow & Close, 2007a), wetlands within the Torbay catchment (McKay et al., 2008), Marbelup Brook (Strehlow & Close, 2007b) and Denmark River (Close & Donohue,

2008). These studies have attempted to quantify the amount of water that is required to prevent unacceptable impacts on the environmental, social and economic values of these systems.

Urban stormwater management initiatives have been developed to provide guidance on improved stormwater design and management, including capturing stormwater for reuse, preparing and implementing stormwater management plans and engaging stakeholders and community for optimal outcomes (Department of Water, 2004; Western Australian Planning Commission, 2008).

7.2.6 Climate change

Climate change will alter the dynamics of surface and ground waters, and plant and animal requirements for water. These changes will affect aquatic species and many other species dependent on rivers, wetlands, floodplains and groundwater for food, water or habitat (Dunlop & Brown, 2008). Reduced rainfall in South West Australia will result in reduced inflows into water storages, reduced stream flows in major catchments, and reduced recharge of groundwater. Associated indirect impacts of increased temperature and reduced rainfall include increased risks of algal blooms, changes in the salt loads in streams and possible changes in ecological water requirements. Already, there is a great deal of variability in seasonal rainfall which has led to inconsistent drying and wetting of resources such as wetlands.

The relationship between rainfall and stream flow is non linear. The 10 to 20% decline in rainfall in the South West of Western Australia since the 1970s is associated with a 40-50% reduction in stream flow into Perth Reservoirs (Sadler, 2002; Morgan et al., 2008), which has significantly impacted on surface and groundwater resources. The reduced stream flow led to increased utilisation of groundwater (Sadler, 2002), a situation that has the potential to increase pressure to groundwater dependent parts of the South Coast region.

Halse et al., (2003) has predicted that within 100 years about one third of aquatic freshwater invertebrates and a similar proportion of halophytic invertebrates will disappear from wetlands in the Western Australian wheatbelt. Catastrophic losses of aquatic plants (Davis et al., 2003) and waterbirds are also predicted for the Western Australian wheatbelt (Cale et al., 2003).



7.3 Achievements

The following provides a short summary of achievements for the Water theme (a more complete description of achievements has been compiled in a status report [South Coast NRM, 2011]):

- projects such as Watershed Torbay prepared a collaborative and comprehensive restoration plan for the Torbay catchment which is now being implemented. The project is based on community involvement, creating a vision for the future, sourcing information, implementing restoration plans, monitoring and evaluation.
- regional classification of wetlands across the region contributed to baseline information on status and condition and helped to determine priority issues for resource condition management. Includes identification of ecological values, surveys, management plans and identification of indicator species. Evaluation methodology was developed to guide assessments. Results have been used to guide land use planning and management. Maps and datasets have been attributed.
- the Western South Coast Regional Assessment examined ecological and social water requirements in the western part of the region and provides information which can be used make management decisions relating to groundwater and surface water resources. This project was pioneering as it developed new methodologies for data collection and evaluation and provided new information and findings.
- forty one wetlands have been sampled by the Department of Water in liaison with other NRM stakeholders since 2006. The South Coast Wetland Monitoring Program produced 54 snapshot reports describing individual wetlands, their salinity, nutrient and macro-invertebrate characteristics (Calvert & Randall, 2008). Thirteen wetland management plans have been prepared by Green Skills in collaboration with other NRM groups.
- management plans (protection plans, allocation plans and general management plans) have been developed and implemented for priority catchments, wetlands, estuaries, rivers, public water sources, and for water allocation. Baseline and other information have been used for plan development, priority setting and subsequent on-ground implementation actions.
- management plans prepared for Wellstead Estuary, Culham and Stokes inlets are now being implemented.
- the 'Ecological Values of Rivers' project delivered assessments identifying values of 31 rivers, and hotspots for endemism and biodiversity. Other outcomes included production of methodology DVD, creation of 'Living Rivers' website and community engagement through workshops.
- rivercare projects including foreshore assessments and river action plans for Yerritup Creek, Upper Hammersley River, the Walpole Nornalup coastal creeks, Steere River and Coramup Creek
- development of tools, support, provision of resources for on-ground actions and the implementation of management plans has been provided in key areas (e.g. fencing vegetation, revegetation, rehabilitation, stream crossings and stock watering sites, surface water drainage, establishment of perennial pastures (Master et al., 2011) and tools to understand nutrient balances on farms)
- project officers and other stakeholders from across the region have participated in training relating to the use of the uniDap WaterQ Solution which is an online database to assist community groups and NRM stakeholders in the management of water related data. The initiative is being delivered as part of the Bureau of Meteorology project Modernisation and Extension of Hydrological Monitoring Systems.
- a study to examine the effects of blue gum plantations and other land uses on water quality was undertaken in the Marbelup Brook catchment
- sediment geo-chemistry has been studied in Walpole/Nornalup, Wilson Inlet, Wellstead Estuary, Gordon inlet and Beaufort Inlets. This has provided a better understanding of nutrient fluxes between the sediment and water column. Sediment coring and dating undertaken in Stokes Inlet and Wellstead Estuary has enhanced understanding of sedimentation threats and processes in these systems.
- the relationship between dissolved oxygen and salinity in estuaries is better understood as a result of recent studies in Wilson Inlet. Dissolved oxygen loggers provide real-time data demonstrating how the increase in seawater in the estuary as a result of bar openings affects dissolved oxygen levels and nutrient availability in the water column.

- seagrass distribution has recently been mapped in Wilson Inlet and compared with previous studies (Calvert, 2008). An underwater towed video method was trialled in Walpole/Nornalup Inlets, Irwin Inlet, Wilson Inlet, Wellstead Estuary, Beaufort Inlet and Stokes Inlet to measure submerged aquatic vegetation, and this proved to be an effective and time-efficient way of determining extent.
- benthic invertebrate monitoring has commenced on a quarterly basis in the Walpole-Nornalup Inlets, as part of the marine park management by the Department of Environment and Conservation.
- fish of the near-shore shallows and deeper waters offshore of the estuary basins and main tributaries have been studied in six South Coast estuaries including Broke, Irwin, Wilson and Stokes inlets, Oyster Harbour and Wellstead Estuary (Chuwen et al., 2009). The study showed that environmental characteristics of estuaries on the South Coast differ markedly, even amongst those with the same opening characteristics. Information has been presented in two volumes, with a community report.
- new management plans for Stokes and Culham Inlets have been prepared, and new community based governance arrangements have been put in place. The implementation of these plans, as well as the existing plans for the Torbay waterways, Albany Harbours, Wilson Inlet and Wellstead estuary have been initiated.
- water resource initiatives in areas across the region include:
 - a reduced sprinkler roster to reduce total water consumption
 - winter sprinkler bans
 - awareness raising about water efficiency through information exchange sessions
 - ‘Seek a leak week’ has been introduced to encourage people to test for water leaks in their homes
 - rebates and incentives for rainwater tanks and water recycling.

7.4 Current community capacity

Understanding and awareness of waterways, their values and management has improved through a host of different activities including Rivercare activities, school education activities and a tertiary-level unit on waterways which is available at UWA within the region.

Significant technical support for waterway and other community monitoring, planning and management activities is provided by the Department of Water, community organisations and tertiary institutions with skilled personnel in the region.

Good capacity exists, with a number of active catchment groups, estuary advisory committees and management groups contributing to planning and implementation of river and estuary plans. Resources for implementation of catchment and estuary plans, including technical and administrative support are needed to continue community-based management initiatives.

Wetland mapping and monitoring has been undertaken in the region, but data and protocols need to be aligned with State-level processes. Various stages of wetland value identification, condition evaluation and management planning has been undertaken. A review of existing knowledge, development and prioritization of management responses and implementation of recommended actions is required.

7.5 Gaps

The following gaps have been identified:

- monitoring of water resources needs to be funded and undertaken, with data used to undertake adaptive management. The community and interested organisations could be involved in this process.
- baseline information for threatening processes across the region (e.g. invasive species and information relating to climate change)
- need for better understanding and management of groundwater systems
- some key water systems still need to have management plans prepared (e.g. Parry’s and Irwin Inlets)
- continued implementation of existing management plans for wetlands, estuaries and water courses
- promotion and innovation in water use efficiency, conservation and re-use and waste reduction
- assessment of Environmental Water Requirements for the Albany and Esperance Groundwater Areas and development of allocation strategies
- development of a surface water management plan for the Albany coastal area.



7.6 Program logic summary – Water

ASPIRATIONS (25+ YEARS)

South Coast rivers, estuaries, wetlands and water resources are precious and maintained, protected, and/or restored with social, cultural, economic and ecological values recognised and embraced.

- Maintained and/or improved condition of low impacted ('near pristine') and impacted ('degraded') wetlands, waterways and estuaries
- Protected and/or improved habitats, ecological function and biodiversity of rivers, estuaries wetlands and their foreshores
- Prevented or minimised degradation (eutrophication, erosion, sedimentation, salinisation and changed hydrological regimes) of waterways
- Identified and protected regionally, nationally and internationally significant wetlands
- Improved understanding and awareness of the values, attributes and management needs of wetlands and waterways
- Maintained and/or improved quality and improved sustainable, efficient use of water resources
- Maintained and/or improved recreational, cultural, commercial (including fishing) and social amenity values of estuaries, rivers and foreshores.

GOALS (10+ Years)

Goal W1. Waterway health (low impacted ('pristine') rivers, estuaries and wetlands) Maintain and/or improve values and reduce threats to low impacted water resources by 2030 using quantifiable targets reviewed by 2012.

Goal W2. Waterway health (impacted ('degraded') rivers, estuaries and wetlands) Maintain and/or improve values and reduce threats to priority impacted rivers, estuaries and wetlands by 2030, using quantifiable targets reviewed by 2012.

Goal W3. Water resources (surface water and ground water resources) Maintain and/or improve the condition of water resources through sustainable, efficient use and management to provide water for environmental requirements while meeting the needs of the community and commercial use, by 2030, with quantifiable targets reviewed by 2012.

OUTCOMES (1-5 Years)

MEASURES AND MONITORING

Outcome W1. Increased understanding Increased understanding of water assets by maintaining, supporting and/or expanding a water asset monitoring and research program to inform management actions at priority areas using appropriate protocols and indicators by 2012.

Outcome W2. Sustainable social use Increased understanding of recreational, cultural, commercial and social amenity values of estuaries, rivers and foreshores and the application of these values to sustainable management actions by 2012.

Outcome W3. Climate change adaptation and mitigation Identify priority water assets at risk from effects of climate change and associated threatening processes protected by the implementation of adaptive management responses by 2015.

OUTCOMES (1-5 Years) (continued)

ON GROUND ACTIONS

Outcome W4. Improve condition – impacted ('degraded') waterways Maintain and/or improve condition of priority threatened rivers, estuaries and wetlands with management planning and implementation of best management practices and on ground works at 25% priority and/or representative systems by 2015.

Outcome W5. Protect condition – low impacted ('pristine') waterways Maintain and/or improve condition of high value, less threatened rivers, estuaries and wetlands with management planning and implementation of best management practices and/or on ground works at 25% priority and/or representative systems by 2015.

Outcome W6. Protect wetlands Maintain and/or improve the value, level of protection and condition of internationally, nationally and regionally significant wetlands by 2015, with quantifiable targets set based on management plans by 2012.

Outcome W7. Improved urban and rural water management Reduce impacts from urban, commercial and agricultural sources on water assets across the region with the implementation of adequate management responses and best management practices by 2015.

Outcome W8. Control invasive species Reduce the impacts of invasive species in priority riparian zones (including aquatic weeds, feral fish, invasive weeds, feral animals and disease) by the implementation of best management practices by 2015.

Outcome W9. Improve Water Use Efficiency Improve community use of water resources (efficiency, reuse and reduction) through implementation of initiatives that result in water being valued across the region by 2015.

CAPACITY BUILDING

Outcome W10. Integration and partnership Improve integration and partnership regarding water use and management across all levels of government and the community with the implementation of five cross-organisational projects to achieve sustainable management of water resources by 2015.

Outcome W11. Improved education Increase knowledge and appreciation of water asset values, enhanced and embraced by the development and implementation of a regional water asset education program, and training and knowledge retention initiatives, by 2012.

Outcome W12. Improve awareness and recognition of significant assets Review and raise the awareness of the values of water assets across the region in light of State, National and International frameworks by 2012.

PLANNING AND POLICY FRAMEWORKS

Outcome W13. Managed water resources Manage water resources sustainably (including surface and ground water) through adequate planning and management, with support for innovation and efficient use for ecological processes, community and commercial purposes with 80% of water assets secured by 2015.

7.7 Measures and indicators

Use of the following indicators and measures (Table 10) as a guide will assist in setting targets for projects and programs and allow for standard approaches to measurement. Indicators should

be selected according to the principles of cost, simplicity, consistency, practicality and capacity to deliver information across the region. Critical indicators will depend on things such as catchment management priorities, so the information below is a starting point.



Table 10: Measures and indicators – Water

ASSET	INDICATOR HEADING	RECOMMENDED INDICATORS
Inland aquatic ecosystems	<ul style="list-style-type: none"> River conditions 	<p>Critical indicators</p> <ul style="list-style-type: none"> Benthic macro invertebrates Fish Riverine or catchment vegetation. <p>Contextual indicators</p> <ul style="list-style-type: none"> Hydrology Water quality Physical form Drivers (catchment condition). <p>Useful (to be developed and tested)</p> <ul style="list-style-type: none"> Biological processes.
	<ul style="list-style-type: none"> Wetland ecosystem condition 	<p>Catchment disturbance</p> <ul style="list-style-type: none"> Disturbance in the catchment. <p>Physical form and processes</p> <ul style="list-style-type: none"> Area of wetland – change in area Wetland topography Soil disturbance. <p>Hydrological disturbance</p> <ul style="list-style-type: none"> Physical modification to hydrology Changes to water regime. <p>Water and soil quality</p> <ul style="list-style-type: none"> Turbidity regime Salinity regime Change in pH Soil properties. <p>Buffer zone</p> <ul style="list-style-type: none"> Change in fringing vegetation. <p>Biota</p> <ul style="list-style-type: none"> Change in wetland vegetation Change in invertebrates Change in vertebrates Change in introduced species Change in algae.

Table 10: Measures and indicators – Water (continued)

ASSET	INDICATOR HEADING	RECOMMENDED INDICATORS
Aquatic environments	<ul style="list-style-type: none"> Nutrients in aquatic environments 	<ul style="list-style-type: none"> Total nitrogen and flow leaving sub catchments or whole catchment Total phosphorus and flow leaving sub catchment or whole catchment.
	<ul style="list-style-type: none"> Turbidity, suspended particulate matter in aquatic environments 	<ul style="list-style-type: none"> Turbidity Total suspended solids (TSS) and Flow.
	<ul style="list-style-type: none"> Salinity in freshwater aquatic environments 	<ul style="list-style-type: none"> Total dissolved solids (TDS) and flow Electrical conductivity (EC) and flow.
Water resources	<ul style="list-style-type: none"> Allocation of water resources Water conservation Wastewater recycling 	<ul style="list-style-type: none"> Volume of water used per person per year Percentage reduction or reuse of water % of potable scheme water used for non potable uses (e.g. public open space, industry).

(Based on Department of Environment, Water, Heritage and the Arts, 2007)

7.8 Trade-offs

Access to clean water for drinking, stock, rural, urban and industrial uses is a primary concern for our communities. The maintenance of healthy waterways and wetlands with their associated biota and the opportunities they offer for recreation and tourism are also highly valued. The balancing of water consumption with environmental requirements becomes increasingly difficult as development of industry and urban areas proceed. Statutory planning processes have sought to provide better mechanisms for achieving the balance.

In the region, many of the land uses and management practices of the past (clearing, fertiliser application, tillage, etc.) have contributed to sedimentation and eutrophication of waterways. Some of the trade-offs that will have to be considered in managing water resources are similar to those discussed in the Land section, including achieving increased productivity without degrading the environmental values.

Reactive management generally means that investment occurs for resources that are already degraded. However, pristine or low impacted

systems need proactive or best practice management to prevent degradation. This may need to occur at the initial expense of more degraded systems so an appropriately balanced management framework needs to be developed in consultation with stakeholders.

Increasing recreational use of the region's waterways can offer opportunities for enhancing community awareness of the values of those resources, but it can also be a threatening process in itself.

In addressing investment in the region, a further trade-off is likely to be required between future planning, the on-ground actions that can be taken now, and the investment in developing better information through monitoring and resource assessment about the region's rivers, estuaries and waterways. Programs such as Watershed Torbay and the planning and implementation of estuary management plans across the region can yield valuable information and experience that can be extended to other areas, but major investment in one or a few catchments will limit the capacity to work in other areas at the same time.



PHOTO: Vennessa Sijkes.

Pristine or low impacted systems need proactive or best practice management to prevent degradation.