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of South Australia**

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Primary Industries  
and Regions SA

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# **MANAGEMENT PLAN FOR THE PELICAN LAGOON AQUATIC RESERVE**

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Approved by the Minister for Agriculture and Fisheries pursuant to section 44 of the *Fisheries Management Act 2007*.

Hon Michael O'Brien MP  
Minister for Agriculture and Fisheries  
1 October 2011

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## EXECUTIVE SUMMARY

The Pelican Lagoon Aquatic Reserve is located on the north-eastern side of Kangaroo Island, South Australia, within the American River system. European settlement occurred in the area in the early 1800's and as a result human impact through colonisation has increased pressures on the local environment.

The Pelican Lagoon Aquatic Reserve has long been identified as a key nursery habitat for commercially and recreationally important fish species. In 1971, it was gazetted as an aquatic reserve, making it the oldest aquatic reserve in South Australia. The reserve was re-proclaimed by the South Australian Government on 29 November 2007, in line with the introduction of the *Fisheries Management Act 2007*.

The Pelican Lagoon Aquatic Reserve system is managed under the *Fisheries Management Act 2007*. A Management Plan for this reserve applies from 1 October 2011 for a period of ten years. A comprehensive review of this management plan for the purpose of determining whether the plan should be amended replaced or reinstated without amendment, will be undertaken after the fifth anniversary of the commencement of the plan

Although anecdotal evidence points to the significance of the Pelican Lagoon Aquatic Reserve, currently there is only limited scientific knowledge of the ecosystem. This management plan aims to identify the possible threats to the reserve system and put in place management tools which will minimise threats. At the time of drafting this management plan, the Kangaroo Island Natural Resources Management Board (KINRM Board) was in the process of developing a *Pelican Lagoon Issues Paper*, which assisted PIRSA in the identification of possible threats to the reserve system.

Water quality has been identified as important to the health of the Pelican Lagoon Aquatic Reserve. As part of the South Australian Government's strategy to monitor water quality throughout the state, a set of assessment guidelines and trigger limits have been developed by the Environment Protection Authority (EPA). The trigger limits will be monitored as part of the management plan strategy.

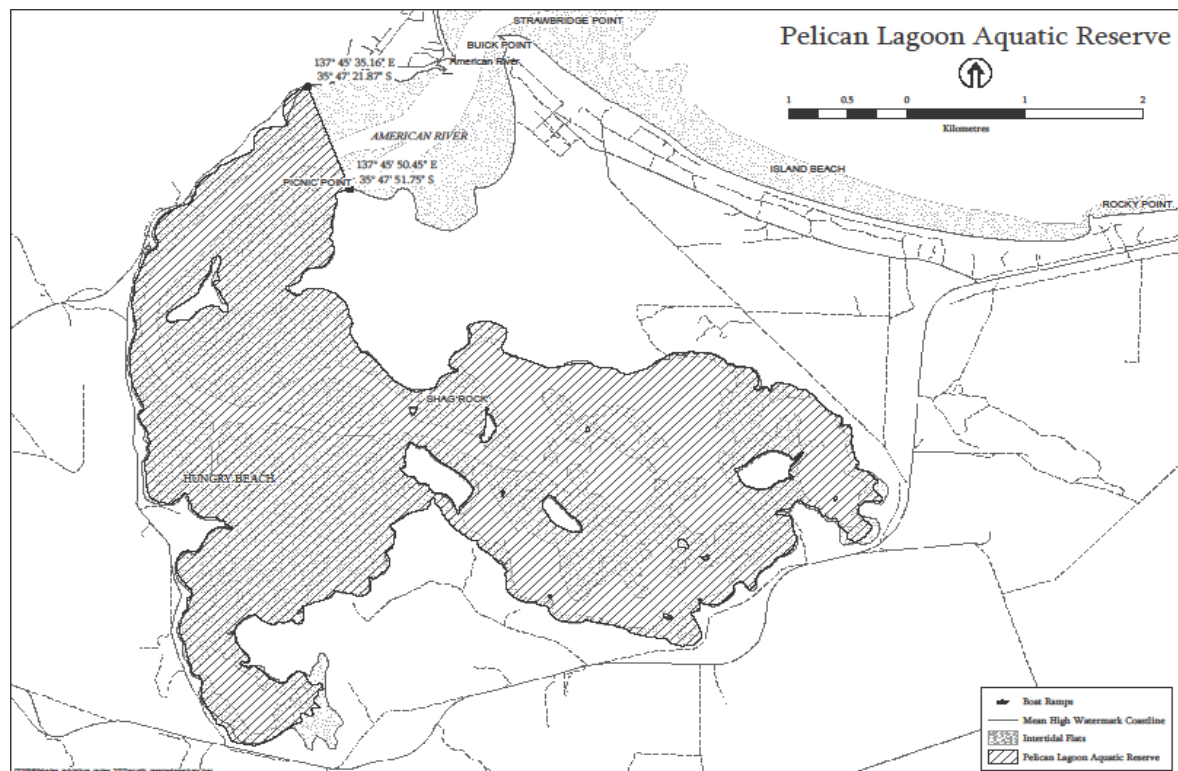
Threats that may have an impact on the reserve may not always remain constant. In light of this, an adaptive management approach will be employed to deal with issues as they appear. Not all threats can be addressed through the *Fisheries Management Act 2007* and this is where other government departments will need to be consulted and have input into the management of the area.

The management plan for the Pelican Lagoon Aquatic Reserve is a stand alone document, which will aid in the management of the aquatic reserve. This plan will work in conjunction with the Kangaroo Island Natural Resource Management Board (KINRM) plan for the surrounding area and the Department of Environment and Natural Resources (DENR) management plan for the adjacent conservation park. These three plans will address issues that are specific to their direct legislation and collectively provide for an integrated management plan for Pelican Lagoon.

The most important management tool for PIRSA is communication with and education of stakeholders. This is a key aspect of managing the aquatic reserve and allows the community to have ownership and pride in the reserve for the benefit of the people who directly utilise the reserve and for future generations.

# 1 INTRODUCTION

This management plan applies to the Pelican Lagoon Aquatic Reserve, which was re-proclaimed in the South Australian Government Gazette on 29 November 2007. The reserve is legally defined as ‘the waters of American River Upstream of the geodesic from the location on Mean High Water Springs closest to 35°47'21.87" South, 137°45'35.16" East to the location on Mean High Water Springs closest to 35°47'51.75" South, 137°45'50.45" East (Picnic Point)’ (Figure 1).



**Figure 1** Location and boundary of the Pelican Lagoon Aquatic Reserve.

Access to the reserve is permitted through the *Fisheries Management (Aquatic Reserves) Regulations 2008*; however, activities other than access, such as fishing or collecting of marine species, and the disturbance of the bed of any waters in the reserve, are not permitted. The reserve is one of six aquatic reserves in South Australia where all forms of fishing are prohibited and as a result it is one of the state's most important and iconic marine areas.

## 1.1 PLANNING AND POLICY FRAMEWORK

Currently there are two significant frameworks for planning and policy relating to protection of the marine environment in South Australia: aquatic reserves and marine parks. An aquatic reserve is proclaimed under the *Fisheries Management Act 2007* and intended to protect fisheries resources and their habitats from over exploitation and degradation. A marine park is declared under the *Marine Parks Act 2007* and is an area of sea especially dedicated to the protection and maintenance of biodiversity

and of natural and associated cultural resources. Whilst the objects of the two frameworks are quite different, both are complementary in many situations, as biodiversity is a key component in the health of fisheries and protecting fisheries can protect biodiversity.

The management plan for the Pelican Lagoon Aquatic Reserve has therefore been developed to protect fisheries values. However, it may complement and utilise the management strategies included in the Encounter Marine Park Management Plan when it becomes available.

Additionally, the plan complements the management strategies in the Management Plan for the South Australian Marine Scalefish Fishery and local recreational fishery management arrangements. It also forms part of the Pelican Lagoon Integrated Catchment Management Plan, which seeks to improve the health of the Pelican Lagoon region through the *Natural Resources Management Act 2004*. This plan is consistent with marine park planning, fisheries management plans and natural resource management plans to ensure resources and data are shared and management strategies are consistent.

## **1.2 TERM OF PLAN**

The management plan applies from 1 October 2011 and expires on the tenth anniversary of its commencement.

Section 49 of the *Fisheries Management Act 2007* prescribes the requirements for reviewing or reinstating this management plan.

## **1.3 REVIEW OF THE PLAN**

Management plans have duration up to 10 years under the *Fisheries Management Act 2007*, with a major review scheduled at 5 years. The review will allow consideration of whether the current arrangements are effective in reducing threats to the aquatic reserve. A review may be carried out at any time during the life of the management plan and may be hastened if there are concerns about the integrity of the aquatic reserve.

A review of the management arrangements will be based on the best information available at the time to PIRSA.

## 2 THE AQUATIC RESERVE

### 2.1 LOCATION

The Pelican Lagoon Aquatic Reserve is located on the north-eastern side of Kangaroo Island, South Australia, within the American River system (Figure 1). The reserve covers approximately 15.2 km<sup>2</sup> and its boundary is primarily determined by the natural extremities of the lagoon, other than a small portion extending across the inlet near American River Township. Signs on each side of the inlet mark this 'entrance' to the reserve.

### 2.2 DOMINANT BIOLOGICAL AND ENVIRONMENTAL CHARACTERISTICS

Pelican Lagoon Aquatic Reserve covers an area dominated by a central basin (the 'lagoon') with smaller areas of flood/ebb delta, tidal flats and channels (Oz Estuaries 2001). The water of the lagoon overlays a limestone embayment (Haines 2000). Recent bathymetry of the area, completed in September 2008 by DENR, has revealed that the lagoon has a highly variable benthic profile ranging from tidal flats exposed at low tide to distinct 'holes' of up to 10m depth (Figure 2).

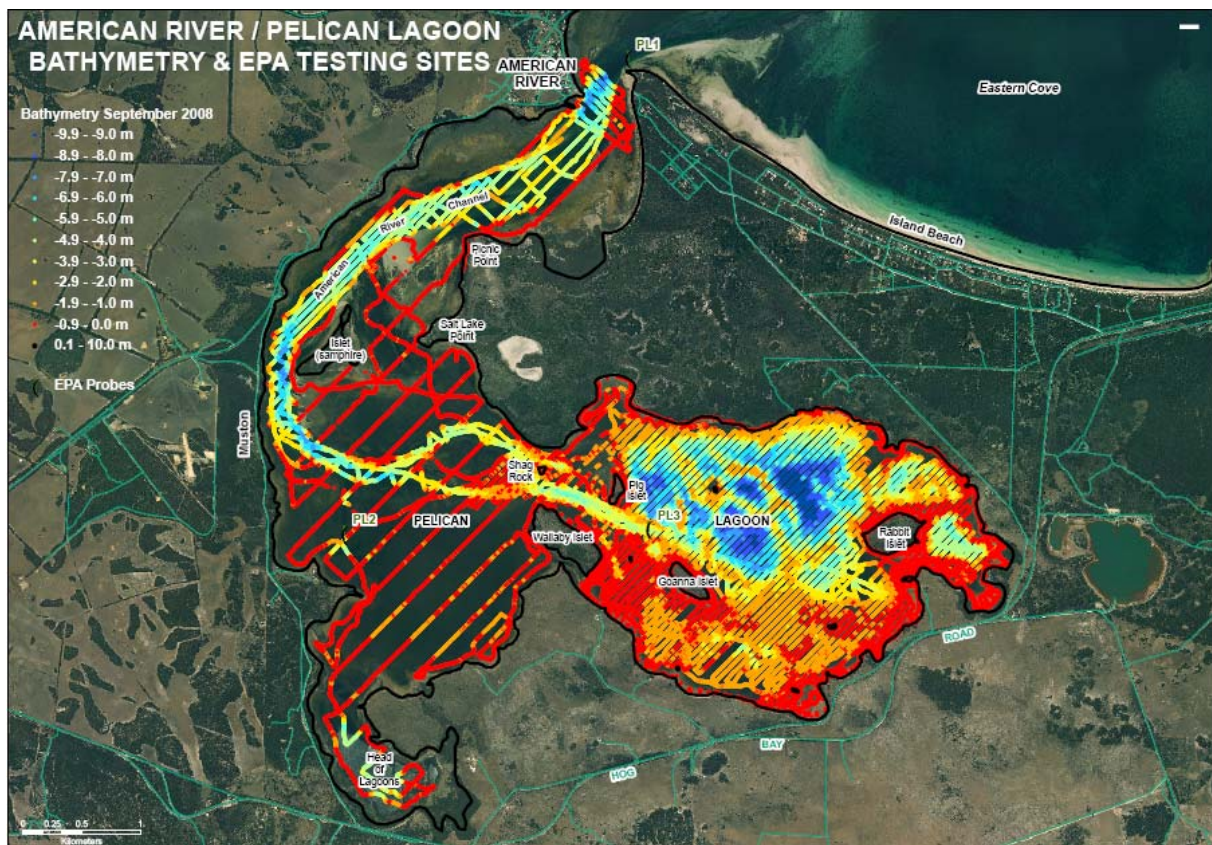


Figure 2 Bathymetric profile of American River and Pelican Lagoon on Kangaroo Island, South Australia.

Water moves in and out of the lagoon through one narrow channel approximately 3-5 m deep. This movement is tidal with tidal currents known to reach speeds of up to 3 knots. Freshwater inputs to the lagoon are negligible and occur only through runoff from rainfall events. Inputs from groundwater are currently unknown but it is possible that seepage of rainfall and nutrients may occur through the porous limestone.

The climate of Kangaroo Island is temperate, but with a distinct winter rainfall maximum. Relatively mild conditions are experienced during both summer and winter, a situation typical of the insular character of smaller island climates (Tyler et al. 1979).

Habitats within the lagoon include seagrass meadows, un-vegetated soft bottom, tidal flats, samphire and small tidal creeks. The distribution and extent of these habitats have been mapped by Bryars (2003).

From a fisheries perspective, the seagrass meadows of the Pelican Lagoon Aquatic Reserve are arguably the most important habitat. They support the larval, juvenile and adult life stages of a number of commercially and recreationally important fish species, such as King George Whiting (*Sillaginoides punctata*), Southern Garfish (*Hyporhamphus melanochir*) and Western Australian Salmon (*Arripis truttacea*) (Table 2).

### **2.3 CURRENT SCIENTIFIC KNOWLEDGE OF SITE**

There is currently very limited scientific knowledge on the Pelican Lagoon system. Previous studies have focussed on tagging surveys of juvenile and adult King George Whiting found in the Lagoon (Jones 1980), but no systematic sampling of the fish assemblages in the lagoon has been undertaken. More recently the KINRM Board and DENR have been undertaking small projects to build data on tidal flows, nutrient levels, turbidity and bathymetry.

Further surveys have been conducted by PIRSA and KINRM Board focusing on seagrass distribution throughout the reserve. In 2007 Kinloch *et al.* reported that the seagrass beds in Pelican Lagoon are considered to be exhibiting signs of poor health.

KINRM Board and the EPA have also undertaken initial monitoring of the area to record tidal movement and water quality at selected points throughout the site.

At the time of drafting this management plan the KINRM Board was in the process of developing a *Pelican Lagoon Issues Paper*, which would provide a basis for drafting a Pelican Lagoon Management Plan. The issues paper identified 11 key threats to Pelican Lagoon's natural resources.

As part of this management plan it is envisaged that more in-depth studies and long term monitoring be implemented to gain a better understanding of the aquatic reserve and the impact which the surrounding catchment may be having on the reserve system.

## **2.4 HISTORY OF THE AQUATIC RESERVE**

The outline below is based on research into the history of the Pelican Lagoon conducted by Jennie Teasdale, a resident of Kangaroo Island who has a long term personal interest in the development and maintenance of the reserve.

At the time of first European exploration by Mathew Flinders, Kangaroo Island had no Aboriginal settlement, although evidence suggests that previously the island was inhabited by Aboriginal people. European settlement occurred in the area in the early 1800's. Sealing was a major activity in the area and pelts were shipped to the mainland for sale.

The areas surrounding Pelican Lagoon were used as pastoral areas and were extensively cleared during the mid to late 1800's. The islands located within the lagoon itself were burnt to encourage pastoral growth. Local fishers also burnt vegetation to deter pelicans from the area in the belief that they competed with them for fish.

Prior to 1971, the lagoon had been closed to both line and net fishing (Scott 1954) because of its recognised importance as a nursery area for key species such as King George Whiting. Research on the growth of juvenile King George Whiting continued into the 1960s (Caton 1963).

In the early 1970's a rubbish dump was located at Remembrance Park. This dump was covered by water at high tide and potentially leaked toxic materials into nearby marine waters.

Pelican Lagoon Aquatic Reserve was gazetted in 1971, making it the oldest aquatic reserve in South Australia.

## **2.5 IDENTIFICATION OF STAKEHOLDERS**

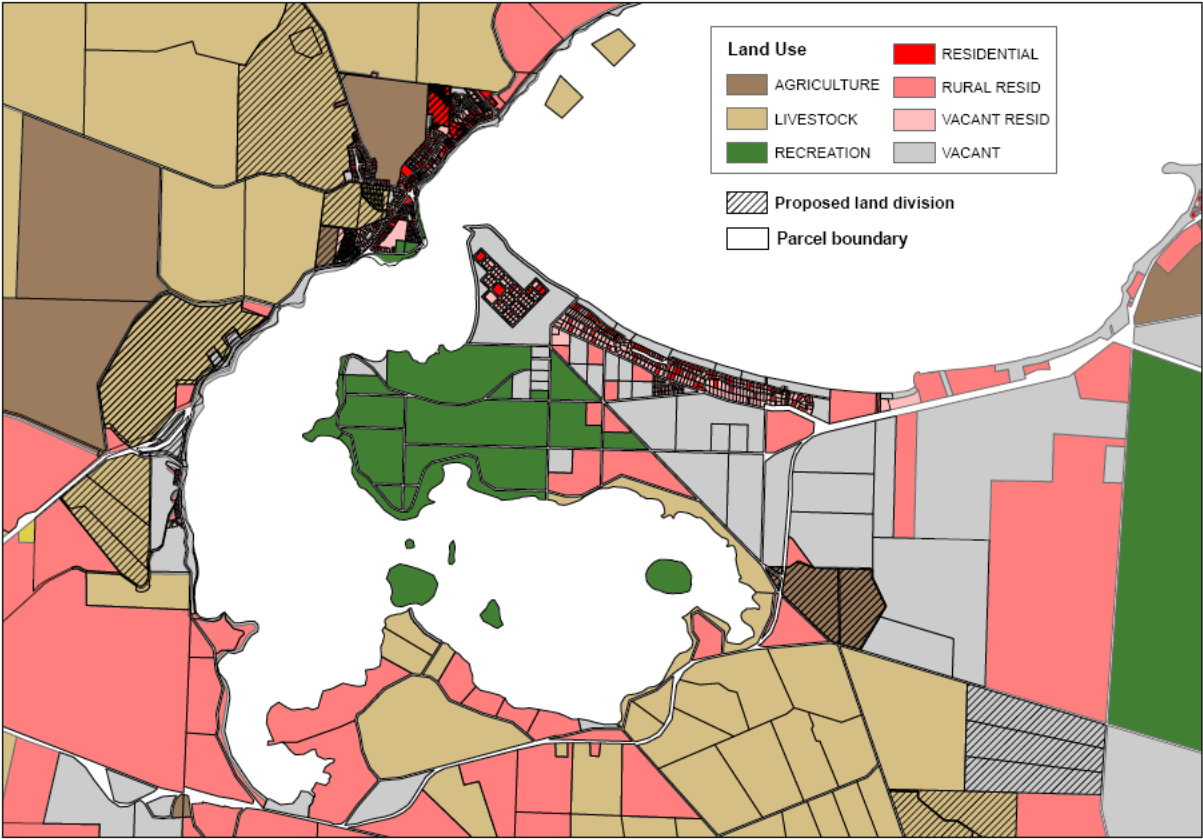
The Pelican Lagoon Aquatic Reserve has a number of stakeholders with an interest in maintaining the full protection of the area. Key stakeholders include the local KINRM Board, residents surrounding the lagoon, PIRSA, Kangaroo Island Council, DENR, Conservation Council of South Australia and the general Kangaroo Island community.

The interests in the area may vary between the stakeholders but the overarching goal is to maintain the integrity of the reserve for the future.

## **2.6 ACTIVITIES WITHIN THE RESERVE AND SURROUNDING AREA**

The KINRM Board has provided a land use map of the area surrounding the reserve. The map in Figure 3 shows that there is a mix of land use types surrounding the reserve, ranging from vacant land to proposed development areas. These activities could pose some level of threat to the reserve system and if measures aren't taken to reduce risks the activities could have a detrimental impact on the marine system in the area.

As the reserve is a full protection reserve meaning there is no allowed take of aquatic resources or disturbance of the benthic environment, fishing is not permitted within the reserve. Illegal fishing, which allegedly does occur, is addressed in section 7.4 of this management plan.



**Figure 3 Map of land use surrounding the Pelican Lagoon Aquatic Reserve.**

Information gathered by the KINRM Board and Jennie Teasdale indicates that there is a great deal of local ownership over the lagoon system by the local community. They are very much aware of the threats to the lagoon and show interest in being involved in the management of the area.

Table 1 lists activities that are known to take place within the aquatic reserve. This list does not take into account the activities occurring on the land surrounding the lagoon system, which are managed by other legislation.

**Table 1 Summary of stakeholders of the aquatic reserve and associated activities.**

<b>Stakeholder</b>	<b>Activities</b>
Community / Residents	Boating
	Bird watching
	Snorkelling
	Diving
	Photography
	Tourism
	Education
PIRSA / SARDI	Monitoring / Compliance / Research
Other Gov Departments	Research / Monitoring

### 3 FISHERIES VALUES OF THE RESERVE

The Pelican Lagoon Aquatic Reserve meets a number of objects of the *Fisheries Management Act 2007*, including the principal object (1)(a) 'proper conservation and management measures are to be implemented to protect the aquatic resources of the State from over-exploitation and ensure that those resources are not endangered'. The reserve contributes to this object by being of primary value to the state's Marine Scalefish Fishery and recreational fisheries and of secondary value to seagrass habitat, tidal and saltmarsh habitats.

#### 3.1 SPECIES VALUABLE TO FISHERIES

Species valuable to fisheries directly associated with the Pelican Lagoon Aquatic Reserve ('first order fisheries values') are listed in Table 2.

**Table 2 Fisheries related species present in Pelican Lagoon Aquatic Reserve (Bryars 2003).**

Common Name	Scientific Name	Breeding	Juvenile	Adult
<b>Crustaceans</b>				
Sand Crab	<i>Ovalipes australiensis</i>			✓
<b>Molluscs</b>				
King Scallop	<i>Pecten fumatus</i>	✓	✓	✓
Queen Scallop	<i>Equichlamys bifrons</i>	✓	✓	✓
Razorfish	<i>Pinna bicolor</i>	✓	✓	✓
Southern Calamari	<i>Sepioteuthis australis</i>	✓		✓
<b>Fin Fishes</b>				
Flathead	<i>Platycephalus</i> spp.		✓	✓
King George Whiting	<i>Sillaginoides punctata</i>		✓	✓
Leatherjacket	Family Monacanthidae		✓	✓
Red Mullet (Goatfish)	Family Mullidae		✓	✓
Snook	<i>Sphyraena novaehollandiae</i>			✓
Southern Sea Garfish	<i>Hyporhamphus melanochir</i>		✓	✓
Tommy ruff	<i>Arripis georgiana</i>		✓	✓
Trevally	<i>Pseudocaranax</i> spp.		✓	✓
Western Australian Salmon	<i>Arripis truttacea</i>		✓	✓

#### 3.2 SPECIES PREFERENCES

There are several key recreational and commercial species that use the Pelican Lagoon Aquatic Reserve as a nursery ground. The two most important species are King George Whiting and Southern Garfish.

## KING GEORGE WHITING

King George Whiting spawn in the offshore waters of Spencer Gulf and Gulf St Vincent from later summer to winter: May to July in Victoria; late February to early June in South Australia. Spawning peaks in mid April in South Australia.

King George Whiting eggs are buoyant and the larvae are planktonic. The larvae move inshore to sheltered areas and settle out of the plankton when 60-80 days old and 15-18mm long. It has long been accepted that Pelican Lagoon was a recognised nursery area for post-larval and juvenile King George Whiting, with the nearest known spawning area located on the northern coast of Kangaroo Island (Fowler *et al.* 2000).

Juvenile King George Whiting feed on benthic amphipods and other crustaceans. As they grow larger, the fish's diet expands to include polychaete worms, molluscs and peanut worms (Kailola *et al.* 1993).

## SOUTHERN GARFISH

Southern Garfish spawn in the summer (October to March), with a peak in spawning activity from October to November and again in March (Noell & Ye 2008). Eggs are dependent on seagrass beds where they adhere to the seagrass leaves and subsequently hatch. Of all the inshore economically important fish species found along the SA coastline, Garfish have the highest dependence on seagrass meadows throughout their entire life history (Scott *et al.* 2000).

Garfish are generally herbivorous; seagrasses provide the dominant food source including algal filaments. Together, they comprise about 75% of the diet, the remainder consisting of diatoms, insect larvae, polychaete worms and small crustaceans (Kailola *et al.* 1993).

The northern bays of Kangaroo Island are known refuges for Southern Garfish from the prevailing southerly winds and provide a low wave energy area with extensive food sources in seagrass beds, both in intertidal and sub-tidal areas (Fowler *et al.* 2008).

## OTHER FISH ASSEMBLAGES

Knowledge about the habitat and species dynamics in the Pelican Lagoon Aquatic Reserve is limited. Species may exist in the lagoon which may be endemic to the lagoon system and found no where else in the state. The deep 'holes' that exist within the reserve are unique as they have no aquatic plant assemblages within them and show signs of high turbidity (Kinloch *et al.* 2007). This unique feature may have significant influence on the fish species that may utilise this environment.

Further research needs to be undertaken to understand the reserve system and its components. The information can then be used to determine further management requirements for the area.

## **4 THREATS TO THE FISHERIES VALUES**

Any threats to the aquatic reserve can impact its fisheries values and thus reduce its effectiveness in achieving the objects of the Act. Identified threats can therefore form the basis in the design of management objectives, strategies and planning. The threats identified in this management plan are a combination of those already inventoried (Bryars 2003) and issues raised by the local community through the Pelican Lagoon Issues Paper prepared by the KINRM Board.

Threats to reserves can be internally based, or originate from outside the boundaries of the reserve. These are discussed below.

### **4.1 INTERNAL**

Threats to Pelican Lagoon Aquatic Reserve that have their source from inside the reserve boundary are:

- Fishing - illegal fishing
- Boating - damage from boats and engine propellers running aground and anchoring damage to seagrass
- Tourism and recreation - pollution, rubbish, hydrocarbons, noise, wash, and wake

### **4.2 EXTERNAL**

Threats to Pelican Lagoon Aquatic Reserve that have their source outside the reserve boundary are:

- Coastal Development
- Nutrient Inputs - from adjacent land uses (grazing, cropping) and residential areas (seepage of septic systems, storm water runoff) and catchment discharges
- Marine pest incursions
- Climate change
- Fire

## 5 CONDITION SUMMARY STATEMENT

The Pelican Lagoon Aquatic Reserve can be described as under threat from both internal and external factors.

Internal threats such as illegal fishing and damage to the benthic habitat through anchoring and propeller damage are considered to be moderate to low risk and are being managed by PIRSA through compliance operations to address illegal fishing and ongoing monitoring. Further survey work is considered necessary to monitor sites with a higher likelihood of benthic damage from vessels. This work will most likely be co-ordinated with the help of the KINRM Board using seagrass mapping information collected during surveys in 2009.

External threats pose a higher risk to the aquatic reserve. These include coastal development, climate change, marine pest incursion and nutrient input from the surrounding land, both through rural and agricultural land use and residential development near the reserve.

The townships in and around the Pelican Lagoon area have growing communities of both permanent and itinerant residents. In addition, there has been a shift in the catchments over the past 25 years from broadacre agricultural properties towards subdivision into smaller lifestyle blocks, resulting in higher rural residential density. Subdivision into smaller holdings has created concern over increased housing and infrastructure development, increased effluent loads, reduced natural freshwater runoff, introduction of exotic weeds etc. (KINRM Board 2010).

Predicted changes to climate pose serious risks to natural resources and the socio-economic values of those resources on Kangaroo Island. The far-reaching effects of immediate relevance to Pelican Lagoon include sea level rise, increased sea temperature, changes in rainfall and winds, and impacts on marine ecosystem processes such as alterations of currents, ocean acidification and frequency of upwelling events.

Marine pests have also been identified as a serious threat to the reserve (Kinloch *et al.* 2009). Incursions of pests usually occur through vessels travelling from infested areas of the state or country. The introduction of marine pests could have a serious impact on the dynamics of the reserve, especially with the limited knowledge available to determine the current baseline condition of the Pelican Lagoon system.

Rural runoff carries pollutants such as animal wastes and agricultural chemicals, as well as soil eroded from cleared paddocks or stream banks accessed by farm stock. High nutrient, sediment and pollutant loads degrade water and benthic habitat quality and may, for example, lead to long term losses in highly productive ecosystems such as seagrass beds.

## **6 MANAGEMENT OBJECTIVES AND BENCHMARKING**

### **6.1 CURRENT MANAGEMENT ARRANGEMENTS**

The current management arrangements for the Pelican Lagoon Aquatic Reserve under the *Fisheries Management (Aquatic Reserves) Regulations 2007* limit the public to the following:

#### **4—Authorised access to aquatic reserves**

For the purposes of section 76 of the Act, a person may enter and remain in.

- (b) American River Aquatic Reserve;

The public may enter the reserve, but are not able to take aquatic resources or disturb the substrate without authorisation from the Minister or his delegate.

This management plan maintains the same fisheries management arrangements for the Pelican Lagoon Aquatic Reserve. For the life of this plan, the regulation listed above will continue the 'no take' management of the reserve and its aquatic resources.

### **6.2 MANAGEMENT OBJECTIVES**

All South Australian management plans are required to meet the objectives of the *Fisheries Management Act 2007*, which are listed below. The Act clearly outlines the objectives in place and particularly indicates that the principles of ecologically sustainable development (ESD) be followed when developing management plans for aquatic resources.

#### **7—Objects of Act**

(1) An object of this Act is to protect, manage, use and develop the aquatic resources of the State in a manner that is consistent with ecologically sustainable development and, to that end, the following principles apply:

- (a) proper conservation and management measures are to be implemented to protect the aquatic resources of the State from over-exploitation and ensure that those resources are not endangered;
- (b) access to the aquatic resources of the State is to be allocated between users of the resources in a manner that achieves optimum utilisation and equitable distribution of those resources to the benefit of the community;
- (c) aquatic habitats are to be protected and conserved and aquatic ecosystems and genetic diversity are to be maintained and enhanced;
- (d) recreational fishing and commercial fishing activities are to be fostered for the benefit of the whole community; and
- (e) the participation of users of the aquatic resources of the State and of the

community more generally, in the management of fisheries is to be encouraged.

(2) The principle set out in subsection (1)(a) has priority over the other principles.

(5) For the purposes of subsection (1), *ecologically sustainable development* comprises the use, conservation, development and enhancement of the aquatic resources of the State in a way and at a rate, that will enable people and communities to provide for their economic, social and physical well-being while;

(a) sustaining the potential of aquatic resources of the State to meet the reasonably foreseeable needs of future generations;

(b) safeguarding the life-supporting capacity of the aquatic resources of the State; and

(c) avoiding, remedying or mitigating adverse effects of activities on the aquatic resources of the State.

(taking into account the principle that if there are threats of serious or irreversible damage to the aquatic resources of the State, lack of full scientific certainty should not be used as a reason for postponing measures to prevent such damage).

The objectives and ESD principles of the *Fisheries Management Act 2007* must be consistent with the management arrangements for the Pelican Lagoon Aquatic Reserve.

### **6.3 ESTUARINE, COASTAL AND MARINE ENVIRONMENTAL INDICATORS**

South Australia has a Common Indicator Pool as part of the State Monitoring and Evaluation Operational Plan for Natural Resource Management in South Australia (refer to Appendix). These indicators provide consistency across programs and projects and are applied to aquatic reserve management plans under the *Fisheries Management Act 2007*.

Indicators selected to assess the state of the Pelican Lagoon Aquatic Reserve and the effectiveness of management objectives are:

1. Unvegetated Soft Sediments
  - a. Macro and microalgae including microphytobenthos
  - b. Pest species presence and abundance recorded during other monitoring programs for species listed above
2. Seagrass
  - a. Change in distribution and abundance of seagrass
  - b. Population structure and density of seagrass
  - c. Abundance and extent of epiphytes
  - d. Pest species presence and abundance recorded during other monitoring programs for species listed above

3. Nutrients
  - a. Dissolved nutrients in water column
4. Turbidity/water clarity
  - a. Secchi disc reading
5. Stock status of the main fisheries species targeted by commercial and recreational fishers.

#### **6.4 LIMITS OF ACCEPTABLE CHANGE**

As part of the South Australian Government's strategy to monitor water quality throughout the state, a set of assessment guidelines and limits have been developed by the EPA. The reference limits are set for different characteristics in marine water (e.g. nutrient levels, oxygen levels) to give an indication of the state of the particular marine water body. These characteristics are taken into account when assessing the importance of the water body for a particular use, be it recreational, consumption or ecosystem importance.

Trigger values for each measurable characteristic are listed in Gaylard (2005) and can be used as a guide when monitoring and testing water samples throughout the reserve. An unacceptable triggering of one of these indicators may require action to identify the source and reason for the trigger.

##### **6.4.1 Unvegetated soft bottom and seagrass**

Changes in unvegetated soft bottom communities are difficult to assess, but refer to any rapid change in the extent or spread of such habitat would be deemed undesirable.

The mere detection of a marine pest in an area previously free of such pests would exceed the limit of acceptable change. Any loss of seagrass meadows and detectable increase in the amount of epiphytes on seagrass leaves would also be beyond the limits of acceptable change.

##### **6.4.2 Nutrient levels**

Nutrients that may be monitored to determine the condition of the marine water body and their marine trigger values, as taken out of Gaylard (2005) include:

<b>Nutrient</b>	<b>Trigger value (mg/L)</b>
Ammonia	0.05
Oxidised Nitrogen.	0.05
Total dissolved Nitrogen	1.00
Total dissolved Phosphorus.	0.10
Chlorophyll a concentrations.	1 (ug/L)

### **6.4.3 Turbidity**

Trigger points similar to those used by Gaylard (2005) would be used to monitor turbidity levels. These are based on the position of the 90th percentile compared to a range of values: the lower value of 5 nephelometric turbidity units (NTU) and an upper value of 10 NTU.

### **6.4.4 Stock status**

As the Pelican Lagoon Aquatic Reserve is a no fish area, negative changes in stock status of fish caught recreationally and commercially would have no impact on stakeholders entering the reserve. Notwithstanding this, a change in fish population structure may be a useful indicator of the impact of internal and external factors on the overall health of the Pelican Lagoon system, or of mitigation methods that are undertaken.

## **6.5 TRAFFIC LIGHT ASSESSMENT**

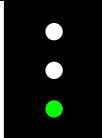
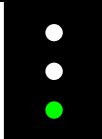
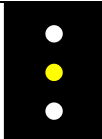
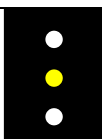
The traffic light system is designed to help managers and stakeholders of the aquatic reserve assess the health of the aquatic reserve at a glance and what threats are the most significant.

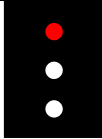
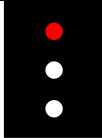
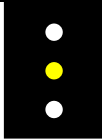
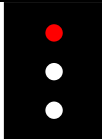
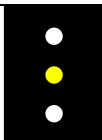
There are three colours in the traffic light system:

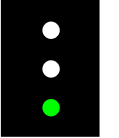
- Red light      The threat has had a significant detrimental impact on fisheries values and warrants urgent management intervention
  
- Yellow light    There are indications the threat may be having a detrimental impact on fisheries values however further investigation needs to be undertaken to confirm this
  
- Green light     The threat is being adequately addressed or is not a significant enough threat to fisheries values to warrant actions at this stage

**TRAFFIC LIGHT ASSESSMENT OF THREATS TO THE AQUATIC RESERVE**

**Table 3 Summary of the Traffic Light Assessment of Threats to the Aquatic Reserve.**

THREAT	INDICATORS	TARGET	TRAFFIC LIGHT	RESPONSE
<b>INTERNAL</b>				
<b>Fishing - Illegal fishing</b>	Reports of illegal fishing	100% Voluntary compliance of fishing closure in the American River Aquatic Reserve or reduction in the number of illegal reports to FISHWATCH		<ul style="list-style-type: none"> <li>▪ Visits by local Fisheries Officers</li> <li>▪ Responses to intelligence gathered FISHWATCH phone calls</li> <li>▪ General public education</li> </ul>
<b>Boating - Damage from boat propellers and boats running aground</b>	Decrease in seagrass abundance in higher traffic areas (surrounding channel, accessible beach areas) – visual decline	Damage to less than 10% of seagrass beds through boat damage		<ul style="list-style-type: none"> <li>▪ Public awareness</li> </ul>
<b>Boating - Anchoring damage to seagrass</b>	Decrease in seagrass abundance in higher traffic areas (surrounding channel, accessible beach areas) – visual decline	Damage to less than 10% of lagoon substrate through inappropriate anchor use		<ul style="list-style-type: none"> <li>▪ Public awareness</li> </ul>
<b>Tourism and recreation – pollution, rubbish, hydrocarbons, noise, wash and wake</b>	An increase in pollution, rubbish, hydrocarbons, noise, wash and wake from tourism and recreational activities within and around the aquatic reserve	Current or improved levels of pollution, rubbish, hydrocarbons, noise, wash and wake better from tourism and recreational activities within and around the aquatic reserve		<ul style="list-style-type: none"> <li>▪ Public awareness</li> <li>▪ Monitoring of the reserve by the KINRM Board and PIRSA</li> </ul>

<b>EXTERNAL</b>				
<b>Coastal development</b>	Increased housing and infrastructure development, increased effluent loads, reduced natural freshwater runoff, introduction of exotic weeds etc	Avoid or minimise damage to the health of the ecosystem within the aquatic reserve		<ul style="list-style-type: none"> <li>▪ Kangaroo Island Council is implementing the Regional Coastal Areas Policy</li> <li>▪ Kangaroo Island Council is in the process of undertaking a Coastal Planning Amendment Review</li> </ul>
<b>Nutrient inputs - from adjacent agriculture (grazing, cropping)</b>	Increased nutrient levels in the aquatic reserve system (trigger values for nutrients exceeded or sharp increase from previous level)	Trigger values for key nutrient set out as per EPA guidelines, exact targets outlined in – <ul style="list-style-type: none"> <li>▪ 5.3.1</li> <li>▪ 5.3.2</li> </ul>		<ul style="list-style-type: none"> <li>▪ Monitoring of levels by KINRM on an agreed basis (eg annually)</li> </ul>
<b>Nutrient inputs - from adjacent residential areas (seepage of septic systems, storm water runoff) and catchment discharges</b>	Increased nutrient levels in the aquatic reserve system (trigger values for nutrients exceeded or sharp increase from previous level)	Trigger values for key nutrient set out as per EPA guidelines, exact targets outlined in – <ul style="list-style-type: none"> <li>▪ 5.3.1</li> <li>▪ 5.3.2</li> </ul>		<ul style="list-style-type: none"> <li>▪ Monitoring of levels by KINRM on an agreed basis (eg annually)</li> </ul>
<b>Marine pest incursions</b>	Increased number of pest species compared to previous studies – or increase in areas affected by pest species	No marine pest incursions in the American River Aquatic Reserve system No marine pest colonies established in the American River Aquatic Reserve system		<ul style="list-style-type: none"> <li>▪ Monitoring of reserve by PIRSA and KINRM Board</li> <li>▪ Physical removal of pest species where practical</li> <li>▪ Public awareness and policies in place for vessel movement from known pest areas</li> </ul>
<b>Climate change</b>	Various / unknown	Difficult to set target indicators. Any management should be in line with the National Climate Change and Fisheries Action Plan		<ul style="list-style-type: none"> <li>▪ In line with national approach.</li> </ul>

<b>Fire</b>	Increase in the number of incidents of fire around the aquatic reserve	Current or improved levels of the number of incidents of fire around the aquatic reserve		<ul style="list-style-type: none"><li>▪ Monitoring the surrounds of the aquatic reserve to reduce the potential for fire</li></ul>
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## 7 ADAPTIVE MANAGEMENT THROUGH MONITORING OUTCOMES

### 7.1 MONITORING FRAMEWORK

There are a number of indicators that can be monitored through inter-agency co-operation to ensure that the Pelican Lagoon Aquatic Reserve is meeting the objectives of the *Fisheries Management Act 2007*. PIRSA is able to monitor the internal threats to the reserve through the compliance and bio-security programs (see section 6.5 of *Fisheries Management Act 2007*).

External threats to the aquatic reserve that lie outside of the fisheries legislation require an integrated approach with other agencies which are able to utilise their legislation for the protection of the area. Aside from PIRSA, there are another two agencies that have separate management plans for the area adjacent Pelican Lagoon; these are DENR and the KINRM Board. The three agencies together will provide an integrated management approach to deal with threats which may affect the Pelican Lagoon Aquatic Reserve.

The following table outlines monitoring framework options to address threats to the Pelican Lagoon Aquatic Reserve.

**Table 4 Monitoring framework for internal and external threats.**

<b>Threat</b>	<b>Monitoring Framework</b>
<i>Fishing - Illegal fishing</i>	<p><b>Indicator:</b> Increased reports of illegal fishing to FISHWATCH</p> <p><b>Objective:</b> Voluntary compliance of fishing closure in the Pelican Lagoon Aquatic Reserve.</p> <p><b>Monitoring:</b> Kangaroo Island Fisheries Officers (as per compliance operational plan).</p> <p><b>Responsibility:</b> PIRSA.</p> <p><b>Reporting:</b> Annual compliance report provided to Executive Director, Fisheries and Aquaculture</p>
<p><i>Boating - Damage from boat propellers and boats running aground</i></p> <p>&amp;</p> <p><i>Anchoring damage to seagrass</i></p>	<p><b>Indicator:</b> Decrease in seagrass abundance in higher traffic areas (surrounding channel, accessible beach areas) – visual decline.</p> <p><b>Objective:</b> Minimise damage on seagrass beds through boat damage.</p> <p><b>Monitoring:</b> Annual.</p> <p><b>Methodology:</b> Visual surveys of selected sites.</p> <p><b>Responsibility:</b> KINRM Board.</p>

	<p><b>Reporting:</b> Regular reports to PIRSA Bio-security.</p>
<p><i>Tourism and recreation – pollution, rubbish, hydrocarbons, noise, wash and wake</i></p>	<p><b>Indicator:</b> An increase in pollution, rubbish, hydrocarbons, noise, wash and wake from tourism and recreational activities within and around the aquatic reserve</p> <p><b>Objective:</b> Current or improved levels of pollution, rubbish, hydrocarbons, noise, wash and wake better from tourism and recreational activities within and around the aquatic reserve</p> <p><b>Monitoring:</b> Annual</p> <p><b>Methodology:</b> Visual surveys of selected sites.</p> <p><b>Responsibility:</b> KINRM Board</p>
<p><i>Coastal development</i></p>	<p><b>Indicator:</b> increased housing and infrastructure development, increased effluent loads, reduced natural freshwater runoff, introduction of exotic weeds etc</p> <p><b>Objective:</b> Avoid or minimise damage to the health of the ecosystem within the aquatic reserve</p> <p><b>Monitoring:</b> Other</p> <p><b>Methodology:</b> Various</p> <p><b>Responsibility:</b> Kangaroo Island Council</p>
<p><i>Nutrient inputs from adjacent agriculture (grazing, cropping)</i></p> <p>&amp;</p> <p><i>Nutrient inputs from adjacent residential areas (seepage of septic systems, storm water runoff) and catchment discharges</i></p>	<p><b>Indicator:</b> Increased nutrient levels in the aquatic reserve system (trigger values for nutrients exceeded or sharp increase from previous level).</p> <p><b>Objective:</b> Trigger values for key nutrient set out as per EPA guidelines are not exceeded.</p> <p><b>Monitoring:</b> Undertaken in conjunction with KINRM Board on an annual basis.</p> <p><b>Methodology:</b> As set out in the EPA water monitoring guidelines.</p> <p><b>Responsibility:</b> KINRM Board.</p> <p><b>Reporting:</b> Results made available to all relevant agencies.</p>
<p><i>Marine pest incursions</i></p>	<p><b>Indicator:</b> Increased number of pest species compared to previous studies – or increase in areas affected by pest species</p> <p><b>Objective:</b> Maintain or eliminate the number of pest species found/introduced within the Pelican Lagoon Aquatic Reserve system</p> <p><b>Monitoring:</b> Annual.</p> <p><b>Methodology:</b> As per PIRSA Biosecurity / KINRM Board agreed methodology. (as undertaken in American River).</p>

	<p><b>Responsibility:</b> PIRSA Biosecurity and KINRM Board.</p> <p><b>Reporting:</b> Reporting as per PIRSA requirements.</p>
<i>Climate change</i>	<p><b>Indicator:</b> Various / Unknown</p> <p><b>Objective:</b> Minimise impact of climate change on American River Aquatic Reserve.</p> <p><b>Monitoring:</b> Other.</p> <p><b>Methodology:</b> Various.</p> <p><b>Responsibility:</b> All relevant agencies.</p> <p><b>Reporting:</b> As per South Australia's 'Greenhouse Strategy – Tackling Climate Change: 2007- 2020'.</p>
<i>Fire</i>	<p><b>Indicator:</b> Increase in the number of incidents of fire around the aquatic reserve</p> <p><b>Objective:</b> Current or improved levels of the number of incidents of fire around the aquatic reserve</p> <p><b>Monitoring:</b> KINRM Board</p> <p><b>Methodology:</b> Visual surveys of selected sites</p> <p><b>Responsibility:</b> KINRM Board</p>

## 7.2 ASSESSMENT FRAMEWORK AND TIMELINES

The threats relevant to the Pelican Lagoon Aquatic Reserve will be addressed annually as per the monitoring framework. Any significant changes will be addressed as required and as resources become available.

## 7.3 ADAPTIVE MANAGEMENT

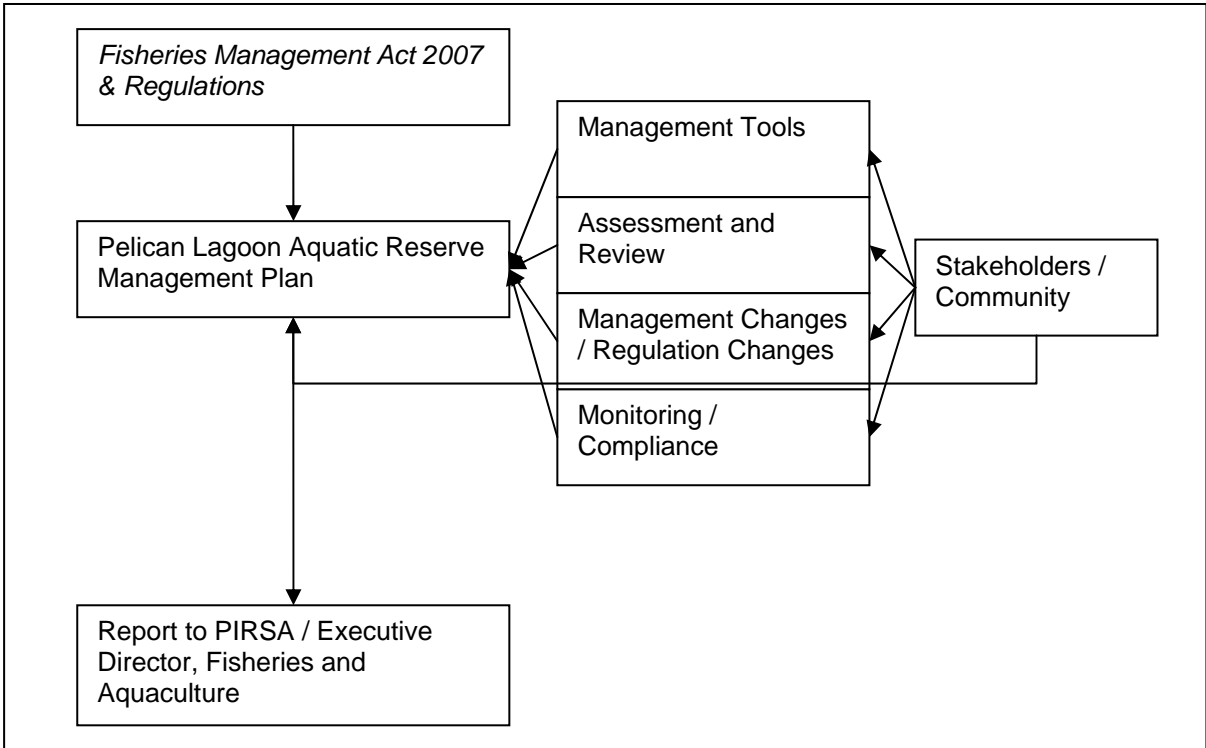
The management plan for the Pelican Lagoon Aquatic Reserve is a stand-alone document which is designed to guide the management of the aquatic reserve. The plan works in conjunction with the KIRNM Board's management plan for land adjacent to the aquatic reserve and the DENR management plan for the Pelican Lagoon Conservation Park. The three plans address threats to the area by firstly identifying them and secondly ensuring that management arrangements can adequately address these threats.

The threats that may have an impact on the reserve are likely to change with time. In light of this an adaptive management approach needs to be employed. The arrangements outlined in this plan need to be able to change as threats change. The five year review period mentioned above is one mechanism which can help address this.

A significant part of the adaptive management approach relies on the availability of data to make decisions. For this reason it is important to gather information on the lagoon system to monitor changes in the ecosystem. This can be done through methods outlined in section 6.3.

Figure 4 provides an outline of how adaptive management can work in relation to managing the Pelican Lagoon Aquatic Reserve and provides avenues for changing management arrangements where necessary.

**Figure 4 Flow diagram of the reporting lines and avenues for adaptive management.**



## **8 MANAGEMENT TOOLS**

### **8.1 ENGAGING EXTERNAL AGENCIES**

The Pelican Lagoon Aquatic Reserve Management Plan is one part of a three part 'integrated' management approach to protect the Pelican Lagoon area. The KINRM Board and DENR have a common interest in protection of the area and both agencies will have a separate management plan tied in with their respective legislation. One piece of legislation cannot provide full protection from all threats.

PIRSA will work closely with the two agencies along with any other relevant body to provide effective management of the Pelican Lagoon system.

Close collaboration and information sharing should be a key outcome from all management plans and will deliver better outcomes for the protection of the region.

### **8.2 COMMUNICATION**

Communication is a key aspect of managing an aquatic reserve. It can involve different communication methods for different stakeholders such as educational signs for visitors, information booths at local shopping centres or high level meetings between management agencies and industry. Including the local community in the decision making processes can help to:

- Educate;
- Promote awareness of the reserve; and
- Promote and sense of ownership and stewardship

#### **8.2.1 Community Education**

Community education is a critical strategy to reduce threats and ensure that the reserve system is maintained at a healthy and productive level. Providing adequate information to the community in regard to the aquatic reserve and the reason for the reserve being established will lead to the community seeing a benefit for the aquatic resources which rely on the system and to the broader community.

Under the *Fisheries Management Act 2007* the reserve is fully protected and parts of it come under the jurisdiction of PIRSA. The threats faced by the reserve are not always internal ones as outlined in this management plan. It is therefore important to educate the broader community not just the people utilising the lagoon itself.

KINRM Board can play a significant role in the provision of this education through engagement with the local community, education sessions, pamphlets and the distribution of educational material such as this management plan. PIRSA and the KINRM Board will work together to disseminate such information.

Other potential education tools include the education of Adelaide boat owners of the risks associated with sailing into the reserve if their vessels have been previously moored in known pest infested areas (e.g. fan-worm from metro waters in Adelaide).

### **8.2.2 Stakeholder Collaboration**

Below is a list of key stakeholders that have a potential interest in the preservation or utilisation of the aquatic reserve and the surrounding areas.

- PIRSA
- DENR
- KINRM Board
- Kangaroo Island Council
- Local Residents
- South Australian Community
- Conservation sector
- Other government agencies

These stakeholders need to work together to ensure that there are no significant negative impacts on the reserve system. Where appropriate, collaboration between the stakeholders may be needed. This may be in the form of holding stakeholder workshops or convening working groups to address issues as they arise. The onus will be on the relevant stakeholder to organise such collaboration where ever appropriate or necessary.

### **8.2.3 Reserve Identification**

A set of access markers have been in place identifying the Pelican Lagoon Aquatic Reserve for a number of years. In 2009 a new sign was erected in the area to make it easier for people entering the lagoon to identify it as an aquatic reserve. The new sign is displayed in Figure 5.

**Figure 5 Newly erected (in 2009) sign at entrance to Pelican Lagoon.**



### **8.3 REVIEW OF RESERVE MANAGEMENT ARRANGEMENTS**

Management plans have duration up to 10 years under the *Fisheries Management Act 2007*, with a major review scheduled at 5 years. The review will allow consideration of whether the current arrangements are effective in reducing threats to the aquatic reserve. A review may be carried out at any time during the life of the management plan and may be hastened if there are concerns about the integrity of the aquatic reserve.

A review of the management arrangements will be based on the best information available at the time to PIRSA.

### **8.4 COMPLIANCE**

Voluntary compliance with the management arrangements of the aquatic reserve is the goal of fisheries management. The community has an important role to play in abiding by and modelling behaviour consistent with the regulatory arrangements in place to manage the aquatic reserve, which will assist in promoting the sustainability of natural resources for present and future generations.

PIRSA uses several strategies to ensure voluntary compliance with the current management arrangements, including;

- Physical presence of compliance officers in the area;

- Public education through signs and other media; and
- Information gathering through FISHWATCH reporting line.

There are a number of other deterrent and enforcement tools, which include fines, prosecution and seizure of equipment used to offend. These tools are aimed as a deterrent in the first instance and as a last result if voluntary compliance fails.

## **8.5 ON-GROUND WORKS**

There are a number of on ground works that could have a significant impact on the Pelican Lagoon Aquatic Reserve. These on ground works are mainly external and involve surrounding land use and local land development for residential use. To ensure that the surrounding land use is managed in a way that minimises disturbance to the aquatic reserve, PIRSA will work closely with the KINRM Board and DEH.

The other major development in the area is proposed residential subdivisions and increased build up of residential areas surrounding the reserve. These may have an impact on the Pelican Lagoon area through run-off from stormwater and the potential for increased use of the area.

## **8.6 ACTIVATING COMPLEMENTARY LEGISLATION**

There are a number of relevant legislative instruments that can be activated to maintain the sustainability of the Pelican Lagoon Aquatic Reserve and the surrounding areas. These range from Acts and regulations governing terrestrial use of land surrounding the aquatic reserve to policies followed by local government when addressing development proposals.

The legislation can be activated through co-operation between PIRSA and the relevant department or local government to ensure that the best possible practices are in place to ensure the sustainability of the aquatic habitat.

Complementary legislation includes:

- *Natural Resources Management Act 2004*
- *Coast Protection Act 1972*
- *Development Act 1993*
- *Environmental Protection Act 1993*
- *National Parks and Wildlife Act 1972*
- *Native Vegetation Act 1991*
- *Aquaculture Act 2001*
- *Local Government Act 1999*
- *Harbours And Navigation Act 1993*
- *Marine Parks Act 2008*
- *Aboriginal Heritage Act 1982*

## 9 REFERENCES

- Bryars, S. (2003). *An Inventory of Important Coastal Fisheries Habitats in South Australia*. Fish Habitat Program, Primary Industries and Resources South Australia.
- Fowler, A.J., Jones, G.K. and McGarvey, R. (2002) *Characteristics and consequences of movement patterns of King George whiting (Perciformes: Sillaginodes punctata) in South Australia*. Marine & Freshwater Research, 53, 1 – 14.
- Gaylard, S. (2005). *Ambient Water Quality of Nepean Bay, Kangaroo Island*. Report No 1: 1999-2004. Environment Protection Authority.
- Haines, P.W. (2000). *Deposit of Terminal Eocene Age, South Australia: The Inferred Effects of a Low-Angle Multiple Impact Event*. Catastrophic Events Conference, July 9-12, Vienna.
- Jones, G. K. (1980) *Research on the biology of spotted (King George) whiting in South Australian waters*. SAFIC Magazine, 4 (1), 3 – 7.
- Kailola, P.J., Williams, J.M., Stewart, C.P., Reichelt, E.R., McNee, A. and Grieve, C. *Australian Fisheries Resources*. Bureau of Resource Sciences, Department of Primary Industries and Energy, and the Fisheries Research and Development Corporation. Canberra, Australia. Imprint Limited, Brisbane.
- Kangaroo Island Natural Resources Management Board. (2010). *Draft Pelican Lagoon Issues Paper*
- Kinloch, M.A, Brock, D.J. and Lashmar, K.G. (2009) *Kangaroo Island Marine Pest Surveys 2008-2009*. KI NRM Board Coast and Marine Program Report No. CMP09/008.
- Noell, C & Ye, Q. (2008) *Southern Sea Garfish*. In: Shepherd, S. A., Bryars, S., Kirkegaard, I., Harbison, P & Jennings J. T. (eds) *Natural History of Gulf St Vincent*. Publ. Royal Soc. Of South Australia. Pp 429 - 436
- OzEstuaries. (2001). *National Land & Water Resources Audit*. Geoscience Australia.
- Scott, L.C., Boland, J.W., Edyvane, K.S. & Jones, G.K. (2000) *Development of a seagrass-fish habitat model. 1. A seagrass residency index for economically important species*. Environmentrics, 11, 541 - 552
- Teasdale, J., (2009). *People and Pelican Lagoon – Environmental Challenges*. (Unpublished). South Australia.
- Tyler, M.J., Twidale, C.R., Ling, K. K. (1979) *Natural History of Kangaroo Island*. Royal Society of South Australia. Graphic Services Pty Ltd. Adelaide. South Australia.

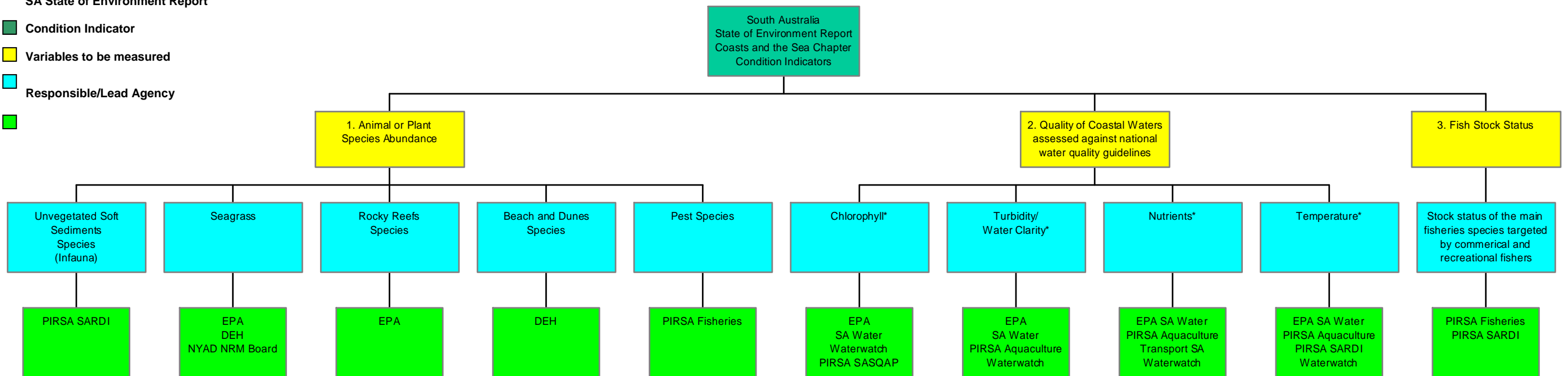
# 10 APPENDIX: CONDITION INDICATORS

South Australian State of the Environment Report 2008: Coasts and the Sea Chapter Indicators as recommended by the Marine and Coastal Managers Forum

## KEY

SA State of Environment Report

- Condition Indicator
- Variables to be measured
- Responsible/Lead Agency
- 



\*Indicators will be measured across SA's significant habitats (soft sediments, seagrasses, mangroves, saltmarshes, rocky reefs, beach/sand dunes and estuaries where relevant). Some of these habitats are currently measured by the agencies listed, however there are still some gaps to address.

