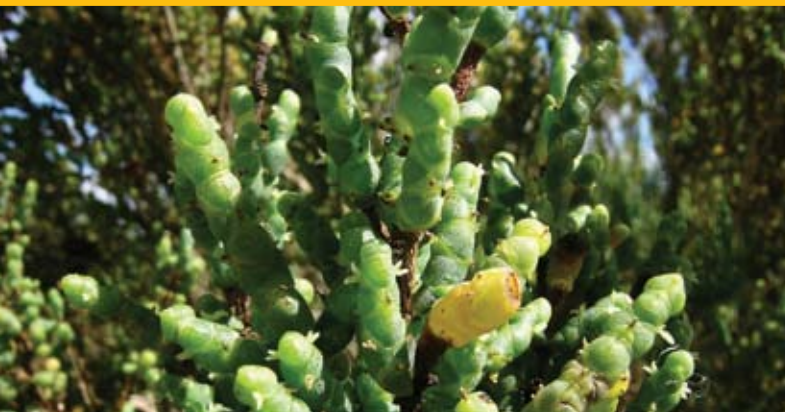


Department for Environment and Heritage

Northern and Yorke Natural Resources Management Region



Estuaries Information Package



Government
of South Australia



Australian Government



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Overview

The Northern and Yorke Natural Resources Management region (NY NRM region) is one of eight NRM regions within the State (see Figure 1). The region covers over three million hectares and includes large expanses of coast and marine waters. Sixteen estuaries have been identified across the region. These provide substantial environmental, economic and social values to the community.

Environment

- The nine estuaries identified in the National Land and Water Resources Audit (NLWRA) are tide dominated, with the exception of the Light River Delta which is river dominated.
- Many of the estuaries are ephemeral (ie flow only for short periods), with poor connectivity between the watercourse and ocean.
- Most of the estuaries in the region and their catchments have been modified to some degree, with all of the estuaries included in the NLWRA (2001) identified as modified or extensively modified.

Conservation and Protection

- Extensive saltmarshes, mangroves, mudflats and seagrasses support a variety of internationally and nationally protected bird species and commercially important fish species.
- The nationally and State vulnerable bead samphire *Halosarcia flabelliformis* (*Environment Protection and Biodiversity Conservation (EPBC) Act 1999, National Parks and Wildlife (NPW) Act 1972*) is present around the Light River Delta and Wakefield River estuary.
- All of the estuaries, with the exception of Salt Creek/Coobowie Inlet (Yorke) and Pavy Creek, are included in the Directory of Important Wetlands in Australia.
- The Light River Delta fulfils the criteria of World Conservation Union (IUCN) category II protection.

Cultural and socio-economic values

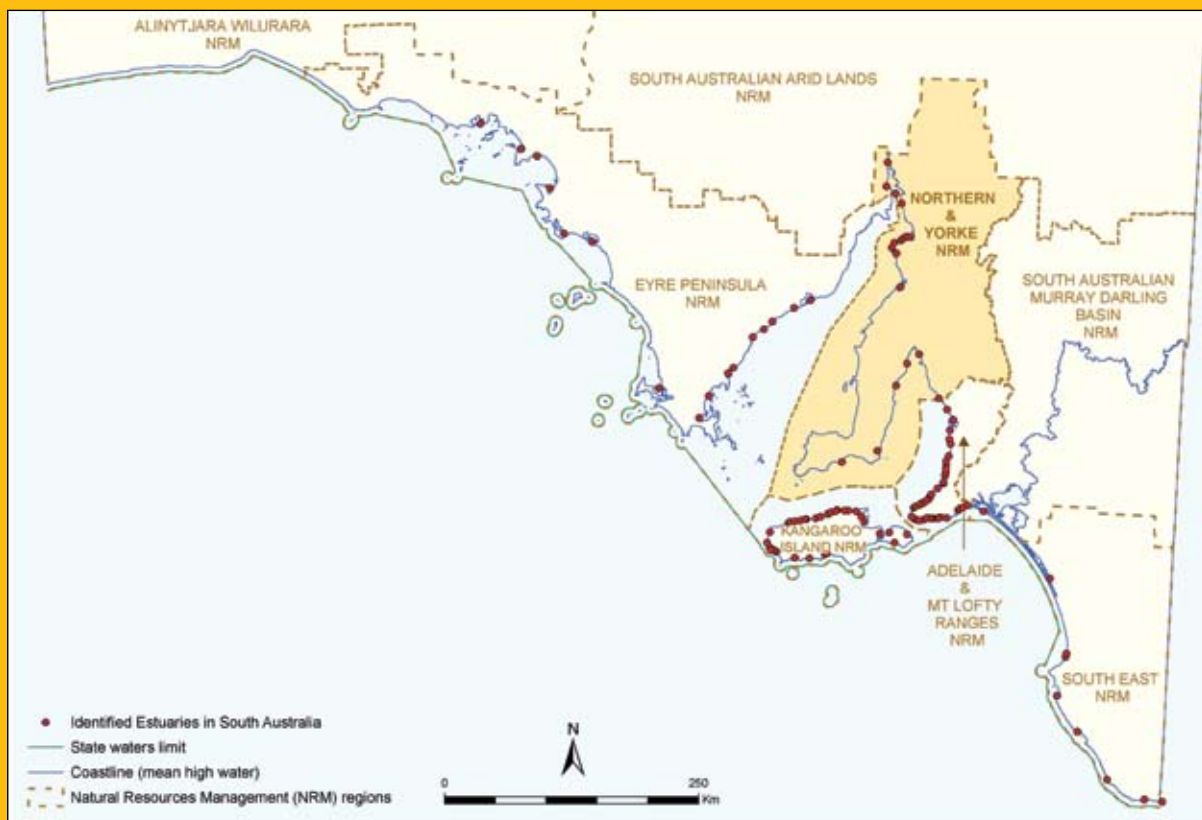
- There are several significant Aboriginal heritage sites associated with the region's estuaries.
- The Port Augusta wharf is the only site associated with estuaries in the region included in the State Heritage Register.
- The main economic activities in the region include: agriculture, industry, recreation, tourism and urbanisation.
- Many of the estuaries provide significant economic benefits to the community through employment, tourism, agricultural activities and international exports.



Issues and initiatives

- Estuaries are under pressure from a range of activities including land use, recreational pursuits, and agricultural and industrial practices that are impacting on estuarine condition.
- Several initiatives are underway that aim to increase our understanding about the local estuarine environments and to better manage and protect the NY NRM region's estuaries.

Figure 1. The NY NRM region and identified estuaries in South Australia





1. Introduction

The South Australian Department for Environment and Heritage (DEH), with support from the Australian Government's Natural Heritage Trust, has developed this estuaries information package (EIP) for the Northern and Yorke (NY) region to support natural resources management (NRM) bodies, State and local government and other agencies in undertaking planning and management in estuarine areas.

There are four other EIPs in the series for South Australia: Eyre Peninsula (EP), Adelaide and Mount Lofty Ranges (AMLR), Kangaroo Island (KI) and South East (SE) NRM region EIPs.

Each EIP consists of information collated from various sources relevant to the estuaries within that region. As a result, some key information gaps and potential directions have been included as a guide for management options for South Australia's estuaries.

As part of the State NRM Plan 2006, one of the resource condition targets for water is that by 2015, no further net loss of wetlands or estuaries, extent or condition, has occurred compared to 2006.

2. What is an estuary?

Estuaries and the land surrounding them are places of transition - where water from the land meets and mixes with the sea. They may be large or small systems, influenced by tidal exchange, stormwater discharge or groundwater intrusion.

Fluctuating salinity levels occur in estuaries. A variety of flora and fauna species have been able to adapt to these conditions and live within the estuaries.

Estuaries are generally highly productive systems that are essential for the health and well being of the marine environment. The health of the estuary is very dependent on the catchment-coast-ocean connection. Land management practices and land uses occurring upstream and on the adjacent lands have the potential to affect water quality, animal life and habitats within the estuary.

The *Natural Resources Management Act 2004* defines an estuary as:

'A partially enclosed coastal body of water that is either permanently, periodically, intermittently or occasionally open to the sea within which there is a measurable variation in salinity due to the mixture of seawater with water derived from on or under the land'.

The Act also notes that an estuary may include any ecosystem processes or biodiversity associated with an estuary and estuarine habitats adjacent to an estuary.



3. Estuaries of the NY NRM region

3.1 Estuary classification

Sixteen estuaries have been identified for the region by an across-agency Estuaries Working Group (see Figure 2). Further information on estuary classification, maximum length, perimeter and water area is contained in Table 1, and catchment size where available for each estuary is shown in Table 2 (First, Second Third and Fisherman Creeks and the Port Davis Creek/Broughton River are within the same catchment).

3.2 Regional NRM Groups

The NY NRM region is separated into three areas¹ for management purposes: Upper North, Lower North and Yorke Peninsula NRM Group areas (see Figure 2). Within each of these group areas there are estuaries with differing features, functions and pressures.

It is a role of the NRM Groups, in consultation with other organisations, to oversee and implement a range of management actions to protect those estuaries within each of their group's boundaries.

3.3 Coastal councils

Eight coastal councils are located within the NY NRM region, with a varying number of estuaries in each (see Figure 3). Although land-based influences can occur upstream in non-coastal council areas (and there is a duty of care for upstream councils), it is the coastal councils that have direct responsibility for managing estuaries within their boundaries.

Port Pirie Regional Council contains six estuaries identified in the region followed by the District Council of Yorke Peninsula with four estuaries. The Port Augusta City Council contains two estuaries, whilst the District Councils of Mount Remarkable and Barunga West and Wakefield Regional Council each contain one estuary. The District Council of Mallala has two estuaries, however only one falls within the boundaries of the NY NRM region. The District Council of The Copper Coast is the only council in the region to have no estuaries located in its boundaries.

¹ These NRM Group areas have been established by the NRM Board as part of the initial concept statement for the region. These areas maybe subject to change (NY NRM Board 2006).

Figure 2. Estuaries of the NY NRM region

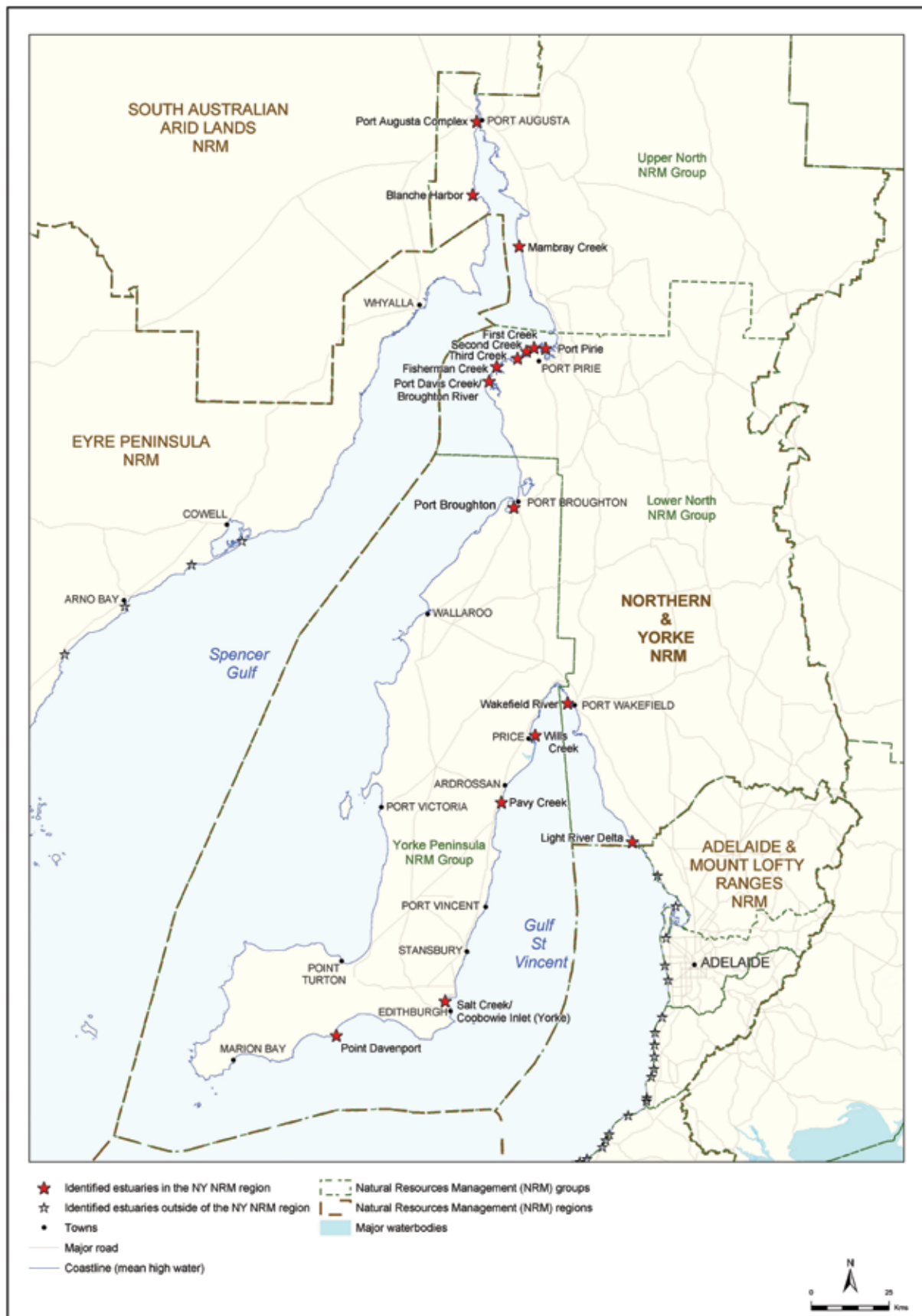


Table 1. NY NRM region estuary classification and size

Estuary	Classification	Sub classification	Approximate size of estuary (maximum length, perimeter and water area) L = length (km) P = perimeter (km) A = area (km ²)
Port Pirie River	Tide dominated	Tidal flat/creek	L = 12.33 P = 50.40 A = 14.65
Third Creek	Tide dominated	Tidal flat/creek	L = 2.51 P = 6.29 A = 0.35
Second Creek	Tide dominated	Tidal flat/creek	L = 3.07 P = 8.89 A = 0.70
First Creek	Tide dominated	Tidal flat/creek	L = 1.53 P = 3.43 A = 0.10
Fisherman Creek	Tide dominated	Tidal flat/creek	L = 3.59 P = 14.43 A = 0.75
Port Davis Creek/ Broughton River	Tide dominated	Tidal flat/creek	L = 6.92 P = 17.99 A = 0.77
Port Broughton	Tide dominated	Tidal flat/creek	L = 11.10 P = 43.49 A = 19.28
Wakefield River	Tide dominated	Tidal flat/creek	L = N/A P = N/A A = N/A
Light River Delta	River dominated	Tide-dominated delta	L = 1.15 P = 2.42 A = 0.06

Note: only those estuaries mapped as part of the NLWRA (2001) are included in Table 1.

Table 2. Estuaries and their associated catchment size

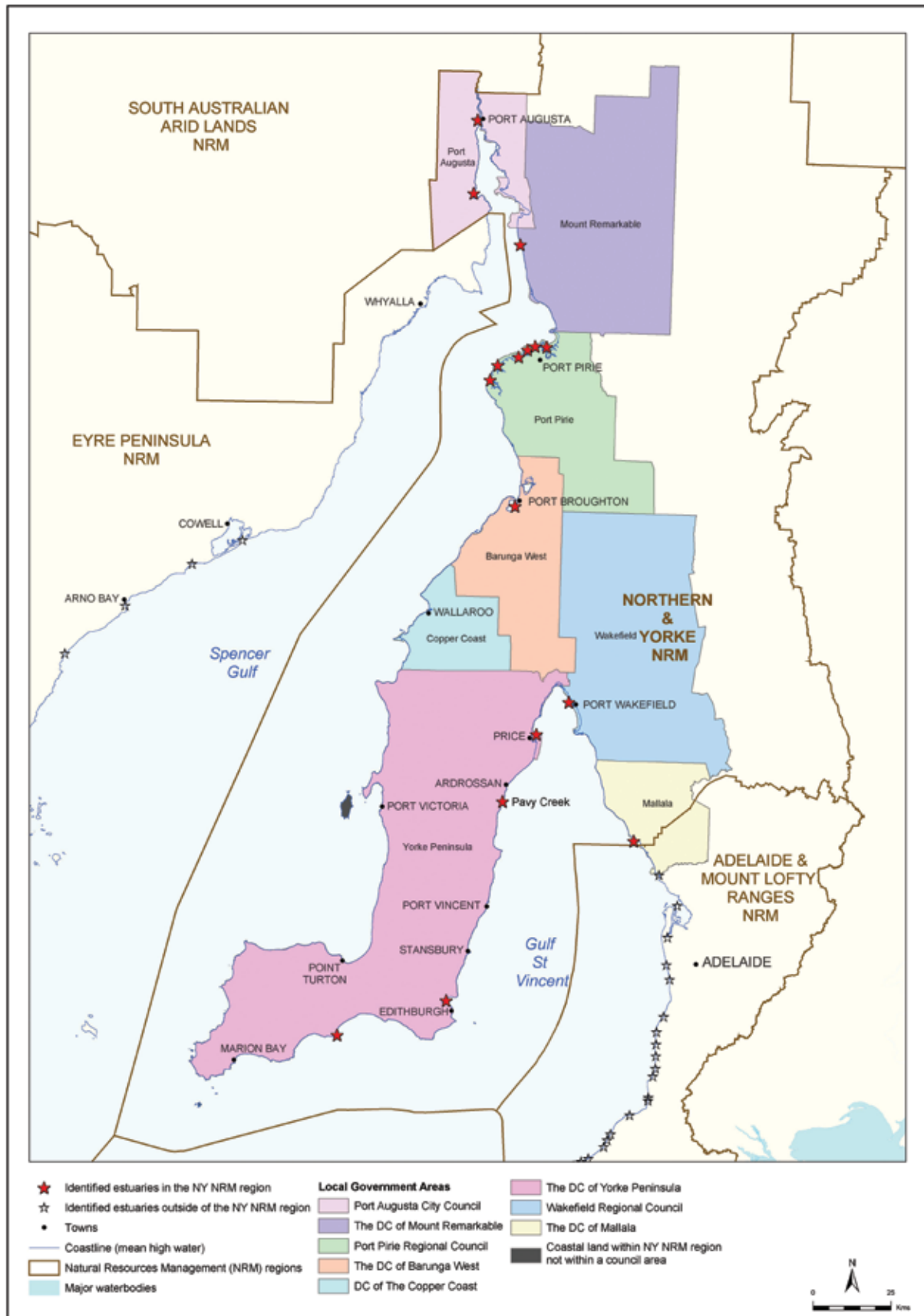
Estuary	Catchment size (km ²)	Estuary	Catchment size (km ²)
Blanche Harbor	N/A	Port Davis Creek/ Broughton River	5,651
Port Augusta Complex	N/A	Port Broughton	N/A
Mambray Creek	1,738	Point Davenport (Scott Creek)	N/A
Port Pirie River ²	7,389	Salt Creek/Coobowie Inlet	N/A
First Creek	5,651	Pavy Creek	N/A
Second Creek	5,651	Wills Creek	N/A
Third Creek	5,651	Wakefield River	691
Fisherman Creek	5,651	Light River Delta	1,745

Source: surface-water catchments – DWLBC

Note: although every effort has been made to ensure the accuracy of the statistical information provided from the spatial data, errors in the spatial data are possible.

² The Port Pirie estuary encompasses two catchment areas: Mambray Coast (1,738 km²) and Broughton River (5,651 km²).

Figure 3. Estuaries located within coastal council areas





4. Surface water, groundwater and marine areas

4.1 Environmental flows

Most of the estuaries in the region are either tidal channels or represent the mouth of ephemeral rivers. There is limited water exchange between fresh and marine waters. Table 3 shows environmental flow information where available.

4.2 Groundwater influence

Groundwater features in the NY NRM region are shown in Figure 4. Groundwater is likely to contribute to stream flow in the Light River Delta, Wakefield River and the Port Davis/Broughton River estuaries, particularly in the winter months due to the shallow watertable.

4.3 Marine bioregions and biounits

A marine bioregion is an area within the marine environment that has distinctive biodiversity and can consist of several smaller biounits. Each marine biounit is defined primarily on the basis of coastal physiography, topography and major marine physical habitat or seascape features of habitat distributions at a scale of 100 km². For further information see: http://www.environment.sa.gov.au/coasts/marineparks/background/marine_bioregions.html.

The NY NRM region covers four marine bioregions and twelve biounits (see Figure 5). The estuaries from the Light River Delta to Point Davenport are within the Gulf St Vincent bioregion, whereas those from Port Broughton to Blanche Harbor are located in the North Spencer Gulf bioregion. Estuaries are located in the following marine biounits within the region: Clinton, Orontes, Sturt, Yonga and Winninowie. While there are other marine biounits in the region, no estuaries occur within them.

Table 3. Environmental flow information

Estuary	Environmental flow
Port Davis Creek/Broughton River	This creek has no freshwater baseflow, with connection only occurring during medium flow events and through tidal exchange. The last known connection to the sea occurred prior to 1998 (Favier et al. 2004, Lloyd 2000).
Wakefield River	This is an ephemeral river with a highly erratic pulse system. A mid flow is required for fish migration between the freshwater and marine environments, as well as for connectivity, physical habitat generation and organic matter pulses (Favier et al. 2000).
Light River Delta	A variable flow regime is a natural characteristic of this river. It is an ephemeral river, with river flow reaching the estuary annually between late winter and spring. It is likely that low to mid flows are important for the migration of fish and higher flows are important for fish breeding (Vanlaarhoven et al. 2004).

Figure 4. Groundwater watertable depth and groundwater basins

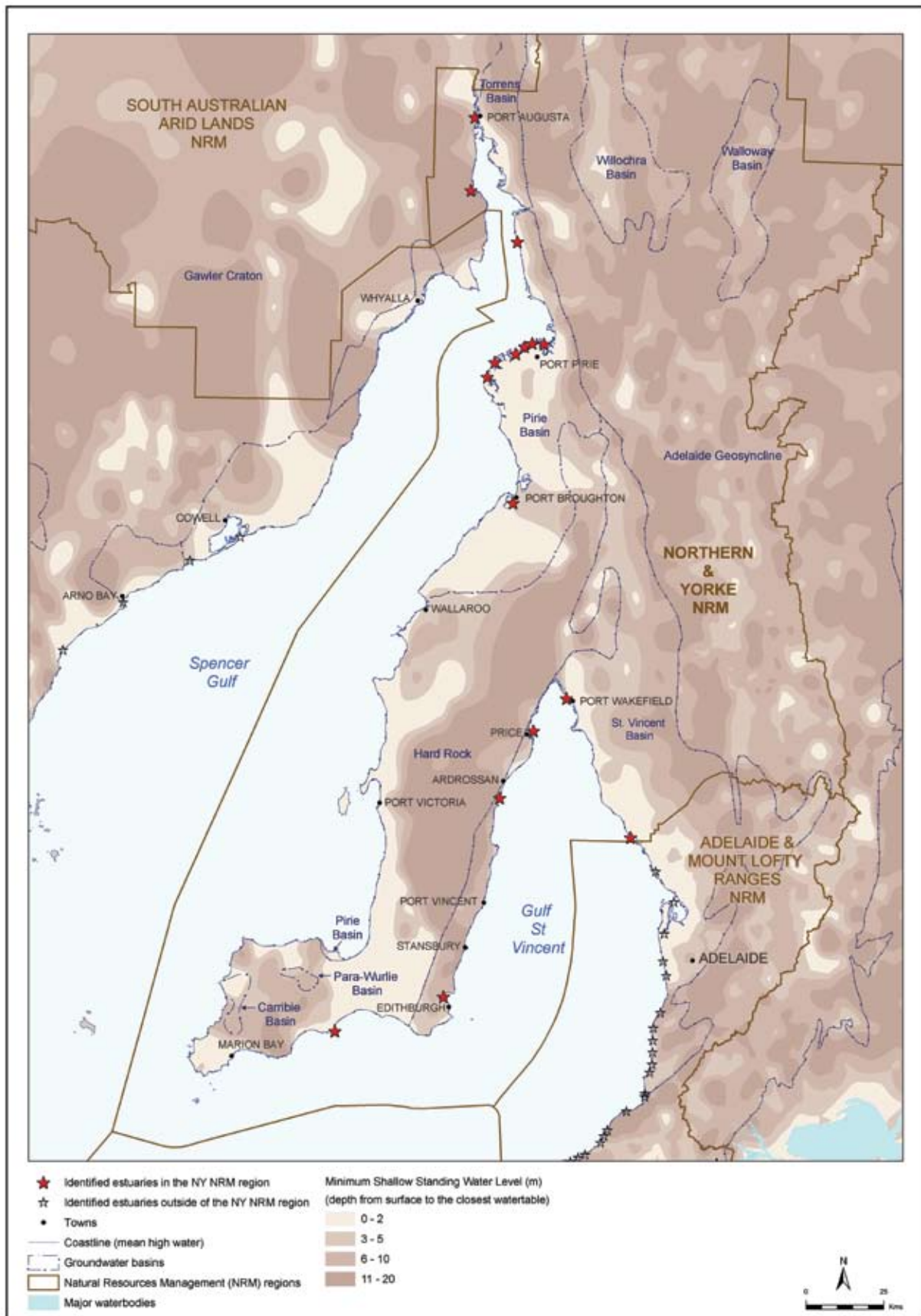
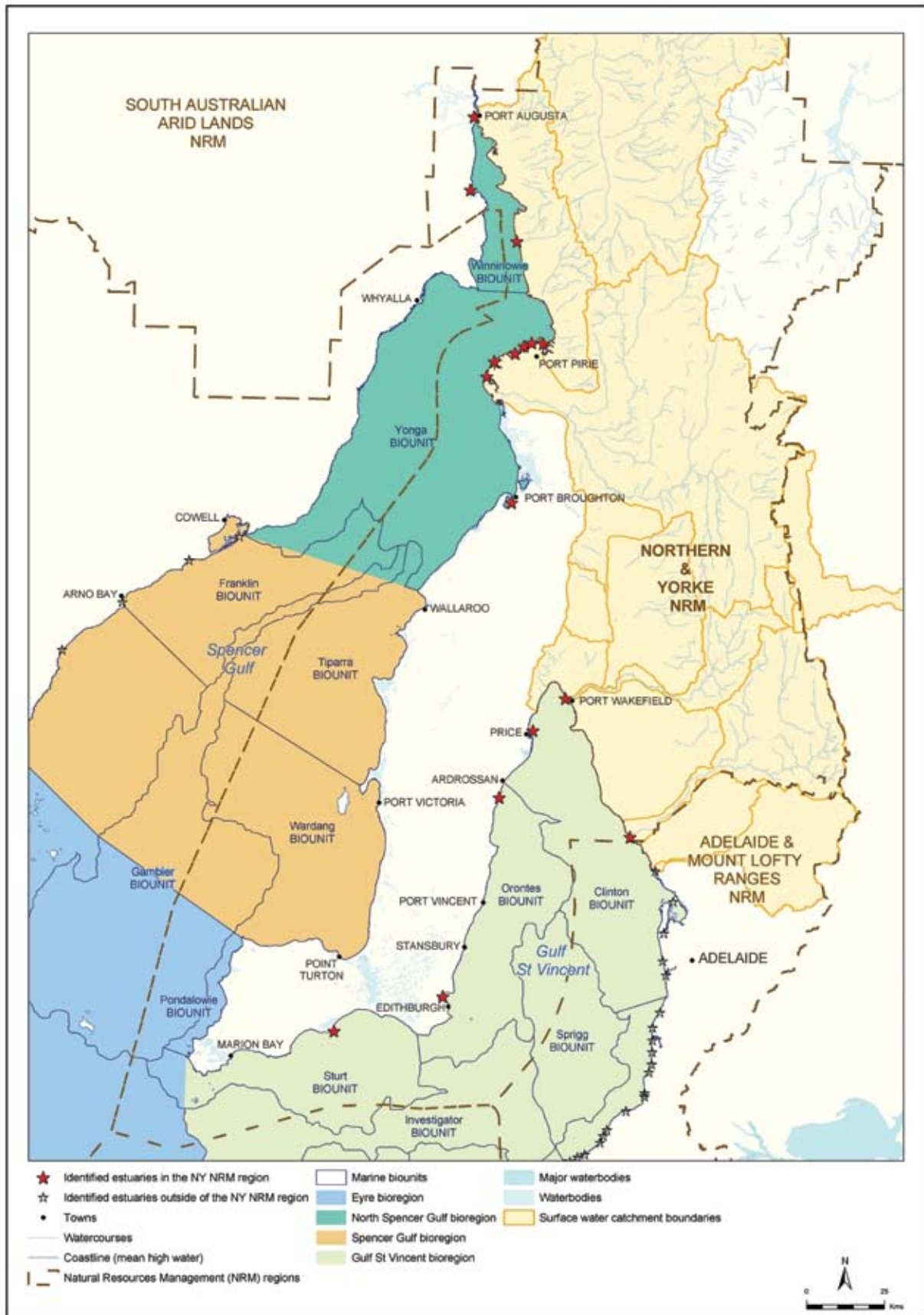


Figure 5. Marine bioregions and biounits



5. Habitats of the NY NRM region's estuaries

The mangrove, saltmarsh and seagrass communities within this region are considered to be important ecological communities due to the habitats they provide for a range of marine flora and fauna (Graham et al. 2001) (see Figure 6 and Table 4).

5.1 Floodplains

Floodplains can provide valuable habitat and act as a refuge for migratory birds and other animals during the dry season (Turner et al. 2004). Plant species most commonly found in the floodplain include *Melaleuca* species, sedges and grasses.

5.2 Saltmarshes

Within this region, intertidal and supratidal samphires³ are a common feature (Table 4). The most extensive communities of samphire extend from Port Pirie to the Port Davis/Broughton River estuary and from Wills Creek to the Light River Delta (see Figure 6).

Of note is the nationally and State vulnerable bead samphire *Halosarcia flabelliformis* (EPBC 1999, NPW Act 1972), present in the coastal fringe around Gulf St Vincent and in Northern Spencer Gulf (see <http://www.flora.sa.gov.au/>).

Clearance of saltmarsh (samphire) without consent can be an offence under the *Native Vegetation Act 1991*. Note there are exemptions.

Saltmarshes are under threat from inappropriate use, networks of access tracks through the saltmarsh communities, off-road vehicles and illegal dumping of rubbish. Projected sea level rise resulting from climate change will likely cause habitat retreat and have secondary impacts on fish and many other species dependent on saltmarsh habitat for survival.

5.3 Intertidal mudflats

Mudflats are home to a range of invertebrate species such as polychaete worms, amphipods, molluscs and crustaceans. The tidal cycle also increases the use of the mudflats by other animals (eg crabs), and provides feeding sites for migratory shorebirds.

5.4 Mangrove communities

Nearly half of the State's mangroves are located within the NY NRM region, with extensive mangrove networks surrounding many of the estuaries (see Table 4 and Figure 6) (Graham et al. 2001). Mangroves surrounding the Light River Delta represent one of the largest areas of pristine mangroves in South Australia (DC MFAC 2002).

The NY NRM region's mangroves are under threat from increased nutrient loading, sedimentation and heavy metals from industrial and sewage effluent, urban and agricultural runoff, hydrocarbons from oil spills, physical disturbance and destruction from dredging, anchoring and human trampling (Bryars 2003).

Mangroves are protected under the *Fisheries Management Act 2007*, in addition to the *Native Vegetation Act 1991*.

5.5 Seagrass communities

Gulf St Vincent and Spencer Gulf contain the most abundant areas of seagrass in South Australia (NYAD INRM 2003) (see Figure 6).

Seagrasses in the Northern Spencer Gulf bioregion provide habitat for many species. One of South Australia's most important commercial and recreational fish, the King George whiting *Sillagnodes punctata*, spends much of its post larval and juvenile stage in beds of eelgrass *Zostera* spp. Many marine invertebrates, eg polychaete worms and seastars, also dwell amongst seagrass communities.

Seagrasses in this region are under pressure from a range of influences such as agricultural and urban runoff, wastewater and industrial effluents (Bryars 2003).

³ Samphires are saltmarsh plants dominated by the family *Chenopodiaceae*.



Table 4. Saltmarshes, mangroves, seagrass and intertidal mudflats mapped in the National Land and Water Resources Audit

Habitats (km ²)	Port Pirie River	First Creek	Second Creek	Third Creek	Fisherman Creek	Pot Davis/Broughton River	Port Broughton	Wakefield River	Light River Delta
Saltmarshes¹	16.2	5.3	17.3	9.9	25.2	25.2	4	2.5	3.1
Mangroves²	12.8	1.9	4.7	1.7	3.1	2.9	1.2	1.4	0.9
Seagrass³	5.2	0.1	1.4	2.1	0.9	0.9	23	0.4	0.1
Intertidal mudflats	0.1	1.00	0.3	0.5	0.7	1.0	3.7	0.3	0.1

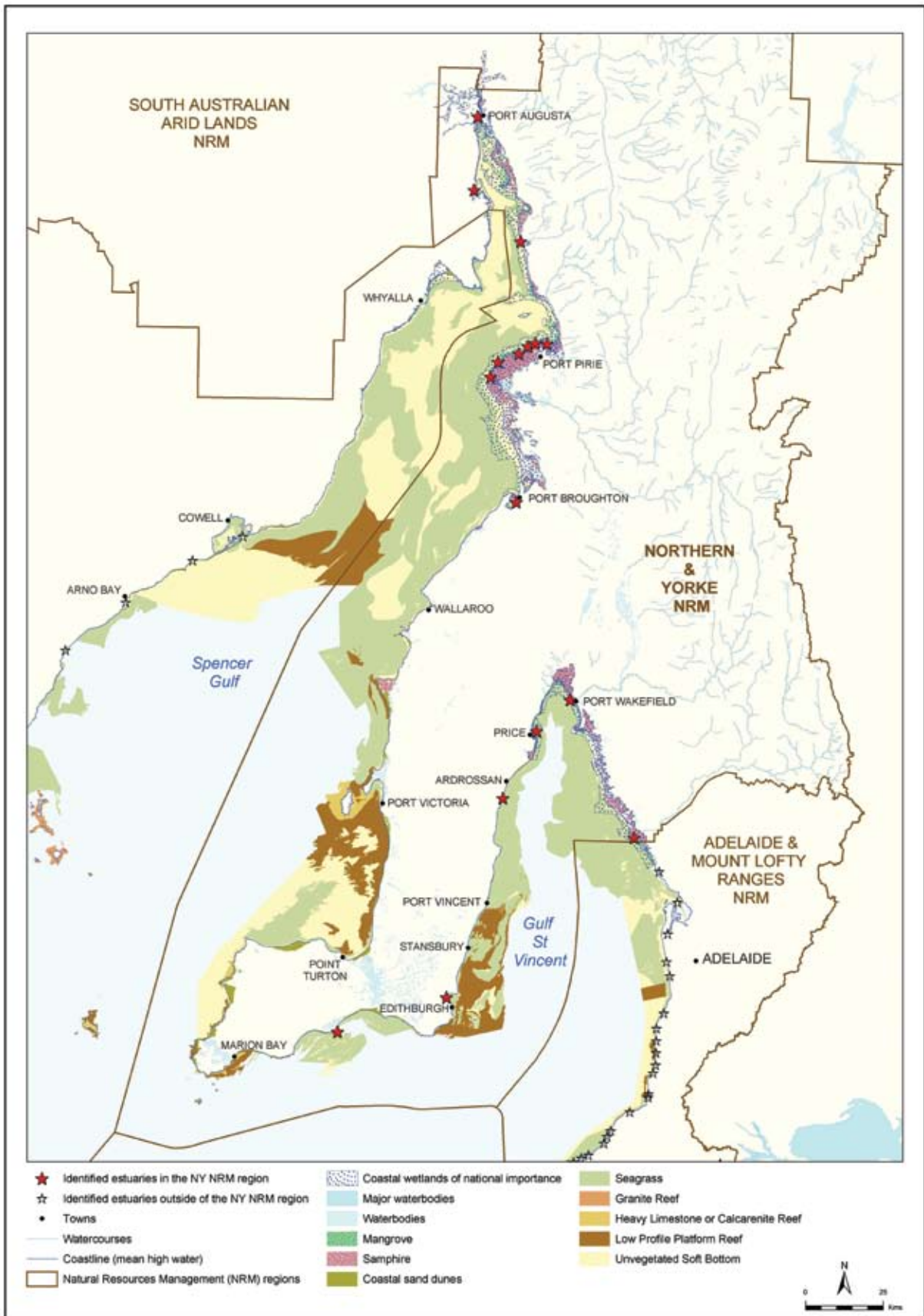
Note: only mapped estuaries included in the NLWRA (2001) are shown in the Table 4.

¹ Saltmarsh species include: *Sarcocornia* spp., *Halosarcia* spp., *Sclerostegia* spp., *Suaeda* spp., *Atriplex* spp. and *Maireana* spp.

² Only one species of mangrove, the grey mangrove *Avicennia marina*, is represented in South Australia.

³ Seagrass species include: *Posidonia* spp., *Zostera* spp., *Lepilaena* spp., *Amphibolis* spp., and *Ruppia* spp.

Figure 6. Habitats within and surrounding estuaries





6. Internationally and nationally protected bird species

The coastline of the NY NRM region provides important feeding, nesting and roosting habitats for a suite of coastal waterbird species (see Appendix 1), with over 120 species and 60,000 individuals visiting or resident within the region (Graham et al. 2001). In the *National Plan for Shorebird Conservation in Australia*, Spencer Gulf (with 10 internationally and 12 nationally important species listed) (EPBC Act 1999 and international treaties), Price saltfields (8 and 10) and Clinton Conservation Park (6 and 7) were rated among the top 5 sites in South Australia in terms of providing habitat for more than 1% of the worldwide population of five or more shorebird species (Watkins 1993).

The Sapphire Coast region extends from Port Gawler to Ardrossan and is a significant site for shorebirds. It supports four internationally important bird species with estimated populations of at least 0.5% of the world population (DC MFAC 2002). These bird species are the red-capped plover *Charadrius ruficapillus* (EPBC Act 1999), sharp-tailed sandpiper *Calidris acuminata* (EPBC Act 1999 and international treaties), red-necked stint *Calidris ruficollis* (EPBC Act 1999 and international treaties) and the banded stilt *Cladorhynchus leucocephalus*.

Wilson (2000) identifies the Port Augusta complex, Port Davis/Broughton River, Salt Creek/Coobowie and Wills Creek (Price saltfields) as important sites for wader birds in South Australia.

Important seabird sites are located around Port Pirie River, First Creek, Fisherman Creek, Salt Creek/Coobowie Inlet (Yorke) and Wills Creek (Copley, 1996).

Rare and threatened birds species (listed in the EPBC 1999 and NPW Act 1972) are documented in the *Biodiversity Plan for the Northern Agricultural Districts of South Australia* (Graham et al. 2001).

7. Fish and other marine life

Economically important fish within the region include the King George whiting *Sillagnodes punctata*, southern sea garfish *Hyporhamphus melanochir* and yellow-eyed mullet *Aldrichetta forsteri* (Appendix 2). Anadromous fish species, such as the congolli *Pseudaphritis urvillii*, and other native fish species, such as the small-mouthed hardyhead *Atherinosoma microstoma* and blue spot goby *Pseudogobius olorum*, have been recorded in several estuaries. The congolli *Pseudaphritis urvillii*, which is dependent on water exchange between coastal, estuarine and river environments for its recruitment, breeding and migration, is generally under threat in the region.

Several seahorses and pipefish from the internationally and nationally protected *Syngnathid* family (eg the pugnose pipefish *Pugnaso curtirostris* and the widebody pipefish *Stigmatopora nigra*) (EPBC Act 1999) have been recorded in seagrasses around the Port Pirie estuaries (McDonald pers. comm.).

In addition, crustaceans such as the blue swimmer crab *Portunus pelagicus* and the western king prawn *Penaeus latissulcatus*, and the razorfish *Aeoliscus strigatus* and mud cockle *Katelysia* spp. are found in the region's estuaries.

8. Protection arrangements of NY NRM region's estuaries

8.1 Parks and reserves

The Point Davenport (Scott Creek) estuary is located in the Point Davenport Conservation Park. Wills Creek has been identified as a new reserve but is yet to be proclaimed, and Blanche Harbor is also part of the Blanche Harbor-Douglas Bank Aquatic Reserve managed by Primary Industries and Resources South Australia (PIRSA) (see Figure 7).

Edyvane (2000) suggests that the Light River Delta fulfils World Conservation Union (IUCN) criteria Category II protection, having both fresh and saltwater wetlands, in addition to being abundant in bird life and plant species.

8.2 Wetlands of National Importance

Fourteen estuaries within the region are listed as wetlands of national significance in the Directory of Important Wetlands in Australia (DIWA) (refer to Table 5 and Figure 6). Only Pavy Creek and Salt Creek/Coobowie Inlet (Yorke) are not currently within the Directory. With the recent (2005) opening of the Coobowie Inlet, restoration of this estuary could potentially lead to its inclusion in the Directory in the future. The criteria for inclusion into the Directory are shown in Appendix 3.

Table 5. Estuaries included in the Directory of Important Wetlands in Australia

Wetland name	Estuaries included	Criteria for inclusion
Northern Spencer Gulf	<ul style="list-style-type: none"> • Blanche Harbor • Port Augusta Complex • Mambray Creek • Port Pirie River • First Creek • Second Creek • Third Creek • Fisherman Creek • Port Davis Creek/Broughton River • Port Broughton 	1, 3, 5, 6
Point Davenport	<ul style="list-style-type: none"> • Point Davenport (Scott Creek) 	1, 3, 5
Wills Creek	<ul style="list-style-type: none"> • Wills Creek 	1, 3
Clinton	<ul style="list-style-type: none"> • Wakefield River 	1, 3
	<ul style="list-style-type: none"> • Light River Delta 	

Source: EA (2001)

8.3 Register of the National Estate and State Heritage Register

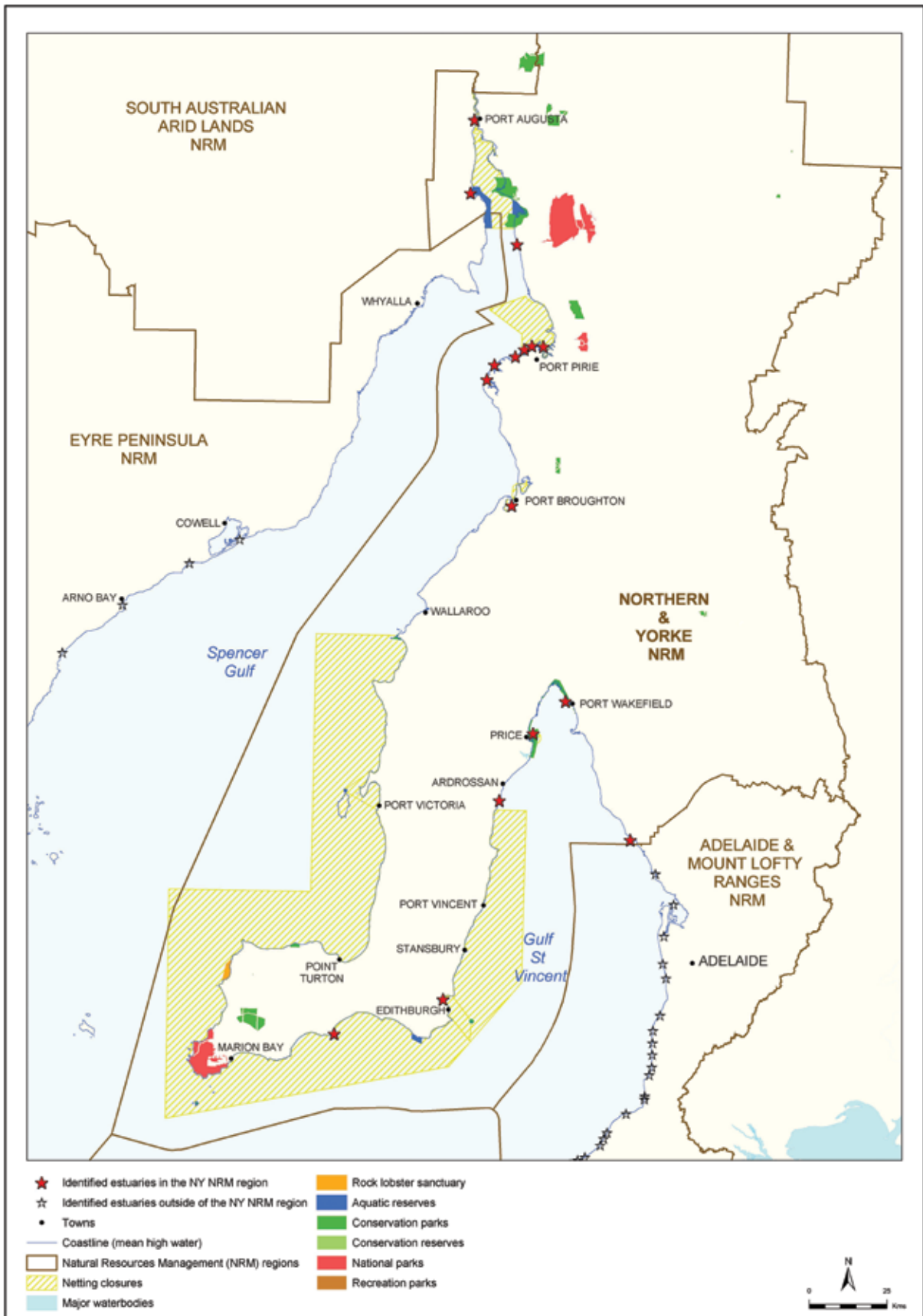
No significant sites associated with estuaries are registered with the National Estate within this region.

The Port Augusta wharf is the only site associated with estuaries included in the State Heritage Register (<http://www.environment.sa.gov.au/heritage/assess.html> - database).

Caton et al. (2005) recommended several coastal sites for entry in the State Heritage Register, of which the following are associated with estuaries:

- Port Broughton Jetty
- Salt Creek Causeway – Coobowie.

Figure 7. Conservation areas and aquatic reserves including estuaries



Note: Point Davenport Conservation Park cannot be represented due to its small area.



9. Cultural assets

The NY NRM region is rich in Aboriginal culture. Traditionally, more than six Aboriginal groups lived in the area including the Narrungga, Kurna, Nukuna, Ngadjuri, Meru and the Dangaii people (NYAD INRMC 2003).

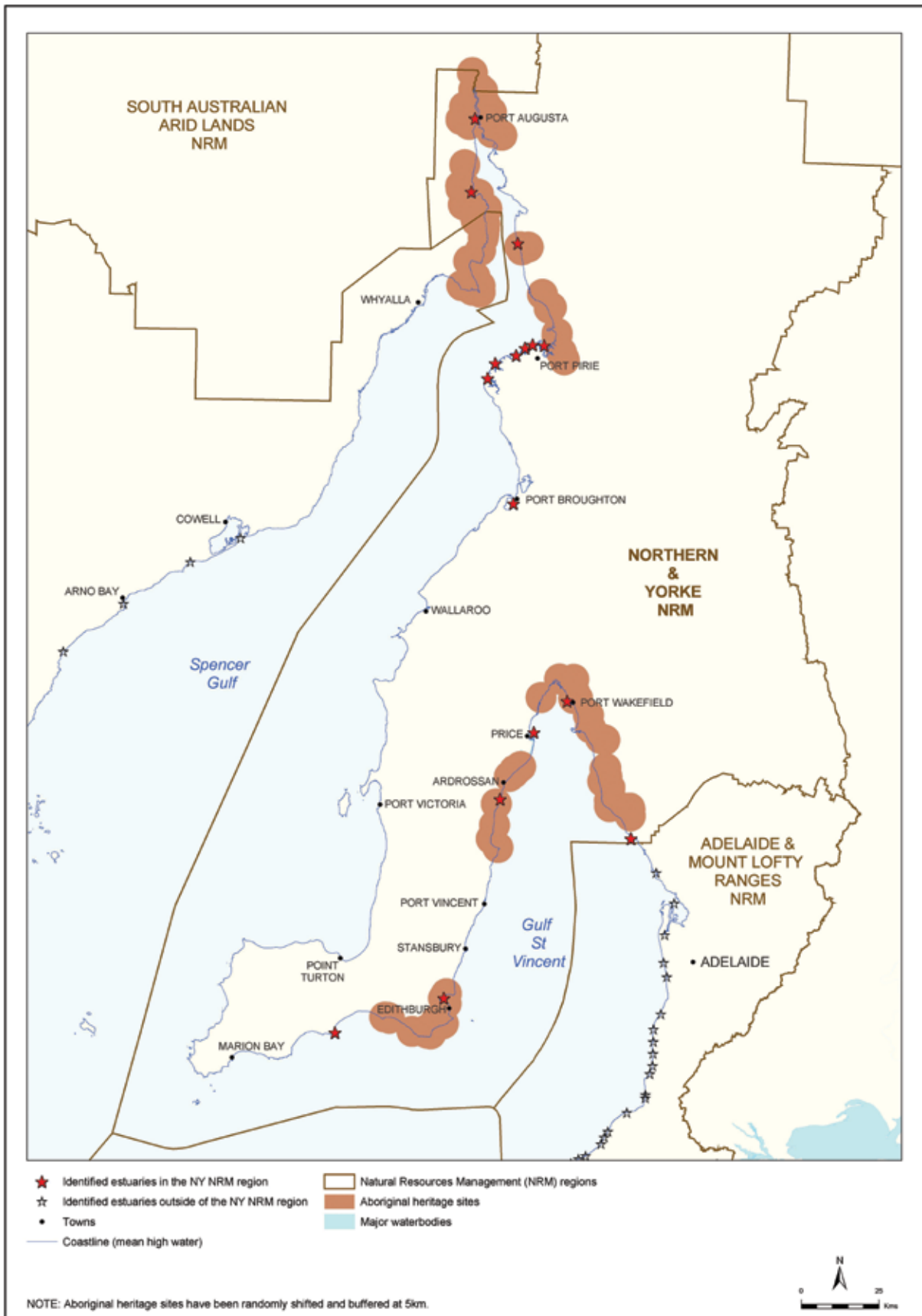
There are many Aboriginal sites of cultural significance associated with estuaries in the region. Although no sites are currently listed on the Register of the National Estate, several sites are recorded with the Department of Premier and Cabinet, Aboriginal Affairs and Reconciliation Division (see Figure 8). All Aboriginal sites, objects and remains of significance in South Australia are protected under the *Aboriginal Heritage Act 1988*.

The *Aboriginal Heritage Act 1988* provides protection for Aboriginal sites, objects, anthropology, history and tradition.

NOTE: Pursuant to section 23 of the *Aboriginal Heritage Act 1988 (SA)*, a person must not, without the authority of the Minister [for Aboriginal Affairs and Reconciliation] -

- (a) damage, disturb or interfere with any Aboriginal site; or
- (b) damage any Aboriginal object; or
- (c) where any Aboriginal object or remains are found -
 - (i) disturb or interfere with the object or remains; or
 - (ii) remove the object or remains.

Figure 8. Aboriginal heritage sites associated with estuaries





10. Economic and social regional importance

Much of the economic development within the region is strongly linked to the local environment, including the estuarine areas. Economic drivers for the region include:

- **Industry, eg mining, mineral processing and salt production**

Zinifex, the world's largest lead-zinc smelter (<http://www.zinifex.com/>) employs more than 650 people and Primo Australia (<http://www.primosmallgoods.com.au>), the largest manufacturer of smallgoods in Australia employs over 240 people, with expansion planned. Cheetham Salt (<http://www.cheethamsalt.com.au/>) located in Price is Australia's largest producer and refiner of salt for food and industrial markets.

- **Agriculture**

This region is rich in agricultural resources, providing one quarter of the State's agricultural-based earnings. Almost 80% of the region is devoted to agricultural activities, including growing cereals and legumes for grains, livestock and wool production (NYAD INRMC 2003).

- **Commercial fisheries and aquaculture**

Commercial fisheries species throughout the entire Spencer Gulf are valued at \$43.6 million (1999/2000) (DEH 2003), with the prawn fishery valued at \$31 million (PIRSA 2007). Within Gulf St Vincent, the prawn fishery has been valued at over \$3.7 million (2004/2005) (PIRSA 2007).

Aquacultural produce also contributes to the regional economy with 30 operators generating an output of \$7 million (2000/01) (NYAD INRMC 2003, <http://www.yorkeregion.com.au/>).

- **Tourism**

During 2005, Yorke Peninsula attracted a higher number of intrastate visits and visitor nights than any other tourism region within South Australia except for Adelaide and the Fleurieu Peninsula (SATC 2005).

Social values associated with all of the above activities are varied. Industries such as commercial fishing are thought to have multiplier effects for other industries, especially for increasing employment opportunities (Aslin and Bryon 2003). Even so, there are many health concerns arising from the impacts of some industrial emissions and discharges, and the '10 by 10' project has been introduced for Port Pirie to reduce lead levels in the blood of 95% of children in the area (DH 2005).

In a community attitudes survey completed in 2001 for the development of the South Australian Tourism Plan, the community indicated that tourism is more important to community prosperity and quality of life than agriculture, manufacturing, mining, wine or information technology (SATC 2002a, SATC 2002b). In addition, recreational activities such as boating and fishing are thought to enhance interpersonal skills, make people more adaptable to change and enhance community stewardship (Planning SA 2004).



11. Activities and pressures associated with estuaries of the NY NRM region

The NLWRA (2001) identified all of the estuaries included in the Audit as being in a modified or extensively modified condition⁴ and under moderate to high or high to very high pressure. Modifications to these estuaries have occurred over time to support human settlement and economic development and to provide recreational opportunities to the community. Each of these is linked to a range of activities occurring in and on the land surrounding the estuaries. These include:

- cropping and grazing
- salt production
- electricity supply
- wastewater disposal
- fishing, boating, camping
- tourism
- transportation of goods and services
- other industry usage
- petroleum, mining and geothermal exploration⁵.

(See Figure 9 and 10).

Some of the infrastructure and issues related to these activities are given in Table 6. Of note in the NY NRM region is the industrial infrastructure and marinas, as well as the potential for impacts arising from climate change, especially in low-lying coastal areas.

Additional pressures within estuaries across the region include land use (eg illegal rubbish dumping, use of off-road vehicles), regional developments, urban and agricultural runoff (eg stormwater and erosion), industry-based discharges, alterations to river flows and control of mosquitos and weed infestation.

⁴ Modified estuaries are generally recognised and documented as having some problems due to a complexity of impacts from within the catchment, waterway and estuary, whereas extensively modified estuaries are generally recognised and documented as having multiple problems (NLWRA 2001).

⁵ Both the *Petroleum Act 2000* and the *Petroleum (Submerged Lands) Act 1982* have similar requirements. Environmental values and appropriate protection measures must be identified prior to activities occurring in the affected area, eg coastal waters. *The Petroleum Act 2000* also requires existing management plans to be considered and incorporated into the objectives of the proposed activity prior to the mineral or petroleum industry receiving access. *The Mining Act 1971* further requires activities not to contravene the *Fisheries Management Act 2007*, which has provisions for aquatic reserves. Specific conditions can be placed on exploration licences on a case-by-case basis to ensure environmental values are protected.



Table 6. Some of the infrastructure, activities and issues within estuaries

	Feature	Location
Infrastructure	Boat ramps	<ul style="list-style-type: none"> • 4 at Port Augusta • 1 at Wills Creek, Port Broughton, Port Davis/Broughton River • 2 at Port Pirie • 2 at Port Wakefield (1 accessible)
	Marina/moorings	<ul style="list-style-type: none"> • 1 marina: Port Pirie • Moorings: Port Augusta complex, Port Broughton, Port Wakefield (available high tide only)
	Wastewater treatment plant (WWTP)	<ul style="list-style-type: none"> • Port Augusta – 2 WWTP • Second Creek – outfall for Port Pirie WWTP • Port Pirie – 1 WWTP
	Electricity plant	<ul style="list-style-type: none"> • Port Augusta
Activities	Industry	<ul style="list-style-type: none"> • Salt production (Light River Delta), salt works (Wills Creek) • Lead-zinc smelter (Port Pirie) • Proposed magnesium plant (Port Pirie)
	Aquaculture	<ul style="list-style-type: none"> • Salt Creek/Coobowie Inlet • Port Broughton (land-based facilities)
	Petroleum applications, mineral and petroleum licences	<ul style="list-style-type: none"> • Port Pirie to Port Davis/Broughton River – Petroleum exploration applications • Blanche Harbor, Port Augusta complex, Pavy Creek, Wills Creek, Port Wakefield – mineral exploration licences • Wakefield River – petroleum exploration licences
Issues	Coastal acid sulfate soils ⁶	<ul style="list-style-type: none"> • Potential acid sulphate soils: Port Augusta Complex, Port Pirie to Port Davis, Port Wakefield and the Light River Delta.
	Climate change	<p>Possible sea level rise, increase in water temperature and CO₂ absorption, and likelihood of more frequent storm events. One of the impacts of climate change will be habitat retreat, particularly for mangroves and saltmarshes.</p>

Sources: Topography - boat ramps – DEH, Coast Protection Branch

Acid sulfate soils – Coast maps, Government of SA

Marina/moorings – DEH

Note: although every effort has been made to ensure the accuracy of the statistical information provided from spatial data, errors in the spatial data are possible.

⁶ Coastal acid sulfate soils are soils that generate sulfuric acid when exposed to oxygen.

Figure 9. Activities occurring in and around estuaries

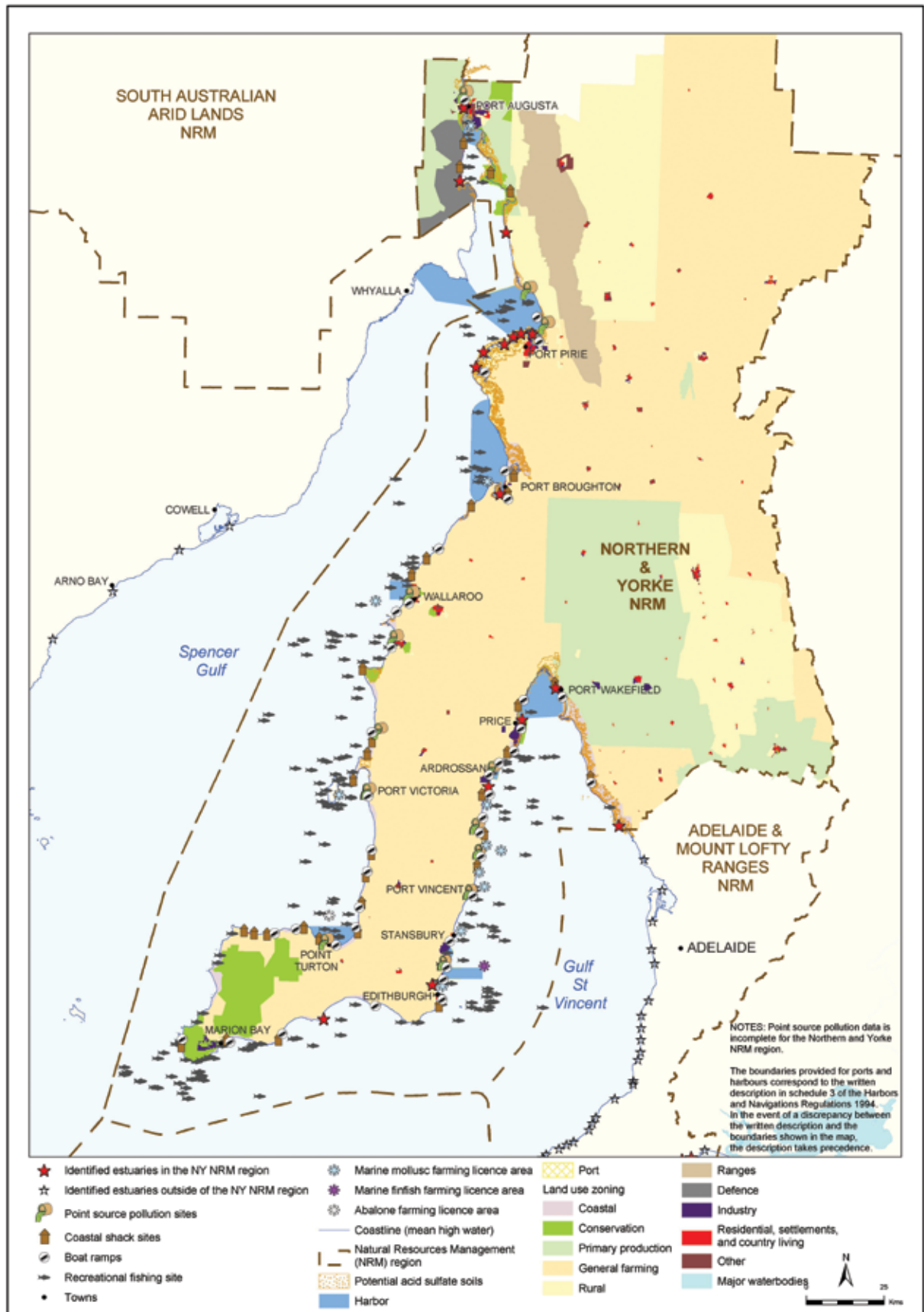
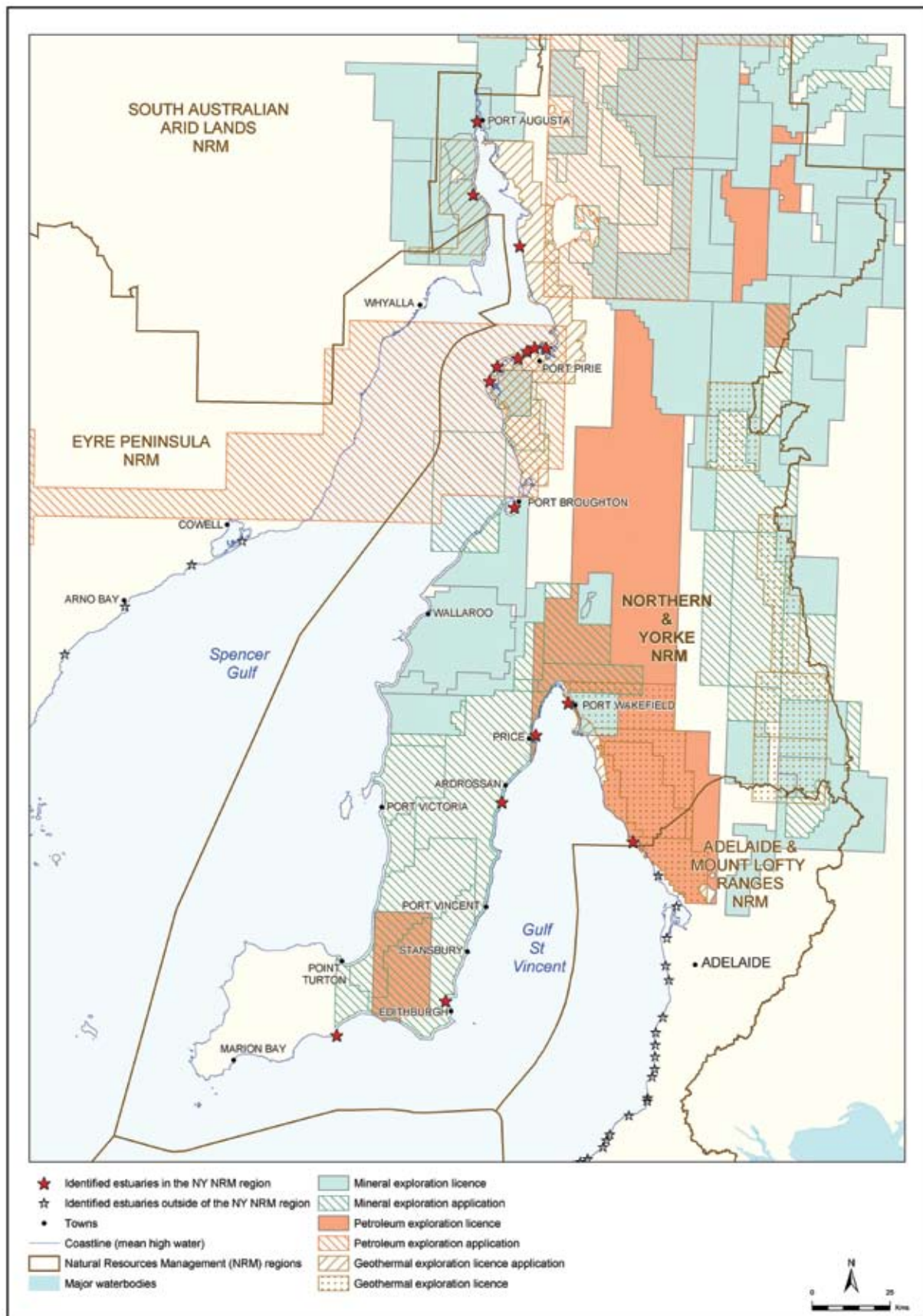


Figure 10. Petroleum, mining and geothermal exploration licences and applications





12. Case study

As with many of the region's estuaries, the Port Davis/Broughton River is valued environmentally, socially and economically for the benefit it provide to the community.

This estuary is under threat from a range of influences, with further planning, management and action required to ensure its health is sustained. Further information on this estuary is given in the following case study.

Case study: Port Davis/Broughton River estuary

The Port Davis/Broughton River estuary is located amongst extensive saltmarsh and mangrove communities at Port Davis in the upper Spencer Gulf. The estuary is included in the Directory of Important Wetlands in Australia. The upper Spencer Gulf area has been identified as the most significant area within South Australia for shorebirds by Watkins (1993) and is also an important site for wader birds (Wilson 2000).

The Port Davis/Broughton River estuary is a nursery area for several commercial fish species including the King George whiting *Sillagnodes punctata*, snapper *Chrysophrys auratus* and southern sea garfish *Hyporhamphus melanochir*. The site is a popular launching and fishing site for local fisherman.

The major threats facing the Port Davis Creek/Broughton River estuary include:

- land clearance for agriculture (mostly historical)
- land use, eg unsustainable agricultural practices, illegal dumping and many informal tracks through the saltmarshes
- increased sedimentation causing a reduction in channel width
- reduced environmental flow as a result of a reduction in channel width
- uptake of mining leases (for further information on mining lease locations <http://www.pir.sa.gov.au/>)
- potential sea level rise and coastal erosion.

Caton et al. (2005) indicate that this site is of high conservation value, particularly for the saltmarsh and tidal flat area, and should be a priority for management.

13. Current management initiatives

Table 7 indicates those projects currently underway in the NY NRM region's estuaries. Many agencies, local government and community groups are responsible for the management and protection of these estuaries. Across the region there is also scope for other research, monitoring, education, awareness-raising and on-ground activities.

Table 7. Current management initiatives

Initiative	Agency/group involved	Estuaries included in the project	Contact details
Investigating the use of biological indicators of estuarine condition in South Australia	EPA	Port Broughton	Senior Aquatic Biologist Environment Protection Authority Ph.(08) 8204 2044
Finalise and implement domestic ballast water management arrangements as part of the National Ballast Water Framework and the National System for the Prevention and Management of Marine Pest Incursions	PIRSA	Estuaries that have ports and marinas	Primary Industries and Resources, South Australia (PIRSA) Fisheries Marine Biosecurity Program Ph.(08) 8226 2874
Development of Coastal Marina Strategy and Guidelines	Chaired by Planning SA (DPC, DEH, DTEI, DWLBC, EPA, OLG, PIRSA, SATC)	SA coast	Planning SA (Strategic and Social Planning) http://www.planning.sa.gov.au Ph.(08) 8303 0760
Rehabilitation and revegetation of Salt Creek/Coobowie Inlet estuary	Coobowie Estuary Steering Committee	Salt Creek/Coobowie Inlet (Yorke)	Economic Development Officer Yorke Regional Development Board Ph.(08) 8854 5055
Variation of fish assemblages in estuaries within and among regions of temperate Australia	University of Adelaide	Light River Delta, Port Augusta Complex and Port Broughton estuaries	School of Earth and Environmental Sciences University of Adelaide Ph.(08) 8303 3999
Minimum disturbance control approach with mosquito control in estuarine areas	Barunga West Council	Estuaries located within the Barunga West Council area	District Council of Barunga West Manager Environmental Services Ph.(08) 8635 2107
Community estuarine monitoring programs	Coobowie Estuary Steering Committee	Salt Creek/Coobowie Inlet (Yorke)	Coobowie Estuary Steering Committee Ph.(08) 8854 5055
Friends of Point Davenport Conservation Park	DEH	Point Davenport	Senior Ranger Yorke - Mid North Region DEH Ph.(08) 8854 3205
Mainland parks of Yorke Peninsula Management Plan	DEH	Point Davenport, Wills Creek	Land Management Branch DEH Ph.(08) 8204 9000



14. Potential directions

There are several information gaps that could be addressed to improve the management of estuaries in the NY NRM region.

Information gaps and potential directions for management include:

- develop a regional inventory of estuaries
- refine regional targets for healthy estuarine ecosystems and describe ecosystem services
- identify environmental flow requirements
- identify groundwater influences and use within estuaries (including whether salinity levels are rising and impacting estuarine condition, flora and fauna)
- develop and implement an estuarine monitoring program for priority estuaries (including biogeochemical, water quality and water quantity, habitat assessment and species diversity, presence and abundance) to monitor trends in the condition of estuaries
- determine whether the artificial opening of entrances to estuaries is an issue, and develop management strategies where required
- determine the impacts of stormwater and urban encroachment on estuaries and amend council development plans accordingly
- investigate and address other potential sources of pollution to the estuarine environment
- develop targeted education programs and activities to engage landholders, tourists, industry and other estuary users, and the broader community to build capacity for the management of estuaries
- identify potential climate change impacts for estuaries and their adjacent habitats.

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Australian Heritage Database

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Birds Australia

<http://www.birddata.com.au/> (viewed March 28th 2007)

Cheetham Saltworks

<http://www.cheethamsalt.com.au/> (viewed April 16th 2007)

Department for Environment and Heritage

<http://www.environment.sa.gov.au> (viewed March 28th 2007)

Estuaries Management and Planning (SA)

<http://www.environment.sa.gov.au/coasts/estuaries.html> (viewed 28th March 2007)

Referenced and recommended websites continued

National Land and Water Resources Audit

<http://audit.ea.gov.au/anra/> (viewed March 28th 2007)

Primo Australia Pty Ltd.

<http://www.primosmallgoods.com.au/> (viewed March 28th 2007)

Protecting Waterways Manual

http://www.transport.sa.gov.au/pdfs/environment/waterway_pdfs/all_chapters.pdf
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Fisheries Management Act 2007

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Heritage Places Act 1993

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Natural Resources Management Act 2004

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Petroleum Act 2000

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Petroleum (submerged lands) Act 1982

<http://www.legislation.sa.gov.au/browseActs.aspx> (viewed March 28th 2007)

Abbreviations

DEH	Department for Environment and Heritage
DH	Department of Health
DIWA	Directory of Important Wetlands in Australia
DPC	Department of Premier and Cabinet
DTEI	Department of Transport, Energy and Infrastructure
DWLBC	Department of Water, Land and Biodiversity Conservation
EA	Environment Australia
EPA	Environment Protection Authority
ha	hectare
IUCN	International Union for the Conservation of Nature and Natural Resources (World Conservation Union)
NLWRA	National Land and Water Resources Audit (2001)
NRM	Natural Resources Management
NYAD INRM	Northern and Yorke Agricultural Districts Integrated Natural Resources Management Committee
NY NRM	Northern and Yorke Natural Resources Management
OLG	Office of Local Government
PIRSA	Primary Industries and Resources, South Australia
SARDI	South Australian Research and Development Institute
SATC	South Australian Tourism Commission

Appendices

Appendix 1. A sample of bird species associated with the NY NRM region's estuaries

	Port Pirie River	Port Davis/ Broughton River	Port Broughton	Point Davenport	Salt Creek/ Coobowie Inlet	Wills Creek	Wakefield River	Light River Delta
Australian white ibis	•							•
banded stilt	•	•	•			•		•
bar-tailed godwit	•	•	•		•	•	•	
black-faced cormorant	•	•	•		•			
black-winged stilt			•			•		
caspian tern	•	•			•	•		•
common greenshank	•	•	•	•	•	•	•	•
common redshank		•	•					
common sandpiper			•			•		
crested tern	•	•			•			
curlew sandpiper				•	•	•	•	•
eastern curlew		•	•	•		•		•
fairy tern	•	•		•	•	•	•	
glossy ibis		•	•					
great egret	•							•
great knot		•	•			•	•	
grey plover	•	•	•		•	•	•	•
hooded plover	•	•	•	•				
intermediate egret	•							
Latham's snipe				•				
little egret	•	•	•					
marsh sandpiper						•		
masked lapwing					•	•		•
musk duck				•				
nankeen night heron	•	•	•					
pacific golden plover	•	•	•	•				
pectoral sandpiper				•		•		
piebald oystercatcher								
red-capped plover	•	•			•	•	•	•
red knot						•	•	•
red-necked avocet					•	•		
red-necked stint			•	•	•	•	•	•
ruddy turnstone	•	•	•	•		•	•	•
sharp-tailed sandpiper				•	•	•	•	•

table continued



Appendix 1. A sample of bird species associated with the NY NRM region's estuaries continued

	Port Pirie River	Port Davis/ Broughton River	Port Broughton	Point Davenport	Salt Creek/ Coobowie Inlet	Willis Creek	Wakefield River	Light River Delta
silver gull					•			
slender-billed thornbill	•	•	•			•	•	•
straw-necked ibis	•							
whimberel						•		
whiskered tern								•
white-bellied sea eagle		•	•			•		

Appendix 2. A sample of fish species recorded in the NY NRM region's estuaries

	Blanche Harbour	Port Augusta Complex	Port Pirie Creeks (Including First, Second, Third Creeks)	Fisherman Creek	Port Broughton	Salt Creek/Coobowie Inlet	Wills Creek	Light River Delta
Commercial fish species								
King George whiting	•	•	•	•		•	•	•
southern sea garfish	•	•	•	•		•	•	
flathead	•	•				•	•	
red mullet	•	•						
school whiting	•	•						
snapper	•	•	•	•				
snook	•	•						
tommy ruff	•	•	•			•	•	
trevally	•	•						
yellow-eyed mullet	•	•	•		•	•		•
yellowfin whiting	•	•	•	•		•		
Western Australian salmon	•						•	
flounder	•	•	•			•	•	
Other fish species								
black bream							•	
flattail mullet			•				•	
goby-sculptured			•			•	•	
small-mouthed hardyhead					•	•		•
blue-spot goby								•
long-fin goby		•			•			•
congolli			•				•	•
seahorse – shortsnout, bigbelly			•					
pipefish – brushtail, pugnose, spotted, widebody, Port Phillip, longsnout			•					

Sources: Bryars (2003), Favier et al. (2004), Favier et al. (2000), Jones (pers. records.), McDonald (pers. coms.) and Rowntree (2004). (Note: the data included in this table is limited, not all of estuaries in the region have been included and fish lists are not extensive).

Appendix 3. Criteria for determining important wetlands in Australia

A wetland may be considered nationally important if it meets at least one of the following criteria (EA 2001):

1. It is a good example of a wetland type occurring within a bio-geographic region in Australia.
2. It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex.
3. It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.
4. The wetland supports 1% or more of the national populations of any native plant or animal taxa.
5. The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level.
6. The wetland is of outstanding historical or cultural significance.

Maps produced by

Coast and Marine Conservation Branch
Department for Environment and Heritage
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Map Source

Topographic data, NPWSA reserves, rock lobster sanctuary, point source pollution, boat ramps, ports and harbours, coastal shack sites, CASS data, saltmarsh and mangrove mapping, coastal sand dune mapping, recreational fishing sites, LGAs, - DEH
Estuaries - NLWRA and DEH
Marine bioregions, marine biounits - DEH and SARDI, PIRSA
Coastal wetlands data from 'A Directory of Important Wetlands in Australia, 3rd ed., 2001'
Benthic habitat mapping - CSIRO, DEH and SARDI, PIRSA
Aquatic reserves, netting closures, aquaculture licenses, mining data - PIRSA
Water catchment boundaries, NRM boundaries, groundwater basins,
shallow standing water level data - DWLBC
Land use zoning - Planning SA, PIRSA
Aboriginal heritage sites - AARD, DPC
Maritime boundaries - Geoscience Australia

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Northern and Yorke Natural Resources Management Region
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