Delta
Environmental Consulting

Environmental Management Plan, Mangrove Cove, SA

Mangrove Cove

Management Plan

Peri Coleman and Renae Eden

5 August 2005

LIMITATIONS STATEMENT

The sole purpose of this report and the associated services performed by Delta Environmental Consulting is to conduct an environmental assessment of the Mangrove Cove area in accordance with the scope of services set out in the contract between Delta Environmental Consulting ('Delta') and the Land Management Corporation ('the Client'). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

Delta derived the data in this report primarily from visual inspections, examination of records in the public domain and interviews with individuals with information about the site. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data, analysis and a re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, Delta has relied upon and presumed accurate certain information (or the absence thereof) relative to the site, provided by government officials and authorities, the Client and others identified herein. Except as otherwise stated in the report, Delta has not attempted to verify the accuracy or completeness of any such information.

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1. Introduction

The Land Management Corporation is undertaking a major urban redevelopment in Ethelton, between the railway line and the Port River. A portion of the development area is Crown Land under the custodianship of the Minister for Environment and Conservation. The land is often called Mangrove Cove, Mangrove Park, or the Ethelton Mangroves. The Department for Environment and Heritage has agreed to transfer the parcel of land to the LMC for inclusion into the urban redevelopment project on the conditions that the land in its entirety is used for open space purposes, and that a management plan is prepared relating to the future use of the land.

The management plan and monitoring program for Mangrove Cove are designed to include outcomes required by the various stakeholders, while maximising the biodiversity within the reserve and enhancing the native vegetation and community values of the site. The management plan has an adaptive management structure and is written so that it may be easily incorporated into local and state government planning or policy documentation. The management plan and monitoring guidelines are written so that they may be used as practical resources for stakeholders and community groups that have an interest in the Cove.

2. Consultant

Delta Environmental Consulting is an independent South Australian consulting business. The company provides services in the areas of: biological survey work, environmental education programs, saltfield technology and saline wetland ecology, scientific illustration & desktop publishing, preparation of herbarium and museum specimens, taxonomy and classification, revegetation and rehabilitation, and computer application development.

The company is a member of Standards Australia, and its quality assurance management system has been third party certified to the international Q-base standard by NATA Certification Services International. A copy of the scope of certification is available on request.

Delta Environmental Consulting has a policy of continuous improvement in the areas of:

- providing a quality service to our clients
- providing ongoing training and educational opportunities for our consultants
- maintaining high standards in the areas of health, safety and environment both within Delta and while working with our clients

The consultants undertaking this project are detailed in the *Appendices*.

Water Industry Alliance

QUALITY CERTIFIED COMPANY

3. Management Context

3.1 Location and existing reserve features

Mangrove Cove, or the Ethelton Mangroves, is located on the upper reach of the Port River in Port Adelaide, just north of the railway bridge. The land forming the reserve is delineated in Crown Record Volume 5766 Folio 844, and has an area of 2.176 hectares. The reserve is an arced wedge, similar in shape to a segment of an orange, bounded by the railway embankment on the south and west, the river on the east and Rennie Road to the north. An additional area of open space exists along the eastern boundary of the reserve, in the river. This extra area is not controlled by this management plan.

Figure 1 - Location of reserve (red outline) and additional open space (orange outline)

The northern portion of the reserve comprises an elevated area of fill, while the central and southern portions of the site are at natural surface elevation. These lower areas of the site support mangrove, saltmarsh and mud flat habitats. Several wrecks are prominent on the mud flats, and a wooden boardwalk is present in the mangrove zone. The northerly filled areas support several mounds, planted with indigenous plant species, and an amphitheatre. Adjacent to the easternmost boundary of the fill, there is a rough boat ramp constructed from various materials including smelter slag and limestone grits.

The reserve currently does not have an official name. During the community consultation process, stakeholders agreed that an Aboriginal name for the site would be appropriate. Some of the interpretive features of the site are part of the Kaurna Cultural Heritage Trail and the site has considerable interest to local Aboriginal people. The local aboriginal community has brought forward the name “Patangga” (pronounced “Putunga”) meaning Mangrove. The Port Adelaide Enfield Council’s reserve naming body is requested to consider this name for submission to the Geographical Names Board.

3.2 Stakeholder objectives for the site

Reserves are managed, ultimately, for the users of the reserves. Therefore the aspirations of the people who regularly use and care for Mangrove Cove are an important input into the management plan. The following stakeholders were approached, to determine their aspirations for the site: the Heritage Branch of the Department for Environment and Heritage, the staff of the Adelaide Dolphin Sanctuary, the City of Port Adelaide Enfield, the Portside Christian School, the regional Our Patch staff, the Aboriginal Advisory Panel to the Port Adelaide Enfield Council, the Port Adelaide Residents Environment Protection Group, the SA Recreational Fishing Advisory Council, the local catchment board, Flinders Ports, the Port Adelaide Historical Society, the Land Management Corporation, and the developers of the neighbouring residential project (Newport Quays and their landscaping team, Taylor Cullity and Lethlean).

Details of the stakeholder consultation are provided in the *Appendices*, however there were common threads through much of the consultation. There was a desire from most groups that the reserve should continue to provide the widest range of values possible. That is:

- Preserving historic values, both Kaurna and European,
- Preserving the biodiversity values of mangrove, saltmarsh, mud flat and dune (including both the vegetation and fauna),
- Supporting educational values through activities undertaken in a natural area close to a school,
- Providing a link between existing bicycle routes and the riverfront plaza proposed for the neighbouring residential development,
- Providing passive recreational values such as bird watching, viewing the features of the marked trails (Jervois Basin Ships’ Graveyard Trail and Port Adelaide Kaurna Cultural Heritage Trail), sitting in the quiet areas of the site, and viewing the Swim Through Sculptures, and
- Providing aesthetic values such as having an open area with water views or the dense jungle-like feel of the existing boardwalk in the mangroves.

3.3 Preferred ecological outcomes

The northern portion of Mangrove Cove contains elevated land comprising assorted filling materials dominated by building rubble, with a small quantity of what appears to be sandy fluvial fill. It has proved difficult to establish plantings on this material. The majority of stakeholders have indicated that future plantings should be limited to those species that have shown an ability to survive the very harsh conditions. Plants with natural distributions that extend into lower rainfall zones would comprise the majority of the species that may thrive.

Details of the existing plantings and proposed plantings are contained in *Section 5.2.3 Flora and fauna communities*.

The intertidal zone supports three habitats – mangroves, saltmarsh and mud flats. The mangroves are expanding across the other habitats and are likely to establish a monoculture in the intertidal zone. During the consultation process people were asked to consider whether undertaking experimental 'active management' to slow down this change was their preferred option in order to maintain the range of biodiversity and other outcomes that were specified. The alternative approach of 'passive management' would simply interpret the change. This management plan reflects the view of stakeholders, that active management of the site would provide the maximum biodiversity benefit.

The boat ramp will not have any vehicular access once the neighbouring residential development is built. During consultation stakeholders discussed either removing the boat ramp from the site or else leaving it in-situ, capping it with clay and making the slope available as an area for saltmarsh/mangrove retreat. Both of these approaches have perceived benefits and risks, and these are detailed in *Section 5.4.1 Threats to ecological values and mitigation measures*. This management plan reflects the view of stakeholders, that removal of the boat ramp may have larger environmental risks than leaving it in-situ and revegetating it as a saltmarsh retreat zone.

4. Management Framework

4.1 Current management

Mangrove Cove is currently managed as unallocated Crown land under the custodianship of the minister for Environment and Conservation. The reserve's day-to-day care is undertaken by the Port Adelaide Enfield Council. The Council has nominated the site as a Natural Resource Management Area under the City of Port Adelaide Enfield's Draft Open Space Plan. Council-wide objectives for the management of NRM areas are:

- Preserve and manage native wildlife,
- Preserve geological, natural and scenic features,
- Encourage public use and enjoyment through understanding, education and interpretation,
- Promote recreational use while conserving habitat value,
- Control pest plants and animals,
- Manage animal and vegetation diseases, and
- Minimise the impact of fire and other destructive natural events.

Management of the Cove as public open space has a considerable history, which is detailed in *Sections 5.3.1* and *5.3.2* While the legal title to the land will change hands in the near future the land will remain as a reserve under the care and control of the PAE Council. It is envisaged that the management of the site will continue to reflect the Council's objectives for NRM areas.

At present the reserve does not have an official name. After consulting with interested parties, the consultants were asked to seek advice from the Aboriginal Advisory Panel to see whether

there were any names that may be appropriate to use for the reserve area. The Panel brought forward the name “Patangga” (pronounced “Putunga”) meaning Mangrove. The Port Adelaide Enfield Council’s reserve naming body is requested to undertake their processes related to naming reserves prior to submitting a request for a joint name (Aboriginal and European) to the Geographical Names Board.

4.2 Relevant legislative and planning instruments

The land forming this reserve is currently Crown Land under the care of the Minister for Environment and Conservation. As a condition of surrendering the land to the Land Management Corporation the Department for Environment and Heritage has stipulated that a management plan, similar in scope to management plans developed for reserves under Section 38 of the *National Parks and Wildlife Act 1972* be formulated. Section 38 management plans control actions taken on a reserve and are reviewed annually by reserve managers who use the priorities outlined in the plan to draw up work programs and implement some of the strategies outlined in the document. Implementation of works is dependant on the availability of resources such as staff and funding.

Further legislative support to help protect the area may be available under,

- the *Fisheries Act 1982*, as the area is a fish breeding area and contains mangroves,
- the *Coast Protection Act 1972*,
- the *Environment Protection and Biodiversity Conservation Act 1999*,
- the *Adelaide Dolphin Sanctuary Act 2005*,
- the *Development Act 1993*,
- the *Native Vegetation Act 1991*,
- the *Historic Shipwrecks Act 1981*,
- the *Environment Protection Act 1993 (Water Quality EPP 2003)*, and
- the *Local Government Act 1999*.

The City of Port Adelaide-Enfield also has an interest in the area, as current and future land managers, and has the option of creating council by-laws and planning changes appropriate to the site.

Community groups such as the Portside Christian School’s Mangrove Cove Care Team, Waterwatch, Our Patch, Port Adelaide Residents Environment Protection Group and Port Adelaide Historical Society also have considerable interest in the area, although they have no legislative powers.

4.3 Native title

Native title is used to describe the interests Aboriginal and Torres Strait Islander People have in land and waters according to their traditional laws and customs. The Commonwealth *Native Title Act 1993* was enacted to:

- Provide for the recognition and protection of native title,
- Establish ways in which future dealings affecting native title may proceed and set standards for those dealings,
- Establish a mechanism for determining claims to native title, and

- Provide for, or permit, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title.

This management plan is subject to any native title rights and interests that may continue in relation to the land and/or waters. Nothing in the management plan is intended to affect native title, and furthermore this management plan encourages the development of partnerships with Aboriginal people in the management of this reserve.

The Land Management Corporation applied to the Department of Aboriginal Affairs and Reconciliation to determine whether there were Aboriginal sites and/or objects within the Mangrove Cove site and one other site. This application was made under Section 12 of the South Australian *Aboriginal Heritage Act 1988*.

In the summary findings of the resultant anthropological report Dennis (2005) records that:

- There is little specific documentation, with the exception of the Melvin Report (1994) [Melvin, 1994] on the subject areas of land.
- Consultation with members of the Kaurna community qualified to speak for and of country indicates that there is a Site immediately north of the current Jervois Bridge [ie. no Sites were disclosed at Mangrove Cove].
- Black Swan Dreaming contextualizes the area of the Jervois Bridge for descendants of the 'Port River Tribe' (as they identify themselves).
- The Tjilbruke Dreaming Story/Song contextualizes the Port River region for Kaurna people.
- [The presence of any Aboriginal objects/sites from an Archeological perspective is the] Disciplinary domain of engaged Archeologist.

5. Management Prescription

5.1 Cove zones

Zonings within reserves aim to ensure that public use and management actions remain compatible with the reserve values. Mangrove Cove has been divided into two types of zones: conservation zones and access zones.

5.1.1 Access zones

The access zones are located entirely on the filled area of the site. The **objectives of the access zones** include providing the public with access to the site, providing amenities such as seating and shade and providing interpretation (eg providing information on the habitats and cultural history of the site).

Strategy:

- Some of the parking access, all the interpretive trails except the small mangrove boardwalk, and public seating including the amphitheatre are all contained within the access zones of the reserve. All such developments should be in keeping with the history and function of the reserve, paying particular attention to both Kaurna and European cultural values of the site. The shared bicycle/pedestrian way is located

outside the reserve boundary. Newport Quays drawing AEV-421-C-DWG-805 shows the details of the parking area agreed to by the stakeholders.

5.1.2 Conservation zones

The conservation zones include the intertidal area and the boat ramp. The **objectives of the conservation zones** include providing safe habitat for fauna and management for maintaining the highest possible biodiversity, given the constraints of the site.

Strategy:

- No developments are proposed for this area apart from ongoing maintenance of the mangrove boardwalk and the remediation of the boat ramp area.

Figure 2 - Mangrove Cove usage zones

5.2 Managing natural resources

Mangrove Cove lies on the Northern Adelaide Plains within the Flinders Lofty Block IBRA region (Interim Biogeographic Regionalisation for Australia, version 5.1, Environment Australia, 2001). IBRA regions are a landscape-based classification of the land surface into 85 bioregions Australia-wide. Each bioregion represents a unified set of major environmental influences that define the occurrence flora and fauna. Descriptions of the IBRA regions were published by Environment Australia (2000).

5.2.1 Climate, geology and soils

The climate on the Northern Adelaide Plains is described as Mediterranean, with cold, wet winters and hot dry summers. The nearest, and most similar, weather station is located in the extratidal areas at the Dry Creek Saltfields. The Dry Creek Saltfields' weather station records an average of 420 mm of rain annually. This rainfall mainly occurs between May and September. Strong south-westerly winds regularly occur during autumn and spring, with hot northerly winds often occurring during summer. In winter a light northerly breeze blows in the early mornings. Lightning storms occasionally occur through out the year, but with higher intensity in mid to late spring.

Table 1 - Weather details

Weather Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total	Annual Daily Average
Av Monthly Rain (56 years)*(mm)*	19.3	20.8	20.7	36.9	53.9	52.7	57.1	48.7	22.6	40.4	23.7	23.6	420.4	
Av Daily Maximum Temp (10 yrs) *(°C)*	26.0	27.8	26.1	21.6	18.5	15.6	14.5	15.5	17.9	20.9	23.6	25.6		21.1
Av Daily Minimum Temp (10 yrs)(*°C)*	15.9	15.6	15.0	11.8	9.6	8.4	7.1	7.6	8.9	11.1	13.2	15.0		11.6
Av Daily Vapour Pressure (10 yrs) *(mm Hg)*	12.0	11.3	10.7	9.7	9.1	8.4	7.9	8.1	8.6	8.9	10.1	11.2		9.7
Av Daily Wind Speed (7 yrs) *km/hr*	5.7	4.3	4.0	3.5	3.4	4.1	4.4	4.7	5.6	5.7	5.1	5.3		4.6
Av Monthly Gross Evap. (56 yrs) (*mm)*	302	217	217	133	82	56	56	76	109	164.9	274	273	1960	
Av Monthly Nett Evap. (56 yrs*) (mm)*	283	197	196	97	28	3	-1	27	86	125	250	2500	1539	

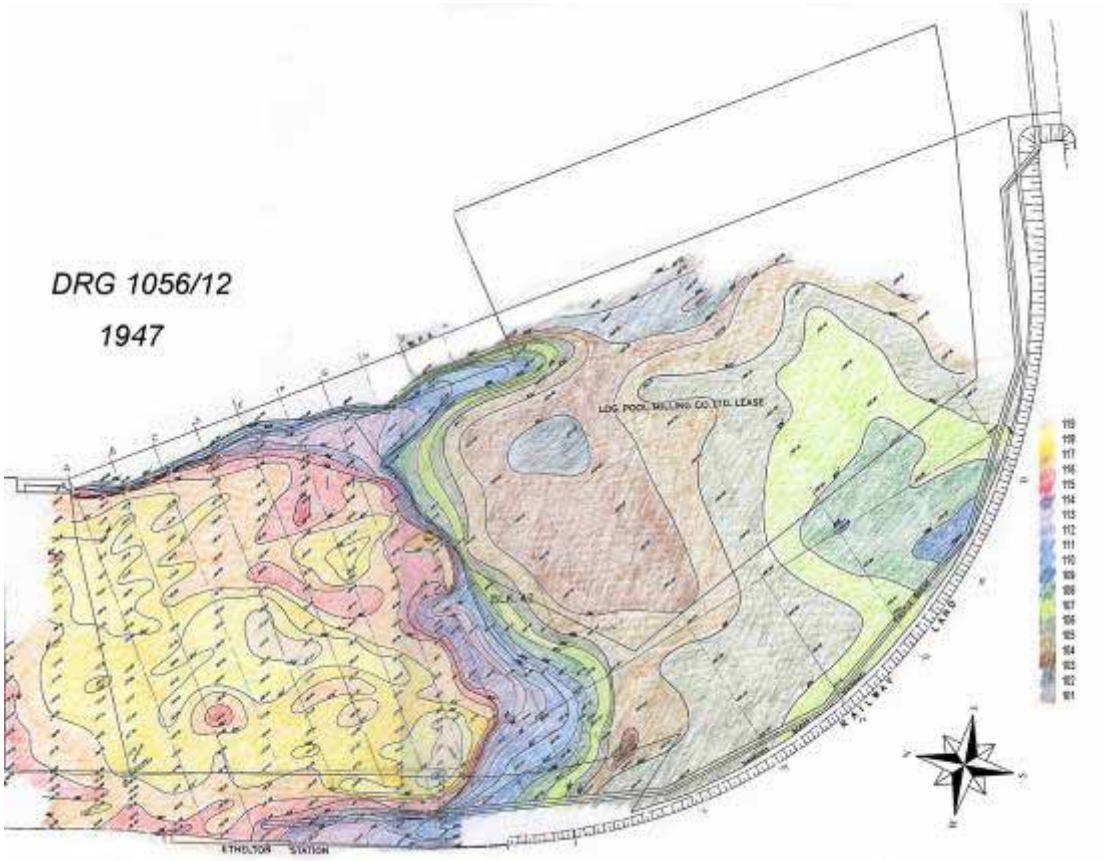
According to the Soil Association Map of the Adelaide Region (Taylor, 1989) the underlying soils in the area are historic estuarine muds and sands (layered sediments, being sands, silts, clays and organic deposits of mixed marine and river origins) that form part of the Port River estuary.

5.2.1.1 Evolution of the landscape

The Port River was quite narrow in its upper reaches and was edged with swamplands and mangroves when Europeans first settled the area. Most land to the east and west of the river was originally intertidal swamp, mudflats, small dunes (berms) and chenier ridges, which have been raised and levelled with hydraulic fill or industrial dumping. Early diagram books and field survey books at the Lands Titles Office show that much of the area south of the current Jervois Bridge has been earmarked for reclamation at one stage or another in the period between 1856 and the present. The southern area of Mangrove Cove is one of the few areas along the inner Port that remains at natural surface level. This may be because it was the location of a small creek that once drained Section 914 (west of the railway). It was also useful as a drainage aid for any hydraulic filling that occurred on the northerly parts of the site.

Figure 3 - Early diagrams of the site (Field survey book 130 p 80, Diagram book p 20, Harbour Drawing DR388)

The diagram book for the Hundred of Port Adelaide page 20 shows clearly the shape of the river and what we now call Mangrove Cove at the location referred to then as Harbours Board Reserve 17 (gazetted 1879). The creek that ran into the small cove meandered to the reserve and the river through sections 913, 914 and 911, according to the survey drawings in Field Book 130 page 80. Two of these blocks (911 & 914) were directly adjacent to the reserve and were, according to surveyor Michael O'Reilly in notes on page 20 of the Port Adelaide diagram book, 'swamp subject to tidal inundation' while the last block traversed by the creek (913), further south contained 'sandy pasture,' possibly a small sandy ridge similar to those noted nearby by the Quaker James Backhouse in 1837.



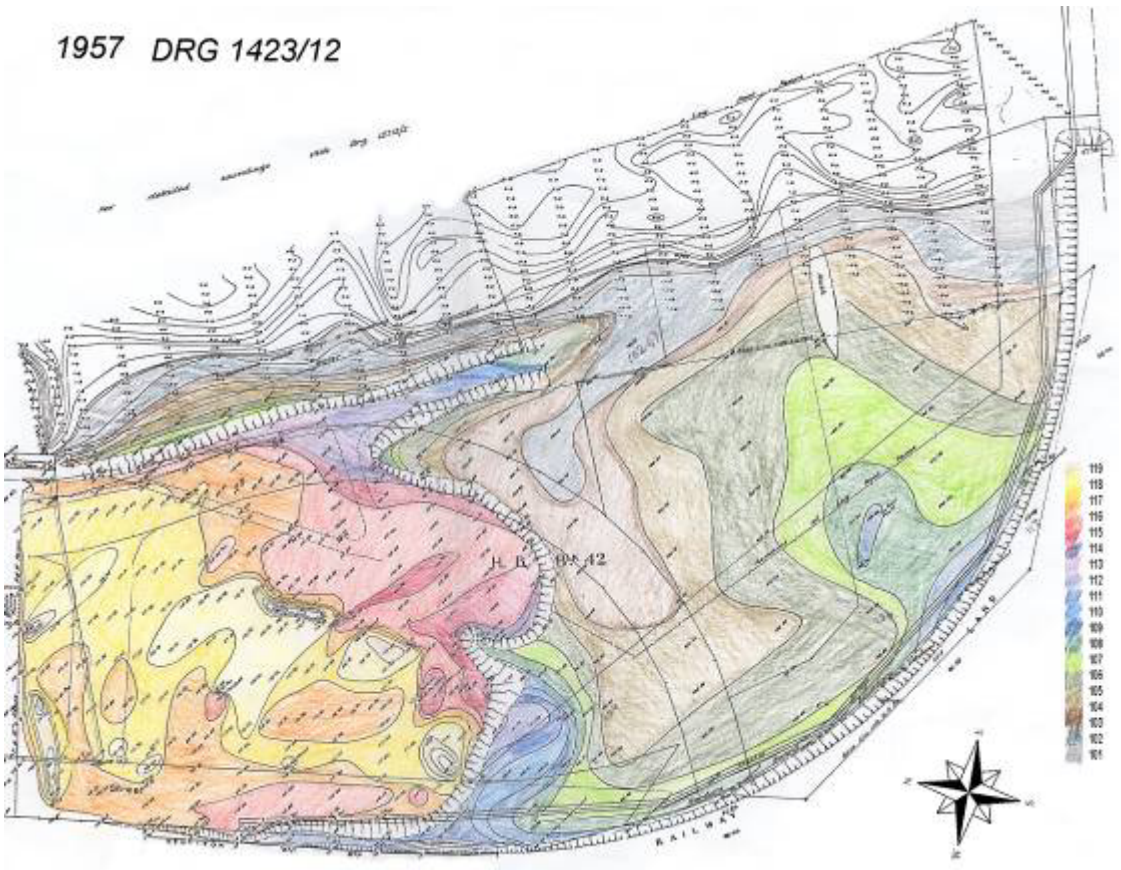


Figure 4 - Harbour Board drawings of the site, 1947 and 1957

By 1923 the reserve land was listed as 'in process of reclamation' in survey DR/388N and the railway reserve is shown running between the reserve and section 914. The railway bridge had been constructed in 1910 and opened a year later in 1911. In 1920 a water main from Hope Valley was laid on the railway bridge, and in 1928 a wooden trestle bridge was constructed alongside the railway bridge to carry gas from the SAGASCO's Osborne works. This trestle bridge also provided foot access across the river (Ritter, 1996).

The Harbour Board surveyed spot levels across the site in 1947 to establish land surface levels and repeated the survey, with soundings again in 1957 (*Figure 4*). These surveys show a considerable quantity of fill had been placed onto the site by 1957.

Aerial photography as early as 1956 (Survey 205/6292) shows the remains of the creek in Section 914, behind the railway. A small drain appears to be present, under the railway embankment at that point. A drain from land further to the west is debouching into the creek.

An area of fresh fill material is visible jutting into the Cove from the northern area of higher land. Tracks lead down to this area and the fill playa has a jagged shadow running along its edge, suggesting that the fill was being dumped by trucks and was a considerable height above natural surface.

In the reserve itself there appears considerable activity - there is a large (over 40m long) wreck lying on the landward edge of the northern mud bank, what appears to be another at the end of the bank, as well as other wreckage including the Fish Market Pontoon and the Trafalgar on the central mud bank towards the south of the reserve. This central mud bank is relatively high and appears to support saltmarsh vegetation. There are several other small boats either moored or beached on this small area of higher land. To the south of the mud bank there is a small piece of high land adjacent to the railway embankment. It is unknown if this was fill or the tail of a pre-existing riverside sandbank (berm).

The piles of the milling company's log pool can clearly be seen, both those in deep water and those marking the landward edge of the log pool. This landward line of piles crosses the central mud bank and appears to have been used as a pathway from the high land to the central mud bank.

The gasworks pipeline can be seen running along its trestle bridge alongside the railway bridge.

Figure 5 – Extracts from aerial photographs from 1956 and 1963

There appears little intertidal vegetation in this early aerial photograph, which is to be expected considering the amount of activity occurring in the Cove. The log pool would not have provided a habitat conducive for mangrove trees and the small mud banks were used for wrecking and were probably heavily trampled. Even so, some saltmarsh vegetation appears to be present on the central mud bank and also in the north- western corner of the Cove, where the drain from under the railway embankment enters the site. Mangroves are scanty. There appears to be one large mangrove with a canopy of more than three metres (or a dense patch of small trees) between the landward boundary of the log pool and the railway embankment. Four smaller individual mangroves are easily visible close to the trestle bridge, and there are maybe a half dozen small dots on the photograph that may be seedlings.

Details of historic uses of the site mentioned in this section are provided in *Section 5.3.2 History of the site since European settlement*.

In the 1963 photograph there appears considerably more fill, with a large semicircular playa of fill protruding into the cove. Housing has appeared on Sections 911 and 914 and the drainage system, incorporating the remnants of the old creek, appears to be diverted south along the western side of the railway. This photograph is of poor quality, making any examination of vegetation difficult.

Only a few years later, in 1969, Rennie Road had been built and had cut off the natural coastline from the cove. Not all of the land to the north of the road was completely filled, and an area of stranded saltmarsh is visible in the photograph, just north west of the road. South of the Cove filling is also evident. Areas of fill are visible south of the railway, just north of the Bower Road causeway. In the reserve area, only scattered saltmarsh vegetation on the central mud bank appear to be standing taller than the shallow tidal waters that wash across the site. The most obvious feature in this photograph, within the reserve boundaries, is the remains of the Fish Market Pontoon, visible above the water level.

The 1978 photograph shows another area of fill, this one south of Rennie Road, within the reserve area. The mud flat forming the majority of the reserve site is exposed at a very low tide, with the wrecks clearly visible. Small patches of saltmarsh are growing on slightly higher ground between the Fish Market pontoon and the shore with possibly some small mangroves growing there as well, but the wrecks are lying in isolation on the mud banks. There is a patch of mangroves established in the western corner of the site, extending south along the trestle bridge. Near the centre of the railway embankment curve the small patch of higher ground that extends out from under the trestle bridge appears vegetated with herbaceous plants probably saltmarsh species.

Figure 6 – Extract from aerial photographs from 1969 and 1978

Recent aerial photography (2004) reveals that filling of the site slowed down not long after 1978, with the outline of that fill still clearly visible, although extending a little further along the river's edge than in 1978. Additionally the trestle bridge is not visible in the 2004 photograph, having been demolished in 1980 (Ritter, 1996). The largest change in the recent photograph is the extension in the range of the vegetation. The small patches of saltmarsh north and west of the Fish Market pontoon have expanded considerably and in some cases the patches have joined up, while the pontoon itself now has a stand of mangroves growing through the remaining structure. Mangroves have entirely filled the western corner of the reserve and appear to be spreading east and south. They have spread around the small patch of higher land midway around the curve of the railway embankment. The patch itself supports saltmarsh, while the embankment itself has a lighter coloured vegetation – comprising nitre bush and boxthorn.

Figure 7 - Recent aerial photograph

5.2.1.2 Current topography

Most of the reserve is fairly flat and low-lying, subject to daily tidal inundation. The northern higher areas mark the 'reclaimed' areas. The railway embankment forms the southern boundaries of the site.

The reclamation materials appear to come from a variety of sources. Digging on the site reveals large amounts of 'kunkar,' the calcrete material that underlies the St Kilda formation in the Port Adelaide area. Whenever portions of the Port needed deepening, this layer had to be removed. It is possible that some of the 'kunkar' material on the site came from the excavation of West Lakes that occurred in 1974. Other materials include bricks, concrete, asbestos (Messenger, 25/3/86) and slags of unknown origin.

The boat ramp that slopes down from the filled area to the natural surface has slag of unknown origin exposed along its eastern edge, and is topped by a thick layer of 'limestone grits' that were probably sourced from the Soda Ash Plant at Osborne.

Coastal acid sulfate soils (ASS) are formed during and after periods of seawater inundation, such as occurred in the Adelaide region during the Flandrian Transgression. These soils are quite stable while they remain inundated, and are usually referred to as PASS (potential acid sulfate soils). PASS soils convert to actual ASS after they are drained. The mudflats, saltmarsh and mangroves all occur on intertidal soils likely to be classified as PASS. While these areas remain undisturbed and subject to daily tidal inundation, these potential acid sulfate soils are unlikely to become actual ASS.

The **management objective** is to minimise any further degradation of the site and attempt remedial actions where possible.

Strategies:

- Disturbance to the soils of the intertidal areas shall be minimised.
- Should any actions that could disturb areas of coastal acid sulfate soils be contemplated, an impact mitigation plan shall be developed in cooperation with the Coastal Protection Branch of DEH.
- The preferred treatment for the boat ramp area is revegetation, maintaining biodiversity and improving amenity. The details relating to the methods and practical completion of the project will be negotiated between the PAE Council and Newport Quays, outside this management plan.

5.2.2 Hydrology

Mangrove Cove historically contained a small creekline that reached the Port River in the Cove. This creekline was part of the estuary, and early records relate that the land drained by the creek was swampy and subject to the tides. The salinity of the creek would therefore have been quite variable, as one would expect in an estuary. In summer, high evaporation combined with the tidal inundation would have resulted in periods of hypersalinity. In winter, the swamp discharge may have been brackish.

The creek has been redirected from the Cove, indeed its original course is buried under Rennie Road and the reserve now receives only the freshwater that falls on it. The 'creek' that has developed in the Cove appears to be a drainage line that has formed in the lowest remaining area of the Cove and that allows the daily draining of tidal waters. This creek may become more defined over time as mangroves become dense on either side of it.

Groundwater around the Barker Inlet and under Port Adelaide occurs as a series of shallow quaternary aquifers, some of which are located just below the natural surface. Salinity in these

surficial aquifers is very high (often around twice the salinity of seawater) and the water table moves up and down in response to tidal cycles (Pavelic and Dillon 1993). The presence of this saline groundwater may impact on plants growing on the filled area, particularly if the fill material has a porous nature. Shallow rooted plants, or plants with a tolerance to occasional salt inundation will tolerate the changes in the water table, which are most noticeable during the highest winter tides.

Management objectives include revegetating the filled areas with plants appropriate for the hydrological constraints of the site.

Strategy:

- Observe successful plant species and use these for the majority of plantings.

5.2.3 Flora and fauna communities

The flora and fauna communities present within Mangrove Cove are an important and significant part of the local ecosystem. The site contains areas of mangrove, saltmarsh and fill that are being revegetated by community groups with indigenous dune plants. While small, the area forms a significant patch of native vegetation in the district.

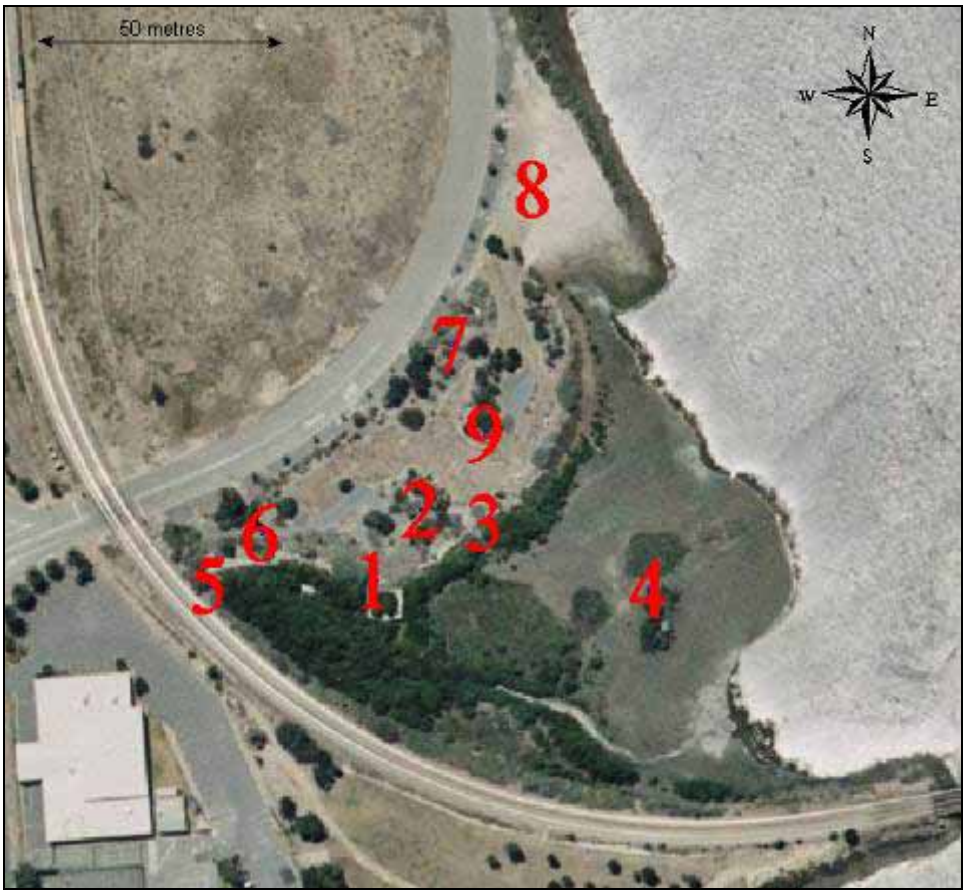


Figure 8 - Flora sampling locations

In May 2005 the consultants undertook a baseline flora survey on the site. Any single flora survey will not sample the entire biodiversity of a site, and single surveys during a droughted autumn are the most likely to under represent the diversity of plant life. A springtime survey would capture any annuals and more of the grasses that could occur. However the majority of the perennial herbaceous and shrubby plants would have been identified in this survey.

The purpose of the survey was to provide a baseline, to ensure that any future vegetation changes due to management actions may be detected easily. Herbarium voucher specimens were collected for future reference and were lodged with both the Plant Biodiversity Centre and the Land Management Corporation. The latter organisation will transfer their voucher specimens to the City of Port Adelaide Enfield when the transfer of land occurs.

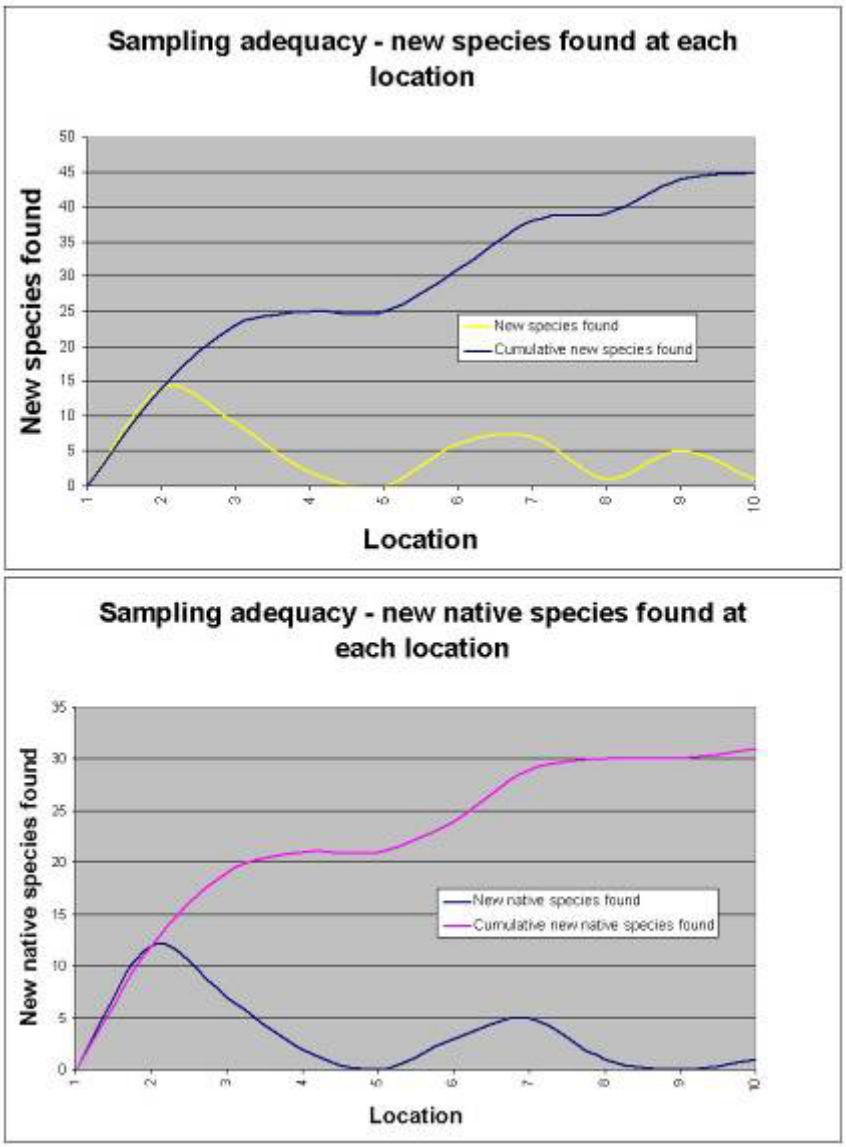


Figure 9 - Sampling adequacy graphs

The method used to conduct the vegetation survey was to select sampling areas based on sampling multiple sites within each of the vegetation units present within the area. The approximate number of different vegetation units was determined using image analysis software. At the first selected location a GPS was used to record the location (accurate to approximately 5m) and a thirty-metre square was searched for plants. The surveyors gathered vouchers of each new plant species found on the site, as each species was encountered. Two vouchers of each species found were collected. Once the area was searched, a new location was then chosen and the process repeated, except that only species not found so far were collected.

This process continued until sufficient sampling areas were surveyed to ensure representation of all vegetation units occurring on the body of the site. A graph of new species found at each site shows the reduction in new species encountered at each sample location as sampling progresses, with occasional increases as new vegetation units are encountered. This is the sampling adequacy graph and is a test for survey thoroughness.

Where similar species are difficult to determine in the field, extra vouchers were gathered. As a result of these replicates there are more voucher pairs collected than there are species on the site. All vouchers were returned to the laboratory for identification, as some species may only be determined using microscopic features. The pairs of vouchers were then pressed and dried. One of each voucher pair was sent to the Herbarium as required under the collection license, and the second sample was retained. The retained voucher was mounted on a herbarium sheet and provided to the client for their reference and for use by the community.

A species list for the site is provided below (Table 2). Conservation ratings for each species were derived from Briggs & Leigh (1996), the Schedules of the *National Parks and Wildlife Act 1972* of South Australia and *Florlist* (Taplin, 2004). Details of all vouchers collected and the GPS references of each sampling location are attached to this report in the *Appendices*.

Table 2 - Plant species recorded on the site

Family	*Species*	Common name	Exotic	Conservation significance
Aizoaceae	*Carpbrotus rossii*	Karkalla or Ross' noonflower		
Aizoaceae	*Galenia secunda*	Galenia, or blanket weed	*	
Amaranthaceae	*Amaranthus albus*	Tumble weed	*	
Arecaceae	*Phoenix dactylifera*	Date palm	*	
Avicenniaceae	*Avicennia marina*	Grey mangrove		
Boraginaceae	*Heliotropium europaeum*	Potato weed	*	
Casuarinaceae	*Allocasuarina verticillata*	Drooping she-oak		
Chenopodiaceae	*Atriplex cinerea*	Coast saltbush		
Chenopodiaceae	*Atriplex nummularia*	Old man saltbush		T in SL
Chenopodiaceae	*Atriplex paludosa* var *cordata*	Marsh saltbush		
Chenopodiaceae	*Atriplex rhagodiodes*	River saltbush		
Chenopodiaceae	*Enchylaena tomentosa*	Ruby saltbush		
Chenopodiaceae	*Maireana oppositifolia*	Heathy bluebush		

Family	*Species*	Common name	Exotic	Conservation significance
Chenopodiaceae	*Rhagodia candolleana*	Seaberry saltbush		
Chenopodiaceae	*Sarcocornia quinqueflora*	Beaded glasswort		
Chenopodiaceae	*Suaeda australis*	Sea blite		
Compositae	*Lactuca serriola*	Prickly lettuce	*	
Compositae	*Olearia axillaris*	Coast daisy-bush		
Compositae	poss *Reichardia tingitana*	False sow-thistle	*	
Cruciferae	*Cakile maritima*	Sea rocket	*	
Cruciferae	*Diplotaxis muralis*	Wall rocket	*	
Cupressaceae	*Callitris preissii*	Southern, or coastal cypress-pine		U in SL
Cyperaceae	*Isolepis nodosa*	Knobby club-rush		
Euphorbiaceae	*Adriana klotzschii*	Coast bitter-bush		U in SL
Gramineae	*Avena* sp.	A wild oat	*	
Gramineae	*Critesion murinum*	Barley grass	*	
Gramineae	*Lolium perenne*	Perennial rye grass	*	
Gramineae	*Stipa* sp.	A spear grass		
Leguminosae	*Acacia cupularis*	Coastal umbrella bush, cup wattle		R in SL
Leguminosae	*Acacia cyclops*	Western coastal wattle		
Leguminosae	*Acacia dodonaeifolia*	Sticky wattle, bop bush wattle		R in State & SL
Leguminosae	*Acacia ligulata*	Umbrella bush		K in SL
Leguminosae	*Acacia pycnantha*	Golden wattle		
Leguminosae	*Acacia victoriae*	Bramble wattle or elegant wattle		V in SL
Leguminosae	*Medicago polymorpha*	Burr medic	*	
Liliaceae	*Asphodelus fistulosus*	Onion weed	*	
Liliaceae	*Dianella brevicaulis*	Short fruit black anther flax lily		
Limoniaceae	*Limonium companyonis*	Sea lavender	*	
Myrtaceae	*Eucalyptus camaldulensis*	River gum		
Myrtaceae	*Eucalyptus odorata*	Peppermint box		
Myrtaceae	*Melaleuca halmaturorum*	Swamp paper-bark		V in SL
Myrtaceae	*Melaleuca lanceolata*	Moonah or dryland tea-tree		U in SL
Sapindaceae	*Dodonaea viscosa*	Sticky hop bush		
Solanaceae	*Solanum nigrum*	Bayberry nightshade	*	
Zygophyllaceae	*Nitraria billardierei*	Nitre bush or dillon berry		

Codes used in table above: T = Threatened, U = Uncommon, R = Rare, K = Unknown, V = Vulnerable, SL = Southern Lofty Herbarium Region, State = South Australia

An extra species, not collected, was *Maireana brevifolia* (small leafed bluebush), found on several of the planted mounds, and fruiting profusely. It is included in the following biodiversity statistics.

Table 3 - Biodiversity information

Total species	46
Plant species exotic to Australia	15
Native plant species exotic to Southern Lofty	1
Species indigenous to Southern Lofty	30
Exotics as percentage of biodiversity	35%
Species of conservation significance	5
Species of conservation interest	4

The plant associations currently present at the sampled locations on the site are detailed in the following table.

Table 4 - Vegetation associations

Location	Easting	Northing	Description
1	270955	6140526	*Avicennia* marina woodland and adjacent planted embankment
2	270967	6140547	Planted sandy mounds
3	270986	6140544	Low marsh dominated by *Suaeda australis* with some *Sarcocornia quinqueflora*
4	271034	6140527	Corner of fish pontoon, with *Avicennia marina* woodland and adjacent low marsh dominated by *Suaeda australis* with some *Sarcocornia quinqueflora*
5	270907	6140522	Railway embankment, filled embankment and planted sandy mound, dominated by *Nitraria billardierei* and *Atriplex cinerea*
6	270921	6140538	Planted sandy mounds
7	270974	6140595	Planted sandy mounds
8	270996	6140641	Grits-topped boat ramp with occasional weedy forbs
8	270985	6140570	Planted sandy mounds

Between the sampled locations the ground was virtually bare, with scanty amounts of *Galenia secunda* and the remains of some smaller grasses (*Critesion murinum*) being the only plants surviving the very dry summer. The current distribution of vegetation on the site is shown in *Figure 10*.

Figure 10 - Vegetation zones on the site

While the plant species currently found in the mangrove and saltmarsh, and the plantings on the filled, drier portions of the site are the same species as would have occurred prior to European settlement, the biodiversity is now much reduced. The marsh, and lower embankment areas in particular bear little resemblance to the scene Backhouse viewed in 1837:

> "30th 11th mo. Near to Port Adelaide, where the land becomes saline, crimson mesembryanthemums of three species abound, along with numerous maritime shrubs; and on a sand bank separating the plain from the saltmarsh, which borders the creek or inlet that forms the harbour, there are trees of a species of Callitris, (called here pines, and resembling cypress,) about forty feet high, the trunks of which are used for piles, *Casuarina quadrivalvis* and *Banksia australis* etc. I also noted on this bank an orobanche… The saltmarsh is covered with two species of *Salicornia*, one of which is shrubby, two Frankenias, one of which is bushy, about a foot high, and besprinkled with rosy pink blossoms, the size of a silver penny"
>
> Backhouse, 1841

Kraehenbuehl (1996) suggests *Casuarina quadrivalvis* may be synonymous with today's *Allocasuarina verticillata* and *Banksia australis* would have been *Banksia marginata*. Kraehenbuehl (1996) examined some of Backhouse's original manuscript diary notes, which have more detail on the other plants the missionary botanist saw on the sandbank next to the canal John Barton Hack was cutting across the saltmarsh at the Old Port. This canal was not

the Portland Canal - it was the Old Port Canal a little south of Mangrove Cove. The canal was 400m long and finished where the anchor is now located in the median strip of Old Port Road. The additional plants mentioned in Kraehenbuehl (1996) in his report on Backhouse's visit include mangroves, and occurring on the sandbank just back from the Port River, *Grevillea ilicifolia*, muntries, *Ptilotus polystachys*, nitre bushes, a *Chrysocephalum* (probably *C. apiculatum)* myoporums, native apricots, *Podolepis* and two species of *Acacia*.

The samphires (*Salicornia*) seen by Backhouse would most likely be *Sarcocornia quinqueflora* (beaded glasswort) and either *Halosarcia pergranulata* (black seed samphire) or *Sclerostegia arbuscula* (shrubby samphire). Both of the latter are shrubby, both occur in the intertidal zone and both are still common in the vicinity. At the time of Backhouse's visit, Bentham had reclassified all samphires in Australia into the genus *Salicornia* (Wilson 1980).

It is apparent that mangroves are becoming the dominant species in the intertidal zones, and this many have an impact on the biodiversity of the site. Details of this issue and possible mitigation measures are discussed in *Section 5.4.1 Threats to ecological values and mitigation measures*.

Fauna lists have been compiled from past surveys of the site and the surrounding area as well as from data collected during site visits. Birds were recorded on site or overflying the site during site visits, and these birds are presented in the list below. The consultants' site list is necessarily limited by the weather on the days of the site visits, and is supplemented by an additional list of common bird records from the immediate site provided by the SA Ornithological Association and published in *A Quiet Spot Within Our Reach* (Schultz *et al*, 1996). As usual, asterisks mark the introduced species.

Table 5 - Bird sightings, 2004 site visit

Scientific name	Common name
Pelicanus conspicillatus	Australian pelican
Phalacrocorax sulcirostris	Little black cormorant
Larus novaehollandiae	Silver gull
Himantopus himantopus	Black winged stilt
Phalacrocorax melanoleucos	Little pied cormorant
Phalacrocorax varius	Pied cormorant
Ceciopsis nigircans	Tree martin
Grallina cyanoleuca	Magpie-lark
Glossopitta concinna	Musk lorikeet
*Columba livia**	Feral pigeon
Threskornis molucca	Australian white ibis
Gymnorhina tibicen	Australian magpie
Lichenostomus leucotis	White eared honeyeater
*Turdus merula**	Blackbird

Table 6 - Common birds of the Port River near the Ethelton Railway (Schultz et al 1996)

Scientific name	Common name
*Alauda arvensis**	Skylark
Ardea novaehollandiae	White faced heron
Ceciopsis nigircans	Tree martin
Charidus ruficapillus	Red capped plover
Elanus notatus	Black-shouldered kite
Grallina cyanoleuca	Magpie-lark
Himantopus himantopus	Black winged stilt
Hirundo neoxena	Welcome swallow
Hydroprogne caspia	Caspian tern
Larus novaehollandiae	Silver gull
*Passer domesticus**	House sparrow
Pelicanus conspicillatus	Australian pelican
Phalacrocorax (Leucocarbo) fuscescens	Black-faced shag
Phalacrocorax melanoleucos	Little pied cormorant
Phalacrocorax sulcirostris	Little black cormorant
Poliocephalus poliocephalus	Hoary-headed grebe
Rhipidura leucophyrs	Willy wagtail
Sterna bergii	Crested tern
Sterna hybrida	Whiskered tern
*Sturnus vulgaris**	Common starling
Vanellus miles	Masked lapwing

Schultz *et al* (1996) record sightings of plovers, pigeons, honeyeaters, ibis, hawks, galahs, and a dotterel. Historically black swans (*Cygnus atratus)* have been known to utilise the mud flats south of the Jervois Bridge (Schultz 1996), but they no longer appear here regularly since the disappearance of the intertidal widgeon grasses (a type of seagrass) that were once common in the area. Black swans are essentially vegetarian, with Frith (1977) finding minimal quantities of animal material in the stomachs of swans he examined. Deepening works in the Port River have progressively reduced the area available for shallow water seagrasses, with an inevitable decline in swan numbers as a result.

Many of the birds currently using the site depend on small fish for feed. It is expected that with the reduction in bait-digging, more use may be made of the area by migratory waders. These birds prefer saltmarsh and tidal flats as a feeding habitat, and harvest a range of infauna from the mud.

Daytime examination of the site for scats and tracks provided confirmation that rabbits utilise the site. There were many crab holes visible in the saltmarsh areas. Shultz *et a*l (1996) records seeing a water-rat, crabs, tubeworms and dolphins, but notes a sea-lion that used to bask nearby no longer frequents the area. The presence of water-rats in the mangroves has been confirmed by a teacher at the Portside Christian School (Lee Grigg, *pers comm*).

The days of site visits were cool and breezy, resulting in few invertebrates being recorded. Those seen included black ants collecting sap from some of the *Acacia pycnantha* trees,

honeybees, paper wasps (nest), many small pysllids flying in the mangroves, saltbush blue butterflies and spider egg masses.

Fish have been observed in abundance in the area, many in excess of 70mm in length. Their presence encourages fishing birds such as pelicans and cormorants to visit the site. Dolphins enter the area at high tide, chasing feed. The shape of the reserve allows dolphins to 'herd' small schools of fish.

Bryars (2003) classified Mangrove Cove as comprising both tidal flat and estuarine river habitats. He lists the following species of fisheries interest that could utilise the riverine portion of the site for at least a portion of their life cycle: blue swimmer crabs, razorfish, King George whiting, yellowfin whiting, snapper, WA salmon, tommy ruff, southern sea garfish, western river garfish, yelloweye mullet, black bream, mulloway, flathead, yellowtail kingfish flounder and whaler shark. The tidal flat portion of the site could be utilised by the following species for at least a portion of their lifecycle: blue swimmer crab, mud cockle, razorfish, baitworm, yellowfin whiting, WA salmon, tommy ruff, southern se garfish, yelloweye mullet, black bream, flathead, flounder, leatherjacket, school whiting and western king prawns.

This is not to say that the site currently supports all these species. The area has been heavily impacted by bait digging and other disturbances over a long period. However, managing the site to reduce this impact may result in an improved diversity and abundance of some of the above species.

The **management objective** is to conserve the biodiversity of the native flora and fauna on the site.

Strategies:

- When replanting areas utilise plants from the species list in the *Appendices*, with an emphasis on those plants that provide habitat for locally significant fauna.
- When planting the saltmarsh retreat zone, plant bands of plants representing the varying saltmarsh zones (see *Appendices*).
- Attempt to re-establish widgeon-grasses in the intertidal zone to provide feeding grounds for black swans (see *Appendices*).
- Maintain bait-digging ban.
- Attempt to actively manage mangrove incursion by salting and interpret the attempt for the public. Design a salting program and monitor, as detailed in the *Appendices*.

5.3 Managing cultural heritage

5.3.1 Aboriginal [Kaurna] values of the site

Before European settlement the Aboriginal people of the area had camping sites spread along the western bank of the river from Hawkers Creek to where Bower Road is now. They used the extensive mud flats to forage for shellfish, lobster, mussels, oysters, birds and fish. Water was obtained from springs further north on the Peninsula and vegetable and animal foodstuffs were collected between their camp at the river and the dunes at Semaphore (Melvin and Schultz, 1996).

Dennis (2005) records that the mangrove area along the Port River was of great significance as it harboured black swans (Kudlyo), the totem species of the Kaurna people that lived on the western banks of the Port River. The river itself is part of the one remaining detailed Dreaming journey of the Kaurna. This is the story, or song, of Tjilbruke (Tindale, 1987). The Port River was created by the ancestors for the purpose of hunting emu. When Tjilbruke and his companions hunted emu they drove them across the plain towards the coast, and then the river helped them to funnel the birds up the Peninsula, to Mudlang (the nose) near Outer Harbour, where they were trapped. The Tjilbruke story is attached to this plan in the *Appendices*.

After European settlement the camping areas were reduced. Finally there was only one small area just north of the present Jervois Bridge. Some of the people who lived at the camps along the river worked for Captain Hart at his Glanville Hall estate and a few, including descendants of Aboriginal people who still live in the district, took the name 'Glanville'. The campsite was broken up in 1891 when the Colonial Sugar Refinery took over the land (Couper-Smartt, 2003), and many of the people moved to Raukkan.

In 1993 the Lartelare Homeland Association was formed, headed by Veronica Brodie and composed of direct descendants of Lartelare Spender (Melvin and Schultz, 1996) to register the campsite with the State Aboriginal Heritage Committee. The Kaurna Heritage Trail was launched in June 2003 and comprises six sites on both sides of the river in the old Port Reach. The Trail is a joint venture between Tauondi College and the City of Port Adelaide Enfield's Visitor Information Centre. Locations 5 and 6 occur in Mangrove Cove. The markers for the trail at these locations discuss the importance of the mangroves as a food source, and methods of weaving with the reeds that grew in the area.

The **management aim** for the site is to conserve the site as a representative of Kaurna values for the area, and interpret this where appropriate.

Strategies:

- Maintain the Kaurna Heritage Trail through the site
- Continue to provide brochures detailing the self-guided walk along trail at the Port Adelaide Visitor Information Centre.
- Seasonal guided tours of the Kaurna Heritage Trail may be offered by the Tauondi Cultural Agency – details are available from the Port Adelaide Visitor Information Centre.
- Request that the Council bring forward the Kaurna name "Patangga" for the reserve.
- Ensure plantings of *Isolepis nodosa* (knobby club-rush) and *Cyperus gymnocaulos* (spiny flat-sedge) are maintained near the trail marker for location 5 of the Kaurna Heritage Trail.
- Attempt to reintroduce widgeon-grass and intertidal zone seagrass onto the site, to provide grazing habitat for black swans.

5.3.2 History of the site since European settlement

The upper reaches of the Port River were amongst the earliest areas settled by Europeans in the Adelaide area. The location now known as Mangrove Cove was, in early diagram books, called Harbours Board Reserve 17 (gazetted 1879). By 1923 the reserve land was listed as 'in process of reclamation' in survey DR 388/N. Reclamation (filling) started nearer to Port

Adelaide and gradually moved south. It is possible that the area was already being used as a Ships' Graveyard and that as ships were wrecked they were gradually filled over. The floating boys reformatory ship *Fitzjames* was dismantled somewhere in the Jervois Basin after the end of the 1800's. What remains of the wreck is likely incorporated into some of the fill occurring between the Jervois Bridge and Mangrove Cove. Other features from survey DR 388/N include the wharf adjacent to Block 43 (north of the Cove), which was called the Cable Company's Wharf, and the railway bridge. The railway bridge had been constructed in 1910 and opened a year later in 1911.

In 1928 a certificate of title (CT 1501/41) for a large block of land (Blocks 41, 42, 43, 44 & 48) including the area of the Cove was issued to the South Australian Harbours Board. In the same year a wooden trestle bridge was constructed alongside the railway bridge to carry gas from the SAGASCO's Osborne works. This trestle bridge also provided foot access across the river.

In 1934 the schooner *Fides* was beached north of the Cove and south of the Cable Company's Wharf. She was progressively dismantled. The remains of the hull were gradually covered by fill, however a small portion of the ship can still be seen at low tide. Details of all the wrecks in the Cove are attached in the *Appendices*.

The Harbours Board did not have immediate requirements for all of the land along the riverbank and in 1939 Block 48 was cancelled from the title and Block 43 was subdivided, with the subdivision being numbered Block 384. A portion of Block 43 was leased from the SA Harbours Board to the Colonial Sugar Refinery (Lease #1309003).

In 1940 a new title for the balance of the land (CT 1742/98) was issued to the South Australian Harbours Board. The Harbour Board survey DRG 10566/12 of the site, drawn in 1947, shows the existence of a lease to the Log Pool Milling Company, but the Log Pool must have been either already disused or near the end of its life, because by 1957 the piles are described as 'remains of Log Pool fence' and the reclamation fill on the site is encroaching into the lease area.

In 1947 the River Murray paddler *Trafalgar* was towed to Port Adelaide, but found to be unsuitable for conversion to a ketch. She was beached in the Log Pool area and partly dismantled. By 1957 the hulk was a local feature and was incorporated into Harbour Board drawing DRG 14243/12.

In 1953 a portion of Block 41, south of the Cove, was leased from the SA Harbours Board to the Minister of Works (Lease #1781579). 1957 saw the surrender of Lease #1309003 (Block 43) by the Colonial Sugar Refinery.

In 1960 the pontoon from the Port Adelaide Fish Market (on the north-eastern side of the Jervois Bridge) was towed to the Log Pool area and abandoned, not far from the wreck of the *Alert*, which had been beached in the Log Pool on 10 February of that same year and which was being dismantled. Both of these wrecks are clearly visible today.

Another lease to the Minister of Works, of portion of Block 41 (Lease #2645749) was issued in 1965 and in 1966 portions of Block 42 and 43 were taken for new road (Tracing #5502).

After these alterations a new title (CT 3491/25) was issued for the remainder of the land to the Minister of Marine in 1967. This title included Block 41, portions of Block 42 & portions of Block 43. Portions of Blocks 42 and 43 were transferred in a separate title (CT 3512/116) to the Sugar Refining Company Limited. The existing Leases #1781579 and #2645749 to the Minister of Works were transferred from the previous title onto the new title. In the same year a new title (CT 3512/117) for the remaining land was issued to Minister of Marine, after portions of Blocks 44 and 43 were withdrawn from the Minister of Marine and vested in the Crown.

The 1970's saw State Government plans to revitalise the Port, and a key component of their strategy was the establishment of a Western Regional Park along the banks of the Port River (Walsh, 1996). The location of the park was not settled and became a matter for ongoing discussion over the next 20 years.

In 1983 Blocks 41, 42 & 43 were redesignated Lots 4 of FP3256, Lot 5 of Section 660 & portion of Lot 6 of Section 662. A new title (CT 4206/542) was issued for Lots 5, 6 & 7 to the Minister of Marine.

Lease #2645749 to the Minister of Works was surrendered in 1984 and Lots 6 and 7 were vested in the Crown.

The 1986 Minutes and correspondence of the Port Adelaide Residents Environment Protection Group (PAREPG) show that the Group was concerned that the riverbank 'park' was being used as an excuse to continue dumping fill into the mangroves at the Cove. Residents held a working bee to clean up around the mangroves. In the same year the National Trust recognised the Ethelton Mangroves as 'significant trees' and they were cited in the *National Trust Register of Significant Trees* as the southernmost stand of mangroves remaining in South Australia.

PAREPG suggested a boardwalk in the mangroves and landscaping of the area south of Rennie Road in 1987. The Group also approached the Department of Fisheries to confirm that the mangroves were protected under the *Fisheries Act* and the State Heritage Branch to ask for protection of the Ships Graveyard. The union movement became involved in what was becoming known as the 'Battle for the Ethelton Mangroves' and in July of 1987 the United Trades and Labour Council and the Seaman's Union passed motions to retain an 'area of the west bank of the Port River which was originally set aside for a regional park.'

In 1989 Lot 52 was freed from trusts & renumbered Section 661 and transferred to Queen Elizabeth II as a new title (CT 4343/995). Proposals to use the area for residential development were floated (Harbourside Quay) that showed the mangroves cut off from tidal inundation by a causeway, as part of a marina/hotel development. Public outcry followed, but the development did not eventuate when the development consortium was placed into receivership (Messenger Press, 1/11/89, 14/3/90, 24/10/90).

Of Ships, Strikes and Summer Nights (Murphy, 1991), an oral history of Port Adelaide, was released with a chapter on the upbringing of Laura Glanville Spender, daughter of Lartelare Spender (a Kaurna woman), on the western banks of the Jervois basin.

In 1993 the Western Regional Park was again on the agenda, with Federal funding (Better Cities) being provided to the Multi Function Polis to contract Landsystems EBC to draw up plans for the Park. PAREPG held consultation with local residents through the "Three Creek Walk" to gauge views on how the Park should be developed. They also met with Aboriginal residents to hear about their history on the site, and the significance of black swans to the local people. During this time the mangrove boardwalk was installed and the amphitheatre was constructed.

The *Swim Through Sculptures*, by sculptor Steve Brown, were erected atop the log pool piles in 1994 to celebrate the annual swimming events that were held in the Port Adelaide River last century. Swimming clubs were based in the Port Canal directly across the river from the sculptures. The forms were designed to be "semi-figurative" representation of the once popular Port River swim rather than a literal interpretation, eliminating any suggestion of race, culture, nationality and gender.

Also in 1994, the Lartelare Homeland Association conducted a *Kaurna Site Tour* of sites of significance to local Aboriginal people.

Two years later the *Picnic Within our Reach* was held in the reserve. It was organised by Chester Schultz and friends to mark the release of *Within Our Reach: A Symphony of the Port River*, a CD inspired by the sounds of the Port River environment. The picnic was advertised as a 'free festive mud stomp' (Messenger Press, 10/4/96) and people gathered at the amphitheatre for an event that featured performances from the Junk Naturals (playing junk), choirs, mud dancing, Kaurna stories and a tour of the soundscapes of the site.

The event was followed by the publication of *A Quiet Spot Within Our Reach: Essays on the Old Port Reach* (Schultz *et a*l, 1996), a small book that provides a wealth of information on community activism in the Port and which illustrates the depth of community feeling for the Ethelton mangroves.

1996 also saw the formation of the Mangrove Cove Care Team at the Portside Christian School (under the auspices of *Our Patch*). Teacher, Lee Grigg, and her team started removing rubbish from the mangroves, planting propagules, revegetating the filled areas of the site and monitoring water quality. Students have hosted visits from groups of interested people and have shared their experiences with many. The school was awarded a special commendation from the SA Urban Forest Biodiversity Program in 1999 for its work at Mangrove Cove (Grigg, 2001)

In 2000, Crown Record 5766/884 was issued for Section 662, putting the land forming Mangrove Cove under the custodianship of the Minister for Environment and Conservation.

In 2004 The Port Adelaide Council requested a consultant's report, *Mangrove Cove – Issues and Impacts of the Port Adelaide Waterfront Development* (Zechmeister, 2004). This report looked at impacts of the proposed Newport Quays residential development, in relation to the management of Mangrove Cove. The paper assessed the Cove's core values and provided a series of recommendations to ensure that the construction and habitation phases of the residential development would not cause an impact on the reserve area.

For such a small area, the site has a rich usage history. The **management aim** is to conserve culturally interesting aspects of the site and interpret this, where appropriate, for visitors.

Strategies:

- Maintain the Ships' Graveyard interpretive trail.
- Replicate the sign describing the *Swim Through Sculptures* that is present on the eastern bank of the river so that visitors to Mangrove Cove are aware of these pieces of public art.

5.4 Managing threats and opportunities

5.4.1 Threats to ecological values and mitigation measures

Mangrove Cove is a very small reserve, surrounded by commercial and industrial users and soon to have a residential development as a neighbour. Besides the past practices that have degraded portions of the site, there are ongoing risks to the site from maritime and terrestrial invasive species of plants and animals, illegal domestic and commercial dumping, stormwater runoff from increased areas of sealed land surface in the residential subdivision, noise intrusion from the railway and Port, bait digging and mangrove incursion.

While the first five of these threats are self explanatory, the latter threat has only been recognized relatively recently and so is discussed in more detail here. Mangrove and saltmarsh habitats are 'seral' or 'change habitats.' That is, their boundaries do not stay the same over time, but change to reflect factors such as sea-level change and sediment supply. In Mangrove Cove the mangroves are expanding rapidly, as they are right around the Barker Inlet. Harty (2002) suggests that some of the basic causes of this expansion of mangrove habitat at the expense of saltmarsh include:

- Sea level rise allowing mangroves to colonise saltmarshes;
- Increased rainfall or the discharge of stormwater to saltmarshes, which reduces soil salinity within saltmarsh areas and allows mangroves to migrate into saltmarsh vegetation;
- Increased nutrients in estuaries and the intertidal zone favouring mangrove colonisation;
- Mangroves recolonising previously cleared areas;
- Modified estuary entrances or channels through dredging which alters tidal patterns and allows increased tidal inundation favouring mangrove expansion;
- Subsidence of the intertidal flats permitting mangroves to migrate inland into saltmarsh communities; and
- Saltmarsh being considered as a pioneer species, which is subsequently replaced by mangroves.

This change is not an issue in areas where saltmarsh can also retreat, but in areas adjacent to urban development, or where the topography changes suddenly, the saltmarsh becomes trapped, and eventually is extirpated. In Barker Inlet particularly, where saltmarsh is trapped between the mangroves and the seawalls, this habitat has gradually been over run since the 1940's and now very little remains.

In the case of Mangrove Cove, the speed of this change has been high, and the number of young mangrove trees sprouting amongst the saltmarsh plants suggests that the pace of this expansion is not slowing. The site has a very gentle slope and it would not be unreasonable to suggest that within another twenty years mangroves would have reached beyond the edge of the reserve to where the deeper channel starts (shown in *Figure 4* of *Section 5.2.1.1 Evolution of the landscape*).

There are two responses to this change - observe and interpret the change in habitat as mangroves gradually reclaim the site, or actively manage the site to maintain the highest range of biodiversity and cultural values.

Change is a natural process in intertidal communities, and watching it occur is an important educational facet of environmental awareness. It takes man from the 'controlling centre' of the universe and places him in his niche – a small cog in a large wheel. This is a valuable lesson, and the mangroves at Ethelton may be used to illustrate several salient points – sea-level change, land subsidence, the temporary nature of even quite large structures such as boats and the importance of providing saltmarsh retreat areas for not only the plants but also the animals and migratory birds that depend on them.

The negative side of allowing change to occur in this instance is the resulting reduction in biodiversity value (vegetation species diversity, mud flat infauna and wader bird habitat) and cultural values (shipwrecks, log pool piles and the 'swim through sculptures', indigenous values). Where the 'observe' option is selected, interpretive signage is recommended to assist the public in recognising what is occurring on the site.

As noted above, a monoculture of mangrove has lower biodiversity value than an area that includes both mangroves and salt marsh. The obvious differences are observable in vegetation diversity and wader bird habitat, both of which are smaller in a mangrove monoculture.

Mangroves are normally limited in their incursion into saltmarshes by the increased soil salinity. In areas such as Mutton Cove, a restricted tidal entrance allows control of the water levels and resulting soil salinity. In other parts of Barker Inlet such control is not available. In some small areas there is land available for saltmarsh retreat (Little Para) but in most areas the saltmarsh will be over run by mangroves. The Mangrove Cove saltmarshes are very small and have no tidal restrictions, however they could possibly be managed by salting the saltmarsh areas and wrecks. This should be a low impact, low cost method of slowing the advance of the mangroves, leaving open area for the wrecks, saltmarshes and migratory birds.

The negative side of undertaking such an action is the essentially artificial nature of the control. The process is experimental, so determining the degree of intervention may be iterative. Also, it is unknown how effective the process would be. While the process is likely to work to slow the mangrove expansion down in the short term (10-20 years) it may not be sufficient to prevent the change in the case of extreme sea-level change over the longer term. Indeed, should sea-level change be very large, even the mangroves may not survive.

Stakeholders have selected 'active management' as a management tool in Mangrove Cove, however they recognise that this is an experimental procedure. It is recommended that the salting program be designed as an experiment, monitored over several years and interpretation provided.

The **management objective** is to reduce threats to the ecological values of the site.

Strategies:

- Provide the Portside Christian School's Mangrove Cove Care Team with assistance in recognising maritime and terrestrial invasive species (Our Patch and Waterwatch).
- At least some signage of the reserve should highlight dumping penalties.
- No stormwater runoff should be directed from the residential subdivision into the reserve.
- Additional planting on the filled area may minimise some of the noise intrusion,
- Maintain the bait-digging ban.
- Attempt to actively manage mangrove incursion and interpret this for the public.

5.4.2 Identification of site soil constraints from historic records

The reclamation materials used in the filled area appear to come from a variety of sources. Digging on the site reveals large amounts of 'kunkar,' the calcrete material that underlies the St Kilda formation in the Port Adelaide area. Other materials include bricks, concrete, asbestos waste (Messenger, 25/3/86) and slags. The boat ramp in the north eastern corner of the site appears to be composed of slag of unknown origin and is topped by a thick layer of 'limestone grits' that were probably sourced from the Soda Ash Plant at Osborne. No soil testing had been carried out anywhere on the reserve site, as far as can be ascertained by the consultants.

As the filled portion of the site is not proposed for residential use, or other sensitive uses, and no change in land use is contemplated, the most appropriate method of dealing with the site would be containment and management to reduce the risk of any solutes from the fill materials entering the groundwater and the estuary. Establishing vegetation that does not require additional watering reduces any risk of dissolving and mobilising any materials from the fill. The evaporo-transpiration from indigenous plants will utilise much of the rain that falls on to the site, returning it to the atmosphere.

Minimal earth works should be undertaken on the filled portion of the site and a reasonably thick topping of soil should remain in place.

The boat ramp will not be accessible once the neighbouring residential development is built. It is possible to either remove the boat ramp to the natural surface, or to cap the ramp with sandy clay to provide for area suitable for saltmarsh retreat zone.

The ramp appears to be composed of smelter slag with a topping of ICI limestone grits. At present it is partially capped, preventing freshwater ingress, although carbonate-rich seawater ingress occurs through the exposed faces. The ramp material would probably not meet clean fill guidelines and if removed would need disposal to a specifically licensed landfill. The removal process could create turbidity in the waterway and may release unknown substances into the water column. The resulting area would either be sufficiently deep to maintain water at most tides, or shallow enough for mangroves to colonise, depending on the amount of material that had to be removed.

This engineering solution is feasible, but likely to be expensive. Any increase in turbidity during ramp removal would need to be managed. The boat ramp is more than nine cubic metres and so a development application would be required.

Stakeholders considered that an alternative option that did not disturb the existing boat ramp was preferable, in order to reduce environmental risk and provide for the widest biodiversity on the site. The preferred option is to retain the ramp and use it as the base for a saltmarsh retreat area. This option does not increase the degree of degradation of the site, although it does not remove the boat ramp material. Some further application of lime-rich grits over the exposed slag on the faces of the ramp may be required. A depth of at least 50cm of clay, right over the boat ramp is proposed, with a further topping of 10-20 cm of sandy clay in the intertidal zone, and sand in the supratidal zone. There may be some increase in water turbidity on the first incoming tide after the clay is placed.

Plantings of zones of subtidal and intertidal saltmarsh species would provide an area where saltmarsh could retreat up a slope on the site. This is not available anywhere else on the site, and mangroves are gradually dominating the site. The slope is ideal from the point of view of daily tidal drainage, and any saltmarsh established on it would not support mosquito breeding.

An artificially constructed saltmarsh has not been attempted over an impervious base before, so there may be an iterative process required to establish the plantings. However, the local saltmarsh will produce a reasonable degree of natural colonisation within a short time, and this will help delineate appropriate planting zones. The experimental nature of this approach needs to be recognised, and should this approach be selected there should be ongoing monitoring incorporated, as part of the overall monitoring program for the site. A preliminary construction plan for the suggested saltmarsh retreat zone is included in the *Appendices*.

Intertidal areas of the site, and the soils underlying the boat ramp may contain Potential Acid Sulfate Soils (PASS) as detailed in *Section 5.2.1.2 Current topography*. Such zones usually remain innocuous if undisturbed and exposed to regular tidal inundation. Excavating PASS can lead to the formation of actual Acid Sulfate Soils, and this is to be avoided.

The **management aim** is to minimise the impacts of any historic soil constraints on the site.

Strategies:

- Avoid earth moving activities in the filled areas of the site (moving the surficial planting mounds may be appropriate in some cases).
- Select plants from the species list in the *Appendices* that are recorded as being successful on the site to vegetate the filled areas.
- Do not disturb intertidal soils that may contain PASS.
- The preferred treatment for the boat ramp is revegetation, maintaining biodiversity and improving amenity. The details relating to the methods and practical completion of the project will be negotiated between the Council and Newport Quays, outside this management plan.

5.4.3 Buffering recommendations to reduce edge effects on Mangrove Cove

Mangrove Cove is a small conservation reserve therefore edge effects are likely to be an issue when dealing with the management of the site. These edge effects include noise impacts on

bird life, trampling impacts on mangrove and saltmarsh vegetation, erosion of the filled area, and weed invasion.

Community groups have already started the process of reducing the edge effects by removing litter and revegetating the higher land. Other amelioration methods may include fencing, additional planting along the boundaries, signage, walking path construction and public education.

The **management aim** is to reduce edge effects within the reserve.

Strategies:

- Use dense plantings on higher, filled area to reduce noise impacts.
- Place dense, low growing plants between pathways and embankment edge to prevent indiscriminate passage.
- Plant intricately branched plants on the embankment areas where erosion is occurring.
- Maintain the mangrove boardwalk as an access point for people wishing to experience the mangrove habitat.
- Ensure viewpoints across the intertidal portion of the reserve allow clear vision so that people do not need to 'bush bash' to get a better view. A useful viewpoint could be at the northern end of the current boat ramp area.
- Maintain the bait-digging ban.
- Interpret views so that people appreciate the presence of birds and recognise the need to allow them undisturbed use of the tidal flats.
- The revegetated boat ramp area could be used for interpretation of the saltmarsh habitat and also be used allow some degree of access to the higher parts of the saltmarsh, reducing the urge to explore further into the saltmarshes in the main part of the reserve.

5.5 Managing ecotourism and visitor access

Ecotourism and accessibility is an important aspect of ensuring the long-term conservation of an area or habitat type, however frequent visitor access to an area may be detrimental if not controlled. Methods of allowing, but controlling, access include pedestrian access entries, bicycle tracks, and boardwalks in suitable areas. Increasing visitors' enjoyment of an area is an important component in reducing the damage done to a site. Bird hides, rubbish bins, picnic shelters, seating and signage are often used to make visits to a sensitive area more enjoyable or educational.

Access starts with allowing people to reach the site. There is public transport within walking distance, and the riverside plaza planned by the consortium developing Newport Quays will provide access for pedestrians and cyclists. People arriving at the site by motor vehicle will require a parking area. Newport Quays drawing AEV-421-C-DWG-805 shows the details of the parking area agreed to by the stakeholders.

The site currently has two interpretive trails running through it, the Kaurna Heritage Trail and the Ships' Graveyard Trail. These trails reflect the cultural history of the site and it is important that they are maintained as an integral part of the reserve. During the construction phase of Newport Quays it may be necessary to temporarily remove some of the Ships' Graveyard interpretive signage along the riverside plaza. In the event that occurs, the signage

shall be replaced after consultation with the appropriate bodies, who may wish to conduct maintenance of the signs. Stewardship of the Kaurna Heritage Trail rests with the Aboriginal Advisory Panel to the Port Adelaide Council. The Department for Environment and Heritage, Heritage Branch is responsible for the Ships' Graveyard Trail signage.

Additional cultural interpretation for the site could include information on the "Swim Through Sculptures" that are mounted on the piles of the old log pool.

The site currently has little ecological interpretation. Information about tidal flats, mangroves and saltmarshes, migratory birds, and the interactions between the flora and fauna could be provided. This may be particularly relevant if either active management of the wreck sites and saltmarsh is contemplated or if an area of saltmarsh retreat is incorporated into the site. The mangrove boardwalk provides a shady and quiet experience of the growing mangrove forest and is served well by the presence of a seat, and this should be maintained.

The amphitheatre is a useful area for containing groups of people and focussing them on the scene before them. It has also provided a useful focus in the recent past for community activities. The area may require some 'sprucing up' but has the benefit of providing seating areas and viewing spaces. If it were removed these amenities would need replacing.

The **management objective** is to provide the public with the opportunity to access the reserve and learn about its ecological and cultural values while maintaining the integrity of those values.

Strategies:

- Newport Quays drawing AEV-421-C-DWG-805 shows the details of the parking area agreed to by the stakeholders.
- Consider time restrictions on the reserve's parking bays to ensure they are available for reserve visitors rather than being utilised by visitors to the residential areas.
- Ensure bicycle access along the Riverside Plaza meets the Council-wide guidelines for shared use bicycle/pedestrian access.
- Maintain existing interpretive trails and signage (Kaurna Heritage and Ships' Graveyard).
- Provide additional interpretation about the *Swim Through Sculptures* and about the ecological values of the reserve.
- Maintain the mangrove boardwalk and seating.
- Maintain the existing amphitheatre or replace with a structure that provides similar amenities (an area to sit, a viewing point, an area to collect a number of people together).
- A viewing platform at the northern end of what is currently the boat ramp may be a useful place to provide interpretive material about the changing mangrove and saltmarsh environment.

6. Management arrangements

6.1 Long term maintenance requirements

Maintenance is an important part of management, particularly in small conservation areas with high visitation potential. Maintenance of Mangrove Cove will include typical 'parks and grounds' maintenance requirements for the access zones of the reserve.

Should the management authority (ultimately the PAE Council) determine on active management of the saltmarsh and wrecks area, or the development an area for saltmarsh retreat, there may be some additional maintenance requirements, as detailed in the following table.

Table 7 - Maintenance

Area	Maintenance requirements
Planted mounds and open space	Removal of dead plants and assisting volunteer groups with replanting more appropriate species, recording unsuccessful species so that they are avoided in the future (see *Monitoring program*), slashing long grass, pathway maintenance, bins etc
Car parking area	Maintenance of parking signs, kerbs & gutters etc, bins
Interpretive signage	Graffiti removal
Mangrove boardwalk	Physical repairs to structure, graffiti removal
Amphitheatre	Physical repairs to structure (not frequent as the structure is very simple and earth-sheltered, reducing vandalism)
Wrecks and saltmarsh management	Salting annually and recording details (see *Monitoring program*)
Mud flat area	Assisting volunteer groups with replanting widgeon and sea grasses.
Saltmarsh retreat zone	Assisting volunteers with any extra plantings required after initial installation

6.2 Roles and responsibilities of key stakeholders

It is envisaged that the land (currently under the care and control of the Minister for Environment and Conservation) will be freeholded and vested in the Land Management Corporation. The land will form part of the Newport Quays development and the developer and Port Adelaide Enfield Council will negotiate the conditions of development approval and the ultimate hand over of the land into the care of the Council. Once the land is vested to the care and control of the City of Port Adelaide Enfield as a reserve, the PAE Council will be responsible for the day-to-day operation of the reserve. *Table 8* notes the organisations that have responsibilities or roles in the management of the Mangrove Cove reserve.

Table 8 – Key roles and responsibilities

Stakeholder	Responsibility	Contact
DEH	Maintenance & interpretation of heritage items including shipwrecks	Shipwrecks Officer, Heritage Branch, DEH
	Compliance (eg bait-digging ban), assistance at volunteer days	Dolphin Sanctuary Ranger, DEH
	Funding partner for future small grants	Coastal Protection Branch Community Officer, DEH
Land Management Corporation	Interim land owner – funder for management plan	Project Manager, Port Adelaide Waterfront Redevelopment
Port Adelaide Enfield Council	Future land owner Council's reserve planning and funding	Strategic Policy Officer, Environment, City of Port Adelaide Enfield
	Provision of advice to the developer in the development of construction, revegetation and landscape plans. Practical completion inspections	Strategic Policy Officer, Urban Planning, City of Port Adelaide Enfield
	Operational reserve maintenance	Manager Parks and Gardens, City of Port Adelaide Enfield
	Stewardship of Kaurna Heritage Trail (through the Aboriginal Advisory Panel)	Aboriginal Development Officer, City of Port Adelaide Enfield
Adelaide and Mt Lofty Ranges NRM Board	Funding partner for NHT grants for future projects (eg saltmarsh and reserve plantings)	Regional NRM Liaison Officers
Newport Quays	Development consortium – funding and construction of initial works to the satisfaction of the City of Port Adelaide Enfield	Project Manager, Newport Quays

6.3 Community involvement

Volunteers typically are involved in revegetation efforts in most reserves, however some monitoring activities are suitable for volunteer groups, as is the provision of interpretive and educative tours and activities.

Table 9 - Volunteer groups

Group	Contact	Phone	Activities that may be undertaken
'Our Patch' regional coordinator	Caroline Wilson	8416 6352	Co-ordinate volunteer activities at site, provide insurance cover for activity days
Portside Christian School	Lee Grigg Richard Bunting	8341 0857 8341 5133	Mangrove Cove Care Team – replanting, litter removal, education activities, monitoring and water testing activities
'Waterwatch' regional coordinator	Amy Blaylock	8234 7255	Co-ordinate volunteer water monitoring activities at site and provide materials and equipment
Aboriginal Advisory Panel	Brett Hill Angela Sloan	8405 6788 8405 6868	Education activities (eg tours of Kaurna Heritage Trail)
Port Adelaide Residents Environment Protection Group	Tony Bazeley		Restoration activities, monitoring activities

Community involvement in conservation efforts is often the only financially practicable method to complete required works. Volunteer efforts are also an effective way to help educate the community and provide the community with a sense of ownership. This involvement also comes with some specific issues. The management organisation or body in charge of a reserve needs to consider how the costs of insurance are to be met, and ensure that they meet their duty of care under state OHS&W legislation.

The site is already a registered "Our Patch" site and the management authority should ensure that all activities conducted on the site by volunteers are "Our Patch" events.

6.4 Recording progress

A community based monitoring program is proposed that will provide the reserve managers with specific information on the impact of management actions. The monitoring program will provide information on water quality, habitat issues and success of management actions. In some cases the information will be useful for other agencies, will provide an ongoing record of changes in the reserve's habitats, or provide information that will assist restoration efforts in other reserves. In some cases the information provided will trigger an action on behalf of the management body. Unless specified otherwise, monitoring is conducted by the Portside Christian School's Mangrove Cove Care Team.

Table 10 - Recording progress

Aspect	Records	Response
Water quality	1. Waterwatch Estuarine Monitoring Site Record Form	1. When water quality falls outside the ranges specified in the monitoring program, the results are provided to the Waterwatch regional coordinator who may decide whether to report the abnormality to the EPA or NRM Board. 2. Oil slicks are reported to the EPA who will initiate cleanup procedures if required. 3. Copies of regular monitoring are provided to the Waterwatch regional coordinator who may make them available to other agencies (eg the PAE Council) so that the impact of projects such as the Water Quality Improvement Plan for the Port River may be assessed.
Habitat values	1. Waterwatch Estuarine Bird Observation Record 2. Waterwatch Estuarine Monitoring Site Record Form (invasive species are recorded in 'additional site information') 3. Aerial photographs of the site.	1. Bird observation records are provided to the Waterwatch regional coordinator. Should either the diversity or abundance fall over three consecutive observations, the management authority shall investigate whether there have been any habitat changes that may account for this. 2. In the event of any invasive species being found in the reserve, either PIRSA (marine pests) or the PAE Council (weeds and feral animals) shall be advised so that the appropriate actions may be initiated. 3. Aerial photographs, taken approximately 5-yearly, of the site shall be maintained by the management authority to allow estimations of habitat change to be made.
Success of management actions	1. Planting records 2. Widgeon and sea grass transect data 3. Mangrove expansion photo points 4. Saltmarsh retreat zone	1. Annual planting lists, and records of failed plants removed or replaced, shall be maintained by the PAE Parks and Gardens Manager. 2. When a species fails frequently it shall not be included in future plantings. 3. In the event that seagrass or widgeon grass are planted,

Aspect	Records	Response
	photo point 5. Optional saltmarsh vegetation transect data	photographic transect records are to be maintained by the PAE Parks and Gardens Manager. Photographs may be taken by community monitoring group. 4. Failure within 3 months of initial planting of more than 50% of seagrass plantings shall result in the management authority seeking advice from a coastal wetland ecologist. 5. Failure of seagrass plants to expand their cover over three years shall be indicative of inappropriate site conditions and further attempts to replant these species shall be suspended. 6. Photo point records of mangrove expansion are to be taken by the community monitoring group and copies supplied to the PAE Parks and Gardens Manager who will maintain these records for later analysis. 7. Photo point records of the constructed saltmarsh area are to be taken by the community monitoring group and copies supplied to the PAE Parks and Gardens Manager who will maintain these records for later analysis and as a data source for similar projects. 8. In the event that more than 50% of initial saltmarsh plantings fail, the management authority shall seek advice from a coastal wetland ecologist, in formulating a new planting plan.

6.5 Ongoing review

Ongoing review of the management plan, any action plans, monitoring results and procedures is an important part of conservation management. A management plan is usually relevant for 5-10 years, depending on the variability of the habitat and political climate. Action plans are usually relevant for three years, while procedures are generally subject to yearly or continuous review.

Annually the management authority (ultimately the City of Port Adelaide Enfield) shall review this management plan and the results from the monitoring program. The outcome of the review shall be used to determine the future year's work plans, whether specific action plans or studies are required and to set the annual budget.

7. Monitoring program

Measuring the effects of actions taken as part of a management plan is an essential element of any plan. Monitoring needs to be undertaken over a long period of time and may be costly if not well planned.

When restoring tidal wetlands, intensive monitoring is generally recommended for 3 to 7 years, depending on the speed of recovery. Less intensive monitoring may be informative for up to 20 years after a management action has taken place.

Most of the procedures selected for this monitoring program have been selected using the criteria below;

- How useful is the data?

- Do we really need to monitor it?
- How much time or financial outlay is required to complete this action?
- Do the benefits outweigh the costs?
- Are the procedures repeatable and likely to be consistent between monitoring groups?
- If the management plan is not accessible, are the methods and justification publicly available?
- Are similar monitoring actions occurring elsewhere, so that the results may be compared?
- Is it possible for community groups to complete test actions if required?

Due to the limitations enforced by the criteria, most of the methods and justifications used in this monitoring program are selected from the *Waterwatch SA Estuarine Monitoring Guidelines* (Coleman and Cook, 2003). This handbook is available from the South Australian EPA or the State Waterwatch office.

Table 11 - Suggested monitoring program

Frequency / Attribute	Bimonthly (or Waterwatch 'Snapshot' Days)	Annual	As needed, or desired
Site observations	X		Whenever any monitoring is undertaken
Water temperature	X		
PH	X		
Water clarity	X		
Water salinity	X		
Ammonium	X		
Recording wading birds		X	X
Recording invasive species		X	X
Recording revegetation plantings and unsuccessful species		X	
Monitoring success of widgeon grass & seagrass plantings		X	
Monitoring mangrove expansion		X	
Monitoring saltmarsh plantings		X	
Using aerial photographs to map habitat change			X

The matrix presented here illustrates the monitoring program. It shows the parameters to be monitored, and the required frequency of monitoring. Monitoring may be done for a wider

range of attributes than those listed in the matrix, and may be done more frequently, if there are sufficient time and resources. The suggested program provides the basic data required to quantify the changes occurring within the Cove and assumes that the majority of monitoring will be carried out by a community monitoring group. It assumes that an area for saltmarsh retreat will be planted, that plantings of widgeon and seagrasses may be attempted on the mud flats and that 'salting' of the wrecks and saltmarsh areas may occur. Monitoring relating to these items will not be needed if these management actions are not being undertaken.

Water monitoring is currently being conducted by Waterwatch volunteers from the Portside Christian School. Their monitoring results are reported to the KESAB Waterwatch regional coordinators, who can supply copies to the reserve's management authority. The Waterwatch estuarine kit would be the most useful monitoring kit for use in Mangrove Cove. The Our Patch regional coordinator is an appropriate person to assist the community with vegetation monitoring.

7.1 Monitoring locations

The monitoring locations shown below are indicative locations only. Some, such as the seagrass monitoring transect would depend on the planting location. Once monitoring locations are confirmed map grid references (and bearing, in the case of photo points) should be recorded for each location.

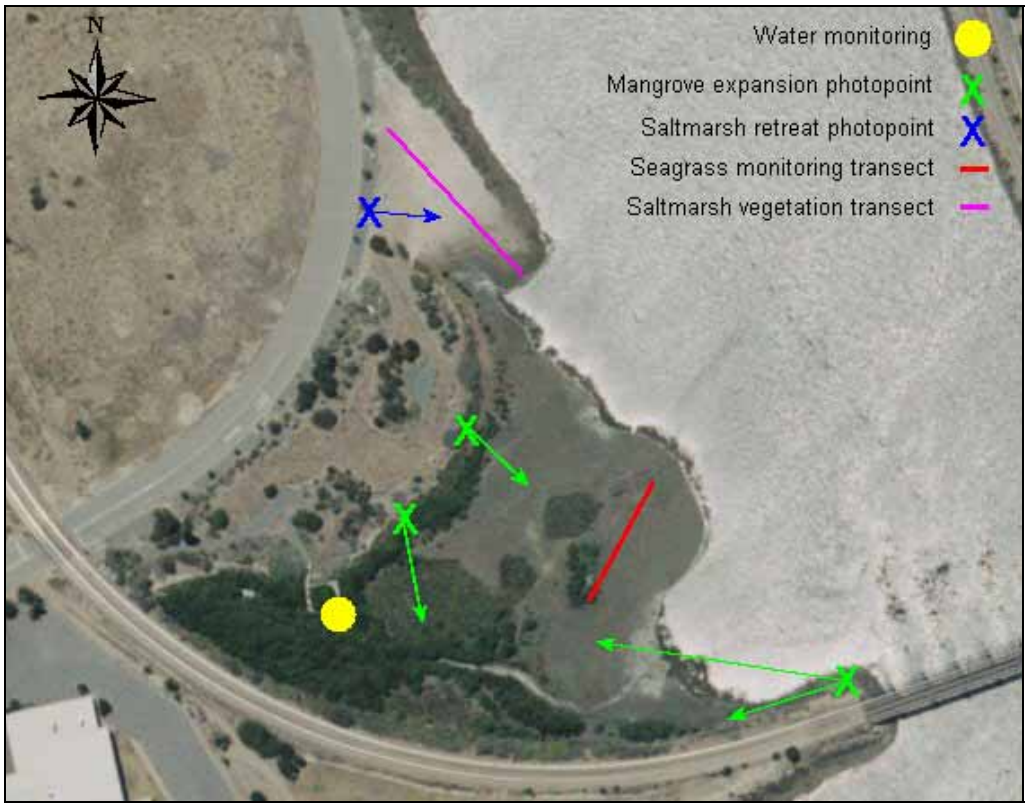


Figure 11 - Monitoring locations

7.2 Data quality

Good quality data is essential for setting milestones and trigger thresholds for the Mangrove Cove management plan. It is expected that data collected for this monitoring program will comply with a Waterwatch estuarine data quality of 'advanced' or 'standard', depending to the frequency of testing and the abilities of the samplers.

Taking representative water samples is discussed in depth in the Waterwatch Estuarine Guidelines (2003) and these procedures should be followed. Additionally, chemical water samples within the Cove are best taken while the tide is ebbing. If desired, additional samples may be taken outside the Cove, or extra sample events may be performed.

7.3 Site observations

Ideally, monitoring events should be undertaken at a similar times of day on calm, sunny days that are not excessively hot, however this is not always practical. To compensate for variations in climate and other attributes, site observations should be recorded when any form of monitoring is undertaken. These attributes provide the analyst with some context for the monitoring results. For example, lower bird counts may be expected on a cold rainy day, or lower water clarity may occur if the day has been fairly windy.

Site observations are a significant part of a monitoring program. Field personnel should record the weather, state of the tide, surface water conditions and any odours, oily slicks or observations using the Waterwatch estuarine site record sheet.

The presence of extensive oil slicks on the surface (not just mangrove oils) shall be immediately reported to the Environment Protection Authority.

7.4 Temperature, pH, salinity and clarity

These four attributes are the basic water quality indicators for the Cove. They indicate whether the water is likely to be polluted. These attributes also interfere with some of the chemical tests, so should be measured whenever any chemical testing is done.

The ranges expected for each of these parameters at the designated sample point are shown in the table below. If the results fall outside these ranges, test the parameter again, then report the abnormality to the Waterwatch co-ordinator.

Table 12 - Physical water quality ranges

Attribute	Low	High
Temperature (^{o}C)	10	30
pH	7	9
Salinity (g/L)	25	70
Water clarity	3 events less than 2m, or 1 event less than 0.5m.	No upper limit.

Water colour and water depth are useful parameters, and may be measured at the same time as water clarity, however there are no trigger thresholds for these readings, as they are for information only.

Salinity may be measured using a dipper and hydrometer or with an electrical conductivity meter. The former method is recommended in estuarine waters. Water clarity, depth and colour are measured using a secchi disk.

7.5 Ammonium

Ammonium is one measure of nutrient enrichment. The Waterwatch estuarine kits include an ammonium test kit appropriate for saline waters. This test provides a good indication of eutrophication.

Levels of ammonium greater than 0.5mg/L-NH_4 are considered high in estuarine ecosystems (EPA, 2003). Unfortunately there is little that can be done about high nutrients within the Cove, unless water quality in the Port River is improved. This test is done for the purpose of informing the management body, and other government agencies. In this way, the results of improvement programs for Port River water quality may be measured.

7.6 Recording wading birds

Mangrove Cove provides habitat for a range of wading and fishing birds. It may also host black swans again if the tidal flats can support a growth of marine grasses.

Observations of the waders frequenting the site provide an indication of the species diversity and dominance of each species. Many bird species have known habitat preferences, so this is a further indication of changes happening within the Cove. Record bird observations on the monitoring sheet provided. If the diversity or number of birds visiting the area reduces over a period of three or more observations, steps should be taken by the management body to identify why this is occurring.

7.7 Recording invasive species

Invasive species of plants and animals may significantly damage a small site like Mangrove Cove. There is also a legal obligation to control or report some species, and this needs to be considered by the management body. Complete lists of terrestrial invasive species are available on weed and pest control board websites, and leaflets are available from most urban councils. A list of marine pests in South Australia is provided by PIRSA at http://www.pir.sa.gov.au/pages/sus_res/mar_hab/pests.htm.

A particular issue at Mangrove Cove is the invasive seaweed *Caulerpa taxifolia*. Should this, or any other unusual organism be found, then the PIRSA should be notified.

7.8 Recording revegetation plantings & unsuccessful species

Each year a record should be made of what species of plants, and how many, were planted on the site. Also, the unsuccessful plant species should be recorded when they are removed. It may be useful to record the previous year's rainfall total next to the names of removed dead plants – this may provide information on the drought tolerance of the species selected.

7.9 Monitoring success of widgeon grass & seagrass planting

Annually lay out a marked string line across the area planted with seagrasses. Make sure the line extends beyond the planted area at both ends. Use a fixed point to run the line from (eg a post on the *Trafalgar*). Photograph the extent of the planted area, if it is small enough. If the area is large, photograph several evenly spaced points along the line. Be sure to include the tape in the photographs. The spread of the plants can be estimated from this measure, as well as the density (coverage) of the plants.

7.10 Monitoring mangrove expansion

Mangrove expansion is an expected occurrence in the reserve however expansion that results in a monoculture, or that completely hides the Ships Graveyard, is not desirable. Should annual salting of the wrecks and saltmarshes be undertaken, then several photo points should be set up at the Cove to monitor the effectiveness of this program.

Photo points should be placed perpendicular to embankments, looking across the leading edge of the mangroves. There should be two locations where no salting will be occurring (mangrove/mudflat or mangrove/saltmarsh interfaces), and two locations where salting will be occurring (mangrove/saltmarsh interface). Suggested locations for the photo points are shown in *Figure 11 – Monitoring locations*. Each view should include a fixed object (eg parts of a wreck or a stake) that is a known size. This will provide a scale in the photographs. A short stake or other fixed point should be driven into the ground where the camera will be placed for each photograph. In this way each year's photograph will be able to be overlaid on the previous year to detect change.

Heights and breadths of the mangrove fringe may be calculated from these photographs. A new photo point may be established as the mangrove zone expands.

7.11 Monitoring saltmarsh plantings

Should an area for saltmarsh retreat be constructed and planted, a record shall be kept, by the developer, of the original plantings and their placements (a planting plan). A fixed photo point shall be established on the filled area of the site with a view that encompasses the saltmarsh retreat site as shown in *Figure 11 – Monitoring locations*. A photograph shall be taken on completion of planting and at least annually after that.

To determine specific species' success, a line transect, as detailed in the *Waterwatch SA Estuarine Monitoring Guidelines* (Coleman and Cook, 2003) may be undertaken, if desired. A suggested location for a transect in the saltmarsh retreat zone is shown in *Figure 11 – Monitoring locations.* Record the details on the vegetation transect monitoring sheet provided.

7.12 Using aerial photographs to map habitat change

Aerial photography is the easiest method of identifying the extent of gross habitat change. A simple classification of georectified aerial photography into three classifications (mangrove, saltmarsh and mud flat) will suffice. If aerial photography is purchased from Mapland every

five years or so, the reserve managers will be able to examine the rate of change in the habitats, predict future change and make decisions on managing that change.

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Appendices

Aims and strategies table

MANAGEMENT ISSUE	OBJECTIVES	STRATEGIES
Reserve zoning	**Access zones:** Providing the public with access to the site, providing amenities such as seating and shade and providing interpretation (eg providing information on the habitats and cultural history of the site).	Some of the parking access, all the interpretive trails except the small mangrove boardwalk, and public seating including the amphitheatre are all contained within the access zones of the reserve. All such developments should be in keeping with the history and function of the reserve, paying particular attention to both Kaurna and European cultural values of the site. The shared bicycle/pedestrian way is located outside the reserve boundary. Newport Quays drawing AEV-421-C-DWG-805 shows the details of the parking area agreed to by the stakeholders.
	Conservation zones: Providing safe habitat for fauna and management for maintaining the highest possible biodiversity, given the constraints of the site.	No developments are proposed for this area apart from ongoing maintenance of the mangrove boardwalk and the remediation of the boat ramp area.
Site topography	Minimise any further degradation of the site and attempt remedial actions where possible	Disturbance to the soils of the intertidal areas shall be minimised. Should any actions that could disturb areas of coastal acid sulfate soils be contemplated, an impact mitigation plan shall be developed in cooperation with the Coastal Protection Branch of DEH. The preferred treatment for the boat ramp area is revegetation, maintaining biodiversity and improving amenity. The details relating to the methods and practical completion of the project will be negotiated between the PAE Council and Newport Quays, outside this management plan.
Hydrology	Revegetating the filled areas with plants appropriate for the hydrological constraints of the site.	Observe successful plant species and use these for the majority of plantings.
Biodiversity values	Conserve the biodiversity of the native flora and fauna on the site.	When replanting areas utilise plants from the species list in the *Appendices*, with an emphasis on those plants that provide habitat for locally significant fauna. When planting the saltmarsh retreat zone, plant bands of plants representing the varying saltmarsh zones (see *Appendices*). Attempt to re-establish widgeon-grasses in the intertidal zone to provide feeding grounds for black swans (see *Appendices*). Maintain bait-digging ban. Attempt to actively manage mangrove incursion by salting and interpret the attempt for the public. Design a salting program and monitor, as detailed in the *Appendices*.

MANAGEMENT ISSUE	OBJECTIVES	STRATEGIES
Cultural values	**Kaurna values:** Conserve the site as a representative of Kaurna values for the area, and interpret this where appropriate.	Maintain the Kaurna heritage trail through the site Continue to provide brochures detailing the self-guided walk along trail at the Port Adelaide Visitor Information Centre. Seasonal guided tours of the Kaurna Heritage Trail may be offered by the Tauondi Cultural Agency – details are available from the Port Adelaide Visitor Information Centre. Request that the Council bring forward the Kaurna name "Patangga" for the reserve. Ensure plantings of *Isolepis nodosa* (knobby club-rush) and *Cyperus gymnocaulos* (spiny flat-sedge) are maintained near the trail marker for location 5 of the Kaurna Heritage Trail. Attempt to reintroduce widgeon-grass and intertidal zone seagrass onto the site, to provide grazing habitat for black swans.
	Post European settlement history: Conserve culturally interesting aspects of the site and interpret this, where appropriate, for visitors.	Maintain the Ships' Graveyard interpretive trail. Replicate the sign describing the *Swim Through Sculptures* that is present on the eastern bank of the river so that visitors to Mangrove Cove are aware of these pieces of public art.
Threats to ecological values and mitigation measures	Reduce threats to the ecological values of the site.	Provide the Portside Christian School's Mangrove Cove Care Team with assistance in recognising maritime and terrestrial invasive species (Our Patch and Waterwatch). At least some signage of the reserve should highlight dumping penalties. No stormwater runoff should be directed from the residential subdivision into the reserve. Additional planting on the filled area may minimise some of the noise intrusion, Maintain the bait-digging ban. Attempt to actively manage mangrove incursion and interpret this for the public.
Identification of site soil constraints from historic records	Minimise the impacts of any historic soil constraints on the site.	Avoid earth moving activities in the filled areas of the site (moving the surficial planting mounds may be appropriate in some cases). Select plants from the species list in the *Appendices* that are recorded as being successful on the site to vegetate the filled areas. Do not disturb intertidal soils that may contain PASS. The preferred treatment for the boat ramp is revegetation, maintaining biodiversity and improving amenity. The details relating to the methods and practical completion of the project will be negotiated between the Council and Newport Quays, outside this management plan.

MANAGEMENT ISSUE	OBJECTIVES	STRATEGIES
Buffering to reduce edge effects on Mangrove Cove	Reduce edge effects within the reserve.	Use dense plantings on higher, filled area to reduce noise impacts. Place dense, low growing plants between pathways and embankment edge to prevent indiscriminate passage. Plant intricately branched plants on the embankment areas where erosion is occurring. Maintain the mangrove boardwalk as an access point for people wishing to experience the mangrove habitat. Ensure viewpoints across the intertidal portion of the reserve allow clear vision so that people do not need to 'bush bash' to get a better view. A useful viewpoint could be at the northern end of the current boat ramp area. Maintain the bait-digging ban. Interpret views so that people appreciate the presence of birds and recognise the need to allow them undisturbed use of the tidal flats. The revegetated boat ramp area could be used for interpretation of the saltmarsh habitat and also be used allow some degree of access to the higher parts of the saltmarsh, reducing the urge to explore further into the saltmarshes in the main part of the reserve.
Visitor access	To provide the public with the opportunity to access the reserve and learn about its ecological and cultural values while maintaining the integrity of those values.	Newport Quays drawing AEV-421-C-DWG-805 shows the details of the parking area agreed to by the stakeholders. Consider time restrictions on the reserve's parking bays to ensure they are available for reserve visitors rather than being utilised by visitors to the residential areas. Ensure bicycle access along the Riverside Plaza meets the Council-wide guidelines for shared use bicycle/pedestrian access. Maintain existing interpretive trails and signage (Kaurna Heritage and Ships' Graveyard). Provide additional interpretation about the *Swim Through Sculptures* and about the ecological values of the reserve. Maintain the mangrove boardwalk and seating. Maintain the existing amphitheatre or replace with a structure that provides similar amenities (an area to sit, a viewing point, an area to collect a number of people together). A viewing platform at the northern end of the boat ramp area may be a useful place to provide interpretive material about the changing mangrove and saltmarsh environment.

Flora collection permit

Department for Environment and Heritage
Science and Conservation Directorate
Research Permits Section
GPO Box 1047, Adelaide 5001 SA
1 Richmond Road, Keswick 5035 SA (Telephone 08 8124 4700 Fax 08 8124 4719)

YOU MUST CONTACT THE APPROPRIATE REGIONAL STAFF MEMBER BEFORE CONDUCTING FIELD WORK
PLEASE CARRY THIS PERMIT WHEN CONDUCTING RESEARCH

The SA Department for Environment and Heritage encourages scientific research both within the State's system of conservation reserves and on our protected native plants and animals. It is only through increased scientific understanding that we can develop a soundly based system of conservation management for the State.

In carrying out such research projects, you should be conscious that you are manipulating a part of Australia's natural heritage and this carries certain responsibilities. Some of the more obvious responsibilities are outlined under the standard conditions listed below. In addition the Department requires you to always conduct your research project in such a way as to have the smallest possible impact on the natural environment.

The Department for Environment and Heritage trust that this research project will be successful and looks forward to receiving a report of the results in due course.

Permit to Undertake Scientific Research

Title ***Mangrove Park Management Plan Flora Survey***

This permit is valid from **26/04/2005** to **31/05/2005** unless cancelled or revoked.

PERMIT CONDITIONS

The permit is issued subject to the following conditions

1. The permit does not authorise the collection of specimens from private property without the written consent of the landowner granted not more than six months beforehand.
2. The Ranger-in-Charge of parks listed in the permit shall be notified beforehand of the exact dates on which research will be undertaken within approved reserves. Details of any vehicles to be used in field work should also be provided. If, for some reason, dates are changed, the Ranger-in-Charge must be advised accordingly. For research in remote areas, the Ranger-in-Charge must be notified at least 14 days in advance of visiting the area.
3. Upon arrival in a reserve attended by a resident Ranger, the permit shall be shown to the Ranger before research is undertaken.
4. Samples collected shall be limited in size and taken where they will cause the least disfigurement or disturbance.
5. The number of specimens of any one species which may be taken is limited to the number specified in the permit, or where the number is not stated to the minimum required for the approved scientific research.
6. You as the permit holder are responsible for the actions of other persons who may undertake this research or collect specimens on your behalf.
7. Specimens collected shall not be exported from this State without the consent of the Director, National Parks and Wildlife.
8. Specimens or the progeny and carcasses of animals taken under the permit may not be sold or transferred without the written consent of the Director, National Parks and Wildlife and all such specimens shall be disposed of in the manner specified in this permit at the termination of the permit or a time specified by the Director.
9. Upon completion of the research, all equipment shall be removed from the reserve, unless specific approval to the contrary has been obtained.
10. Within 14 days of the expiration of the permit, the Director, National Parks and Wildlife must be given a full report (marked 'Attention: Research Permit Section"), including all collection data, on the research carried out under the permit. Numbers and locations of all specimens collected must be supplied, together with a progress report if the project is not complete.
11. If an account of the research is published, or information circulated, a copy of the account or information shall be lodged with the Research Permit Section, within 28 days of its publication or circulation.
12. Any permits involving research on vertebrates will require the approval of an official South Australian Animal Experimentation Ethics Committee as a condition of this permit.
13. When planning and conducting your research, please be aware that your work may intrude on locations or involve species with cultural significance to local Aboriginal communities. As part of your project planning it would be a courtesy, and in some cases a requirement, to consult with local Aboriginal representatives to determine any potential impacts and the means of avoiding or limiting them.
14. This permit will cease to have effect upon a determination that native title exists in any of the lands or waters covered by this permit to the extent that such determination affects those lands or waters.

Permit Holder

Ms PSJ Coleman
Delta Environmental Consulting 12 Beach Rd
ST KILDA 5110 SA

PERMIT NO

A24976 1

..... Signature of Permit Holder

..... John Hill, MP
MINISTER FOR ENVIRONMENT AND CONSERVATION

Additional Condtions:

GENERAL FLORA SURVEYS
Plant specimens are to be collected when validating a field identification, when a field identification cannot be reliably made, or if the specimen constitutes a new park species record, a significant range extension or an unusual form.

Advice on species likely to fall within these criteria, and recommended number of specimens is to be obtained from the appropriate specialist (eg from the Biodiversity Survey and Monitoring Section, Department for Environment and Heritage or the Plant Biodiversity Centre (State Herbarium). If such advice is not available then the specimen should be the minimum required to authenticate the record, ie one representative plant voucher specimen (representative is taken to mean a sample that includes foliage, flowers, fruits etc of sufficient quantity to meet State Herbarium standards).

In any case no more than ten percent of the visible local population (within an area of continuous habitat) is to be collected.

Collections of plant species classified as endangered, vulnerable or rare under the National Parks and Wildlife Act (SA) 1972, are to be kept to the minimum required to authenticate the record. Collection of additional material from these species must be anticipated prior to collection and specific approval sought.

MINIMUM DATASET
Researchers must collect at least a minimum set of data when carrying out biological studies under a Scientific Permit. The NPWSA Biodiversity Survey and Monitoring Group (BSM) has prepared guidelines, 'Scientific Permit Minimum Dataset', to ensure that the information collected is accurate, comprehensive and has relevance beyond the confines of the project for which it may have been originally intended.

Unless the recommended minimum dataset is collected, the information may be useless and is unlikely to be acceptable for addition into recognised, statewide, environmental databases (eg : DEH Environmental databases of SA (ESDA), South Australian Museum or Plant Biodiversity Centre). It is the responsibility of all researchers to maximise the use of the information they collect. This is especially important where studies involve the handling of and interaction with animals, and the collection of plant and animal specimens.

Specimen:

NSXCODE:

SPECIMEN: Plant specimens - see Note

NUMBERSIZE: As encountered

LOCALITY: Mangrove Park

Notes:
Collection of shrubs, grasses and herbs, including weeds, for ID and vouchering.

Disposition:

Vouchers will be lodged with the Herbarium and with the client.

Affiliates

Renae Eden, Delta Environmental Consulting.

Please contact these offices when using this Permit:

Vegetation field data

Mangrove Cove field data Permit: A24976-1 Delta code: PSC_LMC_05/05 Collectors: Peri Coleman (COLP), Renae Eden (EDER), Sue Martin (MARS)

Datum: ADG 66 GPS Zone: 54H GPS accuracy 4m

Location number	Voucher prefix	Voucher number	Date collected	Collector	Easting	Northing	Family	Species	Common name	Exotic	Conservation status
1	PSC_LMC_05/05	1	2/05/2005	COLP, EDER, MARS	270955	6140526	Avicenniaceae	*Avicennia marina*	Grey mangrove		
	PSC_LMC_05/05	2	2/05/2005	COLP, EDER, MARS	270955	6140526	Chenopodiaceae	*Atriplex cinerea*	Coast saltbush		
	PSC_LMC_05/05	3	2/05/2005	COLP, EDER, MARS	270955	6140526	Zygophyllaceae	*Nitraria billardierei*	Nitre bush or dillon berry		
	PSC_LMC_05/05	4	2/05/2005	COLP, EDER, MARS	270955	6140526	Compositae	*Olearia axillaris*	Coast daisy-bush		
	PSC_LMC_05/05	5	2/05/2005	COLP, EDER, MARS	270955	6140526	Chenopodiaceae	*Rhagodia candolleana*	Seaberry saltbush		
	PSC_LMC_05/05	6	2/05/2005	COLP, EDER, MARS	270955	6140526	Gramineae	*Critesion murinum*	Barley grass	*	
	PSC_LMC_05/05	7	2/05/2005	COLP, EDER, MARS	270955	6140526	Cyperaceae	*Isolepis nodosa*	Knobby club-rush		
	PSC_LMC_05/05	8	2/05/2005	COLP, EDER, MARS	270955	6140526	Liliaceae	*Dianella brevicaulis*	Short fruit black anther flax lily		
	PSC_LMC_05/05	9	2/05/2005	COLP, EDER, MARS	270955	6140526	Myrtaceae	*Melaleuca lanceolata*	Moonah or dryland tea-tree		U in SL
	PSC_LMC_05/05	10	2/05/2005	COLP, EDER, MARS	270955	6140526	Leguminosae	*Acacia pycnantha*	Golden wattle		
	PSC_LMC_05/05	11	2/05/2005	COLP, EDER, MARS	270955	6140526	Chenopodiaceae	*Atriplex paludosa var cordata*	Marsh saltbush		
	PSC_LMC_05/05	12	2/05/2005	COLP, EDER, MARS	270955	6140526	Gramineae	*Stipa* sp.	A spear grass		
	PSC_LMC_05/05	13	2/05/2005	COLP, EDER, MARS	270955	6140526	Gramineae	*Avena* sp.	A wild oat		
	PSC_LMC_05/05	14	2/05/2005	COLP, EDER, MARS	270955	6140526	Compositae	poss *Reichardia tingitana*	False sow-thistle	*	
2	PSC_LMC_05/05	15	2/05/2005	COLP, EDER, MARS	270967	6140547	Chenopodiaceae	*Atriplex rhagodiodes*	River saltbush		
	PSC_LMC_05/05	16	2/05/2005	COLP, EDER, MARS	270967	6140547	Leguminosae	*Acacia dodonaeifolia*	Sticky wattle		R in State & SL
	PSC_LMC_05/05	17	2/05/2005	COLP, EDER, MARS	270967	6140547	Leguminosae	*Acacia pycnantha*	Golden wattle		
	PSC_LMC_05/05	18	2/05/2005	COLP, EDER, MARS	270967	6140547	Liliaceae	*Asphodelus fistulosus*	Onion weed	*	
	PSC_LMC_05/05	19	2/05/2005	COLP, EDER, MARS	270967	6140547	Sapindaceae	*Dodonaea viscosa*	Sticky hop bush		
	PSC_LMC_05/05	20	2/05/2005	COLP, EDER, MARS	270967	6140547	Chenopodiaceae	*Enchylaena tomentosa*	Ruby saltbush		
	PSC_LMC_05/05	21	2/05/2005	COLP, EDER, MARS	270967	6140547	Leguminosae	*Acacia ligulata*	Umbrella bush		K in SL
	PSC_LMC_05/05	22	2/05/2005	COLP, EDER, MARS	270967	6140547	Myrtaceae	*Melaleuca halmaturorum*	Swamp paper-bark		V in SL
	PSC_LMC_05/05	23	2/05/2005	COLP, EDER, MARS	270967	6140547	Leguminosae	*Acacia cupularis*	Coastal umbrella bush		R in SL
	PSC_LMC_05/05	24	2/05/2005	COLP, EDER, MARS	270967	6140547	Aizoaceae	*Galenia secunda*	Galenia, or blanket weed	*	
3	PSC_LMC_05/05	25	2/05/2005	COLP, EDER, MARS	270986	6140544	Chenopodiaceae	*Suaeda australis*	Sea blite		
	PSC_LMC_05/05	26	2/05/2005	COLP, EDER, MARS	270986	6140544	Chenopodiaceae	*Sarcocornia quinqueflora*	Beaded glasswort		
5	PSC_LMC_05/05	27	2/05/2005	COLP, EDER, MARS	270907	6140522	Chenopodiaceae	*Maireana oppositifolia*	Heathy bluebush		
	PSC_LMC_05/05	28	2/05/2005	COLP, EDER, MARS	270907	6140522	Limoniaceae	*Limonium companyonis*	Sea lavender	*	
	PSC_LMC_05/05	29	2/05/2005	COLP, EDER, MARS	270907	6140522	Leguminosae	*Acacia cyclops*	Western coastal wattle		
	PSC_LMC_05/05	30	2/05/2005	COLP, EDER, MARS	270907	6140522	Compositae	*Lactuca serriola*	Prickly lettuce	*	
	PSC_LMC_05/05	31	2/05/2005	COLP, EDER, MARS	270907	6140522	Aizoaceae	*Carpbrotus rossii*	Karkalla or Ross' noonflower		
	PSC_LMC_05/05	32	2/05/2005	COLP, EDER, MARS	270907	6140522	Arecaceae	*Phoenix dactylifera*	Date palm	*	
6	PSC_LMC_05/05	33	2/05/2005	COLP, EDER, MARS	270921	6140538	Euphorbiaceae	*Adriana klotzschii*	Coast bitter-bush		U in SL
	PSC_LMC_05/05	34	2/05/2005	COLP, EDER, MARS	270921	6140538	Casuarinaceae	*Allocasuarina verticillata*	Drooping she-oak		
	PSC_LMC_05/05	35	2/05/2005	COLP, EDER, MARS	270921	6140538	Myrtaceae	*Eucalyptus camaldulensis*	River gum		
	PSC_LMC_05/05	36	2/05/2005	COLP, EDER, MARS	270921	6140538	Cruciferae	*Cakile maritima*	Sea rocket	*	
	PSC_LMC_05/05	37	2/05/2005	COLP, EDER, MARS	270921	6140538	Myrtaceae	*Eucalyptus odorata*	Peppermint box		
	PSC_LMC_05/05	38	2/05/2005	COLP, EDER, MARS	270921	6140538	Amaranthaceae	*Amaranthus albus*	Tumble weed	*	
	PSC_LMC_05/05	39	2/05/2005	COLP, EDER, MARS	270921	6140538	Leguminosae	*Acacia victoriae*	Bramble wattle or elegant wattle		V in SL
7	PSC_LMC_05/05	40	2/05/2005	COLP, EDER, MARS	270974	6140595	Chenopodiaceae	*Atriplex nummularia*	Old man saltbush		T in SL
8	PSC_LMC_05/05	41	2/05/2005	COLP, EDER, MARS	270996	6140641	Solanaceae	*Solanum nigrum*	Bayberry nightshade	*	
	PSC_LMC_05/05	42	2/05/2005	COLP, EDER, MARS	270996	6140641	Boraginaceae	*Hekiotropium europaeum*	Potato weed	*	
	PSC_LMC_05/05	43	2/05/2005	COLP, EDER, MARS	270996	6140641	Gramineae	*Lolium perenne*	Perennial rye grass	*	
	PSC_LMC_05/05	44	2/05/2005	COLP, EDER, MARS	270996	6140641	Cruciferae	*Diplotaxis muralis*	Wall rocket	*	
	PSC_LMC_05/05	45	2/05/2005	COLP, EDER, MARS	270996	6140641	Leguminosae	*Medicago polymorpha*	Burr medic	*	
9	PSC_LMC_05/05	46	2/05/2005	COLP, EDER, MARS	270985	6140570	Cupressaceae	*Callitris preissii*	Southern, or coastal cypress-pine		U in SL

Collectors:

Peri Coleman	COLP
Renae Eden	EDER
Sue Martin	MARS

Species list for replanting with notes re salinity tolerance and fauna habitat value

Species	Common name	Rainfall needed, salinity tolerance	Comments
Acacia cupularis	Coastal umbrella bush, cup wattle	150-400mm	Very successful on site
Acacia dodonaeifolia	Sticky wattle, bop bush wattle	>400mm	Surviving
Acacia ligulata	Umbrella bush	>150mm	Very successful on site
Acacia victoriae	Bramble wattle or elegant wattle	>125mm, salt tolerant	Prickly habitat for wrens & other small birds. Seeds used for bush tucker.
Adriana klotzschii	Coast bitter-bush		Habitat plant for Bitterbush Blue Butterfly
Atriplex cinerea	Coast saltbush	1000-3000 μS/cm (1:5)	Very successful on site
Atriplex paludosa	Marsh saltbush	>350mm	Very successful on site
		1000-3000 μS/cm (1:5)	
Atriplex semibaccata	Scrambling berry saltbush	>200mm	Berries eaten by birds, ants & lizards. Bush tucker.
		1000-3000 μS/cm (1:5)	
Atriplex suberecta	Lagoon saltbush	>250mm	
		1000-3000 μS/cm (1:5)	
Callitris preissii	Southern, or coastal cypress-pine	>350mm	Tall conical shaped tree
Carpobrotus rossi	Karkalla or Ross' noonflower		Succulent ground cover. Highly tolerant of salt, both dry and wet periods. Pink flowers, fruit used by birds & lizards as food. Bush tucker. Successful on site.
Chloris truncata	Windmill grass	>400mm	
Clematis microphylla	Old man's beard	>300mm	Climber, decorative flowers & seeds
Cyperus gymnocaulos	Spiny flat-sedge		A weaving sedge
Danthonia caespitosa	Wallaby grass	>400mm	
Dianella brevicaulis	Short fruit black anther flax lily		Fruit source for birds
Dianella revolute	Black anther flax lily		Fruit source for birds
Disphyma crassifolium	Round leaf pig face		Succulent ground cover. Highly tolerant of salt, both dry and wet periods. Pink flowers.
Enchylaena tomentosa	Ruby saltbush	>250mm, salt tolerant	Berries eaten by birds, ants & lizards. Bush tucker. Very successful on site
Grevillea ilicifolia	Holly-leaved grevillea		Sand, overlying limestone. Habitat for small birds.

Species	**Common name**	**Rainfall needed, salinity tolerance**	**Comments**
Isolepis nodosa	Knobby club-rush		A weaving rush.
Lawrencia squamata	Thorny lawrencia		
Maireana brevifolia	Small leafed blue bush		Very successful on site
Maireana decalvans	Black cotton bush		
Maireana oppositifolia	Heathy bluebush		Successful on site.
Melaleuca halmaturorum	Swamp paperbark	>400mm 10000 μS/cm (1:5)	Nectar source. Successful on site.
Melaleuca lanceolata	Moonah or dryland tea-tree	>250mm 8000-16000 μS/cm (1:5)	Nectar source. Very successful on site.
Myoporum insulare	Boobialla	6000 μS/cm (1:5)	Nectar & berry source for birds.
Nitraria billardierei	Nitre bush or dillon berry		Tangled bushes provide shelter, berries eaten by birds and lizards. Bush tucker. Nectar source. Very successful on site.
Olearia axillaris	Coast daisy-bush	>400mm	
Pelargonium australe	Native stork's bill		
Pittosporum phylliraeoides	Native apricot	250mm, salt tolerant	Attractive seed pods
Ptilotus polystachys	Long tails		
Rhagodia candolleana	Seaberry saltbush	>350mm 10000 μS/cm (1:5)	Berries eaten by birds and lizards. Bush tucker.
Scaevola crassifolia	Cushion fanflower		Blue fan flower
Senecio lautus	Variable groundsel		Herb with yellow flowers
Stipa nitida	Balcarra grass		Habitat for Grass Blue Butterflies and for Skippers
Stipa flavescens	A spear-grass		Habitat for Grass Blue Butterflies and for Skippers
Stipa drummondii	Cottony spear-grass		Habitat for Grass Blue Butterflies and for Skippers
Threlkeldia diffusa	Coast bonefruit		Low spreading bush. Berries eaten by birds and lizards.
Vittadinia gracilis	Wooly New Holland daisy	>300mm	Herb with blue daisy flowers

Species list for intertidal and saltmarsh areas with notes on zone

Species	Common name	Location in the intertidal zone
Atriplex cinerea	Coast saltbush	High marsh
Atriplex paludosa	Marsh saltbush	High marsh
Carpobrotus rossii	Karkalla or Ross' noonflower	High marsh
Cyperus gymnocaulos	Spiny flat-sedge	High marsh and sandy areas
Disphyma crassifolium	Round leaf pig face	Mid marsh
Frankenia pauciflora	Sea heath	Mid and high marsh
Gahnia filum	Thatching grass	High marsh - fresher
Halosarcia halocnemoides	Grey samphire	Mid marsh
Halosarcia pergranulata	Black seed samphire	Mid marsh
Isolepis nodosa	Knobby club-rush	High marsh and sandy areas
Lepilaena marina	Water-mat	Inter & sub tidal
Maireana oppositifolia	Heathy bluebush	High marsh
Melaleuca halmaturorum	Swamp paper-bark	High marsh
Puccinellia stricta	Australian saltmarsh-grass	High marsh
Ruppia spp.	Widgeon grasses	Inter & sub tidal
Sarcocornia quinqueflora	Beaded glasswort	Low marsh
Sclerostegia arbuscula	Shrubby samphire	Mid marsh
Senecio lautus	Variable groundsel	High marsh
Suaeda australis	Sea blite	Low marsh
Wilsonia humilis	Silky wilsonii	High marsh
Zostera muelleri	Garweed, dwarf seagrass	Inter & sub tidal

The story of Tjilbruke

THE WANDERINGS OF TJIRBRUKE

(extracted from Tindale, NB. 1987. The wanderings of Tjirbruke: a tale of the Kaurna people of Adelaide, *Records of the SA Museum,* 20:5-13.)

Tjirbruki and his fellow Patpangga clansfolk were living at Tankulrawun near Rapid Bay. Tankulrawun (its name has the meaning of the Granite Place) was one of their summer camping places near Witawatang. Today Witawatang is known as Rapid Head.

There came an urge among some of the members of the band assembled there including some young visitors to go north and arrange a hunt for *kari* (or emus). Many *kari* were to be seen in the *ruwe* clanlands of the Tandanja people at Adelaide, because that big bird was their *naitji* or totem. They did not kill them although they feasted on their eggs.

Tjirbruki, who was a hunter skilled in kangaroo spearing did not wish to go, but his much loved *nangari* or sister's son, named Kulultuwi, who was visiting with him along with several companions did so wish. Kulultuwi called his mother's brother (*wannu* or *kawannu*) as did two other younger lads whom he persuaded to go along with him. Both Jurawi and Tetjawi bore the same relationship in Tjirbruki although they were by different mothers. They departed hastily. It may be assumed that their families accompanied them although the story, as told, often omits such details.

Tjirbruki not wishing to take part, shifted his camp more leisurely, moving through the *ruwe* of the Witjarlun clan which began near Karikalinga, a name still on the map as Carrickalinga. He arrived at Wituwatangk (now known as Brighton). He and his family were welcome visitors in the clan lands of the Jatabiling at Wituwatangk whose *pangkarra* (hunting territory) extended northward along the coast beyond the place now known as Outer Harbor. Tjirbruki spent much of his time at Wituwatangk fishing for *kurari*, also called *darawe* (beaked salmon, *Gonorhynchus greyi*). He used a special *nere* or net, termed a *darawenjeri nere*, with which several persons helped in the haul.

Meanwhile Kulultuwi and his companions, travelling ahead, had sought out, and quietly were driving several emus ahead of them without revealing their presence masking their moves by holding up shields of branches of eucalyptus leaves. They moved across the middle of the Mikawoma, the Adelaide plain, because they needed to keep the birds close to the coast so as to corner them at Muldang on the northern tip of the Outer Harbor Peninsula. Ancestors had made the Port River for them so that this could be done. Four male *kari* and four females, known as *tartja*, were caught up in their drive. By keeping on the coastward side of the plain, the hunters were avoiding trespass on Tandanja hunting grounds because they had not received permission to take emus there. The hunt was going well.

However there was a disturbance. Near Patawiljank, now called Glenelg, some Jatabiling women were cooking herbs in their stone ovens. This caused the emus to turn away inland. Kulultuwi had to race around, going far into

the Tandanja *ruwe* by way of Medaindi, now known as Medindie, to prevent the birds escaping from the trap. During this trespass Kulultuwi had killed a female bird. Some *kari* had escaped but others were successfully held over several days at Muldang while the men arid their families fed on the body of the *tartja.*
While this was going on Tjirbruki and other people with him had shifted camp to Tulukudangk, now called Kingston Park. From here he made short excursions inland. He saw the old tracks of emus and their hunters going north but also the fresh tracks of one male bird, he decided that this would be his bird to hunt, since according to custom the first to sight the presence of game had the right to take it. For a while he continued lo fish, taking several further hauls of *kurari* for his journey.

Then Tjirbruki left, following the track of his *kari* along he coast to Kareildug (Hallett Cove) and on to Tainbarang now Port Noarlunga, to Ruwarun (Port Wilunga) and to Witawali where the tracks turned inland. There, near Sellicks Hill, the old name of which has been forgotten, the tracks were lost.

Meanwhile the hunters decided to go back to the rest of their people. They arrived in Wituwatangk during a very heavy morning fog, found the camp empty and that Tjirbruki had left.

Tjirbruki, having lost all traces of tracks, and judging that the male bird would continue its movements southward along the coast, turned inland on a path which took him through the valley at Maitpanga (which still bears the name as Myponga), travelling to Mutaparinga, a place where there are many blackwood trees, continuing down the Hindmarsh Valley (Jaladula), and passing Jerltoworti, to Victor Harbor at Latarng. He still thought the emu might come around by the coast so he hid in ambush and watched for several days. No tracks appeared so he went back on his own trail and found a place where the old tracks had been covered by newer ones. There was good food for the bird here in the forest, far inland from his Witawatang camp at Rapid Head. In the distance he saw the smoke of a small fire and, heading in that direction, he heard the voice of Kulultuwi singing while one of the younger men was preparing a cooking Fire for an emu Kulultuwi had killed.

This was the bird which Tjirbruki had been following and expecting to spear. He confronted Kulultuwi claiming that his *nangari* had been wrong in killing his male bird. His own footprints should have indicated this to the younger man.

Kulultuwi said, “Sorry, I did not know it was your *kari.* You saw the bird first. Cook it and take it home to your children'.

Tjirbruki replied, 'No! You killed it. You cook it and give us some of the meat'. He had some kangaroo meat and did not need the emu. Tjirbruki then departed.

Kulultuwi made ready the *wintjimi* oven, making the bed of hot stones, placing the green herbs over them, putting the bird on and covering it with further herbs and earth, and pouring on water to make much steam After waiting for it to cook Kulultuwi, as was customary, dug in and took out the head of the bird to see if it was ready when a sudden burst of steam blinded him. Thereupon his part brothers, Tetjawi arid Jurawi taking advantage rushed in, speared, and killed him.

The boys reasoned they had killed their *junalja*, or elder brother, because he had transgressed, having really known from reading the tracks that the bird belonged to their *wannu.* The youths cut off the meat'. from the bones of the bird and carried it to their own people of the Jatabiling clan. They left the body of Kulultuwi. They told their folk that Kulultuwi had done wrong. They used a northern word for emu implying that the bird meat was evidence that Kulultuwi transgressed. Their people carried the body of Kulultuwi to Warrpari (Sturt Creek) on the Adelaide plains near Marion where they continued the drying of the flexed body on a rack over a fire.

The youths made up a story that Kulultuwi, in fear of the anger of Tjirbruki, had gone away elsewhere to hunt further for emus. When this false story reached him at Rapid Bay, Tjirbruki asked several members of the Witjarlung clan living north of his country give a message of forgiveness to Kulultuwi. Although they knew of the death of Kulultuwi they with malice, did not tell him the truth.

Searching for Kulultuwi Tjirbruki went first to Longkowar (Rosetta Head), the great bluff on Encounter Hay, then up Mulapari the Inman River to Towarangk near Moon Hill and on to Maikabanangk near the coast at Normanville. His family had gone with him. Then he began lo wander about by himself going as far as Nutarang (Lands End), at that little still in Kaurna country (according to informant Karlowan).

Heading north again, he came to the place near where he had seen Kulultuwi last and chanced to see some sugar ants on the track. He picked up some ants carrying human hair and others with blood and red ochre. Further on, he found more and knew in his thoughts that *nangari* was dead. He saw where the body had been, and where people had made a smoke fire. They had made a *tirukati*, or drying rack of poles tied together like a raft such as a man uses when fishing. On the third day they had, as was customary, covered the body with red ochre *tauwe* from Potartang. They had carried the bier towards Adelaide.

Having made these discoveries Tjirbruki said, 'I have only one spear properly fixed. I am off!' He left the place in the *wita* (peppermint tree forest) and went towards Rawarangal (Port Elliot). At Rawarangal he had opportunities, through his *nianiampe* (trading partners), to obtain good spears which had come from the Tanganekald people on the Coorong. On the way, while walking along the Mulapari (Inman River), he met Jorlu the red-backed kingfisher *(Halcyon pyrrhopygius)* man. On hearing his story Jorlu gave him a spear as did another man, Joldi, of the black cormorant

(Phalacrocorax carbo) totem at the Finniss. Tjirbruki, with his new weapons, chose to follow tracks along the eastern side of the Mount Lofty Ranges through Peramangk tribal country, keeping to their eastern boundary to avoid serious trespass. On the way he camped at Wiljauar near Strathalbyn then at Peiera (Woodchester Waterfall), then at Motonengal (Mount Barker), and at Barukungga, now the mining township of Brukunga. Travelling on through places not now remembered, he came to Kalia (Gawler) which was the beginning of Tandanja clan country. Keeping near the coast he travelled south. He had learned where a big camp (*taldamari*) was gathering al Marion on Sturt Creek. he arrived. very weary, at Witawatangk.

Children saw him and cried out, ‘Here is old *mutari*’. Old father's mother's brother soon was the centre of a gathering and he told them he would stay to rest only the one night. He saw that the two men, Jurawi and Tetjawi were present. Acknowledging that Kulultuwi was dead, they deceived Tjirbruki about the real killers. blaming his death on strange people who might have been Peramangk tribes-folk who had come along the Mount Lofty Range.

Tjirbruki ignored their implications, knowing that they were lying. He practised deception also, saying, 'Yes! I know! Strange men came from the *wirra* (forest) country in the north'. He thus made out that he thought the young men were innocent. On the following day Jurawi and Tetjawi with their families made a part day's journey to Warrpari (the Sturt Creek at Marion) where they settled in at the big *taldamari* hut. The body of Kulultuwi was still being smoke-dried there on a rack. In the evening they began *kuti* (dancing) for the old man and he initiated others. Then he sang the whole camp to sleep. He tested them by calling out, 'Come! Give help with a haul of *kurari* fish'. There was no response and the old man said, 'Ah! I've got you!'

Tjirbruki was a master at fire-making. He took powdered stringybark tree bark *morthi* (tinder) and set it round the *taldamari* with much grass, leaving only a small gap at the entrance. Then. using a *baruke* (iron pyrites) stone and a piece of flintstone (*paldari*), he started fires at each pile of *morthi* or tinder, telling the fire to blaze up quickly. He cried out loudly, ‘You are getting burned! Camp on fire'.

The top of the *taldamari* began to fall in as it burned and all the people attempted to rush out. As children came out he kicked them with his foot and hit them with his club. Out came Jurawi whom he speared with a *wundi* or dread-spear, one set with quartz chips in resin on its head. The spear entered Jurawi right up to the tungi or swelling of resin set on the spear to prevent its too ready removal from the wound.

Out came Tetjawi whom he speared also and held in the fire. Only when he felt no further kicking did he accept that 'they were done'. He pulled out the spears and waited until morning as the *taldamari* burned to the ground.

Tjirbruke took the dried body of his *nangari* to Tulukandangk, a spring of good water on the beach of Kingston Park Reserve at Marino. There he completed the smoking of the body of Kulultuwi and an inquest was held. Many people gathered for the ceremony. The names of the two killers were confirmed. Tjirbruki learned that his *nangari* had indeed been struck down while raking the head of the emu from the fire, looking for tire steam coming from its bill, indicating the bird was cooked.

Carrying his burden, now a dry compact parcel. Tjirbruki said, 'I go back now!' He departed walking along the coast to Kareildun, now called Hallett Cove, where he rested. As he reclined he began to think about his nephew and burst into crying (*kareildun*). Tears ran down his face and here they fell to [he ground a spring of water welled up (thus the spot became a camping place). Tjirbruki then journeyed to Tainbaran (Port Noarlunga) where he burst into fresh tears. He went on to Potartang (Red Ochre Cove, Section 362, Hundred of Willunga) where he cried again; yet another spring of water came up. He then walked to Ruwarun (several hundred metres south of Port Willunga jetty). The tide was out. He sat down on the beach and cried once more. The *luki* (tears) dropped on the sand, causing a spring lo appear. At high tide the sea covered it, but when the tide fell again the fresh water could be obtained by scraping in the sand. It remains so today.

The old man then carried the body to Witawali (on the beach north of Sellicks Hill). He noticed that there was a fine bay which would serve at night as a good netting place for sea salmon. His tears were still flowing and brought a spring into being there (vicinity of Section 639 Hundred of Willunga).

While there, Tjirbruki began to think of further grudges and as he was passing through the *pangkara* of the Wiljarlung families it disturbed him that they had failed to pass on his message of forgiveness to Kulultuwi and his other nephews. Instead of continuing along the beach he turned inland and climbed over Sellicks Hill. He kept Maitpanga on his left and climbed another high hill (it may have been Mount Jeffcott or Black Hill). There he made a smoke signal. White smoke went straight up. People who were camped at a place called Warabati (saw the smoke and began to interpret its meaning:

Turtil garwand werati. (Smoke plenty/going upwards.)
Korn loro kutu malbur undul. (Men/straight up/good news of killing.) (Loosely translated as 'guilty of murder' in Jaralde.)
Itji nel lund. (He is coming home.)

Tjirbruke made other fires as he picked up the answering smoke, and continued to do so until he was close enough to hear the people shouting. It was the camp of the men Limi and Ngarakkani.

Naitj purtulunul. (He is coming.)

Those who were still in their huts asking:

Janaleitj? (How far away?)
Nitj teipuland. (He is close.)

Tjirbruki heard their questioning. He untied his bundle of spears taking as many as he could hold, arid walked directly into the camp. A first spear he drove into Ngarakkani, another into Nenaratawi, a third into Limi, and the last one into Tulaki. (Even in those days it was proper to spear people in the legs unless murder was the direct intention). The men saw that Tjirbruki meant mischief and all took headers into the water and turned into fish. Thus, in the sea off Naldenga today you will find Ngarakkani the gummy shark (*Mustelus antarcticus),* Limi the cobbler carpet shark (*Surorectus tentaculatus),* also Nenaratawi the southern fiddler (*Trygonorrhina guanerius),* and Tulaki, the long thin shark with the flag on it (which we have not identified although it perhaps is the cocktail shark, *Carcharhinus brachyurus).* These fish became the *ngaitji* or totems of members of the Witjarlung clan of the Kaurna tribe. Any other people who were present when Tjirbruki took his revenge fled and turned into birds, leaving only the old man there, alone. Satisfied, Tjirbruki stayed there a while and when his nephew's body was again dry enough to carry, he rolled it in a kangaroo skin and continued on his journey.
Tjirbruki came to Karikalinga (Section 1018, Hundred of Yankalilla), just south of the place known to Europeans as Carrickalinga Head. Here there was (and is, for informant Karlowan had seen it himself) a little swamp flat where *nuri* grows, very green like a reed. Rafts, called *kundi* were made of the dried stems of this plant (probably a *Typha*). Tied up in bundles, they were used along the Murray River.

Continuing his journey along the coast Tjirbruki went to Konarartinga where there *is* a *perki,* or cave. Just before he arrived at the *perki* he again sat down and cried: a small spring flowed there. He did not go into the cave but walked further on, a few hundred metres to the mouth of a small creek that is a camping place. He continued walking, sometimes on the shore and at other times above the cliffs, all the way to Parewarangk (now Cape Jervis). From Parewarangk he returned northwards along the foreshore below the cliffs and came to another *perki* (called Janarwing by another informant). It is close to the place from which you *janarwing* (turn back) because the water is too deep for one to pass along the shore.

Tjirbruki left his nephew's body outside and, walking into the darkness, found a place where there was a suitable ledge of rock. He put sticks up, just was done when the body was being smoked, carried the body in, placed it on the platform, and left it. He did not emerge from the cave but went on into the depths of the hill for a long way. He made the way wide enough for him to continue inside right up on top of the range at Wateira nengal (now Mount Hayfield). Emerging there he shut the 'airhole' where he came out. He ‘fixed it up with gravel’ to appear he had ‘never come out there’. Going down to the foot oft he hill he shook his body and dust came off him. This became the *mulkali* (yellow paint or ochre) which is used for decorating or 'making spears flash'. (A further comment from the informant: 'Gold has been found there. It may be from off him’).

Tjirbruki arrived at Tjutjugawi (west of Mount Robinson), the camp of the Ramindjeri tribesmen Kengori of the *wanmarai* totem (ring-tail possum, *Pseudocheirus peregrinus).* Kengori was a member of the Polumpindjeri clan and Tjirbruki received permission from him to take *wanmarai* so that be could make a skin rug for the coming winter. He was feeling old. He looked out and saw a swampy lagoon and said to himself, ‘There is no use in my living like a man anymore'. However, he left the camp of Kengori (whose adventures, which became a separate story, took place after Tjirbruki departed). The old man walked along the southern shore of the Fleurieu Peninsula on land well above the sea until he came to the *koinkanja* or 'high hill' called Longkowar (Rosetta Head).

‘This place will do for me’, Tjirbruki thought. How will I do it?' The answer came. On a tree nearby there was a bird, a *kelendi* (the grey curawong, *Strepera versicolor*). He stalked the bird, killed it, plucked the feathers, and then rubbed the bird's fat over his own body. He recalled that Kelendi, when he was still a man, was a great messenger who travelled around the country singing songs and telling people of the coming meetings for initiation of their young men. Tjirbruki tied the bird's tail feathers on his arms with hairstring. Then he split the flesh between his big toes, and the third and fourth ones, made a run, and ‘straight away started to fly’. As a Tjirbruke, which white people today call the glossy ibis *(Plegadis falcinellus),* his spirit still appears in bird form where there are swampy areas. His body became a *martowatan* (a memorial), a rocky outcrop at Barukungga (on Section 1887, Hundred of Kanmantoo) the place of ‘hidden fire’.

Shipwrecks in the Cove

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TRAFALGAR – Jervois Basin

The composite paddle steamer *Trafalgar* was built in 1877 by T J McDonald of Echuca, for W J Davies. The vessel was adapted to carry 80 tons of cargo and measured 105.7 feet (32.2 m) in length, 18.9 feet (5.8 m) breadth and 7.9 feet (2.4 m) depth. It was originally 228 gross tons, altered to 127 gross tons in 1918 and to a dumb barge of 116 gross tons in 1933.

The *Riverine Herald* 14 April 1877, reporting on the launch, described the vessel :

> *…unlike any other boat built at Echuca, she has iron topsides of plates a quarter inch thick. The frames are 2½" angle iron and wooden planking is used below the 3' 6" water line.*

R Parsons, 1996, *Ships of the Inland Rivers*, p 137

The River Murray paddler was intended for the Wentworth trade, carrying both passengers and goods. On one occasion it carried 208 prize Merino rams and a pure-bred stallion called Young Hercules, which was valued at 800 guineas and proved difficult to ship.

Trafalgar on the Murrumbidgee, c1900
Photo: Ron Blum

In August 1880 the *Trafalgar* and the South Australian paddler *Gem* entered into a race from Morgan to Wentworth – a distance of 300 miles. The stakes were £100 per side, which was largely supplemented by bets. Despite leaving Morgan half an hour behind the *Gem*, the *Trafalgar* passed its rival two hours later and arrived at Wentworth 12 hours ahead. The event created great interest all along the Murray, as both vessels were considered two of the fastest on the river.

Some weeks later the two vessels raced again – a distance of 100 miles from Lake Victoria Station to Wentworth. Although it made 3 stoppages and was delayed about 25 minutes, the *Gem* was the victor this time, reaching its destination 15 minutes ahead of the *Trafalgar*.

In the late 1880s, following the increase in passenger trade brought about by the Chaffey Brothers' Mildura settlement, the *Trafalgar* was refitted and for some years ran a regular passenger service from Echuca to Mildura.

In 1891 the paddler was purchased by Permewan, Wright & Co Ltd and in 1893 was described as the pride of the Permewan fleet. The *Trafalgar* was sold in 1918 to the SA Farmers Co-op Union Ltd and registered in Port Adelaide. In 1933 the vessel was converted to a dumb barge. It was resold in 1935 to Robert Hy and C Smith of Murray Bridge. In 1941 the *Trafalgar* was purchased by W Dodd of Murray Bridge, who stripped it and removed the wheels.

In 1947 the *Trafalgar* was purchased by Reginald Crouch, for conversion to a ketch. The barge was towed to Port Adelaide, but weakness of the iron frame prevented the conversion and it was beached at the Log Milling Company Area and partly dismantled. In 1954 the vessel was purchased by S C Waterhouse with the intention of completely breaking it up.

Trafalgar today

Today the remains of the *Trafalgar* are a significant feature on the Ethelton mudbank at low tide. Iron framework and wooden planks indicate the original vessel's length, breadth and other construction details.

FITZJAMES - possibly Jervois Basin

The three masted ship *Fitzjames* was built in 1852 by J J Jardine and Co. of Richibucto, New Brunswick, Canada and sold to Jardine and Co. of Liverpool. The wooden vessel of 1307 gross tons measured 186.0 feet (56.7 m) in length, 32.5 feet (9.9 m) breadth and 22.7 feet (6.9 m) depth.

Shortly after arriving in England, the *Fitzjames* was sold to Pilkington and Partners to become part of the White Star Line. The ship at first traded in the Atlantic, but in 1854 made its first trip to Australia with emigrants, arriving in Melbourne on 15 June. The *Fitzjames* also voyaged to Adelaide and Sydney with emigrants.

On 20 January 1866 the *Fitzjames* sailed from Liverpool for Melbourne, on what became the vessel's last major voyage. With emigrants on board and only a few days out, the ship sprang a leak and put into Lisbon. The vessel was considered unseaworthy and on arrival in Melbourne was condemned and hulked.

In 1876 the South Australian Government bought the vessel for use as a quarantine ship, and in 1880 the *Fitzjames* became a floating reformatory for neglected and delinquent children. The Destitute Board took charge of the vessel where it was anchored at Largs Bay, marking the seaward end of the channel into Port Adelaide.

Less than four months after the transfer, with the first big storm, the Board realised that it had inherited a leaking, rotting vessel, with repairs an ongoing necessity. Pumping was essential to keep the ship afloat and it was so wet below decks that bedding was often ruined. When storms hit, the vessel strained at its moorings and was brought into the Port to have the leaks stopped. In more settled weather it was towed out again and anchored off Largs or Semaphore. Eventually the leaks became too severe and the *Fitzjames* was towed to shallow water off the Port River.

In 1885 the Royal Commission into the administration of the Destitute Board strongly criticised the management of the *Fitzjames*, and responsibility for the reformatory ship was transferred to the newly created State Children's Council, who campaigned to have the Boys' Reformatory moved to a land-based institution. This was not a high Government priority and a suitable site did not become available until 1891, when the boys were moved to Magill. Meanwhile, the state of the ship deteriorated, although conditions for the boys improved.

Fitzjames in the Upper Reaches of the Port River, c1900
Photo: Ron Blum

At some stage following the relocation of the boys' reformatory to Magill, the *Fitzjames* was towed along the Port River and through the Jervois Bridge, where it was beached and moored at the end of the Cable Company Wharf.

No artefactual evidence of the *Fitzjames* has so far been located in Jervois Basin, but it is likely that the vessel's remains have been covered by reclamation.

Department for Environment and Heritage

Ships' Graveyards of South Australia

FISH MARKET PONTOON – Jervois Basin

Prior to the construction of berths in the North Arm of the Port River, the Port Adelaide Fishing Fleet moored on the north-eastern side of the Jervois Bridge, which became the site of the Port Adelaide Fish Market. A floating wooden pontoon, connected to the wharf via a gangway, provided a landing platform for the fishing tenders. The pontoon also offered safe and easy access for customers buying the fresh fish on offer from the fishermen.

Fish Market Pontoon today

Circa 1960 the wooden pontoon was removed and abandoned high on the Ethelton mudflats. Today the remains are a predominant feature in the area. The lower sections are intact with most frames and some iron fittings clearly evident.

Government of South Australia

environment and heritage

FIDES – Jervois Basin

The four-masted auxiliary schooner *Fides* was built in 1918 by Linstol & Sons of Risor, Norway. The wooden hulled vessel measured 141 feet (43 m) in length, 31 feet (9.5 m) breadth, 14 feet (4.3 m) depth and 430 gross tons. It had accommodation for up to 20 crew, was built at a cost of £35 000 and was used in a variety of trades between the Baltic Region and England.

In 1927 Captain J Olsen of Birkenhead, South Australia, purchased the *Fides*, to carry timber between Port Adelaide and New Zealand. The schooner's delivery voyage began from Gothenburgh, Sweden on 1 September 1927, laden with Baltic timber for Port Adelaide. During what became an epic 15 month journey, the vessel suffered storms, a cyclone and calms; damage to masts and rigging; trouble with the engines; and sickness among the crew.

Fides at Corporation Warf. C1930
Photo: Ron Blum

Eventually, in late 1928, the *Fides* reached Port Adelaide and was registered there in March 1929. Unfortunately the Depression had crippled coastal shipping and the timber trade, and the schooner lay idle for the next four years.

In 1930, Captain Olsen and the Reverend T P Willason, of the Port Adelaide Central Methodist Mission, proposed a scheme which, if acted upon, would have been the first of its kind in Australia. They suggested that the *Fides* should be converted to a deep-sea fishing vessel, to employ 30 men in fishing operations off the West Coast and the Great Australian Bight, specifically between Streaky Bay and Denial Bay. This scheme had the double effect of providing a livelihood for many Port Adelaide unemployed (with a wealth of sea and fishing experience), and developing an industry which was seen as sadly neglected in South Australia. Reverend Willason and Captain Olsen hoped to raise finance by public subscription and through government assistance. Prominent South Australians, Sir Langdon Bonython and Tom Elder Barr Smith each pledged £500 towards the project, but it did not proceed.

In 1932 the South Australian Harbors Board seized the *Fides* for non-payment of harbour dues. An attempt to sell the schooner was unsuccessful and so in November the vessel was moved to Commercial Wharf and workmen began to break it up. Two masts, the engine and fittings were removed and sold.

In January 1933 Reverend Willason purchased the *Fides* on behalf of the Port Adelaide Central Methodist Mission and had it moved to the Portland Canal, where it was broken up by the unemployed for firewood. The breaking-up process was slow, taking more than a year.

During the night of 2 January 1934 the *Fides* began to take on water and, after an unsuccessful attempt to pump it out, was beached at Ethelton during the early hours of the 4th. Two days later the remains were placed well up onto the beach during an extra high tide and wreckers continued to dismantle the hull.

Today, remains of the *Fides* are exposed in the silt on the western side of Jervois Basin at low water, although they are generally covered by the tide. Only about one third of the length of the vessel can be seen, with the majority covered by reclamation and earthworks.

Fides today

ALERT – Jervois Basin

The wooden ketch Alert was built by J & D McKay in Hobart in 1872, with original measurements of 65.6 feet in length (20 m), 17.9 feet (5.46 m) breadth, 6.6 feet (2 m) depth and 44.89 gross tons. In 1898 the vessel was lengthened to 70 feet, with 18 feet breadth, 6.2 feet depth and 58 gross tons.

The *Alert* was first registered in Port Adelaide in 1873 by partners J Evans and J McLeod. A succession of owners followed, until the vessel finally became the property of the Wright family in the 1930s. The *Alert* was a regular trader to ports in St Vincent and Spencer Gulfs, as well as between Port Adelaide and Victor Harbor. At the end of its working life, the ketch lay derelict near the Jervois Bridge.

Alert, c1930s
Photo: Ron Blum

Alert today

On 10 February 1960 the *Alert* was moved to the logpool at Ethelton, near the Railway Bridge and, until 1961, gradually broken up by Robert Gregory. However demolition was not carried out to the satisfaction of the Harbors Board and in 1962 the vessel was subsequently burnt to the waterline in lieu of further salvage. Mr Gregory's inability to meet with the conditions of the breaking-up contract led to the involvement of the Crown Solicitor and eventually a three month jail sentence.Today substantial remains of the *Alert* are evident on the mudbank in Jervois Basin, although much of the vessel now lies beneath sections of reclaimed shore. Of particular interest is a substantial section of the keel and centreboard casing.

Department for Environment and Heritage

Ships' Graveyards of South Australia

UNIDENTIFIED WOODEN PONTOON – Jervois Basin

An unidentified wooden pontoon lies in the south-eastern section of the Log Pool. The largely intact vessel is approximately 49 feet (15m) length and 24 feet (7.5m) breadth with the upper deck exposed only during low tides.

Although its origin is unknown, fittings and other structure suggest that the pontoon was possibly a platform for one of the floating cranes which moved about the Port.

A similar pontoon in Portland canal, c1910
Photo: Ron Blum

Unidentified wooden pontoon today

Government of South Australia

environment and heritage

Planting seagrasses

Remediating seagrass beds

The original intertidal estuarine seagrasses that would have occurred at Mangrove Cove have been completely destroyed. There are several methods of assisting the establishment of a small patch of seagrasses that may lead to natural spread across the mud flat area, now that disturbance of the site is more limited.

As no beds remain on the site, the option of improving local niches for seagrass to establish is likely to have a low success. The need to establish a small population from which expansion may occur restricts the choices to transplanting and direct seeding.

The species for planting into the estuarine mud flats at Port Adelaide should be selected from *Lepilaena marina* (water mat), *Zostera muelleri, Zostera mucronata* (eel grasses or garweeds) and *Ruppia* species (widgeon grasses).

There have been few attempts to transplant seagrasses into the intertidal zone in Australia. Fortunately one recent attempt, in Westernport Bay in Victoria, was thoroughly documented.

Walker (2002) details a range of methods that were used to transplant the intertidal seagrass *Zostera muelleri* in Westernport Bay. This plant is one of the three species that would be suitable for planting into Mangrove Cove. The study examined the success of the transplant methods and also examined the impacts of removing donor material from healthy seagrass beds.

The most successful approach for this species was determined to be the planting of 150mm diameter plugs of seagrass that had been removed from donor beds. The study determined that although planting density was not a decided factor in planting success, the closer spacing (0.5m centres) formed a more rapid cover and the plants resisted tidal current damage better than where plantings had lower density (1m centres).

Donor beds had the plugs removed at 1-metre intervals. Most donor areas had recovered within one month, in the Westernport study. The authors report that the impact of small donations appears to be minimal, but recommend that for large projects, in principle, some form of propagation should be carried out instead of relying on donor beds. The Mangrove Cove site is very small, and therefore suitable for using donor plugs.

Donor plugs may be sourced from further around Barker Inlet, where the damage from bait diggers is less pronounced and extensive beds still exist. Donor plugs should be carefully placed in warwicks with seawater and transported immediately to the recipient site. There, they should be placed into holes dug with a spade and firmed down well. It is recommended that the plugs be planted in a grid pattern as this will make later monitoring of the success of the planting easier to monitor.

The Westernport study found that the most successful time of the year to attempt to transplant seagrasses was April. This is the start of the cooler period, and provides the

plants with the longest period to establish before the warmer water and higher evaporation rates of spring and summer.

Other species of intertidal seagrass may be similarly transplanted. Indeed, in most intertidal beds around Barker Inlet support mixed populations of seagrass species.

Seddon (2004) has raised the possibility of direct seeding as a more sustainable method of obtaining propagation material for larger areas. Her studies show that waves and tidal currents are an issue with direct seeding, but this may not be an issue at Mangrove Cove, which is very sheltered. Both *Zostera* and *Ruppia* species produce prolific seed, and this may be collected from wrack that washes ashore.

Distributing the wrack over the site may be sufficient, although in North America some groups have buried the wrack into very shallow runnels on the surface of the mud flat to stop it drifting away with the daily tide. Around Barker Inlet the wrack from intertidal seagrass beds tends to become dispersed in the mangroves, or strands in anaerobic conditions at locations such as St Kilda. Better locations for collecting would be at the Garden Island boat ramp or possibly from the embankments of the initial ponds of the Dry Creek Saltfields. These ponds support good populations of the target species.

Figure 1 - Ruppia seed structures (Ailstock & Shafer, 2004)

Prior to attempting any remediation of the Mangrove Cove mud flats, the appropriate permissions must be sought. To collect reproductive material, either plugs of plants or seed-containing wrack material, will require a permit from the Department for Environment and Heritage. This applies whether the donor location is within private ponds or on public land. Additionally, should private land be a prospective source of reproductive material it is a condition of any permit issued by DEH that the permission of the landholder is obtained, in writing.

Should an area of seagrass replanting be undertaken at Mangrove Cove, monitoring should be performed as specified in the Monitoring Program of the management plan for the reserve.

Ailstock S and Shafer D (2004) *Restoration Potential of Ruppia maritima and Potamogeton perfoliatus by Seed in the Mid-Chesapeake Bay,* Report ERDC/TN EL-04-02, US Army Corps of Engineers.

Seddon S (2004) "Going with the flow: facilitating seagrass restoration" in *Ecological management & restoration* **5:**3 167-176

Walker J (2002) *Western port seagrass restoration project*, Natural Heritage Trust, EPA Victoria and the Western Port Seagrass Partnership, Melbourne.

Active management of mangrove expansion

Active management of mangrove expansion

Active management of mangrove expansion does not address the causal issues of mangrove incursion across saltmarsh areas (Harty, 2002). Additionally, trying to remove or prevent mangroves from growing is impractical over large areas. That said, in very small areas where there are biodiversity and cultural benefits from maintaining the widest range of habitats, the active management of mangrove expansion may be possible.

The most usual method of controlling mangroves in Australia is the physical removal of mangroves from saltmarsh and mud flat habitats. This method requires annual repetition and does nothing to prevent the future year's crops from establishing on the site. The numbers of plants to be removed may be quite large (numbering in the hundreds), requiring considerable volunteer or other effort. This effort may be less than forthcoming, considering that volunteers may have, with all best intentions, assisted the mangroves to establish in certain areas. The Ethelton mangroves are still protected by legislation, and still listed of the National Trust's register of significant trees.

Figure 1 - Numbers of small mangroves across the mud flat and in the saltmarsh

Mangroves, once their pneumatophores have established, do not take kindly to being transplanted, so many of the plants removed will simply die if planted to other parts of the site. This is especially so for the larger plants that have established around the wrecks, many of which exceed 2m height.

Figure 2 - Mangroves in the Fish Market Pontoon

Finally, the disturbance of the soil during the removal of so many closely growing plants may increase water turbidity and any remaining holes may suffer increased erosion.

Ideally, a control method should simply reduce the likelihood of new plants establishing, slow down the growth (stunt) the already established mangroves and cause little impact on the other habitats.

A feature of mangroves on the landward fringe of the Barker Inlet mangrove forests is that they are stunted compared to the trees in the main forest. This is thought to be the result of both less frequent tidal inundation and the increased salinity of the saltmarsh area. Seawater in saltmarsh pools and creeks can reach twice the salinity of open seawater, as a result of evaporation occurring between the high tide cycles.

Mangrove Cove drains very well and is subject to regular tidal flooding, so the water salinity in its saltmarsh area is similar to the salinity in the main part of the river. In fact, in winter the salinity may be even lower as large amounts of stormwater enter the river. These are the conditions that are considered likely to cause mangroves to spread over saltmarsh.(Harty, 2002).

A possible control method is to ‘salt’ the wreck areas and saltmarsh areas with a small quantity of large crystal (water softener) salt in springtime each year. It is envisaged that only a small quantity of salt would be necessary (possibly a total of 50 kg for the selected locations). The aim is for the large crystal to lodge in the sediment, gradually increasing the soil salinity in that location. The saltier water derived from the salt is denser than the daily tidal water and will tend to sink into the sediment where it will

only slowly diffuse away. The change in salinity is not envisaged to be very large, nor to extend over a large area. The mangroves in all other portions of the site will not be affected. Indeed, the salinity change is not envisaged to be large enough to cause any mortality in the existing established mangroves growing on the wrecks. The target is to kill only the new season's recruits each year, and stunt the established trees in those locations.

Figure 3 - Suggested salting locations

Springtime would appear to be the most useful period to salt the wrecks, as the large tides of winter have dissipated, and the salinity increase would need to occur in conjunction with the onset of warmer weather, in order to have an impact on the new recruits.

Should active management of mangrove expansion at Mangrove Cove be contemplated, it is recommended that PIRSA Fisheries be approached to provide an exemption under the *Fisheries Act* and to provide advice. As a minimum, details of any salting undertaken should be maintained, and regular photographs taken as specified in the Monitoring Program of the management plan for Mangrove Cove. The regular water quality data collected by the Mangrove Cove Care Team at the Portside Christian School will provide details on any salinity changes that may be detected within the main mangrove forest.

For this information to be useful in similar areas, it is recommended that one of the Universities be approached and an Honours student, or other, be provided with the opportunity to monitor the project in more detail.

Reference:
Harty (2002) *Planning for Mangroves and Saltmarshes*. Proceedings of the Coast to Coast Conference, 2002. pp. 145-8.

Preliminary suggestions for construction and planting of proposed saltmarsh retreat zone

Preliminary suggestions for construction and planting of proposed saltmarsh retreat zone

The existing boat ramp in the reserve appears to be composed of smelter slag with a topping of ICI limestone grits. At present it is partially capped, preventing freshwater ingress, although carbonate-rich seawater ingress occurs through the exposed faces.

One option for dealing with the ramp area that does not disturb the existing boat ramp is to mitigate the area by constructing a saltmarsh retreat zone on it. Such a project would not increase the degree of degradation of the site, although it would not remove the boat ramp material.

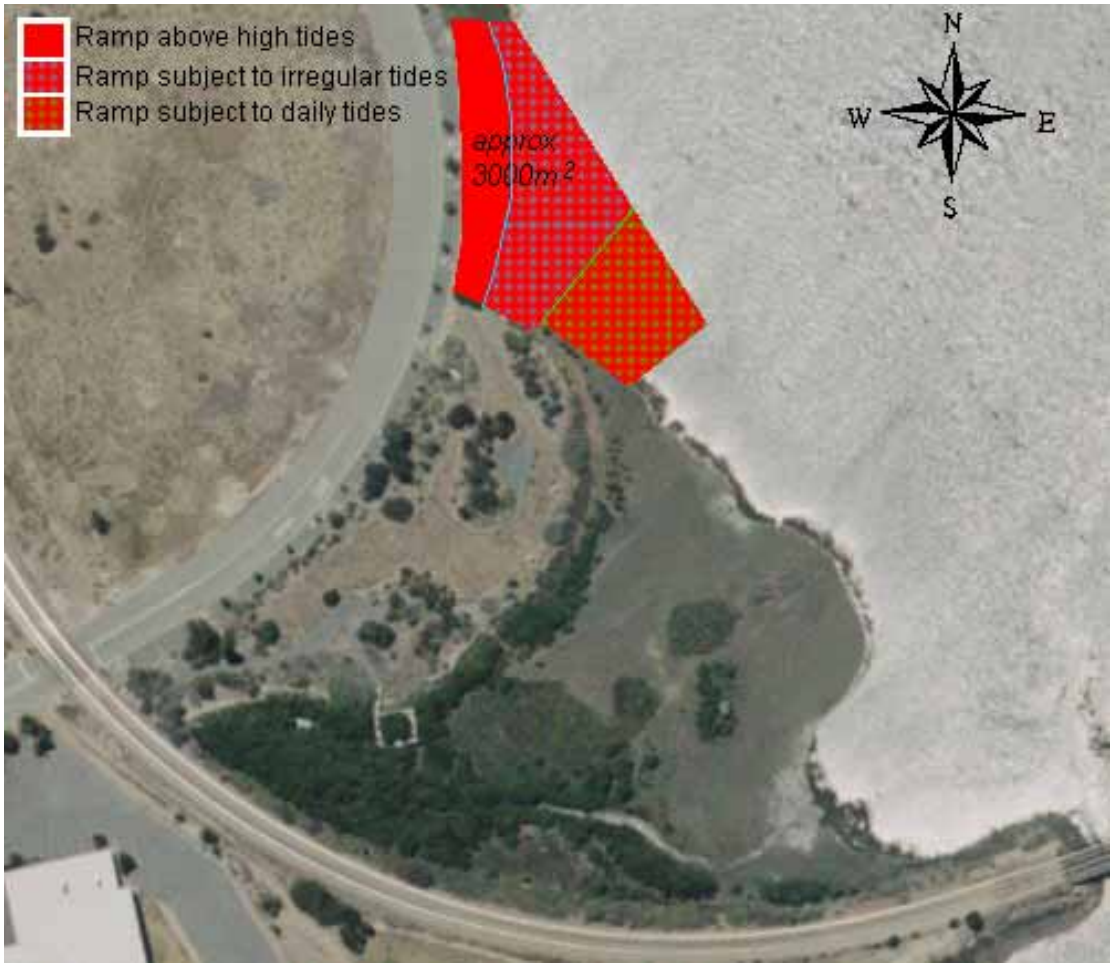


Figure 1 - Location and size of the existing boat ramp

As may be seen in the figure above, the boat ramp covers an area of approximately 3000m^2. About one third of that area is subject to daily tidal inundation, while another third receives tidal inundation occasionally, and a final third receives no inundation at all.

The existing boat ramp material is not suitable as a planting medium and it is suggested that the ramp have an amount of suitable growing medium placed on it, sufficient to support low growing saltmarsh, embankment and dune species. The

necessarily shallow capping would not support the growth of large plants. The low height of the plants is not perceived to pose a problem, as the ramp is in a location where open views are to be maintained. The shallow growing medium is likely to be tolerated well in the intertidal zone, however the higher areas may be subject to some water stress. This should be addressed by selecting plants with very low water requirements to plant in the upper portions of the site, or by using small amounts of irrigation in the plantings on the highest parts of the ramp.

Prior to placing any planting medium it is suggested that a further application of lime-rich grits be placed over the exposed slag on the riverside edge of the ramp. Alternatively a revetment along this edge may be appropriate. The proposed capping (planting medium) is suggested to be clay, placed to an average depth of 50cm, right over the boat ramp. The attached drawing shows that the depth of the clay may be smaller at the crest of the ramp and where the ramp meets the natural surface. As the ramp is approximately 3000 m^3, the quantity of clay required would be 1500 m^3.

Above the clay layer a growing medium with a depth of 10-20 cm is required. This medium should comprise sandy clay soil in the intertidal zone (approximately 400m^3) and sandy soil in the supratidal zone (approximately 200m^3). The depth of this lighter planting medium should be greatest on the highest parts of the ramp, tapering off down the grade of the ramp. This will provide deeper rooting material in the drier parts of the site as well as allowing for the inevitable gravitational migration of some material downslope. There may be some temporary increase in water turbidity on the first incoming tide after the clay and soils are placed.

Plantings will occur in five zones across the ramp area. The zones are denominated subtidal, low marsh, mid marsh, high marsh and embankment or dune plantings. Once plantings are established, the slope of the site will ensure that should sea-level change significantly the marsh zones will be able to migrate to higher land. Additionally, the slope is ideal from the point of view of daily tidal drainage, as any saltmarsh established on it would not support mosquito breeding.

While artificial saltmarshes have been constructed before, they have not been attempted over an impervious base. As a result there may be an iterative process required to establish the plantings. However, the local saltmarsh will produce a reasonable degree of natural colonisation within a short time, and this will help delineation of appropriate planting zones.

After the capping materials have been placed, the surface elevation will be higher than it was. A record should be made of the daily tidal inundation patterns, in order to select the most suitable plants.

Zones that stay underwater at normal low tides (they may be exposed at spring low tides) are zoned SUBTIDAL. Appropriate plants for this zone are the seagrasses and widgeon grasses *Ruppia* spp, *Zostera muelleri* and *Lepilaena marina*. Mangroves will readily colonise this zone.

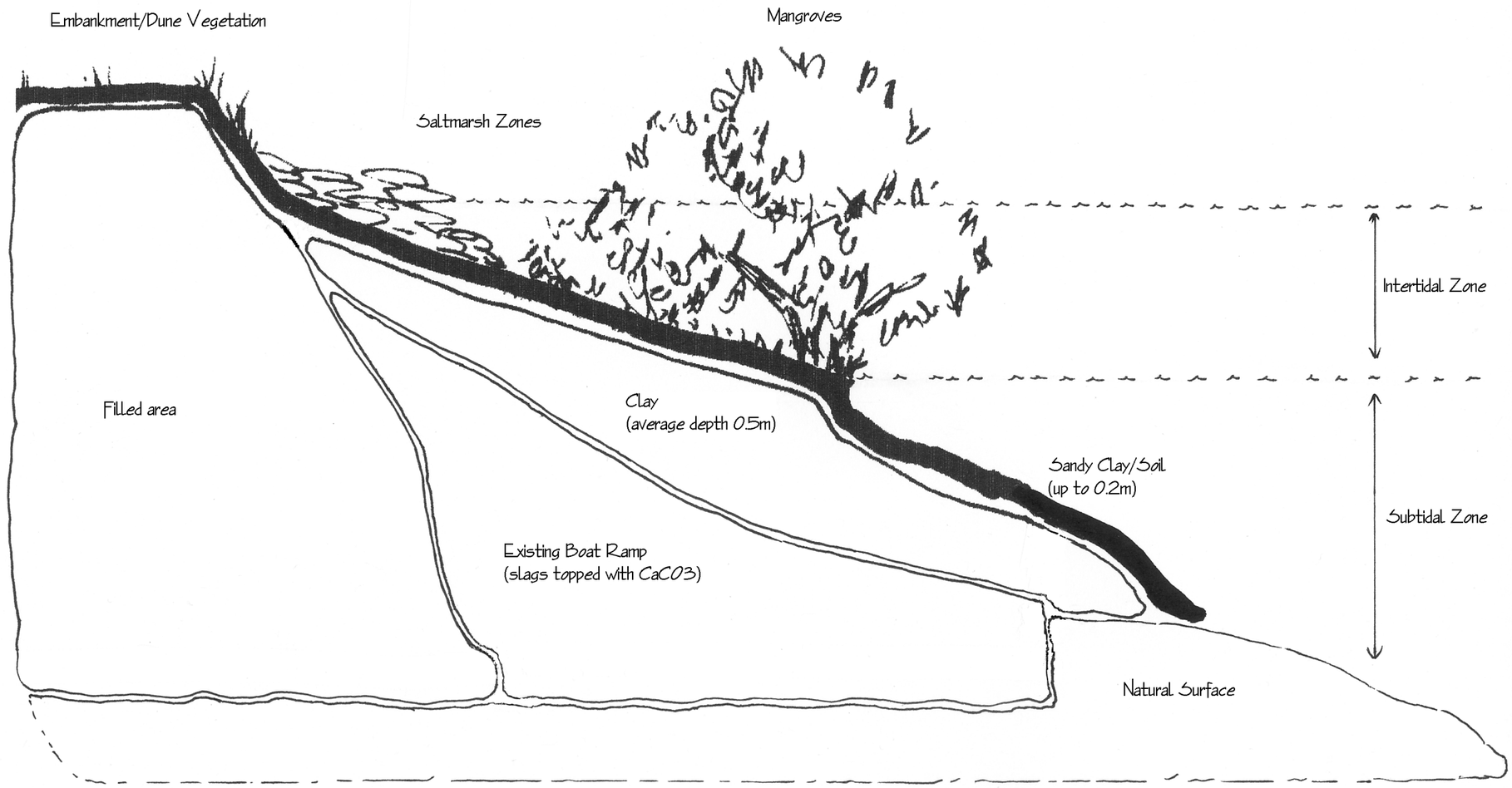
Where the tides cover the ground every day the area will be zoned LOW MARSH. Species suitable for this zone include *Sarcocornia quinqueflora* and *Suaeda australis*.

The area flooded only every few days by the tide is the MID MARSH. *Halosarcia halocnemoides, Halosarcia pergranulata, Sclerostegia arbuscula, Frankenia pauciflora* and *Disphyma crassifolium* are all suitable for this zone.

The HIGH MARSH may only be flooded very irregularly – anywhere from once a month to once a year. Species that form the bulk of the high marsh plantings with include *Atriplex cinerea, Atriplex paludosa, Carpobrotus rossii, Disphyma crassifolium, Maireana oppositifolia,* and *Wilsonia humilis*. In the higher parts of the high marsh and wherever rainfall runoff accumulates, the grasses, rushes and sedges may be planted – *Isolepis nodosa, Cyperus gymnocaulos, Gahnia filum* and *Puccinellia stricta*.

The area that does not receive tidal inundation is zoned EMBANKMENT/DUNE and should be planted with low growing dune or embankment plants that tolerate very dry conditions. *Atriplex semibaccata, Carpobrotus rossii, Disphyma crassifolium, Enchylaena tomentosa, Vittadinia gracilis, Senecio lautus, Scaevola crassifolia, Threlkeldia diffusa, Maireana decalvans* and *Stipa* spp. are recommended.

Attached:
Cross-sectional drawing



PROJECT

Mangrove Cove

DRAWING TITLE

Boat ramp—saltmarsh retreat zone

DRAWING NUMBER

LMC-MCR-001-A

AMENDMENT HISTORY

SCALE

Not to scale

DATE

1 June 2005

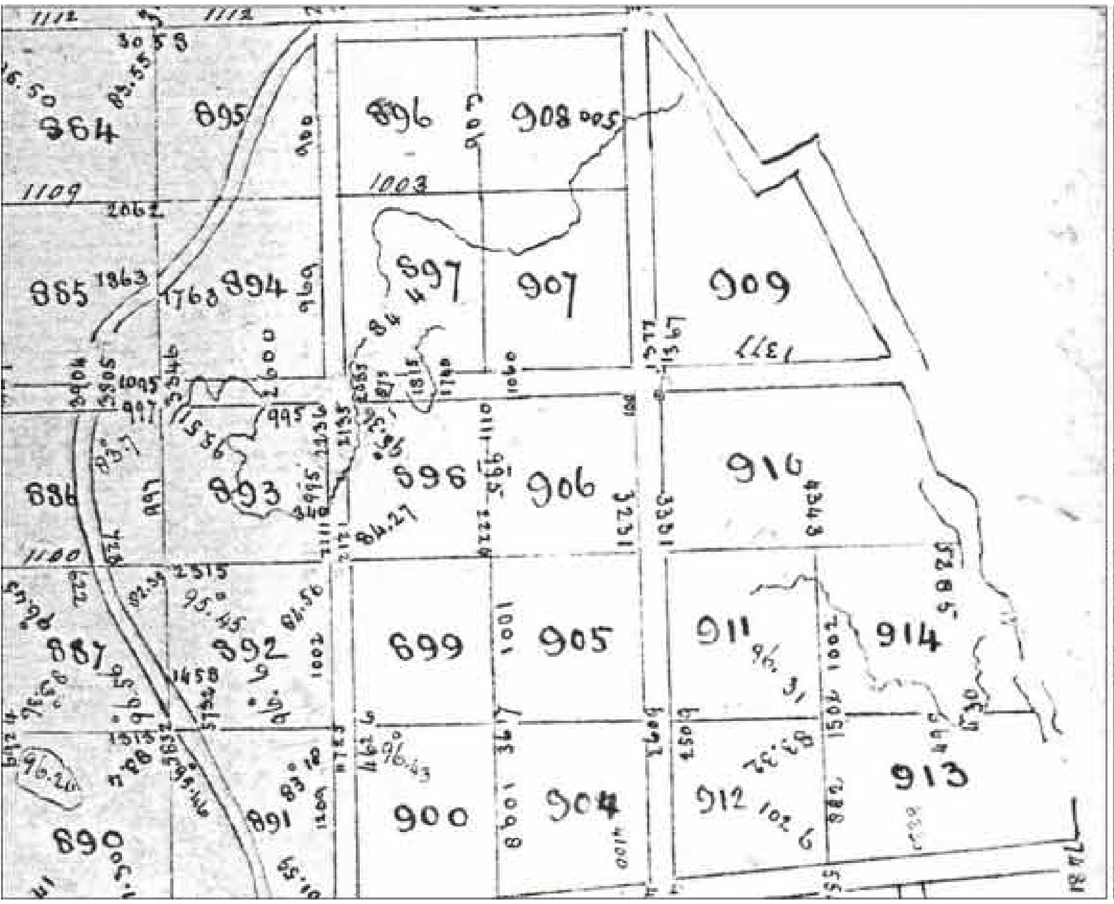
Delta
Environmental Consulting

Delta Environmental Consulting

12 Beach Road
ST KILDA SA 5110

Phone: 08-8280-5910
Fax: 08-8280-5179
Email: peri@deltaenvironmental.com.au

Historic land records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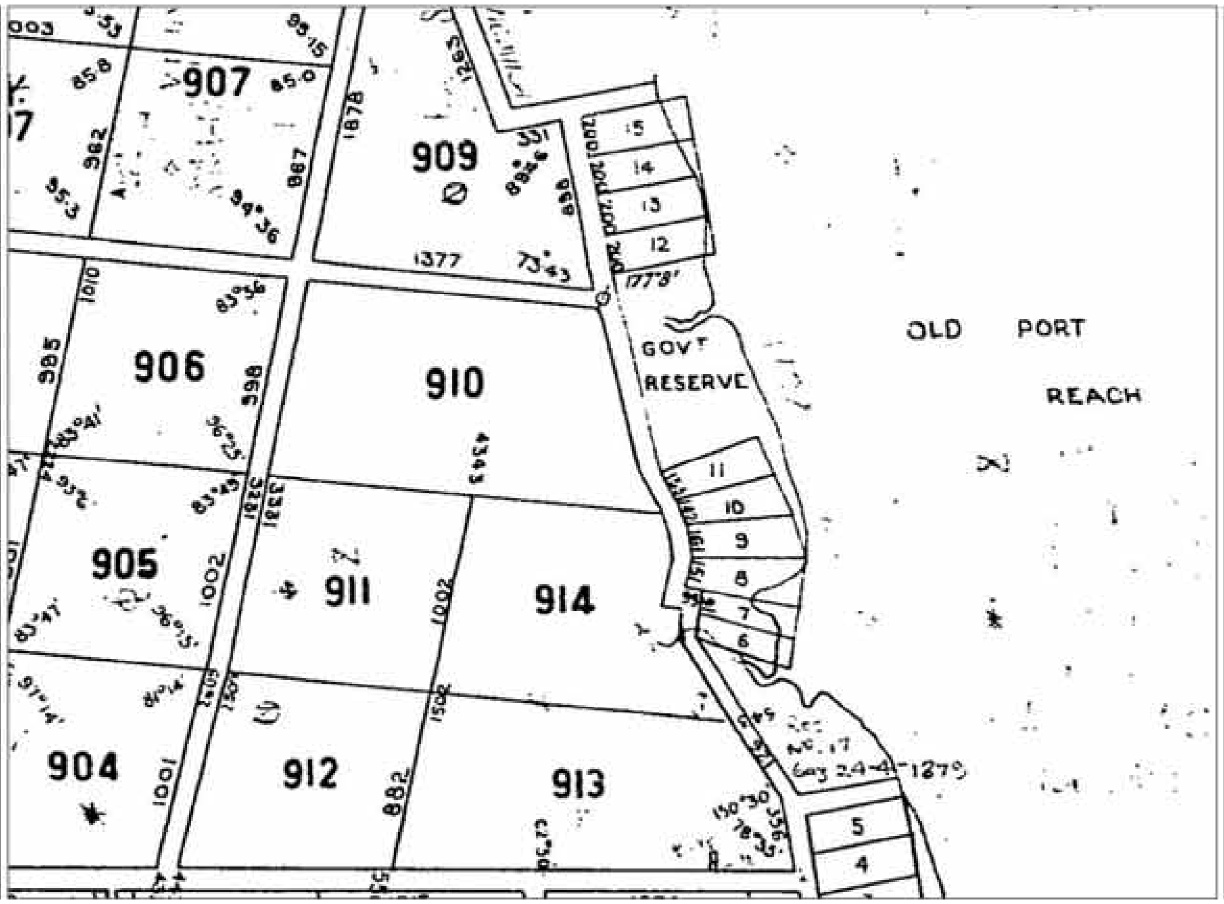
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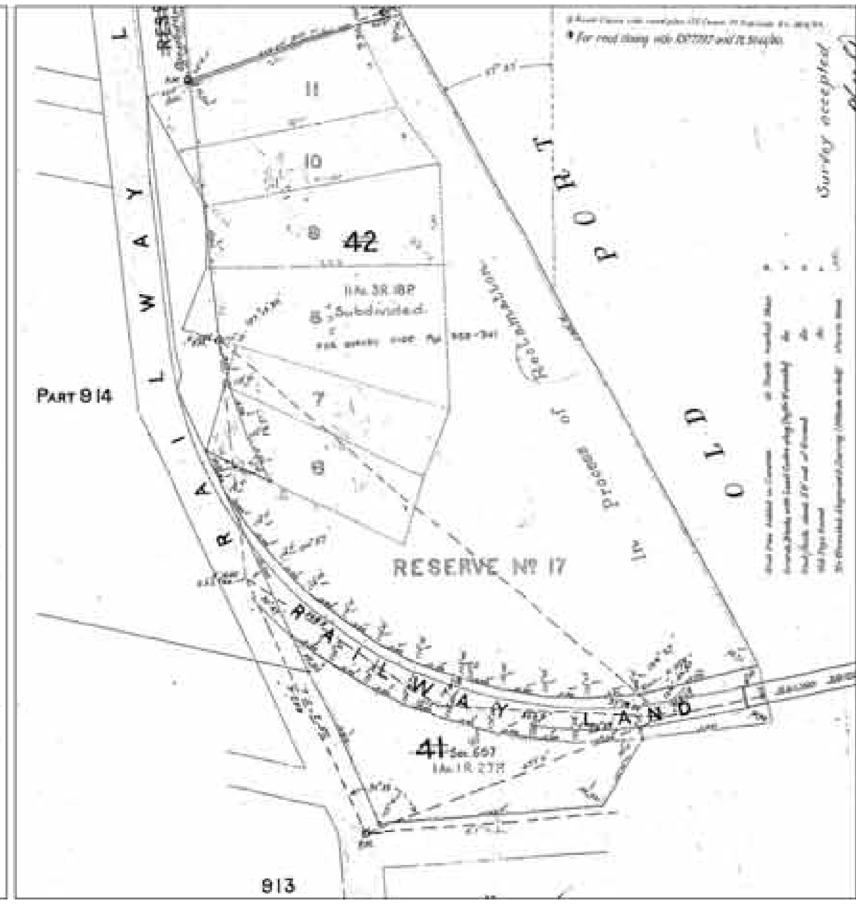

PART 914
42
RESERVE No 17
RAILWAY LAND
41
913
Survey accepted

Year	Blocks numbered 41, 42, 43, 44, 48 in the Hundred of Pt. Adelaide
1928	**CT 1501/41** South Australian Harbours Board.
1939	Block 48 cancelled from title and Block 43 subdivided, subdivision being numbered Block 384
	Portion of block 43 leased from SA Harbours Board to Colonial Sugar Refinery. Lease # 1309003
1940	**CT 1742/98**, new title for the balance of the land above issued to South Australian Harbours Board
1953	Portion of Block 41 leased from SA Harbours Board to Minister of Works. Lease # 1781579
1957	Surrender of Lease #1309003
1965	Portion of Block 41 leased to Minister of Works. Lease # 2645749
1966	Portions of Block 42 and 43 taken for new road. Tracing # 5502
1967	**CT 3491/25**, new title for the remainder of the land issued to Minister of Marine, includes Block 41, portions of Block 42 & portions of Block 43
	Portions of Blocks 42 and 43 transferred in a new title (CT 3512/116) to Sugar Refining Company Limited.
	Leases #1781579 and #2645749 from previous title noted on new title
1967	**CT 3512/117** new title for remaining land issued to Minister of Marine
	Portion of the within Block 44 and portion of Part Block 43 withdrawn from the Minister of Marine and vested in the Crown
1983	Blocks 41, 42 & 43 redesignated Lots 4 of FP3256, Lot 5 of Section 660 & portion of Lot 6 of Section 662.
	CT 4206/542, new title issued for Lots 5, 6 & 7 to the Minister of Marine
1984	Lease # 2645749 surrendered, Lot 7 vested in the Crown, Lot 6 vested in the Crown
1989	Lot 52 freed from trusts & renumbered Section 661, transferred to QEII as new title CT 4343/995
2000	**Crown Record 5766/884** issued for Section 662 under custodianship of the Minister for Environment and Conservation

REGISTER SEARCH OF CROWN RECORD * VOLUME 5766 FOLIO 844 *

COST : $15.10 (GST exempt)
REGION : L.T.O. GROUND FLOOR - LGHP13
AGENT : TEST
SEARCHED ON : 17/05/2005 AT : 12:37:30

NO PARENT TITLE
AUTHORITY : RT 8862605
DATE OF ISSUE : 03/05/2000
REGISTRATION : 1

OWNER

THE CROWN

CUSTODIAN

MINISTER FOR ENVIRONMENT AND CONSERVATION OF ADELAIDE SA 5000

DESCRIPTION OF LAND (UNALIENATED)

SECTION 662
HUNDRED OF PORT ADELAIDE
IN THE AREA NAMED ETHELTON

TOTAL AREA: 2.176 HECTARES CALCULATED

EASEMENTS

NIL

SCHEDULE OF INTERESTS

NIL

NOTATIONS

DOCUMENTS AFFECTING THIS TITLE

NIL

REGISTRAR-GENERAL'S NOTES

NIL

ADMINISTRATIVE INTERESTS AND CROWN NOTES

NIL

END OF TEXT.

ORIGINAL

CERTIFICATE OF TITLE

South Australia

Register Book,
Volume 4206 Folio 542

New Certificate for the whole of the Land in Vol.3512 Folio 117

MINISTER OF MARINE is the proprietor of an estate in fee simple IN TRUST to permit and suffer the land hereinafter described to be used at all times for the purposes of Part III of the Harbors Act 1936 as amended subject nevertheless to such encumbrances liens and interests as are notified by memorial underwritten or endorsed hereon in ALLOTMENTS 5.6 and 7 of portion of Section 910 HUNDRED OF PORT ADELAIDE in the area named ETHELTON (L.T.R.O. FILED PLAN No.3256)

In witness whereof I have signed my name and affixed my seal this 20th day of April 1983

Signed the 20th day of April)
1983, in the presence of Maurice)

A.J. Sharman

Deputy Registrar-General

REGISTRAR-GENERAL SOUTH AUSTRALIA

F.P. 16062
APPROVED

~~CANCELLED as regards the within Lot 7 the same having been revested in the Crown vide 5121493~~ CANCELLED 29.8.84

LEASE 1781579 to MINISTER OF WATER RESOURCES of a right of way and easement over portion of the within Allotment 7 Term 999 years from 30.3.1953 Produced 26.5.1953 at 11 a.m. (Including other land)

~~SE-5285720-SE5285721-V-5285722 V-5285722.~~
SURRENDER of Lease 1781579 vide 5285720 Produced 16.8.1984 at 3.55 p.m.

LEASE 2645749 to MINISTER OF WATER RESOURCES of a right of way and easement over portion of the within Allotment 7 Term 999 years from 12.7.1965 Produced 16.7.1965 at 2.35 p.m.

~~V 5121493~~

SURRENDER of Lease 2645749 vide 5285721 Produced 16.8.1984 at 3.55 p.m.

~~The within Lot 7 has been withdrawn from the Minister of Marine and vested in the Crown pursuant to Section 64(4) of the Harbors Act 1936 as amended freed from the within trusts vide 5121493 Produced 17.10.1983 at 10 a.m.~~
CANCELLED 29.8.84

The within Lot 7 has been withdrawn from the Minister of Marine and vested in the Crown pursuant to Section 64(4) of the Harbors Act 1936 as amended freed from the within trusts vide 5285722 Produced 16.8.1984 at 3.55 p.m.

CANCELLED as regards the within Lot 7 the same having been revested in the Crown vide 5285722

over

PORTION of the within Lot 6 (Lot 53 F.P. 16062) and the within Lot 5 has been withdrawn from the Minister of Marine and vested in the Crown pursuant to Section 64(4) of the Harbors Act 1936 as amended freed from the within trusts vide 5285723 Produced 16.8.1984 at 3.55 p.m.

CANCELLED as regards PORTION of the within Lot 6 (Lot 53 F.P. 16062) and the within Lot 5 the same having been revested in the Crown vide 5285723

CANCELLED

AND NEW CERTIFICATE OF TITLE
ISSUED VIDE 5285722 FILED PLAN No. 16062
VOL. 4234 FOL. 474

South Australia

(CERTIFICATE OF TITLE)

Register Book,

Vol. 3512 *Folio* 117

Balance Certificate of Title from Vol.3491 Folio 25

MINISTER OF MARINE

is the proprietor of an estate in fee simple

subject nevertheless to such encumbrances liens and interests as are notified by memorial underwritten or endorsed hereon in

THOSE PIECES of land situated in the HUNDRED OF PORT ADELAIDE COUNTY OF ADELAIDE being the BLOCKS 41 containing one acre one rood and twenty seven perches or thereabouts and 44 containing twenty perches or thereabouts PORTIONS OF BLOCK 42 containing together ten acres and three roods or thereabouts and PORTION OF BLOCK 43 containing two roods or thereabouts and more particularly delineated and bounded as appears in the plan in the margin hereof and therein colored green EXCEPT AND RESERVED unto Her Majesty Her heirs and successors all gold silver copper tin and other metals ore minerals and other substances containing metals and all gems and precious stones coal and mineral oil in and upon such land and all incidental powers referred to in the original Land Grant for the within land RESERVING ALSO unto Her said Majesty Her heirs and successors the right to resume all such parts of the said land as now or may at any time hereafter be required for a road or roads IN TRUST to permit and suffer the said pieces of land to be used at all times for the purposes of Part III of the Harbors Act 1936-1966

Which said ~~Section~~ Blocks are delineated in the public map of the said Hundred deposited in the Land Office at Adelaide.

In witness whereof I have hereunto signed my name and affixed my seal this 4th day of September 19[illegible]

Signed the 4th day of September 1967, in the presence of [illegible]

F.P. 16062 APPROVED

B. A. Nairn

Acting Registrar-General

REGISTRAR-GENERAL SOUTH AUSTRALIA

The land in this Certificate is REDESIGNATED as ALLOTMENT(S) 5,647 in FILED PLAN 3256

Lease No.1781579 to Minister of Works of a right of way and easement over portion of the within Block 41 of the within land Term 999 years from the 30 day of March 1953 Produced 26.5.1953 at 11 a.m. (Including other land)

B. A. Nairn

Act.Reg.Genl.

Lease No.2645749 to Minister of Works of a right of way and easement over portion of the within Block 41 Term 999 years from 12.7.1965 Produced 16.7.1965 at 2.35 p.m.

B. A. Nairn

Act.Reg.Genl.

V

~~[illegible]~~

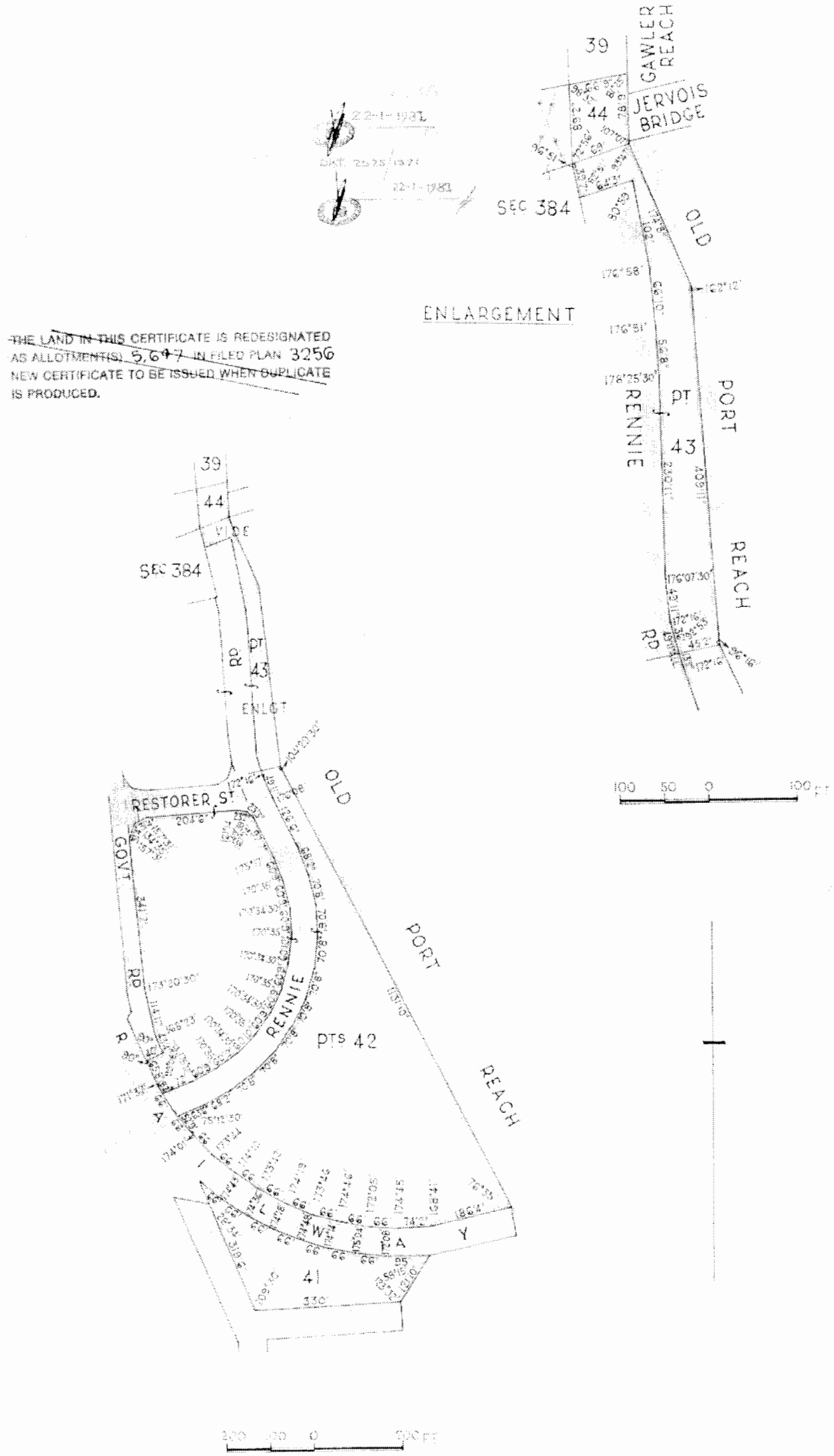
OVER

Portion of the within Block 44 and portion of Part Block 43 has been withdrawn from the Minister of Marine and vested in the Crown pursuant to Section 64 (4) of the Harbors Act [illegible] as amended freed from the within trust

CANCELLED as regards portion of the within land the same having been revested in the Crown vide 4338416 Produced 28-4-1982 at 1:15pm

CANCELLED

AND NEW CERTIFICATE OF TITLE
ISSUED VIDE 4338416 FILED PLAN NO 3256
VOL 4206 FOL 542


39
GAWLER REACH
44
JERVOIS BRIDGE
SEC 384
OLD
PORT
REACH
ENLARGEMENT
THE LAND IN THIS CERTIFICATE IS REDESIGNATED AS ALLOTMENT(S) 5,647 IN FILED PLAN 3256
NEW CERTIFICATE TO BE ISSUED WHEN DUPLICATE IS PRODUCED.
PT
43
RENNIE
RD
39
44
SEC 384
PT
43
ENLGT
RESTORER ST
GOVT
RD
RENNIE
PTS 42
OLD
PORT
REACH
41
330'
100 50 0 100 FT
200 100 0 300 FT

ORIGINAL

CERTIFICATE OF TITLE

South Australia

Register Book,
Volume 4206 Folio 542

New Certificate for the whole of the Land in Vol.3512 Folio 117

MINISTER OF MARINE is the proprietor of an estate in fee simple IN TRUST to permit and suffer the land hereinafter described to be used at all times for the purposes of Part III of the Harbors Act 1936 as amended subject nevertheless to such encumbrances liens and interests as are notified by memorial underwritten or endorsed hereon in ALLOTMENTS 5,6 and 7 of portion of Section 910 HUNDRED OF PORT ADELAIDE in the area named ETHELTON (L.T.R.O. FILED PLAN No.3256)

In witness whereof I have signed my name and affixed my seal this 20th day of April 1983

Signed the 20th day of April)
1983, in the presence of Maurice)

A.J. Sharman

Deputy Registrar-General

F.P. 16062
APPROVED

~~CANCELLED as regards the within Lot 7 the same having been revested in the Crown vide 5121493~~ CANCELLED 29.8.84

LEASE 1781579 to MINISTER OF WATER RESOURCES of a right of way and easement over portion of the within Allotment 7 Term 999 years from 30.3.1953 Produced 26.5.1953 at 11 a.m. (Including other land)

~~SL-5285720-SL5285721-V-5285722~~
V 5285722

SURRENDER of Lease 1781579 vide 5285720 Produced 16.8.1984 at 3.55 p.m.

LEASE 2645749 to MINISTER OF WATER RESOURCES of a right of way and easement over portion of the within Allotment 7 Term 999 years from 12.7.1965 Produced 16.7.1965 at 2.35 p.m.

SURRENDER of Lease 2645749 vide 5285721 Produced 16.8.1984 at 3.55 p.m.

~~V 5121493~~

~~The within Lot 7 has been withdrawn from the Minister of Marine and vested in the Crown pursuant to Section 64(4) of the Harbors Act 1936 as amended freed from the within trusts vide 5121493 Produced 17.10.1983 at 10 a.m.~~

~~CANCELLED 29.8.84~~

The within Lot 7 has been withdrawn from the Minister of Marine and vested in the Crown pursuant to Section 64(4) of the Harbors Act 1936 as amended freed from the within trusts vide 5285722 Produced 16.8.1984 at 3.55 p.m.

CANCELLED as regards the within Lot 7 the same having been revested in the Crown vide 5285722

over

PORTION of the within Lot 6 (Lot 53 F.P. 16062) and the within Lot 5 has been withdrawn from the Minister of Marine and vested in the Crown pursuant to Section 64(4) of the Harbors Act 1936 as amended freed from the within trusts vide 5285723 Produced 16.8.1984 at 3.55 p.m.

CANCELLED as regards PORTION of the within Lot 6 (Lot 53 F.P. 16062) and the within Lot 5 the same having been revested in the Crown vide 5285723

CANCELLED

AND NEW CERTIFICATE OF TITLE
ISSUED VIDE 5285722 FILED PLAN No. 16062
VOL. 4234 FOL. 474

South Australia

(CERTIFICATE OF TITLE)

Register Book,

Vol. 3491 *Folio* 25

New Certificate of Title for the whole of the Land in Vol.1242 Folio 98 and issued pursuant to Section 20(a) of the Roads (Opening and Closing) Act 1932-1946

MINISTER OF MARINE

is **the proprietor** of an estate in **fee simple**

subject nevertheless to such encumbrances liens and interests as are notified by memorial underwritten or endorsed hereon in THOSE PIECES of land situated in the HUNDRED OF PORT ADELAIDE COUNTY OF ADELAIDE being the BLOCKS 41 containing one acre one rood and twenty seven perches or thereabouts and 44 containing twenty perches or thereabouts PORTIONS OF BLOCK 42 containing together ten acres and three roods or thereabouts and PORTIONS OF BLOCK 43 containing together two acres and two roods or thereabouts and more particularly delineated and bounded as appears in the plan in the margin hereof and therein colored green EXCEPT AND RESERVED unto Her Majesty Her heirs and successors all gold silver copper tin and other metals ore minerals and other substances containing metals and all gems and precious stones coal and mineral oil in and upon such land and all incidental powers referred to in the original Land Grant for the within land RESERVING ALSO unto Her said Majesty Her heirs and successors the right to resume all such parts of the said land as now or may at any time hereafter be required for a road or roads IN TRUST to permit and suffer the said pieces of land to be used at all times for the purposes of Part III of the Harbors Act 1936-1966

Which said ~~Section~~ Blocks are delineated in the public map of the said Hundred deposited in the Land Office at Adelaide.

In witness whereof I have hereunto signed my name and affixed my seal this 22nd day of May 1967

Signed the 22nd day of May 1967, in the presence of P Baltzer

R.L. Collins

Registrar-General

REGISTRAR-GENERAL SOUTH AUSTRALIA

Lease No.1781579 to Minister of Works of a right of way and easement over portion of the within Block 41 of the within land Term 999 years from the 30 day of March 1953 Produced 26.5.1953 at 11 a.m. (Including other land)

R.L. Collins

Reg.Genl.

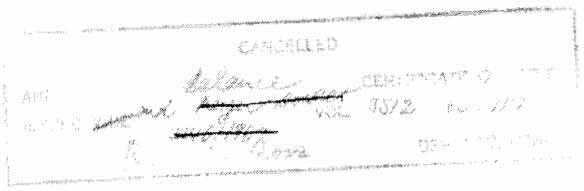
Lease No.2645789 to Minister of Works of a right of way and easement over portion of the within Block 41 Term 999 years from 12.7.1965 Produced 16.7.1965 at 2.35 p.m.

R.L. Collins

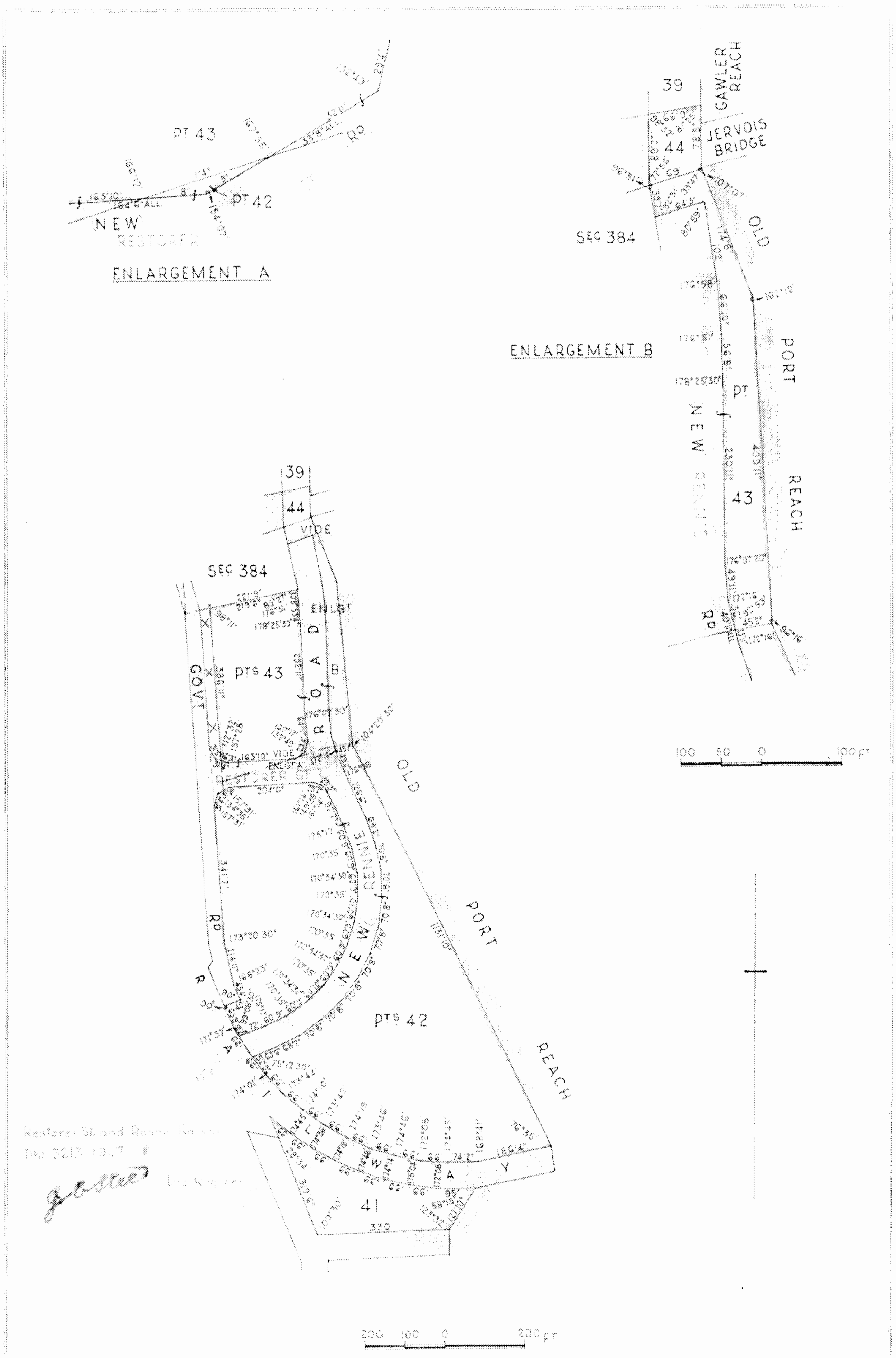
Reg.Genl.

Lease No. 2830776 to The Colonial Sugar Refining Company Limited of portion of the within Parts Blocks 42 and 43 freed from

CANCELLED AS REGARDS PORTION AND NEW C.T. ISSUED



SHEET No. 2 ATTACHED


ENLARGEMENT A
PT 43
PT 42
NEW
RESTORER
RD
ENLARGEMENT B
39
44
GAWLER REACH
JERVOIS BRIDGE
SEC 384
OLD
PORT
REACH
PT
43
NEW RENNIE
RD
100 50 0 100 FT
39
44
VIDE
SEC 384
GOVT
RD
PTS 43
ROAD
OLD
PORT
REACH
RESTORER ST
NEW RENNIE
PTS 42
41
RAILWAY
200 100 0 200 FT

South Australia.

(CERTIFICATE OF TITLE.)

Register Book,

Vol. 1742 *Folio* 98

Balance Certificate of Title from Vol.1501 Folio 41

THE SOUTH AUSTRALIAN HARBORS BOARD is the proprietor of an estate in fee simple subject nevertheless to such encumbrances liens and interests as are notified by memorial underwritten or endorsed hereon in THOSE PIECES of land situated in the HUNDRED OF PORT ADELAIDE COUNTY OF ADELAIDE being the BLOCKS 41 containing one acre one rood and twenty seven perches or thereabouts 42 containing eleven acres three roods and eighteen perches or thereabouts and 44 containing twenty perches or thereabouts and PORTION OF BLOCK 43 containing three acres one rood and thirty three perches or thereabouts WHICH said pieces of land are more particularly delineated and bounded as appears in the plan in the margin hereof and therein colored green EXCEPT AND RESERVED unto His Majesty His heirs and successors all gold silver copper tin and other metals ore minerals and other substances containing metals and all gems and precious stones coal and mineral oil in and upon such land and all incidental powers as provided for in "The Crown Lands Acts 1915 to 1926" and RESERVING ALSO unto His said Majesty His heirs and Successors the right to resume all such parts of the said land as now or may at any time hereafter be required for a road or roads IN TRUST to permit and suffer the said pieces of land to be used at all times for Harbors Board Purposes WHICH said Blocks are delineated in the Public Map of the said Hundred deposited in the Land Office at Adelaide

In witness whereof I have hereunto signed my name and affixed my seal this thirteenth day of January 1940

Signed the 13th day of January 1940 in the presence of B. M. Alexander

Registrar-General.

REGISTRAR-GENERAL SOUTH AUSTRALIA

EXCEPT MINERALS

Lease No. 130903 from The South Australian Harbors Board To The Colonial Sugar Refining Company Limited of portion of the within part Block 43 reserving a right of way. Term ~~to commence on the~~ 21 years from the 1 day of November 1939 Produced for registration the 19 day of December 1939 at 2 40pm

Dep Reg Genl

LEASE No. 105570 BOX

The South Australian Harbors Board to Minister of Works of a right of way and Easement over portion of the within Block 41 OF THE WITHIN LAND. TERM 999 years from the 30 day of March 1953.

PRODUCED FOR REGISTRATION THE 26 DAY OF May 1953 at 9.30 a.m.

Registrar-General of Titles

Book 41

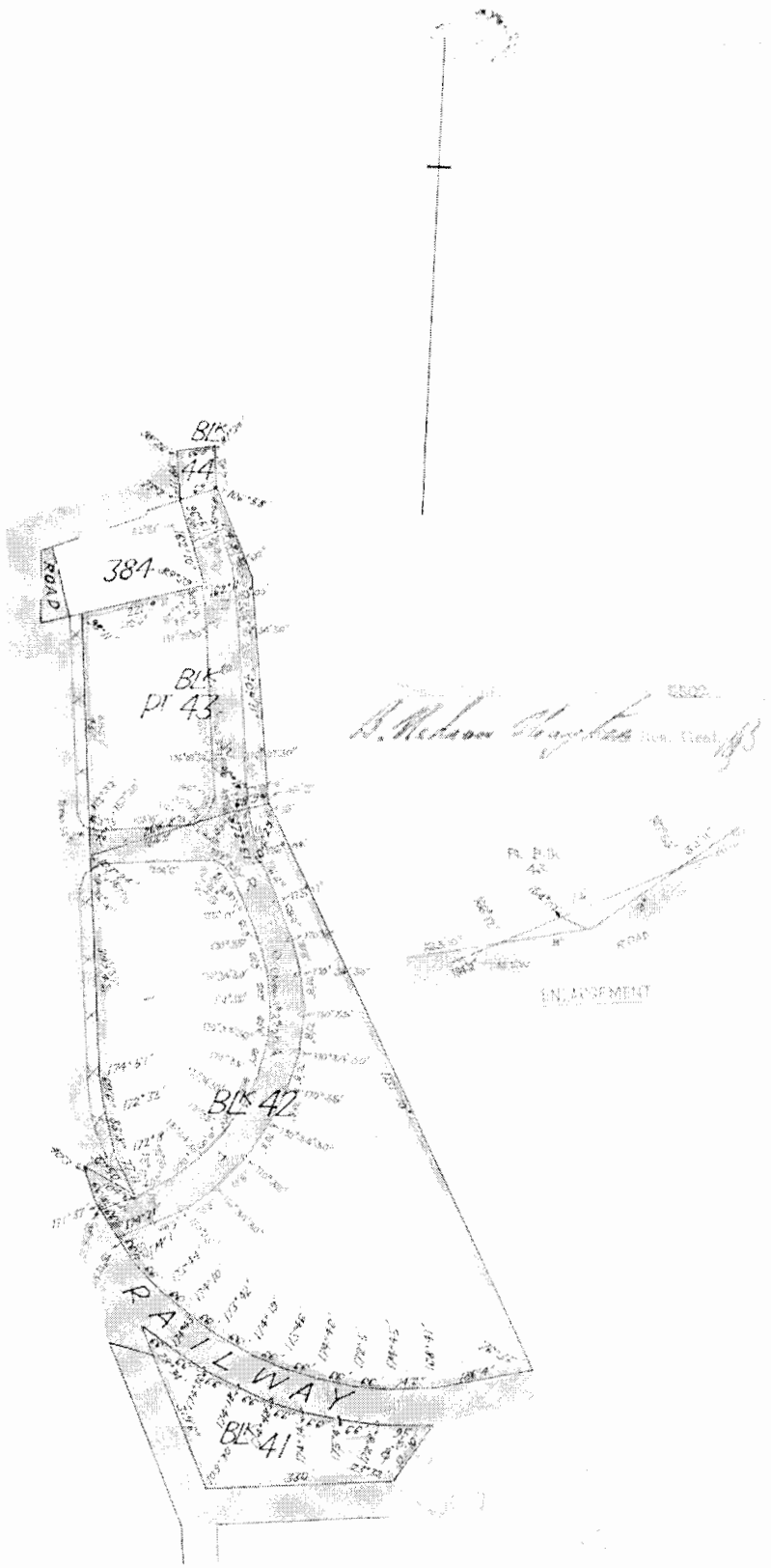
to Minister of Works of a right of way and easement over portion of [illegible] for 999 years from 13/7/1965

ORDER 14/9/1965 AT 2.35

PORTION OF THE WITHIN Blk 42 & Pt Blk. 43. [illegible] TAKEN FOR A NEW ROAD VIDE CONFIRMATION OF ROAD ORDER IN GAZETTE DATED 17th OF November 1966 (TRACING No. 5502)

CANCELLED

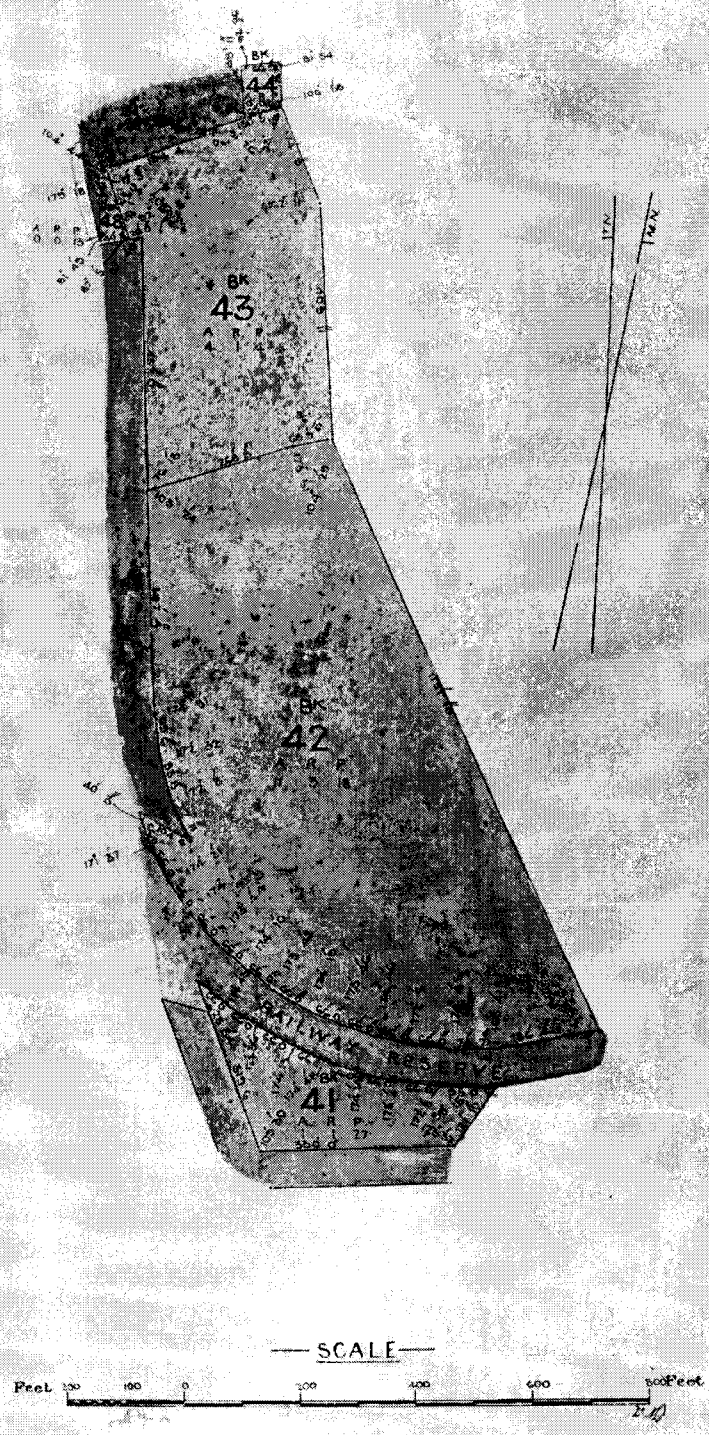
Now [illegible] 999


BLK 44
384
ROAD
BLK PT 43
BLK 42
RAILWAY
BLK 41
ENLARGEMENT

Cancelled as regards the northern
Block 48 pursuant to Section 64
Subsection (4) of the Mining
Act 1936 vide G.L.O. 1438 of 1939
[illegible] Dept Mines

CANCELLED

Balance
Letter No. 1435 of 1939
1742 98


BK
44
BK
43
BK
42
BK
41
— SCALE —
Feet
100
0
200
400
600
Feet

Stakeholder consultation

Group	Interests
DEH - biodiversity	Mangrove-saltmarsh balance
	Impacts of vegetative change on wading birds
	Actively manage habitats or observe change?
	Information linking mangrove/samphires/food chain/dolphins
	Naming the reserve - dual or Kaurna name could be appropriate
	Viewpoint near northern end of boat ramp would provide an 'end-point ' to promenade
	Parking preferably outside the reserve, on the road reserve
	Ramp area - removal would require DA
	Ramp area - if topped, would it be suitable for saltmarsh retreat area?
	Maintain spirit of the area - amphitheatre part of 'A Quiet Place'?
	Maintain plantings undertaken by the school
DEH - heritage	Maritime heritage trail interpretation to remain, or if removed for development, to be replaced/upgraded by developer in consultation with DEH
	Kaurna trail put in by Taoundi College is to remain
	Will mangroves cover all the wrecks etc?
	The piles for the Log Pool have sculptures on them
Newport Quays	Parking will need to be slightly inside the reserve to allow access for the first block of townhouses Parking bays have never been provided for the reserve, and now that they are to be provided, they are part of the reserve. Not part of the Development area. Moving the parking bays northwards will impinge upon the open space directly abutting the townhouses. This open space is required as a buffer between the townhouses and the roadway.
	Rennie Road remains at approximately current level
	Norfolk Pines are proposed for along the promenade. Some of the existing pines may be reused, if they can be relocated. Doubtful that any of the existing pines will be in the correct ultimate locations.
	Consortium's preference is the ramp be removed.
	Plaza edged with a high 'seating' type kerb. Kerb won't prevent access (but should deter), and is proposed for aesthetic and functional (seating) purposes.
	Southernmost boardwalk/platform is located at northern end of boatramp to act as a viewing point. Platform is slightly higher than the boat ramp…steps would be required if boat ramp stays in place.
	Reserve currently has safety (hidden areas) and maintenance (dead plants) issues, as well as general amenity and aesthetic issues.
Portside Christian College and "Our Patch"	School has been involved in plantings for many years, in conjunction with Our Patch and the Council's wetlands officer.
	Importance of mangroves and mud to help students connect to the earth
	School uses amphitheatre area when taking visitors to the mangroves
	Boat ramp area - some interest in attempting a saltmarsh retreat area
	Steep banks near boat ramp need more of the larger concrete wastes removing, but once they are gone, mangroves will eventually lean right up against the bank, hiding it, as they have nearer to the school.
	Soil on site is incredibly difficult and plantings reflect numerous attempts to find appropriate species.
	Some of the plants that are succeeding on the site may be suitable for use in the development site, and could provide an element of continuity in the visual change from development area to reserve area
	School would like to make a CDROM of their special place to share with the new residents. They would also welcome new residents to join them in caring for the reserve.
Bicycle Users Group	Concern that parking area within the reserve will be at the expense of a complying shared use bicycle track as specified in the Council's PAR and in the council-wide development guidelines.

Mangrove Park Management Plan

This document sets out the initial vision and requirements that Council see as the priorities for the Mangrove Park area to assist in the formulation of the Management Plan.

Strategic Direction - Open Space Plan

Mangrove Park is aligned as an area of 'Natural Resource Management' within Councils Draft Open Space Plan.
The objectives for Natural Resource Management areas are to:

1. Preserve and manage native wildlife.
2. Preserve geological, natural and scenic features.
3. Encourage public use and enjoyment through understanding, education and interpretation.
4. Promote recreational use while conserving habitat value.
5. Control pest plants and animals.
6. Manage animal and vegetation diseases.
7. Minimise the impact of fire and other destructive natural events.

A key direction from the plan that would apply is:
Rehabilitation of coastal habitat to increase biodiversity as well as creating a wider coastal and inland natural open space network.

The Strategic Actions under this set out as further actions:

- Undertake ecological assessment of natural areas to ascertain baseline information and guide future revegetation or development
- Develop management plans for individual natural areas in accordance with strategic directions

Mangrove Park is also part of the 'Linear Parks, Trails and Links', in particular the Western Region Circuit. This is considered a neighbourhood connection in the hierarchy of the plan. In the Strategic Actions the neighbourhood trails can be implemented in relation to linear open space, footpaths, residential road networks and bike routes. The Western Region Circuit is one of 16 local trails flagged to be 'maintained and developed'.

Vision for area

Area	Feature of Park	Comments on preferences for Management Plan
Environment	Mangroves, Salt Marsh, birds	▪ Options are allowing Mangroves to flourish, or salting of marshes to minimise encroachment in this area. A decision will be determined by options put forward, including maintenance and monitoring requirements. Would like to investigate both options. ▪ Information required for assessment ▪ baseline ecological assessment of the area (incl. species), what is the bottom line functional

		requirements and management objectives for ongoing habitat viability; · assessment of future environmental pressures on the area; · recommendations about required dimensions for viability of habitat; · required works to protect areas; short and long term monitoring needs. ▪ Boardwalk –Visitor Information centre know of locals who love the tranquility of current boardwalk – also gives rare opportunity to experience of being amidst a mangrove forest. Would prefer existing boardwalk to be maintained/upgraded. ▪ View from the current boardwalk is limited. Suggest the construction of new boardwalk which minimises disturbance to salt marshes / mangroves but enhances viewing of the overall area, in particular ship's graveyard. ▪ Port Adelaide Kaurna Cultural Heritage Tour Guides from Tauondi Cultural Agency use Mangrove Park as a point of reference on guided tours to illustrate what the Port River would have looked like prior to settlement – last bit of remnant Port River vegetation
Tourism	Shipwrecks Sculptures (log pools)	▪ Desire for interpretive signage for Log Poles, current signage on other side of river ▪ Shipwrecks are an important part of South Australia's Maritime Heritage – Port Adelaide's Ships' Graveyards are the most accessible ships' graveyard in Australia. There is a brochure and website dedicated to the Ships' Graveyards, which features the "Jervois Basin". Refer to brochures at Council's Visitor Information Centre (VIC) (www.shipsgraveyards.sa.gov.au) ▪ Heritage SA worked with Council's VIC to develop the interpretive signage, which was installed in 2002. The signage should be repaired or upgraded (there are scratches in surface of signage), but should not be removed. ▪ Log Pool Sculptures Symbolic of swimmers in the Port River. Commissioned as part of Western Park Development.
Recreation	Boat Ramp, Ampitheatre, boardwalk, other	▪ Boat ramp to be closed, will not fit with new development and Council not prepared to maintain. Council preference is to remove boat ramp. Suggestion made by developer to create sandy beach swimming area, however swimming area is not appropriate at this location for safety reasons. ▪ Management Plan should contain the proposed options for use of the boat ramp area given nature of fill. ▪ Ampitheatre not used. Space can be used for other purposes. ▪ Western Region Circuit – should be enhanced as part of trail ▪ Anticipated that reserve will provide Open Space for new residents within development. Links to Mangrove Park are proposed from promenade and Rennie Road. ▪ Passive recreation – would like area to provide defined walking trails linked to a boardwalk that incorporates educational and interpretive signage, a viewing area, and public seating if appropriate. Mangrove Walk at St Kilda is a good example. ▪ The nature of fill on site in both the boat ramp and general site need to be considered in regards to propose landscaping and the appropriate uses of these areas.

Cultural	Kaurna significance	▪ The Port Adelaide Kaurna Cultural Heritage Trail plaques were developed as a joint project between Council's VIC and Tauondi College, with Kaurna Elder Uncle Lewis O'Brien as consultant. Council's Aboriginal Advisory Panel was consulted during the process. At the 2003 launch of the Port Adelaide Kaurna Cultural Heritage Trail the Aboriginal Advisory Panel was given stewardship of the trail by Tauondi College. There are several signs in Mangrove Park and more signs on the opposite side of the Port River, adjacent Harbourside Quay river path – all part of same trail. ▪ The Port Adelaide Kaurna Cultural Heritage Trail took several years to develop with Tauondi College, so the plaques should be preserved. ▪ VIC has brochures detailing self-guided walk along trail. Tauondi Cultural Agency still operates guided tours along trail on a seasonal monthly basis – brochures with details at VIC.
Other	Landscaping	▪ Recognise that Our Patch group and Portside Christian School are involved in current landscaping and maintenance of site. ▪ Fill area is considered suitable for re-landscaping, subject to concerns about disturbing fill. ▪ Information should be contained in management plan about what would be required to maintain landscaping. ▪ Form of landscaping and species be kept in context with the natural environment of mangroves/salt marshes. Also needs to provide views for new redevelopment. ▪ Anticipated that the fill area can accommodate the functions listed for recreation above. ▪ The revetment wall where Rennie Road abuts the reserve should be detailed. ▪ Any landscaping should take into account Crime Prevention principals. ▪ Suggestion is to plant some of the Indigenous grasses used by the Kaurna people for weaving. Weaving is mentioned on the Port Adelaide Kaurna Cultural Heritage sign overlooking the mangroves. These could then be harvested by local weavers – Local artist Sandy Elverd knows the species.
	Car parking	▪ Car parking may be considered as suitable on site subject if there are suitable arrangements with current vegetation and proposed landscaping of site, and it does not interfere with Biodiversity of site.
	Legal Considerations	▪ It is noted from Clause 9.2.4 of the Port Waterfront Redevelopment Project Commitment Agreement that LMC will procure the tenure of Mangrove Park from DEH, and following this the land will be transferred to the Developer. The Developer will then procure the deposit of a plan of division which identifies the Mangrove Park as a dedicated Public Reserve to be vested in Council pursuant to the Local Government Act 1999 (SA). Accordingly it is imperative that all parties (DEH, LMC, Newport Quays and Council) agree to the details of the Management Plan. In particular it is important that agreement is reached between all of the parties regarding responsibility for any works to be done prior to the vesting of the land to Council, and that Council is also satisfied with any ongoing management responsibilities for the site.

Details of consultants

Peri Coleman (M AppSc - Environmental Management and Restoration) has extensive experience in identifying marine and terrestrial flora and fauna of the mainland states and Tasmania, conducting biological surveys, and producing reports and educational materials. Her main interests include biological survey work, revegetation and rehabilitation, scientific illustration and desktop publishing, preparation of herbarium and museum specimens, management plans, taxonomy and classification, solar salt field biology, environmental education programs, computer application development, wetland studies and mangrove and samphire ecosystems.

Peri owns, and is senior consultant for, Delta Environmental Consulting. She is a member of the South Australian Coast Protection Board, Barker Inlet Port Estuary Committee and chair of the Northern Adelaide & Barossa Regional Steering Committee of Waterwatch. Peri has a strong commitment to research, with several recent papers accepted for international publication. She is a fellow of the Royal Society of South Australia and member of the International Society for Salt Lake Research.

Renae Eden provides technical and consulting services. She has a background in biodiversity conservation and communication. She is currently undertaking additional studies in environmental management as well as conducting research on samphire habitats.

For further information on any Delta Environmental Consulting staff member, or information on the projects the company has been involved with, please visit our web site at http://www.deltaenvironmental.com.au