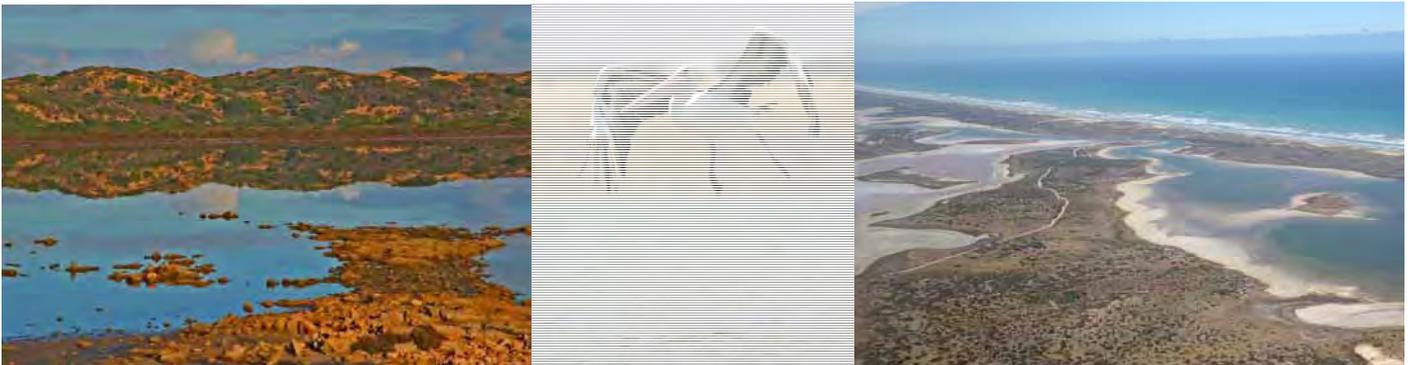


Coorong South Lagoon Salinity Reduction Strategy: Pumping Scheme



**Environment Protection and Biodiversity
Conservation Act 1999- Referral**

Document Control

Version	Date	Comment	Action Officer
V.34	19/04/09	Final edits	Glynn Ricketts
V.35	to 28/5/10	Final review	Tiana Nairn

Contents

1. Summary of proposed action.....	5
1.1 Short Description.....	5
1.2 Latitude and Longitude.....	5
1.3 Locality.....	5
1.4 Size of the Development Footprint or Work Area.....	6
1.5 Street Address of the Site.....	6
1.6 Lot Description.....	6
1.7 Local Description Area and Council Contact.....	6
1.8 Timeframe.....	6
1.9 Alternatives.....	6
1.10 State Assessment.....	7
1.11 Component of Larger Action.....	7
1.12 Related Actions or Proposals.....	7
1.13 Australian Government Funding.....	7
2. Detailed description of proposed action.....	8
2.1 Description of proposed action.....	8
2.1.1 Impetus for the Proposed Action.....	8
2.1.2 Objectives of the Proposed Action.....	8
2.1.3 Elements of the Proposed Action.....	9
2.2 Alternative Locations, Time Frames or Activities that form part of the Referred Action.....	11
2.2.1 Do Nothing Scenario.....	11
2.2.2 Pumping and/or excavation scenarios.....	11
2.2.3 Fresh Water Inputs from the River Murray.....	14
2.2.4 Fresh Water Inputs from Redirection of Water from the South East Drainage Network.....	14
2.2.5 Pumping Seawater in and Hypersaline Water out.....	14
2.2.6 A Proposal to use the Difference in Water Level between the Coorong and Sea.....	14
2.2.7 Alternative Project Locations.....	15
2.2.8 Alternative Decommissioning Scenarios.....	15
2.3 Context, Planning Framework and State/local Government Requirements.....	15
2.4 Environmental Impact Assessments under Commonwealth, State or Territory Legislation.....	18
2.5 Consultation with Indigenous Stakeholders.....	18
2.6 A Staged Development or Component of a Larger Project.....	18
3. Matters of National Environmental Significance.....	19
3.1 World Heritage Properties.....	19
3.2 National Heritage Places.....	19
3.3 Nuclear Actions.....	19
3.4 Wetlands of International Importance (Declared Ramsar Wetlands).....	19
3.4.1 Coorong and Lakes Alexandrina and Albert Ramsar site.....	20
3.4.2 Species that Contribute to the Ramsar Status of the site.....	21
3.5 EPBC-listed Species and Ecological Communities.....	29
3.5.1 EPBC-listed Threatened Species.....	29
3.5.2 EPBC-listed Migratory Species.....	31
3.5.3 Likelihood of Occurrence of EPBC-listed Plant Species.....	33
3.5.4 Likelihood of Occurrence of Faunal EPBC-listed Threatened and Migratory Species.....	37
3.5.5 Threatened Ecological Communities.....	57
3.6 Commonwealth Areas.....	58
4. Nature and Extent of Likely Impacts.....	59
4.1 World Heritage Properties.....	59
4.2 National Heritage Places.....	59
4.3 Species that Contribute to the Ramsar Status of the Site.....	59
4.3.1 Plant Species.....	60
4.3.2 Amphibian Species.....	61
4.3.3 Fish Species.....	61
4.3.4 Bird Species.....	64
4.4 EPBC-listed Threatened Species.....	75

4.5 EPBC-listed Migratory Species	87
4.6 EPBC-listed Threatened Ecological Communities	93
4.7 Commonwealth Marine Area.....	94
5. Other Important Features of the Environment.....	95
5.1 Soil and Vegetation Characteristics	95
5.2 Water Flows, including Rivers, Creeks and Impoundments.....	96
5.3 Outstanding Natural Features, including Caves.....	99
5.4 Gradient (or depth range if action to be taken in a marine area)	99
5.5 Buildings or other Infrastructure	99
5.6 Marine Areas.....	99
5.7 Kinds of Fauna and Flora.....	99
5.8 Current State of the Environment in the Area	100
5.9 Other Important or Unique Values of the Environment	100
5.10 Tenure of the Project Area.....	101
5.11 Existing Land/Marine Uses of Project Area.....	101
5.12 Any Proposed Land/Marine Uses of Project Area.....	101
6. Measures to Avoid or Reduce Impacts on Matters of NES	102
7. Environmental Management Plan and Monitoring	104
7.1 Environmental Management Plan	104
7.2 Environmental Monitoring Plan	104
8. Conclusion on the Likelihood of Significant Impacts	106
9. Environmental History of the Responsible Party	107
10. Information Sources and Attachments	108
10.1 References.....	108
10.2 Reliability and Date of Information	111
11 Attachments.....	111
12. Contacts, Signatures and Declarations	113
12.1 Person Proposing to take Action.....	113

1. Summary of proposed action

1.1 Short Description

Urgent, Critical Management Action

Hypersalinity in the Coorong's South Lagoon is resulting in the severe, continuing degradation of critical habitat for nationally listed bird species. Salinity is the current critically limiting factor for Coorong health and the status of the described RAMSAR ecological character. The ecosystem of the South Lagoon is now considered to be close to irretrievable collapse.

This project comprises an urgent and important response aimed at mitigating the extensive adverse impacts of current hypersalinity. The proposal, the South Lagoon Pumping Scheme (SLPS), involves the pumping of hypersaline water from the Coorong's South Lagoon into the marine waters of the Southern Ocean for the purposes of reducing the salinity of the South Lagoon to target levels, thereby supporting the restoration of ecological function and system health in the Coorong. The proposed works associated with the proposal comprise:

- 1) Construction of a pipeline from the South Lagoon across the Youngusband Peninsula (Coorong National Park) to the Southern Ocean;
- 2) Pumping in the order of 250GL of hypersaline water from the South Lagoon to the Southern Ocean (with an optimal rate of 250ML/day), over approximately three years. There is to be a nominal five year ultimate project life depending in order to reach target salinity levels in the Lagoon, depending upon conditions.
- 3) Monitoring of salinity levels and water quality at key locations in the Coorong Lagoons and around the Southern Ocean outfall, with associated adaptive management of the pumping regime; and
- 4) Decommissioning of the pumping infrastructure after reaching target salinity levels and securing a more abundant and diverse ecological functioning system.

1.2 Latitude and Longitude

Table 1 Latitude and Longitude of the project area.

The works shall be allocated within the area bounded by the following coordinates as shown in Appendix A, Figure A: NE Corner E372221 / N6012848 NW Corner E366823 / N6009853 SW Corner E373027 / N5998360 SE Corner E378509 / N6001366
The actual route will be informed via Early Contractor Involvement during a detailed design, build and operate procurement process, which is running in parallel to State and Federal approval processes.

1.3 Locality

The locality for these management actions is within the Coorong National Park, 5 – 10 km NW of Salt Creek and 50 - 60 km SE of Meningie. For maps of the project area see Appendix A. The exact location of the pipeline, pumps, beach outfall and generators is still to be determined, during detailed design. The exact location will ultimately be decided on a range of factors including;

- depth of water within the Coorong;
- pumping length;
- height/width of dunes;
- native vegetation
- cultural heritage considerations and approvals and
- community considerations in relation to noise, traffic, dust and visual impact

1.4 Size of the Development Footprint or Work Area

The exact location of the plant and equipment will be determined during the detailed design phase of project implementation. An area within which works may potentially occur (comprising the effective pumping zone) has been identified and all impacts in this area assessed. The total footprint of the work area is <4.5ha of construction work and comprises the following project components:

- 1) Generator and fuel storage (<400 m²).
- 2) Electrical cable to pump (up to 1.5 km long, on lagoon floor or suspended on floats).
- 3) Pump (on an anchored barge or sunken container ; final location and design to be determined based on engineering and bathymetry requirements) in the Coorong South Lagoon (12 m x 8 m, ca. 100 m² . A temporary excavated channel or causeway may be required to obtain necessary draught for laden barge, causeway 5 metres wide by estimated 300metres long).
- 4) Possible widening of existing access track for construction traffic for the pipeline and Southern Ocean outfall: track widened to 10 m from Princes Highway to crossing, then to Southern Ocean beach (distance ca. 5 km, 2 ha). Main highway may require upgrade to enable safe access/egress
- 5) Pipelines (approx. 2 pipelines, 2 km long, crossing ca. 0.7 – 1.5 km of coastal dunes; corridor width 12 m - 20 m (total 0.8 to 2 ha) includes access track along pipeline.

1.5 Street Address of the Site

Not Applicable.

1.6 Lot Description

Coorong National Park, Coorong District Council.

1.7 Local Description Area and Council Contact

Coorong District Council
Local Planning Officer (Derek Henderson)
PO Box 28
Meningie
SA 5264

The Coorong District Council is not a relevant planning authority for this project; however they remain important stakeholders in the project. DEH have regularly kept the Planning Officer up to date with this project.

1.8 Timeframe

The following timeframes are proposed for:

- 1) Construction of a pipeline from the South Lagoon of the Coorong to the Southern Ocean, and supporting infrastructure: 8 –12 weeks. Likely to commence September 2010
- 2) Pumping of hypersaline water from the South Lagoon of the Coorong to the Southern Ocean: approximately three years, depending upon pumping rate and rate of decrease of South Lagoon salinity levels. Likely to commence from January 2011
- 3) Decommissioning of pumping infrastructure: 6 – 8 weeks. Timeline to be established during the adaptive management of the pumping operation. Total project life will be up to 5 years from the start of pumping.

1.9 Alternatives

Alternatives for this project are described in Section 2.2.

1.10 State Assessment

A number of state approvals and assessments will be required for this project to proceed. These approvals and assessments are listed and discussed in more detail in Section 2.3.

1.11 Component of Larger Action

The SLPS comprises the core element of the South Lagoon Salinity Reduction Strategy and exists as a “stand alone” project. The other elements that could contribute to the achievement of this Strategy are described in Section 2.6.

1.12 Related Actions or Proposals

The South Lagoon Salinity Reduction Strategy is a component of the Long Term Plan for the Coorong, Lower Lakes and Murray Mouth (CLLMM) region. The Long Term Plan “Shaping the future of the Coorong and Lower Lakes” has been developed by SA Department for Environment and Heritage (DEH) across 2009 and early 2010 with extensive community consultation. It is currently being finalised and the latest updates can be found at <http://www.environment.sa.gov.au/cllmm/the-long-term-plan.html>.

The following referrals for related management actions in the CLLMM region have been submitted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- EPBC 2007/3484 South Australian Government Department of Environment and Heritage / Water management and use / Lake Alexandrina / SA / Proposed temporary weir at Pomanda Island near Wellington.
- EPBC 2008/4618 South Australian Department for Environment and Heritage / Natural resources management / Lake Alexandrina and the Coorong / SA / Opening the barrage network separating the lakes.
- EPBC 2009/4743 SA Water Corporation / Water management and use / NW of Lake Alexandrina from Jervois to Currency Creek / SA / Lower Lakes Irrigation Pipeline, lower Murray Darling Basin.
- EPBC 2009/4833 South Australian Department for Environment and Heritage / Water management and use / Goolwa Channel, Finniss River & Currency Creek / SA / Emergency Response for the Crisis Management of Acid Sulphate Soils (ASS).
- EPBC 2009/5227 South Australian Department for Environment and Heritage / Water management and use / Goolwa Channel/SA / Goolwa Channel Water Level Management Project

These referred management actions and the current proposal are related in that they seek to restore ecological functions and provide water security for the CLLMM region.

1.13 Australian Government Funding

The business case for the implementation of the Long Term Plan for the CLLMM region is being finalised in parallel with the preparation of this referral document. The Long Term Plan “Shaping the future of the Coorong and Lower Lakes” is available at <http://www.environment.sa.gov.au/cllmm/the-long-term-plan.html>.

Funding has now been made available by the Australian Government for progression and implementation of this project as part of the early works component of the Long Term Plan.

2. Detailed description of proposed action

2.1 Description of proposed action

2.1.1 Impetus for the Proposed Action

The South Lagoon forms an important component of the Coorong, a Ramsar-listed wetland of international importance.

The South Lagoon has a build-up of excessive salinity levels as a result of low or no fresh water inputs to the Coorong from the Murray, over the barrages, for a number of years. This follows a longer period of slow decline in environmental conditions and ecological character of the Coorong.

The area is now a severely degraded environment in terms of ecological function and has suffered drastic changes in the ecology at the site. The primary issues are very high and increasing salinity and limited or no fresh water inputs over an extended period, with impacts of high salinity increasing.

The South Lagoon is now 5-6 times more saline than seawater (Lester et al. 2009). Historically it has only been 2-3 times more saline than seawater (eg in Geddes and Hall 1990).

The diversity of fauna and flora in this lagoon has decreased dramatically in recent years as the vast majority of biota that previously inhabited the region is no longer able to survive the extremely saline conditions. The ecosystem of the South Lagoon is now considered to be close to irretrievable collapse. For example,

- the keystone plant species *Ruppia tuberosa* is now missing from the lagoon due to salinity and water levels,
- chironomids (midges) and small-mouthed hardyhead fish (*Atherinosoma microstoma*) are also gone,
- there have been substantial decreases (30-99.9%) in the populations of 23 out of 27 of the most common species of Coorong waterbirds (Paton et al. 2009b), and
- threatened species (eg fairy tern) are also in decline, largely due to reduced breeding opportunities in the South Lagoon.

Descriptions of this decline are given in the Ecological Character Description for the Ramsar site (Phillips and Muller 2006), in Brookes et al (2009a), in Paton et al (2009a; 2009b see Appendix B) and in a recent paper by Brookes et al (submitted 2009b).

Ruppia tuberosa grows well in water at concentrations around 60-100ppt and chironomids and hardyheads can tolerate salinity of up to 120ppt. These species are all food sources or provide habitat structure for birds, including species listed under international migratory bird agreements. Compared to historic levels of less than 100ppt, salinity in the South Lagoon was around 180ppt in summer 2009 and reached over 200ppt in 2007. Salinity continues to fluctuate seasonally and annually and is currently around 170ppt.

If there are no freshwater flows from the River Murray over the barrages, or even under low flow regimes (304-579GL/yr), the situation in the South Lagoon will remain unsuitable for the recovery of keystone species in the absence of intervention (CLLAMM ecology 2008). Without action, the ecological values of the South Lagoon and the surrounding areas will continue to degrade, placing the character of this Ramsar-listed wetland further at risk.

2.1.2 Objectives of the Proposed Action

The objective of the proposal is to achieve biodiversity conservation through critical habitat restoration for a number of EPBC-listed bird species, including listed migratory bird species protected under international agreements, and restoration of the ecological character of the Ramsar listed wetland of the Coorong South Lagoon. The SLPS will significantly reduce the salt concentration within the south lagoon, preparing the site for future freshwater flows, through:

- pumping of hypersaline water from the South Lagoon across the Youngusband Peninsula to the Southern Ocean, and
- natural flow of less saline water from the Coorong's North Lagoon to the South Lagoon, resulting in reduced salt concentrations in the South Lagoon via dilution. Additional dilution will occur from freshwater flows from the Upper South East drainage network, groundwater contributions and direct rainfall.

The SLPS is an important, urgent management action and it is expected that the project will:

- restore approximately 12,000 hectares (winter) / 8,000 hectares (summer) of aquatic habitat in the South Lagoon of the Coorong and benefit additional areas of fringing vegetation and terrestrial vegetation, which are currently being impacted by having roots in excessively saline groundwater (whilst having a construction footprint of <4.5ha).
- benefit many species (including the IUCN red-listed Fairy Tern) that contribute to the Ramsar status of the project area in the Coorong under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act) whilst having no significant negative impacts on any threatened species or species contributing to the Ramsar status of the project area or threatened species.

2.1.3 Elements of the Proposed Action

The Figures in Appendix A give locality maps, photos and diagrams for the proposal.

Construction Phase for the Pipeline and Associated Infrastructure

The likely scenario for installation of infrastructure, based on existing vehicle access tracks, is as follows:

- 1) Preparation for access to the pumping and pipeline site, which may involve:
 - Potential widening of the existing public access track from the Princess Highway to any site compound, for construction traffic, and during operations fuel and maintenance.
 - Access to the beach for construction traffic has been given careful consideration in order to reduce impacts on Hooded Plover in particular. The proposed solution involves barging of plant and equipment across the Lagoon opposite the selected route of the discharge pipes. In order to provide constant access for plant and equipment if this option is adopted, a temporary causeway, pontoon or channel out into deeper water may be required to provide enough draft for a fully loaded barge during low summer time water levels.
- 2) Generators (enclosed in acoustic housings) and fuel storage (in accordance with EPA requirements) on the eastern side of the South Lagoon (ie off Princes Highway side).
- 3) Electric cable from the generators to pumps located in the South Lagoon.
- 4) Submerged Pumps or pumps (enclosed in acoustic housings) on the barge platform.
- 5) Pipeline from the submerged pumps or barge platform and across Younghusband Peninsula to the beach. The pipeline is likely to consist of two x 1000mm diameter HDPE pipes.
- 6) Ocean outfall discharging into the surf zone of the Southern Ocean.

Figure 1 shows a schematic diagram of the proposed works. The exact siting of works will depend on final investigation of the best location in terms of:

- The optimal path for the pipeline across the Younghusband Peninsula taking into account Aboriginal heritage matters, vegetation, engineering requirements, noise mitigation, road access, visual amenity, width of Peninsula, sand dune height and the length of pipeline required); and
- The siting of the pump and pipeline in relation to the depth of the South Lagoon.

At this stage the designs are concept and will be subject to further refinement during the detailed design phase of the procurement stage. The design team will propose a low impact solution balanced with acceptable water transfer efficiency. It is considered that none of the possible engineering solutions within the potential development envelope (effective pumping zone) are more or less likely to have any significant adverse impacts on matter of National Environmental Significance in comparison to one another, due to the severely degraded condition of the Coorong and given that the fundamental purpose of the project is for ecological restoration.

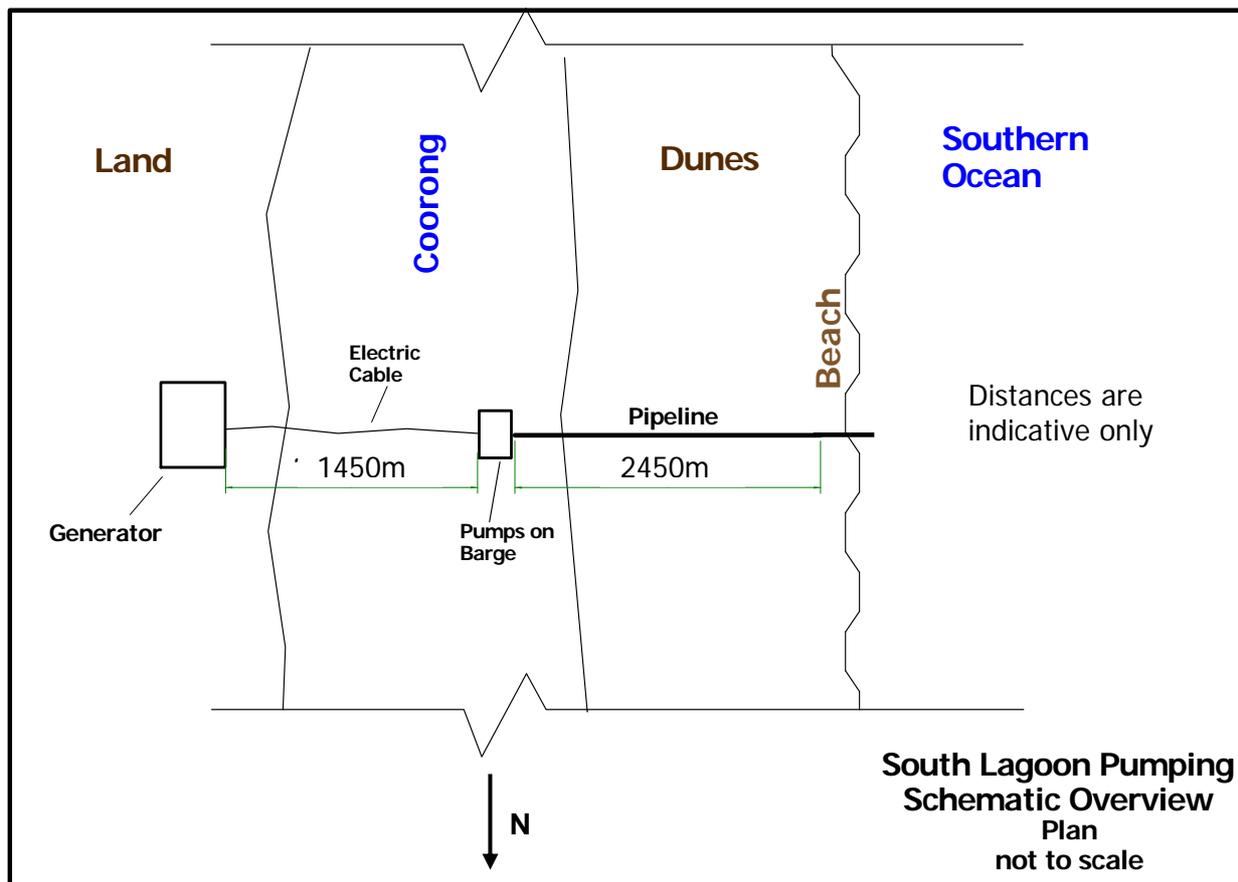


Figure 1: South Lagoon Pumping Schematic Overview (SA DWLBC).

Two alternative designs for ocean beach outfalls were considered. These were (1) at the top of the beach and (2) in the surf zone. It has been determined that the preferred option is the top of beach with traffic management. This conclusion was reached after considering minimal impacts, modelled scenarios, engineering aspects such as durability and physical impact at the outfall (see report from Aurecon; Appendix D, following initial consideration by Tonkin Consulting (2009)). The current (May 2010) design process will ultimately define final solution.

Operational Phase

The operational phase will involve:

- 1) The pumping of hypersaline water from the South Lagoon to the Southern Ocean. Several pumping locations and rates have been assessed, with an optimal pumping rate of 250ML/day being selected, after consideration of benefits to the Coorong and possible impacts to the Ocean.¹ It is anticipated that in the order of 250 GL shall be pumped over the life of the project to meet the salinity outcome targets.

Early modelled scenarios (Lester et al., 2009 Appendix E2; Aurecon 2009a, Appendix D) assessed varying pumping rates of 150 ML to 450 ML per day (approximately 54 GL to 160 GL per year). Further scenarios were then modelled using both 1D and 2D models using a pumping volume of 250ML. On review it was decided that this rate provided the optimum solution.

The final actual volume of water to be transferred will depend on a number of future factors including (a) commencement date against salinity concentrations, (b) potential inward flows, (c) seasonal conditions and evaporation regimes, (d) progress against salinity targets and (e) the adaptive management of the pumping regime as determined by ongoing monitoring and modelling inputs.

¹ Attachment C: Aurecon (2010) *Preliminary Hydrodynamic modelling for Coorong temporary saline discharge*. Prepared for: SA Murray Darling Basin NRM Board, and Lester R, Webster I, Fairweather P, Langley R (2009) *Predicting the ecosystem response of the Coorong to the South Lagoon Salinity Reduction Scheme*, Flinders University, report for the SA MDB NRM Board.

- 2) Monitoring of the environment, including salinity, water level and water quality in the South Lagoon and around the ocean outfall, and biological / ecological parameters (see Section 4).

There will be adaptive management of the pumping regime using data from the monitoring program to influence timing, duration and rate of pumping. Pumping will be able to be managed to address any seasonal influences or specific impacts or opportunities.

The length of the operational component of the project is anticipated to be three years, however, depending on the adaptive management pumping regime this may extend to approximately 5 years or may be accelerated if favourable conditions are met. Under the modelled scenarios, target salinity levels in the South Lagoon should be achieved in this timeframe, subject to variations caused by potential inflows, seasonal conditions and salinity variations.

Decommissioning Phase

Decommissioning of the pumping infrastructure will commence progressively after the South Lagoon salinity targets are met and strategically reviewed. Various hold points are planned for strategic review of progress against targets.

2.2 Alternative Locations, Time Frames or Activities that form part of the Referred Action

Action to reduce hypersalinity levels in the Coorong South Lagoon is considered urgent and important. It needs to be undertaken in the short term to be effective in allowing habitat restoration before irreversible ecosystem changes have occurred. Alternative solutions to the hypersalinity problem and alternative locations for the project are considered below.

2.2.1 Do Nothing Scenario

Under a 'Do Nothing' scenario, seawater would continue to be allowed to enter through the Murray Mouth, with no significant entry of freshwater into the system in the short term. This has been the case for the past 6 years. With continued seawater entry and no mechanism for salt removal and evaporation from the South Lagoon, salt concentrations will continue to remain extremely high (CLLAMMecology 2008; Appendix E1). As a consequence, very high salinity levels are likely to continue, producing associated unhealthy hyper marine ecological conditions (Lester et al., 2009; Appendix E2).

The salinity of the Coorong South Lagoon in summer has been around 100 ppt (around 3 times that of seawater) in the past, but this has risen to 180 ppt over the past 6 years (5 - 6 times that of seawater) and was even more than 200 ppt in 2007. Twenty-year hydrological scenario modelling of a continuation of drought conditions and no freshwater inflows (CLLAMMecology 2008; Appendix E1) shows that the salt concentrations in the South Lagoon would continue to fluctuate between 120 – 140 ppt (winter) and 170 - 220 ppt (summer). These conditions would result in a continuation of the current status of the ecology of the South Lagoon, i.e. a degraded unhealthy hyper marine ecosystem.

The diversity of fauna and flora in the South Lagoon has decreased dramatically in recent years due to the extremely saline conditions as discussed in section 2.1.1. The ecosystem of the South Lagoon is now considered to be close to irretrievable collapse. Hence, the "Do Nothing" scenario is considered unacceptable.

2.2.2 Pumping and/or excavation scenarios

Lester et al. (2009; Appendix E2) initially considered 86 alternatives to the 'Do Nothing' scenario. The components considered as potential management actions included (a) pumping water (various volumes) out of the South Lagoon, (b) excavating parts of the Parnka channel which connects the North and South Lagoons to allow more rapid exchange of water between North and South Lagoons, (c) increased dredging of the Murray Mouth and (d) constructing a regulator across the Parnka channel connecting the North and South Lagoons to allow maintenance of ecologically desirable water levels in the South Lagoon.

The effects of individual components and of various combinations on salinity and water level in the South Lagoon were modelled. Based on the study by Lester et al. (2009; Appendix E2) the best options for management of the South Lagoon compared to a 'Do Nothing' option was (a) pumping water out of the South Lagoon and (b) excavating parts of the Parnka Channel. Twenty scenarios were then investigated in further detail. These included (a) pumping at different rates, (b) excavation to different levels in the Parnka Channel, and (c) the effect of delaying the works.

Of the alternative individual actions modelled by Lester et al. (2009; Appendix E2), the most beneficial in terms of reducing South Lagoon salinity was the pumping of hypersaline water to the Southern Ocean. Modelling of pumping scenarios considered different pumping rates from 150 ML per day through to 450 ML per day, with each potentially achieving the desired outcome but with differences in project duration.

The most beneficial effect of a combination of potential management actions was initially assessed as being from (a) pumping together with (b) Parnka Channel excavation works to a depth of -0.8 m (Lester et al, 2009, Figure 4.1; see Appendix E2).

More recent modelling, building on the initial assessment and informed by new bathymetry data, updated salinity levels and a revised, later start date, indicated that the benefits of excavating sections of the Parnka Channel would not be as great as initially modelled, for the pumping phase. In this modelling, BMT WBM Pty Ltd (2009; Appendix F) tested 6 scenarios against the base case of doing nothing:

- 1) Base case - do nothing option;
- 2) Dredging a deeper and wider channel through Hells Gate [= Parnka Channel];
- 3) Pumping 150 ML/day 1/1/2008 – 31/12/2010;
- 4) Pumping 150 ML/day (Winter) 1/6/2008 – 31/12/2010;
- 5) Combined Dredging at Hells Gate [= Parnka Channel];
- 6) Pumping 150 ML/day 1/1/2008 – 31/12/2010; and
- 7) Pumping 250 ML/day 1/1/2008 – 31/12/2010.

This modelling included the following features:

- Generate initial conditions based EC spatial survey data from the 16th December 2009;
- Run base case model for 6 years (1/1/2010 – 1/1/2016) using new initial conditions;
- Then run the 250 ML/day pumping and the 250 ML/day pumping with dredged (~50m) channel models;
- Revise the dredged mesh to 100m width and re-run the dredge scenario;
- Re-run the pumping run with the low UPSE flows (15GL in 2013-2016 instead of 60GL).

Time-series showing predicted salinity in the Southern Lagoon at Policeman’s Point is shown in Figure 2.

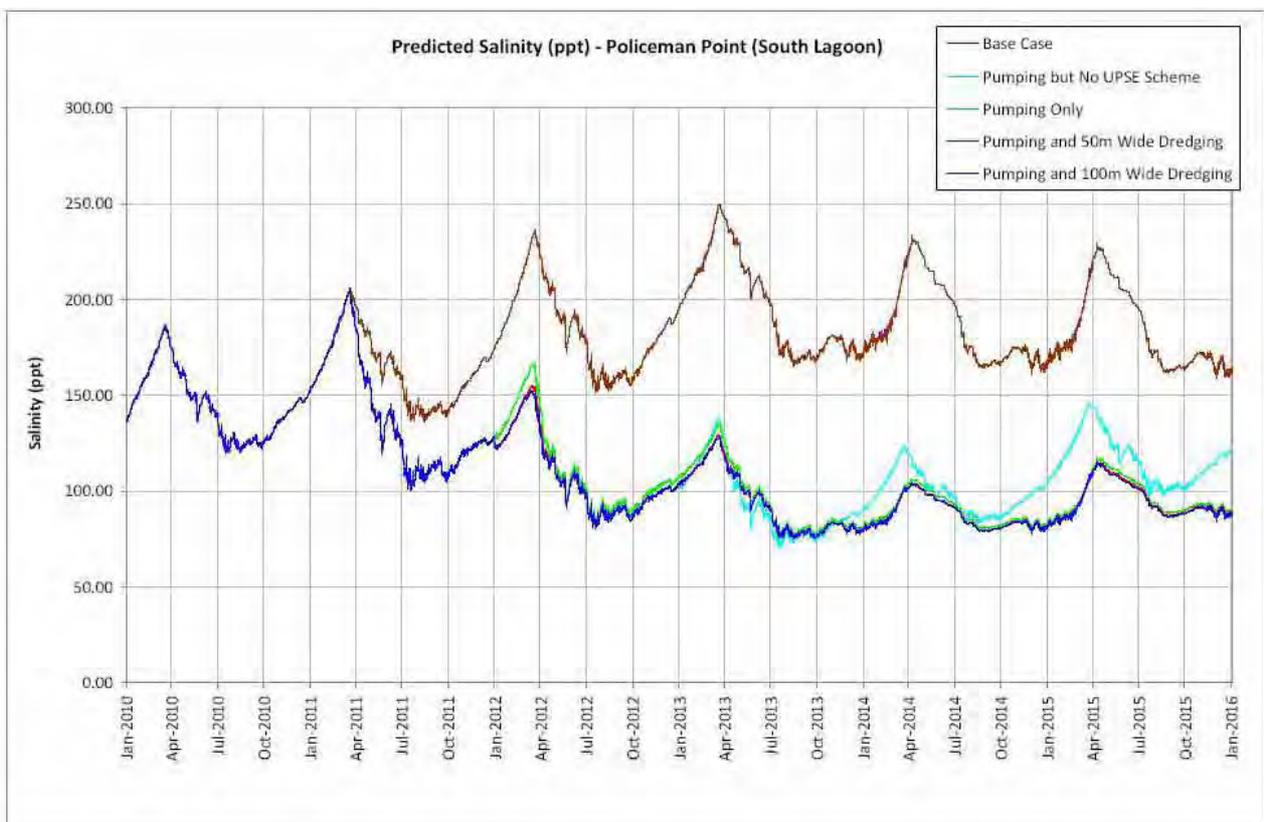


Figure 2. Simulated Salinities at Policeman’s Point (South Lagoon) for “Future” Scenarios

Modelling demonstrates there will always be a salinity gradient along the Coorong Lagoons, with increasing salinity in the SE direction away from the Murray Mouth. It is possible that there will also be an interaction with freshwater flows from the Upper South East Drainage (USED) scheme if further redirection of Upper South East (UPSE) flows are carried out.

Figure 2 clearly shows the beneficial impact of pumping on salinity within the South Lagoon, with peak summer salinity reducing from 200 ppt to ~ 150 ppt at Policeman's Point within a year. By the end of the three year pumping program peak summer salinity is expected to be ~ 100 ppt (April 2014). If pumping is not used, peak summer salinity within the southern Lagoon at Policeman's Point could reach 250 ppt by April 2013.

The results show that dredging either a 50m or 100m wide channel to a minimum bed level of -0.8m AHD, between the north and south lagoon has minimal impact on salinity within the Southern Lagoon. Investigations are continuing to determine if these works do provide a longer term benefit once salinities have been "re-set" to target levels.

If 60 GL/year of inflow from the UPSE occurs a year later (after cessation of pumping) peak summer salinity is expected to be ~ 115 ppt (April 2015). However, if the UPSE scheme connection does not occur and UPSE inflow is only 15 GL/year peak summer salinity is expected to be ~ 145 ppt (April 2015).

Taking these outcomes into account, a pumping rate of 250 ML per day was chosen for the proposed action. Redirection of UPSE flows is under consideration as a medium term option (see section 2.2.4 below).

The importance of timing

According to Lester et al (2009), "delaying either pumping or works at the Parnka channel [by 6-9 months] did affect the amount of time until the system began to recover, with delays in recovery in the order of a year". An additional comment to this was that while the delay in recovery of conditions might seem minor on the face of it, intervention as quickly as possible was recommended owing to the degraded state of the system and doubts about its continued ability to recover.

The ability to recover will depend on the ecosystem being able to maintain resilience during the degradation that is currently occurring. Part of this resilience lies in the continued survival of remnant populations of keystone species such as *Ruppia tuberosa* (for example, in the North Lagoon). However, increases in salinity in the North Lagoon that are occurring as a result of salinisation of the South lagoon have the potential to threaten the sources of organisms for the recolonisation of the South Lagoon. The longer the delay in habitat restoration, the less certainty there is that the ecosystem can recover. Recent studies on macro invertebrates support these statements (Ditman et al 2010, in press).

In the medium term (3 to 5 years), it is possible that freshwater flows, either from the River Murray over the barrages and/or from modifications to the South East Drainage Schemes will influence salinity concentrations (see Section 2.2.3 and Section 2.2.4). However, given current predicted short term future inputs, these freshwater flows will not be able to deliver the required salinity reduction in the South Lagoon within the timeframe required to enable ecological recovery.

None of the interventions considered in the Lester et al (2009) study were "a replacement for a return to barrage flows" (freshwater entry) in terms of ability to restore and then maintain the health of the Coorong South Lagoon.

After consideration of all the possible practical options for current circumstances, pumping hypersaline water from the South lagoon to the Southern Ocean is considered to be the best short term option to achieve salt concentrations to a level where keystone species will be able to recolonise the South Lagoon. The SA Government considers that none of the interventions planned for the restoration of the Coorong are a substitute for future barrage flows.

The hydrological relationship between the North and South Lagoons and potential impact of the project on the North Lagoon are discussed further in Section 9.4.5.

2.2.3 Fresh Water Inputs from the River Murray

Fresh water input from the River Murray across the barrages is the best long-term solution to the problem of salinity reduction in the Coorong South Lagoon. However, this option relies on sufficient rainfall occurring in the Murray Darling Basin (MDB), followed by water allocation and/or water purchase for the CLLMM region.

Freshwater input from the River Murray is only likely to sufficiently reduce salinity levels in the Coorong South Lagoon if flow rates of over 1000 GL per annum can be maintained for 7 to 8 years (CLLAMMecology 2008; Appendix E1). CLLMM Projects has also assessed that these flows are not sufficient as an environmental water requirement for the Coorong in the longer term and that additional flow of thousands of gigalitres over the barrages are required to achieve a “Healthy Hypersaline” ecosystem state for the South Lagoon (Ecosystem states for the Coorong are discussed in Lester and Fairweather 2009). Achievement of the required inputs is not considered to be a realistic, viable and affordable option in the short-term given the current circumstances applying in the River Murray system.

The proposed SLPS will urgently address ecological decline in the Coorong by reducing salinity levels and complements other medium- to long-term management actions. As increased environmental flows from the Murray-Darling Basin are delivered or, in the medium term, water is diverted into the Coorong from the South East Drainage network (Section 2.2.4), then the possibility of returning to higher states of ecological health is further improved.

2.2.4 Fresh Water Inputs from Redirection of Water from the South East Drainage Network.

Redirection of water from the South East Drainage Network could assist the maintenance of lower salinity levels in the Coorong South Lagoon in the future – depending upon the alignment for any route, the redirection of water can supply a median of 40 GL per year (average 60 GL per year). However, this is a medium term option (3 – 6 years) only and it could not significantly reduce South Lagoon salinity from current levels in the short term without additional intervention. Restoring flows from the South East is seen as a complementary action to pumping that could help maintain appropriate salinity in the Coorong South Lagoon in the long term once salinity has been reduced by pumping. Investigations are continuing into this flow restoration option.

2.2.5 Pumping Seawater in and Hypersaline Water out

A cost benefit analysis (SA MDB NRM Board) of pumping seawater in and hypersaline water out along the same corridor across Younghusband Peninsula showed that this option is not cost effective. In summary, access, engineering and power supply issues, sand blocking the pipe, marine biofilming and high maintenance costs resulted in high pumping costs per ML.

2.2.6 A Proposal to use the Difference in Water Level between the Coorong and Sea

A proposal to use the difference in water level between the Coorong and the sea to drive a piped water discharge from the Coorong into the sea has been considered. This proposal was evaluated in the early 1980s and found not to be viable; however the option has been revisited recently.

The investigations assessed the potential benefit of a pipe connecting the South Lagoon with Encounter Bay (the Ocean) which would flush salt naturally; that is, flows through it would occur as a consequence of the water level difference between the ends of the pipe. Water level differences between the South Lagoon and Encounter Bay vary due to wind, evaporation in the South Lagoon, the tides and other longer term sea level variation in Encounter Bay. These conditions would cause back and forth water exchanges through the pipe depending on whether water level is higher in the Coorong or in the sea (Figure 3).

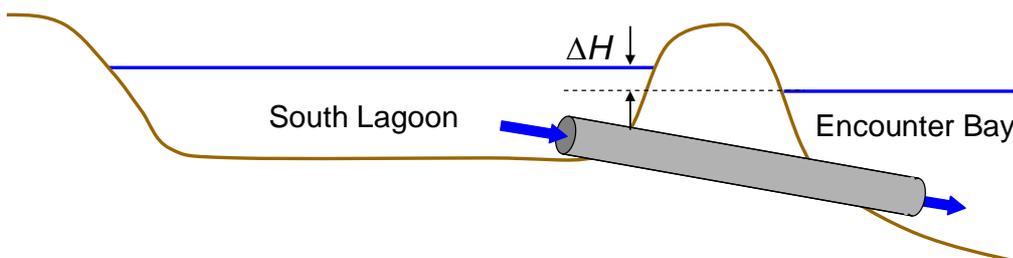


Figure 3. Schematic cross section of the South Lagoon showing a pipe connection to the sea.

Further investigation of this scenario has been undertaken (I.T. Webster et al., CSIRO; Appendix E3) and showed that this method might be feasible but that there are also some serious doubts about whether target salinity levels can be reached owing to the potential problems with mixing the inflow from the ocean with water in the South Lagoon. The solution is also very expensive with a requirement to extend the pipe into a water depth of 15-20 metres in the Ocean to prevent sand blocking the pipe opening.

2.2.7 Alternative Project Locations

The SLPS pipeline and pumps are proposed to be between Fat Cattle Point and Snipe Island (refer to Appendix A). Alternative potential locations in the South Lagoon have also been considered for pumping (eg Parnka Point) but have been discounted, primarily due to lower efficiency in reducing salinity and associated cost considerations. The final choice of exact project location will require striking a balance between the engineering and logistical requirements (which are related to feasibility and cost), optimisation of the physical location for removal of water from the basins that make up the Coorong South Lagoon, residential impacts, native vegetation and Aboriginal cultural heritage. Irrespective of exact final location, the environmental associations and cultural heritage considerations are very similar along the relevant section of the Younghusband Peninsula. Authorisation has been given under the *Native Vegetation Act 1993 (SA)* for the clearance of native vegetation in this area. It is anticipated the pipeline route will be located within a 'corridor' of a few hundred metres, with the actual final route anticipated to produce a direct disturbance over the dunes of approximately 10-20 metres wide, subject to terrain constraints.

Various potential construction access routes (i.e. access in order to position construction and operational machinery) for the pipeline and ocean outfall have been considered taking into account existing vehicle access roads, with various options being discounted for impact or cost reasons. Ecological considerations have also been an important factor with some routes being discounted because of the potential impacts on listed species, eg the Hooded Plover. A final decision on the access route will require a thorough analysis and comparison of the feasibility and the cost of alternatives, but is based on utilising existing access track networks or utilising the proposed path of the pipeline infrastructure to minimise any additional disturbance.

2.2.8 Alternative Decommissioning Scenarios

Two alternative scenarios for the decommissioning of pumping infrastructure could be pursued.

Complete Removal of Infrastructure

Complete removal of infrastructure would require removal of the pipeline and ocean outfall, the pumps, generators and possibly the fuel storage facility. There could be possible short term disturbance to bird populations, including species which may have begun to recolonise the South Lagoon area. There would be disturbance to the regenerating vegetation in close proximity to the pipeline across Younghusband Peninsula. A re-vegetation plan is required for the project.

Partial Removal of Infrastructure

A likely partial removal scenario includes the removal of the pumps on the barge, and the barge, from the South Lagoon, as well as the pipes connecting the pumps to the pipeline and the electrical cable connecting the pumps to the generator. Generators would also be removed. The pipelines themselves would be sealed at each end and left in place for a period beyond initial project life until it was clear via the overall long-term progress of returned flows for the system that no additional pumping in the medium term would be required. There would be almost no impact on bird populations and vegetation under this scenario. If the pipeline were to be left in place this would enable further pumping of hypersaline water to be carried out in the future if required and agreed upon as a feasible and reasonable course of action to maintain habitat.

2.3 Context, Planning Framework and State/local Government Requirements

The SLPS forms an element of the Long Term Plan for the CLLMM region that is close to finalisation following extensive consultation. This plan will seek to combat negative impacts of low water flows to the Coorong and Lower Lakes below Lock 1 in the River Murray and will include actions to protect the water quality, to protect the local and regional environment from irreversible damage and to minimise adverse impacts on infrastructure and the regional community. As part of this, the SLPS will help the SA Government satisfy its targets under the South Australian Strategic Plan 2007 relating to tourism, investment in strategic infrastructure, regional population, and conservation of species.

The SLPS requires assessment under a range of South Australian statutes. A brief description of key legislation is set out below, with other legislation and policy of relevance presented in Appendix G.

The SA Government is obtaining relevant approvals and authorisations and will ensure that this process is completed prior to project implementation.

Aboriginal Heritage Act 1988 (SA)

The Ngarrindjeri People are the traditional owners, as defined in the *Aboriginal Heritage Act 1988*, of Aboriginal sites, objects and remains within the project area. The *Aboriginal Heritage Act 1988* provides for the protection and preservation of Aboriginal heritage. Section 23 of the Act states that a person must not, without the authority of the Minister, damage, disturb, interfere with or remove any Aboriginal site, object or remains. The project will be undertaken in accordance with this Act, with engagement being further guided by the Kungun Ngarrindjeri Yunnan Agreement (Listen to Ngarrindjeri People Talking): an agreement between the peak Ngarrindjeri bodies and the Government of South Australia, providing a framework for consultation and negotiation with the Ngarrindjeri Regional Authority concerning the management and planning of the Coorong, Lower Lakes and Murray Mouth.

Environment Protection Act 1993 (SA)

The *Environment Protection Act 1993* provides for the protection of the environment, and its objects include coordinating action to minimise or avoid environmental harm and ensure effective environmental protection, restoration or enhancement. The Act creates a general environmental duty (s25) which provides that a person must not undertake an activity that pollutes or might pollute the environment, unless taking all reasonable and practical measures to prevent or minimise any resultant harm. Several significant offences exist for causing environmental harm. The Act has environment protection policies relating to water quality, noise and air quality that will need to be complied with in the conduct of the project.

The *Environment Protection (Water Quality) Policy 2003* under the Act sets out water quality criteria for protection of waters within South Australia. The Environment Protection Authority will assess the SLPS and determine whether or not an environmental authorisation (in the form of an exemption) should be granted in relation to particular water quality characteristics, taking into account the impacts on water quality that are likely to arise if the project is not pursued. An application is currently being assessed by the Environment Protection Authority.

National Parks and Wildlife Act 1972 (SA)

The SLRS Project is situated within the Coorong National Park. The written permission of the Director National Parks and Wildlife is required under the *National Parks and Wildlife Act 1972* and associated regulations to enter and use the Park for specified purposes, to dig or disturb soil, etc, use vehicles or boats, or use generators as part of this project. Assessment will have regard to the Coorong National Park Management Plan 1991.

Native Vegetation Act 1991 (SA)

The clearance of any native vegetation must be undertaken in accordance with the *Native Vegetation Act 1991*. Any clearance proposed to support the preservation or enhancement of ecological processes or the construction of infrastructure or other development must be able to satisfy the criteria set out in the regulations under the Act and effectively requires approval from the Native Vegetation Council. The proposal has been assessed under this Act and clearance may be undertaken subject to a management plan and operational code of practice compiled to the satisfaction of the Native Vegetation Assessment Panel prior to the commencement of works and reporting on the results of aquatic monitoring being submitted.

Natural Resources Management Act 2004 (SA)

The *Natural Resources Management Act 2004* is designed to promote sustainable and integrated management of the State's natural resources. The SLPS must be undertaken in accordance with the duties established by the Act.

Development Act 1993 (SA)

Under the *Development Act 1993* no development may be undertaken unless approved or exempted in accordance with the Act. This proposal constitutes "development" but is considered exempt from any need for approval under section 49 of the Act pursuant to regulation 67 and Schedule 14 of the *Development Regulations 2008*.

River Murray Act 2003 (SA)

This Act provides for the protection and enhancement of the River Murray and related areas and ecosystems. Objectives, collectively known as the Objectives for a Healthy River Murray are defined under section 7 of the Act and include:

- River health objectives
- Environmental flow objectives
- Water quality objectives
- Human dimension objectives

This Act may be used to support entry onto land for the purposes of undertaking any work in connection with furthering its objects and projects relating to the River Murray.

The proposed action is situated within the River Murray Floodplain Protection Area designated by the Act. Through integration with other legislation, the objectives of this Act need to be considered in the assessments under other State legislation.

Water Act 2007 (Commonwealth) and Murray-Darling Basin Agreement

Section 18E of the *Water Act 2007* provides that the Murray Darling Basin Authority (MDBA) has the functions, powers and duties that are expressed to be conferred on it by the Murray-Darling Basin Agreement. Clause 49 of the Murray-Darling Basin Agreement provides that the Authority must be informed of certain proposals which may significantly affect the flow, use, control or quality of any water in the River Murray in South Australia. Information relating to the proposal must be provided with time to allow the Authority to assess the possible effect of the proposal and make representations on it to the State. Arrangements are in place to refer this document to the Authority.

Living Murray Icon Site Management Plan (Inter-Governmental)

The Lower Lakes, Coorong and Murray Mouth site is one of six Living Murray icon sites selected by the Murray Darling Basin Ministerial Council for its high ecological value and wider cultural significance. The Living Murray Initiative is a cooperative program of the Commonwealth and State governments, with a primary focus on the 'recovery' of water for the River Murray and the use of this water for the benefit of ecosystems and the human communities it supports.

The Murray-Darling Basin Commission (MDBC) prepared the Lower Lakes, Coorong and Murray Mouth Icon Site Environmental Management Plan 2006-2007 to identify how to deliver and manage environmental flows at this site. The plan notes that current dry conditions limit options for additional flows. The plan establishes three main ecological objectives and sets ecological targets for particular species and areas requiring action to achieve the objectives. The ecological objectives are:

- An open Murray Mouth, to allow flow of tides in the Coorong, providing for the key aquatic plant *Ruppia*, fish breeding, water birds and macro-invertebrates;
- Enhanced migratory water bird habitat in the Lower Lakes and Coorong, including appropriate water level variability for populations of macro-invertebrates and *Ruppia*; and
- More frequent estuarine fish spawning, including opening the barrages to create the medium salinity water critical for estuarine dependent fish, facilitating spawning and allowing connectivity between the river and sea.

The plan also includes conceptual models of the system, options for managing water flows, a barrage operating strategy, a risk based process for prioritising competing actions and the basis for a monitoring and evaluation framework. The proposal is considered to be consistent with the objectives of the plan.

Other Relevant Agreements Policies

Additional international and Australian agreements and policies that may be relevant to International Agreements:

- Convention on Wetlands of International Importance (Ramsar Convention). The *Environment Protection and Biodiversity Conservation Act 1999* establishes a framework for managing Ramsar wetlands, which is in accordance with the Ramsar Convention, through the Australian Ramsar management principles.
- China-Australia Migratory Birds Agreement (CAMBA) 1986;
- Japan-Australia Migratory Birds Agreement (JAMBA) 1974;
- Republic of Korea–Australia Migratory Bird Agreement (RoKAMBA) 2007.

Each of these agreements provide for the protection of migratory birds from take or trade except under limited circumstances, the protection and conservation of habitats, the exchange of information, and building cooperative relationships.

- East Asian — Australasian Flyway Partnership. The goal of the Flyway Partnership is to recognise and conserve migratory waterbirds in the East Asian - Australasian Flyway for the benefit of people and biodiversity.

See <http://www.environment.gov.au/biodiversity/migratory/waterbirds/index.html>

2.4 Environmental Impact Assessments under Commonwealth, State or Territory Legislation

No single overarching environmental impact assessment is required for this proposal at a State level. However, the potential impacts associated with the proposal are required to be assessed under a number of State laws. These have been covered in more detail in Section 2.3.

The current degraded state of the Coorong South Lagoon environment is well documented (see Section 8.8 and Appendix E2) and is becoming continually more degraded. The objective of the proposed SLPS is habitat restoration in a Ramsar-listed wetland of International importance and its impacts have been considered through the development of the proposal. This referral provides an assessment of potential environmental impacts, both positive and negative. Impacts are considered and evaluated in Sections 6 and 9. The potential **benefits** of undertaking this management action have been assessed to be **significant**, whereas the risks are considered to be low and temporary during (a) the construction phase (estimated to be 3 months) and (b) the operational period of pumping hypersaline water to the ocean (approximately 3 years). Impacts are considered acceptable, short term and recoverable.

2.5 Consultation with Indigenous Stakeholders

The SA Government has signed a consultation and collaboration agreement with the Ngarrindjeri, who are the Traditional Owners of the Coorong Region. This document is known as the Kungun Ngarrindjeri Yunnan Agreement, or KNY Agreement. The Coorong and Lower Lakes are particularly important to the Ngarrindjeri people (Ngarrindjeri Tendi et al. 2007) and the SLPS falls within this region. The SA DEH is in the process of establishing a set of protocols under which this proposal will be discussed and negotiated with the Traditional Owners.

Prior to the recent development of this overarching agreement, discussions about the Salinity Reduction project were held with Ngarrindjeri (July 2009 and prior). A draft of this document was made available to the Ngarrindjeri in October 2009 and again in early May 2010, and their feedback has sought via a formal arrangement. The pumping proposal is discussed regularly in meetings between the SA Government and the Ngarrindjeri. Once Ngarrindjeri have had the opportunity to review all technical reports, investigations and risk assessments a formal position on this proposal will be issued

Issues include:

- 1) Ngarrindjeri views on the South Lagoon Salinity Reduction Scheme (including SLPS), via a formal review process; and
- 2) Aboriginal heritage that is likely to be present on the Youngusband Peninsula and therefore may be encountered during the project (e.g. construction phase- see Section 9.2).

2.6 A Staged Development or Component of a Larger Project

The South Lagoon Salinity Reduction Strategy is a component of the Long Term Plan for the Coorong, Lower Lakes and Murray Mouth (CLLMM) region. The Long Term Plan “Shaping the future of the Coorong and Lower Lakes” has been developed by SA Department for Environment and Heritage (DEH) across 2009 and early 2010 with extensive community consultation. It is currently being finalised and the latest updates can be found at <http://www.environment.sa.gov.au/cllmm/the-long-term-plan.html>. The development of the Long Term Plan is part of the State Government’s Murray Futures program, which is funded by the Commonwealth’s Water for the Future initiative.

The proposed South Lagoon Salinity Reduction Strategy is the only part of the CLLMM Long Term Plan that directly addresses the health of the Coorong South Lagoon and the restoration of habitat in that area. It forms a discrete, coherent project within the overall plan.

Within the umbrella of the South Lagoon Salinity Reduction Scheme, the SLPS operates as a stand alone, no regrets project. It is an important and urgent short-term management action to maximise the opportunities for recovery of habitat in the South Lagoon.

Other actions under consideration that fall within the scope of the South Lagoon Salinity Reduction Scheme in the medium-term are:

- The redirection of water from the Upper South East Drainage (USED) Network (discussed in Section 2.2.4); and
- Limited excavation work between the North and South Lagoons to enhance the rate of water exchange between the Lagoons.

The USED scheme work is related to the SLPS in that the aim is to provide inflows of freshwater to the Coorong South Lagoon, but the timing is important here. The proposed pumping action is regarded as urgent and is required as soon as practicable, whereas the USED redirection project is a medium term (3 – 6 yr) action, which will assist the system in future without the need for further pumping (assuming future barrage flows). Other interventions, such as limited excavations within the constriction between the north and south lagoons are also being investigated. Further monitoring of flows within the lagoons is required to determine if this action is to be progressed further.

3. Matters of National Environmental Significance

Throughout section 3, the likelihood of occurrence of each species in the project area was determined by reference to databases (e.g. DEWHA SPRAT, Biological Database of SA, e-Flora South Australia, Australian Virtual Herbarium, recent literature reviews such as Kerr (2009), Orange-bellied Parrot survey data, recent vegetation surveys) and by consulting expert advice (SA Government, SA Museum, University of Adelaide, Flinders University, Birds Australia).

The types of potential impact were assessed by reference to the significant impact criteria (DEWHA 2006; Appendix K). The significance level of the risk was assessed by considering the likelihood of occurrence of a species, the stage of the life cycle, and the potential severity of the consequence. .

3.1 World Heritage Properties

There are no World Heritage listed properties within or near the proposed project area. The nearest site is the Australian Fossil Mammal Site which is over 200 km away at Naracoorte.

3.2 National Heritage Places

There are no listed National Heritage places within or near the project area. The nearest National Heritage listed sites are in Adelaide, over 140 km from the project area.

3.3 Nuclear Actions

The proposed action is not a nuclear action.

3.4 Wetlands of International Importance (Declared Ramsar Wetlands)

The EPBC protected matters search (Appendix H) identified that the project area is potentially within the catchment of five Ramsar wetlands:

- The Banrock Station Wetland Complex is located on the River Murray floodplain, opposite the township of Overland Corner, 26 km North West of Berri in the state of South Australia.
- Bool and Hacks Lagoons are located in the Lower South East of South Australia, approximately 160 km from the proposed project site.
- Coorong and Lakes Alexandrina and Albert Ramsar site.
- Hattah Kulkyne Lakes are situated in north-western Victoria, approximately 300 km from the project site.

- Riverland Ramsar site is located adjacent to the Murray River between Renmark and the Victorian and New South Wales borders.

Due to their distance from the project site it is expected that the Riverland Ramsar Site, the Barrock Station Wetland Complex (both are well upstream along the Murray River), Bool and Hacks Lagoons (160 km away) and Hattah Kulkylne lakes (300 km away) will not be impacted by the proposal. As such these Ramsar wetlands will not be described further. The proposal falls within the Coorong and Lakes Alexandrina and Albert Ramsar site.

3.4.1 Coorong and Lakes Alexandrina and Albert Ramsar site

Appendix A shows that the boundary of the Coorong National Park and the Ramsar listed wetland is identical in this part of the Ramsar site. The area of the Coorong and Lakes Alexandrina and Albert Ramsar site is approximately 140,500 ha and encompasses:

- Lakes Alexandrina and Albert and the tributaries of the Finniss River and Currency Creek (including land and wetlands connected to the lakes and the islands in the lakes).
- The Coorong (including all land and water in the Coorong National Park, the Younghusband Peninsula and Ocean Beach to the low water mark) (See <http://ramsar.wetlands.org/>).

The Ramsar listing of the Coorong and Lakes Alexandrina and Albert was established in 1985 on the basis that the region met a number of the required criteria (Ramsar 2009; Phillips and Muller 2006; see Table 2 for listing criteria). The site qualified under Ramsar criteria 1 to 6 in 2000. Phillips and Muller (2006) also assessed the Ramsar site against criteria 7, 8 and 9 and concluded that the site qualified against 8 of the 9 criteria. Criteria 2 to 9 are all biodiversity-related criteria.

Lakes Alexandrina and Albert are large freshwater lakes that receive water principally from River Murray flows but also under normal circumstances from the Eastern Mount Lofty Ranges via Finniss River, Tookayerta Creek and Currency Creek. The interconnected, freshwater lakes have been hydraulically separated from the estuarine environments of the Coorong and Murray Mouth by a series of five barrages since the 1940s. Prior to European settlement the Lower Lakes may have experienced brief periods of seawater intrusion during severe drought periods, but generally the lakes would have remained fresh or brackish at worst (Sims and Muller 2004).

The Ramsar-listed area below the barrages can be divided into three main parts: the Murray Mouth and estuary, the Coorong North Lagoon and the Coorong South Lagoon. The Murray Mouth and estuary are dominated by sea water due to low river flows and regular dredging to connect the channel to the sea. The North Lagoon is currently a saline water body with saline inflows from the Murray Mouth and South Lagoon, and freshwater inflows (rarely, when available) from the Tauwitchere Barrage. The South Lagoon is a hypersaline water body and is connected to the North Lagoon and therefore to the sea by a narrow channel at the northern end (Parnka Point / The Narrows). At least 23 separate wetland types existed within the Coorong and the freshwater lakes in 2006 (Phillips and Muller, 2006). These wetlands provide specific habitat for both state and EPBC-listed fauna and flora species.

In December 2006, the SA Government notified the Ramsar secretariat of changes in the ecological character of The Coorong and Lakes Alexandrina and Albert Ramsar site (in accordance with Article 3.2 of the Ramsar Convention (UNESCO, 1994)). These changes were documented in the Coorong and Lakes Alexandrina and Albert Wetland of International Importance – Ecological Character Description report (Phillips and Muller 2006). The 2006 report identified the following key points:

- A comprehensive shift in ecological character (ECD) of The Coorong and Lakes Alexandrina and Albert Wetland was in progress that, without significant and urgent intervention, may prove irreversible.
- The Lakes and the Coorong were being negatively impacted upon by sediments and increasing salinity and turbidity as well as inappropriately low water levels primarily due to reduced River Murray inflows.
- The components and processes of the estuarine Coorong ecosystem were only supported in a 30 km stretch from the Goolwa barrage to Pelican Point, and this represented less than 25% of the original estuarine ecosystem.

Ramsar Wetland Listing Criteria

Table 2 lists the criteria that are used to qualify Wetlands of International Importance (Phillips and Muller 2006). These criteria are referred to in Tables 3, 4, 5 and 6.

Table 2. Ramsar criteria used to qualify Wetlands of International Importance.

In order to qualify a site must satisfy one or more of the following:

Criterion 1:	Contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate bioregion.
Criterion 2:	Supports vulnerable, endangered or critically endangered species or threatened ecological communities.
Criterion 3:	Supports populations of plant and/or animal species important for maintaining the biological diversity of the region.
Criterion 4:	Supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.
Criterion 5:	Regularly supports 20,000 or more waterbirds.
Criterion 6:	Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
Criterion 7:	Supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.
Criterion 8:	Is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.
Criterion 9:	A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

3.4.2 Species that Contribute to the Ramsar Status of the site

Plant Taxa

Table 3 is taken from Phillips and Muller (2006) and is the list of plant species that contribute to the assignment of Ramsar status to the Coorong, Lakes Alexandrina and Albert Wetland of International Importance. It also includes the criteria for Ramsar listing for each species, and national and state conservation status.

Table 3. Plant taxa that contribute to qualifying the site for Ramsar status (Phillips and Muller 2006).

Common name	Scientific name	Ramsar criteria	Status - National	Status - IUCN	Status - SA
Family Asteraceae					
Silver Daisy-bush	<i>Olearia pannosa</i> ssp. <i>pannosa</i>	2,3	V		V
George's Groundsel	<i>Senecio georgianus</i> var. <i>georgianus</i>	2,3	V		E
Family Mimosaceae					
Yellow Swainson-pea	<i>Swainsona pyrophila</i>	2,3	V		R
Family Orchidaceae					
Sandhill Greenhood	<i>Pterostylis arenicola</i>	2,3	V		V
Metallic Sun-orchid	<i>Thelymitra epipactoides</i>	2,3	E		E
Family Proteaceae					
Scarlet Grevillea	<i>Grevillea treueriana</i>	2,3	V		V
Family Goodeniaceae					
Dune Fanflower	<i>Scaevola calendulacea</i>	3			

Key:

Conservation status: National and SA: E – Endangered, V – Vulnerable

IUCN: CE = Critically endangered, Endangered, V – Vulnerable in the IUCN Red list

Keystone species

The aquatic flowering plant *Ruppia tuberosa* in the Coorong South Lagoon has been, until the last two or three years, a central and critical plant component of the ecosystem (a keystone species). Its turions, seeds and

foliage are known to be consumed by waterfowl. This plant also provided important habitat for fish and chironomids (Rogers and Paton, 2009).

***Ruppia tuberosa* has virtually disappeared from the Coorong South lagoon owing to the excessive salinity**, which is considerably higher than the salinity level in which the species can maintain populations (Rogers and Paton 2009). It seems clear that *Ruppia tuberosa* populations are not able to be maintained above around 120 ppt total dissolved salts. The SLPS seeks to restore habitat by decreasing salt concentrations in the South Lagoon to a point where the keystone species *Ruppia tuberosa*, plus keystone benthic macroinvertebrates including chironomids and fish species can re-establish and grow. This in turn is anticipated to lead to the recovery of bird populations.

Animal taxa

There is a range of animal taxa that contribute to the Ramsar status of the site, listed in Tables 4, 5 and 6.

Keystone species

The productivity of the Coorong South Lagoon and the large diversity of bird life in the area have been based on populations of *Ruppia tuberosa* (see above), the chironomid *Tanytarsus barbitarsis* (both larvae and pupae of this invertebrate) and the Small-mouthed Hardyhead, *Atherinosoma microstoma*. **All three species are no longer present in the South Lagoon, due to the high salinity levels beyond the limit of tolerance for these species** (Rogers and Paton 2009). Reduction of the salinity levels to below 120 ppt should allow the recovery of populations of these species. The presence, after population recovery, of *Ruppia tuberosa* is likely to enhance the recovery of the chironomids and Small-mouthed Hardyhead, *Atherinosoma microstoma*.

Amphibian Taxa

Table 4. Amphibian taxa that contribute to the Ramsar status of the site (Phillips and Muller 2006).

Common name	Scientific name	Ramsar criteria	Status - National	Status - IUCN	Status - SA
Amphibians					
Southern Bell Frog	<i>Litoria raniformis</i>	2,3,4	V	E	V

Key:

Status: E = Endangered, V = Vulnerable

Fish Taxa

The native fish community of the whole of the Ramsar site includes some 49 species of note (Table 5). Among these are:

- Five species that are listed as vulnerable at either global or national levels;
- Twenty further species that are classified as protected or have been provisionally listed as of conservation concern within SA;
- Twenty species that utilise the site at critical stages of their life cycle, such as, seven diadromous species, twelve estuarine species that spawn or have large populations and any freshwater species that spawn or recruit within the wetland;
- Eight so-called ‘marine stragglers’; being marine fish species that “randomly enter and leave inlets and estuaries” (Phillips and Muller 2006).

Table 5. Fish taxa that contribute to the Ramsar status of the site (Phillips and Muller 2006).

Common name	Scientific name	Ramsar criteria	Status - national	Status - IUCN	Status - SA
Glassfishes – Family Ambassidae					
Chanda perch (Agassiz's glassfish)	<i>Ambassis agassizii</i>	3,4,7,8			P,C
Freshwater eels – Family Anguillidae					
Short-finned eel	<i>Anguilla australis</i>	3,4,7			C
Hardyheads or Silversides – Family Atherinidae					
Small-mouthed hardyhead	<i>Atherinosoma</i>	4,7,8			

Common name	Scientific name	Ramsar criteria	Status - national	Status - IUCN	Status-SA
	<i>microstoma</i>				
Murray hardyhead	<i>Craterocephalus fluviatilis</i>	2,3,4,7,8	V	E	C
Fly-specked hardyhead	<i>Craterocephalus stercusmuscarum fulvus</i>	3,4,7,8			C
Herrings –Family Clupeidae					
Sandy sprat	<i>Hyperlophus vittatus</i>	4,7,8			
Bony bream	<i>Nematalosa erebi</i>	4,7,8			
Blue sprat	<i>Spratelloides robustus</i>	4,7,8			
Gudgeons – Family Eleotrididae					
Purple-spotted gudgeon	<i>Mogurnda adspersa</i>	3,4,7,8			P,C
Flathead gudgeon	<i>Philypnodon grandiceps</i>	4,7,8			
Dwarf flathead gudgeon	<i>Philypnodon</i> sp.	3,4,7,8			C
Western carp gudgeon	<i>Hypseleotris klunzingeri</i>	3,4,7,8			C
Midgley's carp gudgeon	<i>Hypseleotris</i> sp.	4,7,8			
Murray Darling carp gudgeon	<i>Hypseleotris</i> sp.	3,4,7,8			C
Hybrid carp gudgeon (e.g. Lakes carp gudgeon)	<i>Hypseleotris</i> spp.	4,7,8			
Freshwater blackfishes - Family Gadopsidae					
River blackfish	<i>Gadopsis marmoratus</i>	3,4,7,8			P,C
Galaxids or Native minnows – Family Galaxiidae					
Climbing galaxias	<i>Galaxias brevipinnis</i>	3,4,7,8			C
Common galaxias	<i>Galaxias maculatus</i>	4,7,8			
Mountain galaxias	<i>Galaxias olidus</i>	3,4,7,8			C
Pouched lampreys – Family Geotriidae					
Pouched lamprey	<i>Geotria australis</i>	3,4,7,8			C
Gobies – Family Gobiidae					
Bridled goby	<i>Acentrogobius bifrenatus</i>	3 [#] ,4,7,8			
Tamar goby	<i>Afurcagobius tamarensis</i>	3 [#] ,4,7,8			
Western blue spot (Swan River) goby	<i>Pseudogobius olorum</i>	3 [#] ,4,7,8			
Lagoon goby	<i>Tasmanogobius lasti</i>	3 [#] ,4,7,8			
Halfbeaks - Family Hemiramhidae					
River garfish	<i>Hyporhamphus regularis</i>	4,7,8			
Leptoscopids- Family Leptoscopidae					
Sand fish	<i>Crapatalus arenarius lasti</i>	7			
Rainbowfishes – Family Melanotaeniidae					
Murray (Crimson-spotted) rainbowfish	<i>Melanotaenia fluviatilis</i>	4,7,8			
Goblin shark – Family Mitsukurinidae					
Goblin shark	<i>Mitsukurina owstoni</i>	7			

Common name	Scientific name	Ramsar criteria	Status - national	Status - IUCN	Status - SA
Shorthead lampreys – Family Mordaciidae					
Shortheaded lamprey	<i>Mordacia mordax</i>	3,4,7,8			C
Grey mullets - Family Mugilidae					
Yellow-eye mullet	<i>Aldrichetta forsteri</i>	4,7,8			
Jumping mullet	<i>Liza argentea</i>	4,7,8			
Freshwater basses and cods – Family Percichthyidae					
Southern pygmy perch	<i>Nannoperca australis</i>	3,4,7,8			P,C
Yarra pygmy perch	<i>Nannoperca obscura</i>	2,3,4,7,8	V	V	P,C
Murray cod	<i>Maccullochella peelii peelii</i>	2,3,7,8	V		
Golden perch	<i>Macquaria ambigua ambigua</i>	4,7,8			
Estuary perch	<i>Macquaria colonorum</i>	3,4,7,8			C
Righteye flounders - Family Rhombosoleinae					
Greenback flounder	<i>Rhombosolea tapirina</i>	4,7,8			
Eel-tailed catfishes – Family Plotosidae					
Freshwater eel-tailed catfish	<i>Tandanus tandanus</i>	3,4,7,8			P
Congollis – Family Pseudaphritidae					
Congolli (Tupong)	<i>Pseudaphritis urvillii</i>	3,4,7,8			C
Smelts – Family Retropinnidae					
Australian smelt	<i>Retropinna semoni</i>	4,7,8			
Drums - Family Sciaenidae					
Mulloway	<i>Argyrosomus japonicus</i>	4,7,8			
Scorpion fishes – Family Tetrarogidae					
South Australian Cobbler	<i>Gymnapistes marmoratus</i>	4,7,8			
Breams – Family Sparidae					
Black bream	<i>Acanthopagrus butcheri</i>	4,7,8			
Pipefishes & seahorses – Family Syngnathidae					
Big-bellied seahorse	<i>Hippocampus abdominalis</i>	2,3,7		V	
Grunters – Family Terapontidae					
Silver perch	<i>Bidyanus bidyanus</i>	2,3,4,7,8		V	P,C
Striped perch	<i>Helotes sexlineatus</i>	4,7,8			
Pufferfishes– Family Tetraodontidae					
Prickly toadfish	<i>Contusus brevicaudus</i>	7			
Smooth toadfish	<i>Tetractenos glaber</i>	4,7,8			
Richardson's toadfish	<i>Tetractenos hamiltoni</i>	7			

Key:

Conservation status:

National: V – vulnerable under the *EPBC Act 1999*.

IUCN: E – Endangered in the IUCN Red list, V- Vulnerable in the IUCN Red list

State: P – protected under the *Fisheries Act 1982*, C – provisional State conservation concern under the *draft Threatened Species Schedule NPWSA*. (http://www.environment.sa.gov.au/biodiversity/latest_news.html#review_of_status).

Bird Taxa

There are 76 bird species listed in Table 6, with the majority, but not all, being waterbirds. The list includes:

- “Three species that are listed as endangered or critically endangered at either global or national levels;
- Six further species that are classified as vulnerable within South Australia;
- Forty-nine species that rely on the wetland at critical life stages, such as migration stop-over, for breeding habitat or as refuge during times of drought;
- Forty-four species that are listed under Australia’s migratory bird agreements with Japan, China or South Korea, or the Convention on Migratory Species; and,
- Fourteen species that occurs at the site in numbers 1% of their estimate population or sub-population numbers (criterion 6 in the table below)” (Phillips and Muller, 2006).

Table 6. Bird taxa that contribute to the Ramsar status of the site (Amended from Phillips and Muller 2006)

Common name	Scientific name	Ramsar criteria*	Status - national	Status IUCN [@]	J/CAMBA/ROKAMBA or CMS	Status- SA
Pelicans - Family Pelecanidae						
Australian Pelican	<i>Pelecanus conspicillatus</i>	4, 5.1, 5.2, 5.3				
Darters - Family Anhingidae						
Australian Darter	<i>Anhinga melanogaster</i>	4				
Cormorants – Family Phalacrocoracidae						
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	4				
Pied Cormorant	<i>Phalacrocorax varius</i>	4				
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	4, 5.1, 5.2				
Great Black Cormorant	<i>Phalacrocorax carbo</i>	4, 5.1, 5.2				
Grebes – Family Podicipedidae						
Great Crested Grebe	<i>Podiceps cristatus</i>	5.3, 6				R
Hoary-headed Grebe	<i>Podiceps poliocephalus</i>	5.1, 5.2, 5.3, 6				
Geese, Swans and Ducks – Family Anatidae						
Cape Barren Goose	<i>Cereopsis novaehollandiae</i>	6			CMS	R
Black swan	<i>Cygnus atratus</i>	4, 5.1, 5.3			CMS	
Australasian Shoveler	<i>Anas rhynchotis</i>	4			CMS	R
Musk Duck	<i>Biziura lobata</i>	5.3			CMS	R
Australian Shelduck	<i>Tadorna tadornoides</i>	4, 5.1, 5.2, 5.3			CMS	
Grey Teal	<i>Anas gracilis</i>	5.1, 5.2, 5.3			CMS	
Chestnut Teal	<i>Anas castanea</i>	4, 5.1, 5.2, 5.3			CMS	
Rails, Crakes, Swampheens, Coot – Family Rallidae						
Lewin’s Rail	<i>Rallus pectoralis</i>	3				V
Spotless Crake	<i>Porzana</i>	5.3				

Common name	Scientific name	Ramsar criteria*	Status - national	Status IUCN @	J/CAMBA/ROKAMBA or CMS	Status- SA
	<i>tabuensis</i>					
Dusky Moorhen	<i>Gallinula tenebrosa</i>	4				
Purple Swamphen	<i>Porphyrio porphyrio</i>	4, 5.3				
Herons, Egrets, Bitterns – Family Ardeidae						
Australasian Bittern	<i>Botaurus poiciloptilus</i>	2,3		E		V
Little Egret	<i>Ardea garzetta</i>	4				
Cattle Egret	<i>Ardea ibis</i>	4				
Great Egret	<i>Ardea alba</i>	4			J/CAMBA	
White faced Heron	<i>Ardea novaehollandiae</i>	4, 5.3				
Rufous NightHeron	<i>Nycticorax caledonicus</i>	4, 5.3				
Ibises, Spoonbills – Family Threskiornidae						
Glossy Ibis	<i>Plegadis falcinellus</i>	4			CAMBA	R
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	4, 5.1				
Australian White Ibis	<i>Threskiornis molucca</i>	4, 5.3				
Royal Spoonbill	<i>Platalea regia</i>	4, 5.3				
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	4, 5.3				
Curlews, Sandpipers, Snipes, Godwits, Phalaropes – Family Scolopacidae						
Latham's Snipe	<i>Gallinago hardwickii</i>	3,4			J/CAMBA ROKAMBA CMS	V
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	4, 5.3, 6			J/CAMBA ROKAMBA CMS	
Curlew Sandpiper	<i>Calidris ferruginea</i>	4, 5.3, 6			J/CAMBA ROKAMBA CMS	
Common sandpiper	<i>Tringa hypoleucos</i>	4			J/CAMBA ROKAMBA CMS	
Marsh Sandpiper	<i>Tringa stagnatilis</i>	4			CAMBA ROKAMBA CMS	
Terek Sandpiper	<i>Xenus cinereus</i> (<i>Tringa terek</i>)	4			J/CAMBA ROKAMBA CMS	
Pectoral Sandpiper	<i>Calidris melanotos</i>	4			JAMBA ROKAMBA CMS	
Red-necked Stint	<i>Calidris ruficollis</i>	4,5.3,6			J/CAMBA ROKAMBA	

Common name	Scientific name	Ramsar criteria*	Status - national	Status IUCN @	J/CAMBA/ ROKAMBA or CMS	Status- SA
					CMS	
Sanderling	<i>Crocethia alba</i>	4,6			J/CAMBA ROKAMBA CMS	
Common Greenshank	<i>Tringa nebularia</i>	4,5,3,6			J/CAMBA ROKAMBA CMS	
Red-necked Phalarope	<i>Phalaropus lobatus</i>	4			J/CAMBA ROKAMBA CMS	
Eastern curlew	<i>Numenius madagascariensis</i>	3,4,5,3			J/CAMBA ROKAMBA CMS	V
Bar-tailed godwit	<i>Limosa lapponica</i>	4			J/CAMBA ROKAMBA CMS	
Black-tailed godwit	<i>Limosa limosa</i>	4, 5,3			J/CAMBA ROKAMBA CMS	
Great Knot	<i>Calidris tenuirostris</i>	4			J/CAMBA ROKAMBA CMS	
Red Knot	<i>Calidris canutus</i>	4			J/CAMBA ROKAMBA CMS	
Grey-tailed Tattler	<i>Tringa brevipes</i>	4			J/CAMBA ROKAMBA CMS	
Ruddy turnstone	<i>Arenaria interpres</i>	4			J/CAMBA ROKAMBA CMS	
Ruff	<i>Philomachus pugnax</i>	4			J/CAMBA ROKAMBA CMS	
Oystercatchers – Family Haematopodidae						
Pied Oystercatcher	<i>Haematopus longirostris</i>	4,5,3,6				
Sooty Oystercatcher	<i>Haematopus fuliginosa</i>	5,3				
Lapwings, Plovers, Dotterels – Family Charadriidae						
Hooded Plover	<i>Charadrius rubricollis</i>	3,4,5,3,6			CMS	V
Red-capped Plover	<i>Charadrius ruficapillus</i>	4, 5,3, 6			CMS	
Pacific Golden Plover	<i>Pluvialis fulva</i>	4, 5,3, 6			J/CAMBA ROKAMBA CMS	
Grey Plover	<i>Pluvialis squatarola</i>	4			J/CAMBA ROKAMBA CMS	
Lesser Sand Plover	<i>Charadrius mongolus</i>	4			ROKAMBA CMS	
Oriental Plover	<i>Charadrius</i>	4			ROKAMBA	

Common name	Scientific name	Ramsar criteria*	Status - national	Status IUCN @	J/CAMBA/ ROKAMBA or CMS	Status- SA
	<i>veredus</i>				CMS	
Double-banded Plover	<i>Charadrius bicinctus</i>	4			CMS	
Masked Lapwing	<i>Vanellus miles</i>	4, 5.3			CMS	
Red-kneed Dotterel	<i>Erythrogonys cinctus</i>	5.3			CMS	
Stilts, Avocets – Family Recurvirostridae						
Banded Stilt	<i>Cladorhynchus leucocephalus</i>	5.3,6			CMS	
Black-winged Stilt	<i>Himantopus himantopus</i>	4, 5.3			CMS	
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	5.3,6			CMS	
Gulls, Terns etc – Family Laridae						
Little Tern	<i>Sterna (now Sternula) albifrons</i>	3,4			J/CAMBA ROKAMBA	V
Fairy Tern	<i>Sterna (now Sternula) nereis</i>	3,4, 5.1, 5.2, 5.3,6				V
Crested Tern	<i>Sterna (now Thalasseus) bergii</i>	4,5.1,5.2			JAMBA	
Caspian Tern	<i>Hydropogne tschegrava (now Hydroprogne caspia)</i>	4,5.3,6			CAMBA	
Whiskered Tern	<i>Chlidonias hybridus</i>	5.1,5.2,5.3				
Pacific Gull	<i>Larus pacificus</i>	4				
Silver Gull	<i>Larus novaehollandiae</i>	4, 5.1,5.2,5.3				
Parrots – Family Psittacidae						
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	2,3,4	E	CE		E
Fairy-wrens – Family Maluridae						
Mount Lofty Ranges Southern Emu-wren &	<i>Stipiturus malachurus intermedius</i>	2,3,4	E	E		E
Old World Warblers – Family Sylviidae						
Great (Oriental) Reed-Warbler	<i>Acrocephalus arundinaceus</i>	4			CAMBA ROKAMBA	
Little Grassbird	<i>Megalurus gramineus</i>	4				
Golden-headed Cisticola	<i>Cisticola exilis</i>	4				

The order used follows that of *Field Guide to the Birds of Australia*, 6th Edition by Simpson and Day, 1999

Key:

E = Endangered, V = Vulnerable, R = Rare, & = This species occupies the critically endangered ecological community, the swamps of the Fleurieu Peninsula, JAMBA = Japan-Australia Migratory Bird Agreement, CAMBA = China-Australia Migratory Bird Agreement
 ROKAMBA = Republic of Korea – Australia Migratory Bird Agreement (added for this EPBC referral)
 CMS = Convention on Migratory Species

3.5 EPBC-listed Species and Ecological Communities

3.5.1 EPBC-listed Threatened Species

An EPBC Protected Matters Report (based on the Coorong and Murray Mouth plus 5 km buffer) is attached as Appendix H. The results of the search are summarised in Table 7. The search identified 58 threatened species including 26 bird species, 1 frog species, 6 mammal species, 3 ray-finned fish species, 2 shark species and 20 plant species. Of these, 5 species are considered to be critically endangered (Spotted Quail-thrush, *Cinclosoma punctatum anachoreta*, Orange-bellied Parrot, *Neophema chrysogaster*, *Cassinia tegulata*, Fleurieu Leek Orchid, *Prasophyllum murfetii*, and Blue Top Sun-orchid, *Thelymitra cyanapicata*) and 18 are endangered under the EPBC Act.

Table 7. Threatened species or species habitat potentially occurring in the project area (alphabetically).

	Species	Common Name	Status
Plant	<i>Acacia pinguifolia</i>	Fat-leaved Wattle	Endangered
Plant	<i>Acacia rheticarpa</i>	Neat Wattle, Resin Wattle (SA)	Vulnerable
Mammal	<i>Balaenoptera musculus</i>	Blue Whale	Endangered
Plant	<i>Caladenia colorata</i>	Small Western Spider-orchid, Coloured Spider-orchid, Painted Spider-orchid	Endangered
Plant	<i>Caladenia conferta</i>	Coast Spider-orchid	Endangered
Plant	<i>Caladenia tensa</i>	Greencomb Spider-orchid, Rigid Spider-orchid	Endangered
Bird	<i>Calyptorhynchus lathami halmaturinus</i>	Glossy Black-Cockatoo (Kangaroo Island), Glossy Black-Cockatoo (SA)	Endangered
Shark	<i>Carcharodon carcharias</i>	Great White Shark	Vulnerable
Plant	<i>Cassinia tegulata</i>	a shrub	Critically Endangered
Bird	<i>Cinclosoma punctatum anachoreta</i>	Spotted Quail-thrush (Mt Lofty Ranges)	Critically Endangered
Ray-finned fish	<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Vulnerable
Bird	<i>Diomedea epomophora epomophora</i>	Southern Royal Albatross	Vulnerable
Bird	<i>Diomedea epomophora sanfordi</i>	Northern Royal Albatross	Endangered
Bird	<i>Diomedea exulans (sensu lato)</i>	Wandering Albatross	Vulnerable
Bird	<i>Diomedea exulans amsterdamensis</i>	Amsterdam Albatross	Endangered
Bird	<i>Diomedea exulans exulans</i>	Tristan Albatross	Endangered
Bird	<i>Diomedea exulans gibsoni</i>	Gibson's Albatross	Vulnerable
Mammal	<i>Eubalaena australis</i>	Southern Right Whale	Endangered
Plant	<i>Euphrasia collina subsp. osbornii</i>	Osborn's Eyebright	Endangered
Plant	<i>Frankenia plicata</i>		Endangered
Shark	<i>Galeorhinus galeus</i>	School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark	Conservation Dependent
Plant	<i>Glycine latrobeana</i>	Clover Glycine, Purple Clover	Vulnerable

	Species	Common Name	Status
Bird	<i>Halobaena caerulea</i>	Blue Petrel	Vulnerable
Bird	<i>Hylacola pyrrhopygia parkeri</i>	Chestnut-rumped Heathwren (Mt Lofty Ranges)	Endangered
Mammal	<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot	Endangered
Bird	<i>Lathamus discolor</i>	Swift Parrot	Endangered
Bird	<i>Leipoa ocellata</i>	Malleefowl	Vulnerable
Frog	<i>Litoria raniformis</i>	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog	Vulnerable
Ray-finned fish	<i>Maccullochella peelii peelii</i>	Murray Cod, Cod, Goodoo	Vulnerable
Bird	<i>Macronectes giganteus</i>	Southern Giant-Petrel	Endangered
Bird	<i>Macronectes halli</i>	Northern Giant-Petrel	Vulnerable
Mammal	<i>Megaptera novaeangliae</i>	Humpback Whale	Vulnerable
Ray-finned fish	<i>Nannoperca obscura</i>	Yarra Pygmy Perch	Vulnerable
Bird	<i>Neophema chrysogaster</i>	Orange-bellied Parrot	Critically Endangered
Mammal	<i>Neophoca cinerea</i>	Australian Sea-lion	Vulnerable
Mammal	<i>Nyctophilus timoriensis (South-eastern form)</i>	Eastern Long-eared Bat	Vulnerable
Plant	<i>Olearia pannosa subsp. pannosa</i>	Silver Daisy-bush	Vulnerable
Bird	<i>Pachycephala rufogularis</i>	Red-lored Whistler	Vulnerable
Plant	<i>Prasophyllum frenchii</i>	Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid	Endangered
Plant	<i>Prasophyllum murfetii</i>	Fleurieu Leek Orchid	Critically Endangered
Plant	<i>Prasophyllum pallidum</i>	Pale Leek-orchid	Vulnerable
Bird	<i>Psophodes nigrogularis leucogaster</i>	Western Whipbird (eastern)	Vulnerable
Bird	<i>Pterodroma mollis</i>	Soft-plumaged Petrel	Vulnerable
Plant	<i>Pterostylis arenicola</i>	Sandhill Greenhood Orchid	Vulnerable
Plant	<i>Pterostylis cucullata</i>	Leafy Greenhood	Vulnerable
Bird	<i>Rostratula australis</i>	Australian Painted Snipe	Vulnerable
Plant	<i>Senecio macrocarpus</i>	Large-fruit Fireweed, Large-fruit Groundsel	Vulnerable
Bird	<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (Fleurieu Peninsula)	Endangered
Plant	<i>Tecticornia flabelliformis</i>	Bead Glasswort	Vulnerable
Bird	<i>Thalassarche bulleri</i>	Buller's Albatross	Vulnerable
Bird	<i>Thalassarche cauta cauta</i>	Shy Albatross, Tasmanian Shy Albatross	Vulnerable

	Species	Common Name	Status
Bird	<i>Thalassarche cauta salvini</i>	Salvin's Albatross	Vulnerable
Bird	<i>Thalassarche chrysostoma</i>	Grey-headed Albatross	Vulnerable
Bird	<i>Thalassarche melanophris</i>	Black-browed Albatross	Vulnerable
Bird	<i>Thalassarche melanophris impavida</i>	Campbell Albatross	Vulnerable
Plant	<i>Thelymitra cyanapicata</i>	Blue Top Sun-orchid, Dark-tipped Sun-orchid	Critically Endangered
Plant	<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	Endangered
Plant	<i>Thelymitra matthewsii</i>	Spiral Sun-orchid	Vulnerable

3.5.2 EPBC-listed Migratory Species

The EPBC Protected Matters Report identified that 41 migratory species, including migratory birds, mammals and sharks, or their habitat, may occur in the project area. The species are listed in Table 9 and also in Appendix H.

Table 9. Listed migratory species potentially occurring within the project area.

	Species	Common name
Birds		
Terrestrial	<i>Hirundapus caudacutus</i>	White-throated Needletail
Terrestrial	<i>Leipoa ocellata</i>	Malleefowl
Terrestrial	<i>Merops ornatus</i>	Rainbow Bee-eater
Terrestrial	<i>Neophema chrysogaster</i>	Orange-bellied Parrot
Terrestrial	<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (Fleurieu Peninsula), Mount Lofty Southern Emu-wren
Wetland, Marine	<i>Ardea alba</i>	Great Egret, White Egret
Wetland, Marine	<i>Ardea ibis</i>	Cattle Egret
Wetland	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper
Wetland	<i>Calidris alba</i>	Sanderling
Wetland	<i>Calidris ferruginea</i>	Curlew Sandpiper
Wetland	<i>Calidris ruficollis</i>	Red-necked Stint
Wetland	<i>Gallinago hardwickii</i>	Latham's Snipe, Japanese Snipe
Wetland	<i>Pluvialis fulva</i>	Pacific Golden Plover
Wetland	<i>Rostratula benghalensis s. lat.</i>	Painted Snipe
Wetland	<i>Tringa nebularia</i>	Common Greenshank, Greenshank
Marine	<i>Apus pacificus</i>	Fork-tailed Swift
Marine	<i>Diomedea amsterdamensis</i>	Amsterdam Albatross
Marine	<i>Diomedea dabbenena</i>	Tristan Albatross
Marine	<i>Diomedea epomophora (sensu stricto)</i>	Southern Royal Albatross
Marine	<i>Diomedea exulans (sensu lato)</i>	Wandering Albatross
Marine	<i>Diomedea gibsoni</i>	Gibson's Albatross

	Species	Common name
Birds		
Marine	<i>Diomedea sanfordi</i>	Northern Royal Albatross
Marine	<i>Macronectes giganteus</i>	Southern Giant-Petrel
Marine	<i>Macronectes halli</i>	Northern Giant-Petrel
Marine	<i>Sterna (now Sternula) albifrons</i>	Little Tern
Marine	<i>Sterna (now Hydroprogne) caspia</i>	Caspian Tern
Marine	<i>Thalassarche bulleri</i>	Buller's Albatross
Marine	<i>Thalassarche cauta (sensu stricto)</i>	Shy Albatross, Tasmanian Shy Albatross
Marine	<i>Thalassarche chlororhynchos</i>	Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross
Marine	<i>Thalassarche chrysostoma</i>	Grey-headed Albatross
Marine	<i>Thalassarche impavida</i>	Campbell Albatross
Marine	<i>Thalassarche melanophris</i>	Black-browed Albatross
Marine	<i>Thalassarche salvini</i>	Salvin's Albatross
Mammals		
Marine	<i>Balaenoptera edeni</i>	Bryde's Whale
Marine	<i>Balaenoptera musculus</i>	Blue Whale
Marine	<i>Caperea marginata</i>	Pygmy Right Whale
Marine	<i>Eubalaena australis</i>	Southern Right Whale
Marine	<i>Lagenorhynchus obscurus</i>	Dusky Dolphin
Marine	<i>Megaptera novaeangliae</i>	Humpback Whale
Marine	<i>Orcinus orca</i>	Killer Whale, Orca
Shark		
Marine	<i>Carcharodon carcharias</i>	Great White Shark

According to information from SARDI Aquatic Sciences, the shortfin mako shark (*Isurus oxyrinchus Rafinesque*) should also be added to this list of listed migratory species (listed under the convention on Migratory Species in Dec 2008). This species is mostly oceanic and found inshore only rarely (Last and Stephens, 1994).

The following EPBC-listed marine mammals and dolphins could occur off the ocean beach of the Coorong (C Kemper, SA Museum, pers. comm.):

Balaenoptera edeni Bryde's Whale

Balaenoptera musculus Blue Whale **EN**, E

Eubalaena australis Southern Right Whale* **EN**, V

Megaptera novaeangliae Humpback Whale **VU**, V

Orcinus orca Killer Whale (Orca)

Caperea marginata Pygmy Right Whale*

Bold EN (Endangered), VU (Vulnerable) refer to national (EPBC) listing; not bold R (Rare), E (Endangered), V (Vulnerable), refer to South Australian State listing. Some species (e.g. Fin Whale) occur mainly in deeper waters off the continental shelf (DEWHA SPRAT); * denotes that the species has been recorded in project area according to Biological Data Base of South Australia.

3.5.3 Likelihood of Occurrence of EPBC-listed Plant Species

Table 8 summarises the key habitat of flora species identified as potentially occurring in the project area by an EPBC Protected Matters Report, and the likelihood of their occurrence there. In addition, the Native Vegetation Assessment conducted in February 2010, reported that none of nationally threatened flora species known for the Coorong area were noted along any of the survey transects (Rural Solutions 2010 Appendix N).

Table 8. Threatened flora species potentially occurring in the project area, habitat and likelihood of occurrence.

Species	Common Name	Habit Description	Likelihood of Occurrence
<i>Acacia pinguifolia</i>	Fat-leaved Wattle	This species occurs on the southern Eyre Peninsula in the Cummins to Port Lincoln area with a small, disjunct occurrence near Finniss in the southern Lofty region, SA. As a result of land clearance, it is now almost entirely confined to the narrow strips of roadsides and rail reserves. The small disjunct Finniss distribution is 55 km SSE of Adelaide, immediately W of L. Alexandrina. There are several small populations in the Finniss area, ranging from 5 to 50 plants each. These populations are confined to railway reserves or road reserves (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Acacia rheticarpa</i>	Neat Wattle, Resin Wattle (SA)	The species usually grows in open scrub in calcareous sand, sandy loam, red shallow porous loam or grey-brown calcareous loamy earths. Average annual rainfall is 250-350 mm. In the Southern Lofty/Murray region, the species grows in dark grey brown sandy loams of pH 7 that are frequently scattered with limestone nodules. Found on the undulating floors of large, shallow, broad depressions, and on the gentle 'W to NE' facing slopes of low broad ridges (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Caladenia colorata</i>	Small Western Spider-orchid, Coloured Spider-orchid, Painted Spider-orchid	Grows on sand over loam Occurs in <i>Eucalyptus leucoxylo</i> / <i>E. fasciculosa</i> / <i>Allocasuarina stricta</i> and <i>Callitris gracilis</i> woodland over scattered shrubs, sedges and grasses (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Caladenia conferta</i>	Coast Spider-orchid	Coast Spider-orchid is endemic to South Australia, where it occurs in Mallee woodlands or Broombush (<i>Melaleuca uncinata</i>) scrubs in terra-rossa soils over limestone, in sedgeland on sandy soils, or on fertile red-brown soils among granite outcrops. Four populations are known at two disjunct locations: in Ngarkat Conservation Park and Mt Boothby; near Port Vincent and near Maitland. In the Upper South-east, the Coast Spider-Orchid is historically known from five subpopulations. Three of these subpopulations were recorded between 1977 and 1988, however their current status is not known (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Caladenia richardsiorum</i>	Little Dip Spider-orchid	The Little Dip Spider-orchid grows in a range of habitats from exposed limestone cliffs to sheltered coastal mallee vegetation. Overstorey plants associated with Little Dip Spider-orchids include: • Coastal Daisy-bush (<i>Olearia axillaris</i>) & Coast Beardheath (<i>Leucopogon parviflorus</i>) • Coastal Mallee (<i>Eucalyptus diversifolia</i>) • Dryland Tea-tree (<i>Melaleuca lanceolata</i>) and Drooping Sheoak (<i>Allocasuarina verticillata</i>).	May occur (DEH, SA); though not recorded in southern Coorong area (BDB SA)
<i>Caladenia tensa</i>	Greencomb Spider-orchid, Rigid Spider-orchid	Widespread in and surrounding the Little Desert in western Victoria. Also known from southeast South Australia where considered widespread but uncommon (Bob Bates, SHSA, pers. comm.). Examples include Telowie Gorge, Murray Bridge and Mt Boothby CP. Habitat - Cypress-pine/Yellow Gum Woodland, Heathy Woodland and Mallee on sands and sandy loams derived from aeolian sand deposits.	Not likely to occur; not recorded in southern Coorong area (BDB SA)

Species	Common Name	Habit Description	Likelihood of Occurrence
<i>Cassinia tegulata</i>	a shrub	This species is known from <i>Melaleuca brevifolia</i> / <i>Gahnia filum</i> Shrubland. Found on seasonally inundated interdune flats composed of shallow grey clay-loams of high pH which are underlain by limestone (R. Johnson 2006, pers. comm.). Generally occupy areas with little or no incline. Associated species include: Mealy Wattle (<i>Acacia farinosa</i>), <i>Lawrencia spicata</i> , Kangaroo Grass (<i>Themeda triandra</i>), <i>Olearia floribunda</i> , Swamp Weed (<i>Selliera radicans</i>), Lemon Beauty-heads (<i>Calocephalus citreus</i>), <i>Hakea</i> sp. and Blueberry Lily (<i>Dianella revoluta</i>).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Euphrasia collina</i> subsp. <i>osbornii</i>	Osborn's Eyebright	Occurs in the critically endangered ecological community – Swamps of the Fleurieu Peninsula. This species is confined to SA and has been collected in the Upper SE (Yumali-Meningie road), on eastern Kangaroo I. (Dudley Peninsula-W of Cape Willoughby), Eyre Peninsula (Venus Bay), Yorke Peninsula, Northern Lofty region (Clare, Burra), Southern Lofty region (including Fleurieu Peninsula and Mt Compass) and the Flinders Ranges. The species has generally been recorded as growing in mallee scrubland but has also been found growing in sclerophyll forest and sometimes in sclerophyll woodland. It is also found in heathy openings in wet sclerophyll forest and in a swamp at Mt Compass (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Frankenia plicata</i>		not relevant: occurs only in northern South Australia	
<i>Glycine latrobeana</i>	Clover Glycine, Purple Clover	In Southern Australia this species is found on undulating plains, gentle south-west facing ridge slopes and lower south facing river valley slopes. The soils in which Clover Glycine is found are sandy or loamy sand with and pH of 5.5- 6, and are reported to have a water retaining capacity. In the south-east of South Australia Clover Glycine has been "collected beneath Bracken in scrub and from woodland of <i>Eucalyptus baxteri</i> with <i>Banksia</i> lower cover". The Iron-grass Natural Temperate Grassland of South Australia ecological community provides potential habitat for Clover Glycine.	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Olearia pannosa</i> subsp. <i>pannosa</i>	Silver Daisy-bush	Occurs in mallee, woodland and forest communities. Also recorded in low heath scrub associated with <i>Acacia calamifolia</i> , <i>Eucalyptus gracilis</i> and <i>E. diversifolia</i> . Occurs predominantly on slopes, on hard, pedal, mottled-yellow duplex soils and hard, pedal, red duplex soils. Also occurs in areas with flat, sandy terrain, and woodland or mallee areas with rocky soils. Recorded in road-side vegetation from Strathalbyn to Sandergrove, in <i>Eucalyptus dumosa</i> open scrub over <i>Melaleuca lanceolata</i> , <i>Bursaria spinosa</i> and <i>Lomandra effusa</i> . In the Waitpinga and Finnis area recorded with <i>Eucalyptus fasciculosa</i> , <i>Acacia acinacea</i> , <i>Xanthorrhoea semiplana</i> and <i>Bursaria spinosa</i> as well as mixed <i>Eucalyptus fasciculosa</i> , <i>E. socialis</i> low woodland. In Newland Head CP recorded with <i>Eucalyptus diversifolia</i> in low heath (from DEH SA).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Prasophyllum frenchii</i>	Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid	Occurs in the critically endangered ecological community – Swamps of the Fleurieu Peninsula <i>Prasophyllum frenchii</i> occurs in the lower south-east of South Australia and Victoria. According to DEH (SA, SE region, pers. comm., Nov 2009), <i>P. frenchii</i> occurring around Goolwa are now reclassified as <i>P. murfettii</i> , and <i>P. frenchii</i> are recognized as occurring only in the Lower SE of SA, outside and well away from the Ramsar site and project area.	Not likely to occur; not recorded in southern Coorong area (BDB SA)

Species	Common Name	Habit Description	Likelihood of Occurrence
<i>Prasophyllum murfetii</i>	Fleurieu Leek Orchid	<i>Prasophyllum murfetii</i> occurs on the Fleurieu Peninsula, south of Adelaide. <i>Prasophyllum murfetii</i> is endemic to South Australia. The species occurs in two locations on the Fleurieu Peninsula south of Adelaide: the Mount Compass area, and the Parawa area near the southern tip of the Fleurieu Peninsula. These two locations are separated by the broad Inman Valley that does not have any suitable habitat for the species. Suitable habitat for <i>Prasophyllum murfetii</i> occurs in swampy sites in low-lying areas around the margins of permanent swamps or lakes. It is found on brown to black, wet, loam soils and occurs at altitudes from 0 to 300 m.	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Prasophyllum pallidum</i>	Pale Leek-orchid	Pale Leek-orchid is known singly or in groups in well-grassed open forests from the Flinders Ranges to the Northern and Southern Lofty regions of South Australia, also referred to as the Lofty Block of the Interim Bio-Regions of Australia (State Herbarium of South Australia, 2007). The distribution of this species is known to overlap with the following EPBC Act-listed threatened ecological communities: • Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions, • Swamps of the Fleurieu Peninsula, • Iron-grass Natural Temperate Grassland of South Australia, and • Peppermint Box (<i>Eucalyptus odorata</i>) Grassy Woodland of South Australia.	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Pterostylis arenicola</i>	Sandhill Greenhood Orchid	Sandhill Greenhood Orchid is endemic to South Australia and is restricted to a small proportion of its former distribution. It is known from several populations at Tailern Bend, Grange, Potters Scrub in Coorong National Park, Potalloch (near Meningie), and other locations on the Narrung Peninsula. Sandhill Greenhood Orchid occurs within mallee and native pine woodland. The overstorey of the mallee communities are usually dominated by <i>Eucalyptus porosa</i> , <i>Eucalyptus diversifolia</i> , <i>Acacia pycnantha</i> and <i>Allocasuarina verticillata</i> , with understorey typically composed of open shrub, heath, sedge and grass. The native pine communities are dominated by <i>Callitris preissii</i> and <i>Allocasuarina verticillata</i> , with understoreys consisting mainly of native grass and saltbush. This species generally occurs on sloping or undulating sites on sand and sandy loam. Sandhill Greenhood Orchid occurs in areas with mild winters and warm to hot summers with winter dominant rainfall ranging from 320 to 470 mm (from DEWHA SPRAT).	Unlikely to occur
<i>Pterostylis cucullata</i>	Leafy Greenhood	The Leafy Greenhood is known from four locations in the Mount Lofty Ranges, east of Adelaide, and potentially a fifth location in the south-east of the State (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Senecio macrocarpus</i>	Large-fruit Fireweed, Large-fruit Groundsel	In South Australia, Large-fruit Fireweed occurs most commonly in depressions in low lying closed sedgeland but may occur in sedgeland, hermland, low shrubland to low open woodland where competition from understorey plants is low. The soils range from clay to loamy sand (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)

Species	Common Name	Habit Description	Likelihood of Occurrence
<i>Tecticornia flabelliformis</i>	Bead Glasswort	Salt-tolerant and usually associated with saline environments, such as inland saline flats, evaporation pans and the margins of salt lakes, coastal tidal flats, and coastal or sub-coastal salt pans and clay pans. Reported to grow in wet, blue-grey, fine, silty muds, and on sandy soils with a high kopi (flour gypsum) content. Can tolerate a very wide range of soil moisture content (Coleman and Cook unpublished data). Commonly forms monospecific low shrublands or grows in mixed stands with other Samphires species such as <i>Halosarcia</i> spp., <i>Sclerostegia</i> spp., <i>Sarcocornia</i> spp and <i>Atriplex paludosa</i> (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Thelymitra cyanapicata</i>	Blue Top Sun-orchid, Dark-tipped Sun-orchid	Endemic to South Australia, the Blue Top Sun-orchid is known only in one location on the Fleurieu Peninsula near Kuinto (State Herbarium of South Australia 2007). The extent of occurrence of the Blue Top Sun-orchid is estimated to be 1 km ² (SA DEH 2007a; State Herbarium of South Australia 2007). Distribution is severely fragmented, with a total known population size of 130 individuals. This species can be found in low-lying seepages, creeks and swamps with wet, sandy soils (J. Quarmby 2007, pers. comm.). It is known to occur in Manna Gum (<i>Eucalyptus viminalis</i>), Messmate (<i>Eucalyptus obliqua</i>) open swampy woodland with a dense understorey of tea-tree, sedges, rushes and ferns including Prickly Tea-tree (<i>Leptospermum continentale</i>), Totem-poles (<i>Melaleuca decussata</i>), Blackwood (<i>Acacia melanoxylon</i>), Golden Spray (<i>Viminaria juncea</i>), Sword Grass (<i>Gahnia sieberiana</i>), Black Bristle-sedge (<i>Chorizandra enodis</i>), <i>Juncus</i> sp. and Leafless Globe-pea (<i>Sphaerolobium vimineum</i>).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	Shoreline in association with <i>Melaleuca</i> woodlands. In South Australia, scattered populations have been recorded in the South East, Murray Darling Basin and the Eyre Peninsula Natural Resource Management Regions. It is now considered extinct in the Southern Mt Lofty Ranges.	May occur (DEH, SA), recorded near Salt Creek..
<i>Thelymitra matthewsii</i>	Spiral Sun-orchid	<i>Thelymitra matthewsii</i> favours open forests and woodlands in well-drained sand and clay loams. It is a post-disturbance coloniser that is usually found in open areas around old quarries and gravel pits, on road verges, disused tracks and animal trails. It has been recorded as growing on gravelly soils in disturbed areas of low coastal forest, in swampy soils, on lateritic podsol on gently sloping plateaus or from sand overlying limestone on undulating plain (from DEWHA SPRAT).	Not likely to occur; recorded from Messent CP, but not in southern Coorong area (BDB SA)

BDB SA = Biological Data Base of South Australia

3.5.4 Likelihood of Occurrence of Faunal EPBC-listed Threatened and Migratory Species

Table 10 summarises the key habitat of faunal threatened and migratory species identified as potentially occurring in the project area by an EPBC Protected Matters Report, and the likelihood of their occurrence there. In addition, baseline marine survey work undertaken in the marine environment adjacent to the project area found no EPBC listed species in either infauna or epifauna sampling (Rowling et al 2010 Appendix P1).

Table 10. Threatened (Th), migratory (Mi) and marine (Ma) EPBC-listed fauna species potentially occurring within the project area, habitat and likelihood of occurrence

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
Birds							
<i>Apus pacificus</i>	Fork-tailed Swift			✓	✓	Low to very high airspace over almost any habitat. Non-breeding summer migrant, which seldom lands in Australia.	Liikely to occur: recorded rarely from Coorong South Lagoon and southern Youngusband Peninsula (BDB SA)
<i>Ardea alba</i>	Great Egret, White Egret			✓	✓	Wetlands, flooded pastures, dams, estuarine mudflats. In Australia, the breeding season of the Great Egret is variable, depending to some extent on rainfall, but generally extends from November to April, with pairs at southern latitudes breeding in spring and summer (particularly November and December). Regularly use saline habitats: estuaries & mudflats mainly in summer & autumn or as a drought refuge.	Likely to occur: Ramsar site: recorded, populations declining; Coorong: recorded, populations declining between 2002 - 2005 (Kerr, 2009)
<i>Ardea ibis</i>	Cattle Egret	Rare		✓	✓	Moist pastures with tall grass, shallow open wetlands and margins, mudflats. Use of saline habitats is rare. Cattle Egrets nesting in Australia migrate to cooler Tasmania and New Zealand in the winter and return in the spring (from Kerr, 2009).	May occur. Ramsar site; recorded in Lower Lakes area; Coorong: not recorded between 2002 - 2005
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper			✓	✓	Fresh or salt wetlands, the muddy edges of lagoons, swamps, dams, soaks, temporary floodwaters. Nonbreeding summer migrant to Australia. Arrive in SA mid-Aug Dec-Jan and depart mid- Feb (Kerr, 2009).	Likely to occur. Recorded from Coorong South Lagoon (more on the mainland side), southern Youngusband Peninsula (BDB SA. Ramsar site: common, variable; Coorong common, variable (Kerr, 2009)
<i>Calidris alba</i>	Sanderling	Rare		✓	✓	The Sanderling, a small wader, is a circumpolar Arctic breeder, and is a long-distance migrant, wintering south to South America, South Europe, Africa, and Australia. It is a complete migrant, travelling between 3,000 to 10,000 km from its breeding grounds to its wintering sites. Habitat: mostly open sandy beaches exposed to open sea-swell, also on exposed sandbars and spits, and shingle banks. Less often on more sheltered sandy shorelines of estuaries, inlets and harbours. Rarely near coastal wetlands e.g. lagoons, hypersaline lakes, saltponds, and samphire flats. Coorong: roost on the sheltered shores. Non-breeding migrant – arrive in SA October & depart Australia March – April (Kerr, 2009).	Likely to occur. Recorded from Coorong South Lagoon (BDB SA). Ramsar site: Rare, variable; Coorong: rare, variable (Kerr, 2009), recorded mainly on beach Murray Mouth (D. Paton pers. comm.)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Calidris ferruginea</i>	Curlew Sandpiper			✓	✓	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, also round non-tidal swamps, lakes and lagoons near coast. Less often recorded inland around ephemeral and permanent wetlands with bare edges of mud or sand. Occasionally round floodwaters. Non-breeding migrant – arrive in SA late Aug- Sep and depart late Mar to Apr (Kerr, 2009).	Likely to occur. Recorded from Coorong South Lagoon and southern Youngusband Peninsula (BDB SA). Ramsar site: trend variable; Coorong: trend declining
<i>Calidris ruficollis</i>	Red-necked Stint			✓	✓	Sheltered inlets, bays, lagoons, and estuaries with intertidal mudflats, often near spits, islets and banks, sometimes on protected sandy shores, occasionally on exposed or open beaches, sometimes on stony or rocky shores. Also occur on saltmarsh, ephemeral or permanent shallow wetlands near coast or inland. Non-breeding migrant – arrive in SA late Aug – Nov and depart Feb - March (Kerr, 2009).	Likely to occur. Recorded from Coorong South Lagoon and southern Youngusband Peninsula (BDB SA). Ramsar site: common, variable; Coorong: common, trend declining (Kerr, 2009); declining sharply (D. Paton, pers. comm.)
<i>Calyptorhynchus lathamii halmaturinus</i>	Glossy Black-Cockatoo (Kangaroo Island), Glossy Black-Cockatoo (South Australian)	Endangered	✓			The main distribution of Glossy Black Cockatoo is on Kangaroo Island (SA). All the mapped <i>Allocasuarina verticillata</i> habitat on the island may be regarded as critical to the survival of the SA Glossy Black-Cockatoo. On the mainland, the Southern Fleurieu Peninsula is likely to be the main region supporting critical habitat. In the next five years, it is unlikely that GBCs will make more than irregular forays in small groups to forage on the mainland (from Recovery Plan for the South Australian subspecies of the Glossy Black-cockatoo (<i>Calyptorhynchus lathamii halmaturinus</i>): 2005-2010)	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Catharacta skua</i>	Great Skua	Vulnerable			✓	Breeds in New Zealand, on Antarctica, and on many islands in the southern hemisphere. Ranges over the northern and southern oceans; habitat: coastal moorlands and rocky islands and outcrops.	Unlikely to occur; not recorded in southern Coorong area (BDB SA)
<i>Cinclosoma punctatum anachoreta</i>	Spotted Quail-thrush (Mt Lofty Ranges)	Endangered	✓			Spotted Quail-thrush (Mt Lofty Ranges) is known only from one location in South Australia, has an estimated extent of occurrence of 10km ² and area of occupancy is estimated to be 1km ² . Last recorded in 1984.	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Diomedea amsterdamensis</i>	Amsterdam Albatross		✓	✓	✓	The Amsterdam Albatross is a marine, pelagic seabird. It nests in open patchy vegetation (among tussocks, ferns or shrubs) near exposed ridges or hillocks. It sleeps and rests on ocean waters when not breeding. The Amsterdam Albatross is migratory or dispersive (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Diomedea dabbenena</i> / <i>Diomedea exulans exulans</i>	Tristan Albatross		✓	✓	✓	The Tristan Albatross is a marine, pelagic seabird. It forages in open water in the Atlantic Ocean near the Cape of Good Hope, South Africa. It sleeps and rests on ocean waters when not breeding (from DEWHA SPRAT).	Very unlikely to occur, but habitat provided by the Coorong is unlikely to be of significance to this species.
<i>Diomedea epomophora (sensu stricto)</i>	Southern Royal Albatross	Vulnerable	✓	✓	✓	The Southern Royal Albatross is marine and pelagic. It occurs in subantarctic, subtropical and occasionally Antarctic waters. It nests on flat or gently sloping ground on slopes, ridges, gullies and plateaux of large islands, and on the summits of islets (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Diomedea epomophora sanfordi</i>	Northern Royal Albatross	Endangered	✓	✓	✓	The Northern Royal Albatross is marine, pelagic and aerial. Its habitat includes subantarctic, subtropical, and occasionally Antarctic waters. It nests on flat or gently sloping ground, on slopes, ridges, gullies and plateaux of large islands, and on the summits of islets (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Diomedea exulans (sensu lato)</i>	Wandering Albatross	Vulnerable	✓	✓	✓	Wandering Albatrosses are highly dispersive and have been identified 10 000 kilometres from where they were banded and adults may forage hundreds to thousands of kilometres during breeding season. The Albatross frequents the Southern Ocean and a breeding colony is located on Macquarie Island. The Wandering Albatross visits Australian waters from Fremantle WA to northern NSW between June and September each year. At other times birds roam the southern oceans and commonly follow fishing boats for several days. They spend most of their life in flight, landing only to breed and feed (SA Water, SA Government).	May occur, but uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species
<i>Diomedea gibsoni</i>	Gibson's Albatross		✓	✓	✓	This species is endemic to New Zealand and forages within the Tasman Sea and South Pacific Ocean. Individuals have also been known to forage in South-eastern Australian waters from Coff's Harbour to Wilson's Promontory (SA Water, SA Government).	Not likely to occur; not recorded in southern Coorong area (BDB SA).
<i>Gallinago hardwickii</i>	Latham's Snipe, Japanese Snipe	Rare		✓		This species a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia. The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia but breeds in Japan and eastern Russia. Habitat is usually overgrown river-flats, swamps and marshes (SA Water, SA Government). (Kerr, 2009).	Not likely to occur; Ramsar site including Coorong: not recorded in past 6 years (Kerr, 2009)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Endangered		✓	✓	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats. Birds have been recorded at or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs, saltmarsh and sewage ponds. They also occur at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas. Breeding has been recorded on the coast, at inland sites, and on offshore islands. The White-bellied Sea-Eagle generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore, where they forage over in-shore waters (from DEWHA SPRAT).	Likely to occur. Recorded from Coorong South Lagoon and southern Youngusband Peninsula (BDB SA)
<i>Halobaena caerulea</i>	Blue Petrel		✓		✓	The Blue Petrel is a small seabird with a circumpolar distribution, breeding near the Antarctic Polar Front. Blue Petrels forage in Australian and New Zealand waters and sightings at Macquarie Island have been made (SA Water, SA Government).	Very unlikely to occur; recorded in Coorong region (BDB SA); however critical habitat for the species does not occur in the project area.
<i>Hirundapus caudacutus</i>	White-throated Needletail			✓	✓	This species is moderately common in Australia but is locally common on the east coast and ranges. Mainly an aerial species. Individuals begin reaching Australian shores in early October and begin departing in March. White-throated Needletails are almost exclusively aerial, often seen flying over trees, below canopy, over most types of habitat but often over wooded areas, including open forest and rainforest, usually in flocks. (SA Water, SA Government)	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Hylacola pyrrhopygia parkeri</i>	Chestnut-rumped Heathwren (Mt Lofty Ranges)		✓			The Chestnut-rumped Heathwren (Mount Lofty Ranges) occurs in dense heathland and undergrowth in <i>Eucalyptus</i> forests and woodlands, and is most commonly found in rocky areas (such as those that occur on hillsides). The vegetation in these areas consists of a mixture of dense shrubs (such as <i>Banksia</i> , <i>Hakea</i> and <i>Leptospermum</i>), grass trees <i>Xanthorrhoea</i> and ferns <i>Pteridium</i> , beneath a canopy of Eucalyptus trees (including <i>E. obliqua</i> and <i>E. odorata</i>) and (in at least some sites) scattered <i>Allocasuarina</i> trees (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Larus novaehollandiae</i>	Silver Gull				✓	Coasts and islands. inland near large expanses of water.	Very likely to occur.
<i>Lathamus discolor</i>	Swift Parrot	Endangered	✓		✓	Inhabits forests and woodlands with flowering trees (Morcombe 2003). The Ramsar site is at the extreme western edge of their autumn / winter migratory range.	May occur; recorded in Coorong region (BDB SA)
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	✓	✓		The Malleefowl occurs in semi-arid and arid zones of temperate Australia, where it occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine <i>Callitris</i> woodlands, acacia shrublands, Broombush <i>Melaleuca uncinata</i> vegetation or coastal heathlands. The breeding habitat of the Malleefowl, within its home range, is characterised by light soil and an abundant leaf litter, which is used in the construction of nesting mounds. The Malleefowl sometimes forages in open areas located near more typical habitat i.e. in grasslands, crop fields and around roads (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Limnodromus semipalmatus</i>	Asian Dowitcher				✓	Does not breed in Australia; marine intertidal mud-flats and salt marshes, saltmarshes (from http://www.birdlife.org)	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Macronectes giganteus</i>	Southern Giant-Petrel	Vulnerable	✓	✓	✓	The Southern Giant-Petrel is marine bird that occurs in Antarctic to subtropical waters. In summer, it mainly occurs over Antarctic waters, and it is widespread south as far as the pack-ice and onto the Antarctic continent. It occurs in both pelagic and inshore waters. The Southern Giant-Petrel breeds on the Antarctic Continent, Peninsula and islands, and on subantarctic islands and South America (from DEWHA SPRAT).	May occur. Not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on population trends (Kerr, 2009)
<i>Macronectes halli</i>	Northern Giant-Petrel		✓	✓	✓	The Northern Giant-Petrel is marine and oceanic. It mainly occurs in sub-Antarctic waters. During its first year, it probably occurs mainly on continental shelves, slopes and cold eastern boundary currents off South America, South Africa, Australia and New Zealand. It may be more oceanic from its second year. It is attracted to land at sewage outfalls, and scavenges at colonies of penguins and seals. The Northern Giant-Petrel breeds on sub-Antarctic islands (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Merops ornatus</i>	Rainbow Bee-eater			✓		The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	Endangered	✓	✓		Throughout the year Orange-bellied Parrots are found in salt marshes, coastal dunes, pastures, shrub lands, estuaries, islands, beaches and moorlands within 10 km of the coast (OBPRT 2006a). The breeding habitat of the Orange-bellied Parrot is usually within 30 km of the coast of south-western Tasmania. During winter, on mainland Australia, Orange-bellied Parrots are found mostly within 3 km of the coast. In South Australia, they are found mostly on beaches and coastal dunes, but also sometimes at the edges of estuaries and coastal lagoons. In these habitat types they are mostly found among colonising plants, especially Sea Rocket (<i>Cakile maritima</i>) growing on beaches above the high tide mark, in dune frontages and blowouts. They are also found in <i>Sarcocornia</i> dominated saltmarsh, including patches growing in sediment-deposits in drains. They were once recorded in coastal scrub on a cliff top. During winter on the mainland Orange-bellied Parrots have been recorded roosting in dense clumps of Coastal Tea-tree (<i>Leptospermum laevigatum</i>) or Melaleuca, in extensive <i>Sclerostegia</i> shrublands within salt marsh and in clumps of boxthorn (<i>Lucium</i>). At Carpenter Rocks, South Australia, they have been recorded roosting among thickets of Coastal Wattle, Coast Beard Heath (<i>Leucopogon parviflorus</i>) and Coast Daisy-bush (<i>Olearia axillaris</i>) and in dense Eucalyptus and Melaleuca woodland dominated by Moonah (<i>Melaleuca lanceolata</i>) (from DEWHA SPRAT).	Rare but likely to occur. The orange-bellied parrot has been observed on the Youngusband Peninsula and elsewhere in the Coorong National Park (BDB SA). The recent 2008 Winter survey lists several sightings of up to 4 birds on the northern end of the Youngusband Peninsula near the Murray Mouth on saltmarsh at "the Snake Pit" (Ehmke and Jones, 2008); in winter 2006 and 2007, sightings were made around Parnka Point and the northern end of the South Lagoon.
<i>Pachycephala rufogularis</i>	Red-lored Whistler	Rare	✓			Found in dense low broombush or mallee heath, native pine and stringybark banksia heath with groundcover of shrubs and spinifex. Present range in Southern Australia: Ninety-Mile Desert, Billiatt Conservation Park (CP), Danggali CP, Bookmark Biosphere Reserve, along Murray R. and northern Eyre Peninsula. Breed where mallee eucalypts 5-8 m tall form an open canopy over a moderately dense and diverse but patchy shrub layer. Birds dispersing in the non-breeding season can occupy a variety of other woodland habitats. The Ramsar site is to the south and west of likely range and predicted habitat (from Kerr, 2009).	Recorded from southern Coorong area (BDB SA). However the project area is not likely to provide critical habitat to this species.

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Pluvialis fulva</i>	Pacific Golden Plover	Rare		✓	✓	Inhabit sandy, muddy or rocky shores, estuaries and lagoons, reefs, saltmarsh, and short grass in paddocks and crops, usually coastal. Often on beaches and mudflats, also sandflats, in estuaries and lagoons. Terrestrial subcoastal wetlands such as fresh, brackish or saline lakes, billabongs and swamps usually with muddy margins and often with submerged vegetation or short emergent grass. Also on saltmarsh. Non-breeding summer migrant to Australia. Arrive in Australia Sep- Nov, moving down east coast and across inland routes reaching SA in Oct-Nov. Leave Australia mid-Feb to May. Small numbers of birds remain in non-breeding range throughout the southern winter (Kerr, 2009).	Likely to occur. Recorded from Coorong South Lagoon area (BDB SA) but not in last 10 years (D. Paton pers. comm.); most likely to occur Nov - March. Coorong: population trends variable but possible medium-term decline (Kerr, 2009)
<i>Psophodes nigrogularis leucogaster</i>	Western Whipbird (eastern)	Endangered	✓			The Western Whipbird (eastern) inhabits mallee and thicket vegetation in coastal and inland areas of southern South Australia. It usually occurs in habitats that have an open layer of mallee about 3–5 m tall and an understorey of dense shrubs about 1.5–2 m tall. It occurs in mallee scrub on sand flats, dunes and limestone that consists of an overstorey of mallee eucalypts and characterised by a dense species-rich heath understorey of shrubs (from DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Pterodroma mollis</i>	Soft-plumaged Petrel		✓		✓	This species of petrel has a large range including South America, Antarctica, New Zealand, South Africa and Australia. The species is pelagic and has been sighted in Australian waters (SA Water, SA Government).	Very unlikely to occur, but uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species
<i>Rostratula australis</i>	Australian Painted Snipe		✓	✓	✓	Inhabits wetlands with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire, often with scattered clumps of lignum, canegrass or Melaleuca (Kerr, 2009).	Not likely to occur; not recorded in southern Coorong area (BDB SA); not recorded in Coorong 2000 - 2005 or Ramsar site 2002 - 2009 (Kerr 2009)
<i>Rostratula benghalensis s. lat.</i>	Painted Snipe	Vulnerable		✓	✓	Inhabits wetlands with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire, often with scattered clumps of lignum, canegrass or Melaleuca (Kerr, 2009).	Not likely to occur; not recorded in southern Coorong area (BDB SA); not recorded in Coorong 2000 - 2005 or Ramsar site 2002 - 2009 (Kerr 2009)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Sterna</i> (now <i>Sternula</i>) <i>albifrons</i>	Little Tern	Endangered		✓	✓	Mainly inhabits lagoons, estuaries, river mouth and deltas, lakes, bays, harbours and inlets, also on sandy ocean beaches (wide and flat or gently sloping). The little tern is migratory. Three separate populations of one subspecies are found in Australia. The east and north Australian populations breed. The east Australian population moves north to Java, the Lesser Sundas etc, but the range is not well understood. The east Australian population occasionally breeds in SA. Breeds in spring and summer on sandspits, banks, ridges or islets in sheltered coastal environments, usually within 150 m of tideline (Kerr, 2009).	May occur. Uncommon in SA, where recorded from Coorong among other locations. Ramsar site: not recorded since 2002; Coorong: have bred on islands in the Coorong but not recorded 2000 - 2005 (Kerr, 2009)
<i>Sterna</i> (now <i>Thalasseus</i>) <i>bergii</i>	Great Crested Tern, Crested Tern, Swift Tern				✓	The great crested tern forages in the shallow waters of lagoons, coral reefs, estuaries, along all types of shoreline, and also far out to sea in open water. Nesting sites are usually located on offshore islands, low-lying coral reefs, coastal islets, spits, and lagoons (from http://www.arkive.org).	Recorded from Coorong South Lagoon and southern Youngusband Peninsula (BDB SA). Ramsar site: steep decline in Lower Lakes; Coorong: variable but stable numbers
<i>Sterna</i> (now <i>Hydroprogne</i>) <i>caspia</i>	Caspian Tern			✓	✓	The breeding, passage and wintering habitats of this species are similar, although during the winter it is largely confined to the coast. It frequents sheltered sea coasts, estuaries, inlets, bays, harbours, coastal lagoons, saltmarshes and salt pans, also occurring inland on fresh or saline wetlands including large lakes, inland seas, large rivers, creeks, floodlands, reservoirs and sewage ponds. When breeding the species shows a preference for nesting on sandy, shell-strewn or shingle beaches, sand-dunes, flat rock-surfaces, sheltered reefs or islands with sparse vegetation and flat or gently sloping margins surrounded by clear, shallow, undisturbed waters. It also forms winter roosts on sandbars, mudflats and banks of shell. (http://www.birdlife.org). Movement poorly known in Australasia. Partly resident, partly dispersive and, possibly partly migratory (Kerr, 2009).	Likely to occur. Ramsar site: steep decline in Lower Lakes; Coorong S Lagoon: variable but stable numbers (Kerr, 2009)
<i>Sterna fuscata</i> (now <i>Onychoprion fuscatus</i>)	Sooty Tern				✓	Breeding It breeds on flat, open, sparsely or heavily vegetated, oceanic or barrier islands of sand, coral or rock in productive tropical and subtropical offshore waters rich in plankton, fish and squid. It is absent from cold current areas and generally avoids islands with terrestrial predators. Non-breeding Outside of the breeding season the species is highly pelagic but generally avoids cold current areas (from http://www.birdlife.org).	Rare vagrant in SA; Ramsar site: not recorded in past 6 years

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Sterna</i> (now <i>Sternula</i>) <i>neréis</i>	Fairy Tern	Endangered			✓	Though it may be stable in Western Australia, numbers elsewhere in Australia have declined rapidly during the last thirty years. It breeds on sheltered mainland coastlines and close islands, usually on sandy beaches. It feeds almost entirely on fish. It lays one or two eggs. In South Australia inappropriate water level management has lead to a collapse in the numbers of prey fish, and a subsequent decline in colonies (from www.birdlife.org).	Recorded from Coorong South Lagoon and southern Youngusband Peninsula (BDB SA). Ramsar site; not recorded / rare in Lower Lakes; Coorong S Lagoon: variable numbers, no longer breeding in region.
<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (Fleurieu Peninsula), Mount Lofty Southern Emu-wren	Endangered	✓	✓		The Coorong subspecies of Southern Emu-wren is not EPBC-listed	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Thalassarche bulleri</i>	Buller's Albatross	Vulnerable	✓	✓	✓	During the breeding season the majority of these birds forage around Southern New Zealand, however, they have been sighted around Tasmania and west of the Eyre Peninsula (SA Water, SA Government).	Very unlikely to occur; not recorded in southern Coorong area (BDB SA)
<i>Thalassarche cauta</i> (<i>sensu stricto</i>)	Shy Albatross, Tasmanian Shy Albatross	Vulnerable	✓	✓	✓	The Shy Albatross is a marine species occurring in subantarctic and subtropical waters, reaching the tropics in the cool Humboldt Current off South America. During the non-breeding season, the Shy Albatross occurs over continental shelves around continents. The species occurs both inshore and offshore and enters harbours and bays. The birds are scarce in pelagic waters (DEWHA SPRAT).	Not likely to occur; not recorded in southern Coorong area (BDB SA). Uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species.
<i>Thalassarche cauta salvini</i>	Salvin's Albatross	Vulnerable	✓	✓	✓	This species is common in Australian seas, north to about Robe SA and Sydney NSW and is found to be progressively less common further north (SA Water, SA Government).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Thalassarche chlororhynchus</i>	Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Endangered		✓	✓	Little is known about this species. It is most common between 150 bS and 500 S in the southern Atlantic Ocean, over both pelagic and inshore waters. Adults may forage far from their southern breeding grounds. Post-breeding adults and juveniles disperse to become abundant off the east coast of South America and the west coast of Southern Africa. They are very rarely seen in Australian waters (SA Water, SA Government).	Low likelihood of occurrence; not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on population trends or Coorong (Kerr, 2009). Habitat provided by the Coorong is unlikely to be of significance to this species.

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Thalassarche chrysostoma</i>	Grey-headed Albatross	Vulnerable	✓	✓	✓	The Grey-headed Albatross is a marine species. It can be found in the Pacific, Indian and Atlantic oceans. In winter, most leave the Antarctic Zone and their range extends into the southern Subtropics. The species breeds on subantarctic and Antarctic islands of the Indian and Atlantic Oceans and seas south of New Zealand. Nests of the Grey-headed Albatross are found on tussock-covered cliffs, steep slopes and hillsides overlooking the sea, or run inland from the coast (from DEWHA SPRAT).	Recorded from southern Coorong area (BDB SA) but unlikely to occur. Uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species
<i>Thalassarche impavida</i>	Campbell Albatross		✓	✓	✓	This species breeds only on the Sub-Antarctic Ocean Campbell Island. Individuals are known to forage around New Zealand, Tasmania, Victoria and New South Wales (SA Water, SA Government).	Not likely to occur; not recorded in southern Coorong area (BDB SA)
<i>Thalassarche melanophris</i>	Black-browed Albatross	Vulnerable	✓	✓	✓	The Black-browed Albatross is probably the most widespread of all of the Albatross species occurring from the Antarctic ice sheet to the equator. These birds are known to be pelagic and forage off of the Southern Coast of Australia (SA Water, SA Government).	Low likelihood of occurrence; not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on numbers or Coorong (Kerr, 2009). Habitat provided by the Coorong is unlikely to be of significance to this species.

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Thinornis rubricollis rubricollis</i>	Hooded Plover (eastern)	Vulnerable			✓	The Hooded Plover (eastern) occurs in coastal areas, on or near high energy sandy beaches. They are generally found close to shore, but may occasionally visit sites located a short distance inland (e.g. lakes near the coast). Hooded Plovers (eastern) mainly inhabit sandy ocean beaches and their adjacent dunes. They have been claimed to have reasonably narrow preferences when it comes to beach habitat, but recent studies suggest that a variety of beach types may be used. Hooded Plovers (eastern) are sometimes found in habitats other than beaches, e.g. on rock platforms, reefs, around near coastal lakes and lagoons. Beaches occupied by Hooded Plovers (eastern) tend to be broad and flat, with a wide wave-wash zone for foraging and much beachcast seaweed, and backed by sparsely-vegetated sand-dunes that provide shelter and foraging and nesting sites. Hooded Plovers (eastern) visit saline and freshwater lakes and lagoons near the coast, especially during the non-breeding season, but the importance of these sites is not well known. They may use near-coastal lakes as a refuge from high levels of disturbance on adjacent beaches. The Hooded Plover (eastern) does not associate with any other species listed as threatened under the EPBC Act 1999, but it can co-occur with species listed at the state level such as Little Terns <i>Sterna (Sternula) albifrons</i> . It can also occur coincidentally near some other creatures (e.g. shorebirds, seals) that are listed as Marine and/or Migratory species under the EPBC Act 1999 (from DEWHA SPRAT).	Likely to occur. Coorong trend: uncommon but stable, 2000 - 2005. There is a Hooded Plover Recovery plan, under which about 110 km of the northern end of the Coorong Ocean Beach is closed to vehicles from 24 October to 24 December each year, specifically to protect the this species (SA Government 1993).
<i>Tringa nebularia</i>	Common Greenshank, Greenshank			✓	✓	Typically on large mudflats, and saltmarsh, mangroves or seagrass, including embayments, harbours, river estuaries, deltas and lagoons. Frequent permanent or ephemeral terrestrial wetlands including swamps, lakes and saltflats (Kerr, 2009).	Recorded from Coorong South Lagoon and southern Youngusband Peninsula (BDB SA). Populations have declined considerably; limited distribution in parts of South Lagoon (D. Paton, pers. comm.)
Mammals							
<i>Arctocephalus forsteri</i>	New Zealand Fur-seal				✓	New Zealand fur seals prefer rocky habitat with shelter, particularly on locations more exposed to wind and weather; they readily enter vegetation. Little is known of distribution at sea, although they apparently prefer waters of the continental shelf and slope. Diet: mainly cephalopods and fish, also seabirds.	Newly recorded in the Murray Mouth and Coorong North Lagoon; not historically in these locations
<i>Arctocephalus pusillus</i>	Australian Fur-seal, Australo-African Fur-seal	Rare			✓	Australian fur seals (<i>A. p. doriferus</i>) are found along the coast and continental shelf and slope waters from Victoria, along southern New South Wales, including Tasmania, and the islands of Bass Strait. They range up to 160 km offshore. On land, they have a decided preference for rocky habitat.	Likely to occur

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Balaenoptera acutorostrata</i>	Minke Whale	Rare			✓	Minke whales live at the surface of the ocean in all but polar seas.	Not likely to occur
<i>Balaenoptera edeni</i>	Bryde's Whale	Rare		✓	✓	Bryde's whales occur in tropical and sub-tropical waters all year round. They often feed on schooling fish and unlike the surface Sei Whales they are deep divers. They rarely venture beyond 40°S. Although their feeding grounds are well defined, location of breeding has not been identified (SA Water, SA Government).	Very unlikely to occur
<i>Balaenoptera musculus</i>	Blue Whale	Endangered	✓	✓	✓	Sighting records indicate that the Blue Whale may occur within all of Australian waters. Surveys have found Blue Whales to be feeding on the continental shelf along the coast of South Australia, however Western Australia is the only area within Australian waters which Blue Whales are found feeding annually (SA Water, SA Government).	Could occur
<i>Caperea marginata</i>	Pygmy Right Whale	Rare		✓	✓	This species lives in the Southern Hemisphere and is believed to be circumpolar, living in a band from about 300 S to 500 S in areas with surface water temperature between 5 and 20 degrees Celsius. Sightings occur in Tasmania year round and seasonally along the coasts of South Australia, New Zealand, South Africa, the Falkland Islands and some areas of the Antarctica. (SA Water, SA Government)	Could occur
<i>Delphinus delphis</i>	Common Dolphin, Short-beaked Common Dolphin				✓	Information on the species' habitats is only available from outside of Australia. In most areas where they have been studied, Common Dolphins appear to occur mainly in medium water depths over the continental shelf. Common Dolphins are usually found in areas where surface water temperatures are between 10°C and 20°C, and in habitats also inhabited by small epipelagic fishes such as anchovies and sardines (from DEWHA SPRAT).	Likely to occur in Commonwealth waters > 3 nm offshore

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Eubalaena australis</i>	Southern Right Whale	Vulnerable	✓	✓	✓	Habitat requirements have not been well studied. Early observations on calving grounds indicated a preference for water depth of less than 5 m; differential habitat use by calving females and unaccompanied whales has been documented. Females with calves occurred in shallower waters with a sandy bottom and closer to shore than whales without calves, presumably conditions preferred for energy conservation and calf rearing. A multi-scale study of Australian coastal habitat preference is underway utilising existing and new distribution and movement datasets and historic information. The feeding habitat is very poorly known. Based on sightings information, most feeding areas are thought to be in deeper offshore waters (sub-Antarctic areas to locations south of 60°S) in areas probably associated with high productivity. Migratory habitat parameters are unknown (from DEWHA SPRAT).	Likely to occur; recorded off Southern Coorong. The nearest important calving area is Middleton to Murray Mouth in Encounter Bay. The proposed outfall is >50 km from the outer extent of the marked calving zone and will not be affected by elevated salinity.
<i>Grampus griseus</i>	Risso's Dolphin, Grampus	Rare			✓	Risso's Dolphin occur mainly on steep sections of the upper continental slope, usually in waters deeper than 1000 m, in tropical and warm temperate latitudes. Risso's Dolphins show a marked preference not only for water greater than 1000m deep, but also for warm temperate to tropical conditions, although they do sometimes extend their range into cooler latitudes in summer (from DEWHA SPRAT).	Not likely to occur
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot	Vulnerable	✓			Southern Brown Bandicoots are usually associated with coastal or near-coastal heathlands and healthy woodlands over sandy soil however, they are also found in lowland forests with a healthy understorey or a dense cover of tussocky grasses or rushes and bracken. The critical habitat feature appears to be the dense cover of low growing vegetation (DSE Victoria).	Not recorded from South lagoon area or Youngusband Peninsula (BDB SA)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Lagenorhynchus obscurus</i>	Dusky Dolphin			✓	✓	Dusky Dolphins occur mostly in temperate and sub-Antarctic waters. They are considered to primarily inhabit inshore waters but may also be pelagic at times. All sightings of Dusky Dolphins in Australian waters have been correlated with abnormally warm sea surface temperatures (more than 0.5 °C above normal temperature). It is postulated that such oceanographic changes may promote conditions suitable for aggregation of Dusky Dolphin prey species, thereby increasing abundance of the dolphins. Dusky Dolphins are resident inshore for much of year but are known to seek out colder water (<18 C) as inshore temperatures rise in summer. Off Australia, the seasonal reports of Dusky Dolphin sightings suggest a causal link with changes in one or more oceanographic features in this region. Seasonal distribution of Dusky Dolphins may also coincide with El Niño Southern Oscillation (ENSO) events, which expand the extent of cold waters (from DEWHA SPRAT).	Not likely to occur
<i>Megaptera novaeangliae</i>	Humpback Whale	Vulnerable	✓	✓	✓	Humpback Whales breed and calve mainly off the northwest and northeast coasts of Australia. Locations along the west and east coasts are also used as resting places. Australian Antarctic Territory waters are important feeding grounds for both Australian populations of Humpback Whales.	Likely to occur
<i>Neophoca cinerea</i>	Australian Sea-lion	Vulnerable	✓		✓	Australian sea-lions typically breed and haul out on rocks and sandy beaches on the sheltered sides of islands, although there are several small colonies on the Australian mainland. An important feature of colony sites is shallow, protected pools in which pups congregate. The waters adjacent to breeding colonies are also important feeding areas. Breeding sites are all located in South Australia (at Dangerous Reef, The Pages Islands, West Waldegrave Island, Seal Bay and Olive Island).	Likely to occur
<i>Nyctophilus timoriensis</i> (South-eastern form)	Eastern Long-eared Bat		✓			River Red Gum forest, semi-arid woodlands and savannahs. It also occurs in box/ironbark/Callitris open forests and Buloke woodland in northern New South Wales and inland south-east Queensland. In South Australia it is confined to tall mallee shrublands north of the Murray River and is known to roost in hollows in <i>Eucalyptus gracilis</i> . In South Australia records are confined to north of the Murray River, east of Canegrass Station and south of the Barrier Highway (DEWHA, 1999).	Not likely to occur; not recorded in southern Coorong area (BDB SA)

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Orcinus orca</i>	Killer Whale, Orca			✓	✓	The preferred habitat of Killer Whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters. They may be more common in cold, deep waters, but off Australia, Killer Whales are most often seen along the continental slope and on the shelf, particularly near seal colonies. Killer Whales have regularly been observed within the Australian territorial waters along the ice edge in summer. The habitat of Killer Whales is difficult to categorise due to the cosmopolitan nature of the species and its ability to inhabit all oceans. Killer Whales are not part of, nor do they rely on, a listed ecological community. However, they do prey on other listed threatened species, such as Southern Elephant Seals in the subantarctic, plus other cetaceans (from DEWHA SPRAT).	Could occur
<i>Tursiops aduncus</i>	Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin				✓	In Australia, the Indian Ocean Bottlenose Dolphin is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands. Mixed groups of Indian Ocean Bottlenose Dolphins and Indo-Pacific Humpback Dolphins have been observed in east Africa and eastern Australia. Indian Ocean Bottlenose Dolphins are also known to associate with whales, such as Humpback Whales (from DEWHA SPRAT).	Not likely to occur
<i>Tursiops truncatus s. str.</i>	Bottlenose Dolphin				✓	Although Bottlenose Dolphins are primarily known from coastal waters around the world, in the Indian Ocean, and in Australia in general, they tend to inhabit offshore waters. Bottlenose Dolphins are found in tropical and temperate waters. They inhabit inshore areas such as bays, lagoons, fjords and estuaries, and nearshore (open coast) and offshore environments, including the coast of oceanic islands. They are associated with many types of substrate and habitats, including mud, sand, seagrasses, mangroves and reefs. Bottlenose Dolphins are known to associate with several cetacean species such as Pilot Whales, White-sided, Spotted, Rough-toothed and Risso's Dolphins, and Humpback and Right whales (from DEWHA SPRAT).	Likely to occur
Sharks							
<i>Carcharodon carcharias</i>	Great White Shark		✓	✓	✓	Great White Sharks are uncommon, however certain areas are prone to have more sightings of the shark including waters in and around seal and sea lion colonies such as the Pages in Kangaroo Island in South Australia. Great White Sharks are known to be transient and return to feeding grounds annually. (SA Water, SA Government). Live in open water to 1 km depth (Edgar, 2000).	Likely to occur

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Galeorhinus galeus</i>	School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark		✓			The School Shark is most abundant in cold to temperate continental seas, from the surfline and very shallow water to well offshore. The School Shark is often found near the sea bed, in waters between 2–471 m, but may range through the water column and extend into the pelagic zone (DEWHA SPRAT). The project site is well away from the important pupping areas in Tasmania and Victoria.	Likely to occur.
Fish							
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead		✓			This species inhabits the margins of slow, lowland rivers, and lakes, billabongs and backwaters. It is found amongst aquatic plants and over gravel beds in both fresh and highly saline waters (Wager & Jackson 1993). Adults are fairly saline tolerant, but little is known of pre-hardened eggs, recently shed and recently hatched larvae (T.A.Raadik 2002, pers. comm.).	Does not occur in the project area
<i>Maccullocheila peelii peelii</i>	Murray Cod, Cod, Goodoo		✓			The Murray Cod is found in a wide range of warm water habitats, from clear, rocky streams to slow-flowing turbid rivers and billabongs. Generally, they are found in waters up to 5 m deep and in sheltered areas with cover from rocks, timber or overhanging banks. The species is highly dependant on wood debris for habitat, using it to shelter from fast-flowing water (from DEWHA SPRAT).	Does not occur in the project area
<i>Nannoperca obscura</i>	Yarra Pygmy Perch		✓			The Yarra Pygmy Perch prefers slow flowing creeks or still lakes with abundant aquatic vegetation and log snags. It occurs in fresh and brackish waters (from DEWHA SPRAT).	Does not occur in the project area

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
Frog							
<i>Litoria raniformis</i>	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	Vulnerable	✓			This species is found mostly amongst emergent vegetation, including <i>Typha</i> sp. (bullrush), <i>Phragmites</i> sp. (reeds) and <i>Eleocharis</i> sp. (sedges), in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams. The Growling Grass Frog can be found floating in warmer waters in temperatures between 18–25°C. Breeding Habitat The Growling Grass Frog is dependent upon permanent freshwater lagoons for breeding. The ideal breeding habitat is the shallow part of lagoons (up to approximately 1.5 m) where there is generally a complex vegetation structure.	Not recorded in Coorong National Park. Not likely to occur: freshwater soaks may provide habitat but the species has not been recorded.
Syngnathids							
(NOTE: Habitat information is from Browne et al., 2008)							
<i>Acentronura australe</i>	Southern Pygmy Pipehorse				✓	Reef habitat (Browne et al., 2008)	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Campichthys tryoni</i>	Tryon's Pipefish				✓	No specific detail of preferred marine habitat appears to be available	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Heraldia nocturna</i>	Upside-down Pipefish				✓	Reef habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Hippocampus abdominalis</i>	Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse, Bigbelly Seahorse				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Hippocampus breviceps</i>	Short-head Seahorse, Short-snouted Seahorse				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Histiogamphelus cristatus</i>	Rhino Pipefish, Macleay's Crested Pipefish				✓	Mixed mosaic of margins of seagrass meadows, shelly or rubbly bottom, and sandy bottom with patchy seagrass or detritus	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Hypselognathus rostratus</i>	Knife-snouted Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Kaupus costatus</i>	Deep-bodied Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Leptoichthys fistularius</i>	Brushtail Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Lissocampus caudalis</i>	Australian Smooth Pipefish, Smooth Pipefish				✓	Mixed mosaic of margins of seagrass meadows, shelly or rubbly bottom, and sandy bottom with patchy seagrass or detritus	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Lissocampus runa</i>	Javelin Pipefish				✓	Mixed mosaic of margins of seagrass meadows, shelly or rubbly bottom, and sandy bottom with patchy seagrass or detritus	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Maroubra perserrata</i>	Sawtooth Pipefish				✓	Reef habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Notiocampus ruber</i>	Red Pipefish	Vulnerable			✓	Reef habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Phycodurus eques</i>	Leafy Seadragon				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Phyllopteryx taeniolatus</i>	Weedy Seadragon, Common Seadragon				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Pugnaso curtirostris</i>	Pug-nosed Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Solegnathus robustus</i>	Robust Spiny Pipehorse, Robust Pipehorse				✓	No specific detail of preferred marine habitat appears to be available	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Solegnathus spinosissimus</i>	Spiny Pipehorse, Australian Spiny Pipehorse				✓	No specific detail of preferred marine habitat appears to be available	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Stigmatopora argus</i>	Spotted Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Stigmatopora nigra</i>	Wide-bodied Pipefish, Black Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Stipecampus cristatus</i>	Ring-backed Pipefish				✓	Mixed mosaic of margins of seagrass meadows, shelly or rubbly bottom, and sandy bottom with patchy seagrass or detritus	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Urocampus carinirostris</i>	Hairy Pipefish				✓	No specific detail of preferred marine habitat appears to be available	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Vanacampus margaritifer</i>	Mother-of-pearl Pipefish				✓	Mixed mosaic of margins of seagrass meadows, shelly or rubbly bottom, and sandy bottom with patchy seagrass or detritus	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Vanacampus phillipi</i>	Port Phillip Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore

Species	Common Name	SA State listing	EPBC MNES			Habitat description	Likelihood of Occurrence
			Th	Mi	Ma		
<i>Vanacampus poecilolaemus</i>	Australian Long-snout Pipefish, Long-snouted Pipefish				✓	Seagrass and macroalgal habitat	Not likely to occur in Commonwealth waters > 3 nm offshore
<i>Vanacampus vercoi</i>	Verco's Pipefish				✓	Mixed mosaic of margins of seagrass meadows, shelly or rubbly bottom, and sandy bottom with patchy seagrass or detritus	Not likely to occur in Commonwealth waters > 3 nm offshore

MNES = matters of national environmental significance

Th = threatened, Mi = migratory, Ma = marine

3.5.5 Threatened Ecological Communities

An EPBC Protected Matters Report (see Appendix H) identified four threatened ecological communities as outlined in Table 11 below.

Table 11. Threatened ecological communities identified in an EPBC protected matters report.

Ecological community	Status	Regional distribution
Iron-grass Natural Temperate Grassland of South Australia	CE	South of Murray Bridge to south of Port Pirie, SA
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	E	Near Bordertown in South Australia through to the northwest of Victoria and south west of New South Wales
Peppermint Box (<i>Eucalyptus odorata</i>) Grassy Woodland of South Australia	CE	Southern Flinders Ranges to Lake Alexandrina
Swamps of the Fleurieu Peninsula	CE	Southern Mount Lofty Ranges; NE boundary of Lake Alexandrina; Finniss River; Currency Creek
CE = critically endangered; E = endangered		

Iron-grass Natural Temperate Grassland of South Australia

This vegetation structure can be described as ‘tussock grassland’ incorporating tussock-forming perennial and iron-grasses which dominate the ground layer, while a range of herbaceous plant species occurs in the inter-tussock spaces. Trees and tall shrubs are absent to sparse, making up less than 10% of the cover of the community. Iron-grasses, *Lomandra effusa*, are the dominant feature of this ecological community.

Iron-grass natural temperate grassland of South Australia generally occurs on gentle slopes of low hills above 380 m above sea level (DEWHA 2007). Although specimens of *Lomandra effusa* have been collected from the Coorong National Park and from near Policeman’s Point (Flora of South Australia), the iron-grass-dominated grassland habitat is uncommon in the region. The nearest iron-grass grassland habitat to the project area is approx 50 km (distribution map, DEWHA 2007).

Buloke Grassy Woodlands of the Riverina and Murray–Darling Depression Bioregions

The Buloke woodlands of the Riverina and Murray–Darling Depression Bioregions occur across the Riverina and Murray-Darling bioregions in tracts or patches within other habitats such as open forests or woodlands.

Buloke woodlands are characterised by the Buloke tree, which is a leafless Casuarina or Sheoak tree that grows to about 15 m and has twisted branchlets and cones. Buloke woodlands support many types of plants with a generally grassy understorey with native grasses such as wallaby grasses, as well as many herbs and smaller shrubs.

Buloke woodlands can be found from the far south east of SA near Bordertown through to Victoria’s northwest and northern plains and the south west of New South Wales (DEWHA 2008).

As this type of plant community is not found within 60 km of the Coorong (near the lower lakes: DEWHA 2008), it is not expected to be impacted by the project.

Peppermint Box Grassy Woodland of South Australia

The Peppermint Box, *Eucalyptus odorata*, grassy woodland of South Australia ecological community extends from the southern Flinders Ranges to Lake Alexandrina.

This community typically occurs on gentle to moderate slopes, hills above 380 m above sea level and adjacent plains (DEWHA 2007). The peppermint box communities nearest to the project area are west of the Lake Alexandrina (approximately 100 km) and at Mount Monster in the Upper South East (100 km). These communities are not expected to be impacted by the proposed project.

The Swamps of the Fleurieu Peninsula

The Swamps of the Fleurieu Peninsula ecological community are listed as a critically endangered under the EPBC Act. The Swamps of the Fleurieu Peninsula are geographically restricted to the Southern Mount Lofty

Ranges and are located on the north-eastern boundaries of Lake Alexandrina, and along the Finniss River and Currency Creek.

3.6 Commonwealth Areas

The nearest Commonwealth marine reserve is the Murray Commonwealth Marine Reserve (CMR), which begins approximately 6 km offshore from the Murray Mouth. The Murray CMR stretches south of the River Murray mouth off the SA coast for a distance of more than 400 km from the inshore State waters to the edge of Australia's Exclusive Economic Zone. The Murray CMR includes an extensive system of canyons. It covers some 25,803 km² – refer to <http://www.environment.gov.au/coasts/mpa/publications/southeast-murray-map.html>.

Commonwealth waters are located >5.66 km offshore from the project area along the Coorong Southern Ocean beach.

There are two parcels of Commonwealth Land situated near the southern shores of Lake Albert. This land is too far from the project site to be of relevance.

4. Nature and Extent of Likely Impacts

Potential impacts of relevance to matters of national environmental significance are considered throughout this Section. Key potential impacts considered for this assessment for each element of the proposal comprise:

Construction Phase

- Disturbance of plants and vegetative habitat on Youngusband Peninsula along the pipeline corridor.
- Short-term disturbance of nesting, foraging or feeding (threatened and migratory birds).
- Noise, dust or vibration impacts
- Indirect impacts.

Operational Phase

- Saline and nutrient plume in the Southern Ocean of more than 10% above background seawater salinity.
- Noise from generators and pumps.
- Potential acid sulphate soil formation as a result of lower water levels in the South Lagoon during pumping.
- Impact of the project on the characteristics of the Coorong North Lagoon.

Decommissioning Phase

- As for the construction phase outlined above.

4.1 World Heritage Properties

Given the distance to the nearest World Heritage listed property, no impact is expected.

4.2 National Heritage Places

Given the distance to the nearest National Heritage places, no impact is expected.

4.3 Species that Contribute to the Ramsar Status of the Site

Extremely high salinity levels have led to dramatic decreases in abundance of a number of keystone species, threatening the unique character of the wetlands in the area (Phillips and Muller, 2006; Paton et al., 2009a, 2009b). The objective of the proposal is to achieve biodiversity conservation through critical habitat restoration for a number of EPBC-listed bird species, including listed migratory bird species protected under international agreements, and restoration of the ecological character of the Ramsar listed wetland of the Coorong South Lagoon. The SLPS will significantly reduce the salt concentration within the south lagoon, preparing the site for future freshwater flows,

It is anticipated that approximately **12,000 ha (winter) / 8,000 hectares (summer) of aquatic habitat will be restored in the South Lagoon of the Coorong as a result of carrying out the SLPS** (this is the estimated total area of the South Lagoon water body). In addition, fringing vegetation and terrestrial vegetation, which are currently being impacted by having roots in excessively saline groundwater are also expected to benefit from the project. **Many species are expected to benefit from this habitat restoration.**

It is anticipated that **less than 4.5 ha of land will be affected by construction work**, and there are only **risks of limited or low negative impacts to a small number species** after mitigation measures are put in place. Furthermore these impacts are predicted to be temporary and given the predicted reduction in salinity, the project will provide enhanced conditions over current baseline.

It is anticipated that after pumping has led to a decline in salinity levels to around 100 - 110 ppt (from current levels of 170 ppt and higher), the South Lagoon will be able to be recolonised by the keystone species *Ruppia tuberosa* and chironomids which are still present at refuges in the North lagoon and within the salt Creek/Morella system. This recolonisation is necessary to allow the return of fish species listed under the ecological character description for the Ramsar site and EPBC-listed migratory and wetland bird species.

The potential for the project to impact upon species that contribute to the ecological character of the site and its Ramsar listing is considered here, building on the assessment of likelihood of occurrence in Tables 8-11. Tables 12- 16 give the likelihood of occurrence of each species in the project area and also an assessment of the likely impact of the project on the species.

4.3.1 Plant Species

Table 12 lists the plants that contribute to qualifying the site for Ramsar status, their likelihood of occurrence and potential impact of the project. The risk of any potential negative impact on these plant species, if present, would be highest at the construction and decommissioning phases. Some vegetation will need to be temporarily cleared for construction of the pipeline; regeneration will be encouraged following the cessation of the project. The area of vegetation cleared will be 2 ha at most. The total area of habitat available on the Youngusband Peninsula (length of approx 100 km, average width 1.5 km) is approximately 15,000 ha. The risk to any populations of plant species from the SLPS or any associated erosion is considered to be very low, with the anticipated temporary clearance of less than 0.01% of the Youngusband Peninsula.

A vegetation survey of a proposed pipeline route was undertaken (Rural Solutions 2010 Appendix U) to ascertain whether these species are present in the locality.

Risks of negative impact on plants in Table 12 are considered to be none to low.

Table 12. Likelihood of occurrence of plant taxa that contribute to the Ramsar status of the site in project area and potential impact of project upon these species.

Common name	Scientific name	Likelihood of occurrence	Potential impact
Silver Daisy-bush	<i>Olearia pannosa ssp. pannosa</i>	Not likely to occur; not recorded in southern Coorong area (BDB SA*)	None to very low (not likely to occur)
George's Groundsel	<i>Senecio georgianus var. georgianus</i>	Considered to be extinct (DEWHA SPRAT; DEH SA)	None
Yellow Swainson-pea	<i>Swainsona pyrophila</i>	Unlikely to occur – nearest record is at Mannum SA, 110 km from Coorong S Lagoon	None to very low (not likely to occur)
Sandhill Greenhood	<i>Pterostylis arenicola</i>	Unlikely to occur	None to very low (not likely to occur)
Metallic Sun-orchid	<i>Thelymitra epipactoides</i>	May occur (DEH, SA), recorded near Salt Creek.	Very low (may occur)
Scarlet Grevillea	<i>Grevillea treueriana</i>	This species is unlikely to occur – recorded only from western SA and WA	None (does not occur)
Dune Fanflower	<i>Scaevola calendulacea</i>	May occur in the project area (e-flora SA)	Low. While the species may occur, the project area will take up <0.1% of available habitat on the Youngusband Peninsula.

* Biological Data Base of South Australia

4.3.2 Amphibian Species

The Southern Bell Frog (Table 13) has not been recorded in the Coorong National Park and **is very unlikely to be impacted by the project.**

Table 13. Likelihood of occurrence of amphibian taxa that contribute to the Ramsar status of the site in project area and potential impact of project upon these species.

Common name	Scientific name	Likelihood of occurrence	Potential impact
Southern Bell Frog	<i>Litoria raniformis</i>	Not recorded in Coorong National Park. Not likely to occur; freshwater soaks may provide habitat but not recorded in South Lagoon.	None to very low (not likely to occur)

4.3.3 Fish Species

Of the 49 species of fish listed in Table 14, six were recorded in the Coorong South Lagoon in 1990 -91. These species are Small-mouthed hardyhead, *Atherinosoma microstoma*, Western blue spot goby, *Pseudogobius olorum*, River garfish, *Hyporhamphus regularis*, Yellow-eye mullet, *Aldrichetta forsteri*, Greenback flounder *Rhombosolea tapirina*, and Congolli, *Pseudaphritis urvillii*. Also, Black bream, *Acanthopagrus butcheri*, have been recorded historically in South Lagoon commercial fish catches (B. Zampatti SARDI, pers. comm., October 2009).

Seven fish species (15% of the total, *dark green shading, Table 9*) including Small-mouthed hardyhead, Western blue spot goby, River garfish, Yellow-eye mullet, Greenback flounder and Congolli and Black bream would be **expected to recolonize the South Lagoon** after the reduction of salinity levels is achieved. **A strongly positive impact of the project upon these fish species is anticipated.**

In addition, **another 15 fish species (30%)** may be **positively** impacted by salinity reduction in the South Lagoon (*light green shading, Table 9*).

Twenty-seven species (55%) are not expected to be impacted by the salinity reduction, because they are either freshwater species that do not occur in the South Lagoon or estuarine / marine species that are not likely to tolerate hypermarine conditions. **None** of the fish species listed in Table 9 **are expected to be negatively impacted.**

Summary: Significant positive impact expected on 22 species (45% of species in Table 9). No impact expected on the remainder of species.

Table 14. Likelihood of occurrence of fish taxa that contribute to the Ramsar status of the site in project area and potential impact of project upon these species.

Common name	Scientific name	Likelihood of occurrence	Potential impact	
			High positive	Low positive
Chanda perch (Agassiz's glassfish)	<i>Ambassis agassizii</i>	Unlikely to occur in Coorong South lagoon		No potential to impact.
Short-finned eel	<i>Anguilla australis</i>	Unlikely to occur in Coorong South lagoon		No potential to impact.
Small-mouthed hardyhead*	<i>Atherinosoma microstoma</i>	Currently rare. Likely to re-establish if salinity levels decrease.		Positive. Salinity reduction is very likely to enable reestablishment in the Coorong South Lagoon
Murray hardyhead	<i>Craterocephalus fluviatilis</i>	Unlikely to occur in Coorong South lagoon		No potential to impact.
Fly-specked hardyhead	<i>Craterocephalus stercusmuscarum fulvus</i>	Unlikely to occur in Coorong South lagoon		No potential to impact.

Common name	Scientific name	Likelihood of occurrence	Potential impact
Sandy sprat	<i>Hyperlophus vittatus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Bony bream	<i>Nematalosa erebi</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Blue sprat	<i>Spratelloides robustus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Purple-spotted gudgeon	<i>Mogurnda adspersa</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Flathead gudgeon	<i>Philypnodon grandiceps</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Dwarf flathead gudgeon	<i>Philypnodon sp.</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Western carp gudgeon	<i>Hypseleotris klunzingeri</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Midgley's carp gudgeon	<i>Hypseleotris sp.</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Murray Darling carp gudgeon	<i>Hypseleotris sp.</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Hybrid carp gudgeon	<i>Hypseleotris spp.</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
River blackfish	<i>Gadopsis marmoratus</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Climbing galaxias	<i>Galaxias brevipinnis</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Common galaxias	<i>Galaxias maculatus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Mountain galaxias	<i>Galaxias olidus</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Pouched lamprey	<i>Geotria australis</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Bridled goby	<i>Acentrogobius bifrenatus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Tamar goby	<i>Afurcagobius tamarensis</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Western blue spot (Swan River) goby*	<i>Pseudogobius olorum</i>	Currently not present in Coorong S Lagoon; may reestablish if salinity levels decrease.	Salinity reduction is likely to enable reestablishment in the Coorong South Lagoon
Lagoon goby	<i>Tasmanogobius lasti</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
River garfish*	<i>Hyporhamphus regularis</i>	Currently not present in Coorong S Lagoon; may reestablish if salinity	Salinity reduction is likely to enable reestablishment in the Coorong South Lagoon

Common name	Scientific name	Likelihood of occurrence	Potential impact
		levels decrease.	
Sand fish	<i>Crapatalus arenarius lasti</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Murray (Crimson-spotted) rainbowfish	<i>Melanotaenia fluviatilis</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Goblin shark	<i>Mitsukurina owstoni</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Shortheaded lamprey	<i>Mordacia mordax</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Yellow-eye mullet*	<i>Aldrichetta forsteri</i>	Currently rare. Likely to re-establish if salinity levels decrease.	Positive. Salinity reduction is very likely to enable reestablishment in the Coorong South Lagoon
Jumping mullet	<i>Liza argentea</i>	Currently not present. May establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Southern pygmy perch	<i>Nannoperca australis</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Yarra pygmy perch	<i>Nannoperca obscura</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Murray cod	<i>Maccullochella peelii peelii</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Golden perch	<i>Macquaria ambigua ambigua</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Estuary perch	<i>Macquaria colonorum</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Greenback flounder*	<i>Rhombosolea tapirina</i>	Currently not present in Coorong S Lagoon; may reestablish if salinity levels decrease.	Salinity reduction is likely to enable reestablishment in the Coorong South Lagoon
Freshwater eel-tailed catfish	<i>Tandanus tandanus</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Congolli (Tupong)*	<i>Pseudaphritis urvillii</i>	Currently not present in Coorong S Lagoon; may reestablish if salinity levels decrease.	Salinity reduction is likely to enable reestablishment in the Coorong South Lagoon
Australian smelt	<i>Retropinna semoni</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Mulloway	<i>Argyrosomus japonicus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
South Australian Cobbler	<i>Gymnapistes marmoratus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Black bream**	<i>Acanthopagrus butcheri</i>	Currently not present in Coorong S Lagoon; may re-establish if salinity levels decrease.	Salinity reduction is likely to enable reestablishment in the Coorong South Lagoon
Big-bellied seahorse	<i>Hippocampus abdominalis</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels	Salinity reduction may enable establishment in the Coorong South Lagoon

Common name	Scientific name	Likelihood of occurrence	Potential impact
		decrease.	
Silver perch	<i>Bidyanus bidyanus</i>	Unlikely to occur in Coorong South lagoon	No potential to impact.
Striped perch	<i>Helotes sexlineatus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Prickly toadfish	<i>Contusus brevicaudus</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Smooth toadfish	<i>Tetractenos glaber</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon
Richardson's toadfish	<i>Tetractenos hamiltoni</i>	Currently not present in Coorong S Lagoon; may establish if salinity levels decrease.	Salinity reduction may enable establishment in the Coorong South Lagoon

* Present in the South Lagoon in 1990 - 1991 (Molsher et al., 1994).

** Historically recorded in commercial fish catches in the South Lagoon.

4.3.4 Bird Species

The bird species that contribute to the Ramsar status of the site were assessed for likelihood of occurrence in the project area and for the potential impact of the various aspects of the SLPS as set out in Table 15.

Of the 76 species listed in Table 15, **19 bird species (25%, dark green shading, Table 15) are very likely to benefit from the project and 14 species (17%, light green shading, Table 15) are likely to benefit to a lesser extent.**

Many species (42 species, = 55%) are not likely to be impacted, either because they normally occur in other parts of the Ramsar site rather than the Coorong South Lagoon, or because they are rare across the entire Ramsar site.

The South Lagoon habitat restoration project is expected to lead to an increase in availability of nesting sites and / or feeding areas for 7 species of EPBC-listed migratory birds which have been in decline in the Coorong, but for which the area has been a particularly important habitat (i.e. Coorong populations were >1% of estimated flyway populations in at least 4 of 8 surveys (Paton et al., 2009b)). These species are the Sharp-tailed sandpiper, *Calidris acuminata*, Red-necked stint, *Calidris ruficollis*, Curlew sandpiper, *Calidris ferruginea*, Pied oystercatcher, *Haematopus longirostris*, Red-capped plover, *Charadrius ruficapillus*, Red-necked avocet, *Recurvirostra novaehollandiae*, and Fairy tern, *Sternula nereis*, all of which are listed in Table 15. The restoration of habitat is expected to lead to population recovery & reduction of threat to local extinction in the medium to long term.

One species, the Banded Stilt, may incur some limited negative impacts (tan shading, Table 15). Banded stilt are currently present in extremely high numbers owing to their ability to feed on brine shrimp which are present in the South Lagoon. The population of banded stilt is likely to decrease initially as brine shrimp decrease in numbers as salinity is reduced. However, the species was present in the South Lagoon prior to the appearance of brine shrimp and thus no significant impact is expected, with banded stilts being able to switch to other sources of food as salinity decreases.

Three species may incur some minor, short term negative impacts (tan shading, Table 15) but can also expect positive outcomes that strongly counteract this: the Red-necked Avocet, the Hooded Plover and the Orange-bellied Parrot.

Red-necked avocets may suffer a negative impact initially as brine shrimp, a food source, decrease in numbers as salinity is reduced. However, the impact will be limited as the species also feeds on crustaceans, insects, chironomids and other food sources. The species has been in decline in recent years: its abundance

appears to be linked to the availability of chironomids so it is expected to benefit from reduced salinity supporting their return.

The **Hooded Plover**, *Charadrius (Thinornis) rubricollis*, may suffer some limited and temporary negative impact on nesting but is also likely to benefit strongly from reduced salinity across the Coorong Lagoons and changes in prey availability.

The Hooded Plover nests on the Southern Ocean beach of the Youngusband Peninsula and on the western shore of the Coorong South Lagoon. The beach (110 km of the northern end of the Coorong Ocean beach) is closed to public vehicular traffic from October 24 to December 24 each year as a protective measure (SA Government 1993). The actual breeding season may extend from September to March. Construction during breeding months would create the potential for some negative impact on the species. Mitigation measures are discussed in Section 6.

Orange-bellied parrots (OBPs), *Neophema chrysogaster*, may suffer some low negative impacts through disturbance to foraging during the pipeline construction phase and decommissioning, if works were undertaken during winter, but is also likely to benefit strongly from increased habitat following reductions in salinity.

OBPs arrive on the mainland from as early as February, but usually during early April. Most 'early' records (February-April) are from Victoria, and birds are not usually detected in South Australia until later, usually from late April-May. However, it should be considered that much of the South Australian coast is remote and less frequently accessed and surveyed for OBPs. Over the course of winter, the dispersal patterns of the OBP are poorly understood. They remain for varying durations at different locations, largely dictated by the availability of food resources. The birds appear to be particularly erratic and highly-mobile in SA.

By late September-October, OBPs commence their departure from the mainland. Some birds are still recorded in Victoria as late as early November but the return migration to Tasmania is rapid and most birds will have returned and be ready to commence breeding by mid-November.

OBPs have been observed near the project area on the island between Parnka Point and Hack's Point and at Parnka Point, on the landward side of "The Narrows", in 2006 and 2007. The latter sighting was less than 100 metres from the existing access track. The species has not been sighted at this location since, probably due to increasingly high salinities adversely affecting their habitat. Direct contact with the species is unlikely but some disturbance to foraging could occur due to noise and vibration depending upon the timing of construction.

Given their migratory habits, there will be no disturbance of OBPs if construction is undertaken outside of the winter months as planned. If construction were to occur in winter, OBPs may forage elsewhere for that period due to noise and dust but the proposal is not likely to cause direct harm. The main food source for the Orange-bellied parrot at Parnka Point in 2006–07 appears to have been *Acaena-nova zelandiae* (bidgee-widgee). There is other Sarcocornia marshland habitat available in the region, which can be used by this species, though the amount of useful habitat is decreasing over time with the excess salinity of the waters in the South Lagoon causing degradation of this habitat (Ehmke, 2009; Ehmke et al., 2009). Mitigation measures are discussed in Section 6.

Summary: There is the potential for a large or some positive impact on 33 species (43% of the list in Table 15). Four species may incur a low or limited moderate negative impact, although three of these will also benefit from the proposal. Almost all of the species (73/76) are likely to be either impacted positively or not impacted at all.

Table 15. Likelihood of occurrence of bird taxa that contribute to the Ramsar status of the site in project area and potential impact of project upon these species (All population data taken from Kerr, 2009).

Common name	Scientific name	Likelihood of occurrence	Potential impact		
			High positive	Positive	Negative
Australian Pelican	<i>Pelecanus conspicillatus</i>	Likely to occur, but populations and breeding in decline. Reference 2: <u>Coorong South Lagoon</u> 1985: 6,045; 2000-2007 range 394-2,600. Change in abundance between '85 and mean '00 -'07: 77.3% decline . 2000 - 2005: range 2,293 ('05) – 5,649 ('01). Trend: decline.	Moderate potential to impact positively on breeding, through restoration of critical habitat.		
Australian Darter	<i>Anhinga melanogaster</i>	May occur. Observed in the river channel and Lake Alexandrina near the barrages. Reference 2: Coorong populations 2000 - 2005: 3 (05). Trend: rare.	Low potential to impact positively; normally occur in the Murray Mouth area.		
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	Likely to occur. Reference 2: Coorong populations 2000 - 2005: range 189 ('03) – 779 ('00). Trend: variable.	There is likely to be a small positive impact because reducing salinity in the South Lagoon will dampen high salinities in the North Lagoon, potentially allowing various fish prey to expand southwards, further down the northern Coorong.		
Pied Cormorant	<i>Phalacrocorax varius</i>	Likely to occur. Reference 2: Coorong populations 2000 - 2005: range 130 ('00) – 485 ('01). Trend: variable, stable.	There is likely to be a small positive impact because reducing salinity in the South Lagoon, will dampen high salinities in the North Lagoon, potentially allowing various fish prey to expand southwards into the northern Coorong		
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	Likely to occur, but populations in decline. Reference 2: <u>Coorong South Lagoon</u> 1985: 1,190; 2000-2007 range 0-430. Change in abundance between '85 and mean '00 -'07: 93.9% decline . 2000 - 2005: range 295 ('00) – 2,934 ('01). Trend: tenfold increase and five-fold decrease.	High potential to impact positively, through restoration of critical habitat in the Coorong South Lagoon. In addition, there should be a slightly increased area for hunt for fish prey in the North lagoon.		
Great Black Cormorant	<i>Phalacrocorax carbo</i>	Likely to occur. Reference 2: Coorong populations 2000 - 2005: range 266 ('03) – 1,860 ('02). Trend: fivefold increase and then decrease. Dramatic population decreases in lower lakes.	High potential to impact positively, through restoration of critical habitat in the Coorong South Lagoon. In addition, there should be a slightly increased area for hunt for fish prey in the North lagoon.		
Great Crested Grebe	<i>Podiceps cristatus</i>	Likely to occur, but populations in dramatic decline across Ramsar site. Reference 2: <u>Coorong South Lagoon</u> 1985 263, 2000-2007 range 0-94. Change in abundance between '85 and mean '00 -'07: 92.6% decline . 2000 - 2005: range 62 ('01) – 543('05). Trend: variable.	High potential to impact positively, through restoration of critical habitat. This species will be able to expand its distribution in the North Lagoon, and also expand back into the South Lagoon if and when small mouthed hardyhead fish re-establish.		

Common name	Scientific name	Likelihood of occurrence	Potential impact
Hoary-headed Grebe	<i>Podiceps polocephalus</i>	Likely to occur but populations in dramatic decline. Reference 2: <u>Coorong South Lagoon</u> 1985: 16,766; 2000-2007 range 50-8,141. Change in abundance between '85 and mean '00 -'07: 85.0% decline . 2000 - 2005: range 2,324 ('03) – 8,461 ('0). Trend: fourfold decline.	High potential to impact positively, through restoration of critical habitat. This species has recently used brine shrimps in the Coorong South lagoon, probably at a physiological cost to the bird. Reducing the salinity level and re-establishing fish populations will improve habitat quality for this species
Cape Barren Goose	<i>Cereopsis novaehollandiae</i>	Likely to occur. Reference 2: Coorong populations 2000 - 2005: range 15 ('02) – 402 ('03). Trend: variable. (Data from Kerr, 2009).	No impact is expected: this species feeds almost entirely on terrestrial pastures.
Black swan	<i>Cygnus atratus</i>	Likely to occur but populations in decline. Reference 2: <u>Coorong South Lagoon</u> 1985: 676; 2000-2007 range 68-526. Change in abundance between '85 and mean '00 -'07: 59.3% decline . 2000 - 2005: range 706 ('05) – 3,488 ('03). Trend: increase and recent decrease.	High potential to impact positively, through restoration of critical habitat. Although the Coorong is not a breeding habitat, re-instatement of <i>Ruppia</i> will greatly improve the food resources for this species (food resources are almost non-existent now).
Australasian Shoveler	<i>Anas rhynchos</i>	Likely to occur, but population in serious decline across Ramsar site. Reference 2: Coorong populations 2000 - 2005: range 0 ('01) - 203 ('03). Trend: variable.	This species occurs in only very small numbers in the Coorong and Lakes, and is unlikely to be impacted.
Musk Duck	<i>Biziura lobata</i>	Likely to occur. Reference 2: Coorong populations 2000 - 2005: range 66 ('01) – 441 ('04). Trend: decrease and then increase.	This species occurs in only small numbers in the Coorong and Lakes, and is unlikely to be impacted.
Australian Shelduck	<i>Tadorna tadornoides</i>	Likely to occur. Reference 2: <u>Coorong South Lagoon</u> 1985 6,059, 2000-2007 range 1,339-6,242. Change in abundance between '85 and mean '00 -'07: 45.7% decline . 2000 - 2005: range 2,738 ('02) – 8,581 ('01). Recent trend: stable.	High potential to impact positively, through restoration of critical habitat. Although the Coorong is not a breeding habitat, re-instatement of <i>Ruppia</i> will greatly improve the food resources for this species (food resources are almost non-existent now).
Grey Teal	<i>Anas gracilis</i>	Likely to occur but population in serious long term decline. <u>Coorong South Lagoon</u> 1985: 59,113; 2000-2007 range 2,446- 24,460. Change in abundance between '85 and mean '00 -'07: 85.2% decline . 2000 - 2005: range 10,811 ('00) - 39,510 ('02). Trend: increase and then decrease.	High potential to impact positively, through restoration of critical habitat. Although the Coorong is not a breeding habitat, re-instatement of <i>Ruppia</i> will greatly improve the food resources for this species (food resources are almost non-existent now).
Chestnut Teal	<i>Anas castanea</i>	Very likely to occur. Reference 2: <u>Coorong South Lagoon</u> 1985: 660, 2000-2007 range 430-10,147. Change in abundance between '85 and mean '00 -'07: 522.8% increase . 2000 - 2005: range 7,149 ('01) - 21,228 ('02). Trend: increase and then decrease.	High potential to impact positively, through restoration of critical habitat. Although the Coorong is not a breeding habitat, re-establishment of <i>Ruppia</i> will greatly improve the food resources for this species (food resources are almost non-existent now). This species also consumes large numbers of <i>Ruppia</i> turions. It has not

Common name	Scientific name	Likelihood of occurrence	Potential impact
			vanished from the southern Coorong because it has adapted to using brine shrimps.
Lewin's Rail	<i>Rallus pectoralis</i>	May occur. Occur in lakes and fringing wetlands. Coorong populations 2000 - 2005: not recorded.	Not likely to impact (rare in Coorong)
Spotless Crake	<i>Porzana tabuensis</i>	May occur. Occur in lakes and fringing wetlands. Coorong populations 2000 - 2005: not recorded.	Not likely to impact (rare in Coorong)
Dusky Moorhen	<i>Gallinula tenebrosa</i>	May occur. Occur in lakes and fringing wetlands. Coorong populations 2000 - 2005: range 0 ('00, '03 – '05) - 3 ('02). Trend: rare.	Not likely to impact (rare in Coorong)
Purple Swamphen	<i>Porphyrio porphyrio</i>	May occur. Occur in lakes and fringing wetlands. Coorong populations 2000 - 2005: ('04). Trend: rare. Sudden large decline in other parts of Ramsar site in last year.	Not likely to impact (rare in Coorong)
Australasian Bittern	<i>Botaurus poiciloptilus</i>	May occur. Occur in lakes and fringing wetlands. Coorong populations 2000 - 2005: not recorded.	Not likely to impact (rare in Coorong)
Little Egret	<i>Ardea garzetta</i>	Not likely to occur. Coorong populations 2000 - 2005: range 3 ('02, '05) – 34 ('01). Trend: uncommon.	Potential positive impact. Although numbers are small, this species should expand into the South Lagoon as fish return to the lower salinity waters.
Cattle Egret	<i>Ardea ibis</i>	Not likely to occur. Coorong populations 2000 - 2005: not recorded.	Not likely to impact (rare across Ramsar site)
Great Egret	<i>Ardea alba</i>	Likely to occur, but recent decline. Coorong populations 2000 - 2005: range 8 ('04, '05) – 145 ('02). Trend: recent decline.	Potential positive impact. This species should expand into the South Lagoon as fish return to the lower salinity waters.
White faced Heron	<i>Ardea novaehollandiae</i>	Likely to occur. Reference 2: <u>Coorong South Lagoon</u> 1985: 128, 2000-2007 range 15-75. Change in abundance between '85 and mean '00 –'07: 69.4% decline . 2000 - 2005: range 89 ('04) – 212 ('01). Recent trend: stable but long-term decline.	High potential to impact positively, through restoration of critical habitat. This species should expand into the South Lagoon as fish return to the lower salinity waters.
Rufous NightHeron	<i>Nycticorax caledonicus</i>	Not relevant for Coorong (present in Lower Lakes)	Not likely to impact.
Glossy Ibis	<i>Plegadis falcinellus</i>	Not likely to occur. Coorong populations 2000 - 2005: not recorded; recent declines in other parts of Ramsar site. This species has rarely been seen in the region and never in Coorong.	Not likely to impact (very rare across Ramsar site).
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	Likely to occur. Reference 2: <u>Coorong South Lagoon</u>	This species is mainly restricted to the northern Coorong and Lower Lakes & is unlikely to be

Common name	Scientific name	Likelihood of occurrence	Potential impact
		1985: 150, 2000-2007 range 0-1. Change in abundance between '85 and mean '00 –'07: 99.9% decline . 2000 - 2005: range 14 ('01) – 111 ('05). Recent trend: variable.	impacted.
Australian White Ibis	<i>Threskiornis molucca</i>	Likely to occur. Reference 2: Coorong populations 2000 - 2005: range 129 ('04) – 625 ('01). Trend: variable, stable.	This species is mainly restricted to the northern Coorong and Lower Lakes & is unlikely to be impacted.
Royal Spoonbill	<i>Platalea regia</i>	Likely to occur. Reference 2: Coorong populations 2000 - 2005: range 9 ('05) – 161 ('01). Trend: X 15 increase and then decrease; recent large increases in other parts of Ramsar site.	This species is mainly restricted to the northern Coorong and Lower Lakes & is unlikely to be impacted.
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	Not likely to occur. Coorong populations 2000 - 2005: not recorded.	This species is mainly restricted to the northern Coorong and Lower Lakes & is unlikely to be impacted.
Latham's Snipe	<i>Gallinago hardwickii</i>	Recorded in lakes and Goolwa channel. Coorong populations 2000 - 2005: not recorded.	Not likely to impact (not recorded in Coorong).
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	Likely to occur. Reference 1: Coorong total counts 81, 82, 87, 93, 00-08: Max 55,739 ('82) Min 3,848 ('07) – variable over survey period. Reference 2: <u>Coorong South Lagoon</u> 1985 6,013, 2000-2007 range 188-4,202. Change in Abundance between '85 and mean '00 –'07: 63.1% decline (9). 2000 - 2005: range 4,399 ('01) – 17,473 ('03). Trend: variable.	High potential to impact positively, through restoration of critical habitat. Chironomids are a key food resource.
Curlew Sandpiper	<i>Calidris ferruginea</i>	Likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 40,000 ('93) Min 2,171 ('07) – Trend: decline. Reference 2: Coorong South Lagoon 1985: 9,449, 2000-2007 range 7-3,198. Change in Abundance between '85 and mean '00 –'07: 94.2% decline . 2000 - 2005: range 1,830 ('04) – 8,157 ('00). Trend: decreasing.	High potential to impact positively, through restoration of critical habitat. Chironomids are a key food resource.
Common sandpiper	<i>Tringa hypoleucos</i>	May occur. Reference 1 Coorong populations - total counts 81, 82, 87, 93, 00-08: Max 13 ('81) Min 0 ('00, '04, '08) – No trend; Reference 2: 2000 - 2005: range 1 ('01) - 3 ('02). Trend: rare.	This species occurs in only very small numbers in the Coorong and Lakes, and is unlikely to be impacted.
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Likely to occur in low numbers especially in the Northern Lagoon. Coorong populations, Reference 1: total counts '81, '82, '87, '93 '00-'08: Max 68 ('02) Min 0 ('81, '00, '01) – Trend: Low counts with intermittent peaks; Reference 2: 2000 - 2005: range 0 ('00,	Potential positive impact. This species should benefit and expand southwards following the decrease in salinities of the South Lagoon.

Common name	Scientific name	Likelihood of occurrence	Potential impact
		'02) – 12 ('04). Trend: Low counts with intermittent peaks.	
Terek Sandpiper	<i>Xenus cinereus</i> (<i>Tringa terek</i>)	Not likely to occur. Reference 1 Coorong populations - total counts '81, '82, '87, '93 '00-'08: Max 1 ('02, '08) Min 0 (all other years) – Trend: Rare; Reference 2: 2000 - 2005: not recorded.	Potential for a positive impact, but populations are small.
Pectoral Sandpiper	<i>Calidris melanotos</i>	Not likely to occur. Reference 1 Coorong populations - total counts '81, '82, '87, '93 '00-'08: Max 1 ('82) Min 0 ('81, '87, '00, '01, '02 '08) – Trend: consistently low; Reference 2: 2000 - 2005: not recorded.	Very low potential to impact, positively or negatively as this species is uncommon across the Ramsar site.
Red-necked Stint	<i>Calidris ruficollis</i>	Likely to occur, significant long term population decline. Reference 1: Coorong populations - total counts '81, '82, '87, '93 '00-'08: Max 63,800 ('93) Min 12,288 ('08) – Trend: Medium term decline, fivefold decline since early '90's; Reference 2: <u>Coorong South Lagoon</u> 1985 29,020, 2000-2007 range 1,591-22,453. Change in abundance between '85 and mean '00 –'07: 68.3% decline . 2000 - 2005: range 23,606 ('05) – 43,300 ('03). Trend: increase, then decrease.	Very high potential to impact positively, through restoration of critical habitat. Chironomid larvae are a prominent component of the diet in the Coorong.
Sanderling	<i>Crocethia</i> (<i>Calidris</i>) <i>alba</i>	Not likely to occur. Reference 1: Coorong populations - total counts 81, 82, 87, 93, 00-08: Max 930 ('93) Min 10 ('02) – No trend, Variable; Reference 2: 2000 - 2005: range 0 ('00, '01, '05) - 289 ('03). Trend: increase and then decrease to zero.	Not likely to be impacted. This species is found mainly around the Murray Mouth.
Common Greenshank	<i>Tringa nebularia</i>	Likely to occur, but dramatic long-term decline. Reference 1 Coorong populations - total counts '81, '82, '87, '93 '00-'08: Max 720 ('93) Min 305 ('01) – Trend: Variable but relatively stable; Reference 2: <u>Coorong South Lagoon</u> 1985 313, 2000- 2007 range 16- 103. Change in abundance between '85 and mean '00 –'07: 80.1% decline . 2000 - 2005: range 417 ('01) – 591 ('02). Trend: stable.	Very high potential to impact positively, through restoration of critical habitat. This species will benefit a great deal from the reestablishment of small-mouthed hardyhead fish, which was its staple diet in the South Lagoon in 1980s & 1990s.
Red-necked Phalarope	<i>Phalaropus lobatus</i>	May occur. Reference 1: Coorong populations - total counts '81, '82, '87, '93 '00-'08: Max 3 ('87) Min 0 ('81, '82, '00, '01, '08) – Trend: Rare; Reference 2: 2000 - 2005: 1 ('05). Trend: rare.	This species is not likely to be affected (rare migrant).
Eastern curlew	<i>Numenius madagascariensis</i>	May occur. Was common in N Coorong from 1930 to 1967-68, 15 in 1981, 22 in 1982. Reclamation of land, construction of	This species is mainly restricted to the northern sections (estuary) of the Murray mouth region & is unlikely to be

Common name	Scientific name	Likelihood of occurrence	Potential impact
		barrages and stabilization of water levels as destroyed feeding habitat. Reference 1: Total counts Coorong '81, '82, '87, '93 '00-'08: Max 29 ('07) Min 2 ('02, '03) – Trend: Uncommon; Reference 2: 2000 - 2005: range 1 ('00,'01) – 57 ('02). Trend: variable.	impacted.
Bar-tailed godwit	<i>Limosa lapponica</i>	May occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 150 ('08) Min 0 ('82, '01, '02) – Trend: marked increase in last four years; Reference 2: 2000 - 2005: range 0 ('03, '04) – 32 ('05). Trend: rare.	This species is mainly restricted to the northern sections (estuary) of the Murray mouth region & is unlikely to be impacted.
Black-tailed godwit	<i>Limosa limosa</i>	Likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 210 ('00) Min 0 ('02) – Trend: High variability among years since '02; Reference 2: 2000 - 2005: range 0 ('05) - 140 ('00). Trend: variable.	This species is mainly restricted to the northern sections (estuary) of the Murray mouth region & is unlikely to be impacted.
Great Knot	<i>Calidris tenuirostris</i>	May occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 5 ('93) Min 0 ('87, '01) – Trend: Uncommon; Reference 2: 2000 - 2005: range 0 ('00) - 441 ('04). Trend: generally uncommon.	This species is mainly restricted to the northern sections (estuary) of the Murray mouth region & is unlikely to be impacted.
Red Knot	<i>Calidris canutus</i>	May occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 100 ('93) Min 0 ('87, '01, '08) – Trend: low numbers '01 to '08; Reference 2: 2000 - 2005: not recorded.	This species is mainly restricted to the northern sections (estuary) of the Murray mouth region & is unlikely to be impacted.
Grey-tailed Tattler	<i>Tringa (Heteroscelus) brevipes</i>	Not likely to occur. 2000 - 2005: not recorded (Ref 2).	This species is mainly restricted to the northern sections (estuary) of the Murray mouth region & is unlikely to be impacted.
Ruddy turnstone	<i>Arenaria interpres</i>	Not likely to occur. Reference 1: Coorong total counts 81, 82, 87, 00-08: Max 3 ('06) Min 0 ('81, '87, '01, '04, '08). No trend; Reference 2: 2000 - 2005: 4 ('00) - 1 ('02). Trend: rare.	This species is mainly restricted to the northern sections (estuary) of the Murray mouth region & is unlikely to be impacted.
Ruff	<i>Philomachus pugnax</i>	Not likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 1 ('00) Only year recorded – Trend: Rare; Reference 2: 2000 - 2005: not recorded.	Not likely to impact (rare across Ramsar site).
Pied Oystercatcher	<i>Haematopus longirostris</i>	Likely to occur, but long term decline. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 630 ('93) Min 9 ('01) – Trend: Variable, but relatively stable;	High potential to impact positively, through restoration of critical habitat. This species is very likely to benefit from lower salinities and possibly from associated key prey items (brine

Common name	Scientific name	Likelihood of occurrence	Potential impact
		Reference 2: <u>Coorong South Lagoon</u> 1985: 142, 2000-2007 range 15-113. Change in abundance between '85 and mean '00 –'07: 58.0% decline . 2000 - 2005: range 115 ('00) – 216 ('03). Short term trend: stable.	fly larvae).
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	May occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 24 ('02) Min 0 ('81, '82) – Trend: A small but persistent population appears to have established since the early 80's; Reference 2: 2000 - 2005: range 0 ('01) - 29 ('02). Trend: uncommon.	This species is mainly restricted to marine shorelines in the northern areas near the Murray Mouth & is unlikely to be impacted.
Hooded Plover	<i>Charadrius (Thinornis) rubricollis</i>	Likely to occur on Southern Ocean beach. Also occurs in increasing numbers on the western shoreline of the South lagoon of the Coorong. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 23 ('06) Min 0 ('81, '82) – Trend: a small but stable population established; Reference 2: 2000 - 2005: range 8 ('00) – 29 ('04). Trend: uncommon, stable.	<i>Southern Ocean beach:</i> Some potential for negative impact from construction works (hooded plover nests on ocean beach and western shore of Coorong South lagoon). <i>Coorong Lagoons:</i> This species regularly shifts to the Coorong Lagoons & is very likely to benefit from reduction in salinity and the potential change in prey availability.
Red-capped Plover	<i>Charadrius ruficapillus</i>	Likely to occur, but long-term decline. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 5,700 ('93) Min 737 ('07) – Trend: Medium term decline, fivefold decline since early '90's; Reference 2: Coorong South Lagoon 1985 2,158, 2000-2007 range 206-1,038. Change in abundance between '85 and mean '00 –'07: 75.2% decline . 2000 - 2005: range 474 ('05) – 1,638 ('01). Trend: variable.	High potential to impact positively, through restoration of critical habitat. This species is likely to benefit from reduction in salinity and consequent return of chironomid larvae.
Pacific Golden Plover	<i>Pluvialis fulva</i>	Likely to occur, but long-term decline. Reference 1: Coorong total counts Total counts Coorong '81, '82, '87, '93 '00-'08: Max 290 ('93) Min 30 ('04) – Trend: Variable but possible medium term decline; Reference 2: 2000 - 2005: range 6 ('04) – 85 ('05). Trend: variable; Recent decline elsewhere in Ramsar site.	This species occurs mainly in the North Lagoon but has also been recorded in the South lagoon. Some potential for positive impact.
Grey Plover	<i>Pluvialis squatarola</i>	May occur. Reference 1: Coorong total counts total counts '81, '82, '87, '93 '00-'08: Max 12 ('00) Min 0 ('82, '87, '01) – Trend: Uncommon; Reference 2: 2000 - 2005: 4 ('02, '05). Trend: rare.	This species is mainly restricted to the Murray estuary & is unlikely to be impacted.
Lesser Sand Plover	<i>Charadrius mongolus</i>	Not likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 2 ('02), 1 ('08)	Not likely to impact (rare across Ramsar site).

Common name	Scientific name	Likelihood of occurrence	Potential impact
		Min 0 (all other years) – Trend: Rare; Reference 2: 2000 - 2005: not recorded.	
Oriental Plover	<i>Charadrius veredus</i>	Not likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 18 ('81) Min 0 (all other years) – Trend: rare; Reference 2: 2000 - 2005: not recorded.	Not likely to impact (rare across Ramsar site).
Double-banded Plover	<i>Charadrius bicinctus</i>	Not likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 150 ('93) Min 0 ('81, '82, '00, '01, '08) – Trend: Generally rare; Reference 2: 2000 - 2005: not recorded. This species is a winter visitor which is more prominent in the North Lagoon.	Not likely to be impacted.
Masked Lapwing	<i>Vanellus miles</i>	Likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 978 ('82) Min 233 ('00) – Trend: Stable at half the count in early '90's and '80's; Reference 2: <u>Coorong South Lagoon</u> 1985: 323, 2000-2007 range 86-262. Change in abundance between '85 and mean '00 –'07: 49.8% decline . 2000 - 2005: range 373 ('04) – 764 ('01). Trend: stable.	Potential to impact positively, through restoration of habitat.
Red-kneed Dotterel	<i>Erythrogonys cinctus</i>	May occur. Observed around Salt Creek (South Coorong) Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 18 ('04) Min 0 ('87, '00, '01) – Trend: Uncommon; Reference 2: 2000 - 2005: range 0 ('00-'02) – 28 ('03). Trend: absent, then uncommon since 2003. Dramatic recent reductions in other parts of Ramsar site.	Low potential to be impacted; this species is found mainly in fresher and estuarine habitats.
Banded Stilt	<i>Cladorhynchus leucocephalus</i>	Very likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 261,229 ('08) Min 9,106 ('07) – Trend: Highly Variable; Reference 2: <u>Coorong South Lagoon</u> 1985 6,208, 2000-2007 range 1,297-64,250. Change in abundance between '85 and mean '00 –'07: 258.5% increase . 2000 - 2005: range 2,354 ('00) – 32,305 ('05). Trend: 15 X Increase.	This species may be impacted negatively for a time, because brine shrimps will be reduced with the decrease in salinity, but the species has used the Coorong in the past in the absence of brine shrimps.
Black-winged Stilt	<i>Himantopus himantopus</i>	Very likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 991 ('82) Min 132 ('07) – Trend: Variable, but Stable; Reference 2: <u>Coorong South Lagoon</u> 1985: 32, 2000-2007 range 14-505. Change in abundance between '85 and mean '00 –'07: 353.9% increase .	This species may benefit from the reestablishment of chironomids following reduction in salinity.

Common name	Scientific name	Likelihood of occurrence	Potential impact
		2000 - 2005: range 258 ('01) – 696 ('03). Trend: stable.	
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	Likely to occur. Reference 1: Coorong total counts '81, '82, '87, '93 '00-'08: Max 5,687 ('04) Min 93 ('00) – Trend: Recent decline, 10 to 20 fold decrease in last two years; Reference 2: <u>Coorong South Lagoon</u> 1985: 7,210; 2000-2007 range 104 - 4,864. Change in abundance between '85 and mean '00 –'07: 74.8% decline . 2000 - 2005: range 163 ('00) – 6,030 ('05). Trend: large recent increase.	May impact negatively initially, as this species feeds on brine shrimp. However it is also able to feed on crustaceans, insects, chironomids and other food sources
			Potential to impact positively, through restoration of critical habitat. Abundance of this species in the South Lagoon appears to be linked to availability of chironomids so it should benefit from salinity reduction.
Little Tern	<i>Sterna</i> (now <i>Sternula</i>) <i>albifrons</i>	Not likely to occur. Uncommon in SA, where recorded from Coorong among others. Have bred on island in The Coorong. Reference 2: 2000 - 2005: not recorded.	Not likely to be impacted (rare across Ramsar site).
Fairy Tern	<i>Sternula nereis</i>	Likely to occur, but sharply declining populations. Reference 2: <u>Coorong South Lagoon</u> 1985: 1,330, 2000-2007 range 6-586. Change in abundance between '85 and mean '00 –'07: 82.0% decline . 2000 - 2005: range 175 ('04) – 687 ('01). Trend: variable.	High potential to impact positively, through restoration of critical habitat. It is important to prevent this species from becoming regionally regional extinct, and this requires reestablishment of conditions suitable for fish in the South Lagoon near islands that offer secure breeding opportunities.
Crested Tern	<i>Sterna</i> (now <i>Thalasseus</i>) <i>bergii</i>	Likely to occur. Reference 2: <u>Coorong South Lagoon</u> 1985: 6,687, 2000-2007 range 877-8,186. Change in abundance between '85 and mean '00 –'07: 50.7% decline . 2000 - 2005: range 1,300 ('03) – 5,638 ('05). Trend: variable, stable.	Not likely to be greatly impacted. This species fishes in the ocean for food and is largely uncoupled from the Coorong.
Caspian Tern	<i>Hydropogne tschegrava</i> (now <i>Hydroprogne caspia</i>)	Likely to occur. Reference 2: <u>Coorong South Lagoon</u> 1985 329, 2000-2007 range 0-345. Change in abundance between '85 and mean '00 –'07: 75.7% decline . 2000 - 2005: range 227 ('04) – 1,362 ('01). Trend: variable. Recent sharp declines in other parts of Ramsar site.	Some potential to impact positively, through restoration of habitat. This species will be dependent on the Northern Coorong and Lower Lakes for food, but may be able to expand to the South Lagoon.
Whiskered Tern	<i>Chlidonias hybridus</i>	Likely to occur. Reference 2: <u>Coorong South Lagoon</u> '98: 2,656, 2000-2007 range: 334-2,847. Change in abundance between '85 and mean '00 –'07: 58.7% decline . 2000 - 2005: range 3,163 ('02) – 4,660 ('00). Trend: stable.	High potential to impact positively, through restoration of critical habitat. The return of fish to the South Lagoon will allow this once abundant species to return.
Pacific Gull	<i>Larus pacificus</i>	Not likely to occur. Reference 2: 2000 - 2005: 1 ('01), 7 ('02). Trend: rare. Occurs near Murray mouth only.	Not likely to impact (uncommon across Ramsar site).

Common name	Scientific name	Likelihood of occurrence	Potential impact
Silver Gull	<i>Larus novaehollandiae</i>	Likely to occur. Reference 2: <u>Coorong South Lagoon</u> 1985 4,090, 2000-2007 range 1,077-8,445. Change in abundance between '85 and mean '00 –'07: 30.8% decline . 2000 - 2005: range 5,218 ('04) – 10,418 ('01). Trend: stable.	Potential to impact positively. The abundance of this species may not change, but its resource base may change. It is capable of using Brine Shrimps, but shifting to a less saline environment will be a benefit.
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	May occur. This critically endangered species was recorded at Parnka Point in winter, 2006 to 2008.	Low. Foraging may be affected during pipeline construction phase and decommissioning, if works are undertaken during winter. Likely positive impact of SLPS, through increased habitat (inferred from Ehmke 2009; see also Ehmke et al., 2009)
Mount Lofty Ranges Southern Emu-wren	<i>Stipiturus malachurus intermedius</i>	This subspecies of <i>Stipiturus malachurus</i> does not occur in the Coorong region.	Will not impact (does not occur in Coorong).
Great / Clamorous Reed-Warbler	<i>Acrocephalus arundinaceus</i>	May occur. Majority of population around lower lakes.	This species may benefit to a small extent, through reduction in risks to degradation of fringing vegetation and freshwater soaks.
Little Grassbird	<i>Megalurus gramineus</i>	May occur. Majority of population around lower lakes.	This species may benefit to a small extent, through reduction in risks to degradation of fringing vegetation and freshwater soaks.
Golden-headed Cisticola	<i>Cisticola exilis</i>	Unlikely to be present in project area.	Not likely to be impacted. This species does not use the South Lagoon.

* The order used follows that of *Field Guide to the Birds of Australia*, 6th Edition by Simpson and Day, 1999

Reference 1: Wainwright, P. and M. Christie (2008)

Reference 2: Paton, D.C. (2005) and Paton, D.C., et al., (2009b).

4.4 EPBC-listed Threatened Species

The potential impacts of the SLPS on EPBC-listed threatened species is given in Table 16 below.

None of the threatened plant species (Tables 16) has been recorded on the Youngusband Peninsula. A vegetation survey (Rural Solutions SA 2010 Appendix U) of the pipeline corridor was also undertaken to support the applications for Commonwealth and State approvals to ascertain the presence / absence of listed threatened plant species. No nationally listed threatened plant species were noted within the survey transects.

No fauna species are considered to be at risk of high or moderate negative impact of the project. Species for which the potential impact is considered to be **low** or **very low to low** are the **Orange-Bellied parrot**, the **Australian Sea-lion**, the **Blue whale**, the **Southern right whale**, the **Great white shark** and the **School shark**. **All other species are considered to be at no risk or very low risk of negative impact due to the project.**

Implications of the proposal for Orange-bellied parrots are discussed in Section 4.3.4.

The proposal involves the release of hyper-saline water into the adjacent marine environment. This area is one of the highest energy coastline in Australia (Short AD and Woodcroffe CD 2009); such that there will be rapid dilution and dispersal of the Coorong water. The ocean typically has a salinity of around 36ppt. Modelling has been undertaken to provide an understanding of the likely plume footprint of the discharged hypersaline water under the 'worst case' conditions for tides and winds (Aurecon 2010 Attachment D). The results of this modelling indicate that the saline discharge is likely to disperse rapidly, with 3ppt excess salinity (39ppt and 38 fold dilution) likely to be confined within a distance of less than 200 metres of the discharge during worst case

conditions and 1ppt excess salinity (37ppt and 100 fold dilution) extending to around 2 kilometres offshore and, when under the influence of SE shore-parallel winds, a similar distance alongshore. Figure 4 gives an indicative depiction of the salinity and nutrient plume from the proposal in a worst case scenario.

A number of the marine migratory mammals may occur off the Coorong coast. The endangered Southern Right whale frequents calving areas off the South Australian coast at Middleton in Encounter Bay in winter. The areas used by this species are between Waitpinga / Newland Head in the west and approx. 10 km east of the Murray Mouth. The easternmost end of the calving area is conservatively estimated to be at least 60 km from the proposed ocean outfall. Salinity levels in the calving area will not be altered by the project.

Individual whales, sea-lions or sharks may pass along the Coorong coast. The use of the high energy coast line as a preferred transport corridor for marine mammals is considered low; however, any such species on this trajectory that may encounter the hypersaline plume would be able to readily avoid it. Impact on feeding areas, assuming that some of these species do feed in the surf zone, is negligible (note Figure 4).

Mitigation measures are discussed in Section 6.

Table 16. Likely impact of the SLPS on threatened EPBC-listed threatened species potentially occurring within the project area

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact	
							High positive	Low Negative
Bird	<i>Calyptorhynchus lathamii halmaturinus</i>	Glossy Black-Cockatoo (Kangaroo Island), Glossy Black-Cockatoo (South Australian)	✓	✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact (no habitat available for this species)	
Bird	<i>Cinclosoma punctatum anachoreta</i>	Spotted Quail-thrush (Mt Lofty Ranges)	✓	✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact (does not frequent coastal habitat)	
Bird	<i>Diomedea epomophora epomophora</i>	Southern Royal Albatross	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)	
Bird	<i>Diomedea epomophora sanfordi</i>	Northern Royal Albatross	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)	
Bird	<i>Diomedea exulans (sensu lato)</i>	Wandering Albatross	✓	✓	✓	May occur, but uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species	Very low; habitat provided by the Coorong is unlikely to be of significance for this species	
Bird	<i>Diomedea exulans amsterdamensis</i>	Amsterdam Albatross	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)	
Bird	<i>Diomedea exulans exulans</i>	Tristan Albatross	✓	✓	✓	Very unlikely to occur, habitat provided by the Coorong is unlikely to be of significance to this species.	None to very low (not likely to occur)	

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
Bird	<i>Diomedea exulans gibsoni</i>	Gibson's Albatross	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA).	None to very low (not likely to occur)
Bird	<i>Halobaena caerulea</i>	Blue Petrel			✓	Very unlikely to occur; recorded in Coorong region (BDB SA); however critical habitat for the species does not occur in the project area.	None to very low; habitat provided by the Coorong is unlikely to be of significance for this species.
Bird	<i>Hylacola pyrrhopygia parkeri</i>	Chestnut-rumped Heathwren (Mt Lofty Ranges)	✓	✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact (occurs in mallee areas only)
Bird	<i>Lathamus discolor</i>	Swift Parrot	✓	✓		May occur; recorded in Coorong region (BDB SA)	None to very low; no preferred habitat occurs in the project site area.
Bird	<i>Leipoa ocellata</i>	Malleefowl		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact
Bird	<i>Macronectes giganteus</i>	Southern Giant-Petrel	✓	✓	✓	May occur. Not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on population trends (Kerr, 2009)	None to very low: not critical habitat for this species
Bird	<i>Macronectes halli</i>	Northern Giant-Petrel			✓	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low: not critical habitat for this species
Bird	<i>Neophema chrysogaster</i>	Orange-bellied Parrot	✓	✓	✓	Rare but likely to occur. The orange-bellied parrot has been observed on the Youngusband Peninsula and elsewhere in the Coorong National Park (BDB SA). The recent 2008 Winter survey lists several sightings of up to 4 birds on the northern end of the Youngusband Peninsula near the Murray Mouth on saltmarsh at "the Snake Pit" (Ehmke and Jones, 2008); in winter 2006 and 2007, sightings were made around Parnka Point and the northern end of the South Lagoon.	Low. Foraging may be affected during pipeline construction phase and decommissioning, if works are undertaken during winter. Likely positive impact of SLSRS, through increased habitat (inferred from Ehmke 2009; see also Ehmke et al., 2009)
Bird	<i>Pachycephala rufogularis</i>	Red-lored Whistler	✓	✓		Recorded from southern Coorong area (BDB SA). However the project area is not likely to provide critical habitat to this species.	No potential to impact: suitable habitat for this species not present

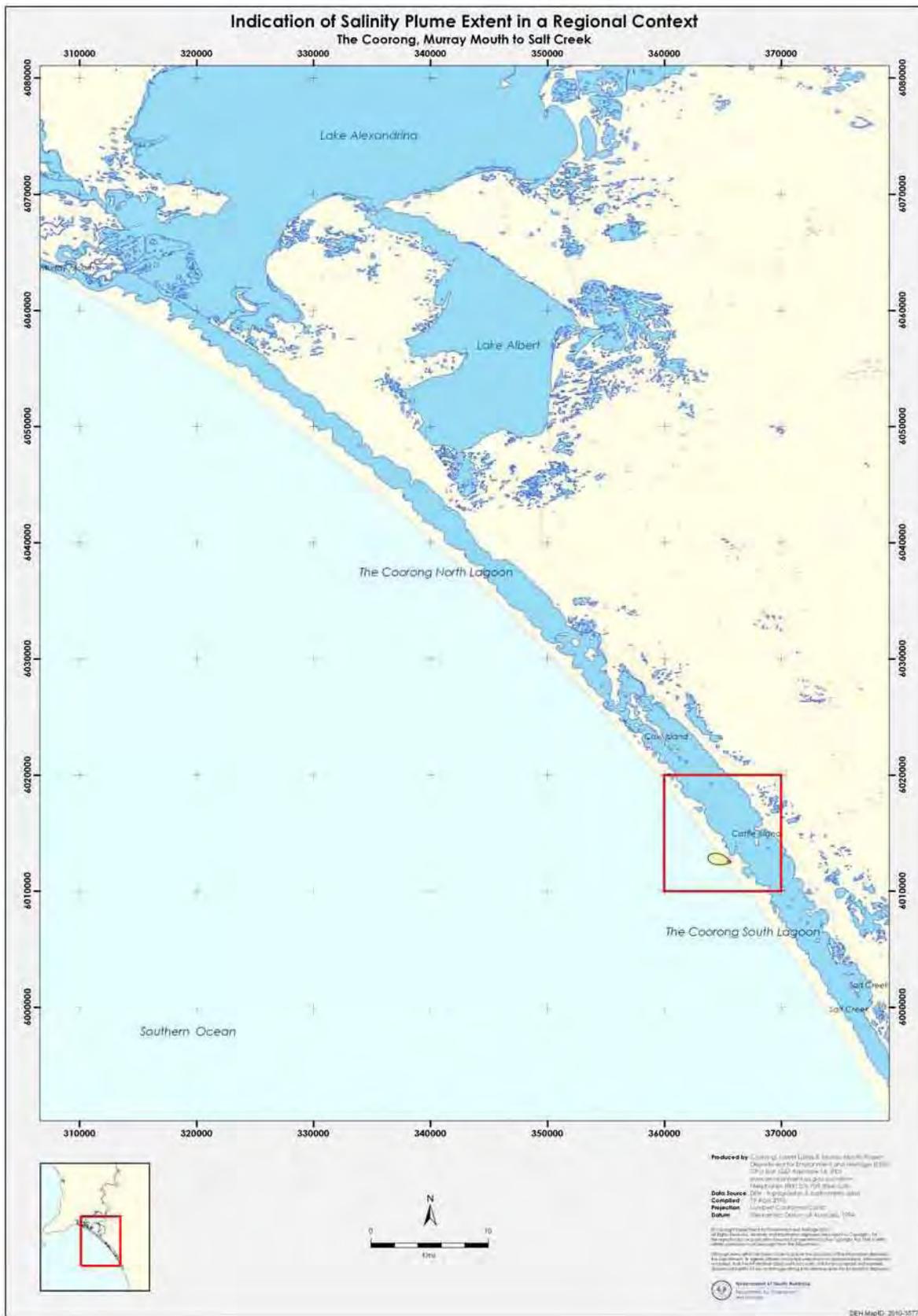
	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
Bird	<i>Psophodes nigrogularis leucogaster</i>	Western Whipbird (eastern)	✓	✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low: habitat in the project area is not critical for this species
Bird	<i>Pterodroma mollis</i>	Soft-plumaged Petrel			✓	Very unlikely to occur; uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species	Very low; habitat provided by the Coorong is unlikely to be of significance to this species
Bird	<i>Rostratula australis</i>	Australian Painted Snipe	✓	✓		Not likely to occur; not recorded in southern Coorong area (BDB SA); not recorded in Coorong 2000 - 2005 or Ramsar site 2002 - 2009 (Kerr 2009)	None to very low (not likely to occur)
Bird	<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (Fleurieu Peninsula), Mount Lofty Southern Emu-wren				Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact
Bird	<i>Thalassarche bulleri</i>	Buller's Albatross	✓	✓	✓	Very unlikely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (very unlikely to occur)
Bird	<i>Thalassarche cauta cauta</i>	Shy Albatross, Tasmanian Shy Albatross	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA). Uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species.	None to very low: not critical habitat for this species
Bird	<i>Thalassarche cauta salvini</i>	Salvin's Albatross	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Bird	<i>Thalassarche chrysostoma</i>	Grey-headed Albatross	✓	✓	✓	Recorded from southern Coorong area (BDB SA) but unlikely to occur. Uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species	None to very low: not critical habitat for this species
Bird	<i>Thalassarche melanophris</i>	Black-browed Albatross	✓	✓	✓	Low likelihood of occurrence; not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on numbers or Coorong (Kerr, 2009). Habitat provided by the Coorong is unlikely to be of significance to this species.	None to very low: not critical habitat for this species

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
Bird	<i>Thalassarche melanophris impavida</i>	Campbell Albatross	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Frog	<i>Litoria raniformis</i>	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog				Not recorded in Coorong National Park. Not likely to occur; freshwater soaks may provide habitat but not recorded in S Lagoon.	None to very low (not likely to occur)
Mammal	<i>Balaenoptera musculus</i>	Blue Whale			✓	Likely to occur; recorded on shelf off Southern Coorong (Gill et al. unpublished data). The proposed pipeline outfall is more than 50 km from the critical habitat of these whales and will not be affected by elevated salinity	Low: although the species may occur in the area, being mobile, it will be able to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Eubalaena australis</i>	Southern Right Whale			✓	Likely to occur; recorded off Southern Coorong. The nearest important calving area is near the Murray Mouth and to the west. The proposed pipeline outfall is more than 50 km from the outer extent of the calving zone and will not be affected by elevated salinity	Low: although the species may occur in the area, being mobile, it will be able to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot		✓		Not recorded from South lagoon area or Youngusband Peninsula (BDB SA)	None to very low (unlikely to occur)
Mammal	<i>Megaptera novaeangliae</i>	Humpback Whale			✓	Not likely to occur	None to very low (not likely to occur)
Mammal	<i>Neophoca cinerea</i>	Australian Sealion			✓	Likely to occur; breed on Pages Is and are known to forage in this area. The proposed pipeline outfall is more than 50 km from the Pages Is and will not be affected by elevated salinity	Low: although the species occurs in the area, being mobile, it will be able to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Nyctophilus timoriensis (South-eastern form)</i>	Eastern Long-eared Bat				Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact
Ray-finned fish	<i>Craterocephalus fluviatilis</i>	Murray Hardyhead				Does not occur in project area	No potential to impact
Ray-finned fish	<i>Maccullochella peelii peelii</i>	Murray Cod, Cod, Goodoo				Does not occur in project area	No potential to impact

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
Ray-finned fish	<i>Nannoperca obscura</i>	Yarra Pygmy Perch				Does not occur in project area	No potential to impact
Shark	<i>Carcharodon carcharias</i>	Great White Shark			✓	Likely to occur	Very low to low, as this species, being mobile, is able to avoid hypersaline area.
Shark	<i>Galeorhinus galeus</i>	School Shark, Eastern School Shark, Snapper Shark, Tope, Soupin Shark			✓	Likely to occur.	Very low to low, as this species, being mobile, is able to avoid the hypersaline plume area.
Plant	<i>Acacia pinguifolia</i>	Fat-leaved Wattle		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Acacia rheticarpa</i>	Neat Wattle, Resin Wattle (SA)		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Caladenia colorata</i>	Small Western Spider-orchid, Coloured Spider-orchid, Painted Spider-orchid		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Caladenia conferta</i>	Coast Spider-orchid		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Caladenia richardsiorum</i>	Little Dip Spider-orchid		✓		May occur (DEH, SA) though not recorded in southern Coorong area (BDB SA)	Very low (may occur)
Plant	<i>Caladenia tensa</i>	Greencomb Spider-orchid, Rigid Spider-orchid		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Cassinia tegulata</i>	a shrub		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Euphrasia collina subsp. osbornii</i>	Osborn's Eyebright		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Frankenia plicata</i>			✓		Does not occur in project area	None to very low (not likely to occur)
Plant	<i>Glycine latrobeana</i>	Clover Glycine, Purple Clover		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Olearia pannosa subsp. pannosa</i>	Silver Daisy-bush		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
Plant	<i>Prasophyllum frenchii</i>	Maroon Leek-orchid, Slaty Leek-orchid,		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (do not occur)
Plant	<i>Prasophyllum murfettii</i>	Fleurieu Leek Orchid		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Prasophyllum pallidum</i>	Pale Leek-orchid		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Pterostylis arenicola</i>	Sandhill Greenhood Orchid		✓		Unlikely to occur	None to very low (not likely to occur)
Plant	<i>Pterostylis cucullata</i>	Leafy Greenhood		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Senecio macrocarpus</i>	Large-fruit Fireweed, Large-fruit Groundsel		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Tecticornia flabelliformis</i>	Bead Glasswort		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Thelymitra cyanapicata</i>	Blue Top Sun-orchid, Dark-tipped Sun-orchid		✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Plant	<i>Thelymitra epipactoides</i>	Metallic Sun-orchid		✓		May occur (DEH, SA), recorded near Salt Creek..	Very low (may occur)
Plant	<i>Thelymitra matthewsii</i>	Spiral Sun-orchid		✓		Not likely to occur; recorded from Messent CP, but not in southern Coorong area (BDB SA)	None to very low (not likely to occur)

Figure 4. Indicative salinity and nutrient plume for the SLPS in a worst case scenario
 (The red square helps highlight the relevant area. The indicative plume of 1ppt excess salinity is in green.)



4.5 EPBC-listed Marine Species

An analysis of likely impacts on relevant marine species is contained in Table 17.

A habitat mapping exercise has been undertaken in the vicinity of the proposed outfall (Rowling et al 2010 Appendix P1). It showed that the surroundings were comprised entirely of soft sediments (ie mainly bare sand) with no reef or seagrass habitat observed within the area through video ground-truthing. Weather restrictions meant that sampling had to be conducted from approximately 2 kilometres offshore; however, the high-energy swash zone that persists for the majority of the year inshore of that point means that any more complex habitat is unlikely. Other surveys of the beach and intertidal zones have also failed to find evidence of more complex habitats in the swash or near-shore zone (Goreman et al (2009) and Fairweather P (unpublished data)).

The extent of worst-case scenario impacts was considered by Aurecon (2010, Appendix D). The indicative extent of the salinity and nutrient plume in such conditions is depicted in Figure 4.

The likelihood of any negative impact on listed Marine species is considered to be **low to none**. The possible impacts on the hooded plover and whales are discussed in Sections 4.3.4 and 4.4.

Two of the EPBC-listed marine bird species are likely to be positively impacted by the project, particularly the **Fairy Tern, which is currently in danger of becoming regionally extinct** due to excessive salinity in the Coorong Lagoons and is red-listed by the IUCN (Table 17).

Table 17. Likely impact on marine EPBC-listed species potentially occurring within or near the project area.

	Species	Common Name	Coorong South Lagoon	Younghusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact	
							High positive	Negative
							High positive	Negative
Bird	<i>Catharacta skua</i>	Great Skua			✓	Unlikely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)	
Bird	<i>Larus novaehollandiae</i>	Silver Gull	✓	✓	✓	Very likely to occur; however no rare subpopulations occur in South Australia.	Not relevant to this proposal.	
Bird	<i>Limnodromus semipalmatus</i>	Asian Dowitcher	✓	✓	✓	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)	
Bird	<i>Sterna</i> (now <i>Thalasseus</i>) <i>bergii</i>	Great Crested Tern, Crested Tern, Swift Tern	✓		✓	Recorded from Coorong South Lagoon and southern Younghusband Peninsula (BDB SA). Ramsar site: steep decline in Lower Lakes; Coorong: variable but stable numbers (Kerr, 2009).	Not likely to be greatly impacted. This species fishes in the ocean for food and is largely uncoupled from the Coorong.	
Bird	<i>Sterna fuscata</i> (now <i>Onychoprion fuscatus</i>)	Sooty Tern	✓			Rare vagrant in SA; Ramsar site: not recorded in past 6 years	None to very low (not likely to occur).	
Bird	<i>Sterna</i> (now <i>Sternula</i>) <i>neréis</i>	Fairy Tern	✓			Recorded from Coorong South Lagoon and southern Younghusband Peninsula (BDB SA). Ramsar site; not recorded / rare in Lower Lakes; Coorong S Lagoon: variable numbers, no	High potential to impact positively, through restoration of critical habitat. It is important to prevent this species from becoming regionally regional extinct, and	

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
						longer breeding in region.	this requires reestablishment of conditions suitable for fish in the South Lagoon near islands that offer secure breeding opportunities.
Bird	<i>Thinornis rubricollis rubricollis</i>	Hooded Plover (eastern)	✓	✓	✓	Likely to occur, particularly on ocean beach (nesting sites). Also occurs on the western side of the Coorong South Lagoon. Coorong population trend: uncommon but stable, 2000 - 2005. There is a Hooded Plover Recovery plan, under which about 110 km of the northern end of the Coorong Ocean Beach is closed to vehicles from 24 October to 24 December each year, specifically to protect the this species (SA Government 1993).	<p><i>Southern Ocean beach:</i> Moderate potential negative impact of construction works (hooded plover nests on ocean beach and western shore of Coorong South lagoon).</p> <p><i>Coorong Lagoons:</i> This species regularly shifts to the Coorong Lagoons & is very likely to benefit from reduction in salinity and the potential change in prey availability.</p>
Mammal	<i>Arctocephalus forsteri</i>	New Zealand Fur-seal			✓	Newly recorded in the Murray Mouth and Coorong North Lagoon; not previously in these locations	Very low: although this species may occur in area, being mobile, is able to avoid hypersaline area; hypersaline plume is not likely to extend to 3 nm offshore even under worst case scenarios. Unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Arctocephalus pusillus</i>	Australian Fur-seal, Australo-African Fur-seal			✓	Likely to occur	Very low: although this species may occur in area, being mobile, is able to avoid hypersaline area; and hypersaline plume is not likely to extend to 3 nm offshore even under worst case scenarios. Unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Balaenoptera musculus</i>	Blue whale			✓	Likely to occur; recorded on shelf off Southern Coorong (Gill et al. unpublished data). The	Low: although the species may occur in the area, being mobile, it will be able

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
						proposed pipeline outfall is more than 50 km from the critical habitat of these whales and will not be affected by elevated salinity	to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Balaenoptera acutorostrata</i>	Minke Whale			✓	Not likely to occur	None to very low, not likely to occur and, being mobile, is able to avoid hypersaline area.
Mammal	<i>Delphinus delphis</i>	Common Dolphin, Short-beaked Common Dolphin			✓	Likely to occur in Commonwealth waters > 3 nm offshore	None to very low: hypersaline plume is not likely to extend to 3 nm offshore even under worst case scenarios.
Mammal		Southern Right whale				Likely to occur; recorded off Southern Coorong. The nearest important calving area is Encounter Bay. The proposed outfall is >50 km from the outer extent of the marked calving zone and will not be affected by elevated salinity..	Low: although the species may occur in the area, being mobile, it will be able to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Grampus griseus</i>	Risso's Dolphin, Grampus			✓	Not likely to occur	None to very low: unlikely to occur, and hypersaline plume is not likely to extend to 3 nm offshore even under worst case scenarios.
Mammal	<i>Tursiops aduncus</i>	Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin			✓	Likely to occur	Very low: hypersaline plume is not likely to extend to 3 nm offshore even under worst case scenarios.
Mammal	<i>Tursiops truncatus s. str.</i>	Bottlenose Dolphin			✓	Likely to occur	Very low: hypersaline plume is not likely to extend to 3 nm offshore even under worst case scenarios. Being mobile, is able to avoid hypersaline plume area further inshore.
Syngnathid	<i>Acentronura australe</i>	Southern Pygmy Pipehorse			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Campichthys tryoni</i>	Tryon's Pipefish			✓	Not likely to occur in Commonwealth waters >	No potential to impact (not likely to occur)

	Species	Common Name	Coorong South Lagoon	Younghusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
						3 nm offshore	
Syngnathid	<i>Heraldia nocturna</i>	Upside-down Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Hippocampus abdominalis</i>	Eastern Potbelly Seahorse, New Zealand Potbelly, Seahorse, Bigbelly Seahorse			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Hippocampus breviceps</i>	Short-head Seahorse, Short-snouted Seahorse			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Histiogamphelus cristatus</i>	Rhino Pipefish, Macleay's Crested Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Hypselognathus rostratus</i>	Knife-snouted Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Kaupus costatus</i>	Deep-bodied Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Leptoichthys fistularius</i>	Brush-tail Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Lissocampus caudalis</i>	Australian Smooth Pipefish, Smooth Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Lissocampus runa</i>	Javelin Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Maroubra perserrata</i>	Sawtooth Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Notiocampus ruber</i>	Red Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Phycodurus eques</i>	Leafy Seadragon			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Phyllopteryx taeniolatus</i>	Weedy Seadragon,			✓	Not likely to occur in Commonwealth waters >	No potential to impact (not likely to occur)

	Species	Common Name	Coorong South Lagoon	Younghusband Peninsula	Southern Ocean Outfall	Likelihood of occurrence	Potential to impact
		Common Seadragon				3 nm offshore	
Syngnathid	<i>Pugnaso curtirostris</i>	Pug-nosed Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Solegnathus robustus</i>	Robust Spiny Pipehorse, Robust Pipehorse			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Solegnathus spinosissimus</i>	Spiny Pipehorse, Australian Spiny Pipehorse			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Stigmatopora argus</i>	Spotted Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Stigmatopora nigra</i>	Wide-bodied Pipefish, Black Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Stipecampus cristatus</i>	Ring-backed Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Urocampus carinirostris</i>	Hairy Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Vanacampus margaritifer</i>	Mother-of-pearl Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Vanacampus phillipi</i>	Port Phillip Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Vanacampus poecilolaemus</i>	Australian Long-snout Pipefish, Long-snouted Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)
Syngnathid	<i>Vanacampus vercoi</i>	Verco's Pipefish			✓	Not likely to occur in Commonwealth waters > 3 nm offshore	No potential to impact (not likely to occur)

4.5 EPBC-listed Migratory Species

The likely impacts of the SLPS on EPBC-listed migratory species are presented in Table 18.

Nine species are expected to have high to some positive impacts from the proposal. This table also includes the orange-bellied parrot, blue whale, southern right whale and great white sharks as potentially being impacted by the proposal: impacts on these species have been discussed in Sections 4.3.4 and 4.4. It is observed that the sanderling,

Calidris alba, may have some disturbance from construction and decommissioning works; this impact is considered low due to the limited relevant footprint of the SLPS.

Table 18. Likely impact on migratory EPBC-listed species potentially occurring within the project area.

	Species	Common Name	Coorong South Lagoon	Younghusband Peninsula	Southern Ocean Outfall	Wetland-dependent*	Likelihood of occurrence	Potential to impact
Bird	<i>Apus pacificus</i>	Fork-tailed Swift	✓	✓	✓	no	Likely to occur: recorded rarely from Coorong South Lagoon and southern Younghusband Peninsula (BDB SA)	No potential to impact (mainly aerial species)
Bird	<i>Ardea alba (A. modesta)</i>	Great Egret, White Egret	✓	✓	✓	yes	Likely to occur: Ramsar site: recorded, populations declining; Coorong: recorded, populations declining between 2002 - 2005 (Kerr, 2009)	High, positive, through habitat restoration, increase in food sources; possible disturbance from construction and decommissioning phases
Bird	<i>Ardea ibis</i>	Cattle Egret	✓	✓	✓	yes	May occur. Ramsar site; recorded in Lower Lakes area; Coorong: not recorded between 2002 - 2005	None to very low (not likely to occur)
Bird	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	✓	✓		yes	Likely to occur. Recorded from Coorong South Lagoon (more on the mainland side), southern Younghusband Peninsula (BDB SA. Ramsar site: common, variable; Coorong common, variable (Kerr, 2009)	High, positive, through habitat restoration, increase in food sources; low possibility of disturbance from construction and decommissioning if carried out over summer
Bird	<i>Calidris alba</i>	Sanderling	✓	✓		yes	Likely to occur. Recorded from Coorong South Lagoon (BDB SA). Ramsar site: Rare, variable; Coorong: rare, variable (Kerr, 2009), recorded mainly on beach Murray Mouth (D. Paton pers. comm.)	Some potential for disturbance from construction and decommissioning
Bird	<i>Calidris ferruginea</i>	Curlew Sandpiper	✓	✓		yes	Likely to occur. Recorded from Coorong South Lagoon and southern Younghusband Peninsula (BDB SA). Ramsar site: trend variable; Coorong: trend declining	High, positive, through habitat restoration, increase in food sources; possible disturbance from construction and decommissioning if carried out over summer

	Species	Common Name	Coorong South Lagoon	Younghusband Peninsula	Southern Ocean Outfall	Wetland-dependent*	Likelihood of occurrence	Potential to impact
Bird	<i>Calidris ruficollis</i>	Red-necked Stint	✓	✓		yes	Likely to occur. Recorded from Coorong South Lagoon and southern Younghusband Peninsula (BDB SA). Ramsar site: common, variable; Coorong: common, trend declining (Kerr, 2009); declining sharply (D. Paton, pers. comm.)	High, positive, through habitat restoration, increase in food sources; possible disturbance from construction and decommissioning if carried out over summer
Bird	<i>Diomedea amsterdamensis</i>	Amsterdam Albatross	✓	✓	✓	no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (unlikely to occur)
Bird	<i>Diomedea dabbenena</i> / <i>Diomedea exulans exulans</i>	Tristan Albatross	✓	✓	✓	no	Very unlikely to occur, habitat provided by the Coorong is unlikely to be of significance to this species.	None to very low (unlikely to occur)
Bird	<i>Diomedea epomophora (sensu stricto)</i>	Southern Royal Albatross	✓	✓	✓	no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Bird	<i>Diomedea epomophora sanfordi</i>	Northern Royal Albatross	✓	✓	✓	no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Bird	<i>Diomedea exulans (sensu lato)</i>	Wandering Albatross	✓	✓	✓	no	May occur, but uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species	Very low; habitat provided by the Coorong is unlikely to be of significance to this species
Bird	<i>Diomedea gibsoni</i>	Gibson's Albatross	✓	✓	✓	no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Bird	<i>Gallinago hardwickii</i>	Latham's Snipe, Japanese Snipe	✓	✓		yes	Not likely to occur; Ramsar site including Coorong: not recorded in past 6 years (Kerr, 2009)	None to very low (not likely to occur)
Bird	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	✓	✓	✓	yes	Likely to occur. Recorded from Coorong South Lagoon and southern Younghusband Peninsula (BDB SA)	Very low; current sightings at North Lagoon only (D. Paton, pers. comm.).
Bird	<i>Hirundapus caudacutus</i>	White-throated Needletail	✓	✓		no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact (mainly aerial species)
Bird	<i>Leipoa ocellata</i>	Malleefowl		✓		no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Wetland-dependent*	Likelihood of occurrence	Potential to impact
Bird	<i>Macronectes giganteus</i>	Southern Giant-Petrel	✓	✓	✓	no	May occur. Not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on population trends (Kerr, 2009)	None to very low: not critical habitat for this species
Bird	<i>Macronectes halli</i>	Northern Giant-Petrel			✓		Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low: not critical habitat for this species
Bird	<i>Merops ornatus</i>	Rainbow Bee-eater	✓	✓			Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact (no suitable habitat available)
Bird	<i>Neophema chrysogaster</i>	Orange-bellied Parrot	✓	✓	✓	yes	Rare but likely to occur. The orange-bellied parrot has been observed on the Youngusband Peninsula and elsewhere in the Coorong National Park (BDB SA). The recent 2008 Winter survey lists several sightings of up to 4 birds on the northern end of the Youngusband Peninsula near the Murray Mouth on saltmarsh at "the Snake Pit" (Ehmke and Jones, 2008); in winter 2006 and 2007, sightings were made around Parnka Point and the northern end of the South Lagoon.	Foraging may be affected during pipeline construction phase and decommissioning , if works are undertaken during winter Likely positive impact of SLSRS, through increased habitat (inferred from Ehmke 2009; see also Ehmke et al., 2009)
Bird	<i>Pluvialis fulva</i>	Pacific Golden Plover	✓	✓	✓		Likely to occur. Recorded from Coorong South Lagoon area (BDB SA) but not in last 10 years (D. Paton pers. comm.); most likely to occur Nov - March. Coorong: population trends variable but possible medium-term decline (Kerr, 2009)	This species occurs mainly in the North Lagoon but has also been recorded in the South lagoon. Some potential for positive impact from habitat restoration..
Bird	<i>Rostratula benghalensis s. lat.</i>	Painted Snipe	✓	✓	✓		Not likely to occur; not recorded in southern Coorong area (BDB SA); not recorded in Coorong 2000 - 2005 or Ramsar site 2002 - 2009 (Kerr 2009)	No potential to impact (not likely to occur)

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Wetland-dependent*	Likelihood of occurrence	Potential to impact
Bird	<i>Sterna</i> (now <i>Sternula</i>) <i>albifrons</i>	Little Tern	✓	✓	✓	yes	May occur. Uncommon in SA, where recorded from Coorong among other locations. Ramsar site: not recorded since 2002; Coorong: have bred on islands in the Coorong but not recorded 2000 - 2005 (Kerr, 2009)	High, positive, through habitat restoration, increase in food sources; possible disturbance from construction and decommissioning if carried out over summer, though not recorded recently.
Bird	<i>Sterna</i> (now <i>Hydroprogne</i>) <i>caspia</i>	Caspian Tern	✓	✓	✓	yes	Likely to occur. Ramsar site: steep decline in Lower Lakes; Coorong S Lagoon: variable but stable numbers (Kerr, 2009)	High, positive, through habitat restoration, increase in food sources; possible disturbance from construction and decommissioning phases.
Bird	<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (Fleurieu Peninsula), Mount Lofty Southern Emu-wren		✓			Not likely to occur; not recorded in southern Coorong area (BDB SA)	No potential to impact
Bird	<i>Thalassarche bulleri</i>	Buller's Albatross	✓	✓	✓	no	Very unlikely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Bird	<i>Thalassarche cauta</i> (<i>sensu stricto</i>)	Shy Albatross, Tasmanian Shy Albatross	✓	✓	✓	no	Not likely to occur; not recorded in southern Coorong area (BDB SA). Uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species.	None to very low: not critical habitat for this species
Bird	<i>Thalassarche cauta salvini</i>	Salvin's Albatross	✓	✓	✓	no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Bird	<i>Thalassarche chlororhynchos</i>	Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	✓	✓	✓	no	Low likelihood of occurrence; not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on population trends or Coorong (Kerr, 2009). Habitat provided by the Coorong is unlikely to be of significance to this species.	None to very low: not critical habitat for this species

	Species	Common Name	Coorong South Lagoon	Younghusband Peninsula	Southern Ocean Outfall	Wetland-dependent*	Likelihood of occurrence	Potential to impact
Bird	<i>Thalassarche chrysostoma</i>	Grey-headed Albatross	✓	✓	✓	no	Recorded from southern Coorong area (BDB SA) but unlikely to occur. Uses predominantly marine pelagic habitat and is seldom seen inshore; habitat provided by the Coorong is unlikely to be of significance to this species	None to very low: not critical habitat for this species
Bird	<i>Thalassarche impavida</i>	Campbell Albatross	✓	✓	✓	no	Not likely to occur; not recorded in southern Coorong area (BDB SA)	None to very low (not likely to occur)
Bird	<i>Thalassarche melanophris</i>	Black-browed Albatross	✓	✓	✓	no	Low likelihood of occurrence; not recorded in southern Coorong area (BDB SA). Ramsar site: recorded but no information on numbers or Coorong (Kerr, 2009). Habitat provided by the Coorong is unlikely to be of significance to this species.	None to very low: not critical habitat for this species
Bird	<i>Tringa nebularia</i>	Common Greenshank, Greenshank	✓	✓		yes	Recorded from Coorong South Lagoon and southern Younghusband Peninsula (BDB SA). Populations have declined considerably; limited distribution in parts of South Lagoon (D. Paton, pers. comm.)	High, positive, through habitat restoration, increase in food sources; low possibility of disturbance from construction and decommissioning if carried out over summer
Mammal	<i>Balaenoptera edeni</i>	Bryde's Whale			✓		Not likely to occur	None to very low (not likely to occur)
Mammal	<i>Balaenoptera musculus</i>	Blue Whale			✓		Likely to occur; recorded on shelf off Southern Coorong (Gill et al. unpublished data). The proposed pipeline outfall is more than 50 km from the critical habitat of these whales and will not be affected by elevated salinity	Low: although the species may occur in the area, being mobile, it will be able to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Caperea marginata</i>	Pygmy Right Whale			✓		Not likely to occur	None to very low (not likely to occur)

	Species	Common Name	Coorong South Lagoon	Youngusband Peninsula	Southern Ocean Outfall	Wetland-dependent*	Likelihood of occurrence	Potential to impact
Mammal	<i>Eubalaena australis</i>	Southern Right Whale			✓		Likely to occur; recorded off Southern Coorong. The nearest important calving area is Encounter Bay. The proposed outfall is >50 km from the outer extent of the marked calving zone and will not be affected by elevated salinity..	Low: although the species may occur in the area, being mobile, it will be able to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources
Mammal	<i>Lagenorhynchus obscurus</i>	Dusky Dolphin			✓		Not likely to occur	None to very low (not likely to occur)
Mammal	<i>Megaptera novaeangliae</i>	Humpback Whale			✓		Not likely to occur	None to very low (not likely to occur)
Mammal	<i>Orcinus orca</i>	Killer Whale, Orca			✓		Not likely to occur	None to very low (not likely to occur)
Shark	<i>Carcharodon carcharias</i>	Great White Shark			✓		Likely to occur	Low: although the species may occur in the area, being mobile, it will be able to avoid the hypersaline salt plume; unlikely to affect breeding; negligible effect on food sources

4.6 EPBC-listed Threatened Ecological Communities

The main vegetation types in the project area do not include any of the threatened ecological communities identified in an EPBC Protected Matters Report.

In the project area, the main vegetation types are: coastal dune vegetation dominated by either dune grasses *Ammophila* and *Spinifex*, or low trees and shrubs (*Acacia longifolia* var. *sophorae*, *Olearia* and *Leucopogon*; sapphire marshland, sedgeland, mallee heath and shrublands, and *Melaleuca* shrublands).

Although specimens of Iron-grass, *Lomandra effuse*, have been collected from the Coorong National Park and from near Policeman's Point, this grassland habitat is uncommon in the region. A recent vegetation survey undertaken along the proposed preferred pipeline route over the Dunes did not find any evidence of this species (Rural Solutions SA 2010 Appendix U). In the event that a new pipeline route is proposed as a result of the ongoing detailed design phase, then a new vegetation survey will be conducted and a variation submitted to the Native Vegetation Council.

The nearest Peppermint Box communities are approx 100 km distant from the project area, and Buloke grassy woodlands are not found within approx 60 km of the project area. The swamps of the Fleurieu Peninsula are quite distinct and distant from the project area (at least 70 km away).

4.7 Commonwealth Marine Area

The distance between the nearest boundary of the Murray Commonwealth Marine Reserve to the Project area (ocean outfall) is 35 km. Commonwealth Marine Reserve at 139°9.867'E; ocean outfall at 139°30.633' E [note latitude coordinates are not given at <http://www.environment.gov.au/coasts/mpa/publications/pubs/southeast-murray-map.pdf>]. Given the distance between the two points, and the size of the modelled hypersaline plume (taken as the zone where ocean salinity is likely to be greater than 10% above background marine salinity) extends for no more than 200m radius around the outfall in perceived worst case scenarios (Appendix D), it is not likely that the proposed project will have any discernible impact on the Murray Commonwealth Marine Reserve.

5. Other Important Features of the Environment

5.1 Soil and Vegetation Characteristics

Components of the environment in the project area described here include Parnka Point, the Younghusband Peninsula and the Coorong Southern Ocean beach. The Coorong South Lagoon is covered in Section 3.3.1.

Detailed terrestrial habitat maps are available for the Coorong National Park (see Appendix A; SA DEH). A recent vegetation survey has been undertaken along the proposed preferred pipeline route over the dunes on Younghusband Peninsula (Rural Solutions SA 2010 Appendix U).

Benthic habitat maps are available for the nearshore marine environment of the Southern Ocean at the Coorong in the area that where the plume of hypersaline water will occur (Appendix D).

The Younghusband Peninsula

The following description is taken from an article by Gilbertson (1977). While the study area described by Gilbertson was 30 km SE of the proposed SLPS project area, much of the description applies equally well to the SLPS project area.

“The Younghusband Peninsula is a coastal barrier of vegetated and mobile dunes. The sand is predominantly calcareous in character. The system rests upon a calcreted sand ridge which continues to about 1 km seaward of the present beach. There is frequently a low foredune, 0.5 to 1 m in height, which is partially stabilized by the sand binding grasses *Ammophila arenaria* and *Spinifex hirsutus* [*S. sericeus*], and the sea rocket, *Cakile maritima*. A linear frontal dune ridge, 2 – 3 m in height, and up to 50 m in width occurs in certain regions. In addition to the foredune vegetation, this ridge is fixed by *Scirpus nodosus* [*Isolepis nodosa*], *Stackhausia* [*Stackhousia*] *spathulata*, *Euphorbia paralais*, and low growing specimens of the shrubs *Calocephalus brownii* and *Olearia axillaris*. Aerial photograph examination shows the fixed vegetated, stable dunes are a nested series of parabolic or U-dunes, which produces a highly complex topography of ridges and hollows (swales).”.....“The depth of organic matter in the topsoil [of vegetated dunes] is usually in excess of 0.1 m. Admixture of clay/silt sized particles by easterly winds from the claypans of the dried up lagoons gives rise to surprisingly deep (0.7 – 1 m) loamy soils on the landward faces of several of the dune ridges. The dunes support a dense scrub cover characterised by *Acacia sophorae* [*Acacia longifolia* var. *sophorae*], *Olearia axillaris*, *Leucopogon parviflorus*, *Tetragonia implexicoma*, *Pimelia* [*Pimelea*] *serpyllifolia*, and pockets of gum *Eucalyptus diversifolia*. Dominance varies considerably.”.....

“‘Blow-outs’ in the frontal dune ridge and/or the parabolic dunes are common. These blow-outs are oriented almost [perpendicular] to the coast and are parallel to the [strongest prevailing wind]. The blow-outs may be 200 m long, over 50 m wide, and often in excess of 10 m in depth. The dune swale behind the frontal dune ridge is usually lacking any important vegetation cover. It is, however, covered in the remains of the bivalve ‘Goolwa Cockle’ (pipi, *Plebidonax deltoides*), which have in pre-European times been gathered by the aboriginal inhabitants from the nearshore zone as a food source. The more inland swales, dune ridges and blow-out floors are often similarly very rich in this midden material. Non-vegetated dunes occupy some 40% of the dune system in this part of the Younghusband Peninsula.”...“The mobile sands comprise a series of transgressive sand sheets. Residual mounds up to 10 m in height can occur above the sand sheets. The residuals are often capped by quite dense scrub, but their walls, like the sand sheets, often only support *Ammophila*, *Spinifex* and *Cakile*. The landward face of the mobile dunes is 10 to 20 m high; Residual pockets of *Acacia* and *Leucopogon* dominated scrub occur in hollows on the main dune face.”

“At the landward margin of the vegetated and mobile dunes lies a discontinuous hard sheet of calcrete which underlies much of the dune system. Freshwater pools or soaks occur within it. These soaks lie in depressions in the calcrete and are fed by groundwater seepage through the dunes. Dense thickets of scrub are naturally promoted around these pools which offer an unusual linear series of freshwater habitats for the indigenous and migratory biota in an otherwise often highly saline environment”.

* A sand sheet deposited under the sea at times of higher sea level relative to the land.

The vegetation list compiled by Correll (1963) for the southern Younghusband Peninsula, reproduced and cited in Noye (1975b), includes all species mentioned above and, in addition, includes club-rushes and sedges which would occur most commonly at fresh-water soaks on the Lagoon side of the Peninsula (Noye, 1975b).

The main vegetation types that occur in the project area are shown in Appendix A. The vegetation types occurring include: Melaleuca open forests and woodlands, mallee heath and shrublands, Melaleuca shrublands, other coastal shrublands, tussock grasslands, sedgeland and samphire marshland.

The Coorong Southern Ocean Beach

The Coorong Ocean beach is approximately 190 km in length, between the Murray Mouth (Encounter Bay) in the northwest and Cape Jaffa (Lacepede Bay) in the southeast. The beach from the Murray Mouth is generally described as being a “high-energy environment”.

As described in the recent report by Aurecon (2009a):

“The ocean shoreline adjacent to Policeman’s Point [approx 75 km from the Murray Mouth] is a gently sloping beach of fine to medium sand exposed to the high energy wave input from the Southern Ocean. The southern end of the beach consists of coarse shell gravel grading to finer sands toward the north. The beach is flat with high wave exposure and is backed by bare or partially vegetated dune systems”

Short and Hesp (1980) describe the beach surfzone in the first 100 km of the Younghusband Peninsula as being “characterised by persistent high wave energy arriving parallel to the shoreline after crossing a moderate nearshore slope. ... Dune, beach and surfzone grain size is consistently uniform and fine (2.0 – 2.5 mm ϕ) ... apart from an increase in size (0 – 1.0 mm ϕ) between 30 and 60 km. The increase is associated with an overall increase in carbonate shell content. Overall carbonate content increases from a low of 20% at Murray Mouth to over 50% at 100 km, reflecting the decreasing influence of quartz sediment ultimately derived from the Murray River system, and increasing input of carbonate marine shell material from the swash-surfzone. ... Beach gradient is consistent the length of this section at 1:20. ... In summary this zone represents a high energy but relatively stable beach system, backed by a foredune of moderate stability and moderate to high dune transgression”.

Appendices P1 and P2 show that benthic habitat in the Southern Ocean off the coast of the project area consists of bare sand to approximately 4 km offshore. This was derived from sonar mapping together with video ground-truthing using a remotely operated video camera to survey the ocean floor at the beginning and end of sonar transects. The recent marine survey identified no species of National Environmental Significance.

5.2 Water Flows, including Rivers, Creeks and Impoundments

The Coorong Lagoons are a part of the larger river and lake system of the River Murray and Lower Lakes near the Murray Mouth in South Australia.

According to Noye (1974), the “central feature of the Coorong region is the permanent lagoon, a narrow stretch of salt water, two miles [three km] across at the widest point and approximately fifty miles [80 km] long in the summer, sixty miles [100km] long in the winter. Its average depth in summer is four feet [1.2 m] in winter eight feet [2.4 m]. The lagoon is separated from Encounter Bay by Younghusband Peninsula, a ridge of Recent sand dunes about one mile [1.6 km] wide. It is bordered on its landward side by a composite range of Pleistocene dunes; this shoreline consists of small cliffs separated by sandy embayments, and is studded with many sharp-edged rocky reefs.

At the Narrows, a channel less than one hundred yards [90 m] wide and about 15 feet [4.5 m] deep, this stretch of water is divided into two approximately equal sections referred to as South Lagoon and North Lagoon.

The Coorong South Lagoon

(Note: this section is taken directly from Phillips and Muller (2006)).

The South Lagoon is a “long, narrow coastal lagoon extending from Parnka Point to 42 Mile Crossing, comprising the southern most arm of the Coorong. Area: approximately 9,440ha.

“The South Lagoon of the Coorong is a saline-hypersaline permanent waterbody that is connected to North Lagoon by a narrow channel at the northwest end. Water levels vary seasonally by approximately 0.9m (Lamontagne et al. 2004), being higher in winter and lower in summer, resulting in the seasonal exposure of extensive areas of mudflats which provide foraging and nesting habitat for large numbers of waterbirds. At its southern end, the South Lagoon grades through an annually drying section into a series of shallow and ephemeral salt lakes (Boon 2000). Salinity in the South Lagoon is controlled by inflows from the North Lagoon, rainfall on the lagoon surface, evaporation, openness of the Murray Mouth and historical inflows of fresh water from groundwater via soaks and the South East of South Australia via Salt Creek. These latter two inputs have been reduced significantly since European settlement due to drainage, land clearance (altering groundwater recharge) and localised water resource development.

“Under natural conditions, marine flushing strongly influenced the South Lagoon although less frequently or to a lesser extent than the North Lagoon. Areas at the southern end of South Lagoon may have occasionally become hypersaline prior to European settlement but show biota indicative of regular freshwater inputs presumably from the South East rather than the River Murray. The South Lagoon became more turbid perhaps as early as the beginning of European settlement and more saline after 1940 with further increases in salinity after 1980 (Gell and Haynes 2005)”

“River Murray inflows have little direct influence on the water quality of the South Lagoon but indirectly affect it via North Lagoon water quality and inputs such as salt and silt accumulating in the lagoons. River Murray flows also indirectly impact on the South Lagoon by keeping the Murray Mouth open and thus maintaining connectivity between the lagoons and the Southern Ocean. If the connection to the sea is lost or constricted, the volumes of water that enter the Coorong exceed that which leave the Coorong on any given tidal cycle. Therefore water levels in the Coorong lagoons increase, drowning out mudflats and causing major changes to ecological processes such as denying access to mudflats by waders. Water temperatures and salinities also increase with evaporation over summer creating a stratified water column that becomes poor in dissolved oxygen. Such a scenario is devastating to all biota of the Coorong lagoons and prevention of these physicochemical conditions has been the primary purpose of dredging the Murray Mouth to maintain oceanic exchange since 2001”

“As a consequence of the interactions of the above drivers and levers, the South Lagoon has a salinity gradient with lower salinity in the northwest (as low as 20ppt during times of freshwater inflow) and higher salinity towards the southern end and the boundary of the national Park (up to 140ppt during low flow periods). The highest readings in the South Lagoon were recorded in March 1983, 1984 and 1985 (up to 140 ppt) and January 2003 (up to 110ppt), both periods were preceded by Murray Mouth closure (1981) or severe constriction (2001) and long periods of barrage closure (Geddes 2003). Once such extremely high salinity levels are reached, large volumes of fresh water are required to lower the salinity gradients significantly and flush out the accumulated silts and salts. Meanwhile, irreversible changes can occur to the ecological character of the salinised wetland because salinity and turbidity levels and sedimentation rates exceed the thresholds for many ecosystem components and processes”

“Historically, the submerged annual plant *Ruppia tuberosa* dominated these areas, and is the primary diet of a number of waterbirds (Oborne, 2003). During spring as water levels recede, *Ruppia tuberosa* sets seeds and retreats to its underground organs (turions). When water levels rise again in autumn and winter, seeds and turions germinate and sprout (Jensen et al., 2000) and grow to match the rising water levels, forming blankets that float over the water surface and provide cover for fauna when in dense stands. Other submerged aquatic plants such as *Lamprothamnion* sp. once made up a significant proportion of the submerged biomass in these plant beds but are now considered locally extinct in the Coorong lagoons. Recent surveys recorded only sparse shoots of *Ruppia tuberosa* and the biota in general was considered to be extremely depauperate. Coupled with the loss of other intertidal habitats, this has impacted on waterbird populations that relied on these habitats and food sources for feeding and/or nesting. Redirected groundwater and surplus surface water from the USED Scheme may be a source of fresh water inflows for the South lagoon”. However it should be noted that reliance on these flows alone will not allow habitat recovery”

“Contributions to the Coorong water body from freshwater soaks have never been quantified. The freshwater soaks provide important habitat and water for plants, birds and the animals which inhabit the Youngusband Peninsula”

The Coorong North Lagoon

The Coorong North Lagoon is situated between the Murray Mouth estuary and barrages in the north, and the South Lagoon in the south. The North and South lagoons are connected at Parnka Point, where there is a series of narrow channel sections variously referred to as The Narrows, Parnka Channel and Hells Gate (see Appendix A,) Taken together, the North and South Lagoons are the two largest components of an inverse estuary system which becomes more saline with distance from the mouth (Appendix E2).

Conditions in the Coorong North Lagoon have changed in the recent past, and the southern end has become more saline. Salt concentrations in the southern part of the North Lagoon increased dramatically from around 50 ppt in January 2001 (which is similar to the level measured in January 1985) to 120 – 150 ppt in January 2007. The increases have been particularly marked since 2006 (CLLAMMecology, 2008). As a result, plants such as *Ruppia tuberosa* have now appeared in the southern part of the North Lagoon, whereas this species

was previously restricted to the South Lagoon (Rogers and Paton, 2009). The excessive hypersalinity in the South lagoon is also affecting the southern part of the North Lagoon, through water flow between the two water bodies.

The hydrological connection and seasonal variations in water levels and water flows between the two lagoons were described and modelled by Webster (2007), and by BMT WBM (Appendix F). The components of the hydrodynamic model of the Coorong are shown in Figure 5 (see also Appendix E2)

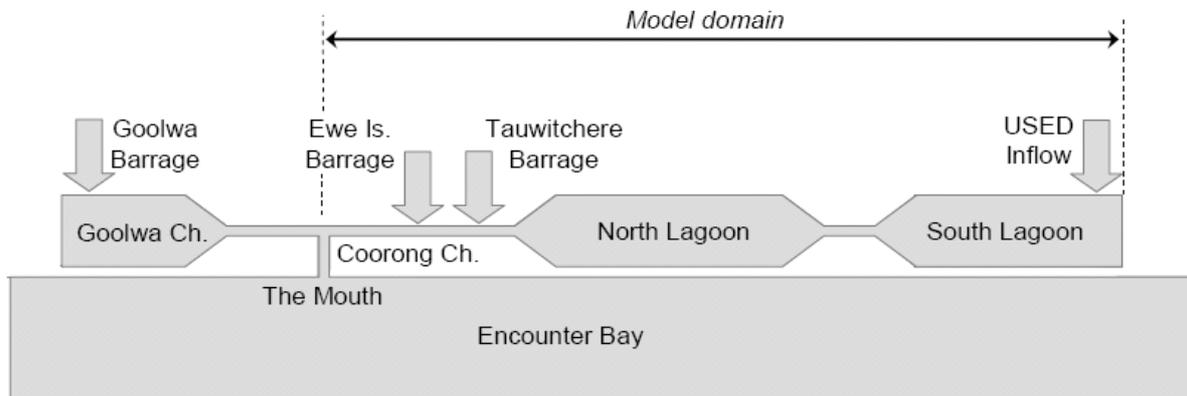


Figure 5. Components of the Coorong inverse estuary system, showing connections (from Webster, 2007).

According to Lester et al (2009; Appendix E2), the “base hydrodynamic model simulates water motions and water levels along the Coorong from the Mouth to the south end of the South Lagoon as these respond to the driving forces associated with water level variations in Encounter Bay (including tidal, weather bands, and seasonal), the wind blowing over the water surface, barrage inflows, flows in Salt Creek (Upper Southeast Drainage), and evaporation from the water surface. The model domain extends from the Mouth to the south end of the South Lagoon (~5 km past Salt Creek) and is shown in Figure 5 with the major inflows. Major channel constrictions occur at the Mouth and in the channel connecting the two lagoons past Parnka channel (Parnka channel)”.

The project is aimed at reducing extremely high salinity levels in the Coorong South Lagoon. Predictions from modelling by WBM BMT (Appendix F, Figure 4.2) show that after three years of pumping, this will result in a substantial reduction in salinity levels for the Coorong the two lagoons. Salinity reductions in the vicinity of 50-100 ppt are predicted (summer and winter). Modelling predicts substantial reductions in salinity will occur in the southern part of the North Lagoon as well, this impact is considered beneficial as long as the salinity reduction is not immediate. The effect of the project on salinity levels at the northern end of the North Lagoon is expected to be small, with salinity at Long Point after pumping expected to vary between 30 – 40 ppt, i.e. near seawater compared to 30 - 60 ppt without pumping (Appendix F).

According to WBMBMT (2009; Appendix F) the various management options to reduce South Lagoon salinity, including pumping at 250 ML / day “have an insignificant impact on water levels within the North Lagoon”.

The project is expected to have a positive impact on the North Lagoon, in that salinity levels at the southern end, which have increased dramatically in the past 3 to 4 years, are very likely to be reduced towards historic “normal” levels such as those observed until 2001. No target salinity levels have been set for the North Lagoon in this project. Salinity and water quality will be monitored in the North Lagoon as well as in the South Lagoon during the project. The North Lagoon is an important source of organisms (aquatic vegetation such as *Ruppia tuberosa*, chironomids, and fish species) for the recolonisation of the South Lagoon when target salinity levels are reached. Populations of these organisms will be monitored in the North Lagoon as well as the South Lagoon during and beyond the life of the project.

Potential for acid sulfate soil formation in the Coorong South Lagoon

The potential for acid sulfate soil formation from the SLRS was investigated by CSIRO (Fitzpatrick et al., 2008) who reported on acid sulphate soils and the potential for formation of acid sulphate soils at 10 sites along the North and South Lagoons in mid-2008. While all sites had sulfidic soil materials, no sites were sulphuric at the time that samples were taken. This was attributed to the large acid-neutralization capacity (ANC) present in the Coorong. The ANC is from ubiquitous carbonate deposits, calcareous dunes, alkaline seawater and hypersaline water containing carbonate. The conclusion of this study was that the risk of formation of acid sulphate soils in the Coorong lagoons is low to moderate. A short summary of the report as it relates to the

Coorong South Lagoon is appended (Appendix J). Monosulfidic materials are commonly present in the sediments of the Coorong Lagoons and are regarded as a natural feature. These monosulfidic materials could be a source for release of toxic metals such as arsenic, and are also a source of malodours. The risk of metal mobilisation is considered to be moderate.

Acid sulphate soils may form in the South Lagoon as a result of lowered water levels during pumping. Modelling (Appendix F) suggests that with pumping at 250 ML per day, water levels in the South Lagoon will be lowered by approx. 10 cm at the end of summer, compared to the “no pumping” scenario. This would expose an additional 130 ha of mudflats and sediments. The risk of ASS formation in the South Lagoon is generally regarded as low (Appendix J) and the Lagoon has a substantial acid neutralization capacity.

5.3 Outstanding Natural Features, including Caves

Notable natural features are the wetlands which cover a large variety of wetland habitat types (Phillips and Muller 2006). The natural environment is protected and listed as follows:

- Coorong National Park
- Coorong, Lakes Alexandrina and Albert Wetland of International Importance
- International Migratory Bird Agreements (JAMBA, CAMBA, ROKAMBA).

5.4 Gradient (or depth range if action to be taken in a marine area)

According to Short and Hesp (1980), the Coorong Southern Ocean beach gradient is consistent along the first 100 km from the Murray Mouth, being around 1:18 to 1:20.

The surf zone width in this region is approx 500m (Short and Hesp 1980). There are two sandbars running parallel to the coast along the first 100 km of Coorong Beach from the Murray Mouth. At Woods Well / Policeman’s Point (approx. 70 km from the Murray Mouth), the inner bar is located ca. 150 – 200 m offshore (50 m wide) and the outer bar at 300 – 500 m offshore, where the outer break point of the surf zone is reached (Short and Hesp 1980; Figure 19).

5.5 Buildings or other Infrastructure

The project is situated within the Coorong National Park. Infrastructure associates with the proposal is discussed in the description of the proposal. At Woods Well and Policeman Point, west of the Princes Highway, there are a number of private occupied dwellings and businesses. The location of these is being taken into account in final siting considerations to avoid noise impacts. Similar considerations may apply to alternative locations for the siting of the generators / pumps. Noise levels will comply with State legislation for all noise sensitive receptors.

5.6 Marine Areas

The nearest boundary of the Murray Commonwealth Marine Reserve is 35 km away from the proposed ocean outfall.

The marine habitat along the Coorong coast was surveyed by Haig et al (2006; Appendix P2) and the area around the proposed ocean outfall was recently re-surveyed (SARDI Aquatic Sciences 2010 Appendix P1).

5.7 Kinds of Fauna and Flora

The Coorong South Lagoon is part of a Ramsar-listed wetland which is renowned for its critical importance in the life cycles of a number of endemic and migratory wetland-dependent birds (Phillips and Muller 2006).

Terrestrial animals of the Coorong lagoons area as a whole have been listed (e.g. Hawkes, 1975) and include monotremes (echidna), a variety of marsupials (kangaroos, possums), rodents, bats and reptiles (tortoises, geckoes, legless lizards, skinks, snakes, goannas, elapids, dragons and pythons).

Fish of the Coorong have been described and listed as part of a larger listing of fish of the Ramsar site (Phillips and Muller, 2006). Fish that contribute to the ecological character of the Ramsar site and potential impact of the project are discussed earlier in this document.

Flora

The following is a general description of the flora of Younghusband Peninsula (UEPG, 1982):

“The plant communities of the Coorong are relatively diverse, occurring in response to saline conditions, soil type, elevation and susceptibility to inundation.

On the ephemeral lake flats in the southern part of the Coorong, *Salicornia* spp and *Arthrocnemum* occur in the most flood prone areas, with *Atriplex paludosa* and *Threlkeldia diffusa* on higher ground. Tussock grasslands of *Gahnia* spp., *Juncus* spp., *Scirpus* spp. and *Stipa teretifolia* are common in locally hummocky areas.

Around the shores of the permanent waters of the Coorong lagoon and other lakes, *Melaleuca halmaturorum* forms dense thickets. *Frankenia pauciflora* and *Wilsonia humilis* often occur as low shrubland in these areas as well. On the higher elevations away from the lakes *Eucalyptus diversifolia* is the dominant tree species with *E. baxteri*, *E. incrassata*, *E. fasciculosa* and *Melaleuca lanceolata* as sub-dominants. The understorey in these areas commonly consists of *Banksia* and *Hakea* species, *Leucopogon parviflorus* and *Olearia axillaris*.”

The tussock grass *Gahnia filum* (threatened sedgeland ecosystem, SA DEH) is found along the South Lagoon of the Coorong (Phillips and Muller 2006). This species is relatively salt tolerant but may be in decline due to habitat degradation (build up of salinity).

Aquatic Plants

Ruppia species (widgeon grass), principally *R. tuberosa* was, until the last three years or so, a major plant species in the Coorong South lagoon (Womersley 1975; Phillips and Muller 2006; Rogers and Paton 2009). In addition, *Lamprothamnium papulosum* (an alga also called “musk grass”) was previously present also and was an important source of starch of waterbirds. Various species of algae were also recorded, such as *Acetabularia peniculus* (Womersley 1975).

Marine environment

A recent survey identified no species of National Environmental Significance. Possible impacts of salinity on the commercially important species, the Goolwa Cockle, were also investigated (Appendix O). The potential impacts on the marine environment have been synthesised and put into regional context by Flinders University (Appendix R). This report concludes that even if modelled impacts into the Ocean were an order of magnitude greater than predicted, then these impacts for the receiving environment would still be acceptable, due to the benefits to the Coorong.

5.8 Current State of the Environment in the Area

The habitat in the South Lagoon is severely degraded as it is excessively hypersaline and water levels are low, primarily through lack of any significant freshwater inputs for at least 7 years. Refer to Section 2.1.1 and Appendix B for further discussion of the state of the area.

5.9 Other Important or Unique Values of the Environment

Aboriginal Cultural Heritage

A great deal of important information about Aboriginal cultural heritage and history and the relationship of the Ngarrindjeri Traditional Owners to their homeland in the Coorong region is contained in the Ngarrindjeri Sea Country Plan (Ngarrindjeri Tendi and others, 2007).

Ngarrindjeri perspectives on ecological character of the region and its decline are documented in Section 7 of Phillips and Muller (2006).

In relation to the route of the proposed pipeline, the following brief description of Aboriginal cultural heritage in the Coorong area comes from UEPG (1982):

“Although Aboriginal sites are spread throughout the length of the South East coast, they are particularly numerous along the Coorong. An extraordinary quantity of shell middens occur near both the ocean beach and the lagoon shoreline. A number of important Aboriginal cemetery sites have also been discovered in this section of coastline. ... The middens, predominately of *Plebidonax* shells, decrease in frequency towards the south and finally disappear some 25 km north of Kingston. ... Other middens containing estuarine shellfish remains have also been found near Cattle Island [near Woods Well, South Lagoon]”. The estimated age of some of these Aboriginal deposits is 4500 to 5600 years.

Wetlands and International Wildlife Agreements

The SLPS project area lies within the Coorong National Park (*National Parks and Wildlife Act 1993* (SA)).

The Coorong National Park forms part of a “Wetland of International Importance” under the Ramsar convention (1975). This wetland is the “Coorong, Lakes Alexandrina and Albert Wetland” of International Importance as discussed in Section 3.4.

In the management of the Coorong National Park, the SA Government, through SA DEH, also has obligations to manage and protect wildlife and wetland habitat under several International Migratory Bird Agreements. These are agreements between the Commonwealth Government and the Governments of Japan (JAMBA 1974), China (CAMBA 1986) and the Republic of Korea (ROKAMBA 2007). The Coorong is also formally recognised as a nationally and internationally important wetland under the Living Murray Initiative. The Lower Lakes, Coorong and Murray Mouth region (a Living Murray Icon Site) is subject of an Environmental Management Plan (MDBC 2006).

5.10 Tenure of the Project Area

The proposed project will be located on Crown Land and in State Waters. In the event that any private land is required the State Government will enter into a contractual arrangement with the landowner.

5.11 Existing Land/Marine Uses of Project Area

Conservation and recreation are undertaken in the project area under the principles of the Ramsar Convention. Goolwa cockle (pipi) industry occurs on the Southern Ocean beach side of Youngusband Peninsula. Recreational and commercial fishing is common in the Coorong and Lower Lakes.

5.12 Any Proposed Land/Marine Uses of Project Area

No known proposed new uses for the area. The proposed Marine Parks boundaries are north and south of the proposed discharge area and modelling has shown that it is very unlikely to detect any adverse impacts from any discharge of coorong waters into the Ocean.

6. Measures to Avoid or Reduce Impacts on Matters of NES

A primary strategy during the development of this urgent and important management action for ecological restoration has been the avoidance of any negative impacts on species where possible.

Broad impact mitigation measures associated with the SLPS will be minimising the construction footprint, having Construction, Operational and Decommissioning Environmental Management Plans in place for use by contractors, and revegetation after construction and decommissioning. The project's environmental management plans will outline best practice procedures and methods which will need to be adhered to by contractors (including prevention of any fuel spillages or noise issues). Compliance with good management practices as outlined in the plans will minimise the risks of any environmental, cultural or amenity damage to the site.

The duration of construction access (site positioning) will also be compressed into as short an active timeframe as possible. The construction period is expected to be 8 to 12 weeks, subject to seasonal conditions and capital equipment availability and supply.

DEH National park staff and ecologists will be directly involved in site operations and will monitor for any potential disturbance impacts.

Section 4 identifies the potential impacts of the proposal on matters of national environmental significance. Taking this assessment into account, additional specific mitigation measures proposed are:

Plants

The risks arising from the SLPS to any plant species that are either threatened or contribute to the ecological character of the Ramsar wetland has been assessed as none to very low.

Any residual risks will be mitigated against through the following measures:

- Minimisation of impact on any vegetation by choosing the shortest practical pipeline route across the Peninsula (minimising the footprint) and construction methods that minimise the width of disturbance (estimated 12-20m). This is very likely to be achieved because it coincides with the economic rationale behind choosing the route. The route may target swales and non-vegetated areas, subject to Aboriginal Heritage considerations, common along the Peninsula.
- The submission of a native vegetation management plan and operation code of practice that has been compiled to the satisfaction of the Native Vegetation Assessment Panel prior to the commencement of works in compliance with clearance requirements under the *Native Vegetation Act 1991*.

Notably, the clearance is temporary in nature with no requirement to maintain a cleared area beyond project life, with natural regeneration to be encouraged and additional rehabilitation, weed control and revegetation measures to be incorporated into the vegetation management plan.

Hooded plover

The impact analysis has identified that the proposal may have some limited and temporary impact on nesting but is also likely to have a significant positive impact on the hooded plover through the improvement of conditions in the Coorong lagoons and changes to prey availability.

Mitigation measures that are or will be undertaken to further reduce the potential for impacts on nesting and breeding of the hooded plover are:

- Consideration of the hooded plover breeding requirements through design processes to date leading to the exclusion of development options that could have had a greater impact on nesting habitat (eg access along the Southern Ocean beach to the pipeline and outfall construction site).
- The area of possible disturbance due to construction and access work being minimised in the final site selection.
- Surveying of the construction and access areas for nests, marking & monitoring of any nesting sites during the construction period and the introduction of an appropriate speed limit for construction vehicles to minimise disturbance during works in accordance with a risk management plan to be developed with SA DEH National Parks staff.

With these measures, the residual risk to the hooded plover from the SLPS is considered to be low.

It is noted that the disturbance impact on hooded plover would be minimal if pipeline and ocean outfall construction occurred outside the breeding period: however construction will be unable to commence before September 2010 and should not be delayed due to the significant impacts for ecological restoration (as discussed in Section 2.2.2).

Orange-bellied parrots (OBPs)

The impact analysis has identified that the proposal may have some limited and temporary impact on the foraging by OBPs in the vicinity of the project depending upon the timing of construction, but is also likely to have a significant positive impact on the OBP through the improvement of habitat availability over time.

Due to their migratory habits, any negative impact on the OBP can be avoided through avoiding construction (or decommissioning) during winter months. This has been considered and it is anticipated that construction will be undertaken outside of winter.

If, due to delays, construction were to extend into winter months, the low existing risk would be able to be further mitigated by:

- The area of possible disturbance due to construction and access work being minimised in the final site selection.
- Monitoring of OBPs during the construction period and the introduction of an appropriate speed limit for construction vehicles to minimise any disturbance from noise, dust or vibration during works in accordance with a risk management plan to be developed with SA DEH National Parks staff.

With these measures, the residual risk to OBPs from the SLPS is considered to be very low.

Marine animals

The impact analysis has identified that the SLPS could have very low to low impacts on whales, sharks or sea-lions. The proposal will affect water quality across a limited area; it is expected to have a negligible impact on feeding and given the high mobility of these species the impacted area can be readily avoided. Nevertheless, further mitigation measures of relevance that will reduce this risk even further are:

Monitoring of water quality impacts – Monitoring of the marine environment (building on existing monitoring plans for the Coorong – Appendix M) is required to form a condition of an environmental authorisation under the *Environment Protection Act 1993* and will enable adaptive management as required.

Generators and pumps will be enclosed in acoustic housings as may be required to satisfy noise requirements under the *Environment Protection Act 1993*.

Collaboration could also be undertaken with existing monitoring of marine mammals to further monitor the outcomes of the SLPS.

With these measures, the residual risks from the SLPS are considered to be very low to negligible.

There is an existing environmental monitoring program for the Coorong which will be continued during the SLPS (See Appendix M). A monitoring program for the marine environment is required under the *Environment Protection Act 1993*. An acid sulfate soil (ASS) monitoring program will also be developed with CSIRO and implemented throughout the life of the project to ascertain ASS behaviour and risk profile. This monitoring will be compatible with the large scale ASS monitoring program already underway in the Lower Lakes and tributaries.

Adaptive management of pumping will be implemented having regard to all monitoring outcomes.

7. Environmental Management Plan and Monitoring

7.1 Environmental Management Plan

The development of Construction, Operational and Decommissioning Environmental Management Plans (EMPs) will be developed by or on behalf of the proponent during the different stages of the project. It will also involve environmental monitoring of the impact of the pumping of hypersaline water on the three main elements of the project: Coorong South Lagoon, Younghusband Peninsula and Southern Ocean.

7.2 Environmental Monitoring Plan

A proposed Environmental Monitoring Plan may cover the following aspects:

Coorong Lagoons (South and North)

- Physical environment monitoring
 - Continuation of existing monitoring protocol for water quality and water depth (see Appendix M)
- Ecological / biological monitoring
 - Continuation of existing monitoring protocol for aquatic plants, invertebrates, fish, birds (see Appendix M). NOTE: A great deal of baseline information exists for comparison (CLLAMMecology reports; Brookes et al. 2009a; Rogers and Paton 2009).

Younghusband Peninsula

- Vegetation survey prior to construction, if preferred alignment moves from original Native Vegetation assessment
 - Detailed vegetation survey of pipeline route
 - Need to avoid freshwater soaks in deciding on pipeline route
 - Establishment of photo points prior to construction (Vegetation and sand dune condition)
- Aboriginal cultural clearance and monitoring during construction
 - Survey of middens and burial sites prior to construction
 - Monitoring for middens and burial sites during construction

Southern Ocean Outfall

- Physical environment monitoring
 - Benthic habitat mapping prior to pumping
 - Salinity and water quality monitoring (program to be developed by DEH, SARDI and Flinders University)
- Ecological / biological monitoring
 - A biological survey monitoring program will be developed by DEH, SARDI fisheries and the Flinders University

Purpose of Survey and Monitoring

- 1) Establish baselines for comparison in the future

Collect data on the physical and biological conditions of the environment in the Coorong South (and North) lagoons, and the Southern Ocean around the ocean outfall.

- 2) Monitor impact of the hypersaline water in the ocean
 - Compare actual conditions to model predictions (size of the hypersaline plume)
 - Potential to use the information to manage the pumping program
 - Biological monitoring: includes sessile species of commercial importance (cockle or pipi); joint program with SARDI Marine Science.
- 3) Monitor the effectiveness of pumping on salinity levels and impact on water levels in the South Lagoon (compare to model predictions).
- 4) In the medium to long term: to assess the effectiveness of the project in its impact on habitat and consequently on restoration.

- 5) Compare actual physical and biological responses to the project to predictions made by Lester et al (Appendix E2).
- 6) Baselines for habitat type and condition have already been established for the Coorong itself for both vegetation and aquatic habitat (Sharma et al. 2009).
- 7) Inform pumping operations.

8. Conclusion on the Likelihood of Significant Impacts

The risk assessment and mitigation measures for the potential impacts of the SLSRS demonstrate that the project is unlikely to have any significant impacts upon matters of national environmental significance, and as such it is considered that the proposed action is **not a controlled action**.

Detailed and varied assessments have involved conservative assumptions and actual impacts are expected to be lower than modelled/predicted. In addition the concentration of salt in the Coorong is expected to reduce during the operational phase, as the southern Coorong is diluted. Hence impacts into the ocean due to salinity are expected to reduce over time. The pumping regime will be informed by a robust monitoring framework and operational risks managed by regularly audited Environmental Management Plans.

The proposal will not have any significant negative impacts, but will have extensive positive impacts on matters of national environmental significance. In particular:

- the proposal is expected to restore approximately 12,000 hectares (winter) / 8,000 hectares (summer) of aquatic habitat in the South Lagoon of the Coorong (part of a Ramsar wetland) and benefit additional areas of fringing vegetation and terrestrial vegetation, which are currently being impacted by having roots in excessively saline groundwater.
- in considering all species that contribute to the Ramsar status of the project area in the Coorong under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act), CLLMM Projects has assessed that highly positive to some benefits can be expected for 45% of the fish species and 43% of the bird species.
- significant positive impacts are also expected by CLLMM Projects for the marine EPBC-listed Fairy Tern (*Sternula nereis*), also listed as endangered under the *National Parks & Wildlife Act 1972* and red-listed by the IUCN, which is currently in danger of becoming regionally extinct due to the excessive salinity in the Coorong.

Without the proposed intervention, the ecological values of the South Lagoon and the surrounding areas will continue to degrade, placing the character of this Ramsar-listed wetland at further risk.

9. Environmental History of the Responsible Party

The South Australian Department for Environment and Heritage (DEH) has a satisfactory record of responsible environmental management and is responsible for South Australia's nature conservation, heritage conservation and animal welfare.

DEH collects and provides information and knowledge about the state's environment.

DEH manages the state's public land including national parks, marine parks, botanic gardens and the coastline.

DEH also advises on environmental policy.

DEH is part of the Environment and Conservation Portfolio and reports to the South Australian Minister for Environment and Conservation. DEH delivers the Government's environment policies directly and through partnerships. These are with other government agencies, including the Department of Water, Land and Biodiversity Conservation, the Environment Protection Authority, Zero Waste SA, Natural Resources Management Boards, and Primary Industries and Resources SA, as well as a wide range of non-government environment organisations, industry bodies and the community.

DEH's work is determined by its obligation to achieve related targets in South Australia's Strategic Plan to administer legislation dedicated to the Minister for Environment and Conservation and to respond to the needs of South Australians.

DEH aims to effectively manage environmental resources in a responsible manner and has been progressive in implementing protected area management initiatives. DEH has demonstrated a commitment to responsible environmental management.

DEH manages several protected areas within the Coorong and Lakes Alexandrina and Albert Ramsar site. These include:

- Coorong National Park (48,958 ha);
- Tolderol Game Reserve (428 ha);
- Currency Creek Game Reserve (128 ha);
- Salt Lagoon Islands Conservation Park (76 ha); and
- Mud Islands Game Reserve (125 ha).

DEH has never been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.

DEH has previously referred actions requiring for consideration under the EPBC Act.

10. Information Sources and Attachments

10.1 References

- Aurecon 2009a, *Data Collection, Review and Preliminary Hydrodynamic Modelling. Coorong Temporary Saline Water Discharge*. Report prepared for the South Australian Murray-Darling Basin Natural Resources Management Board. (Aurecon Australia Pty Ltd: Adelaide, South Australia). [Appendix D]
- Aurecon 2009b, *Data Collation, Review and Preliminary Ecological Assessment Coorong Temporary Saline Water Discharge*. Report prepared for the South Australian Murray-Darling Basin Natural Resources Management Board. (Aurecon Australia Pty Ltd: Adelaide, South Australia).
- AWE 2009, *Coorong South Lagoon Restoration Project: Hydrological Investigation*. Report for Department of Water, Land and Biodiversity Conservation, SA Government. (Australian Water Environments: Adelaide, South Australia)
- Birds Australia 2007, Coorong and Murray Lakes Orange-bellied Parrot surveys summary 2007. http://www.birdsaustralia.com.au/images/stories/current-projects/obp/OBP_Coorong_Survey_low.pdf
- BMT WBM Pty Ltd (2009) Coorong Salinity Modelling (Update six out of six scenarios modelled). Report by BMT WBM Pty Ltd, Broadmeadow NSW, for SA MDB NRM Board. [Appendix F]
- Boon, PI 2000, *Biological impacts of changes to water level and salinity in the Coorong*. Prepared for the Upper South east Dryland Salinity and Flood Management Scheme.
- Brookes, JD, Lamontagne, S, Aldridge, KT, Bengner, S, Bissett, A, Bucater, L, Cheshire, AC, Cook, PLM, Deegan, BM, Dittmann, S, Fairweather, PG, Fernandes, MB, Ford, PW, Geddes MC, Gillanders, BM, Grigg, NJ, Haese, RR, Krull, E, Langley, RA, Lester, RE, Loo, M, Munro, AR, Noell, CJ, Nayar, S, Paton, DC, Revill, A T, Rogers, DJ, Rolston, A, Sharma, SK, Short, DA, Tanner, JE, Webster, IT, Wellman, NR and Ye, Q 2009a, *An Ecosystem Assessment Framework to Guide Management of the Coorong*, CLLAMMecology Final Report <http://www.clw.csiro.au/publications/waterforahealthycountry/clamm/CLLAMM-Final-Report-Ecosystem-Assessment.pdf>
- Brookes, JD, Rogers, DJ, Aldridge, KT, Deegan, B, Hipsey, MR, Paton, DC, Ganf, GG, Rolston, A, Webster, I and Noell, C 2009b, *Managing the Lower Lakes and Coorong*, submitted to Marine and Freshwater Research.
- Browne, RK, Baker, JL and Connolly, RM 2008, "Syngnathids: Seadragons, Seahorses, and Pipefishes of Gulf St Vincent" in *Natural History of Gulf St Vincent* eds Scoresby AS, Bryars, S, Kirkegaard, IR, Harbison, P and Jennings, JT, University of Adelaide, Royal Society of South Australia (Inc), pp. 162-176.
- CLLAMMecology 2008, *Response of the Coorong Ecosystems to Alternative Murray-Darling Flow Scenarios*, report to South Australian Murray Darling Basin Natural Resource Management Board (Appendix E1).
- Culik, BM 2004, *Review on Small Cetaceans: Distribution, Behaviour, Migration and Threats*, compiled for the Convention on Migratory species (CMS), http://www.cms.int/reports/small_cetaceans/.
- DEH 2005, *Southern Right Whale Recovery Plan 2005 – 2010*, Government of Australia Department of the Environment and Heritage.
- DEWHA 2006, EPBC Act Policy Statement 1.1 Significant Impact Guidelines, Commonwealth of Australia, <http://www.environment.gov.au/epbc/publications/pubs/nes-guidelines.pdf>.
- DEWHA 2007, *Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*, EPBC Act Policy Statement 3.7, Commonwealth of Australia, <http://www.environment.gov.au/epbc/publications/peppermint-box-iron-grass-policy.html>.
- DEWHA 2008, *Buloke Woodlands*, Fact sheet, Commonwealth of Australia, <http://www.environment.gov.au/biodiversity/threatened/publications/tsday08-buloke-woodlands.html>.
- Edgar, G 2000, *Australian Marine Life*, New Holland Publishing, Australia.

- Ehmke, G, Jones, C 2008, *Orange-bellied Parrot winter surveys summary 2008*, Birds Australia, <http://www.birdsaustralia.com.au/images/stories/current-projects/obp/WinterSurveysSumm08.pdf>.
- Ehmke, G 2009, '*Habitat*' in focus - the Coorong, *Trumped up Corella*, No. 3, pp 2-3.
- Ehmke, G, Herrod, A, Green R and Tzaros, C 2009, *Habitat Protection and Restoration Plan for the Orange-bellied Parrot Neophema chrysogaster in the South East of South Australia*, Birds Australia, Melbourne.
- Flora of South Australia, <http://www.flora.sa.gov.au/>.
- Fitzpatrick, RW, Shand, P, Thomas, B, Marvanek, S, Merry, RH, Creeper, N, Thomas, M, Raven, M, Simpson, SL, McClure, S & Jayalath, N 2008, *Acid sulfate soils in subaqueous, waterlogged and drained soil environments in the Coorong, Lake Alexandrina and Lake Albert: properties, distribution, genesis, risks and management*, CSIRO Land and Water Science Report to DEWHA, Canberra.
- Geddes, M 2003, *Survey to investigate the ecological health of the North and South Lagoons of the Coorong*, June/July 2003, a report prepared for the Department for Environment and Heritage and the Department of Water, Land and Biodiversity Conservation, Adelaide.
- Geddes, M, Hall, D 1990, *The Murray Mouth and Coorong*, in *The Murray* ed. Mackay, N, Eastburn, D, Murray-Darling Basin Commission, Canberra, pp. 200-213.
- Gell, P, Haynes, D 2005, *A Palaeoecological Assessment of water quality change in the Coorong, South Australia* in *Diatoma*, November 2005, The University of Adelaide, report for SA DWLBC, Adelaide.
- Haig, J, Russell, B, Murray-Jones, S 2006, *Offshore marine habitat mapping and near-shore marine biodiversity within the Coorong bioregion*, report for the SA MDB NRM Board, SA DEH, Adelaide.
- Hawkes, WR 1975, *Wildlife of the Coorong Area*, in *The Coorong*, ed Noye, BJ, Department of Adult Education, Publication No. 39, pp 125-131, University of Adelaide.
- Jensen, A, Nicholson, C 1993, *Conservation value of the Coorong ecosystem: A background paper prepared for the Upper South East Dryland Salinity and Flood Management Plan Environmental Impact Statement*, SA Department of Environment and Land Management, Adelaide.
- Jensen, A, Good, M, Harvey, P, Tucker, P, Long, M (eds.) 2000, *River Murray Barrages Environmental Flows: An Evaluation of Environmental Flow Needs in the Lower Lakes and Coorong*, report for the Murray-Darling Basin Commission, Department for Water Resources, Adelaide.
- Kerr, G. 2009, *Literature review of the ecology of birds of The Coorong, Lakes Alexandrina and Albert Ramsar wetland*, SA DEH, South Australia.
- Lamontagne, S, McKewan, K, Webster, I, Ford, P, Leaney, F, Walker, G 2004, *Coorong, Lower Lakes and Murray Mouth. Knowledge gaps and knowledge needs for delivering better ecological outcomes*, Water for a Healthy Country National Research Flagship, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra.
- Last, PR, Stephens, JD 1994, *Sharks and rays of Australia*, CSIRO Australia.
- Lester, R, Webster, I, Fairweather, P, Langley, R 2009, *Predicting the ecosystem response of the Coorong to the South Lagoon Salinity Reduction Scheme*, Flinders University of South Australia, report for the SA MDB NRM Board (Appendix E2).
- Molsher, R, Geddes, MC, Paton, DC 1994, *Population and reproductive ecology of the small-mouthed hardyhead Atherinosoma microstoma (Günther) (Pisces: Atherinidae) along a salinity gradient in the Coorong*, South Australia, Proceedings of the Royal Society of South Australia, No. 118, pp. 207-216.
- MDBC 2006, *The Lower Lakes, Coorong and Murray Mouth Icon Site Environmental Management Plan 2006-2007*, MDBC, Canberra, ACT.
- National Parks and Wildlife Service, South Australia 1990, *Coorong National Park Management Plan*.
- Ngarrindjeri Tendi, Ngarrindjeri Heritage Committee, Ngarrindjeri Native Title Management Committee 2007,

Ngarrindjeri Nation Yarluwar Ruwe Plan (Ngarrindjeri Nation Sea Country Plan), Ngarrindjeri Land and Progress Association, Meningie, South Australia.

- Noye, BJ 1974, Hydrology of the Coorong Lagoons, in *The Coorong* ed Noye BJ, Department of Adult Education, The University of Adelaide, No. 38.
- Noye, BJ 1975, The Younghusband Peninsula, in *The Coorong*, ed Noye BJ, Department of Adult Education, The University of Adelaide, No. 39, pp 39-57.
- Nunes, RA, Lennon, GW 1986, "Physical Property Distributions and Seasonal Trends in Spencer Gulf, South Australia: an Inverse Estuary", in *Australian Journal of Marine and Freshwater Research*, No. 37, pp. 39-53.
- Osborne, J 2003, *Ecological Requirements of the Coorong*, paper prepared for the Department of Water, Land and Biodiversity Conservation, Adelaide.
- Paton, DC 2005, *Monitoring of biotic systems in the Coorong region 2004-2005*, Earthwatch and SA DEH, Adelaide.
- Paton, D, Rogers, D, Aldridge, K, Deegan, B and Brookes, J 2009a, "A future for the Coorong and Lower Lakes", *Pacific Conservation Biology*, No. 15, pp. 7-10.
- Paton, DC, Rogers, DJ, Hill, BM, Bailey, CP, Ziembicki, M 2009, "Temporal changes to spatially stratified waterbird communities of the Coorong, South Australia: implications for the management of heterogeneous wetlands", *Animal Conservation*, No. 12, pp. 408-417.
- Phillips, W, Muller, K 2006, *Ecological Character of the Coorong, Lakes Alexandrina and Albert Wetland of International Importance*, SA DEH.
- Pittock, J 2008, *Over-allocation of water and climate change wreak ecological havoc: big issues for Ramsar COP10?*, Ramsar September 2008, http://www.ramsar.org/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1-26-45-85^16211_4000_0.
- Ramsar 2009, *What are the Criteria for Identifying Wetlands of International Importance?* http://www.ramsar.org/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1-36-37^7726_4000_0__
- River Murray Environmental Management Unit 2008, *The Coorong and Murray Mouth, an Element of the River System*, SA MDB NRM Board, Internal Discussion Document.
- Rogers, DJ, Paton, DC 2009, *Changes in the distribution and abundance of Ruppia tuberosa in the Coorong*, CSIRO: Water for a Healthy Country National Research Flagship, Canberra.
- Sharma, SK, Bengler, SN, Fernandes, MB, Webster, IT, Tanner, JE 2009, *The CLLAMM Dynamic Habitat: Habitat mapping and dynamic modelling of species distributions*, Water for a Healthy Country National Research Flagship, Canberra, and South Australian Research and Development Institute (Aquatic Sciences), Adelaide.
- Short, AD, Hesp, PA 1980, *Coastal Engineering and Morphodynamic Assessment of the Coast within the South East Coast Protection District South Australia*, Department of the Environment, Adelaide, South Australia.
- Simpson, K Day, N 1999, *Field Guide to the Birds of Australia*, 6th Edition, Viking Penguin Books, Australia.
- Tonkin Consulting 2009, *Coorong Temporary Pumping Review* (for South Australian Murray Darling Basin NRM Board).
- UEPG (Urban and Environmental Planning Group) 1982, *South East Coast Protection District Study Report*, Department of Environment and Planning, South Australia.
- Wainwright, P, Christie, M 2008, *Wader surveys at The Coorong and S.E. Coastal Lakes, South Australia. February 2008*, Birds Australia and Australasian Wader Studies Group, Adelaide.
- Webster IT 2007, *Hydrodynamic modelling of the Coorong*, Water for a Healthy Country National Research Flagship, CSIRO.

Womersley, HBS 1975, Plant life in the Coorong Lagoons, in *The Coorong*, ed Noye, BJ, Department of Adult Education, The University of Adelaide, No. 39, pp 81-88.

World Biodiversity Database: Netherlands Biodiversity Information Facility <http://nlbif.eti.uva.nl/bis/>

10.2 Reliability and Date of Information

The information presented in this referral has been obtained from a number of scientific and Government sources and is the most reliable currently available. Appendices used may include point-in-time descriptions of this project which has been evolved over time taking into account a range of engineering and impact considerations.

11 Attachments

APPENDIX A Maps and photographs of the project area

APPENDIX B Background and scientific information about the need for the SLSRS

APPENDIX D1 Preliminary Hydrodynamic Modelling Report, Coorong Temporary Saline Water Discharge (Aurecon Australia Pty Ltd).

APPENDIX D2 Preliminary Hydrodynamic Modelling Report, Part 2 (Aurecon Australia Pty Ltd).

APPENDIX E1 Response of the Coorong Ecosystems to Alternative Murray-Darling Flow Scenarios. CLLAMMecology Research Cluster, June 2008

APPENDIX E2 Predicting the ecosystem response of the Coorong to the South Lagoon Salinity Reduction Scheme. (Dr R. Lester et al., 2009).

APPENDIX E3 Investigation of three variations on management intervention in the Coorong, (Dr I.T. Webster, CSIRO Land and Water, October 2009).

APPENDIX F Coorong Salinity Modelling (BMT WBM Pty Ltd)

APPENDIX G Federal and State Legislation & Policies

APPENDIX H EPBC Protected Matters Search result

APPENDIX J Risk assessment of Acid Sulfate Soil materials in Ramsar wetlands of the Murray Darling Basin: Coorong

APPENDIX K Significant Impact Criteria (DEWHA 2006)

APPENDIX M Intervention Monitoring Framework

APPENDIX N Inter-tidal infauna of the Youngusband Peninsula (SARDI Aquatic Sciences)

APPENDIX O Tolerances of juveniles and early life stages of the pipi, *Donax deltoids*, to elevated salinity produced by mixing of Coorong and se water.

APPENDIX P1 Baseline surveys of the marine Environment (SARDI Aquatic Sciences)

APPENDIX P2 Baseline surveys of the marine Environment

APPENDIX Q Report Review for Nutrient discharges (Flinders University 2010)

APPENDIX U Native Vegetation Assessment (Rural Solutions 2010)

APPENDIX R Synthesising potential impacts of the proposed south Lagoon Salinity Reduction Scheme on the Encounter Bay receiving marine environment (Flinders University 2010)

12. Contacts, Signatures and Declarations

12.1 Person Proposing to take Action

This is the individual, government agency or company that will be principally responsible for, or who will carry out, the proposed action.

If the proposed action will be taken under a contract or other arrangement, this is:

- The person for whose benefit the action will be taken; or
- The person who procured the contract or other arrangement and who will have principal control and responsibility for the taking of the proposed action.

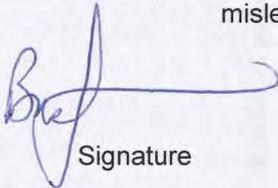
The Minister may also request additional information from this person, for the purposes of deciding whether the action is a controlled action, the controlling provisions that apply, and for the making of an approval decision (if applicable).

If approval for the action is required and is granted, it will be issued to the person proposing to take the action. This person will be responsible for complying with any conditions of approval.

If the Minister decides that the action is a controlled action, the Minister must also designate a person as a proponent of the action. The proponent is responsible for meeting the requirements of the EPBC Act during the assessment process. The proponent will generally be the person proposing to take the action².

Name Brenton Grear
Title Director, Coorong, Lower Lakes and Murray Mouth Project
Organisation South Australian Department for Environment and Heritage
ACN / ABN (if applicable) NA
Postal address GPO Box 1047
Adelaide, SA, 5001
Telephone 08 8204 9069
Email brenton.grear@sa.gov.au

Declaration I declare that the information contained in this form is, to my knowledge, true and not misleading. I agree to be nominated as the proponent for this action.


Signature

28/5/2010
Date

APPENDIX A

Coorong South Lagoon Salinity Reduction Strategy

Maps and photographs of the project area

APPENDIX B

Background and scientific information about the need for the SLSRS

(1) Summary of the case for the SLSRS

(2) Paton, D., Rogers, D., Aldridge, K., Deegan, B. and Brookes, J. (2009a). A future for the Coorong and Lower Lakes. *Pacific Conservation Biology* **15**: 7-10.

(3) Paton, D.C., Rogers, D.J., Hill, B.M., Bailey, C.P. and Ziembicki, M. (2009b) Temporal changes to spatially stratified waterbird communities of the Coorong, South Australia: implications for the management of heterogeneous wetlands. *Animal Conservation*, **12**: 408-417.

APPENDIX C

Coorong Temporary Pumping Review

Tonkin Consulting, Adelaide, Sept 2009

for the SA Murray Darling Basin NRM Board

APPENDIX D1

Preliminary Hydrodynamic Modelling Report
Coorong Temporary Saline Water Discharge

Aurecon Australia Pty Ltd
Adelaide, August 2009

APPENDIX D2

Preliminary Hydrodynamic Modelling Report, Part 2

Aurecon Australia Pty Ltd
Adelaide, October 2009

for the SA Murray Darling Basin NRM Board

APPENDIX E1

Response of the Coorong Ecosystems to Alternative Murray-Darling Flow Scenarios

CLLAMMecology Research Cluster
June 2008

for the SA Murray Darling Basin NRM Board

APPENDIX E2

Predicting the ecosystem response of the Coorong to the South Lagoon Salinity Reduction Scheme.

Lester, R., Webster, I., Fairweather, P. and Langley, R. (2009)
Flinders University of South Australia

for the SA Murray Darling Basin NRM Board

APPENDIX E3

Investigation of three variations on management intervention in the Coorong.

Dr I.T. Webster
CSIRO Land and Water
October 2009

for the SA Murray Darling Basin NRM Board

APPENDIX F

Coorong Salinity Modelling

BMT WBM Pty Ltd
New South Wales, August 2009

for the SA Murray Darling Basin NRM Board

APPENDIX G

Federal and State Legislation & Policies

APPENDIX H

EPBC Protected Matters Search result

Coorong South Lagoon Salinity Reduction Strategy project area

APPENDIX J

Risk assessment of Acid Sulfate Soil materials in Ramsar wetlands of the Murray Darling Basin: Coorong

CSIRO Land and Water

APPENDIX K

Significant Impact Criteria (DEWHA 2006)

APPENDIX L

Data Collation, Review and Preliminary Ecological Assessment
Coorong Temporary Saline Water Discharge

Aurecon Australia Pty Ltd
Adelaide, August 2009

for the SA Murray Darling Basin NRM Board

APPENDIX M

Coorong South Lagoon pumping project – Intervention Monitoring Framework

APPENDIX N

Inter-tidal infauna of the Younghusband Peninsula (SARDI Aquatic Sciences)

APPENDIX O

Tolerances of juveniles and early life stages of the pipi, *Donax deltoids*, to elevated salinity produced by mixing of Coorong and se water.

APPENDIX P

Baseline surveys of the marine Environment (SARDI Aquatic Sciences & Haig et al)

APPENDIX Q

Report Review for Nutrient discharges (Flinders University 2010)

APPENDIX U

Native Vegetation Assessment (Rural Solutions 2010)

APPENDIX R

Synthesising potential impacts of the proposed south Lagoon Salinity Reduction Scheme on the Encounter Bay receiving marine environment (Flinders University 2010)