Northern Connector

Environment Protection and Biodiversity Conservation Act 1999

Referral of proposed action

November 2015

Australian Government

BUILDING OUR FUTURE

Government of South Australia

Department of Planning, Transport and Infrastructure

Project title: Northern Connector

1 Summary of proposed action

1.1 Short description

The Northern Connector is a proposed transport corridor connecting the Northern Expressway to the South Road Superway. The project includes the construction of 15.5 km non-stop motorway standard road with three lanes in each direction and four road interchanges as well as a 16 kilometre path for cyclists and pedestrians. It is proposed to be located in Adelaide's outer northern metropolitan area; about 12 km north of Adelaide's central business district (Figure 1). The project has been developed in response to South Australia's Strategic Plan and The 30-Year Plan for Greater Adelaide which forecasts a significant increase in population growth, road traffic and economic expansion in the northern Adelaide region.

The proponent for the project is the Department of Planning, Transport and Infrastructure (DPTI).

1.2 Latitude and longitude

The latitude and longitude bounding points of the Northern Connector project corridor are detailed below.

POINT ID	LATITUDE (d m s)	LONGITUDE (d m s)	POINT ID	LATITUDE (d m s)	LONGITUDE (d m s)
1	34° 42' 7.2000" S	138° 34' 19.2000" E	26	34° 49' 57.9360" S	138° 34' 42.0960" E
2	34° 42' 43.2000" S	138° 34' 30.0000" E	27	34° 50' 0.0960" S	138° 33' 1.8720" E
3	34° 42' 42.2640" S	138° 34' 30.7560" E	28	34° 49' 59.8800" S	138° 33' 2.1960" E
4	34° 42' 54.0000" S	138° 34' 19.2000" E	29	34° 49' 55.2000" S	138° 33' 36.0000" E
5	34° 43' 44.4000" S	138° 34' 33.6000" E	30	34° 49' 48.0000" S	138° 33' 39.6000" E
6	34° 43' 55.2000" S	138° 34' 55.2000" E	31	34° 49' 37.2000" S	138° 33' 39.6000" E
7	34° 43' 58.8000" S	138° 34' 58.8000" E	32	34° 49' 22.8000" S	138° 33' 43.2000" E
8	34° 44' 9.6000" S	138° 34' 40.8000" E	33	34° 49' 15.6000" S	138° 33' 36.0000" E
9	34° 44' 52.8000" S	138° 34' 55.2000" E	34	34° 48' 54.0000" S	138° 33' 36.0000" E
10	34° 45' 7.2000" S	138° 35' 13.2000" E	35	34° 48' 43.2000" S	138° 33' 39.6000" E
11	34° 45' 54.0000" S	138° 35' 27.6000" E	36	34° 48' 25.2000" S	138° 34' 15.6000" E
12	34° 45' 50.4000" S	138° 35' 34.8000" E	37	34° 48' 18.0000" S	138° 34' 19.2000" E
13	34° 45' 54.0000" S	138° 35' 34.8000" E	38	34° 47' 34.8000" S	138° 34' 40.8000" E
14	34° 46' 15.6000" S	138° 35' 27.6000" E	39	34° 47' 27.6000" S	138° 34' 44.4000" E
15	34° 46' 26.4000" S	138° 35' 24.0000" E	40	34° 47' 2.4000" S	138° 34' 51.6000" E
16	34° 47' 6.0000" S	138° 34' 55.2000" E	41	34° 46' 15.6000" S	138° 35' 24.0000" E
17	34° 47' 42.0000" S	138° 34' 44.4000" E	42	34° 45' 57.6000" S	138° 35' 20.4000" E
18	34° 48' 10.8000" S	138° 34' 37.2000" E	43	34° 44' 56.4000" S	138° 34' 51.6000" E
19	34° 48' 25.2000" S	138° 34' 22.8000" E	44	34° 44' 13.2000" S	138° 34' 37.2000" E
20	34° 48' 57.6000" S	138° 33' 43.2000" E	45	34° 44' 2.4000" S	138° 34' 12.0000" E
21	34° 49' 33.6000" S	138° 33' 50.4000" E	46	34° 43' 58.8000" S	138° 34' 12.0000" E
22	34° 49' 44.4000" S	138° 34' 4.8000" E	47	34° 43' 48.0000" S	138° 34' 30.0000" E
23	34° 49' 51.6000" S	138° 34' 15.6000" E	48	34° 42' 39.6000" S	138° 34' 12.0000" E
24	34° 49' 55.2000" S	138° 34' 19.2000" E	49	34° 42' 7.1280" S	138° 34' 17.9040" E
25	34° 49' 57.6120" S	138° 34' 42.0600" E	50	34° 42' 6.9480" S	138° 34' 18.4800" E

1.3 **Locality and property description**

The project is located in Adelaide's outer northern metropolitan area, approximately 12 km north of Adelaide's central business district (Figure 1). The road is proposed to pass through the three council areas of the City of Playford, City of Salisbury and City of Port Adelaide Enfield and through the suburbs of Virginia, Waterloo Corner, St Kilda, Bolivar, Globe Derby Park and Dry Creek.

The Northern Connector Project Corridor (Project Corridor) includes the proposed road alignment and a buffer area that is likely to be impacted during construction, rehabilitated and managed during the operation of the road (in a more or less natural state). The Project Corridor is depicted outlined in black on Figure 2.

From north to south, land use generally consists of agricultural land (typically used for horticulture); SA Water Bolivar Wastewater Treatment Plant; Globe Derby Park (small resident population on semi-rural land holdings used for horse agistment and training facilities); open land formally used for salt production Mangroves and Barker Inlet wetlands.

1.4	**Size of the development footprint or work area (hectares)**	The operational project footprint is approximately 278 ha.
1.5	**Street address of the site**	Not applicable

1.6 **Lot description**

Land tenure of the project area is varied as the project corridor passes through a number of allotments comprising a mix of industrial, commercial, horticultural, recreational and residential uses.

1.7 **Local Government Area and Council contact (if known)**

The Project Corridor passes through three local government areas. The contacts are each Council are as follows:

1. City of Playford. Chief Executive Officer: Dr Mal Hemmerling. 12 Bishopstone Road, Davoren Park SA 5113. Phone 08 8253 0333. Email: playford@playford.sa.gov.au
2. City of Salisbury. Chief Executive Officer: John Harry. 12 James Street, Salisbury SA 5108. Phone 08 8406 8222. Email: city@salisbury.sa.gov.au
3. City of Port Adelaide Enfield. Chief Executive Officer: Mark Withers. 163 St Vincent Street, Port Adelaide SA. Phone 08 8405 6772. Email: custserv@portenf.sa.gov.au

1.8 **Time frame**

Major construction will start in mid-2016. The project is expected to be completed in late 2019.

1.9	**Alternatives to proposed action** Were any feasible alternatives to taking the proposed action (including not taking the action) considered but are not proposed?		No
		✓	Yes, you must also complete section 2.2
1.10	**Alternative time frames etc.** Does the proposed action include alternative time frames, locations or activities?	✓	No
			Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3.3 (where relevant).

1.11	**State assessment**	✓	No The Northern Connector Project will not be assessed under SA's *Development Act 1993*, as the required land would be acquired under the *Highways Act 1926*, which excludes the Development Act. In addition, road construction by the crown is also not considered development. However, the DPTI is following an environmental impact assessment process similar to Major Projects processes under the Development Act.
			Yes, you must also complete Section 2.5
1.12	**Component of larger action**	✓	No
			Yes, you must also complete Section 2.7
1.13	**Related actions / proposals**	✓	No
			Yes, provide details:
1.14	**Australian Government funding**		No
		✓	Yes, provide details: The project is to be jointly funded by the Australian and South Australian Governments with the Australian and South Australian Governments each contributing $788 million and $197 million respectively.
1.15	**Great Barrier Reef Marine Park**	✓	No
			Yes, you must also complete Section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

2.1 Description of proposed action

The Northern Connector road project is a critical component of Adelaide's North-South Corridor that will link major transport routes. The project will connect the already completed Northern Expressway and South Road Superway links, and will provide an unimpeded journey from Gawler to Regency Park; a total of 43 kilometres.

The project scope includes (Figure 1):

- A new 110 km/h non-stop motorway standard road (15.5 km) with three lanes in each direction between the Northern Expressway and the South Road Superway
- Four road interchanges:
  - Northern interchange (Northern Expressway / Port Wakefield Road)
  - Waterloo Corner interchange (Waterloo Corner Road)
  - Bolivar interchange (Bolivar Road)
  - Southern interchange (South Road Superway / Port River Expressway)
- Intersection upgrades at Port Wakefield Road / Waterloo Corner Road and Port Wakefield Road / Bolivar Road to connect to Northern Connector interchange ramps
- A 16km shared-use (pedestrian and cyclist) path
- Local road accommodation and upgrade works
- Bridge structures over North Arm Creek, Dry Creek and Little Para River to enable tidal and stormwater exchange to continue
- Construction of a partial sea wall embankment through the current salt fields land that would form the future rail corridor
- Service protection/relocation
- A system of swales and water quality treatment basins to receive and, where appropriate, detain stormwater
- Barker Inlet wetland modifications
- Wetland replacement and rehabilitation areas (for flood storage, water quality treatment and habitat)
- Landscaping and urban design

The corridor cross-section (Figure 3) is typically 120 m wide in the northern area and 100 m wide in the southern section. As detailed above it will consist of two separated three-lane road carriageways, provision for a future rail corridor (approximately 20 m) wide generally located to the west of the road carriageways and a shared-use path for pedestrians and cyclists to the east. The road carriageway will generally have a wide median and standard outer roadside shoulders and verges north of the salt fields and narrower median and standard outer roadside shoulders and verges south of the salt fields. The remainder of the corridor width will be taken up with water quality treatment measures, batter slopes, noise mounds, buffer zones and, where applicable, landscape plantings. The width of the corridor also allows for future widening of the road.

While provision for a future rail corridor will be allowed for within the Project Corridor, no rail is currently proposed as part of the project.

The project is required to improve connectivity and congestion for both private motor vehicles and freight transport to improve efficiency and productivity for land transport. The new motorway is expected to significantly improve freight access to the Port of Adelaide and the industrial areas of Adelaide's north and northwest, improved road safety and efficiency, reduction in travel times for commuters travelling to and from the northern suburbs and better serve the industrial and commercial sectors along Port Wakefield Road, with the myriad of businesses along Port Wakefield Road benefiting from improved traffic flow.

The project is expected to support about 480 jobs each year during construction in a boost for Adelaide's north which will be affected by the closure of Holden at the end of 2017.

Other works will also be undertaken in the region including the Bolivar Road / Kings Road upgrade, Robinson Road upgrade, a trial embankment for the road component and service protection/relocations. These works are specifically excluded from this referral. They are being undertaken in areas of lower environmental value and a

risk assessment process has been applied to determine that these actions will not significantly affect Matters of National Environmental Significance and as such have not been considered as part of this referral.

The likely activities associated with the project are included in Table 2.1.

Table 2.1 Summary of likely construction components and activities

Component	Activity
Site establishment	▪ property adjustments and property acquisition ▪ delineation of project boundary and no-go areas ▪ site set out ▪ site access tracks/haul roads ▪ site compounds and other ancillary sites ▪ initial environmental safeguards (including soil erosion and drainage management protection measures at all key locations in line with Contractor's Soil Erosion and Drainage Management Plan (SEDMP))
Site preparation	▪ clearing and grubbing ▪ mulching ▪ stripping and stockpiling of topsoil, spoil and unsuitable material ▪ construction access
Structures	▪ piling, pile caps and pier construction ▪ bridge erection
Earthworks	▪ pre-loading on soft soils ▪ borrow pits ▪ cuttings ▪ fill embankments ▪ select zones ▪ batter treatments
Drainage	▪ swales, culverts, pipes ▪ water quality treatment basins
Road Construction	▪ laying and compacting of pavement sub-grade ▪ laying of asphalt ▪ construction of bridges and ramps for interchanges
Other works	▪ pavement construction ▪ asphalt and concrete batching plants ▪ asphalt laying ▪ concrete pouring ▪ flora and fauna protection measures ▪ landscaping and wetland construction ▪ noise treatments ▪ safety barriers ▪ lighting, line-marking and signposting ▪ shared use path construction
Ancillary works	▪ modification/upgrade of local roads ▪ property access ▪ service protection or relocation ▪ if required: batching plants, crushing plants, pug mills, stockpile and storage sites
Finishing works	▪ remove temporary works ▪ restore and landscape temporary sites
Operation and maintenance	▪ operation of the road ▪ ongoing maintenance of the road

2.2 Alternatives to taking the proposed action

During the planning phase, a number of options were considered, but are not proposed. Options considered included do nothing'/'do minimum' and alternative locations for the project corridor as outlined below.

Do nothing/do minimum

Should the Northern Connector not proceed, traffic volumes on Port Wakefield Road and Salisbury Highway, as well as Main North Road and some arterial and local connecting roads (including Kings Road, Bolivar Road and Martins Road), will increase significantly and result in:

- increased traffic congestion and delays
- reduced access to adjacent businesses and local neighbourhoods
- higher likelihood of increased road crashes
- reduced efficiency for freight transport to/from Port Adelaide to regional areas
- ongoing environmental effects — noise, air quality, water quality
- reduced economic benefits/development.

Sections of Port Wakefield Road, Salisbury Highway and Main North Road would require substantial upgrading and widening to support forecast traffic volumes, and efficient and safe transport. Some sections of these roads could not feasibly be upgraded to expressway standard because of the high social and environmental impacts of land acquisition, reduced community accessibility increased noise and high construction costs.

Roadside residential and commercial properties would be significantly affected by upgrades to Port Wakefield Road, between Waterloo Corner and the Greenfields wetlands, and Main North Road, between Gawler and Mawson Lakes.

Salisbury Highway, between Port Wakefield Road and South Road, would need to be widened substantially by at least two lanes in each direction by 2031. This would significantly affect the Greenfields and Barker Inlet wetlands along both sides of the road. The Salisbury Highway–Port Wakefield Road interchange would also require upgrades to allow higher volumes of traffic.

These road upgrades would not provide the same levels of service as an expressway nor meet the required national transport objectives.

A number of other arterial roads in the project area would also need to be upgraded to improve safety and access: sections of Kings Road and Waterloo Corner Road, between Port Wakefield Road and Salisbury Highway.

Changes to the local road network could be expected with increased development:

- upgrade of Bolivar Road, between Port Wakefield Road and Kings Road, to four lanes, including upgrades to the Bolivar Road–Kings Road intersection, due to increased traffic
- upgrade of Kings Road, between Bolivar Road and Salisbury Highway, to cater for forecast traffic demands
- additional lanes on Martins Road, between Kings Road and Port Wakefield Road.

The secondary economic benefits from increased development and employment opportunities would be foregone without the project. The additional traffic congestion could produce a net negative economic result through increased travel costs and making the area unattractive to additional development.

Route selection

A number of environmental, social, economic and engineering assessments and investigations have been undertaken to determine the appropriate location and extent of the Northern Connector Project. These are summarised in the Project Impact Report:
http://www.infrastructure.sa.gov.au/nsc/northern_connector/publications

During the project's planning phase, a weighted multi-criteria evaluation was adopted to assess the relative benefits and impacts of a number of route options. The assessment criteria included estimated construction cost, accessibility, functionality, operations and maintenance, social/amenity impacts, property acquisition, environmental impacts and land-use and zoning.

The preferred route was further developed resulting in the current Northern Connector Project Corridor.

2.3 Alternative locations, time frames or activities that form part of the referred action

There are no alternative locations, timeframes or activities that form part of the referred action. To maximise benefits to the economy (e.g. job creation), following an announcement by the Australian and South Australian Governments, construction of the major works is proposed to begin in mid-2016 with completion anticipated by the end of 2019.

2.4 Context, planning framework and state / local government requirements

South Australian Planning Framework and State Government Requirements

The Northern Connector will contribute to, or facilitate, the achievement of policy outcomes and regional planning objectives for the South Australian Government. These documents include:

- South Australia's Strategic Plan (2011) - the overarching strategic planning document for the state, which reflects South Australia's aspirations for 2011 and beyond.
- Premier's Ten Economic Priorities for Growth - In 2014, the Premier Jay Weatherill announced ten economic priorities for the growth of South Australia
- The 30-Year Plan for Greater Adelaide (2010) - outlines how the State Government seeks to balance population and economic growth with the need to preserve the environment and protect the heritage, history and character of Greater Adelaide.
- The Integrated Transport and Land Use Plan (2013) - The plan guides investment in the transport system for the next 30 years, with a focus on integrating land-use, strategic infrastructure and transport investment planning, including identification of specific transport projects to be progressively undertaken.
- The Strategic Infrastructure Plan for South Australia (2005) – This plan sets out the opportunities for infrastructure development over a 10-year period to assist in achieving the Goals and Targets of South Australia's Strategic Plan.
- Housing and Employment Land Supply Program (2010) – outlines how the State Government will manage the supply of land for residential, industrial, retail and commercial purposes.

Approvals and Legislative Requirements

Under South Australian State legislation, further environmental and other approvals, permits or licences may need to be obtained as part of the project. These approvals are summarised in Table 2.2.

Table 2.2 Likely South Australian legislative environmental approvals

Legislation	Approval required
Aboriginal Heritage Act 1988	▪ determine an Aboriginal site (s12) ▪ disturb an Aboriginal site/object (s23)
Development Act 1993	▪ remove or damage a Significant or Regulated Tree ▪ open a borrow pit
Environment Protection Act 1993	▪ undertake prescribed activity of environmental significance, including: - earthworks drainage and dredging licence - concrete batching licence - asphalt batching licence - operate a waste and recycling facility
Mines and Works Inspection Act 1920	▪ open and operate a borrow pit
National Parks and Wildlife Act 1972	▪ collect or remove native fauna and native seed
Adelaide Dolphin Sanctuary Act	▪ the approving authority for other legislative approvals is required to refer the application to the Sanctuary Minister for comment.
Native Title (South Australia) Act 1994	▪ determine native title on land being acquired for construction

Legislation	Approval required
Native Vegetation Act 1991	▪ clearance of native vegetation
Fisheries Management Act 2007	▪ permit to remove or interfere with animals or plants inside an aquatic reserve
Natural Resources Management Act 2004	▪ water affecting activities permit

South Australian Local Government Requirements

As noted previously, the project affects the following Councils: City of Port Adelaide Enfield, City of Salisbury and City of Playford. Councils are required to align with the goals of the South Australian Planning Strategy when formulating development policies, and take the full range of social, economic and environmental goals in the Planning Strategy into account as stipulated under the *Local Government Act 1999*.

Each Council prepares a Strategic Management Plan that is to be updated every five years and outlines the key directions for the future growth and development of the Council area in terms of the community, economic prosperity, the environment, and Council operations. The local Councils should be consulted throughout the project and to assist in communicating project updates to the local community.

The key overarching strategic plans for each Council are briefly summarised below.

City of Port Adelaide Enfield – City Plan 2010-2016

The City Plan is the guiding framework for achieving the vision for the City of Port Adelaide Enfield that is updated every five years. The City Plan was prepared in consultation with the local community and provides the strategic directions for the Council through a Vision, Goals and Objectives.

The City Plan goals to 2016 are:

- A strong and sustainable local economy built on the growth of a diverse range of economic activities that provides employment and other benefits for the community.
- A healthy and connected community that supports and values people, culture and place.
- Natural and urban environments characterised by clean air, soil, water and biodiversity that are cared for and respected by businesses and the community.
- A vibrant and attractive City that is well-planned and accessible, with safe and healthy places to live, work and play.
- Elected Members and staff are committed to achieving the 2030 Vision for the Port Adelaide Enfield community.

City of Playford – Strategic Plan

The City of Playford Strategic Plan is the overarching planning document that outlines Council's vision to the year 2043 and sets out a series of strategies to achieve this. The Strategic Plan was prepared in consultation with the community and seeks to achieve the community's vision for the local government area into the future.

The overarching strategies are:

- Strategy 1: Our foundations – services, city presentation and community pride
- Strategy 2: Securing Playford's future and building value
- Strategy 3: Elizabeth – Adelaide's Northern CBD
- Strategy 4: Securing Playford's position in the global economy
- Strategy 5: Building our capabilities.

City of Salisbury – Salisbury City Plan 2020: Sustainable Futures

The City Plan 2020 is the overarching strategic planning document to implement the future vision of the Council area as developed in consultation with the local community. The City Plan seeks to address the unique challenges of the Council area by developing and benefiting from a range of opportunities and partnerships, with a particular focus on sustainability.

The City Plan is implemented through four key directions, each with a separate plan and series of objectives:

- The Prosperous City
- The Sustainable City
- The Living city
- Achieving Excellence.

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

As outlined in Section 1.11, the project does not require approval under the South Australian *Development Act 1993*. However, DPTI has undertaken an environmental assessment process for the project similar to the state Environmental Impact Assessment.

The process involved the preparation of a *Project Impact Report* for the project. This process included the following technical investigations:

- Flora
- Fauna, including avifauna
- Noise and vibration
- Air quality
- Water quality, flooding and drainage
- Site contamination
- Greenhouse, sustainability and climate change
- Community engagement
- Socio-economic
- Land use, planning and zoning
- Aboriginal heritage
- Non-Aboriginal heritage
- Traffic and transportation
- Urban design, landscape and visual assessment.

The process also involved community and agency consultation, public display of the project, and opportunities for community comment on the project. The *Project Impact Report* was released for public comment in July 2011 for a two month period. This report was based on the Integrated Road and Rail Transport Corridor option.

These assessments are provided in the Project Impact Report available at:
http://www.infrastructure.sa.gov.au/nsc/northern_connector/publications.

2.6 Public consultation (including with Indigenous stakeholders)

The two main community and stakeholder engagement processes undertaken have been:

- communication – activities delivering factual information about the project to all interested parties, including local residents, businesses and stakeholder groups, to increase awareness and understanding of the project
- consultation – discussions between the project team and interested parties to gain detailed information and feedback that enable project impacts and route selection to be assessed.

To date, the community has been engaged through a project information telephone line, email and website communication, one-to-one meetings with property owners, meetings with local and state government agencies and industry groups, community forums, letters and feedback forms and the public release of the *Project Impact Report*. A summary of the previous public consultation can be found in Part A of the Project Impact Report:
http://www.infrastructure.sa.gov.au/__data/assets/pdf_file/0005/70736/Northern_Connector_-_Project_Impact_Report_-_Introduction_July_2011.PDF

Overall, most feedback has been positive and identified the benefits of:

- increased safety and reduced traffic congestion on Port Wakefield Road

- travel time savings and a faster route between Adelaide's north and the Port of Adelaide
- diverting freight traffic away from local suburban roads
- removing freight trains from suburban rail lines
- possible future land zoning changes.

The most common negative issues raised were:

- social and economic impacts of property acquisition
- safety in a multiple use transport corridor
- possible future land zoning changes
- changes to local road access
- community severance
- perceived effect on property values from the proximity of a transport corridor.

The release of the Northern Connector Project Impact Report in mid-2011 was a major step in the community engagement process inviting comments and submissions on the all aspects of the project (including Aboriginal heritage).

Engagement of the traditional owners of this region began early in the planning process through the Kaurna Heritage Board.

2.7 A staged development or component of a larger project

The Northern Connector Project is a component of Adelaide's North–South transport Corridor extending 78 km from the Northern Expressway at Gawler to the Southern Expressway at Old Noarlunga. The Northern Connector is however considered a stand-alone project and not a staged development nor a component of a larger action. The Northern Connector is joined at the Northern end by the Northern Expressway (completed 2010) and at the southern end, the South Road Superway (completed 2014) (Figure 1).

3 Description of environment & likely impacts

3.1 Matters of national environmental significance

3.1 (a) World Heritage Properties

Description

There are no World Heritage Properties within the vicinity of the Northern Connector Project.

Nature and extent of likely impact

None

3.1 (b) National Heritage Places

Description

There are no National Heritage Places within the vicinity of the Northern Connector Project.

Nature and extent of likely impact

None

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description

There are no Wetlands of International Significance (declared Ramsar Wetlands) within the catchment of the Northern Connector Project. The nearest Ramsar Wetland is the Coorong and Lakes Alexandrina and Albert Ramsar Wetland near the mouth of the River Murray, approximately 75km south-east of the Project Corridor.

Nature and extent of likely impact

None

3.1 (d) Listed threatened species and ecological communities

Description

Ecological Communities

Four threatened ecological communities have previously been identified as either occurring or having the potential to occur within the vicinity of the Project Corridor by the Protected Matters Search tool (Table 3.1). Of these, only one has been identified as occurring within the Project Corridor and likely to be impacted by the proposed works; the Subtropical and Temperate Coastal Saltmarsh vegetation community which is listed as 'vulnerable'. This community was listed as a Matter of National Environmental Significance in 2013 (Department of Sustainability Environment Water Populations and Communities 2013) so vegetation was not specifically mapped as this community during the EBS Ecology Pty Ltd (2011) assessment of the Project Corridor. Nonetheless, this vegetation community was assessed and mapped as Vegetation Association 6: Samphire Very Low Open Shrubland, which is a state based classification closely correlated with this community (EBS Ecology

Pty Ltd 2015). Patches of this vegetation community were identified at Barker Inlet North Wetland, North Arm, Swan Alley and the Little Para River (Figures 4a, 4b and 4c).

The Subtropical and Temperate Coastal Saltmarsh occurs in Queensland, New South Wales, Victoria, Tasmania, South Australia and Western Australia (Threatened Species Scientific Community 2013). Whilst relatively widespread, it has experienced a decline in all states (Threatened Species Scientific Community 2013). Within South Australia, an estimated 9.7% of the total distribution has been lost since European settlement (Threatened Species Scientific Community 2013). The Gulf St Vincent has a total of about 15% of the states' total intertidal samphire and 22% of the supratidal samphire's, with a total estimated extent of 17,959 hectares (Threatened Species Scientific Community 2013). As this ecological community is listed as vulnerable and not listed as endangered or critically endangered, it is not considered a Matter of National Environmental Significance and as such a Referral is not required for this ecological community (Department of the Environment 2013). Nonetheless, it has been discussed within this Referral as a listed Matter of National Environmental Significance.

Aside from the coastal fringe, the Project Corridor is highly degraded and largely lacking remnant vegetation (EBS Ecology Pty Ltd 2015). None of the other three ecological communities, which are predicted to occur within the Project Corridor by the Protected Matters Search tool are present within the Project Corridor due to this level of modification and the lack of suitable habitat for these communities. The majority of the remnant trees within the Project Corridor are River Red-gums *Eucalyptus camaldulensis,* with a range of other trees species planted within the Project Corridor for functional or aesthetic purposes. These species are not representative of the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (only 12 historic records of Grey Box within 5km of the Project Corridor (Department for Transport Energy and Infrastructure 2009)) or the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia (only 2 historic records of Peppermint Box within 5km of the Project Corridor (Department for Transport Energy and Infrastructure 2009)), which suggests that neither of these communities were historically found within large parts of the Project Corridor. The Iron-grass Natural Temperate Grassland of South Australia community is found above 380m above sea-level, further to the east of the Project Corridor, and is therefore not present within the Project Corridor (Department of Environment and Water Resources 2007).

Flora Species

Nineteen nationally threatened flora species have previously been identified as either occurring or having the potential to occur within 5km of the Project Corridor by the Protected Matters Search Tool (Table 3.2) (Department of the Environment 2015d). Of these, six have previously been recorded within 5km of the Project Corridor (Department of Environment Water and Natural Resources 2015), Three of these species are considered to be woodland / mallee species with the records being more than 70 years old. One species occurs within sand dunes / sand plains areas and another species was recorded within a floodplain area. Only one has been identified as potentially occurring within the Project Corridor and therefore may be impacted by the proposed works: Bead Glasswort *Tecticornia flabelliformis,* listed as vulnerable.

A number of the flora species listed in Table 3.2 are orchid species which are associated with relatively intact woodland habitats. This type of habitat was only recorded within the Project Corridor in a highly modified form. EBS Ecology Pty Ltd (2015) identified three types of woodland habitat (Vegetation Association 3: Planted Woodland of Eucalypt and Old Man Saltbush; Vegetation Association 2. River Red gum Woodland over Low Chenopod Shrubland and Vegetation Association 10: Planted River Red-gum Open Woodland over Exotic Grasses; Table 3.2), of which only Vegetation Association 2 was naturally occurring. All are characterised by a disturbed understorey that is dominated by exotic species (EBS Ecology Pty Ltd 2015). No threatened flora species were recorded within these vegetation communities and none are likely to occur.

Bead Glasswort is known to occur in the wider region, but not the Project Corridor: the nearest known records are from targeted surveys for the species as part of the Ridley Dry Creek Pty Ltd EPBC Act referral, approximately 1km west of the Project Corridor (EcoAerial 2015). These surveys found 10 patches of Bead Samphire and large numbers of individual plants, approaching as many as 5,000 individuals (EcoAerial 2015). Other records come from Middle Beach, Parham and Light Beach to the north of the Project Corridor (Figure 5) (Department of Environment Water and Natural Resources 2015). EBS Ecology undertook vegetation assessments of the project's vegetation associations in winter, spring and summer 2008–09 and summer 2011. There is also an additional vegetation assessment underway that begun spring 2015. Bead Samphire was not identified during these assessments, despite the summer surveys being undertaken at the preferred time of year to detect the species (EBS Ecology Pty Ltd 2015). More recent records have not identified the species within the vicinity of the Project Corridor (Brett Lane and Associates Pty Ltd 2015). Further detailed vegetation surveys of the Project Corridor are currently being undertaken and will identify if the Bead Glasswort is present within the Project Corridor.

No other flora species of national conservation significance were recorded in the Project Corridor during the project's flora assessment and no other species are likely to occur. If Bead Glasswort species is recorded within the Project Corridor, a detailed management plan will be developed for the species. The management plan will incorporate a range of management strategies as detailed in Section 5 of this Referral.

Fauna Species

Forty-five threatened fauna species have previously been identified as either occurring or having the potential to occur within 5km of the Project Corridor (Table 3.3) (Figures 6a-f) (Department of the Environment 2015d). Twenty-five of these species are identified in Table 3.3 as having primarily pelagic habitat preferences, comprising 18 birds, three mammals, three reptiles and one fish. The occurrence of these species within the Project Corridor, which does not include any pelagic habitats, is only likely to consist of sick, injured, lost or immature animals outside their normal range and not representative of a significant component of that species' population. On that basis, these species are not considered as present.

Birds

Of the remaining 14 bird species, seven other species are highly unlikely to occur within the Project Corridor based on historic records, the habitat preferences and the ecology of the species. Malleefowl *Leipoa ocellata* and Plains-wanderer *Pedionomus torquatus* are shy species that do not tolerate disturbance well (Higgins and Davies 1996; Marchant and Higgins 1990). There are no records of Malleefowl and the most recent record of Plains-wanderer is from 1925 (Department of Environment Water and Natural Resources 2015). Painted Honeyeater *Grantiella picta*, Spotted Quail-thrush (Mt Lofty Ranges) *Cinclosoma punctatum anachoreta* and Bassian Thrush (South Australian) *Zoothera lunulata halmaturina* are woodland or forest birds that inhabit inland habitats to the west of the Project Corridor (Higgins and Peter 2002; Higgins *et al.* 2006; Higgins *et al.* 2001). No preferred habitat for these species occurs within the Project Corridor. The Night Parrot *Pezoporus occidentalis,* is likely to be extinct within the region, if it ever occurred. Night Parrots are confined to inland areas where small populations of the species have only recently been rediscovered and there are no records of this species within the vicinity of the Project Corridor. Single Hooded Plovers *Thinornis rubricollis* have been recorded on occasions at the salt fields near St Kilda (Department of Environment Water and Natural Resources 2015), however their preferred habitat is along sandy coastlines and they are generally observed in estuaries, coastal lakes, and less frequently at inland salt lakes (Higgins and Davies 1996). Sightings in South Australia are more often along the southern coast of Fleurieu Peninsula, Yorke Peninsula and on Kangaroo Island where more suitable habitat is located. None of these species are likely to occur within the Project Corridor because of the general lack of preferred habitat and therefore are unlikely to be impacted by the Northern Connector Project.

Seven other threatened bird species have been recorded in and around the Project Corridor. These species have a higher likelihood of occurrence and so have been discussed individually below.

Australasian Bittern *Botaurus poiciloptilus*

Australasian Bitterns prefer dense vegetation, especially tall reedbeds and sedges (Marchant and Higgins 1993). Their distribution in South Australia is confined to the South East, Adelaide Plains, Murray Mallee and Mount Lofty Ranges regions. Numbers of the species are declining in South Australia, as freshwater habitats are degraded and lost (Adelaide and Mount Lofty Ranges Natural Resources Management Board 2008).

A small breeding population has established near the Project Corridor at Greenfields Wetlands Stages 1 and 3, with an occasional record of the species in the northern most section of the Barker Inlet South Wetlands (Figure 6a). These wetlands provide the largest stands in the region of the Bittern's preferred habitat of tall reedbeds and regular standing water. The Greenfields Wetlands Stage 3 is now considered an important wetland for the species, especially during periods of drought. This wetland will not be affected by the project. Within the Project Corridor, there is little of this species' preferred habitat. Limited stands of tall reedbeds are located in Barker Inlet South Wetlands which will also not be impacted by the project scope.

Australian Painted Snipe *Rostratula australis*

The Australian Painted Snipe has been recorded at numerous locations within the Project Corridor, local and wider region in the past (Figure 6b) (Adelaide and Mount Lofty Ranges Natural Resources Management Board 2008; Armstrong *et al.* 2003). The species was not recorded during the surveys undertaken in 2011 (Kellogg Brown & Root Pty Ltd 2011), although it often remains undetected because of its cryptic behaviour. The distribution of the Australian Painted Snipe across South Australia is patchy and its presence in any particular area is usually unpredictable (Higgins and Davies 1996). Some individuals are nomadic in the non-breeding season and are believed to travel widely across the landscape in search of suitable foraging areas, while other individuals are resident in areas where suitable habitat exists (Higgins and Davies 1996). Australian Painted Snipe have been recorded in a wide range of locations, from freshwater or brackish wetlands, which are either permanently or temporarily filled, to wet vegetation in swamps, along drainage lines or in tall grasslands (Higgins and Davies 1996).

The species' distribution within South Australia is limited according to available records and their unpredictability means they are recorded irregularly (Rogers *et al.* 2005). The species has been recorded in the Mid-North of South Australia in the Clare-Burra region, as well as in the Southern Lofty Ranges and South East (Rogers *et al.* 2005). The Murray–Darling drainage system also appears to have been a key area for this species (Rogers *et al.* 2005). There are also regular records from the South Australian Riverland, with sightings from Paiwalla Wetlands (Rogers *et al.* 2005).

A maximum of 30 Painted Snipe have been recorded from wetlands in the South East of South Australia, and up to eight birds at a time have been seen at Greenfields Wetlands Stage 3 (Department of Environment Water and Natural Resources 2015). Large flocks are very rare and records of single birds are more common. On the Adelaide Plains single birds have been recorded from The Paddocks Wetlands in Para Hills and Edinburgh Park in Edinburgh, both sites are inland of the Project Corridor (Department of Environment Water and Natural Resources 2015).

The Greenfields Stage 3 wetland, adjacent to the Project Corridor, may support a large proportion of the regional population on a regular basis (approximately 10 birds). Australian Painted Snipe are known to breed at this site, from an observation of two adults and three juveniles. Breeding events have also been documented near Strathalbyn and Goyders Lagoon in the Riverland (Rogers *et al* 2005). The regular sightings at Greenfields Wetlands Stage 3 indicates that this wetland supports an important population of Australian Painted Snipe,

especially as this population is at the south-western extent of the species range (Garnett and Crowley 2000). Protection of all recently used habitat is identified as a key management action for this species (Garnett and Crowley 2000). The Greenfields Stage 3 wetland is not directly impacted by the project. The Barker Inlet North Wetlands have small areas of potential suitable habitat only and there are no recorded sightings of the species here.

Eastern Curlew *Numenius madagascariensis* and Curlew Sandpiper *Calidris ferruginea*

Both Eastern Curlew and Curlew Sandpiper are regularly reported from within and around the Project Corridor (Figure 6c and 6d). Eastern Curlews are large migratory shorebirds that spend the austral summer feeding in habitats with large mudflats or sandflats, including estuaries, inlets, inlets and harbours (Higgins and Davies 1996). They are often found among saltmarsh and on mudflats surrounded by mangroves (Higgins and Davies 1996). Curlew Sandpipers similarly occur in sheltered coastal areas, but are also found foraging around ephemeral and permanent lakes and dams (Higgins and Davies 1996).

Up to 1000 individual Curlew Sandpipers have been recorded in the Project Corridor, with recent records of up to 150 birds in 2013 near St Kilda beach (BirdLife Australia 2015), north-west of the Project Corridor. Ninety-five Eastern Curlews were recorded in 1979 (Department of Environment Water and Natural Resources 2015), however it seems that numbers of this species have dramatically declined with no records after 2006 and no more than 42 birds recorded at any one time since 2005 (BirdLife Australia 2015). Most of these regional sightings of these species are from the salt-fields at the northern end of the Ridley Dry Creek Pty Ltd works (i.e. north of Dry Creek) and further north along the Gulf (BirdLife Australia 2015; Department of Environment Water and Natural Resources 2015). These areas provide high tide roost sites for these species and the shallow saltwater and mudflats in these ponds, and along the coastline are also foraging habitat. Nonetheless, some records come from within the Project Corridor and wetlands adjacent to the southern section of the Project Corridor.

Fairy Tern *Sternula nereis nereis*

Up to 50 Fairy Terns have been recorded during one observation within the vicinity of the Project Corridor (Figure 6e) (Department of Environment Water and Natural Resources 2015) illustrates the records of the Fairy Terns within 5 km of the project corridor. Most records of this species come from the north of the Project Corridor. Fairy Terns have also previously been recorded within the Project Corridor (BirdLife Australia 2015).

Fairy Terns are found close to land, usually in sheltered coasts as well as harbours, inlets, bays, estuaries and lagoons (Higgins and Davies 1996). They nest on sheltered beaches in the sand and roost in similar areas on spits, banks and bars (Higgins and Davies 1996). The Project Corridor is likely to provide only supplementary foraging habitat for the species, rather than core habitat, given the Fairy Terns preference for foraging over shallow, open water of coasts, embayment's and estuaries (Higgins and Davies 1996).

Slender-billed Thornbill (Gulf St Vincent) *Acanthiza iredalei rosinae*

Torrens Island, less than 2km from the Project Corridor, is identified as one of three population foci for the Gulf St Vincent subspecies of the Slender-billed Thornbill (Department of The Environment 2015b). This thornbill, unlike all of its congeners, is found in samphire dominated chenopod shrublands, usually near a tidal channel or saline lake (Garnett and Crowley 2000; Higgins and Peter 2002). The species is considered highly sedentary, rarely crossing gaps between sub-populations (Higgins and Peter 2002). Sixty-eight observations of this subspecies have been recorded within the vicinity of the Project Corridor, all of them to the west of the Project Corridor (Figure 6f) (BirdLife Australia 2015; Department of Environment Water and Natural Resources 2015). It is likely that the species irregularly uses southern parts of the Project Corridor that support suitable habitat.

Orange-bellied Parrot *Neophema chrysogaster*

The entire wild population of the Orange-bellied Parrot is less than 50 individuals, with extinction likely if current trends continue (Peter and Herrod 2010). The Orange-bellied Parrot is a winter migrant to the mainland of Australia, arriving between February and March from breeding grounds in south-west Tasmania, and returning from late September to October (Higgins 1999). Dispersal patterns across Victoria and South Australia over the course of winter are poorly understood. The parrots remain for varying durations at different locations, largely dictated by the availability of food resources. Their over-wintering range is identified in maps in the National Recovery Plan for this species (Department of the Environment and Heritage 2005), but in recent years various locations, including those in South Australia, have recorded very few, if any individuals (Peter and Herrod 2010). It is therefore unlikely that the Orange-bellied Parrot is now found within the Project Corridor.

Of the three records in the Adelaide Plains region over the past 10 years, one was from the tidal saltmarsh along the western fringe of the Ridley Dry Creek Pty Ltd salt fields adjacent to Bolivar Waste Water Treatment Plant (WWTP) in October 2006 (Department of Environment Water and Natural Resources 2015). This sighting confirms that the tidal saltmarsh habitat in the Project Corridor is potentially used by this species. The other two recent records were at Port Gawler 13km to the north of the Project Corridor in 2006 and at the Onkaparinga River 38km south of the Project Corridor, 10 years ago (Department of Environment Water and Natural Resources 2015). During 2011 regional surveys only three birds were recorded in all of South Australia. All were from the South East region.

Mammals

In addition to the three pelagic mammal species, two other mammals have been recorded within 5km of the Project Corridor. In addition to the three pelagic mammal species, two other mammals have been recorded within 5km of the Project Corridor. There are 175 observations of Grey-headed Flying-fox *Pteropus poliocephalus* recorded in the SA Biological Database, including one record of 1324 individuals (Department of Environment Water and Natural Resources 2015). Although the species is likely to regularly fly over the Project Corridor, there is little or no preferred habitat for Grey-headed Flying-foxes, which includes fruiting trees and gully roosting areas (Menkhorst 2001) and this species is unlikely to be impacted by the proposed works. There are also four records of Australian Fur-seal *Neophoca cinerea* from within the Project Corridor (Department of Environment Water and Natural Resources 2015). Whilst not strictly a pelagic species, this species is confined to marine environments (Menkhorst 2001) and is unlikely to find any suitable habitat within the Project Corridor. A final mammal species, the Southern Brown Bandicoot *Isoodon obesulus obesulus,* was modelled to occur by the Protected Matters Search Tool (Department of the Environment 2015d). Given the lack of records of this species, the generally high level of disturbance to this species' preferred habitat within the Project Corridor, it is unlikely that Southern Brown Bandicoots will be impacted by the proposed works.

Reptiles

In addition to the three pelagic reptile species, two other reptiles have been recorded within 5km of the Project Corridor. The Flinders Ranges Worm-lizard *Aprasia pseudopulchella* has been recorded on six occasions to the east of the Project Corridor (Department of Environment Water and Natural Resources 2015). This species generally prefers stony soils, or clay soils with a stony surface (Cogger 2000; Wilson and Swan 2010). This habitat is not present within the Project Corridor and this species is unlikely to be impacted by the proposed works.

There is also a record of a single Pygmy Bluetongue Lizard from 1899 (Department of Environment Water and Natural Resources 2015). Although habitat for this species was historically present within the Project Corridor, the species is sensitive to soil disturbance and the range of this species is thought to have contracted to an area along a line of hills in the North Mount Lofty Ranges, from just south of Burra north to about Peterborough

(Milne *et al.* 2000). Therefore this species is unlikely to be found within the Project Corridor and is unlikely to be impacted by the proposed works.

Amphibians

No nationally threatened amphibians have been previously recorded from within 5km of the Project Corridor and none are modelled to occur by the Protected Matters Search Tool.

Fish

The Murray Cod *Maccullochella peelii peelii* is modelled to occur within the Project Corridor by the Protected Matters Search Tool (Department of the Environment 2015d). None of the rivers within the Project Corridor provide preferred habitat for this species and it is therefore unlikely that the species will be impacted by the proposed works.

Table 3.1. Nationally significant vegetation communities known or predicted to occur within the Project Corridor.

Vegetation Community Name	EPBC Act Status	Benchmarks	Likelihood of Presence [1]
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	All Patches • Minimum patch size is 0.5 hectares • Canopy layer contains Grey Box as the dominant or co-dominant species • Vegetative cover of non-grass weed species in the ground layer is <30% cover Patches >2ha • At least 8 trees/ha with that are hollow bearing or have a DBH of 60cm or more; AND • At least 10% of the vegetative ground cover comprises perennial native grasses; OR • At least 20 trees/ha have a DBH of 12cm or more; AND • At least 50% of the vegetative cover in the ground layer comprises perennial native species. Patches <2ha • At least 50% of the vegetative cover in the ground layer comprises perennial native species at any time of the year; AND • 8 or more perennial native species are present in the mid and ground layers at any time of the year Derived Grassland Patches • Derived grassland has clear evidence that the site was formerly a woodland with a tree canopy dominated or co-dominated by Grey Box; AND • At least 50% of the vegetative cover in the ground layer is made up of perennial native species at any time of the year; AND • 12 or more native species are present in the ground layer at any time of the year (SEWPaC 2012).	Unlikely
Iron-grass Natural Temperate Grassland of South Australia	Critically Endangered	• Located east of Adelaide on gentle slopes of low hills above 380 metres above sea level (Department of Environment and Water Resources 2007).	Unlikely
Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia	Critically Endangered	• Dominated by Peppermint Box; • Occurs on gentle to moderate slopes, hilltops and adjacent plains; • The soil types range from sandy-loam to clay-loam; • The annual rainfall is between 310 and 610 millimetres a year; • The vegetation structure is an open to dense woodland. The tree canopy comprises low trees, generally 5–10 metres tall but sometimes up to 15 metres tall, with a typical canopy cover of 5–40 per cent which can occasionally reach 70 per cent (Department of Environment and Water Resources 2007).	Unlikely

Subtropical and Temperate Coastal Saltmarsh	Vulnerable	• Occurs south of 23° 37' S latitude - from the central Mackay coast on the east coast of Australia, southerly around to Shark Bay on the west coast of Australia (26° latitude), and including the Tasmanian coast and islands within the above range; • Occurs on the coastal margin, along estuaries and coastal embayment's and on low wave energy coasts; • Occurs on places with at least some tidal connection, including rarely-inundated supratidal areas, intermittently opened or closed lagoons, and groundwater tidal influences, but not areas receiving only aerosol spray; • Occurs on sandy or muddy substrate and may include coastal clay pans (and the like) consists of dense to patchy areas of characteristic coastal saltmarsh plant species (i.e. salt-tolerant herbs, succulent shrubs or grasses, that may also include bare sediment as part of the mosaic); and, • Proportional cover by tree canopy such as mangroves, Melaleucas or Casuarinas is not greater than 50%, nor is proportional ground cover by seagrass greater than 50% (Department of Sustainability Environment Water Populations and Communities 2013).	Present

Table notes

[1] Likelihood of Presence Definitions:

- *Unlikely* – Project Corridor does not contain habitat and/or it is outside the species' known, current distribution.
- *Low* –Project Corridor contains some marginal habitat, but the species was not observed and has not been recently recorded in previous surveys in the area.
- *Moderate* – Project Corridor contains preferred habitat that may support a population of the species. However, other factors, such as fragmentation, disturbance or predators may be impacting any local population.
- *High* - Project Corridor contains the preferred habitat which is likely to support the species.
- *Present* – Preferred habitat is present within the Project Corridor, and the species was observed within the Project Corridor, or recently recorded within the Project Corridor.

Table 3.2. Nationally significant flora species known or predicted to occur within the Project Corridor.

Common Name	*Scientific Name*	EPBC Act Status	Broad habitat preference [1]	Most Recent and Number of Previous Records	Habitat Present within the Project Corridor	Likelihood of Occurrence within the Project Corridor [2]
White-beauty Spider-orchid	*Caladenia argocalla*	Endangered	Open grassy herbland under light, in a mixed Eucalypt and Callitris forest.	×	No	Unlikely
Pink-lipped Spider-Orchid	*Caladenia behrii*	Endangered	Open and shrubby woodlands	×	No	Unlikely
Bayonet Spider-orchid	*Caladenia gladiolata*	Endangered	South Australian Blue Gum *Eucalyptus leucoxylon* woodlands	×	No	Unlikely
Large-club Spider-orchid	*Caladenia macroclavia*	Endangered	Grows in fertile shallow loams in mallee-boombrush woodland in sandy loam over limestone	×	No	Unlikely
Stiff White Spider-orchid	*Caladenia rigida*	Endangered	Open-forest dominated by Eucalypts in ridge tops and hillslopes	1908 3 Records	No	Unlikely
Greencomb Spider-orchid	*Caladenia tensa*	Vulnerable	A range of dry habitats including Cypress-pine (family Cupressaceae)/Yellow Gum Woodland, Pine/Box woodland, mallee-heath sites, heathy woodland and mallee woodland, generally with rock outcrops.	×	No	Unlikely
Woolcock's Spider-orchid	*Caladenia woolcockiorum*	Vulnerable	Open forests or woodlands on the mid to lower slopes of steep gullies, in relatively open, herbaceous understorey vegetation with loam soil	×	No	Unlikely
Osborn's Eyebright	*Euphrasia collina* subsp. *Osbornii*	Endangered	Mallee scrubland, sclerophyll forest and sometimes in sclerophyll woodland	1943 1 Record	No	Unlikely
Clover Glycine	*Glycine latrobeana*	Vulnerable	Grassy woodland; plains grassland; box woodland; dry sclerophyll forest.	×	No	Unlikely
Silver Daisy-bush	*Olearia pannosa* subsp. *pannosa*	Vulnerable	Woodland or mallee in sandy, flat areas and hilly, rocky areas	×	No	Unlikely
Pale Leek-orchid	*Prasophyllum pallidum*	Vulnerable	Fertile soils in woodlands and well-grassed forests	×	No	Unlikely
Plum Leek-orchid	*Prasophyllum pruinosum*	Endangered	Open woodlands	1929 2 Records	No	Unlikely
Sandhill Greenhood orchid	*Pterostylis arenicola*	Vulnerable	The Sandhill Greenhood Orchid is restricted to consolidated, coloured sand-hills in near coastal areas. Soils are red sand dunes, sandy clay-loams or sandy areas amongst limestone.	2008 22 Records	No	Unlikely
Leafy Greenhood	*Pterostylis cucullata*	Endangered	Tea-tree heath	×	No	Unlikely
Halbury Greenhood	*Pterostylis lepida*	Endangered	Mallee form Peppermint Box, Southern Cypress Pine and Sea Box	×	No	Unlikely

			woodlands. The orchid occurs in open mossy clearings, gaps and pathways between the trees and shrubs			
Behr's Groundsel	*Senecio behrianus*	Endangered	Poorly known. Generally close to floodplains or on poorly-drained sedimentary grey clays or sandy clays	1994 1 Record	No	Unlikely
Bead Glasswort	*Tecticornia flabelliformis*	Vulnerable	Generally occur on the margins of salt lakes, saline flats, evaporation pans and coastal salt marshes over gypsum deposits	2014 28 Records	Yes	High
Spiral Sun-orchid	*Thelymitra matthewsii*	Vulnerable	Open forests and woodlands in well-drained sand and clay loams	×	No	Unlikely
Blue Top Sun-orchid	*Thelymitra cyanapicata*	Critically Endangered	Occurs in Manna Gum, Messmate open swampy woodland with a dense understorey of tea-tree, sedges, rushes and ferns in low-lying seepages, creeks and swamps with wet sandy soils	×	No	Unlikely

Table notes

Data is derived from Biological Databases of South Australia (Department of Environment, Water and Natural Resources 2015) and covers an area comprising a 10km buffer of the Northern Connector Project Corridor. The data includes all threatened species records up to 2015, it also includes SA Museum records up to 2012. Species that have no previous records have modelled habitat within the search area based on the Protected Matters Search Tool (Department of the Environment 2015b).

[1] Habitat data drawn from the Species Profile and Threats Database (Department of the Environment 2015e) for each of the threatened species listed, or their conservation advice.

[2] Likelihood of occurrence definitions:

- *Unlikely* – Project Corridor does not contain habitat and/or it is outside the species' known, current distribution.
- *Low* –Project Corridor contains some marginal habitat, but the species was not observed and has not been recently recorded in previous surveys in the area.
- *Moderate* – Project Corridor contains preferred habitat that may support a population of the species. However, other factors, such as fragmentation, disturbance or predators may be impacting any local population.
- *High* - Project Corridor contains the preferred habitat which is likely to support the species.
- *Present* – Preferred habitat is present within the Project Corridor, and the species was observed within the Project Corridor, or recently recorded within the Project Corridor.

Table 3.3. Nationally significant fauna species known or predicted to occur within the Project Corridor.

Common Name	Scientific Name	EPBC Act Status	Broad habitat preference [1]	Most Recent and Number of Previous Records (Max. Count)	Habitat Present within the Project Corridor	Likelihood of occurrence within the Project Corridor [2]
Birds						
Malleefowl	*Leipoa ocellata*	Vulnerable	Mallee, acacia, paperbark and other scrubs as well as open eucalypt woodlands or coastal heaths on sandy or gravelly soils.	×	No	Unlikely
Blue Petrel	*Halobaena caerulea*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	1991 2 Records (1)	No	Unlikely
Soft-plumaged Petrel	*Pterodroma mollis*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Fairy Prion	*Pachyptila turtur*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Wandering Albatross	*Diomedea exulans*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	1900 1 Record (1)	No	Unlikely
Tristan Albatross	*Diomedea exulans exulans*	Endangered	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Antipodean Albatross	*Diomedea exulans antipodensis*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Gibson's Albatross	*Diomedea exulans gibsoni*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Amsterdam Albatross	*Diomedea exulans amsterdamensis*	Endangered	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Southern Royal Albatross	*Diomedea epomophora epomophora*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Northern Royal Albatross	*Diomedea epomophora sandfordi*	Endangered	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Sooty Albatross	*Phoebetria fusca*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Black-browed Albatross	*Thalassarche melanophris melanophris*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Campbell Albatross	*Thalassarche melanophris impavida*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Shy Albatross	*Thalassarche cauta cauta*	Vulnerable	A non-breeding visitor, mostly to offshore waters.	×	No	Unlikely

			Largely pelagic in behaviour			
White-capped Albatross	*Thalassarche cauta steadi*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Buller's Albatross	*Thalassarche bulleri*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Southern Giant Petrel	*Macronectes giganteus*	Endangered	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	1983 4 Records (1)	No	Unlikely
Northern Giant Petrel	*Macronectes hallii*	Vulnerable	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely
Australasian Bittern	*Botaurus poiciloptilus*	Endangered	Reed beds, dense vegetation of freshwater swamps and creeks.	2013 123 Records (5)	Yes	Likely
Australian Painted-Snipe	*Rostratula australis*	Vulnerable	Uncommon summer migrant to Victoria. Lowlands on shallow freshwater swamps with emergent vegetation, and flooded salt marshes.	2014 46 Records (12)	Yes	Likely
Eastern Curlew	*Numenius madagascariensis*	Critically Endangered	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2006 154 Records (95)	Yes	High
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 280 Records (998)	Yes	High
Hooded Plover	*Thinornis rubricollis rubricollis*	Vulnerable	Intertidal mudflats, estuaries and beaches.	2009 5 Records (5)	No	Low
Plains-wanderer	*Pedionomus torquatus*	Vulnerable	Sparse, treeless, lightly grazed native grasslands/herbfields with bare ground, old cereal crops, low shrubland.	1925 11 Records (1)	No	Unlikely
Fairy Tern	*Sternula nereis nereis*	Vulnerable	Coastal waters, bays, inlets, brackish lakes, sewerage ponds near coasts.	2012 100 Records (50)	Yes	Moderate
Orange-bellied Parrot	*Neophema chrysogaster*	Critically Endangered	Saltmarsh, coastal pastures	2006 3 Records (3)	Yes	Low
Night Parrot	*Pezoporus occidentalis*	Endangered	Long unburnt spinifex plains away from disturbance	×	No	Unlikely
Slender-billed Thornbill (Gulf St Vincent)	*Acanthiza iredalei rosinae*	Vulnerable	Confined to chenopod shrublands, particularly samphire dominated by shrubby glasswort (*Sclerostegia arbuscula*), on narrow coastal saline mudflats usually within 20m of a tidal channel or saline lake. Torrens Island identified as providing habitat	2014 68 Records (11)	Yes	Moderate
Painted Honeyeater	*Grantiella picta*	Vulnerable	Open box-ironbark forests and woodlands, particularly where trees are infested with mistletoe.	×	No	Unlikely

Spotted Quail-thrush (Mt Lofty Ranges)	*Cinclosoma punctatum anachoreta*	Critically Endangered	Occurs in sclerophyll woodlands that are dominated by Eucalyptus trees (especially *E. fasciculosa* and peppermints) and have sparse understorey vegetation, and in heathlands. Likely extinct	×	No	Unlikely
Bassian Thrush (South Australian)	*Zoothera lunulata halmaturina*	Vulnerable	Densely forested areas and gullies are favoured, usually with a thick canopy overhead, a thick understorey of small trees and tall shrubs, and leaf-litter below	×	No	Unlikely
Mammals						
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	Endangered	Heathy forest, heathland and coastal scrub.	×	No	Unlikely
Grey-headed Flying-fox	*Pteropus poliocephalus*	Vulnerable	Roost sites commonly occur in gullies, in vegetation with dense canopy cover and close to water. May forage widely.	2015 175 Records (1324)	No	Moderate
Blue Whale	*Balaenoptera musculus*	Endangered	Pelagic	1989 1 Record (1)	No	Unlikely
Southern Right Whale	*Eubalaena australis*	Endangered	Pelagic	2006 9 Records (2)	No	Unlikely
Humpback Whale	*Megaptera novaeangliae*	Vulnerable	Pelagic	1994 4 Records (2)	No	Unlikely
Australian Sea-lion	*Neophoca cinerea*	Vulnerable	Onshore habitats used include exposed islands and reefs, rocky terrain, sandy beaches and vegetated fore dunes and swales. They also use caves and deep cliff overhangs as haul-out sites or breeding habitat	2013 4 Records (2)	No	Unlikely
Reptiles						
Leathery Turtle	*Dermochelys coriacea*	Vulnerable	Pelagic, some breed in Queensland	1996 1 Record (1)	No	Unlikely
Loggerhead Turtle	*Caretta caretta*	Endangered	Pelagic	×	No	Unlikely
Green Turtle	*Chelonia mydas*	Vulnerable	Pelagic	2008 2 Records (1)	No	Unlikely
Flinders Ranges Worm-lizard	*Aprasia pseudopulchella*	Vulnerable	The species occurs in open woodland, native tussock grassland, riparian habitats and rocky isolates. It prefers stony soils, or clay soils with a stony surface, and has been found sheltering beneath stones and rotting stumps. Records from northern suburbs of Adelaide	1993 6 Records (1)	No	Low
Pygmy Bluetongue Lizard	*Tiliqua adelaidensis*	Endangered	Occurs in a variety of habitats, ranging from highly degraded grasslands (dominated by exotic grasses) to grasslands with high native biodiversity	1899 1 Records (1)	Yes	Low
Fish						

Murray Cod	*Maccullochella peelii peelii*	Vulnerable	Small clear, rocky, upland streams with riffle and pool structure on the upper western slopes of the Great Dividing Range to large, meandering, slow-flowing, often silty rivers in the alluvial lowland reaches of the Murray-Darling Basin.	×	No	Unlikely
Great White Shark	*Carcharadon carcharias*	Vulnerable	Pelagic	×	No	Unlikely

Table notes

Data is derived from Biological Databases of South Australia (Department of Environment, Water and Natural Resources 2015) and covers an area comprising a 10km buffer of the Northern Connector Project Corridor. The data includes all threatened species records up to 2015, it also includes SA Museum records up to 2012 and BirdLife Australia data up to 2006. Additional data for the period from 2006 to the present was sourced from BirdLife Australia (2015) comprising a 10km buffer around the point -34.80177, 138.5766042, which is the location of the Little Para River approximately half way along the Project Corridor. Species that have no previous records have modelled habitat within the search area based on the Protected Matters Search Tool (Department of the Environment 2015b).

[1] Habitat data drawn from: Cogger 2000; Higgins 1999; Higgins and Davies 1996; Higgins and Peter 2002; Higgins et al. 2006; Higgins et al. 2001; Marchant and Higgins 1990; Marchant and Higgins 1993; Menkhorst 2001; Pizzey and Knight 2012; Wilson and Swan 2010.

[2] Likelihood of occurrence definitions:

- *Unlikely* – Project Corridor does not contain habitat and/or it is outside the species' known, current distribution.
- *Low* –Project Corridor contains some marginal habitat, but the species was not observed and has not been recently recorded in previous surveys in the area.
- *Moderate* – Project Corridor contains preferred habitat that may support a population of the species. However, other factors, such as fragmentation, disturbance or predators may be impacting any local population.
- *High* - Project Corridor contains the preferred habitat which is likely to support the species.
- *Present* – Preferred habitat is present within the Project Corridor, and the species was observed within the Project Corridor, or recently recorded within the Project Corridor.

Nature and extent of likely impact

This section discusses the likely direct impacts of the Northern Connector Project on threatened communities, flora and fauna that have a likelihood of occurrence within the Project Corridor of Moderate or above as per Tables 3.1–3.3.

Ecological Communities

The vulnerable Subtropical and Temperate Coastal Saltmarsh vegetation community is likely to be impacted by the Northern Connector Project. Of the total estimated extent of 17,959 hectares known to exist within Gulf St Vincent, approximately 17Ha of this vegetation community is within the Northern Connector Project Corridor Wakefield (Threatened Species Scientific Community 2013). This vegetation community was assessed and mapped as Vegetation Association 6: Samphire Very Low Open Shrubland, which is a state based classification closely correlated with this community (EBS Ecology Pty Ltd 2015). Patches of the community are mapped around Little Para River and south to the Barker Inlet North Wetlands (Figure 4a-c). Additional targeted surveys for this vegetation community are currently being commissioned by DPTI as part of the requirements under South Australia's *Native Vegetation Act 1993*.

As this vegetation community is listed as vulnerable and not endangered or critically endangered, an impact assessment for this vegetation community is not required for determination of this Referral.

Flora

Bead Glasswort has not previously been recorded within the Project Corridor (Figure 5), although it is possible that this species does occur within areas of the Subtropical and Temperate Coastal Saltmarsh vegetation community. Although up to 9 hectares of this community may be impacted by the project, this figure is expected to be reduced during the design phase of the project, reducing the potential impact to any Bead Glasswort plants that may occur in these habitats. Further, targeted surveys for this species are being commissioned by DPTI and this will enable further alterations to the design of the road to avoid individuals of this species. If it is likely that any Bead Glasswort plants will be impacted by the project, a detailed management plan will be developed for the species.

Likely impacts to Bead Glasswort

Loss of potential habitat

Likelihood of a significant impact to Bead Glasswort

On the basis that there are no records of Bead Glasswort within the Project Corridor, pending the targeted surveys, there is unlikely to be a significant impact on this species.

Fauna

Australasian Bittern

Impacts to the Australasian Bittern are likely to occur as a result of loss of some habitat and through disturbance both during and after construction. Loss of habitat is likely in the south of the Project Corridor in the Barker Inlet North Wetlands where a small area of reedbeds will be impacted (Figure 4b). Australasian Bitterns that use the general area are likely to use this patch of reedbed as they move around the landscape. However, most recent records of this species come from adjacent wetlands, particularly including the Greenfields Stage1 and 3 wetlands (Figure 6a), which will not be directly impacted by the Northern Connector Project. Restoration of the Barker Inlet North Wetlands is likely to allow Bitterns to return to the Project Corridor, once construction is complete,

limiting the long term impacts to the species.

Likely impacts to Australasian Bittern

Loss of small areas of potential habitat in Barker Inlet North; temporary displacement and noise disturbance during construction activities; ongoing noise disturbance once the road is commissioned.

Likelihood of a significant impact to Australasian Bittern

On the basis that the habitat impacted by the proposed works is in areas that do not regularly support this species and reconfiguration/rehabilitation of the Barker Inlet North Wetland and any associated replacement wetland will mitigate long-term impacts, it is unlikely that there will be a significant impact to Australasian Bitterns.

Australian Painted Snipe

The discussion above indicates that the Barker Inlet North Wetlands have small areas of potential suitable habitat Australian Painted Snipe, but that there are no recorded sightings of the species within the Northern Connector Project Corridor. The Greenfields Stage 3 wetland, which is likely to regularly support a large proportion of the regional population of this species, is not directly affected by the project.

Given the above, the Australian Painted Snipe's habitat is largely unaffected by the project, with the loss of only relatively small areas of potential habitat. The species is likely to have the ability to adapt to the disturbance caused by the development and, because of its habitat plasticity, has a wide range of suitable habitats available within the local area during construction of the project. Restoration of the Barker Inlet North Wetlands is likely to allow Snipe to return to the Project Corridor, once construction is complete, limiting the long term impacts to the species.

Likely impacts to Australian Painted Snipe

Loss of small areas of potential habitat in Barker Inlet North; temporary displacement and noise disturbance during construction activities; ongoing noise disturbance once the road is commissioned.

Likelihood of a significant impact to Australian Painted Snipe

On the basis that the habitat impacted by the proposed works is in areas that do not regularly support this species and reconfiguration/rehabilitation of the Barker Inlet North Wetland and any associated replacement wetland will mitigate long-term impacts, it is unlikely that there will be a significant impact to Australian Painted Snipe.

Eastern Curlew and Curlew Sandpiper

Impacts to these two migratory wader species are discussed in detail in relation to the suite of migratory shorebirds discussed below in section 3.1 (e).

Likely impacts to Eastern Curlew and Curlew Sandpiper

Loss of small areas of potential foraging habitat in Barker Inlet North, Little Para River and Dry Creek; temporary displacement and noise disturbance during construction activities; ongoing noise disturbance once the road is commissioned.

Likelihood of a significant impact to Eastern Curlew and Curlew Sandpiper

On the basis that there is extensive, higher quality, habitat elsewhere within the region and that the provision of new wetlands designed for shorebird habitat and reconfiguration/rehabilitation of the Barker Inlet North wetlands will mitigate long-term impacts, it is unlikely that there will be a significant impact on the population size or viability of either Eastern Curlew or Curlew Sandpipers.

Fairy Tern

The Fairy Tern is an uncommon visitor to the Project Corridor, where it forages over the wetlands, salt-fields and shallow bays of the eastern Gulf St Vincent. The Northern Connector Project is likely to displace foraging opportunities along its alignment and cause disturbance to the wider area during construction.

Likely impacts to Fairy Tern

Loss of small areas of potential foraging habitat; temporary displacement and noise disturbance during construction activities; ongoing noise disturbance once the road is commissioned.

Likelihood of a significant impact to Fairy Tern

On the basis of the lack of core habitat for this species, including breeding and roosting habitat, it is unlikely that the project will have a significant impact on this species.

Slender-billed Thornbill (Gulf St Vincent)

Most of the records for Slender-billed Thornbill (Gulf St Vincent) come from Torrens Island, approximately 2km west of the Project Corridor and further north in the Ridley Dry Creek Pty Ltd salt-fields near St Kilda.

Likely impacts to Slender-billed Thornbill (Gulf St Vincent)

Loss of small areas of potential habitat to the west of the proposed corridor; temporary displacement and noise disturbance during construction activities; ongoing noise disturbance once the road is commissioned.

Likelihood of a significant impact to Slender-billed Thornbill (Gulf St Vincent)

Although it is likely that this species does occasionally use habitat that will be impacted by Northern Connector Project, because of their sedentary nature, inability to disperse widely and that no populations have been regularly reported from the Project Corridor, these impacts are unlikely to represent a significant impact to this species.

Grey-headed Flying-fox

Although Grey-headed Flying-foxes have been regularly reported from within the Project Corridor, they are unlikely to be interacting with the habitats that the Project Corridor supports. There is no known roost site within the Project Corridor.

Likely impacts to Grey-headed Flying-foxes

Impacts are extremely unlikely as they are nocturnal species that range widely for food. Light disturbance is possible during night works.

Likelihood of a significant impact to Grey-headed Flying-foxes

As large, mobile species Grey-headed Flying-foxes are unlikely to be affected by the proposed works and there is not likely to be a significant impact on this species.

Indirect Impacts

Acid sulphate soils are also known to actually or potentially exist in the Southern Project Corridor. Acid sulphate soils occur naturally around Australia's coastline in areas that are, or once were, coastal environments. Coastal acid sulphate soils are commonly found in mangrove forests, saltmarsh, floodplains, and salt- and freshwater wetlands. It is generally assumed that coastal areas with approximate surface elevations less than five metres above mean sea level, Australian Height Datum (AHD) potentially have the necessary requirements for the formation of acid sulphate soils. However, it is important to note that this elevation criterion is only a guide and there are exceptions. Aquatic ecosystems may be affected by changes to water and soil quality. This can lead to negative effects on the species and ecological communities that depend on this ecosystem. While acid sulphate soils are not explicitly addressed in the EPBC Act, actions which may expose or disturb such soil must be referred to the Minister if they are likely to have a significant impact on any matters of national environmental significance (sourced from: Department of the Environment 2015a).

Management measures associated with Acid sulphate spoils are described in Section 5.

3.1 (e) Listed migratory species

Description

Sixty-seven migratory fauna species have previously been identified as either occurring or having the potential to occur within 5km of the Project Corridor (Table 3.4). These species can be grouped into one of four categories:

- 23 migratory marine species, comprising 13 birds, five mammals, three reptiles and two fish that are not likely to be found within the Project Corridor and which are unlikely to be significantly impacted by the Northern Connector Project. These species are not considered further;
- 33 migratory wetland species (shorebirds) that are likely to use the Project Corridor and surrounding habitat to some extent, discussed below;
- Four migratory wetland species (other birds) that are likely to use the Project Corridor and surrounding habitat to some extent; and,
- Seven loosely defined migratory terrestrial bird species that may occasionally use the Project Corridor and surrounding habitat to some extent.

Those species with a Moderate or higher likelihood of occurrence, based on their usual range and habitat preferences as per Table 3.4 are discussed further below.

Migratory Wetland Species (Shorebirds)

Of the 33 migratory wetland species, 29 have been previously recorded within 5km of the Project Corridor (Table 3.4) (Figure 10). These records largely come from the north of the Project Corridor in the Ridley Dry Creek Pty Ltd salt-fields, but also in the south of the Project Corridor in and around the Barker Inlet wetlands. Significant Impact threshold counts within the Project Corridor and buffer, taken from Migratory Shorebirds of the East Asian - Australasian Flyway; Population Estimates and Internationally Important Sites (Bamford et al. 2008), have only been recorded for three species: Red-necked Stint *Calidris ruficollis* (BirdLife Australia 2015), Sharp-tailed Sandpiper *Calidris acuminata* and Common Greenshank *Tringa nebularia* (Brett Lane and Associates Pty Ltd 2015).

In 2015, Brett Lane and Associates Pty Ltd prepared the EPBC Act referral for the decommissioning of the Ridley Dry Creek Pty Ltd salt-fields. As part of this referral migratory shorebirds surveys were undertaken within the salt-fields between Middle Beach Pumping Station in the north to the area adjacent to the Barker Inlet Wetlands in the south (Brett Lane and Associates Pty Ltd 2015). These surveys demonstrated that prior to 2013 the salt-fields supported more than 1% of the Australian populations of Red-necked Stint (3.0%), Sharp-tailed Sandpiper (2.1%) and Common Greenshank (2.6%) (Brett Lane and Associates Pty Ltd 2015). Curlew Sandpiper, which is also listed as Critically Endangered, occurred at 0.8%of the Australian population (Brett Lane and Associates Pty Ltd 2015). Data from Birdlife Australia (2013) indicates that in addition to these four species, Red Knots *Calidris canutus* and Eastern Curlews have also been recorded in numbers exceeding 1% of the Australian population. Impacts to this number of birds would represent a significant impact to these species. The referral survey report notes, however, that between the mid-1980s and 2013, the Gulf St Vincent suffered substantial declines in the populations of most migratory and resident shorebirds (Brett Lane and Associates Pty Ltd 2015).

The ponds that held the highest numbers of shorebirds were immediately north and south of St Kilda at the Chapman Creek Pumping Station (Brett Lane and Associates Pty Ltd 2015), more than 2km west of the Northern Connector route. The southern section of the salt-fields (Section 1: Dry Creek as it is described in that report), which is likely to be impacted by the current project, held very few ecological values and supported far fewer birds in terms of both abundance and diversity (Brett Lane and Associates Pty Ltd 2015). These crystallisation ponds (highly saline) provide little habitat for shorebirds or waterbirds and have been assessed as being low priority for shorebirds (Priority 4) within the Gulf St Vincent region (Purnell *et al.* 2012).

Migratory Wetland Species (Other birds)

The Northern Connector Project Corridor is likely to support a resident population of Eastern Great Egrets *Ardea alba* and a visiting population of Cattle Egrets *Ardea ibis*. There are a relatively large number of records of both species from within and adjacent to the Project Corridor (BirdLife Australia 2015; Department of Environment Water and Natural Resources 2015). Most of these records are of small numbers of individuals, although a record of 50 individual Eastern Great Egrets in 2014 at the St Kilda waterfront is notable (BirdLife Australia 2015). Despite this, both species are widespread and able to use a wide range of wetland habitats (Marchant and Higgins 1993), which are not limited within the landscape. On this basis it is not considered likely that there will be a significant impact on either of these species.

The Little Tern *Sterna albifrons sinensis* is an irregular visitor to the Project Corridor, with only six previous records documented. Like the Fairy Tern, this species is likely to forage over the wetlands, salt-fields and shallow bays of the eastern Gulf St Vincent. The Northern Connector Project is likely to displace foraging opportunities along its alignment and cause disturbance to the wider area during construction. Despite this, because of the lack of core habitat for this species, including breeding and roosting habitat, it is unlikely that the project will have a significant impact on this species.

Migratory Terrestrial Bird Species

Of the seven other birds identified as migratory species, only the Fork-tailed Swift *Apus pacificus* and White-throated Needletail *Hirundapus caudacutus* are likely to occur within the Project Corridor. Both species breed in Asia and migrate to Australia in summer (Higgins 1999). They are an almost entirely aerial species when in Australia, rarely coming to land, even sleeping on the wing (Higgins 1999). They forage aerially over a wide range of habitat types and when seen they are often in large numbers. There is an historic records of a flock of 81 birds within the Project Corridor from 2008 (Department of Environment Water and Natural Resources 2015), however it is not expected that the project will have any substantial impact on either of these species.

Table 3.4. Migratory fauna species known or predicted to occur within the Project Corridor.

Common Name	Scientific Name	EPBC Act Status	Broad Habitat Preferences [1]	Most Recent and Number of Previous Records (Max. Count)	Habitat Present	Likelihood of Occurrence within the Project Corridor [2]	Nationally Significant Impact Threshold [3]
Birds							
Wandering Albatross	*Diomedea exulans*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	1900 1 Record (1)	No	Unlikely	N/A
Antipodean Albatross	*Diomedea exulans antipodensis*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
Tristan Albatross	*Diomedea exulans exulans*	Endangered Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
Southern Royal Albatross	*Diomedea epomophora epomophora*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
Northern Royal Albatross	*Diomedea epomophora sandfordi*	Endangered Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
Black-browed Albatross	*Thalassarche melanophris melanophris*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
Campbell Albatross	*Thalassarche melanophris impavida*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
Shy Albatross	*Thalassarche cauta cauta*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
White-capped Albatross	*Thalassarche cauta steadi*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A
Sooty Albatross	*Phoebetria fusca*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	×	No	Unlikely	N/A

Common Name	Scientific Name	EPBC Act Status	Broad Habitat Preferences [1]	Most Recent and Number of Previous Records (Max. Count)	Habitat Present	Likelihood of Occurrence within the Project Corridor [2]	Nationally Significant Impact Threshold [3]
Southern Giant Petrel	*Macronectes giganteus*	Endangered Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	1983 4 Records (1)	No	Unlikely	N/A
Northern Giant Petrel	*Macronectes hallii*	Vulnerable Migratory Marine Bird	A non-breeding visitor, mostly to offshore waters. Largely pelagic in behaviour	x	No	Unlikely	N/A
Flesh-footed Shearwater	*Puffinus carneipes*	Migratory Marine Bird	Largely pelagic, returning to breeding colonies including one on southern tip of Eyre Peninsula	1988 2 Records (3)	No	Unlikely	N/A
Eastern Great Egret	*Ardea alba*	Migratory Wetlands Species	Floodwaters, rivers and shallows of wetlands, intertidal mud flats.	2015 688 Records (50)	Yes	High	N/A
Cattle Egret	*Ardea ibis*	Migratory Wetlands Species	Woodlands, grasslands and terrestrial wetlands. Regularly forage on low-lying, poorly drained pastures	2014 27 Records (14)	Yes	High	N/A
Osprey	*Pandion haliaetus*	Migratory Wetlands Species	Coastal areas, including wetlands and offshore islands	2000 5 Records (2)	Yes	Low	N/A
Ruddy Turnstone	*Arenaria interpres*	Migratory Wetlands Species	Tidal reefs and pools, mudflats	2006 73 Records (15)	Yes	High	*35*
Pacific Golden Plover	*Pluvialis fulva*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2007 60 Records (29)	Yes	High	*100*
Grey Plover	*Pluvialis squatarola*	Migratory Wetlands Species	Tidal mudflats and sandflats, beaches, saltmarsh, estuaries	2010 30 Records (35)	Yes	Moderate	*125*
Greater Sand Plover	*Charadrius leschenaultii*	Migratory Wetlands Species	Tidal mudflats and sandflats, beaches, saltmarsh, estuaries	1988 1 Records (1)	Yes	Moderate	*110*
Lesser Sand Plover	*Charadrius mongolus*	Migratory Wetlands Species	Tidal mudflats and sandflats, beaches, saltmarsh, estuaries	2007 8 Records (2)	Yes	Moderate	*140*
Double-banded Plover	*Charadrius bicinctus*	Migratory Wetlands Species	Winter visitor to fresh or saline wetlands beaches, saltmarsh, estuaries	x	Yes	Moderate	*50*

Common Name	Scientific Name	EPBC Act Status	Broad Habitat Preferences [1]	Most Recent and Number of Previous Records (Max. Count)	Habitat Present	Likelihood of Occurrence within the Project Corridor [2]	Nationally Significant Impact Threshold [3]
Oriental Plover	*Charadrius veredus*	Migratory Wetlands Species	Usually inland on open grasslands, although sometimes in low estuarine or littoral habitats	×	No	Low	*70*
Eastern Curlew	*Numenius madagascariensis*	Critically Endangered Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2006 154 Records (95)	Yes	High	*40*
Little Curlew	*Numenius minutus*	Migratory Wetlands Species	Short dry grasslands and sedgelands. Sometimes in open woodlands and coastal swamps	×	Yes	Low	*180*
Whimbrel	*Numenius phaeopus*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2010 99 Records (54)	Yes	High	*100*
Terek Sandpiper	*Xenus cinereus*	Migratory Wetlands Species	Tidal mudflats, saltmarshes, coastal swamps, estuaries.	2006 46 Records (6)	Yes	High	*60*
Wood Sandpiper	*Tringa glareola*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 182 Records (20)	Yes	High	*100*
Grey-tailed Tattler	*Heteroscelus brevipes*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2004 9 Records (1)	Yes	Moderate	*50*
Common Sandpiper	*Actitus hypoleucos*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 204 Records (17)	Yes	High	*25*
Broad-billed Sandpiper	*Limicola falcinellus*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	×	Yes	Moderate	*25*
Common Greenshank	*Tringa nebularia*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 228 Records (101)	No	Unlikely	*60*
Marsh Sandpiper	*Tringa stagnatilis*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 151 Records (41)	No	Unlikely	*100*

Common Name	Scientific Name	EPBC Act Status	Broad Habitat Preferences [1]	Most Recent and Number of Previous Records (Max. Count)	Habitat Present	Likelihood of Occurrence within the Project Corridor [2]	Nationally Significant Impact Threshold [3]
Common Redshank	*Tringa totanus*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins	×	Yes	Low	*75*
Bar-tailed Godwit	*Limosa lapponica*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins	2007 44 Records (15)	Yes	Moderate	*325*
Black-tailed Godwit	*Limosa limosa*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins	2013 100 Records (137)	Yes	High	*160*
Sharp-tailed Sandpiper	*Calidris acuminata*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 265 Records (600)	Yes	High	*160*
Sanderling	*Calidris alba*	Migratory Wetlands Species	Coastal. Open sandy beaches	2003 3 Records (6)	No	Low	*22*
Pectoral Sandpiper	*Calidris melanotus*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2014 80 Records (7)	Yes	High	N/A
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 277 Records (998)	Yes	High	*180*
Red-necked Stint	*Calidris ruficollis*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2015 216 Records (8000)	Yes	High	*325*
Long-toed Stint	*Calidris subminuta*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2014 73 Records (28)	Yes	High	*25*
Red Knot	*Calidris canutus*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2007 17 Records (1)	Yes	Moderate	*220*
Great Knot	*Calidris tenuirostris*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2007 10 Records (60)	Yes	Moderate	*375*
Ruff	*Philomachus pugnax*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river	2005 56 Records (2)	Yes	Moderate	N/A

Common Name	Scientific Name	EPBC Act Status	Broad Habitat Preferences [1]	Most Recent and Number of Previous Records (Max. Count)	Habitat Present	Likelihood of Occurrence within the Project Corridor [2]	Nationally Significant Impact Threshold [3]
			margins, coastal or inland				
Latham's Snipe	*Gallinago hardwickii*	Migratory Wetlands Species	Wet grasslands, open and wooded swamps.	2014 39 Records (3)	Yes	Moderate	*36*
Swinhoe's Snipe	*Gallinago megala*	Migratory Wetlands Species	Wet grasslands, open and wooded swamps.	×	No	Unlikely	*25*
Pin-tailed Snipe	*Gallinago stenura*	Migratory Wetlands Species	Wet grasslands, open and wooded swamps.	×	No	Unlikely	*25*
Red-necked Phalarope	*Phalaropus lobatus*	Migratory Wetlands Species	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	2001 7 Records (4)	Yes	Low	*100*
Little Tern	*Sternula albifrons sinensis*	Migratory Marine Bird	Coastal waters, bays, inlets, brackish lakes, sewerage ponds near coasts.	2006 6 Records (6)	Yes	Moderate	N/A
Orange-bellied Parrot	*Neophema chrysogaster*	Critically Endangered	Saltmarsh, coastal pastures	2006 3 Records (3)	Yes	Low	N/A
White-throated Needletail	*Hirundapus caudacutus*	Migratory Terrestrial Species	Aerial insectivore that rarely lands to perch, often sleeping on the wing	×	Yes	Moderate	N/A
Fork-tailed Swift	*Apus pacificus*	Migratory Marine Bird	Aerial insectivore that rarely lands to perch, often sleeping on the wing	2008 1 Record (81)	Yes	Moderate	N/A
Rainbow Bee-eater	*Merops ornatus*	Migratory Terrestrial Species	Open or lightly timbered areas, often near water	×	Yes	Low	N/A
Grey Wagtail	*Motacilla cinerea*	Migratory Terrestrial Species	Open areas with low vegetation including pastures and other modified grasslands	×	No	Unlikely	N/A
Yellow Wagtail	*Motacilla flava*	Migratory Terrestrial Species	Wetlands and watercourses, woodlands near water	×	Yes	Unlikely	N/A
Satin Flycatcher	*Myiagra cyanoleuca*	Migratory Terrestrial Species	Usually wet eucalypt forests or woodlands with open understorey	×	Yes	Low	N/A
Mammals							
Brydes Whale	*Balaenoptera edeni*	Migratory Marine	Pelagic	×	No	Unlikely	N/A

Common Name	Scientific Name	EPBC Act Status	Broad Habitat Preferences [1]	Most Recent and Number of Previous Records (Max. Count)	Habitat Present	Likelihood of Occurrence within the Project Corridor [2]	Nationally Significant Impact Threshold [3]
		Species					
Pygmy Right Whale	*Caperea marginata*	Migratory Marine Species	Pelagic	×	No	Unlikely	N/A
Southern Right Whale	*Eubalaena australis*	Endangered Migratory Marine Species	Pelagic	2006 9 Records (2)	No	Unlikely	N/A
Humpback Whale	*Megaptera novaeangliae*	Vulnerable Migratory Marine Species	Pelagic	1994 4 Records (2)	No	Unlikely	N/A
Dusky Dolphin	*Lagenorhynchus obscurus*	Migratory Marine Species	Pelagic	×	No	Unlikely	N/A
Reptiles							
Leathery Turtle	*Dermochelys coriacea*	Vulnerable Migratory Marine Species	Pelagic, some breed in Queensland	1996 1 Record (1)	No	Unlikely	N/A
Loggerhead Turtle	*Caretta caretta*	Endangered Migratory Marine Species	Pelagic	×	No	Unlikely	N/A
Green Turtle	*Chelonia mydas*	Vulnerable Migratory Marine Species	Pelagic	2008 2 Records (1)	No	Unlikely	N/A
Fish							
Great White Shark	*Carcharadon carcharias*	Vulnerable Migratory Marine Species	Pelagic	×	No	Unlikely	N/A
Porbeagle	*Lamna nasus*	Migratory Marine Species	Pelagic	×	No	Unlikely	N/A

Table notes

Data is derived from Biological Databases of South Australia (Department of Environment, Water and Natural Resources 2015) and covers an area comprising a 10km buffer of the Northern Connector Project Corridor. The data includes all threatened species records up to 2015, it also includes SA Museum records up to

2012 and BirdLife Australia data up to 2006. Additional data for the period from 2006 to the present was sourced from BirdLife Australia (2015) comprising a 10km buffer around the point -34.80177, 138.5766042, which is the location of the Little Para River Interchange approximately half way along the proposed Project Corridor. Species that have no previous records have modelled habitat within the search area based on the Protected Matters Search Tool (Department of the Environment 2015b).

[1] Habitat data drawn from: Cogger 2000; Higgins 1999; Higgins and Davies 1996; Higgins and Peter 2002; Higgins et al. 2006; Higgins et al. 2001; Marchant and Higgins 1990; Marchant and Higgins 1993; Menkhorst 2001; Pizzey and Knight 2012; Wilson and Swan 2010.

[2] Likelihood of occurrence definitions:

- *Unlikely* – Project Corridor does not contain habitat and/or it is outside the species' known, current distribution.
- *Low* –Project Corridor contains some marginal habitat, but the species was not observed and has not been recently recorded in previous surveys in the area.
- *Moderate* – Project Corridor contains preferred habitat that may support a population of the species. However, other factors, such as fragmentation, disturbance or predators may be impacting any local population.
- *High* - Project Corridor contains the preferred habitat which is likely to support the species.
- *Present* – Preferred habitat is present within the Project Corridor, and the species was observed within the Project Corridor, or recently recorded within the Project Corridor.

[3] Significant Impact Thresholds refer to *Migratory Shorebirds of the East Asian - Australasian Flyway; Population Estimates and Internationally Important Sites* (Bamford et al. 2008) which lists the estimated numbers of birds that comprise the flyway and presents the 1% thresholds for International Wetland significance to calculate 0.1% thresholds for a Nationally significant impact to those species. N/A means that this data is unavailable for this species.

Nature and extent of likely impact

The Significant Impact Guidelines for 36 Migratory Shorebird Species EPBC Act Policy Statement 3.21 (Department of the Environment Water Heritage and the Arts 2009) provides significance thresholds and defines 'important habitat' for a range of species that have been recorded within the Project Corridor.

Important habitat for migratory shorebirds is "defined as habitat that supports at least:

- 0.1 per cent of the flyway population of a single species;
- 2000 migratory shorebirds; or
- 15 shorebird species" (Department of the Environment Water Heritage and the Arts 2009, p. 10).

This criterion is unlikely to be met in Barker Inlet Wetlands or anywhere else within the proposed project corridor and historic data fails to support any claim to national importance. However, this wetland should not be taken in isolation. Instead "the entire (discrete) area of contiguous habitat used by the same group of migratory shorebirds, which may include multiple roosts and feeding areas" (Department of the Environment Water Heritage and the Arts 2009, p. 10) should be included. This means that the entire eastern Gulf St Vincent coast-line should be considered when classifying the wetlands within the study area. As discussed previously, the wetlands in and around St Kilda on the Ridley Dry Creek Pty Ltd Salt-fields, to the north of the wetlands within the Project Corridor and up to 2km west of its proposed alignment, are known to support more than 0.1% of the Australian population of at least three migratory wader species and regularly support more than 2000 shorebirds at any given time (Brett Lane and Associates Pty Ltd 2015). On this basis all the wetlands within the study area would be considered Nationally Important Habitat for migratory shorebirds.

Having determined that the site does provide important habitat for migratory species, consideration needs to be given to whether the level of degradation, disturbance and direct mortality associated with the proposed works will lead to a substantial reduction in shorebird numbers (Department of the Environment Water Heritage and the Arts 2009).

The greatest impact to shorebird habitat will occur in the south of the proposed alignment at the Barker Inlet North Wetlands. Other potential impacts to habitat are likely to occur at Little Para River and, to a lesser extent at Dry Creek. However, at a regional level, this impact is likely to be small. Table 3.5 summarises the vegetation communities that occur from Port Adelaide along the east coast of Gulf St Vincent to Port Wakefield and the percentage impact to each one as a result of the Northern Connector Project (Figure 8). Approximately 13Ha of the Barker Inlet Wetlands North will be impacted through wetland reconfiguration but this area will be revegetated and rehabilitated to create similar habitats to those removed.

Table 3.5. Approximate areas of vegetation communities and habitats in the region and the percent habitat loss through the project

Community or habitat type	Approximate regional habitat area (Ha)*	Approximate % of regional habitat loss
Open saltwater	5320	0.01%
Shallow saltwater	9660	0.02%
Intertidal samphire	3310	0.28%
Mangrove	3,590	0.10%
Open freshwater	670*	0.52%*
Shallow fresh water	126*	1.18%*
Supratidal samphire	5,490*	0.15%*
Sedgeland	12.33*	45.11%*
Reedbed	21*	5.14%*
Shrubland	2,020	0.32%
Woodland/Planted Woodland	450	6.25%

Table note: * Does not include all constructed wetlands in the region that are known to contain these vegetation communities and habitat types (e.g. salt ponds, Greenfields Wetlands Stage 1, 2 and part of 3, Barker Inlet South, and the Little Para wetlands) as the data was unavailable at the time of preparing the referral.

The disturbance associated with works in these areas is likely to lead to the dispersal of shorebirds away from these areas during construction. At this time these birds are likely to find other suitable habitat to the north of these impacts in Ridley Dry Creek Pty Ltd salt-fields and further afield along the Gulf St Vincent. These areas currently provide shorebird habitats of greatest importance to shorebirds in the region. They include the northern part of the salt-fields (around and north of St Kilda), Bolivar WWTP and the Port River estuary. None of these areas will be impacted by the proposed construction and operation of the transport corridors and they can be expected to operate as a refuge during construction. Other suitable habitat and potential refuge sites, for some species, closer to the Barker Inlet includes the Greenfields Stage 1, 2 and 3 and Barker Inlet South wetlands which will not be impacted by the project.

Restoration of the Barker Inlet North Wetlands post construction will enable some birds to return to these habitats, although the higher level of traffic may reduce the habitat quality for some species and individuals. This will minimise the long-term degradation of the wetlands in the medium term, although the restored habitats will be in a noisier environment with increased light pollution. A recent study on the western side of the Barker Inlet wetlands demonstrated that despite the increased traffic noise exposure at the bird survey sites, no obvious changes in the abundance and diversity of species were observed by KBR over the assessment period. This suggests that bird species using the survey sites have tolerated, or habituated to, the increased traffic noise exposure (AECOM Australia Pty Ltd 2009). Directional lighting and engineering solutions to reduce noise, such as lower noise road asphalts (e.g. Stone Mastic Asphalt), will be investigated in the design of the southern interchange.

Direct mortality is unlikely to occur as a result of the project. Shorebirds are mobile species that will vacate any area under construction. Shorebirds are rarely hit by motor vehicles because they tend to fly at low altitudes, close to foraging habitat.

It should be noted that the salt-fields are in the process of decommissioning, which is outside the control of the project. This is expected to reduce the extent and quality of large parts of the shorebird habitat within the region (Department of Environment Water and Natural Resources 2013). This may increase the significance of the wetlands that will be impacted by the Northern Connector Project. However the establishment of the proposed Adelaide International Bird Sanctuary and the implementation of the sanctuary management plans for the area that it covers, as well as the Barker Inlet will aim to mitigate these impacts (Department of Environment Water and Natural Resources 2013). In the short-term, the reduction in numbers of shorebirds reported by Brett Lane and Associates Pty Ltd (2015) across the eastern Gulf St Vincent, most likely due to habitat loss throughout its breeding range in Asia, suggests that these areas have the capacity to support a slight increase in the numbers of birds that are displaced because of the project.

It is therefore unlikely that the project will lead to a substantial reduction in the numbers of shorebirds within the important shorebird habitat covered by the Adelaide Bird Sanctuary. The project will impact only a very small proportion of medium to low quality habitat within the entire Sanctuary area. The ability for shorebirds to disperse to other areas during the disturbance and the rehabilitation of the Barker Inlet wetlands will mitigate any impacts to these species.

Likely impacts to migratory shorebirds

Loss of small areas of potential foraging habitat in Barker Inlet North, Little Para River and Dry Creek; temporary displacement and noise disturbance during construction activities; ongoing noise disturbance once the road is commissioned.

Likelihood of a significant impact to migratory shorebirds

On the basis that there is extensive, higher quality, habitat elsewhere within the region and that the provision of new wetlands designed for shorebird habitat and reconfiguration/rehabilitation of the Barker Inlet North

wetlands will mitigate long-term impacts; it is unlikely that there will be a significant impact on the population size or viability of any migratory shorebird species.

3.1 (f) Commonwealth marine area

Description

The proposed Northern Connector is not located within or near a Commonwealth Marine Area.

Nature and extent of likely impact

None

3.1 (g) Commonwealth land

Description

The nearest Commonwealth land is within 2km of the Northern Connector Project located at St Kilda (current land use antenna masts) and Dry Creek (current land use rail yards). The project will not impact upon either parcels of Commonwealth land.

Nature and extent of likely impact

None

3.1 (h) The Great Barrier Reef Marine Park

Description

The Northern Connector is not located within or near the Great Barrier Reef Marine Park or its catchments.

Nature and extent of likely impact

None

3.1 (i) A water resource, in relation to coal seam gas development and large coal mining development

Description

The Northern Connector Project is not a mine or coal seam gas development and will not have any impact on water resources.

Nature and extent of likely impact

None

3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

3.2 (a)	**Is the proposed action a nuclear action?**	✓	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment		

3.2 (b)	**Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?**	✓	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment		

3.2 (c)	**Is the proposed action to be taken in a Commonwealth marine area?**	✓	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))		

3.2 (d)	**Is the proposed action to be taken on Commonwealth land?**	✓	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))		

3.2 (e)	**Is the proposed action to be taken in the Great Barrier Reef Marine Park?**	✓	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))		

3.3 Other important features of the environment

3.3 (a) Flora and fauna

Flora

The Project Corridor is located within two bioregions: the Eyre and Yorke Block and the Flinders Lofty Block and within this area, the Project Corridor is predominantly in the Parham and Mallala associations. Only 3.2% of the original cover of native vegetation remains within the Mallala Association, whilst 53.5% remains within the Parham Association (Department of Environment and Heritage 2002). 1.8% and 9.4% of this vegetation respectively is conserved (Department of Environment and Heritage 2002).

The current landscape has been highly modified by intensive human land use, although some of the historical ecosystem features, such as dense mangrove forests, are still present. Extending from the Mount Lofty Ranges, westerly flowing rivers with riparian areas, ephemeral ponds and wetlands extend to floodplains, although the drainage patterns in the landscape now includes constructed wetlands, levee banks, drains and shallow, open water surfaces managed for commercial salt harvesting.

Within the Project Corridor, native vegetation, as defined by the *Native Vegetation Act*, consists of remnant vegetation and disturbed areas that have been naturally colonised by local native species. A total of 55 native flora species were recorded in the Northern Connector Project Corridor during the project vegetation assessment (EBS Ecology Pty Ltd 2015); a further 70 native species have been previously recorded in proximity to the project site (Department of Environment Water and Natural Resources 2015).

Remnant native vegetation within the landscape is still evident and reflects the formerly extensive coastal fringe vegetation, including vegetation communities such as mangrove forests, samphire and chenopod shrubland and open grassy woodlands.

The understorey condition of the River Red Gum creek lines has been highly modified by weed invasion, particularly exotic perennial grasses such as Kikuyu *Pennisetum clandestinum*, Rice Millet *Piptatherum miliaceum* and Mullumbimby Couch *Cyperus brevifolius*. Changes in the landscape ecology, especially altered drainage patterns and influences from roads and tracks, the creation of salt fields and loss of vegetation cover have all degraded the remnant vegetation.

Within the Project Corridor, the highest quality areas are the mangrove forests that fringe Gulf St Vincent that have persisted and colonised mudflat areas and that are not prone to extensive weed invasion.

A total of 12 vegetation associations (native and exotic) have previously been mapped in the Project Corridor, 7 of which represent native vegetation (EBS Ecology Pty Ltd 2015). Only one of these associations is listed as a threatened ecological community under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act) (discussed above) and none are on the provisional list of state threatened ecosystems (Department of Environment and Heritage 2002). Table 3.6 describes the 12 vegetation associations and approximate distribution within the Project Corridor.

Table 3.6 Vegetation associations in the Northern Connector Project Corridor

	Plant association	Vegetation type	Description	Location
1	Grey Mangrove *Avicennia marina* var. *resinifera* Low Open Forest	Remnant native vegetation	Mangroves on mudflats of delta environments on a firm muddy to clayey soil with tidal flows	North Arm Creek, Dry Creek
2	River Red Gum *Eucalyptus camaldulensis* var. *camaldulensis* Woodland over Low Closed Chenopod Shrubland *Maireana decalvans*, *M. brevifolia, M. aphylla, M. enchylaenoides*	Remnant native vegetation	Terrestrial woodland ecosystem	Bolivar
3	Planted woodland of *Eucalyptus* spp., wattle *Acacia* spp. including *Acacia pendula*, Paperbark *Melaleuca* spp., Sheoak *Allocasuarina verticillata* and *Casuarina cunninghamiana*, Old Man Saltbush *Atriplex nummularia* ssp. *nummularia*	Planted vegetation	Roadside amenity planting	Bolivar, Swan Alley, Little Para, Dry Creek, Perkins Drive to Whicker Rd, reserve parallel with Whicker Rd, north of Cormack Rd & Greenfields, Barker Inlet South
4	River Sheoak *Casuarina cunninghamiana* Low Closed Forest	Planted vegetation	Shrubland revegetation at constructed wetlands and roadside amenity planting	Grand Junction Road to Cormack Road
5	Cottonbush *Maireana aphylla* Low Chenopod Shrubland with scattered native grasses *Austrodanthonia* sp. *Austrostipa* sp and *Eragrostis* sp.	Remnant native vegetation	Dryland coastal zone ecosystem	Jobson Road
6	Samphire *Tecticornia blackiana* +/- *T. quinqueflora*, +/- T. *arbuscula*, +/- *Suaeda australis*, +/- *T. halocnemoides* +/- *T. pergranulata* Very Low Open Shrubland	Remnant native vegetation	Saltwater wetlands in delta environments on firm muddy to clayey soil; intertidal submergent samphire in tidal zones and supratidal emergent samphire on seasonally inundated flats, saline depressions, chenier ridges and dune rises	Barker Inlet, North Arm, Swan Alley, Little Para, Dry Creek, North Arm to Grand Trunkway, reserve parallel with Whicker Road
7	Nitre Bush *Nitraria billardierei*, Marsh Saltbush *Atriplex paludosa*, Ruby Saltbush *Enchylaena tomentosa* Open Shrubland	Remnant/ planted native vegetation	Terrestrial low open shrubland with scattered grasses	Barker Inlet
8	Common Reed *Phragmites australis* and Bulrush *Typha* sp.	Remnant/ planted/	Freshwater tall reedbed	Barker Inlet

	Plant association	Vegetation type	Description	Location
	Reedbeds	colonising native vegetation		
9	Flat-sedge *Cyperus vaginatus* / Water-buttons *Cotula coronopifolia* Sedgeland	Remnant/ planted/ colonising native vegetation	Freshwater low sedgeland on shorelines	Barker Inlet
10	River Red Gum *Eucalyptus camaldulensis* var. *camaldulensis* Open Woodland over exotic grasses	Planted vegetation	Revegetation area adjoining remnant native woodland	Swan Alley, Little Para
11	Planted Mixed Shrubland *Melaleuca brevifolia, M. halmaturorum, M. lanceolata, M. oraria, M. quinquinervia, M. styphelioides, Acacia notabilis, A. paradoxa, A. pycnantha, A. sophorae, A. victoriae A. stenophylla*	Planted vegetation	Shrubland revegetation at constructed wetlands	Barker Inlet
12	Exotic Grassland	Planted vegetation		Perkins Drive to Whicker Rd, reserve parallel with Whicker Rd, Grand Junction Road to Cormack Road, north of Cormack Road, Greenfields, Barker Inlet South, parallel with Grand Trunkway

Fauna

In addition to the information on nationally listed fauna species listed above, there are a number of state listed species (under the *National Parks and Wildlife Act 1972* (SA)) that are also found in the Project Corridor and the region. Further details of these species can be found in the Fauna Technical Report (Kellogg Brown & Root Pty Ltd 2011):
http://www.infrastructure.sa.gov.au/__data/assets/pdf_file/0003/70743/Northern_Connector_-_Technical_Report_-_Fauna_July_2011.PDF.

There are numerous fauna habitats available across the Project Corridor and across the region. A narrow band of relatively intact to entirely intact coastal vegetation extends from the southern section of the Project Corridor, north to Port Wakefield along Gulf St Vincent (Figure 8). The vegetation in this area is predominately a mixture of samphire and mangrove communities, with small areas of bare ground, shrubland and woodland vegetation, providing a number of habitats for fauna species. This region, especially the Barker Inlet to St Kilda coastal area, is particularly important for a range of avifauna, with more than 120 species recorded from both marine and terrestrial areas.

Parts of the Ridley Dry Creek Pty Ltd salt-fields, extending from Dry Creek to Middle Beach and the Port River estuary, have been identified as areas of international importance in South Australia for shorebirds (Watkins 1993). The salt-fields, ranked fourth in importance in South Australia, have two types of habitat:

- The concentration ponds north of Dry Creek along the coast to Middle beach adjacent to and north of the Project Corridor (the northern areas provide important habitat); and
- The crystallisation ponds at Dry Creek, which are of limited habitat value (Day 1997).

Wilson (2000) identified the Port River–Barker Inlet area as an important site for wading birds. Artificial wetlands, such as the salt ponds and Bolivar WWTP areas, are valued for supplying habitat for a variety of species, mainly waders and waterbirds. These areas are included in the boundary of the Barker Inlet and St Kilda Wetland of National Importance [SA005] (Department of the Environment 2015c) and will be included in the proposed national park that will encompass the Adelaide International Bird Sanctuary (Department of Environment Water and Natural Resources 2013). Bird surveys undertaken in the “Barker Inlet Area” by Port Adelaide Council between 2012 and 2015 have returned an average of 41 species per survey comprising 106 different species (City of Port Adelaide Enfield 2015).

Relatively large areas with conservation values close to the project site include:

- Little Para Estuary;
- Greenfields wetlands;
- Bolivar WWTP;
- The northern section of the Dry Creek salt-fields;
- Thompson Creek;
- Little Para Linear Park (Berkinshaw 2004; City of Port Adelaide Enfield 2007; Coleman and Cook 2009; Kellogg Brown & Root Pty Ltd 2004; Purnell *et al.* 2012).

Other areas in the wider region with important conservation values include:

- Buckland Park (grassland, chenopod shrubland);
- Buckland Park Lake (aquatic ecosystem);
- Gawler River — banks and western floodplain (River Red-gum and Black Box woodlands);
- Port Gawler Conservation Park (mangrove woodland and coastal shrublands);
- Samphire Coast region from Light Beach to Port Parham.

The Range wetland and Barker Inlet South wetlands are of lower value, but may still provide useful habitat for some avifauna, particularly aquatic species.

The terrestrial areas adjacent to most of the Project Corridor (including almost the entire Gillman region), Magazine Creek, Magazine wetland, the dryland areas around both sections of Barker Inlet wetlands and the salt ponds around Dry Creek have relatively low ecological value for fauna species because of historic and ongoing disturbance for agriculture and other development.

Further detail on fauna habitats available in the Project Corridor and the region is provided in the Fauna Technical Report (Kellogg Brown & Root Pty Ltd 2011).

3.3 (b) Hydrology, including water flows

The Project Corridor crosses several major waterways as listed below. All watercourses and flow paths within the Northern Connector Project Corridor flow into the Barker Inlet and eventually the Gulf St Vincent. Watercourses crossed by the Northern Connector corridor include:

- Helps Road Drain;
- Little Para River and overflow;
- Dry Creek Drain / Swan Alley Creek;
- North Arm Creek; and,
- Barker Inlet North Wetlands.

The Barker Inlet (North and South) Wetlands collect stormwater runoff from an urban/commercial/industrial catchment of approximately 48km^2, they were constructed in the 1990s with the following broad objectives:

- flood mitigation and water storage/retention capacity;
- water quality treatment of stormwater before it enters Gulf St Vincent; and
- to provide diverse habitat for threatened and non-threatened bird species and other fauna (Department for Transport Energy and Infrastructure 2011).

Stormwater flow from the Barker Inlet wetlands discharges into the North Arm Creek before flowing into Gulf St Vincent.

Sea walls are present in the south of the Project Corridor protecting the salt-fields at Dry Creek.

3.3 (c) Soil and Vegetation characteristics

In the Northern and Central sections of the Project Corridor, the near-surface geology comprises the Pleistocene aged Pooraka Formation, which is a deposit of alluvial origin over the Lower Alluvial Plain. It comprises red-brown to light brown sandy clays and clayey sands. Some calcareous silt is present in the unit. The thickness of the Pooraka Formation may show considerable variation, up to a maximum of approximately 6m. The clayey strata within the unit are typically stiff (Department for Transport Energy and Infrastructure 2011).

In the southern parts of the Project Corridor, the near surface geology comprises the Holocene aged St Kilda Formation, which is of marine and estuarine origin and confined to the Coastal Plain (Department for Transport Energy and Infrastructure 2011).

An identifiable soil profile is associated with both the St Kilda Formation and Pooraka Formation surficial geological units.

In the Northern and Central project sections, the soil profile is a red-brown earth type (RB6/RB7). which typically comprises brown loamy topsoil, over red-brown to brown, sandy clay soil with low carbonate content overlying light brown sandy clay, clayey sand and sand below 1–2m depth.

Along Little Para River and Dry Creek drain, the alluvial-type soil profile is poorly developed and typically comprises variable mixtures of brown clay, silt and sand.

In the southern parts of the Project Corridor, the soil profile is an estuarine muds and sands type, which typically comprises dark coloured clays, silts, sands and organic deposits in variable combinations and sequences.

Acid sulphate soils are also known to actually or potentially exist in the southern parts of the Project Corridor (Department for Transport Energy and Infrastructure 2011).

Vegetation characteristics of the Project Corridor are discussed in Section 3.3 (a).

3.3 (d) Outstanding natural features

There are no outstanding natural features within the Project Corridor, with the exception of the natural coastal and wetland environment within and beyond the Project Corridor. Specifically, the 'Barker Inlet and St Kilda' is a Wetland of National Importance, listed on the Directory of Important wetlands in Australia (Department of the Environment 2015c).

3.3 (e) Remnant native vegetation

Vegetation characteristics of the Project Corridor are discussed in Section 3.3 (a). Based on the current concept design, approximately 50Ha of native vegetation, as defined by the *Native Vegetation Act 1991* (SA), would need to be cleared for the construction of the project corridor (EBS Ecology Pty Ltd 2015). Detailed vegetation surveys and the final impact to native vegetation will be determined during the pre-construction/detailed design phase of the project. Approval under South Australia's *Native Vegetation Act 1991* will be required and sought for the project during the pre-construction phase. A Significant Environmental Benefit (SEB), which is required under the Act, will be achieved through a number of options including payment into the Native Vegetation Fund, protection of sites supporting native vegetation, revegetation and rehabilitation.

3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

The gradient of the area is predominantly flat, with the gradient estimated to be approximately 1 in 800. At the northern end, the natural surface elevation is at 9m AHD and at the southern end the natural surface elevation is 0.5m AHD. The flat gradient requires the majority of the road corridor to be elevated on fill to protect it from major flood and future sea level rise.

3.3 (g) Current state of the environment

Section 3.3 (a) provides details regarding the types of vegetation present within the Project Corridor and its overall condition.

The Project Corridor has been significantly developed and altered since European settlement. As a result, pre-European vegetation associations have either been removed or are reduced in extent, quality and viability. Land use within the Project Corridor is discussed in Section 3.3 (l).

Vegetation assessments undertaken for the project have identified that the condition of native vegetation in the area varies greatly, from very poor (e.g. degraded samphire areas) to excellent (e.g. remnant mangrove forest) (EBS Ecology Pty Ltd 2015).

A number of introduced weed species were recorded during the flora assessments, some declared under the *Natural Resources Management Act 2004* (SA) and considered to be serious environmental weed species. Weeds (declared, environmental and agricultural) and non-indigenous native plants are common and widespread across the Project Corridor, particularly along roadsides and in ornamental plantings. A range of introduced species have been planted for their visual amenity value, despite some species, such as Athel Pine *Tamarix aphylla*, being 'declared' species and serious environmental weeds.

3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

There are no Commonwealth Heritage Places within the project Corridor.

The Dry Creek Explosive Magazine and Earth Mounds are State Heritage listed and located approximately 250m to the east of the Northern Connector Project Corridor; however they will not be affected by the project.

3.3 (i) Indigenous heritage values

The Project Corridor is located in the native title claim area of the applicants, the Kaurna Peoples (SAD6001/00) and adjacent to the native title claim area of the native title applicants, the Ramindjeri peoples (SAD162/10).

A search of the Central Archive, including the Register of Aboriginal Sites and Objects and previous heritage assessments for the Project Corridor, indicated that there are a number registered and unregistered sites, objects or remains in the vicinity of the project corridor (Department for Transport Energy and Infrastructure 2011).

The design of the project has avoided all known Aboriginal sites where possible. A heritage survey of the Project Corridor will be undertaken to determine possible locations of other sites, objects and remains during the pre-construction phase of the project. However, in accordance with the *Aboriginal Heritage Act 1988* (SA), an authorisation will be sought under section 23 of the Act for the project to authorise damage, disturbance and interference with Aboriginal sites, objects and remains (as applicable) in the Project Corridor.

3.3 (j) Other important or unique values of the environment

Other important environmental values that are relevant to the area include:

- *Barker Inlet Aquatic Reserve:* The Aquatic Reserve was established for the conservation of mangrove and seagrass communities and for the protection of important nursery areas for recreational and commercial fish species. Part of the proposed Project Corridor is situated within the boundary of the Barker Inlet Aquatic Reserve (Figure 9) and will comprise a bridge structure that largely spans the Reserve to minimise the project footprint on the Reserve.
- *Barker Inlet and St Kilda Wetland*: This wetland is a Wetland of National Importance listed on the Directory of Important Wetlands in Australia (Department of the Environment 2015c). The directory is a collaboration between the Commonwealth Government and State and Territory nature conservation and government agencies to identify important wetlands in Australia, as well as providing important ecosystem information that helps define the significance of each of the wetlands (for example, the flora and fauna species that are dependent on the wetland habitat). Part of the proposed Project Corridor is situated within the boundary of the Barker Inlet section of this wetland (Figure 9).
- *Adelaide Dolphin Sanctuary:* The Dolphin Sanctuary was established through the *Adelaide Dolphin Sanctuary Act 2005* (SA) to provide long term protection for the population of Indo-Pacific Bottlenose Dolphins *Tursiops aduncus* and their habitat in the Port Adelaide River and Barker Inlet estuary area. If approval is required under other legislation for activities in the Sanctuary, the approving authority is required to refer the application to the Sanctuary Minister for comment. Part of the proposed Project Corridor is situated within the boundary of the Adelaide Dolphin Sanctuary (Figure 9) and will comprise a bridge structure that largely spans the Reserve to minimise the project footprint on the Sanctuary.
- *Adelaide International Bird Sanctuary:* In 2014, the South Australian Government committed to the creation of a conservation area to protect the habitat of migratory shorebirds along the eastern coastal fringe of Gulf St Vincent (Department of Environment Water and Natural Resources 2013). The proposed sanctuary stretches from Barker Inlet to Parham, along approximately 60km of the Gulf St Vincent coast.

Approximately 1 km of the Project Corridor is situated within the provisional boundary of the Bird Sanctuary (Figure 9), at its southernmost extent. It is proposed that most of the Crown land within the sanctuary will be proclaimed a National Park by mid-2018. However, whilst the route of the Northern Connector will cross land intended for inclusion of the Bird Sanctuary, the subject land will not be included in the National Park component. The process for developing management plans for the Bird Sanctuary has recently started. It is likely that the Northern Connector Project will commence prior to the completion of the Bird Sanctuary's management plan, and it is proposed that it will accommodate the construction and continued operation of the Northern Connector.

3.3 (k) Tenure of the action area (e.g. freehold, leasehold)

All properties are located within the Hundred of Port Adelaide with the tenure of the land including freehold, lease hold and Crown land. Approximately 40% of the land required for the Northern Connector is in the ownership of local and state or Ridley Corporation. The remaining land required for the project is held in private ownership.

3.3 (l) Existing land / marine uses of area

Major existing land uses within the Project Corridor include:

Southern Section	Central Section	Northern Section
Industrial businesses	Wastewater treatment	Wastewater treatment
Commercial businesses	Residential	Horticultural
Conservation	Horticultural	Rural living/Residential
Stormwater wetlands	Commercial businesses	Agriculture
Salt-fields	Vacant Land	
Horse agistment		
Residential		
Vacant land		

3.3 (m) Any proposed land / marine uses of area

Upon completion the proposed land use will be a road corridor, with associated infrastructure. A number of properties will be acquired for the project and surplus land will likely be disposed of at the completion of the project.

4 Environmental outcomes

By the completion of the project, the following positive environmental outcomes are expected to occur as a result of the Northern Connector Project:

1. No net-loss to the extent of shorebird habitat directly affected by the project. DPTI will continue to work in collaboration with DEWNR to identify opportunities for the creation of shorebird habitat, including in any replacement wetland developed as part of the project.
2. Rehabilitation and restoration of the remaining areas of the Barker Inlet North wetland. The restoration of these wetlands will enable some of the species displaced by the Northern Connector to return to habitats previously occupied.

Management plans, including defined monitoring of the effectiveness of management techniques, will be developed for these outcomes.

5 Measures to avoid or reduce impacts

The Northern Connector must balance the requirements of traffic demands associated with national and regional economic drivers with the potential impact on environmental values including Matters of National Environmental Significance.

During the planning phase of the project a range of ecological surveys were undertaken to determine impacts to ecological values within the proposed corridor and surrounding areas to determine the best route for the project. These surveys are summarised in Northern Connector Project Review of Fauna Surveys prepared by Ecolink Consulting Pty Ltd (2015). The locations of targeted avifauna field assessments undertaken between 2008 and 2011 are shown in Figure 7.

Significant impacts to Matters of National Environmental Significance, and flora and fauna in general, within the project area have been avoided and minimised through a route selection process and then fine scale refinement of the proposed route. This process is outlined in Section 2.2. As result of this design intent there will be no significant impact on any Matter of National Environmental Significance in accordance with the relevant Commonwealth Significant Impact Guidelines, specifically:

- avoidance of the higher quality, more significant habitat that occurs elsewhere within the region (including the northern part of the Ridley Dry Creek Pty Ltd salt-fields (around and north of St Kilda), Greenfields Stage 3 wetlands, Bolivar WWTP and the Port River estuary). The majority of the Project Corridor is to the east of the proposed Adelaide International Bird Sanctuary (AIBS) boundary
- limited impact on only a small proportion of the regional habitat for threatened birds and migratory species. The Project Corridor will affect only 0.4% of the proposed AIBS area at the southernmost extent
- reconfiguration and rehabilitation of the affected areas within the Barker Inlet North wetlands
- commitment to protect and create additional shorebird habitat in any replacement wetland that may be developed as part of the project.

Environmental management during construction

This section outlines how any residual environmental impacts will be managed during construction.

DPTI is currently developing a specification for the design and construction of the Northern Connector Project. DPTI's master specification, Parts G50 and CH50, identifies standard environmental management systems and environmental protection requirements placed on contractors (this document can be found at: http://www.dpti.sa.gov.au/contractor_documents/specifications_-_division_CH).

The specification requires the Construction Contractor to develop and implement a Contractor's Environmental Management Plan (CEMP) in line with the DPTI's relevant Guidelines. This will include:

- the requirements for environmental management during the planning, design, construction and operation of the project
- roles and responsibilities
- environmental controls and limits to ensure identified environmental objectives and targets are met
- environmental inspections and audit requirements
- environmental monitoring.

The CEMP will include management measures that specifically relate to Matters of National Environmental Significance. A summary of these is provided in Table 5.1.

Table 5.1: Matters of National Environmental Significance and EMP controls

EPBC Act MNES	EMP measure	Timeframe
Subtropical and Temperate Coastal Saltmarsh vegetation community	While an impact assessment for this vegetation community is not required for determination of this Referral. Where possible, impacts to this community will be minimised and mitigated in the detailed design phase of the project.	Design/ construction
Listed threatened flora species	If the additional surveys for the Bead Glasswort detect the species within the project alignment, a detailed management plan will be developed for implementation during construction. In addition to standard flora protection measures as outlined in Table 23.1 of the Northern Connector PIR, a range of specific management strategies will be developed. These will be depend on the number of plants recorded, their location and the likely impacts, however, management strategies may include: • translocation of impacted individuals to suitable habitat nearby • collection of vegetative material / seed for incorporation into suitable revegetation areas; and/or • suitable threat management activities within nearby populations (such as weed control).	Construction / operation
	All vegetation clearance will be either approved by the Native Vegetation Council (where required) or approved under the internal DPTI vegetation clearance approval process. All of the project's Significant Environmental Benefit (SEB), as defined in the *Native Vegetation Act 1991* (SA), must be permanent: identified and committed to in perpetuity. This process will result in an overall increase in vegetation and habitat that is secure from disturbance in the long term. DPTI will work with the Department of Environment, Water and Natural Resources to determine the best means to achieve a SEB. DPTI will continue to engage with the Department of Environment, Water and Natural Resources to utilise the payment into the Native Vegetation Fund to contribute to priority actions for the management plans currently being prepared for the Adelaide International Bird Sanctuary.	Construction / operation
	Any areas that are considered to be 'high' value (including native vegetation), that do not require removal for construction, shall be protected by bunting prior to commencing works. The location of these areas will be included an Environmentally Sensitive Areas plan for construction.	Construction
Listed threatened birds and migratory species	<u>Barker Inlet North Wetland reconfiguration and rehabilitation</u> To enable the construction phase of the Northern Connector southern interchange, the Barker Inlet North wetlands will require modification/reconfiguration to enable the wetland to continue to efficiently operate in relation to flood storage, water quality perspective and ecological function. These works may occur outside of the	Construction / operation

	Project Corridor. Habitat areas for shorebirds will also be provided in this design. A preliminary concept design is provided in Figure 11. The detailed wetland design will be developed in consultation with the City of Port Adelaide Enfield, City of Salisbury, government agencies and other interest groups. Restoration of this wetland will minimise long-term impacts to this area of shorebird habitat. The concept design involves: • site clearance • the installation of culverts to provide connection between isolated areas of the wetland – these structures will also serve as habitat connections to fragmented areas of the wetland • construction of bridges and/or bridges • reconfiguration of the existing waterways – with the opportunity to create island habitats • rehabilitation of the modified wetland areas • Revegetation of wetlands that allow for bare ground and low plantings (<2m) to ensure habitat is suitable for shorebirds. To minimise the disturbance to foraging shorebirds these wetlands will be designed so that small islands constructed for bird resting/roosting are located at the greatest distance possible from elevated roadways or overpasses. In addition, shallow water areas and constructed roost sites along pond edges will be placed at the maximum distance possible from elevated roadways or overpasses to minimise disturbance from the Northern Connector once it is in operation.	
	<u>Replacement wetland</u> The primary function of the Barker Inlet North wetlands is to provide flood storage for a large upstream catchment. The replacement wetland, however, will be designed to replicate and enhance shorebird habitat. These wetlands will be created as early as possible in the construction process to provide refuges for shorebirds during the construction phase of the project. These works may occur outside of the Project Corridor. It is anticipated that the size of this wetland would be sized to ensure no net loss of wetland area. Tidal flows will be used to alternately expose and inundate mud flats, which supplies feeding habitat for a wide range of waterbirds and shorebirds. The design intent of the replacement wetland areas includes a range of different intertidal habitats. Broadly, these will be designed to include areas of mangrove forest, samphire vegetation, bare soil and mudflats, channels conveying flows into and out of the various areas, and deeper pools retaining water at all times.	Construction / operation
	<u>Mangrove/Samphire retreat zones</u> DPTI propose to investigate the feasibility of mangrove/samphire retreat zones adjacent to the Project Corridor to form part of the project's Significant Environmental Benefit required under South Australia's Native Vegetation Act 1991 and as such will be permanent offsets identified and committed to in perpetuity.	Construction / operation
	Fauna inspection of the construction area shall be undertaken before vegetation clearance with the aid of a suitably qualified person. Any fauna located within the construction area shall be either relocated (to an appropriate location) or dealt with in accordance with appropriate permits or approvals or the recommendations made by the qualified persons.	Construction

	Directional lighting will be provided at interchanges to minimise the potential for bird strike and reduce spread light spill into adjacent habitat areas.	Construction / operation
Indirect impacts - hydrology	With the exception of the Barker Inlet North wetlands, which will require reconfiguration, the remaining water crossings, may require bridge and culvert structures to allow stormwater and tidal flows to continue either side of the Northern Connector Project. Hydrological modelling will be undertaken in the detailed design phase where appropriate sizing of these structures will be determined.	Detailed design/ Construction
Indirect impacts - Acid Sulphate Soils	As part of its CEMP, the Construction Contractor shall develop, implement and maintain an Acid Sulphate Soils Management Plan. It shall be developed in accordance with EPA Guideline: Site Contamination - Acid Sulphate Soils. The management plan would include as a minimum, proposed management strategies, monitoring requirements and verification testing requirements.	Construction

Monitoring

The environmental outcomes and management measures outlined above will require performance measures for determining if the desired outcomes are on track.

A monitoring program, including defined monitoring of the effectiveness of management techniques, will be developed and implemented to monitor the performance measures.

6 Conclusion on the likelihood of significant impacts

6.1 Do you THINK your proposed action is a controlled action?

✓	No, complete section 5.2
	Yes, complete section 5.3

6.2 Proposed action IS NOT a controlled action.

Significant impacts were considered for the following Matters of National Environmental Significance on the basis that they are likely to occur within the Project Corridor on a resident or regular basis and that they rely on the resources and habitats that occur within the Project Corridor:

- Bead Glasswort *Tecticornia flabelliformis* (vulnerable);
- Australasian Bittern *Botaurus poiciloptilus* (endangered);
- Australian Painted Snipe *Rostratula australis* (vulnerable);
- Eastern Curlew *Numenius madagascariensis* (critically endangered);
- Curlew Sandpiper *Calidris ferruginea* (critically endangered);
- Fairy Tern *Sternula nereis nereis* (vulnerable);
- Slender-billed Thornbill (Gulf St Vincent) *Acanthiza iredalei rosinae* (vulnerable);
- Grey-headed Flying-fox *Pteropus poliocephalus* (vulnerable); and,
- 29 shorebird species and three other wetland dependent listed as migratory under the EPBC Act.

None of the remaining seven Matters of National Environmental Significance are relevant to the Northern Connector Project.

A detailed review of the types and extents of the likely impacts to these Matters of National Environmental Significance is included in section 3.1(d) and 3.1(e). In relation to threatened and migratory species, these sections conclude that on the basis that the Project Corridor provides only a small proportion of the regional habitat for these species, the project is likely to impact an even smaller amount of these habitats and that field assessments and a review of historical data demonstrates that higher quality, more significant habitat for these species occurs elsewhere within the region (including the northern part of the Ridley Dry Creek Pty Ltd salt-fields (around and north of St Kilda), Bolivar WWTP ponds and the Port River estuary). None of these areas will be impacted by the project and they can be expected to operate as a refuge during construction. Other suitable habitat and potential refuge sites closer to the Barker Inlet includes the constructed Greenfields Stage 1, 2 and 3 and Barker Inlet South wetlands.

Furthermore, rehabilitation and reconfiguration of the Barker Inlet North wetlands (including any other associated replacement wetland) will allow species to return to the these areas once construction is complete. This will mitigate any long term impacts. It is therefore unlikely that the impact to any of these species will reach thresholds to be considered 'significant'.

The field assessment and a review of the habitat requirements of remaining three threatened ecological communities, 18 threatened flora species, 38 threatened fauna species and 11 migratory species that have either previously been recorded within the 5km of the Project Corridor, or are predicted to occur within that area, demonstrate that none of these species are likely to occur within the Project Corridor on anything but an irregular or vagrant basis and are unlikely to be impacted by the Northern Connector Project.

On this basis, the proposed Northern Connector Project is not a controlled action.

6.3 Proposed action IS a controlled action

	Matters likely to be impacted
	World Heritage values (sections 12 and 15A)
	National Heritage places (sections 15B and 15C)
	Wetlands of international importance (sections 16 and 17B)
	Listed threatened species and communities (sections 18 and 18A)
	Listed migratory species (sections 20 and 20A)
	Protection of the environment from nuclear actions (sections 21 and 22A)
	Commonwealth marine environment (sections 23 and 24A)
	Great Barrier Reef Marine Park (sections 24B and 24C)
	A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
	Protection of the environment from Commonwealth actions (section 28)
	Commonwealth Heritage places overseas (sections 27B and 27C)

7 Environmental record of the responsible party

		Yes	No
7.1	**Does the party taking the action have a satisfactory record of responsible environmental management?** **Provide details** DPTI has an environmental management system for Road, Rail and Marine projects and operates under various environment-related policies and procedures and a planning framework to ensure that environmental aspects are managed on each project. The Contractor will be required to develop a Contractor's Environmental Management Plan (CEMP) in response to the contract specifications developed by DPTI. The actions undertaken by contractors are audited regularly. All Departmental contractors must comply with the relevant environmental legislation and Departmental Environmental Code of Practice for Construction. DPTI's Prequalification Scheme for Roadworks and Bridgeworks requires the contractors to have an Environmental Management System (EMS) in accordance with specifications and requirements of AS/NZS 14001.	✓	
7.2	**Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever 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?** **If yes, provide details**		✓
7.3	**If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?** **If yes, provide details of environmental policy and planning framework** DPTI is not a corporation. However, DPTI will ensure that the action will be undertaken in accordance with the Environmental Management requirements (forming part of the construction Contract), and relevant environmental policies and guidelines as discussed above.	✓	
7.4	**Provide name of proposal and EPBC reference number (if known)** • Mt Compass Overtaking Lane (Northbound) (EPBC Ref 2007/3457) • Rapid Bay Jetty (EPBC Ref 2007/3468) • Sturt Highway Duplication – Seppeltsfield Road to Greenock Road (EPBC Ref 2008/4502) • Coast to Coast Light Rail Stage 2 – City West to Adelaide Entertainment Centre (EPBC Ref 2008/4679) • Wolseley to Kalangadoo Rail Upgrade 2009 (EPBC Ref 2009/5078) • Noarlunga to Seaford Rail Extension (EPBC Ref 2009/5118) • Adelaide to Gawler Central Station Upgrade & Revitalisation of Existing Rail Line (EPBC Ref 2010/5342) • Repairs to Gawler Island Causeway, Victor Harbour, South Australia (EPBC Ref2010/5938) • Extending and widening of the O'Bahn City Access bus route (EPBC Ref 2010/5542) • Southern Expressway Duplication Project (EPBC Ref 2011/6111)		

8 Information sources and attachments

(For the information provided above)

8.1 References

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8.2 Reliability and date of information

The information in this referral was summarised from the references listed above and cited within the text. The reliability of these data has not been verified by the authors; however databases that provide species records including the Biological Database of South Australia and BirdLife Australia Atlas Data undergo a vetting process before being included.

In addition, field assessments were undertaken in conjunction with the Northern Connector Technical Report Flora (EBS Ecology Pty Ltd 2015) and Northern Connector Technical Report Fauna (Kellogg Brown & Root Pty Ltd 2011) in 2010 and 2011. These assessments verified data from the desktop analyses and provided assessments of the current ecological values of the Project Corridor. Methods for these assessments are detailed in each of these reports.

8.3 Attachments

		✓ attached	Title of attachment(s)
You must attach	figures, maps or aerial photographs showing the project locality (section 1)	✓	Figures 1-4c Figures 5-6f Figures 7-11
	GIS file delineating the boundary of the referral area (section 1)		Northern Connector GIS data
	figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3)	✓	Figures 1-4c Figures 5-6f Figures 7-11
If relevant, attach	copies of any state or local government approvals and consent conditions (section 2.5)	Not applicable	
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)	Not applicable	
	copies of any flora and fauna investigations and surveys (section 3)	✓	Northern Connector Technical Report Flora
			Fauna – refer to link provided in Section 3.3(a)
	technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4)	✓	Northern Connector Project Review of Fauna Surveys
	report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)		Refer to link provided in section 2.6.

9 Contacts, signatures and declarations

Project title: Northern Connector

9.1 Person proposing to take action

1. Name and Title:	George Panagopoulos, Project Manager, Northern Connector
2. Organisation:	Department of Planning, Transport and Infrastructure
3. EPBC Referral Number:	NA
4: ACN / ABN :	92 366 288 135
5. Postal address	77 Grenfell Street, Adelaide
6. Telephone:	1300 916 221
7. Email:	DPTI.NorthernConnector@sa.gov.au
8. Name of designated proponent (if not the same person at item 1 above:	Not applicable
9. ACN/ABN of designated proponent (if not the same person named at item 1 above):	Not applicable
I qualify for exemption from fees under section 520(4C)(e)(v) of the EPBC Act because I am:	Not applicable
If you are small business entity you must provide the Date/Income Year that you became a small business entity:	Not applicable
I would like to apply for a waiver of full or partial fees under Schedule 1, 5.21A of the EPBC Regulations. Under sub regulation 5.21A(5), you must include information about the applicant (if not you) the grounds on which the waiver is sought and the reasons why it should be made:	Not applicable
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence. I agree to be the proponent for this action. I declare that I am not taking the action on behalf of or for the benefit of any other person or entity.
Signature	Date 18/11/2015

9.2 Person preparing the referral information (if different from 8.1)

Not applicable