



# CHAPTER 13

## TERRESTRIAL FLORA AND FAUNA



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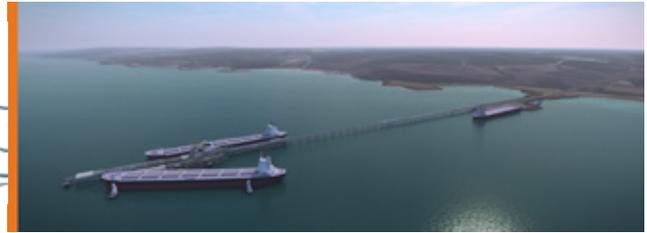
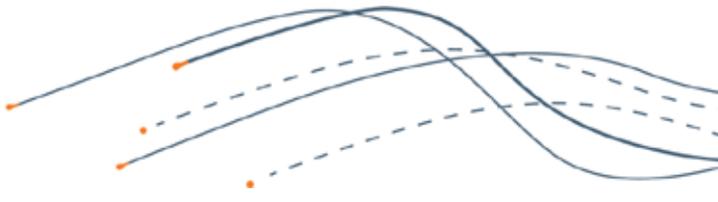
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## 13 Terrestrial Flora and Fauna

This chapter describes the existing ecological values of the proposed CEIP Infrastructure locations and the potential impacts and risks to habitat quality, native vegetation and fauna communities. Outcomes of desktop and field assessments are summarised and information is presented regarding design modifications and management measures to reduce impacts where relevant. This chapter also provides the outcomes of an assessment of the effectiveness of the mitigation measures and the residual impacts of the proposed CEIP infrastructure on plant and animal communities, with a particular focus on listed species, migratory species and species protected under conservation legislation.

The proposed port facility and infrastructure corridor occur within a region which supports diverse landscapes and habitats (e.g. ranging from Mallee woodlands to coastal shrublands); however, habitat clearance and fragmentation are widespread on the Eyre Peninsula and represent ongoing threatening processes to native flora and fauna in the region (see Figure 13-1). Degradation has occurred historically as a result of the significant clearance of native vegetation for agriculture and grazing. Subsequent weed infestations and pest vertebrate presence throughout the agricultural land and within some remnant vegetation patches have further degraded available habitat for native flora and fauna. Along the proposed infrastructure corridor, vegetation cover is patchy and there is a broad transition from semi-arid to arid plant and animal species. The condition of the habitat varies along the infrastructure corridor, where smaller vegetation patches are generally subject to greater impacts from weeds and pests, and some larger patches support higher quality vegetation, often on dune crests and in road or rail reserves. The infrastructure corridor avoids one of the key biodiversity values of the Eyre Peninsula region; the Central-Northwest Linkage Large Remnant Area (LRA). This LRA primarily includes remnant vegetation in conservation reserves such as Hambidge Wilderness Protection Area (WPA), Hincks WPA and Conservation Park (CP) and Bascombe Well CP. The infrastructure corridor also avoids key Threatened Habitat Areas (THA) (see Figure 13-2).

### 13.1 Applicable Legislation and Standards

Threatened flora and fauna species and some vegetation communities (as indicated by legislatively established Conservation Status) within South Australia are protected both at the Commonwealth and State levels. Additionally, all native vegetation and some birds which are migratory or inhabit or utilise terrestrial, marine and wetland environments are also afforded legislative protection under Commonwealth legislation that gives effect to international treaties. The applicable legislation relating to terrestrial flora and fauna within South Australia is as follows:

#### Commonwealth Legislation

*Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)*

This Act prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas. Under the environmental provisions of the EPBC Act, actions that are likely to have a 'significant impact' on a matter of National Environmental Significance require assessment and approval by the Commonwealth Environment Minister. There are nine matters of National Environmental Significance identified under the EPBC Act; of relevance to terrestrial and coastal flora and fauna are:

- Wetlands of international importance (listed under Ramsar Convention)
- Threatened species and ecological communities
- Migratory species as listed under international agreements

### South Australian Legislation

#### *National Parks and Wildlife Act, 1972 (Schedules 7, 8 and 9 of the Act) (NPW Act)*

This Act provides for the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters) and provides for the use of wildlife through a system of permits allowing certain actions, i.e. keeping, selling, trading, harvesting, farming, hunting and the destruction of native species.

This Act also assigns species to state conservation categories; Endangered (Schedule 7), Vulnerable (Schedule) 8, and Rare (Schedule 9).

#### *Natural Resource Management Act, 2004 (NRM Act)*

This Act is to assist in the achievement of ecologically sustainable development in the State by establishing an integrated scheme to promote the use and management of natural resources that recognises and protects the intrinsic value of natural resources. The Act combines critical elements of the now repealed *Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986*, the *Soil Conservation and Land Care Act 1989* and the *Water Resources Act 1997*.

#### *Native Vegetation Act, 1991 (NV Act)*

This Act controls the clearance of native vegetation within South Australia and provides incentives and assistance to landowners and proponents in relation to the preservation and enhancement of native vegetation. Broad objectives include:

- The conservation, protection and enhancement of the native vegetation of the State, and in particular, remnant native vegetation, in order to prevent further reduction of biological diversity and degradation of the land and its soil, loss of quantity and quality of state vegetation and loss of critical habitat
- Provision of incentives and assistance to landowners for preservation and management of vegetation
- Limitations on clearance of native vegetation
- Encouragement of research into protection and management of vegetation
- Encouragement of re-establishment of native vegetation in areas where vegetation has been cleared or is degraded.

The NV Act also sets out principles of clearance, and if permitted, details conditions and requirements for a Significant Environmental Benefit (SEB) to be made to counter the loss of habitat and impacts to biodiversity.

For more detail about the application of these Acts, refer to Chapter 5 of the Environmental Impact Statement which examines the Statutory Framework for the project in detail.

## 13.2 Assessment Method

The assessment methods for the proposed CEIP Infrastructure are provided under separate headings below for each of the project components.

### 13.2.1 Infrastructure Corridor

The ecological study of the infrastructure corridor involved a staged assessment of approximately 200 km of alignment options from the proposed port site to the proposed mine site during both December 2011 and November 2012 before the final route was established. Each vegetation patch within or intersected by the infrastructure corridor (including those assessed on previous alignment options) was given a unique numerical identifier and captured in a GIS data layer as a polygon for future analysis. Ecological studies involved both desktop review of flora and fauna records, as well as rapid field survey to determine vegetation type and habitat condition. The results of the studies were used to inform the design process, determine habitat conditions and therefore appropriate Significant Environmental Benefit (SEB) offset requirements, and to assess the potential for conservation significant flora and fauna to be present. The data was used to determine likely and potential impacts to ecological values as a result of the project, and to develop mitigation measures that may be required. Brief details on these methods are provided below.

#### Desktop Review

The desktop review involved evaluation of the following:

- Relevant literature
- General distribution ecology texts
- Species specific government fact sheets (e.g. species profiles (SPRAT) from the DotE)
- Published biodiversity plans, recovery plans and regional ecological surveys (e.g. Biodiversity Plan for Eyre Peninsula, Draft Recovery Plan for 23 threatened flora taxa on EP, Bush Condition Monitoring Manual for the EP, Biological Survey of the EP; EP Coastal Action Plan) (DEH 2002; Pobke 2007; Milne et al. 2008; Brandle 2010 and Caton et al. 2011)
- Spatial data
- Modelled species distributions in the EPBC Act Protected Matters Search Tool (PMST)
- Historic records from the Biological Database South Australia (BDBSA)
- Regional spatial information (e.g. DEWNR vegetation mapping, IBRA regions, DEWNR vegetation statistics, conservations reserves and parks locations and aerial imagery)

The EPBC Act PMST identifies protected species that may occur in the area as well as potential pests and weed species, including Weeds of National Significance (WoNS). The PMST review incorporated a buffer of 5 km from the centreline of the proposed infrastructure corridor, including the borefield and transmission line. Search results are discussed in the Corridor Terrestrial Ecology Assessment (Appendix O) and results are summarised below in Section 13.3.2.

BDBSA searches incorporated the entire infrastructure corridor with buffers of 5 km from the centreline of the proposed corridor, including the borefield and transmission line. Search results are provided in the Corridor Terrestrial Ecology Assessment (Appendix O) and summarised below in Section 13.3.2. Reference to regional records within wider search areas are made where there is a paucity of information for a particular species.

## Field Survey

Field surveys were undertaken in both December 2011 and November 2012 as the alignment of the infrastructure corridor was being developed. The field surveys were undertaken to establish the environmental values present, such as vegetation type and condition, threatened communities, threatened or listed species or suitable habitat to support such species.

The field surveys involved the following tasks:

- Each vegetation patch within (or intersected by) the infrastructure corridor, including those assessed on previous alignment options, was given a unique numerical identifier and captured in a GIS data layer as a polygon for future analysis.
- A rapid assessment of native vegetation patches intersected by the proposed infrastructure corridor (and options) was undertaken on private land (where approval was provided by the landowners) and within vegetation along publicly accessible road corridors. Broad vegetation characterisation and condition assessment for all accessible patches was undertaken.
- Identification of potential 'hot spots' e.g. habitat for EPBC listed species and NPW Act listed species.
- Assignment of 'condition' ratings for vegetation patches as a basis for determining Significant Environmental Benefit (SEB) offsets (as a requirement of the Native Vegetation Act) and assessing potential regional impact (see below).

## Condition

Condition of the vegetation within the infrastructure corridor, including borefield and transmission line was assessed in the field as part of the surveys mentioned above. A number of patches were not assessed in the field because they were either inaccessible during the time of the surveys (i.e. landowner permission had not been granted) or incorporated into the final footprint after the timing of the initial surveys. The condition of these remaining native vegetation patches has been inferred based on proximity and knowledge of assessed patches, a review of aerial imagery and the apparent vegetation density, the size and contiguity of patch, surrounding land use and the DEWNR vegetation layer (DEWNR 2011). Given the assessment method for these patches, a conservative approach was taken where condition of patches was generally overestimated.

A key component of this assessment was the determination of vegetation condition and the assignment of a "significant environmental benefit" (SEB) ratio to calculate the overall requirement for an environmental offset (as per the *Native Vegetation Act, 1991*) to compensate for the clearance of native vegetation habitat as a result of the project. Habitat condition of remnant native vegetation patches was derived from criteria outlined by DWLBC (2005) (Table 1). Condition categories are presented in Section 13.3.2; where 10:1 represents excellent condition, 8:1 is good, 6:1 is moderate, 4:1 is poor and 2:1 is very poor. Further details of the proposed SEB for the project are provided below in Section 13.5.2.

### 13.2.2 Port Site

A detailed baseline study of the terrestrial flora, fauna and ecological communities on the land of the port site was undertaken in November 2011 (SKM 2014) and is presented in Appendix P. The study involved both a desktop review and field survey.

## Desktop Review

The desktop review process was the same as was undertaken for the infrastructure corridor, with the exception of the buffer used for the EPBC PMST search and the BDBSA search. Both searches incorporated the area of the proposed port land owned by Iron Road and a buffer of 1 km. Full search results are presented in the technical report (Appendix P). Reference to regional records within wider search areas, or records within 5 km, are made where there is a paucity of information for a particular species that are considered more likely to occur in the area, based on known habitat preferences.

## Flora and Fauna Field Survey

A field survey at the proposed port site was undertaken from 5 – 9 November 2011 (see Plate 13-1, Plate 13-2) and involved detailed fauna surveys, habitat and landform descriptions, detailed survey of vegetation monitoring plots, and land condition assessments. Vegetation surveys were undertaken at seven sites and fauna surveys were undertaken at four sites (see Section 13.3.3). Table 13-1 below outlines broad survey methodologies employed to collect ecological information for the sites established within the project area. Broadly, methodologies followed vegetation and vertebrate (fauna) guidelines developed for Biological Survey of South Australia (Heard and Channon 1997, Owens 2000). Further details regarding methodologies for each of the survey components are provided in Appendix P.



Plate 13-1 Euro Kangaroo at the Port Site

Table 13-1 Broad Survey Components for 2011 Flora and Fauna Survey, Proposed Port Site

Survey Component	Target
Establish and survey approximately 100 m square plot	Vegetation community, (native and introduced flora species present)
Physical and Landscape description	Soils, biological crust, underlying geology / topography – overall habitat and condition
Nights & day trapping (Pitfall trapline, Elliott traps, cage traps)	Terrestrial mammals and reptiles

Survey Component	Target
Nightly spotlighting and 'eyeshine' searches	Nocturnal mammals, birds and reptiles (geckos)
Call playback	Targeted species including nocturnal birds, limited mammals.
ANABAT recording	Bats
Diurnal active and opportunistic reptile search/capture	Reptiles
Morning and afternoon bird surveys (audio/visual)	Birds, opportunistic mammals and reptiles

### Condition

Condition of the vegetation within the port site was assessed in the field as part of the survey mentioned above. A number of vegetation patches at the port site were not specifically assessed in the field because they were either inaccessible during the time of the survey or alternative representative patches were targeted during the survey. The condition of these native vegetation patches was inferred based on proximity and knowledge of assessed patches, vegetation density via aerial imagery, size and contiguity of patch, surrounding land use and the DEWNR vegetation layer (DEWNR 2011).

Condition categories are the same as those outlined above for the infrastructure corridor.



Plate 13-2 Fauna Trapping at Port Site

## 13.3 Existing Environment

This section provides a regional context for the whole of the proposed CEIP Infrastructure (Section 13.2.1), followed by specific information for both the infrastructure corridor and the proposed port development.

### 13.3.1 Regional Context

#### Biodiversity and Conservation

Remnant native vegetation is scattered throughout the broader region primarily within conservation areas (Parks, Reserves, Wilderness Protection Areas (WPA) and vegetation Heritage Agreement areas (HA)), but also as discrete and isolated patches within cleared private land, and linear strips along roadsides and in rail reserves. Conservation areas in the region range from a HA of 87 ha (HA 61) to a WPA (Hincks) comprising 66,873 ha (see Figure 13-1, Plate 13-3). These areas are managed to protect species and generally contain larger numbers of protected flora and fauna than smaller isolated patches that occur within the agricultural landscape. Both the proposed port development and infrastructure corridor primarily avoid a key biodiversity planning area on the Eyre Peninsula, classified as a Large Remnant Area (LRA) (Nature Maps 2013, DEH 2002) which includes Hambidge WPA, Hincks WPA and Hincks Conservation Park (CP). Figure 13-2 below shows the project area in relation to key regional biodiversity priority areas; LRA and Threatened Habitat Area (THA). One LRA and several TRAs are generally avoided by the project. There are two areas of the infrastructure corridor that come within 1 km of conservation areas, including a section that runs through agricultural land adjacent the northern boundary of the Hambidge WPA. The existing boundary of the WPA is buffered from the agricultural land by a 20 m fire break and access track. The infrastructure corridor itself will include a 10 m maintenance track that will serve as a buffer (for weed and fire risk) between the WPA and the railway, water and power transmission lines. In addition, HA 625 is approximately 4 km east of the infrastructure corridor and 4 km north of the proposed transmission line from Yadnarie, and the Rudall CP is also 2 km north of the line from Yadnarie.



Plate 13-3 Example of Excellent Quality Regional Remnant Vegetation within Hambidge WPA

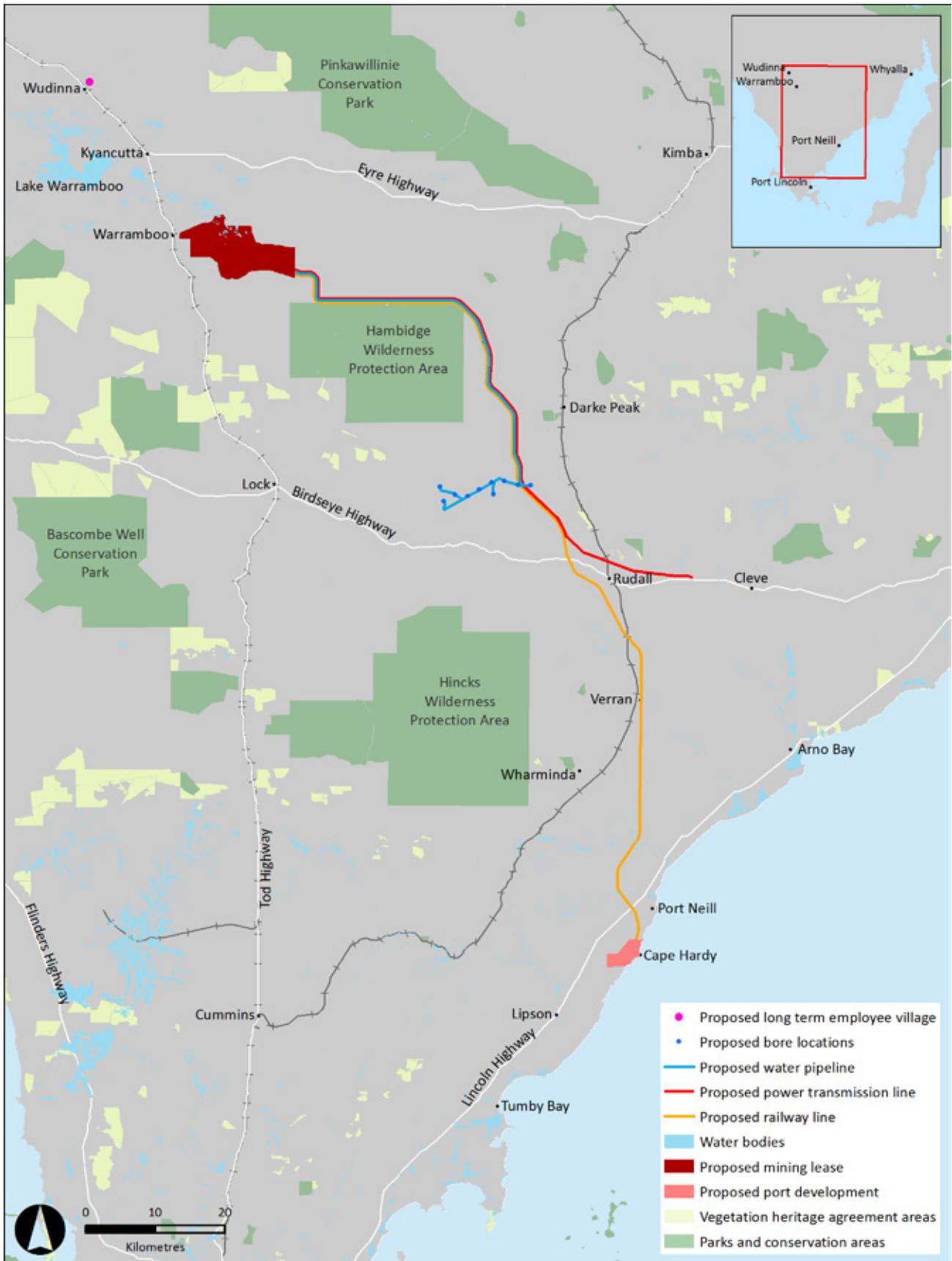


Figure 13-1 Location of Proposed CEIP Infrastructure and Mining Lease

## Bioregion

The broad project area is located within the Eyre Yorke Block (EYB) bioregion as described by the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995). Due to the diverse landscapes and habitats found within the bioregion, sub-regions are used for the purposes of describing biodiversity. Within the EYB bioregion, there are three sub-regions located within the Eyre Peninsula (Eyre Hills eastern and southern, Talia and Eyre Mallee). The proposed CEIP infrastructure, including the borefield and the long-term employee village, are located across the Eyre Mallee subregion in the north and the Eyre Hills (eastern uplands) subregion to the southeast of Hincks WPA. Part of the transmission line occurs in the Eyre Mallee and part occurs in the Eyre Hills. The proposed port development is located within the Eyre Hills (southern uplands) subregion.

Broadly, the EYB bioregion is characterised by Archaean basement rocks and Proterozoic sandstones overlain by undulating to occasionally hilly calcarenite and calcrete plains and areas of aeolian quartz sands, with mallee woodlands, shrublands and heaths representing remnant vegetation on calcareous earths, duplex soils and calcareous to shallow sands. Habitat fragmentation and degradation are recognised as the key threatening processes for native flora and fauna in the bioregion as a result of the significant clearance of native vegetation which has occurred for agriculture and grazing (see Plate 13-4).

The bioregion comprises an overlap point for several species at the western or eastern extents of their distribution. The area also contains the transition from semi-arid to arid plant and animal species, with at least 25 plant species endemic to the bioregion (DEH 2002)



Grazing in Mallee north of Hambidge WPA



Native and exotic animal tracks, Hambidge WPA boundary



Mallee shrubland of *Eucalyptus incrassata* and *E. socialis* adjacent agricultural land



Poor quality Mallee fragment surrounded by agricultural land; Boxthorn in foreground

### Plate 13-4 Habitat Fragmentation Examples throughout the Region

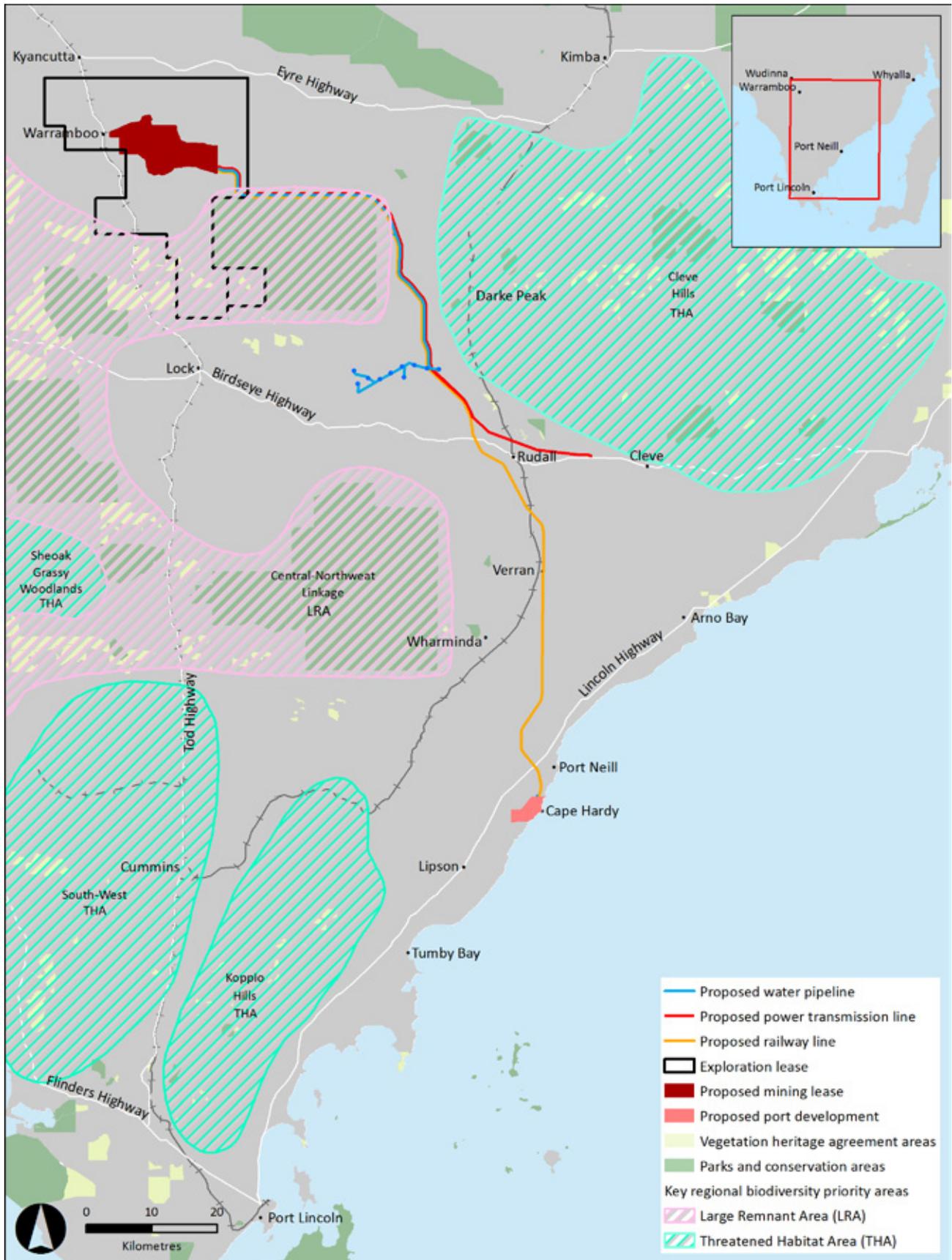


Figure 13-2 Project Area in Relation to Conservation Reserves, Vegetation Heritage Agreement Areas and Key Biodiversity Priority Areas

### Eyre Mallee (EYB5) Subregion

The climate of the Eyre Mallee subregion (EYB5) is more arid than the other two subregions of the EYB bioregion. Consistent with the history of the broader bioregion, the mallee vegetation that previously dominated the subregion has been significantly cleared for agriculture and livestock grazing (DEH 2002). However, this sub-region has a significantly higher proportion of native vegetation in reserves than the other two subregions of the Eyre Peninsula. The Eyre Mallee subregion contains 44% native vegetation compared to 25% for Eyre Hills and 17% for Talia (DEH 2002). The proposed infrastructure corridor occurs in the least vegetated areas of this subregion.

This subregion consists of undulating plains with an extensive cover of dunes and sand sheets. The shallow calcareous earths or deeper duplex soils of the plains support a mallee association of *Eucalyptus socialis* and *E. gracilis*, with *E. incrassata* / *Melaleuca uncinata* mallee occurring on the dune sands (DEH 2002).

The Eyre Mallee subregion has the highest biodiversity within the EYB bioregion with 1,212 recorded plant species (six endemic), 177 bird species, 82 reptile species and 23 species of mammals (DEH 2002). Nationally Endangered flora species that occur within this subregion include: *Acacia cretacea* (Chalky Wattle), *A. enterocarpa* (Jumping-jack Wattle), *A. pinguifolia* (Fat-leaved Wattle), *A. whibleyana* (Whibley Wattle), *Haloragis eyreana* (Prickly Raspwort) and *Thelymitra epipactoides* (Metallic Sun-orchid) (ANRA 2009). There are also a number of flora species with Vulnerable or Rare ratings under the EPBC Act and the NPW Act, see Section 13.3.2 for further detail.

### Eyre Hills (EYB3) Subregion

The Eyre Hills subregion has two areas (southern and eastern uplands) that occur spatially either side of the Eyre Mallee subregion. Consistent with the history of the broader bioregion, the mallee vegetation that previously dominated the subregion has been significantly cleared for agriculture and livestock grazing (DEH 2002). This sub-region only has 25% of native vegetation in reserves and those areas are primarily located in the Eyre Hills eastern subregion, apart from a section of Lincoln National Park in Eyre Hills southern subregion. The proposed infrastructure corridor and port facility will be located in the southern area of this subregion (at least 75 km north of Lincoln National Park).

This subregion consists of undulating plains with an extensive cover of dunes and sand sheets. The plains to the south and west are predominantly formed on old alluvium or on calcarenite near the coastal fringe. Shallow reddish loams with rock outcrops support Mallee (*Eucalyptus incrassata*), with Broombush (*Melaleuca uncinata*) on the plains or Dryland Tea-Tree (*M. lanceolata*) Woodland / Shrubland occurring along the coast fringe (DEH 2002).

The Nationally Endangered flora species that occur within the Eyre Mallee subregion (above) also occur in this subregion. The Eyre Hills subregion has the highest occurrence of endemism within the EYB bioregion. Nineteen endemic plant species and two endemic plant communities have been recorded within the area; Eyre Peninsula Blue Gum (*Eucalyptus petiolaris*) Grassy Woodland on heavy fertile soils on plains and Cummins Mallee / Merrit (*E. peninsularis*, *E. dumosa* complex) Mallee on loams or clay-loam flats (DEH 2002). It should be noted that previous records for *E. dumosa* on the Eyre Peninsula are now considered to be *E. calcareana* (Nundroo Mallee) (Nicolle 2013). Similarly Brandle (2010) suggested the *E. dumosa* complex on the EP had “unresolvable taxonomic issues”.

The Eyre Peninsula Blue Gum (*E. petiolaris*) Woodland community has recently been listed under the EPBC Act as Endangered (August 2013). Areas where this community are ‘known to occur’ and ‘may occur’ have been mapped (SPRAT Profile August 2013). These key areas occur south of Ungarra and north of Cleve outside the project area.

### Regional Vegetation Associations (IBRA)

Regional native vegetation associations have been inferred from the IBRA (Thackway and Cresswell 1995), from each unifying set of environmental influences (e.g. geology, landform patterns, climate and other ecological features) that defines the bioregion. These native vegetation associations provide a high level overview of typical vegetation structure and composition.

Native vegetation is scattered throughout the region. The proposed infrastructure corridor largely traverses degraded and isolated patches of vegetation on dune ridges surrounded by agricultural land. Similarly, the native vegetation at the proposed port site is predominantly highly degraded, the site having been historically cleared for agricultural use.

Six distinct IBRA regional native vegetation associations are described across the project area; Koongawa, Hambidge, Wharminda, Butler, Waretta and Cleve (Laut et al. 1977). Of these associations, Hambidge and Koongawa have moderate remnancy (28% and 35% respectively) of which greater than 50% is protected in reserves, parks or vegetation Heritage Agreement areas. The other four associations have poor to moderate remnancy and are poorly conserved within the region. Table 13-2 summarises the regional vegetation association statistics and shows the area of each association that occurs within the project footprints. Note for the infrastructure corridor, this figure relates to IBRA vegetation within the footprint, not patches that intersect the footprint. The IBRA vegetation associations intersected by the project components are shown in Figure 13-3.

Table 13-2 Regional Vegetation Association Statistics within the CEIP Footprint

IBRA Association	Environmental Characteristics <sup>1</sup>	Original IBRA Region Area (ha)	Remaining Native Vegetation <sup>2</sup>	Total Area in Corridor Footprint <sup>3, 4</sup>	Total Area at Port Site
Butler <sup>5</sup>	Vegetation: Open scrub of Ridge-fruited Mallee and Broombush and chenopod shrubland (Samphire and Nitrebush). Geology: Undulating plain on partly calcreted alluvium with isolated quartzite hills, ending in low cliffs along the coastline. Soil: Hard pedal mottled-yellow duplex soils, red friable loams and crusty red duplex soils.	77,299	5,127 ha	4.86 ha (0.1% of remaining)	8.7 ha <sup>5</sup> (0.2% of remaining)
Cleve	Vegetation: Open scrub of Beaked Red Mallee and Yorrell, with or without Ridge-fruited Mallee and Broombush, Open shrubland (Coast Daisy Bush, Coast Beard Heath and Coastal Wattle). Landform: Gently sloping sandy plains and footslopes with some dunes and low cliffs along the coastline. Soil: Red calcareous earths, hard pedal red duplex soils, brownish sands and whitish calcareous sands.	97,765	17,456 ha	0.42 ha (<0.01% of remaining)	0
Hambidge	Vegetation: Open scrub of Ridge-fruited Mallee, Narrow-leaved Mallee and Broombush, low Melaleuca woodland, low chenopod shrubland (Samphire) and low shrubland (Coastal Wattle and Coast Beard Heath). Geology: Extensive undulating plain with parallel dunes and occasional low Inselbergs, with tidal flats and sand dunes on the coastal margin. Soil: Sandy pedal mottled-yellow duplex soils, brownish sands, dense brown loams, grey calcareous loams and whitish calcareous sands.	353,460	99,967 ha	50.17 ha (0.05% of remaining)	0
Koongawa	Vegetation: Open scrub of Ridge-fruited Mallee, Narrow-leaved Mallee or Broombush. Geology: Undulating plain with parallel dunes and occasional quartzite or granite Inselbergs. Soil: Brown calcareous earths or sandy apedal mottled-yellow duplex soils, brownish sands and dense brown loams.	538,678	188,448 ha	11.47 ha (<0.01% of remaining)	0
Waretta	Vegetation: Grasslands. Geology: Undulating plain and low hills on metasediments, with cliffs along the coastline. Soil: Hard pedal mottled-yellow duplex soils and red duplex soils.	11,263	1,501 ha	1.26 ha (0.08 % of remaining)	112.4 ha (7.5% of remaining)
Wharminda	Vegetation: Chenopod shrubland (Samphire and Nitrebush). Geology: Undulating plain with sand sheets and dunes, and isolated hills. Soil: Sandy pedal mottled-yellow duplex soils, brownish sands, dense brown loams, crusty red duplex soils and whitish calcareous sands.	70,255	6,179 ha	13.15 (0.21% of remaining)	0
Total area of native vegetation in project footprints				81.4 ha	121 ha

<sup>1</sup> Laut et al. 1977 as adopted into IBRA v. 7.0; <sup>2</sup> Remnancy based on DEWNR statistics provided 2013 (DEWNR data to 2006), ha of remnant native vegetation within IBRA region; <sup>3</sup> Area of native vegetation calculated from DEWNR 2011 Native Vegetation (Floristic) – state-wide dataset, and updated using detailed aerial imagery and field survey results (Appendix O and P); <sup>4</sup> Percentage of total ha of native vegetation within corridor footprint, divided by the total ha of remaining IBRA vegetation association; <sup>5</sup> Hectares may be overestimated, this association occurs in the port site area, but areas mapped as Butler has been historically cleared for agricultural purposes, some degraded roadside vegetation remains and areas mapped as grasslands, are mostly cleared or highly degraded.

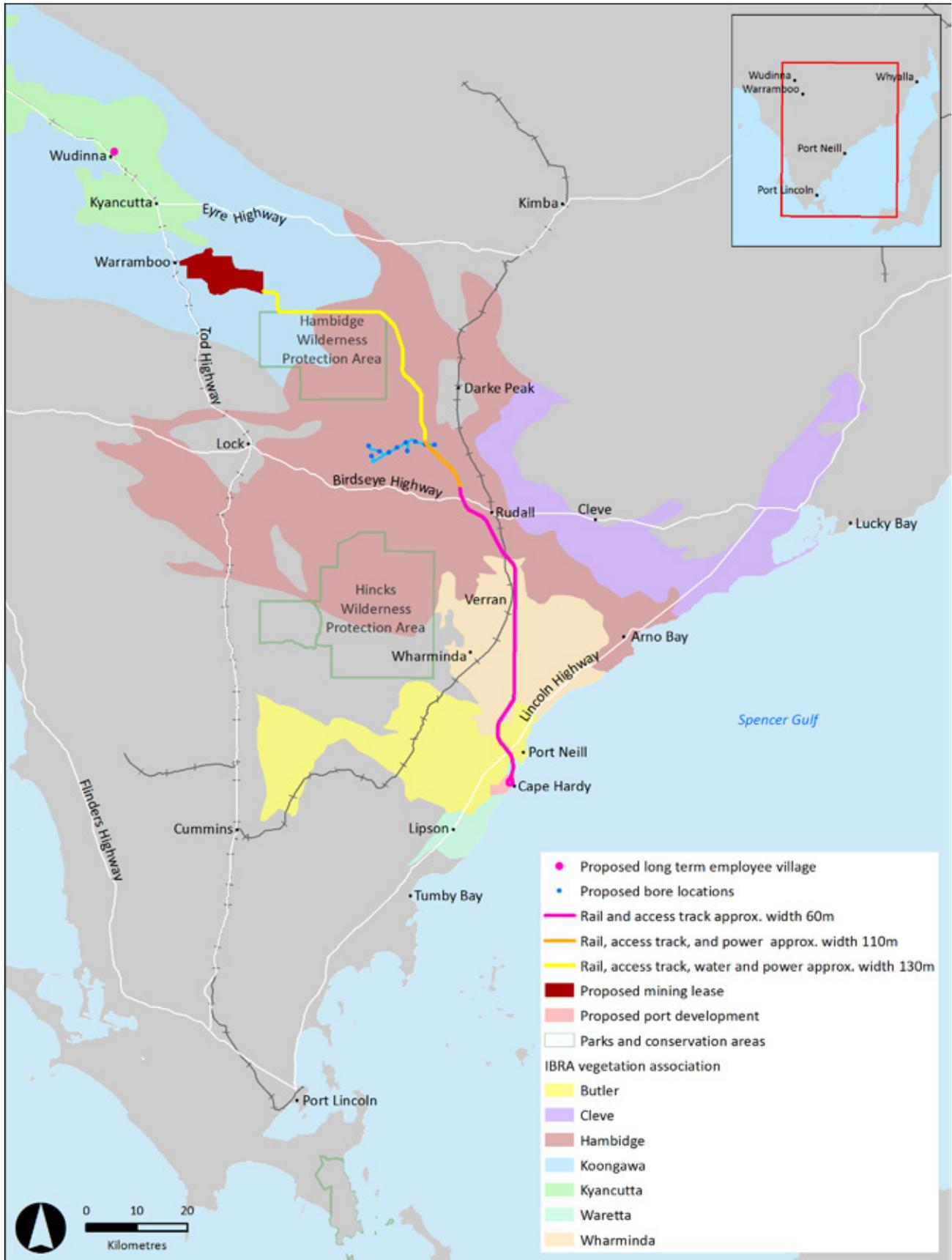


Figure 13-3 IBRA Vegetation Association Boundaries along the Infrastructure Corridor and Port Site

## Regional Vegetation Community Types

The IBRA provides very broad high level vegetation associations; however, given the current land use and degraded condition they are not particularly effective at describing the habitats encountered. Eyre Peninsula Vegetation Communities, herein referred to as EP Community Types, provide richer descriptions that have been benchmarked and therefore allow a more accurate assessment of condition against regional examples (Milne et al. 2008).

Broadly, 14 vegetation communities are noted to occur across the Eyre Peninsula as defined by Milne and colleagues (2008). These communities are further divided into subgroups based on soil type and depth of sand. Condition characteristics are described for each sub-group and factors that cause natural variance are also taken into account. For example, seasonality, level of rainfall or a particular species presence within a vegetation community. Similar variation occurs for other 'Bush Condition' estimates such as number and threat of weed species per vegetation community in very poor to excellent condition. Further details about site-specific community types for each project component are provided in the technical reports (Appendix O, P).

Table 13-3 summarises the EP Community Types that occur across the CEIP area and relates these to the earlier mentioned broad IBRA vegetation associations. Descriptions of the community types are as follows (as per Milne et al. 2008):

- EP 5 - Mallee with open to mid-dense sclerophyll shrub understorey on inland dunes and sandy-loams
- EP 5.1 - Mallee on inland sand dunes and deep sands (Nullarbor-Spencer Dune System)
- EP 5.2 - Mallee on sandy-loams of inland swales and low dunes
- EP 11 - Inland, sub-coastal and Coastal Mallee with a mid-dense sclerophyll shrub understorey on limestone soils
- EP 11.1 - Inland Mallee and Low Woodlands with mid-dense sclerophyll scrub understorey on limestone soils
- EP 11.2 - Sub-coastal and Coastal low mallee and woodlands with mid-dense sclerophyll on limestone soils
- EP 12.2 - Coastal shrublands of stable dunes and cliff-top dunes
- EP 13 - Coastal and inland saline and freshwater swamp vegetation

**Table 13-3 Broad EP Community Types and IBRA Vegetation Associations of the Project Areas**

Project Area	IBRA Association <sup>1</sup>	EP Community Type <sup>2</sup>
Transmission line from Yadnarie	Cleve	EP 5.1, EP 5.2
Corridor	Koongawa	EP 5.1, EP 5.2
Corridor	Hambidge	EP 5.1, EP 5.2
Corridor	Wharminda	EP 5, EP 5.1, EP 13, EP 13.2
Corridor & port	Butler	EP 5, EP 11.1, EP 11.2
Corridor & port	Waretta	EP 11.1, EP 11.2

<sup>1</sup> Regional vegetation associations as per Laut et al. 1977; <sup>2</sup> Milne et al. 2008, note where information is available community groups have been distinguished to sub-group level.

## Regional Weeds

Historical vegetation clearance and degradation are key threatening processes to native flora and fauna species and habitats on the Eyre Peninsula. Weeds (exotic plant species) further contribute to degradation processes within native habitat. The main long-term threatening weed species for the EP region are considered to be perennial species such as Bridal Creeper (*Asparagus asparagoides* f. *asparagoides*), Perennial Veldt Grass (*Ehrharta calycina*) and African Boxthorn (*Lycium ferocissimum*). Bridal Creeper is a Weed of National Significance (WoNS) and occurs widely across the EP, with the heaviest infestations found in the wetter regions of the south (Brandle 2010). There are 20-25 weed species that are regularly controlled on the Eyre Peninsula, including the recently Declared species Buffel Grass (*Cenchrus ciliaris*) (G. Kerr pers. Com.). Buffel Grass is currently controlled as soon as it is found in the region and presents a significant and ongoing risk to the region. Whilst this weed is not currently known to occur within the vicinity of Hambidge WPA, it would have significant impacts to ecological values if it became established within or adjacent the WPA (e.g. affecting habitat suitability and fire intensity / regimes). Transmission of Buffel Grass does not occur easily through agricultural landscapes, but it is known to occur via transport corridors, particularly railway and road, where it can easily spread into the surrounding landscape (G. Kerr pers. comm., Biosecurity SA 2012).

## Regional Introduced Animals

Introduced animals, along with some native animals in high numbers, can cause threats to a region's biodiversity. Impacts include directly preying on native animals, displacing native animals or competition for food and habitat resources, land degradation and removal of palatable plant species (DEH 2002, Brandle 2010). The distribution of some weed species can also be exacerbated by the activities of introduced species, further impacting the degradation of areas of native vegetation.

On the Eyre Peninsula the main introduced animals that impact biodiversity and are listed as key threatening processes include the Cat (*Felis catus*), European Red Fox (*Vulpes vulpes*), Feral Rabbits (*Oryctolagus cuniculus*) and Feral Goats (*Capra hircus*) (DEH 2002, Brandle 2010)). Other pest animals in the region include Feral Honeybees (*Apis mellifera*), Egyptian Beetle (*Blaps polycresta*), European Starling (*Sturnus vulgaris*), House Sparrows (*Passer domesticus*), European Wasp (*Vespula germanica*), Camels (*Camelus dromedarius*) and Horses (*Equus caballus*) (DEH 2002).



Plate 13-5 Rabbit Warren on the Eyre Peninsula

### 13.3.2 Infrastructure Corridor

#### Vegetation Community Types

Broadly, the native vegetation within the proposed infrastructure corridor, including the power transmission line, borefield and pipeline, is comprised of various densities and composition of Mallee associations (often on dune crests) surrounded by agricultural paddocks. The alignment and associated vegetation patches along the route are shown in detail by a series of maps in (Appendix O) However, it should be noted that the final alignment presented in the EIS Chapters supersede any maps presented within technical reports presented in Appendix O. Summary information for each patch (e.g. northings and eastings, photos, dominant species and condition information) are also provided in the technical report.

Mallee associations encountered along the corridor can be broadly grouped into three of the major Eyre Peninsula Communities; EP 5, 11, 13 (as per Milne et al. 2008). These communities range from Mallee on sandy loams of inland dunes, swales and low dunes to coastal Mallee on limestone soils. There are also a few patches of vegetation that are comprised of Samphire or Chenopod shrublands with infrequent inundation (see Figure 13-4).

Over 200 of the vegetation patches that intersect the infrastructure corridor study area were assessed in the field and were broadly grouped into vegetation types. The proposed infrastructure corridor primarily comprised EP Community 5 (approximately 90 % of patches), which is dominant in the northern two thirds of the alignment. EP Community 11 only occurs in the southern third of the alignment as the corridor nears the coast (approximately 7% of patches). EP Community 13 was associated with Samphire / Chenopod Shrublands (approximately 3% of patches).

Key vegetation associations that occur within EP Community 5 (Milne et al. 2008) that occur throughout the corridor include:

- Ridge-fruited Mallee (*Eucalyptus incrassata*) +/- Narrow-leaved Red Mallee (*E. leptophylla*) +/- Beaked Mallee (*E. socialis*). Broombush (*Melaleuca uncinata*) is a common understory species. This association occurs on the parallel dunes of Hincks CP and surrounds.
- Ridge-fruited Mallee also dominates most of Hambidge Conservation Park on the NW-SE ridges and surrounds.
- Red Mallee (*E. oleosa*) +/- Beaked Red Mallee +/- Ridge-fruit Mallee, Mallee is dominant northeast of Cowell. Other species present include Nundroo Mallee (*E. calcareana*) and Narrow-leaf Mallee, Broombush, Dryland Tea-tree (*M. lanceolata*), False Sandalwood (*Myoporum platycarpum*) and Nealie (*Acacia rigens*).
- Merrit or Cummins Mallee (*E. peninsularis*), Nundroo Mallee (*E. calcareana*), White Mallee ssp. (*E. phenax*) +/- Square-fruit Mallee (*E. calycogona*), Narrow-leaved Red Mallee and Red Mallee, Mallee. Broombush, Dryland Tea-tree and other sclerophyll shrubs are common. Occurs in the Cummins-Yeelana region.
- Nundroo Mallee, White Mallee +/- Ridge-fruited Mallee, Mallee occurs in the swales adjoining sand dunes where Nundroo Mallee or White Mallee occur with Ridge-fruited Mallee, e.g. near Rudall.

The technical report in Appendix O provides further details regarding assessment of vegetation patches, e.g. Appendix tables summarise vegetation patches along the corridor and categorise them into broader Eyre Peninsula Vegetation Communities (Milne et al. 2008) and IBRA vegetation associations. It should be noted that details about the vegetation of the infrastructure corridor, vegetation clearance calculations and SEB offset information in this chapter supersedes information presented in Appendix O.

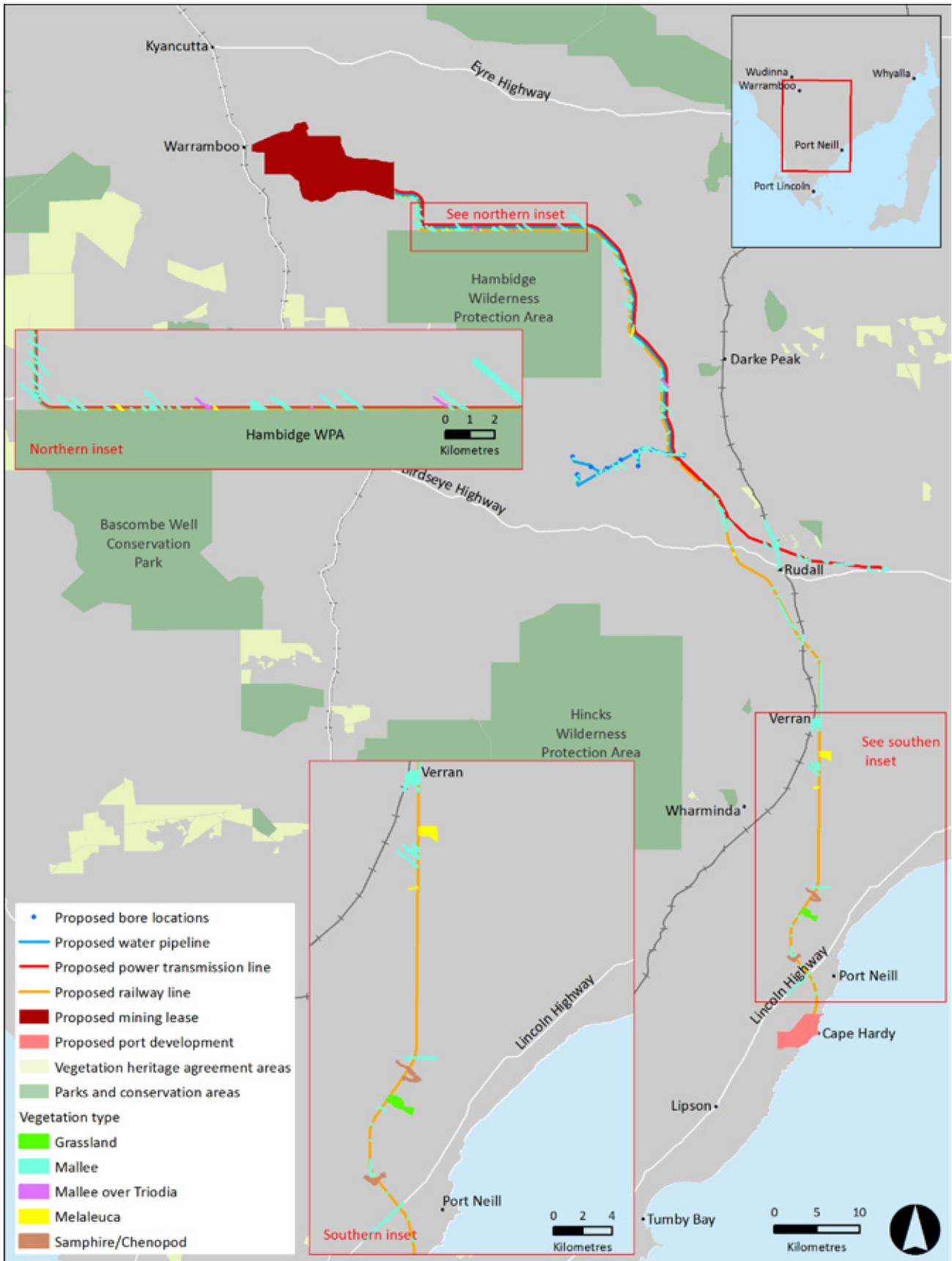


Figure 13-4 Vegetation Patches of the Infrastructure Corridor, Borefield and Transmission Line

## Vegetation Condition

The vegetation condition of patches within the proposed infrastructure corridor, including the transmission line and borefield, is heavily influenced by anthropogenic factors. The majority of patches are small, isolated, oblong and narrow in shape, subjected to large edge effects, and subject to ongoing disturbance factors such as grazing and trampling by livestock, agricultural weed invasion, pest mammal invasion (e.g. Cats, Foxes), and direct human disturbance (e.g. trampling, vehicle tracks, dust from road trains, rubbish etc.). The habitats encountered were largely disturbed remnants with the absence of one or more structural dominants, a lack of age and structural diversity, and poor species diversity. No patches are subject to once regular, natural fire disturbance (as experienced pre-European settlement) leading to further declines in biodiversity.

There are 149 vegetation patches that intersect the final infrastructure corridor footprint (including a footprint buffer of 10 m). Condition ratings have been estimated, using data collected in the field and from inference (see Section 13.2.1); with the majority of patches considered to be of very poor to moderate quality (Table 13-4). Species composition for a large portion of the patches was also considered to be poor, when compared with benchmark community descriptions from Milne (et al. 2008). Plate 13-6 below shows a benchmark comparison of Hambidge WPA vegetation (EP Community 5) against examples of good to very poor quality vegetation encountered throughout the alignment.

The current condition of vegetation patches is shown on Figure 13-5. Figure 13-6 to Figure 13-8 zoom into several areas of the route, showing the examples of different quality patches and their location within the landscape. Better quality patches (e.g. 8:1 and 10:1) do occur in the region; however, the majority of these were avoided during corridor route selection (e.g. Patch 360, see Figure 13-8 below). Four 8:1 patches occur along the route, three occur north of Hambidge WPA and in the southern section of the infrastructure corridor (Patch 100) (see Figure 13-7). Note that Patch 183 was subdivided into section a, b and c. Section 183a was classified as 8:1 (see Plate 13-6) but is actually avoided and not included in the final calculation. Only a small section of roadside vegetation (183c) surrounded by agricultural land that links to patch 183a is part of the final infrastructure corridor footprint.

**Table 13-4 Summary of Vegetation Condition per Patch**

Condition Rating <sup>1</sup>	No. of Vegetation Patches	Cumulative Total Area (ha) of Patches that Intersect the Corridor <sup>2</sup>
10:1 (Excellent)	0	0
8:1 (Good)	4	109.9
6:1 (Moderate)	54	450.4
4:1 (Poor)	72	415
2:1 (Very Poor)	19	24.7
TOTAL	149	1000 ha

<sup>1</sup> Vegetation condition rating based on preliminary Significant Environmental Benefit (SEB) ratio criteria as defined by Table 1 in DWLBC 2005; <sup>2</sup> Note that this is the total amount of vegetation that intersects the corridor, the actual amount within the corridor footprint is much less (see Section 13.5.2).



Hambidge WPA (excellent condition, 10:1)



Patch 183a (good condition, 8:1)



Patch 175a (moderate condition, 6:1)



Patch 132 (poor condition, 4:1)



Patch 133 (very poor condition, 2:1)



100% cleared of native vegetation, 0:1

Plate 13-6 Visual Comparison of EP Community 5 Compared to Regional Benchmark from Hambidge WPA

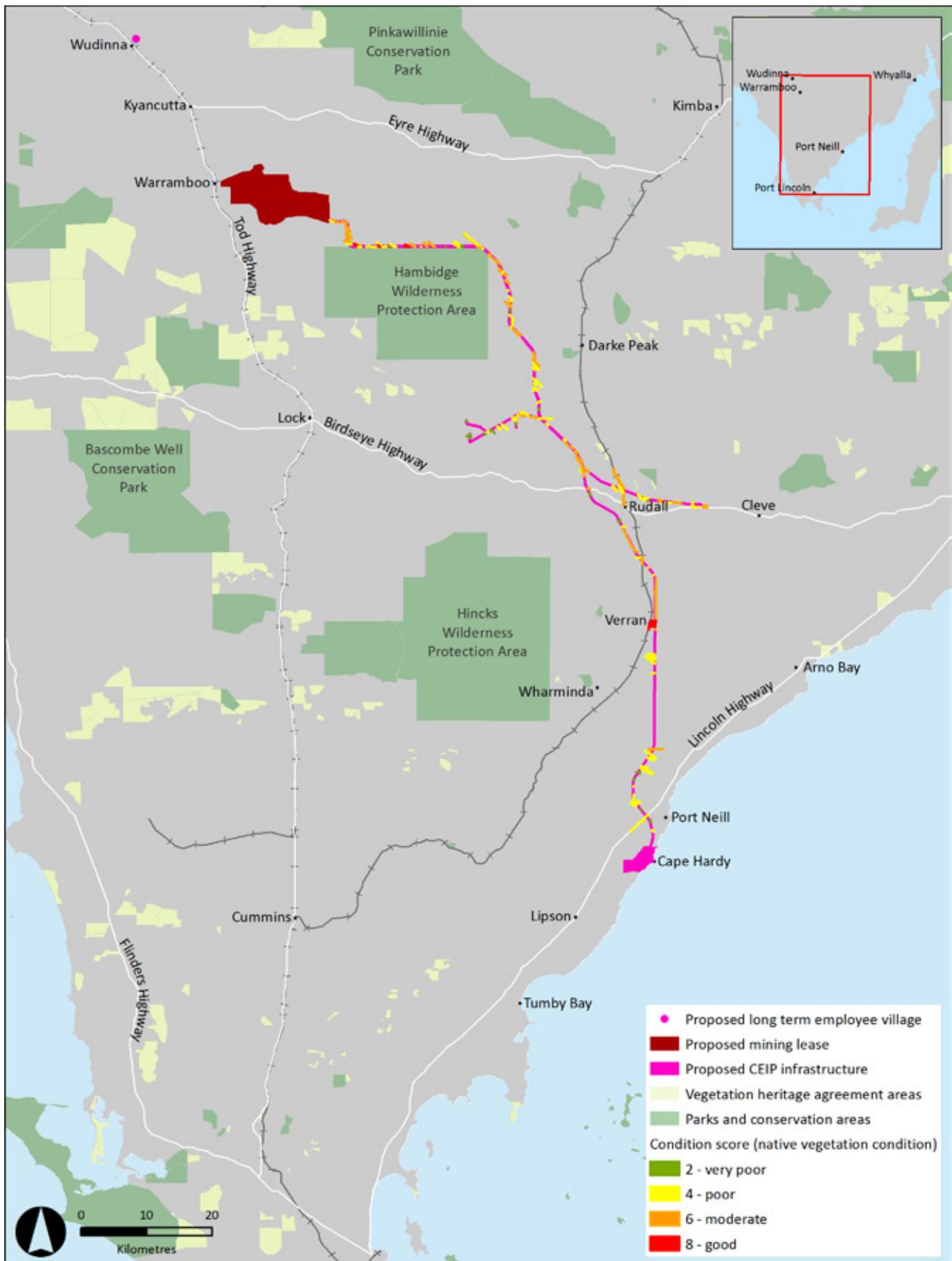


Figure 13-5 Condition of Vegetation Patches along the Infrastructure Corridor (overview)

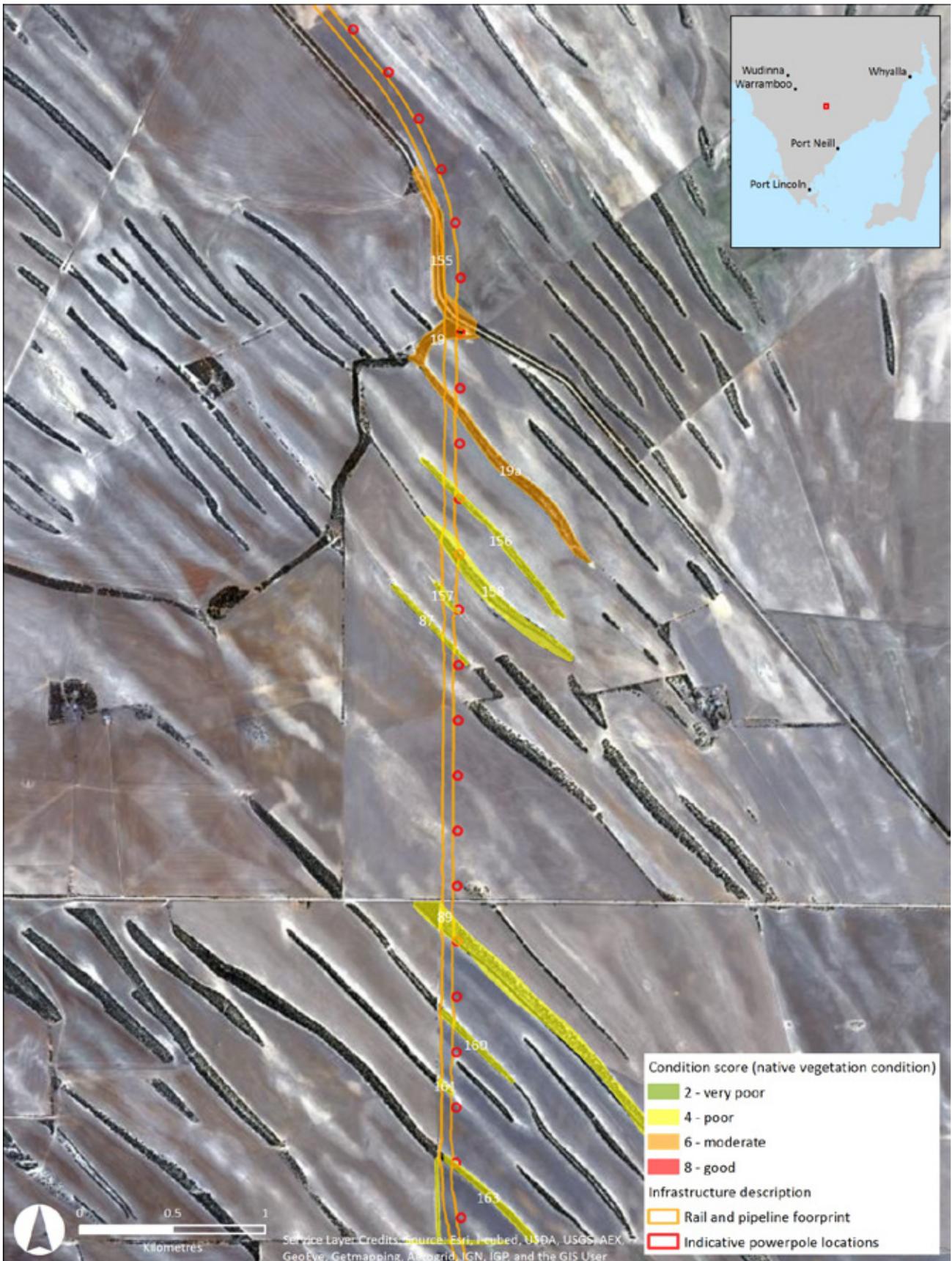


Figure 13-6 Example of Poor to Moderate Condition Vegetation Patches along the Infrastructure Corridor

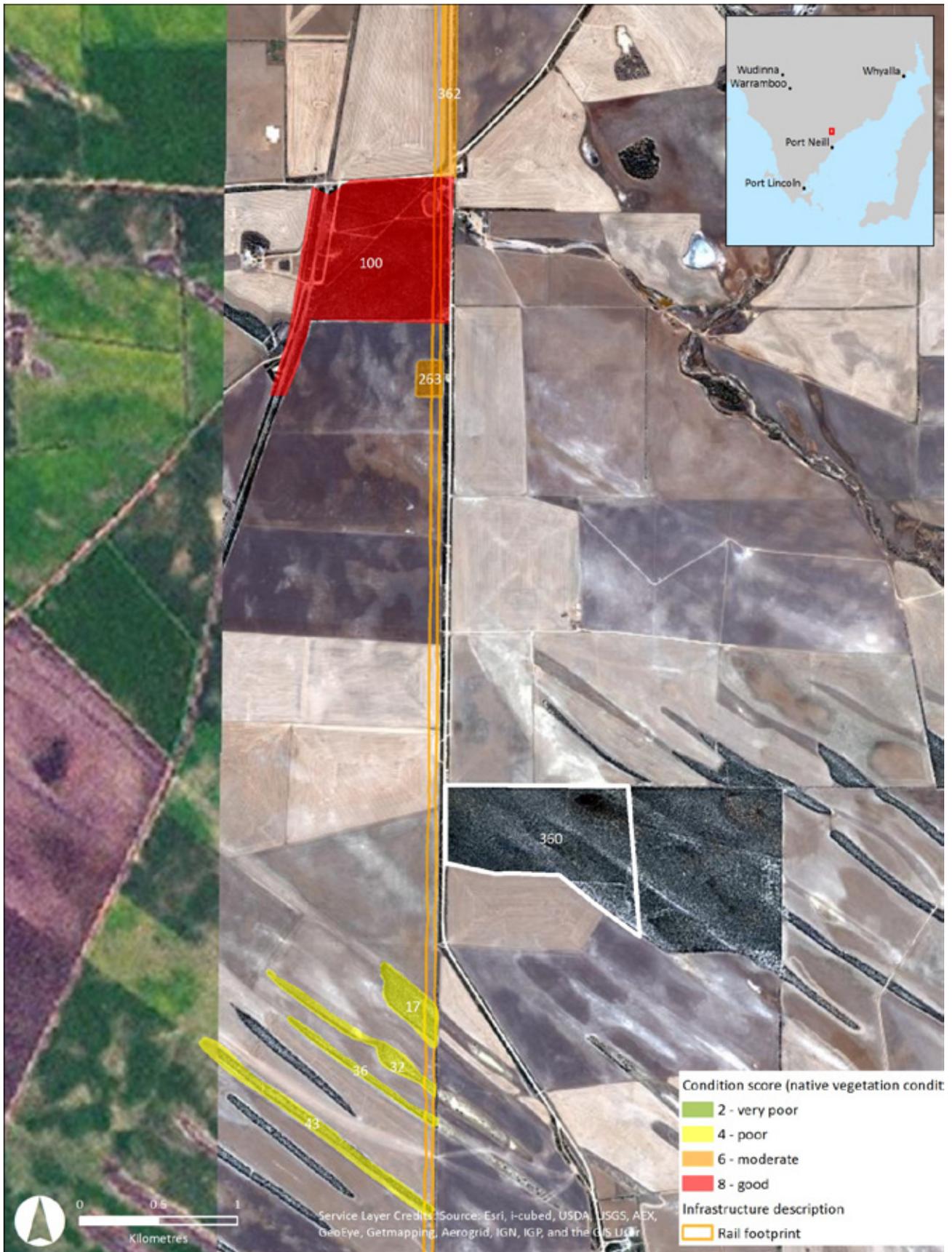


Figure 13-7 Example of Moderate to Good Condition Vegetation Patches along the Infrastructure Corridor

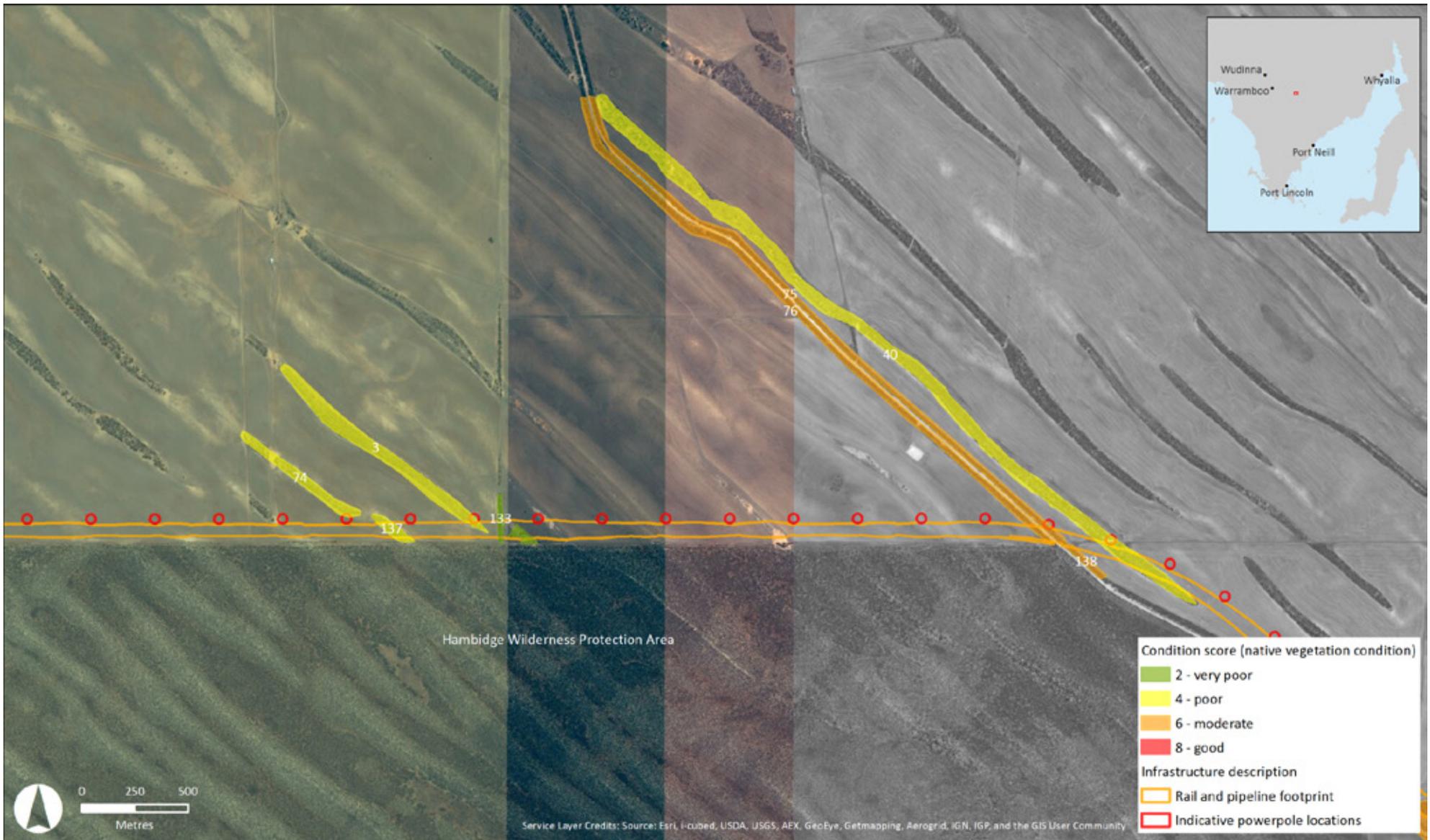


Figure 13-8 Example of Very Poor to Moderate Condition Vegetation Patches along the Infrastructure Corridor

## Native flora

Over 500 flora species have been recorded in the vicinity of the proposed infrastructure corridor, borefield and transmission line from Yadnarie, including 89 exotic species (BDBSA 2013). Over 100 of the flora species were recorded in field assessments for the EIS study. A summary of common species per strata is provided in Table 13-5.

Table 13-5 Common and Occasional Flora Recorded Throughout the Infrastructure Corridor

	Overstorey <sup>1</sup>	Mid Storey	Understorey
Common species	<i>Eucalyptus incrassata</i> (Ridge-fruit Mallee), <i>E. socialis</i> (Beaked Mallee), <i>E. calcareana</i> (Nundroo Mallee), <i>E. leptophylla</i> (Narrow-leaved Red Mallee), <i>E. brachycalyx</i> (Gilja or Chindoo Mallee), <i>E. oleosa</i> (Red Mallee) and <i>E. phenax</i> spp. <i>Phenax</i> (White Mallee).	<i>Melaleuca uncinata</i> (Broombush) and <i>M. Lanceolata</i> (Dryland Tea-tree)	<i>Enchylaena tomentosa</i> (Ruby Salt bush), <i>Austrostipa</i> spp. (Spear grasses), <i>Austrodanthonia</i> spp. (Wallaby grasses), <i>Rhagodia candolleana</i> ssp. <i>candolleana</i> (Sea-berry Saltbush), <i>Triodia irritans</i> (Porcupine Grass), <i>Vittadinia</i> spp. (New Holland Daisies), <i>Lepidosperma</i> spp. (Sedge) and <i>Maireana brevifolia</i> (Small-leaved Bluebush)
Occasional species	<i>Allocasuarina verticillata</i> (Drooping Sheoak)	<i>Callitris verrucosa</i> (Mallee Cypress-pine), <i>Santalum acuminatum</i> (Quandong), <i>Pittosporum angustifolium</i> (Native Apricot) and <i>Bursaria spinosa</i> (Christmas Bush).	<i>Lomandra</i> spp. (Irongrass), <i>Helichrysum leucopsidium</i> (Satin Everlasting), <i>Carpobrotus rossii</i> (Angular Pig Face), <i>Dianella revoluta</i> (Black-anther Flax-lily), <i>Sclerolaena uniflora</i> (Small-spine Bindyi), <i>Tecticornia pergranulata</i> (Samphire) and <i>Threlkeldia diffusa</i> (Coast Bonefruit)

<sup>1</sup>Nicolle 2013 now suggests previous records for *Eucalyptus foecunda* (Freemantle Mallee) on the EP are now considered to be *E. leptophylla* and these records have accordingly been updated throughout. Similarly previous records for *E. dumosa* (White Mallee) on the EP are now considered to be *E. calcareana*, as per Nicolle (2013) and have also been updated.



Plate 13-7 *Ptilotus nobilis*, Hambidge WPA Fire Track

### Flora of Conservation Significance

The desktop assessment (review of EPBC Act PMST) initially highlighted nine EPBC listed flora species as potentially occurring along the infrastructure corridor. A likelihood assessment for species that may actually occur considered these results as well as historical BDBSA records, current distribution information, survey results and regional information (e.g. Pobke 2007, Brandle 2010). It was determined that only one endangered and two vulnerable EPBC listed flora species are present or possibly present; *Acacia enterocarpa* (Jumping-jack Wattle), *Acacia rheticocarpa* (Resin Wattle) and *Swainsona pyrophila* (Yellow Swainson-pea). An additional six flora species (four endangered and two vulnerable) are considered unlikely to occur within the infrastructure corridor footprint and surrounding buffer zone. Table 13-6 below summarises the likelihood of occurrence assessment for species that are present, possibly occur or are unlikely to occur. Further details about justification for these likelihood decisions are provided in Appendix O. Note there were no records for EPBC listed flora within 5 km of the borefield, and only 1 record for an EPBC listed flora species within 5 km of the power transmission line from Yadnarie (*Caladenia tensa*, Inland Green-comb Spider-orchid).

The Threatened Flora Species Recovery Plan for Eyre Peninsula SA (Pobke2007) outlines some additional priority one and two species that may occur near the proposed corridor. A number of these nationally threatened species occur in degraded habitat and in rail and road reserves. These species have not been highlighted in searches to date. E.g. *Acacia Whibleana* (Whibley wattle) and *Haloragis eyreana* (Prickly Raspwort), but records occur within 20 km of the route (e.g. Prickly Raspwort).

**Table 13-6 Summary of Likelihood Assessment for Potential EPBC Listed Flora Species within the Proposed Infrastructure Corridor**

Species	Common Name	AUS <sup>1</sup>	SA <sup>2</sup>	Likely to occur?	Summary of Justification for Likelihood of Occurrence <sup>4</sup>
<i>Acacia enterocarpa</i>	Jumping-jack Wattle	EN	E	Present / possible	Records within 1-5 km, observed in the field at one location (disturbed habitat adjacent a quarry), alignment was changed to avoid species. No other observations within the project area during project field surveys. Given the degraded nature of the project area, it is unlikely that a significant population occurs.
<i>Acacia rheticocarpa</i>	Resin Wattle	VU	V	Possible	No records occur within 5 km. Species has fragmented distribution on the EP, occurring between Streaky Bay, Kimba and Arno Bay. Known populations have not been identified within the project area of the corridor. Unlikely that a significant and viable population occurs.
<i>Swainsona pyrophila</i>	Yellow Swainson-pea	VU	R	Possible	Fire and soil disturbance enhances germination in this species. Records occur between 1-5 km of the corridor in Hambidge WPA and most recently from Pinkawillinie CP. Not observed in the field, may be present as dormant seed if historic specific conditions for germination have been met or may not occur at all.
<i>Acacia pinguifolia</i>	Fat-leaved Wattle	EN	E	Unlikely	No records within 5 km. No field records.
<i>Caladenia tensa</i>	Inland Green-comb Spider-orchid	EN	-	Unlikely	Mallee vegetation along the corridor likely to be too fragmented and disturbed. Known from the southeast. Not observed during surveys for the CEIP. No records within 5 km of the main corridor, but 1 record within 5 km of the transmission line, taxonomic confusion for this species in SA (Todd 2000), more likely to be common species.
<i>Frankenia plicata</i>		EN	V	Unlikely	Generally known from further north in South Australia. No records within 5 km of project area. Limited suitable and degraded habitat present along the corridor and not observed during surveys for the CEIP.
<i>Prostanthera calycina</i>	West Coast Mintbush	VU	V	Unlikely	Key populations near Streaky Bay. No records within 5 km of project area. Not observed during surveys for the CEIP.
<i>Ptilotus beckerianus</i>	Ironstone Mulla Mulla	VU	V	Unlikely	Known populations in Wanilla CP and Tucknott's Scrub CP. No records within 50 km. Not observed during surveys for the CEIP.
<i>Pultenaea trichophylla</i>	Tufted Bush-pea	EN	R	Unlikely	Occurs in roadside vegetation in DC of Tumby Bay; Ungurra, Tucknott Scrub CP. No records within 5 km. Suitable habitat has not been identified in the project area.

<sup>1</sup> Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) status: Endangered (EN), Vulnerable (VU);

<sup>2</sup> South Australian National Parks and Wildlife Act 1972 (NPW) status: Endangered (E), Vulnerable (V), Rare (R);

<sup>3</sup> Records from Biological Database of South Australia (BDBSA) see Appendix O for further detail and references.

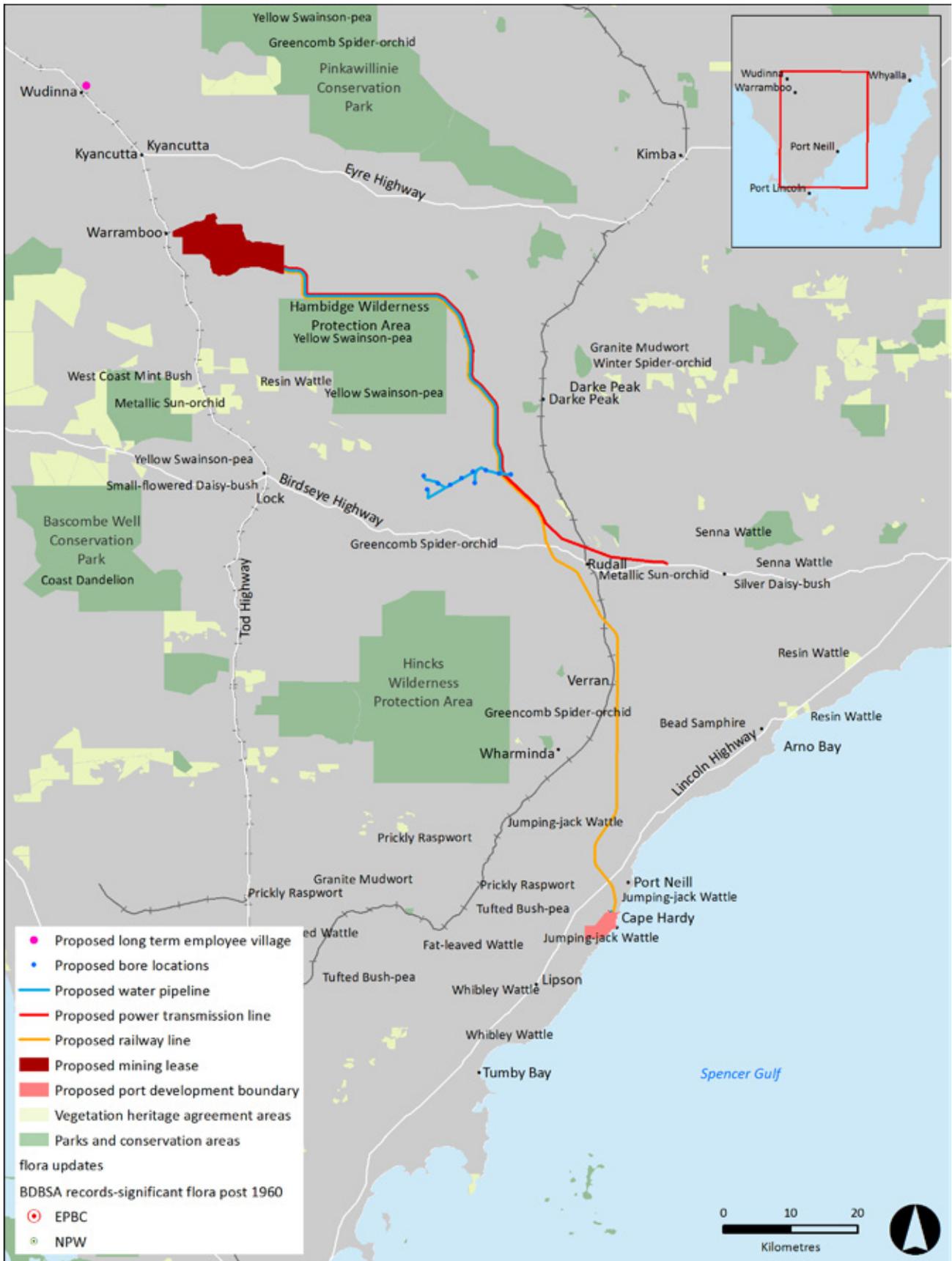


Figure 13-9 Historic Threatened Flora Records of the Region

The desktop study also revealed 21 flora species with SA NPW Act ratings, but no EPBC ratings, that have historical records from within the CEIP Infrastructure area. All 21 flora species have previously been recorded within 5 km of the proposed infrastructure corridor, but only five of those species have been recorded within 1 km of the corridor. Locations of previous threatened flora records (both EPBC and NPW SA) are shown in Figure 13-9. Of the 21 SA NPW threatened species, the likelihood assessment identified that one species is confirmed present, but was avoided early in the design process (*Eucalyptus. cretata*). There are also four state threatened flora species that are considered 'likely' to occur (Large-fruited Crassula, Mallee Bitter-pea, Myrtle Fan Flower and Western Daddy Long Legs Orchid), 11 possibly occur and five are considered unlikely to occur in the project area. The species, current likelihood and associated justifications are provided in Appendix O.



Jumping-jack Wattle, open mallee of *Eucalyptus rugosa*  
(adjacent degraded quarry site, now avoided)



Jumping-jack Wattle (*Acacia enterocarpa*)

Plate 13-8 Threatened Flora Habitat and Individual Specimen (EPBC listed Jumping Jack Wattle) Avoided by Corridor

### Native Fauna and Habitats

As mentioned earlier the proposed infrastructure corridor, including power transmission line and borefield, largely comprises isolated remnant patches of vegetation surrounded by agricultural land. This fragmented landscape provides limited habitat for a number of common birds, mammals and reptiles. Higher quality habitat occurs in the conservation parks and vegetation Heritage Agreement areas that are avoided by the infrastructure corridor (e.g. Hambidge WPA, Hincks WPA and Rudall CP).

The results of the government biological survey of the wider EP region (Brandle 2010) suggested the most commonly recorded mammal species on the Eyre Peninsula are the Western Grey Kangaroo and the introduced House Mouse, Rabbit and Fox. The Western Pygmy-possum is a small ground dwelling mammal that was also frequently recorded in surveys, particularly in low mallee habitat (Brandle 2010). Eight species of micro bat were recorded during the recent EP biological survey and it is likely that five of these bat species are the most common native mammals in the area, aside from Kangaroos (Brandle 2010).

Brandle (2010) found that reptile diversity (or species richness) per site was not significantly related to physical habitat parameters. It was noted that swamps, clay soils and low shrublands generally supported fewer species. In the EP biological survey, more than 30 reptile species were significantly associated with specific habitat parameters (e.g., some species associated with rock outcrops and others with surface strew (Brandle 2010)). The majority of reptiles with conservation ratings on the Eyre Peninsula have restricted distributions and isolated populations. Mallee sites were found to support significantly higher numbers of reptile species than low shrubland sites (Brandle 2010). However, Williams (et al. 2011) noted that there are two important factors that influence number of reptiles in mallee fragments within agricultural landscapes on the Eyre Peninsula; distance from conservation parks and quality of habitat. They also suggest that some roadside remnants on the EP may be too isolated to provide sufficient opportunities for reptile dispersal.

Bird species that were observed commonly throughout the EP Biological survey include Grey Shrike-thrush, Inland Thornbill, Weebill, Grey Butcherbird and Red Wattle Bird (Brandle 2010). Brandle (2010) also reported that the vegetation types on the Eyre Peninsula that support the greatest number of bird species included Red Gum, Mallee Box and EP Blue Gum woodlands and Sugar Gum Woodlands. These vegetation types either do not occur or are poorly represented throughout the infrastructure corridor, suggesting that habitats within the area of the infrastructure corridor supported lower avifauna diversity.

No fauna surveys have been undertaken in the proposed infrastructure corridor footprint. Within 5 km of the corridor footprint, BDBSA records exist for 171 fauna species, including 14 mammal, 31 reptile and 126 birds. Of these 171 records, 23 were for threatened species (four with EPBC / NPW ratings and 19 with only NPW ratings) and eight were exotic species. All of the threatened and exotic species are discussed further below.

### **Fauna of Conservation Significance**

As mentioned in the flora of conservation significance section above, the EPBC Act and the NPW Act provide legislative protection and management of threatened and protected species.

The desktop study highlighted 36 EPBC listed fauna species as potentially occurring along the proposed infrastructure corridor (disregarding marine mammals, sharks, reptiles (marine turtles) and pipefish which were highlighted by the EPBC search tool). A likelihood assessment considered these historical records together with current distribution information and knowledge from other surveys in the area.

Of the 36 fauna with national conservation significance identified as having the potential to occur within the project area, 13 are considered possibly present or likely to occur (Table 13-7) and 23 are considered unlikely to occur (see Appendix O). The 13 EPBC fauna that are possibly present or likely to occur include: Australian Fairy Tern, Cattle Egret, Common Sandpiper, Osprey, Fork-tailed Swift, Malleefowl, Pacific Golden Plover, Rainbow Bee-eater, Red-lored Whistler, Sandhill Dunnart, White-bellied Sea-eagle and two Listed Marine species (Rock Parrot and Cape Barren Goose). Justifications of the likelihood assessment are provided in detail in the technical report in Appendix O. Figure 13-10 shows the distribution of EPBC Act threatened and migratory fauna records for the region (excludes species with Listed Marine ratings unless they have NPW status).



**Plate 13-9 Rainbow Bee-eater (Source: Daryl Bray, Andrew Dawson)**

The desktop assessment also considered 11 fauna species of state conservation significance that have potential to occur in the area based on searches of historic datasets and opportunistic observations in the field. Ten of these fauna species, including nine birds, and one reptile (Bardick) have previous records within 5 km of the project area. A current likelihood assessment identified that one species is present in the project area (White-wing Chough), one is considered 'likely' to occur (Gilbert's Whistler), five possibly occur and four are considered unlikely to occur. The assessments of likelihood for these species are provided in Appendix O. Figure 13-10 shows the distribution of NPW Act threatened fauna records for the region.

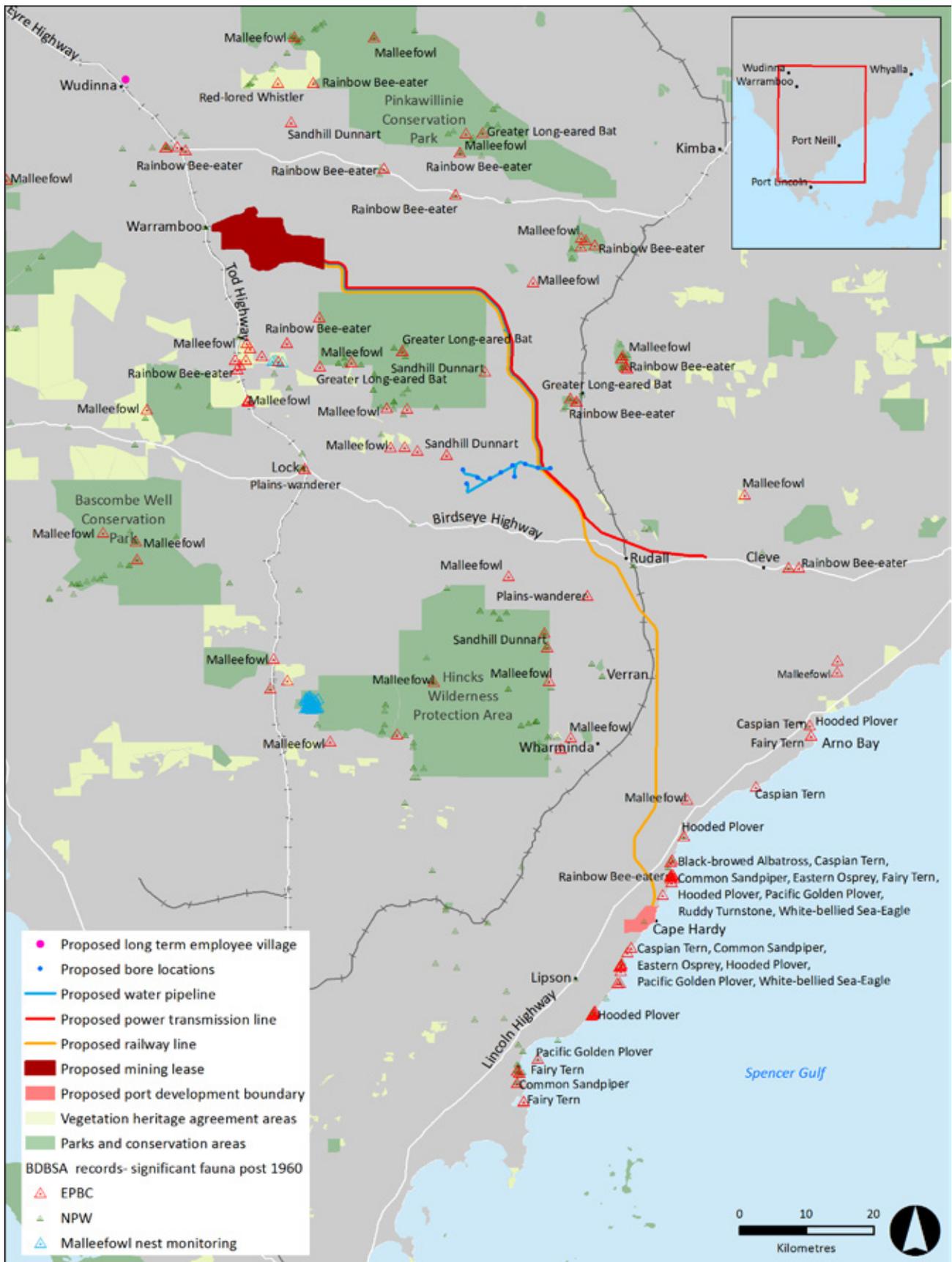


Figure 13-10 Historic Threatened and Migratory Fauna Records of the Region (labels for EPBC species only)



Figure 13-11 Recent and Historic Hooded Plover Records along the Coast

Table 13-7 Summary of EPBC Listed Fauna Species that are Likely to or Possibly Occur within the Proposed Infrastructure Corridor and Buffer

Species Name	Common Name	AUS <sup>1</sup>	SA <sup>2</sup>	Likely to Occur?	Summary of Justification for Likelihood of Presence <sup>3,4</sup>
<i>Ardea ibis</i>	Cattle Egret	MT, LM	R	Possible	Suitable habitat may be present within cleared areas in the project area, although most are degraded due to weed invasion. No records within 5 km. Highly mobile species, not expected to be reliant upon habitat features present within the project area.
<i>Actis hypoleucos</i>	Common Sandpiper	LM, MM	R	Possible	Has global distribution and regularly migrates to Australia where it occurs in small numbers due limited available suitable habitat (prefers rocky creeks, channels, dams, mangrove-lined inlets). Observed within proposed port site area. Limited preferred habitat along infrastructure corridor, aside from coastal section near port facility.
<i>Sternula nereis</i> / <i>Sternula nereis nereis</i>	Fairy Tern / Australian Fairy Tern	VU, LM	E	Possible near coast	Known to occur in coastal habitats, suitable habitat present within the coastal section of the project area, last record within 5 km. Recent FT Census located individuals at Munyaroo CP (over 100 km from study area). Not observed as part of current surveys of the project area. Highly mobile species, not considered to be directly reliant on habitat within the project area.
<i>Apus pacificus</i>	Fork-tailed Swift	MM, LM	-	Possible	Has global distribution. Occurs commonly in coastal areas of the EP as far west as Streaky Bay and as far north as Wudinna. Migrates to Australia between October and April. Known to use many habitat types, including coastal, arid and urban areas. Records within 5 km. Highly mobile species not considered directly reliant upon habitat found within the project area.
<i>Leipoa ocellata</i>	Malleefowl	VU, MT	V	Possible	Inhabits sandy dune/ mallee habitats throughout the north of the EP. Requires deep organic matter to build mounds for egg incubation (best provided by long unburnt remnants). Also utilises habitat adjacent cropping areas to feed on grain. Record within 1-5 km. Remaining vegetation in the project area is primarily on dune crests, rather than swales, which is not preferred by Malleefowl. If present, likely to be a rare visitor.
<i>Pandion haliaetus</i> / <i>Pandion cristatus</i>	Osprey / Eastern Osprey	LM, MM	E	Possible	Uses coastal habitats, including elevated coastal cliffs exposed sites and sea stacks. Known to have a sparse distribution within SA, estimated 52 breeding pairs are located on the west coast of the EP. Record, for <i>Pandion cristatus</i> within 5 km. Habitat may be present within the southern end of the wider project area. Suitable nesting habitat not observed during inland field assessments, therefore these areas unlikely to provide key foraging and nesting locations.
<i>Pluvialis fulva</i>	Pacific Golden Plover	LM, MM	R	Possible	Shorebird known to occur globally, breeds in Siberia and migrates annually to Australia where it is widespread in coastal regions, but also known to inhabit inland areas, including samphire and sometimes pasture. Some appropriate habitat near the coastal section of corridor and surrounds. Last record within 5 km. Individuals may visit the area, but not expected to be reliant on specific habitat features within the project area.
<i>Merops ornatus</i>	Rainbow Bee-eater	MT, LM		Likely	Known to use a range of habitat types, that occur in terrestrial to coastal environments. Widely distributed throughout Australia. In SA, frequently visits Dangalli CP and breeding populations are known to migrate north during the southern winter. Suitable habitat present within the project area, one record within 5 km. Species is highly mobile, has wide ranging distribution, but would not be directly reliant on habitat within the project area.

Species Name	Common Name	AUS <sup>1</sup>	SA <sup>2</sup>	Likely to Occur?	Summary of Justification for Likelihood of Presence <sup>3,4</sup>
<i>Pachycephala rufogularis</i>	Red-lored Whistler	VU	R	Possible	Endemic to southern Australia and primarily occurs in the Murray Mallee Region. On the EP, known from an outlying population at Pinkawillinie CP. No records within 5 km. Suitable habitat along corridor route; however, no records since 1993 and its distribution in the region is considered uncertain. May be present in area as a result of movement between outlying populations, but is not expected to be directly reliant on habitat within the project area.
<i>Sminthopsis psammophila</i>	Sandhill Dunnart	EN	E	Possible	Elusive species known from 3 populations in SA that do not occur within the project area. Occupies low parallel dunes with open woodland, diverse shrubbery and large mature hummocks of <i>Triodia</i> ( <i>Spinifex</i> ). Populations also occur SE of the Gawler Ranges and populations may occur in Pinkawillinie and Hincks CP / WPA. Two records within 5 km of project area (2011, SE corner of Hambidge WPA west of Wickstein road), other regional records from Hincks WPA.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	MT, LM	E	Likely near coast	Known to use many habitat types, particularly coastal regions. Previous records on the EP are from the west coast (Venus Bay and Cowell). Preferred habitat characterised by large areas of open water, but birds have been recorded in (or flying over) a variety of terrestrial habitats including those in semi-arid zones. Record within 5 km and observed in Cape Hardy field study. Likely to occur in habitat closer to the coastline.
<i>Cereopsis novaehollandiae</i>	Cape Barren Goose	LM	R	Possible	Known on the EP, particularly near Port Lincoln (near North Shields and Little Swamp). Records within 5 km. Opportunistically observed north of Port Lincoln in field assessments for corridor. The species generally breeds on offshore islands rather than remaining on mainland.
<i>Neophema petrophila</i>	Rock Parrot	LM	R	Likely	Inhabits off-shore islands on the EP, coastal dunes and saltmarsh / samphire habitats. Little known about the ecology and current population of this species. Record within 5 km. Observed near coast during field survey for the port (in coastal dune community). Highly mobile species that is unlikely to be directly reliant on degraded habitat within the project area.

<sup>1</sup>Environment Protection and Biodiversity Conservation Act 1999 status: Endangered (EN), Vulnerable (VU), Migratory Marine (MM), Migratory Terrestrial, (MT), Migratory Wetland (MW), Listed Marine (LM);

<sup>2</sup>South Australian National Parks and Wildlife Act 1972 (NPWA) status: Endangered (E), Vulnerable (V), Rare (R);

<sup>3</sup>'Records' are from BDBSA = Biological Database South Australia obtained January 2014;

<sup>4</sup> See (Appendix O) for further justification.

## Introduced flora

Declared pest plants are invasive flora species that landholders have legal obligations to control under the *Natural Resources Management Act 2004* (NRM Act) (see Chapter 5, Section 5.3.4). Declared plants have different control requirements depending on the NRM region they occur in, level of threat posed to that region, ease of control, time of year and whether the plant is a new invader or widespread (Declared Plants of SA Factsheet; [www.nrm.sa.gov.au](http://www.nrm.sa.gov.au)). In addition, some weed species are also classified as Weeds of National Significance (WoNS) (AWC 2012). The EPBC PMST identifies which of the 32 WoNS may occur in a search area, along with other introduced plants that are considered by the States and Territories to pose a significant threat to biodiversity.

The EPBC PMST identified nine invasive weeds that 'may' occur or are 'likely' to occur (see Appendix O) within the proposed infrastructure corridor area. The potential presence of five of these weeds was supported by corresponding BDBSA records within 5 km of the railway line (nominally the infrastructure corridor centreline), namely Bridal Creeper, Ward's Weed, Boneseed, African Boxthorn and Silver Nightshade. All five of these exotic species are known to exist in the greater Eyre Peninsula region (DEH 2002, Brandle 2010). These species are all recognised as WoNs and 'Declared' in South Australia under the NRM Act, with the exception of Ward's Weed.

Bridal Creeper (*Asparagus asparagoides*) is the most widespread weed throughout the Eyre Peninsula, with heavier infestations primarily occurring in wetter areas to the south (Brandle 2010). Weeds that are considered to have long-term impacts to vegetation communities on the Eyre Peninsula include perennial species such as Bridal Creeper, Veldt Grass and African Boxthorn (Brandle 2010).

Recent records (i.e. within the last 20 years) from the BDBSA indicate that over 70 exotic floral species have previously been recorded within 5 km of the project area, mainly comprising minor weed species through to Declared and aggressive species (see Appendix O). Bridal creeper is considered very aggressive and has also been flagged as a 'red alert weed' along with African Boxthorn and Horehound (DEWNR 2013). Aggressive weeds have a moderate ability to invade native vegetation and are difficult to eradicate once established (DWLBC 2005).

Rapid field assessments in 2012 and 2011 recorded over 20 exotic species throughout vegetation patches along the proposed infrastructure corridor (and intersected by previous alignment options) including Declared species mentioned above, as well as False Caper. Table 13-8 provides a summary of weed species recorded in the field. Plate 13-10 shows some of the weeds present along the corridor.

Table 13-8 Summary of Exotic Flora Species Recorded During Field Assessments of Project Area (2011, 2012)

Species Name	Common Name	Previous Records <sup>2</sup>	Comment <sup>1</sup>
<i>Asparagus asparagoides f. asparagoides</i>	Bridal Creeper	Main corridor, Transmission line	Very aggressive (Declared SA, WoNS), Red Alert weed for EP
<i>Asphodelus fistulosus</i>	Onion Weed	Main corridor, Transmission Line	Non-aggressive (Not declared for area), WT2
<i>Avena barbata</i>	Bearded Oat	Main corridor	Aggressive, WT2
<i>Brassica tournefortii</i>	Wild Turnip	Main corridor, Transmission line	Aggressive, WT2
<i>Bromus diandrus</i>	Great Brome	Main corridor, Transmission line	Aggressive, WT2
<i>Carthamus lanatus</i>	Saffron Thistle	No records	WT2
<i>Conyza bonariensis</i>	Flax-leaf Fleabane	Main corridor, Transmission line	WT1
<i>Cucumis myriocarpus</i>	Paddy Melon	Main corridor, Transmission line	Aggressive
<i>Ehrharta calycina</i>	Perennial Veldt Grass	Main corridor, Transmission line	Aggressive WT4
<i>Euphorbia terracina</i>	False Caper	No records	WT3, Declared
<i>Galenia pubescens var. pubescens</i>	Coastal Galenia	Main corridor, Transmission line	Aggressive, WT2
<i>Hordeum glaucum</i>	Blue Barley-grass	Main corridor, Transmission line	WT1
<i>Hypochaeris glabra</i>	Smooth Cat's Ear	Main corridor	WT1
<i>Lolium rigidum</i>	Wimmera Ryegrass	Main corridor, Transmission line	Aggressive, WT2
<i>Lycium ferocissimum</i>	African Boxthorn	Main corridor, Transmission line	Aggressive (Declared SA), WoNS, Red Alert weed for EP, WT4
<i>Marrubium vulgare</i>	Horehound	Main corridor, Transmission line	Aggressive, Declared SA, WT3
<i>Medicago minima var. minima</i>	Little Medic	Main corridor	WT2
<i>Mesembryanthemum crystallinum</i>	Common Iceplant	Main corridor, Transmission line	Aggressive, WT2
<i>Mesembryanthemum nodiflorum</i>	Slender Iceplant	Main corridor, Transmission line	WT2
<i>Scabiosa atropurpurea</i>	Pincusion	Main corridor, Transmission line	Aggressive, WT2
<i>Sisymbrium erysimoides</i>	Smooth Mustard	Main corridor, Transmission line	WT1
<i>Sonchus oleraceus (NC)</i>	Common Sow-thistle	Main corridor, Transmission line	WT1
<i>Vulpia myuros f. myuros</i>	Rat's-tail Fescue	Main corridor	WT2

<sup>1</sup> Proclaimed status as per Natural Resources Management Act 2004, WoNS = Weed of National Significance, Aggressiveness as per Appendix 4 (DWLBC 2005), Alert threat status as per Appendix 6, BushRAT Manual for Native Vegetation, where WT1 is low weed threat and WT3-5 are Red Alert Weeds (DEWNR 2013b).

<sup>2</sup> All BDBSA records are for within 1 km of main alignment unless otherwise mentioned (e.g. additional borefield or transmission spur searches are within 5km buffer, 5 km buffer results for main corridor are in Technical Report). For further detail about records see Technical Report (Appendix O).



Boxthorn (*Lycium ferocissimum*) at patch 194 – degraded dune crest vegetation adjacent agricultural land



Horehound (*Marrubium vulgare*) in roadside vegetation



Onion weed (*Asphodelus fistulosus*) occurs throughout the project area



Common Ice plant (*Mesembryanthemum crystallinum*) occurs throughout the project area

Plate 13-10 Examples of the Weed Species Present along the Proposed Infrastructure Corridor

## Introduced Fauna

The desktop study including review of the recent biological survey of the Eyre Peninsula (Brandle 2010) identified 12 introduced fauna that may be present through the proposed infrastructure corridor area, including five mammals and seven birds. The species are listed in Table 13-9. Opportunistic observations of a number of rabbits and foxes (including pups) were made along the proposed infrastructure corridor. Foxes in particular are not only destructive for farmers, but also impact native threatened species (e.g. Malleefowl) as well as common native fauna (e.g. Spinifex Hopping Mice). It was noted that several landholders in the region have established fox bait programmes on their land.

**Table 13-9 Introduced Fauna Species along the Proposed Infrastructure Corridor**

Species Name	Common Name	Records <sup>1,2</sup> and / or Field Observation
<b>Birds</b>		
<i>Alauda arvensis</i>	Skylark	Records within 6 km
<i>Carduelis carduelis</i>	European Goldfinch	No BDBSA records
<i>Columba livia</i>	Rock Dove / Pigeon	Multiple BDBSA records, closest 1.9 km from infrastructure corridor, associated with human habitation
<i>Passer domesticus</i>	House Sparrow	Multiple BDBSA records, closest 1.9 km associated with human habitation
<i>Stigmatopelia chinensis</i>	Spotted Turtle Dove	Multiple BDBSA records, approximately 3.0 km (Port Neill).
<i>Sturnus vulgaris</i>	Common Starling	Multiple BDBSA records, closest record within 1 km
<i>Turdus merula</i>	Common Black Bird	Multiple BDBSA records, approximately 3.0 km (Port Neill), associated with human habitation
<b>Mammals</b>		
<i>Capra hircus</i>	Goat	Records within 44 km
<i>Felis catus</i>	Cat	Records within 55 km
<i>Mus musculus</i>	House Mouse	Multiple BDBSA records, 1 and 5 km from alignment, generally widespread
<i>Oryctolagus cuniculus</i>	Rabbit	One BDBSA record, 4.8 km from alignment (Darke Peak CP); plus field observations.
<i>Vulpes vulpes</i>	European Red Fox	1 BDBSA record, Darke Peak Range, 4.6 km from alignment; field observations

<sup>1</sup> Biological Database South Australia (BDBSA) records within 1 km and 5 km of project area or wider if available;

<sup>2</sup> All 12 species suggested by EPBC Act Protected Matters Search Tool, invasive species suggestions based on National Land and Water Resources Audit maps 2001 for species or species habitat potential to occur within the project area.

### 13.3.3 Port Site

#### Vegetation Communities

Typical of the broader district, the majority of the proposed port site area has been cleared for agriculture and remnant vegetation is restricted to scattered and small isolated scrub blocks on farmland and as roadside vegetation (see Plate 13-11). Subsequent weed infestations have further degraded available habitat.

Remnant vegetation within the proposed port site would have originally been defined by three broad Eyre Peninsula Communities (as per Milne et al. 2008):

- EP11.1 comprises inland Mallee and low woodlands with mid-dense sclerophyll scrub understory on limestone soils
- EP 11.2 comprises sub-coastal and coastal low mallee and woodlands with mid-dense sclerophyll on limestone soils
- EP 12.2 comprises coastal shrublands of stable dunes and cliff-top dunes.

Original compositions of these community types represent benchmarks for assessing the current condition of remnant vegetation in the area.



Plate 13-11 Typical Views of the Landscape across the Port Site, Noting Remnant Vegetation in Isolated Patches

#### Vegetation Type

Small, isolated and degraded patches of remnant vegetation are present scattered throughout the port site. Six broad vegetation types were identified during a flora and fauna survey undertaken at the site (see Figure 13-12). Additional assessments of small patches of vegetation of the port site were also undertaken as part of the infrastructure corridor field studies. Vegetation types at the port are summarised in Table 13-10 and Figure 13-12. Examples of surveyed vegetation types are shown in Plate 13-12.

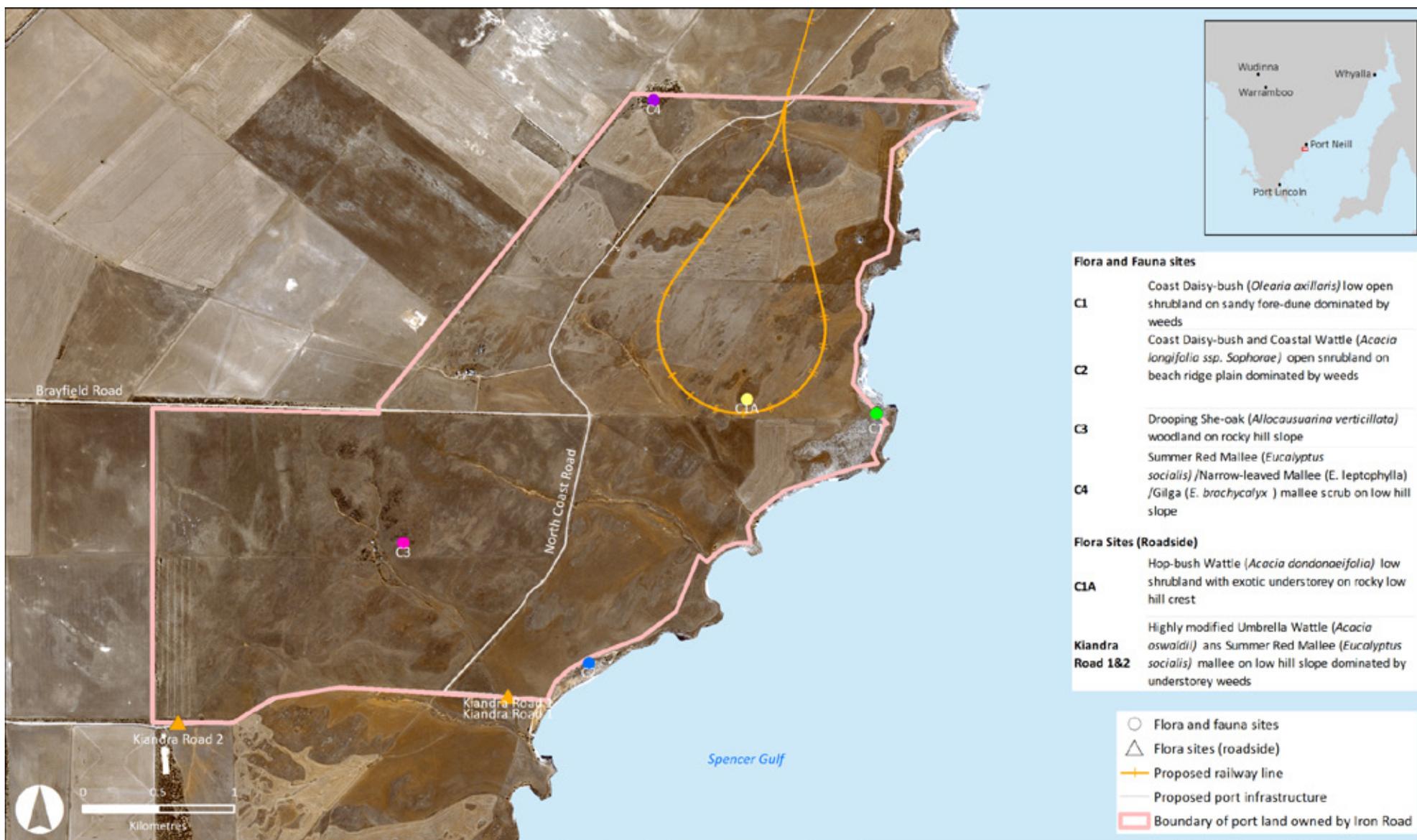


Figure 13-12 Port Flora and Fauna Survey Site Locations

Table 13-10 Summary of Vegetation Types of the Port Site

Site	Broad Vegetation Type	Vegetation Description	Original EP Vegetation Community <sup>1</sup>
C1	Coast Daisy-bush ( <i>Olearia axillaris</i> ) low open shrubland on sandy fore-dune	<i>O. axillaris</i> low open shrubland on sandy fore-dune with sparse midstorey predominantly comprising <i>Leucophyta brownii</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia candolleana</i> and <i>Maireana brevifolia</i> . Native understorey species mainly comprise <i>Dianella revoluta</i> , <i>Ficinia nodosa</i> , <i>Threlkeldia diffusa</i> and <i>Lomandra effusa</i> . Dominated by weeds.	EP 12.2
C2	Coast Daisy-bush and Coastal Wattle ( <i>Acacia longifolia</i> ssp. <i>sophorae</i> ) open shrubland on beach ridge plain	<i>O. axillaris</i> and emergent <i>Acacia longifolia</i> ssp. <i>sophorae</i> open shrubland on beach ridge plain over same midstorey and understorey species as site C1. Also dominated by weeds.	EP 12.2
C3	Drooping She-oak ( <i>Allocasuarina verticillata</i> ) woodland on rocky hill slope	<i>A. verticillata</i> woodland on rocky hill slope over dense midstorey dominated by <i>Dodonaea viscosa</i> ssp. <i>spatulata</i> , <i>Bursaria spinosa</i> and <i>Acacia oswaldii</i> . Understorey species mainly comprise <i>Austrodanthonia</i> and <i>Austrostipa</i> species, <i>Dianella revoluta</i> and <i>Vittadinia cuneata cuneata</i> .	EP 11.1
C4	Summer Red Mallee ( <i>Eucalyptus socialis</i> ) / Narrow-leaved Mallee ( <i>E. leptophylla</i> ) / Gilga ( <i>E. brachycalyx</i> ) mallee scrub on low hill slope	<i>E. socialis</i> , <i>E. leptophylla</i> , <i>E. brachycalyx</i> Mallee on low hill slope <i>Melaleuca uncinata</i> , <i>M. lanceolata</i> , <i>Pittosporum angustifolium</i> and <i>Exocarpos aphylla</i> in the midstorey. The low shrub layer dominated by <i>Enchylaena tomentosa</i> , <i>Prostanthera serpyllifolia</i> ssp. <i>microphylla</i> and <i>Rhagodia candolleana</i> . Understorey species mainly comprise <i>Austrostipa</i> species, <i>Lepidosperma carphoides</i> and <i>Triodia</i> species.	EP 11.1
C1A	Hop-bush Wattle ( <i>Acacia dodonaeifolia</i> ) low shrubland on rocky low hill crest	<i>A. dodonaeifolia</i> low shrubland with <i>Myoporum brevipes</i> , <i>Pittosporum angustifolium</i> and <i>Eremophila longifolia</i> . Understorey species mainly comprise <i>Lomandra effusa</i> and the highly invasive weed <i>Asphodelus fistulosus</i> .	EP 11.2
Kiandra Road 1 and 2	Highly modified Umbrella Wattle ( <i>Acacia oswaldii</i> ) and Summer Red Mallee ( <i>Eucalyptus socialis</i> ) mallee on low hill slope	Highly modified <i>A. oswaldii</i> and <i>E. socialis</i> mallee over sparse <i>Maireana brevifolia</i> and <i>Enchylaena tomentosa</i> in the low shrub layer, with weeds dominating the understorey, including <i>Asphodelus fistulosus</i> , <i>Euphorbia terracina</i> , <i>Brassica tournefortii</i> , <i>Avena barbata</i> and <i>Galenia pubescens</i> .	EP 11.1

<sup>1</sup> As per corresponding EP community or subgroup description based on EP Bush Condition Monitoring (Milne et al. 2008), as discussed in section 13.3.1. Note Nicolle 2013 now considers *E. foecunda* (Freemantle Mallee) on the EP is *E. leptophylla* (Narrow-leaved Mallee), changes have been made accordingly.

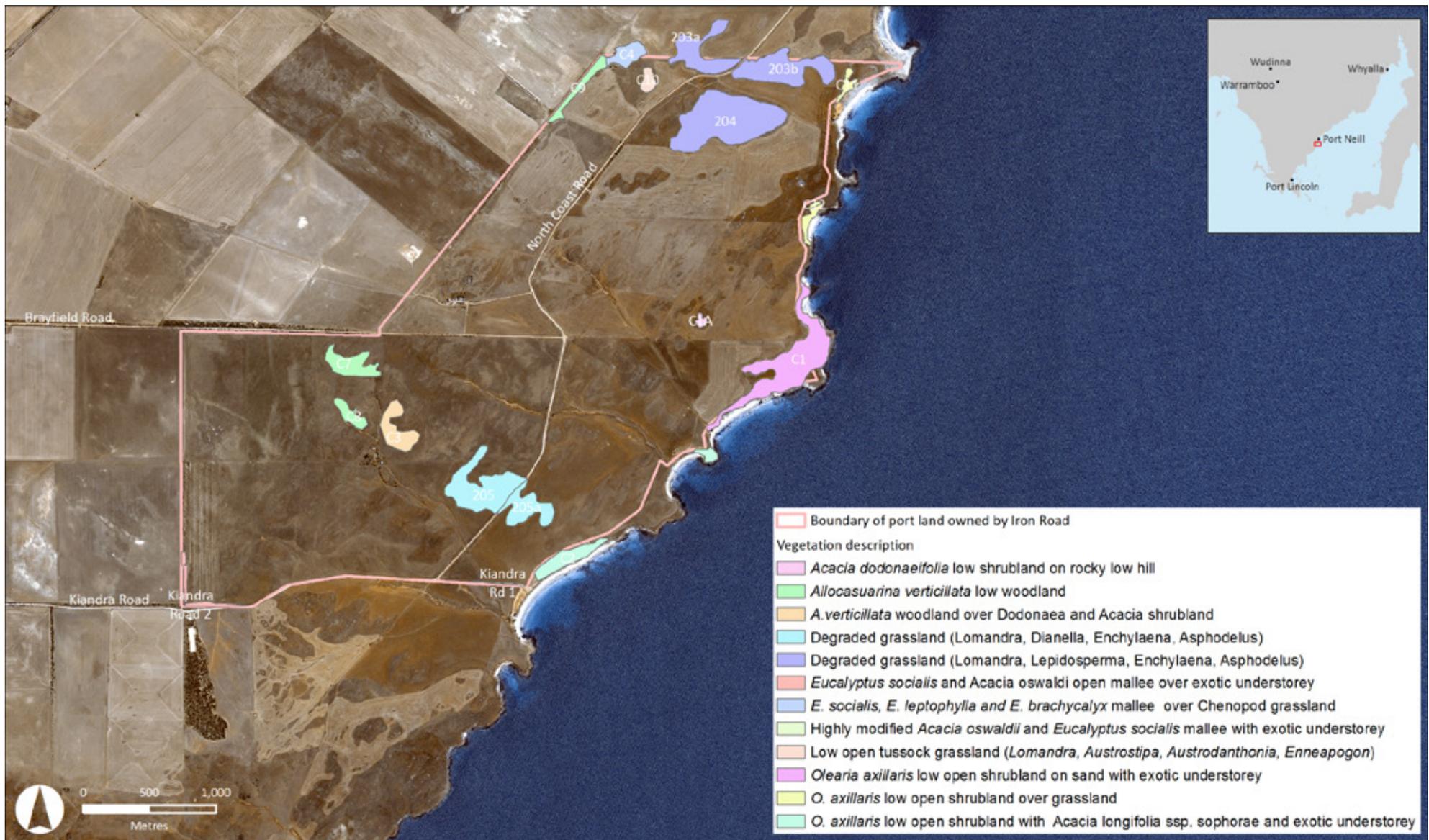


Figure 13-13 Vegetation Types at the Port Site



Coast Daisy-bush low open shrubland



Coast Daisy-bush low open shrubland and Onion Weed understorey



Drooping Sheoak woodland



Drooping Sheoak woodland



Summer Red Mallee / Narrow-leaved Mallee / Gilja mallee (avoided by project, boundary of project area)



Site C1A Hop-bush Wattle low shrubland with Onion Weed on rocky, low hill crest, adjacent cleared weed infested pasture

Plate 13-12 Examples of Surveyed Vegetation Types within the Proposed Port Site

## Vegetation Condition

The majority of native vegetation within the proposed port site is degraded and in relatively poor condition. Primary causes are historic land clearance, vegetation isolation and subsequent weed infestations, grazing impacts (sheep and rabbits) and refuse dumping (e.g. site C2). Weed invasion within remnant vegetation has been exacerbated by the size of the vegetation patches which are typically isolated blocks or coastal fringes surrounded by agricultural land. Ongoing edge effects are common in these patches and also prevalent along the road reserves. In these areas opportunities for weed invasion through diverse dispersal mechanisms have been numerous. Consequently, weeds have spread locally and are successfully competing with native species.

Degradation of vegetation structure within the understorey layer is common across the site. Common herbaceous and grassy weeds comprise the majority of weeds observed throughout the site; however, 'declared' weeds also occur (see Introduced Flora section below). The proportion of weeds compared with native species is generally high. The proportion of weedy species is lowest at sites C4 and C3 (26% and 31% respectively). The sites with highest proportionate weed diversity are Kiandra Road 1 and 2 (53 % and 58 % respectively) which is consistent with location in the road reserve and proximity to previously cleared agricultural land.

Generally, remnant vegetation throughout the area is mature, however, some recruitment is evident at Site C3 by *Allocasuarina verticillata* and *Dodonaea viscosa ssp. spatulata*. No recent fire scars are evident throughout the wider project area. Examples of vegetation are shown in Plate 13-13.



Agricultural land with isolated patches of native vegetation



Weeds (Onion Weed, Coastal Galenia) along Kiandra Road

Plate 13-13 Vegetation at the Port Site

Similar to the proposed infrastructure corridor, vegetation condition within the port area was scored using preliminary vegetation offset ratio criteria (see 13.2.2). These condition scores are presented in Table 13-11 and Figure 13-14 below, where values are representative of the poor to moderate condition observed, including the high proportion of weeds observed per site.

Table 13-11 Vegetation Condition Score for Sites in the Port Project Area

Vegetation Survey Site / Patch	Condition Indicators	Assessment <sup>2</sup>	Condition Rating <sup>1</sup>
C1	Coastal Daisybush ( <i>Olearia axillaris</i> ) low open shrubland with significantly weedy understorey. Signs of digging and grazing by rabbits. Common suite of understorey and midstorey species.	Field	4:1
C1a	Hop-bush Wattle ( <i>Acacia dodonaeifolia</i> , Rare under SA NPW Act) low open shrubland. Understorey dominated by weeds, including Boxthorn and Onion Weed. Extensively cleared surrounding landscape contributing to weed infestation.	Field	4:1
C2	Coastal Daisybush low open shrubland with emergent Coastal Wattle ( <i>Acacia longifolia ssp. sophorae</i> ) shrubland with understorey dominated by Onion Weed ( <i>Asphodelus fistulosus</i> ). Degraded site with signs of human impact - refuse dumping.	Field	2:1
C3	Drooping Sheoak ( <i>Allocasuarina verticillata</i> ) woodland with dense midstorey and diverse understorey species. Recruitment obvious. Good quality vegetation amidst extensively cleared landscape. Weeds present, including African Boxthorn and Onion Weed.	Field	6:1
C4	Mallee (Summer Red Mallee and Narrow-leaved Mallee) with mature overstorey, diverse midstorey and understorey layers. Good quality vegetation amidst extensively cleared and modified surrounding landscape. Weeds present, including Bridal Creeper.	Field	6:1
C7	Drooping Sheoak low open woodland	Desktop	4:1
C8	Drooping Sheoak low open woodland	Desktop	6:1
C9	Drooping Sheoak low open woodland	Desktop	2:1
C10, C11, 204, 205, 205a	<i>Lomandra effusa</i> , <i>Austrostipa nitida</i> and <i>A. eremophila</i> , <i>Austrodanthonia caespitosa</i> , <i>Enneapogon nigricans</i> , low open tussock grassland; <i>Acacia dodonaeifolia</i> (patch 205, 205a)	Desktop / Field	2:1
C12, 203a, 203b	<i>Lomandra effusa</i> , <i>Austrostipa nitida</i> and <i>A. eremophila</i> , <i>Austrodanthonia caespitosa</i> , <i>Enneapogon nigricans</i> , low open tussock grassland	Desktop / Field	4:1
Kiandra Road 1	Highly modified vegetation along roadside. Highly weed infested, adjacent to cleared land.	Field	1:1
Kiandra Road 2	Modified open mallee and tall very open shrubland along roadside. Highly weed infested understorey, featuring some common understorey species. Adjacent to previously cleared land. Weeds included False Caper and Bridal Creeper	Field	2:1

<sup>1</sup>Vegetation condition score, based on preliminary Significant Environmental Benefit Ratio criteria, where 6:1 is moderate, 4:1 is poor and 2:1 is very poor.

<sup>2</sup>Patches with a number were assessed as part of the Infrastructure corridor survey (Appendix O).



Figure 13-14 Vegetation Patch Condition at the Port

## Native Flora

The BDBSA has records from the proposed port site (and a surrounding buffer of 5 km due to a paucity of records) for a total of 69 flora species, including 46 native species and 23 introduced species. During the survey of the proposed port area, a total of 106 plant species were recorded, comprising 72 native and 34 introduced species. The most diverse community was found to be the *Allocasuarina verticillata* woodland occurring on sandy loam with scattered rocky outcropping on hill-slope. The least diverse community was found to be the *Olearia axillaris* low open shrubland on sand with weed dominant understorey. Species lists are provided in the technical report for the port site (Appendix P).

## Flora of Conservation Significance

The desktop assessment highlighted five EPBC Act listed flora species which could potentially occur within the proposed port site (e.g. through EPBC PMST modelled distributions and historical BDBSA records). However, no flora species listed under the EPBC Act were observed at the site during the field survey. A likelihood assessment considering all desktop results as well as survey results and current regional information (e.g. Pobke 2007, Brandle 2010) determined that one EPBC listed flora species may be present; *Acacia enterocarpa* (Jumping-jack Wattle, Endangered). The other five EPBC listed flora species (four endangered and one vulnerable) are considered unlikely to occur within the port site and surrounding buffer zone. Table 13-12 summarises the likelihood of occurrence assessment for EPBC listed flora species, and further details are provided in the technical report (Appendix P).

In addition to the EPBC flora species, four flora species that only have NPW Act ratings have historical records in the area and 5 km surrounds or were recorded during recent surveys (e.g. *Acacia dodonaeifolia* Hopbush Wattle, Plate 13-14). Of these species, one is present (e.g. Hopbush Wattle), two are possibly present (e.g. Myrtle Fanflower and Knotted Poa), but have no records within 1 km of project site, and one is considered unlikely to occur. No other floral species of conservation significance were recorded during the field survey. A summary of the species, current likelihood and associated justifications are provided in Table 13-12, with further details available in the technical report (Appendix P). Regional threatened flora records are presented in Figure 13-9 above (Section 13.3.2).



Plate 13-14 Hopbush Wattle (*Acacia dodonaeifolia*), 'Rare' Status under NPW Act, at the Proposed Port Site

Table 13-12 Summary of Likelihood Assessment for EPBC Listed Flora Species within the Port Site Area and 1 km Buffer

Species	Common Name	EPBC Act <sup>1</sup>	NPW <sup>2</sup>	Likely to Occur	Summary of Justification for Likelihood <sup>3,4</sup>
<i>Acacia dodonaeifolia</i>	Hop-bush Wattle	-	R	Present	Major populations known on the southern EP, and the Southern Lofty regions. Multiple records in the southern EP region, but not within 5km of project area. Species was observed at Site C1a, within a low shrubland on a rocky, low hill, plus multiple observations (100 plants) during subsequent survey of the southern end of the infrastructure corridor.
<i>Acacia enterocarpa</i>	Jumping-jack Wattle	EN	E	Possible	Records within 1 km. Observed as part of infrastructure corridor survey, less than 500 m from alignment. Grows in rail and pipeline reserves and roadside vegetation. Not observed at port site.
<i>Poa drummondiana</i>	Knotted Poa	-	R	Possible	No records within 1 km, records within 5 km. Regional records primarily from Hincks WPA and Hincks CP.
<i>Scaevola myrtifolia</i>	Myrtle Fan-flower	-	R	Possible	No records within 1 km, 1 record within 5 km. Not observed during survey of project area. Regional records from Lincoln Highway, Arno Bay and between Wharminda and Butler Tanks.
<i>Acacia montana</i>	Mallee Wattle	-	R	Unlikely	No records within 1 km, 2 records within 5 km. Minimal regional records. Herbarium records primarily from Northern lofty near Clare and into Murray Region. Not observed on site.
<i>Acacia pinguifolia</i>	Fat-leaved Wattle	EN	E	Unlikely	Known from 3 disjunct subpopulations (Ungarra and Butler Tanks, Cummins and Hundreds of Koppio and Hutchinson). Prefers the 400-500 mm rainfall zone, apart from two outlying recorded sub-populations that require verification.
<i>Caladenia tensa</i>	Green-comb Spider-orchid	EN	-	Unlikely	Known from south-east SA, rather than EP. Record within 5 km likely taxonomic confusion with common species <i>C. clavula</i> .
<i>Frankenia plicata</i>		EN	V	Unlikely	Generally known from further north in SA and is not expected to be present within project area. No records within 5 km.
<i>Ptilotus beckerianus</i>	Ironstone Mulla Mulla	VU	V	Unlikely	Species is endemic to SA, occurring on Kangaroo Island and lower EP. No records within 50 km of project area.
<i>Pultenaea trichophylla</i>	Tufted Bush-pea	EN	R	Unlikely	No records within 1 km and no suitable habitat identified in the project area.

<sup>1</sup> Environment Protection and Biodiversity Conservation Act 1999 Status: Endangered (EN), Vulnerable (VU);

<sup>2</sup> South Australian National Parks and Wildlife Act 1972 (NPW) Status: Endangered (E), Vulnerable (V), Rare (R);

<sup>3</sup> Records are from Biological Database of South Australia (BDBSA records) within 5 km;

<sup>4</sup> see Technical Report (Appendix P) for further detail and references.

## Native Fauna and Habitats

Highly disturbed areas occur throughout much of the proposed port site, including cleared paddocks and weed infested roadside reserves. The majority of available terrestrial habitat within the area is disturbed to some extent. However, a variety of common native fauna continue to use these remaining habitats, including mammals, reptiles and birds (see Plate 13-16). Nankeen kestrels (*Falco cenchroides*) continue to hunt for prey among weed-infested pasture, presumably house mice (*Mus musculus*). Additionally, several other bird species utilise degraded habitats, including Stubble Quail (*Coturnix pectoralis*), Willie Wagtail (*Rhipidura leucophrys*), Richard's Pipit (*Anthus novaeseelandiae*) and Spotted Pardalote (*Pardalotus punctatus*). Nankeen Night Heron (*Nycticorax caledonicus*) are also present adjacent to cleared and degraded habitat.

Native mammals that utilise the degraded habitat included the Euro (*Macropus robustus*) and the White-striped Freetail Bat (*Tadarida australis*). Thirteen common reptile species were also recorded, including the Sand Goanna (*Varanus gouldii*) and Painted Dragon (*Ctenophorus pictus*).

In general native fauna diversity was low, reflective of the highly degraded nature of the site. However, minor differences in fauna diversity were observed between habitat types across the site. Fauna diversity was highest at Site C1, a coastal dune community, and C4, a mallee community on the north eastern boundary of the project area. Site C4, being dominated by *Eucalyptus* species, had greater microhabitat resources, including more abundant leaf litter, fallen timber, flaky bark for under-bark shelter and floral resources (see Plate 13-12). Fauna diversity was lowest at Site C2 and C3, despite Site C2 representing very similar habitat to Site C1 (see Plate 13-15). Both C1 and C2 are coastal habitats, featuring large stone boulders along sandy shores. Both sites support similar vegetation communities, dominated by low open *Olearia axillaris* shrubland, with typical coastal understorey species. Both sites have been subject to disturbance through weed invasion and clearance of adjacent vegetation for cropping land.



Shoreline adjacent Site C1 had greater diversity of fauna, including marine birds



Shoreline adjacent Site C2 had the lowest diversity of fauna

Plate 13-15 Coastal Sites within the Proposed Port Development Area

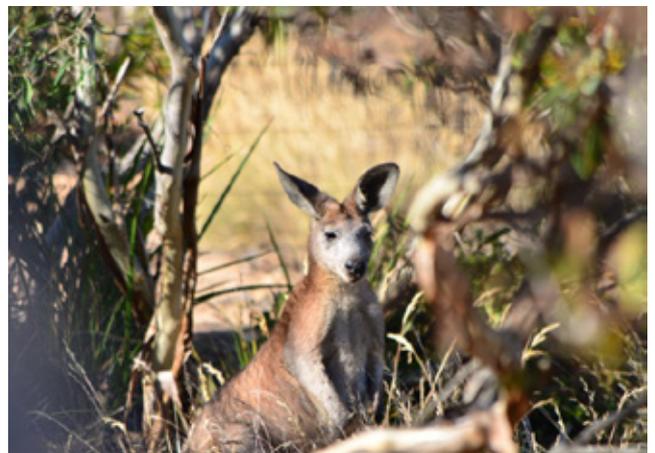


Plate 13-16 Common Fauna of the Proposed Port Development Site

### Fauna of Conservation Significance

The desktop assessment considered 40 EPBC listed terrestrial fauna species as potentially occurring at the proposed port site (e.g. through EPBC PMST and historical BDBSA records). Based on a review of historical records, current known distributions, and data from field surveys in the area, the following was determined:

- Thirteen EPBC listed fauna are confirmed as present at the proposed port site. Of these 13 species, four are threatened and / or migratory under the EPBC Act (Caspian Tern, Common Sandpiper, Hooded Plover and White-bellied Sea-eagle). The remaining nine species have 'Listed Marine' status only, apart from the Rock Parrot which also has status under the NPW Act.
- Ten EPBC listed fauna (all bird species) are considered possibly present at the site.
- Seventeen EPBC listed fauna (mostly Migratory or Listed Marine birds) are considered unlikely to occur in the project area.

Table 13-13 summarises the conservation status of confirmed present and possibly present EPBC listed fauna species considered for the site. Those with Listed Marine status only are not provided conservation protection when in a terrestrial environment, but are discussed further in Chapter 14, the Marine and Coastal Environment. Fauna species considered unlikely to occur and associated justifications are summarised in the technical report Appendix P.

Likelihood assessments were also conducted for species with only state conservation significance under the NPW Act, which highlighted the following:

- Four fauna listed under the NPW Act possibly occur or may occur as visitors; including the Australian Pied Oyster Catcher, Peregrine Falcon, Sooty Oyster Catcher and the Slender-billed Thornbill.
- Two other fauna with NPW Act status have historical records near the port site, but were considered unlikely to be present, based on lack of preferred habitat (Australian Bustard) and known vagrant status on the Eyre Peninsula (Brown Quail).

Further details about these state listed species and justification for likelihood of presence are summarised in the technical report (Appendix P). Regional threatened and migratory fauna records are presented in Figure 13-10 above (Section 13.3.2).



Plate 13-17 Pacific Gull (Listed Marine) and Hooded Plover (Vulnerable and LM) Observed Site C2 of the Port Site

Table 13-13 EPBC Listed Fauna Species Present or Potentially Present at the Proposed Port Site

Species Name	Common Name	AUS <sup>1</sup>	SA <sup>2</sup>	Likely to Occur?	Summary of Justification for Likelihood of Presence <sup>3,4</sup>
<i>Pelecanus conspicillatus</i>	Australian Pelican	LM	-	Present	Occurs throughout Australia. Was observed at Site C2, which is directly adjacent to coastline. Conspicuous and mobile.
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo Shrike	LM	-	Present	Inhabits open woodland and forest habitats throughout Australia. Was observed at Site C4. Widespread and mobile species.
<i>Sterna caspia</i> (now <i>Hydroprogne caspia</i> )	Caspian Tern	LM, MM		Present	Global species. Occurs commonly on the EP, particularly on off-shore Islands, and breeding sites are widely distributed in SA. Observed at Site C1 during field survey. No signs of breeding or nesting were observed.
<i>Actis hypoleucos</i>	Common Sandpiper	LM, MM	R	Present	Global shorebird, uses coastal habitats. Record within 5 km. Observed during field survey at site C1. Highly mobile species.
<i>Thinornis rubricollis rubricollis</i>	Hooded Plover (eastern)	LM, V	V	Present	Mainly occurs on coastal stretches of SE Australia, with over 60% of the SA population occurring on Kangaroo Island and the Yorke Peninsula (TSSC 2014). In addition, recent Hooded Plover surveys on the EP indicate that local EP population is larger than previously thought (G. Kerr pers. com.). Breeds on upper levels of beaches and foredunes, including stony terraces and sparsely vegetated dunes. Utilises large breeding territories of up to 37 ha, and utilises both non-breeding and breeding sites along the coastline. A number of natural and human induced threats can reduce breeding success; pairs may remain at sites and breed year after year or abandon sites after breeding failures <sup>5</sup> . Some suitable habitat occurs near the coast of the port site. Historic records within 5 km, primarily near Port Neil and more recent records all along the coast (see Figure 13-11). One pair observed during field survey at site C1 (See Plate 13-17). Significant conservation activities are being undertaken at the national and state level for this species, but recovery plans are still required. Impacts to the species as a whole are unlikely.
<i>Corvus mellori</i>	Little Raven	LM	-	Present	Habitat generalist, occupies a wide range of habitat types. Observed in all fauna trapping locations. Highly mobile species.
<i>Falco cenchroides</i>	Nankeen Kestrel	LM	-	Present	Cosmopolitan species, occupies many different habitats throughout Australia. Observed at Site C1, C2 and C4.
<i>Nycticorax caledonicus</i>	Nankeen Night Heron	LM	-	Present	Occupies creek lines, intertidal flats, estuaries and other water bodies. Broad range across the eastern half of Australia and coastal areas along the west coast. Overwintering range includes EP, but breeding does not occur in SA. Observed west of Site C3. Conspicuous and mobile species, likely to be rare and occasional visitor to the area.

Species Name	Common Name	AUS <sup>1</sup>	SA <sup>2</sup>	Likely to Occur?	Summary of Justification for Likelihood of Presence <sup>3,4</sup>
<i>Larus pacificus</i>	Pacific Gull	LM	-	Present	Uses coastal habitats, reefs and scavenge within human waste collection areas. Observed at Site C1 and C2 (See Plate 13-17). Records within 5 km. Highly mobile locally common species.
<i>Neophema petrophila</i>	Rock Parrot	LM	R	Present	Little known about the ecology and current population status of this species in SA. But known to breed on coastal off-shore islands of the EP and disperse to mainland coastal habitats. Record within 5 km. Species observed near site C1. Highly mobile species.
<i>Chroicocephalus novaehollandiae</i>	Silver Gull	LM	-	Present	Uses wide range of coastal habitats and is frequently seen inland and in urban environments. Common species known to occur in high numbers on EP. Highly mobile and common species was observed at coastal sites C1 and C2. Name changed from <i>Larus novaehollandiae</i> .
<i>Coturnix pectoralis</i>	Stubble Quail	LM	-	Present	Occupies many habitats, including cropping land, natural grasslands, and low shrublands. Has wide distribution in Australia. Observed at Site C1 during the field survey. No records within 20 km of the Port Site project area.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	MT, LM	E	Present	Uses many habitat types, particularly coastal regions. Observed during field study of Port Site. Records within 5 km. Species is intolerant to disturbance. No nesting pairs observed in project area.
<i>Phalacrocorax fuscescens</i>	Black-faced Cormorant	LM	-	Possible	Inhabits marine habitats. Highly mobile species, which is sedentary when not feeding.
<i>Cereopsis novaehollandiae</i>	Cape Barren Goose	LM	R	Possible	Records within 5 km. Opportunistically observed north of Port Lincoln in agricultural land during field surveys 2011 / 2012 for the infrastructure corridor. Conspicuous mobile species.
<i>Ardea ibis</i>	Cattle Egret	MT, LM	R	Possible	Suitable pasture habitat present within cleared areas of project area, but no permanent wetland habitat. No records within 5 km. Highly mobile species.
<i>Sternula nereis nereis</i>	Fairy Tern (Australian)	VU, LM	E	Possible	Occurs in coastal habitats. Suitable habitat present within project area. Record within 5 km. Highly mobile species.
<i>Apus pacificus</i>	Fork-tailed Swift	MM, LM	-	Possible	Uses many habitat types, including coasts, arid areas and urban areas. Records within 5 km. Highly mobile species.
<i>Eudyptula minor</i>	Little Penguin	LM	-	Possible	Occurs frequently throughout southern Australia. Feeds in coastal bays and open water, and known to breed in rocky, cliff crevices, sandy and vegetated dunes. Not observed during the field survey, but suitable habitat present.

Species Name	Common Name	AUS <sup>1</sup>	SA <sup>2</sup>	Likely to Occur?	Summary of Justification for Likelihood of Presence <sup>3,4</sup>
<i>Pandion haliaetus</i> (now <i>crystatus</i> )	Osprey	LM, MM	E	Possible	Uses coastal habitats, including elevated coastal cliffs exposed sites, sea stacks, elevated habitats. Suitable nesting habitat not observed during field assessments, but may occur within project area nearer coast. Record, for <i>Pandion cristatus</i> (Eastern Osprey) within 5 km. Taxonomy of species is controversial <sup>4</sup> .
<i>Pluvialis fulva</i>	Pacific Golden Plover	LM, MM	R	Possible	Global shorebird, highly mobile and migrates annually from Siberia (where breeding occurs). Records within 6 km of the project area. Some appropriate habitat near the coastal section of corridor.
<i>Merops ornatus</i>	Rainbow Bee-eater	MT, LM		Possible	Uses a wide range of habitats. Widely distributed throughout Australia. No records within 5 km. Suitable habitat present within the project area. Highly mobile species.
<i>Arenaria interpres</i>	Ruddy Turnstone	LM, MM	R	Possible	Migratory shorebird that breeds in Arctic Tundra across the globe and migrates to a number of continents, including Australia. Some suitable habitat near the coast, particularly site C1 and C2. Records within 5 km. Highly mobile species.

<sup>1</sup> Environment Protection and Biodiversity Conservation Act 1999 Status: Endangered (EN), Vulnerable (VU), Migratory Marine (MM), Migratory Terrestrial, (MT), Migratory Wetland (MW), Listed Marine (LM);

<sup>2</sup> South Australian National Parks and Wildlife Act 1972 (NPWA) Status: R, Rare; V, Vulnerable; E, Endangered

<sup>3</sup> Records are from BDBSA = Biological Database South Australia records obtained 2011, 2013;

<sup>4</sup> For further detail and references see Appendix P;

<sup>5</sup> Hooded Plover Conservation Advice (TSSC 2014).

Note: the EPBC rating of 'Listed Marine' relates to the protection of a species only within Commonwealth waters (between 3 and 12 nautical miles from the coast). The project area for this chapter is terrestrial, therefore the following species highlighted by the EPBC PMST are not applicable as they are not listed under other EPBC status (e.g. Migratory or threatened) or NPW status, namely: the Australian Pelican, Black-faced cuckoo Shrike, Black-faced Cormorant, Little Penguin, Little Raven, Nankeen Kestrel, Nankeen Night Heron, Pacific Gull, Stubble Quail and Silver Gull.

## Introduced Flora

The desktop study revealed six significant weeds that could potentially occur at the proposed port site (EPBC Protected Matters database). These weeds included Bridal Creeper (*Asparagus asparagoides f. asparagoides*), Boneseed (*Chrysanthemoides monilifera ssp. Monilifera*), African Boxthorn (*Lycium ferocissimum*), Olive (*Olea europaea*), Blackberry (*Rubus fruticosus aggregate*) and Gorse (*Ulex europaeus*). These weeds are all 'Declared' in South Australia and are all known to exist in the greater Eyre Peninsula region (DEH 2002, Brandle 2010). Bridal Creeper, Boneseed, African Boxthorn, Blackberry and Gorse are also recognised as Weeds of National Significance (WoNS).

Recent records (i.e. within the last 20 years) from the BDBSA indicate that 23 exotic flora species have previously been recorded within 1 km of the project area, and 49 exotic flora species have been recorded within a wider search area of 5 km. The majority of these records are for minor weeds, but several Red Alert Weeds and Declared weeds have been recorded (e.g., Horehound (*Marrubium vulgare*) and Boxthorn, (*Lycium ferocissimum*)). The field assessment of the proposed port site identified 34 exotic flora species including highly invasive 'declared' species such as Bridal Creeper, Boxthorn, Horehound and False Caper. Onion Weed, also a 'declared weed' in some parts of the state, was also prevalent throughout. Other weeds that were particularly common in the understorey, included Cat's Ear, Wild Turnip, Sow-thistle, Coastal Galenia, Perennial Veldt Grass and other exotic grasses. Blackberry, Gorse and Olive were not located in the project area. The high number of weeds identified within the project area is consistent with the historic land use at the site. Further discussion and a summary of the introduced species of the port site, identified through desktop (1 km buffer) and field assessment, are summarised in Appendix P.

## Introduced Fauna

Eleven introduced animal species are identified as potentially present at the proposed port site based on regional records and PMST suggestion (DEH 2002; Brandle 2010). This includes four mammals and seven birds. Eight of these species (four mammals and four birds) were observed at the site during the field study. The species are summarised in Table 13-14 below.

Table 13-14 Introduced Fauna Species with Potential<sup>1</sup> or Recorded Presence at the Port Site

Species Name	Common Name	Records <sup>2</sup> and / or Field Observations
<b>Birds</b>		
<i>Turdus merula</i>	Common Blackbird	Records within 5 km (1998-2001), but not within project area; observed during field survey.
<i>Sturnus vulgaris</i>	Common Starling	Records within 5 km (1998-2007); confirmed during survey.
<i>Carduelis Carduelis</i>	European Goldfinch	No records within region; not observed during survey.
<i>Passer domesticus</i>	House Sparrow	Records within 5 km (1998-2001); not observed during survey.
<i>Columbia livia</i>	Rock Pigeon	No records within project area, records within 5 km (1998-2001); not observed during field survey
<i>Alauda arvensis</i>	Skylark	No records within project area, 1 record 4.2 km (2007); observed during survey.
<i>Stigmatopelia / Streptopelia chinensis</i>	Spotted Turtle Dove	No records within project area. Nearest records 4.5 km (1998-2001); observed during field survey.
<b>Mammals</b>		
<i>Felis catus</i>	Cat	No records within project area, record within 5 km (2008); observed during field survey.
<i>Vulpes vulpes</i>	European Red Fox	No records within 5 km, nearest records > 19km 2004; observed during field survey.

Species Name	Common Name	Records <sup>2</sup> and / or Field Observations
<i>Mus musculus</i>	House Mouse	Nearest records 5.1 km (2008); observed in field.
<i>Oryctolagus cuniculus</i>	Rabbit	No records within project area, record within 5 km (2008); observed during field survey.

<sup>1</sup> EPBC Act Protected Matters Search Tool invasive species modelled suggestions based on National Land and Water Resources Audit maps 2001;

<sup>2</sup> Biological Database South Australia (BDBSA) records to 2013 within 1-5 km of project area.

### 13.3.4 Long-Term Employee Village

#### Vegetation Type

The allotments proposed for the long-term employee village are cropping / grazing paddocks immediately adjacent the township of Wudinna. The total size of these paddocks is approximately 78 ha of which only an area of up to 5 ha is required for the development of the village (see Chapter 4). The paddocks have been cleared and native vegetation is restricted to two single Mallee trees (Plate 13-18). The northern allotment is bordered by Standley Road on the southern boundary and Edmonds Road on the western side. Thin strips of remnant mallee vegetation that occur along both roads are comprised of Red Mallee (*Eucalyptus oleosa*) / White Mallee (*E. gracilis*) mallee with Boree (*Melaleuca pauperiflora* ssp. *mutica*), Weeping Pittosporum (*Pittosporum angustifolium*) and Desert Cassia (*Senna artemisioides filifolia*) (see Plate 13-19 and Plate 13-20). Exotic species are common in the understorey including Wild Oats (*Avena fatua*), Wild Turnip (*Brassica tournefortii*) and Ice Plant (*Mesembryanthemum nodiflorum*).



Plate 13-18 Proposed Site for Long-Term Employee Village, Northern Allotment



Plate 13-19 Remnant Roadside Vegetation of Red Mallee (*Eucalyptus oleosa*) / White Mallee (*E. gracilis*) Open Woodland looking SE along Edmonds Road



Plate 13-20 Roadside Vegetation Adjacent to Proposed Village Site (on left) looking East along Standley Road

### **Vegetation Condition**

No threatened plant species or communities were recorded and the roadside vegetation was assessed to be in moderate condition (SEB ratio 6:1) as indicated by:

- Vegetation structure altered (ground storey depleted)
- Obvious signs of disturbance (e.g. tracks, bare ground)
- Minor clearing (<10% of area)
- Considerable weed infestations

### **Flora of Conservation Significance**

Given the site location is agricultural land with minimal roadside vegetation along the southern and western boundaries, it is unlikely that flora of conservation significance would occur. If threatened flora species do occur, they are likely to occur as isolated individuals. The site does not contain the quantity and quality of native vegetation to support viable populations of threatened flora species with status under the EPBC Act or the state NPW Act.

### **Fauna of Conservation Significance**

For the same reasons as stated above, it is unlikely that fauna of conservation significance would occur at the proposed long-term employee village site. If threatened fauna species do occur, they are likely to occur as isolated individuals or occasional visitors. The site does not contain the quantity and quality of native vegetation (as habitat and resources) to support viable populations of threatened fauna species with status under either the EPBC Act or the state NPW Act.

### **Introduced Flora**

Exotic species that were noted as occurring commonly in the understorey of the roadside vegetation adjacent this site included Wild Oats (*Avena fatua*), Wild Turnip (*Brassica tournefortii*) and Ice Plant (*Mesembryanthemum nodiflorum*).

### **Introduced Fauna**

This site is primarily agricultural land, bounded on two sides by a thin strip of degraded remnant vegetation on the edge of a peri-urban environment. It is likely that introduced fauna such as rabbits, foxes, feral birds and mice occur in this area.

## **13.3.5 Summary of Key Environmental Values**

Section 13.3 describes the existing environment with regard to biodiversity values and threats. The key environmental values identified include:

- Flora and fauna species with National conservation significance, as listed under the EPBC Act
- Flora and fauna species with State conservation significance, as listed under the NPW Act
- Native vegetation communities and habitat value
- Common native fauna and flora

## 13.4 Design Measures to Protect Environmental Values

The design of the CEIP Infrastructure has incorporated several measures to minimise impacts to environmental values. These are summarised below.

### 13.4.1 Proposed Infrastructure Corridor

The design of the proposed railway line and its subsequent operation includes the following measures to minimise impacts to environmental values:

#### Proposed Railway Line

- Route selected to generally avoid known areas of high ecological value such as conservation parks, reserves, vegetation heritage agreement areas and other areas known to contain higher likelihood of occurrence of threatened species (e.g., Jumping-Jack Wattle and Darke Peak Mallee respectively).
- One section of the infrastructure corridor is directly adjacent the northern boundary of Hambidge WPA, which is an area of high ecological value. This section of the corridor passes through agricultural land, but does not utilise an existing road. A 10m maintenance track will serve as a buffer (weeds and fire) between the rail component of the infrastructure corridor and the boundary fence of the WPA.
- Proposed infrastructure corridor width minimised where possible (whilst enabling the safe development of required infrastructure) to minimise disturbance footprint.
- Infrastructure components co-located within a single corridor to minimise overall project footprint wherever practicable.
- Utilising existing road corridors or other land devoid of native vegetation wherever possible.
- Establishment of designated maintenance tracks, light vehicle roads and vehicle lay down areas in locations which minimise vegetation clearance, to restrict vegetation impacts to designated areas and minimise ongoing disturbance.
- Dust design measures as per Chapter 10 to minimise impacts to flora habitat via dust impacts to vegetation.
- Location of transmission line in Section of Infrastructure Corridor north of Hambidge WPA to provide a minimum buffer of 35 m from northern boundary fence of Hambidge WPA (to rail track) to reduce bushfire risk. Noting that there is also an existing fire break of 20 m within Hambidge WPA.
- Determination of offset requirements to compensate for ecological impacts from the proposed project.
- Design of rail crossing and access points for emergency vehicles.

#### Proposed Borefield and Water Pipeline

- Bore locations sited within road reserves avoiding native vegetation where practicable.
- Borefield eliminates need for water pipeline that extends to the port, reducing the width of the infrastructure corridor in the southern portion, and therefore the overall project footprint.
- Pipeline located with other infrastructure (e.g. rail, transmission line) to minimise overall project footprint.

#### Proposed Power Transmission Line

- Proposed power transmission line from Yadnarie to follow existing ElectraNet transmission line where possible, thereby utilizing land where vegetation is already cleared and / or degraded.
- Use of poles rather than towers to further minimise footprint.

- Proposed power transmission line to be designed to reduce fire risk (e.g. through use of dampers and spreaders).

#### **Long-Term Employee Village**

- The long-term employee village site selected to avoid known areas of ecological value.

### **13.4.2 Proposed Port Development**

The design of the proposed port development includes the following measures:

- Port location selected to avoid terrestrial and marine environmental values.
- Identification and mapping of known NPW flora species at the port site (e.g., Hop-bush Wattle) undertaken to avoid where possible.
- Establishments of designated vehicle roads and lay-down areas to restrict vegetation clearance to designated areas.
- Surface water and drainage management to maintain natural flows as per Chapter 15.
- Lighting design methodologies to minimise unnecessary night lighting impacts to fauna (e.g. bats and nocturnal birds). Light spill will be reduced wherever practicable by managing spread and direction of lighting, using screens and directional lighting and avoiding use of UV wavelength insect attracting light globes.
- Noise design measures as per Chapter 12.
- Dust design measures as per Chapter 10.

## **13.5 Impact Assessment**

This section assesses impacts on terrestrial ecological values (flora and fauna) that would result from the construction and operation of the proposed CEIP Infrastructure.

Impacts have been assessed in accordance with the impact assessment methodology outlined in Chapter 9 and Section 13.2. A summary table of key impacts is provided in Section 13.5.11.

### **13.5.1 Sources of Impacts**

Impacts to flora and fauna associated with the proposed CEIP Infrastructure may result from construction activities, rail transport of the iron concentrate and port operations. The sources of impacts for each project component are summarised below.

During construction, flora and fauna (including threatened species) could be impacted by:

- Vegetation clearance required for construction (13.5.2)
- Habitat fragmentation as a result of vegetation clearance (13.5.3)
- Direct or indirect disturbance (listed flora) (13.5.4)
- Direct or indirect mortality (general fauna and conservation significant species) (13.5.5)
- Light disturbance (fauna) (13.5.6)
- Noise disturbance (fauna) (13.5.7)
- Dust emissions (vegetation) (13.5.8)
- Recreational activities in the region (13.5.9)
- Listed ecological communities (13.5.10)

A summary table of these impacts and the level of impact is provided in Section 13.5.11.

In addition, there are impacts from the project that are considered to be risks, and these are discussed the end of this section, including the following:

- Spread of existing weeds and introduction of new weeds
- Vertebrate pests and overabundant native species
- Bushfire impacts to vegetation and fauna

### 13.5.2 Vegetation Clearance

Clearance of native vegetation will be required for various components of the proposed port development and infrastructure corridor. A large portion of the remaining vegetation in the region occurs in conservation reserves (which are avoided by the project), strips of roadside vegetation (in poor to moderate condition) and on dune crests surrounded by agricultural land devoid of native vegetation. Clearance of vegetation will be minimised wherever practicable, primarily through placement of project components in areas already devoid of native vegetation such as cleared paddocks. At the port site clearance of coastal shrubland (mostly degraded) would be restricted to the construction of the conveyor leading to the required jetty infrastructure. Other areas classified as native grassland at the port site are highly degraded areas within agricultural properties. The proposed port development and infrastructure corridor combined would result in a maximum of 98.4 ha of native vegetation clearance, discussed further below.

#### Infrastructure Corridor

Total vegetation clearance required for the proposed infrastructure corridor (including the borefield and transmission line from Yadnarie) is 81.4 ha, assuming all native vegetation beneath the project footprint is cleared (see Table 13-15, Table 13-16). The assumptions for the clearance estimate are based on the following:

- The proposed corridor includes an earthworks footprint to account for required cut and fill for the railway line, plus a 10 m buffer to the west to allow for construction, and a 30 m buffer to the east to allow for the rail maintenance track, the water pipeline and construction leeway.
- The southern section of the alignment which does not include the water pipeline allows for a reduced buffer of 20 m on the eastern side of the earthworks footprint to allow for the rail maintenance track and leeway for construction. The 10 m buffer beyond the earthworks footprint on the western side remains.
- The borefield and water pipeline leading into the main corridor have assumed a conservative 10 m buffer either side of 2 x 2 m bore hole locations to allow for drilling and construction, a 10 m buffer around all borefield associated infrastructure to allow for construction, and a 10 m buffer either side of the pipeline to allow for construction. Native vegetation will be avoided where practicable.
- The transmission line footprint allows for poles and associated pads every 300 m (a conservative estimate as the design indicates towers every 400 m). Clearance estimates have conservatively assumed no specific placement to avoid vegetation, and assumed a pole footprint of 10 x 10 m with a 10 m buffer surrounding to allow for laydown of materials and construction (i.e. a clearance footprint of 30 x 30 m for each pole location). It is assumed that no vegetation clearance will be required between towers.

The maximum area of IBRA vegetation associations that will be cleared is <0.1%, (see Table 13-15). The IBRA association that will have the greatest percentage of clearance is Waretta (0.08%) and Hambidge (0.05%) of which 73,287 ha (all Hambidge) is protected elsewhere in the region. It should be noted that no clearance is required in conservation reserves or Heritage Agreement areas (see Figure 13-1). A small number of vegetation patches that are existing Significant Environmental Offsets occur within the vicinity of the infrastructure corridor near Verran and Cape Hardy, if clearance is required in these areas it will be compensated within the overall project environmental offset.

Table 13-16 shows estimated condition of vegetation to be cleared, based on the clearance assumptions outlined above. Over 50% of the native vegetation within the patches that intercept the corridor has been assessed in the field (accessible patches and roadside vegetation). The other 50% has been conservatively inferred based on proximity to assessed patches, apparent vegetation density assessed via aerial imagery, size and contiguity of patch, surrounding land use and DEWNR vegetation layer. The condition criteria allocated to inferred patches are likely to be an overestimate of condition, given that a large portion of the patches that were missed were primarily highly fragmented patches that were on dune crests within the middle of paddocks, subject to multiple edge effects (including invasion of pasture weeds) and ongoing stock grazing.

Based on the above, vegetation clearance within the infrastructure corridor footprint is likely to have a long-term impact on environmental values within the project area. Therefore, vegetation clearance for the construction and operation of the infrastructure corridor is considered to have a **medium** impact, though it is noted that the SEB Offset for the project will mitigate these impacts to some degree.

**Table 13-15 Estimated Vegetation Clearance within Infrastructure Corridor (by IBRA association)**

IBRA Vegetation Association	Remnant Regional IBRA (ha) <sup>1</sup>	Infrastructure Corridor Native Vegetation (ha)	Transmission Line Native Vegetation (ha) <sup>3</sup>	Borefield Native Vegetation (ha) <sup>3</sup>	Maximum Clearance (ha) <sup>4</sup>	% Remnant IBRA Vegetation Clearance
Butler <sup>2</sup>	5,127	4.9			4.9	0.1
Cleve	17,456		0.6		0.5	<0.1
Hambidge	99,967	47.4	2.7	0.1	50.1	0.1
Koongawa	188,448	10.8	0.7		11.5	<0.1
Waretta	1,501	1.3			1.3	0.1
Wharminda	6,179	13.2			13.2	<0.01
TOTAL	318,678	77.4	4	0.1	81.4	<0.1% <sup>5</sup>

<sup>1</sup> Remnant statistics provided by DEWNR 2013 - amount of native vegetation that remains in the region; <sup>2</sup> mapped area of this association is already cleared / devoid of native vegetation. <sup>3</sup> Refer to clearance assumptions above; <sup>5</sup> Percentage calculation of maximum hectares to be cleared by remnant hectares IBRA in the region.

**Table 13-16 Estimated Vegetation Clearance within Infrastructure Corridor based on Condition**

Condition Rating <sup>1</sup>	Total Native Vegetation Intersecting Corridor (ha) <sup>2</sup>	Maximum Clearance Required for Project Footprint (Ha) <sup>2</sup>
10:1 (Excellent)	0	0
8:1 (Good)	109.9	10.6
6:1 (Moderate)	450.4	34.7
4:1 (Poor)	415	33.1
2:1 (Very Poor)	24.7	3
TOTAL	1000	81.4

<sup>1</sup> Categories based on disturbance levels and diversity as per DLWBC 2005;

<sup>2</sup> Condition estimates based on ground-truthed sites as per Appendix O, aerial imagery review, density and cover of vegetation, DEWNR vegetation layer, size of patch, contiguity of patch, final footprint (see Section 13.2.1 methods).

## Port

Total vegetation clearance at the port would be 17 ha which assumes the following:

- All vegetation beneath the entire project footprint is cleared (including infrastructure, roads, conveyors and stockpiles) and a 10 m buffer has been included around all project components to allow for construction. The exception to this is fencelines where a 5 m buffer has been allowed.
- The proposed clearance area at the port includes an earthworks footprint for the rail loop to account for required cut and fill for the railway line. The 10 m buffer is included outside of the earthworks footprint to allow for construction.

The location of vegetation and the final infrastructure footprint at the port site is shown on Figure 13-15 and Figure 13-16. Table 13-17 below indicates that the maximum area of IBRA vegetation associations (Waretta and Butler) that will be cleared as a result of the proposed port development is <1%.

Table 13-18 shows the area of vegetation to be cleared in relation to vegetation condition at the port site. The majority of clearance is estimated to be of vegetation that is in poor to very poor condition. Any native vegetation that is cleared will be offset in accordance with the Native Vegetation Act.

Based on the above, vegetation clearance within the port footprint is likely to have a negative impact on limited environmental values within the area of the proposed port site, therefore vegetation clearance for the construction and operation of the port is considered to have a **low** impact.

**Table 13-17 Estimated Vegetation Clearance at Port Site (by IBRA associations)**

IBRA Vegetation Association	Remnant Regional IBRA (ha) <sup>1</sup>	Total Native Vegetation Within Project Boundary <sup>2</sup> (ha)	Vegetation Clearance Within Footprint (ha) <sup>3</sup>	% Remnant IBRA Vegetation Clearance <sup>2</sup>
Butler	5,127	8.7	2.2	<0.1
Waretta	1,501	112.3	14.7	1
TOTAL	6,628	121	17	<1%

<sup>1</sup>Remanancy statistics provided by DEWNR 2013 - amount of native vegetation that occurs in the region; <sup>2</sup> based on DEWNR vegetation GIS data layer and assessment of aerial imagery of vegetation within project boundary; <sup>3</sup> Assumes clearance of all native vegetation within infrastructure footprint and a 10 m buffer (a conservative estimate as some of the grassland 'vegetation' in the data layer is actually agricultural land).

**Table 13-18 Estimated Vegetation Clearance at the Port Site Based on Condition**

Condition Rating <sup>1</sup>	Total Native Vegetation Within Project Footprint (ha) <sup>2</sup>	Maximum Clearance Required for Project Footprint (ha)
10:1 (Excellent)	0	0
8:1 (Good)	0	0
6:1 (Moderate)	11.49	0.02
4:1 (Poor)	49.11	4.7
2:1 (Very Poor)	60.16	12.25
TOTAL	121	17

<sup>1</sup> As per DLWBC 2005 categories based on disturbance levels and diversity; <sup>2</sup> Vegetation condition estimate based on field assessment and knowledge of site, aerial imagery, vegetation cover, surrounding land use and inferred from ground-truthed patches.



Figure 13-15 Port Vegetation Condition Overlay with Clearance Footprint (including buffer)



Figure 13-16 Native Vegetation and Clearance Requirement at the Port

### 13.5.3 Habitat Fragmentation

Remaining native vegetation in the region is already highly fragmented and concentrated in areas usually less suited to agriculture (DEH 2002). Remnant vegetation is largely conserved within the reserves of the region (e.g., Hambidge WPA, Hincks CP and WPA, vegetation Heritage Agreements). Other remnants persist along roadsides or as scattered trees within farmland (DEH 2002) and on dune crests surrounded by pasture. The size of many of the vegetation fragments scattered across the region are too small to support a number of conservation listed species and unlikely to sustain viable populations of many species in the long term (DEH 2002). In addition, most of these small blocks or patches are subject to ongoing edge effects and impacts from weeds and pest animals, so continued degradation is likely. However, small and narrow blocks can facilitate movement for small mammals and reptiles and act as 'stepping stones' between larger viable blocks for some species.

Vegetation clearance as part of the project will marginally increase the fragmentation of vegetation blocks across the landscape. However, the proposed offset (required under the Native Vegetation Act for clearance of native vegetation) presents an opportunity to increase the quality of remaining vegetation and potentially increase the size of some remaining blocks (e.g. via revegetation buffers and links), thus increasing the viability and sustainability of these fragments to support the flora and fauna species of the region. Other offset activities, such as contribution to weed and pest management in the region, can also reduce the existing edge effects of selected smaller vegetation blocks in the region.

Whilst clearance of some regional vegetation (primarily degraded) may have short-term impacts in the region, the proposed offset activities will provide positive long lasting benefits to the region. Similarly, construction of rail and water pipelines may provide barriers to movement for small mammals and reptiles in the short term. In the long-term revegetation of corridors and buffers along the infrastructure corridor has the potential to facilitate movement and will allow fauna species to disperse more widely in the region. The primarily north south orientation of the corridor represents an important opportunity for critical habitat linkages in a region subjected to increasing pressures from climate change.

Based on the above the impacts of habitat fragmentation associated with CEIP Infrastructure components are summarised below.

#### Infrastructure Corridor Construction and Operation

- Remnant vegetation at the site is limited and the majority is in poor to moderate condition.
- Remnant vegetation is unlikely to provide critical habitat or resources for threatened flora and fauna species, but may provide habitat for common species.
- Habitat values are present throughout the site, and those present are already moderately fragmented.
- Any additional habitat fragmentation that occurs as part of construction and operation will result in a negative change, but below measurable changes.
- Revegetation as part of SEB offset requirements may produce a positive change, but below measurable changes.

Based on the above, impacts related to habitat fragmentation are considered to be **low**.

### Port Construction and Operation

- Remnant vegetation at the site is limited and the majority is in very poor to poor condition.
- Remnant vegetation at the site is unlikely to provide critical habitat or resources for threatened flora and fauna species.
- There are few habitat values present at the site, and those present at the site are already highly fragmented or will not be cleared (refer Chapter 14).
- Any additional habitat fragmentation that occurs as part of construction and operation will result in a negative change that is below measureable changes.
- Revegetation as part of SEB offset requirements may produce a positive change, but changes are unlikely to be notable.

Based on the above, impacts related to habitat fragmentation are considered to be **negligible**.

### 13.5.4 Effects on Listed Flora

Of the threatened flora species identified as occurring or having suitable habitat in the CEIP Infrastructure areas, the likelihood assessment has identified species or groups of species that could be affected by the project (refer to likely and possible species in Table 13-6 for the infrastructure corridor and Table 13-12 for the port in Sections 13.3.2 and 13.3.3 above respectively).

#### Infrastructure Corridor Construction and Operation

Given the low potential for EPBC listed flora to occur, limited vegetation clearance of primarily poor condition vegetation, and offset activities required under the Native Vegetation Act, it is considered that construction and operation of the proposed infrastructure corridor will result in **low** impacts to individual plants and **negligible** impacts to listed species as a whole.

#### Port Construction and Operation

Given the low potential for EPBC listed flora to occur, minimal vegetation clearance and offset activities required under the NVC Act, it is considered that construction and operation of the proposed port development will result in **negligible** impacts to individuals and **negligible** impacts to listed species as a whole.

Impact and mitigation measures for specific listed flora species addressed by the project are summarised below in Table 13-21 and Table 13-22.

Table 13-19 Impacts on Listed and Protected Flora as a Result of CEIP Infrastructure

Species Name	Background Comments	Project Hazard	Impact
<b>EPBC species</b>			
Jumping-jack Wattle	Shrub. BDBSA records in the project area; observed in the field in 2012 in degraded habitat.	Vegetation clearance, weed introduction or spread within EIS project area.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
Yellow Swainson-pea	Small shrub. Mallee habitat occurs along the proposed rail corridor. Previous records occur within 5 km. Germination is triggered by soil disturbance or fire.	Soil disturbance within Infrastructure Corridor.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
Resin Wattle	Shrub. No known populations identified within corridor, but may occur in surveyed patches.	Vegetation clearance, weed introduction or spread within Infrastructure Corridor.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
<b>NPW species</b>			
Western Daddy Long Legs	Orchid. Occurs on calcareous sand over limestone. Visible from August to October. Likely to occur.	Soil disturbance, vegetation clearance (habitat), weed introduction or spread within Infrastructure Corridor.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
Large-fruit Crassula	Small succulent herb. Occupies diverse habitats. Previous records and observed near mine site. Likely to occur.	Vegetation clearance and soil disturbance within Infrastructure Corridor.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
Myrtle Fan-flower	Spreading shrub. Mallee habitat. Records near coast. Likely to occur.	Vegetation clearance, weed introduction or spread in EIS project area.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
Hop-bush Wattle	Shrub. Present in project area. Site 205 avoided (3 plants), site 203 can be avoided or clearance minimised (80 plants), 20 plants are outside project area. Numerous plants protected in regional studies.	Vegetation clearance, weed introduction or spread in port site area.	Low. Individuals may be cleared from degraded habitat surrounded by pasture. Negligible impacts to local population and species as a whole.
Mallee Wattle	Shrub. Potential to occur in habitat of project area.	Soil disturbance, vegetation clearance, weed introduction or spread at port site	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
Knotted Poa	Grass. Potential to occur in habitat of EIS project area.	Vegetation clearance and soil disturbance within EIS project area.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
Other 11 species that possibly occur	Preferred habitat and multiple previous records in project area, but not observed in field to date.	Vegetation clearance, weed introduction or spread within Infrastructure Corridor.	Negligible. Minor impacts to individuals if they occur, unlikely to be key population.
EPBC and NPW species unlikely to occur <sup>2</sup>	Historical or single records in project area, but considered unlikely to occur due to current restricted range and / or lack of suitable habitat.	Vegetation clearance, weed introduction or spread within EIS project area.	Negligible. Minor impacts to individuals if they occur, highly unlikely to be key population.

<sup>1</sup> Infrastructure corridor, see Appendix O; <sup>2</sup> Infrastructure Corridor: 6 unlikely EPBC listed species (see Table 13.6); 5 unlikely NPW species (see Table 3 of Appendix O). Port site area: 5 unlikely EPBC species (see Table 13.14); 6 unlikely NPW species (see Appendix P).

### 13.5.5 Effects on Fauna

Eighteen fauna species with State and National conservation ratings are known to occur, or are considered likely to occur, within the CEIP Infrastructure area, and a further 38 listed species may potentially occur in the area (see Table 13-20 and Appendix O).

Impacts to listed fauna, as well as general fauna that may occur during construction and operation could include the following:

- Direct mortality through strike with vehicles or machinery or barriers to movement (e.g., pipeline trenches)
- Habitat clearance, habitat degradation or weed introduction
- Increase in predators (e.g., fox /cat) through poor waste management practices
- Impacts to breeding regimes as a result of increased disturbance, changes in noise levels and changes in light levels. Some species are particularly prone to disturbance (e.g. White-bellied Sea-eagle, Osprey and Little Penguin)

Impacts to all fauna populations (including listed) within the CEIP Infrastructure area are predicted to be **low** to **negligible**, based on the following assumptions:

- Habitat condition across the CEIP Infrastructure footprint is already highly degraded, resulting in reduced diversity of native fauna.
- Most species are highly mobile and will move away from an area during disturbance (e.g. as trains approach).
- A number of migratory species and or other fauna species may only occur as occasional visitors to the region. Habitat and associated resources that are critical to the survival of individuals, and local populations of species do not occur within the project area (see Table 13-13 above and Table 13-20 below).
- Local populations of species present within the project footprint are likely to be small, due to the size and condition of available habitat. Therefore impacts to overall species populations are likely to be small.
- If there are impacts to individuals or populations, they are likely to be short term (e.g., construction phase) as fauna will move away from the area and return when disturbance has reduced or offset habitat has been established.

#### Infrastructure Corridor Construction and Operation

Based on the methodology of Chapter 9, the justification outlined above, and the range of species that may occur at the site it is considered that construction and operation will result in **low** to **negligible** impacts to individual fauna and **negligible** impacts to species as a whole for both common and listed fauna.

#### Port Construction and Operation

Based on the methodology of Chapter 9, the justification outlined above, and the range of species that may occur at the site it is considered that construction and operation of the port will result in **low** to **negligible** impacts to individual fauna and **negligible** impacts to species as a whole for both common and listed fauna.

Table 13-20 Impact on Fauna (listed and protected) – CEIP Infrastructure

Species Name / Type	Background Comments	Project Hazard	Impact
Rainbow Bee-eater / Rock Parrot	Likely / known occurrence. Whilst known to use habitat in project area, species are highly mobile and are unlikely to be directly reliant on degraded habitat within the project area.	Bird strike, habitat destruction, increase in pest predators in EIS project area.	Negligible impacts to individuals and local population. Known occurrence, but mobile and wide ranging, no critical habitat in project area.
Hooded Plover	Known presence. Recent records indicate suitable habitat occurs for more than 5 km along coast line either side of port site. Whilst birds are sensitive to a number of human and natural threats, breeding pairs are known to utilise several nesting sites, abandon sites and return a few years later once disturbance has subsided.  Hooded Plover Conservation Advice (TSSC 2014) suggests over 60% of the SA population occurs on Kangaroo Island and the Yorke Peninsula. In addition recent surveys suggest that the population on the EP is larger than previously thought (G. Kerr pers. com), suggesting any impacts to one known pair near the port site will not affect the local Hooded Plover population, and will not impact the species as a whole.	Bird strike, habitat destruction, increase in pest predators in EIS project area. At least one pair known to occur within the project site.	Low to negligible short-term impacts to individuals, pairs and local population. Known occurrence, but known to utilise several nesting sites, suitable habitat is available along the coast for birds to move into during short-term disturbance (i.e. construction phase only).  No impact to species as a whole.
Pacific Golden Plover <sup>1</sup> , Fork-tailed Swift <sup>1</sup> , Common Sandpiper <sup>1</sup> , Cattle Egret <sup>1</sup> , Cape Barren Goose <sup>1</sup> , Fairy Tern <sup>1</sup> ; Ruddy Turnstone <sup>2</sup> ; Red-lored Whistler <sup>3</sup>	Known or possible occurrence (as per Section 13.3.2, 13.3.3). Suitable habitat within project area, but species not expected to be solely reliant on habitat. Mobile species.	Bird strike, habitat destruction, increase in pest predators in EIS project area.	Negligible impacts to local populations and species as a whole. Species possibly occur. Mobile species, likely to move away from the area during construction if they occur.
Malleefowl <sup>3</sup>	Possible occurrence. Limited, suitable habitat, generally too small, isolated, disturbed and on crest rather than swale. Would move away from area if present.	Bird strike, habitat destruction, increase in pest predators of the corridor in EIS project area.	Low impacts to local population and species as a whole. Likelihood of occurrence is low, critical habitat is limited in EIS project area.

Species Name / Type	Background Comments	Project Hazard	Impact
White-bellied Sea-eagle / Osprey / Little Penguin <sup>2</sup>	White-bellied Sea-eagle observed, suitable habitat features also for the Eastern Osprey may be present within the southern end of the project area. Inland areas of the corridor unlikely to provide key foraging and nesting locations. Breeding success impacted by disturbance.	Bird strike, habitat destruction or alteration, bioaccumulation through consumption of affected prey. Infrastructure corridor (less likely) or port site area (where spp. more likely to occur).	Negligible impacts to the species, Low impacts to local population. No local populations identified to date. If species occur, may be short-term impacts to local individuals. Habitat in project area is not critical.
Sandhill Dunnart <sup>3</sup>	Possible, but unlikely occurrence. Limited, suitable habitat, generally too small, isolated and disturbed. Would likely move into adjacent WA, if present.	Mammal strike, habitat destruction, increase in pest predators within Infrastructure Corridor project area.	Low impacts to local population and species as a whole. Likelihood of occurrence is low, critical habitat in project area is limited.
EPBC and NPW listed species (Possibly occur, or unlikely to occur)	Species that may occur or are unlikely to occur in the region (as per Appendix O, P). These are primarily highly mobile species and not considered to be directly reliant upon habitat in the project area. If they occur, they are infrequent visitors to coastal EP.	Bird Strike during vegetation clearance, increased vehicle movements on roads. EIS project area.	Negligible impacts to local populations and species as a whole. Species unlikely to occur, highly mobile species, likely to move away from the area during construction if they occur.
General fauna	Local native reptiles, mammals and birds; exotic mammals and birds. Habitat in the project area is limited and degraded. Populations and groups of fauna are likely to be small.	Vegetation clearance, habitat destruction, barriers to movement EIS project area.	Low (minor impacts to local populations, but negligible impacts to species as a whole). Most species are highly mobile and likely to move away from the area during construction.

<sup>1</sup> Species known or possible at within whole EIS project area;

<sup>2</sup> Species known or possible within port site area only;

<sup>3</sup> Species known or possible within infrastructure corridor project area only, see Appendix P and Appendix O.

### 13.5.6 Light

Light from construction and operation of the CEIP Infrastructure and port could impact upon behaviour of native fauna during nightly construction activities, port operation and lighting on the train (running every two hours during the night).

Introduction of artificial lighting to an area can affect the local fauna and impact ecosystems (Schelling 2006). Foraging behaviour, predator / prey interactions, reproduction, migration and social interactions of fauna could all be influenced by changes in light conditions. Indirect impacts to flora that rely on nocturnal pollinators are also possible. These impacts can occur as a direct result of the intensity, brightness, colour, direction or elevation of artificial light or be indirectly related to the increase in insects attracted to the light (Rich and Longcore 2006). An increase in insects can result in an increase in predators up the food chain such as insectivorous microbats, geckos and some spiders. Some nocturnal bird species (e.g. owls) may then be attracted to the geckos and the microbats. The aerial predators that are attracted to artificial lights (e.g. microbats and owls) may become disoriented resulting in collision with lighting structures. Similarly other birds (e.g. migratory birds) may become disoriented when attracted to artificial lighting, particularly on tall structures, resulting in collision with structures or be subject to exhaustion and increased predation (Gautheraux and Belser 2006; Monevecchi 2006 cited in BHP EIS 2009).

Lighting will be required during construction of the CEIP Infrastructure and the port as well as during operation of the port and train operation at night (12 passes per day). Impacts from lighting are expected to occur throughout the life of the CEIP Infrastructure and port development and operation. Although there are no regulatory limits for lighting impacts to fauna, design and operation measures will be used to reduce impacts from lighting as much as practicable. If fauna remain in the area, rather than move to surrounding habitat, short-term negative changes to fauna behaviour may occur and these changes may be measurable (e.g. there would be an increase in fauna activity near lighting structures or fauna mortalities below lighting structures). Species that may be particularly susceptible to lighting are nocturnal birds, coastal birds, nocturnal reptiles and common microbat species that occur within Hambidge WPA.

Based on the methodology of Chapter 9, the justification outlined above, and the range of species that may occur within the project area (Table 13-20), it is considered that construction and operation of the CEIP Infrastructure will result in short-term impacts to common and conservation significant fauna, hence lighting related impacts are considered to be **low**.

Similarly, short-term lighting would be required during construction of rail north of Hambidge WPA, and would be limited during the operation of rail north of Hambidge WPA. Lighting impacts during rail operation would be momentary as the train passes. If there are any short-term lighting impacts, fauna can move deeper into the WPA (e.g. during the construction phase as construction crews move along rail route). It is therefore considered that construction and operation of the CEIP Infrastructure in the vicinity of Hambidge WPA, would result in **low** lighting related impacts to common and conservation significant fauna.

In addition, given the limited fauna present at the port site, lighting impacts are considered to be **low**. Whilst, two Hooded Plovers are known to occur along the beach at the port site, they are expected to move to other suitable beach sites adjacent the port site during construction, and if they return they are unlikely to be impacted by the operation of the port.

### 13.5.7 Noise

Increases in noise from background levels can impact native fauna. Changes to existing noise levels can affect the behaviour of, including breeding behaviour and social interactions. This can ultimately affect long-term fecundity of local individuals and populations. Fauna may exhibit stress above 48 dB (see references below). For the CEIP, noise sources including general construction and operation of the associated infrastructure and the port could impact upon behaviour of native fauna (e.g. primarily construction activities and operation of the rail, port and borefield).

Noise impacts vary depending on the noise levels, frequency and duration of levels and are likely species (and body size) specific. For example some studies on traffic noise suggest birds are affected when noise levels are above 55 dB(A) (Dooling and Popper 2007). Both mammals and birds can be affected by noise; however, bird hearing at higher and lower frequencies is reduced compared with mammals due to structural differences of the middle ear (Dooling and Popper 2007). Bird species are most sensitive to noise that occurs at frequencies where absolute hearing threshold is lowest (Dooling *et al.* 2000). A review of noise induced hearing damage in birds indicated that continuous noise levels between 93 and 110 dB(A) may cause temporary hearing loss in birds, with higher levels possibly resulting in permanent loss (e.g. single blasting noise above 140 dB(A) or multiple passes of 125 dB(A)) (Dooling and Popper 2007). General traffic noise adjacent highways does not normally exceed exposure criteria for noise-induced hearing damage in birds; however, construction activities during road projects can induce hearing impacts for birds (Phoenix Environmental Sciences 2011). Whilst birds do have the ability to mask noise and alter the frequencies they use for communication, this varies per species and depends on ambient noise levels. Where ambient noise levels range between 50-55 dB(A), difficulties in acoustic communication between birds is likely to occur between 55-60 dB(A) (Dooling and Popper 2007). Similarly a number of studies have been undertaken for a range of mammals and reptiles, where animals showed stress when noise levels were above 48 dB (Brumm and Slabbekoorn 2005, Patricelli and Blickley 2006, Warren *et al.* 2006, Christensen *et al.* 2011, Aitkin 1995).

In terms of the CEIP Infrastructure, habitat along the corridor and at the port site is largely limited, and the sites are surrounded by agricultural land, hence significant blocks of habitat are limited. The exception to this is Hambidge Wilderness Protection Area, where the infrastructure corridor runs along the northern boundary (to minimise impacts on landowners in the area). Examples of typical noise levels are provided in Chapter 12 (Noise), ranging from 15 dB(A) for a woodland to 65 dB(A) within a standard office. Noise modelling predicts that maximum noise levels during rail operation will be 50 dB(A) at the northeastern boundary of Hambidge WPA and would dissipate to less than 20 dB(A) down the eastern boundary of the WPA as the rail line moves southeast to south away from the WPA. Maximum noise levels at the northern boundary of Hambidge WPA are predicted to be higher during rail operation as the railway line runs adjacent the WPA, and are dependent on speed of the train, number of wagons and whether they are empty or loaded with iron concentrate. A maximum of 75 dB(A) is predicted at the northern boundary, dissipating to 45 dB(A) at approximately 1,200 m from the northern boundary of the WPA. Trains will pass-by approximately 12 times per day with the noise increasing to the peak level and then decreasing once the train has passed. Similarly noise modelling at the port predicted noise levels ranging from 25 dB(A) to 46 dB(A) for sensitive receiver number 44 (within the port site boundary), which is indicative of the noise ranges expected at the port during operations.

It is likely therefore that some local fauna may become accustomed to the construction noise and the operation noise of the rail and port and may remain in local habitat patches, whilst others will move away from an area and may or may not return when the noise levels subside. Some conservation significant species that have potential to periodically occur in the vicinity of project area are particularly affected by disturbance (e.g. White-bellied Sea-eagle, Osprey). See Table 13-20 above and Appendix O, P).

### Infrastructure Corridor Construction and Operation Construction

Based on the above, potential short-term noise impacts to local fauna restricted to the project area are expected to occur during construction of the infrastructure corridor. Noise related impacts to fauna associated with the rail construction are therefore considered to be **low**.

During the operation of the rail impacts to fauna within the project area are considered to be **low / negligible**, particularly given the limited habitat within the project footprint and the frequency of rail operation (12 passes per day).

For fauna within Hambidge WPA, some species that are less mobile and more sensitive to noise are likely to exhibit short-term negative changes, whilst other species may become accustomed to changes in noise or retreat deeper into the WPA if impacted by noise, hence impacts are considered to be **medium**.

### Port Construction and Operation

Based on the above, potential short-term noise impacts to local fauna may occur during construction of the port site, but are unlikely during the operation of the port given that noise criteria for human sensitive receivers within the port site are below thresholds for birds and fauna habitat within the port site is limited. If fauna occur at the port site, they will either become accustomed to the noise, or return when noise has subsided or is at lower levels (e.g. during operation). Noise related impacts to fauna associated with the port construction and operation are therefore considered to be **low**.

#### 13.5.8 Dust

Dusts from excavation activities during construction can be deposited on vegetation to the extent that it can impede growth, threaten the survival of individual plants, resulting in degradation of habitat for native flora and fauna species. Other particulate matter (e.g. reactive dusts such as cement dust) can alter nutrient balances within plants, resulting in adverse effects on plant growth rates (Doley 2003). Impacts to vegetation from dust can be variable, as the relationship between rate of deposition and dust load will vary depending on the type, size and colour of the dust and the size of leaf surfaces on which the dust falls (Doley 2003, Doley 2006). In addition, the position of the plant species within the plant community can also affect the degree of impact from dust deposition on a species (Doley and Rossato 2010). Modelling by Doley and Rossato (2010) suggested that impacts from dust deposition are generally greater at the bottom of plant canopies than on vegetation exposed to sunlight. It should be noted that in locations with regular rainfall events, dust impacts would be lower as regular rainfall would wash dust away. This project is located in a semi-arid to arid environment where there are often long periods without rain, hence there are limited opportunities to wash any dust impacts away.

As mentioned in Chapter 10 (Air Quality), existing dust levels within the study area relate to wheat-crop farming. Elevated particulate matter and dust levels resulting from dry windy conditions (especially during the dry summer and autumn periods) occur frequently in the project area.

Dust impacts on vegetation within the vicinity of the CEIP Infrastructure and the port may arise as a result of:

- Ground disturbance, excavation and stockpiling
- Increased truck movements on haul routes that are not bitumised during construction
- Dust from rail operations
- Limited rainfall events to wash dust away.

Based on the information above dust impacts are expected, primarily during construction. Given the methodology of Chapter 9, the control and management strategies outlined in Section 13.6 below and dust mitigation strategies in Chapter 10, impacts are likely to be short term and localised, therefore it is considered that construction and operation will result in **low** impacts to local vegetation.

### 13.5.9 Recreational Activities

An increase in workers to the region as a result of the project could lead to an increase in regional recreational activities such as off-road driving, riding, bush camping and sight-seeing (See Chapter 22, Social). If uncontrolled, these activities can exacerbate existing degradation of the environment through increases in littering, overflow of bins, erosion, wood collection, disturbance to wildlife, and lighting of fires, which could impact vegetation.

These impacts could occur in regional conservation parks and coastal areas removed from the project area where there may be an increase in 4WD and other recreational activities. In addition, beach nesting birds may be particularly at risk if 4WD activities increase along the beach front.

Alternatively an increase in informed people in the community could result in greater participation in community activities which support regional conservation efforts (e.g. Clean up Australia day, National Tree-planting Day, Bush Care sites).

Based on the above it is expected that the population will increase as a result of the project and there will be an increase in recreational activities. However, any impacts are likely to be incremental to existing low levels and are not likely to be detectable, hence it is considered that impacts to flora and fauna as a result of an increase in recreational activities would be **negligible**. It should be noted that there will be restricted access to beaches that occur within the port site, hence it is unlikely that there would be an increase in 4WD activities within the beach zone of the port site.

### 13.5.10 Effects on Listed Ecological Communities

#### Infrastructure Corridor

No threatened ecological communities have been recorded along the proposed infrastructure corridor, therefore no impacts to ecological communities are anticipated.

#### Port

No threatened ecological communities have been recorded within the proposed port site, therefore no impacts to ecological communities are anticipated.

### 13.5.11 Summary of Impacts

Impacts relating to flora and fauna as a result of the construction and operation of the proposed port and infrastructure corridor are summarised in Table 13-21. Through to the implementation of design and management controls, all impacts have been reduced to **negligible** to **medium**, for the infrastructure corridor and **negligible** to **low** for the port, all of which are considered to be as low as reasonably practicable for the project and therefore acceptable.

Table 13-21 Summary of Impacts: Flora and Fauna, Infrastructure Corridor and Long-Term Employee Village

Impact	Comment	Level of Impact
Impacts fauna and flora habitat (listed and common species) via vegetation clearance for development and operation.	Vegetation clearance during construction will be minimised where possible, all clearance will be approved and offset as per Native Vegetation Act requirements. A substantial portion of vegetation to be cleared is already degraded. Proposed offset activities will have lasting benefits to the region.	Medium
Habitat fragmentation as a result of vegetation clearance.	Remnant vegetation within the region already occurs with a fragmented landscape. Whilst vegetation clearance may contribute to further fragmentation in the short term, proposed offset activities will have long-term benefits to the region.	Low
Effects on listed flora (loss of species) via vegetation clearance during construction.	Potential for species presence is low, localised impacts to individuals are not likely to affect local populations. Impact level ranges depending on likelihood of occurrence for listed species.	Low to Negligible
Effects of listed fauna (loss of species) via vegetation clearance, weed spread, direct impact during construction, increase in predators.	Potential for species presence is low, localised impacts are not likely to affect local populations. Impact level ranges depending on likelihood of occurrence for listed species.	Low to Negligible
Behaviour and abundance impacts on listed fauna from night lighting during construction and operation of rail.	Localised impacts within vegetation patches / habitat in close proximity to corridor.	Low
Behaviour and abundance impacts on general fauna from night lighting during construction and operation of rail and port.	Localised short-term impacts within vegetation patches / habitat in close proximity to corridor (including Hambidge WPA).	Low
Noise impacts to listed and general fauna from construction and operation (e.g. rail noise).	Localised short-term impacts within vegetation patches / habitat in close proximity to corridor (including Hambidge WPA).	Low to Medium
Direct and indirect impacts to general fauna (vehicle strike, habitat clearance, increase in predators).	Localised short-term impacts within vegetation patches / habitat in close proximity to corridor (including Hambidge WPA).	Low to Negligible
Dust impacts to vegetation (indirect impacts to fauna).	Localised short-term impacts within vegetation patches / habitat in close proximity to corridor (including Hambidge WPA).	Low
Impacts to threatened ecological communities.	No known threatened ecological communities in the EIS project areas.	None

Table 13-22 Summary of Impacts: Flora and Fauna, Port

Impact	Comment	Level of Impact
Impacts fauna and flora habitat (listed and common species) via vegetation clearance for development and operation.	Vegetation clearance during construction will be minimised where possible, all clearance will be approved and offset as per Native Vegetation Act requirements. A substantial portion of vegetation to be cleared is already degraded. Proposed offset activities will have lasting benefits to the region.	Low
Habitat Fragmentation as a result of vegetation clearance.	Remnant vegetation within the site already occurs with a highly fragmented landscape. Whilst vegetation clearance may contribute to further fragmentation in the short term, proposed offset activities will have long-term benefits to the region.	Negligible
Effects on listed flora (loss of species) via vegetation clearance, during construction.	Potential for species presence is low, localised impacts are not likely to affect local populations. Impact level ranges depending on likelihood of occurrence for listed species.	Negligible
Effects of list fauna (loss of species) via vegetation clearance, direct impact during construction.	Potential for species presence is low, localised impacts to individuals are not likely to affect local populations. Impact level ranges depending on likelihood of occurrence for listed species.	Low to negligible
Behaviour and abundance impacts on threatened fauna from night lighting during construction and operation of port.	Localised short-term impacts within vegetation patches / habitat in close proximity or within the port site area. Two individual pairs of Hooded Plover are known to occur along coast near the port site, and are likely to move away from the area during construction. Impacts are not expected from operation of the port. There are multiple records along the coast of the Eyre Peninsula. Impacts to the species as a whole will be too low to measure.	Low
Behaviour and abundance impacts on general fauna from night lighting during construction and operation of port.	Localised short-term impacts within vegetation patches / habitat in close proximity or within the port site area. Given the limited habitat and low fauna diversity within and around the site, changes in behaviour and abundance are likely to be too low to measure.	Low
Behaviour and abundance impacts on fauna (common). Noise impacts from truck movements, drilling and excavation machinery. Operation of machinery at the port.	Localised short-term impacts within vegetation patches / habitat in close proximity or within the port site area. Given the limited habitat and low fauna diversity within and around the site, changes in behaviour and abundance are likely to be too low to measure.	Low
Impacts to threatened (beach nesting) and general fauna from increases in recreational activities.	Localised impacts within vegetation patches / habitat in close proximity or within the port site area. Two individual pairs of Hooded Plover are known to occur along coast near the port site project area, and are likely to move away from the area during construction. There are multiple records along the coast of the Eyre Peninsula. Impacts to the species as a whole will be too low to measure.	Negligible
Impacts to threatened ecological communities.	No known threatened ecological communities in the EIS project areas.	None

## 13.6 Control and Management Strategies

In order to minimise and mitigate the impacts to flora and fauna during construction activities, the following management approaches would be incorporated into the CEMP (Construction and Environmental Management Plan) or Operations and Environmental Management Plan (OEMP) for each project component. Key control and management strategies are outlined below in Table 13-23. Chapter 24 provides a framework for implementation of these strategies.

**Table 13-23 Control and Management Strategies: Flora and Fauna**

Control and Management Strategies	EM ID
<b>Construction</b>	
All clearance of native vegetation to have approval from the Native Vegetation Council (as required under the <i>Native Vegetation Act</i> ) prior to commencement.	VC_C1
Native vegetation clearance to be offset via implementation of an appropriate (commensurate) Significant Environmental Benefit (SEB), as approved by the Native Vegetation Council (NVC). The required SEB Offset plan will be developed in collaboration with Native Vegetation Management Unit officers (DEWNR) and regional stakeholders. The final offset will be approved by the Native Vegetation Council prior to any clearance occurring. Current proposals are being considered from the EP NRM Board and the Nature Foundation for potential offset projects which align with regional conservation objectives. Other options include payment into the Native Vegetation Fund.	VC_C2
Vegetation to be retained on site wherever practicable, and progressive rehabilitation of vegetation to occur as soon as practicable. Rehabilitation strategies will include use of locally indigenous plant species, use of existing seedbank from stockpiled material where practicable, and align with regional NRM objectives where possible.	VC_C3
Prior to disturbance, areas of high habitat value in close proximity to proposed disturbance areas will be marked as 'no go' areas on construction design drawings and in the field with flagging tape and/or hazard fencing.	FI_C1
Supervision of clearance contractors and / or auditing of vegetation clearance to ensure no unauthorised vegetation clearance occurs.	VC_C4
Ground disturbance footprints will be minimised by utilising existing tracks and designated tracks established for the project.	VC_C5
Location of soil stockpiles would avoid vegetated areas unless appropriate approvals are in place.	VC_C6
Where required, seed will be collected from conservation significant plants which will be cleared (e.g. several NPW listed Hop-Bush Wattle in degraded sites at the port) to be used in site revegetation. If EPBC listed plants that have potential to occur in the area are identified in patches to be cleared (e.g. Jumping-jack Wattle, Resin Wattle), seed can also be collected for revegetation projects.	VC_C7
<p>Implementation of best practice weed management strategies outlined in the CEMP, including incorporation the following:</p> <ul style="list-style-type: none"> <li>• Develop control strategies with the EP NRMB, DEWNR and local landholders</li> <li>• Identify existing presence of regional significant weeds at the port site and along the infrastructure corridor, particularly the rail, and periodically monitor extent of spread</li> <li>• Weed hygiene practices will be followed such as cleaning of plant, equipment and vehicles before construction and after access to known areas infested with Declared weeds</li> <li>• Maintain and monitor tracks for weed outbreaks, in particular for Declared weed of regional concern - Buffel Grass.</li> </ul> <p>Periodic monitoring within areas adjacent or in close proximity to high value vegetation (e.g. Hambidge WPA). Adaptive management and control measures to be applied as required.</p>	PPA_C1

Control and Management Strategies	EM ID
Implementation of incident reporting process for regular weed control and weed outbreak as part of broader environmental site management checks.	PPA_C3
Implementation of best practice bushfire management strategies outlined in the CEMP, including incorporation of the following: <ul style="list-style-type: none"> <li>• Develop control strategies with EP NRMB, DEWNR and CFS</li> <li>• Education of workforce about local bushfire risk (during site inductions)</li> <li>• Maintain awareness of local seasonal restrictions, particularly regarding hot works during fire ban season</li> <li>• Pipeline welding activities to be undertaken in accordance with Australian safety standards and the safety management plan for the activities</li> <li>• Programme of regular inspection of assets</li> <li>• Maintenance of vegetation clearance buffers, particularly along the transmission line</li> <li>• Emergency response protocols and equipment in place and regularly checked</li> <li>• Regular maintenance and clearance of vegetation along railway line and around transmission lines as per voltage and design requirements</li> <li>• Restriction of high risk fire activities during fire periods</li> </ul>	BF_C1
Speed limits on site to reduce any fauna strike.	FI_C2
Temporary fencing of trenches and excavations which are left open for more than a week during construction to limit impacts to native fauna.	FI_C3
Provision of ramps and refuges within all open trenches during construction to minimise stress on any trapped fauna.	FI_C4
Regular monitoring of fencing and long-term trenches for trapped fauna in accordance with regular site safety checks during construction.	FI_C5
Qualified fauna handling expert be present on site during construction to remove any trapped animals from trenches and to manage displaced fauna during vegetation clearance. Species details to be recorded (to enhance survey information). Humane disposal of feral animals captured following Wildlife Ethics Committee protocols.	FI_C6
Education about conservation significant fauna that may occur within the project site for all staff, their families and contractors via awareness training (e.g. during site inductions, notice board fact sheets and newsletters). In particular, Hooded Plover pair near Port Site.	FI_C7
Periodic monitoring of pest species populations at the site during construction. Adaptive management and control measures to be applied as required as per CEMP.	PPA_C2
Incident reporting of weed outbreaks and feral animal sightings to facilitate adaptive management measures and control strategies.	PPA_C3
Site wide noise impacts to native fauna during construction will be managed through implementation of the noise CEMP requirements, as outlined in Chapter 12.	NV_C1 – NV_C6
Dust impacts to native vegetation during construction will be managed through implementation of the air quality CEMP requirements, as outlined in Chapter 10.	PE_C1 – PE_C9
Manage impacts to topsoil and vegetation through implementation of erosion and surface water controls as per CEMP	SD_C1 – SD_C8
<b>Operation</b>	
Operational lighting will be kept to a minimum to reduce light spill and potential impacts to fauna behaviour.	FI_O1
Light spill will be reduced wherever practicable by managing the spread and direction of lighting, using screens and directional lighting, and avoiding high UV wavelength insect attracting light globes.	FI_O2
Lighting pole heights will be as low as possible.	FI_O3

Control and Management Strategies	EM ID
Improvements will be made to available habitat in the local region as part of Native Vegetation SEB offsets (e.g. rehabilitation activities to improve poor to moderate vegetation, establishment and protection of new native vegetation blocks).	FI_O4
Implementation of best practice weed management strategies outlined in the OEMP, including periodic monitoring of the occurrence and extent of weed species, particularly following trigger events (e.g. seasonally after winter rains or following fire) and within areas adjacent or in close proximity to high value vegetation (e.g. Hambidge WPA). Adaptive management and control measures to be applied as required, particularly for Declared weed Buffel Grass.	PPA_O1
Weed hygiene practices to be followed during operation such as cleaning of plant, equipment and vehicles before and after access to known areas infested with Declared weeds.	PPA_O2
Pest species management for the site during operation to include periodic monitoring of pest flora (particularly Declared species) and fauna species populations at the site. Adaptive management and control measures to be applied as required as per OEMP.	PPA_O3
Liaison with EP NRM Board, DEWNR, local councils and community regarding existing vertebrate pest control activities and strategies, and effective cat and dog management (particularly for the influx of workers and families to the region).	PPA_O4
Education regarding conservation significant flora and fauna for all staff, their families and contractors via awareness training (e.g. during site inductions, notice board fact sheets).	FI_O5
Education regarding potential recreational impacts to regional flora and fauna as a result of increased population through awareness training of staff and families (e.g. during site inductions, notice board fact sheets).	FI_O6
Noise impacts to native fauna during operation will be managed through implementation of the noise OEMP requirements.	FI_O7
Dust impacts to native vegetation during operation will be managed through implementation of the air quality OEMP requirements.	FI_O8
Implementation of waste management practices and controls as per OEMP to avoid attraction and exacerbation of existing pest animal problems, and to avoid attracting native fauna to the site.	PPA_O5
Regular best practice inspection and maintenance of transmission line and rail to reduce fire risk as per OEMP (e.g. vegetation proximity, systems failure, spark potential).	BF_O1

### 13.6.1 Environmental Offsets

Clearance of native vegetation is prohibited under the *Native Vegetation Act 1991* unless approval has been obtained from the Native Vegetation Council or an exemption applies. Approved clearance requires agreement of a commensurate Significant Environmental Benefit (SEB) offset.

Iron Road have been in discussions with the Eyre Peninsula NRM Board and the Nature Foundation about potential environmental programmes which would be suitable to offset the impact from clearance of native vegetation as a result of the proposed CEIP Infrastructure, and are also considering alternate options to cover the SEB Offset.

The SEB offset for the project would be subject to final approval from the Native Vegetation Council. Ongoing discussions with the Native Vegetation Management Unit (DEWNR) are occurring in parallel to this EIS process.

Key concepts or options for SEB offsets include:

- Purchase of regional property to protect environmental values. This would require a suitable property being available in the region to ensure equivalent value to that being impacted is protected and enhanced.
- Fencing and rehabilitation of existing patches of poor to moderate native vegetation in the region to ensure ongoing protection and enhancement (e.g. fencing, stock exclusion, weed control). Ideally these would be selected to provide habitat linkages where possible.
- Improvements to available habitat for threatened flora.
- Contributions to local weed and pest controls, in collaboration with EP NRM Board strategies.
- Liaison with local and regional stakeholders to ensure sustainable and viable offsets are selected.
- Monitoring, research, weed and pest management inputs to region (TBC by NVC).
- Payment into the Native Vegetation Fund if no other options are available.

## 13.7 Residual Risk Assessment

This section identifies and assesses the risks to terrestrial ecology that would not be expected as part of the normal operation of the CEIP Infrastructure, but could occur as a result of faults, failures and unplanned events. Although the risks may or may not eventuate, the purpose of the risk assessment process was to identify management and mitigation measures required to reduce the identified risks to a level that is as low as reasonably practicable and therefore acceptable. A summary of the residual environmental risks after management and control strategies are applied is presented in Table 13-24, with brief discussions below. The terrestrial ecology management and mitigation measures were summarised in Section 13.6. These measures, along with the summary of risks and impacts, form the basis of the Environmental Management Framework presented in Chapter 24.

### Unauthorised Vegetation Clearance

Clearance of native vegetation is planned as part of the project, and anticipated impacts have been described above in Section 13.5.2. There is a risk that additional unauthorised clearance of native vegetation could occur, resulting in similar impacts to native flora as authorised clearance such as habitat removal and potential direct loss of common flora and / or conservation significant flora.

Given that all clearance of native vegetation will be subject to approval under the Native Vegetation Act (as well as a requirement for a commensurate Significant Environmental Benefit offset for associated with such clearance), it is considered that unauthorised clearance would only occur if there was a breakdown in protocols or equipment failure. The consequences to common flora and vegetation communities would be **minor**; localised short-term decreases in abundance with no lasting effects on the local population and able to be remediated in the future through the SEB offset programme. Similarly, given the low likelihood for conservation significant fauna to occur within the

project area, consequences to such flora species are also considered to be minor or **insignificant**. Given the design and management strategies outlined in Section 13.6 and the CEMP and OEMP, it is considered the likelihood of this event occurring during the life of the project is **unlikely**. As such, the risks to flora associated with unauthorised clearance are considered to be **low**.

#### **Higher than Expected Fauna Mortality**

As mentioned in Section 13.5.5, fauna mortalities may occur as a result of construction and operation during the project. This could occur through vehicles strike, accidental capture in trenches and excavations or accidental capture in fencing. There is a risk that fauna mortality numbers could be higher than expected. This could occur through a failure of management controls, equipment failure, extreme weather conditions or higher than expected numbers of fauna occurring within the project site or moving into the project (e.g. seasonal variation, resource attractant, behavioural response to light or noise). The consequences to local populations of fauna species within the project area from higher than expected fauna mortalities are considered to be **minor**; short-term decrease in abundance of the local population (common and listed species). Even with the management control strategies in place, fauna by their nature can be unpredictable, therefore it is considered **possible** that this event may occur at some time throughout the life of the mine project. As such, the overall risk of higher than expected fauna mortality occurring as a result of the project is considered to be **low**.

#### **Greater than Predicted Impacts to Listed Flora and Fauna**

Section 13.5.4 and Section 13.5.5 describe impacts to conservation significant flora and fauna that are predicted to occur as a result of the project. These impacts have been based on likelihood assessments about the presence and abundance of listed flora and fauna species actually occurring within the project area. Whilst conservation significant flora and fauna are often difficult to detect because they occur in low numbers or are cryptic (flora) and secretive (fauna) by nature, there is a risk that greater than predicted impacts to such species could occur as a result of the project.

Greater than predicted impacts to listed flora and fauna species could occur if the likelihood of occurrence estimates are wrong, if listed fauna move into the area, if species were not detected during formal flora and fauna surveys due to seasonal variations or climatic conditions, or species were dormant in topsoil or subsoil (e.g. Wattles, Orchids, Yellow-swainson Pea and some worm-lizards). In addition, flora species that are dormant in subsoil or topsoil could occur in greater numbers following a trigger event (e.g. manual disturbance of soil, fire, extreme rainfall event).

Based on the above, the consequences of greater than predicted impacts to listed flora and fauna are considered to be **minor**; local short-term decreases in abundance without lasting effect on the local population since the project is not considered to be located in key habitat areas for any species. Although there are a number of control and management strategies in place to protect listed species, given they are often difficult to detect and generally occur in low numbers it is considered **possible** that this event could occur throughout the life of the project. As such, the risks to listed flora or fauna associated with this event are considered to be **low**.

## Noise Impacts to Fauna of Hambidge WPA

Section 13.5.7 provides information about how noise can impact fauna. It is acknowledged that noise impacts will occur as a result of the project, particularly associated with the railway line near Hambidge WPA. There is a risk that noise impacts to fauna could be greater than predicted, or more fauna species than anticipated are impacted by noise, particularly for fauna within Hambidge WPA. This could occur if there were unplanned noise impacts, if there was a failure of control and management strategies or if there were errors in noise modelling. It is considered that unplanned noise events could have **moderate** consequences to fauna at worst, resulting in long-term behavioural impacts that significantly affect the ecology of local fauna populations. Given the control and management strategies that will be in place as part of the project, and the well understood and tested noise modelling undertaken, the likelihood of this occurring is considered to be **unlikely**. Therefore the risk associated with this event is considered to be **medium**.

## Bushfire

Bushfires are a natural occurrence; however, the increased incidence of bushfires as a result of human activity can have ongoing impacts on the ecology of an area, particularly where the habitat is already fragmented through adjacent land use practices such as farming.

Unplanned and unmanaged activities that can lead to bushfires can include:

- Failure of management controls during construction and operation
- External weather conditions, lightning strike, recreational activities
- System failure
- Inadequate emergency response
- Inadequate protection of assets (e.g. not in line with GAFMWG 2015 standard fire break widths, water points, signage)
- Proximity of vegetation near transmission line towers and wires, if left unmanaged
- Use of equipment that produces sparks, particularly during fire ban season when risk is higher
- Sparks from rail operation (e.g. bogie failure where wheel set locks up)
- Welding and other hot works activities (e.g. track repairs or rail grinding)
- Use of petrol vehicles close to pasture stubble, native or exotic grasses
- Ageing infrastructure

Based on the above, bushfire impacts to flora and fauna may occur as a result of the project. However, if impacts to flora and fauna occur as a result of unmanaged bushfire events associated with the project, the consequences are considered to be **minor** given that wild fires are naturally occurring events and are important in maintaining floral diversity. Given the design and control measures outlined in Section 13.6, the likelihood of this occurring throughout the project life is considered to be **unlikely**. Therefore the risk associated with the project is considered to be **low**.

Similarly, in the event that a bushfire did occur as a result of construction and operation of the infrastructure corridor, the consequences to significant areas of native vegetation, such as Hambidge WPA would be **minor to moderate**; localised long-term decrease in abundance of flora of fauna species and or local loss of species diversity depending on the size of the fire and the conservation significance of the species impacted. It is also noted that whilst every measure will be taken to avoid fire as a result of the development, some native flora species actually require fire as part of their lifecycle, that fire can assist in reducing weed impacts, and that occasional fire can improve the age class mosaic of an area and therefore provide greater structural diversity. Given the design and control measures in place for this project, the existing regional management, the straight section of track adjacent Hambidge (and therefore reduced spark risk), and the welded continuous lengths of track proposed to be used, it is considered **unlikely** that construction and operation of the

infrastructure would result in a bushfire which impacts remnant vegetation within Hambidge WPA. In addition, no evidence has been forthcoming to suggest that any previous fires on the Eyre Peninsula have been caused by the existing Buckleboo rail corridor. Considering the worst case consequence the risk to the flora and fauna of Hambidge WPA as a result of bushfire would be **medium**.

### **Vertebrate Animal Pests and Over-Abundant Native Species**

Vertebrate animal pests already exist in the CEIP Infrastructure area (see 13.3.2 and 13.3.3). Pest animals can threaten agriculture, industry and the health and safety of people (EPNRB 2010). Animal pests in overabundance are one of the major threats to native fauna, particularly threatened fauna in the region (DEH 2002, Brandle 2010). Small mammals, reptiles and ground-nesting birds are particularly at risk from predator pests such as foxes and cats. Other vertebrate pests can impact both native fauna and flora (e.g., rabbits and goats) through resource competition, weed spread and habitat degradation. Increases in pest bird species, as well as atypical numbers of native species (e.g. Silver Gulls, Pacific Gulls, Raven species) can also be detrimental to native fauna populations (particularly Osprey, White-bellied Sea-eagle and Hooded Plover) through resource competition and predation on chicks (Caton et al. 2011).

On the Eyre Peninsula, the EPNRM Board assists the community in coordinating integrated pest management (between all stakeholders), which provides more successful outcomes for all. The Board's particular focus is on foxes and rabbits (EPNRMB 2010). Impacts to native fauna can be detrimental if a pest control programme is not well managed, e.g., if the ratio of pest predators (cats, foxes) to pest prey (e.g., rabbits, mice) is out of balance, pest predators may focus more on small native reptiles and mammals or pest prey may increase in number.

Activities that may result in an increase of introduced pest fauna or increase in abundance of native fauna, particularly scavenging species include unmanaged waste collection areas and landfill sites, increases in road-kill, increased human activity in the region resulting in an increase in recreational activities and an increase in cats and dogs, initially as domestic pets.

Based on the above, it is considered that construction and operation of the CEIP Infrastructure may possibly result in an increase in the number of vertebrate pests in the region. If increases to vertebrate pests (or native animals to atypical numbers) occur, the consequences would be **minor**, localised and at worst able to be remediated in the long term. Given the control and management strategies outlined in Section 13.6, existing pest levels and existing management that occurs in the region, the likelihood of this occurring in the project area is considered **unlikely**. Therefore the risk associated with increase in abundance of pests or over-abundant native species is considered to be **low**.

### **Introduction or Spread of Weeds**

As mentioned above, regional weed priorities are determined by the *Natural Resource Management Act, 2004* and the CEIP Infrastructure falls within the jurisdiction of the Eyre Peninsula Natural Resource Management Board (EPNRMB).

Priority weeds of concern for the project area are outlined in Section 13.3 above, and include:

- Declared weeds previously observed in the area include Bridal Creeper, Perennial Veldt Grass, African Boxthorn, Horehound and Silver Nightshade
- Declared weeds that have the potential to move into the area (e.g. Buffel Grass)
- Red Alert Weeds or highly invasive weeds (as per Milne et al. 2008) and BushRAT Manual (DEWNR 2013)
- Community weed concerns e.g. Caltrop.

In addition to the spread of existing weeds, new weeds can also be introduced in an area inadvertently. If not managed correctly, new weeds can become established and have a consequential detrimental impact to the local environment.

During construction activities weed introduction and spread can occur via spread of weed supporting material (e.g. soils containing seeds, propagules) and an increase in available habitat for weeds following vegetation clearance (e.g. for rail tracks, water pipeline trenches, maintenance tracks and transmission line infrastructure). Seeds and rhizomes can lie dormant in existing soil and exploit the increased availability to light and water where native vegetation is removed. Weed seeds and propagules can also be spread unintentionally through importation of soil and rock from other areas, or soil attached to machinery. In addition, weeds may also be spread inadvertently if adequate measures are not in place to dispose of the cleared native vegetation debris that may also contain exotic seeds and propagules. An increase in pest animal species can also exacerbate or increase weed spread in an area (e.g., foxes spread olives, rabbits and goats spread exotic grasses).

During the operation phase of the project, weeds may increase where there is a breakdown of weed control protocols, for e.g., tracks are not maintained and monitored for new outbreaks. Weed dispersal methods vary depending on the weed, e.g., some spread by wind, some spread via native and pest fauna. If weeds are not controlled within the project area, they may spread to the remnant vegetation patches in the vicinity of the project area, leading for further degradation and fragmentation of the limited available habitat within the region.

Based on the above, it is considered that construction and operation of the CEIP Infrastructure and port could potentially result in an increase or spread of weeds in the project area. If weeds are introduced or spread as a result of the project, the consequences would be **minor**, localised and at worst able to be remediated in the short term. Given the design and control measures outlined in Section 13.6, the existing management that occurs in the region, and existing edge effects from agricultural landuse, the likelihood of this occurring is considered to be **unlikely**. Therefore the risk associated with an increase in existing weed levels is considered to be **low**.

As mentioned previously Hambidge Wilderness Protection Area is in the vicinity of the infrastructure corridor, in particular a section of the corridor occurs immediately north of the WPA. It is considered therefore that the project may result in an increase in the spread of weeds within the WPA. As a result, specific management measures have been included in the CEMP and OEMP about weed monitoring and controls in this area, including Buffel Grass. The northern boundary of the WPA is already subject to edge effects from the surrounding agricultural landuse, including stock access through various gates along the northern boundary. This boundary also includes an existing 25 m fire break and an access track. Given the proximity of sections of rail corridor to Hambidge WPA, particularly the northern boundary, if weeds are introduced or spread as a result of the project, the consequences would be **moderate**, local to regional long-term impacts without reduction in local population viability. Given the design and control measures outlined in Section 13.6, the existing management that occurs in the region and the existing agricultural edge effects of the northern boundary, the likelihood of this occurring is considered **unlikely**. Therefore the risk associated with an increase in existing weed levels is considered to be **medium**.

## Dust

As mentioned earlier in Section 13.5.8, dust has the potential to impact vegetation. Section 13.5.8 outlined a number of activities that will occur as part of the project that may contribute to dust impacts. It is also considered that there is a risk that dust impacts on vegetation may arise as a result of:

- Unplanned higher than predicted dust emissions
- Unplanned truck movements on haul routes that are not bitumised during construction
- Failure of dust controls (see Chapter 10).

Based on the assessment it is considered that construction and operation of the port and infrastructure corridor may result in dust impacts to vegetation. If unplanned dust impacts occur, the effect on the local flora community and indirect effects to local fauna are likely to be minor given the already degraded environment, and short-term exposure, therefore the consequence will be **insignificant**; localised and, and at worst able to be remediated in the long term or during a rainfall event. Given the design and control measures outlined in Section 13.6, the likelihood of this occurring is **possible**. Therefore the risk associated with unplanned dust impacts to flora as habitat and food resources for fauna are considered to be **low**.

### Recreational Activities

As mentioned above in Section 13.5.9, an increase in workers to the region as a result of the project can lead to an increase in regional recreational activities such as off-road driving, riding, bush camping and sight-seeing (See Chapter 22). If uncontrolled, these activities can exacerbate existing degradation of the environment through increases in littering, overflow of bins, erosion, wood collection, lighting of fires and disturbance to wildlife.

Although it is expected that the population will increase as a result of the project and there will be an increase in recreational activities, given the control and management strategies in place and existing management that occurs in the region, any indirect and direct impacts to flora and fauna are not expected as part of the project. This event may occur if there is a breakdown in local recreational management protocols and induction information for workers and their families is not followed. It is considered that the consequences to flora and fauna from this risk event range from **insignificant** to **minor**, depending on the status of the flora and fauna (common or listed) and the type of impact (e.g. weed and pest level exacerbation or bushfire). Given the control and management strategies in suggested, the likelihood of this event occurring is considered **possible**, in that it could occur at some time during the life of the mine. Therefore the risk to flora and fauna associated with an increase in recreational activities in the region as a result of the project is considered to be **low**.

### Impacts to Threatened Ecological Communities

There are no known threatened ecological communities (Commonwealth or State) that occur within the proposed infrastructure corridor footprint or at the proposed port site. However, there is a risk that information sources about the threatened ecological communities that are present in the region are incorrect or communities have yet to be identified and as such impacts to these communities as a result of the project will be greater than predicted.

Given the fragmented nature of the landscape throughout the infrastructure corridor and the proposed port site, the consequences of additional impacts as a result of the project are considered to be **insignificant**; short-term decreases in abundance with no lasting effects on the viability of the ecological community. It is considered **unlikely** that the estimations about threatened ecological communities are incorrect. As such, the risk of this event is considered to be **low**.

#### 13.7.1 Summary of Risks

The key environmental risks associated with flora and fauna are presented in Table 13-24. Through the adoption of design modifications or specific mitigation measures, the identified risks were reduced to levels of **medium or lower**. Risks would be monitored through the CEIP environmental management framework outlined in Chapter 24.

Table 13-24 Summary of Risks: Flora and Fauna

Risk Event	Pathway	Receptor	Project Phase <sup>1</sup>	Consequence	Likelihood	Residual Risk
Unauthorised Vegetation clearance	Failure of clearance protocols, equipment failure	Native flora and fauna (listed and common)	C, O	Minor	Unlikely	Low
Higher than expected fauna mortality	Failure of or inadequate management controls, equipment failure, extreme weather, higher presence than predicted	Fauna (common and listed)	C, O	Minor	Possible	Low
Higher than expected impacts to listed fauna and flora	Species under-predicted, move into the area, or are dormant in subsoil	Listed fauna and flora	C, O	Minor	Possible	Low
Noise impacts Hambidge fauna	Unplanned noise event, failure of management controls, error in noise modelling	Fauna of Hambidge WPA	C, O	Moderate	Unlikely	Medium
Bushfire	External, extreme weather, failure of or inadequate management controls	Flora and fauna	C, O	Minor to moderate	Unlikely	Medium
Increase in vertebrate pests and / or abundance of native species as pests	Failure of waste management protocols, increases in human occupation	Native flora and fauna	C, O	Minor	Unlikely	Low
Spread / infestation of Declared weed(s)	Breakdown in weed control and management protocols	Flora and fauna	C, O	Minor	Unlikely	Low
Spread / infestation of Declared weed(s) into Hambidge	Breakdown in weed control and management protocols	Flora and fauna	C, O	Moderate	Unlikely	Medium
Higher than predicted (unplanned) dust emissions	Abnormal conditions, higher than predicted dust emissions, Failure of dust controls	Flora and fauna	C, O	Insignificant	Possible	Low
Increase in recreational degradation of habitat	Lack of awareness about no go areas, workforce and families unaware of environmental values, unmanaged waste	Local fauna and flora	C, O	Insignificant to minor	Possible	Low
Threatened ecological community presence higher than predicted	Presence is higher than predicted, vegetation clearance, weed spread	Threatened ecological community	C, O	Insignificant	Unlikely	Low

<sup>1</sup>C = Construction, O = Operation

## 13.8 Findings and Conclusion

The assessment of impacts to the terrestrial ecology environment (flora and fauna) at the proposed port site and along the infrastructure corridor (including borefield and power transmission line from Yadnarie) has shown that all anticipated impacts are expected to be **negligible to medium** (negligible to low for the port).

The majority of impacts on flora and fauna, including listed fauna, would be as a result of approved vegetation clearance required for regular construction and operation activities. However, it should be noted that there will also be residual benefits to the flora and fauna of the region as a result of the SEB offsets required for the project.

In addition, the risk assessment identified a number of potential threats that may occur as a result of unplanned or unexpected events. The residual risk of these events, following design controls and mitigation measures, were considered to be low to medium and as low as reasonably practicable, and therefore acceptable. Impacts and risks will be minimised through the environmental management framework outlined in Chapter 24