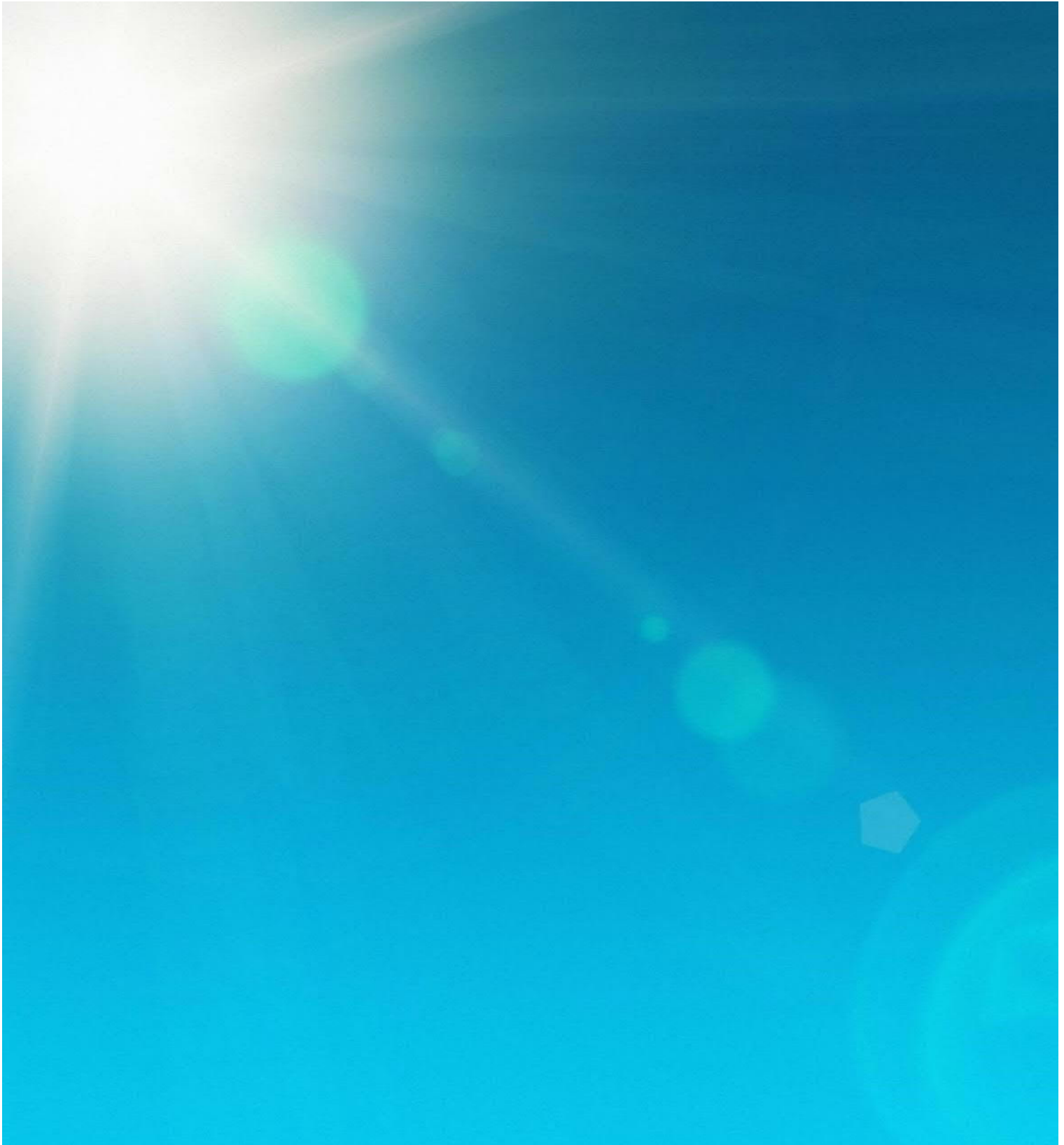


March 2022

# Chapter 5 – Terrestrial Ecosystems

Australia-Asia PowerLink Environmental Impact Statement

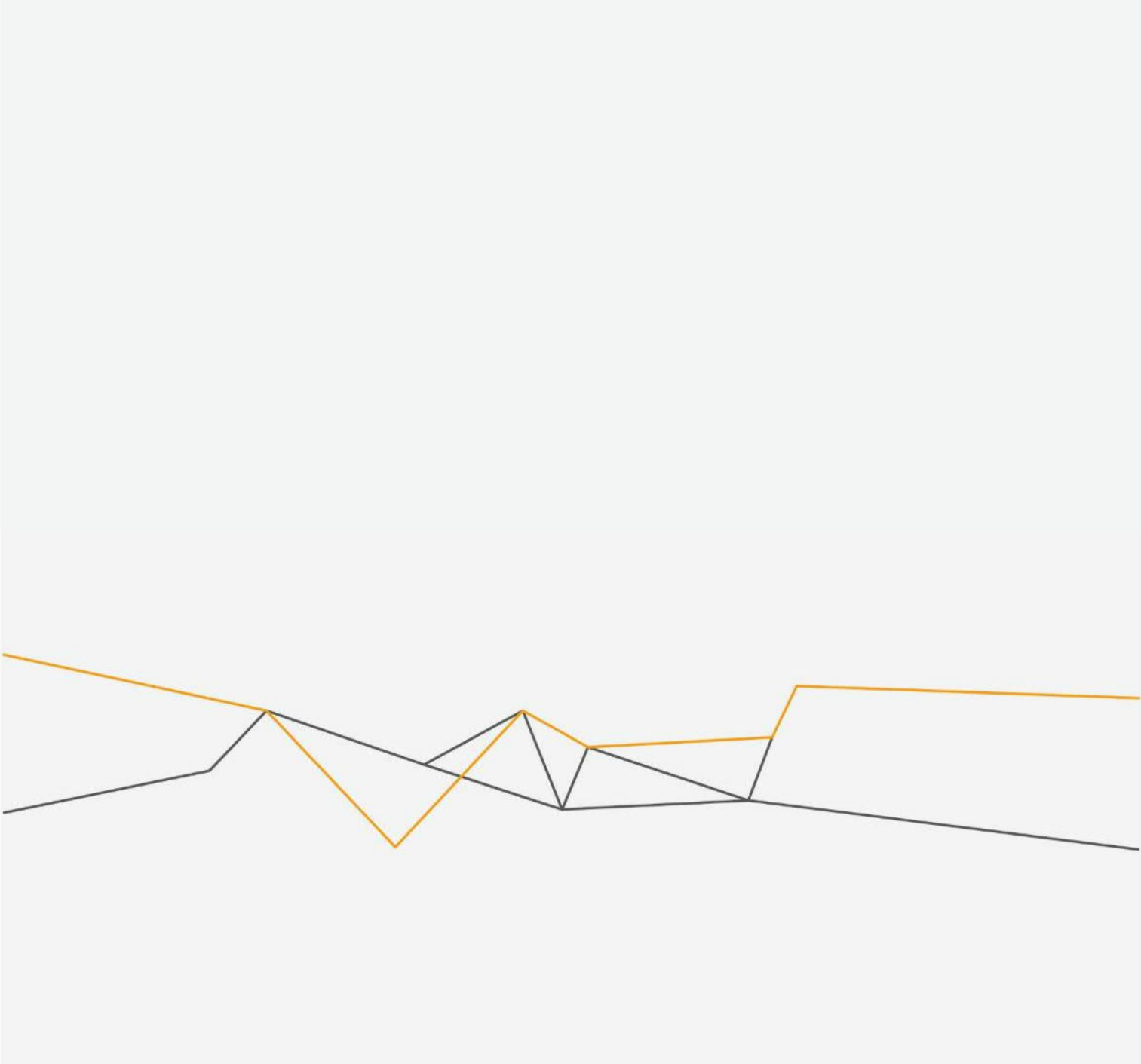


# Chapter 5 – Terrestrial ecosystems

Document ID: 200232

## Revision history

Revision	Date	Purpose	Reviewed by	Approved by
0	18/03/2022	Draft EIS submission	Joe Sheridan	Mark Branson



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## 5 Terrestrial Ecosystems

The NT EPA's objective for the Terrestrial ecosystems factor is to:

*"Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning."*

This chapter discusses the significance of potential impacts to terrestrial ecosystems (i.e., flora and fauna) associated with the Australia-Asia PowerLink (AAPowerLink). The potential impacts considered in this chapter were identified for assessment based on the EIS Terms of Reference (TOR) issued by the NT Environment Protection Authority (NT EPA) (Appendix A), issues raised by stakeholders, and/or on the professional judgement of the EIS team (Appendix D). The EIS team identified potential impacts from their knowledge and understanding of the AAPowerLink components and activities described in Chapter 2 Proposal Description and experience assessing ecological impacts in the NT. Potential impacts were then assessed using the Environmental Impact Assessment (EIA) methods described in Chapter 3 Impact Assessment. This chapter presents the findings of the EIA process undertaken for the Terrestrial environmental quality factor.

This chapter focuses on impacts to terrestrial (land-based) habitats – including riparian<sup>1</sup> and wetland vegetation – including the terrestrial species that utilise these habitats. Freshwater habitats and aquatic species (i.e., species such as fish that live entirely in aquatic freshwater environments) are considered in Chapter 8 Aquatic ecosystems. Marine habitats and species are considered in Chapter 10 Marine Ecosystems.

### 5.1 Information sources

The information presented in this chapter comes from a combination of desktop analysis and fieldwork. A wide range of spatial datasets – predominantly created by the NT Government – together with aerial imagery were used to identify likely ecological values and, where relevant and possible, inform fieldwork to ground-truth these. Species records were garnered from the NT Flora and Fauna Atlases – two datasets maintained by the NT Government that include records from the Atlas of Living Australia, Birdlife Australia Birdata and eBird Australia.

A comprehensive helicopter-based land type survey of the Solar Precinct was undertaken in late 2020, together with a targeted survey for Greater Bilby. Access roads to the Solar Precinct were also traversed by helicopter. The survey report is presented in Appendix O.

Access permission issues precluded any field surveys of the Overhead Transmission Line (OHTL) in the Railway Corridor, which is now planned to take place in early 2022. In the interim, desktop spatial data and high-resolution aerial imagery provided by the NT Government was examined to identify potential values. The OHTL (Utilities Corridor), Darwin Converter Site and Cable Transition Facilities have all been surveyed to ground-truth land units and significant vegetation types and identify potentially suitable habitat for threatened species. Follow-up surveys targeting restricted range threatened species within the OHTL corridor will be undertaken in early 2022 with results provided in the Supplementary EIS.

### 5.2 Relevant policies and guidelines

The EIA for the Terrestrial ecosystems factor references the following policies and guidelines:

#### *NT Land Clearing Guidelines*

The *NT Land Clearing Guidelines* (DENR 2019) are formally recognised under the *Planning Act 1999* and play an important role in guiding good land development practice in the NT by establishing standards for the management (clearing and retention) of native vegetation. The guidelines address biodiversity, cultural

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<sup>1</sup> Habitat specifically along the edges of watercourses

heritage, land management, soil, vegetation, water, and weeds. They also identify sensitive and significant vegetation types, which are assessed in this chapter.

### *NT and Commonwealth threatened species listings*

Specific species were identified for assessment based on the threatened species listings under the *Territory Parks and Wildlife Conservation Act 1976* and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and migratory species listings under the *EPBC Act*.

### *Significant Impact Assessment Guidelines*

Assessment of impacts to listed threatened and migratory species was undertaken with reference to the *EPBC Significant Impact Guidelines 1.1* (DEWHA 2013) and *EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing, and mitigating impacts on EPBC Act listed migratory shorebird species* (DOE 2015).

## 5.3 Existing environment and values

This section presents the ecological context and an overview of the terrestrial ecosystem values encountered within the proposal footprint and surrounding areas (the area of influence) that could be indirectly affected by proposal activities. The proposal footprint and area of influence adopted for assessment of impacts to terrestrial ecosystems are described in Section 5.4.1.2. The existing environmental conditions and values are summarised for each proposal component under the following headings:

- **Land condition** refers to the current condition of the land and considers threatening processes to ecological values that may be present. Key threatening processes discussed in this chapter are fire, weeds, and human land use (e.g., development, pastoralism). Feral animals are a threatening process, but their ubiquitous presence in suitable habitat across the NT makes redundant the need to detail them in this section.
- **Habitat** is described using one of three spatial land resources – land systems, land units and land types. These all categorise the landscape by using aerial imagery and ground surveys to identify groups of areas throughout which there is a recurring pattern of topography, soils, and vegetation. Each land system or land unit therefore represents a reasonably homogenous part of a land surface – distinct from surrounding terrain – with consistent properties in landform, soils, or vegetation (Hooper 1970). The key difference between land systems, land units and land types are the scale at which they have been mapped, with land types being the most detailed.
- **Significant areas** are parks and reserves protected under NT or Commonwealth legislation, and Sites of Conservation Significance (SOCS) identified by the NT Government as important sites for biodiversity conservation. SOCS are not protected under legislation; however, their value is in highlighting areas that support important populations of significance species and/or habitat that may be protected under environmental legislation.
- **Significant vegetation types** are those listed as such in the *Land Clearing Guidelines* (DEPWS 2021d) due to their unique and/or inherently high biodiversity values. They are rainforest, vine thicket, closed forest or riparian vegetation, mangroves, monsoon vine forest, sandsheet heath and vegetation containing large trees with hollows suitable for fauna. In addition, the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) allows for the listing of threatened ecological communities – of which there is only one in the NT, the Arnhem Plateau Sandstone Shrubland Complex.

Threatened species are discussed separately in Section 5.5. Migratory species are discussed in Chapter 16 Matters of National Environmental Significance (MNES).

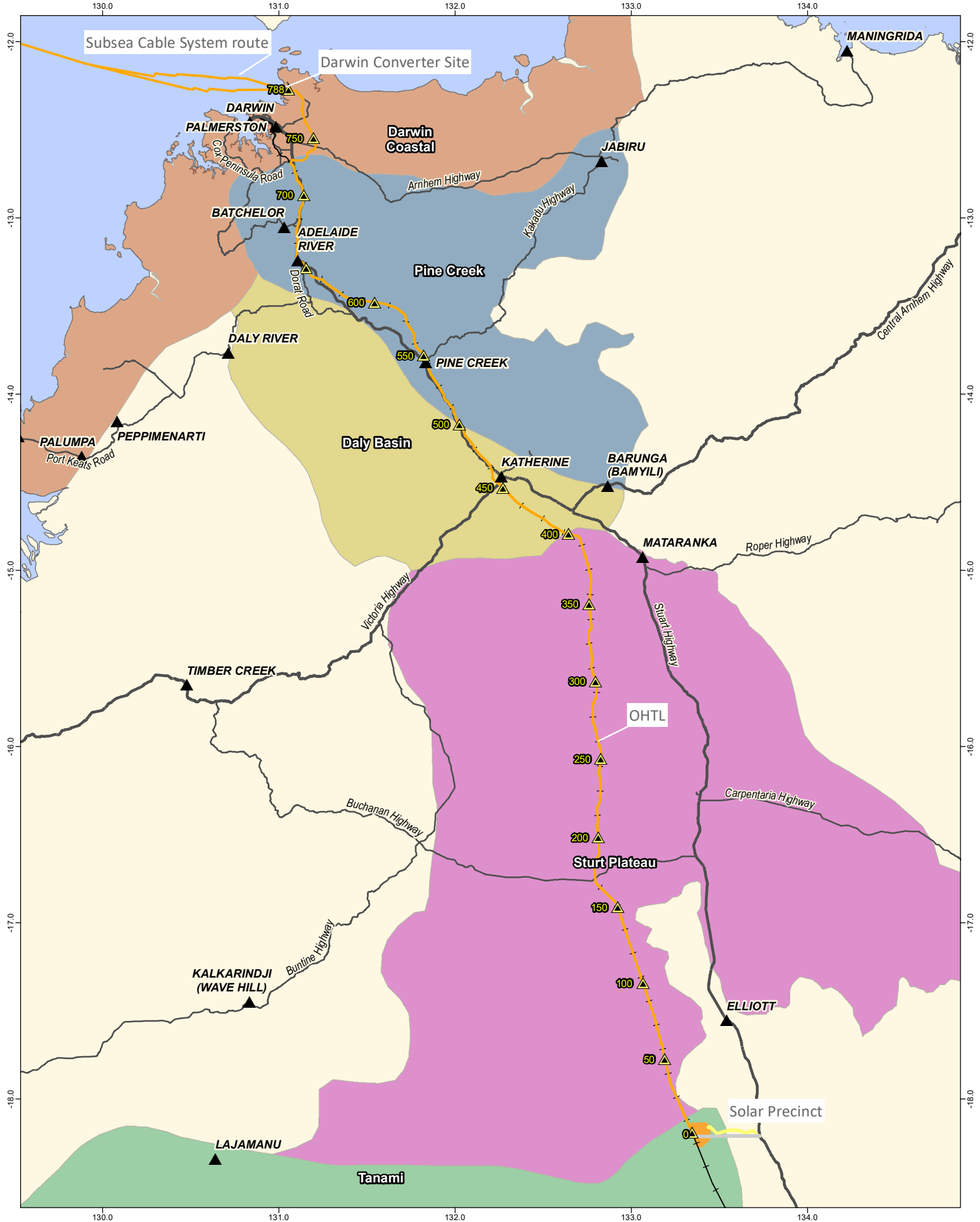
### 5.3.1 General context

Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. They capture the large-scale geophysical patterns across Australia. These patterns in the landscape are linked to fauna and flora assemblages and processes at the ecosystem scale, thus providing a useful means for simplifying and reporting on more complex patterns of biodiversity (NPWS 2003). NT bioregions are described in Baker et al. (2005).

The AAPowerLink spans five diverse bioregions. These are described in Table 5-1 and shown in Figure 5-1. All are within the humid climatic zone, except the Tanami bioregion, where the Solar Precinct is located, which is in the arid climatic zone.

Table 5-1. Description of bioregions spanned by AAPowerLink (listed from north to south)

Bioregion	Landform	Vegetation
<b>Darwin Coastal (DAC)</b>	Gently undulating plains on laterised sandstones and siltstones. Extensive and diverse floodplain associated with the lower reaches of the many large river systems.	The dominant inland vegetation type is <i>Eucalyptus tetradonta</i> and <i>Eucalyptus miniata</i> dominated tall open forest. There are substantial areas of mangroves, and rainforest and other riparian vegetation fringing the rivers.
<b>Pine Creek (PCK)</b>	Predominantly hilly to rugged ridges with undulating plains on igneous granite and metamorphic gneiss.	Mostly open mixed Eucalyptus woodlands or tall forest dominated by <i>Eucalyptus tetradonta</i> and <i>Eucalyptus miniata</i> , with patches of monsoon rainforests, Melaleuca woodlands, riparian vegetation, and tussock grasslands.
<b>Daly Basin (DAB)</b>	Gently undulating plains and scattered low plateau remnants; loamy and sandy red earths on sandstones, siltstones, and limestones.	<i>Eucalyptus tetradonta</i> and <i>Eucalyptus miniata</i> dominated open forest with perennial and annual grassy understorey.
<b>Sturt Plateau (STU)</b>	Flat to gently undulating plains with mainly lateritic soils. Deep sands occur in the south and cracking clays in the southeast.	Predominantly Eucalypt woodlands or tall shrublands and woodlands of bullwaddy and lancewood. Perennial grasses dominate in more open areas.
<b>Tanami (TAN)</b>	Mainly red sandplains with small areas of alluvial plains, low ridges, and stony rises.	Predominantly spinifex hummock grassland with a tall sparse shrub overstorey of <i>Hakea subarea</i> , desert bloodwoods, acacias, and grevilleas.



**Legend**

- ▲ Towns
- AAPowerLink infrastructure
- ▲ OHTL Kilometre Points
- Railway
- Principal road
- Secondary road
- All-weather access road (unsealed)
- Main access road (sealed)

**Bioregions**

- Daly Basin
- Darwin Coastal
- Pine Creek
- Sturt Plateau
- Tanami

Source: Sun Cable, EcOz, NTG (NR Maps)



**Figure 5-1: Map of bioregions proximate to the AAPowerLink proposal**

Project: **Australia-Asia PowerLink**

Reference: M-Files ID 200232

Date: 09/03/2022

Revision: 2

Scale: 1:3,000,000

Datum: GDA2020

Coordinate System: GDA2020

A4

**SUN CABLE**

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### 5.3.2 Solar Precinct

The *Terrestrial Ecological Assessment for the Solar Precinct* (Appendix O) describes in detail the methods and results of desktop and field surveys undertaken to characterise the ecology and biodiversity within the Solar Precinct footprint. The report focuses on the actual Solar Precinct because of its size, and because its location had been confirmed. Less detail is provided on the access roads because of their smaller footprints, and because their footprints were still indicative at this time surveys were undertaken. Survey effort is adequate to be confident that there are no significant values present that will be impacted. Further assessment of watercourse crossing locations along the access roads will be undertaken to consider options to minimise impacts to riparian vegetation, as well as other identified values, such as heritage features.

#### 5.3.2.1 Habitat

At a broad scale, the Solar Precinct predominantly occurs within the Redsan land system – a member of the desert sandplains group – which covers an extensive area of land (~2,770,000ha) within the northern and north-eastern region of the Tanami Desert – see Figure 5-3.

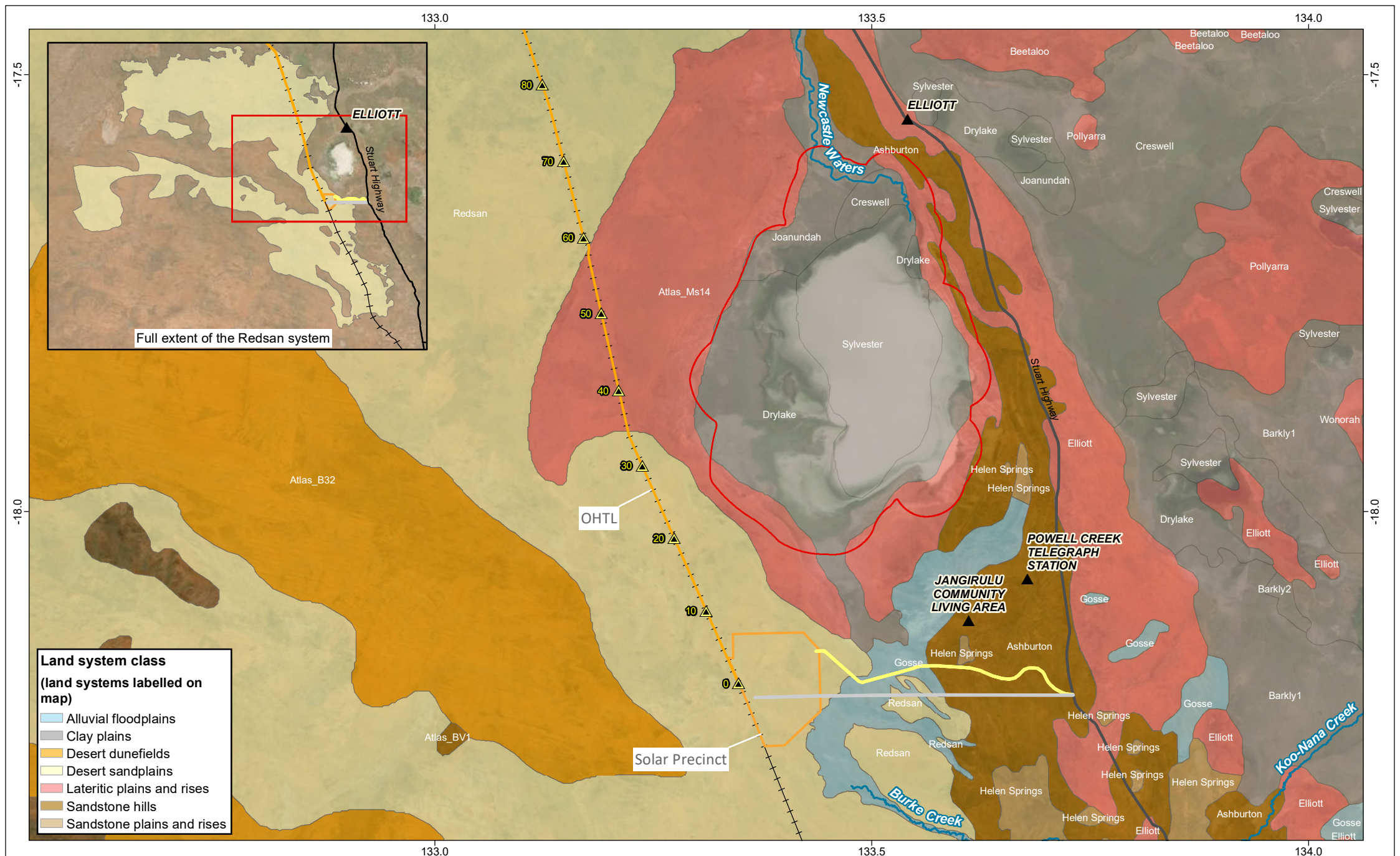
Land type mapping was undertaken within the Solar Precinct footprint in November 2020 at a scale of 1:20,000. The mapping identified four land types which are described in detail in Chapter 4 Terrestrial Environmental Quality. Most of the footprint is a flat to gently sloping loamy plain that supports a patchy shrubland of *Acacia* species (with sandier areas supporting scattered *Corymbia opaca*) – see Figure 5-2. The western side of the footprint is a loamier area supporting mostly *Eucalyptus pruinosa*. Small, localised depressions are scattered throughout that support plant species suited to episodic and ephemeral inundation. A small portion of the south-east of the footprint intersects lower alluvial flats associated with significant outflow events from westerly flowing drainages from the Ashburton Range. This land type has loamy surface soils and supported a malleed form of *Corymbia opaca* and shrubby *Melaleucas*. There are scattered, small, localised depressions within this land type that have a high clay content and moisture-holding capacity (and were often more densely vegetated).

Surveys conducted within the Solar Precinct footprint<sup>2</sup> incidentally recorded the presence of numerous common and widespread native fauna species – such as Red Kangaroo, Dingo, various goanna and dragon species, and arid land birds (doves, buttonquail, honeyeaters, and Budgerigar). None of the species identified are listed as threatened under Commonwealth or NT legislation.



Figure 5-2. Photographs of the dominant land types within the Solar Precinct

<sup>2</sup> The ecological surveys targeted detection of threatened species. General fauna surveys were not undertaken; however, incidental observations of fauna were recorded by the field survey team.



- Land system class**  
(land systems labelled on map)
- Alluvial floodplains
  - Clay plains
  - Desert dunefields
  - Desert sandplains
  - Lateritic plains and rises
  - Sandstone hills
  - Sandstone plains and rises

- Legend**
- AAPowerLink infrastructure
  - Main access road (sealed)
  - Lake Woods SOCS
  - OHTL Kilometre Point
  - All-weather access road (unsealed)
  - Places
  - Principal road
  - Major drainage
  - Railway



**Figure 5-3: Land systems relevant to the Solar Precinct**

Project: <b>Australia-Asia PowerLink</b>		Reference: M-Files ID 200232		Revision: 2
Coordinate System: GDA2020		Date: 09/03/2022		<b>SUN CABLE</b>
		Scale: 1:600,000		

Source: Sun Cable, EcOz, NTG (NR Maps)  
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### 5.3.2.2 Significant vegetation

None of the land types within the Solar Precinct support significant vegetation types. Drainage depressions and alluvial flats are present – but although they are run-on drainage features, they are not considered to be wetlands because they have loamy rather than clayey soils, and inundation events are only expected to be episodic and short-lived. Moreover, there are no drainage lines or watercourses within the Solar Precinct.

The Solar Precinct access road corridors intersect ephemeral creeks and tributaries that support riparian vegetation at some locations.

### 5.3.2.3 Land condition

Pastoralism is the primary land use within the Solar Precinct footprint. The soft spinifex land within which the Solar Precinct footprint occurs is considered to have a low stock carrying capacity (Stewart et al. 1970), and observations made during the land type surveys within the Solar Precinct footprint indicated that grazing pressure is low. No weeds or erosion issues (or other types of land degradation) were observed. Vegetation within the footprint has been exposed to numerous fires over the past 10 to 20 years. Fires in 2015 and 2017 burnt large portions of the footprint area, and only small pockets have not been burnt for 10 years.

### 5.3.2.4 Significant areas

The Solar Precinct footprint does not fall within a SOCS; however, the Lake Woods SOCS boundary is located approximately 10 km to the north – see Figure 5-3. Lake Woods is one of the largest temporary freshwater lakes in the Northern Territory and tropical Australia, and generally occupies an area of approximately 350 to 500 km<sup>2</sup> after wet season rains (SWE&S 2021). However, during periods of high rainfall, the lake can occupy up to 1,000 km<sup>2</sup>, and can retain water for 12 consecutive months. The SOCS has international significance due to seasonal presence of large aggregations of waterbirds, and presence of important wetland habitat.

Flood modelling prepared to inform the Solar Precinct Site selection and layout (Appendix N) indicates that during extreme flood events (i.e., 1-in-1,000 and 1-in-2,000-year events) Lake Woods could swell such that it would inundate a small portion of the north-east corner of the Solar Precinct. The usual extent of Lake Woods is over 10 km away, such that it is outside the area of influence for this proposal. However, to inform the assessment of the potential for bird collisions with solar panels (see Section 5.4.3.2) this section provides further information regarding the birdlife that can be present.

Lake Woods SOCS has international significance due to seasonal presence of large aggregations of waterbirds, and presence of important wetland habitat (BirdLife International 2021, Jaensch & Bellchambers 1997). After significant rainfall events, Lake Woods can support very large numbers of waterbirds – including internationally-significant numbers of the Plumed Whistling-duck (>27,000 birds), nationally-significant numbers of Great Egret (>3,000 birds), and large numbers of Australian Pelican, Grey Teal, Intermediate Egret, Glossy Ibis and Freckled Duck.

The SOCS has been surveyed sporadically, with the highest abundances were recorded by Jaensch in 1993 and 1994.<sup>3</sup> Sixty-seven species of waterbirds have been recorded at Lake Woods – including the threatened Australian Painted Snipe – of which 23 species have been reported breeding (BirdLife International 2021, Jaensch & Bellchambers 1997) and 24 are migratory species. An ecologically-significant population of two migratory species (i.e., at least 0.1 per cent of the flyway population) – Little Curlew and Oriental Pratincole – have been recorded at Lake Woods by Jaensch (in 1993/94) who, at the time, also counted more than 2,000 migratory shorebirds in total.

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<sup>3</sup> For context, 1991 and 1993 had above average rainfall, 1992 had slightly below-average rainfall, and 1994 was significantly below average.

### 5.3.3 Overhead Transmission Line

The *Terrestrial Ecology Report for the OHTL and Murrumjuck Facilities*<sup>4</sup> (Appendix P) describes in detail the methods and results of desktop and field surveys undertaken to characterise the ecology and biodiversity within the OHTL footprint. In the report, the OHTL corridor is divided into two sections to reflect the difference in existing land use and condition:

- The first 722 km (from the Solar Precinct to near Livingstone) lie within the existing Railway Corridor that has already been subjected to some previous disturbance and clearing along its entire length, but which also includes remnant bushland.
- The final 66 km from Livingstone to the Darwin Converter Site at Murrumjuck will be contained within a Utilities Corridor, two-thirds of which is natural bushland.

Where necessary, this distinction has been maintained in this chapter. Because of access constraints, the Railway Corridor has not been subjected to any field surveys (except the first 150 km that were surveyed aerially for Greater Bilby – see Section 5.5.4.8). Vegetation, land units and habitat suitability have been surveyed within the Utilities Corridor, but no targeted surveys for threatened species have been undertaken. The report identifies areas within both sections of the OHTL footprint that could support threatened species (summarised in Section 5.5.4), and Sun Cable have committed to surveying for these species (to determine presence and significance) with results to be provided in the Supplementary EIS.

Vegetation, land units and habitat have been surveyed in the Utilities Corridor section of the OHTL and based on the findings, targeted surveys for certain restricted-range threatened species are planned for the first half of 2022 – discussed in Section 5.5.4. Similarly, targeted threatened species surveys are planned in the Railway Corridor (also for the first half of 2022) in areas identified as suitable habitat based on NT Government modelling. The results of targeted threatened species surveys in the OHTL footprint will be reported in the Supplementary EIS.

#### 5.3.3.1 Habitat

##### *Railway Corridor*

Given the very long but narrow OHTL (Railway Corridor) footprint, land systems have been used to present an overview of habitat – see Table 5-2. The southern half of the OHTL (Railway Corridor) predominantly traverses lateritic plains and rises, and desert sandplains. The northern half of the OHTL (Railway Corridor) predominantly traverses lateritic plains and rises, and sandstone plains and rises.

Eucalyptus and Corymbia savanna woodlands are dominant within, and surrounding, the Railway Corridor footprint, as they are across northern Australia. Sections of the corridor traverse rocky country, floodplains, watercourses, which typically support a different suite of species to the savanna woodlands.

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<sup>4</sup> Murrumjuck facilities covers both the Darwin Converter Site and Cable Transition Facilities footprints and surrounding areas.

Table 5-2. Land systems intersected by Overhead Transmission Line (Railway Corridor) footprint

Class	Vegetation*	Land systems	Approximate length of OHTL (km)
Alluvial floodplains	Low to tall Eucalyptus woodland over tall grasses; mid-high woodland of <i>Melaleuca</i> spp. and <i>Corymbia</i> spp. over tall grasses; Tall grasslands of <i>Chrysopogon</i> spp., <i>Sorghum</i> spp. and <i>Themeda</i> spp.	Banyan, Effington, Fabian, Flatwood, Jundee, McKinlay, Western	23.92
Clay plains	Tall sparse shrubland of <i>Carissa lanceolata</i> , <i>Ventilago viminalis</i> , <i>Terminalia volucris</i> with scattered trees ( <i>Lysiphyllum cunninghamii</i> , <i>Atalaya hemiglauca</i> , <i>E. microtheca</i> ) over <i>Aristida</i> spp, <i>Sorghum</i> sp., <i>Astrebla squarrosa</i> . *	Larrimah	3.69
Coastal floodplains	Tall open forest of <i>Melaleuca cajuputi</i> , <i>M. leucadendra</i> , <i>M. viridiflora</i> , <i>Acacia auriculiformis</i> over <i>Eleocharis</i> spp., <i>Cyperus</i> spp., <i>Pseudoraphis spinescens</i>	Pinwinkle	0.67
Desert sandplains	No description*	Redsan	133.15
Granite hills	Mid-high open woodland of <i>E. tetradonta</i> , <i>E. tectifera</i> , <i>C. latifolia</i> , <i>Erythrophleum chlorostachys</i> , <i>E. miniata</i> over tropical tall grass ( <i>Heteropogon triticeus</i> , <i>Chrysopogon fallax</i> , <i>Sorghum</i> spp.)	Currency	0.84
Granite plains and rises	Low to high woodland to open woodland of <i>Corymbia</i> spp. and <i>Eucalyptus</i> spp., sometimes with <i>Terminalia</i> spp. and <i>Xanthostemon</i> sp. over tall grasses ( <i>Heteropogon</i> sp., <i>Chrysopogon</i> sp., <i>Sorghum</i> sp. and <i>Themeda triandra</i> ) and <i>Eriachne</i> sp.	Cully	40.46
Lateritic plains and rises	Mid to tall open woodland of <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. over tall grasses ( <i>Chrysopogon</i> spp., <i>Themeda</i> spp., <i>Sehima</i> spp., <i>Sorghum</i> spp., <i>Heteropogon</i> spp., <i>Triodia</i> spp.), with some low open woodland of <i>Acacia</i> spp., <i>Grevillea</i> spp., <i>Melaleuca</i> spp. with low shrubs ( <i>Calytrix exstipulata</i> , <i>Acacia</i> spp., <i>Grevillea</i> spp.) over <i>Sorghum</i> spp., <i>Heteropogon</i> spp.*	Atlas_Ms14, Banjo, Birrimbah, Birrimbah 1, Bulwaddy, Claravale, Elsey, Forrest, Kay, Keating, Keckwick, Keefers Hut, Knifehandle, Krans, Sturt, Woggaman 1	332.78
Lateritic plateaux	Mid-high forest to open woodland of <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., sometimes with <i>Terminalia</i> spp. and <i>Lophostemon lactifluus</i> , over tall grasses ( <i>Sorghum</i> spp., <i>Aristida</i> spp., <i>Triodia bitextura</i> , <i>Heteropogon</i> spp. and <i>Chrysopogon</i> spp.	Yujullowan	1.40

Class	Vegetation*	Land systems	Approximate length of OHTL (km)
Limestone plains and rises	Low woodland to tall open forest of <i>Eucalyptus spp.</i> , <i>Corymbia spp.</i> , sometimes with <i>Erythrophleum chlorostachys</i> over tall grasses ( <i>Triodia bitextura</i> , <i>Sorghum spp.</i> , <i>Heteropogon sp.</i> , <i>Chrysopogon sp.</i> , <i>Themeda spp.</i> , <i>Sehima sp.</i> , <i>Panicum mindanaense</i> , <i>Eragrostis spp.</i> , <i>Eriachne spp.</i> ).	Beemla, Budbudjong, Jindara, Kimbyan, Tagoman, Wallingin	85.66
Sandstone hills	Mid-high woodland of <i>Corymbia dichromophloia</i> , <i>Eucalyptus. miniata</i> , <i>C. bleeseri</i> , <i>E. tectifera</i> , <i>C. terminalis</i> over <i>Sorghum spp.</i> , <i>Themeda triandra</i> , <i>Chrysopogon spp.*</i>	Baker	30.58
Sandstone plains and rises	Low to tall woodland of <i>Eucalyptus spp.</i> and <i>Corymbia spp.</i> , with some <i>Erythrophleum chlorostachys</i> and <i>Terminalia spp.</i> over tall grasses ( <i>Sorghum spp.</i> , <i>Heteropogon spp.</i> , <i>Chrysopogon spp.</i> , <i>Eriachne spp.</i> , <i>Themeda spp.</i> ). Some low shrubland of <i>Eucalyptus spp.</i> , <i>Xanthostemon paradoxus</i> and <i>Buchanania spp.*</i>	Bend, Bustard, Rumwaggon	141.56

\*Vegetation description apply to northern NT only – these details are not available for southern NT land systems

### Utilities Corridor

There are twenty land units that intersect the proposed OHTL (Utilities Corridor) – see Table 5-3. Ground-truthing found the existing mapping was reliable with the exception of some minor line work required to refine demarcations between land units. The most common land units intersecting the OHTL Utilities Corridor were 2b1 (side slopes), 3a, 3b and 3c (flat to gently undulating upland surfaces). These land units were associated with mixed Eucalypt woodland located on landforms of plains or rises, with red to brown kandosol soils. Land unit 3e, 4c and 6b were also relatively common, intersecting the OHTL Utilities Corridor on multiple occasions. These land units were associated with plains or drainage systems with hydrosol soils indicating poorer drainage – i.e., wet season water-table.

Table 5-3. Land units relevant to the Overhead Transmission Line (Utilities Corridor) footprint

Land unit	Landform class	Landform description	Vegetation	Length of OHTL (km)
1a	Low hills	Flat hillcrests	Open woodland to open forest of <i>Eucalyptus tetradonta</i> and <i>Eucalyptus miniata</i> over annual <i>Sorghum spp.</i> and <i>Heteropogon triticeus</i> .	0.77
1b		Steep ridges	Woodland of <i>Eucalyptus miniata</i> , <i>Eucalyptus tectifera</i> and <i>Corymbia foelscheana</i> over <i>Sorghum plumosum</i> .	1.15
1c	Rises	Rises and short steep slopes	Woodland of <i>Eucalyptus miniata</i> and <i>Corymbia bleeseri</i> over <i>Sorghum</i> species.	1.73
2a1		Rises	Open woodland of <i>Eucalyptus miniata</i> , <i>Eucalyptus tetradonta</i> , or <i>Corymbia foelscheana</i> , <i>Corymbia confertifolia</i> , <i>Eucalyptus tectifera</i> over mixed grasses.	0.65

Land unit	Landform class	Landform description	Vegetation	Length of OHTL (km)
2b1		Side slopes	Open woodland to woodland of <i>Eucalyptus miniata</i> , <i>Eucalyptus tetradonta</i> , <i>Corymbia foelscheana</i> and <i>Eucalyptus tectifera</i> over <i>Sorghum</i> species.	11.08
2b2			Low open woodland to open woodland of <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> or a mix of species over sparse grasses.	2.51
3a	Plains	Flat to gently undulating upland surfaces	Open forest of <i>Eucalyptus tetradonta</i> and <i>Eucalyptus miniata</i> over mixed grasses.	4.42
3b			Woodland of <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> over <i>Sorghum</i> species.	11.97
3c		Gently undulating upland surfaces	Woodland of <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> over <i>Sorghum</i> species.	9.61
3d			Open woodland of <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> over <i>Sorghum</i> species.	0.80
3e		Flat to gently undulating upland surface	Woodland of <i>Corymbia polycarpa</i> and <i>Erythrophleum chlorostachys</i> over mixed grasses; wet season watertable.	3.66
4c			Open forest of <i>Eucalyptus</i> spp. over mixed grasses; wet season watertable.	1.87
5b1	Drainage systems	Drainage floors within upland terrain	Woodland to open forest of <i>Lophostemon lactifluus</i> , <i>Corymbia bella</i> , and <i>Melaleuca viridiflora</i> over mixed grasses.	0.08
5b2		Incised drainage floors within upland terrain	Open shrubland to open woodland of <i>Corymbia polycarpa</i> , <i>Melaleuca</i> spp. and <i>Eucalyptus alba</i> over <i>Eriachne</i> and <i>Sorghum</i> species	0.17
6a2		Broad lowland plains	Open woodland or woodland of <i>Lophostemon lactifluus</i> , <i>Corymbia polycarpa</i> , <i>Eucalyptus alba</i> , <i>Melaleuca viridiflora</i> over <i>Eriachne burkittii</i> , <i>Sorghum stipoideum</i> .	0.24
6b			Tall shrubland of <i>Grevillea</i> spp., <i>Melaleuca</i> spp. and <i>Lophostemon lactifluus</i> over annual <i>Sorghum</i> spp. and <i>Heteropogon triticeus</i> .	4.05
8a		Upland depressions & floodways	Grassland of <i>Eriachne</i> spp., annual <i>Sorghum</i> sp. with scattered trees and shrubs.	0.34
8b	Swamps	Swamp depressions	Open to closed forest of <i>Melaleuca</i> spp.	1.45
Disturbed				5.71

### 5.3.3.2 Significant vegetation

#### *Railway Corridor*

The OHTL (Railway Corridor) footprint is mapped as passing through, or adjacent to, the following significant vegetation types:

- Wetlands, most notably the Adelaide River floodplain and south towards Hayes Creek
- Riparian vegetation along many of the 154 watercourses crossed by the corridor. The extent of that vegetation usually increasing with stream order (i.e., large rivers will support a wider corridor of riparian vegetation than a lower order ephemeral creek). The major rivers have the thickest fringes of the most riparian vegetation.
- Dry rainforest at one location near Katherine
- Two sinkholes within 100 m of the corridor.

The locations of these features are presented in Table 5-4 and are shown on Figure 5-4 and Figure 5-5.

There is a low likelihood that any Threatened Ecological Community (TEC) occur within or near the Railway Corridor. The EPBC Protected Matters Search indicated that the Arnhem Plateau Sandstone Shrubland Complex – listed as Endangered under the *EPBC Act* – could occur. The TEC is restricted to massive sandstone environments of the Arnhem plateau and outliers and is distributed from Katherine Gorge to the vicinity of Oenpelli, with portions of these landscape protected in Kakadu NP and Nitmiluk NP. The TEC is comprised mostly of native shrubs, grasses and animals living in rocky country, with a range of endemic plant species. The likely and possible extents of this complex have been mapped, showing that the Railway Corridor intersects land classed as possibly supporting this TEC in three locations north-west and south-east of Katherine (noting that the TEC mapping includes a buffer). However, it can be seen from aerial imagery that the Railway Corridor does not intersect with sandstone environments. Moreover, both modelled areas are a significant distance from habitat known, or likely, to support the Arnhem Plateau Sandstone Shrubland Complex – especially the large area south-east of Katherine. Consequently, there is a low likelihood that the Arnhem Plateau Sandstone Shrubland Complex is present within the OHTL Railway Corridor. This will be confirmed by field inspections in 2022.

#### *Utilities Corridor*

The OHTL Utilities Corridor footprint is mapped in Figure 5-4 and Figure 5-5 as passing through, or adjacent to, the following significant vegetation types:

- The corridor traverses the eastern edge of Shoal Bay – Mickett Creek wetland along its last 20 km. The wetland is an area of estuarine habitats containing marshes, mangrove woodlands, beaches, mudflats, and creeks. Within the wetland complex, the OHTL corridor intersects 6 ephemeral Melaleuca swamps and a permanent billabong.
- Riparian vegetation is present along three drainage lines intersected by the OHTL Utilities Corridor – two of which support monsoon rainforest.
- There is a small pocket of monsoon rainforest intersected by the corridor and another patch likely to be present (but inaccessible by the field survey team) south of Black Jungle Conservation Reserve.
- The corridor traverses the Howard River Catchment which has a high proportion of the sandsheet heath in the region. There are 16 mapped potential sandsheet communities intersecting the corridor (Hempel 2003), of which three were considered highly modified habitats and two are yet to be verified.
- A few large hollow-bearing trees were observed at three locations within Utilities Corridor. These could provide habitat for threatened fauna species.

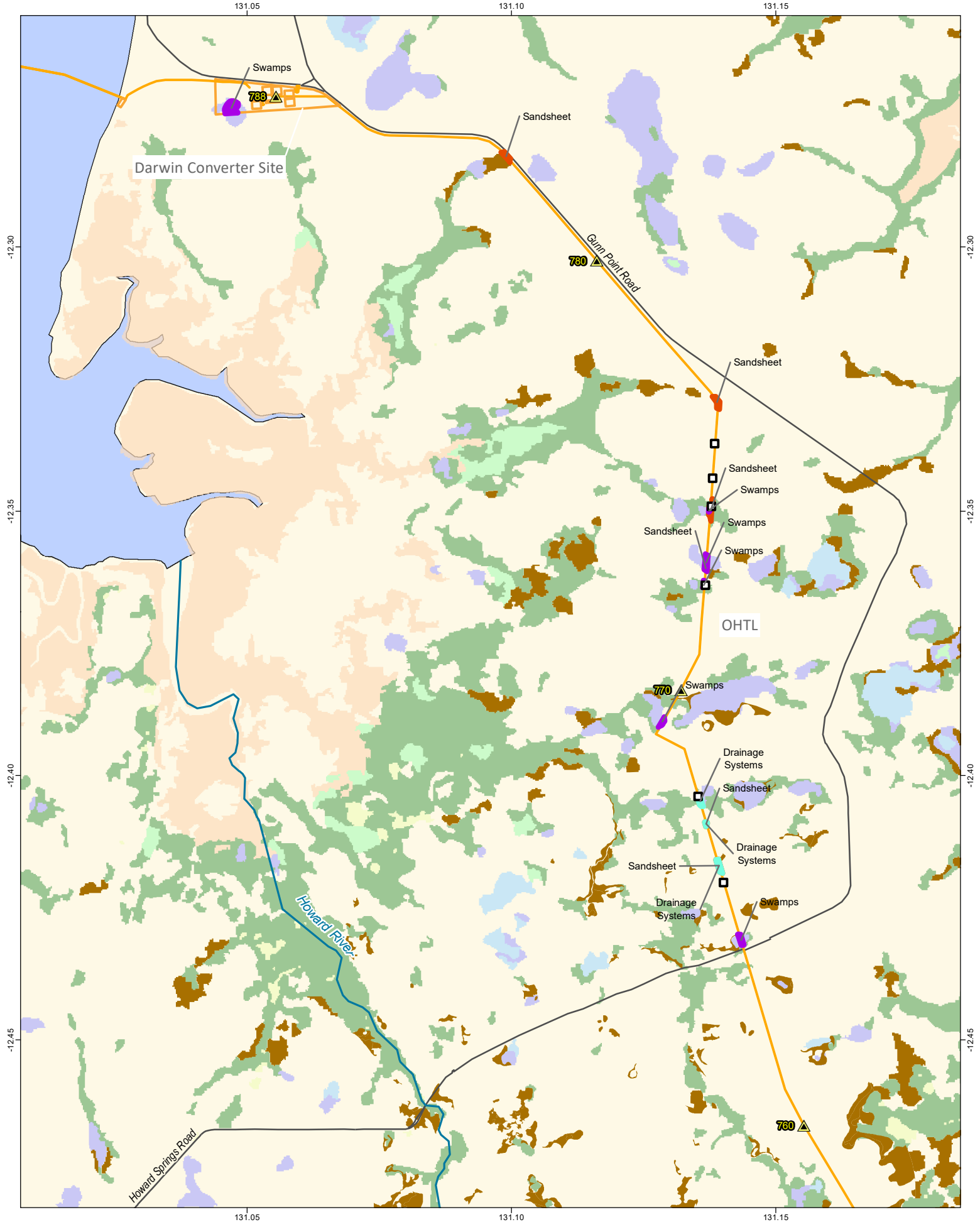
The locations of these features are presented in Table 5-4 and are shown in Figure 5-4 and Figure 5-5.

Table 5-4. Significant vegetation types within the Overhead Transmission Line corridor

Vegetation type	Approx. KP	Comment
Arnhem Plateau Sandstone Shrubland Complex	363 - 411	Land modelled as 'possibly' supporting this Threatened Ecological Community
Riparian	414	King River
Arnhem Plateau Sandstone Shrubland Complex	415 - 437	Land modelled as 'possibly' supporting this Threatened Ecological Community
Riparian	456	Katherine River
Sinkhole (depression)	462	According to NR Maps
Dry rainforest	463	According to rainforest mapping (Russell-Smith 2000)
Sinkhole (cave)	467	According to NR Maps
Arnhem Plateau Sandstone Shrubland Complex	480 - 487	Land modelled as 'possibly' supporting this Threatened Ecological Community
Riparian	498	Edith River
Riparian	513	Fergusson River
Riparian	519	Cullen River
Riparian	596	Saunders Creek
Riparian	598	Margaret River
Riparian	624	Howley Creek
Riparian	628	Bridge Creek
Riparian	652	Burrell Creek
Riparian	657	Adelaide River
Sandsheet heath	726 - 727	Alverly Road (1 patch)
Swamp	727	Ephemeral
Swamp	728	Ephemeral
Riparian with rainforest	728 - 729	Elizabeth River crossing
Monsoon rainforest	728 - 729	Adjacent to Elizabeth River crossing
Sandsheet heath	735 - 741	Southern portion of Koolpinyah Station (3 patches)
Sandsheet heath	745 - 763	Between Arnhem Hwy and Gunn Point Road (6 patches)
Rainforest	748	Based on aerial imagery - within an area that has not yet been surveyed
Sandsheet heath	748- 749	Based on aerial imagery - within an area that has not yet been surveyed (2 patches)
Riparian	750	Transitioning channel
Riparian with rainforest	754 - 755	Large trees fringing a creek
Swamp	767	Ephemeral
Billabong	769 - 770	Permanent
Swamp	772	Ephemeral

Vegetation type	Approx. KP	Comment
Sandsheet heath	772 - 783	Alongside Gunn Point Road (4 patches)
Swamp	773	Ephemeral
Swamp	774	Ephemeral

*Only large rivers transected by the OHTL Railway Corridor are included*



**Legend**

- AAPowerLink infrastructure
- Secondary road
- ▲ OHTL Kilometre Point
- Drainage Systems
- Sandsheet heath
- Swamp
- Floodplain
- Grassy swamp
- Mangrove forest
- Melaleuca swamp
- Riparian open forest
- Spring rainforest
- Sandsheet heath
- Swamp
- Hollow-bearing trees

Source: Sun Cable, EcOz, NTG (NR Maps)



**Figure 5-4: Map of significant vegetation types within the OHTL Utilities Corridor (north)**

Project: Australia-Asia PowerLink

Reference: M-Files ID 200232

Date: 25/02/2022

Revision: 0

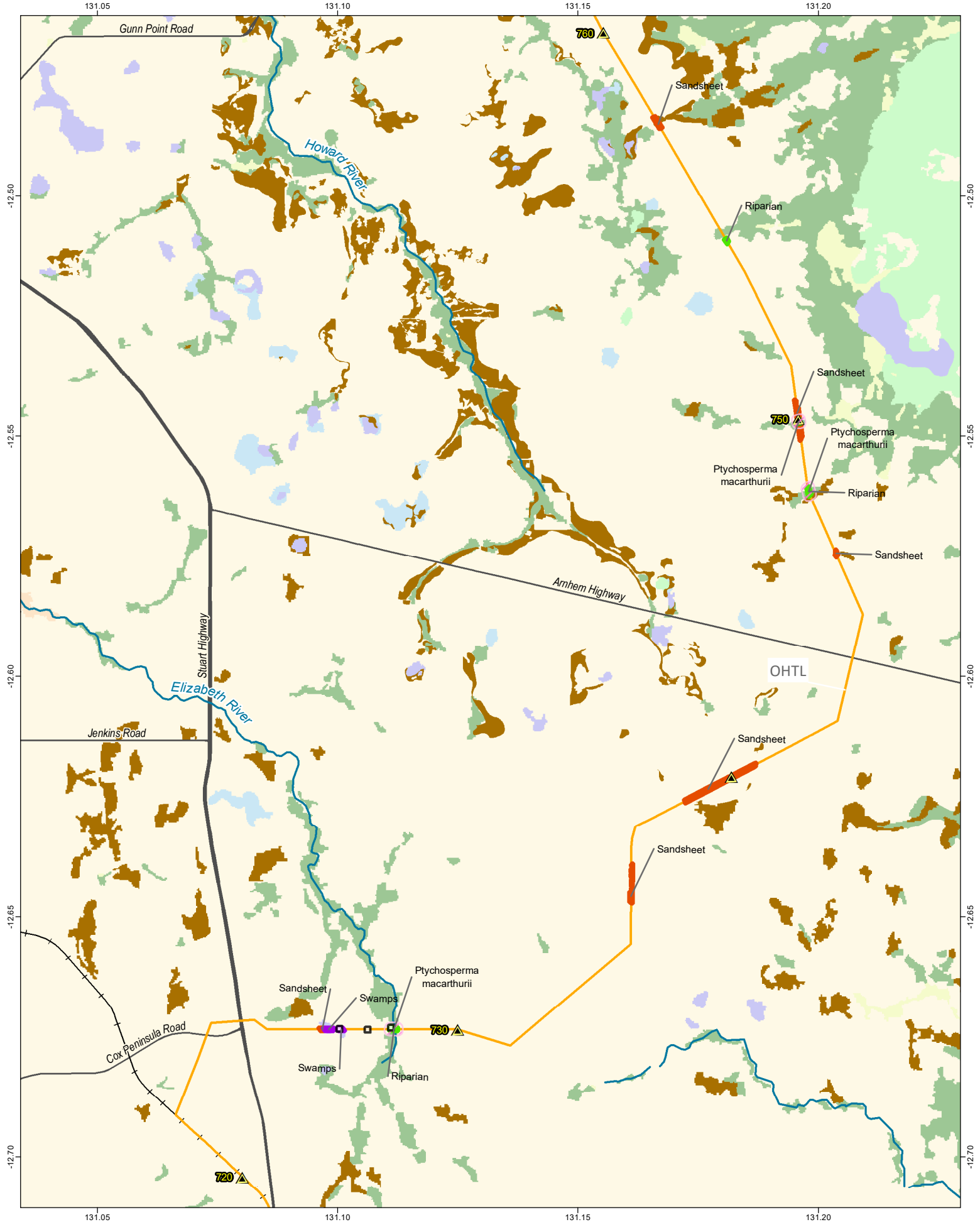
Scale: 1:100,000

Coordinate System: GDA2020

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**Legend**

AAPowerLink infrastructure	Veg intersected by OHTL	Modelled significant vegetation
OHTL Kilometre Points	Drainage Systems	Floodplain
Principal road	Riparian	Grassy swamp
Secondary road	Sandsheet heath	Mangrove forest
Hollow-bearing trees	Swamp	Melaleuca swamp
		Riparian open forest
		Spring rainforest
		Sandsheet heath



**Figure 5-5: Map of significant vegetation types within the OHTL Utilities Corridor (south)**

Project: **Australia-Asia PowerLink**

Reference: M-Files ID 200232

Date: 25/02/2022

Revision: 0

Scale: 1:110,000

Coordinate System: GDA2020

0 3 Kilometres

### 5.3.3.3 Land condition

#### *Railway Corridor*

The OHTL (Railway Corridor) passes through a diverse range of land uses and, along its entire length, has been partially cleared to accommodate railway infrastructure. The railway line that it follows is nearly entirely located within easement parcels, leased to the AustralAsia Railway Corporation. Over 65% of the OHTL railway and Utilities Corridor passes through land used for grazing native vegetation (Staben and Edmeades 2017). Of the remainder, ~11% is classed as traditional Indigenous uses (managed resource protection), ~7% is residual native cover, and the remaining ~17% covers 55 other different land uses, most less than 1%.

The Railway Corridor traverses a wide variety of habitats, and linear developments are notorious for assisting in the proliferation of weeds. There are records of 16 weed species within the OHTL Railway Corridor – 12 of which are listed weeds. The three most numerous species are Gamba Grass (*Andropogon gayanus*), Mission Grass (*Cenchrus species*) and Hyptis (*Mesosphaerum suaveolens*) – with the majority of records within the Darwin region. Some weed control is undertaken by the operators of the railway line.

#### *Utilities Corridor*

The majority of the Utilities Corridor crosses areas of remnant native vegetation cover – including two conservation reserves. It also crosses a quarry and a rural residential area near its intersection with Arnhem Highway (east of Humpty Doo), and rural properties around its diversion from the Stuart Highway. During the field survey, there was little evidence of significant erosion, rubbish dumping or any other degradation as a result of direct human activity.

Fieldwork noted only three weed species within the Utilities Corridor: some significant patches of Gamba Grass, a few minor patches of Hyptis, and occasional occurrences of Stylo (*Stylosanthes species*).

The northern savannas constitute the most fire-prone landscapes in Australia (Russell-Smith & Whitehead 2015), and regular fires have always been a natural part of the environment in the Top End. However, frequent fires can result in fewer flora species and reduced structural complexity (McKay 2017), both of which can also significantly diminish the habitat quality for fauna and facilitate weed invasion. Most of the Utilities Corridor comprises areas with abundant remnant native vegetation cover; these have been burnt almost every year during that period, likely having a negative impact on biodiversity. The peri-urban districts around Humpty Doo, however, have only been burnt once or twice.

### 5.3.3.4 Significant areas

The following significant areas are mapped in Figure 5-6.

#### *Railway Corridor*

The OHTL (Railway Corridor) runs for ~15 km along the edge of the Manton Dam Recreation Area – approximately 60 km south-east of Darwin. This area is used for boating, fishing, and water sports. The OHTL Railway Corridor runs very near (~400 m) to the easternmost edge of Litchfield National Park at KP658, and close (~2 km) to Kintore Caves Conservation Reserve at KP466.

The corridor also crosses through ~35 km of the Yinberrie Hills SOCS just north of Katherine, which is an area of important habitat for the endangered Gouldian Finch (see Section 5.5.4.7 for detail).

#### *Utilities Corridor*

The OHTL Utilities Corridor transects Black Jungle Conservation Reserve for 2.6 km (between KP752 and 755) and runs just inside the eastern boundary of the Shoal Bay Coastal Reserve for 5.1 km (between KP769 and 777).

The corridor also crosses three SOCS:

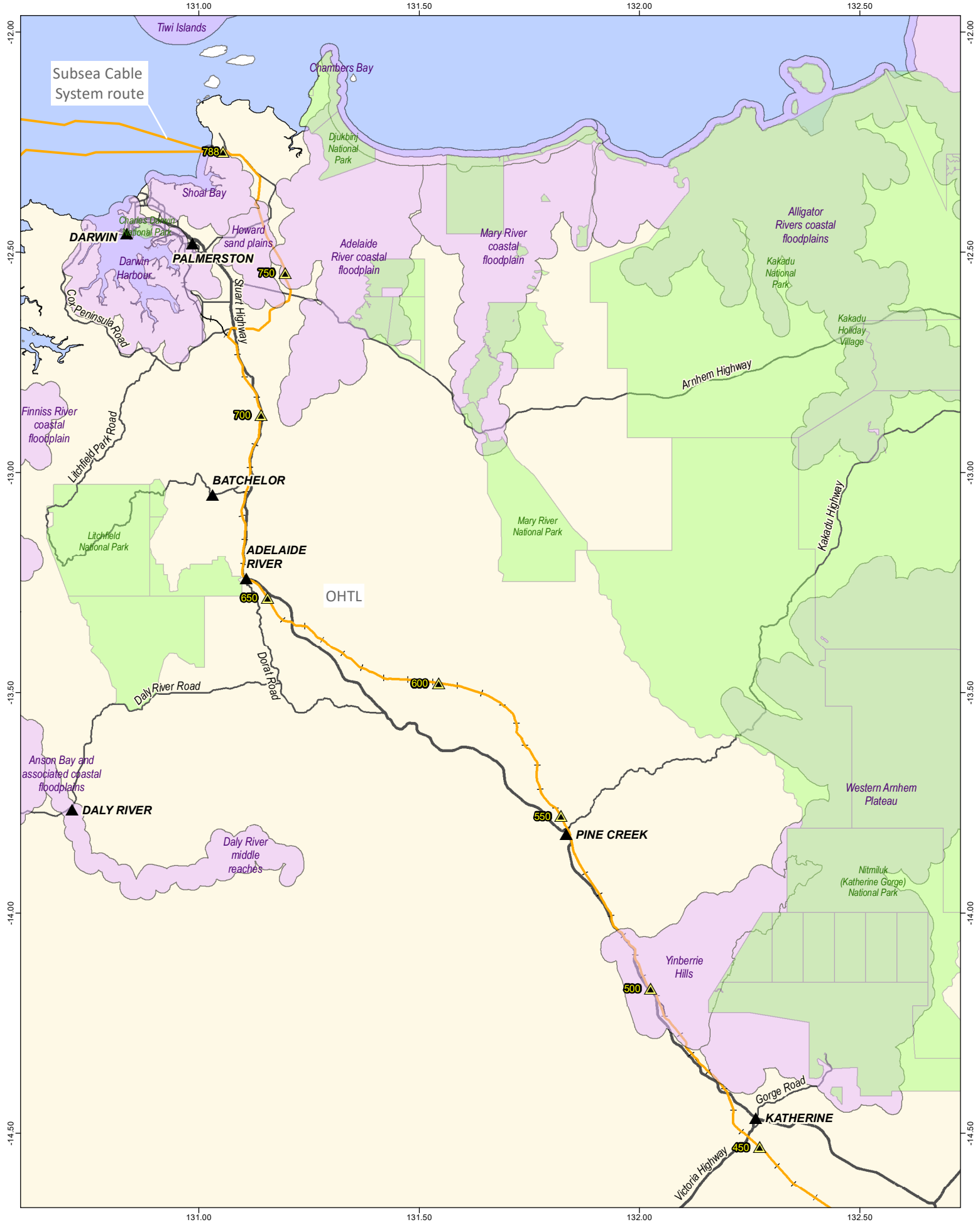
- **Shoal Bay SOCS** is intersected by the corridor for a total of approximately 5 km (between KP771 and 776). The extensive tidal flats in the SOCS provide an important feeding and roosting area for migratory shorebirds in their non-breeding season. In addition, up to 5,000 waterbirds are known to aggregate on small freshwater wetlands inland of the tidal flats late in the dry season as more extensive coastal floodplains dry out across the Top End.
- **Howard sand plains SOCS** is intersected twice by the OHTL Utilities Corridor, for a total of approximately 15 km (between KP739 and 742 and again from KP757 and 768). It supports the largest and most continuous stretch of seasonally inundated wetlands with shallow lagoons and swamps on sandy substrates of the Darwin region. The sand plains support distinctive vegetation types of *Grevillea* heath and paperbark forest. Many plant and animal species have adapted to, and are largely or entirely restricted to, this habitat type – including the Howard River Toadlet (*Uperoleia daviesae*). The sandy heaths also support populations of rare and endangered species, particularly the small carnivorous bladderwort plants of the genus *Utricularia*.
- **Adelaide River coastal floodplain SOCS** is a seasonally inundated freshwater floodplain, the very western edge of which is crossed by the OHTL Utilities Corridor for approximately 11 km (between KP745 and 757)<sup>5</sup>. The floodplain regularly supports large numbers of waterbirds including internationally significant numbers of many species. The upper and middle parts of the floodplain provide core nesting habitat for Magpie Geese, and the largest waterbird breeding colony in the Northern Territory is found in mangroves in the lower reaches of the Adelaide River. Significant numbers of at least three species of migratory shorebird periodically use inland wetland areas on the floodplain. The OHTL Utilities Corridor does not intercept any wetland habitat within the SOCS.

Also of relevance is the Mapping the Future project for Gunn Point that was undertaken by the NT Government which included development of a biodiversity risk map where studies of land, water and biodiversity values were integrated to assist land use planning and development (Stokeld et al. 2020). The study area and survey sites varied between studies, extending as far south as KP749 (approximately 4.5 km north of Arnhem Hwy). Five biodiversity risk classes were assigned – with Class 5 (High) corresponding to high biodiversity areas, Class 4 (Moderate) corresponding to areas of significant vegetation, and Class 3 (Uncertain) corresponding to areas requiring further biodiversity assessment before development approval.

As shown in Figure 5-7, of the length of the OHTL footprint within the mapped extent for the Gunn Point study area, 3.88% of OHTL footprint is High risk (0.78 km), 2.78% (0.56 km) is Moderate and 63% is Uncertain (11.4 km).

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<sup>5</sup> The areas crossed by the OHTL utilities corridor are not seasonally inundated (they are within the SOCS' buffer).



**Legend**

- ▲ Town
- AAPowerLink infrastructure
- ▲ OHTL Kilometre Point (KP)
- Railway
- Principal road
- Secondary road
- National Parks
- Sites of Conservation Significance

Source: Sun Cable, EcOz, NTG (NR Maps)



**Figure 5-6: Map of significant areas relevant to the OHTL**

Project: **Australia-Asia PowerLink**

Reference: M-Files ID 200232

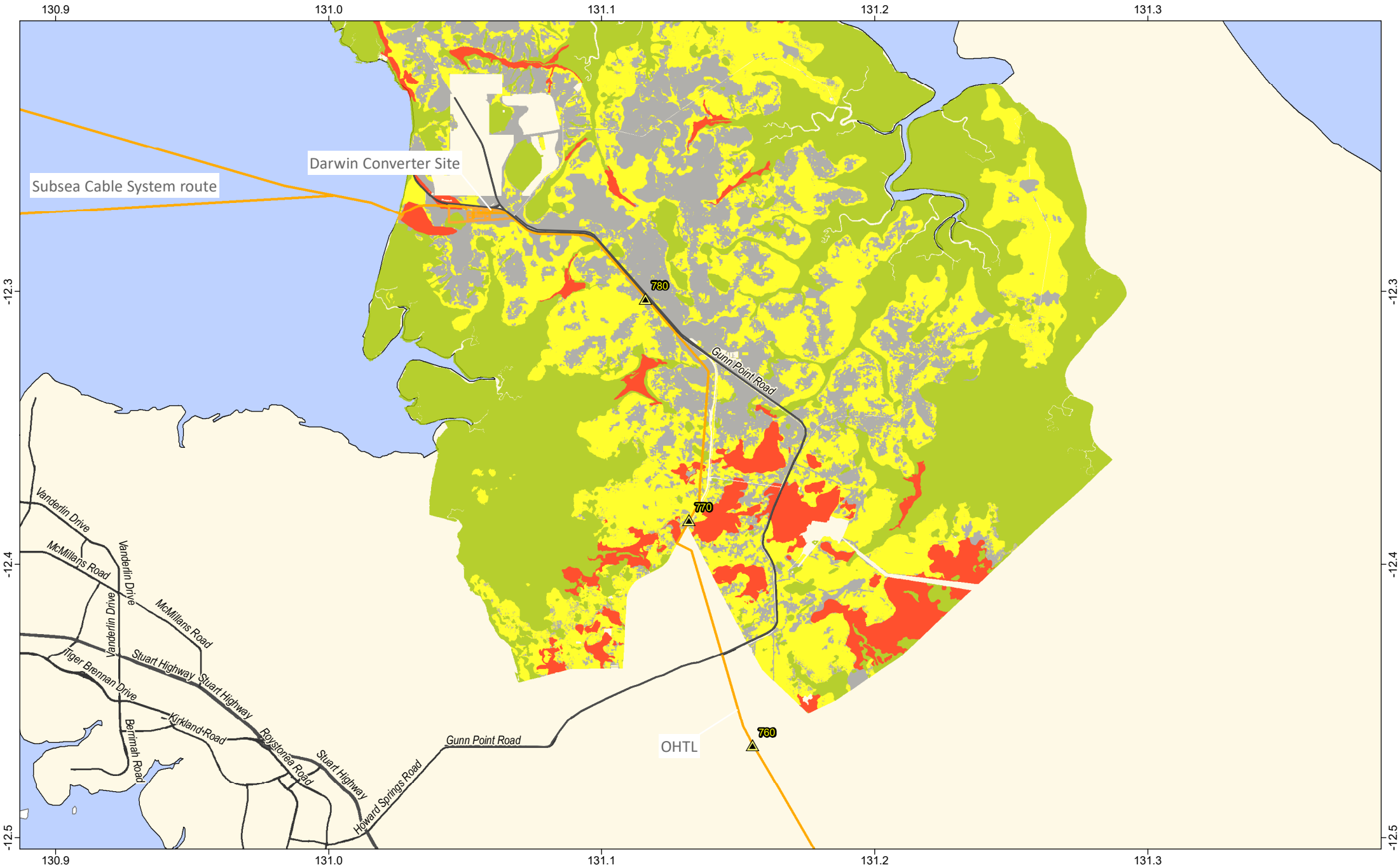
Date: 25/02/2022      Revision: 0

Scale: 1:1,200,000      Datum: GDA2020

Coordinate System: GDA2020      A4

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**Legend**

AAPowerLink Infrastructure	Uncertain
OHTL Kilometre Points	Moderate
Principal road	Low
Secondary road	High



**Figure 5-7: Map of biodiversity values within the Gunn Point Peninsula, as identified by Stokeld et al. (2020)**

Project: <b>Australia-Asia PowerLink</b>	Reference: M-Files ID 200232	Revision: 0
Coordinate System: GDA2020	Date: 25/02/2021	
0  5 Kilometres	Scale: 1:196,096 A4	

Source: Sun Cable, EcOz, NTG (NR Maps), Stokeld et al. (2020)  
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### 5.3.4 Darwin Converter Site and Cable Transition Facilities

#### 5.3.4.1 Habitat

There are ten land units that intersect the footprints of the Darwin Converter Site and Cable Transition Facilities at Murrumujuk – consisting of plains, rises, swamps, drainage systems and marine landforms (see Table 5-5, Figure 5-8 and Figure 5-9). The most widespread land units were associated with Eucalypt open to mid woodlands, with deep red to brown kandosol soils.

Land units 1c, 2b1, 3a, 3b, and 9c are intersected by the underground cable route from the western edge of the converter site to the coast. The land units intersected by the Cable Transition Facilities were generally associated with Eucalypt mid woodlands to open forests, except for one coastal land unit which comprises of dunes with small patches of monsoon forest.

Table 5-5. Summary of the land units relevant to the Darwin Converter Site and Cable Transition Facilities footprints

Land unit	Landform class	Landform description	Vegetation	Area (ha)		
				DCS <sup>6</sup>	CTF <sup>7</sup>	LSJ <sup>8</sup>
1c	Rises	Rises and short steep slopes	Woodland of <i>Eucalyptus miniata</i> and <i>Corymbia bleeseri</i> over <i>Sorghum</i> species.	0	1.5	0.05
2b1		Side slopes	Open woodland to woodland of <i>Eucalyptus miniata</i> , <i>Eucalyptus tetradonta</i> , <i>Corymbia foelscheana</i> and <i>Eucalyptus tectifica</i> over <i>Sorghum</i> species.	0	3.2	0.3
3a	Plains	Flat to gently undulating upland surfaces	Open forest of <i>Eucalyptus tetradonta</i> and <i>Eucalyptus miniata</i> over mixed grasses.	0	4.7	0
3b		Flat to gently undulating upland surfaces	Woodland of <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> over <i>Sorghum</i> species.	0.8	2.3	0
8a*		Gently undulating upland plains; local relief <2m; slopes 1-2%	Mid woodland to open woodland of <i>Eucalyptus tetradonta</i> , +/- <i>Eucalyptus miniata</i> over <i>Heteropogon triticeus</i> mid tussock grassland.	19.6	0	0
8a1*	Plains	Gently undulating upland plains; local relief <2m; slopes 1-2%	Mid woodland of <i>Eucalyptus tetradonta</i> and <i>Eucalyptus miniata</i> over <i>Heteropogon triticeus</i> mid tussock grassland.	79.4	0.4	0
8a2*		Gently undulating upland plains; local relief <2m; slopes 1-2%	Open woodland of <i>Eucalyptus tetradonta</i> , <i>Corymbia bleeseri</i> and <i>Eucalyptus miniata</i> over <i>Sorghum intrans</i> and <i>Heteropogon triticeus</i> mid tussock grassland.	9.4	0	0
9c	Marine	Dunes and beach ridges	Grassland of <i>Sporobolus virginicus</i> ; some pockets of monsoon vine thickets.	0	0.7	0

<sup>6</sup> DCS = Darwin Converter Site

<sup>7</sup> CTF = Cable Transition Facilities

<sup>8</sup> LSJ = Land Sea Joint Station (a component of the Cable Transition Facilities)

Land unit	Landform class	Landform description	Vegetation	Area (ha)		
				DCS <sup>6</sup>	CTF <sup>7</sup>	LSJ <sup>8</sup>
10b*	Drainage Systems	Gently sloping broad drainage floors; including open spillway depressions	Low or low open woodland of <i>Melaleuca viridiflora</i> , <i>Melaleuca nervosa</i> , <i>Grevillea pteridifolia</i> +/- <i>Lophostemon lactifluus</i> , <i>Asteromyrtus symphyocarpa</i> over <i>Sorghum intrans</i> and <i>Eriachne burkittii</i> mid tussock grassland.	14	0	0
11b*	Swamps	Seasonally flooded open depressions including upper margins of wetter swamps, wetlands, and perennial billabongs	Community 1: mid closed forest or open forest of <i>Melaleuca dealbata</i> over <i>Pseudoraphis spinescens</i> mid tussock grassland Community 2: low woodland to low open forest of <i>M. viridiflora</i> +/- <i>M. cajuputi</i> , <i>Corymbia polycarpa</i> over <i>Pseudoraphis spinescens</i> mid tussock grassland	5.7	0	0

\* Denotes Easey et al. (2020) land unit mapping



Figure 5-8. Photographs of the dominant land types within the Darwin Converter Site and Cable Transition Facilities footprints



Figure 5-9. Photographs of the coastal habitats relevant to the Land Sea Joint Station and Shore Crossing

#### 5.3.4.2 Significant vegetation

A seasonal swamp occurs in the south-west corner of the Darwin Converter Site – see Figure 5-8. It is comprised of two distinct *Melaleuca* communities and is unlikely to support any threatened flora species. Aquatic habitat values associated with the swamp are considered in Chapter 8 Aquatic Ecosystems.



Figure 5-10. Photograph of the seasonal swamp proximate to the Darwin Converter Site

#### 5.3.4.3 Land condition

The Darwin Converter Site and Cable Transition Facilities footprints are adjacent to an area that could support residential land use in the future. There is no current formal land use on the site. There are limited land holders in the area, it is sparsely populated, and much of the land, including the proposal footprint site, is owned by the NT Land Corporation, and zoned for the future development. The site is located adjacent to the proposed Seafarms Project Sea Dragon aquaculture facility. To the west, Gunn Point Beach is a popular beach recreation and camping area, and the land to the south of the site is part of the Tree Point Conservation Reserve.

The footprint was relatively free of weeds at the time of survey. The largest infestation was observed on the sand dunes adjacent to the shoreline. Caltrop was observed as the dominant species in this area, forming a dense mat. Spinyhead Sida and Annual Mission Grass were isolated and in low densities.

In the past decade, the southern side of the Darwin Converter Site has burnt almost every year, compared with the more coastal areas having only burnt a few times. This high frequency would likely reduce habitat value (as per McKay 2017).

#### 5.3.4.4 Significant areas

The Underground Cable Corridor and Land Sea Joint Station components of the Cable Transition Facilities footprint overlap with the buffer zone of the Shoal Bay Site of Conservation Significance (see Section 5.3.3.4). The Land Sea Joint Station also lies ~350 m to the north of Tree Point Conservation Area.

The biodiversity risk map for the Mapping the Future project for Gunn Point discussed in Section 5.3.3.4, depicts 0.34% of the Darwin Converter Site footprint and 65% of the Cable Transition Facilities footprint as High risk, 0.68% of the Cable Transition Facilities as Moderate, and 75% of the Darwin Converter Site and 22% of the Cable Transition Facilities as Uncertain. This reflects the presence of significant occurrences of two threatened flora species – *Typhonium praetermissum* and Darwin Cycad – as discussed in Section 5.5.5.

## 5.4 Potential impacts

The potential impacts to terrestrial ecosystems associated with the AAPowerLink have been assessed using the EIA methodology described in Chapter 3 Impact Assessment. The EIA identified and assessed the following potential impacts that could occur during construction:

- Loss of vegetation and habitat due to land clearing
- Loss or deterioration of significant vegetation by land clearing
- Degradation of flora and vegetation in surrounding areas by dust deposition
- Introduction and spread of weeds
- Changes in fire regimes
- Direct fauna mortality by collision with construction vehicles
- Habitat degradation and fragmentation
- Changes to fauna behaviour due to noise, light, and waste management.

The EIA identified and assessed the following potential impacts that could occur during operations:

- Introduction and spread of weeds
- Direct fauna mortality caused by the perceived 'lake effect' of solar fields
- Direct fauna mortality caused by collision with Overhead Transmission Line
- Degradation of flora and vegetation in surrounding areas caused by shading
- Changes to fauna behaviour due to noise, light, and waste management.

The EIA considered the impact avoidance and mitigation measures detailed in Section 5.6 and assessed the residual impacts to terrestrial ecosystems assuming these measures are effectively implemented. A residual impact rating was then assigned taking into consideration the scale, magnitude and duration of the impacts, the presence/absence of environmental values and/or sensitive receptors and the level of certainty with respect to the intensity of the impact and the effectiveness of the mitigation measures. The residual impact ratings adopted in the assessment are provided in Table 5-6. The outcomes of the EIA are summarised in Table 5-7 and Table 5-8 below and are discussed in the subsequent sections.

Significant impacts to threatened species were assessed using the methods prescribed in the *EPBC Significant Impact Guidelines 1.1* produced by the Commonwealth Government (DEWHA 2013). These impacts are discussed separately in Section 5.5.

Table 5-6. Residual impact ratings adopted for the AAPowerLink EIA

Ratings and Description
<p><b>Minor: A minor residual impact is unlikely to be significant.</b></p> <p>A minor impact generally has two or more of the following characteristics:                      Scale: Limited/Localised Magnitude: Negligible/Minor Duration: Short-term/ Medium-term/Reversible.  <b>OR</b> There are no sensitive receptors or land uses present, and the environment does not contain any aspects that are valuable or otherwise important or unique (i.e., Very Low/Low rating), and there is moderate to high degree of certainty about the likelihood and intensity of the impact, and the effectiveness of proposed mitigation measures.</p>
<p><b>Moderate: A moderate residual impact has potential to be significant. The significance depends on the acceptability of the impacts and the effectiveness of mitigation measures.</b></p> <p>A moderate impact generally has two or more of the following characteristics:                      Scale: Localised/Regional Magnitude: Moderate Duration: Medium-term/Long-term  <b>AND/OR</b> There are sensitive receptors or land uses present, or environmental aspects that are valuable or otherwise important or unique (i.e., Medium-High value rating), and there is a low degree of certainty about the impact, and the effectiveness of proposed mitigation measures.</p>
<p><b>Major: A major residual impact is likely to be significant. The level of acceptability will depend on offsets or benefits compensating for the impact.</b></p> <p>Impact generally has two or more of the following characteristics:                      Scale: Regional/ Widespread Magnitude: Moderate/Major Duration: Long-term/Permanent  <b>AND</b> There are sensitive receptors or land uses present, or environmental aspects that are valuable or otherwise important or unique (i.e., Medium-High value rating).</p>

Table 5-7. Summary of EIA results - Terrestrial ecosystems factor - Construction

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
<b>Loss of vegetation and habitat</b> See Section 5.4.2.1	Solar Precinct	<b>Likely</b> Loss will occur	<b>Widespread</b> Footprint is approximately 12,000ha	<b>Long-term</b> Infrastructure will remain for an extended period. Remediation back to pastoral land use is proposed at end of life.	<b>Minor</b> No core habitat for threatened species. Minor occurrence of riparian vegetation. Limited biodiversity impact.	<b>Low</b> Cleared habitats are common and represents 0.43% of the relevant land system.	<b>High</b> Ecological surveys undertaken.	<b>Minor</b>
	OHTL	<b>Likely</b> Loss will occur	<b>Limited</b> Narrow 22m wide linear corridor	<b>Medium-term</b> Land cleared during construction will be reinstated with native vegetation, excepting for a 6m wide access track.	<b>Minor</b> Narrow zone of disturbance. Pole placement will be used to avoid clearing riparian vegetation.	<b>Medium</b> Riparian vegetation, sandsheet heath, and monsoon rainforest present in corridor is locally important.	<b>High</b> Ecological surveys undertaken in Utilities Corridor section where key values are present.	<b>Minor</b>
	Darwin Converter Site	<b>Likely</b> Loss will occur	<b>Localised</b> Clearing footprint is approximately 55ha	<b>Permanent</b> Infrastructure will remain for an extended period. Future land use unknown.	<b>Minor</b> No direct impact to rare or significant vegetation so limited biodiversity impact.	<b>Low</b> Habitats are common. No threatened species or significant vegetation.	<b>High</b> Ecological surveys undertaken.	<b>Minor</b>
	Cable Transition Facilities	<b>Likely</b> Loss will occur	<b>Localised</b> Clearing footprint is narrow 35m wide corridor and	<b>Medium-term</b> Land cleared during construction will	<b>Minor</b> No direct impact to rare or significant	<b>Low</b> Habitats are common. No threatened	<b>High</b> Ecological surveys undertaken.	<b>Minor</b>

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
			2ha site for Land Sea Joint Station	be reinstated with native vegetation.	vegetation so Limited biodiversity impact.	species or significant vegetation.		
<b>Loss or deterioration of significant vegetation</b> See section 5.4.2.2	Solar Precinct	<b>Possible</b> Access routes cross areas of sparse riparian vegetation.	<b>Limited</b> Access road corridors are approximately 10m wide	<b>Permanent</b> Riparian vegetation in footprint will be removed	<b>Minor</b> Loss of vegetation in corridor will not affect ecosystem more broadly	<b>Medium</b> Riparian vegetation along access roads is locally important	<b>High</b> Ecological surveys undertaken	<b>Minor</b>
	OHTL	<b>Possible</b> OHTL corridor traverses watercourses where riparian vegetation is present.	<b>Limited</b> Commitment made to minimise clearing at major watercourses. Impact limited to minor watercourses.	<b>Long-term</b> Any cleared vegetation outside of the access corridor will grow back over time.	<b>Minor</b> Loss of vegetation in corridor will not affect ecosystem more broadly	<b>Medium</b> Riparian, sandsheet heath and monsoon rainforest vegetation in corridor is locally important	<b>High</b> Location and extent of riparian vegetation known. Commitment made to minimise clearing.	<b>Minor</b>
	Darwin Converter Site and Cable Transition Facilities	<b>Unlikely</b>	Not assessed as no significant vegetation in footprint.					<b>High</b> Ecological surveys undertaken.
<b>Degradation of flora and vegetation in surrounding areas</b> See Section 5.4.2.3	All sites	<b>Possible</b> Dust deposition could affect vegetation around footprint.	<b>Limited</b> Deposited dust is modelled to affect an area of approximately 100-380m from footprint (see Chapter 11 Air Quality).	<b>Short-term</b> Dust will only be an issue during construction and will be washed off vegetation each wet season.	<b>Minor</b> Short-term dust deposition is unlikely to harm vegetation.	<b>Low-Medium</b> Riparian vegetation along access roads and watercourses could be sensitive to dust.	<b>High</b> Extent of dust deposition modelled (see Chapter 11 Air Quality). Mitigation measures are routine and proven effective.	<b>Minor</b>

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
<b>Introduction and spread of weeds and pests</b> See Section 5.4.2.4	All sites	<b>Likely</b> Weeds are present in footprint and are likely to be spread.	<b>Localised</b> Weed infestations are likely to occur at some locations in the disturb footprint, but unlikely to extend far into surrounds.	<b>Permanent</b> Once weeds are introduced, they are very difficult to eradicate.	<b>Moderate</b> Implementation of Weed MP will limit impact to ecological function and integrity.	<b>Medium</b> Sensitive values present in footprint riparian, sand sheet heath, rainforest, and the Black Jungle Reserve.	<b>High</b> Potential impacts are well understood from other projects and Weed MP will reduce risk to ALARP.	<b>Moderate</b>
<b>Changes in fire regimes</b> See Section 5.4.2.5	All sites	<b>Possible</b> Construction activities could spark a fire	<b>Localised</b> Bushfire response plans will be in place to limit the extent of area burnt	<b>Short-term</b> Impact could occur occasionally during construction	<b>Minor</b> Vegetation is resilient to occasional fire	<b>Medium</b> Sensitive values present in footprint riparian, sand sheet heath, rainforest, and the Black Jungle Reserve.	<b>High</b> Bushfire risks well understood, and bushfire response will reduce risk to ALARP.	<b>Minor</b>
<b>Direct fauna mortality</b> See Section 5.4.2.6	All sites	<b>Possible</b> Fauna deaths could occur from clearing and roadkill.	<b>Limited</b> Fauna deaths will occur in isolated locations in direct disturbance footprint	<b>Short-term</b> Impact will occur sporadically during construction	<b>Minor</b> Isolated deaths will not impact on the viability of fauna populations.	<b>Low</b> No threatened species populations present.	<b>High</b> Potential impacts are well understood from other projects. Mitigation measures are routine and will reduce risk to ALARP.	<b>Minor</b>

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
<b>Habitat fragmentation</b> See Section 5.4.2.7	Solar Precinct	<b>Unlikely</b>	Not assessed. Open sparse vegetation types that are regionally common means fragmentation impacts are unlikely.				<b>High</b> Ecological surveys undertaken.	<b>None</b>
	OHTL	<b>Possible</b> OHTL Utilities Corridor will traverse habitats	<b>Limited</b> Fauna in proximity to the corridor may be affected but no wider impact to viability of fauna populations.	<b>Long-term</b> Vegetation cleared for construction will gradually regrow, but fragmentation will persist for an extended period.	<b>Moderate</b> Narrow unfenced corridor will not limit movement for most species.	<b>Medium</b> Sensitive values present in riparian, sand sheet heath, rainforest, and the Black Jungle Reserve.	<b>High</b> Ecological surveys undertaken.	<b>Minor</b>
	Darwin Converter Site and Cable Transition Facilities	<b>Unlikely</b>	Not assessed. Small footprint in habitat types that are not susceptible to fragmentation impacts.				<b>High</b> Ecological surveys undertaken.	<b>None</b>
<b>Changes to fauna behaviours due to noise, light, and waste management</b> See Section 5.4.2.8	All sites	<b>Possible</b> Fauna could either be attracted or deterred by construction activities.	<b>Limited</b> Affects expected to be limited to within close proximity to construction activities.	<b>Medium-term</b> Impact will occur intermittently during construction.	<b>Minor</b> Localised behavioural change will not affect biodiversity or ecosystem function/integrity.	<b>Low</b> There are no proximate ecological receptors that are sensitive to these disturbances.	<b>High</b> Potential impacts are well understood from other projects. Mitigation measures are routine and proven effective.	<b>Minor</b>
<b>Loss of habitat from erosion</b>	All sites	<b>Unlikely</b>	Not assessed. The residual impact associated with erosion was assessed as low (see Chapter 4 Terrestrial Environmental Quality). This level of impact would not cause loss of habitat.				<b>High</b> Erosion hazard assessed in accord with accepted guidelines.	<b>None</b>

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual impact
<b>Loss of habitat from disturbance of acid sulfate soils</b>	All sites	<b>Unlikely</b>						
			Not assessed. The residual impact associated with ASS was assessed as low (see Chapter 4 Terrestrial Environmental Quality). This level of impact would not cause loss of habitat.				<b>High</b> ASS risk assessed and managed in accord with accepted guidelines.	<b>None</b>
<b>Degradation of habitats by contamination and pollution</b>	All sites	<b>Unlikely</b>						
			Not assessed. The residual impact associated with contamination and pollution was assessed as low (see Chapter 4 Terrestrial Environmental Quality). This level of impact would not cause degradation or loss of habitat.				<b>High</b> Mitigation measures for spill prevention and response are routine and proven effective.	<b>None</b>

Table 5-8. Summary of EIA results - Terrestrial Ecosystems factor - Operations

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty rating	Residual impact
<b>Introduction and spread of weeds and pests</b> See Section 5.4.3.1	All sites	<b>Likely</b> Maintenance activities and/or inadequate weed control post-construction could spread weeds	<b>Localised</b> Weed infestations are likely to occur at some locations in the disturb footprint, but unlikely to extend far into surrounds.	<b>Permanent</b> Once weeds are introduced, they are very difficult to eradicate.	<b>Moderate</b> Implementation of Weed MP will limit impact to ecological function and integrity.	<b>Medium</b> Sensitive values present in riparian, sand sheetheath and rainforest, and the Black Jungle Reserve.	<b>High</b> Potential impacts are well understood from other projects and Weed MP will reduce risk to ALARP.	<b>Moderate</b>
<b>Direct fauna mortality</b> See Section 5.4.3.2	Solar Precinct	<b>Possible</b> Some recent studies suggest that birds may collide with solar panels for unknown reasons.	<b>Limited</b> The impact of bird deaths will be limited to isolated locations within the proposal footprint.	<b>Medium-term</b> Impact could occur intermittently over the life of the Solar Precinct.	<b>Moderate</b> Intermittent bird deaths would not be expected to affect biodiversity or ecological function/integrity.	<b>Medium</b> Species most likely to be affected are those most abundant, but less common species could also be affected.	<b>Low</b> There has been limited study of this impact around the world and no assessment relevant to the proposed location.	<b>Minor</b>
	OHTL	<b>Possible</b> The large diameter of the powerlines makes then conspicuous and avoidable but strikes by birds are possible.	<b>Limited</b> The impact of bird deaths will be limited to isolated locations within the proposal footprint.	<b>Medium-term</b> Impact could occur intermittently over the life of the Solar Precinct.	<b>Negligible</b> The number of birds deaths will be low and will not affect biodiversity or ecological function/integrity.	<b>Low</b> Species most likely to be affected are larger birds. There are no threatened large bird species that are likely to be affected.	<b>High</b> Potential impacts are well understood from other projects. Proven mitigation measures (visibility markers) are available to implement if issues arise.	<b>Minor</b>

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty rating	Residual impact
	Darwin Converter Site and Cable Transition Facilities	Not assessed as the impact is unlikely. Operational traffic movements will be mainly daytime small vehicle movements, with period truck movements for delivery of goods to site. Risk will be no greater than it is on any road in the region.					<b>High</b> Potential impacts are well understood from other projects.	<b>None</b>
<b>Degradation of flora and vegetation in surrounding areas</b> See Section 5.4.3.3	All sites	Unlikely	Not assessed as the impact is unlikely. The presence of solar panels will likely preclude plant growth beneath them; however, this impact will not extend beyond the direct disturbance footprint.				<b>High</b> Potential impacts are well understood from other projects.	<b>None</b>
<b>Changes to fauna behaviours due to noise, light, and waste management</b> See Section 5.4.3.4	Solar Precinct and Darwin Converter Site No impact OHTL corridor or Cable Transition Facilities	<b>Possible</b> Fauna could either be attracted or deterred by operational activities.	<b>Limited</b> Affects expected to be limited to within close proximity to activities.	<b>Medium-term</b> Impact will occur intermittently during operations.	<b>Minor</b> Localised behavioural change will not affect biodiversity or ecosystem function/integrity.	<b>Low</b> There are no proximate ecological receptors that are sensitive to these disturbances.	<b>High</b> Potential impacts are well understood from other projects. Mitigation measures are routine and proven effective.	<b>Minor</b>

## 5.4.1 Areas of potential impact

### 5.4.1.1 Proposal footprint (direct disturbance)

The area within which flora and fauna will be directly disturbed includes the extent of land that will be cleared to construct the Solar Precinct and access roads, the OHTL corridor, the Darwin Converter Site, and the Cable Transition Facilities. The direct disturbance footprint for each component is outlined in Chapter 2 Proposal Description.

It is worth re-iterating the extent of the OHTL direct disturbance footprint because it has some variability throughout, and the level of direct disturbance is an important consideration for the assessment of impacts to terrestrial ecosystems. For the entire length of the OHTL, a 22 m wide corridor will be cleared for construction. In addition, every transmission pole will require a 60 x 100 m construction pad, which will be spaced between 300 and 400 m apart along the OHTL corridor. Post-construction, the OHTL corridor and construction pads will be allowed to regrow, excepting a 6 m wide access track along the entire length, and a 12 x 6 m area around each pole foundation that will be maintained free of vegetation.

### 5.4.1.2 Area of influence (indirect disturbance)

Proposal activities can also indirectly disturb flora and fauna in surrounding areas. Noise, dust, and light impacts could occur adjacent to the proposal footprint, although these would rapidly attenuate with distance. Habitat fragmentation, weed infestation and proliferation, and altered fire regimes could all impact the areas surrounding the proposal footprint. This broader 'area of influence' within which indirect disturbances could occur includes watercourses downstream of the proposal footprint, since changes to surface water flows and/or quality has the potential to impact on the health of terrestrial habitats (noting that aquatic ecosystems are assessed in Chapter 8). Again, these impacts will diminish with distance from the proposal footprint. The usual extent of Lake Woods is over 10 km away – this distance, and the design and mitigation measures detailed in Chapters 6 and 7, mean that Lake Woods is not considered to be within the area of influence.

## 5.4.2 Construction

Impacts to flora and fauna will be greatest during the construction phase, when habitat will be cleared or disturbed to install infrastructure, and when there will be potential opportunities for weed introduction or spread. The potential impacts are discussed below for each component of the AAPowerLink.

### 5.4.2.1 Loss of vegetation and habitat

Clearing of native vegetation results in a loss of habitat and can lead to a reduction in biodiversity. The impact of this varies depending on the size, nature, quality, and value of the vegetation being cleared, and the flora and fauna species that occur in the area. Clearing a small area of a regionally uncommon vegetation community may be more significant than clearing a large area of the dominant vegetation type in the region. The size of each component of the AAPowerLink footprint, and the differences in the vegetation communities and habitats within, necessitates this potential impact being discussed separately for each component in the sections below.

Direct mortality of fauna during land clearing activities is addressed in Section 5.4.2.6. Impacts to significant vegetation are addressed in Section 5.4.2.2; threatened species in Section 5.5.

#### *Solar Precinct*

Development of the Solar Precinct requires clearing ~12,000 ha of pastoral land. As discussed in Section 5.3.2.1, the vast majority of this is quite homogenous – comprising only four land types. There are few threatening processes occurring within the proposal footprint, with field observations indicating a low level of grazing impact and no weed infestations, but evidence of bushfires.

The Solar Precinct occurs within Wycliffe subregion of the Tanami Desert bioregion, of which significantly less than 0.1 % is currently cleared (for tracks, bores and building footprints). There is no other broad acre clearing in the subregion. Clearing the Solar Precinct footprint will increase total clearing in the sub-bioregion by approximately 0.75 %.<sup>9</sup> The Redsan land system within which most of the Solar Precinct occurs is one of the largest land systems in southern Australia. Figure 5-3 shows the location of the Solar Precinct within the Redsan land system – the footprint comprises 0.43% of that particular Redsan land system ‘patch’. Whilst the area of land that will be cleared is large, it comprises a small portion of the available habitat and therefore is considered unlikely result in a decline in regional biodiversity.

Sun Cable is currently undertaking a series of vegetation trials to develop a vegetation management program within the Solar Precinct. In addition to helping stabilise the ground around the solar panels, planting low-lying species could lead to a reclamation of some of the footprint for ground-dwelling flora and fauna species.

In addition, a Decommissioning and Rehabilitation Plan for the Solar Precinct footprint will be developed as described in Section 12 Chapter 2 Proposal Description. The objective of rehabilitation post-operations is to return the site to pre-existing pastoral use and land condition.

Clearing ~12,000 ha could be considered a large area; however, in a region containing vast areas of similar vegetation and habitat types, the loss of such an area is likely to have a minor impact on regional biodiversity. This is reflected by the fact that the clearing footprint is not within any reserves or SOCS, which protect areas of land recognised as being important for regional biodiversity conservation.

### *Overhead Transmission Lines*

The OHTL footprint crosses a large variety of different land systems and vegetation communities – the condition and habitat value of which varies depending on land use, fire history and weed occurrence.

Construction of the OHTL requires clearing 1,734 ha of land – all of it within a narrow, linear footprint (22 m wide). Temporary construction pads up to 60 x 100 m will be cleared every 300 to 400 m for assembly and erecting of the power poles. Post-construction, only a 6 m wide access track is required, as well as cleared areas of 12 x 6 m around each pole’s foundations. In the remaining cleared area, the land will be re-instated, and vegetation will be allowed to grow back, with weeds controlled as stated in Section 2.5.5 of Chapter 2 Proposal Description. It is expected that groundcover and shrubs will re-establish quite quickly, but trees will take longer (and in some areas trees may not grow back).

As explained in Section 5.3.3.4, the OHTL corridor intersects the following significant areas where some land clearing will be required:

- Manton Dam Recreation Area (~18 ha)
- Black Jungle Conservation Reserve (3.1 ha)
- Shoal Bay Coastal Reserve (6.1 ha)
- Yinberrie Hills SOCS (~42 ha)
- Shoal Bay SOCS (~18 ha)
- Howard sand plains SOCS (~18 ha)
- Adelaide River coastal floodplain SOCS (~13 ha).

The SOCS and reserves are large enough that the temporary clearing of a 22 m wide corridor of habitat within them for the OHTL represents an insignificant proportion of habitat lost. However, indirect effects of this clearing on surrounding land are possible and are these are discussed in Section 5.4.3.3.

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<sup>9</sup> Calculated by dividing the footprint area by the area of Wycliffe sub-bioregion.

As discussed in Section 5.3.3.4, 3.88% of OHTL footprint within the Gunn Point study area is mapped by Stokeld et al. (2020) as High risk with regards to impacts a development would have on biodiversity values, and 2.78% is mapped as Moderate. These risk categories correlate with the presence of significant vegetation types and/or threatened species, which are covered in Section 5.4.2.2 and Section 5.5 of this chapter.

The clearing of land for the OHTL will result in a loss of vegetation and habitat; however, as the OHTL footprint is narrow, the proportion of habitats that will be impacted in any given area is very small. The nature of the OHTL disturbance is also relatively small-scale, localised and there is some flexibility as to where it occurs. Using the Railway Corridor – much of which has already been cleared – for most of the OHTL reduces the amount of clearing that may have otherwise been required. The OHTL (Utilities Corridor) is situated within a corridor zoned Utilities under the Planning Scheme, and therefore has been earmarked for public infrastructure development for many years. Consequently, with proper planning and design, land clearing within the proposal footprint is unlikely to have a significant impact on most, if not all, ecological values.

#### *Darwin Converter Site and Cable Transition Facilities*

Development of the Darwin Converter Site and Cable Transition Facilities requires clearing 64.5 ha of predominantly Eucalypt open to mid woodlands. Approximately 30% of the area of Gunn Point peninsula within 5 km of the Darwin Converter Site is already cleared for agriculture, forestry, and roads, and given the proximity to Darwin and future NT Government development plans for the Gunn Point region, there is potential for cumulative impacts to terrestrial ecosystems as discussed in Section 5.7 of this chapter. The proposal footprint is not within any reserves or SOCS but does contain the listed threatened plant species *Typhonium praetermissum* and *Cycas armstrongii*. The removal of 64.5 ha of locally and regionally common Eucalyptus woodland habitat is unlikely to have a significant impact on faunal diversity; however, the loss of threatened plant species could be significant and is discussed in Section 5.5.

#### **5.4.2.2 Loss or deterioration of significant vegetation**

Significant vegetation types are defined in Section 5.3. These were not recorded within the main Solar Precinct footprint during surveys, but riparian vegetation is intersected by the access roads to the Solar Precinct. Riparian and rainforest vegetation types occur within the OHTL services corridor and there is a small seasonal swamp proximate to the Darwin Converter Site.

Significant vegetation types may be directly impacted by land clearing. Those which are dependent on surface water flows – such as sandsheet heath, wetlands, and riparian vegetation – can also be impacted upon by changes in surface water flows or quality; however, the OHTL is not predicted to affect these aspects (as discussed in Chapter 6 Hydrological Processes and Chapter 7 Water Quality). Other potential indirect impacts include introduction of weeds (see Section 5.4.2.4) and increased fire events (see Section 5.4.2.5).

At the end of the proposal, it is proposed that all cleared areas not retained by the NT Government will be rehabilitated in accordance with the relevant master plans in place at the time, including – where practical – efforts to return the original vegetation to the sites. As the future landuse is unknown it has been assumed that the impacts associated with loss of vegetation will be permanent.

#### *Solar Precinct*

Minor, ephemeral drainage lines are present within the access road corridor. These drainage lines support low density riparian vegetation – primarily sparse large Eucalypts – see, e.g., Figure 5-11. The access roads will have to cross these drainage lines. Where possible, the placement of the access road will actively try to avoid large trees within drainage lines so that their removal can be avoided. At worst, only a few trees will be cleared if no other clear route is available. In that way, impacts to significant vegetation types during construction of the Solar Precinct access roads can be minimised.



Figure 5-11. Photograph of riparian vegetation within the Solar Precinct access road corridor

### Overhead Transmission Lines

The OHTL (Railway Corridor) intersects many occurrences of significant vegetation types – particularly riparian habitats – noting that these have already been impacted by the construction of a railway across them. In addition to these vegetation types, the OHTL Utilities Corridor intersects sandsheet heath, rainforest, and woodland with large, hollow-bearing trees. Field studies will be undertaken in early 2022 to inform the OHTL route selection, including an assessment of significant vegetation and options for impact avoidance or mitigation

Disturbance of significant vegetation types that occur in discrete patches – such as riparian vegetation, rainforest and sandsheet heath – can largely be avoided through prudent placement (micro-siting) of transmission poles to allow the OHTL to span over these habitats without direct impact (refer Section 2.5.2.3 of Chapter 2 Proposal Description). The Utilities Corridor requires a temporary clearing of a construction access corridor 22 m wide along its entire length (scaled back to 6 m for operations), which could include crossings at minor watercourses; however, major watercourses and other significant vegetation will be spanned and accessed from either side to limit direct impact.

### Darwin Converter Site and Cable Transition Facilities

There are no significant vegetation types within the Darwin Converter Site or Cable Transition Facilities direct disturbance footprints. Potential indirect impacts to the seasonal swamp proximate to the Darwin Converter Site due to changes in surface or groundwater flows/quality are assessed in Chapter 6 Hydrological Processes and Chapter 7 Inland Water Environmental Quality.

#### 5.4.2.3 Degradation of flora and vegetation by dust deposition

Construction activities undertaken within the proposal footprint have the potential to have off-site impacts on adjacent flora and vegetation (i.e., within the proposal's area of influence) associated with dust emissions. Construction activities will generate dust emissions, the extent of which has been modelled and the results discussed in Chapter 11 Air Quality. Depositional dust is predicted to affect areas within 244 m of the site boundary at the Solar Precinct, 105 to 123 m from the OHTL construction, 380 m from the Darwin Converter Site and 123 m from the trenching activities for the Cable Transition Facilities. Vegetation within these footprints may receive deposited dust over the construction phase; however, this is unlikely to affect vegetation health due to the relatively short duration of impact and because the dust is washed off each wet season. Dust suppression measures will be applied as described in Section 11.6 of Chapter 11 Air Quality will further limit the impact of dust emissions on vegetation and habitats surrounding the proposal footprint.

#### 5.4.2.4 Introduction and spread of weeds and pests

There is a real risk that construction activities introduce new weeds into the landscape and/or cause a proliferation in existing weeds. Clearing of native vegetation has the potential to increase the risk of weed spread because the open, disturbed ground is readily colonised and dominated by the fast-growing weed species. Movement of personnel and vehicles throughout and between proposal components also has the potential to increase the likelihood of weed species being introduced into areas previously not recorded. Proliferation of weed species has the potential to lead to displacement of native vegetation, a reduction in habitat quality, reduction in food sources for fauna, and increased frequency and intensity of bushfires. The latter can also negatively impact upon the pastoral productivity of the land, as well as other land uses.

The current weed situation for components of the proposal is:

- Despite its large size, there are no historic weed records within the **Solar Precinct footprint**, nor were any recorded during fieldwork. This is likely due to a combination of the sandy soils (which are less supportive of weed species) and the fact that only limited pastoral activity has occurred.
- Linear developments are notorious for spreading weeds, and although weed management is undertaken by the current operator of the railway within the **OHTL Railway Corridor**, there are recent records of numerous weed species. Field surveys detected only a few weeds within the **OHTL Utilities Corridor**. There generally few weed records in the Gunn Point region, apart from along the main road and towards the southern end of the OHTL Utilities Corridor – the locations nearest to rural residential areas.
- Field surveys detected only a few weeds within the DCS and CTF sites – in line with the situation across most of Gunn Point, apart from along some roads.

Sun Cable has a legal responsibility – under the NT *Weeds Management Act* – to eradicate Class A weeds within the proposal footprint and control the spread and growth of Class B weeds.

To this end, a Weed Management Plan (Appendix Q) has been developed, in accordance with the requirements of the *Weeds Management Act* and relevant statutory weed management plans. Measures to contain and prevent the spread of weeds during the construction phase include preventative actions to ensure appropriate hygiene and weed inspections of vehicles and machinery, education of personnel on weed identification, active management protocols for known infestations (e.g., quarantine zones, hygiene stations, spraying), and monitoring of locations and effectiveness of weed control activities.

Prior to commencement of construction activities, the proposal footprint will be subject to a review of available data and targeted surveys to inform site-specific weed management actions. Outcomes of the review may include a weed survey to describe existing weed infestations and to develop location-specific weed controls and management zones, where necessary. The approach to weed survey will be in accordance with DENR Guidelines (Weed Management Division 2015), which are considered best-practice.

Pest animals are expected to occur throughout the entire proposal footprint in densities commensurate with those found in the wider region. Biting insects aside – which are assessed in Chapter 15 Human Health – the EIA process did not identify any areas within the footprint that are susceptible to invasion by new pests (relevant species have already reached their ‘natural’ north-south distribution boundaries due to climatic limitations). Any human activity in undeveloped areas has the potential to cause a proliferation of existing pest species by creating new food sources – this can easily be mitigated through standard food waste management practices which the proposal will employ. Consequently, impacts from pest animals are inherently low, simply managed and therefore not considered further.

#### 5.4.2.5 Changes in fire regimes

Construction works – particularly welding – could generate sparks and cause bushfires. Bushfire has the potential to cause direct mortality to fauna, displacement of fauna, and/or reduction in habitat quality.

Bushfire, however, is a common occurrence in most vegetation communities relevant to the proposal footprint. Proliferation of weeds – especially grassy species such as Gamba Grass – can dramatically increase fuel loads, causing much hotter fires than would naturally occur. These hotter, more intense fires affect not just the ground and mid strata, which have evolved to adapt to fire, but also the more fire-sensitive canopy stratum. Consequently, their effect on native flora and fauna is usually more detrimental.

To protect personnel, plant, and infrastructure – and to avoid upsetting land holders – it is in Sun Cable’s interest to ensure that construction activities due not lead to a bushfire. Consequently, bushfire prevention and preparedness will be addressed in a Bushfire Management Plan prepared through the management framework described in Chapter 17 Environmental Management. This will include use of firebreaks and will be complemented by the proposed weed management that will be undertaken as part of the Weed MP within all sites presents the opportunity to reduce the fuel loads associated with many grassy weed species. In the event that construction activities started a bushfire, it will be responded to quickly and is therefore not expected to affect a large area. If a bushfire is generated by construction activities, a single fire event will not alter local fire regimes.

#### 5.4.2.6 Direct fauna mortality

Direct fauna mortality due to interactions with vehicles (‘fauna strike’) or construction equipment is a potential construction impact.

Proposal activities will involve increased movement of vehicles, equipment and plant along highways, access tracks and within Powell Creek Station. The Project WHS Management System and Traffic Management Plans developed as part of the management framework described in Chapter 17 Environmental Management will incorporate procedures and controls for safe driving and operation of plant and equipment to minimise risks to workers and the community, and also to fauna associated with collisions. Controls applied at each construction location will be risk-based and will include measures such as nominated speed limits for different vehicle types, traffic control measures, restrictions on night driving in areas of high collision risk, and removal of roadkill away from the side of the road.

Nevertheless, it is likely that fauna strikes will occasionally occur leading to the loss of individual fauna from a variety of species. The numbers of animals that would be expected to be killed are low in the context of assessing potential impacts at the ecosystem level.

Regarding fauna deaths during land clearing, pre-clearing surveys may be undertaken by suitably qualified personnel – in areas of high risk – to identify potential nests, burrows, and roosts, and relocate any fauna that are at risk, and to relocate fauna that may be susceptible. Where possible, clearing will be conducted in a single direction, allowing any fauna to move out of way of clearing activities, and in a progressive manner to allow wildlife to natural disperse from the area as clearing undertaken

#### 5.4.2.7 Habitat degradation and fragmentation

Degradation in habitat quality adjacent to the proposal footprint could occur due to edge effects created by land clearing. An ‘edge effect’ occurs when intact vegetation is disturbed, resulting in the newly created edges between the intact and disturbed areas becoming lower quality habitat. Apart from the increased likelihood of weed infestation, edge effects are more pronounced in forested areas where exposure to wind and sunlight (which change micro-climates, reduce soil moisture, and encourage lower canopy plant species), and increased vulnerability to fire (because of more understorey). Therefore, it is assumed that the open, sparsely vegetated habitats within the Solar Precinct footprint will not experience any significant or substantial edge effects – certainly not such that will impact at an ecosystem level. The OHTL Railway Corridor already contains a linear disturbance and so an edge effect will already have occurred in relevant vegetation types. The OHTL Utilities Corridor is mostly open woodland that is not susceptible to edge effects. Construction of the OHTL through riparian vegetation and rainforest may create a localised edge effect that may reduce the quality of a small area of adjacent habitat.

Another potential impact – habitat fragmentation – is considered in this context to be the permanent process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated remnants. These remnants are then subject to the complex processes of habitat degradation and island biogeography, leading to loss of species diversity – initially locally, but ultimately at the landscape scale. Again, this will not be an issue for the Solar Precinct because it will be constructed in a footprint entirely surrounded by native vegetation. Moreover, changes to fauna behaviours at the scale of the proposal footprint will not affect the viability of local fauna populations, as there are no species present that are particularly susceptible to fragmentation impacts. Wildlife corridors were considered but were ruled out as a major fire risk for the proposal infrastructure and because they could cause shading of the solar arrays.

Any potential for habitat fragmentation relevant to the OHTL (Railway Corridor) has already occurred as a consequence of the construction of the railway. However, constructing the OHTL (Utilities Corridor) – where it traverses undisturbed land – could cause habitat fragmentation. This would be most pronounced when land is cleared and will lessen once vegetation is allowed to re-grow post-construction. The Utilities Corridor will not be fenced and so there will be no physical barrier to movement of fauna. The permanent removal of trees and shrubs from a 6 m wide corridor retained for inspection and maintenance access is not predicted to affect movement of any species that occur. Nevertheless, habitats that occur in small patches (such as rainforest and sandsheet heath) could be vulnerable to combined effects of fragmentation and weed invasion.

#### 5.4.2.8 Changes to fauna behaviours

There are three ways in which proposal activities could detrimentally change fauna behaviour during construction:

- Construction-related **noise** from machinery and plant, which will be unavoidable within each component (noting that no blasting is required for construction). A screening level assessment of noise emissions from the AAPowerLink construction activities is provided at Appendix L and indicates that noise will meet residential noise criteria at approximately 600 m from the works. It is difficult to quantify and measure noise disturbance to native fauna given that different species have different tolerances and different capacities to move away from a noise disturbance. However, it would be reasonable to assume that noise levels that comply with residential noise criteria would also have limited impact on fauna. The species likely to be most sensitive to noise are bats, especially if they have permanent nesting, roosting or colony areas within the OHTL's area of influence. Impacts to threatened bat species are assessed in Section 5.5.
- **Lighting** to facilitate night construction works may be required, particularly at the Darwin Converter Site and Solar Precinct. Artificial lighting may attract some fauna species and deter others. To some degree, the presence of artificial lighting inevitably changes the behaviour of all local wildlife.
- **Waste management.** There are many vertebrate pest animal species extant, consistent with similar areas throughout Australia. It is therefore assumed that the proposal footprint is already populated by the array of vertebrate pest animal species likely to occur in the bioregion. Access to additional food resources due to poorly managed waste streams have the potential to facilitate the proliferation of vertebrate pest animal species. Routine waste management controls will be implemented to meet the requirements of the *Public Health Act* and *Waste Management Pollution Control Act*, and the landfill proposed at the Solar Precinct will comply with the *Guidelines for Siting, Design and Management of Solid Waste Disposal Sites in the NT*. These measures will include covering of waste disposal areas, which will reduce the risk that pest animals could proliferate to a negligible level.

Construction of the OHTL will occur for a short duration in any one spot – limiting the duration and likelihood of noise or lighting impacts. Noise and lighting impacts are likely to persist for months during construction of the Darwin Converter Site and Cable Transition Facilities, and years for the Solar Precinct (but localised within the construction site). The Darwin Converter Site and Cable Transition Facilities footprints do not contain any known sensitive receptors to noise or lighting, such as roosting areas. Likewise, the Solar Precinct occurs in a desert landscape which is less likely to contain many species that are sensitive to noise or lighting. Impacts of

noise and lighting on fauna will likely be limited to a few hundred metres from the source, and hence any impacts of fauna behaviour will be no greater than for any other construction project. For these reasons, this potential impact does not require further assessment.

### 5.4.3 Operations

The operational AAPowerLink infrastructure poses a reduced potential for impacts to terrestrial ecosystems, compared to the more intense activity associated with the construction phase. Weed introduction and/or proliferation remain the key threat. The solar panels and OHTL wires potentially present a new collision risk to birds and bats. Both risks, can be mitigated through project design and active management.

#### 5.4.3.1 Introduction and spread of weeds and pests

During the operations phase, opportunities for weed spread due to proposal activities are substantially reduced. Nevertheless, a reduction in the quality of ecosystems and habitats may occur due to weed introduction and/or proliferation caused by operational usage of vehicles – particularly along the OHTL corridor (noting that this is likely to be minimal). Colonisation by nearby weeds of the revegetating landscape may also occur via seed transported by wind, water, or animals. Finally, as discussed in Section 5.4.2.5, the proliferation of weeds can dramatically alter fire regimes.

The Weed Management Plan (Appendix Q) allows for hygiene and weed management as required during operations, as well as ongoing surveillance. Measures to contain and prevent the spread of weeds during the operational phase include preventative actions to ensure appropriate hygiene and weed inspections of vehicles and machinery, education of personnel on weed identification, active management protocols for known infestations (e.g., quarantine zones, hygiene stations, spraying), evaluation of species used in rehabilitation or erosion controls, and monitoring of locations and effectiveness of weed control activities.

Assuming effective implementation of the Weed MP, the likelihood and severity of the introduction and spread of weeds during construction of all components of the proposal are similar. The EIA summary for the weed risk in construction – presented in Section 5.4.2.4 – is also applicable for operations, although because there will be far fewer vehicle movements and land disturbance during operations, the likelihood of weed introduction and/or proliferation is lower.

#### 5.4.3.2 Direct fauna mortality

##### *Solar Precinct*

There is some recent evidence from the USA that – in some instances – the presence of photo-voltaic solar facilities can lead to mortality or injury of birds colliding with solar panels (Waltson et al. 2016 and Kosciuch et al. 2020).<sup>10</sup> Given that solar panels are close to the ground, the reason why birds collide with these stationary objects is yet to be established. However, the detection of dead waterbird species at a solar facility located in an arid setting, led to the development of the ‘lake effect hypothesis’ (LEH) which posits that some characteristic/s of photo-voltaic solar facilities potentially attract aquatic-habitat birds, leading to collisions (Kagan et al. 2014).

Being a recent hypothesis, it has not been subject to much scrutiny.<sup>11</sup> The most comprehensive studies – by Kosciuch et al. (2020 and 2021) – examined photo-voltaic solar facilities (and nearby reference sites) in southwestern USA to compare bird presence and carcasses. Key relevant findings were:

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<sup>10</sup> Some studies included solar facilities that concentrate solar flux (which can singe birds). The AAPowerLink proposal does not use that method.

<sup>11</sup> In addition to the studies discussed here, the only published study outside of the USA appears to be Visser et al. (2018) in South Africa. However, the study only ran for three months and so provides little illumination on the validity of the LEH.

- One facility – Desert Sunlight (550 MW, 1,600 ha) – is located in a desert ecosystem that lacks many permanent large waterbodies (akin to the AAPowerLink Solar Precinct). From carcass surveys, 48% of identifiable remains found at Desert Sunlight were of aquatic-habitat birds that foraged in water. None of the carcasses were shorebirds.
- Live aquatic-habitat birds were observed flying over solar facilities – including Desert Sunlight – but never landing at the sites. The same species were often observed in the paired reference area (which had similar habitat to the solar facility, but no solar infrastructure) – but, again, never landing.
- There were aquatic-habitat bird detections at all solar facilities and in the agricultural site reference area, but not at reference areas in a desert/scrub or grassland habitat.
- Amongst the dead birds collected at each facility were water-obligate species (i.e., species that can only take-off from water, and which perish on dry land). These were even found at the solar facility in a desert environment that lack water.

The final finding provides the most compelling evidence that these individuals were attracted to the facility, because fatalities were not found in the paired reference areas. The study concluded that some species of aquatic-habitat birds could be attracted to solar facilities and, if attraction occurs, it likely depends on the context – noting that because the causal mechanism is unknown. In other words, while the causal mechanism is not known, there is some kind of attractant at solar facilities that results in bird mortalities at a higher rate compared to background mortality rates on non-developed desert lands.

There is no research or evidence indicating that this phenomenon occurs in Australia, despite the existence of similar solar facilities in semi-arid settings. Kosciuch et al. (2020) identified some factors that may influence bird collisions that are not as relevant to the Australia context. Most notably, many bird species – including waterbirds – in North America are seasonal migrants. Bird collisions showed seasonality – peaking after summer – which coincides with some migratory patterns. In addition, the study noted that proximity to a stop-over/wintering sites for hundreds of thousands of water-associated and water-obligated bird species could be a contributing factor.

In contrast, whilst many species undertake seasonal migrations from Australia to overseas locations (in particular shorebirds), there are very few birds that regularly migrate within arid Australia. Instead, the patterns are more ‘boom and bust’ – dispersing and breeding across the landscape during good rainfall events and contracting to permanent water sources during times of little rainfall. The relative proximity of Lake Woods means that waterbirds will be present – episodically in response to rainfall events – in the vicinity of the Solar Precinct (as described in Section 5.3.2.4). A further key difference is that, compared with the abovementioned studies, the solar panels for the AAPowerLink are essentially at ground level, which may reduce collision rates. Moreover, the solar facilities studied had flat panel arrays that present a uniformly flat surface. In contrast, the Maverick panels that are likely to be used for the AAPowerLink are concertina-ed, creating a less homogenous face, and lower likelihood that the surface is mistaken to be water.

To identify whether this impact manifests for this proposal, to gauge its significance, and hopefully to identify causality (if the impact does occur), the proponent will undertake monitoring of bird fatalities within the Solar Precinct as part of routine monitoring and maintenance programs. Any additional incidental carcass observations will also be recorded. In the meantime, given the emergence of this potential issue and the burgeoning solar power industry, more studies will no doubt be undertaken to identify under what circumstance birds collide with solar panels, and what mitigation measures can be implemented.

### *Overhead Transmission Line*

#### **Bird collisions with transmission wires**

Overhead wires associated with powerlines present a hazard to birds (SNH 2016) through:

- Mortality/injury through collision with powerlines, whereby a bird flies into a wire and is killed either from the impact, from hitting the ground, or from injuries sustained in the process. Studies show that for powerlines, bird collisions are often concentrated along relatively short sections where several factors interact to create a collision 'hotspot'.
- Mortality through electrocution from powerlines, whereby birds that perch or nest on transmission towers/pylons are electrocuted by causing a short circuit, either by touching two live wires, or a live and an earthed component. However, the very high voltage AAPowerLink conductors are spread well apart (the distance between the closest is 12 m) and so the air gap between live components is too large to be bridged by any bird species. This hazard does not need to be considered any further.

Bird injury and mortality due to transmission powerlines is a widespread problem – see, e.g., the references provided in Ferrer et al. (2020). Such interactions have been documented for approximately 350 bird species, with an estimate that it effects around one billion per year worldwide. Some studies suggest that powerline collision mortality can have significant population-level impacts for some species. In south-eastern Australia, there have been records of Brolgas and Wedge-tailed Eagles colliding with transmission lines.

There are numerous factors that influence collision rates – different powerline features, collision-prone species, habitat characteristics, weather conditions, and species-specific behaviours (Ferrer et al. 2020). Bernardino et al. (2018) undertook a systematic review of the literature available on bird collisions with powerlines to assess the existing knowledge of species-specific, site-specific, and powerline-specific factors known to contribute to increased bird collision risk; and to evaluate the effectiveness of existing mitigation measures in reducing collision risk.

Findings from Bernardino et al. (2018) that are relevant to this EIS are:

- Species-specific physiology, morphology and ecology all contribute to collision risk. Gregarious (flocking) species are generally thought to be more vulnerable than solitary species with solitary habits. In addition, powerline collision victims are frequently species that are less manoeuvrable in flight – i.e., with a high wing loading (ratio of weight to wing area) and low or average wing aspect ratio (ratio of wingspan squared to wing area). Relevant examples of such species are bustards, cranes, ducks, and geese. Species that make regular dusk and dawn flights between their roosts and feeding areas may be more susceptible to collisions with powerlines.
- D'Amico et al. (2019) in a study of bird collisions in Spain and Portugal identified populations of large grassland birds (e.g., bustards), large waterbirds and large raptors as most vulnerable to impacts from collisions. These species shared the same general characteristics – low manoeuvrability in flight, hazardous behavioural traits (especially flight height and flocking flight), long-lived and slow-reproducing life-history strategy, habitat, and threatened conservation status. In the United Kingdom, swans and other large waterfowl are of particular concern for collisions (Taylor et al. 2015).
- Powerlines that bisect wetlands, riparian habitats, coastal areas, and major bird congregation habitats are assumed to be the most hazardous.
- Earth wires have been shown to account for the majority of collisions involving transmission lines. Sometimes called static or ground wires, these are less visible than the thicker, often bundled conductor wires and are typically positioned at the top of the wire array, putting them in the flight path of birds which have taken avoiding action to fly over the conductors (SNH 2016) – see, e.g., Figure 5-12. Two studies identified significantly reduced collision rates after removing the earth wire – but whether it is the thinness or the top location of the earth that causes the increased risk is unresolved.
- Whilst it would seem logical that the risk of bird collision depends on the number of vertical levels of wires and the spacing between them, there is little scientific evidence that directly supports this due to the practical difficulties of testing such effects.
- Pylon/tower spacing is thought to play an important role – collision rates near pylons/towers tend to be lower than at mid-span.

- Analysing whether new powerlines should preferably run along existing linear elements (e.g., other powerlines, roads, railways) to reduce habitat fragmentation and mitigate bird collisions, Bernardino et al. (2018) note that:

*Some authors suggest that clustering linear obstacles can reduce collision risk as they become more visible, and birds need to complete only one ascent and descent flight to cross several obstacles at once. However, few studies have attempted to evaluate the effectiveness of this measure in terms of the bird collision hazard. A potential unintended consequence, that multiple adjacent lines of different heights could create a fence which may increase collisions, especially in poor light conditions, has not been evaluated either.*



*Figure 5-12. Photograph showing how hard it is to see powerline earth wires compared with conductors (from Prinsen et al. 2011)*

In light of the research findings presented above, the following aspects of the AAPowerLink proposal are relevant:

Particular bird species that are likely to more susceptible to colliding with the OHTL are Magpie Geese, Brolga and Black-necked Storks in wetland areas, egrets and other large waterbirds along rivers, large birds of prey, and the Australian Bustard (in open country). The characteristics that may contribute to these species' vulnerability are their large size, low manoeuvrability and – for Magpie Geese and whistling ducks – flocking behaviour.

The OHTL corridor crosses some major rivers and transects, or is proximate to, floodplains. Chatto (2006) presents the results of a waterbird survey across the Top End. In the survey area relevant to the northernmost sections of the OHTL (i.e., the Utilities Corridor), two significant areas were identified (see Figure 5-13):

The coast, saline and freshwater wetlands between Lee Point and Tree Point – including the Howard River and Shoal Bay Hunting Reserves. The OHTL Utilities Corridor runs to along the eastern edge of this area.

Within this area there were 24 single significant records during the survey period. These involved numbers in their thousands for Magpie Goose (counts of in excess of 10,000 have been made on Howard Swamps), Wandering Whistling-Duck, Rajah Shelduck, Pacific Black Duck and Australian Pelican. Most of the large species' counts were made in the late dry season. Once the wet season rains commence, these birds quickly leave the survey area, not returning until the wetlands start drying back considerably from July onwards, depending on the individual wetland and/or season.

This site covers the McMinns Lagoon area and some of the associated smaller, isolated swamps to the east of this lagoon. The OHTL Utilities Corridor runs through this area but does not disturb any

swamps. Species counted in reasonably significant numbers in this area during the surveys included Magpie Goose, Masked Lapwing, Whiskered Tern, and several other duck species.

For most of the OHTL Utilities Corridor north of the Arnhem Highway there are swamps on either side, including on Koolpinyah Station, many of which are waterfowl hunting permit areas.

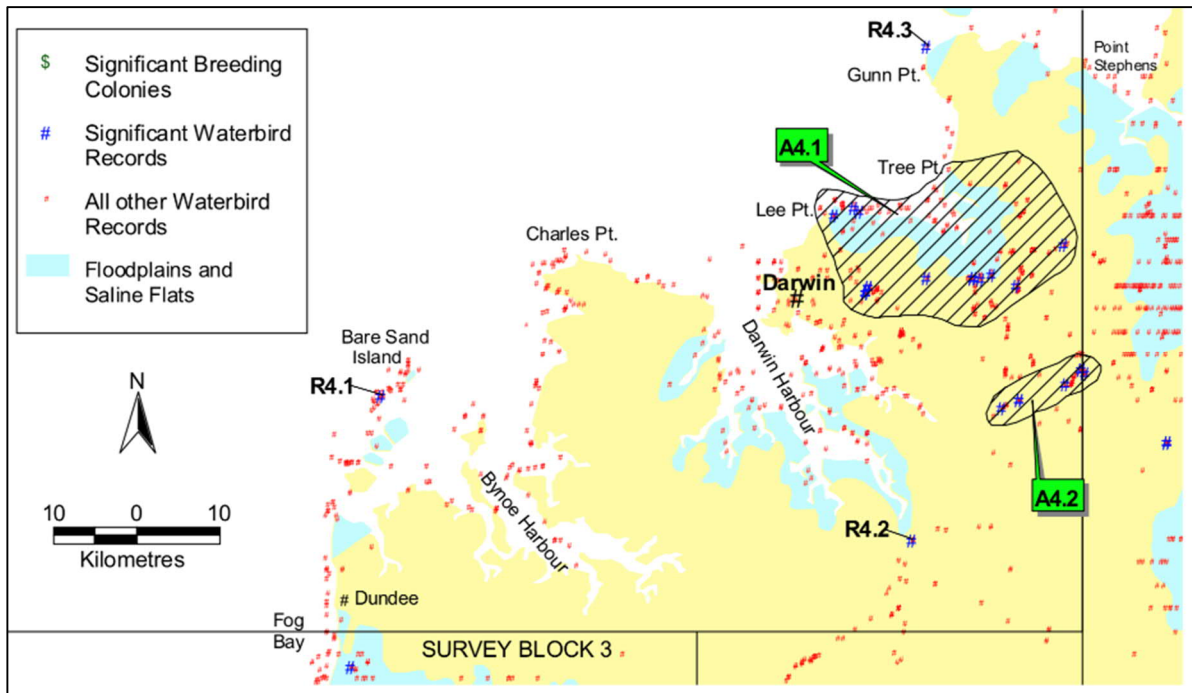


Figure 5-13. Map of significant waterbird areas relevant to the OHTL – from Chatto (2006)

The OHTL comprises two levels of conductor wires. These are 12 m apart. If earth electrodes are adopted into the design, no earth wire will be required. The conductor wires comprise four cables that are bundled together and are therefore very visible because of their thickness (3.5 to 4.0 cm). These characteristics greatly reduce the potential impact of birds colliding with earth wires.

The OHTL footprint aligns with existing railway infrastructure (as well as, in places, major roads and other powerlines) for most of its length.

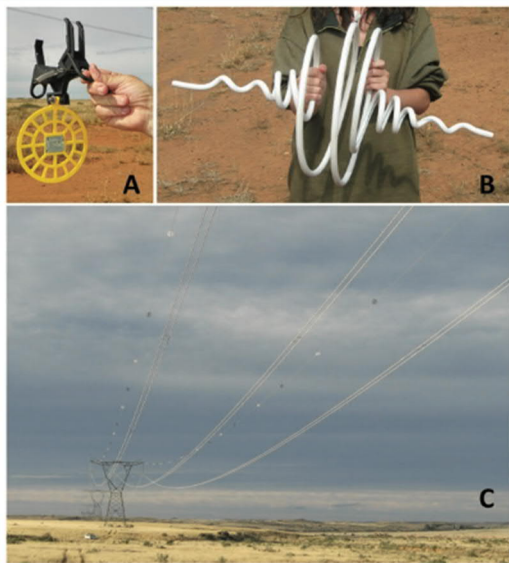
The NT Power and Water Corporation, who operate the high voltage transmissions lines between Katherine and Darwin, have not experienced any noticeable issue with bird collisions (pers. com. Jared Selwood 18 February 2021).

The three most relevant best-practice guidelines relating to the impacts of powerlines on birds are the *Guidelines on how to avoid or mitigate impact of electricity power grids on migratory birds in the African-Eurasian region* (Prinsen et al. 2011), *Reducing Avian Collisions with Powerlines* (APLIC 2012) and the *Assessment and mitigation of impacts of powerlines and guyed meteorological masts on birds* (Scottish National Heritage 2016). These identify some mitigation measures that may help to reduce the impacts of wires on birds (in circumstances where burying cables is not feasible). Most relevant to this proposal is installing line markers/bird diverters on wires to reduce collisions in areas where a high collision risk is identified particularly in likely hotspots. These work by increasing wire visibility for birds and come in a variety of forms – see Figure 5-14 for examples. SNH (2016) and Prinsen et al. (2011) recommend that markers are as large as possible, installed as close together as possible (at least every 5 to 10 m on powerlines), and in contrasting colours for maximum visibility in different weather and light conditions.

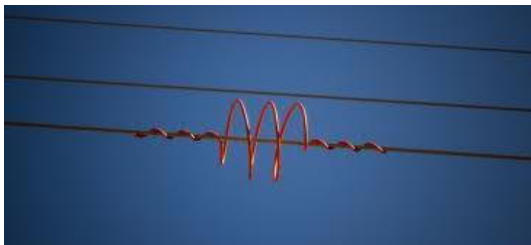
Markers are discussed in more detail in Prinsen et al. (2011) and APLIC (2012). Examples of marker success include:

- Brown and Drewien (1992) found that marking powerlines reduced avian collision mortality by > 50%, with reductions by a factor of 2.1 for ducks, 4.6 for cranes, and 6.7 for geese. Generally, all species flew higher over marked lines.
- Shaw et al. (2021) found that line markers reduced collision rates for Blue Cranes by 92% and all large birds by 51% but had no effect on bustards.
- A study by Frost (2008) noted that in 2004 and 2006, nine and twenty-one Mute Swans were killed through collision with the powerlines, after red flight diverters were installed at 5 m intervals along a 1.5 km length of the powerlines, only one Mute Swan was killed through powerline collision in the following two years.
- Ferrer et al. (2020) investigated the efficacy of three types of flight diverters in reducing avian collision with powerlines: yellow spiral, orange spiral and flapper (see Figure 5-14), with unmarked spans as a control. The flapper flight diverter was responsible for a 70.2% lower mean avian mortality rate, followed by the orange spiral (43.7%) and the yellow spiral (40.4%), compared to control spans.
- Bernardino et al. (2019) performed an extensive literature review and meta-analysis to evaluate the overall effectiveness of wire-marking in reducing bird collisions with powerlines, including the possible influencing factors of powerline voltage, habitat, and type of device. The study found that overall, wire-marking reduced bird collisions with powerlines by 50.4%, with weak evidence that devices with moving parts (flappers) may be more effective than static devices (like spirals), as hypothesised by Martin (2010, 2011) and Martin and Shaw (2010).

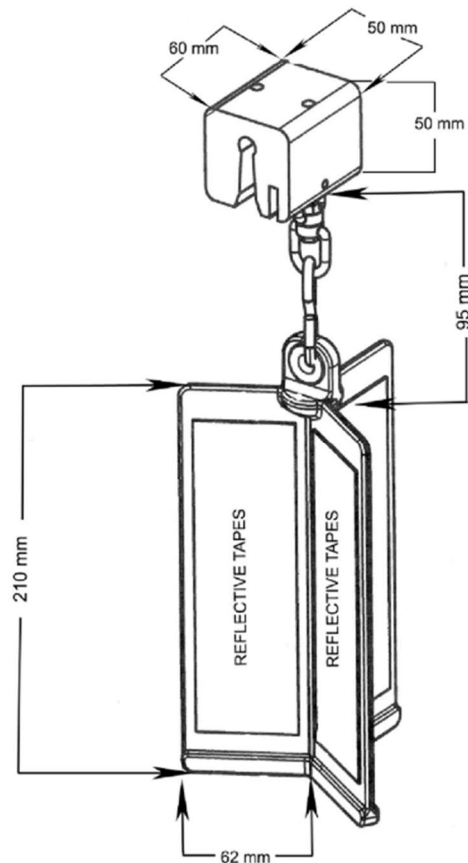
SNH (2016) recommend that ecology survey work for powerlines should be used to identify landscapes used by birds that are known, or likely, to be susceptible to collision, with decisions on where to place markers informed by this. Consequently, Sun Cable will evaluate the need for markers in the Flora and Fauna Management Plan as part of adaptive monitoring and mitigation in areas such as wetlands depicted in Figure 1-13.



From Shaw et al. (2021)



From Ferrer et al. (2020)



From Ferrer et al. (2020)

Figure 5-14. Photographs of powerline markers

### Bat collisions with transmission wires

Most bat species are too small and agile to have a negative interaction with powerlines. Large-bodied tropical bats, such as flying foxes, may be at higher risk of electrocution since their large wingspan (often >1 m) may facilitate the contact with two or more energised wires. Given the large gap between the AAPowerLink conductors (at least 12 m), this is not an issue for this proposal.

There is a possibility that flying foxes may collide with powerlines; however, this appears to have only been studied for urban powerlines, not large-scale transmission lines. The authors are not aware of any issues with flying foxes and powerlines in the NT. Manville (2016) notes that:

*While the recommendations from the Avian Powerline Interaction Committee (APLIC 2006, 2012) have been primarily focused on avoiding and minimizing impacts to protected migratory birds, the recommendations and best practices may also benefit bats, especially where bird-wire marking devices are installed. However, until research is conducted on the etiology of bat-wire collisions, the benefits of APLIC recommendations for bats will continue to remain speculative.*

Flying foxes in the NT roost in colonies. The location of colonies is not well-documented and so it is possible that there are flying fox colonies proximate to the OHTL footprint (especially where it runs close to towns which have known colonies – e.g., Pine Creek). Flying foxes navigate by sight and smell (they do not echolocate). In the absence of information to the contrary, it is assumed in this assessment that mitigation measures useful for reducing bird collisions will also benefit flying foxes.

### 5.4.3.3 Degradation of flora and vegetation due to shading by panels

The EIS TOR identify potential for there to be indirect disturbance or degradation of flora and vegetation – possibly resulting in a long- term decline or loss over time – due to shading from solar panels. The solar panels are placed directly onto the ground and will, therefore, shade the ground beneath them. This will likely preclude plant growth; however, because the panels are only 20 to 70 cm off the ground, this impact will not extend beyond the direct disturbance footprint.

### 5.4.3.4 Changes to fauna behaviours

Operations of the Solar Precinct and Darwin Converter Site involves plant and vehicles that will generate noise, and there will be nigh lighting around the facilities. The operational noise from the transformers will be a constant and is predicted to exceed residential noise criteria for approximately 4 km from the sites based on the screening level noise assessment findings (see Appendix L). Both noise and light could alter fauna behaviour, either attracting or deterring certain species; however, impacts to biodiversity are unlikely as there are no known sensitive receptors or species proximate to the sites.

Glare from solar panels was identified in the EIS TOR as having the potential to change fauna behaviour. This has not been identified as an issue for this proposal – nor has it in other solar farm EIS’s – largely because modern solar panels are designed to absorb – not reflect – light, such that as a little as 2% of light received is reflected (NSW DoI 2016).

## 5.5 Potential impacts to threatened species

Impact assessment for threatened species follows a different process to that for other ecological values, hence a whole separate section in this chapter. Both impacts from construction and operations are considered; however, the highest risks of potential impacts to threatened species relate to the land clearing and development during the construction stage of the proposal.

The International Union for the Conservation of Nature nominates a set of criteria used to identify species at risk of extinction. These criteria are used to define categories of risk (see Figure 5-15) which are used by the NT Government to determine which threatened species are listed under the *Territory Parks and Wildlife Conservation Act (TPWC Act)*, and by the Commonwealth Government to determine which threatened species are listed under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. This report focusses on species that are listed as Vulnerable, Endangered or Critically Endangered under either Act.

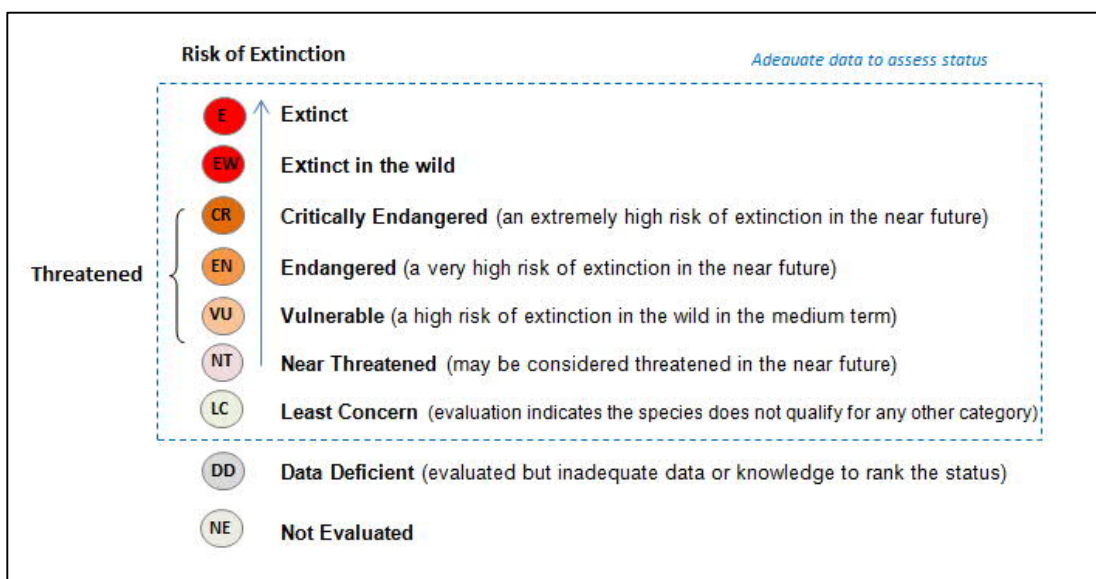


Figure 5-15. The IUCN categories of risk for species

### 5.5.1 Assessment process

The *EPBC Significant Impact Guidelines 1.1* produced by the Commonwealth Government (DEWHA 2013) describe the process for determining the significance of impacts to threatened species. The NT does not have an independent process, and so it is standard practice that species listed as threatened in the NT – but not federally – are also assessed using the Commonwealth’s process.

The process for assessing the potential for a proposal to have a significant impact on threatened species involves:

1. Defining the proposal footprint, as done in Section 5.4.1.
2. Determining which threatened species are likely to be present, see below.
3. Determining the importance of the *population* for each threatened species that is known, or likely, to occur.
4. Determining whether proposal activities are likely to have a *significant impact* on important populations of any threatened species.

When assessing whether a project will have a significant impact on a threatened species known, or likely, to occur in the project footprint to determine whether it does so in an important population – as defined in *EPBC Significant Impact Guidelines 1.1*. This is because, in most circumstances, by definition, a project’s activities can only have a significant impact on an ‘important population’ of a threatened species.

The *EPBC Significant Impact Guidelines 1.1* defines any occurrence of a Critically Endangered or Endangered species within the project footprint as constituting a population, and all populations are ‘important’. For threatened species that are listed as Vulnerable, an ‘important population’ is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified in recovery plans and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity
- Populations that are near the limit of the species’ range.

A ‘population of a species’ is defined under the *EPBC Act* as an occurrence of the species in a particular area – including (but not limited to):

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

Some species are listed under both NT and Commonwealth legislation, but not always under the same status. Throughout this chapter, the high – more threatened status – is the one presented, because it is also the status according to which the species will be assessed using the process described in this section.

For threatened species likely to occur as an important population within a project footprint, the final step is to determine whether project activities are likely to have a *significant impact* on that population. This is done using the criteria within *EPBC Significant Impact Guidelines 1.1*, which varies depending on the threatened category that has been assigned to the species.

### 5.5.2 Solar Precinct

Of the 41 threatened species assessed, only one species – Greater Bilby (*Macrotis lagotis*) – was considered to have a ‘high’ likelihood of occurrence within the Solar Precinct. This was based on their being recent records (from 2020) approximately 100 km to the north on Murrarji Station (and on the same Redsan land system upon which the Solar Precinct is located), and historic reports to the north, south and west of the Solar Precinct.

Subsequently, this species was subject to an intensive, targeted, field study using a sign-based survey based on approved methodologies and advice from DEPWS, and following the key elements of the Commonwealth survey guidelines for the species in terms of tracking and species detection in areas of suitable habitat. Due to the large size of the Solar Precinct, a helicopter survey in combination with ground-based track-plot sampling was employed. The approach was to visit known Greater Bilby sites for reference, and then survey the Solar Precinct. The survey occurred in November 2020 and did not find any Greater Bilby burrows within the Solar Precinct; nor was there any evidence of previous occupation.

Given that no bilbies were detected, it is unlikely that the Solar Precinct contains core habitat or supports a persistent/regular occurrence of the species. Occupancy modelling in the NT indicates that palaeo-drainage lines remain more persistently suitable for Greater Bilby than other habitats such as sand plains and dune fields (Southgate et al. 2018). Nevertheless, the Redsan land system within which the Solar Precinct is located has records of Greater Bilbies to the north (2020), west (circa 1982) and south (2001). Under better climatic conditions – i.e., during a boom<sup>12</sup> season – Greater Bilby may occasionally utilise the area. However, the likelihood of this is reduced by the very low availability of viable food resources and high fire frequency within the Solar Precinct which results in habitat suitability being ‘marginal’, at best. Moreover, the survey was undertaken in a year that had above average rainfall.

### 5.5.3 Access roads

Regarding the access roads, at the time of surveying only an indicative east-west access corridor had been identified. That corridor was inspected using a helicopter and was found to cross a variety of landforms – including low-lying plains; low rocky hills, ridges, and slopes (with sandstone outcropping); plateaux; black soil plains; and minor drainages and tributaries supporting riparian vegetation that are considered to hold local to regional significance. The corridor is unlikely to support any restricted range threatened species. Two threatened species are likely to occur – Grey Falcon and Yellow-spotted Monitor – see below.

The sealed road has subsequently been located just to the south of that corridor; however, the area that was surveyed is considered representative of the landscape traversed by the sealed road. The all-weather unsealed road has not been surveyed. From a review of aerial imagery, there does not appear to be any significant vegetation types of present, and it can be assumed that the threatened species assessment presented above also applies to the unsealed road.

#### 5.5.3.1 Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is a Vulnerable species known to occur in areas of lightly timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm (Ward 2012). This species occupies nests (often built by other bird species) in the tallest trees along watercourses (Garnett et al. 2011), as well as on telecommunications towers. Nesting is normally between June to November (Ward 2012). The Grey Falcon is generally a solitary bird, sometimes found in pairs or family groups.

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<sup>12</sup> Rainfall in the arid region is unpredictable and unreliable – with floods and droughts both possible. In response, many arid flora and fauna species experience ‘boom and bust’ cycles. Populations of fauna species such as the Greater Bilby can ‘disperse after good rainfall into areas not usually known to support the species, and then contract back to core refugial habitat during droughts.

The Grey Falcon is always found in low densities (Garnett et al. 2011), primarily throughout arid and semi-arid areas (Ward 2012), including the Northern Territory and Queensland. Most records are in the Tanami Desert and in the lower third of the Northern Territory. There are records along the Stuart Highway adjacent to Powell Creek Station.

The Grey Falcon has a high likelihood of occurrence in the region traversed by the access roads due to proximity of records, and the presence of potentially suitable nesting habitat along some of the large drainages that support Eucalyptus species. However, aerial observations noted that trees within the proposed access corridor are generally less than 10 m in height and, as such, are considered to be marginally suitable for nesting. The corridor could be used for general foraging/hunting by an individual Grey Falcon or a pair; however, there are no unique characteristics within the corridor that make it a preferred hunting area for the species and suitable foraging habitat is widespread in the surrounding region. As such, although this species has been given a high likelihood of occurrence, it is naturally sparse in the landscape and so an observation of a hunting/foraging individual would be considered to be rare. More frequent observations would only be expected if a nesting site is present within, or close to, the corridor. There is no current evidence of nest occurrence.

The disturbance footprint for the access tracks is long but narrow. Being a mobile species that can avoid road building machinery – the most substantive way individuals of this species could be negatively impacted by the proposal is if active nests are disturbed. These are conspicuous and can be avoided. Given that this species is listed as Vulnerable, construction of the access roads would need to negatively impact many individuals in order to constitute a significant impact. In contrast, the proposal can, and is likely to, avoid impacting upon any individual Grey Falcons.

#### 5.5.3.2 Yellow-spotted Monitor (*Varanus panoptes*)

The Yellow-spotted Monitor (also known as the Floodplain Monitor) occupies variety of habitats – including coastal beaches, floodplains, grasslands, and woodlands (Ward et al. 2012). Its propensity to eat Cane Toads and die from the ingested toxins has caused a significant decline in the population (Ward et al. 2012). This species has a high likelihood of occurrence in the region traversed by the access roads, especially in floodplain and alluvial habitat linked to Lake Woods – which is where the majority of sightings/records of the species are, according to NT Atlas and discussions with Cultural Monitors. This Vulnerable species is relatively widespread in the region, with the majority of records in the Barkly clay plains to the north-east of the access corridor. The access road corridor contains suitable habitat for the species in low land areas to the west of the range, and also in the more substantial valley floors within the Ashburton Range.

Like the Grey Falcon, the Yellow-spotted Monitor is mobile and not restricted to particular habitats within its range. The species' burrows are also conspicuous and can be easily avoided. The narrow disturbance footprint for the access roads will not cause a significant loss in this species' habitat. Only through an occasional vehicle strike is it likely that individual, Yellow-spotted Monitors will be killed. Such a limited impact does not constitute a significant risk to the population of this Vulnerable species.

#### 5.5.4 Overhead Transmission Line

The OHTL corridor traverses 788 km. Consequently, it intersects a large number of habitat types, and therefore potentially impacts a considerable number of different threatened species.

The physical disturbance footprint of the OHTL is – by design – narrow and localised, and there is some flexibility in the location of the poles. Therefore, threatened species with general habitat requirements and/or wide ranges are inherently unlikely to be significantly impacted by the proposed development. Consequently, only species with a restricted-range or localised core habitat are discussed in this section. These species are listed in Table 5-9.

Table 5-9. Threatened species with the potential to be impacted by development of the OHTL corridor

Species	Status		Presence	
	Cwlth	NT	Railway Corridor	Utilities Corridor
<b>FAUNA</b>				
Red Goshawk ( <i>Erythrotriorchis radiatus</i> )	VU	VU	x	-
Northern Leaf-nosed Bat ( <i>Hipposideros stenotis</i> )	-	VU	x	-
Bare-rumped Sheathtail Bat ( <i>Saccolaimus saccolaimus nudicluniatu</i> s)	VU	-	x	x
Ghost Bat ( <i>Macroderma gigas</i> )	VU	-	x	-
Mertens' Water Monitor ( <i>Varanus mertensi</i> )	-	VU	x	x
Mitchell's Water Monitor ( <i>Varanus mitchelli</i> )	-	VU	x	-
Pale Field-rat ( <i>Rattus tunneyi</i> )	-	VU	x	-
Gouldian Finch ( <i>Erythrura gouldiae</i> )	EN	VU	x	-
Greater Bilby ( <i>Macrotis lagotis</i> )	VU	VU	x	-
<b>FLORA</b>				
<i>Typhonium praetermissum</i>	-	VU	x	x
<i>Stylidium ensatum</i>	EN	EN	x	x
Howard River Toadlet ( <i>Uperoleia daviesae</i> )	VU	VU	-	x
<i>Cleome insolata</i>	-	VU	-	x
<i>Utricularia dunstaniae</i>	-	VU	-	x
Darwin Cycad ( <i>Cycas armstrongii</i> )	-	VU	x	x
Darwin Palm ( <i>Ptychosperma macarthurii</i> )	-	EN	-	x
<i>Helicteres macrothrix</i>	EN	EN	x	-

For more detail regarding the species' ecology and distribution, refer to Appendix P.

#### 5.5.4.1 Red Goshawk (*Erythrotriorchis radiatus*)

This Vulnerable species can have a home range of up to 200 km<sup>2</sup> (Czechura and Hobson 2000), but its preferred habitat is tall, open Eucalypt Forest and riparian areas. Red Goshawks forage across a broad range of Top End habitats but have much more specific breeding and roosting habitat requirements. The species nests in large trees – frequently the tallest and most massive in a tall stand – and invariably within 1 km of permanent water (Debus and Czechura 1988; Aumann and Baker-Gabb 1991). Core habitat for this species – and especially nesting habitat – is likely limited to the larger rivers intersected by the OHTL.

General occurrence of a Vulnerable species in a region is not, in itself, sufficient to meet the definition of an 'important' population. The OHTL corridor may overlap with the territory of Red Goshawks, but the only way its development could materially impact upon the species would be collisions with powerlines (which is unlikely, as discussed in Section 5.4.3.2) or disruption to breeding success due to a disturbance of an active nest. As nests are conspicuous, they will be easily detected once the Railway Corridor is open for surveying. In the unlikely event that an active nest is present within the corridor, mitigation measures – such as rescheduling the timing of works – can be adopted to avoid its disturbance.

#### 5.5.4.2 Pale Field-rat (*Rattus tunneyi*)

The Pale Field-rat historically occurred in a wide range of habitats, but now primarily in dense vegetation along creeks (Aplin et al. 2008). Previously widespread and patchily abundant, particularly in the north-west of the Top End, the Pale Field-rat appears to have declined in lower rainfall areas (Woinarski 2000). Despite comprehensive mammal surveys, DENR did not detect the Pale Field-rat on Gunn Point peninsula. As for Red Goshawk, core habitat for this species is likely limited to the larger rivers intersected by the OHTL Railway Corridor, as well as wetter grassy areas.

Despite the Pale Field-rats listing as Vulnerable, the paucity of recent records means that any occurrence of the species within the OHTL footprint should be considered important for maintaining a key source population (either for breeding or dispersal) and/or one that is necessary for maintaining genetic diversity.

Construction within the narrow, linear, and already partially disturbed OHTL Railway Corridor will only disturb small patches of preferred habitat for the Pale Field-rat, with much of that rehabilitated afterwards. Moreover, for engineering reasons, the placement of transmission poles in riparian and wetlands will be avoided as much as possible. Loss of habitat, therefore, will be minimal. Consequently, the likelihood that construction activities will have an impact on a Pale Field-rat – let alone an important population of Pale Field-rats – is low.

#### 5.5.4.3 Water monitors

There are two species of water monitors – Mertens' (*Varanus mertensi*) and Mitchell's (*Varanus mitchelli*) – listed as Vulnerable that occur in the Top End along the edges of freshwater watercourses, swamps, and lagoons, and are seldom seen far from water (Christian 2004, Shine 1986). Mertens' Water Monitors are widespread in the NT, occupying all of the Top End River systems (Ward et al. 2006). Mitchell's Water Monitors are not as widespread, but are also closely associated with riparian habitats, as well as mangroves (Ward 2012). Either of these species may be present in any riparian habitat intersected by the OHTL corridor, including watercourses that only flow during the wet season.

As already noted, the general occurrence of a Vulnerable species in a region is not, in itself, sufficient to meet the definition of an 'important' population. Whilst numbers of both species of water monitor have declined because of Cane Toads, there does not appear to be a range decline for this species, since there are still many post-toad records across its historic distribution. Therefore, there is no evidence that the local occurrence of either water monitor within the project footprint constitutes a key source population, one that is necessary for maintaining genetic diversity, or one near the limit of the species' distribution. For these reasons, the occurrence of this species within the proposal footprint is not considered an important population. Moreover, for the same reasons as presented for the Pale Field-rat (above), the likelihood that construction activities will have an impact on an individual water monitor is low.

#### 5.5.4.4 Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*)

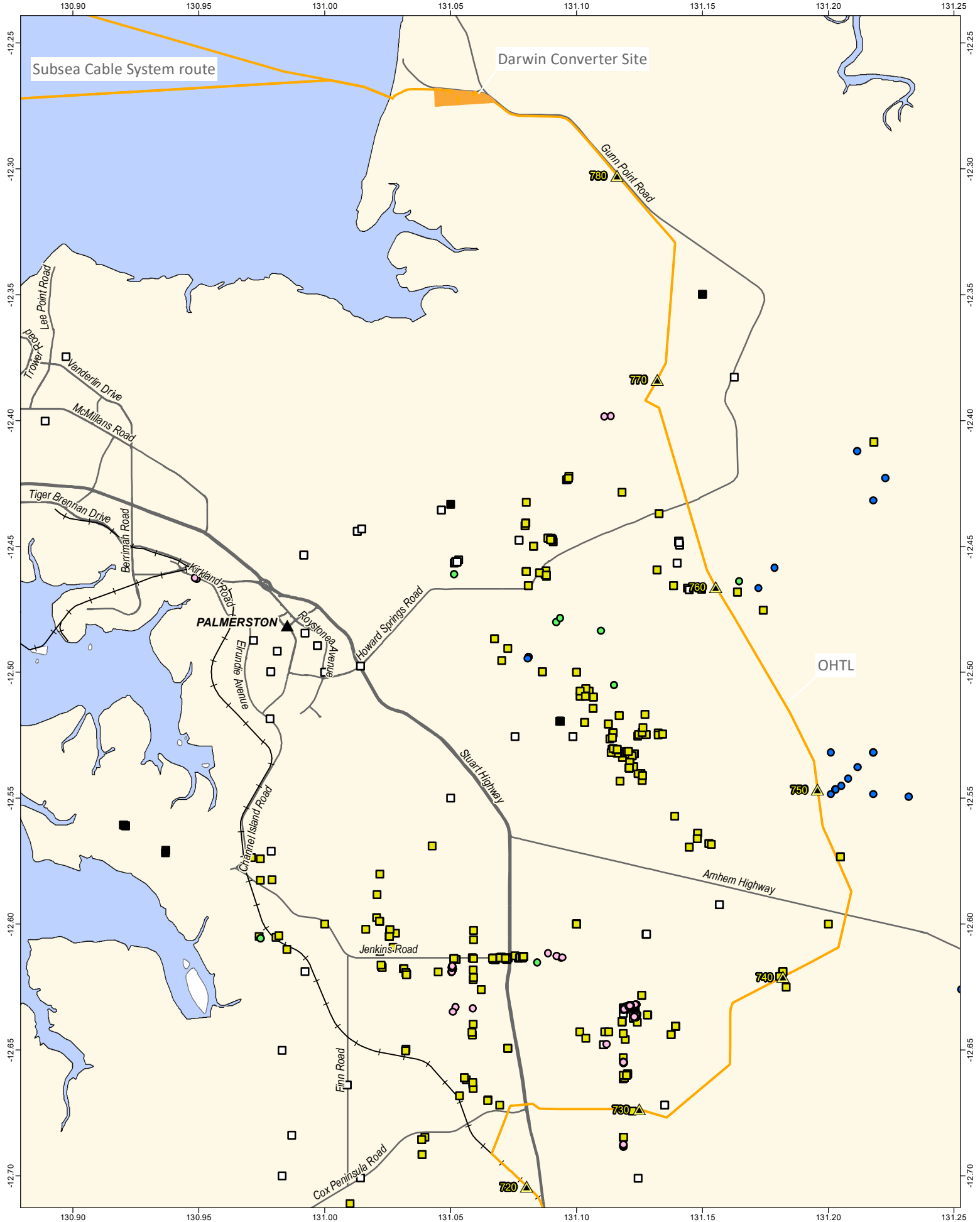
The Bare-rumped Sheathtail Bat (listed as Vulnerable) – has only been detected at 11 locations, all in coastal and adjacent areas. In the NT, specimens have been collected from Pandanus woodland fringing the sedgeland of the South Alligator River, and Eucalyptus tall open forests (Friend and Braithwaite 1986; Churchill 2008) with more recent records from Howard Springs (Milne et al. 2009). The species forages above the canopy and roosts in groups ranging from 10 to 100 individuals in large trees that have deep hollow pipes (Churchill 2008).

There are two Bare-rumped Sheathtail Bat records adjacent to the OHTL Utilities Corridor recorded by an unknown source in 2005 – see Figure 5-16. There are known areas with large hollow-bearing trees within the OHTL Utilities Corridor that may be roost sites for this species, and there could be similar such areas in the northern section of the OHTL Railway Corridor.

Despite the Bare-rumped Sheathtail Bat's listing as Vulnerable, the paucity of recent records (noting that the species is difficult to detect) means that any occurrence of the species within the OHTL footprint should be considered important for maintaining a key source population (either for breeding or dispersal) and/or one that is necessary for maintaining genetic diversity.

The only way that proposal activities could materially impact the Bare-rumped Sheathtail Bat is through mortality of individuals or disruption to breeding success due to a disturbance of an active roost tree. The proponent will mitigate the impact of OHTL construction on this species in the same way any development in the Top End does if there is the possibility of roost trees being present – through avoidance of clearing such trees (if possible) and a pre-clearance surveying of large trees with hollows.

Application of these measures will make it unlikely that the proposal will have a significant impact upon the Bare-rumped Sheathtail Bat.



**Legend**

- AA PowerLink infrastructure
- ▲ OHTL Kilometre Points
- Principal road
- Secondary road
- Railway

**Threatened flora species**

- *Cleome insolata*
- *Ptychosperma macarthurii*
- *Utricularia dunstaniae*

**Threatened fauna species**

- Bare-rumped Sheath-tailed Bat
- Howard Springs Toadlet
- Mertens' Water Monitor

Source: Sun Cable, EcoZ, NTG (NR Maps)



**Figure 5-16: Map of restricted-range threatened species proximate to the OHTL Utilities Corridor**

Project: Australia-Asia PowerLink

Reference: M-Files ID 200232

Date: 09/03/2022

Revision: 1

Scale: 1:210,000

Coordinate System: GDA2020

0 6 Kilometres

A4

#### 5.5.4.5 Northern Leaf-nosed Bat (*Hipposideros stenotis*)

This Vulnerable species prefers rocky outcrops and is an obligate cave rooster. Foraging habitat is broad and includes monsoon vine thickets, woodlands, and open grasslands (Milne 2012). The Northern Leaf-nosed Bat has been rarely recorded and modelling by Milne et al. (2006) suggests the species may be naturally rare. There is a concentration of records around the Pine Creek – including of roosts in old mine adits.

The OHTL footprint does not intersect with any suitable roosting habitat for the Northern Leaf-nosed Bat, but in the Pine Creek area it does run within less than 1 km of known records (and therefore potential roosts). Whilst the general occurrence of a Vulnerable species in a region is not, in itself, sufficient to meet the definition of an ‘important’ population, the concentration of records of Northern Leaf-nosed Bat around Pine Creek indicates the likely presence of a key source population for breeding. And so, applying the precautionary principle, it is assumed that an important Northern Leaf-nosed Bat population occurs within the project footprint.

This species is too small and agile to have a negative interaction with powerlines (as explained in Section 5.4.3.2), so the only way that the proposal could have a negative impact is through noise disturbance during construction. The noise generated by machinery installing OHTL infrastructure will be temporary (each transmission tower will require only a few days to erect). No blasting is required, and the footprint is adjacent to an operating – and therefore periodically noisy – railway line. Localised construction noise for a short duration is unlikely to have a significant impact on roosting Northern Leaf-nosed Bats.

#### 5.5.4.6 Ghost Bat (*Macroderma gigas*)

The Ghost Bat is a Vulnerable species that has also been recorded in concentration around the Pine Creek region. The species has a broad distribution and generalist foraging requirements, but only 14 breeding sites are known (Worthington Wilmer 2012). Permanent roost sites are generally deep natural caves or disused mines; most breeding sites are caves with multiple entrances (TSSC 2016c). Ghost Bats near Pine Creek were found to forage over relatively small areas (mean 61 ha) within 2 km from the daytime roost, and in most cases returned to the same roosting cave (Tidemann et al. 1985). The species moves between a number of caves seasonally or as dictated by weather conditions and require a range of cave sites (Hutson et al. 2001).

The Kohoonir Adit colony – the largest known maternity site for Ghost Bat – is located just south of Pine Creek, and approximately 400 m to the west of the OHTL Railway Corridor. Ghost Bat populations are genetically distinct at both regional and local scales; the presence of a nearby maternity cave – and the species' high degree of female philopatry (i.e., faithfulness to a breeding site) – means the site is likely a key source population for breeding. The disturbance of breeding females has the potential to reduce the area of occupancy and population size significantly (TSSC 2016c). For these reasons, it is assumed that an important Ghost Bat population occurs very close to project footprint for at least part of the year.

Although the largest of micro-bats, this species is still too small (wingspan up to 60 cm) and agile to have a negative interaction with powerlines (as explained in Section 5.4.3.2), so the only way that the proposal could have a negative impact is through noise disturbance during construction. The noise generated by machinery installing OHTL infrastructure will be temporary (each transmission tower will require only a few days to erect). No blasting is required, and the footprint is adjacent to an operating – and therefore periodically noisy – railway line. The placement of poles will be as far from the Kohoonir Adit colony as possible. Localised construction noise for a short duration is unlikely to have a significant impact on roosting Ghost Bats.

#### 5.5.4.7 Gouldian Finch (*Erythrura gouldiae*)

This species is listed as Endangered, although some sources believe that Gouldian Finch populations may have recently stabilised, and perhaps begun to increase and spread (Garnett et al. 2011).

The critical components of suitable habitat for the Gouldian Finch vary seasonally. In the dry season, the critical components are hollow-bearing Eucalyptus trees with an understorey of the favoured species of annual grass and a nearby source of surface water. In the Northern Territory, most known breeding populations occur in the Top End with some isolated records in the Barkly Tableland and in coastal areas of the Gulf of Carpentaria.

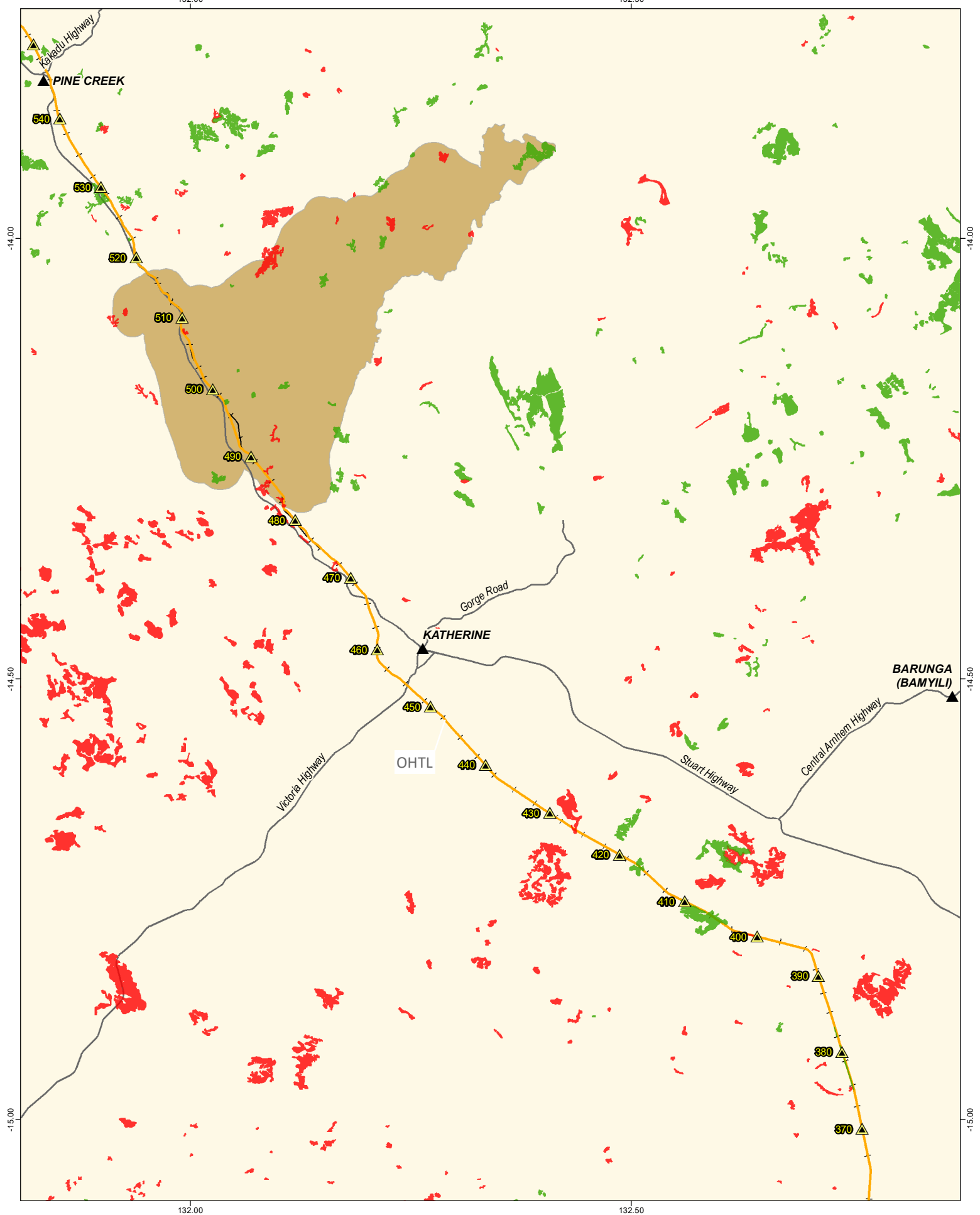
A well-studied site intersected by the OHTL Railway Corridor is the Yinberrie Hills area north of Katherine. This is the location of the largest known breeding population of the Gouldian Finch in the Northern Territory. According to Dostine et al. (2001), that population undertake regular seasonal shifts from breeding areas in hill woodland in the dry season, to adjacent lowlands throughout much of the wet season, in response to seasonal changes in food availability.

The Gouldian Finch's status as Endangered means that any occurrence constitutes an important population. Construction of the OHTL could result in disruption of breeding, loss of breeding habitat and/or loss of core feeding habitat. An analysis has been undertaken for this proposal of the available foraging and roosting habitat within the OHTL Railway Corridor. As shown in Figure 5-17, the OHTL Railway Corridor intersects with multiple patches of breeding and foraging habitat for Gouldian Finches in the Yinberrie Hills region – totalling 3.1 km of breeding habitat and 1.7 km of foraging habitat. There are also many records near to the OHTL Railway Corridor in the Yinberrie Hills SOCS.

Gouldian Finches feed on five grass species as the seeds of these species become seasonally available (Lewis 2007), and birds will move from area to area as the seeds from each species become available (Dostine and Franklin 2002; Dostine et al. 2001). Using the 1:100,000 spatial dataset entitled *Vegetation of the Daly River Catchment* (Cuff 2011), an analysis of the available foraging habitat within the Daly River region that is present within the 60 m OHTL corridor and within a 20 km buffer of that footprint (a search area suggested by DEPWS) has led the following conclusions:

- There is 11,412 ha of Gouldian Finch core foraging habitat within the 20 km buffer. Of this, 9.86 ha (0.09%) is within the OHTL corridor. This may be an overestimate as some of that habitat may have been cleared for the railway and associated infrastructure.
- There is 7,043 ha of Gouldian Finch breeding habitat within the 20 km buffer. Of this, 12.45 ha (0.18%) is within the OHTL corridor. As above, this may be an overestimate.

Micro sitting placement of poles will avoid disturbing these habitats where possible. Given the large area of similar habitat in the region, the clearing of such a small (and narrow) additional area of habitat cannot be considered likely to lead to a long-term decrease in the size of the Gouldian Finch population because the impacts on core foraging or breeding habitat will be negligible.

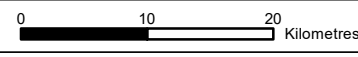


- Legend**
- AAPowerLink infrastructure
  - ▲ OHTL Kilometre Points
  - + Railway
  - Roads
  - Gouldian Finch breeding habitat
  - Gouldian Finch foraging habitat
  - Sites of Conservation Significance
  - Yinberrie Hills



**Figure 5-17: Map of key Gouldian Finch habitat proximate to the OHTL Railway Corridor**

Project: **Australia-Asia PowerLink**



Scale: 1:600,000

Coordinate System: GDA2020

Reference: M-Files ID 200232

Date: 09/03/2022

Revision: 1

Source: Sun Cable, EcoZ, NTG (NR Maps)



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#### 5.5.4.8 Greater Bilby (*Macrotis lagotis*)

The Greater Bilby is listed as Vulnerable and, in the NT, occurs in a wide range of habitats. Vegetation within these predominantly consists of spinifex shrublands and open woodlands. A mosaic of different post-fire ages is preferred (Southgate & Carthew 2007). Fire seems to maintain the sparse vegetation the species favours, and promotes ephemeral plants used as primary and secondary food sources (Southgate & Carthew 2006; Southgate & Carthew 2007; Johnson 1989). However, large-scale burns may restrict breeding, impede dispersal, and reduce food options/availability (Southgate & Carthew 2006).

The Greater Bilby lives in deep burrows excavated in sand. An individual may utilise over a dozen regularly used burrows within its home range, and multiple burrows may be visited in a single night (Pavey 2006). Foraging distance from a burrow can range between 200 to 600 m (Johnston 1989). Greater Bilbies move over a wide area according to available food and vegetation cover conditions (associated with seasons and fires) (Southgate & Carthew 2006; Southgate & Carthew 2007; Southgate 1987; Johnson 1989), and the long-term seasonal home range may be large (up to hundreds of square kilometres) (Southgate 1987).

The southernmost 150 km of the OHTL Railway Corridor area supports areas of suitable habitat for Greater Bilby, and there has been numerous recent (and historic) records of the species on the western side of the Railway Corridor on Murranyi Station – see Figure 5-18. A helicopter survey for the presence of Greater Bilby within the OHTL Railway Corridor was undertaken in late 2020. The survey method is presented in Appendix O. Due to access issues, the OHTL Railway Corridor could not be inspected on the ground. Although no signs within the OHTL Railway Corridor were confirmed as Greater Bilby, it is still considered likely that the species will occasionally occur within certain sections of the OHTL Railway Corridor – those within the Redsan land system near Murranyi station – due to present of suitable habitat and its close proximity to a current colony. To verify presence/absence, a follow-up targeted, ground survey will be undertaken within the OHTL corridor for the Supplementary EIS.

The general occurrence of a Vulnerable species in a region is not, in itself, sufficient to meet the definition of an ‘important’ population. However, the known Murranyi colony is at the northernmost extent of the species current distribution – i.e., near the limit of the species’ range – and therefore qualifies as being an important population (as per the criteria in Section 5.5.1).

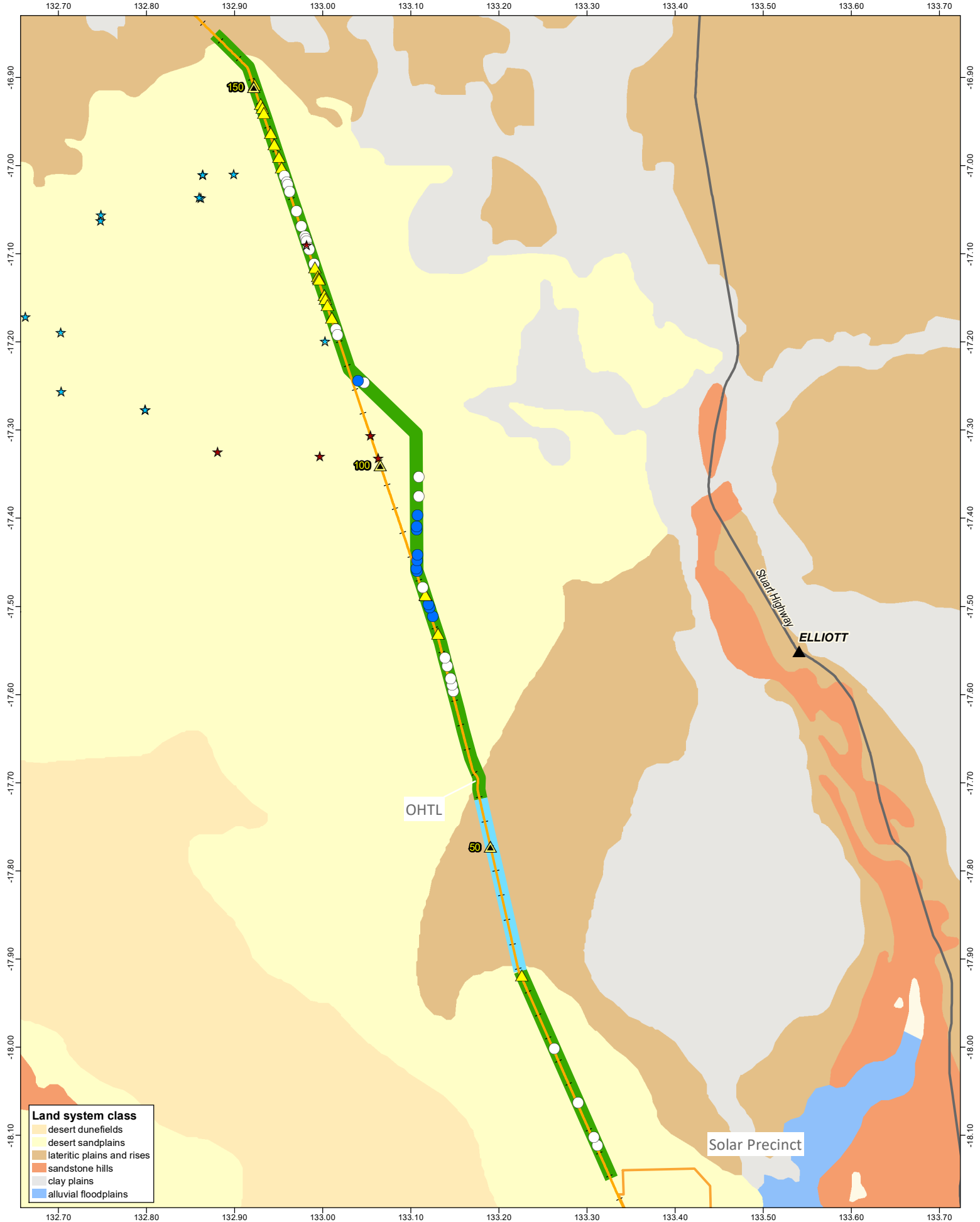
Table 5-10 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses the preliminary aerial survey results and desktop and is based on the assumption that some habitat within the proposal footprint contains Greater Bilby burrows, but so does immediately adjacent habitat that is outside the footprint – in other words, any occurrences of the species are not confined to the proposal footprint. Because the OHTL footprint is narrow, only small areas of foraging habitat will be disturbed – therefore, the focus on the significant impact assessment is on disturbances to burrows used for day-time refuge and breeding.

The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-10 is that it is unlikely that proposal activities will have a significant impact upon the Greater Bilby. Even if this species is present within the OHTL footprint, there are likely aspects of the proposal’s design that can be altered to avoid or minimise impacts to it.

Table 5-10. Preliminary significant impact assessment for Greater Bilby

Criterion	Summary of mitigation measures and significant impact assessment
<p><b>Lead to a long-term decrease in the size of an important population</b></p>	<p>Greater Bilbies utilise numerous burrows across their home range. The OHTL footprint is very narrow and will therefore, at most, only intersect with a few burrows within individuals' home ranges. The only potential cause for a long-term decrease in the size of a local Greater Bilby population would be if burrows within the OHTL are occupied during construction, and the occupants are killed as a result of construction activities.</p> <p>Inherently, this risk is low because Greater Bilbies are generally a solitary species, in the very worst case this would only result in the death of a few individuals. To further reduce this potential impact, if burrows are found within the OHTL footprint, then prior to construction these will be checked for activity (via tracks and/or camera traps). If active, efforts will be made to allow the occupants to vacate safely, and the burrows will then be destroyed to prevent re-inhabitation.</p> <p>This should ensure that mortality of Greater Bilby is very unlikely to occur, and therefore there will not be a long-term decrease in the size of a Greater Bilby population.</p>
<p><b>Reduce the area of occupancy of an important population</b></p>	<p>Determining area of occupancy is based on the IUCN 2 x 2 km grid cell method. If active Greater Bilby burrows are recorded within the OHTL footprint – and their loss cannot be avoided – the only way that can lead to a reduced area of occupancy is if they are entirely confined to within the OHTL footprint. In other words, if the burrows lost constitute the entire local occurrence, and there are no other nearby occurrences, then this could lead to a reduced area of occupancy. There is no reason to suspect that burrows will only occur within the OHTL footprint, and so it is very unlikely that this scenario will eventuate.</p>
<p><b>Fragment an existing important population into two or more populations</b></p>	<p>The clearing of a narrow corridor (22 m reducing to 6 m post-construction) to construct the OHTL will not present a barrier to Greater Bilby movement and will therefore not lead to any fragmentation of a population (if present). Even the existing railway infrastructure is unlikely to have had that effect on this mobile species.</p>
<p><b>Disrupt the breeding cycle of a population</b></p>	<p>This impact could only occur if active burrows are present within the OHTL corridor and construction works are undertaken during breeding season, the timing of which depends on seasonal conditions and food availability (TSSC 2016a). Infant bilbies spend ~75 to 80 days in their mother's pouch, and then another two weeks in a burrow (Woinarski et al. 2014). Therefore, the actual time within which breeding success could be impacted by construction works is limited to a few weeks.</p>
<p><b>Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline</b></p>	<p>For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.</p>

Criterion	Summary of mitigation measures and significant impact assessment
<b>Adversely affect critical habitat</b>	Although not formally designated as such, it is arguable that in the NT, critical habitat for the Greater Bilby is the palaeo-drainage lines in the Tanami Desert (Bradley et al. 2015). This habitat does not occur within the OHTL area of influence.
<b>Result in invasive species, that are harmful to the species, becoming established in the species' habitat</b>	Predation by Feral Cats and Foxes is a known threat to the Greater Bilby. Whilst linear clearings are known to assist cat movements (see, e.g., Wysong et al. 2020), the OHTL Railway Corridor already contains a linear clearing for railway infrastructure, and so this proposal will not facilitate this impact. Creation of water-points can also assist in the spread and proliferation of cats and foxes; however, these are not a feature of this proposal. Altered fire regimes are another threatening process. This could occur if the environmental weed Buffel Grass ( <i>Cenchrus ciliaris</i> ) is introduced into area by construction or operations activities. The proposal's Weed MP (Appendix Q) has been developed to minimise the likelihood of this occurring.
<b>Introduce disease that may cause the species to decline</b>	Disease is not listed as a threatening process for the Greater Bilby. The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.
<b>Interfere with the recovery of the species</b>	The Conservation Advice (TSSC 2016a) lists a number of priority conservation actions, none of which will be interfered with by the activities of this proposal.



**Land system class**

- desert dune fields
- desert sandplains
- lateritic plains and rises
- sandstone hills
- clay plains
- alluvial floodplains

**Legend**

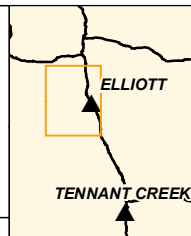
- ▲ Town
- AAPowerLink infrastructure
- Railway
- Primary road
- ▲ OHTL Kilometre Points
- Suitable habitat
- Marginal to not suitable habitat

**Greater Bilby survey results**

- Site - not Bilby
- Site - potential Bilby
- ▲ Site - unlikely Bilby

**Existing Greater Bilby records**

- ★ NT Fauna Atlas
- ★ Murrarji survey (DEPWS 2020)



**Figure 5-18: Map of Greater Bilby results relevant to the OHTL Railway Corridor**

Project: Australia-Asia PowerLink

Reference: M-Files Document ID 204951

Date: 09/03/2022

Revision: 1

Scale: 1:600,000

Coordinate System: GDA2020

A4

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#### 5.5.4.9 *Stylidium ensatum*

The trigger plant, *Stylidium ensatum*, is endemic to the NT and inhabits margins of drainage areas in damp heavy clay or peaty soil (Cowie and Westaway 2012). An Endangered species, at the time that the approved Commonwealth's Conservation Advice (TSSC 2016b) for this species was written there were only two known sub-populations – Hayes Creek (150 km south of Darwin) and the Howard River. Since then, discovery of multiple occurrences within the Gunn Point has significantly increased the abundance and extent of the total known population.

Stokeld et al. (2020) identified more than 4,000 ha with a moderate or high likelihood of habitat suitability for *Stylidium ensatum* within Gunn Point peninsula and, in the field, found this species to be widespread and locally abundant, recorded at 12 discrete sites in the Gunn Point, many close to the OHTL Utilities Corridor.

The proposal footprint does not disturb any known occurrences of *Stylidium ensatum*. There are two habitat models available for this species – a coarse whole-of-range dataset (NTG 2016) and a more refined dataset for the Gunn Point region (Stokeld et al. 2020). Desktop assessment and field observations identified 20 locations of potentially-suitable habitat for *Stylidium ensatum* within the OHTL Utilities Corridor – see Figure 5-19. These assessments were based on preferred habitat characteristics, and proximity to existing locations. There are also areas of high likelihood habitat modelled for this threatened flora species within the OHTL Railway Corridor in small patches near Acacia Hills and around Adelaide River township – see Figure 5-20 – noting that disturbance associated with construction of the railway may mean the species is not present.

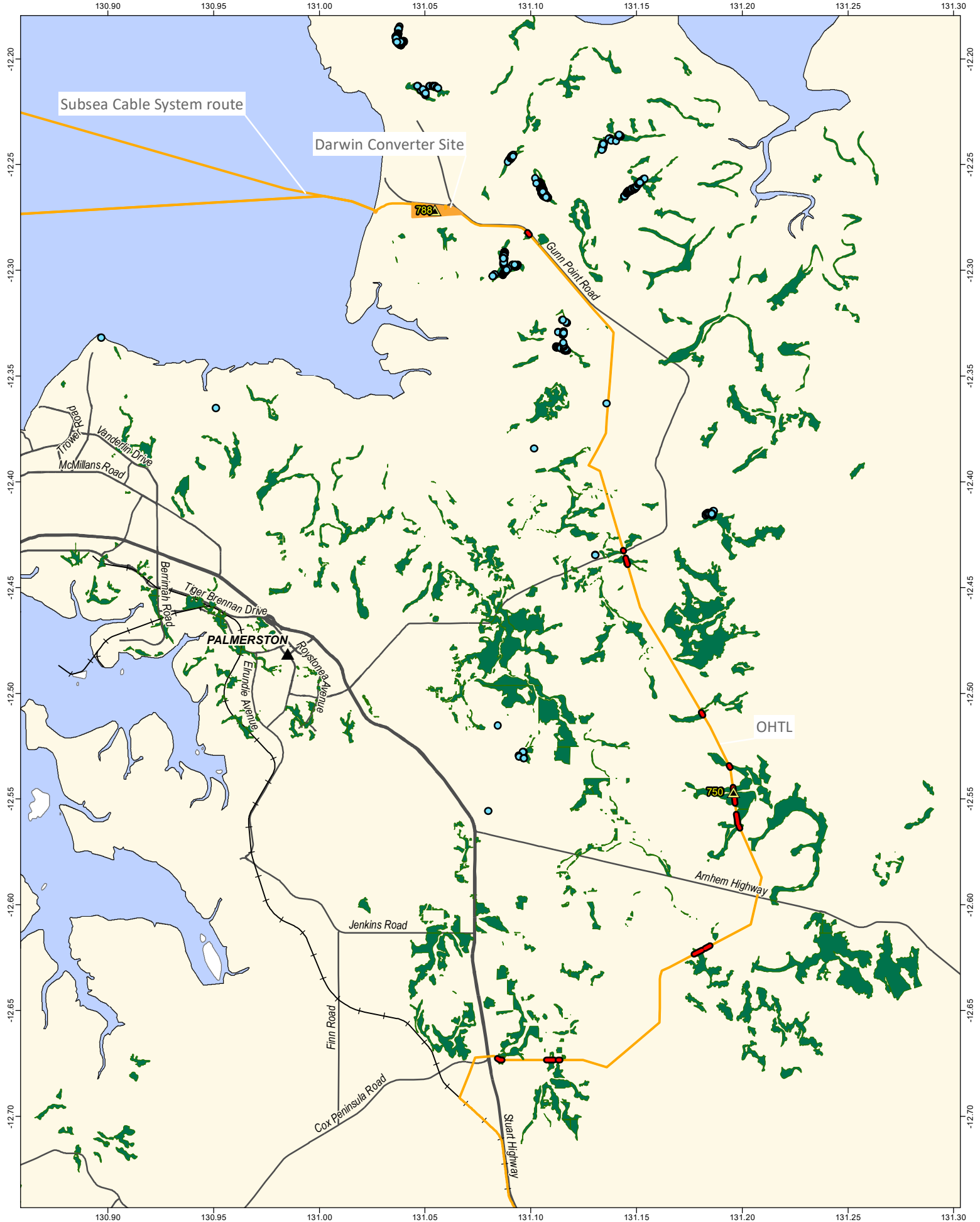
Presence/absence surveys for this species within the proposal's area of influence are yet to be undertaken and are scheduled for mid-2022. Given this species Endangered status, the presence a single individual can be considered an 'important population'. Table 5-11 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses desktop information only, based on the assumption that some of the modelled habitat within the proposal footprint contains *Stylidium ensatum*, but so does immediately adjacent habitat that is outside the footprint – in other words, any occurrences of the species are not confined to the proposal footprint. Surveys may detect *Stylidium ensatum* within the Utilities Corridor because that region's habitat modelling has been refined. The habitat modelling for this species elsewhere is coarse, and it is the author's experience during previous surveys for this species that the species is seldom detected in modelled high likelihood habitat. Consequently, it is unlikely that the modelled habitat within the Railway Corridor footprint will contain *Stylidium ensatum*.

The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-11 is that it is unlikely that proposal activities will have a significant impact upon *Stylidium ensatum*. Even if this restricted-range species is present within the OHTL footprint, its occurrence will almost certainly be very localised, and therefore the proposal's design can be altered to avoid or minimise impacts to it.

Table 5-11. Preliminary significant impact assessment for *Styloidium ensatum*

Criterion	Summary of mitigation measures and significant impact assessment
Lead to a long-term decrease in the size of the population	<p>In TSSC (2016b), the population size estimated for <i>Styloidium ensatum</i> is 11,000 individuals; however, Stokeld et al. (2020) detected thousands of additional plants at multiple Gunn Point sites, noting that ‘records were often located along narrow ecotones, often only tens of metres wide’.</p> <p>If <i>Styloidium ensatum</i> is present within the OHTL footprint, it is likely that some of its habitat will be cleared and there is some mortality of <i>Styloidium ensatum</i> plants. Depending on the location of this habitat, there may be some capacity to modify the design locally to minimise, or even avoid, these impacts. Because of the narrowness of the footprint, and the fact that it is likely that the OHTL corridor will cross <i>Styloidium ensatum</i> habitat (i.e., drainage lines) perpendicularly, the proportion of habitat and individuals that will be destroyed is very small compared with that available in adjacent areas, as well as regionally. Loss of individual <i>Styloidium ensatum</i> within narrow swathes is unlikely to result in a long-term decrease in the size of the species’ population.</p>
Reduce the area of occupancy	<p>According to Stokeld et al. (2021), the area of occupancy for <i>Styloidium ensatum</i> is 92 km<sup>2</sup>, of which 72% is within the Gunn Point region.</p> <p>Determining area of occupancy is based on the IUCN 2 x 2 km grid cell method. If <i>Styloidium ensatum</i> is recorded within the OHTL footprint – and its loss cannot be avoided – the only way that loss can lead to a reduced area of occupancy is if it is entirely confined to within the OHTL footprint. In other words, if the plants lost constitute the entire local occurrence, and there are no other nearby occurrences, then this <u>could</u> lead to a reduced area of occupancy. Because the OHTL corridor will cross <i>Styloidium ensatum</i> habitat perpendicularly, it is very unlikely that this scenario will eventuate.</p>
Fragment the existing population into two or more populations	<p>Because the species often occurs along a linear ecotone – the margins of drainage areas – it is possible that construction of the OHTL could clear a swathe through an existing patch. The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). Across its range, <i>Styloidium ensatum</i> occurs in patches separated by areas of unsuitable habitat. It seems unlikely that such minor additional gaps in its habitat will cause fragmentation into more populations.</p>
Disrupt the breeding cycle of a population	<p><i>Styloidium</i> is a genus of trigger plants that are pollinated by insects. Whilst the relevant insect pollinator species for <i>Styloidium ensatum</i> are not known, it seems unlikely that clearing a narrow corridor through a patch would disrupt pollination of that patch.</p>
Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline	<p>For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species. Moreover, the OHTL will be constructed such that changes to existing surface hydrology are minimal – see Chapter 6 Hydrological Processes.</p>
Adversely affect critical habitat	<p>Critical habitat has not been identified for <i>Styloidium ensatum</i>. This concept is arguably not relevant for rare species with very restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed under previous criteria.</p>
Result in invasive species, that are harmful to the species, becoming established in the species’ habitat	<p>The Conservation Advice (TSSC 2016b) identifies weeds as being a potential threat to <i>Styloidium ensatum</i>. The Weed Management Plan presented in Appendix Q has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.</p>

Criterion	Summary of mitigation measures and significant impact assessment
<p><b>Introduce disease that may cause the species to decline</b></p>	<p>Disease is not listed as a threatening process for <i>Stylidium ensatum</i>. The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.</p>
<p><b>Interfere with the recovery of a species</b></p>	<p>There is no Recovery Plan for this species. In the Conservation Advice (TSSC 2016b), the primary conservation action is identified as being to 'protect extant sites from habitat loss and hydrology changes due to urban development and early dry season burning in the Darwin regional area.' The OHTL is designed to minimise changes to the surface hydrology of watercourses and drainage line it intersects. Neither construction nor operation of the AAPowerLink will result in an increase in bushfire.</p>



**Legend**

- AAPowerLink infrastructure
- ▲ OHTL Kilometre Points
- Principal road
- Secondary road
- Styliidium ensatum* high likelihood habitat as mapped by the NT Government
- Styliidium* high likelihood habitat as verified in the field survey
- *Styliidium ensatum* NTG records

Source: Sun Cable, EcOz, NTG (NR Maps)



**Fig 5-19: Map of potential *Styliidium ensatum* intersected by the OHTL Utilities Corridor**

Project: Australia-Asia PowerLink

Reference: M-Files ID 200232

Date: 09/03/2022      Revision: 1

Scale: 1:250,000

Coordinate System: GDA2020

A4

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#### 5.5.4.10 *Typhonium praetermissum*

This small perennial herb is endemic to the greater Darwin region, extending from the Gunn Point area, south to Lake Bennett and west to Cox Peninsula. A Vulnerable species, *Typhonium praetermissum* occurs in open woodland and favours relatively unshaded areas in red brown clay and shallow gravelly soils. The NT Government has developed a habitat model for *Typhonium praetermissum* for the Greater Darwin region (Cuff and Green 2019). There is one patch modelled as high likelihood habitat for *Typhonium praetermissum* that is relevant to the OHTL Railway Corridor footprint – in Acacia Hills between Leonino Rd and Townend Rd (KP708.5 and KP724) – see Figure 5-20 – noting that disturbance associated with construction of the railway may mean the species is not present.

Fieldwork for this proposal within the OHTL Utilities Corridor was undertaken at a time when *Typhonium praetermissum* is not detectable, and so surveyors assessed the appropriateness of habitat modelling based on their experience surveying for the species. In total, of the habitat mapped by Cuff and Green (2019) as suitable habitat, there was 114.51 ha of habitat deemed highly suitable, 155.72 ha of moderate suitability and 106.76 of low suitability. Habitat suitability for the species could not be assessed for 10.15 ha, due to access constraints. It can be seen from Figure 5-21 that the high likelihood habitat is spread broadly along the length of the OHTL Utilities Corridor. To verify presence/absence, a follow-up targeted flora survey will be undertaken for the Supplementary EIS.

The general occurrence of a Vulnerable species in a region is not, in itself, sufficient to meet the definition of an 'important' population. If *Typhonium praetermissum* is recorded within the OHTL footprint, that occurrence will only be considered an important population if it is a new sub-population (i.e., greater than 2 km from a known sub-population<sup>13</sup>) – and therefore a population necessary for maintaining genetic diversity – or if it occurs near the limit of the species' range (which it could, if detected in the OHTL Railway Corridor). This is because the narrow clearing footprint is very unlikely to contain enough high likelihood *Typhonium praetermissum* habitat to impact upon existing sub-populations. For any patches considered 'important', the significant impact assessment will then depend on the proportion of individuals habitat that will be lost.

Table 5-12 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses desktop information only, based on the assumption that some of the modelled habitat within the proposal footprint contains *Typhonium praetermissum*, but so does immediately adjacent habitat that is outside the footprint – in other words, any occurrences of the species are not confined to the proposal footprint.

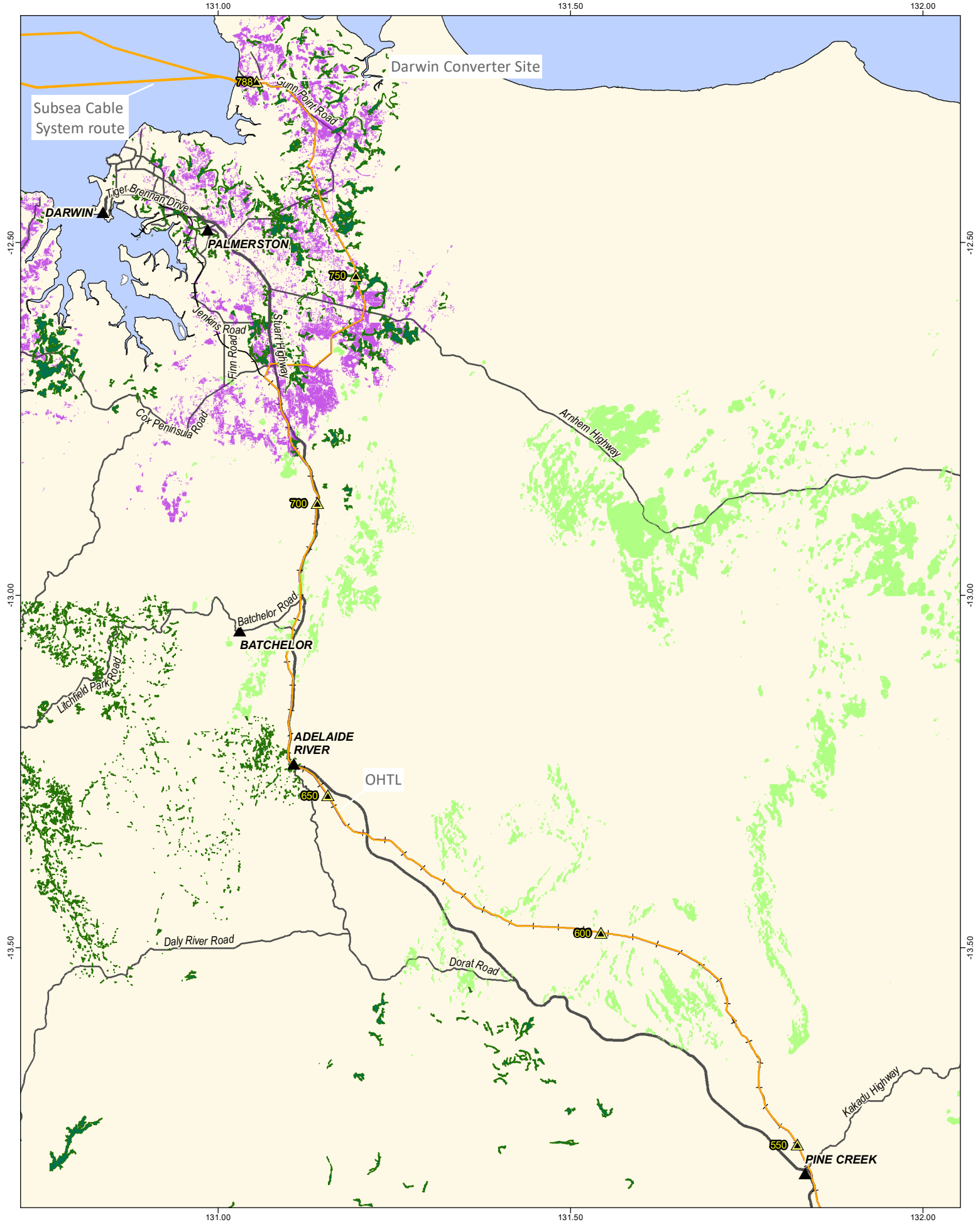
The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-12 is that it is unlikely that proposal activities will have a significant impact upon the *Typhonium praetermissum*. Even if this species is present within the OHTL footprint, there are likely aspects of the proposal's design that can be altered to avoid or minimise impacts to it.

<sup>13</sup> According to Cuff and Green (2019): 'The primary pollination vector for many *Typhonium* species in the Greater Darwin region is thought to be beetles from the Family Staphylinidae (Rove Beetles). Whilst the mobility of these insects is undocumented, it is unlikely that individuals would travel more than 2 km.' This distance between known occurrences is therefore employed to delineate sub-populations.

Table 5-12. Preliminary significant impact assessment for *Typhonium praetermissum* within the OHTL footprint

Criterion	Summary of mitigation measures and significant impact assessment
Lead to a long-term decrease in the size of an important population	<p>There is no information available about the size of the <i>Typhonium praetermissum</i> population. However, numerous new records have been made in the past few years across greater Darwin.</p> <p>If <i>Typhonium praetermissum</i> is present within the OHTL footprint, it is likely that some of its habitat will be cleared and there is some mortality of <i>Typhonium praetermissum</i> plants. Depending on the location of this habitat, there may be some capacity to modify the design locally to minimise, or even avoid, these impacts. Moreover, <i>Typhonium praetermissum</i> has been recorded on historically disturbed sites, suggesting it may be more resilient to disturbance than other threatened species. Because of the narrowness of the footprint, the proportion of habitat and individuals that will be destroyed is likely to very small compared with that available in adjacent areas, as well as regionally. Loss of individual <i>Typhonium praetermissum</i> within narrow swathes is unlikely to result in a long-term decrease in the size of the species' population.</p>
Reduce the area of occupancy of an important population	<p>According to Stokeld et al. (2021), the area of occupancy for <i>Typhonium praetermissum</i> is 256 km<sup>2</sup>, of which 27% is within the Gunn Point region.</p> <p>Determining area of occupancy is based on the IUCN 2 x 2 km grid cell method. If <i>Typhonium praetermissum</i> is recorded within the OHTL footprint – and its loss cannot be avoided – the only way that loss can lead to a reduced area of occupancy is if it is entirely confined to within the OHTL footprint. In other words, if the plants lost constitute the entire local occurrence, and there are no other nearby occurrences, then this could lead to a reduced area of occupancy. Where <i>Typhonium praetermissum</i> is known to occur, it is usually in patches larger than what could be encapsulated entirely within the OHTL footprint. Consequently, it is very unlikely that this scenario will eventuate.</p>
Fragment an existing important population into two or more populations	<p>It is possible that construction of the OHTL could clear a swathe through an existing patch of <i>Typhonium praetermissum</i>. The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). Given the distinction between sub-populations of <i>Typhonium praetermissum</i> requires distances of greater than 2 km, such minor additional gaps in its habitat will not cause fragmentation into more populations or disrupt the breeding cycle.</p>
Disrupt the breeding cycle of a population	<p>It is possible that construction of the OHTL could clear a swathe through an existing patch of <i>Typhonium praetermissum</i>. The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). Given the distinction between sub-populations of <i>Typhonium praetermissum</i> requires distances of greater than 2 km, such minor additional gaps in its habitat will not cause fragmentation into more populations or disrupt the breeding cycle.</p>
Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline	<p>For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.</p>
Adversely affect critical habitat	<p>Critical habitat has not been identified for <i>Typhonium praetermissum</i>. This concept is arguably not relevant for rare species with restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed throughout this table.</p>
Result in invasive species, that are harmful to the species, becoming established in the species' habitat	<p>Westaway and Cowie (2012), identify the proliferation of the weed species Gamba Grass and Mission Grass as dramatically increasing fuel loads resulting in more intense fires which may reduce habitat quality for <i>Typhonium praetermissum</i>.</p> <p>The Weed MP presented in Appendix Q has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.</p>
Introduce disease that may cause the species to decline	<p>The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.</p>

Criterion	Summary of mitigation measures and significant impact assessment
<p><b>Interfere with the recovery of the species</b></p>	<p>There is no Recovery Plan for this species. Westaway and Cowie (2012) consider the main threats to be land clearing for development and weed invasion by Gamba Grass and Mission Grass. The OHTL is designed to minimise clearing of suitable habitat for <i>Typhonium praetermissum</i>. The Weed Management Plan has been developed to minimise introduction and proliferation of weeds within the proposal area of influence.</p>



**Legend**

- AAPowerLink infrastructure
- ▲ OHTL Kilometre Point (KP)
- Railway
- Principal road
- Secondary road
- *Helicteres macrothrix* high likelihood habitat (Source: NTG)
- *Stylidium ensatum* high likelihood habitat (Source: NTG)
- *Typhonium praetermissum* high likelihood habitat (Source: NTG)

Source: Sun Cable, EcOz, NTG (NR Maps)



**Figure 5-20: Map of modelled high likelihood habitat for threatened flora species proximate to the OHTL**

Project: Australia-Asia PowerLink

0 20

Kilometres

Reference: M-Files ID 200232

Date: 09/03/2022

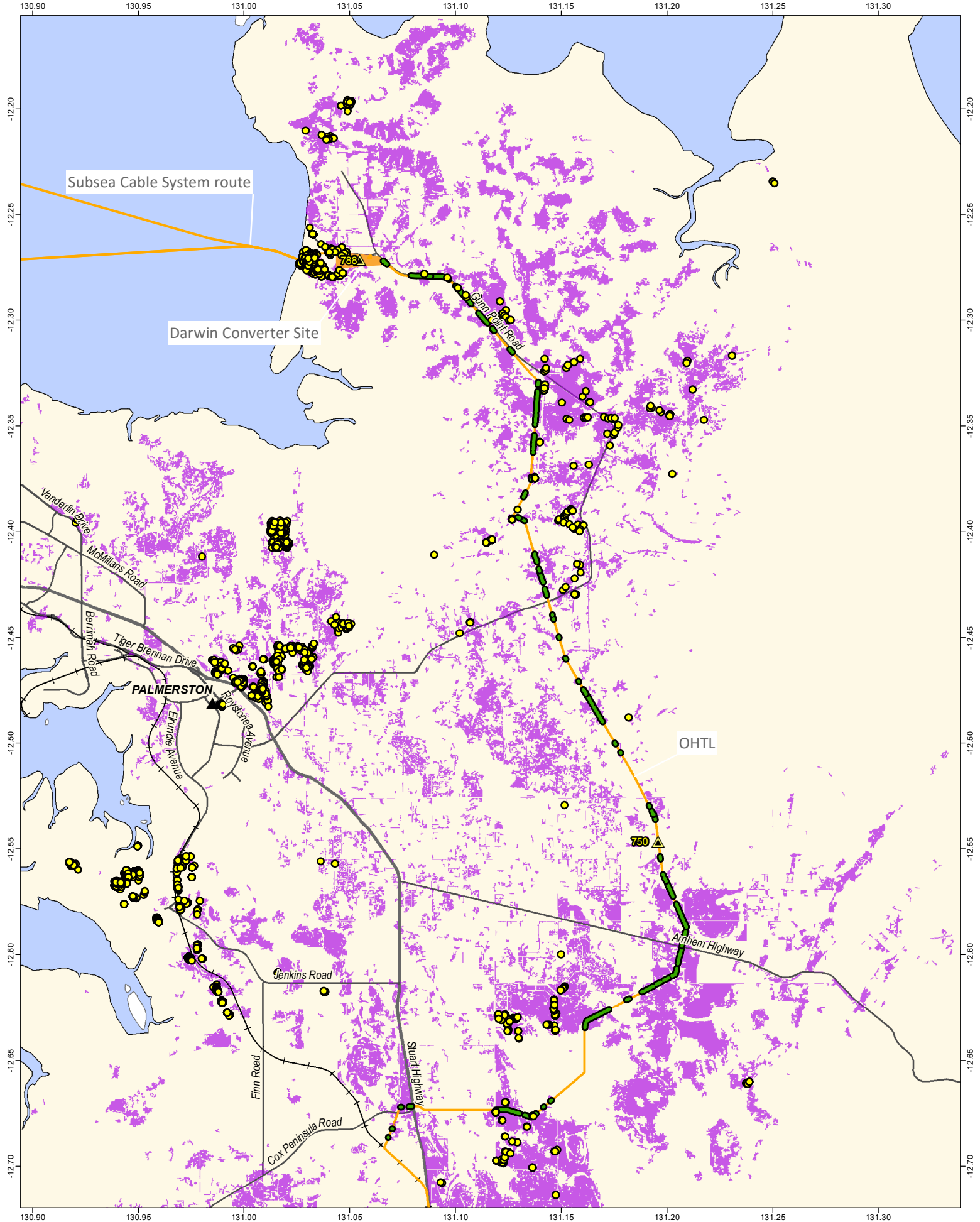
Revision: 1

Scale: 1:750,000

Coordinate System: GDA2020

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**Legend**

- AAPowerLink infrastructure
- ▲ OHTL Kilometre Points
- Principal road
- Secondary road
- *Typhonium praetermissum* high likelihood habitat as mapped by the NT Government
- *Typhonium* high likelihood habitat as verified in the field survey
- *Typhonium praetermissum* NTG records



**Figure 5-21: Map of potential *Typhonium praetermissum* intersected by the OHTL Utilities Corridor**

Project: **Australia-Asia PowerLink**

Reference: M-Files ID 200232

Date: 09/03/2022      Revision: 1

Scale: 1:250,000

Coordinate System: GDA2020

### 5.5.4.11 *Helicteres macrothrix*

*Helicteres macrothrix* is an Endangered plant associated with Eucalyptus woodland on clayey soils derived from siltstone or sandier soils derived from the granite-like rock syenite. This species has been recorded from three populations – near Mt Bundey, near Batchelor and in the Lake Bennett area. The NT Government has mapped the extent of occurrence of *Helicteres macrothrix* based on known recorded locations (DLRM 2016). The OHTL Railway Corridor crosses just over 10 km of habitat – most of which is between Darwin River Dam and Adelaide River (see Figure 5-20) – noting that disturbance associated with construction of the railway may mean the species is not present. There has been little survey effort for this species in the south of its projected distribution, and the only records from that region happen to be near to the OHTL Railway Corridor just south of where it crosses Crater Lake Rd near the Batchelor turn-off.

Presence/absence surveys for this species within the proposal’s area of influence are yet to be undertaken and are scheduled for mid-2022. Given this species Endangered status, the presence a single individual can be considered an ‘important population’. Table 5-13 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses desktop information only, based on the assumption that some of the modelled habitat within the proposal footprint contains *Helicteres macrothrix*, but so does immediately adjacent habitat that is outside the footprint – in other words, any occurrences of the species are not confined to the proposal footprint. Surveys may detect *Helicteres macrothrix* within the Utilities Corridor because that region’s habitat modelling has been refined. The habitat modelling for this species elsewhere is coarse, and it is the author’s experience during previous surveys for this species that the species is seldom detected in modelled high likelihood habitat. Consequently, it is unlikely that the modelled habitat within the Railway Corridor footprint will contain *Helicteres macrothrix*.

The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-13 is that it is unlikely that proposal activities will have a significant impact upon *Helicteres macrothrix*. Even if this restricted-range species is present within the OHTL footprint, its occurrence will almost certainly be very localised, and therefore the proposal’s design can be altered to avoid or minimise impacts to it.

Table 5-13. Preliminary significant impact assessment for *Helicteres macrothrix*

Criterion	Summary of mitigation measures and significant impact assessment
<p><b>Lead to a long-term decrease in the size of the population</b></p>	<p>According to TSSC (2008) and Cowie et al. (2012), the current estimated total number of individuals of this species is in the 100,000s.</p> <p>If <i>Helicteres macrothrix</i> is present within the OHTL footprint, it is likely that some of its habitat will be cleared and there is some mortality of <i>Helicteres macrothrix</i> plants. Depending on the location of this habitat, there may be some capacity to modify the design locally to minimise, or even avoid, these impacts. Because of the narrowness of the footprint, the proportion of habitat and individuals that will be destroyed is likely to very small compared with that available in adjacent areas, as well as regionally. Loss of individual <i>Helicteres macrothrix</i> within narrow swathes is unlikely to result in a long-term decrease in the size of the species’ population.</p>
<p><b>Reduce the area of occupancy</b></p>	<p><i>Helicteres macrothrix</i> occurs in three populations across an extent of 915 km<sup>2</sup>, although the total area of occupancy is only ~0.14 km<sup>2</sup> (TSSC 2008). There remain large areas of habitat for this species that are yet to be surveyed, so this is likely an underestimate.</p> <p>Determining area of occupancy is based on the IUCN 2 x 2 km grid cell method. If <i>Helicteres macrothrix</i> is recorded within the OHTL footprint – and its loss cannot be avoided – the only way that loss can lead to a reduced area of occupancy is if it is entirely confined to within the OHTL footprint. In other words, if the plants lost constitute the entire local occurrence, and there are no other nearby occurrences, then this <u>could</u> lead to a reduced area of occupancy. Where <i>Helicteres macrothrix</i> is known to occur, it is usually in patches larger than what could be encapsulated entirely within the OHTL footprint. Consequently, it is very unlikely that this scenario will eventuate.</p>

Criterion	Summary of mitigation measures and significant impact assessment
Fragment the existing population into two or more populations	It is possible that construction of the OHTL could clear a swathe through an existing patch of <i>Helicteres macrothrix</i> . The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). It seems unlikely that such minor additional gaps in its habitat will cause fragmentation into more populations.
Disrupt the breeding cycle of a population	<i>Helicteres</i> is a genus of flowering plants. It is not known how <i>Helicteres macrothrix</i> is pollinated, but presumably it is by insects. Regardless, it seems unlikely that clearing a narrow corridor through a <i>Helicteres macrothrix</i> patch would disrupt pollination of that patch.
Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline	For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.
Adversely affect critical habitat	Critical habitat has not been identified for <i>Helicteres macrothrix</i> . This concept is arguably not relevant for rare species with very restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed under previous criteria.
Result in invasive species, that are harmful to the species, becoming established in the species' habitat	The Conservation Advice (TSSC 2008) identifies weed invasion by Gamba Grass ( <i>Andropogon gayanus</i> ) and Mission Grass ( <i>Pennisetum polystachion</i> ) as a major threat to <i>Helicteres macrothrix</i> . These weeds may alter fire frequency and intensity, as well as out-competing individual plants.  The Weed Management Plan presented in Appendix Q has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.
Introduce disease that may cause the species to decline	Disease is not listed as a threatening process for <i>Helicteres macrothrix</i> . The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.
Interfere with the recovery of a species	There is no Recovery Plan for this species. In the Conservation Advice (TSSC 2008), the main identified threats are land clearing for development and weed invasion by Gamba Grass and Mission Grass. The OHTL is designed to minimise clearing of suitable habitat for <i>Helicteres macrothrix</i> . The Weed Management Plan has been developed to minimise introduction and proliferation of weeds within the proposal area of influence.

#### 5.5.4.12 Darwin Cycad (*Cycas armstrongii*)

Listed as Vulnerable, the Darwin Cycad occurs in open grassy woodlands where adequate draining appears to be a limiting factor. It also occurs on rocky outcrops, undulating hills and plains (Kerrigan et al. 2006a). Darwin Cycads are endemic to the Top End, with abundant populations occurring throughout the greater Darwin region, often forming dense stands (Kerrigan et al. 2006a). Nevertheless, their long-term conservation has to be considered because they are long-lived, have a slow reproductive rate and localised distribution (Liddle 2009).

Within the OHTL Railway Corridor, Darwin Cycads could occur from about KP660 onwards. No surveys for the Darwin Cycad have occurred within the OHTL Railway Corridor.

Regarding the OHTL Utilities Corridor, according to the recent surveys (Astrebla 2017; Stokeld et al. 2020), the Darwin Cycad has a widespread, patchy distribution on Gunn Point Peninsula. Likelihood of occurrence modelling by Stokeld et al. (2020) identified 7% (4,988 ha) of the Gunn Point Peninsula study area as having a high likelihood of supporting high density cycad stands, and 9% (6,117 ha) a moderate likelihood. The high

likelihood habitat is focussed either side of the central length of Gunn Point Rd which is intersected by the final ~10 km of the OHTL Utilities Corridor (from KP776). During the OHTL Utilities Corridor field survey, Darwin Cycads were generally observed in the most commonly occurring land units throughout the corridor and there were areas of high-density Darwin Cycads noted.

The mainland Darwin Cycad population is considered a single population – one which this proposal’s activities are unlikely to have a significant impact upon. Because the species is locally common within its restricted range, the focus for conservation is typically on high density stands (> 400 stems per hectare). Some conservation-significant stands of Darwin Cycad are known to occur within the proposal footprint; others may be detected once the OHTL Railway Corridor is surveyed.

Disturbance of any individual Darwin Cycads – but especially to high density stands – will be avoided as much as possible. Where disturbance is unavoidable, the proponent acknowledges that the proposal will contribute to the cumulative loss of the Darwin Cycad in the greater Darwin region. However, due to the small area of habitat lost compared to the total distribution of the species, that loss is not likely to affect the conservation status of the species in the Northern Territory.

#### 5.5.4.13 Darwin Palm (*Ptychosperma macarthurii*)

Listed as Endangered, this species is known from eight populations in the Black Jungle region, with an extent of occurrence of 200 km<sup>2</sup> and an area of occupancy of less than 1 km<sup>2</sup> (Duff et al. 1992; Barrow et al. 1993; Liddle et al. 1996). According to Stokeld et al. (2020), within the Gunn Point study area it is unlikely that additional, undetected sub-populations exist. The Black Jungle sub-population is by far the largest, with Crocodile Creek containing 70% of the NT population (Liddle et al. 2006). The OHTL Utilities Corridor passes within 500 m of a Darwin Palm record – see Figure 5-16 – and transects the drainage line along which that record, and many others, occur downstream. Field surveys to date have not recorded the Darwin Palm within the OHTL Utilities Corridor and the absence of the palm in the remaining unsurveyed areas will be confirmed following completion of surveys that were underway at the time this EIS was submitted.

Table 5-14 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses desktop information only, based on the assumption that some of the modelled habitat within the proposal footprint contains the Darwin Palm, but so does immediately adjacent habitat that is outside the footprint – in other words, any occurrences of the species are not confined to the proposal footprint.

The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-14 is that it is unlikely that proposal activities will have a significant impact upon Darwin Palm. Even if this restricted-range species is present within the OHTL footprint, its occurrence will almost certainly be very localised, and therefore the proposal’s design can be altered to avoid or minimise impacts to it.

Table 5-14. Preliminary significant impact assessment for Darwin Palm

Criterion	Summary of mitigation measures and significant impact assessment
<p><b>Lead to a long-term decrease in the size of the population</b></p>	<p>According to Kerrigan et al. (2006b), population counts of Darwin Palm in 2000-01 found a total of 1037 adult plants, 70% of which occurred in one population at Crocodile Creek (which is crossed by the OHTL Utilities Corridor).</p> <p>If the Darwin Palm is present within the OHTL footprint, land clearing would result in mortality of Darwin Palm plants. Individuals could also be lost downstream if there are significant changes (i.e., beyond natural variation) to surface run-off quantity and/or quality because of the development of the OHTL.</p> <p>For a species with such a small population, the loss of a few individuals could lead to a long-term decrease in the size of the population. Therefore, OHTL will be designed to avoid disturbing any occurrences of the Darwin Palm within its footprint. Potential impacts associated with surface water quality and hydrology are discussed below.</p>
<p><b>Reduce the area of occupancy</b></p>	<p>According to Stokeld et al. (2021), the area of occupancy for Darwin Palm is 36 km<sup>2</sup>, of which 78% is within the Gunn Point region.</p> <p>If the Darwin Palm is recorded within the OHTL footprint – and its loss cannot be avoided – then the fact that occurrences of this species are very localised means that loss of individuals could lead to a reduced area of occupancy. Consequently, the OHTL will be designed to avoid disturbing any occurrences of the Darwin Palm within its footprint.</p>
<p><b>Fragment the existing population into two or more populations</b></p>	<p>Because the species often occurs along a linear ecotone – wet rainforest along watercourses – it is possible that construction of the OHTL could clear a swathe through an existing patch. The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). It seems unlikely that such minor additional gaps in its habitat will cause fragmentation into more populations.</p>
<p><b>Disrupt the breeding cycle of a population</b></p>	<p>Whilst the relevant pollinator species for the Darwin Palm are not known, it seems unlikely that clearing a narrow corridor through a patch would disrupt pollination of that patch.</p>
<p><b>Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline</b></p>	<p>The Darwin Palm occurs in habitats that rely on permanent water from springs. If this species is present within the OHTL area of influence, individuals could be lost, habitat degraded, and/or area of occupancy reduced if there are significant changes (i.e., beyond natural variation) to surface run-off quantity and/or quality because of the development of the OHTL.</p> <p>As detailed in Chapter 6 Hydrological processes, OHTL poles will not be placed in watercourses or drainage lines, or in areas where surface drainage could be affected. Only minor drainage lines that do not support threatened species will be crossed by the OHTL access track. All other drainages will be approached from either side to avoid the need for constructing crossings. Watercourse crossings will be installed during the dry season when no flow present. Drainage, erosion, and sediment controls will be installed and maintained in accordance with Erosion and Sediment Control Plans (ESCPs).</p> <p>For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.</p>
<p><b>Adversely affect critical habitat</b></p>	<p>Critical habitat has not been identified for the Darwin Palm. This concept is arguably not relevant for rare species with very restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed under previous criteria.</p>

Criterion	Summary of mitigation measures and significant impact assessment
<p>Result in invasive species, that are harmful to the species, becoming established in the species' habitat</p>	<p>Disturbance from feral buffalo, cattle and pigs are all identified as threatening processes to the Darwin Palm (Kerrigan et al. 2006b), as are weeds which could reduce habitat quality and out-compete individual plants.</p> <p>Proposal activities will not cause any increase in feral animals numbers or occurrence. The Weed Management Plan presented in Appendix Q has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.</p>
<p>Introduce disease that may cause the species to decline</p>	<p>Disease is not listed as a threatening process for the Darwin Palm. The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.</p>
<p>Interfere with the recovery of a species</p>	<p>According to Kerrigan et al. (2006b), a Recovery Plan was created for this species (Liddle and Scott 2005), but it is no longer in the public domain. The priority conservation action relevant to this proposal was to protect habitat from introduced animals and fire. Throughout this chapter, it has been explained how the proposal will not exacerbate existing introduced animal populations or fire regimes.</p>

#### 5.5.4.14 Howard River Toadlet (*Uperoleia daviesae*)

Howard River Toadlet (*Uperoleia daviesae*) is an endemic Vulnerable species that was only formally described in 2005 and listed under the EPBC Act in late 2021. The species is highly restricted to shallow drainage systems that intersect sandsheet habitat of the Darwin region (Young et al. 2005; Fisher et al. 2011). Sandsheet heath is only found in patches within the greater Darwin region with locations relevant to the AAPowerLink shown on Figure 5-4 and Figure 5-5.

The Howard River Toadlet only occurs in the Howard and Elizabeth River catchments, and there are many records proximate to the southern and central sections of the OHTL Utilities Corridor. The species was only recorded at four sites (during a below average wet season) in the Gunn Point region by Stokeld et al. (2020), who noted that presence of the species at a site was associated with the occurrence of debil-debil microrelief, higher proportion of sand in the soil to a depth of 60 cm, and larger patches of sandsheet heath.

This species has not been surveyed to confirm presence, or delineate extent of occurrence, within the OHTL corridor. The Howard River Toadlet is well studied – regionally – and known from many locations. Presence/absence of the species will be verified with a targeted field survey in 2022. The OHTL corridor runs along the eastern limit of the species range, and therefore any records of this Vulnerable species within the OHTL footprint would likely constitute an ‘important population’ near the limit of the species’ range, and therefore necessary for maintaining genetic diversity (as per the criteria in Section 5.5.1).

Table 5-15 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses desktop information only, based on the assumption that some sandsheet habitat within the proposal footprint contains Howard River Toadlet, but so does immediately adjacent habitat that is outside the footprint – in other words, any occurrences of the species are not confined to the proposal footprint. The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-15 is that it is unlikely that proposal activities will have a significant impact upon Howard River Toadlet. Even if this restricted-range species is present within the OHTL footprint, its occurrence will almost certainly be very localised and therefore the proposal’s design can be altered to avoid or minimise impacts to it.

Table 5-15. Preliminary significant impact assessment for Howard River Toadlet

Criterion	Summary of mitigation measures and significant impact assessment
<p>Lead to a long-term decrease in the size of an important population</p>	<p>The number of mature Howard River Toadlets is estimated to be approximately 17,250 (TSSC 2021). If this species is present within the OHTL footprint, it is likely that some of its habitat will be cleared and it is possible there is some direct mortality of toadlets. Depending on the location of this habitat, there may be some capacity to modify the design locally to minimise, or even avoid, these impacts. Because of the narrowness of the footprint, the proportion of habitat and individuals that will be destroyed is likely to very small compared with that available in adjacent areas, as well as regionally. Loss of individual Howard River Toadlets within narrow swathes is unlikely to result in a long-term decrease in the size of the species' population.</p> <p>Potential impacts associated with surface water quality and hydrology are discussed below.</p>
<p>Reduce the area of occupancy of an important population</p>	<p>According to TSSC (2021), the area of occupancy for the Howard River Toadlet is 216 km<sup>2</sup>.</p> <p>Determining area of occupancy is based on the IUCN 2 x 2 km grid cell method. If the Howard River Toadlet is recorded within the OHTL footprint – and its loss cannot be avoided – the only way that loss can lead to a reduced area of occupancy is if it is entirely confined to within the OHTL footprint. In other words, if the toadlets lost constitute the entire local occurrence, and there are no other nearby occurrences, then this <u>could</u> lead to a reduced area of occupancy. It is unlikely that this scenario will eventuate.</p>
<p>Fragment an existing important population into two or more populations</p>	<p>It is possible that construction of the OHTL could clear a swathe through an existing patch of the Howard River Toadlet. The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). The species is mobile, and so as long as there are no physical barriers – e.g., walls – in place, it seems unlikely that such minor additional gaps in its habitat will cause fragmentation into more populations.</p>
<p>Disrupt the breeding cycle of a population</p>	<p>Breeding can occur from December to March (TSSC 2021), with actual breeding activity apparently associated with specific conditions that result in flows of shallow water across sandsheet heath areas. According to TSSC (2021), it is likely that few, if any, males survive one breeding season, and movement between sites is likely to be rare because of the small size of the species. Consequently, if construction activity within or adjacent Howard River Toadlet habitat alters surface water flows in that habitat, breeding may not occur, and the population may be severely impacted.</p> <p>Reynolds and Grattidge (2013) report an instance where a Howard River Toadlet population was divided by a road development which had a drain that intercepted flows across the breeding area, making part of it no longer suitable for the Howard Toadlet.</p> <p>In addition to the measures described in the next row regarding ensuring flows to Howard River Toadlet habitat are not altered, care will be taken will any unavoidable disturbance within toadlet habitat not to create any barriers to movement.</p>

Criterion	Summary of mitigation measures and significant impact assessment
<p><b>Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline</b></p>	<p>The Howard River Toadlet occurs in habitats that are subject to seasonal inundation. If this species is present within the OHTL area of influence, individuals could be lost, habitat degraded, and/or area of occupancy reduced if there are significant changes (i.e., beyond natural variation) to surface run-off quantity and/or quality because of the development of the OHTL.</p> <p>As detailed in Chapter 6 Hydrological processes, OHTL poles will not be placed in watercourses or drainage lines, or in areas where surface drainage could be affected. Only minor drainage lines that do not support threatened species will be crossed by the OHTL access track. All other drainages will be approached from either side to avoid the need for constructing crossings. Watercourse crossings will be installed during the dry season when no flow present. Drainage, erosion, and sediment controls will be installed and maintained in accordance with Erosion and Sediment Control Plans (ESCPs).</p> <p>For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.</p>
<p><b>Adversely affect critical habitat</b></p>	<p>Critical habitat has not been identified for the Howard River Toadlet. This concept is arguably not relevant for rare species with very restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed under previous criteria.</p>
<p><b>Result in invasive species, that are harmful to the species, becoming established in the species' habitat</b></p>	<p>TSSC (2021) identifies invasive flora and fauna species as plausible threats to the Howard River Toadlet, with their impact unknown.</p> <p>Throughout this chapter, it has been explained how the proposal will not exacerbate existing introduced animal populations. The Weed Management Plan presented in Appendix Q has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.</p>
<p><b>Introduce disease that may cause the species to decline</b></p>	<p>Disease is not listed as a threatening process for the Howard River Toadlet. The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.</p>
<p><b>Interfere with the recovery of a species</b></p>	<p>There is no Recovery Plan for this species. In DEPWS (2021), it is stated that 'current knowledge is insufficient to provide much guide to management beyond protecting known localities from development and sand mining.'</p> <p>The OHTL is designed to minimise clearing of suitable habitat for the Howard River Toadlet.</p>

#### 5.5.4.15 *Utricularia dunstaniae*

*Utricularia dunstaniae* is a bladderwort listed as Vulnerable. It is associated with sandsheet heath type habitats such as Melaleuca woodland or shrubland in wet sand – often in shallow water, frequently where water is percolating from the ground. Sandsheet heath is only found in patches within the greater Darwin region with locations relevant to the AAPowerLink shown on Figure 5-4 and Figure 5-5. *Utricularia dunstaniae* has a scattered distribution across north-western NT and is known from the Darwin area (particularly the Howard Springs region), Kakadu National Park and Cobourg Peninsula. There is a record approximately 900 m east of the OHTL Utilities Corridor at KP760. According to Kerrigan and Cowie (2012), populations of *Utricularia dunstaniae* appear to be small and very localised.

General fieldwork thus far did not record *Utricularia dunstaniae* within the OHTL Utilities Corridor. A presence/absence surveys for this species within the proposal's area of influence will be undertaken to inform the Supplementary EIS. Kerrigan and Cowie (2012) note that whilst it is likely that additional, undiscovered sub-populations exist, 'on experience to date, these are not likely to be numerous. This, combined with the narrow OHTL footprint – reduce the likelihood that the species will be detected within the footprint. However, if *Utricularia dunstaniae* is recorded within the OHTL footprint, that occurrence may be a new sub-population.

If so, given there are so few other sub-populations, a new occurrence would be considered an ‘important’ population (as per the criteria in Section 5.5.1) necessary for maintaining genetic diversity. The significant impact assessment will then depend on the proportion of individuals that will be lost.

Table 5-16 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses desktop information only, based on the assumption that some sandsheet habitat within the proposal footprint contains *Utricularia dunstaniae*, and that it is possible that those occurrences are confined to the proposal footprint. The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-16 is that it is unlikely that proposal activities will have a significant impact upon *Utricularia dunstaniae*, providing any occurrences within the current OHTL footprint are avoided.

Table 5-16. Preliminary significant impact assessment for *Utricularia dunstaniae*

Criterion	Summary of mitigation measures and significant impact assessment
<p>Lead to a long-term decrease in the size of an important population</p>	<p>There is no information available about the size of the <i>Utricularia dunstaniae</i> population. However, existing sub-populations tend to be very small and localised (Kerrigan and Cowie 2012). If this species is present within the OHTL footprint, it is likely that some of its habitat will be cleared and there is some mortality of <i>Utricularia dunstaniae</i> plants. Unlike most other flora species assessed in this chapter, the fact that sub-populations tend to be very small and localised means that even the loss of a few individuals could lead to a long-term decrease in the size of an important population. Therefore, OHTL will be designed to avoid disturbing any occurrences of <i>Utricularia dunstaniae</i> within its footprint. Potential impacts associated with surface water quality and hydrology are discussed below.</p>
<p>Reduce the area of occupancy of an important population</p>	<p>According to Stokeld et al. (2021), the area of occupancy for <i>Utricularia dunstaniae</i> is 44 km<sup>2</sup>, of which 9% is within the Gunn Point region.</p> <p>If <i>Utricularia dunstaniae</i> is recorded within the OHTL footprint – and its loss cannot be avoided – then the fact that occurrences of this species are generally very localised means that loss of individuals could lead to a reduced area of occupancy if it is entirely confined to within the OHTL footprint. Consequently, the OHTL will be designed to avoid disturbing any occurrences of <i>Utricularia dunstaniae</i> within its footprint.</p>
<p>Fragment an existing important population into two or more populations</p>	<p>It is possible that construction of the OHTL could clear a swathe through an existing patch of <i>Utricularia dunstaniae</i>. The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). Assuming that clearance does not lead to the long-term loss of that patch, it seems unlikely that such minor additional gaps in its habitat will cause fragmentation into more populations.</p>
<p>Disrupt the breeding cycle of a population</p>	<p><i>Utricularias</i> are typically pollinated by insects. It is no known which insect species pollinate <i>Utricularia dunstaniae</i>, but it seems unlikely that clearing a narrow corridor through a <i>Utricularia dunstaniae</i> patch would disrupt pollination of that patch (assuming that clearance does not lead to the long-term loss of that patch).</p>
<p>Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline</p>	<p><i>Utricularia dunstaniae</i> occurs in habitats that are subject to seasonal inundation. If this species is present within the OHTL area of influence, individuals could be lost, habitat degraded, and/or area of occupancy reduced if there are significant changes (i.e., beyond natural variation) to surface run-off quantity and/or quality because of the development of the OHTL.</p> <p>As detailed in Chapter 6 Hydrological processes, OHTL poles will not be placed in watercourses or drainage lines, or in areas where surface drainage could be affected. Only minor drainage lines that do not support threatened species will be crossed by the OHTL access track. All other drainages will be approached from either side to avoid the need for constructing crossings. Watercourse crossings will be installed during the dry</p>

Criterion	Summary of mitigation measures and significant impact assessment
	<p>season when no flow present. Drainage, erosion, and sediment controls will be installed and maintained in accordance with Erosion and Sediment Control Plans (ESCPs).</p> <p>For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.</p>
<p><b>Adversely affect critical habitat</b></p>	<p>Critical habitat has not been identified for <i>Utricularia dunstaniae</i>. This concept is arguably not relevant for rare species with very restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed under previous criteria.</p>
<p><b>Result in invasive species, that are harmful to the species, becoming established in the species' habitat</b></p>	<p>Invasive species are not identified as a threatening process to <i>Utricularia dunstaniae</i>. It is plausible that weed invasion could reduce habitat quality and out-compete individual plants.</p> <p>The Weed Management Plan presented in Appendix O has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.</p>
<p><b>Introduce disease that may cause the species to decline</b></p>	<p>Disease is not listed as a threatening process for <i>Utricularia dunstaniae</i>. The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.</p>
<p><b>Interfere with the recovery of a species</b></p>	<p>There is no Recovery Plan for this species. In Kerrigan and Cowie (2012), the key threat identified is sand mining and other human activity within sandsheet heath. The OHTL is designed to minimise clearing of suitable habitat for <i>Utricularia dunstaniae</i>.</p>

#### 5.5.4.16 *Cleome insolata*

*Cleome insolata* is an annual herb listed as Vulnerable. It is known to occur in low open woodlands with key wetland plants on seasonally waterlogged sandy soils (NTH 2021). *Cleome insolata* is closely associated with, sandsheet heath – a habitat only found in patches within the greater Darwin region with locations relevant to the AAPowerLink shown on Figure 5-4 and Figure 5-5. This species is only known from the Noonamah/Amys Creek area, Wishart Rd on the outskirts of Darwin, and near Shoal Bay (Westaway and Cowie 2012). The Shoal Bay records are ~1.7 km to the west of KP769.

General fieldwork thus far did not record *Cleome insolata* within the OHTL Utilities Corridor. A presence/absence surveys for this species within the proposal's area of influence will be undertaken to inform the Supplementary EIS. If *Cleome insolata* is recorded within the OHTL footprint, that occurrence would be a new sub-population and – given there are only three known sub-populations – would be considered an 'important' population (as per the criteria in Section 5.5.1) necessary for maintaining genetic diversity. The significant impact assessment will then depend on the proportion of individuals that will be lost.

Table 5-17 presents a preliminary significant impact assessment using the criteria contained within the EPBC Significant Impact Guidelines 1.1 (DEWHA 2013). The assessment uses desktop information only, based on the assumption that some sandsheet habitat within the proposal footprint contains *Cleome insolata*, but so does immediately adjacent habitat that is outside the footprint – in other words, any occurrences of the species are not confined to the proposal footprint. The significant impact assessment will be updated for the Supplementary EIS to include the results of the targeted survey. For now, the conclusion in Table 5-17 is that it is unlikely that proposal activities will have a significant impact upon *Cleome insolata*. Even if this restricted-range species is present within the OHTL footprint, its occurrence will almost certainly be very localised and therefore the proposal's design can be altered to avoid or minimise impacts to it.

Table 5-17. Preliminary significant impact assessment for *Cleome insolata*

Criterion	Summary of mitigation measures and significant impact assessment
<p>Lead to a long-term decrease in the size of an important population</p>	<p>There is no information available about the size of the <i>Cleome insolata</i> population.</p> <p>If this species is present within the OHTL footprint, it is likely that some of its habitat will be cleared and there is some mortality of <i>Cleome insolata</i> plants. Depending on the location of this habitat, there may be some capacity to modify the design locally to minimise, or even avoid, these impacts. Because of the narrowness of the footprint, the proportion of habitat and individuals that will be destroyed is likely to very small compared with that available in adjacent areas, as well as regionally. Loss of individual <i>Cleome insolata</i> within narrow swathes is unlikely to result in a long-term decrease in the size of the species' population.</p> <p>Potential impacts associated with surface water quality and hydrology are discussed below.</p>
<p>Reduce the area of occupancy of an important population</p>	<p>According to Stokeld et al. (2021), the area of occupancy for <i>Cleome insolata</i> is 28 km<sup>2</sup>, of which 14% is within the Gunn Point region.</p> <p>Determining area of occupancy is based on the IUCN 2 x 2 km grid cell method. If <i>Cleome insolata</i> is recorded within the OHTL footprint – and its loss cannot be avoided – the only way that loss can lead to a reduced area of occupancy is if it is entirely confined to within the OHTL footprint. In other words, if the plants lost constitute the entire local occurrence, and there are no other nearby occurrences, then this <u>could</u> lead to a reduced area of occupancy. It is unlikely that this scenario will eventuate.</p>
<p>Fragment an existing important population into two or more populations</p>	<p>It is possible that construction of the OHTL could clear a swathe through an existing patch of <i>Cleome insolata</i>. The maximum width of habitat that would be lost is 22 m, reduced to 6 m post-construction (assuming construction pads and pole sites are chosen to avoid disturbing this species). It seems unlikely that such minor additional gaps in its habitat will cause fragmentation into more populations.</p>
<p>Disrupt the breeding cycle of a population</p>	<p><i>Cleome</i> is a genus of flowering plants. It is no known how <i>Cleome insolata</i> is pollinated, but presumably it is by insects. It seems unlikely that clearing a narrow corridor through a <i>Cleome insolata</i> patch would disrupt pollination of that patch.</p>
<p>Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline</p>	<p><i>Cleome insolata</i> occurs in habitats that are subject to seasonal inundation. If this species is present within the OHTL area of influence, individuals could be lost, habitat degraded, and/or area of occupancy reduced if there are significant changes (i.e., beyond natural variation) to surface run-off quantity and/or quality because of the development of the OHTL.</p> <p>As detailed in Chapter 6 Hydrological processes, OHTL poles will not be placed in watercourses or drainage lines, or in areas where surface drainage could be affected. Only minor drainage lines that do not support threatened species will be crossed by the OHTL access track. All other drainages will be approached from either side to avoid the need for constructing crossings. Watercourse crossings will be installed during the dry season when no flow present. Drainage, erosion, and sediment controls will be installed and maintained in accordance with Erosion and Sediment Control Plans (ESCPs).</p> <p>Westaway and Cowie (2012) observe that <i>Cleome insolata</i> has been recorded in modified environments – paddocks and roadsides – indicating a level of resilience to disturbance. This – together with the reasons given elsewhere in this table – suggest it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.</p>
<p>Adversely affect critical habitat</p>	<p>Critical habitat has not been identified for <i>Cleome insolata</i>. This concept is arguably not relevant for rare species with very restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed under previous criteria.</p>

Criterion	Summary of mitigation measures and significant impact assessment
<p>Result in invasive species, that are harmful to the species, becoming established in the species' habitat</p>	<p>Invasive species are not identified as a threatening process to <i>Cleome insolata</i>. It is plausible that weed invasion could reduce habitat quality and out-compete individual plants.</p> <p>The Weed Management Plan presented in Appendix Q has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.</p>
<p>Introduce disease that may cause the species to decline</p>	<p>Disease is not listed as a threatening process for <i>Cleome insolata</i>. The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.</p>
<p>Interfere with the recovery of a species</p>	<p>There is no Recovery Plan for this species. In Westaway and Cowie (2012b), the key threat identified is development and intensification of land use in the Darwin rural area. The OHTL is designed to minimise clearing of suitable habitat for <i>Cleome insolata</i>.</p>

### 5.5.5 Darwin Converter Site and Cable Transition Facilities

Based on fieldwork and desktop assessment, there are 11 threatened species with a reasonable likelihood of occurring within the footprints – 8 of which are migratory shorebirds.

#### 5.5.5.1 Yellow-spotted Monitor

The Yellow-spotted Monitor (see Section 5.5.3.2 for a description) – has been recently detected at six sites across the Gunn Point Peninsula, including at a site 800 m north of the Land Sea Joint Station. This species is a habitat generalist with conspicuous burrows that can be easily avoided. Given the large area of available habitat within the Gunn Point region, the small disturbance footprint for the DCS and CTF will not cause a significant loss in this species' habitat. Only through an occasional vehicle strike is it likely that individual, Yellow-spotted Monitors will be killed, noting that proposal-related traffic will be restricted to the construction phase. Such a limited impact does not constitute a significant risk to the population of this Vulnerable species.

#### 5.5.5.2 Darwin Cycad

Background to this species is presented in Section 5.5.4.12. The flora survey for the adjacent Project Sea Dragon site (Astrebla 2017) recorded an average of 887 individual Darwin Cycads per ha in Eucalyptus woodland on the site – often in dense clumps separated by areas with relatively few or no cycads. This suggests that across the 90 ha of this habitat type within the Project Sea Dragon site, there may be approximately 79,830 individuals present. Individual Darwin Cycads were also found in other low woodlands, but in much lower densities.

Likelihood of occurrence modelling by Stokeld et al. (2020) identified that northern Gunn Point peninsula near Murrumujuk and Leaders Creek turn-off contains extensive areas with a high likelihood of supporting high density stands of Darwin Cycad. Areas of high-density Darwin Cycads were observed within the Darwin Converter Site and Cable Transition Facilities footprints during field investigations for this proposal.

The mainland Darwin Cycad population is considered a single population – one which this proposal's activities are unlikely to have a significant impact upon. Because the species is locally common within its restricted range, the focus for conservation is typically on high density stands (> 400 stems per hectare). Some conservation-significant stands of Darwin Cycad are known to occur within the proposal footprint; others may be detected once the Darwin Converter Site and Cable Transition Facilities sites are surveyed for the species. Disturbance of any individual Darwin Cycads – but especially to high density stands – will be avoided as much as possible. Where disturbance is unavoidable, the proponent acknowledges that the proposal will contribute to the cumulative loss of the Darwin Cycad in the greater Darwin region. However, due to the small area of habitat lost compared to the total distribution of the species, that loss is not likely to affect the conservation status of the species in the Northern Territory.

### 5.5.5.3 *Typhonium praetermissum*

Described in Section 5.5.4.10, a significant sub-population of *Typhonium praetermissum* is present immediately to the west of the Darwin Converter Site. Stokeld et al. (2020) discusses this sub-population, noting it is one of the largest known of this species and likely to be of high conservation importance. This Murrumujuk sub-population is approximately 5 km from the nearest records.

A targeted survey in 2018 for *Typhonium praetermissum* within the adjacent Project Sea Dragon site and surrounds (Astrebla unpublished) found 578 plants over 400 ha – see Figure 5-22 – noting that the survey methodology did not allow for a full population count. The survey covered the footprint of the Underground Cable Corridor, but only included the western end of the Darwin Converter Site footprint. Only 2 of the records were within the Darwin Converter Site footprint, and approximately 10 were within the Underground Cable Corridor footprint. In comparison, approximately 146 *Typhonium praetermissum* plants are present within the proposed Project Sea Dragon footprint.

The field survey undertaken for this proposal determined that the majority of the footprint comprises either high likelihood (96.10 ha) or moderate likelihood (14.00 ha) habitat for *Typhonium praetermissum*. The Underground Cable Corridor component of the footprint was well covered by previous survey effort; however, most of the high likelihood *Typhonium praetermissum* habitat within the Darwin Converter Site was not surveyed for the Project Sea Dragon proposal.

In February and March 2022, a targeted detection survey for *Typhonium praetermissum* was undertaken within, and surrounding, the proposal footprint using the methodology developed by the NT Department of Environment, Parks and Water Security (Bickerton et al. 2020). All habitat mapped as moderate or high likelihood within the Cable Transition Facilities and Darwin Converter Site boundaries was surveyed – see Figure 5-22. The survey findings are presented in Table 5-18. Greater survey effort (i.e., closer transects) were employed for this survey compared with the Project Sea Dragon one.

The result is that 6.8% of the *Typhonium praetermissum* sub-population occurs within the AAPowerLink direct disturbance footprint. However, this could be a significant overestimate, because a large area of suitable habitat for this species further to the south was not surveyed due to time constraints. The surveyors noted that that area is likely to contain more plants, which would increase the extent and size of the sub-population.

Table 5-18. *Typhonium praetermissum* survey findings for the Darwin Converter Site and Cable Transition Facilities

Location	Number of plants	% of sub-population
All records within the AAPowerLink direct disturbance footprint*	25 (DCS)	2.3%
	50 (CTF)	4.5%
All other records within the Darwin Converter Site boundary	130	11.7%
All other AAPowerLink survey records (i.e., not within the direct disturbance footprint)	331	29.9%
All records within the Project Sea Dragon direct disturbance footprint**	160	14.4%
All other records (including from NT Atlas and Project Sea Dragon surveys)	411	37.1%
Entire sub-population (all NT Flora Atlas and AAPowerLink records for the region)	1,107	100%

\* The 55-ha development footprint of the DCS and the 9.5 ha development footprint of the CTF

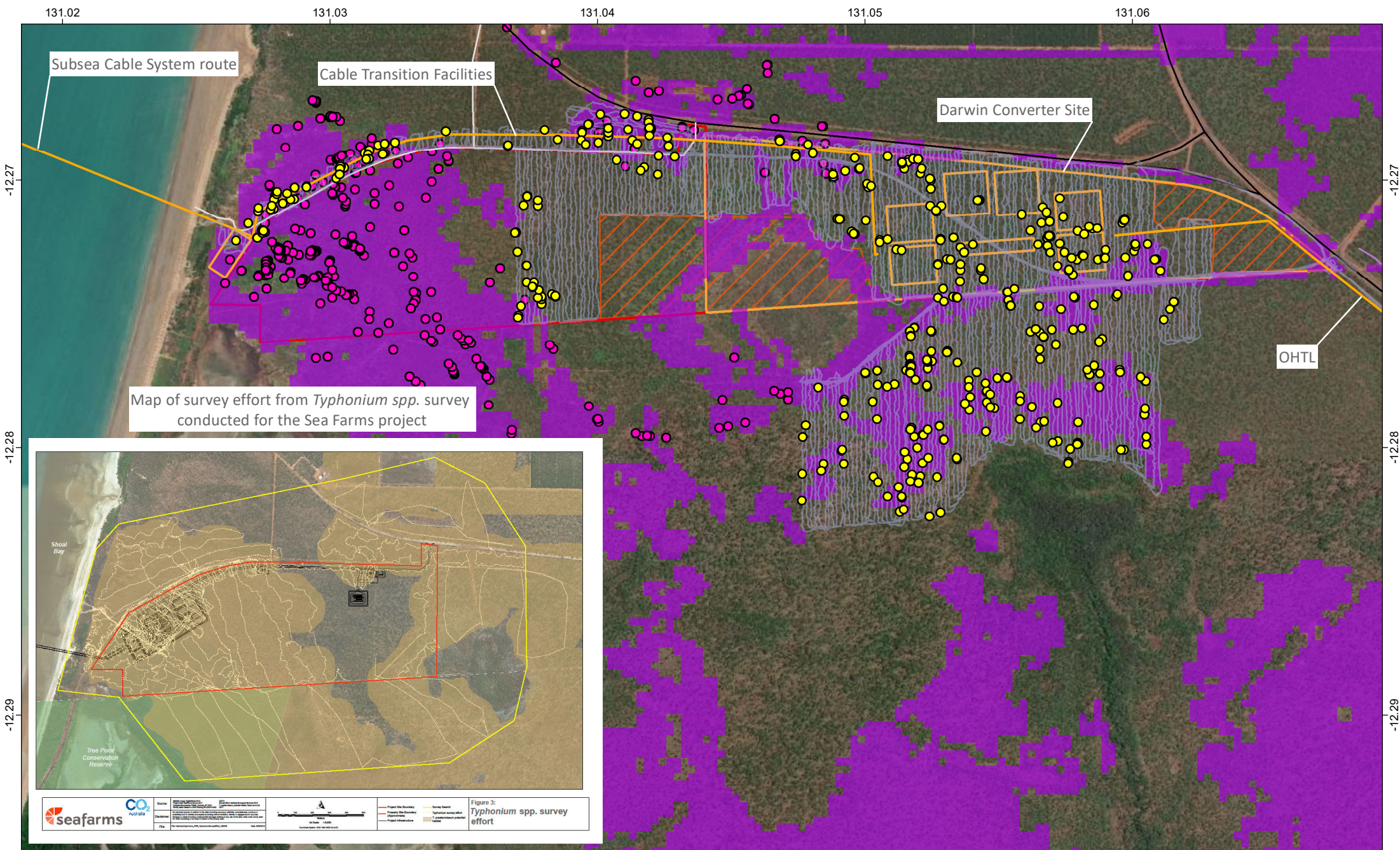
\*\* An approximation based on a geo-referenced image of that project’s footprint

The general occurrence of a Vulnerable species in a region is not sufficient to meet the definition of an ‘important’ population. However, as mentioned above, the *Typhonium praetermissum* known to be present and likely to be further recorded within the Darwin Converter Site and Cable Transition Facilities footprints are members of a very large, and therefore ‘important population’ that is a key source population either for breeding or dispersal (as per the criteria in Section 5.5.1).

Table 5-19 presents a preliminary significant impact assessment using the criteria contained within the *EPBC Significant Impact Guidelines 1.1* (DEWHA 2013). The conclusion is that it possible that proposal activities could have a significant impact upon the *Typhonium praetermissum* sub-population in the vicinity of the DCS and CTF, depending on what is considered to be a reasonable proportion of plants lost.

Table 5-19. Preliminary significant impact assessment for *Typhonium praetermissum* within the Darwin Converter Site and Cable Transition Facilities footprint

Criterion	Summary of mitigation measures and significant impact assessment
<p>Lead to a long-term decrease in the size of an important population</p>	<p>A total of 75 <i>Typhonium praetermissum</i> plants (~6.8% of the sub-population) are within the Darwin Converter Site and Cable Transition Facilities direct disturbance footprints and will be lost during construction. There may be some capacity to modify the design locally to minimise this loss.</p> <p>This could be a significant overestimate, because a large area of suitable habitat for this species further to the south was not surveyed due to time constraints.</p> <p>Nevertheless, there will be some reduction in the sub-population – possibly to such an extent as to lead to a long-term decrease in the size of that sub-population.</p>
<p>Reduce the area of occupancy of an important population</p>	<p>According to Stokeld et al. (2021), the area of occupancy for <i>Typhonium praetermissum</i> is 256 km<sup>2</sup>, of which 27% is within the Gunn Point region.</p> <p>Determining area of occupancy is based on the IUCN 2 x 2 km grid cell method. Once a survey of the DCS and CTF footprints are complete, the area of occupancy may have to be re-calculated to incorporate new <i>Typhonium praetermissum</i> records. However, a reduced area of occupancy can only occur if development of the DCS and/or CTF involves the unavoidable loss of <i>Typhonium praetermissum</i> plants <u>and</u> the plants lost constitute the entire occurrence within a particular grid cell (in other words, there are no other adjacent occurrences that fall within the same grid cell).</p> <p>However, given the large number of records immediately adjacent to the Darwin Converter Site and Cable Transition Facilities footprints, it is very unlikely that this scenario will eventuate.</p>
<p>Fragment an existing important population into two or more populations</p>	<p>The construction of the Cable Transition Facilities will clear a 35 m temporary swathe through an existing patch of <i>Typhonium praetermissum</i>. Given that the distinction between sub-populations of <i>Typhonium praetermissum</i> requires distances of greater than 2 km, minor additional gaps in its habitat will not cause fragmentation into more populations or disrupt the breeding cycle.</p>
<p>Disrupt the breeding cycle of a population</p>	
<p>Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline</p>	<p>For the reasons given in this table, it is unlikely that the loss of, or decrease in quality of, habitat because of proposal activities will cause a decline in the species.</p>
<p>Adversely affect critical habitat</p>	<p>Critical habitat has not been identified for <i>Typhonium praetermissum</i>. This concept is arguably not relevant for rare species with restricted habitat requirements; it can be assumed that the few locations within which the species occurs constitutes critical habitat. Potential impacts to such habitat are assessed throughout this table.</p>
<p>Result in invasive species, that are harmful to the species, becoming established in the species' habitat</p>	<p>Westaway and Cowie (2012), identify the proliferation of the weed species Gamba Grass and Mission Grass as dramatically increasing fuel loads resulting in more intense fires which may reduce habitat quality for <i>Typhonium praetermissum</i>.</p> <p>The Weed MP presented in Appendix Q has been developed to minimise introduction and proliferation of weeds within the proposal area of influence for the life of the proposal.</p>
<p>Introduce disease that may cause the species to decline</p>	<p>The author is not aware of any literature on diseases that could be introduced by the project and that would detrimentally affect this species.</p>
<p>Interfere with the recovery of the species</p>	<p>There is no Recovery Plan for this species. Westaway and Cowie (2012) consider the main threats to be land clearing for development and weed invasion by Gamba Grass and Mission Grass. The Weed Management Plan has been developed to minimise introduction and proliferation of weeds within the proposal area of influence.</p>



Map of survey effort from *Typhonium spp.* survey conducted for the Sea Farms project

		<p><b>Scale:</b> 1:20,000</p> <p><b>Projection:</b> GDA2020</p> <p><b>Units:</b> Meters</p> <p><b>North Arrow:</b> True North</p>	<p><b>Legend:</b></p> <ul style="list-style-type: none"> <li>Project Site Boundary</li> <li>Property Site Boundary</li> <li>Project Infrastructure</li> <li>Survey Search</li> <li>Typhonium survey effort</li> <li>EcOz survey effort</li> <li>Not suitable habitat</li> <li>Other</li> </ul>	<p><b>Figure 3:</b> <i>Typhonium spp.</i> survey effort</p>
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- Legend**
- AAPowerLink Infrastructure
  - 4WD beach access
  - Road
  - Sea Farms boundary
  - Not suitable *Typhonium praetermissum* habitat
  - *Typhonium praetermissum* high likelihood habitat (Source: NTG)
  - *Typhonium praetermissum* NTG records
  - *Typhonium praetermissum* EcOz survey records
  - EcOz survey effort



**Figure 5-22: Map of *Typhonium praetermissum* records and suitable habitat relevant to the DCS and CTF footprints**

Project: <b>Australia-Asia PowerLink</b>	Reference: M-Files ID 200232	Revision: 1
Coordinate System: GDA2020	Date: 09/03/2022	
		Scale: 1:20,000
		A4

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#### 5.5.5.4 Migratory shorebirds

The Directory of Important Habitat for Migratory Shorebirds in Australia (Weller et al. 2020) lists the North Darwin region as one of the 15 important shorebird sites in the NT. Gunn Point Beach is within the North Darwin region, to the north of all the regularly surveyed shorebird sites. Threatened shorebirds have been recorded along Gunn Point Beach area, as reported in Palmer and Smit (2020). This information was collected from past aerial and ground surveys, national volunteer-based programs, and targeted scientific studies. The eight shorebird species recorded from the Gunn Point Beach area are listed as threatened under the *EPBC Act* – see Table 5-20.

Table 5-20. Threatened shorebird species recorded on Gunn Point Beach

Species	Status
Bar-tailed Godwit (western Alaskan subspecies) ( <i>Limosa lapponica baueri</i> )	VU
Bar-tailed Godwit (northern subspecies) ( <i>Limosa lapponica menzbieri</i> )	CE
Curlew Sandpiper ( <i>Calidris ferruginea</i> )	VU
Far Eastern Curlew ( <i>Numenius madagascariensis</i> )	VU
Great Knot ( <i>Calidris tenuirostris</i> )	VU
Greater Sand Plover ( <i>Charadrius leschenaultii</i> )	VU
Lesser Sand Plover ( <i>Charadrius mongolus</i> )	VU
Red Knot ( <i>Calidris canutus</i> )	VU

CE = Endangered, EN = Endangered, VU = Vulnerable

Shorebird species inhabit the coastal zone where they typically feed on invertebrates within the intertidal zone, and roost in the surrounding beaches, reefs, and mangroves. Aerial surveys and site visits conducted by Chatto (2003) confirmed that the southern Shoal Bay area has one of the highest numbers of shorebird sightings within the Gunn Point region, with the Great Knot being the most abundant species in this area – see Figure 5-23. The most important part of this survey block for shorebirds was the coast between Lee Point and Tree Point, followed by Bare Sand Island and the associated chain of islands to the south-east. Within the Gunn Point peninsula, the most records were for the southern Shoal Bay (including southern Gunn Point Beach).

Species abundances could be significantly lower than observed by Chatto (2003) due to habitat loss in Asian migratory stopover sites (Palmer and Smit 2020). It has been reported by Lilleyman (2020); however, that overall migratory shorebird numbers have increased in Darwin Harbour, indicating further site-specific investigations may be required. The area surrounding the proposal has high recreation use which also likely impacts on shorebird presence, as they would be regularly disturbed by recreational users when foraging or resting (Palmer and Smit 2020).

Observations during field investigations for Project Sea Dragon found few shorebirds using the intertidal zone along the adjacent beach, potentially due to a lower abundance of invertebrates due to coarse sandy substrates, and high levels of disturbance by vehicles, people, and pets along the beach (Seafarms 2018).

There are only a few shorebird surveys recorded in the NT Fauna Atlas. Of those that recorded abundance, a February 1984 survey of 755 individual shorebirds was the largest. This was mostly comprised of Greater Sand Plover (320), Great Knot (250) and Red Knot (100). The count of Greater Sand Plover exceeds 0.1 % of the flyway population (which is 200). Palmer and Smit (2020) note that further studies are required to understand shorebird abundance (season, duration, and frequency) and habitat use for feeding and roosting.

It is unlikely that proposal activities will have a significant impact on the migratory shorebirds present within Shoal Bay. The section of the Cable Transition Facility that crosses shorebird habitat is a ~500 m long and 500 m wide corridor where up to 6 trenches, each up to 5 m wide, will be excavated. In comparison, the total length of Gunn Point Beach is ~13.5 km. Installation should only take 1 to 2 months, after which the corridor will be reinstated; no permanent footprint will be maintained.

There is nothing to suggest that the part of the AAPowerLink footprint that intersects Gunn Point Beach is of particular importance to shorebirds. Such a small and temporary loss of habitat cannot reasonably be considered a significant habitat, especially given that section of the beach is already regularly frequented by recreational users – including use of quad bikes and vehicles on the beach. Whilst it is likely that the short-term noise and movement from construction activity on Gunn Point Beach will deter shorebirds from using that end of the beach, as mentioned above, that particular section of the beach is already regularly subject to use of quad bikes and vehicles on the beach. Consequently, during construction, one disturbance will temporarily replace another. Finally, it should be noted that the location of the AAPowerLink footprint is adjacent to the Project Sea Dragon water supply and disposal pipelines – construction of which is at a similar scale to that of the AAPowerLink infrastructure – and which were recently approved.

Neither construction nor operation of the AAPowerLink involves actions that would cause direct mortality of shorebirds, nor disrupt breeding, because these species breed in the northern hemisphere.

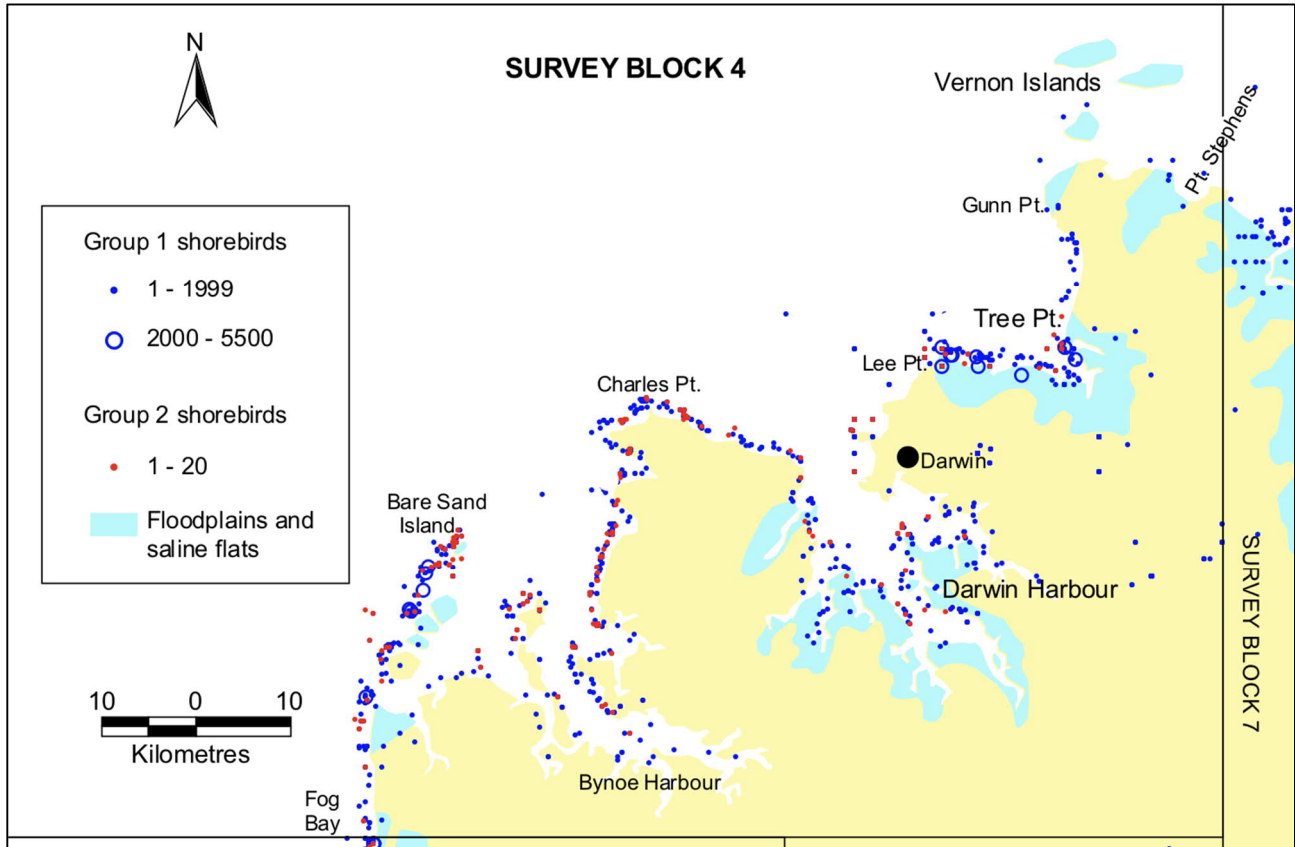


Figure 5-23. Map of Chatto (2003) shorebird survey results for the Darwin and Bynoe Harbour region

## 5.6 Avoidance, Mitigation and Monitoring

Sun Cable is committed to applying the environmental decision-making hierarchy when making decisions that could affect the environment. Consistent with section 26 of the *EP Act* this involves applying the following approaches in order of priority:

1. Avoid – Ensure that actions are designed to avoid adverse impacts on the environment.
2. Mitigate – Identify management options to mitigate adverse impacts on the environment to the greatest extent practicable.
3. Offset – If appropriate, provide for environmental offsets for residual adverse impacts on the environment that cannot be avoided or mitigated.

The environmental management framework that will be adopted for the construction and operation of the AAPowerLink is detailed in Chapter 17 Environmental Management. The framework comprises a Construction Environmental Management Plan (CEMP) and Operations Environmental Management Plan (OEMP) that sit within an overarching Environmental Management System (EMS).

For each of the impacts to terrestrial ecosystems discussed in this chapter, Table 5-21 summarises the actions that will be taken to avoid environmental impacts (through site selection and design) and actions proposed to minimise impacts during construction, operation and decommissioning of the proposal. For the most part, the proposed controls are routine for land development and industrial operations and, assuming proper implementation and adaptive management, will be effective in ensuring no unacceptable impacts to terrestrial ecosystems. The measures provided in this chapter, along with any additional measures required to address conditions of approvals, permits and licences, will be integrated into the CEMP and OEMP prepared for the AAPowerLink.

Table 5-21. Terrestrial ecosystems – Avoidance, mitigation, monitoring and reporting commitments

Impact	Avoidance	Mitigation	Monitoring	Reporting
<p><b>Loss of vegetation and habitat</b></p> <p><b>Loss of significant vegetation</b></p>	<p>Solar Precinct footprint does not contain any significant vegetation types.</p> <p>Micro-siting of transmission towers to avoid significant vegetation where possible.</p> <p>Preferential use of existing cleared areas where possible for temporary construction requirements such as access tracks, laydown areas and construction camps.</p>	<p>Clearance only within the boundaries approved in licences obtained to clear native vegetation as per the <i>Planning Act</i> and/or the <i>Pastoral Land Act</i>.</p> <p>Re-instatement of all temporary construction footprints and follow-up weed control post-construction.</p> <p>Post-operations rehabilitation of cleared areas as per the Decommissioning and Rehabilitation Plan.</p>	<p>Visual inspections during clearing to ensure clearing is within approved boundaries. Results recorded, along with any photographs.</p> <p>Rehabilitation inspections following first wet season post-construction or until vegetation is established and sites are stable.</p>	<p>Records of clearing undertaken</p> <p>External reporting in accordance with environmental approval conditions</p>
<p><b>Introduction and spread of weeds and pests</b></p>	<p>Avoid introducing new weeds into proposal footprint by implementing weed hygiene, as per the Weed Management Plan (Appendix Q).</p>	<p>Implementation of Weed Management Plan (Appendix Q) that has been developed in accordance with the requirements of the <i>Weeds Management Act</i> and relevant statutory weed management plans.</p>	<p>As per the Weed Management Plan (Appendix Q).</p>	<p>As per the Weed Management Plan (Appendix Q).</p>
<p><b>Changes in fire regimes</b></p>	<p>Observe fire bans.</p>	<p>Develop and implement a Bushfire Management Plan, including first response capability.</p>	<p>Visual monitoring for fires.</p> <p>Monitoring NAFI website for proximate fires which may impact proposal.</p> <p>Monitoring conditions for fire risk.</p>	<p>Any fires reported to Bushfires NT or appropriate authority.</p>

Impact	Avoidance	Mitigation	Monitoring	Reporting
<b>Direct fauna mortality</b>	Avoiding clearing large hollow-bearing trees where possible.	<p>Clearing will be conducted in a single direction, allowing any fauna to move out of way of clearing activities.</p> <p>If fauna is spotted in immediate clearing area and are in danger, clearing will be stopped until safe to continue.</p> <p>Clearing in a progressive manner to allow wildlife to natural disperse from the area as clearing undertaken.</p> <p>Site inductions will ensure that all personnel are aware of their obligations and know the correct procedures for fauna encounters.</p> <p>Vehicle speed restrictions apply when travelling near uncleared areas or in higher risk conditions.</p>	Record any fauna encounters, injuries, or death as result of works for the duration of works.	<p>Internal record keeping of incidents of fauna mortality.</p> <p>External reporting in accordance with environmental approval conditions.</p>
<b>Habitat degradation and fragmentation</b>	The OHTL will fragment habitat; the majority of the OHTL route has been located in the railway corridor where habitat fragmentation has already occurred.	Reinstatement of all temporary construction footprints and follow-up weed control post-construction.	Nil	Nil
<b>Bird collisions with panels</b>	Location of Solar Precinct at a distance from waterbodies.	Nil	Incidental observations of carcasses, including during routine infrastructure inspections	<p>Internal incident reporting</p> <p>External reporting in accordance with environmental approval conditions</p>

Impact	Avoidance	Mitigation	Monitoring	Reporting
<p><b>Bird collisions with transmission wires</b></p>	<p>Use of electrodes removes the need for a top earth wire (which is the wire associated with most birds' collision).</p>	<p>Implement a Flora and Fauna Management Plan that includes adaptive monitoring and mitigation in specific areas if collision hotspots are observed. Installing diverting devices in response to any collision hotspots identified during operations.</p>	<p>Incidental observations of carcasses, including during routine infrastructure inspections. Public reports of carcasses.</p>	<p>Internal incident reporting External reporting in accordance with environmental approval conditions.</p>
<p><b>Threatened species (restricted range)</b></p>	<p>Micro-siting of transmission towers and access tracks to avoid identified local occurrences (if present). Re-routing the access track to avoid local occurrences (if present).</p>	<p>Clearance only within the boundaries approved in licences obtained to clear native vegetation as per the <i>Planning Act</i> and/or the <i>Pastoral Land Act</i>. Reinstatement of all temporary construction footprints. Post-operations rehabilitation of cleared areas as per the Decommissioning and Rehabilitation Plan.</p>	<p>Visual inspections during clearing to ensure clearing is within approved boundaries. Results recorded, along with any photographs. Rehabilitation inspections following first wet season post-construction or until vegetation is established and sites are stable.</p>	<p>Records of clearing undertaken. External reporting in accordance with environmental approval conditions.</p>

## 5.7 Residual impact

Each impact to terrestrial ecosystems was assigned a residual impact rating taking into consideration the scale, magnitude and duration of the impacts, the presence/absence of environmental values and/or sensitive receptors and the level of certainty with respect to the intensity of the impact and the effectiveness of the mitigation measures. The residual impact ratings adopted in the assessment were provided earlier in Table 5-6. The combined residual impact to terrestrial ecosystems from all components of the AAPowerLink construction and operations is summarised in Table 5-22.

Table 5-22. Residual impact ratings for impacts to Terrestrial ecosystems

Impacts	Residual Impact Rating
<b>Construction</b>	
Loss of vegetation and habitat	Minor
Loss or deterioration of significant vegetation	Minor
Degradation of flora and vegetation in surrounding areas	Minor
Introduction and spread of weeds	Moderate
Changes in fire regimes	Minor
Direct fauna mortality	Minor
Habitat degradation and fragmentation	Minor
Changes to fauna behaviour	Minor
Impacts to threatened species	Moderate
<b>Operations</b>	
Introduction and spread of weeds	Moderate
Direct fauna mortality caused by the perceived 'lake effect' of solar fields	Minor
Direct fauna mortality caused by collision with Overhead Transmission Line	Minor
Degradation of flora and vegetation in surrounding areas caused by shading	Minor
Changes to fauna behaviour due to noise, light, and waste management.	Minor

In summary, the results of the EIA undertaken for the Terrestrial Ecosystems factor indicate that the proposal will have Minor level of residual impact associated with localised impacts to vegetation and habitats and associated localised and minor impacts to fauna. There will be a residual loss of vegetation through land clearing, and some fauna mortality is possible, but neither is predicted to be at a scale that would lead to loss of biodiversity. This is because the habitats within the proposal footprint are common in the region, and the footprint represents only a very small percentage of the total area of available habitat. Impacts to significant vegetation types along the OHTL corridor are being avoided or minimised by adopting the micro-siting criteria described in Section 2.5.2.3 of Chapter 2 Proposal Description.

A Moderate residual impact rating was assigned to the introduction and spread of weeds because experience shows the effectiveness of mitigation measures is variable in areas where weeds are already present (i.e., in the OHTL corridor) and even with good mitigation in place weeds often proliferate in disturbed areas. Implementation of the Weed Management Plan (Appendix Q) is expected to mitigate the impact to ALARP, but the Moderate rating acknowledges that the potential for residual impact remains, as it does with any development.

Impacts to threatened species were also assigned a Moderate rating. Most of the threatened species that could occur within the proposal footprint have been assessed as unlikely to be subject to a significant impact because of proposal activities. There is currently insufficient spatial information available to confirm whether

the proposal is likely to have a significant impact on eight threatened species. That information will be collected in first half of 2022, for inclusion in the Supplementary EIS. Preliminary significant impacts assessments in this chapter conclude that it is possible that the sub-population of *Typhonium praetermissum* within the Darwin Converter Site and Cable Transition Facilities could be impacted upon, with 6.8% of the sub-population recorded within the direct disturbance footprint. However, this could be a significant overestimate, because a large area of suitable habitat for this species is present further to the south that has not yet been surveyed. There is also potential for cumulative impacts to this species as discussed below.

## 5.8 Cumulative impacts

The framework used to assess cumulative impacts from the AAPowerLink, and other existing and future developments is described in Chapter 3 Impact Assessment. The process involves considering the cumulative or combined impacts to terrestrial ecosystems associated with the residual impacts from the AAPowerLink, residual impacts from existing activities, and impacts associated with reasonably foreseeable developments described in Chapter 3. Through the EIA process, the following areas of potential cumulative impacts were identified:

- There is potential for incremental loss of biodiversity values associated with combined land clearing and development in the Barkly region associated with the AAPowerLink, agriculture, mining, and Beetaloo-Sub-Basin onshore gas developments. The potential for cumulative impacts associated with the Solar Precinct residual impacts combined with the residual impacts from exiting development and land uses is limited because the AAPowerLink proposal at Solar Precinct is occurring within an area that has low levels of current development (apart from low to moderate-level pastoral use) and because the land types in the footprint are different to those targeted by agricultural activities. The Strategic Regional Environmental Baseline Assessment (SREBA) being undertaken by the NT Government is proposed to document the biodiversity values and provide a framework for decision-making in relation to onshore gas developments with a key objective being to minimise cumulative impacts to biodiversity and threatened species in the region.
- In the Railway Corridor component of the OHTL footprint, there is the potential that the additional land use – construction and operation of powerlines – could lead to an increase in weeds. This is particularly so in the sections north of Katherine where the perennial weeds Gamba Grass and Mission Grass are prevalent. However, shared custodianship of the Railway Corridor with the railway operator also creates an opportunity for joint management and control of weeds, potentially leading to a reduction in weed presence and abundance. The potential for cumulative impact to occur is inherently dependent on the effectiveness of measures adopted by both corridor users to minimise the spread of weeds and follow up control measures. The AAPowerLink's strategy and proposed methods are described in the Weed Management Plan (Appendix Q).
- In the Utilities Corridor component of the OHTL footprint, there is potential for cumulative impacts to vegetation and habitats associated with future construction of other utilities. The corridor is assigned as a utilities corridor and so it is reasonably foreseeable that further utilities will be installed. These future projects could disturb areas of vegetation reinstated by Sun Cable and open up the corridor to cumulative impacts associated with the introduction and spread of weeds from multiple different activities.
- Combined land clearing and development on the Gunn Point Peninsula, associated with the AAPowerLink, Sea Dragon Hatchery, and future development of residential areas, and/or a Renewable Energy Hub with powerline connections into Darwin has potential to clear significant areas of vegetation and habitat with potential impacts to threatened species, and introduce weeds across a wide area causing further changes to fire regimes (which are already very frequent). The habitats cleared by the AAPowerLink are currently common and widespread and therefore their loss has not been assessed as significant. There is, however, potential for incremental fragmentation and degradation of biodiversity values to occur in this area over the long-term given its proximity to Darwin.

- Specifically, there is potential for cumulative impact to an important sub-population of the threatened *Typhonium praetermissum* that occurs across the AAPowerLink and Project Sea Dragon Hatchery footprints. The combined loss of plants from these two proposals would constitute a ~20% loss in the *Typhonium praetermissum* population (14.4% in the Project Sea Dragon site and 6.8% within the AAPowerLink footprint). However, this is considered a highly conservative estimate, because a large area of suitable habitat for this species further to the south is yet to be surveyed and is likely to result in an increase in the size of the sub-population.

## 5.9 Offsets

The preliminary assessments of potential impacts to threatened species documented in this chapter indicate that the AAPowerLink will remove a portion (~6.8%) of the known extent of an important sub-population of the threatened species *Typhonium praetermissum*. However, it is considered likely that this portion is smaller as there is adjacent suitable habitat that has not been surveyed. The requirement for offsets for *Typhonium praetermissum* or any other threatened species will be re-assessed in the Supplementary EIS in light of the results of the field surveys that were underway at the time the EIS was submitted.

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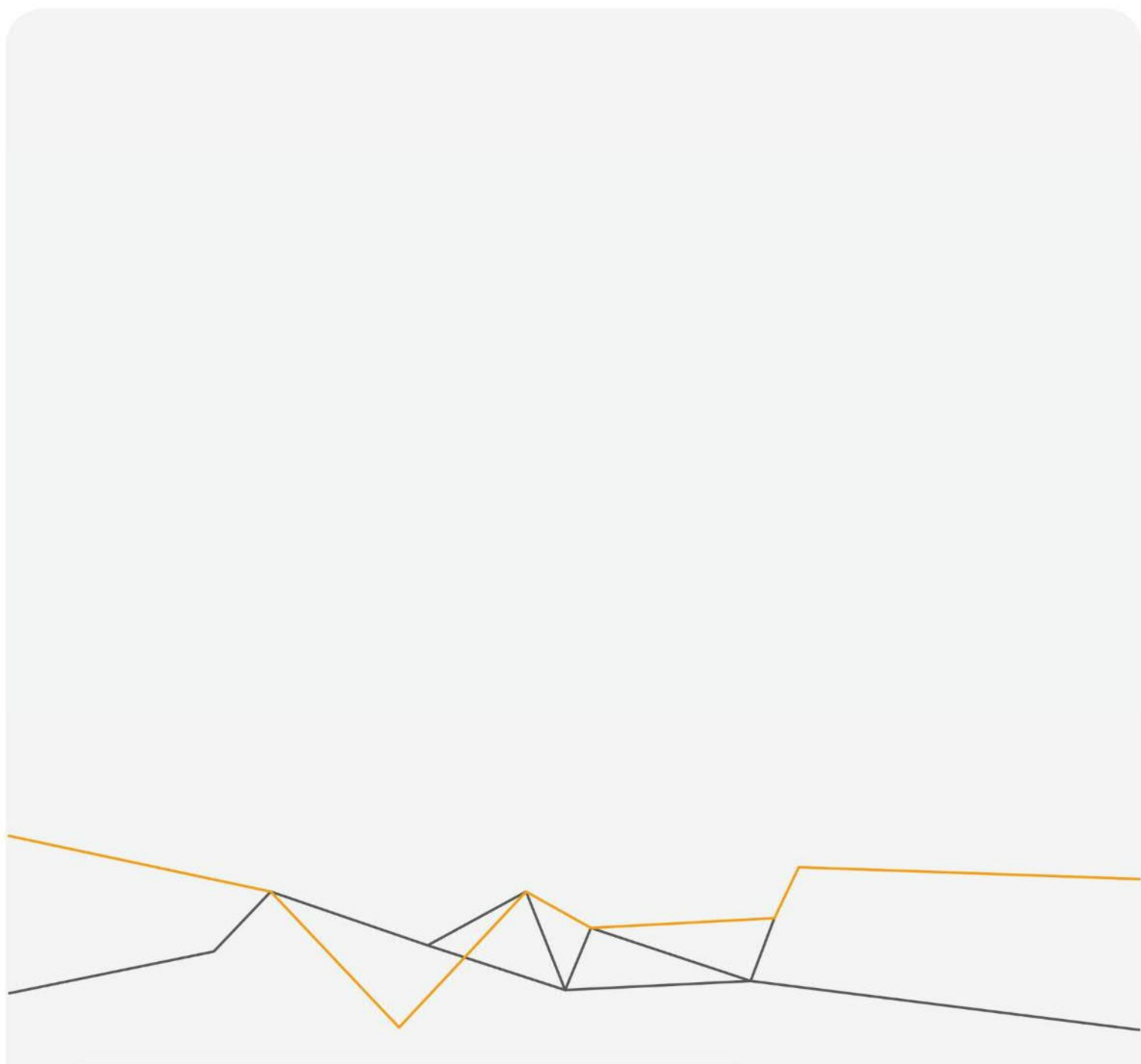
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