DETAILED FLORA AND VEGETATION ASSESSMENT

Onslow Rare Earths Plant

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Prepared by:

RPS

Caroline Gill
Managing Scientist

Level 2, 27-31 Troode Street
West Perth WA 6005

T +61 8 9211 1111
E caroline.gill@rpsgroup.com.au

Prepared for:

Hastings Technology Metals Ltd

Lara Jefferson
Manager, Environment and Approvals

Westralia Square, Level 8, 167 St Georges Terrace
Perth WA 6000

T 0477 340 613
E lara.jefferson@hastingstechmetals.com

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1 INTRODUCTION

RPS Australia West Pty Ltd (RPS) was commissioned by Hastings Technology Metals Ltd (Hastings) to undertake a flora and vegetation assessment of approximately 586.41 hectares (ha) of land within the Ashburton North Strategic Industrial Area (ANSIA), located ten kilometres (km) south-west of Onslow in the Shire of Ashburton.

1.1 Project background

Hastings is proposing to develop a hydromet process plant (rare earths) and an evaporation pond (process plant waste liquor and gypsum) and is considering several areas within the ANSIA.

The ANSIA has had numerous flora and vegetation surveys conducted in the past. The purpose of this assessment is to complement the results of previous surveys and to fill any knowledge gaps to ensure that the survey area data meets Environmental Protection Authority's (EPA) – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016) standards.

The survey area comprises six polygons which include a service corridor, access road corridor, hydromet proposed site, Macedon lease area, evaporation pond option 1 and evaporation pond option 2. The location and the extent of the areas subject to this survey (hereafter referred to as the survey area) and the ANSIA boundary are shown in Figure A.

1.2 Key environmental considerations

RPS understands that the results of the assessment will support referral of the project to the EPA and the Commonwealth Department of Agriculture, Water and the Environment (DAWE). The key environmental issues relating to flora and vegetation are Priority Flora (which have no statutory protection). Specifically, *Eleocharis papillosa, Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata* have been recorded within and proximate to the survey area. No Threatened Flora are known to occur in the survey area.

1.3 Local context and knowledge gaps

1.3.1 ANSIA background

Since 2008, a raft of documentation has been prepared to establish and further develop the ANSIA for the purposes of providing a strategic industrial area that is suitable for hydrocarbon processing industries and support facilities, promoting the common use of infrastructure and industrial synergies. Both the Macedon gas pipeline and the Wheatstone LNG plant were subject to a formal environmental assessment. The associated structure plans and development approvals were subject to comprehensive flora and vegetation surveys and environmental reporting. As a result, the flora and vegetation values within, and immediately surrounding, the survey area have been relatively well captured and mapped as part of numerous independent studies.

The terrestrial flora and vegetation surveys and assessments that have been undertaken within and adjacent to the survey area in recent years are listed in Table 1 and shown in Figure B. The majority of the surveys involved at least one survey under optimal seasonal conditions, however the number of quadrats sampled per vegetation unit was found to be limited in some instances (further explained in the following section).

Table 1: Summary of flora and vegetation surveys for the ANSIA area

Report name	Author	Level of survey	Survey effort
A Vegetation and Flora Survey of the Wheatstone Study Area, near Onslow	Biota (2010a)	Detailed (Level 2) quadrat-based field survey	Three-phase • Phase 1 survey – 2–9 Apr 2009 • Phase 2 survey – 15–24 Apr 2009 • Targeted survey – 23–26 Mar 2009 88 person-days total
Flora and Vegetation Survey – Ashburton North Project	Onshore Environmental Consultants (2008)	Detailed (Level 2) quadrat-based field survey	

Report name	Author	Level of survey	Survey effort
Flora and Vegetation Survey – Ashburton North Project Area – Stage 2	Onshore Environmental Consultants (2009)	Detailed (Level 2) quadrat-based field survey	
Wheatstone Project Flora and Fauna Assessment Addendum	Biota (2010b); Outback Ecology Services (2010)	Desktop survey	Desktop only
Ashburton North Strategic Industrial Area Flora and Vegetation Assessment	ENV (2012)	Detailed (Level 2) quadrat-based field survey Targeted survey	Two–phase • Phase 1 survey – 16–18 May 2011 • Phase 2 survey – 20–22 July 2011 12 person-days total
BHBP Macedon Gas Development - Flora and Vegetation Survey	Astron (2009)	Detailed (Level 2) quadrat-based field survey Targeted survey	Three-phase • Phase 1 survey – 13–20 Nov 2008 • Phase 2 survey – 4–8 Mar 2009 • Phase 3 survey – 17–23 Apr 2009 60 person-days total
Flora and Vegetation Review Ashburton North Strategic Industrial Area	RPS (2016)	Desktop survey	Desktop only
Flora and vegetation assessment - Ashburton North Strategic Industrial Area (ANSIA) - Phase 2 Area	RPS (2019)	Reconnaissance (Level 1) survey	Single-phase • Phase 1 survey – 27 Jul –3 Aug 2018 16 person-days total

1.3.2 Onslow rare earths plant context

This flora and vegetation assessment defined 11 vegetation mapping units which correspond to vegetation units defined and mapped by Biota (2010) and ENV (2012). These vegetation units and the floristic quadrats sampled to describe them are listed in Table 2. All the units were described from three or more quadrats (except for the CP (bare claypan)) albeit across a much wider area than the current assessment area.

For the current assessment to satisfy the requirements of the EPA (2016) guidance a minimum of three quadrats need to have been sampled within the project-specific survey area. Additionally, those quadrats should be spread relatively evenly across the survey area. The historical floristic quadrats that occur within the current survey area are shown in Table 2. Not all the vegetation units mapped for the area are represented by three or more quadrats within the survey area and so additional quadrats were established and sampled to ensure adequate sampling of the vegetation in line with EPA (2016) survey expectations. The final column in Table 2 shows the total number of quadrats (historical and new) sampled for each mapped vegetation unit.

It should be noted that one unit defined for the current assessment, *GsAstTe*, is represented by only two quadrats. This is because *GsAstTe* and *GsTe* were only recognised as separate units after the multivariate analysis performed as part of this assessment determined them to be significantly floristically dissimilar. In previous studies neither Biota (2010) nor ENV (2012) recognised *GsAstTe* as separate to *GsTe*. In the case of the Biota (2010) study this is most likely to be because some of their mapping was extrapolated from aerial imagery due to the large size of their survey area. A total of seven quadrats (current and historical) represents *GsAstTe* and *GsTe* vegetation units combined.

Table 2: Corresponding vegetation units mapped for the survey area and current and historical floristic quadrats sampled for each unit

Vegetation unit			Description (RPS 2021	Floristic quadrats (within the current survey area)			
RPS (2021)	Biota (2010)	ENV (2012)		RPS (2021)	Biota (2010)	ENV (2012)	Total
AteAsyTe	PRpAteAsyTeCEc (CS4)	2	*Acacia tetragonophylla* and *A. synchronicia* Tall to Mid Isolated Shrubs to Open Shrubland over *Triodia epactia* Hummock Grassland	HQ08			4
				HQ11			
				HQ12			
				HQ20			
AteTe	AteTe (CS1) and AteTeCEc (CS2)	3	*Acacia tetragonophylla* Tall to Mid Isolated Shrubs to Open Shrubland over *Triodia epactia* Hummock Grassland			AB09	4
						AB10	
						AB201	
				HQ04			
AstAteTe	AstTe (ID3)	4	*Acacia tetragonophylla* and *A. stellaticeps* Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland			AB11	3
						AB12	
				HQ09			
AstTe			*Acacia stellaticeps* Mid Open Shrubland over *Verticordia forrestii* and *Scaevola sericophylla* Low Sparse Shrubland over *Triodia epactia* Open Hummock Grassland	HQ01			6
				HQ02			
				HQ05			
				HQ06			
				HQ21			
					WSB-16		
GsAstTe	GsCRcTRzTe (ID1)	5	*Grevillea stenobotrya* Tall Sparse Shrubland over *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland	HQ07			2
					WSB-15		
GsTe			*Grevillea stenobotrya* Tall Sparse to Open Shrubland over *Triodia epactia* Open Hummock Grassland			AB14	5
						AB15	
						AB16	
				HQ14			
				HQ17			
HsAstTe			*Hakea stenophylla* subsp. *stenophylla* Mid Sparse Shrubland over *Acacia stellaticeps* Low Sparse Shrubland over *Triodia epactia* Open Hummock Grassland			AB18	6
						ABR202	
				HQ13			
				HQ15			
				HQ16			
				HQ18			
AteTe.Sm/Ef/Eu	AteTe/SPmERIbEUa	2	*Acacia tetragonophylla* Tall to Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland and *Sporobolus mitchellii*, *Eragrostis falcata* and *Eulalia aurea* Tussock Grassland			AB13	4
						AB202	
						ABR01	
				HQ10			
TECSpp.	TECspp. (C3)	1	Tecticornia spp. Low Open Samphire Shrubland over *Lawrencia viridigrisea* and *Eragrostis falcata* Sparse Forbland/ Tussock Grassland			AB17	4
				HQ03			
				HQ19			
				HQ22			
CP	CP		Bare clay pans with only scattered annual grasses and forbs	NA			NA
MF	MF		Bare mudflats	NA			NA

1.4 Scope of works

This flora and vegetation assessment included a:

1. Desktop assessment
2. Single-phase flora and vegetation survey, in accordance with the Environmental Protection Authority's (EPA) technical guidance (EPA 2016) with the aim to complement previous survey efforts
3. Targeted Threatened and Priority flora survey of known or potentially suitable habitat for each of the target species within the survey area.

This report documents the methods and outcomes of the desktop assessment and field surveys undertaken in October 2020.

1.5 Guiding principles and legislative framework

Commonwealth and state legislation pertaining to the conservation of native flora and vegetation include the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and state *Biodiversity Conservation Act 2016* (BC Act) and *Environmental Protection Act 1986* (EP Act).

The EP Act is the primary legislation that governs environmental impact assessment and protection in Western Australia. The aim of the EP Act is "to provide for an EPA, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with foregoing".

The EP Act states that the following principles, applicable to native flora and vegetation should be adhered to in order to protect the environment of Western Australia:

1. The Precautionary Principle – Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
2. The Principle of Intergenerational Equity – The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
3. The Principle of the Conservation of Biological Diversity and Ecological Integrity – Conservation of biological diversity and ecological integrity should be a fundamental consideration.

1.5.1 Flora of conservation significance defined in the legislative framework

Within Western Australia, Threatened flora (TF) are listed if they are considered to be in danger of extinction, rare or otherwise in need of special protection. These taxa are legally protected under the BC Act. The removal of these taxa or impact to their surroundings is not permitted without prior ministerial approval.

The Department of Biodiversity Conservation and Attractions (DBCA) maintains a list of Priority flora (PF) species, which may be rare or threatened but for which there are either insufficient survey data to determine accurately their status, or which are rare but not currently considered to be threatened. A PF taxon is assigned to one of five priority categories. TF and PF categories are defined in Appendix A, Table A-1.

Many taxa listed as TF under the BC Act have additional protection as they are also listed as TF under one of six threat categories (Extinct, Extinct in the wild, Critically Endangered, Endangered, Vulnerable or Conservation Dependent) under the EPBC Act.

TF taxa are defined as Matters of National Environmental Significance (MNES) under the EPBC Act and penalties apply for any damage to individuals, populations or habitats of these flora.

The EPBC Act conservation category codes are defined in Appendix A, Table A-2.

1.5.2 Vegetation of conservation significance

Under the BC Act and the EP Act, Threatened Ecological Communities (TECs), classified by DBCA in one of the TEC categories (Appendix A, Table A-3) have limited protection. Other ecological communities are classified by DBCA in the category of Priority Ecological Communities (PECs) (Appendix A, Table A-4) pending further survey and/or definition.

A subset of the DBCA-listed TECs is also listed and protected as MNES under the EPBC Act. The EPBC Act threat categories for TECs are defined in Appendix A, Table A-5.

2 METHODS

2.1 Desktop assessment

As a component of the flora and vegetation assessment, RPS undertook a desktop review prior to the field survey work to make the best possible use of existing data from the area and to identify specific flora and vegetation values which may occur in, or proximate to, the survey area. This involved:

- A review of all environmental literature and reports relevant to the area, and collation and summary of the historical knowledge of the flora and vegetation values
- A review of the former surveys against the technical guidance (EPA 2016)
- A summary of the vegetation communities and flora present within the survey area
- Assessment of the conservation significance of the flora and vegetation
- Assessment of the adequacy of the available data in satisfactorily describing the flora and vegetation values of the survey area
- Identification of knowledge gaps, if any, in the biological information available for the survey area.

2.2 Field survey

The field survey was coordinated by RPS' Managing Botanist Carrie Gill, and undertaken by Carrie and Consultant Botanist Brian Morgan (Table 3). The single-phase field survey was undertaken over eight days between 16 and 23 October 2020.

Table 3: Botanical team personnel

Personnel	Title	Role	Survey	Flora licence
Carrie Gill	Managing Botanist (RPS)	• Field survey coordination and HSE management • Field survey	16-23 October 2020	Flora Taking - Biological Assessment Licence: FB62000151
Brian Morgan	Consultant Botanist	• Field survey • Taxonomic determinations	16-23 October 2020	Flora Taking - Biological Assessment Licence: FB62000075

The field survey comprised a reconnaissance survey over the service corridor and access road corridor which have been previously mapped by Biota (2010a; 2010b), and a detailed survey with sampling via the collection of floristic data at 50 × 50 m quadrats over the hydromet proposed site, Macedon lease area, evaporation pond option 1 and evaporation pond option 2 areas. The historical Biota (2010a; 2010b) and ENV (2012) quadrats within the survey area were also revisited to check that the data collected for those quadrats was consistent with the data collected at new quadrats for the current assessment.

The vegetation units that had been historically mapped for the area were ground-truthed for accuracy in terms of their floristic composition and extent, as some of the existing mapped boundaries had been extrapolated from aerial imagery and were therefore deemed likely to be somewhat inaccurate. The field survey also involved consolidation (alignment) of the mapping undertaken by the various consultants to ensure consistency in mapping scale and unit descriptions. For example, Biota and ENV's descriptions for the same vegetation types differ to some degree so these were aligned. A comprehensive species list was compiled for the survey area and targeted searches for conservation significant flora known to occur in the area were conducted.

Further detail on the survey methods is provided below.

2.2.1 Reconnaissance level survey

The reconnaissance survey involved the selective sampling of flora and vegetation to produce maps of vegetation units and vegetation condition at an appropriate scale and based on vegetation mapping from past surveys, aerial imagery interpretation, and ground-truthing. An important aspect of this was the consolidation of the vegetation mapping undertaken by different consultants.

The field survey involved traversing the survey area by vehicle and on foot to:

- Verify the data from the desktop survey at a local scale.
- Characterise the vegetation throughout the survey area.
- Identify any constraints and potential impacts of development on local flora and vegetation values, or other environmental features.

The reconnaissance survey involved the sampling of the full range of flora taxa and vegetation community types observed within the survey area via relevés (unbounded flora survey sites), and vegetation mapping sites.

The following parameters were recorded for each relevé and mapping site:

- Site code
- Location (GDA94 GPS coordinates)
- Digital photographs of the vegetation
- Landform and soil description
- Vegetation description - dominant growth form, height, cover and species for the three traditional strata (upper, mid and ground)
- Any other location information that might be useful in vegetation classification including slope, aspect, litter, fire history, vegetation/landform/soil correlations
- Assessment of vegetation and description of disturbances
- A comprehensive species list (annuals and perennials), including weeds and their percentage foliar cover.

2.2.2 Detailed survey

For the remainder of the survey area (~300 ha) detailed quadrat-based sampling of the floristics was undertaken. RPS established and sampled 22 new quadrats across the survey area.

The detailed survey involved:

- Comprehensive quadrat-based flora recording and collection. Bounded 50 m × 50 m quadrats (or quadrats of other dimensions, tailored to characteristics of the vegetation encountered, e.g., narrower transects), were established and sampled in intact, mature vegetation in areas of best condition to provide data for the floristic classification of the vegetation of the survey area
- Collection of information at each quadrat included
  - Site code
  - Location (GDA94 GPS coordinates)
  - Size, shape and orientation of quadrat
  - Photograph/s from north-west corner
  - Landform and soil description
  - Dominant growth form, height, cover and species for the three traditional strata (upper, mid and ground)
  - Any other location information that might be useful in vegetation classification including slope, aspect, litter, fire history, vegetation/landform/soil correlations
  - Assessment of vegetation and description of disturbances
  - A comprehensive species list (annuals and perennials), including weeds
- Opportunistic collections and relevés or systematic transects to verify that the survey area has been well characterised and important values identified

- Compilation of a comprehensive vascular flora inventory of all flora species recorded within the survey area, including weed species
- Vegetation condition mapping using the recommended EPA (2016) scale adapted from Keighery (1994) and Trudgen (1988)
- Vegetation unit description and mapping using the National Vegetation Information System (NVIS) (ESCAVI 2003). Vegetation types were described to Association (Level V).

2.2.3 Targeted flora search

A targeted flora search was undertaken and focused on habitats within the survey area likely to support conservation significant flora identified in database searches and / or recorded for previous surveys in the vicinity. Several Priority 3 Flora species (*Eremophila forrestii* subsp. viridis*, Triumfetta echinata* and *Eleocharis papillosa*) were known to occur either within or proximate to the survey area.

A review of the vegetation mapping completed by Biota (2010a; 2010b) prior to the field survey determined that the PF recorded to date in the vicinity of the survey area were restricted to three “Inland Sand Dunes” vegetation sub associations, and to one “Vegetation of Claypans” vegetation sub-association - *Tecticornia* spp. low shrubland. These vegetation types within the survey area represent potentially suitable habitat for the target species and were systematically searched during the survey. The survey aimed to determine the size and extent of all significant flora populations recorded in the survey area.

The botanists walked systematic traverses through potential habitat for the target species. Rare flora locations (and the number of individuals present) were recorded using a handheld GPS (GDA94 datum).

2.2.4 Weed survey

The location, abundance (percentage cover) and extent of invasive weed species were recorded and mapped across the survey area.

2.3 Data analysis

2.3.1 Taxonomic determinations

Flora specimens were either identified in the field, or collected and identified using the keys, publications and databases of the Pilbara Regional Herbarium. Nomenclature was aligned with the current names in FloraBase (Western Australian Herbarium (WAH) 2020).

2.3.2 Vegetation mapping

The vegetation mapping was conducted using a combination of aerial photointerpretation, regional and local vegetation mapping, on-ground confirmation and vegetation structure data.

Vegetation types were described to Association (Level V) in accordance with the NVIS (ESCAVI 2003) (Appendix A, Table A-6 and Table A-7).

Vegetation condition mapping was undertaken using the recommended EPA (2016) scale for the Eremaean region of Western Australia; that of Trudgen (1988) (Appendix A, Table A-8).

2.3.3 Multivariate analysis of floristic data

All multivariate data analyses followed the procedures outlined in Clarke and Gorley (2015) and were carried out using the appropriate modules of the Primer statistical software package (Plymouth Marine Laboratory-Version 7). Data analyses were conducted using PRIMER v7 modules, including Classification, Similarity Profile Analysis (SIMPROF) (Clarke and Gorley 2015). The analyses aimed to compare the floristic composition of the quadrats sampled for the survey area to identify groups of floristically similar sites to assist in defining the different floristic communities present.

2.3.3.1 Classification and similarity profile analysis (SIMPROF)

Floristic quadrat data (presence / absence) derived from the current survey, in the form of a 'species by site' table, were initially analysed to classify the different floristic communities within the survey area. A resemblance (dissimilarity) matrix of the presence/absence data for the dataset was constructed using the Bray-Curtis Similarity Coefficient. A Hierarchical Cluster Analysis was carried out on this matrix using the group average linkage method.

The purpose of classification is to produce a dendrogram that allows patterns (clusters) in the data to be visualised. Dendrograms illustrate the "relatedness" of groups of samples; in this case, based on floristics. A Bray-Curtis similarity matrix of data from the current survey was subjected to hierarchical (group average) assessment to produce a single dendrogram. Further, a "similarity profile" SIMPROF permutation test was carried out at each node of this dendrogram to look for statistically significant clusters in the set of samples (indicated by the black lines on the dendrogram).

As part of the multivariate analysis of the floristic data, a SIMPER Analysis was run to determine which species contribute most to the dissimilarity between each significant cluster of floristic sites, and which species contribute most consistently to the floristic cohesiveness (similarity) of each significant group.

2.4 Limitations

2.4.1 Field survey

Practitioners who conduct ecological surveys for environmental impact assessment in Western Australia are obliged to report on the limitations and constraints in such studies. Some potential limitations / constraints on surveys may adversely impact on the scientific rigour, completeness or the validity of the survey results. EPA (2016) identifies standard limitations which can limit and constrain the validity of surveys. These limitations / constraints and their relevance to this assessment are presented in Table 4.

Table 4: Survey limitations

Limitation	Relevance	Details
Availability of contextual information at a regional and local scale	No	Numerous flora and vegetation assessments have been undertaken within the ANSIA in the past decade by various consultants on behalf of BHP for their Macedon project and Chevron for Wheatstone. Consequently, the flora and vegetation of the ANSIA has been well characterised and mapped.
Competency and experience of the field team	No	Carrie Gill has 15 years' experience and Brian Morgan over 25 years' experience undertaking flora and vegetation assessments for EIA in WA. Both practitioners have undertaken surveys within the ANSIA area for other proponents in recent years.
Proportion of flora recorded and / or collected, and problems with taxonomic determinations	No	Flora taxa recorded were either identified in the field or collected and identified using the keys and resources of the WAH. Specimens were identified by a consultant who is experienced in undertaking taxonomic determinations for Pilbara flora.
The effort and extent of the survey	No	The area was sufficiently surveyed and considered appropriate for the bioregion.
Access restrictions within the survey area	No	All the survey area was fully accessible to the field survey personnel for the duration of the survey
Survey timing, rainfall, season of survey	Moderate	The survey was undertaken outside the optimal time for ecological surveys in the bioregion. This likely resulted in a less comprehensive flora inventory than may have been recorded at the optimal time (April to June). However previous surveys were conducted at the optimal time and this survey served to complement previous findings.
Disturbances that may have affected the results of survey such as fire, vehicle tracks and weeds	Minor	Disturbances such as weed infestation has caused changes in vegetation structure and health over the last several decades. Fire is a requirement for the germination of one Priority flora species i.e. *Triumfetta echinata*. The last occurrence of a fire was in 2011. The lack of fire has limited targeted survey efforts for this species.

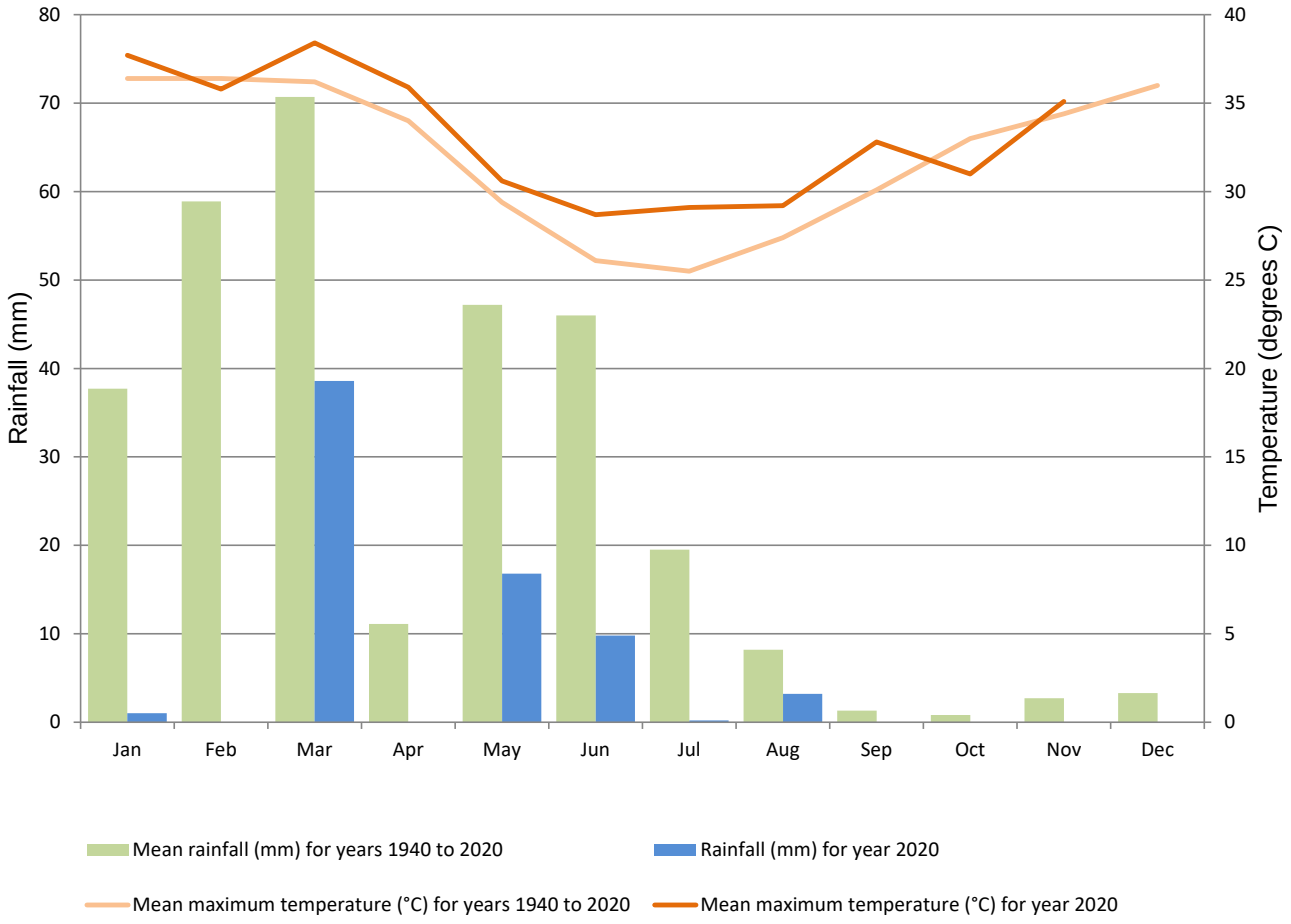
3 EXISTING ENVIRONMENT

3.1 Climate

The survey area is in the broader Carnarvon region of Western Australia which has an arid-tropical bi-seasonal climate.

The Bureau of Meteorology (BoM) weather station closest to the survey area is the Onslow Airport weather station no. 005017, located approximately 12 km to the north-east of the survey area. The 55-year average total rainfall for the area from January to November is 304.1 mm. In 2020 the total rainfall for these months was only 69.5 mm which represents approximately 23% of the long-term average. Additionally, 2020 was warmer than average with a mean monthly temperature maximum for January to November of 33.12 °C, compared to the long-term average of 31.72 °C which represents a difference of 1.4 °C (BoM 2020). The warmer and drier conditions for the area in 2020 resulted in a relatively poor survey season.

Historical climate data collected from the Onslow Airport weather station is presented in Graph 1 (BoM 2020).



Graph 1: Mean monthly rainfall (mm) and maximum temperature data (°C) for Onslow Airport weather station (005017), and rainfall and temperature data for 2020

3.2 Interim Biogeographical Regionalisation of Australia

The Interim Biogeographical Regionalisation of Australia (IBRA) currently recognises 89 bioregions and 419 biological subregions within Australia. The survey area lies within the Cape Range CAR1 subregion of the Carnarvon Region (Environment Australia 2000).

The Cape Range CAR1 subregion is 2,547,911 ha in size and is described by Kendrick and Mau (2002) as “Cape Range and Giralia dune fields form the northern part of Carnarvon Basin. Rugged tertiary limestone and extensive areas of red aeolian dunefield, Quaternary coastal beach dunes and mud flats. Acacia

shrublands over Triodia on limestone (*Acacia stuartii* or *A. bivenosa*) and red dune fields, Triodia hummock grasslands with sparse Eucalyptus trees and shrubs on the Cape Range. Extensive hummock grasslands (Triodia) on the Cape Range and eastern dune-fields. Tidal mudflats of sheltered embayments of Exmouth Gulf support extensive mangroves. Beach dunes with Spinifex communities. An extensive mosaic of saline alluvial plains with samphire and saltbush low shrublands along the eastern hinterland of Exmouth Gulf. Islands of the Muiron, Barrow, Lowendal and Montebello groups are limestone-based".

3.3 Geology, landform and soils

The Carnarvon bioregion consists of a sedimentary basin composed of quaternary alluvial, aeolian and marine sediments with locally exposed rocks of Permian to Recent age (Kendrick and Mau 2002; Beard 1990). The topography includes low plateaux, coastal plains and low folded ranges but it is predominated by gently undulating plains of hard alkaline red soils punctuated with mesas and longitudinal dunes of red sands (Beard 1990).

Surface geology mapping across the survey area is presented in Figure C.

3.4 Land systems

Land system mapping of the rangelands of Western Australia by the Department of Agriculture and Food and Department of Land and Surveys defines a map unit or land system as "an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation". The area was mapped at a scale of 1: 250, 000 and Payne et al. (1988) identified three land systems within the survey area: Dune; Littoral; and Onslow. The land units belonging to these four Land Systems which occur within the survey area are listed and described in Table 5. Land system mapping is shown in Figure D.

Table 5: Land systems represented within the survey area

Land system	Description	
Landform	Soil	Vegetation
Dune land system	**Dune fields supporting soft spinifex grasslands**	**Dune land system**
Linear and reticulate dunes: up to 15 m high and 2.5 km long by 100 to 200 m apart becoming reticulate, hummocky crests, flanks extending 100 m or so with steeper western sides to 20%.	Dark red sands, loamy sands	Hummock grasslands of *Triodia schinzii* with numerous low shrubs and forbs
Swales: sandy surfaces 50 to 300 m wide between dunes.	Dark red sands, loamy sands	Hummock grasslands of *Triodia epactia* and some *Triodia lanigera*, sparse low shrubs such as *Acacia stellaticeps* and forbs
Swamps and depressions: low lying areas between dunes, circular or oval up to 500 m in diameter or extent.	Surface cracking reddish brown clay soils	Low open woodland of *Eucalyptus victrix* with *Muehlenbeckia cunninghamii* and perennial grasses such as *Sporobolus mitchellii* and *Eriachne benthamii*
Claypans: bare, circular, oval or elongated surfaces mostly less than 150 m in diameter or length but up to 500 m, up to 1.5 m below adjacent sandplains or swale with abrupt marginal slopes.	Dark red clay soils after with lime or gypsum in profile, sealed, glazed surfaces or crusted surfaces with desiccation cracks	No vegetation
Littoral land system	**Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches**	
Sandy plains: up to 2 km in extent associated with dunes and on landward margins of samphire fiats.	Loose white calcareous sand, variable depth over limestone, or sand over clay	Hummock grassland of *Triodia epactia* with *Chrysopogon fallax* and occasional *Atriplex bunburyana*
Marginal slopes to mudflats: up to 0.5 km wide and 6 km long, sloping up to 3 per cent, hummocky micro-relief, intense, short parallel drainage lines incised to 1m.	Loose surfaced reddish brown saline silty clay developed by accumulation of deflation deposits from mudflats	Sparse tall shrubland of *Acacia victoriae* with *A. sclerosperma* with sparse *Atriplex bunburyana*, *Tecticornia halocnemoides*

Land system	Description	
Landform	Soil	Vegetation
Samphire flats: flat plains slightly raised above and adjacent to bare mud flats, up to 2 km long and 0.5 km wide.	Hard setting reddish brown gradational soils changing from silty loam to silty clay with depth, calcareous throughout	Low shrubland of *Tecticornia auriculata, T. halocnemoides* and *Maireana amoena*
Mudflats: up to 15 km in extent, bare, near flat surfaces occasionally inundated by sea during peak tides.	Saline muds	No vegetation.
Sandy islands: oval or circular, up to 2 km in extent, usually surrounded by bare mudflats.	Sandy soils	Hummock grassland of *Triodia epactia*
Onslow Land System	**Undulating sandplains, dunes and level clay plains supporting soft spinifex grasslands and minor tussock grasslands**	
Undulating sandplain: up to 30 km in extent, low swales, slopes and sandy spurs sloping 1 to 5%, elevated sand plains up to 20 m above low sections, numerous termite mounds up to 3 m.	Dark reddish-brown sands and sandy loam	Hummock grasslands of *Triodia epactia* with very sparse shrubs such as *Acacia stellaticeps*, near coast *Triodia epactia* and *Cenchrus ciliaris* mixtures with buffel dominating in part
Low sandplain: up to 3 km in extent, gradients 1 in 300 or less, hummocky microrelief up to 2 m, numerous small claypans 5 to 40 m in diameter, loose surfaces.	Dark reddish-brown sands and sandy loam	Mixed grasslands of *Triodia epactia* and *Cenchrus ciliaris*
Clay plains: sinuous, nearly flat clay surfaces up to 3 km long by I km wide between sand plain, subject to sheet flow and becoming wider with scalded surfaces near the coast.	Reddish brown clay soils, occasionally seasonal cracking	Tussock grasslands of variable density, mostly *Sporobolus virginicus* and *Eriachne benthamii*
Samphire flats: flat saline plains marginal to adjacent Littoral system or between sandplain, mostly less than 1 km in extent but up to 2.5 km.	Reddish brown or dark red calcareous clay coils, also inverted soils such as sandy clay loams over sand	Dense low samphire shrublands *Tecticornia halocnemoides, T. auriculata, T.* indica with variable amounts *Sporobolus virginicus* and forbs
Claypans: bare scaled surfaces with steep marginal slopes up to 3 m high to surrounding sand plain; circular, oval or irregularly shaped. mostly less than 50 m in extent but occasionally up to 600 m.	Dark red clays	No vegetation

3.5 Conservation reserves

The Carnarvon IBRA bioregion has only 3.45% represented in conservation reserve (IUCN I-IV). At a subregional level, Cape Range CAR1 has 2.2% in reserve (Kendrick and Mau 2002). CAR1 reserves include:

- Cape Range National Park
- Ningaloo Marine Park
- Bundegi Conservation Park
- Jurabi Conservation Park
- Barrow Island Nature Reserve.

There are also numerous small island reserves in the subregion.

The survey area does not occur within, or adjacent to, any conservation reserves. Nor does it intersect any Environmentally Sensitive Areas.

3.6 Vegetation

3.6.1 Regional vegetation mapping

The survey area lies within the Carnarvon Botanical District of the Eremaean Botanical Province of Western Australia. More specifically it is situated in the Cape Yannarie Coastal Plain (CYCP) subdistrict as mapped and described by Beard (1975). Beard described three broad vegetation community types for the CYCP as follows:

- Mangroves along the coastline within the intertidal zone, dominated by *Avicennia marina* and *Rhizophora stylosa* to a lesser extent
- Behind the intertidal zone, there is a belt of bare hyper-saline mud generally devoid of vegetation but with some samphire (*Tecticornia* spp.)
- Behind the saline tidal mud flats, there is low country with numerous bare clay pans, seasonally filled and interspersed with grass plains (clay soil) and sand ridges (sand) with *Triodia* dominant. On higher ground there are extensive plains with patchy vegetation of *Acacia xiphophylla* (snakewood), *A. tetragonophylla, A. bivenosa* and *A. victoriae (A. synchronicia*), grassland including *Triodia basedowii* (*T. lanigera*?), clay pans and bare patches of gravel.

Beard (1975) mapped the vegetation of the region at a scale of 1:1,000,000. Shepherd, Beetson and Hopkins (2002) used Beard's existing vegetation mapping to produce 1:250,000 scale vegetation association mapping. The survey area intersects the following four vegetation associations described by Shepherd, Beetson and Hopkins (2002) (Table 6) (Figure E).

Table 6: Beard vegetation associations represented within the survey area

Assoc. no.	Beard association description
117	Hummock grasslands, grass steppe; soft spinifex
127	Bare areas; mudflats
589	Mosaic: Short bunch grassland – savannah/grass plain (Pilbara)/hummock grasslands, grass steppe; soft spinifex soft spinifex
670	Hummock grasslands, shrub steppe; scattered shrubs over *Triodia basedowii*.

(Sources: Beard 1975; Shepherd, Beetson and Hopkins 2002)

3.6.2 Reservation priorities of vegetation associations mapped for the survey area

The vegetation associations mapped by Beard (1975) for the survey area are widespread in the subregion with over 87% of their pre-European extent remaining. Kendrick and Mau (2002) assessed the reservation priority for these associations on a subregion level (Table 7).

Table 7: Current extent and reservation status and priority of Beard vegetation associations within the Cape Range CAR1 subregion represented within the survey area

Vegetation association	Pre-European extent (ha)	Present extent (ha) remaining	% of present extent remaining	% of present extent in secure tenure	Reservation priority
117	12,424.35	10,907.99	87.80*	27.46	Medium
127	100,987.52	99,790.74	98.81*	0.42	High
589	78,100.80	77,834.93	99.66*	0.00	High
670	147,808.61	147,792.06	99.99*	11.67	Low

*Above 30% target for biodiversity conservation

(Sources: Government of Western Australia 2019; Kendrick and Mau 2002)

3.6.3 Local vegetation mapping

Interrogation of the historical local vegetation mapping undertaken for the studies listed in Table 1 determined that the survey area intersects six vegetation associations (Table 8).

Table 8: Vegetation units historically mapped for the survey area

Vegetation unit	Description
Ate.Te	*Acacia tetragonophylla* Tall to Mid Open Shrubland to Isolated Shrubs over *Triodia epactia* Open Hummock Grassland to Hummock Grassland
Ast.Te	*Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland
Ate.Asy.Te	*Acacia tetragonophylla* and *A. synchronicia* Mid to Tall Sparse Shrubland over *Triodia epactia* Sparse Hummock Grassland to Hummock Grassland
TECspp.	*Tecticornia* spp. Low Open to Low Samphire Shrublands on and fringing saline claypans
Gs.Te / Gs.Ast.Te	*Grevillea stenobotrya* Tall Sparse Shrubland over *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland
CP	Bare clay pans with only scattered annual grasses and forbs

3.6.4 Conservation significant vegetation

There are two TECs within the Carnarvon IBRA endorsed by the Minister of the Environment (DBCA 2018):

- 39. Camerons Cave Troglobitic Community
- 41. Cape Range Remipede Community.

Neither of these communities relate to vegetation communities within the survey area.

3.7 Flora

3.7.1 Regional flora

A total of 1,099 flora taxa have been recorded for the Cape Range CAR1 subregion (WAH 2020), of which 1,033 are native. Approximately 42% of these belong to five families. The number of taxa for each of these dominant families is presented in Table 9. The numbers in brackets refer to the number of weed species included in each total.

Table 9: Numbers of taxa of the five dominant plant families in the Cape Range subregion

Family	Common name	No. of taxa (weeds)
FABACEAE	Peas	138 (8)
POACEAE	Grasses	103 (10)
ASTERACEAE	Daisies	87 (11)
MALVACEAE	Mallows	76 (2)
CHENOPODIACEAE	Goosefoots	59 (1)

(Source: WAH 2020)

A total of 40 conservation significant flora taxa are known from the CAR1 subregion (WAH 2020), one of these (*Seringia exastia*) is listed as Threatened and is protected under the BC Act, six are Priority 1; twelve are Priority 2; seventeen Priority 3; and four Priority 4 taxa (WAH 2020).

Sixty-six alien (weed) taxa are known from the CAR1 subregion (WAH 2020). The families with the greatest number of weed species are Asteraceae (11 taxa), Poaceae (ten taxa) and Fabaceae (eight taxa).

According to the Western Australian Organism List (WAOL) (Department of Agriculture and Food Western Australia (DAFWA) 2020), which lists organisms that are declared under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), nine flora species with a status of Declared Pest (s22) are identified within the Shire of Ashburton all belonging to the Control Category C3 – Management. Additionally, the list of Weeds of National Significance (WoNS) names two species occurring within the Shire of Ashburton (Table 10).

Table 10: Declared pests (flora taxa) and weeds of national significance for the Shire of Ashburton

Family	Species	Common name	Declared pest	Weed of national significance
PAPAVERACEAE	Argemone ochroleuca Sweet subsp. ochroleuca	Mexican poppy	✓	-
SOLANACEAE	Datura ferox	Fierce thornapple	✓	-
SOLANACEAE	Datura inoxia	-	✓	-
SOLANACEAE	Datura leichhardtii	Native thornapple	✓	-
SOLANACEAE	Datura metel	Downy thornapple	✓	-
SOLANACEAE	Datura stramonium	Common thornapple	✓	-
SOLANACEAE	Datura wrightii	Hairy thornapple	✓	-
LAMIACEAE	Marrubium vulgare	Horehound	✓	-
FABACEAE	Parkinsonia aculeata	Parkinsonia	✓	✓
FABACEAE	Prosopis pallida	Mesquite	✓	✓

(Source: DAFWA 2020)

3.7.2 Local flora

A total of 433 native taxa and 13 exotic (weed) taxa have been recorded from the surveys undertaken for the ANSIA to date. These taxa represent 167 genera from 58 families. The floristic data from the surveys undertaken by OEC (2008; 2009), Astron (2009), RPS (2009), Biota (2010a), Biota (2010b) and ENV (2012) was compiled to create the final flora inventory of 446 species. This total of 446 native and weed taxa recorded for the ANSIA to date represents 40% of the total number of 1,099 flora taxa recorded for the Cape Range CAR1 subregion.

The families and genera with the greatest number of species are presented in Table 11 and Table 12. The numbers in brackets refer to the number of weed species included in each total.

Table 11: Dominant families within the ANSIA area

Family	Common name	No. of taxa	Proportion of total taxa in CAR1 subregion (%)
FABACEAE	Peas	80 (4)	59
POACEAE	Grasses	71 (3)	70
CHENOPODIACEAE	Goosefoots	46 (0)	78
ASTERACEAE	Daisies	29 (1)	35
MALVACEAE	Mallows	30 (1)	39

Table 12: Dominant genera within the ANSIA area

Genus	Common name	No. of taxa
	Wattle	23
Tecticornia	Samphire	18
Ptilotus	Mulla mulla	14
Abutilon	Lantern bush	11
Senna	-	11
Euphorbia	-	12

3.7.3 Conservation significant flora

3.7.3.1 Threatened flora (EPBC Act) listed for the locality

One taxon, *Eleocharis papillosa*, listed by the Commonwealth as Vulnerable under the EPBC Act, was recorded from the ANSIA during surveys in 2009 (Biota 2010a). No other species listed under the EPBC Act have been previously recorded from the site, the locality, or are expected to occur in the habitats within the survey area.

3.7.3.2 Threatened flora (BC Act) listed for the locality

No species listed as TF by DBCA under the BC Act were recorded from the ANSIA Improvement Scheme Area, or from the 50 km database search area. No BC Act listed TF species are expected to occur in the habitats within the survey area.

3.7.3.3 Priority flora listed for the locality

Three PF species have been recorded from the ANSIA Improvement Scheme Area to date (Biota 2010a): *Eleocharis papillosa, Eremophila forrestii* subsp*. viridis* and *Triumfetta echinata*, however only *Eremophila forrestii* subsp*. viridis* was recorded for the current survey. A description of these species follows.

3.7.3.3.1 *Eleocharis papillosa* – Priority 3 (BC Act), Vulnerable (EPBC Act)

Small annual sedge, this species is not considered Critically Endangered or Endangered but is Vulnerable because it is facing a high risk of extinction in the wild in the medium-term future. The species was assigned Priority 3 status by DBCA as its consideration for Threatened status was probably overlooked (Biota 2010a).

E. papillosa has been recorded from one location within the ANSIA in the samphire vegetation mapped for the current study as: TECSpp. - *Tecticornia* spp. Low Open Samphire Shrubland over *Lawrencia viridigrisea* and *Eragrostis falcata* Sparse Forbland/ Tussock Grassland. Approximately 34.01 ha of TECspp occurs within the survey area and 810.67 ha occurs within the broader ANSIA area. This *E. papillosa* record, returned from the DBCA database searches, is located approximately 200 m south-west of the northern end of the services corridor (shown in Figure F). The species was considered by Biota (2010a) to be likely to occur throughout this habitat type and may be more widespread. It is known to grow on red clay over granite, open clay flats and clay pans (WAH 2020).

3.7.3.3.2 *Eremophila forrestii* subsp. *viridis* – Priority 3 (BC Act)

A perennial shrub to one metre (WAH 2020), *E*. *forrestii* subsp*. viridis* is probably restricted to the Onslow locality despite FloraBase showing records further afield; these have probably been misidentified (Biota 2010a).

E. forrestii subsp. *viridis* was recorded during targeted surveys from numerous locations within Lot 152 by ENV (2012), as well as at three locations adjacent to the current survey area by Biota (2010a) within Vegetation of Inland Sand Dunes vegetation sub-associations*.* The species has also been recorded for the wider Onslow locality (OEC 2008; Astron 2009; Biota 2010a and 2010b; RPS 2019; ELA 2021) (Figure F). Approximately 419.57 ha of Vegetation of sand dunes, plains and swales occurs within the survey area and 2,553.02 ha occurs within the broader ANSIA area.

3.7.3.3.3 *Triumfetta echinata* – Priority 3 (BC Act)

A prostrate shrub to 0.3 metres occurring on red sandy soils and sand dunes (WAH 2020), *T. echinata* occurs primarily in the Onslow area although there is an outlier population approximately 120 km south in the Gascoyne bioregion.

T. echinata was recorded from two locations within the survey area (within the services corridor) shown in Figure F, and numerous (> 30) locations adjacent to the survey area (OEC 2008; OEC 2009; Biota 2010a and RPS 2009) within the sand dune vegetation.

The species has also been recorded at other locations in the wider Onslow locality and appears to be relatively widespread; however, it appears to be relatively rare (only observed post-fire events) and restricted to red sand dunes (Biota 2010a). Approximately 419.57 ha of Vegetation of sand dunes, plains and swales occurs within the survey area and 2,553.02 ha occurs within the broader ANSIA area.

4 RESULTS

4.1 Desktop survey results

4.1.1 Threatened and Priority flora database search results

A search of the DBCA's Threatened and Priority Flora databases was undertaken for known TF and PF records within a 50 km radius of the survey area. No TF were identified but six PF were returned including one Priority 1 (P1) and five Priority 3 (P3) species (Table 13). One of these taxa, *Eleocharis papillosa*, is also listed federally as Vulnerable under the EPBC Act. The locations of these records in relation to the survey area are shown in Figure F.

Table 13: Flora database search results for species records within a 50 km radius of the survey area

Species	Cons. code (BC Act / DBCA)	Cons. code (EPBC Act)
Abutilon sp. *Onslow* (F. Smith s.n. 10/9/61)	P1	-
Abutilon sp. *Pritzelianum* (S. van Leeuwen 5095)	P3	-
Carpobrotus sp. Thevenard Island (M. White 050)	P3	-
Eleocharis papillosa	P3	VU
Eremophila forrestii subsp. *viridis*	P3	-
Triumfetta echinata	P3	-

These species were assessed in terms of their likelihood of occurring within the survey area based on proximity of documented records, and on the presence of suitable habitat (Table 14). Definitions of the conservation codes are presented in Appendix A.

One of these six Priority-listed species, *Eremophila forrestii* subsp. *viridis, is* known to occur within the survey area, having been recorded during previous surveys.

Two species, *Eleocharis papillosa* and *Triumfetta echinata,* were deemed to have a moderate likelihood of occurrence within the survey area based on presence of suitable habitat and proximity of the survey area to known records.

Three species were deemed to have a low likelihood of occurrence within the survey area.

Table 14: Likelihood of PF species identified in the database searches occurring in the survey area

Species	Cons. Code	Preferred habitat	Suitable habitat within the survey area	Closest record	Likelihood of occurrence
Eremophila forrestii subsp. *viridis*	P3	Sand dunes and plains	Yes	Recorded within the ANSIA Improvement Plan Area	High - known to occur
Eleocharis papillosa	P3	Red clay over granite, open clay flats. Clay pans	Yes	Recorded within the ANSIA Improvement Plan Area	Moderate
Triumfetta echinata	P3	Red sandy soils. Sand dunes	Yes	Recorded on the eastern boundary of the ANSIA Improvement Plan Area	Moderate
Abutilon sp. *Pritzelianum* (S. van Leeuwen 5095)	P3	Not available	Not known	Recorded 10 km from the ANSIA Improvement Plan Area	Low
Abutilon sp. *Onslow* (F. Smith s.n. 10/9/61) PN	P1	Not available	Yes	Recorded < 30 km to the east of the ANSIA Improvement Plan Area	Low - outside documented range
Carpobrotus sp. *Thevenard Island* (M. White 050)	P3	Coarse white sand. Dune tops, disturbed areas.	No	Recorded on Thevenard Island	Low

4.1.2 Threatened and priority ecological communities

There are no TECs or PECs within the survey area.

4.2 Field survey results

4.2.1 Flora

4.2.1.1 Flora statistics

A total of 111 vascular flora taxa were recorded within the survey area for the current survey of which 105 (94.6%) were native species and 6 (5.4%) were naturalised alien (weed) species.

The taxa recorded represent 24 families and 67 genera. The families represented by the greatest number of taxa are presented in Table 15. The genera represented by the greatest number of taxa are presented in Table 16.

When the species from the Biota (2010a; 2010b) and ENV (2012) floristic quadrats located within the survey area are included, a total of 137 flora taxa have been recorded to date within the survey area of which 131 (95.6%) were native species and six (4.4%) were naturalised alien (weed) species.

The list of taxa recorded for the current survey is presented in Appendix B. The complete species list for the survey area including taxa recorded by Biota (2010a; 2010b) and ENV (2012) is presented in Appendix C, species recorded by floristic site (quadrat) are presented in Appendix D, and detailed floristic quadrat data are presented in Appendix E.

Table 15: Dominant families within the survey area

Family	No. of taxa
FABACEAE	26
POACEAE	17
CHENOPODIACEAE	12
ASTERACEAE	11
MALVACEAE	7
GOODENIACEAE	6
PROTEACEAE	4

Table 16: Dominant genera within the survey area

Family	Genus	No. of taxa
FABACEAE	*Acacia*	9
GOODENIACEAE	*Scaevola*	5
FABACEAE	*Senna*	4
POACEAE	*Eragrostis*	3
POACEAE	*Eriachne*	3
FABACEAE	*Cullen*	3
CHENOPODIACEAE	*Atriplex*	3
CHENOPODIACEAE	*Tecticornia*	3
ASTERACEAE	*Pluchea*	3
ASTERACEAE	*Streptoglossa*	3

4.2.1.2 Field survey effort

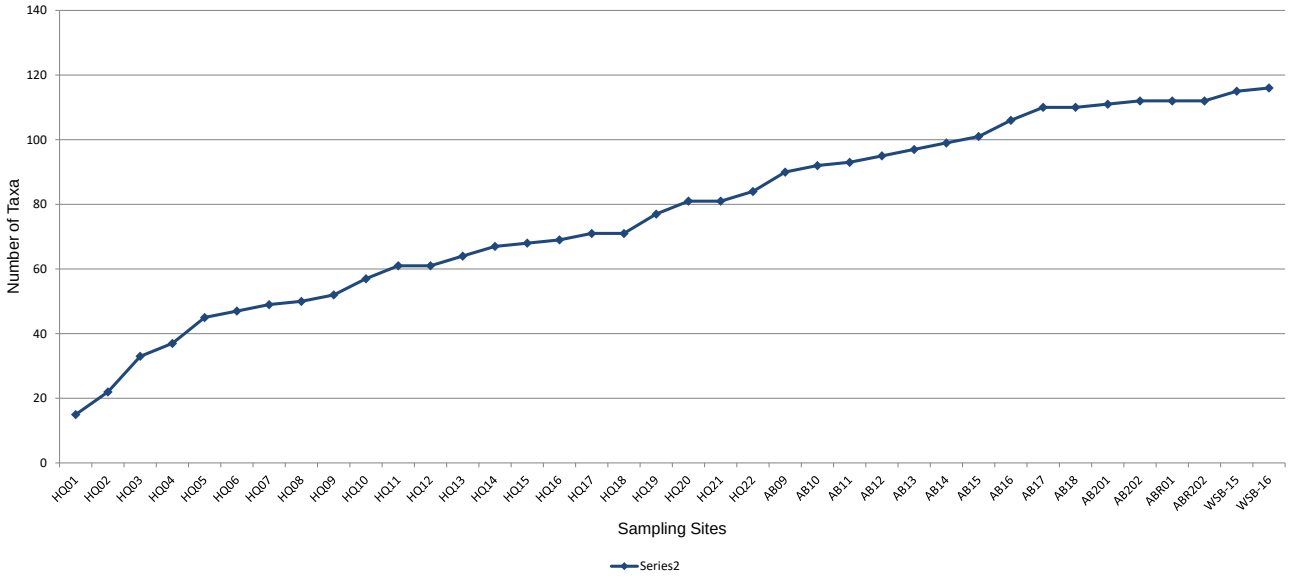
Species accumulation plots were generated for the survey site data using PRIMERv7 SPEC-ACCUM (Graph 2). This expressed the number of species recorded for the field survey as a function of effort (i.e., number of sites sampled).

Initially, the analysis was run on the dataset in the order that the sampling sites (quadrats) from the current survey were sampled in the field (i.e., chronologically) using the 'Sobs' index. This generated a 'stepped' curve showing the actual cumulative number of taxa recorded as each subsequent floristic site was sampled (Graph 2). It should be noted that the Biota (2010a; 2010b) sites and ENV (2012) sites were added after those from the current survey.

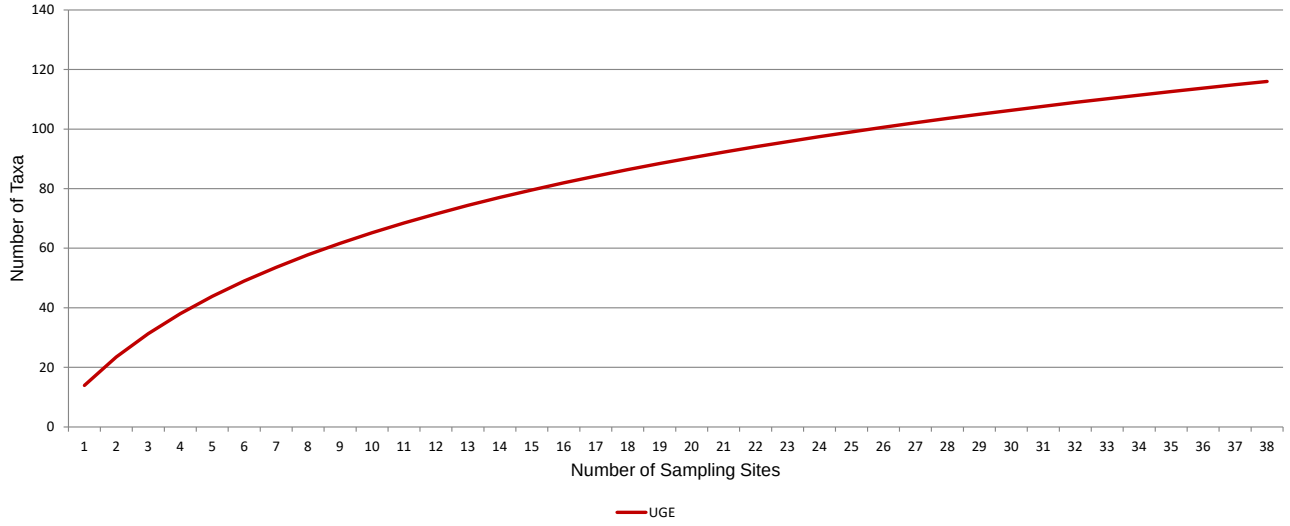
A second analysis was undertaken using the 'UGE' index to generate a smooth curve which was derived from the means of repeated re-sampling of all pooled samples (Graph 3). This curve represents the 'statistical expectation' for the curve shown in Graph 2.

The curves demonstrate that a total of 116 taxa were recorded for the 38 quadrats. The shape of the curve indicates that fewer new species were recorded with the sampling of each additional site and that the number of sites that would have to be sampled to reach the asymptote (theoretical maximum) would be prohibitively large.

It was concluded that the survey effort for the current field survey was very good. It should also be noted that an additional 21 taxa were recorded opportunistically bringing the actual total to 137.



Graph 2: Species accumulation curve (Sobs index)



Graph 3: Species accumulation curve (UGE index)

4.2.1.3 Threatened and priority flora

No TF species listed under the BC Act or the EPBC Act were recorded within the survey area.

One P3 PF species, *Eremophila forrestii* subsp. *viridis*, was recorded within the survey area.

Descriptions of the species, and its location and abundance within the survey area is discussed in the following sections.

4.2.1.3.1 *Eremophila forrestii* subsp. *viridis* (P3)

For the current survey, a total of 1102 individuals were recorded from 176 locations within the survey area (Figure G; Plate 1 and Plate 2). The number of individuals and their locations are presented in Appendix F. These populations were generally associated with the mid and upper slopes of the linear sand dunes, swales and the gently undulating sand plains. The species was recorded either as isolated individuals or isolated clumps within the sand dune and sand plain vegetation. The species has also been recorded at other locations within the ANSIA area and wider Onslow locality (OEC 2008; Astron 2009; ENV 2012; Biota 2010a and 2010b), also shown in Figure G, with additional locations beyond ANSIA recently recorded by EcoLogical (2021).

Plate 1: ***Eremophila forrestii* subsp. *viridis* growing on the slopes of red sand dunes in the survey area**

Plate 2: ***Eremophila forrestii* subsp. *viridis***

4.2.1.4 Flora of other conservation significance

There are several other criteria (apart from the Commonwealth and Western Australian criteria of TF and PF) under which flora taxa may be considered to be of 'other' conservation significance. These taxa are considered significant in EPA (2016) under various categories which include:

- Locally endemic or association with a restricted habitat type (e.g., surface water or groundwater dependent ecosystems)
- New species or anomalous features that indicate a potential new species
- Representative of the range of a species (particularly, at the extremes of range recently discovered range extensions, or isolated outliers of the main range)
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

These taxa are not protected under Commonwealth or state legislation but are required to be assessed as part of flora and vegetation assessments.

None of the flora taxa recorded for the current survey within the survey area are considered to be of 'other' conservation significance based on the criteria listed above.

4.2.1.5 Introduced flora (weeds)

Six naturalised alien (weed) species were recorded for the survey area, representing 4.4% of the total flora taxa recorded. **Cenchrus ciliaris* (Buffel grass), **Prosopis pallida* (Mesquite) and **Vachellia farnesiana* (Mimosa bush) were the most wide-spread weeds within the survey area. Weed species recorded within the survey area in order of abundance are listed in Table 17.

Table 17: Weed species recorded within the survey area

Family	Taxon	Common name	Number of sites	% of sites
POACEAE	**Cenchrus ciliaris*	Buffel grass	35	92.1
FABACEAE	**Vachellia farnesiana*	Mimosa bush	7	18.4
FABACEAE	**Prosopis pallida*	Mesquite	6	15.8
AMARANTHACEAE	**Aerva javanica*	Kapok	1	2.6
ASTERACEAE	**Flaveria trinervia*	Speedy weed	1	2.6
POACEAE	**Cenchrus setiger*	Birdwood grass	1	2.6

4.2.1.5.1 Declared pests and weeds of national significance

The WAOL database was searched to determine the legal status of each weed recorded, and any control requirements that may apply under the BAM Act. One species, **Prosopis pallida* (Mesquite) was determined to be a Declared Pest, and is also listed as a WoNS (Table 18).

Table 18: Weed species recorded within the survey area, their legal status and control requirements under the BAM Act

Name	Legal status	Control / keeping category
**Prosopis pallida*	Declared Pest, Prohibited – s12*	C2 - Eradication / Prohibited† (whole of state)
**Aerva javanica*	Permitted – s11‡	-
**Vachellia farnesiana*	Permitted – s11	-
**Cenchrus ciliaris*	Permitted – s11	-
**Cenchrus setiger*	Permitted – s11	-
**Flaveria trinervia*	Permitted – s11	-

*Declared Pest, Prohibited - s12: Prohibited organisms are declared pests by virtue of section 22(1), and may only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.

†C2 Eradication: Organisms which should be eradicated from part or all of Western Australia.

‡Permitted - s11: Permitted organisms must satisfy any applicable import requirements when imported. They may be subject to an import permit if they are potential carriers of high-risk organisms.

4.2.2 Vegetation

4.2.2.1 Habitat types

The detailed survey identified five broad habitat types across the range of landforms within the survey area as follows:

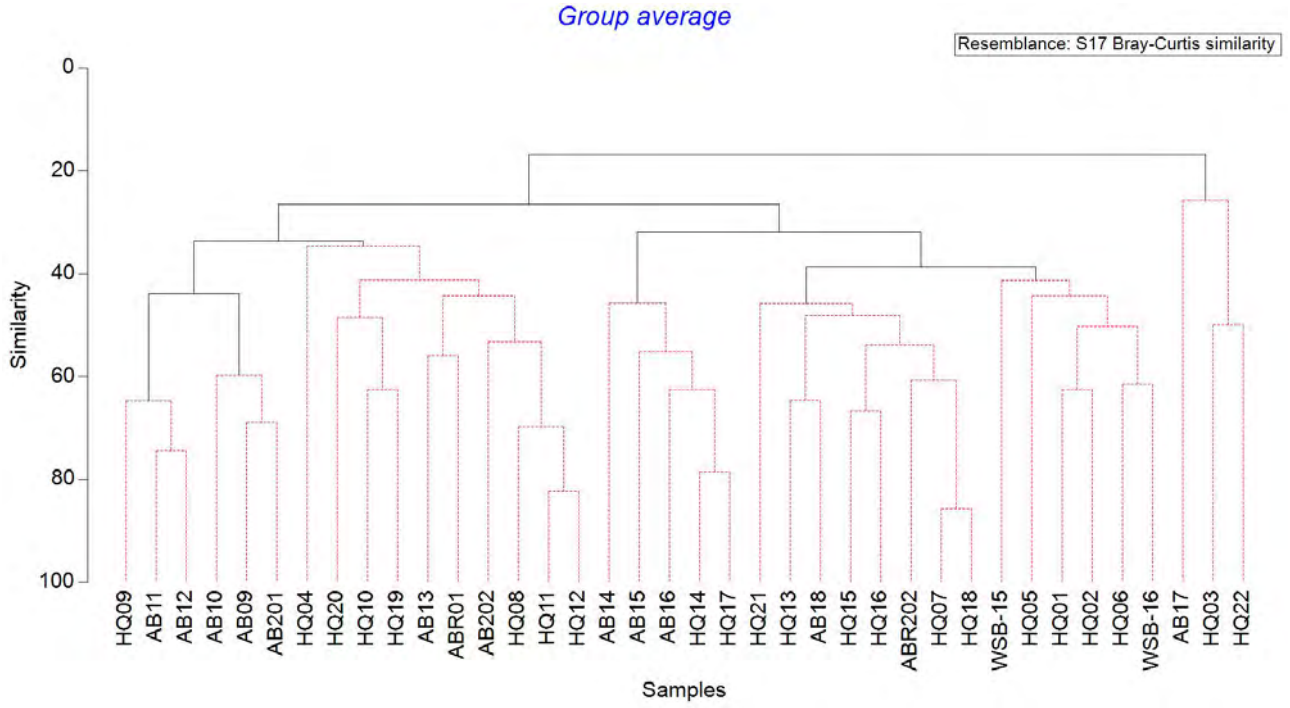
- Sand plains
- Low sandy rises, dunes and swales
- Crests and slopes of tall dunes
- Claypans and clay plains
- Samphire flats.

4.2.2.2 Vegetation units

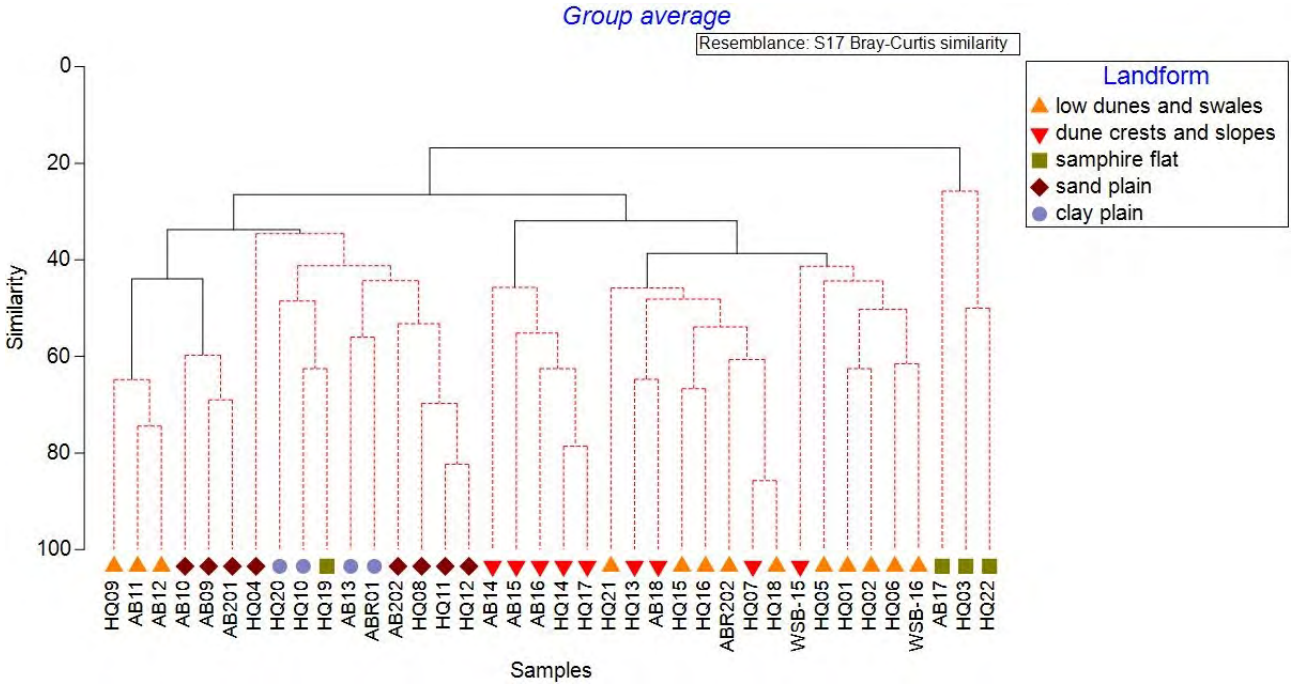
A total of nine vegetation units were described and mapped for the survey area. The vegetation units were defined from 38 floristic quadrats – 22 from the current survey and sixteen from surveys previously undertaken by ENV (2012) and Biota (2010a; 2010b). As stated in methods, vegetation community mapping was conducted using a combination of aerial photointerpretation, on-ground confirmation, vegetation structure data, and multivariate analysis of the floristic quadrat data. The hierarchical cluster analysis of the quadrat data determined there to be seven floristically distinct groups of sites (Graph 4) which were generally well correlated with the different landforms / habitat types present within the survey area: sand plains, dune crests and slopes, low dunes and swales, claypans and clay plains, and samphire flats (Graph 5), and very well correlated to the nine vegetation units defined for the current assessment (Graph 6).

Two additional mapping units were defined for the current study – Claypans and Mudflats. These areas were mapped but because they were bare areas generally devoid of vegetation they were not sampled via floristic sites.

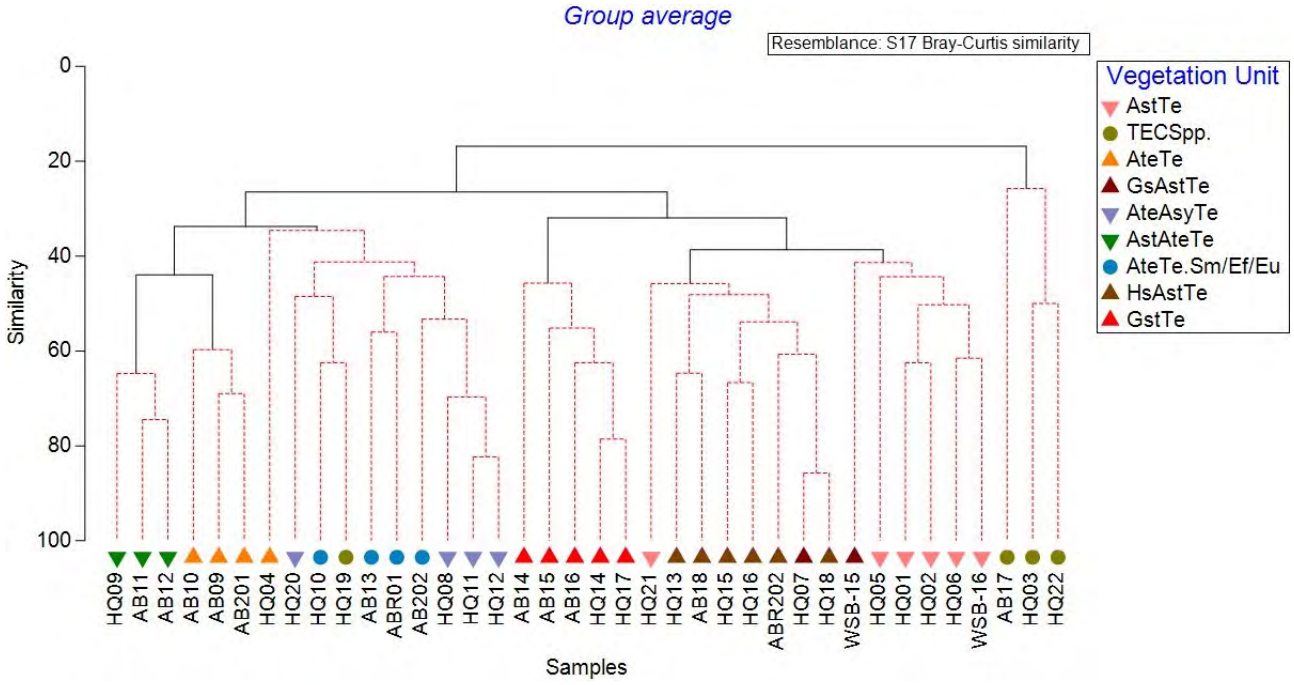
The vegetation unit mapping is presented in Figure H-1 to H-3. A brief description of the vegetation units, their extent (ha) within the survey area, and the floristic sites representative of them is presented in Table 19. The vegetation units are described in further detail in the following sections.



Graph 4: Classification dendrogram showing grouping of the 38 survey quadrats based on floristics



Graph 5: Classification dendrogram showing grouping of the 38 survey quadrats in relation to landform



Graph 6: Classification dendrogram showing grouping of the 38 survey quadrats in relation to vegetation type

Table 19: Vegetation units described and mapped for the survey area (ha), percentage of the survey area and number of quadrats sampled in each vegetation unit

Veg unit	Description	Area (ha)	Percentage (%)	Quadrats
Sand plains				
AteAsyTe	*Acacia tetragonophylla* and *A. synchronicia* Tall to Mid Isolated Shrubs to Open Shrubland over *Triodia epactia* Hummock Grassland	12.70	2.17	HQ08 HQ11 HQ12 HQ20
AteTe	*Acacia tetragonophylla* Tall to Mid Isolated Shrubs to Open Shrubland over *Triodia epactia* Hummock Grassland	216.79	37.00	AB09 AB10 AB201 HQ04
Low dunes and swales				
AstAteTe	*Acacia tetragonophylla* and *A. stellaticeps* Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland	18.69	3.19	AB11 AB12 HQ09
AstTe	*Acacia stellaticeps* Mid Open Shrubland over *Verticordia forrestii* and *Scaevola sericophylla* Low Sparse Shrubland over *Triodia epactia* Open Hummock Grassland	59.41	10.13	HQ01 HQ02 HQ05 HQ06 HQ21 WSB-16
Dune crests and slopes				
GsAstTe	*Grevillea stenobotrya* Tall Sparse Shrubland over *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland	26.03	4.44	HQ07 WSB-15
GsTe	*Grevillea stenobotrya* Tall Sparse to Open Shrubland over *Triodia epactia* Open Hummock Grassland	52.38	8.93	AB14 AB15 AB16 HQ14 HQ17
HsAstTe	*Hakea stenophylla* subsp. *stenophylla* Mid Sparse Shrubland over *Acacia stellaticeps* Low Sparse Shrubland over *Triodia epactia* Open Hummock Grassland	46.26	7.89	AB18 ABR202 HQ13 HQ15 HQ16 HQ18
Clay plain				
AteTe.Sm/Ef/Eu	*Acacia tetragonophylla* Tall to Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland and *Sporobolus mitchellii, Eragrostis falcata* and *Eulalia aurea* Tussock Grassland	92.16	15.72	AB13 AB202 ABR01 HQ10
Samphire flat				
TECSpp.	*Tecticornia* spp. Low Open Samphire Shrubland over *Lawrencia viridigrisea* and *Eragrostis falcata* Sparse Forbland/ Tussock Grassland	34.01	5.80	AB17 HQ03 HQ19 HQ22
Bare areas				
CP	Bare clay pans with only scattered annual grasses and forbs	24.22	4.13	NA
MF	Bare mudflats	3.76	0.64	NA

4.2.2.2.1 Sand plains

Two vegetation units were defined for the sand plains within the survey area.

***AteAsyTe - Acacia tetragonophylla* and *A. synchronicia* Tall to Mid Isolated Shrubs to Open Shrubland over *Triodia epactia* Hummock Grassland**

This unit (Plate 3) was mapped for two low-lying areas within the survey area. This vegetation type ranged in condition from Very Good where disturbance from weeds was low, to Degraded where moderate to dense infestations of **Cenchrus ciliaris*, **Prosopis pallida* and / or **Vachellia farnesiana* were recorded.

Associated species include: *Acacia colei* var*. colei, Acacia sericophylla, Acacia synchronicia, Acacia tetragonophylla, Atriplex bunburyana, Bergia perennis* subsp*. exigua, *Cenchrus ciliaris, Cullen leucanthum, Enchylaena tomentosa, Eragrostis dielsii, Eulalia aurea, Indigofera colutea, *Prosopis pallida, Rhagodia eremaea, Salsola australis, Scaevola spinescens, Sesbania cannabina, Sporobolus mitchellii, Stemodia* sp. Onslow (A.A. Mitchell 76/148), *Streptoglossa ? liatroides, Triodia epactia* and **Vachellia farnesiana*.

No conservation significant flora species were recorded in this unit for the current survey, nor have they been recorded for previous surveys.

Plate 3: *AteAsyTe* vegetation unit

***AteTe - Acacia tetragonophylla* Tall to Mid Isolated Shrubs to Open Shrubland over *Triodia epactia* Hummock Grassland**

This unit (Plate 4) was widespread throughout the survey area occupying the sandplains, and low sandy rises and lower dune slopes. This vegetation type ranged in condition from Very Good throughout much of its extent, to Degraded adjacent to roads and vehicle tracks where moderate to dense infestations of **Cenchrus ciliaris* were recorded.

Associated species include: *Acacia tetragonophylla, Atriplex codonocarpa, *Cenchrus ciliaris, Frankenia ambita, Indigofera boviperda, Lawrencia viridigrisea, Scaevola spinescens* (broad form), *Sclerolaena recurvicuspis, Solanum lasiophyllum, Threlkeldia diffusa* and *Triodia epactia*.

One conservation significant flora species, *Eremophila forrestii* subsp*. viridis* (P3), was recorded in this unit.

Plate 4: *AteTe* vegetation unit

4.2.2.2.2 Low dunes and swales

Two vegetation units were defined for the low dunes and swales within the survey area.

***AstAteTe - Acacia tetragonophylla* and *A. stellaticeps* Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland**

This unit (Plate 5) was mapped at one location for the low sandy rises and lower dune slopes. This vegetation type was in Very Good condition with **Cenchrus ciliaris* only recorded in isolated patches and / or at low densities throughout its extent.

Associated species include: *Acacia stellaticeps, Acacia tetragonophylla, Cassytha capillaris, *Cenchrus ciliaris, Evolvulus alsinoides* var*. villosicalyx, Goodenia forrestii, Grevillea stenobotrya, Pterocaulon sphaeranthoides, Scaevola spinescens* (broad form), *Trichodesma zeylanicum* and *Triodia epactia*.

One conservation significant flora species, *Eremophila forrestii* subsp*. viridis* (P3), was recorded in this unit.

Plate 5: *AstAteTe* vegetation unit

AstTe - Acacia stellaticeps* Mid Open Shrubland over *Verticordia forrestii* and *Scaevola sericophylla* Low Sparse Shrubland over *Triodia epactia Open Hummock Grassland

This unit (Plate 6) was widespread throughout the survey area occupying the lower and mid slopes of the dunes and the swales in between them. This vegetation type ranged in condition from Very Good throughout much of its extent, to Degraded adjacent to roads and vehicle tracks where moderate to dense infestations of **Cenchrus ciliaris* were recorded.

Associated species include: *Acacia coriacea* subsp*. coriacea, Acacia stellaticeps, Acacia synchronicia, Acacia tetragonophylla, Aristida holathera, Bonamia erecta, Cassytha capillaris, Cassytha filiformis, *Cenchrus ciliaris, Crotalaria cunninghamii, Cymbopogon ambiguus, Enchylaena tomentosa, Eremophila forrestii* subsp*. viridis* (P3)*, Eriachne helmsii, Eulalia aurea, Grevillea stenobotrya, Hakea chordophylla,*

Hibiscus brachychlaenus, Pterocaulon sphacelatum, Pterocaulon sphaeranthoides, Ptilotus exaltatus, Salsola australis, Scaevola pulchella, Scaevola sericophylla, Scaevola spinescens, Senna artemisioides subsp*. oligophylla, Senna glutinosa* subsp. × *luerssenii, Solanum horridum, Solanum lasiophyllum, Stemodia* sp. *Onslow* (A.A. Mitchell 76/148)*, Stylobasium spathulatum, Tephrosia uniovulata, Trichodesma zeylanicum, Triodia epactia* and *Verticordia forrestii*.

One conservation significant flora species, *Eremophila forrestii* subsp*. viridis* (P3), was recorded in this unit.

Plate 6: *AstTe* vegetation unit

4.2.2.2.3 Dune crests and slopes

Three vegetation units were defined for the dune crests and slopes within the survey area.

***GsAstTe - Grevillea stenobotrya* Tall Sparse Shrubland over *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland**

This unit (Plate 7) was mapped for the dune crests and upper slopes in the western portion of the survey area. This vegetation type was predominantly in Very Good or Good condition with **Cenchrus ciliaris* only recorded in isolated patches and / or at low densities.

Associated species include: *Acacia coriacea* subsp*. coriacea, Acacia stellaticeps, Acacia tetragonophylla, Bonamia erecta, *Cenchrus ciliaris, Diplopeltis eriocarpa, Grevillea stenobotrya, Hakea stenophylla* subsp*. stenophylla, Solanum lasiophyllum* and *Triodia epactia*.

One conservation significant flora species, *Eremophila forrestii* subsp*. viridis* (P3), was recorded in this unit.

Plate 7: *GsAstTe* vegetation unit

***GsTe - Grevillea stenobotrya* Tall Sparse to Open Shrubland over *Triodia epactia* Open Hummock Grassland**

This unit (Plate 8) was mapped for the dune crests and upper slopes in the south eastern portion of the survey area. This vegetation type ranged in condition from Very Good throughout much of its extent, to Degraded adjacent to roads and vehicle tracks where moderate to dense infestations of **Cenchrus ciliaris* were recorded.

Associated species include: *Acacia stellaticeps, Acacia sericophylla, Adriana tomentosa* var*. tomentosa, Bonamia erecta, Cassytha capillaris, *Cenchrus ciliaris, Crotalaria cunninghamii, Euphorbia wheeleri, Grevillea stenobotrya, Hibiscus brachychlaenus, Scaevola sericophylla, Solanum lasiophyllum, Tephrosia rosea* var. *clementii, Trianthema pilosa, Trichodesma zeylanicum, Triodia epactia* and *Triodia schinzii*.

One conservation significant flora species, *Eremophila forrestii* subsp*. viridis* (P3), was recorded in this unit.

Plate 8: *GsTe* vegetation unit

***HsAstTe - Hakea stenophylla* subsp*. stenophylla* Mid Sparse Shrubland over *Acacia stellaticeps* Low Sparse Shrubland over *Triodia epactia* Open Hummock Grassland**

This unit (Plate 9) occupied the lower and mid slopes of the dunes and the swales in between them in the south-eastern portion of the survey area. This vegetation type was predominantly in Very Good or Good condition with **Cenchrus ciliaris* only recorded in isolated patches and / or at low densities.

Associated species include: *Acacia stellaticeps, Acacia colei* var*. colei, Acacia sericophylla, Acacia synchronicia, Acacia tetragonophylla, Bonamia erecta, Cassytha capillaris, *Cenchrus ciliaris, Corymbia zygophylla, Diplopeltis eriocarpa, Enchylaena tomentosa, Eremophila forrestii* subsp*. viridis* (P3)*, Eriachne helmsii, Eucalyptus victrix, Goodenia forrestii, Grevillea eriostachya, Grevillea stenobotrya, Hakea stenophylla subsp. stenophylla, Indigofera colutea, Scaevola spinescens, Senna glutinosa* subsp. × *luerssenii, Solanum lasiophyllum, Trichodesma zeylanicum* and *Triodia epactia*.

One conservation significant flora species, *Eremophila forrestii* subsp*. viridis* (P3), was recorded in this unit.

Plate 9: *HsAstTe* vegetation unit

4.2.2.2.4 Clay plains

One vegetation unit was defined for the claypans and clay plains within the survey area.

***AteTe.Sm/Ef/Eu - Acacia tetragonophylla* Tall to Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland and *Sporobolus mitchellii, Eragrostis falcata* and *Eulalia aurea* Tussock Grassland**

This unit (Plate 10) was mapped for the low-lying clay plains and claypans within the survey area. This vegetation type ranged in condition from Very Good where disturbance was low, to Degraded where moderate to dense infestations of **Cenchrus ciliaris*, **Prosopis pallida* and / or **Vachellia farnesiana* were recorded.

Associated species include: *Acacia tetragonophylla, Atriplex semilunaris, *Cenchrus ciliaris, Chloris pectinata, Enchylaena tomentosa, Enchylaena tomentosa, Eragrostis falcata, Eriachne helmsii, Eulalia aurea, Marsilea drummondii, *Prosopis pallida, Scaevola spinescens* (narrow form), *Sporobolus mitchellii, Tecticornia indica* subsp*. bidens, Threlkeldia diffusa* and *Triodia epactia*.

No conservation significant flora species were recorded in this unit.

Plate 10: *AteTe.Sm/Ef/Eu* vegetation unit

4.2.2.2.5 Samphire flats

TEC*spp*. - Tecticornia* spp. Low Open Samphire Shrubland over *Lawrencia viridigrisea* and *Eragrostis falcata* Sparse Forbland / Tussock Grassland*.

This unit (Plate 11) was mapped for the saline flats within the survey area. This vegetation type was predominantly in Very Good or Good condition with **Cenchrus ciliaris* only recorded in isolated patches and / or at low densities.

Associated species include: *Acacia synchronicia, Acacia tetragonophylla, Calotis plumulifera, *Cenchrus ciliaris, *Cenchrus setiger, Cullen cinereum, Enchylaena tomentosa, Eragrostis falcata, Eragrostis pergracilis, Eriachne flaccida, Eriachne helmsii, Eulalia aurea, *Flaveria trinervia, Frankenia ambita, Lawrencia viridigrisea, Lotus cruentus, Panicum decompositum, *Prosopis pallida, Rhodanthe stricta, Salsola australis, Scaevola spinescens* (narrow form), *Sclerolaena recurvicuspis, Sporobolus mitchellii, Streptoglossa ? liatroides, Streptoglossa decurrens, Surreya diandra, Tecticornia indica* subsp*. bidens, Tecticornia pruinosa* and *Triodia epactia*.

No conservation significant flora species were recorded in this unit.

Plate 11: *TEC*spp. vegetation unit

4.2.2.3 Vegetation condition

Vegetation condition within the survey area ranged from Very Good to Completely Degraded (Figure H, and Table 20). The vegetation on the sand plains, dune crests and slopes, low dunes and swales, and samphire flats was predominantly in Very Good condition with only low-density infestation from weeds. The vegetation on the broad drainage lines and low-lying areas on the clay plains, however, was generally in worse condition with areas highly disturbed by weeds (**Cenchrus ciliaris, *Prosopis pallida* and **Vachellia farnesiana*) and historical vehicle tracks.

Table 20: Vegetation condition within the survey area

Vegetation condition		Survey area	
		Hectares (ha)	Percentage (%)
E	Excellent	0.00	0.00
VG	Very Good	341.66	58.26
G-VG	Good to Very Good	109.36	18.65
G	Good	92.92	15.85
P	Poor	11.28	1.92
D	Degraded	30.05	5.12
CD	Completely Degraded	1.14	0.19

4.2.2.4 Vegetation of conservation significance within the survey area

None of the nine vegetation units described and mapped for the survey area are representative of TECs listed under the EPBC Act or BC Act, nor are they representative of any PECs listed by the DBCA.

The dune and swale vegetation associated with the P3 PF taxon *Eremophila forrestii* subsp*. viridis*, much of which was in Very Good condition, is considered to be the vegetation of highest conservation significance within the survey area. Six of the units mapped for the current survey are associated with the PF taxon – *HsAstTe, GsTe, GsAstTe, AstTe, AstAteTe* and *AteTe* and so are considered to be of conservation significance.

5 DISCUSSION

5.1 Floristic diversity and representation

In assessing the conservation significance of flora within the survey area, consideration is given to rarity, biodiversity, endemism and representativeness of the flora in the area.

5.1.1 Rarity and endemism

The rarity of the flora was assessed via the various categories of TF (protected under the BC Act and under the EPBC Act) and PF (listed by DBCA), as well as via other criteria relating to range, endemism, restricted habitat or other anomalies (according to EPA 2016).

No TF or putative new taxa were recorded within the survey area for the current survey.

One PF species as currently listed by DBCA was recorded within the survey area – *Eremophila forrestii* subsp*. viridis* (P3). For the current survey, a total of 1,102 individuals were recorded from 176 locations within the survey area. These populations were generally associated with the mid and upper slopes of the inland sand dunes, and the lower slopes and the crests of low undulating dunes in the south-eastern section of the survey area. The species was associated with six of the sand dune and sand plain vegetation units: *HsAstTe, GsTe, GsAstTe, AstTe, AstAteTe* and *AteTe*.

Triumfetta echinata (P3) was not recorded for the current survey despite a thorough search of the portion of the survey area where it had been previously recorded by Biota (2010a) at two locations within the services corridor (Figure F). The species had also been recorded at numerous (>30) locations adjacent to the survey area in previous years by OEC (2008; 2009), Biota (2010a), and RPS (2009) within the sand dune vegetation, which is widespread throughout the locality outside the survey area. It should be noted that *Triumfetta echinata* is often absent in vegetation that has not been recently burnt because it requires fire for germination of the seed (Chevron n.d.) and all these records within the ANSIA area were observed regenerating from the burnt base of the parent plants after a fire, which went through the area in 2011. It is possible therefore that the species would be evident after another fire in the area.

Eleocharis papillosa (P3; VU) was not recorded for the current survey. This species was previously recorded from one location within the ANSIA, but outside the survey area, in the samphire vegetation mapped for the current study as: TECSpp. Approximately 34.01 ha of TECspp occurs within the survey area and 810.67 ha occurs within the broader ANSIA area. The species was considered by Biota (2010a) to be likely to occur throughout this habitat type and may be more widespread. It is known to grow on red clay over granite, open clay flats and claypans (WAH 2020).

5.1.2 Biodiversity

A total of 105 native vascular flora taxa were recorded for the current survey. The ANSIA and Onslow environs were not identified by Kendrick and Mau (2002) as “known special values”, or areas of “high species and ecosystem diversity” within the subregion; the area in the Cape Range CAR1 subregion of particular note in terms of plant biodiversity is the Cape Range caves and gorges, which has particularly high species richness for an arid area (Keighery and Gibson 1993). The floristic diversity is assessed as moderate.

5.2 Vegetation conservation significance

5.2.1 Regional representation

On a regional scale four Beard (1975) vegetation associations (117; 127; 589 and 670) are mapped for the survey area. These vegetation associations are widespread in the subregion with over 87% of their pre-European extent remaining. Kendrick and Mau (2002) assessed the reservation priority for Vegetation Association 127; 589 and 670 on a bioregional level as Medium; High; High; and Low, respectively.

5.2.2 Local representation

On a local scale the vegetation units within the survey area known to support conservation significant flora are considered to have high conservation significance because they are important for the survival/ persistence of the PF populations in the area. Six of the nine vegetation units described and mapped for the sand dune and sand plain vegetation within the survey area supported populations or scattered individuals of *Eremophila forrestii* subsp. *viridis* (P3). The total area (ha) of each of these vegetation units within the survey area, the area (ha) of each unit in Good or better condition (considered therefore to have higher conservation significance), and the total area within the wider ANSIA area are presented in Table 21. A total of 419.57 ha of conservation significant sand dune and sand plain vegetation is present within the survey area; of this 389.45 ha is in Good or better condition representing 66.41% of the survey area. These dune and sand plain vegetation units extend beyond the survey area boundary with a total of 2,553.02 ha mapped for the wider ANSIA area. These vegetation types are also known to support *Triumfetta echinata* (P3) populations in the area, which, as discussed above, may be present in another survey season or year following fire.

The samphire shrubland vegetation unit (*TEC*spp.) fringing the mudflats and occurring in some of the more saline claypans within the survey area are also considered to be of moderate to high conservation significance based on the potential presence of PF *Eleocharis papillosa,* which has been recorded previously at one location outside the survey area in samphire vegetation. The species was not recorded in the survey area for the current survey despite thorough searches. A total of 34.01 ha of this vegetation unit is present within the survey area (Table 21) most of which (33.05 ha) was in Good or better condition which represents 5.64% of the total survey area. Samphire shrublands extend beyond the survey area boundary with a total of 810.66 ha mapped for the wider ANSIA area.

Table 21: Vegetation associations of conservation significance within the survey area, and mapped within the wider ANSIA area

	Vegetation associations	Area (ha) within the survey area	Area (ha) in good or better condition	Area (ha) in good or better condition as a proportion of total survey area (%)	Area (ha) within the wider ANSIA
Vegetation of sand dunes, plains and swales					
AstAteTe	*Acacia tetragonophylla* and *A. stellaticeps* Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland	18.69	18.69	3.19	2,165.99
AteTe	*Acacia tetragonophylla* Tall to Mid Isolated Shrubs to Open Shrubland over *Triodia epactia* Hummock Grassland	216.79	206.38	35.19	
AstTe	*Acacia stellaticeps* Mid Open Shrubland over *Triodia epactia* Hummock Grassland	59.41	51.88	8.85	128.15
GsAstTe	*Grevillea stenobotrya* Tall Sparse Shrubland over *Acacia stellaticeps* Mid Sparse Shrubland over Triodia epactia Hummock Grassland	26.04	25.13	4.29	258.88
GstTe	*Grevillea stenobotrya* Tall Sparse to Open Shrubland over *Triodia epactia* Open Hummock Grassland	52.38	46.03	7.85	
HsAstTe	*Hakea stenophylla* subsp. *stenophylla* Mid Sparse and *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland	46.26	41.34	7.05	
Total		**419.57**	**389.45**	**66.41**	**2,553.02**
Samphire Shrublands					
*TEC*spp.	*Tecticornia* spp. Low Open Samphire Shrubland over *Lawrencia viridigrisea* and *Eragrostis falcata* Sparse Forbland / Tussock Grassland	34.01	33.05	5.64	810.66
Total		**34.01**	**33.05**	**5.64**	**810.66**

5.2.3 Commonwealth-listed threatened ecological communities

No known records of any Commonwealth-listed TECs occur within the survey area, nor is any of the vegetation described and mapped for the survey area likely to represent a Commonwealth-listed TEC.

5.2.4 State-listed threatened and priority ecological communities

No TECs listed under the Western Australian BC Act occur within the survey area.

No PECs listed by the DBCA correlate with any of the vegetation units described and mapped for the survey area.

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FIGURES

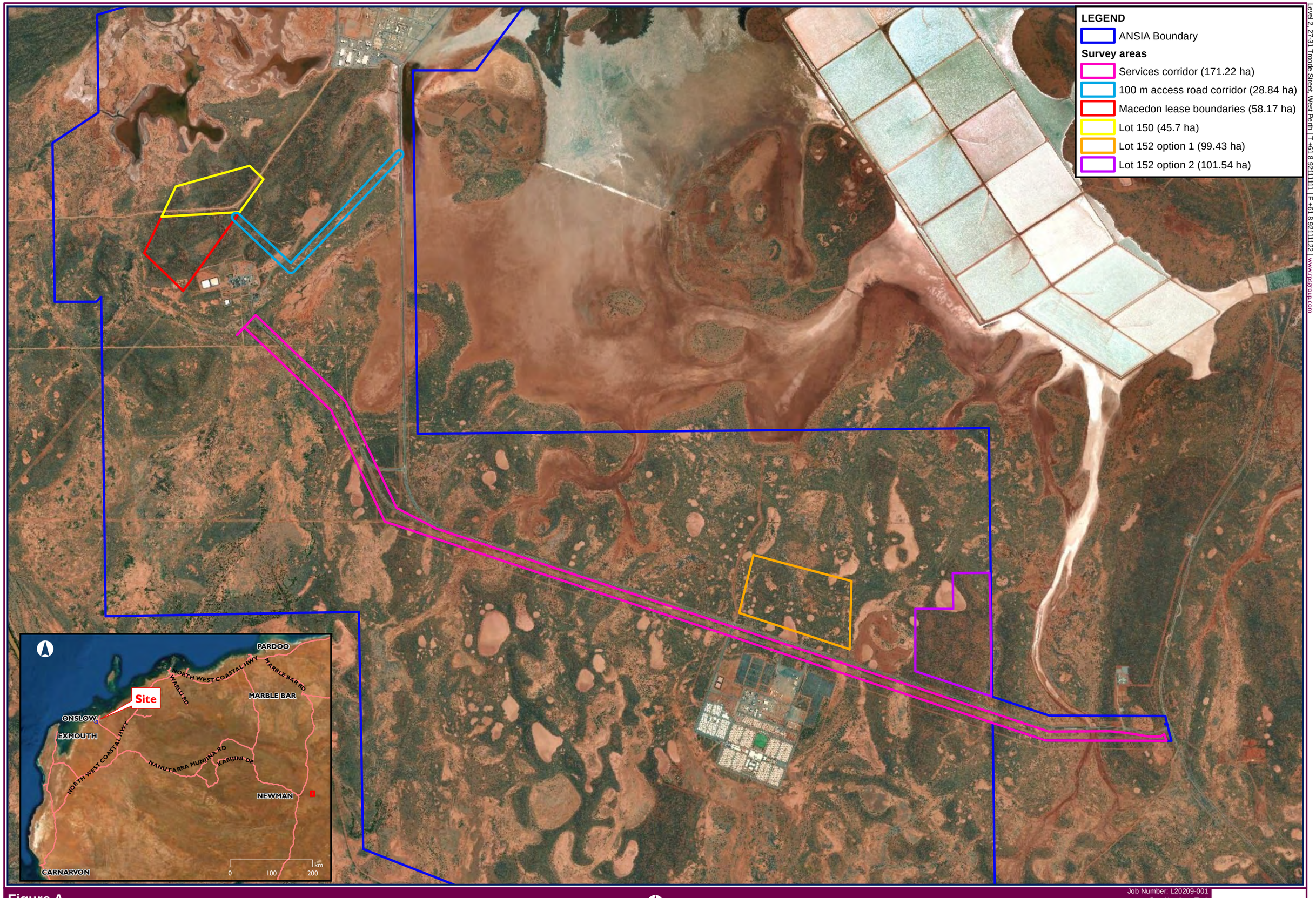

Figure A

Site location and survey areas

GDA 1994 MGA Zone 50

0 500 1,000 2,000 m

Job Number: L20209-001
Doc Number: FigA
Date: 02.02.21
Scale: 1:40,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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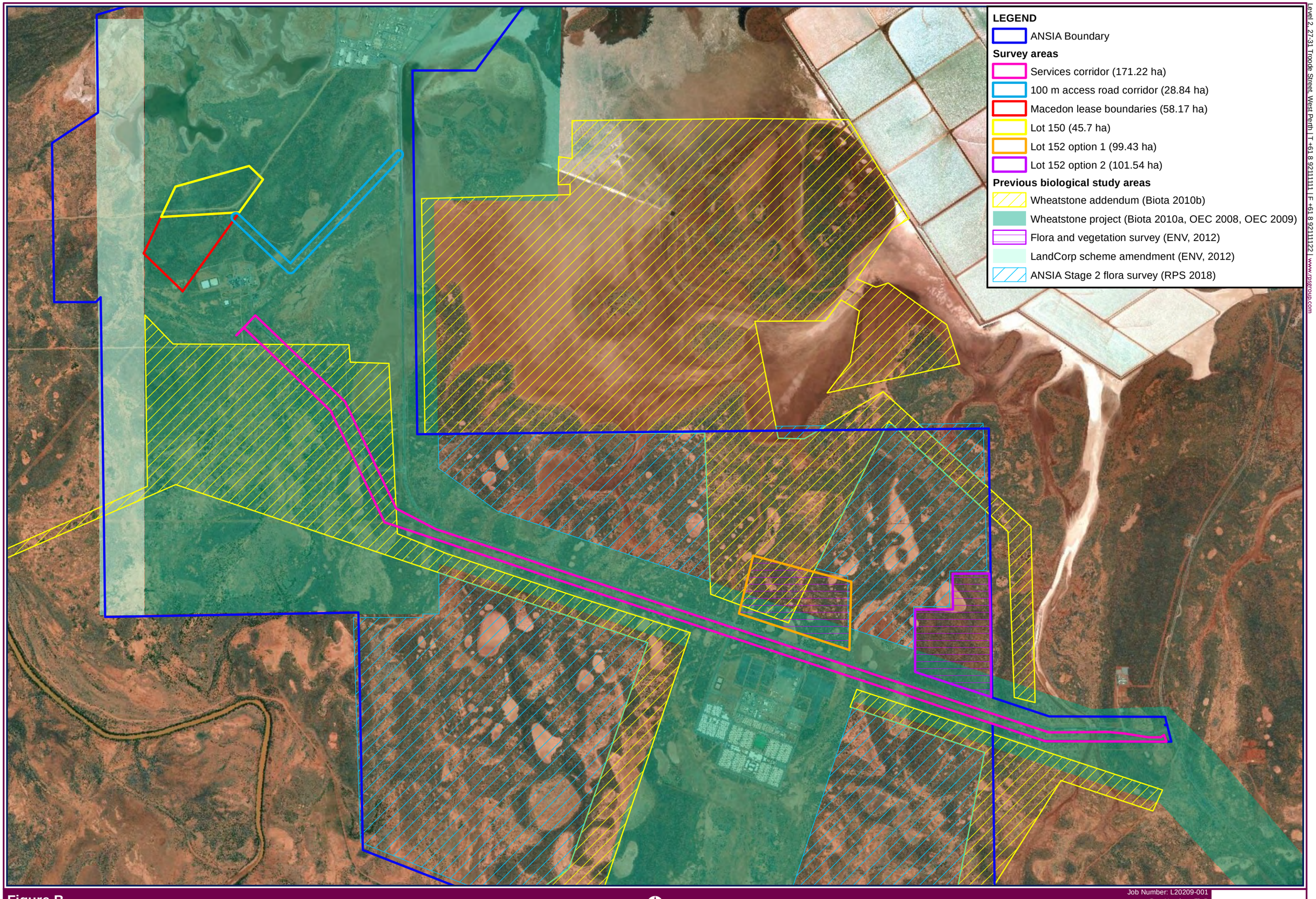

Figure B
Historical terrestrial flora and vegetation surveys undertaken within and adjacent to the survey area in recent years

GDA 1994 MGA Zone 50

0 500 1,000 2,000 m

Job Number: L20209-001
Doc Number: FigB
Date: 02.02.21
Scale: 1:40,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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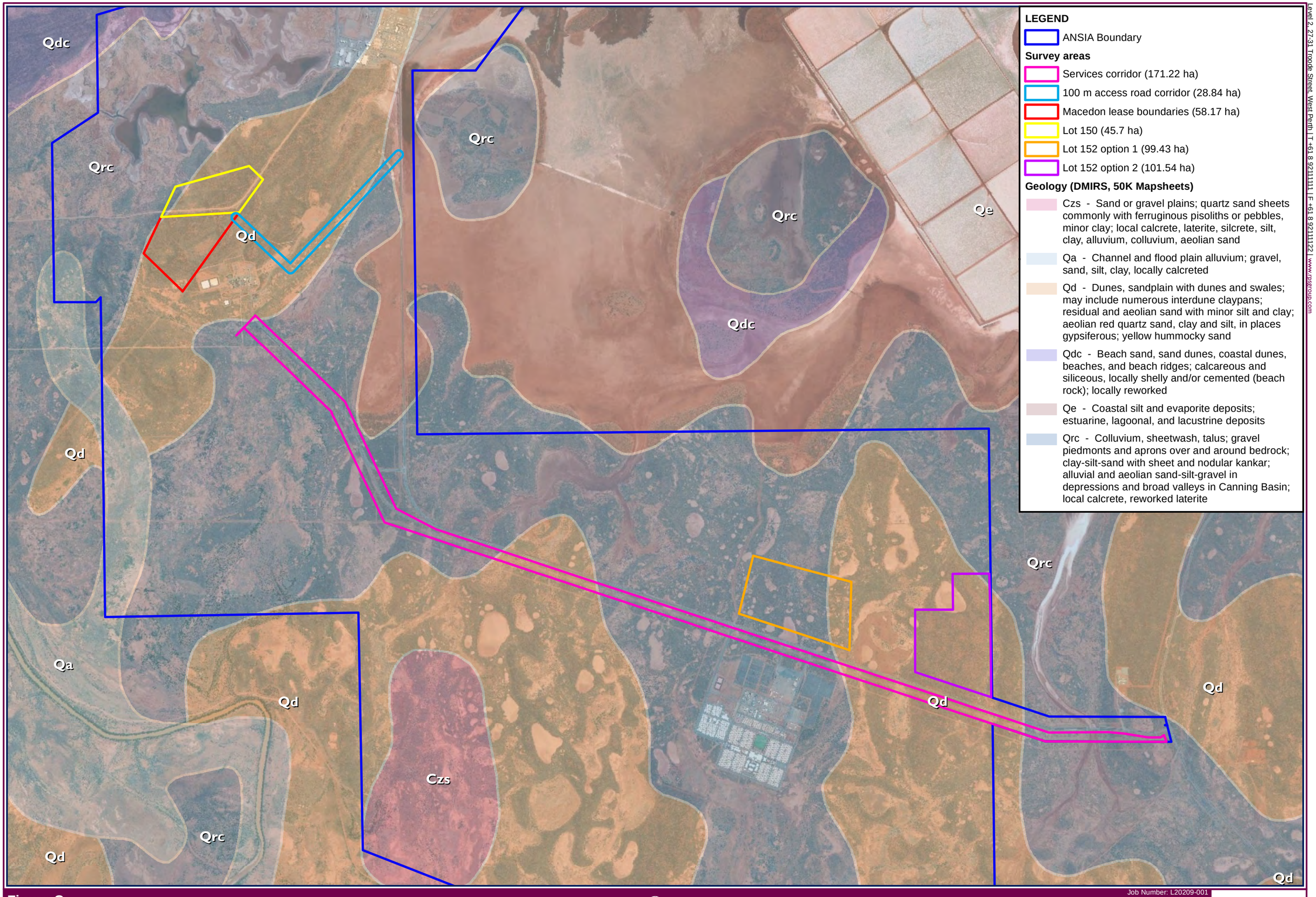

Figure C

Surface geology mapping

GDA 1994 MGA Zone 50

0 500 1,000 2,000 m

Job Number: L20209-001
Doc Number: FigC
Date: 02.02.21
Scale: 1:40,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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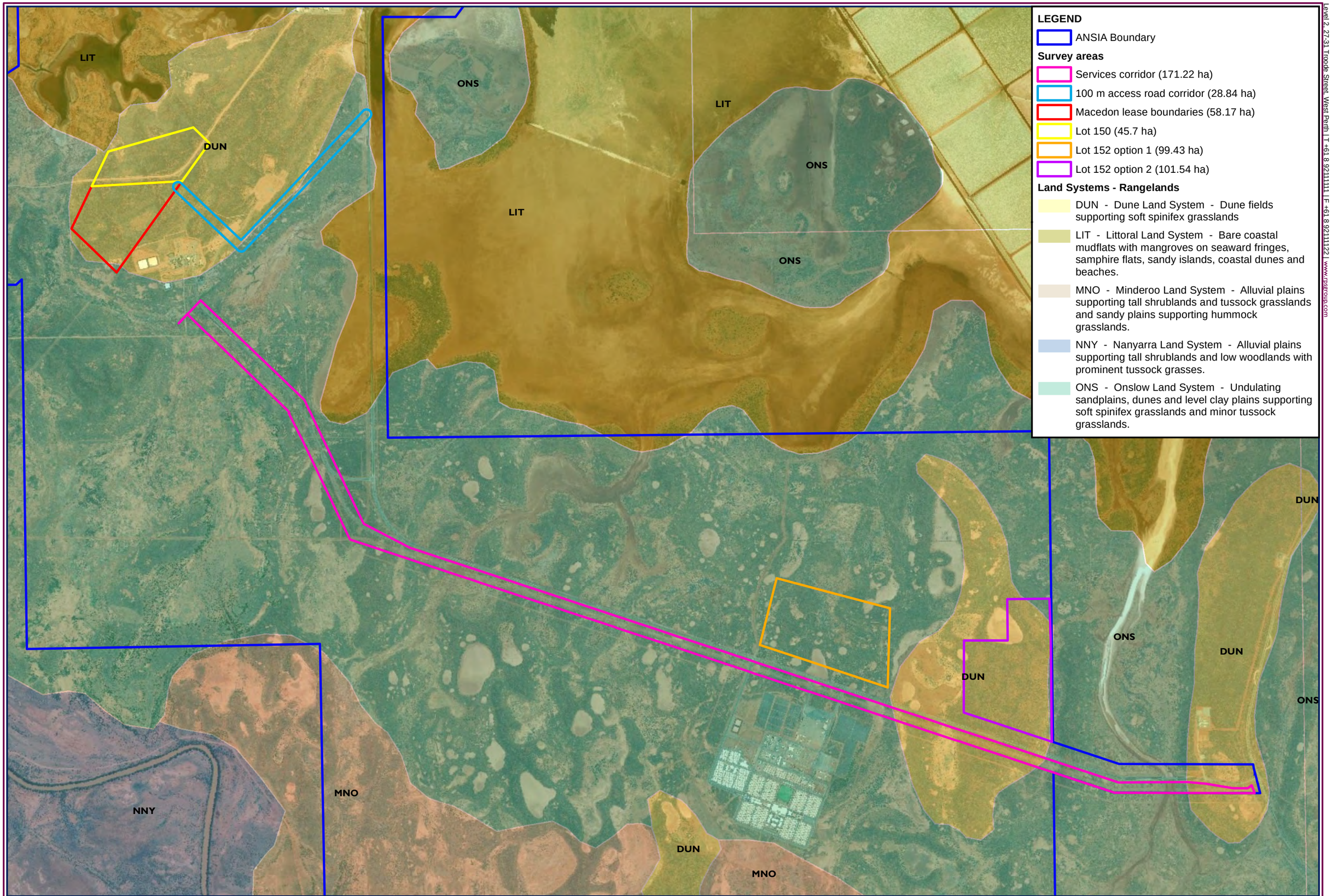

Figure D

Land system mapping

GDA 1994 MGA Zone 50

0 250 500 1,000 m

Job Number: L20209-001
Doc Number: FigD
Date: 02.02.21
Scale: 1:35,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

Document Path: G:\Jobs\L_Jobs\L20209 - Hastings Hydromet Flora\Figures L20209-001\L20209-001_G_FigD_Land systems_210202.mxd

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676
676
117
127
676
676
589
670

LEGEND

ANSIA Boundary

Survey areas

Services corridor (171.22 ha)

100 m access road corridor (28.84 ha)

Macedon lease boundaries (58.17 ha)

Lot 150 (45.7 ha)

Lot 152 option 1 (99.43 ha)

Lot 152 option 2 (101.54 ha)

Pre-european vegetation (DPIRD, 2019)

117 - CAPE YANNARE COASTAL PLAIN - Hummock grassland Triodia spp.

127 - CAPE YANNARE COASTAL PLAIN -

589 - CAPE YANNARE COASTAL PLAIN -

670 - CAPE YANNARE COASTAL PLAIN - Hummock grassland with scattered shrubs or mallee Triodia spp. Acacia spp., Grevillea spp. Eucalyptus spp

676 - CAPE YANNARE COASTAL PLAIN - Tecticornia spp. communities in saline areas

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Figure E

Pre-European vegetation association mapping (Beard 1975)

GDA 1994 MGA Zone 50

0 250 500 1,000 m

Job Number: L20209-001
Doc Number: FigE
Date: 02.02.21
Scale: 1:35,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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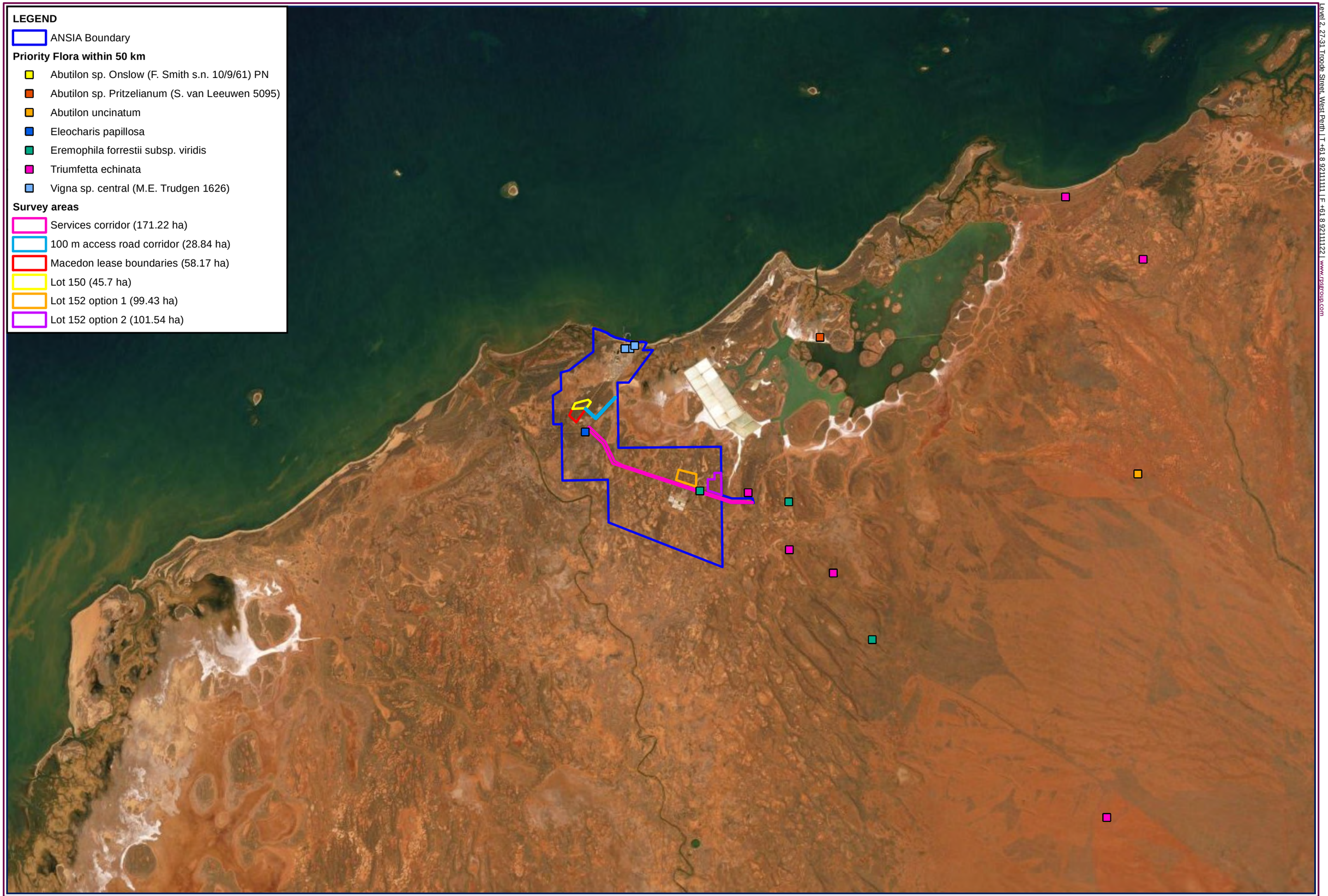

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Figure F

DBCA conservation significant flora locations

GDA 1994 MGA Zone 50

0 2 4 8 km

Job Number: L20209-001
Doc Number: FigF
Date: 02.02.21
Scale: 1:225,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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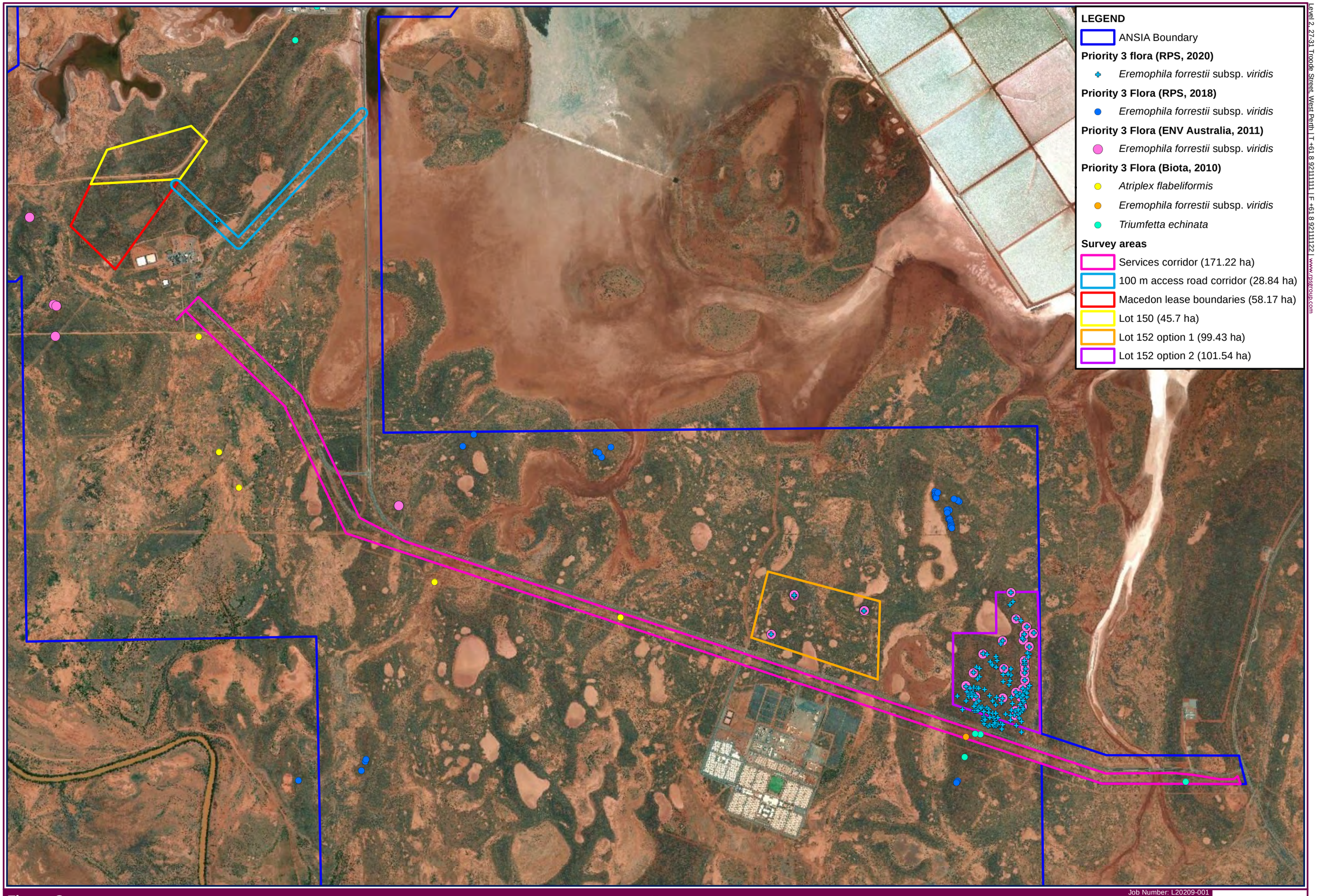

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Figure G

Conservation significant flora locations

GDA 1994 MGA Zone 50

0 250 500 1,000 m

Job Number: L20209-001
Doc Number: FigG
Date: 02.02.21
Scale: 1:35,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

Document Path: G:\Jobs\L_Jobs\L20209 - Hastings Hydromet Flora\Figures L20209-001\L20209-001_G_FigG_Significant flora locations_210202.mxd

LEGEND

- Floristic quadrats (RPS, 2020)
- Historical floristic sites (ENV, 2012 and Biota, 2010)
- ANSIA Boundary

Survey areas

- Services corridor (171.22 ha)
- 100 m access road corridor (28.84 ha)
- Macedon lease boundaries (58.17 ha)
- Lot 150 (45.7 ha)

HQ01 HQ02 HQ03 HQ04 HQ05 HQ06 HQ07

WSB-15 WSB-16

AteTe AstTe AteAsyTe GsAstTe GsTe TECSpp. CP C AteTe.Sm/Ef/Eu

Vegetation Unit	Description
AstTe	Acacia stellaticeps Mid Open Shrubland over Triodia epactia Hummock Grassland
AteAsyTe	***Acacia tetragonophylla*** and ***A. synchronicia*** Tall to Mid Isolated Shrubs to Open Shrubland over ***Triodia epactia*** Hummock Grassland
AteTe	***Acacia tetragonophylla*** Tall to Mid Isolated Shrubs to Open Shrubland over ***Triodia epactia*** Hummock Grassland
AteTe.Sm/Ef/Eu	***Acacia tetragonophylla*** Tall to Mid Isolated Shrubs over ***Triodia epactia*** Hummock Grassland and ***Sporobolus mitchellii, Eragrostis falcata*** and ***Eulalia aurea*** Tussock Grassland
GsAstTe	***Grevillea stenobotrya*** Tall Sparse Shrubland over ***Acacia stellaticeps*** Mid Sparse Shrubland over ***Triodia epactia*** Hummock Grassland
GsTe	***Grevillea stenobotrya*** Tall Sparse to Open Shrubland over ***Triodia epactia*** Open Hummock Grassland
TEC Spp.	***Tecticornia*** spp. Low Open Samphire Shrubland over ***Lawrencia viridigrisea*** and ***Eragrostis falcata*** Sparse Forbland / Tussock Grassland
CP	Bare clay pans with only scattered annual grasses and forbs

Figure H-1

Floristic sites and vegetation unit mapping

GDA 1994 MGA Zone 50

0 125 250 500 m

Job Number: L20209-001
Doc Number: FigH-1
Date: 02.02.21
Scale: 1:15,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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LEGEND

- Floristic quadrats (RPS, 2020)
- Historical floristic sites (RPS, 2018)
- ANSIA Boundary

Survey areas

- Services corridor (171.22 ha)

Vegetation Unit	Description
AstTe	Acacia stellaticeps Mid Open Shrubland over Triodia epactia Hummock Grassland
AteTe	***Acacia tetragonophylla*** Tall to Mid Isolated Shrubs to Open Shrubland over ***Triodia epactia*** Hummock Grassland
AteTe.Sm/Ef/Eu	***Acacia tetragonophylla*** Tall to Mid Isolated Shrubs over ***Triodia epactia*** Hummock Grassland and ***Sporobolus mitchellii, Eragrostis falcata*** and ***Eulalia aurea*** Tussock Grassland
GsTe	***Grevillea stenobotrya*** Tall Sparse to Open Shrubland over ***Triodia epactia*** Open Hummock Grassland
TEC Spp.	***Tecticornia*** spp. Low Open Samphire Shrubland over ***Lawrencia viridigrisea*** and ***Eragrostis falcata*** Sparse Forbland / Tussock Grassland
CP	Bare clay pans with only scattered annual grasses and forbs

TECSpp.
AteTe.Sm/Ef/Eu
AteTe
AteTe.Sm/Ef/Eu
CP
GsTe
AteTe
CP
AstTe
TECSpp.
AteTe
TECSpp.
AteTe
GsTe
TECSpp.
HQ22
GsTe
AteTe
TECSpp.
AteTe
CP
AteTe.Sm/Ef/Eu
AteTe
ANCR25
MNB13
MNC06
ANBR28
MNC07
ANBR10
MNB04
ANCR14
ANBR12
ANCR15

Figure H-2

Floristic sites and vegetation unit mapping

GDA 1994 MGA Zone 50

0 125 250 500 m

Job Number: L20209-001
Doc Number: FigH-2
Date: 02.02.21
Scale: 1:15,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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LEGEND

- Floristic quadrats (RPS, 2020)
- Historical floristic sites (RPS, 2018)
- Historical floristic sites (ENV, 2012 and Biota, 2010)
- ANSIA Boundary

Survey areas

- Services corridor (171.22 ha)
- Lot 152 option 1 (99.43 ha)
- Lot 152 option 2 (101.54 ha)

Vegetation Unit	Description
AstAteTe	***Acacia tetragonophylla*** and ***A. stellaticeps*** Mid Isolated Shrubs over ***Triodia epactia*** Hummock Grassland
AstTe	Acacia stellaticeps Mid Open Shrubland over Triodia epactia Hummock Grassland
AteAsyTe	***Acacia tetragonophylla*** and ***A. synchronicia*** Tall to Mid Isolated Shrubs to Open Shrubland over ***Triodia epactia*** Hummock Grassland
AteTe	***Acacia tetragonophylla*** Tall to Mid Isolated Shrubs to Open Shrubland over ***Triodia epactia*** Hummock Grassland
AteTe.Sm/Ef/Eu	***Acacia tetragonophylla*** Tall to Mid Isolated Shrubs over ***Triodia epactia*** Hummock Grassland and ***Sporobolus mitchellii, Eragrostis falcata*** and ***Eulalia aurea*** Tussock Grassland
GsTe	***Grevillea stenobotrya*** Tall Sparse to Open Shrubland over ***Triodia epactia*** Open Hummock Grassland
HsAstTe	***Hakea stenophylla*** subsp. ***stenophylla*** Mid Sparse and ***Acacia stellaticeps*** Mid Sparse Shrubland over ***Triodia epactia*** Hummock Grassland
***TEC* Spp.**	***Tecticornia*** spp. Low Open Samphire Shrubland over ***Lawrencia viridigrisea*** and ***Eragrostis falcata*** Sparse Forbland / Tussock Grassland
CP	Bare clay pans with only scattered annual grasses and forbs
MF	Bare mudflats

Figure H-3

Floristic sites and vegetation unit mapping

GDA 1994 MGA Zone 50

0 125 250 500 m

Job Number: L20209-001
Doc Number: FigH-3
Date: 02.02.21
Scale: 1:15,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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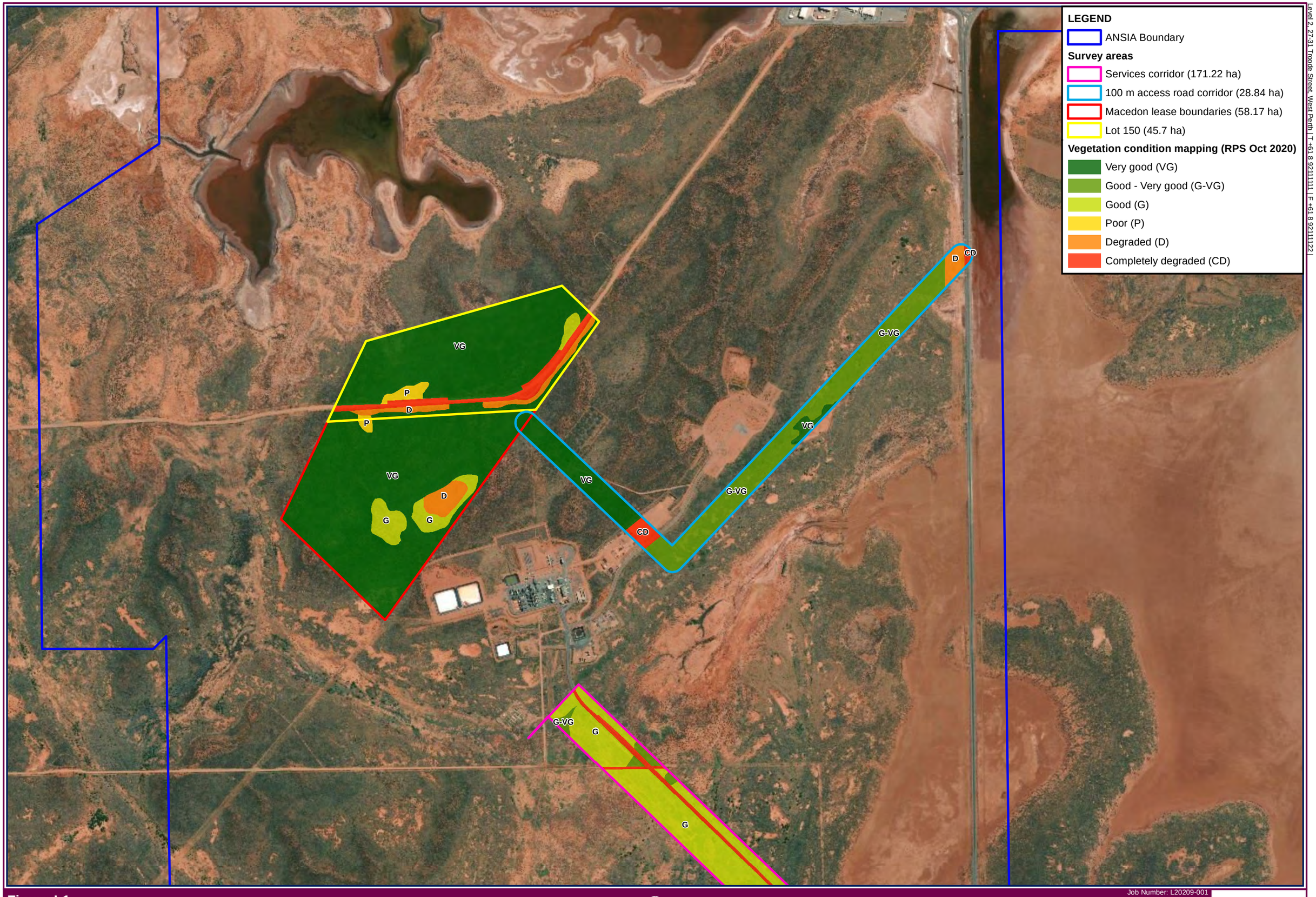

Figure I-1

Vegetation condition mapping

GDA 1994 MGA Zone 50

0 125 250 500 m

Job Number: L20209-001
Doc Number: FigI-1
Date: 02.02.21
Scale: 1:15,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

Document Path: G:\Jobs\L_Jobs\L20209 - Hastings Hydromet Flora\Figures L20209-001\L20209-001_G_FigI-1 to I-3_Vegetation Condition_210202.mxd

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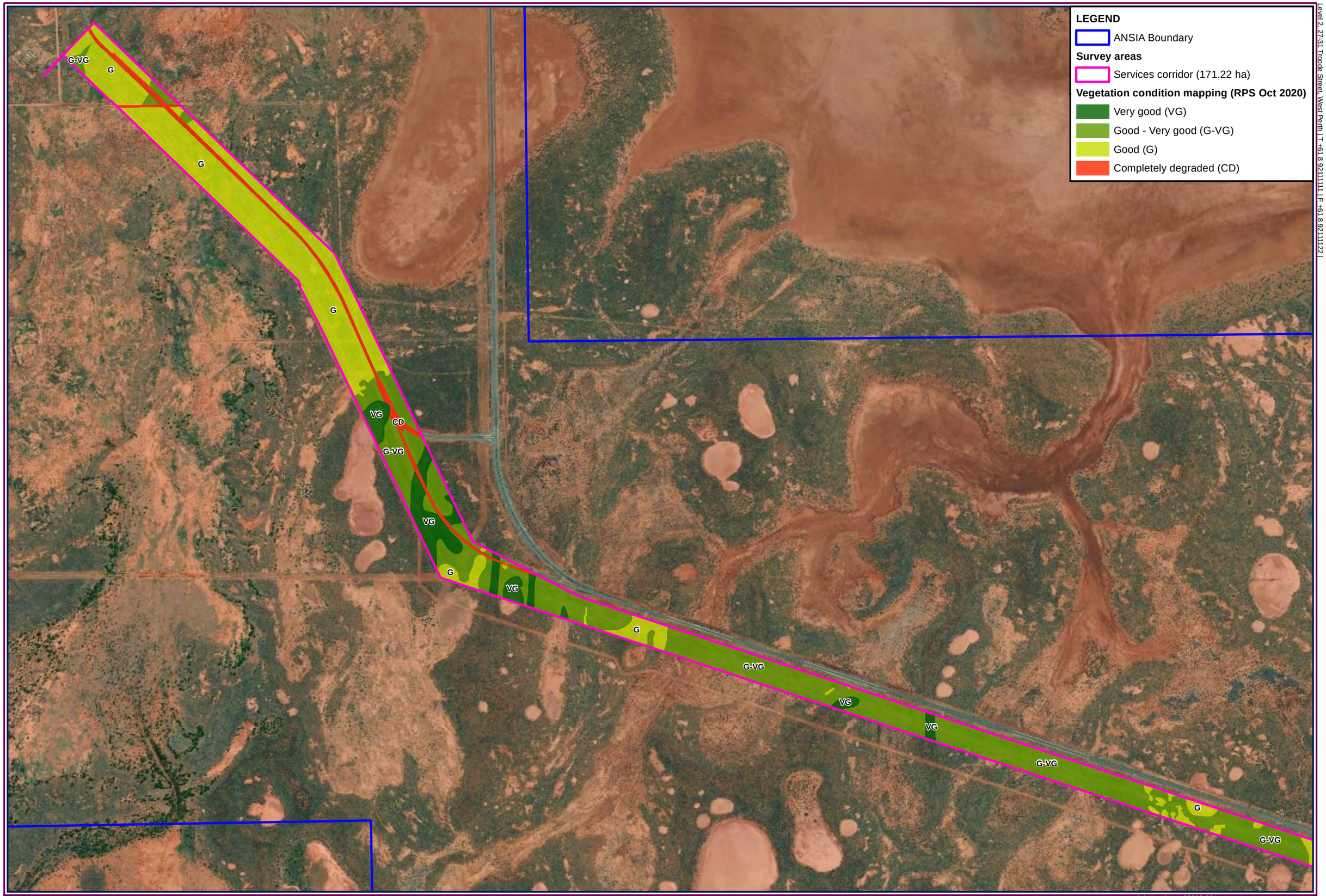

Figure I-2

Vegetation condition mapping

GDA 1994 MGA Zone 50

0 125 250 500 m

Job Number: L20209-001
Doc Number: FigI-2
Date: 02.02.21
Scale: 1:15,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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LEGEND

ANSIA Boundary

Survey areas

Services corridor (171.22 ha)

Lot 152 option 1 (99.43 ha)

Lot 152 option 2 (101.54 ha)

Vegetation condition mapping (RPS Oct 2020)

Very good (VG)

Good - Very good (G-VG)

Good (G)

Poor (P)

Degraded (D)

Completely degraded (CD)

VG

G

VG

G

G

P

G

G-VG

D

VG

VG

G

G-VG

G

CD

D

VG

G

Figure I-3

Vegetation condition mapping

GDA 1994 MGA Zone 50

0 125 250 500 m

Job Number: L20209-001
Doc Number: FigI-3
Date: 02.02.21
Scale: 1:15,000 @ A3
Created by: MA
Source: Orthophoto - Esri - World Imagery

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Appendix A
Definitions

APPENDIX A: DEFINITIONS

Table A-1: Conservation codes for Western Australian flora (DBCA 2019)

Category	Definition
T	Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). **Threatened flora** is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below. • CR: Critically Endangered – considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". • EN: Endangered – considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines" • VU: Vulnerable – considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines".
EX	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
EW	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
P1	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Table A-2: EPBC Act conservation categories (IUCN Red List 2019)

Category	Definition
EX	**Extinct** A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual) throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
EW	**Extinct in the Wild** A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual) throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
CR	**Critically Endangered** A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
EN	**Endangered** A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
VU	**Vulnerable** A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
NT	**Near Threatened** A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
LC	**Least Concern** A taxon is Least Concern when it has been evaluated against the criteria and it does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
DD	**Data Deficient** A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period has elapsed since the last record of the taxon, threatened status may well be justified.
NE	**Not Evaluated** A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Table A-3: Threatened Ecological Communities Category of Threat (English and Blyth 1997)

Category	Definition
Presumed Totally Destroyed (PD)	An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies: 1. Records within the last 50 years have not been confirmed despite thorough searches or known or likely habitats or; 2. All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria: 1. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and **either or both** of the following apply: – Geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately five years). – Modification throughout its range is continuing such that in the immediate future (within approximately five years) the community is unlikely to be capable of being substantially rehabilitated. 2. Current distribution is limited, and **one or more** of the following apply (a, b or c): a. Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately five years). b. There are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes. c. There may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. 3. The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately five years).
Endangered (EN)	An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (1, 2, or 3): 1. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and either or both of the following apply (a or b): a. Geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately 10 years). b. Modification throughout its range is continuing such that in the short term future (within approximately 10 years) the community is unlikely to be capable of being substantially restored or rehabilitated. 2. Current distribution is limited, and one or more of the following apply (a, b or c): a. Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years). b. There are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes. c. There may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. 3. The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately 10 years).

Category	Definition
Vulnerable (VU)	An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long term future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (1, 2 or 3): 1. The ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated. 2. The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. 3. The ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.
Data Deficient (DD)	An ecological community which has not been adequately evaluated with respect to status or where there is currently insufficient information to assign it to a particular category. (An ecological community with poorly known distribution or biology that is suspected to belong to any of the above categories. These ecological communities have a high priority for survey and/or research.)
Lower Risk (LR)	An ecological community that has been adequately surveyed and does not qualify for any of the above categories of threat and appears unlikely to be under threat of significant modification or destruction in the short to medium term future.

Table A-4: Priority ecological communities category definitions (DBCA 2019)

Category	Definition
P1	**Priority One: Poorly-known ecological communities** Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2	**Priority Two: Poorly-known ecological communities** Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3	**Priority Three: Poorly known ecological communities** Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation, or: Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; Communities made up of large, and/or widespread occurrences that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4	**Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.** Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. Ecological communities that have been removed from the list of threatened communities during the past five years.
P5	**Priority Five: Conservation Dependent ecological communities** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table A-5: EPBC Act listed threatened ecological communities' category of threat

Category	Definition
CR	**Critically Endangered** If an ecological community is facing an extremely high risk of extinction in the wild in the immediate future.
EN	**Endangered** If an ecological community is not Critically Endangered but is facing a very high risk of extinction in the wild in the immediate future.
VU	**Vulnerable** If an ecological community is not Critically Endangered or Endangered but is facing a very high risk of extinction in the wild in the medium term future.

Table A-6: NVIS vegetation structure classes (ESCAVI 2003)

Stratum	Growth Form	Height	Structural formation classes (% cover)					
		Foliage cover *	70-100	30-70	10-30	<10	0-5	~0
		Percentage cover †	>80	50-80	20-50	0.25-20	0-5	<0.25
U	Tree, palm	Tall; Mid; Low	Closed forest	Open forest	Woodland	Open woodland	Isolated clumps of trees	Isolated trees
	Tree mallee	Tall; Mid; Low	Closed mallee forest	Open mallee forest	Mallee woodland	Open mallee woodland	Isolated clumps of mallee trees	Isolated mallee trees
M	Shrub, cycad, grass-tree, tree-fern	Tall; Mid; Low	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated clumps of shrubs	Isolated shrubs
	Mallee shrub	Tall; Mid; Low	Closed mallee shrubland	Mallee shrubland	Open mallee shrubland	Sparse mallee shrubland	Isolated clumps of mallee shrubs	Isolated mallee shrubs
	Heath shrub	Tall; Mid; Low	Closed heathland	Heathland	Open heathland	Sparse heathland	Isolated clumps of heath shrubs	Isolated heath shrubs
	Chenopod shrub	Tall; Mid; Low	Closed chenopod shrubland	Chenopod shrubland	Open chenopod shrubland	Sparse chenopod shrubland	Isolated clumps of chenopod shrubs	Isolated chenopod shrubs
	Samphire shrub	Mid; Low	Closed samphire shrubland	Samphire shrubland	Open samphire shrubland	Sparse samphire shrubland	Isolated clumps of samphire shrubs	Isolated samphire shrubs
G	Hummock grass	Mid; Low	Closed hummock grassland	Hummock grassland	Open hummock grassland	Sparse hummock grassland	Isolated clumps of hummock grasses	Isolated hummock grasses
	Tussock grass	Mid; Low	Closed tussock grassland	Tussock grassland	Open tussock grassland	Sparse tussock grassland	Isolated clumps of tussock grasses	Isolated tussock grasses
	Other grass	Mid; Low	Closed grassland	Grassland	Open grassland	Sparse grassland	Isolated clumps of grasses	Isolated grasses
	Sedge	Mid; Low	Closed sedgeland	Sedgeland	Open sedgeland	Sparse sedgeland	Isolated clumps of sedges	Isolated sedges
	Rush	Mid; Low	Closed rushland	Rushland	Open rushland	Sparse rushland	Isolated clumps of rushes	Isolated rushes
	Forb (Herb)	Mid; Low	Closed forbland	Forbland	Open forbland	Sparse forbland	Isolated clumps of forbs	Isolated forbs

* Foliage Cover is defined for each stratum as 'the proportion of the ground, which would be shaded if sunshine came from directly overhead'. It includes branches and leaves and is similar to the Crown type of Walker & Hopkins (1990) but is applied to a stratum or plot rather than an individual crown. It is generally not directly measured in the field for the upper stratum, although it can be measured by various line interception methods for ground layer vegetation. For the attribute COVER CODE in the Stratum table, the ground cover category refers to ground foliage cover not percentage cover.

† The percentage cover is defined as the percentage of a strictly defined plot area, covered by vegetation. This can be an estimate and is a less precise measure than using, for example, a point intercept transect methods on ground layer, or overstorey vegetative cover. That is for precisely measured values (e.g. crown densitometer or point intercept transects) the value measured would be 'foliage' cover. Where less precise or qualitative measures are used these will most probably be recorded as 'percentage' cover.

Table A-7: NVIS vegetation height classes (ESCAVI 2003)

Height	Growth form				
Height class	Height range (M)	Tree, vine (M and U), palm (single-stemmed)	Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)	Tree mallee, mallee shrub	Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)
8	>30	Tall			
7	10-30	Mid		Tall	
6	<10	Low		Mid	
5				Low	
4	>2		Tall		Tall
3	1-2		Mid		Tall
2	0.5-1		Low		Mid
1	<0.5		Low		Low

Table A-8: Vegetation condition scale for the Eremaen and Northern botanical provinces

Condition		Definition
E	Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
V	Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
G	Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
P	Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
D	Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
C	Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation, i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

(Source: adapted from Trudgen 1988)

Appendix B
RPS 2020 flora taxa by family

APPENDIX B: RPS 2020 FLORA TAXA BY FAMILY

Family	Weed	Taxon
AIZOACEAE		*Trianthema pilosa*
		Trianthema turgidifolia
AMARANTHACEAE	*	*Aerva javanica*
		Ptilotus exaltatus
		Ptilotus polystachyus
		Surreya diandra
ASTERACEAE		*Calotis plumulifera*
	*	*Flaveria trinervia*
		Pluchea ? dunlopii
		Pluchea dunlopii
		Pluchea rubelliflora
		Pterocaulon sphacelatum
		Pterocaulon sphaeranthoides
		Rhodanthe stricta
		Streptoglossa ? liatroides
		Streptoglossa decurrens
		Streptoglossa macrocephala
BORAGINACEAE		*Trichodesma zeylanicum*
CHENOPODIACEAE		*Atriplex bunburyana*
		Atriplex codonocarpa
		Atriplex semilunaris
		Enchylaena tomentosa
		Maireana lanosa
		Rhagodia eremaea
		Salsola australis
		Sclerolaena recurvicuspis
		Tecticornia indica subsp. *bidens*
		Tecticornia pruinosa
		Tecticornia sp.
		Threlkeldia diffusa
CONVOLVULACEAE		*Bonamia erecta*
		Bonamia linearis
		Evolvulus alsinoides var. *villosicalyx*
ELATINACEAE		*Bergia perennis* subsp. *exigua*
EUPHORBIACEAE		*Adriana tomentosa* var. *tomentosa*
		Euphorbia wheeleri
FABACEAE		*Acacia colei* var. *colei*
		Acacia coriacea subsp. *coriacea*
		Acacia ligulata
		Acacia pyrifolia
		Acacia sclerosperma
		Acacia sericophylla
		Acacia stellaticeps
		Acacia synchronicia
		Acacia tetragonophylla
		Aenictophyton reconditum
		Crotalaria cunninghamii
		Cullen cinereum
		Cullen leucanthum
		Cullen martinii
		Indigofera boviperda
		Indigofera colutea
		Lotus cruentus
	*	*Prosopis pallida*

Family	Weed	Taxon
		Senna artemisioides subsp. *oligophylla*
		Senna glutinosa subsp. *glutinosa*
		Senna glutinosa subsp. x *luerssenii*
		Senna notabilis
		Sesbania cannabina
		Tephrosia rosea var. *clementii*
		Tephrosia uniovulata
	*	*Vachellia farnesiana*
FRANKENIACEAE		*Frankenia ambita*
GOODENIACEAE		*Goodenia forrestii*
		Scaevola pulchella
		Scaevola sericophylla
		Scaevola spinescens
		Scaevola spinescens (broad form)
		Scaevola spinescens (narrow form)
GYROSTEMONACEAE		*Gyrostemon ramulosus*
LAURACEAE		*Cassytha capillaris*
		Cassytha filiformis
MALVACEAE		*Abutilon lepidum*
		Abutilon sp.
		Gossypium australe
		Hibiscus brachychlaenus
		Lawrencia viridigrisea
		Sida rohlenae subsp. *rohlenae*
		Sida sp.
MARSILEACEAE		*Marsilea drummondii*
MYRTACEAE		*Corymbia zygophylla*
		Eucalyptus victrix
		Verticordia forrestii
PLANTAGINACEAE		*Stemodia* sp. Onslow (A.A. Mitchell 76/148)
POACEAE		*Aristida holathera*
	*	*Cenchrus ciliaris*
	*	*Cenchrus setiger*
		Chloris pectinata
		Cymbopogon ambiguus
		Eragrostis dielsii
		Eragrostis falcata
		Eragrostis pergracilis
		Eriachne flaccida
		Eriachne helmsii
		Eriachne sp.
		Eulalia aurea
		Panicum decompositum
		Sporobolus mitchellii
		Sporobolus virginicus
		Triodia epactia
		Triodia schinzii
PROTEACEAE		*Grevillea eriostachya*
		Grevillea stenobotrya
		Hakea chordophylla
		Hakea stenophylla subsp. *stenophylla*
SANTALACEAE		*Santalum lanceolatum*
SAPINDACEAE		*Diplopeltis eriocarpa*
SCROPHULARIACEAE		*Eremophila forrestii* subsp. *viridis*
SOLANACEAE		*Solanum horridum*
		Solanum lasiophyllum
SURIANACEAE		*Stylobasium spathulatum*

Appendix C
Flora inventory

APPENDIX C: FLORA INVENTORY ALL SURVEYS

Taxon	RPS (2020)	ENV (2012)	BIOTA (2010)
Abutilon aff. *dioicum*		x	
Abutilon lepidum	x	x	
Acacia colei var. *colei*	x	x	
Acacia coriacea subsp. *coriacea*	x		x
Acacia ligulata	x		
Acacia pyrifolia	x		
Acacia sclerosperma	x		x
Acacia sericophylla	x	x	
Acacia stellaticeps	x	x	x
Acacia synchronicia	x	x	
Acacia tetragonophylla	x	x	x
Adriana tomentosa var. *tomentosa*	x	x	
Aenictophyton reconditum	x		
**Aerva javanica*	x		
Alternanthera nodiflora		x	
Alysicarpus muelleri		x	
Aristida holathera	x	x	x
Atriplex bunburyana	x	x	
Atriplex codonocarpa	x		
Atriplex semilunaris	x		
Bergia perennis subsp. *exigua*	x		
Bonamia erecta	x		
Bonamia linearis	x	x	
Bonamia rosea		x	
Calotis plumulifera	x		
Cassytha capillaris	x	x	x
Cassytha filiformis	x		
**Cenchrus ciliaris*	x	x	x
**Cenchrus setiger*	x		
Chloris pectinata	x	x	
Corchorus tectus		x	
Corymbia zygophylla	x	x	
Crotalaria cunninghamii	x	x	x
Cullen cinereum	x	x	
Cullen lachnostachys		x	
Cullen leucanthum	x	x	
Cullen martinii	x		
Cymbopogon ambiguus	x		
Desmodium filiforme		x	
Diplopeltis eriocarpa	x		
Enchylaena tomentosa	x		
Eragrostis dielsii	x		
Eragrostis falcata	x	x	

Taxon	RPS (2020)	ENV (2012)	BIOTA (2010)
Eragrostis pergracilis	x		
Eremophila forrestii subsp. *viridis*	x	x	
Eriachne flaccida	x		
Eriachne helmsii	x		
Eriachne mucronata		x	
Eucalyptus victrix	x		
Eulalia aurea	x	x	
Euphorbia australis		x	
Euphorbia tannensis subsp. *eremophila*		x	
Euphorbia wheeleri	x	x	
Evolvulus alsinoides var. *villosicalyx*	x	x	
**Flaveria trinervia*	x		
Frankenia ambita	x		
Goodenia forrestii	x	x	
Gossypium australe	x		
Grevillea eriostachya	x	x	
Grevillea stenobotrya	x	x	x
Gyrostemon ramulosus	x		
Hakea chordophylla	x		
Hakea stenophylla subsp. *stenophylla*	x	x	
Hannafordia quadrivalvis subsp. *recurva*		x	
Heliotropium crispatum		x	
Hibiscus brachychlaenus	x	x	
Hibiscus sturtii var. *campylochlamys*			x
Indigofera boviperda	x	x	
Indigofera colutea	x		
Indigofera linifolia			
Ipomoea coptica		x	
Ipomoea polymorpha		x	
Lotus cruentus	x		
Maireana lanosa	x		
Marsilea drummondii	x	x	
Olearia sp. Kennedy Range (G. Byrne 66)			x
Panicum decompositum	x	x	
Pluchea ? dunlopii	x		
Pluchea dunlopii	x		
Pluchea rubelliflora	x	x	
Polygala isingii		x	
**Prosopis pallida*	x	x	
Pterocaulon sphacelatum	x		
Pterocaulon sphaeranthoides	x	x	
Ptilotus arthrolasius		x	
Ptilotus exaltatus	x		
Ptilotus polystachyus	x		
Quoya loxocarpa	x	x	x

Taxon	RPS (2020)	ENV (2012)	BIOTA (2010)
Rhagodia eremaea	x		
Rhodanthe stricta	x		
Salsola australis	x		
Santalum lanceolatum	x		
Scaevola pulchella	x		
Scaevola sericophylla	x	x	
Scaevola spinescens	x	x	
Sclerolaena cuneata		x	
Sclerolaena recurvicuspis	x		
Senna artemisioides subsp. *oligophylla*	x	x	
Senna glutinosa subsp. glutinosa	x		
Senna glutinosa subsp. x *luerssenii*	x	x	x
Senna notabilis	x		
Sesbania cannabina	x		
Sida rohlenae subsp. *rohlenae*	x	x	
Solanum horridum	x		
Solanum lasiophyllum	x	x	x
Solanum diversiflorum			x
Sporobolus mitchellii	x		
Sporobolus virginicus	x		
Stemodia sp. Onslow (A.A. Mitchell 76/148)	x		
Streptoglossa ? liatroides	x		
Streptoglossa decurrens	x		
Streptoglossa macrocephala	x	x	
Stylobasium spathulatum	x		
Surreya diandra	x		
Tecticornia auriculata		x	
Tecticornia indica subsp. *bidens*	x	x	
Tecticornia pruinosa	x		
Tephrosia rosea var. *clementii*	x	x	
Tephrosia uniovulata	x		
Trachymene pilbarensis		x	
Threlkeldia diffusa	x		
Trianthema glossostigma		x	
Trianthema pilosa	x	x	
Trianthema turgidifolia	x		
Trichodesma zeylanicum	x	x	x
Tricoryne corynothecoides		x	
Triodia epactia	x	x	x
Triodia schinzii	x		
Triraphis mollis		x	
**Vachellia farnesiana*	x	x	
Verticordia forrestii	x		x
Yakirra australiensis var. *australiensis*		x	

Appendix D
Species by site

APPENDIX D: SPECIES BY SITE

Taxon	RPS (2020)																					ENV (2012)														BIOTA (2010)	
	HQ01	HQ02	HQ03	HQ04	HQ05	HQ06	HQ07	HQ08	HQ09	HQ10	HQ11	HQ12	HQ13	HQ14	HQ15	HQ16	HQ17	HQ18	HQ19	HQ20	HQ21	HQ22	AB09	AB10	AB11	AB12	AB13	AB14	AB15	AB16	AB17	AB18	AB201	AB202	ABR01	ABR202	WSB-15	WSB-16
Abutilon aff. *dioicum*																												x	x								
Abutilon lepidum																														x							
Abutilon sp.																	x																				
Acacia colei var. *colei*																x				x													x				
Acacia coriacea subsp. *coriacea*	x	x			x	x	x																														x
Acacia ligulata																																					
Acacia pyrifolia																																					
Acacia sclerosperma																																				x	
Acacia sericophylla													x				x			x										x		x	x				
Acacia stellaticeps	x	x			x	x	x		x				x	x	x	x		x			x				x	x				x		x			x	x	x
Acacia synchronicia			x			x		x			x	x				x				x		x		x	x	x	x						x	x			
Acacia tetragonophylla				x		x	x	x	x	x	x	x	x		x	x		x	x	x			x	x	x	x	x	xx				x	x	x	x	x		x
Adriana tomentosa var. *tomentosa*														x			x													x							
Aenictophyton reconditum																																					
Aerva javanica																																					
Alternanthera nodiflora																															x						
Alysicarpus muelleri																							x	x									x				
Aristida holathera		x																												x		x				x	
Atriplex bunburyana											x	x											x				x					x	x	x	x		
Atriplex codonocarpa				x																																	
Atriplex semilunaris										x																											
Bergia perennis subsp. *exigua*																				x																	
Bonamia erecta	x	x					x						x	x	x	x	x	x																			
Bonamia linearis																								x				x									
Bonamia rosea																							x		x	x		x	x	x		x					
Calotis plumulifera																						x															
Cassytha capillaris	x				x	x			x				x	x	x	x		x			x				x	x		x		x		x		x			x
Cassytha filiformis		x																																			
Cenchrus ciliaris	x	x	x	x	x	x	x	x	x	x	x	x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cenchrus setiger																			x																		
Chloris pectinata										x																	x				x						
Corchorus tectus																													x	x		x					
Corymbia zygophylla													x																			x					
Crotalaria cunninghamii		x												x			x								x		x			x	x		x			x	x
Cullen cinereum																			x				x										x					
Cullen lachnostachys																								x		x											
Cullen leucanthum																				x							x										
Cullen martinii																																					
Cymbopogon ambiguus					x																																
Desmodium filiforme																							x	x	x	x		x	x	x		x	x				
Diplopeltis eriocarpa							x											x																			
Enchylaena tomentosa					x					x					x					x	x																
Eragrostis dielsii											x																										
Eragrostis falcata			x							x												x					x				x			x			
Eragrostis pergracilis																			x			x															

Taxon	RPS (2020)																					ENV (2012)																BIOTA (2010)	
	HQ01	HQ02	HQ03	HQ04	HQ05	HQ06	HQ07	HQ08	HQ09	HQ10	HQ11	HQ12	HQ13	HQ14	HQ15	HQ16	HQ17	HQ18	HQ19	HQ20	HQ21	HQ22	AB09	AB10	AB11	AB12	AB13	AB14	AB15	AB16	AB17	AB18	AB201	AB202	ABR01	ABR202	WSB-15	WSB-16
Eremophila forrestii subsp. *viridis*													x			x		x			x					x		x	x			x						
Eriachne flaccida																			x																			
Eriachne helmsii										x					x	x			x		x																	
Eriachne mucronata																															x						
Eriachne sp.						x																															
Eucalyptus victrix															x																						
Eulalia aurea						x				x									x	x			x	x		x	x						x	x	x			
Euphorbia australis																							x															
Euphorbia tannensis subsp. *eremophila*																																	x					
Euphorbia wheeleri														x			x								x	x		x	x	x								
Evolvulus alsinoides var. *villosicalyx*									x															x	x	x												
Flaveria trinervia																						x																
Frankenia ambita			x	x																																		
Goodenia forrestii									x				x										x	x	x	x			x			x	x					
Gossypium australe																																						
Grevillea eriostachya	x	x					x						x		x			x														x						
Grevillea stenobotrya					x				x					x	x	x	x								x	x		x	x	x		x					x	
Gyrostemon ramulosus																																						
Hakea chordophylla					x																																	
Hakea stenophylla subsp. *stenophylla*							x						x		x	x		x											x			x				x		
Hannafordia quadrivalvis subsp. *recurva*																													x									
Heliotropium crispatum																										x												
Hibiscus brachychlaenus		x			x									x			x											x		x							
Hibiscus sturtii var. *campylochlamys*																																					x	
Indigofera boviperda				x																												x		x				
Indigofera colutea											x	x			x																							
Indigofera linifolia																																						
Ipomoea coptica																													x									
Ipomoea polymorpha			x	x																		x			x	x												
Lotus cruentus																						x																
Maireana lanosa																																						
Marsilea drummondii										x																	x											
Olearia sp. Kennedy Range (G. Byrne 66)																																					x	
Panicum decompositum																			x								x				x				x			
Pluchea ? dunlopii			x																																			
Pluchea dunlopii																																						
Pluchea rubelliflora																															x							
Polygala isingii																							x										x	x				
Prosopis pallida								x		x									x	x														x	x				
Pterocaulon sphacelatum	x																																		x	x		
Pterocaulon sphaeranthoides					x				x																x	x												
Ptilotus arthrolasius																														x								
Ptilotus exaltatus	x					x																																
Ptilotus polystachyus																																						
Quoya loxocarpa																												x										x
Rhagodia eremaea											x									x																		
Rhodanthe stricta																			x																			

Taxon	RPS (2020)																					ENV (2012)																BIOTA (2010)	
	HQ01	HQ02	HQ03	HQ04	HQ05	HQ06	HQ07	HQ08	HQ09	HQ10	HQ11	HQ12	HQ13	HQ14	HQ15	HQ16	HQ17	HQ18	HQ19	HQ20	HQ21	HQ22	AB09	AB10	AB11	AB12	AB13	AB14	AB15	AB16	AB17	AB18	AB201	AB202	ABR01	ABR202	WSB-15	WSB-16
Salsola australis	x										x									x		x																
Santalum lanceolatum																																						
Scaevola pulchella					x																																	
Scaevola sericophylla	x	x												x			x											x	x	x								
Scaevola spinescens											x	x	x								x		x			x	x	x						x				
Scaevola spinescens (broad form)		x		x	x	x		x	x							x																						
Scaevola spinescens (narrow form)										x									x	x																			
Sclerolaena cuneata																											x											
Sclerolaena recurvicuspis			x	x																																		
Senna artemisioides subsp. *oligophylla*					x																					x						x					
Senna glutinosa subsp. *glutinosa*																																						
Senna glutinosa subsp. x *luerssenii*	x					x							x																			x					x
Senna notabilis																																						
Sesbania cannabina																				x																		
Sida rohlenae subsp. *rohlenae*																									x			x		x								
Sida sp.							x								x	x																						
Solanum horridum	x	x			x																																	
Solanum lasiophyllum	x	x		x	x	x	x							x	x	x		x						x	x			x	x	x							x	x
Solanum diversiflorum																																						x
Sporobolus mitchellii										x									x	x																		
Sporobolus virginicus																																						
Stemodia sp. Onslow (A.A. Mitchell 76/148)						x														x																		
Streptoglossa ? liatroides			x																x	x		x																
Streptoglossa decurrens			x																																			
Streptoglossa macrocephala																														x								
Stylobasium spathulatum					x																																	
Surreya diandra			x																																			
Tecticornia auriculata																															x							
Tecticornia indica subsp. *bidens*			x							x									x								x				x						
Tecticornia pruinosa			x																			x																
Tecticornia sp.			x																																			
Tephrosia rosea var. *clementii*														x			x											x	x	x						x		
Tephrosia uniovulata		x																																				
Trachymene pilbarensis																																		x				
Threlkeldia diffusa				x						x																												
Trianthema glossostigma																										x							x	x				
Trianthema pilosa																	x													x								
Trianthema turgidifolia																																						
Trichodesma zeylanicum		x							x					x	x		x								x	x		x	x	x							x	
Tricoryne corynothecoides																														x								
Triodia epactia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
Triodia schinzii																	x																					
Triraphis mollis																											x							x				
Vachellia farnesiana																				x			x	x	x		x						x		x			
Verticordia forrestii	x	x																																			x	x
Yakirra australiensis var. *australiensis*																							x		x	x		x		x		x						

Appendix E
Flora quadrat data

APPENDIX E: FLORISTIC QUADRAT DATA

Site	**HQ01**					
Described by	CG	Date	17/10/2020	Type	Quadrat	50 x 50
Season	Poor	Uniformity				
Location	ANSIA Onslow					
Lat/Lon	-21.723356	114.972673				
Habitat	Low sand dunes and shallow swale / elevated depression between two dunes					
Soil	Reddish-brown sand with surface gravel. Limestone fragments in swale					
Vegetation	*Acacia stellaticeps* Mid Open Shrubland over *Verticordia forrestii* and *Scaevola sericophylla* Low Sparse Shrubland over *Triodia epactia* Open Hummock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

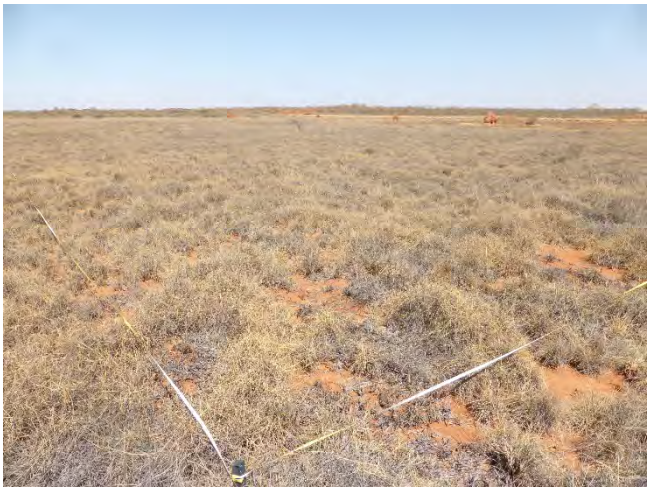
Taxon	Cover	Height	Collection #
Acacia coriacea subsp. *coriacea*	+	60	HQ01-11
Acacia stellaticeps	20	130	
Bonamia erecta	+	40	
Cassytha capillaris	+	cr	HQ01-02
Cenchrus ciliaris	+	40	
Grevillea stenobotrya	+	190	HQ01-06
Pterocaulon sphacelatum	+	35	HQ01-10
Ptilotus exaltatus	+	20	HQ01-08
Salsola australis	+	25	
Scaevola sericophylla	0.5	40	HQ01-03
Senna glutinosa subsp. x *luerssenii*	+	120	HQ01-04
Solanum horridum	+	30	HQ01-09
Solanum lasiophyllum	+	30	
Triodia epactia	20	40	HQ01-01
Verticordia forrestii	1.5	70	HQ01-05

Site	**HQ02**					
Described by	BRM	Date	17/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.722971	114.979252				
Habitat	Crest and slopes of low dune					
Soil	Red sand					
Vegetation	*Grevillea stenobotrya* Tall Sparse Shrubland over *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland					
Veg Condition	Good to Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia coriacea subsp. *coriacea*	0.5	180	=HQ01-11
Acacia stellaticeps	1	120	
Aristida holathera	+	35	
Bonamia erecta	+	35	
Cassytha filiformis	0.5	cr	HQ02-01
Cenchrus ciliaris	4	45	
Crotalaria cunninghamii	+	120	HQ02-04
Grevillea stenobotrya	5	350	=HQ01-06
Hibiscus brachychlaenus	+	110	HQ02-03
Scaevola sericophylla	+	80	HQ02-05
Scaevola spinescens (broad form)	+	40	HQ02-08
Solanum horridum	+	20	=HQ01-09
Solanum lasiophyllum	+	60	
Tephrosia uniovulata	+	70	HQ02-07
Trichodesma zeylanicum	+	150	
Triodia epactia	40	45	=HQ01-01
Verticordia forrestii	+	60	=HQ01-05

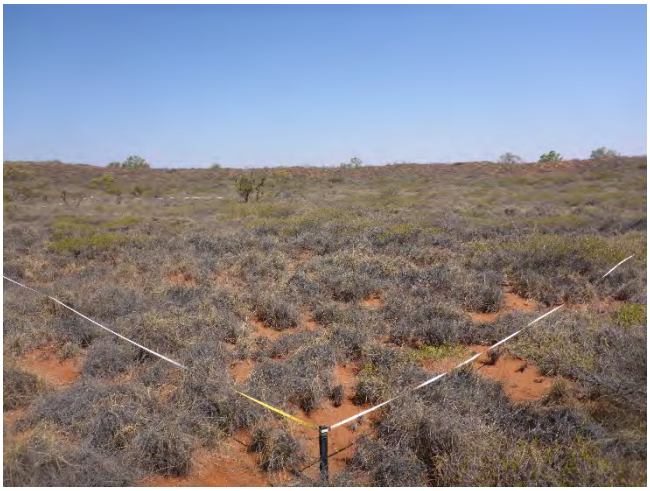
Site	**HQ03**					
Described by	CG	Date	17/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.721379	114.9743				
Habitat	Samphire flat					
Soil	Brown loamy sand					
Vegetation	*Tecticornia* spp. Low Open Samphire Shrubland over *Lawrencia viridigrisea* and *Eragrostis falcata* Sparse Forbland / Tussock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia synchronicia	+	50	HQ03-12
Cenchrus ciliaris	1	30	
Eragrostis falcata	1	15	HQ03-03
Frankenia ambita	+	25	HQ03-05
Lawrencia viridigrisea	1.5	50	HQ03-04
Pluchea ? dunlopii	+	15	HQ03-10
Sclerolaena recurvicuspis	+	25	HQ03-07
Streptoglossa ? liatroides	+	10	HQ03-06
Streptoglossa decurrens	+	50	HQ03-11
Surreya diandra	+	30	HQ03-09
Tecticornia indica subsp. *bidens*	0.5	35	HQ03-08
Tecticornia pruinosa	1	60	HQ03-02
Tecticornia sp.	+	50	HQ03-13
Tecticornia sp.	12	30	HQ03-01
Triodia epactia	+	35	



Site	**HQ04**					
Described by	BRM	Date	17/11/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.722861	114.974902				
Habitat	Plain					
Soil	Reddish-brown loamy sand					
Vegetation	*Acacia tetragonophylla* Mid Isolated Shrubs over *Triodia epactia* Hummock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia tetragonophylla	+	180	
Atriplex codonocarpa	+	25	HQ04-04
Cenchrus ciliaris	3	40	
Frankenia ambita	+	30	HQ04-02
Indigofera boviperda	+	40	HQ04-03
Lawrencia viridigrisea	+	30	HQ04-05
Scaevola spinescens (broad form)	+	80	=HQ02-08
Sclerolaena recurvicuspis	+	12	HQ04-07
Solanum lasiophyllum	+	40	
Threlkeldia diffusa	+	12	HQ04-06
Triodia epactia	50	40	=HQ01-01

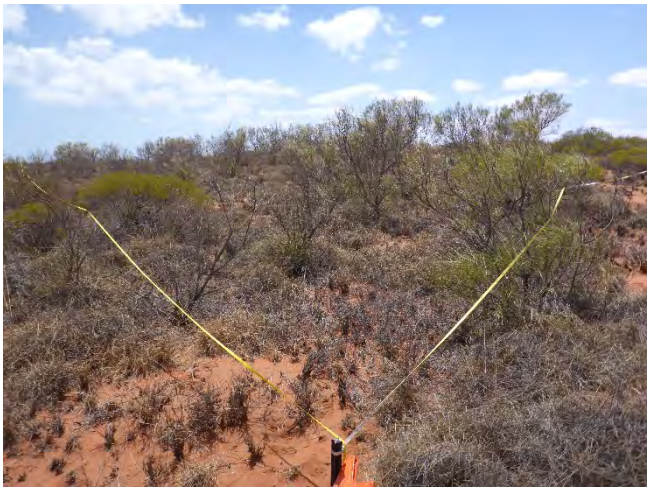


Site	**HQ05**						
Described by	CG	Date	17/10/2020	Type	Quadrat	50 x 50	
Season	Poor						
Location	ANSIA Onslow						
Lat/Lon	-21.720489	114.980857					
Habitat	Broad shallow depression / swale between dunes						
Soil	Red sand						
Vegetation	*Acacia stellaticeps* Mid Open Shrubland over *Triodia epactia* Open Hummock Grassland						
Veg Condition	Very Good						
Fire Age	> 10 years						

Taxon	Cover	Height	Collection #
Acacia coriacea subsp. *coriacea*	+	100	=HQ01-11
Acacia stellaticeps	15	120	
Cassytha capillaris	+	cr	=HQ01-02
Cenchrus ciliaris	+	50	
Cymbopogon ambiguus	+	100	HQ05-07
Enchylaena tomentosa	+	80	HQ05-04
Grevillea stenobotrya	+	180	
Hakea chordophylla	+	300	
Hibiscus brachychlaenus	+	70	HQ05-05
Pterocaulon sphaeranthoides	+	40	=HQ01-10
Scaevola pulchella	+	40	HQ05-01
Scaevola spinescens (broad form)	+	40	HQ05-03
Senna artemisioides subsp. *oligophylla*	+	100	HQ05-02
Solanum horridum	+	40	=HQ01-09
Solanum lasiophyllum	+	50	
Stylobasium spathulatum	+	150	HQ05-06
Triodia epactia	25	40	=HQ01-01

Site	**HQ06**						
Described by	BRM	Date	18/10/2020	Type	Quadrat	50 x 50	
Season	Poor						
Location	ANSIA Onslow						
Lat/Lon	-21.72543	114.97432					
Habitat	Gently sloping NE facing plain between dunes						
Soil	Reddish-brown sand						
Vegetation	*Acacia stellaticeps* Mid Open Shrubland over *Triodia epactia* Hummock Grassland						
Veg Condition	Very Good						
Fire Age	> 10 years						

Taxon	Cover	Height	Collection #
Acacia coriacea subsp. *coriacea*	+	60	=HQ06-11
Acacia stellaticeps	12	90	
Acacia synchronicia	+	140	
Acacia tetragonophylla	+	150	
Cassytha capillaris	+	cr	HQ06-01
Cenchrus ciliaris	+	40	
Eriachne sp.	+	40	HQ06-04
Eulalia aurea	+	45	
Ptilotus exaltatus	+	50	
Scaevola spinescens (broad form)	+	40	HQ06-03
Senna glutinosa subsp. x *luerssenii*	+	130	=HQ01-04
Solanum lasiophyllum	+	40	
Stemodia sp. Onslow (A.A. Mitchell 76/148)	+	70	HQ06-06
Triodia epactia	60	40	=HQ01-01



Site	**HQ07**					
Described by	CG	Date	18/10/2020	Type	Quadrat	33 x 75
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.725287	114.975644				
Habitat	Crest and slopes of linear dune					
Soil	Red sand					
Vegetation	*Hakea stenophylla* subsp. *stenophylla* and *Grevillea stenobotrya* Tall Sparse Shrubland over *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia coriacea subsp. *coriacea*	+	130	=HQ01-11
Acacia stellaticeps	3	120	
Acacia tetragonophylla	+	110	
Bonamia erecta	+	30	
Cenchrus ciliaris	+	30	
Diplopeltis eriocarpa	+	35	=HBM-17
Grevillea stenobotrya	11	250	=HQ01-06
Hakea stenophylla subsp. *stenophylla*			=HCG-06
Sida sp.	+	80	HQ07-01
Solanum lasiophyllum	+	40	
Triodia epactia	40	40	

Site	**HQ08**					
Described by	BRM	Date	18/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.76935202	115.041024				
Habitat	Gently undulating plain					
Soil	Reddish-brown sand					
Vegetation	*Acacia tetragonophylla* Tall Isolated Shrubs over *Triodia epactia* Hummock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

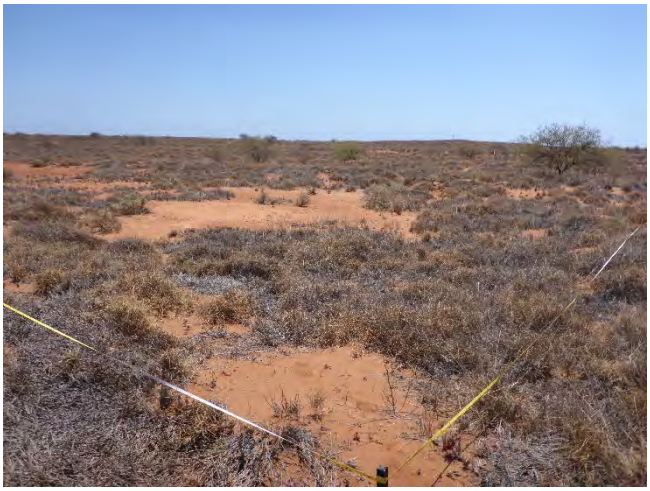
Taxon	Cover	Height	Collection #
Acacia synchronicia	+	45	
Acacia tetragonophylla	1	280	
Cenchrus ciliaris	0.5	40	
Prosopis pallida	0.5	330	HQ08-01
Scaevola spinescens (broad form)	+	40	=HQ06-
Triodia epactia	55	40	=HQ01-01

Site	**HQ09**					
Described by	BRM	Date	18/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.76566498	115.040811				
Habitat	Gentle north facing slopes of low dune					
Soil	Reddish-brown sand					
Vegetation	*Acacia tetragonophylla* Tall Isolated Shrubs over *Triodia epactia* Tussock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia stellaticeps	+	110	
Acacia tetragonophylla	+	210	
Cassytha capillaris	+	cr	
Cenchrus ciliaris	0.5	30	
Evolvulus alsinoides var. *villosicalyx*	+	25	
Goodenia forrestii	+	50	
Grevillea stenobotrya	+	300	
Pterocaulon sphaeranthoides	+	45	
Scaevola spinescens (broad form)	+	40	=HQ06-
Trichodesma zeylanicum	+	90	
Triodia epactia	40	40	=HQ01-01

Site	**HQ10**					
Described by	BRM	Date	19/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.76569801	115.045069				
Habitat	Clay flats / Plain					
Soil	Reddish-brown clayey loam					
Vegetation	*Acacia tetragonophylla* Tall Isolated Shrubs over *Sporobolus mitchellii, Eriachne helmsii, Eragrostis falcata* and *Eulalia aurea* Tussock Grassland					
Veg Condition	Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia tetragonophylla	+	150	
Atriplex semilunaris	+	30	HQ10-04
Cenchrus ciliaris	+	40	
Chloris pectinata	+	30	HQ10-05
Enchylaena tomentosa	+	45	HQ10-06
Enchylaena tomentosa	+	140	HQ10-09
Eragrostis falcata	+	40	HQ10-11
Eriachne helmsii	0.5	45	HQ10-03
Eulalia aurea	3	60	
Marsilea drummondii	+	15	
Poaceae sp.	40	45	HQ10-10
Prosopis pallida	+	350	HQ10-02
Scaevola spinescens (narrow form)	+	45	HQ10-07
Sporobolus mitchellii	+	80	HQ10-08
Tecticornia indica subsp. *bidens*	4	45	
Threlkeldia diffusa	+	20	HQ10-01
Triodia epactia	+	40	=HQ01-01



Site	**HQ11**					
Described by	CG	Date	19/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.766649	115.050316				
Habitat	Low undulating dunes, plain and claypan					
Soil	Reddish-brown sand on banks and clay loam in claypan					
Vegetation	Acacia tetragonophylla Tall Isolated Shrubs over Triodia epactia Open Hummock Grassland					
Veg Condition	Good to Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia synchronicia	+	70	
Acacia tetragonophylla	1	250	
Atriplex bunburyana	0.5	50	
Cenchrus ciliaris	1.5	30	
Eragrostis dielsii	+	6	HQ11-04
Indigofera colutea	+	5	HQ11-03
Indigofera colutea	+	20	HQ11-01
Rhagodia eremaea	+	90	HQ11-02
Salsola australis	+	25	
Scaevola spinescens	+	40	
Triodia epactia	25	40	

Site	**HQ12**					
Described by	BRM	Date	19/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.76614602	115.047668				
Habitat	Plain with dry flat drainage line at SW end					
Soil	Reddish-brown clayey sand					
Vegetation	*Acacia tetragonophylla* Tall Sparse Shrubland over *Triodia epactia* Hummock Grassland					
Veg Condition	Good to Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia synchronicia	+	130	
Acacia tetragonophylla	2.5	190	
Atriplex bunburyana	+	50	HQ12-01
Cenchrus ciliaris	11	40	
Indigofera colutea	+	15	HQ12-02
Scaevola spinescens	+	60	
Triodia epactia	40	40	=HQ01-01

Site	**HQ13**					
Described by	CG	Date	19/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.77422	115.065478				
Habitat	Mid to lower slope of dune					
Soil	Reddish-brown sand					
Vegetation	*Hakea stenophylla* subsp. *stenophylla* Mid Sparse Shrubland over *Acacia stellaticeps* Low Sparse Shrubland over *Triodia epactia* Open Hummock Grassland					
Veg Condition	Very Good to Excellent					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia sericophylla	0.5	160	HQ13-01
Acacia stellaticeps	2.5	100	
Acacia tetragonophylla	+	260	
Bonamia erecta	+	30	
Cassytha capillaris	+	cr	
Corymbia zygophylla	+	140	
Eremophila forrestii subsp. *viridis*	1.5	90	
Goodenia forrestii	+	30	
Grevillea eriostachya	0.5	120	HQ13-02
Hakea stenophylla subsp. *stenophylla*	8	170	HQ13-03
Scaevola spinescens	+	60	
Senna glutinosa subsp. x *luerssenii*	0.5	210	=HQ01-04
Triodia epactia	25	40	

Site	**HQ14**					
Described by	BRM	Date	19/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.77254703	115.062577				
Habitat	Crest, slopes and shallow swale of sand dune					
Soil	Reddish-brown sand					
Vegetation	*Grevillea stenobotrya* Tall Sparse Shrubland over *Triodia epactia* Open Hummock Grassland					
Veg Condition	Excellent to Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia stellaticeps	+	60	
Adriana tomentosa var. *tomentosa*	+	110	HQ14-04
Bonamia erecta	+	30	
Cassytha capillaris	+	40	
Cenchrus ciliaris	+	50	
Crotalaria cunninghamii	+	70	HQ14-06
Euphorbia wheeleri	+	25	HQ14-07
Grevillea stenobotrya	8	400	
Hibiscus brachychlaenus	+	40	HQ14-03
Scaevola sericophylla	+	80	HQ14-01
Solanum lasiophyllum	+	60	
Tephrosia rosea var. *clementii*	+	90	HQ14-02
Trichodesma zeylanicum	+	20	=HBM-05
Triodia epactia	25	40	HQ14-05

Site	**HQ15**					
Described by	CG	Date	20/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.771418	115.060714				
Habitat	Dunes and shallow swale					
Soil	Reddish-brown sand					
Vegetation	*Hakea stenophylla* subsp. *stenophylla* Mid Sparse Shrubland over *Acacia stellaticeps* Low Sparse Shrubland over *Triodia epactia* Hummock Grassland					
Veg Condition	Excellent to Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia stellaticeps	8	90	
Acacia tetragonophylla	+	150	
Bonamia erecta	0.5	30	
Cassytha capillaris	+	cr	=HQ01-02
Enchylaena tomentosa	+	95	=HQ?
Eriachne helmsii	+	50	HQ15-02
Eucalyptus victrix	ADJ	250	HQ15-ADJ01
Grevillea eriostachya	0.5	200	=HQ13-02
Grevillea stenobotrya	0.5	250	=HQ01-01
Hakea stenophylla subsp. *stenophylla*	6	170	=HQ13-03
Indigofera colutea	+	40	=HQ11-01
Sida sp.	+	70	HQ15-01
Solanum lasiophyllum	+	35	
Trichodesma zeylanicum	+	90	
Triodia epactia	35	40	

Site	**HQ16**					
Described by	BRM	Date	20/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.773664	115.061044				
Habitat	Swale between dunes					
Soil	Reddish-brown clayey sand					
Vegetation	*Hakea stenophylla* subsp. *stenophylla* Mid Sparse Shrubland over *Acacia stellaticeps* Low Sparse Shrubland over *Triodia epactia* Hummock Grassland					
Veg Condition	Excellent					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia colei var. *colei*	+	230	HQ16-05
Acacia stellaticeps	5	100	
Acacia synchronicia	+	220	
Acacia tetragonophylla	2.5	280	
Bonamia erecta	+	25	
Cassytha capillaris	+	cr	
Eremophila forrestii subsp. *viridis*	+	60	HQ16-03
Eriachne helmsii	0.5	45	HQ16-02
Grevillea stenobotrya	+	210	
Hakea stenophylla subsp. *stenophylla*	3	160	HQ16-01
Scaevola spinescens (broad form)	+	60	=HQ02-08
Sida sp.	+	40	HQ16-04
Solanum lasiophyllum	+	15	
Triodia epactia	35	40	=HQ14-05

Site	**HQ17**					
Described by	CG	Date	20/10/2020	Type	Quadrat	45 x 56
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.77243899	115.060422				
Habitat	crest and upper slopes of dune					
Soil	Reddish-brown sand					
Vegetation	*Grevillea stenobotrya* Tall Sparse Shrubland over *Triodia epactia* Open Hummock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Abutilon sp.	+	70	HQ17-04
Acacia sericophylla	+	160	HQ17-06
Adriana tomentosa var. *tomentosa*	+	90	=HQ14-04
Bonamia erecta	+	25	
Cenchrus ciliaris	3	40	
Crotalaria cunninghamii	+	120	HQ17-01
Euphorbia wheeleri	+	25	=HQ14-07
Grevillea stenobotrya	4	350	
Hibiscus brachychlaenus	ADJ	30	HQ17-ADJ01
Scaevola sericophylla	+	80	=HQ14-01
Tephrosia rosea var. *clementii*	+	130	=HQ14-02
Trianthema pilosa	+	20	HQ17-03
Trichodesma zeylanicum	+	90	=HBM-05
Triodia epactia	20	40	
Triodia schinzii	+	50	HQ17-02

Site	**HQ18**					
Described by	BRM	Date	20/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.76871801	115.066302				
Habitat	Swale between dunes					
Soil	Reddish-brown clayey sand					
Vegetation	*Hakea stenophylla* subsp. *stenophylla* Mid Sparse and *Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia stellaticeps	*3*	*170*	
Acacia tetragonophylla	*+*	*80*	
Bonamia erecta	*+*	*25*	
Cassytha capillaris	*+*	*cr*	
Cenchrus ciliaris	*1*	*60*	
Diplopeltis eriocarpa	*3*	*35*	*HBM-17*
Eremophila forrestii subsp. *viridis*	*+*	*45*	*=HQ16-03*
Grevillea eriostachya	*+*	*120*	
Hakea stenophylla subsp. *stenophylla*	*3*	*150*	*=HQ16-01*
Solanum lasiophyllum	*+*	*70*	
Triodia epactia	*40*	*40*	

Site	**HQ19**					
Described by	BRM	Date	21/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.776393	115.067238				
Habitat	Samphire flat					
Soil	reddish-brown sandy loam over clay at 15 cm					
Vegetation	*Tecticornia* spp. Low Samphire Shrubland over *Eragrostis pergracilis* and *Sporobolus mitchellii* Sparse Tussock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia tetragonophylla	+	80	
Cenchrus ciliaris	3	40	
Cenchrus setiger	+	45	
Cullen cinereum	+	20	
Enchylaena tomentosa	+	80	=HQ10-09
Eragrostis pergracilis	2.5	15	HQ19-03
Eriachne flaccida	+	35	HQ19-07
Eriachne helmsii	+	40	HQ19-10
Eulalia aurea	+	60	
Panicum decompositum	+	40	
Prosopis pallida	+	210	HQ19-06
Rhodanthe stricta	+	30	HQ19-08
Scaevola spinescens (narrow form)	+	70	
Sporobolus mitchellii	1	30	HQ19-04
Streptoglossa ? liatroides	+	35	HQ19-09
Tecticornia indica subsp. bidens	35	30	HQ19-02
Triodia epactia	0.5	40	=HQ14-05

Site	**HQ20**						
Described by	BRM	Date	21/10/2020	Type		Quadrat	75 x 33
Season	Poor						
Location	ANSIA Onslow						
Lat/Lon	-21.780574	115.086104					
Habitat	Clay flat						
Soil	Reddish-brown clay loam						
Vegetation	*Acacia synchronicia, Prosopis pallida* and *A. tetragonophylla* Tall Open Shrubland over *Eulalia aurea* Sparse Tussock Grassland						
Veg Condition	Good						
Fire Age	> 10 years						

Taxon	Cover	Height	Collection #
Acacia colei var. *colei*	+	280	HQ20-07
Acacia sericophylla	+	180	HQ20-08
Acacia synchronicia	17	300	
Acacia tetragonophylla	1	300	
Bergia perennis subsp. *exigua*	1	5	HQ20-03
Cenchrus ciliaris	+	40	
Cullen leucanthum	+	110	HQ20-04
Enchylaena tomentosa	+	60	
Eulalia aurea	5	70	
Prosopis pallida	4	550	=HCG-08
Rhagodia eremaea	+	130	HQ20-09
Salsola australis	+	20	
Scaevola spinescens (narrow form)	+	80	
Sesbania cannabina	+	170	HQ20-05
Sporobolus mitchellii	1	40	=HQ19-04
Stemodia sp. Onslow (A.A. Mitchell 76/148)	0.5	90	HQ20-02
Streptoglossa ? liatroides	+	50	HQ20-06
Triodia epactia	+	40	
Vachellia farnesiana	+	180	HQ20-01

Site	**HQ21**					
Described by	BRM	Date	22/10/2020	Type	Quadrat	50 x 50
Season	Poor					
Location	ANSIA Onslow					
Lat/Lon	-21.775199	115.053826				
Habitat	Sandy rise and swale between dunes					
Soil	Reddish-brown clayey sand					
Vegetation	*Acacia stellaticeps* Mid Sparse Shrubland over *Triodia epactia* Hummock Grassland					
Veg Condition	Very Good					
Fire Age	> 10 years					

Taxon	Cover	Height	Collection #
Acacia stellaticeps	3	140	
Cassytha capillaris	+	cr	HQ21-02
Cenchrus ciliaris	+	45	
Eremophila forrestii subsp. *viridis*	+	120	=HQ16-03
Eriachne helmsii	+	45	HQ21-01
Scaevola spinescens	+	45	
Triodia epactia	50	50	

Site	**HQ22**						
Described by	BRM	Date	22/10/2020	Type	Quadrat	100 x 25	
Season	Poor						
Location	ANSIA Onslow						
Lat/Lon	-21.764253	115.016531					
Habitat	Saline clay flat						
Soil	Reddish-brown clay						
Vegetation	*Tecticornia pruinosa* Low Open Samphire Shrubland over *Eragrostis falcata* and *E. pergracilis* Open Tussock Grassland						
Veg Condition	Very Good to Good						
Fire Age	> 10 years						

Taxon	Cover	Height	Collection #
Acacia synchronicia	+	80	
Calotis plumulifera	+	20	HQ22-08
Cenchrus ciliaris	+	30	
Eragrostis falcata	15	15	HQ22-02
Eragrostis pergracilis	3	10	HQ22-06
Flaveria trinervia	+	20	HQ22-10
Lawrencia viridigrisea	+	45	HQ22-09
Lotus cruentus	+	12	HQ22-07
Salsola australis	+	40	
Streptoglossa ? liatroides	+	18	HQ22-05
Tecticornia pruinosa	10	80	HQ22-01

Appendix F
Eremophila forrestii subsp. *viridis* locations

APPENDIX F: *EREMOPHILA FORRESTII* SUBSP. *VIRIDIS* LOCATIONS

No. of individuals	Abundance	Latitude	Longitude
3	1-5	-21.776400	115.065300
5	1-5	-21.776000	115.065400
1	1-5	-21.774700	115.066000
2	1-5	-21.772000	115.066500
3	1-5	-21.768700	115.066400
5	1-5	-21.764700	115.065100
4	1-5	-21.769300	115.064200
4	1-5	-21.774100	115.060800
1	1-5	-21.774600	115.061400
3	1-5	-21.764800	115.043000
2	1-5	-21.766300	115.050100
2	1-5	-21.772300	115.061200
3	1-5	-21.764700	115.043000
5	1-5	-21.768400	115.040600
5	1-5	-21.774200	115.065500
4	1-5	-21.773600	115.060400
3	1-5	-21.775600	115.066100
3	1-5	-21.775600	115.066100
1	1-5	-21.766300	115.050100
2	1-5	-21.770500	115.062200
2	1-5	-21.768600	115.067400
1	1-5	-21.773100	115.066400
1	1-5	-21.771600	115.066400
3	1-5	-21.776400	115.065300
5	1-5	-21.776000	115.065400
2	1-5	-21.771200	115.066400
3	1-5	-21.769200	115.066300
5	1-5	-21.768700	115.066400
2	1-5	-21.768000	115.066700
1	1-5	-21.769300	115.064200
4	1-5	-21.774100	115.060800
3	1-5	-21.764800	115.043000
4	1-5	-21.766300	115.050100
3	1-5	-21.772300	115.061200
3	1-5	-21.764700	115.043000
4	1-5	-21.768400	115.040600
5	1-5	-21.774200	115.065500
3	1-5	-21.775600	115.066100
3	1-5	-21.775600	115.066100
1	1-5	-21.766300	115.050100
0	1-5	-21.770500	115.062200
2	1-5	-21.768600	115.067400
1	1-5	-21.765600	115.065300
1	1-5	-21.767400	115.066100
1	1-5	-21.773600	115.066900
5	1-5	-21.771800	115.061500
1	1-5	-21.772700	115.061800
1	1-5	-21.775000	115.060400
1	1-5	-21.774500	115.059500
2	1-5	-21.775800	115.060000
1	1-5	-21.776000	115.062200
1	1-5	-21.776000	115.062200
2	1-5	-21.776500	115.062200
1	1-5	-21.776700	115.062200
2	1-5	-21.776900	115.062100

No. of individuals	Abundance	Latitude	Longitude
3	1-5	-21.777200	115.062200
2	1-5	-21.777400	115.062600
1	1-5	-21.776800	115.062300
1	1-5	-21.777300	115.062800
1	1-5	-21.769600	115.064000
3	1-5	-21.772000	115.065000
5	1-5	-21.771300	115.062900
1	1-5	-21.772900	115.061600
4	1-5	-21.773700	115.061200
1	1-5	-21.773900	115.062300
5	1-5	-21.775400	115.063400
1	1-5	-21.777000	115.066000
2	1-5	-21.776700	115.065800
5	1-5	-21.776300	115.065700
4	1-5	-21.776200	115.065900
1	1-5	-21.776000	115.066100
1	1-5	-21.775800	115.066200
3	1-5	-21.775300	115.065100
5	1-5	-21.775200	115.066300
3	1-5	-21.774700	115.066600
3	1-5	-21.773500	115.064800
2	1-5	-21.773200	115.064200
2	1-5	-21.771800	115.063500
1	1-5	-21.771600	115.063100
2	1-5	-21.771200	115.063600
3	1-5	-21.770800	115.063500
2	1-5	-21.771900	115.061800
2	1-5	-21.773800	115.060800
1	1-5	-21.774100	115.060500
1	1-5	-21.774200	115.061100
1	1-5	-21.774400	115.061200
1	1-5	-21.774300	115.060900
1	1-5	-21.774400	115.060700
5	1-5	-21.774600	115.060700
2	1-5	-21.774600	115.061000
1	1-5	-21.775900	115.061200
2	1-5	-21.775700	115.062500
1	1-5	-21.775800	115.062700
4	1-5	-21.776100	115.062700
1	1-5	-21.776600	115.063600
2	1-5	-21.777200	115.063900
1	1-5	-21.777300	115.064100
2	1-5	-21.777700	115.064000
4	1-5	-21.777300	115.063600
1	1-5	-21.777400	115.063400
1	1-5	-21.777400	115.063200
1	1-5	-21.777300	115.063100
2	1-5	-21.776900	115.063300
4	1-5	-21.776700	115.063200
2	1-5	-21.776500	115.063100
1	1-5	-21.776600	115.062800
1	1-5	-21.728391	114.984591
13	>10-20	-21.773100	115.066400
12	>10-20	-21.771600	115.066400
13	>10-20	-21.773900	115.066200
14	>10-20	-21.768000	115.066700
20	>10-20	-21.773900	115.066200
11	>10-20	-21.772000	115.066500
17	>10-20	-21.771400	115.066400
12	>10-20	-21.772000	115.066500

No. of individuals	Abundance	Latitude	Longitude
17	>10-20	-21.773100	115.064900
20	>10-20	-21.772600	115.065000
16	>10-20	-21.775000	115.061700
20	>10-20	-21.774500	115.062800
15	>10-20	-21.774700	115.065000
11	>10-20	-21.773800	115.061500
16	>10-20	-21.774700	115.063500
11	>10-20	-21.776300	115.064400
15	>10-20	-21.774400	115.065900
14	>10-20	-21.773900	115.066700
20	>10-20	-21.772500	115.064200
16	>10-20	-21.775600	115.062000
11	>10-20	-21.775600	115.061700
50	>20-50	-21.769900	115.066900
50	>20-50	-21.769900	115.066900
50	>20-50	-21.775200	115.061400
50	>20-50	-21.770600	115.066900
6	>5-10	-21.772400	115.066400
10	>5-10	-21.771200	115.066400
6	>5-10	-21.769200	115.066300
6	>5-10	-21.771900	115.064300
6	>5-10	-21.767200	115.065600
10	>5-10	-21.774800	115.064100
10	>5-10	-21.774700	115.066000
6	>5-10	-21.772400	115.066400
6	>5-10	-21.764700	115.065100
6	>5-10	-21.774600	115.061400
6	>5-10	-21.771900	115.064300
10	>5-10	-21.773600	115.060400
6	>5-10	-21.767200	115.065600
10	>5-10	-21.774800	115.064100
6	>5-10	-21.765900	115.065000
9	>5-10	-21.769100	115.066200
10	>5-10	-21.770500	115.066700
8	>5-10	-21.770900	115.066800
8	>5-10	-21.773600	115.066900
10	>5-10	-21.774100	115.066500
9	>5-10	-21.772500	115.064700
8	>5-10	-21.775000	115.066200
7	>5-10	-21.773800	115.061700
8	>5-10	-21.775200	115.064000
8	>5-10	-21.775000	115.063100
6	>5-10	-21.776400	115.064900
6	>5-10	-21.776900	115.064900
6	>5-10	-21.777400	115.065500
10	>5-10	-21.778000	115.066000
6	>5-10	-21.775900	115.065700
8	>5-10	-21.775900	115.065000
7	>5-10	-21.775400	115.065900
7	>5-10	-21.774500	115.066200
10	>5-10	-21.774600	115.065600
10	>5-10	-21.774200	115.066400
6	>5-10	-21.774300	115.066600
7	>5-10	-21.770600	115.062600
7	>5-10	-21.775500	115.061200
8	>5-10	-21.775900	115.061400
8	>5-10	-21.775900	115.061600
6	>5-10	-21.775700	115.061900
6	>5-10	-21.776200	115.063100
9	>5-10	-21.776200	115.063400
7	>5-10	-21.777100	115.063300