NY-RP-EN-0011

NYIDINGHU TARGETED FLORA AND VEGETATION SURVEY

Fortescue Metals Group Limited

ecoscape

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SUMMARY

Fortescue Metals Group Limited (Fortescue) is investigating opportunities to expand its Pilbara mining operations and commissioned Ecoscape to undertake a Targeted flora and vegetation survey for the Nyidinghu Project located in the Shire of East Pilbara, approximately 60 km north of Newman. The survey area is 114,844.5 ha in size and is situated between the Fortescue Marsh and Hancock Range of the Hamersley Ranges.

The majority of the survey area has been subject to several previous flora and vegetation assessments that have identified significant flora and vegetation. Ecoscape conducted the Targeted flora and vegetation survey in two phases, from 4-16 May 2021 and from 16-25 July 2021 concurrently with another survey being undertaken. Seasonal conditions were considered average during the 2021 survey timeframes.

Prior to the field survey, Ecoscape conducted a desktop assessment primarily based on DBCA database searches and Fortescue's significant flora database to identify significant flora and vegetation to target during the field survey. The desktop assessment identified the following significant flora and vegetation associated with the survey area:

- nine known Priority Ecological Communities (PECs) occur within a 50 km buffer of the survey area, three of which intersect the survey area: *Fortescue Marsh (Marsh Land System)* (P1), *Narbung Land System* (P3) and *Vegetation of sand dunes of the Hamersley Range/Fortescue Valley* (P3)
- other significant vegetation types including Groundwater Dependant Vegetation and Sheetflow Dependent Vegetation.
- seventy five conservation-listed flora species occur within a 50 km buffer area, consisting of one Threatened flora, 16 Priority 1 (P1), 14 P2, 36 P3 and eight P4 taxa. Seventeen of these taxa are 'known' to occur based on a likelihood assessment that was undertaken and 10 taxa were identified as likely to occur. These taxa were prioritised for field survey.

The Targeted survey followed the methods outlined in the Flora and Vegetation Technical Guidance (EPA 2016a) including traverses and detailed searches in suitable habitat, opportunistic recording of significant species and estimations of population abundance. The Targeted survey included searches for significant flora, ground validation of significant vegetation and recording the presence of introduced flora within the survey area.

Sixteen conservation-listed flora taxa were confirmed to be present within the survey area including:

- one Threatened taxa; *Seringia exastia*
- five P1 taxa; *Calotis squamigera, Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069), *Myriocephalus scalpellus*, *Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760), *Tecticornia globulifera* and *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)
- three P2 taxa*; Euphorbia inappendiculata* var. *queenslandica, E. inappendiculata* var. *queenslandica* and *Isotropis parviflora* (P2)
- three P3 taxa; *Atriplex flabelliformis*, *Eremophila spongiocarpa* and *Euphorbia australis* var. *glabra*
- three P4 taxa; *Eremophila youngii* subsp. *lepidota*, *Goodenia nuda* and *Lepidium catapycnon*.

Four of the conservation-listed taxa identified within the survey area by the database searches were assessed and deemed unreliable and unlikely to occur including *Acacia subtiliformis* (P3), *Eragrostis crateriformis* (P3), *Stylidium weeliwolli* (P3) and *Tecticornia medusa* (P1).

Past and present surveys have recorded a total of 21 introduced flora taxa from the survey area. None of the species that have been recorded within the survey area are listed as Weeds of National Significance or Declared Pest plants listed under the BAM Act.

Three PECs were recorded within the survey area as per those identified by the desktop assessment. The mapping of these communities was in accordance with previous surveys with additional occurrences of the *Vegetation of sand dunes of the Hamersley Range/Fortescue Valley* PEC identified and mapped during the field survey.

Other significant vegetation including Groundwater Dependent Vegetation and Sheetflow Dependent Vegetation was recorded within the survey area with mapping largely aligning with that of previous surveys.

ACRONYMS AND ABBREVIATIONS

Table 1: Acronyms and abbreviations

Acronyms	
BC Act	Western Australian *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CR	Critically Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
DAWE	Commonwealth Department of Agriculture, Water and Environment (2020-)
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DPaW	Western Australian Department of Parks and Wildlife (2013-2017, now DBCA)
DotEE	Commonwealth Department of the Environment and Energy (2016-2020)
DPIRD	Western Australian Department of Primary Industries and Rural Development
DWER	Western Australian Department of Water and Environmental Regulation
EN	Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDA 94	Geographic Datum of Australia 1994
GDE/GDV	Groundwater Dependent Ecosystem/Groundwater Dependent Vegetation
ha	hectare/hectares
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometre/kilometres
m	metre/metres
MGA	Map Grid of Australia
NVIS	National Vegetation Inventory System
P; P1, P2, P3, P4, P5	Priority Flora and Fauna species rankings (P1-P4) or Priority Ecological Communities (P1-P5)
PEC	Priority Ecological Community
PF	Priority Flora
PMST	Protected Matters Search Tool (hosted by DAWE, used to search for MNES)
SFDV	Sheet Flow Dependent Vegetation
sp.	Species (generally referring to an unidentified taxon or when a phrase name has been applied)
subsp.	Subspecies (infrataxon)
TEC	Threatened Ecological Community
TF	Threatened Flora (formerly termed Declared Rare Flora, DRF, in Western Australia)
var.	Variety (infrataxon)
VU	Vulnerable (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
WAH	Western Australian Herbarium

1 INTRODUCTION

1.1 BACKGROUND

Fortescue Metals Group Limited (Fortescue) is investigating the potential expansion of its Pilbara mining opportunities to include the Nyidinghu Project. The Nyidinghu ore body is located where the Weeli Wolli Creek exits the Hamersley Ranges and flows towards the Fortescue Marsh. The area has been subject to previous flora and vegetation surveys which have identified several conservation-listed flora and significant vegetation. Fortescue commissioned Ecoscape to undertake a Targeted flora and vegetation survey to assess the conservation significance of the area and further support its investigation into the Nyidinghu Project.

1.2 SURVEY AREA

The Nyidinghu Project area, known as the 'survey area' in this report, is located within the Shire of East Pilbara in the Pilbara region approximately 60 km north of Newman at its closest point (**Figure 1**). The survey area is 114,844.5 ha in size and is situated between the Fortescue Marsh and Hancock Range of the Hamersley Ranges.

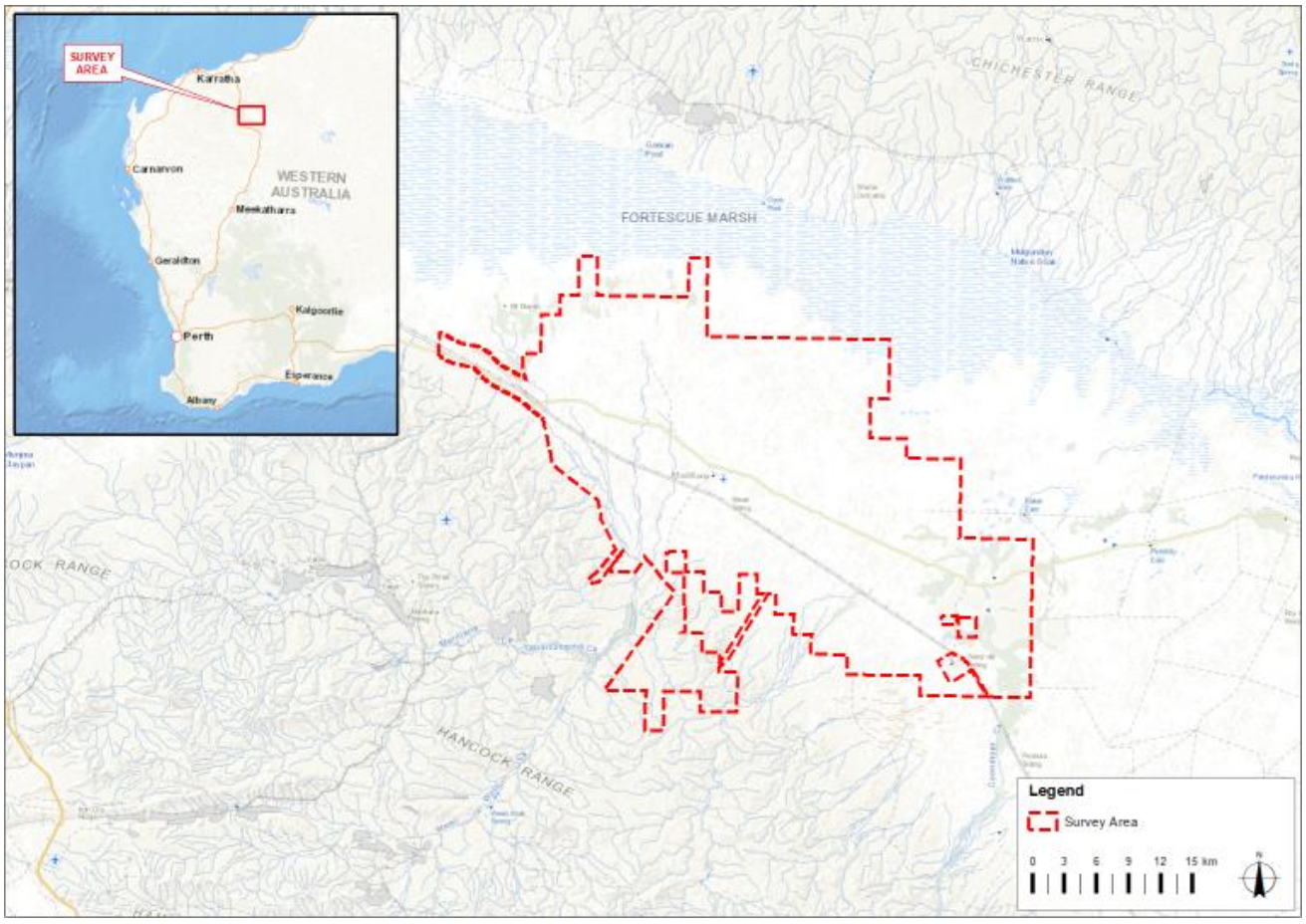


Figure 1: Survey area location

1.3 SURVEY REQUIREMENTS

The survey was conducted as a Targeted flora and vegetation survey over two separate phases. The requirements of the survey were to:

- provide Fortescue with an understanding of the significant flora and vegetation of the Nyidinghu Project area
- comply with Environmental Protection Authority (EPA) requirements for environmental survey and reporting in Western Australia (see below).

1.4 COMPLIANCE

This environmental assessment was conducted in accordance with Commonwealth and State legislation and guidelines:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Western Australian Environmental Protection Act 1986* (EP Act)
- *Western Australian Biodiversity Conservation Act 2016* (BC Act)
- *Western Australian Biodiversity Conservation Regulations 2018*
- Department of Environment, Water, Heritage and the Arts (DEWHA 2009) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999.*

As well as those listed above, the assessment complied with Environmental Protection Authority (EPA) requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2016a) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, known herein as the Flora and Vegetation Technical Guidance
- EPA (2016b) *Environmental Factor Guideline – Flora and Vegetation*
- EPA (2020) *Statement of Environmental Principles, Factors and Objectives*.

In addition, relevant components of Fortescue's Flora and Vegetation Assessment Guidelines 100 GU-EN-0005 (Fortescue 2014) were used for guidance.

Summaries of the flora and vegetation criteria and definitions are available in **Appendix One**.

2 DESKTOP ASSESSMENT

Details presented in this section are presented to identify features relevant to significant flora and vegetation from the survey area and to guide subsequent methodology applied to the field surveys.

2.1 PHYSICAL ENVIRONMENT

2.1.1 CLIMATE

The survey area is located within the Pilbara region, which includes two broad climatic zones. Coastal areas, as well as some higher rainfall inland areas, have a semi-desert tropical climate which experience 9-11 months of dry weather, with hot humid summers and warm winters. Inland areas have a dry desert climate, typically with higher temperatures and lower rainfall, and often experience up to 12 months of dry weather, with hot dry summers and mild winters (Leighton 2004). The survey area is within the dry inland area.

According to the Köppen-Geiger climate classification, the survey area has a hot arid desert climate (Class BWh) (Peel, Finlayson & McMahon 2007), where annual rainfall is generally less than 200 mm or the region loses more water via evapotranspiration than it receives as rain, generally a result of hot, sunny weather without significant cloud. The mean average temperature exceeds 18°C, and summer temperatures are frequently over 40°C.

The closest Bureau of Meteorology (BoM) station with long term records for rainfall is Bonney Downs (BoM 2021 station no. 4006, operating since 1907) located approximately 70 km to the east of the survey area. The mean annual rainfall is 325.3 mm, with 60% falling from January to March (**Figure 2**). Rainfall in the four months preceding the field survey was approximately average with the most substantial rainfall events occurring during February. Data available from Cloudbreak BoM station (12 km from the survey area, short term records only) indicates that rainfall during April 2021 (60.6 mm) was substantially higher that than that recorded at Bonney Downs (38.1 mm). This suggests that seasonal conditions within the survey area may have be better than BoM data indicates.

The closest BoM station with long term records for temperature is Newman Aero (BoM 2021 station no. 7176, operating since 1971) located approximately 100 km to the south-east of the survey area. December is the hottest month with a mean maximum temperature of 39.2°C and minimum of 24.1°C. June is the coldest month with a mean maximum of 23.1°C and minimum of 7.5°C.

Figure 2 shows the average rainfall and temperatures of the survey area, with rainfall for the six months preceding the field survey.

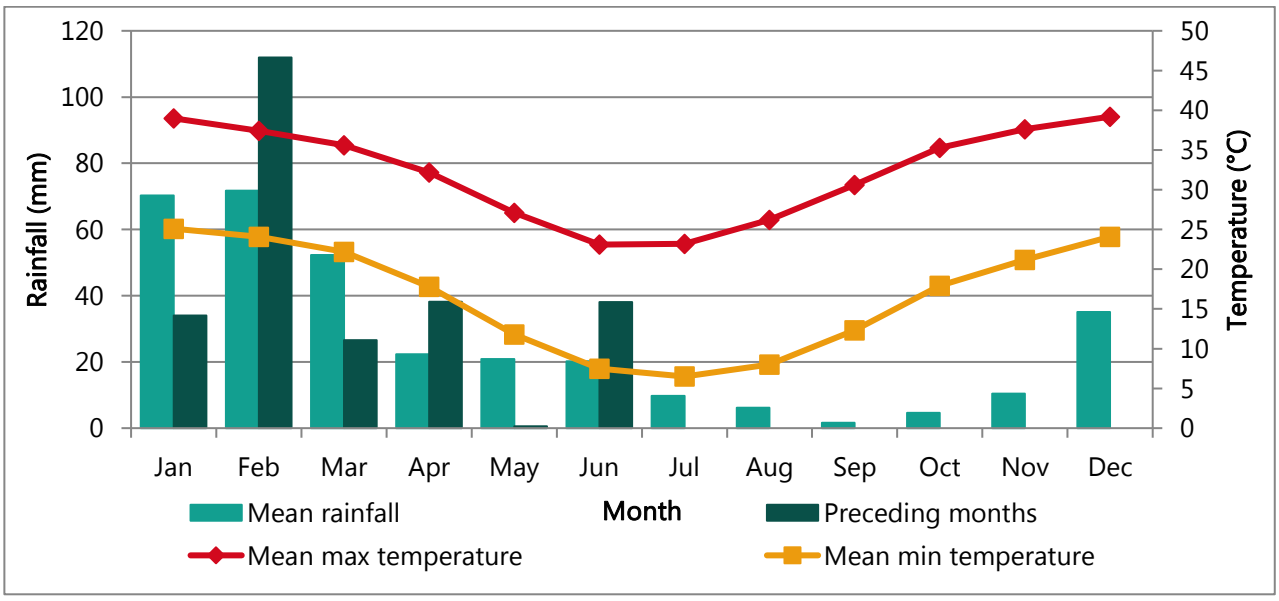


Figure 2: Rainfall and temperature data for the survey area (BoM 2021)

2.1.2 LAND SYSTEMS

According to the Department of Primary Industries and Rural Development (DPIRD 2020) soil landscape mapping, there are 14 land systems that intersect the survey area (**Table 2** and **Map 1**).

Table 2: Land systems (DPIRD 2020)

Mapping unit	Land system	Description	Extent (ha)	%
284Ad	Adrian System	Stony plains and low silcrete hills supporting hard spinifex grasslands.	2,530.27	2.20
285Bg	Boolgeeda System	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	2,341.33	2.04
284Ca	Calcrete System	Low calcrete platforms and plains supporting shrubby hard spinifex grasslands.	3,613.69	3.15
284Dv	Divide System	Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs.	10,927.09	9.51
284Fa	Fan System	Washplains and gilgai plains supporting groved mulga tall shrublands and minor tussock grasslands.	30,838.83	26.85
284Ft	Fortescue System	Alluvial plains and flood plains supporting patchy grassy eucalypt and acacia woodlands and shrublands and tussock grasslands.	3,797.29	3.31
284Mr	Marillana System	Gravelly plains with large drainage foci and unchannelled drainage tracts supporting snakewood shrublands and grassy mulga shrublands.	30,958.85	26.96
284Ms	Marsh System	Lakebeds and flood plains subject to regular inundation, supporting samphire shrublands, salt water couch grasslands and chenopod shrublands.	609.64	0.53
284Na	Narbung System	Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with chenopod low shrubs.	147.97	0.13
285Ne	Newman System	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	6,443.80	5.61
284Ri	River System	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	1,585.25	1.38
285Ro	Robe System	Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands.	0.33	0.0003
284Tu	Turee System	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood.	10,467.46	9.11
284Ur	Urandy System	Stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands.	10,582.73	9.21

2.1.3 ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas around Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs) and are declared under section 51B of the *Environmental Protection Act* (EP Act) and described in the *Environmental Protection (Environmentally Sensitive Areas) Notice*.

The survey area intersects one ESA associated with the Fortescue Marsh at the northern extremities of the survey area (**Map 2**). The next closest ESA is Karijini National Park, located approximately 43 km west of the survey area at its closest point.

2.1.4 GROUNDWATER DEPENDENT ECOSYSTEMS, WETLANDS AND DRAINAGE

The survey area is situated within the Upper Fortescue Catchment and intersects the Fortescue Marsh, a Wetland of National Significance and Priority 3 PEC. The survey area also intersects several drainage features, the most substantial being Weeli Wolli Creek and Mindy Mindy Creek.

The Groundwater Dependent Ecosystems Atlas (Australian Government & BoM 2020) indicates that the survey area has a low to high potential for terrestrial GDEs to occur, with an IDE likelihood of nine to 10.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (2020 DAWE).

The survey area is located in the Pilbara IBRA region in the Fortescue (PIL2) and Hamersley subregions (PIL3), described as follows.

The Fortescue subregion, as described by Kendrick (2001):

> *Alluvial plains and river frontage. Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western (lower) part of the drainage. River gum woodlands fringe the drainage lines. Northern limit of Mulga (Acacia aneura). An extensive calcrete aquifer (originating within a palaeo-drainage valley) feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput Melaleuca woodlands. Climatic conditions are semi desert tropical, with average rainfall of 300 mm, falling mainly in summer cyclonic events. Drainage occurs to the north-west. Subregional area is 2,041,914 ha.*

The Hamersley subregion, as described by Kendrick (2001):

> *PIL3 is the Southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and Eucalyptus leucophloia over Triodia brizoides on skeletal soils of the ranges. The climate is Semi-desert tropical, average 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west. Subregional area is 6,215,092 ha*.

2.2.2 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

A 50 km buffer was used around the survey area for the DBCA database search (search reference 07-0321EC). The search identified nine known PECs within the search area (**Table 3**). Of these, the survey area intersects with mapped occurrences (or administrative buffers) of three PEC. **Map 2** shows the locations of ecological communities identified by the DBCA database search.

Table 3: TECs and PECs identified by the DBCA database search. Blue shading represents mapped PEC's or their buffers, which intersect the Survey area.

Ecological Community	WA status
Brockman Iron cracking clay communities of the Hamersley Range	Priority 1 PEC
Fortescue Marsh (Marsh Land System)	Priority 1 PEC
Four plant assemblages of the Wona Land System (previously 'Cracking clays of the Chichester and Mungaroona Range')	Priority 1 PEC
Freshwater claypans downstream of the Fortescue Marsh - Goodiadarrie Hills on Mulga Downs Station.	Priority 1 PEC
Kumina Land System	Priority 3 PEC
Narbung Land System	Priority 3 PEC
Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara Region	Priority 2 PEC
Vegetation of sand dunes of the Hamersley Range/Fortescue Valley	Priority 3 PEC
Weeli Wolli Spring Community	Priority 1 PEC

A search using the DotEE's Protected Matters Search Tool (PMST) was also conducted (DAWE 2021 search reference 8KLFB3) using a 50 km buffer around a point approximating the centre of the survey area. No EPBC-listed TECs were identified.

2.2.3 PREVIOUS SIGNIFICANT VEGETATION MAPPING

A previous survey (Ecoscape 2018), that included the majority of the survey area (91.9%), identified the following significant vegetation within the current survey area:

- Priority Ecological Communities:
  - Fortescue Marsh (Marsh Land System), corresponding with seven vegetation types (several not present within the current survey area)
  - Narbung Land System, as per the existing Land System mapping
  - Vegetation of sand dunes of the Hamersley Range/Fortescue Valley, corresponding with the AdAh vegetation type
- Groundwater Dependant Vegetation:
  - EvAcCc, dominated by *Eucalyptus victrix* and *E. camaldulensis*
  - MxCc, dominated by *Melaleuca xerophila*
  - EvMxTl dominated by *Eucalyptus victrix* and *Melaleuca xerophila*
- Potential Groundwater Dependant Vegetation:
  - EvDf and EvDfEb dominated by *Eucalyptus victrix*
- Sheet Flow Dependent Vegetation: AaSaEp

2.2.4 THREATENED AND PRIORITY FLORA

No EPBC-listed Threatened Flora (TF) that are known to occur within the 50 km search buffer area were identified in the PMST search.

The requested DBCA databases (search reference 15-0221FL) was conducted using a 50 km buffer around the survey area. The results incorporate the Threatened and Priority Flora (TPFL) List, taken from TPFL Report Forms and DBCA surveys, and WA Herb, taken from vouchered specimens held in the Western Australian Herbarium. **Map 2** shows the locations of conservation-listed flora identified by the DBCA database search.

Fortescue maintains a database of conservation listed flora and other flora of conservation interest associated with its operational and exploration tenements. This database consists of DBCA database search results requested for flora and vegetation assessments and the results of field surveys it has commissioned. The resultant list, and associated location data, provides a comprehensive understanding of the conservation significant flora and other flora of conservation interest (e.g., significant range extensions, unusual forms)

within and close to Fortescue's areas of interest. Fortescue's significant flora database results are presented in **Map 2**.

The combined database searches identified 75 species, listed in **Table 11** in **Appendix Two**, consisting of one TF, 16 P1, 14 P2, 36 P3 and eight P4 taxa.

2.2.4.1 *Seringia exastia* (TF)

Seringia exastia (TF) was identified by the database searches. The recent advice provided by DBCA (19/2/2021) with database search results (reproduced below) indicates this species' listing as TF is a technicality based on outdated taxonomy:

> *The search results include records for Seringia exastia. S. exastia (previous known as Keraudrenia exastia) was a species only known from the Kimberley Region. A recently completed taxonomic study that assessed genomic and morphological characters in several Seringia taxa (Wilkins & Whitlock 2016) has concluded that Seringia exastia and S. elliptica are the same species. The taxonomy of the genus has been revised to synonymise S. exastia and S. elliptica under the oldest valid name of S. exastia. As S. elliptica is common and widespread throughout the Pilbara region, central WA and the Northern Territory and extends into South Australia, following the taxonomic revision S. exastia is now considered common and widespread.*
>
> *A nomination to delist the species due to no plausible significant threats to the species has been prepared and considered by the WA Threatened Species Scientific Committee (TSSC). We anticipate that at the next TSSC meeting recommendations will be made to the Minister to delist. However until changes are officially made to the threatened species list, S. exastia is still legally listed as threatened flora, and authorisation to take under section 40 of the Biodiversity Conservation Act 2016 is still required. Although some loss of plants is likely to have occurred and will continue to occur during mining and road works in some parts of the species' distribution, this is not expected to be significant in the context of the entire population. Therefore there should be no impediments to granting authorisation, following the standard process of application made to DBCA's Species and Communities Program.*
>
> *To reduce timeframes and costs associated with approvals under the BC Act, DBCA will not require the standard targeted surveys to be undertaken to inform the threatened flora authorisation impact assessment for Seringa exastia. However, survey reports should still consider Seringia exastia as a listed threatened species and note the presence of the species within a survey area when encountered. Authorisation applications with basic details that the species is known to occur within the applied project area will be accepted and fast-tracked for approval.*

2.2.4.2 Threatened and Priority Flora Likelihood Assessment

Ecoscape conducted a likelihood assessment to identify the TF and PF species that have potential to occur within the survey area. Information to assess the likelihood of a species occurring includes the following sources: ecology as listed on *FloraBase* (WAH 1998-2021; 2021, including specimen collection information) and information from recent nearby surveys, incorporating an assessment of habitats likely to be present in the survey area.

The attributes taken into consideration were:

- broad soil type usually associated with the species
- broad landform usually associated with the species
- usual vegetation (characteristic species) with which the species is usually associated
- species having previously been recorded from within approximately 20 km of the survey area (considered as 'nearby') taking locational accuracy into consideration
- time since recorded (i.e. within the previous 25 years), taking into consideration land use changes since collection

- reliability of record: species identified by only a TPFL record, without an accompanying verified vouchered specimen, may have been incorrectly identified or been subject to taxonomic updates since the record was entered
- number of records for the species
- if the record is for a not naturally occurring population (planted).

The likelihood rating is assigned using the categories listed in **Table 4**.

Table 4: Categories for likelihood of occurrence of TF and PF

Likelihood Category	Criteria
Known to occur	Species previously recorded within the survey area.
Likely to occur	Suitable habitat is known to occur within the survey area and multiple records of the species exist within close proximity*
May occur	Suitable habitat is expected to occur within the survey area and the species has previously been recorded within proximity**
Unlikely to occur	Suitable habitat is expected to occur within the survey area however previous records are limited and/or historic and/or not in proximity** OR Suitable habitat is not expected to occur within the survey area although previous records exist in proximity**
Very Unlikely to occur	Suitable habitat is not expected to occur in the survey area AND/OR previous records are limited and/or historic and/or not in proximity**

* close proximity = ¼ of the distance of the database search buffer
** proximity = ½ of the distance of the database search buffer

The likelihood assessment is available in **Table 11** in **Appendix Two**. Based on the information available during the desktop assessment, 17 flora taxa were 'known; to occur within the survey area (one TF, four P1, two P2, seven P3 and three P4) and 10 flora taxa were identified as 'likely' to occur (four P1, five P3 and one P4). The flora taxa identified as 'known' or 'likely' were prioritised for field survey.

The likelihood of occurrence was re-evaluated following the field survey when actual survey area characteristics (vegetation types, vegetation condition, visibility for individual species) were better understood, and the level of survey effort was considered. The post-survey likelihood is also incorporated into this table and discussed further in **Section 5.1.2.5**.

2.3 PREVIOUS SURVEYS

The majority of the survey area has been subject to previous flora and vegetation surveys. The studies listed below and shown on **Map 3** intersect the survey area and provide flora and vegetation assessments and mapping relevant to the survey:

- Ecoscape (2018) *Fortescue Valley Flora and Vegetation Survey*, unpublished report for Fortescue Metals Group Ltd.
- Lyons, M (2016) *Fortescue Marsh Vegetation Mapping*
- Cardno (2012a) *Addendum: Nyidinghu Flora and Vegetation Assessment,* prepared for Fortescue Metals Group Ltd.
- Cardno (2012b) *Nyidinghu flora and vegetation assessment*, unpublished report for Fortescue Metals Group Ltd.
- Cardno (2012c) *Nyidinghu Rail Spur Flora and Vegetation Assessment*, report prepared for Fortescue Metals Group Ltd.
- Biota Environmental Sciences (2004a) *Vegetation and Flora Survey of the Proposed FMG Stage A Rail Corridor*, unpublished report for Fortescue Metals Group Ltd.
- Biota Environmental Sciences (2004b) *Fortescue Metals Group Stage B Rail Corridor, Christmas Creek, Mt Lewin, Mt Nicholas and Mindy Mindy Mine Areas*, report prepared for Fortescue Metals Group Ltd.

Other studies reviewed for their relevance to the survey include:

- Markey (2016) *Floristic Survey and Mapping of the Riparian and Halophyte Dominated Communities on the Fortescue Marsh (Martuyitha), Western Australia*
- ENV Australia Pty Ltd (2011) *Cloudbreak Flora and Vegetation Assessment*, unpublished report for Fortescue Metals Group Ltd.
- Coffey Environments (2007) *Supplementary Vegetation and Flora Surveys of the Port Hedland to Cloudbreak Rail Corridor and Associated Borrow Pits and Infrastructure*
- Mattiske Consulting Pty Ltd (2007) *Flora and Vegetation near Fortescue Marshes*, unpublished report for Fortescue Metals Group Ltd.
- Mattiske Consulting Pty Ltd (2005) Flora and Vegetation on the Cloudbreak and White Knight Leases, unpublished report for Fortescue Metals Group Ltd.

3 METHODS

3.1 SURVEY AIMS

The aims of the survey were to undertake:

- targeted searches for conservation-listed flora based on previous records or where suitable habitat occurs
- targeted searches for conservation significant vegetation communities based on previous records or where there is a high likelihood of occurrence
- opportunistic searches for weed species and record their abundance or map infestations where practicable
- report on the results of the targeted searches.

3.2 GUIDING PRINCIPLES

The flora and vegetation survey was conducted as a Targeted survey according to the Flora and Vegetation Technical Guidance (EPA 2016a). The EPA considers that a Targeted survey requires:

- adequate survey design that considers survey timing for the botanical province
- one or more site visits by an experienced botanist to record locations of significant flora and/or vegetation
- systematic searches for significant flora and vegetation in all potentially suitable habitats, including where habitats extend outside the survey boundary
- follow-up Targeted survey (if necessary) where significant flora or vegetation is found during opportunistic sampling
- local or regional Targeted surveys if the results indicate that impacts are likely to occur to significant flora and vegetation.

3.3 FIELD SURVEY

3.3.1 TARGETED SEARCHES FOR SIGNIFICANT FLORA

Targeted searches were conducted in potentially suitable habitat of target species, with the remainder of the site opportunistically searched during site traverses. The searches followed the methods outlined in the Flora and Vegetation Technical Guidance (EPA 2016a) and included:

- traverses and detailed searches in areas identified as likely to support conservation-listed flora
- traverses and ground truthing in areas of potentially significant vegetation
- ground truthing existing populations of conservation-listed flora
- mapping and estimation of population extent/abundance of conservation-listed flora species
- opportunistic recording of weed species and their distribution.

A helicopter was supplied by Fortescue in order to access any location within the survey area. The helicopter was available for approximately four days of the survey timeframe during phase 1 (May 2021). The helicopter was used to search for various conspicuous species from the air and enabled access for more detailed on-ground searches. The helicopter was particularly utilised to access the following remote locations that were considered likely to support conservation-listed flora:

- areas of the Fortescue Marsh along the northern boundary of the survey area
- freshwater claypans within the eastern portion of the survey area
- mountainous areas of the southern portion of the survey area
- Mindy-Mindy Creek that runs through the southern portion of the survey area.

The locations of all targeted taxa collected were recorded using handheld devices with the following data recorded:

- observer, date and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting

- local abundance/population size and/or population boundary, including outside the survey area where possible
- landform
- brief vegetation community description
- representative photos of each species and habitat
- collection of representative specimens.

The majority of the survey area has been the subject of several previous surveys. Previous data was consolidated and reliable previous records were not deemed necessary to reassess, rather the focus was on validating uncertain records as well as identifying new populations and locations of significant flora.

Conservation criteria used in this assessment are outlined in **Table 8**, **Table 9** and **Table 10** in **Appendix One**.

3.3.2 TARGETED SEARCHES FOR SIGNIFICANT VEGETATION

Significant vegetation includes formally listed TECs and PECs as well as other significant vegetation according to the Flora and Vegetation Technical Guidance (EPA 2016a) such as Groundwater Dependent Vegetation (GDV) and Sheetflow Dependent Vegetation (SFDV). The majority of the survey area had been previously mapped in detail for significant vegetation (Ecoscape 2018). This mapping was consolidated and updated applicable to the survey area. During the field survey, a particular focus was on refining existing boundaries and ground-truthing potential new occurrences of significant vegetation.

3.3.3 TARGETED SEARCHES FOR INTRODUCED FLORA

Introduced flora data was available from previous surveys from Fortescue's database. This data was supplemented by new records of introduced flora collected during the field survey. A particular focus was applied to Fortescue's 'priority' weeds. The locations of introduced flora were recorded using handheld devices with the following data recorded:

- observer, date and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting
- local abundance/population size
- representative photos of each species and habitat
- collection of representative specimens if any uncertainty of identification.

3.3.4 FIELD SURVEY TIMING

Phase 1 of the field survey was conducted from the 4th to 16th May 2021 and phase 2 from the 16th to 25th July 2021 concurrently with a survey of the adjacent proposed Nyidinghu Transport Corridor. Targeted searches were conducted by a team of two over a total of 10 days during the two survey periods. Phase 1 was conducted during the optimal period for botanical survey within the bioregion according to the Flora and Vegetation Technical Guidance (EPA 2016a) and corresponded with the flowering period of the majority of flora taxa being targeted. Phase 2 was conducted outside the optimal flowering timeframe, with the focus being on other flora taxa with winter flowering or follow up survey for species identified during Phase 1.

3.4 PERMITS

Fortescue undertook consultation with relevant stakeholders prior to the field survey and issued Ecoscape with a Land Use Certificate (LUC-05555) in order to enable compliance with conditions relating for accessing the survey area. The field surveys were conducted in accordance with the conditions outlined within this LUC.

Flora collecting permits were held by all team leaders:

- Stephen Kern: Flora Collecting Permit FB62000001, Threatened Flora Collecting Permit TFL 74-1920
- Kyla Pannell: Flora Collecting Permit FB62000261
- Louisa Carlsson: Flora Collecting Permit FB62000295.

3.5 TAXONOMIC IDENTIFICATION

Taxonomic identification of the collected voucher specimens was conducted by Stephen Kern and Dr Udani Sirisena. Identification of collections was undertaken with reference to relevant literature, specimens held in the Western Australian Herbarium and scanned specimens available on JSTOR Global Plants (ITHAKA 2000-2021). Several collections were also verified by Michael Hislop via the Western Australian Herbarium's identification service.

3.6 POST-SURVEY LIKELIHOOD ASSESSMENT

Following the field survey, a post-survey likelihood assessment was conducted to identify conservation-listed species that have potential to occur on site. This assessment was based on survey results, survey effort and habitat identified within in the survey area.

4 FIELD SURVEY RESULTS

The Targeted flora and vegetation survey was conducted by Stephen Kern (Principal Botanist, Flora Collecting Permit FB62000001; Threatened Flora Collecting Permit TFL 74-1920), Kyla Pannell (Botanist, Flora Collecting Permit FB62000261) and Louisa Carlsson (Ecologist, Flora Collecting Permit FB62000295) with assistance from Julia Mattner (Senior Botanist), Nicola Storey (Environmental Scientist) and Sophie Cochrane (Graduate Environmental Scientist).

4.1 SIGNIFICANT FLORA

4.1.1 CONFIRMED CONSERVATION-LISTED FLORA

There were sixteen conservation-listed flora taxa confirmed as recorded within the survey area:

- one Threatened Flora
  - *Seringia exastia*
- six Priority 1
  - *Calotis squamigera*
  - *Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)
  - *Myriocephalus scalpellus*
  - *Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)
  - *Tecticornia globulifera*
  - *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)
- three Priority 2
  - *Euphorbia inappendiculata* var. *inappendiculata*
  - *Euphorbia inappendiculata* var. *queenslandica*
  - *Isotropis parviflora*
- three Priority 3
  - *Atriplex flabelliformis*
  - *Eremophila spongiocarpa*
  - *Euphorbia australis* var. *glabra*
- three Priority 4
  - *Eremophila youngii* subsp. *lepidota*
  - *Goodenia nuda*
  - *Lepidium catapycnon*.

Locations of TP and PF are shown on **Map 4** and described in more detail in **Table 5**.

Table 5: PF recorded during the field survey

***Seringia exastia* (T)**	
Description: Shrub to 1 m tall with pink flowers (WAH 1998-2021; 2021). Within the survey area this species was recorded at the edge of a vehicle track. No flowers, buds or fruits were observed. 	**Habitat:** sandy plain with shrubland/grassland vegetation **Location:** southern portion of the survey area **2021 Survey results**: one record with 100 plants in the survey area **Combined survey populations:** three populations **Known records and distribution**: According to *Atlas of Living Australia*, this species is widespread across a large portion of Western Australia and the distribution extends into the Northern Territory and South Australia (ALA 2021).
***Calotis squamigera* (P1)**	
Description: Procumbent annual herb growing to 0.1 m tall with yellow flowers (WAH 1998-2021; 2021). Within the survey area this species was observed growing within a dense mulga grove. 	**Habitat:** dense mulga grove **Location:** Northwest corner of the survey area **2021 Survey results**: one record with 35 plants in the survey area **Combined survey populations:** one population recorded during 2021. An additional previous location has been investigated on numerous occasions without recording this species at that location. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are five records of this species from the Pilbara region of Western Australia, with an overall distribution of approximately 30 km (north-south) by 180 km (east-west), largely near the survey area. However, this species is widespread in Queensland and also known from the Northern Territory (ALA 2021).

***Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069) (P1)**	
Description: A low herb to 0.2 m tall with white flowers (WAH 1998-2021; 2021). 	**Habitat:** riparian zone of a lake **Location:** Coondiner Pool in the southeast corner of the survey area **2021 Survey results**: two records with a total of 30 plants in the survey area **Combined survey populations:** one population **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are five records of this species from the Pilbara, with an overall distribution of approximately 40 km (north-south) by 80 km (east-west), largely northwest of the survey area.
***Myriocephalus scalpellus* (P1)**	
Description: Prostrate to semi-erect herb growing to 10 cm high (WAH 1998-2021; 2021). Stems and leaves cottony. Globular flower head consisting of white bracts surrounding the yellow florets. Within the survey area this species was observed in abundance with most plants in flower. 	**Habitat:** riparian zone of a lake **Location:** Coondiner Pool in the southeast corner of the survey area **2021 Survey results**: five records with a total of 1220 plants in survey area **Combined survey populations:** likely to represent a single population **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are seven records of this species from the Pilbara, with an overall distribution of approximately 70 km (north-south) by 480 km (east-west), largely recorded from Coondiner Pool.

***Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760) (P1)**	
Description: Low herb to 0.2 m high (WAH 1998-2021; 2021)**.** Within the survey area this species was observed mostly in fruit. 	**Habitat:** riparian zone of a lake **Location:** Coondiner Pool in the southeast corner of the survey area **2021 Survey results**: four records with a total of 800 plants in the survey area **Combined survey populations:** one population **Known records and distribution**: According to *FloraBase* (WAH 1998-2021; 2021) there is only a single statewide record of this taxon, recorded from Coondiner Pool in the survey area.
***Tecticornia globulifera* (P1)**	
Description: Samphire shrub to 0.5 m high (WAH 1998-2021; 2021). Distinctive (usually) bright red, terminal, globular articles appearing like balls on the end of the stems. 	**Habitat:** saline marsh **Location:** Northeast corner of the survey area in Fortescue Marsh **2021 Survey results**: six records with a total of 1650 plants in the survey area **Combined survey populations:** one population **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 57 records of this species from the Pilbara, Gascoyne and Great Sandy Desert, with an overall distribution of approximately 200 km (north-south) by 1000 km (east-west), largely north of the survey area in Fortescue Marsh.

***Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063) (P1)**	
Description: Low shrub to 0.5 m high (WAH 1998-2021; 2021). Distinctive opposite and decussate perpendicular fruiting branchlets. 	**Habitat:** saline marsh **Location:** Fortescue marsh in the north of the survey area **2021 Survey results**: 11 records with a total 4415 plants in the survey area **Combined survey populations:** up to six populations **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 101 records of this species from the Pilbara and Little Sandy Desert, with an overall distribution of approximately 260 km (north-south) by 150 km (east-west), largely north of the survey area in Fortescue Marsh.
***Euphorbia inappendiculata* var. *inappendiculata* (P2)**	
Description: Prostrate herb to 0.1 m high (WAH 1998-2021; 2021). Produces a milky latex; Stems to 0.3 m long, without hairs (glabrous).  Image derived from Ecoscape image archive	**Habitat:** mulga-dominated on clay loam soil **Location:** northwestern portion of the survey area **2021 Survey results**: not observed during 2021, known from a reliable 2017 record **Combined survey populations:** one population **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are eight records of this species, mostly from the Pilbara bioregion, with an overall distribution of approximately 400 km (north-south) by 450 km (east-west), largely west of the survey area.

***Euphorbia inappendiculata* var. *queenslandica* (P2)**	
Description: Prostrate herb to 0.1 m high *FloraBase* (WAH 1998-2021; 2021). Stems to 0.3 m long, covered in sparse, white long, spreading hairs. 	**Habitat:** mulga-dominated on clay loam soil **Location:** western portion of the survey area **2021 Survey results**: one record with three plants in the survey area **Combined survey populations:** three populations **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 10 records of this species from the Pilbara and Ord Victoria Plain, with an overall distribution of approximately 500 km (north-south) by 1150 km (east-west), largely west of the survey area. However, *Atlas of Living Australia* indicates this taxon has additional records across southeastern Western Australia and is widespread in all other states of Australia (ALA 2021).
***Isotropis parviflora* (P2)**	
Description: Shrub growing to 0.1 m high with white/pink flowers (WAH 1998-2021; 2021). This species was only encountered from a single location during 2021. It was observed to be more abundant during 2017 (Ecoscape 2018). During 2017, many of the locations had been recently burnt (<2 years), indicating that fire may play an important role in the ecology of *Isotropis parviflora*. 	**Habitat:** low rocky outcrops **Location:** southeast portion of the survey area **2021 Survey results**: one record in the survey area with one plant **Combined survey populations:** up to seven populations from a restricted area surrounding the Coondiner Pool area **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 28 records of this species from Great Sandy Desert, Pilbara, Tanami, with an overall distribution of approximately 400 km (north-south) by 1100 km (east-west), largely west of the survey area. This species is also known from the Northern Territory and Queensland (ALA 2021).

***Atriplex flabelliformis* (P3)**	
Description: Erect, rounded perennial herb to 35 cm high. Fan-shaped or deltoid (inverted triangle) shaped fruit.  Image derived from Ecoscape image archive	**Habitat:** saline marsh **Location:** near the northern boundary of the survey area **2021 Survey results**: not observed during 2021, known from reliable 2017 records **Combined survey populations:** one population **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 51 records of this species with a scattered distribution across Western Australia of approximately 1,100 km (north-south) by 1,400 km (east-west).
***Eremophila spongiocarpa* (P3)**	
Description: An intricately branched, succulent-leaved shrub growing to 1 m high with white flowers. Fruit are spongy in appearance. 	**Habitat:** saline marsh **Location:** Northeast and northwest corner of the survey area in Fortescue Marsh **2021 Survey results**: 20 records with a total of 872 plants in the survey area **Combined survey populations:** likely representative of three populations **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 117 records of this species from the Pilbara with an overall distribution of approximately 50 km (north-south) by 150 km (east-west), largely within the Fortescue Marsh area.

***Euphorbia australis* var. *glabra* (P3)**	
Description: Annual herb, prostrate to spreading up to 0.05 m tall. Leaves mid green above (glabrous) and light green below. Cyanthia red in colour. 	**Habitat:** **Location:** north western edge of the survey area **2021 Survey results**: two records with a total of 10 plants in the survey area **Combined survey populations:** up to six populations **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 25 records of this species from the Pilbara, with an overall distribution of approximately 230 km (north-south) by 550 km (east-west), largely west of the survey area.
***Eremophila youngii* subsp. *lepidota* (P4)**	
Description: Dense spreading shrub to 3 m high, leaves narrow and scaly, tubular pink-purple flowers. 	**Habitat:** typically recorded from low lying areas adjacent to Fortescue Marsh **Location:** eastern portion of the survey area **2021 Survey results**: 25 records with a total of 537 plants in the survey area **Combined survey populations:** likely representative of up to eight populations **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 61 records of this species from Carnarvon, Gascoyne, Little Sandy Desert and the Pilbara in Western Australia and one record from the Northern Territory, with an overall distribution of approximately 500 km (north-south) by 1800 km (east-west).

***Goodenia nuda* (P4)**	
Description: Prostrate or erect herb to 50 cm high with three-veined basal leaves. Yellow flowers with maroon centre.  Image derived from Ecoscape image archive	**Habitat:** various, typically from valley floors or drainage lines. **Location:** scattered across the survey area **2021 Survey results**: not observed during 2021, known from reliable 2017 records **Populations:** several, though possibly continuous. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 130 records of this species, largely from the Pilbara bioregion with an overall distribution of approximately 500 km (north-south) by 600 km (east-west).
***Lepidium catapycnon* (P4)**	
Description: Open herb or shrub to 70 cm high with small succulent leaves and zig zag branch tips. White flowers. 	**Habitat:** rocky hill slopes **Location:** southern section of the survey area **2021 Survey results**: three records with a total of 90 plants in the survey area **Populations:** one population **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 94 records of this species from the Pilbara with an overall distribution of approximately 160 km (north-south) by 300 km (east-west), largely west of the survey area.

4.1.1 PREVIOUS RECORDS OF CONSERVATION-LISTED FLORA

The following flora taxa records from the DBCA database searches are considered unreliable or erroneous, indicated with a cross on **Map 4**:

- *Calotis squamigera* (P1); there is a single record of the species within the survey area based on a previous survey (Cardno 2012b). This location has been investigated during the current survey and during previous surveys (Ecoscape 2018). There were no plants of *Calotis squamigera* recorded at this location that is dominated by degraded vegetation that is infested with Buffel Grass (**Cenchrus ciliaris*). Whilst *Calotis squamigera* is an ephemeral species, it was recorded elsewhere within the survey area during 2021, approximately 20 km to the NNW, indicating that conditions were suitable for its germination and growth. The previous location of *Calotis squamigera* is therefore considered doubtful.
- *Tecticornia medusa* (P1); a single record of this species is located towards the northeast boundary of the survey area. This record is based on a WAH collection from 1990 from a 'Saline plain subject to inundation'. The location was ground truthed and *Tecticornia medusa* was not recorded. The mapped location is

considered inaccurate as the location does not align with the site description of the collection. This species has been typically recorded from the inner areas of the Fortescue Marsh and is considered highly unlikely to occur within the survey area.

- *Acacia subtiliformis* (P3); a single record of this species occurs at the location of Marillana Homestead. This record is based on a WAH collection from 1992, though notes with the collection indicate that the locality may be unreliable. The location was ground truthed during 2017 (Ecoscape 2018) and deemed to be inaccurate as it does not correspond with the typical habitat of this species (low calcareous rises). It is considered unlikely that this species occurs within the survey area.
- *Atriplex flabelliformis* (P3); a historical record of this species is located within survey area. This record is based on a WAH collection from 1990 from a 'Saline marsh marginal to marsh'. The mapped location is mulga-dominated and considered inaccurate as the location does not align with the site description of the collection. This species has been recorded elsewhere within the survey area, though the historical record is considered inaccurate.
- *Eragrostis crateriformis* (P3); two records of this species have been previously documented within the survey area. Both records arise from a previous survey (Cardno 2012b). Both locations were investigated during current and previous surveys (Ecoscape 2018) and no *Eragrostis crateriformis* plants were located. However, *Eragrostis leptopoda*, a morphologically similar species, was observed at these locations. Therefore it is considered likely that the identification of the previous survey may be erroneous.
- *Stylidium weeliwolli* (P3); there is a single record of the species within the survey area based on a very old (1959) WAH collection. The locality attributed to the collection is Weeli Wolli Creek. This location has been investigated during both the current surveys and previous surveys (Ecoscape 2018). *Stylidium weeliwolli* has not been observed at the mapped location that is 3 km from Weeli Wolli Creek at its closest point. Extensive searches have also been conducted in the sections of Weeli Wolli Creek that intersect the survey area without recording this species. The other documented populations of *Stylidium weeliwolli* are located approximately 25 km upstream (south) of the survey area. Searches for this species also undertaken within another large Mindy Mindy Creek that intersects the southern extent of the survey area.

4.2 INTRODUCED FLORA

Extensive mapping of introduced flora has been undertaken from the combined surveys with results available from Fortescue's database.

The consolidated introduced flora recorded from combined survey data is presented in **Map 5** and summarised in **Table 6**. None of the species that have been recorded within the survey area are listed as WONS (Weeds Australia & Centre for Invasive Species Solutions 2021) or Declared Pest plants listed under the BAM Act. Ten of the species are identified as 'Priority' weeds according to a list maintained by Fortescue for management purposes, being **Aerva javanica*, **Cenchrus ciliaris, *Cenchrus setiger* (both *Cenchrus* spp. subject to pastoral exclusion areas), **Chloris virgata, *Echinochloa colona*, **Malvastrum americanum, *Rumex vesicarius, *Setaria verticillata, *Stylosanthes hamata* and **Vachellia farnesiana*.

Table 6: Introduced flora species recorded from the survey area

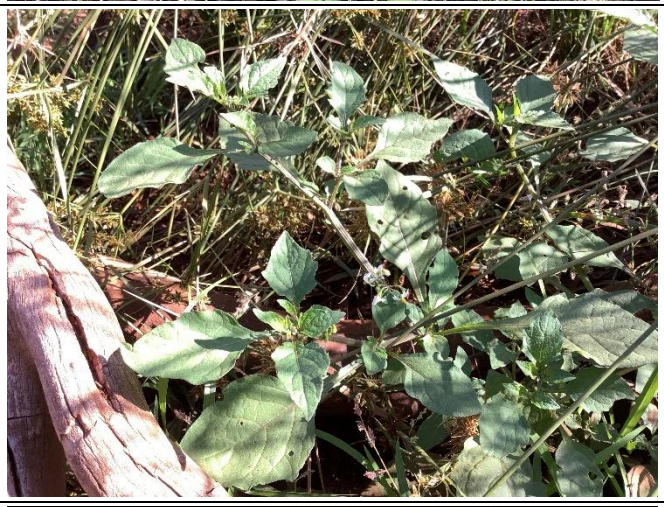
Species	Combined results	Photo
***Aerva javanica* (Kapok Bush)** Perennial herb to 1.6 m high (but usually less) with greyish white flowers throughout much of the year (WAH 1998-2021). Usually associated with disturbed areas and drainage lines, and is found throughout much of northern Western Australia. **This species is a Fortescue 'priority' weed.**	Location: Widespread within the survey area, particularly along existing BHP rail. Impact: significant along existing infrastructure.	
***Argemone ochroleuca* (Mexican Poppy)** Mexican Poppy is a prickly annual herb to 1 m high with cream or yellowish flowers mainly produced in spring. It occurs over much of Western Australia but is more commonly recorded in the Pilbara region (WAH 1998-2021) where it generally occurs in association with rivers and creeks.	Location: Scattered locations throughout the survey area, particularly along drainage lines or freshwater claypans. Impact: moderate within localised areas	
***Bidens subalternans* var. *simulans* (Beggartick**) Specimens of *Bidens* previously recorded as **Bidens bipinnata* have been identified as **Bidens subalternans* according to the most recent treatment of the genus in *Flora of Australia Vol. 37* (Orchard 2015). Many records of *Bidens* in the Pilbara are still listed as **B. bipinnata* (WAH 1998-2021) however, this species does not occur within Western Australia based on the recent revision of the genus. Presumably these records represent specimens yet to be formally reviewed and databased at the WAH. **Bidens subalternans* is an annual herb growing to 1.5 m high in good conditions, although it is more typically less than 0.5 m high. It occurs over much of Western Australia north of Geraldton (WAH 1998-2021).	Location: widespread throughout the survey area. Typically recorded from Mulga dominated plains. Impact: common at low density so impact unlikely to be significant.	

Species	Combined results	Photo
***Cenchrus ciliaris* (Buffel Grass)** **Cenchrus ciliaris* is a perennial tussock-forming grass to 1 m high (WAH 1998-2021). It is generally associated with drainage lines and floodplains, and is more common in grazed areas. **Cenchrus ciliaris* was either deliberately planted for pasture or accidently introduced (Van Vreeswyk et al. 2004) , and has been known from the Pilbara bioregion since the early 1900s (Keighery 2010). **This species is a Fortescue 'priority' weed (subject to pastoral exclusion areas).**	Location: widespread and abundant throughout the survey area, particularly from Mulga dominated flats and drainage lines. Commonly recorded from large infestations where it is a dominant component of the vegetation. Impact: potentially significant due to widespread distribution as a dominant component of the vegetation.	
***Cenchrus setiger* (Birdwood Grass)** **Cenchrus setiger* is a perennial tussock grass to 0.8 m high (WAH 1998-2021). It differs from **C. ciliaris* in its more robust seed heads but vegetatively the two are virtually identical. It occurs over much of the northern portion of Western Australia, and, like **C. ciliaris*, has been known from the Pilbara bioregion since the early 1900s (Keighery 2010). **This species is a Fortescue 'priority' weed (subject to pastoral exclusion areas).**	Location: scattered records throughout the survey area, typically associated with Mulga dominated flats or drainage lines. Impact: potentially significant in some locations.	
***Chloris virgata* (Feathertop Rhodes Grass)** **Choris virgata* is an annual grass to 1 m high (WAH 1998-2021). It is widespread across Western Australia. **This species is a Fortescue 'priority' weed.**	Location: two isolated locations within the survey area. Impact: minor	 Photo: Atlas of Living Australia (ALA 2021). Photo credited to Forest & Kim Starr.

Species	Combined results	Photo
***Citrullus amarus* (Pie Melon)** **Citrullus amarus* is a trailing or climbing annual herb with yellow flowers and striped or mottled melon fruits, found over much of Western Australia where it favours disturbed areas (WAH 1998-2021).	Location: three isolated locations within the survey area. Impact: minor	
Citrullus colocynthis **Citrullus colocynthis* is a trailing or climbing perenial herb with yellow flowers and melon fruits, found over much of Western Australia where it favours disturbed areas (WAH 1998-2021).	Location: one population from near the western boundary of the survey area based on previous data. Impact: minor	Image unavailable
***Datura leichhardtii* (Native Thornapple)** **Echinochloa colona* is an annual grass to 0.6 m high that is widespread across the Pilbara and Kimberley regions, with isolated records in the Perth region (WAH 1998-2021).	Location: a single existing location from near Weeli Wolli Creek from previous data. Impact: minor	
***Echinochloa colona* (Awnless Barnyard Grass)** **Echinochloa colona* is an annual grass to 0.6 m high that is widespread across the Pilbara and Kimberley regions, with isolated records in the Perth region (WAH 1998-2021). **This species is a Fortescue 'priority' weed.**	Location: scattered existing locations from previous data. Typically recorded from drainage lines or Mulga groves. Impact: minor	

Species	Combined results	Photo
***Flaveria trinervia* (Speedy Weed)** **Flaveria trinervia* is an annual herb with distinctive red stems and three-veined leaves and is found throughout much of northern Western Australia. It is listed on *FloraBase* (WAH 1998-2021) as 'alien' (introduced), however Hussey *et al.* (2007) and the Pilbara Ranking Summary (of the Weed Prioritisation Process) (DPaW 2013) do not list this species, indicating there is debate in relation to **Flaveria trinervia* being native or introduced.	Location: one known location from the Fortescue Marsh from previous data. Impact: minor and localised	
***Malvastrum americanum* (Spiked Malvastrum)** **Malvastrum americanum* is a perennial herb or shrub to 1.3 m high (WAH 1998-2021), although within the study area it has generally been recorded as being less than 0.5 m high. It is usually, but not always, associated with drainage lines and has a wide distribution through northern and arid Western Australia. **This species is a Fortescue 'priority' weed.**	Location: widespread throughout the survey area. Typically recorded from Mulga dominated plains or drainage lines. Impact: common at low density so impact unlikely to be significant.	
***Portulaca pilosa* (Djanggara)** This species is a succulent herb that may be either erect or more usually prostrate, with linear leaves and most commonly with pink flowers. Within Australia it is distributed mostly in the northern part of the continent (ALA 2021). Until recently (2016) this species was not listed as a weed.	Location: widespread at low density across the survey area based on previous data, typically from Mulga woodlands/groves Impact: minor	

Species	Combined results	Photo
***Pseudognaphalium luteoalbum* (Jersey Cudweed)** **Pseudognaphalium luteoalbum* is an annual herb to 50 cm high with greyish woolly leaves and stems, and an Australia-wide distribution (ALA 2021). According to FloraBase (WAH 1998-2021) *Pseudognaphalium luteoalbum* is described as being Native in part of its range and Naturalised elsewhere. For the purposes of this report, Ecoscape is considering the species to be introduced, however, it is well recorded from the vicinity of the survey area (ALA 2021) and is not considered to have any significant impact.	Location: single location from Coondiner Pool based on previous data. Impact: minor	 Photo: Atlas of Living Australia (ALA 2021). Photo credited to Michael Bedingfield.
***Rumex vesicarius* (Ruby Dock)** **Rumex vesicarius* is a fleshy annual herb to 80cm high with red fruit and recorded from most of Western Australia except the tropics (WAH 1998-2021). It is frequently found in the Pilbara in disturbed areas including road verges and drainage lines. **This species is a Fortescue 'priority' weed.**	Location: Weeli Wolli Creek and Coondiner Pool Impact: localised (minor)	
***Setaria verticillata* (Whorled Pigeon Grass)** **Setaria verticillata* is an annual grass to 1 m high (WAH 1998-2021), but more usually approximately 0.5 m. It is widely distributed within Western Australia and, within the Pilbara region, is mostly associated with drainage lines. **This species is a Fortescue 'priority' weed.**	Location: widespread at low density, particularly in Mulga and creeklines Impact: minor	

Species	Combined results	Photo
***Sisymbrium orientale* (Indian Hedge Mustard)** **Sisymbrium orientale* is an annual or biennial herb to 1 m high with yellow flowers and pods to 11 cm long, native to western Asia and the Mediterranean (Hussey et al. 2007). It is widely distributed within Western Australia (WAH 1998-2021).	Location: one location from Weeli Wolli Creek based on previous data Impact: minor	
***Solanum nigrum* (Black Berry Nightshade)** **Solanum nigrum* is an erect perennial (or short-lived) herb with white flowers to 1 m high (WAH 1998-2021) with an almost State-wide distribution.	Location: numerous records from Coondiner Pool based on previous data. Impact: potentially significant within a localised area.	
***Stylosanthes hamata* (Verano Stylo)** **Stylosanthes hamata* is prostrate or spreading shrub to 0.7 m high with yellow flowers (WAH 1998-2021). It is widespread across northern Western Australia. **This species is a Fortescue 'priority' weed.**	Location: numerous records from Coondiner Pool and isolated occurrences elsewhere based on previous data. Impact: potentially significant within a localised area.	 Photo: *FloraBase* (WAH 1998-2021)

Species	Combined results	Photo
***Tribulus terrestris* (Caltrop)** **Tribulus terrestris* is a prostrate annual herb (WAH 1998-2021) with an almost State-wide distribution.	Location: one population from near the western boundary of the survey area based on previous data. Impact: minor	 Photo: *FloraBase* (WAH 1998-2021)
***Vachellia farnesiana* (Mimosa Bush)** **Vachellia farnesiana* is an erect spinescent tree or, more often, a shrub to 4 m high. It is widely distributed through the north of Western Australia, however it occurs sporadically in areas closer to Perth (WAH 1998-2021). Hussey *et al.* (2007) consider it to have been introduced to Australia prior to European settlement. **This species is a Fortescue 'priority' weed.**	Location: widespread throughout the survey area, particularly on clay soils and drainage lines. Impact: locally significant especially around cattle bores and sumps	

4.3 SIGNIFICANT VEGETATION

4.3.1 PRIORITY ECOLOGICAL COMMUNITIES

Three PECs were recorded during the field survey, as per those identified by the desktop assessment. Each is described in the following sections. The locations of PECs within the survey area are shown on **Map 5**.

4.3.1.1 Fortescue Marsh (Martuyitha) (Marsh Land System) – Priority 1

This PEC is described as:

> *Fortescue Marsh is an extensive, episodically inundated samphire marsh at the upper terminus of the Fortescue River and the western end of Goodiadarrie Hills. It is regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependant riparian ecosystems. It is an arid wetland utilized by waterbirds and supports a rich diversity of restricted aquatic and terrestrial invertebrates. Recorded locality for night parrot and bilby and several other threatened vertebrate fauna. Endemic Eremophila species, populations of priority flora and several near-endemic and novel samphires* (Species and Communities Program DBCA 2021).

Threats to this PEC are identified as 'clearing for mining, altered hydrology (watering and fresh water), grazing and weed invasion'.

Locations within the survey area that correspond with mapped occurrences of the Fortescue Marsh PEC recorded in a previous surveys (Ecoscape 2018; Markey 2016) were re-assessed. This existing mapping is considered accurate in its representation of this PEC. There are three locations of the PEC within the survey area along the northern boundary (**Map 4**) with a total extent of 1,336.24 ha (1.16%) within the survey area (**Plate 1**, **Plate 2**).

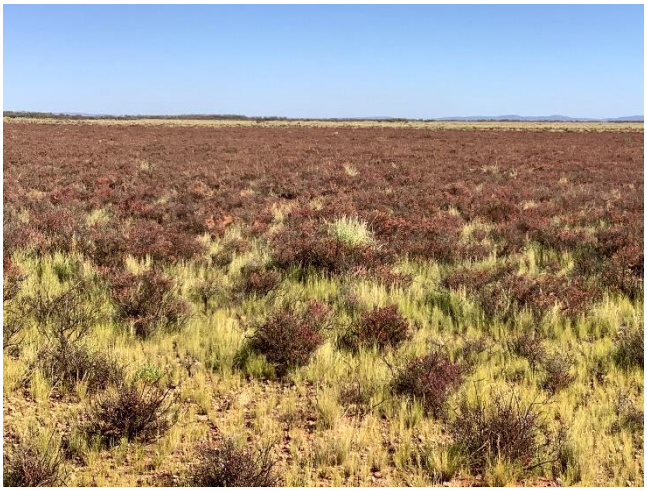


Plate 1: Fortescue Marsh PEC within survey area

Plate 2: Fortescue Marsh PEC within survey area

4.3.1.2 Narbung Land System – Priority 3

This PEC is described as:

> *Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with halophytic low shrubs* (Species and Communities Program DBCA 2021).

Threats to this PEC are identified as 'over grazing'.

This PEC is mapped and defined according to the Land System boundaries. As such, the mapping supplied by the DBCA database search is considered accurate and has not been modified. This PEC occurs along the eastern boundary of the survey area (**Map 4**). The Narbung Land System PEC occupies 147.97 ha (0.13%) of the survey area.

4.3.1.3 Vegetation of sand dunes of the Hamersley Range/Fortescue Valley – Priority 3

The *Vegetation of sand dunes of the Hamersley Range/Fortescue Valley* PEC is described as:

> *These red linear iron-rich sand dunes lie on the Divide Land system at the junction of the Hamersley Range and Fortescue Valley, between Kalgan Creek and the low hills to the west. A small number are vegetated with Acacia dictyophleba scattered tall shrubs over Crotalaria cunninghamii, Trichodesma zeylanicum var. grandiflorum open shrubland. They are regionally rare, small and fragile and highly susceptible to threatening processes* (Species and Communities Program DBCA 2021).

Threats to this PEC are identified as 'weed invasion especially buffel grass, grazing by cattle, altered fire regimes, erosion and clearing for mining and infrastructure'.

Known locations of this PEC from previous surveys were targeted for re-assessment within the survey area. A review of aerial imagery also identified potential sand dunes in several areas that do not correspond with mapped occurrences of the PEC. Field observations confirmed the presence of several new occurrences of linear sand dune features with vegetation characteristic of the PEC (**Appendix Three, Plate 3, Plate 4**). All known and confirmed occurrences of this PEC are shown on **Map 4**, with a combined total extent within the survey area is 126.53 ha (or 0.11%).

Plate 3: Sand Dunes PEC within the survey area

Plate 4: Sand Dunes PEC within the survey area displaying characteristic linear formation

4.3.2 OTHER SIGNIFICANT VEGETATION

Groundwater Dependent Vegetation

Groundwater Dependent Ecosystems (GDEs) have been defined as ecosystems that are dependent on groundwater for their survival at some stage or stages of their life cycle (Eamus 2009). GDEs are considered significant due to the direct and indirect impacts of human activities (such as mining), including clearing, dewatering and aquifer reinjection. In some contexts (including that of a flora and vegetation assessment), GDEs are also known as Groundwater Dependent Vegetation (GDV).

GDV in the Pilbara are generally determined to be vegetation associated with riparian areas of drainage lines and permanent or semi-permanent pools. Vegetation containing *Eucalyptus camaldulensis* and *Melaleuca argentea* is generally considered to represent GDV, whereas vegetation containing *Eucalyptus victrix* is considered to be potential GDV.

Within the survey area, the following GDV (or potential GDV) was identified (shown on **Map 4**):

- Coondiner Pool (**Plate 5**); Coondiner Pool is a semi-permanent to permanent wetland situated near the southeast corner of the survey area. The wetland fringes area dominated by *Eucalyptus victrix* vegetation (totalling 47.44 ha) and is therefore considered potential GDV. Several threatening processes were observed in the vicinity of the wetland including grazing, trampling and disturbance from off-road vehicles. Similar areas of *E. victrix*-dominated vegetation associated with clay depressions within calcrete south of the Fortescue Marsh is similarly considered potential GDV, totalling 35.33 ha within the survey area.
- Weeli Wolli Creek (**Plate 6**) and Mindy Mindy Creek; these two drainage lines partially intersect the survey area and the vegetation was previously determined by Ecoscape (2018) to contain *E. camaldulensis* subsp. *refulgens* as a characteristic species, therefore representing GDV (totalling 477.24 ha within the survey area)
- Fortescue Marsh; DPaW (Markey 2016) considers *Melaleuca xerophila* likely to be groundwater dependent in the Fortescue Marsh area and therefore, vegetation types with this species are considered to be representative of GDV. Vegetation types containing *M. xerophila* have been previously recorded by Ecoscape (2018) within the survey area where it intersects the Marsh, totalling 136.75 ha.

Plate 5: Coondiner Pool fringed by *Eucalyptus victrix* vegetation representative of potential GDV

Plate 6: Weeli Wolli Creek (GDV)

Sheetflow Dependant Vegetation

Mulga is the common name for a group of closely related *Acacia* species, namely *Acacia aneura, A. aptaneura, A. ayersiana, A. caesaneura, A. craspedocarpa, A. fuscaneura, A. incurvaneura, A. macraneura, A. minyura, A. mulganeura, A. paraneura and A. pteraneura.* Mulga vegetation occurring on valley floors can be considered significant vegetation due to threats associated with hydrological change, particularly for sheet flow dependent vegetation (SFDV); characterised by grove-intergrove Mulga formations (**Plate 7**, **Plate 8**).

The previous survey by Ecoscape (2018) mapped the occurrence of Mulga vegetation and identified areas representing SFDV with an extent of 18,607.14 ha (or 16.20 %), shown on **Map 4**.

Plate 7: Mulga dominated SFDV with characteristic grove-intergrove formation

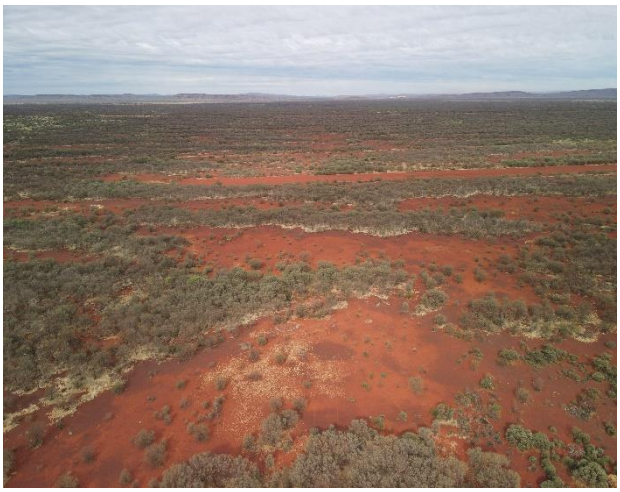


Plate 8: Mulga dominated SFDV with characteristic grove-intergrove formation

4.4 BOTANICAL LIMITATIONS

The survey was undertaken as a two-phase, Targeted flora and vegetation survey with extensive traverses searching for conservation significant flora and vegetation. Results from previous surveys were considered as part of survey design and the desktop assessment. A full summary of botanical limitations is presented in **Table 7**.

Table 7: Botanical limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Availability of contextual information at a regional and local scale	No	The majority of the survey area has been previously surveyed and mapped on multiple occasions with numerous other surveys having been conducted in the surrounding areas. Thus, there is good availability of information to provide local and regional context.
Competence/experience of the team conducting the survey, including experience in the bioregion surveyed	No	The lead botanist conducting the field survey has over 15 years' combined experience conducting flora and vegetation surveys in Western Australia, including the Pilbara region.
Was the appropriate area fully surveyed (effort and extent)	Negligible	The survey area was adequately surveyed with areas of interest (determined by the desktop assessment) targeted for significant flora and vegetation searches.
Access restrictions within the survey area	No	The survey area includes substantial areas without nearby vehicle access. A helicopter was provided that enabled access to all parts of the survey area and hence access was not restricted.
Survey timing, rainfall, season of survey	No	The majority of the field assessments were conducted during May 2021, the optimal period for botanical survey in the Pilbara region and corresponding with the flowering period of most of the targeted flora taxa. Follow up assessments were undertaken during July 2021. The rainfall in the four months prior to the field surveys was 210.7 mm which represents 97% of the mean for this period and is not considered a constraint on the presence of annual or ephemeral species. This is supported by 2021 survey results that recorded the majority of annual or ephemeral species known or considered likely to occur. **Figure 3** shows the rainfall deciles for the six months prior to the field survey.
Disturbance that may have affected the results of the survey e.g. fire, flood, clearing	No	The majority of the survey area was not subject to any recent disturbances.

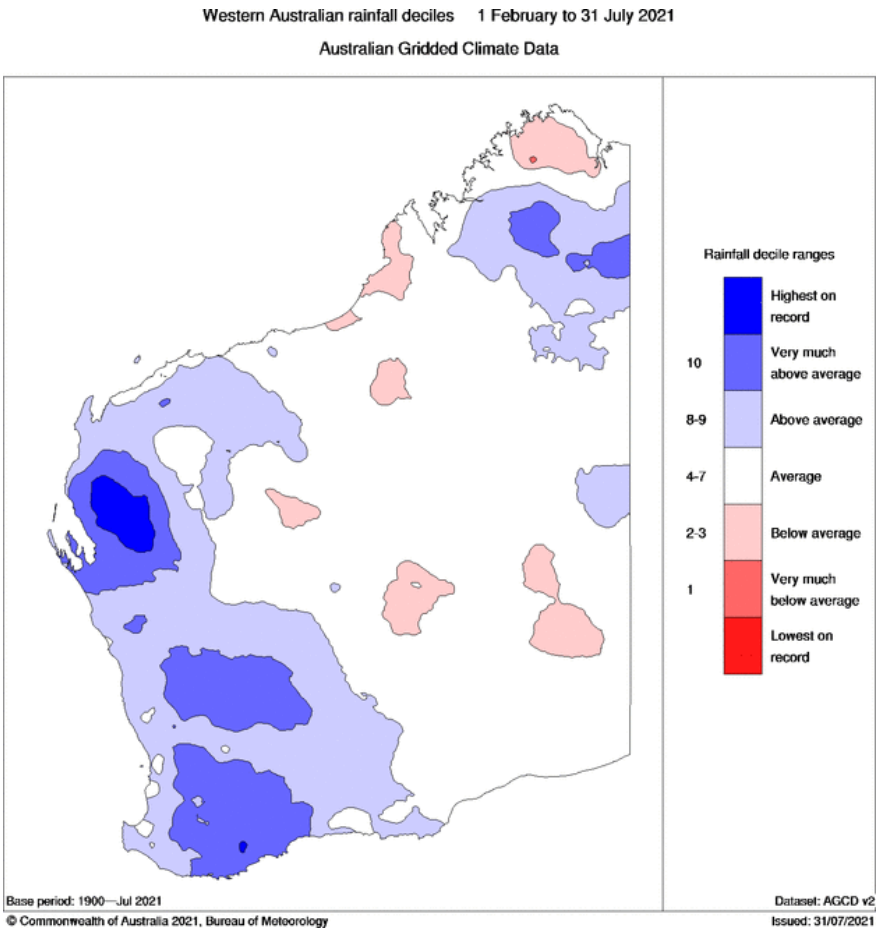


Figure 3: Rainfall deciles for the six months prior to the field survey.

5 DISCUSSION

5.1 SIGNIFICANT FLORA

The field surveys and consolidated data from previous surveys have recorded sixteen conservation-listed flora taxa within the survey area including one TF, six P1, three P2, three P3 and three P4. The field survey concentrated on areas of known habitat for these taxa and others considered likely to occur based on the desktop assessment. The significance of the survey findings is outlined in the following sections.

5.1.1 THREATENED FLORA

One TF (*Seringia exastia*) has been recorded within the survey area from three populations. As outlined in **Section 2.2.4.1**, *S. exastia* has undergone recent taxonomic review and is awaiting formal delisting as TF. Whilst this species was not a focus of the targeted searches, as per DBCA advice, until it has been formally delisted it requires authorisation to take under section 40 of the BC Act 2016. It is understood that authorisation applications with basic details that the species is known to occur within the applied project area will be accepted and fast-tracked for approval.

5.1.2 PRIORITY FLORA

There were 15 PF taxa were confirmed within the survey area:

- six P1 taxa:
  - *Calotis squamigera*; this taxon was previously known from the survey area, however this species was not relocated at the known location despite searches that have been conducted over numerous events (including Ecoscape 2018). It was recorded from one additional population in a dense mulga grove from the northwest of the survey area. The plants were mostly in flower and in healthy condition. *Calotis squamigera* is poorly known in Western Australia with only five records (DBCA 2007-2021) from the restricted distribution in the Pilbara region. However, this species is widespread in Queensland and also known from the Northern Territory (ALA 2021).
  - *Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069); this taxon was recorded from Coondiner Pool along the moist clay banks of this wetland. There are five known records of *Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069) in the Pilbara region, including two records at Coondiner Pool. This taxon is poorly known with a restricted distribution of approximately 40 km (north-south) by 80 km (east-west). This taxon has only recently been formally recognised and listed as PF, hence has not been subject to previous assessments.
  - *Myriocephalus scalpellus;* this taxon was recorded at Coondiner Pool, observed in abundance and in flower during the field surveys. There are seven known records of *Myriocephalus scalpellus* in the Pilbara region, five of which are located at Coondiner Pool. The two remaining records are associated with claypans, approximately 36 km and 450 km northwest of the survey area. The species has an overall distribution of approximately 70 km (north-south) by 480 km (east-west).
  - *Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760); according to *FloraBase* (WAH 1998-2021), there is one known record of this taxon in Western Australia, located at Coondiner Pool where it was recollected during the 2021 surveys. The Coondiner Pool population of *Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760) therefore represents the only known location of this taxon in existence. This taxon has only recently been formally recognised and listed as PF, hence has not been subject to previous assessments.
  - *Tecticornia globulifera;* the database search results (including a review of Fortescue's significant flora database) identified numerous of records for *Tecticornia globulifera* within the Fortescue Marsh. Distribution mapping on *NatureMap* (DBCA 2007-2021) shows that the species is largely restricted to the Fortescue Marsh (51 records) with only six records outside of this habitat.. The survey recorded an additional six records with a total of 1,650 plants within the Fortescue Marsh where it intersects the northeast corner of the survey area.

- *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063); this taxon was recorded from areas where the Fortescue Marsh intersects the survey area. Up to six populations with a total of 4,415 plants were recorded during the survey. There are 95 known records of this taxon associated with the Fortescue Marsh and six records in the Little Sandy Desert bioregion. It has an overall distribution of approximately 260 km (north-south) by 150 km (east-west).

- three P2 taxa:
  - *Euphorbia inappendiculata* var. *inappendiculata*; this taxon has been previously recorded from a single population, located in the northwest of the survey area. The previous record is considered reliable, though this ephemeral taxon was not relocated during 2021. There are nine known records of this taxon in Western Australia with a distribution of approximately 500 km (north-south) by 1,150 km (east-west).
  - *Euphorbia inappendiculata* var. *queenslandica*; this taxon was recorded from a single population of three plants, located in the northeast of the survey area and is known from a total of three populations inclusive of previous record. There are nine known records of this taxon in Western Australia with a distribution of approximately 500 km (north-south) by 1,150 km (east-west). However, *Atlas of Living Australia* indicates this taxon has additional records across southeastern Western Australia and is widespread in all other states of Australia (ALA 2021).
  - *Isotropis parviflora*; a single plant was recorded during 2021 from a known Fortescue database record from a low rocky outcrop. Based on previous record, this species is known from up to seven populations, all restricted to the broad area surrounding Coondiner Pool. This species was observed to be abundant during 2017 in areas that had been recently burnt, while in 2021 it was largely absent at known populations. This indicates that fire likely plays an important role in the ecology of this species and may be a disturbance opportunist. Known records occur in surrounding areas to the west and the species has a distribution of approximately 400 km (north-south) by 1,100 km (east-west). This species is also known from the Northern Territory and Queensland (ALA 2021).
- three P3 taxa:
  - *Atriplex flabelliformis*; this species, known from reliable 2017 records, was not observed during 2021. It has been recorded from a single population within the Fortescue Marsh near the northern boundary of the survey area. There is also a historical record of *Atriplex flabelliformis* within the survey area that has been deemed unreliable. This species has a scattered distribution across Western Australia.
  - *Eremophila spongiocarpa;* this species was recorded from an estimated three populations (total of 872 plants) within the Fortescue Marsh along the northern boundary of the survey area. The species is well known and widespread within Fortescue Marsh and is largely restricted to this area.
  - *Euphorbia australis* var. *glabra*; this taxon was recorded from one population of 10 plants during 2021 with up to six populations known from combined surveys. There is a total of four known records of the species within the survey area and surrounding areas, and it has a wider regional distribution of approximately 230 km (north-south) by 550 km (east-west).
- three P4 taxa:
  - *Eremophila youngii* subsp. *lepidota*; inclusive of previous surveys, this taxon has been recorded from up to eight populations, typically from low lying areas adjacent to the Fortescue Marsh. There are 61 known records of this taxon from an overall distribution of approximately 500 km (north-south) by 1800 km (east-west).
  - *Goodenia nuda*; this species is known from scattered locations across the survey area based on reliable previous records. There area 130 records of this species (DBCA 2007-2021) and it is widespread across the Pilbara region.
  - *Lepidium catapycnon*; this species was recorded from one population on a rocky hill slope near the southern boundary of the survey area. There are 94 known records of this species within the Pilbara region, largely nearby to the survey area.

5.1.2.1 Potential Impacts: P1 Flora

P1 flora taxa are considered poorly known species occurring at limited locations which are potentially at risk from disturbance (DBCA 2019).

Lindernia sp. Pilbara (M.N. Lyons & L. Lewis FV 1069), *Myriocephalus scalpellus* and *Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760) were all recorded at Coondiner Pool, a permanent wetland on Coondiner Creek. Disturbances were commonly observed, including cattle grazing and trampling, evidence of recreational use, and vehicle tracks (established and non-established tracks). All three taxa are locally restricted to Coondiner Pool within the survey area, with few known records in elsewhere (*Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760) is not known from any other locations). Considering this highly restricted distribution, any impacts to these three taxa (or the Coondiner Pool location where they occur) are likely to be considered significant.

Tecticornia globulifera and *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063) were recorded from the Fortescue Marsh along the northern boundary of the survey area. These taxa, whilst largely restricted to the Fortescue Marsh are dominant and abundant within it (Ecoscape 2018; Markey 2016). Impacts to these taxa within the survey are considered likely to be negligible based on the extensive populations known from elsewhere. However, the Fortescue Marsh is more broadly significant as an ESA, PEC and Wetland of National Significance and impacts to these areas should be considered collectively from mining activities, altered hydrology, grazing and weed invasion.

Calotis squamigera is a poorly known species in Western Australia known from only five records, though more widespread in Queensland and the Northern Territory. Considering the limited statewide distribution, impacts to this species may be considered significant at the local/regional scale, though negligible at a national scale. *Calotis squamigera* was a cryptic species to detect, growing amongst other herbs and grasses in a dense understorey. It is also ephemeral, only detectable following favourable seasonal conditions of high rainfall. The Mulga vegetation that this species was recorded from is widespread within and surrounding the survey area and it is considered likely that it may be undetected elsewhere.

5.1.2.2 Potential Impacts: P2 Flora

P2 flora taxa are considered poorly known with very few recorded locations, some of which are on conservation lands such as national parks (DBCA 2019). P2 taxa may also include species with a number of recorded locations but require further survey.

Euphorbia inappendiculata var. *inappendiculata* and *Euphorbia inappendiculata* var. *queenslandica* are ephemeral taxa that can only be detected following favourable seasonal conditions of high rainfall. Ecoscape has regularly encountered each of these taxa from areas of clay soil during flora surveys within the Pilbara region during recent years and considers each of these taxa are likely poorly surveyed to date rather than rare. The Mulga-dominated vegetation that these taxa were recorded from is widespread both within and surrounding the survey area. Consequently the potential impact to these species within the survey area is likely to be negligible.

Isotropis parviflora is known from near the eastern boundary of the survey area. Results from 2021 suggest that this species is more abundant shortly after fire. There are 28 records of this species from Western Australia and it is also known from the Northern Territory and Queensland. Potential impact to this likely disturbance opportunistic species is considered insignificant.

5.1.2.3 Potential Impacts: P3 Flora

P3 flora taxa are species with several recorded locations and are considered not under imminent threat. P3 taxa may also include species that are well known but require further survey (DBCA 2019).

Eremophila spongiocarpa is widespread and abundant within the Fortescue Marsh (Ecoscape 2018; Markey 2016), though is largely restricted to this area. Considering the abundance of this species within the Fortescue Marsh, any impacts to populations within the survey area are likely to be insignificant.

Euphorbia australis var. *glabra* has known records from widespread locations in the Pilbara. This is also a cryptic ephemeral taxon that is likely more abundant and widespread than the existing records suggest. Any impacts to this taxon within the survey area are considered likely to be insignificant.

5.1.2.4 Potential Impacts: P4 Flora

P4 flora taxa include species which have been adequately surveyed and are not under threat but could become vulnerable in the future (DBCA 2019).

The survey recorded three P4 taxa, *Eremophila youngii* subsp. *lepidota* (well-known along the fringe of Fortescue Marsh and surrounding areas), *Goodenia nuda* and *Lepidium catapycnon.* These taxa are known from a relative abundance of records within the Pilbara region and impacts to these taxa within the survey area are likely to be considered insignificant.

5.1.2.5 Post-survey Likelihood Assessment

The likelihood of conservation significant flora occurring in the survey area was revised following the field survey. This revised likelihood, took into account vegetation condition, grazing and other disturbances, actual habitat availability and search effort (**Table 11** in **Appendix Two)**. Following the post-survey likelihood assessment, there are no flora taxa that are considered to remain 'likely' to occur within the survey area that have not been recorded.

Four species that were 'known' to occur, based on the search of available databases (DBCA and Fortescue), were not recorded and are considered unlikely to occur as detailed in **Section 4.1.1**:

- *Acacia subtiliformis* (P3)
- *Eragrostis crateriformis* (P3)
- *Stylidium weeliwolli* (P3)
- *Tecticornia medusa* (P3).

5.1.3 INTRODUCED FLORA

There are 21 introduced flora taxa that have been recorded within the survey area from combined surveys. None of the species that have been recorded within the survey area are listed as WONS (Weeds Australia & Centre for Invasive Species Solutions 2021) or Declared Pest plants listed under the BAM Act. Ten of the species are identified as 'Priority' weeds according to a list maintained by Fortescue for management purposes. The introduced flora considered to have the most significant existing impacts across large portions of the survey area are **Aerva javanica*, **Cenchrus ciliaris*, **Cenchrus setiger* and **Vachellia farnesiana*. Two other species are considered to have a localised significant impact around Coondiner Pool including **Solanum nigrum* and **Stylosanthes hamata.*

5.2 VEGETATION SIGNIFICANCE

5.2.1 PRIORITY ECOLOGICAL COMMUNITIES

Priority One Ecological Communities are poorly known communities under threat that have very few occurrences with a very restricted distribution. P1 communities may also include communities that occur on protected land or those that are well known but do not meet adequacy of survey requirements, or are not well defined and are under threat (Department of Environment and Conservation 2013).

The survey area partially intersects the *Fortescue Marsh (Marsh Land System)* PEC (P1). Previous surveys by Ecoscape (2018) and Markey (2016) have mapped the extent of the PEC which occurs as a single unit within the Marsh Land System. The PEC represents 1336.36 ha (or 1.16 %) of the survey area and occurs where the survey area intersects the southern extent of the Fortescue Marsh.

As well as being listed as a PEC, the Fortescue Marsh is also significant as an ESA and Wetland of National Significance. The Fortescue Marsh supports a unique assemblage of flora including four PF within the survey area (*Atriplex flabelliformis* [P3], *Eremophila spongiocarpa* [P3], *Tecticornia globulifera* [P1] and *Tecticornia*

sp. Christmas Creek [K.A. Shepherd & T. Colmer et al. KS 1063] [P1]). Any impacts to the *Fortescue Marsh (Marsh Land System)* PEC are likely to be considered significant.

Priority Three Ecological Communities are poorly known communities that occur in many locations or in few widespread locations, many of which are not under threat of impact. P3 communities may also include communities that have large and/or widespread occurrences that are under threat or communities that require further survey (Department of Environment and Conservation 2013).

Vegetation of sand dunes of the Hamersley Range/Fortescue Valley PEC (P3) was identified in the DBCA database search and in a previous survey by Ecoscape (2018) as occurring within and near to the survey area. Known locations of the PEC were ground truthed within the survey area and several isolated new locations of this PEC were mapped, with a total of 126.53 ha mapped within the survey area.

The *Vegetation of sand dunes of the Hamersley Range/Fortescue Valley* PEC is restricted to the survey area and nearby surrounding areas. The total area of the PEC mapped by the DBCA (which includes an administrative buffer around the PEC units) is 10,634.48 ha. Most of this mapped area was previously assessed by Ecoscape (2018) with results indicating that the PEC occupies 477.24 ha (not including any buffer). A total of 126.53 ha of this PEC has been mapped within the survey area, likely representing 26.51% of the total known extent. Due to the restricted extent of this PEC, any impacts may be considered significant.

The *Narbung Land System* PEC (P3) was identified in the DBCA database search and in the previous survey (Ecoscape 2018) as occurring within and adjacent to the survey area. The single occurrence is located along the eastern boundary of the survey area. This PEC has a total extent of 14,948.35 ha, of which 147.96 ha is located within the survey area representing a small proportion (0.99%) of the total.

5.2.2 OTHER SIGNFICANT VEGETATION

5.2.2.1 Groundwater Dependent Vegetation

GDVs are characterised by the occurrence of phreatophytic species that rely on access to groundwater for some stages of their life cycle. The following areas have been mapped as GDV or potential GDV:

- *Eucalyptus camaldulensis*-dominated vegetation of Weeli Wolli Creek and Mindy Mindy Creek, considered representative of GDV
- *Eucalyptus victrix*-dominated vegetation of Coondiner Pool and clay depressions south of the Fortescue Marsh, considered representative of potential GDV
- *Melaleuca xerophila*-dominated vegetation of areas fringing the Fortescue Marsh.

Any changes to groundwater may have the potential to affect these vegetation types. Changes to surface water flow also has the potential to impact vegetation, particularly Weeli Wolli Creek and Mindy Mindy Creek.

5.2.2.2 Sheetflow Dependent Vegetation

SFDV mapping was undertaken during the previous assessment (Ecoscape 2018), this mapping has not been modified. The AaSaEp vegetation type displays the characteristic Mulga grove-intergrove formation considered to be representative of SFDV.

SFDV has the potential to be affected by changes to surface water flows that may be caused by obstacles, including roads or railways (or any linear infrastructure), or any changes to topography that prevents heavy rainfall from moving across the slightly-sloping landscape as a ‘sheet’.

5.2.2.3 Vegetation of Particular Importance for Priority Flora

There are two broad areas that are considered particularly important for supporting PF:

- Coondiner Pool, corresponding with the mapped extent of *Eucalyptus victrix* potential GDV. This location supports three P1 taxa (*Lindernia* sp. Pilbara [M.N. Lyons & L. Lewis FV 1069], *Myriocephalus scalpellus* and *Rorippa* sp. Fortescue Valley [M.N. Lyons & R.A. Coppen FV 0760]) that are poorly known from a restricted number of populations. Therefore this vegetation is considered important for the conservation of these taxa and is also potential GDV (see **Section 5.2.2.1**)

- Fortescue Marsh, corresponding with the mapped extent of the *Fortescue Marsh (Marsh Land System)* PEC. These locations support four PF taxa within the survey area (*Atriplex flabelliformis* [P3], *Eremophila spongiocarpa* [P3], *Tecticornia globulifera* [P1] and *Tecticornia* sp. Christmas Creek [K.A. Shepherd & T. Colmer et al. KS 1063] [P1]). Each of these taxa are relatively widespread within areas of the Fortescue Marsh outside of the survey area.

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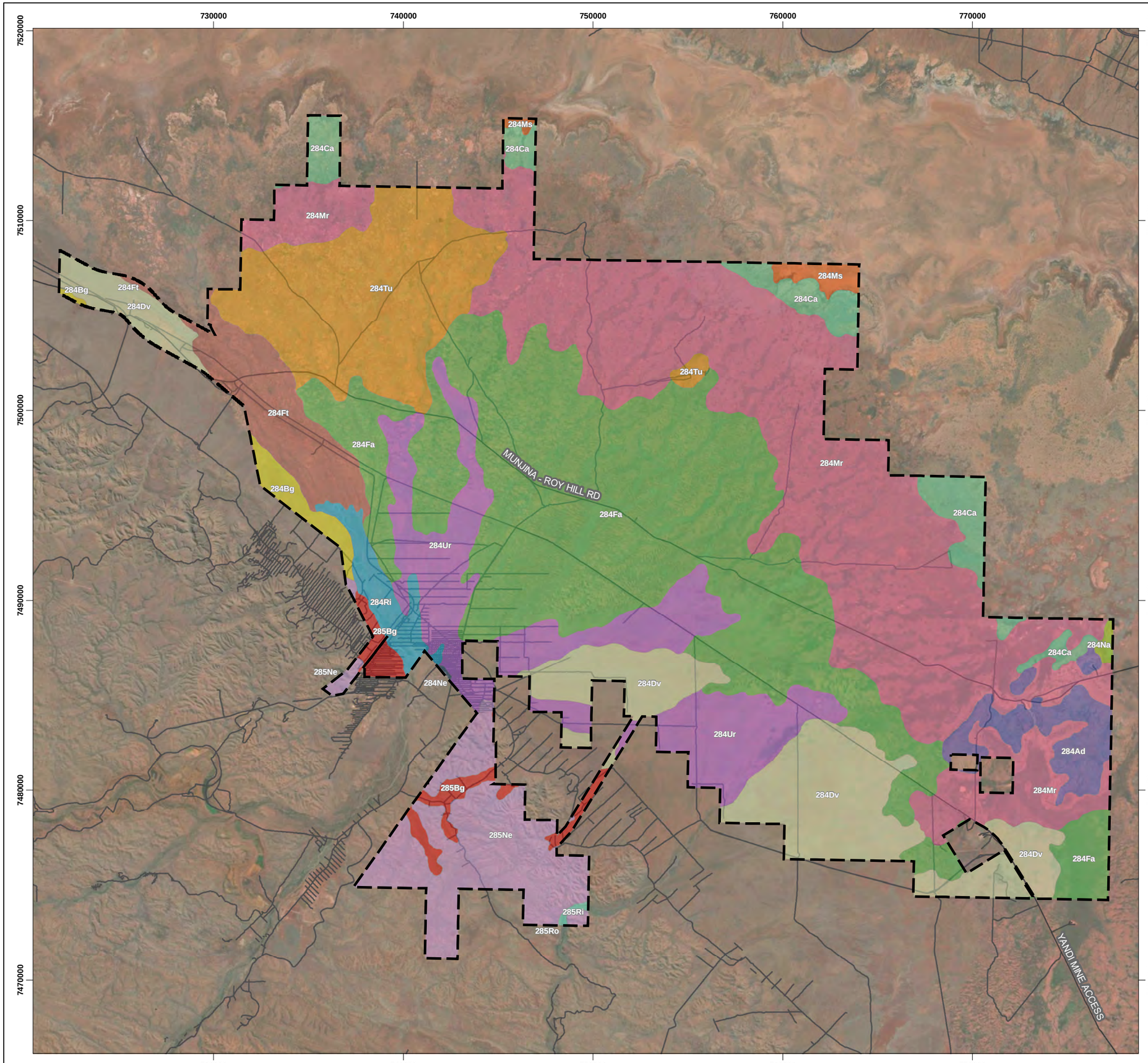
MAPS



LEGEND

Survey Area

Roads

Soil Land Systems (DPIRD 2019)

- 284Ad: Stony plains and low silcrete hills supporting hard spinifex grasslands
- 284Bg: Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands
- 284Ca: Low calcrete platforms and plains supporting shrubby hard spinifex grasslands
- 284Dv: Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs
- 284Fa: Washplains and gilgai plains supporting groved mulga tall shrublands and minor tussock grasslands
- 284Ft: Alluvial plains and flood plains supporting patchy grassy eucalypt and acacia woodlands and shrublands and tussock grasslands
- 284Mr: Gravelly plains with large drainage foci and unchannelled drainage tracts supporting snakewood shrublands and grassy mulga shrublands
- 284Ms: Lakebeds and flood plains subject to regular inundation, supporting samphire shrublands, salt water couch grasslands and chenopod shrublands
- 284Na: Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with chenopod low shrubs
- 284Ne: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands
- 284Ri: Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex
- 284Tu: Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood
- 284Ur: Stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands
- 285Bg: Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands
- 285Ne: Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands
- 285Ri: Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex
- 285Ro: Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands

DATASOURCES:
SOURCE DATA: SOIL-LANDSCAPE MAPPING WESTERN AUSTRALIA – BEST AVAILABLE SOILS (DPIRD 2019); TRANSPORT ROAD CENTRELINES (MRWA 2012)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

ecoscape

SOIL LANDSCAPE MAPPING

NYIDINGHU TARGETED FLORA AND VEGETATION SURVEY

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

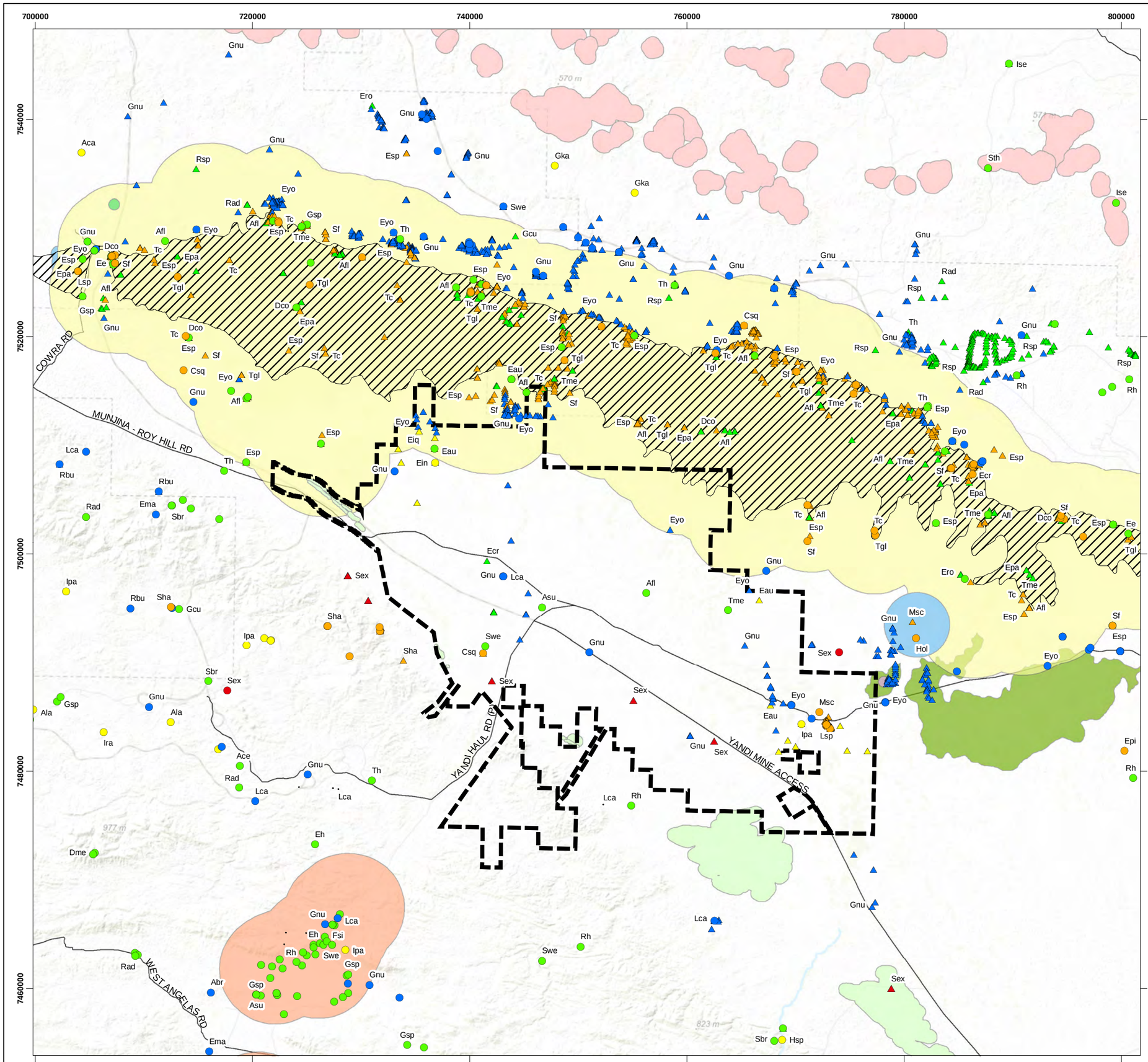
SCALE: 1:200,000 @ A3

0 2 4 6 8 km

PROJECT NO: 4610-21

REV	AUTHOR	APPROVED	DATE
0	KP	SB	13/08/2021

MAP 01



LEGEND

- Nyidinghu Targeted Survey Area

DBCA Conservation Listed Flora

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

FMG Conservation Listed Flora

- Threatened
- Priority 1 (DBCA)
- Priority 2 (DBCA)
- Priority 3 (DBCA)
- Priority 4 (DBCA)
- Environmentally Sensitive Areas

Threatened & Priority Ecological Communities (DBCA 2021)

- Brockman Iron cracking clay communities
- Fortescue Marsh
- Fortescue Valley Sand Dunes
- Freshwater claypans of the Fortescue Valley
- Narbung LS
- Weeli Wolli
- Wona Land System
- Narbung System

Code	Taxon	Status	Code	Taxon	Status
Asp	*Abutilon* sp. Pritzelianum (S.van Leeuwen 5095)	3	Gcu	*Gymnanthera cunninghamii*	3
Abr	*Acacia bromilowiana*	4	Hol	*Helichrysum oligochaetum*	1
Aef	*Acacia effusta*	3	Hmu	*Heliotropium munium*	3
Ale	*Acacia levata*	3	Hsp	*Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen M ET 15708)	2
Asu	*Acacia subtiliformis*	3	Igi	*Indigofera gilesii*	3
Aca	*Adiantum capillus-veneris*	2	Ise	*Iotasperma sessilifolium*	3
Ace	*Amaranthus centralis*	3	Ira	*Ipomoea racemigera*	2
Apr	*Ampelopteris prolifera*	3	Ipa	*Isotropis parviflora*	2
Aje	*Aristida jerichoensis* var. *subspinulifera*	3	Kau	*Kohautia australiensis*	2
Ala	*Aristida lazaridis*	2	Lca	*Lepidium catapycnon*	4
Afl	*Atriplex flabelliformis*	3	Lsp	*Lindernia* •A.43.C76	1
Beh	*Barbula ehrenbergii*	1	Msc	*Myriocephalus scalpellus*	1
Bbu	*Bulbostylis burbidgeae*	4	Num	*Nicotiana umbratica*	3
Csq	*Calotis squamigera*	1	Osp	*Oxalis* sp. P.Ibara (M.E. Trudgen 12725)	2
Cpr	*Cladium procerum*	2	Pre	*Paspalidium retiglume*	2
Cma	*Cochlospermum macnamarae*	1	Ptr	*Pilbara trudgenii*	3
Csm	*Crotalaria smithiana*	3	Pmo	*Prilotus mollis*	4
Dme	*Dampiera metallorum*	3	Rh	*Rhagodia* sp. Hamersley (M. Trudgen 17794)	3
Dch	*Dipteracanthus chichesterensis*	1	Rbu	*Rhynchosia bungarensis*	4
Dsp	*Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)	3	Rlr	*Roripppa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)	1
Dco	*Dysphania congestiflora*	3	Rad	*Rostellularia adscendens* var. *latifolia*	3
Epa	*Eleocharis papillosa*	3	Rin	*Rothia indica subsp. australis*	3
Ecr	*Eragrostis crateriformis*	3	Sf	*Samolus* sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	1
Ee	*Eragrostis* sp. Erect spikelets (P.K. Latz 2322)	3	Sh	*Scaevola* sp. Hamersley Range basalts (S. van Leeuwen 3675)	2
Ema	*Eremophila magnifica subsp. magnifica*	4	Sex	*Seringia exastia*	T
Epi	*Eremophila pilosa*	1	Sbr	*Sida* sp. Barlee Range (S. van Leeuwen 3542)	3
Epu	*Eremophila pusillifora*	2	Scl	*Stachystemon clementii*	3
Eh	*Eremophila* sp. Hamersley Range (K. Walker KW 136)	3	Sbh	*Stemodia* sp. Battle Hill (A.L. Payne 1006)	1
Ew	*Eremophila* sp. West Angelas (S. van Leeuwen 4068)	1	Swe	*Stylidium weeliwolli*	3
Esp	*Eremophila spongiocarpa*	3	Sth	*Swainsona thompsoniana*	3
Eyo	*Eremophila youngii subsp. lepidota*	4	Sha	*Synostemon hamersleyensis*	1
Ero	*Eucalyptus rowleyi*	3	Tgl	*Tecticornia globulifera*	1
Eau	*Euphorbia australis* var. *glabra*	3	Tme	*Tecticornia medusa*	3
Ein	*Euphorbia inappendiculata* var. *inappendiculata*	2	Tc	*Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	1
Est	*Euphorbia stevenii*	3	Tpi	*Teucrium pilbarianum*	2
Fsi	*Fimbristylis sieberiana*	3	Th	*Themeda* sp. Hamersley Station (M.E. Trudgen 1413)	3
Gla	*Glycine falcata*	3	Tba	*Triodia basitricha*	3
Gka	*Gompholobium karijini*	2	Tk	*Triodia* sp. Karijini (S. van Leeuwen 4123)	1
Gnu	*Goodenia nuda*	4	Tm	*Triodia* sp. Mt Ella (M.E. Trudgen 17739)	3
Gsp	*Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727)	3	Tve	*Triodia veniciae*	1
Gsa	*Grevillea saxicola*	3	Vsp	*Viltadinia* sp. Coondewanna Flats (S. van Leeuwen 4684)	1
			Xbo	*Xerochrysum boreale*	3

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FLORA AND COMMUNITIES DATABASE SEARCH RESULTS

NYIDINGHU TARGETED FLORA AND VEGETATION SURVEY

DATASOURCES:
BASEMAP: GEOSCIENCE AUSTRALIA SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

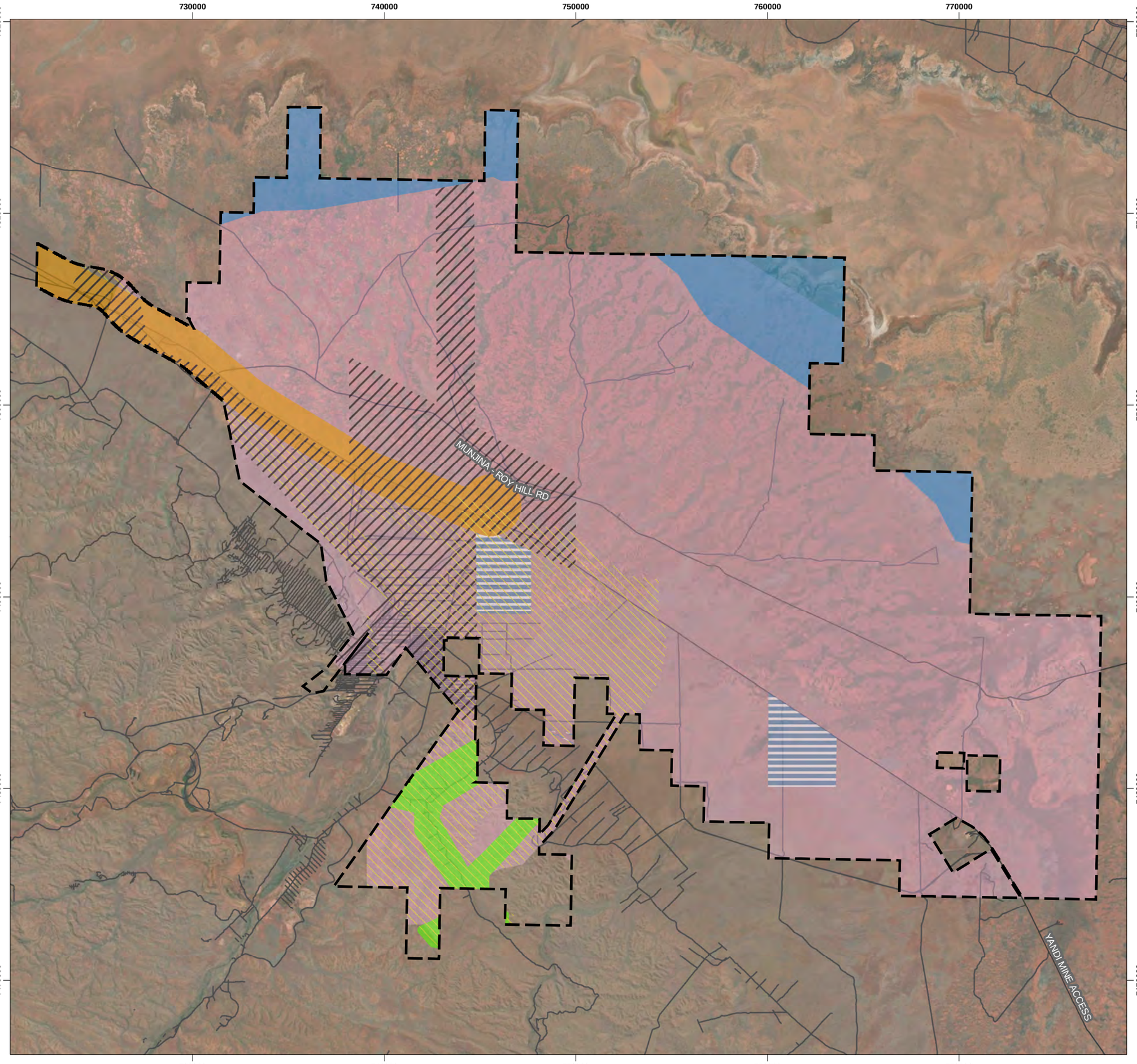
SCALE: 1:350,000 @ A3

0 2.5 5 7.5 10 12.5 km

PROJECT NO: 4610-21

REV	AUTHOR	APPROVED	DATE
0	AHC	SB	07/04/2021

MAP
02



LEGEND

- Survey Area
- Roads

Previous Flora and Vegetation Surveys

- Fortescue Valley Flora and Vegetation Report (Ecoscape 2018)
- Addendum. Nyidinghu Flora and Vegetation Assessment (Cardno 2012)
- Fortescue Marsh Vegetation Mapping (Lyons, M. 2016)
- Fortescue Metals Group Stage B Rail Corridor, Christmas Creek, Mt Lewin, Mt Nicholas and Mindy Mindy Mine Areas (Biota Environmental Sciences 2004)
- Nyidinghu Flora and Vegetation Assessment (Cardno 2012)
- Nyidinghu Rail Spur Flora and Vegetation Assessment (Cardno 2012)
- Vegetation and Flora Survey of the Proposed FMG Stage A Rail Corridor (Biota Environmental Sciences 2004)

DATASOURCES :
SOURCE DATA: TRANSPORT ROAD CENTRELINES (MRWA 2012)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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PREVIOUS SURVEYS

NYIDINGHU TARGETED FLORA AND VEGETATION SURVEY

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

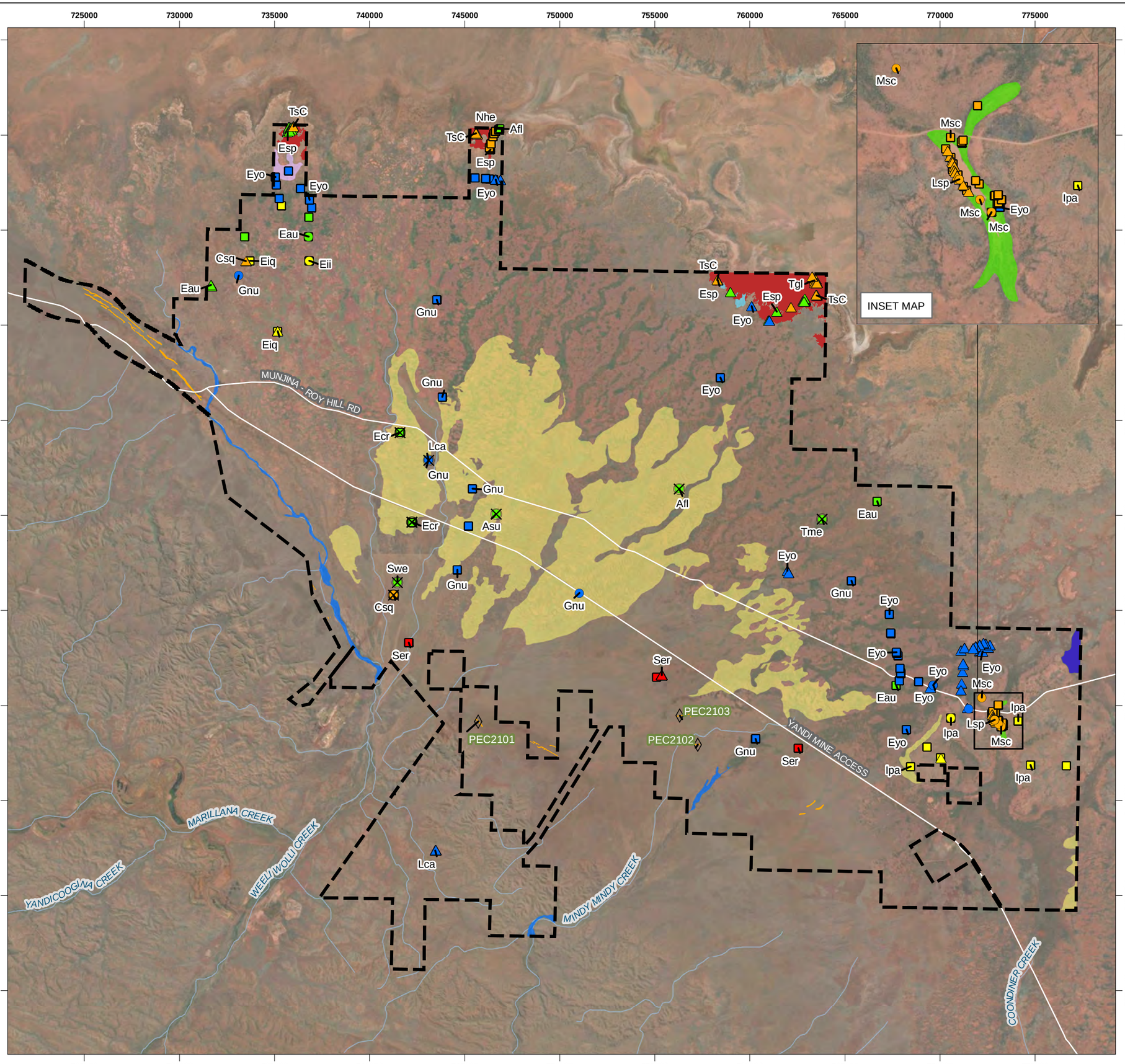
SCALE: 1:200,000 @ A3

0 2 4 6 8 km

PROJECT NO: 4610-21

REV	AUTHOR	APPROVED	DATE
0	AHC/KP	SB	13/08/2021

MAP
03



LEGEND

Survey Area

Releve

Conservation-listed Flora (Ecoscape 2021); see Table 15 in Appendix Two for code descriptions

- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Threatened

Conservation-listed Flora (FMG 2021)

- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Threatened

Conservation-listed Flora (DBCA 2021)

- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Records not reliable

Priority Ecological Communities (Ecoscape 2021)

- Marsh PEC
- Narbung PEC
- Sand Dunes PEC

Signficant Vegetation (Ecoscape 2021)

- Mulga Sheet Flow Dependent Vegetation
- *Melaleuca xerophila* GDE
- *Eucalyptus victrix* GDE
- *Eucalyptus victrix* potential GDE
- *Eucalyptus camaldulensis* GDE

LABEL	TAXON	STATUS
Afl	*Atriplex flabelliformis*	3
Asu	*Acacia subtiliformis*	3
Csq	*Calotis squamigera*	1
Eau	*Euphorbia australis* var. glabra	3
Ecr	*Eragrostis crateriformis*	3
Eii	*Euphorbia inappendiculata* var. inappendiculata	2
Eiq	*Euphorbia inappendiculata* var. queenslandica	2
Esp	*Eremophila spongiocarpa*	1
Eyo	*Eremophila youngii* subsp. lepidota	4
Gnu	*Goodenia nuda*	4
Ipa	*Isotropis parviflora*	2
Lca	*Lepidium catapycnon*	4
Lsp	*Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)	1
Msc	*Myriocephalus scalpellus*	1
Nhe	*Nicotiana heterantha*	1
Rsp	*Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)	1
Ser	*Seringia exastia*	T
Swe	*Stylidium weeliwolli*	3
Tgl	*Tecticornia globulifera*	1
Tme	*Tecticornia medusa*	3
TsC	*Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	1

DATASOURCES:
SOURCE DATA: TRANSPORT ROAD CENTRELINES (MRWA 2012); FLORA DATA (ECOSCAPE 2021)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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SIGNIFICANT FLORA & VEGETATION RESULTS

NYIDINGHU TARGETED FLORA AND VEGETATION SURVEY

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:200,000 @ A3

0 2 4 6 8 km

PROJECT NO: 4610-21

REV	AUTHOR	APPROVED	DATE
0	KP/AHC	SB	13/08/2021

MAP 04

730000 740000 750000 760000 770000

7520000 7510000 7500000 7490000 7480000 7470000

INSET

INSET

LEGEND

Survey Area

Ecoscape 2021

- *Aerva javanica*
- *Cenchrus setiger*
- *Chloris virgata*
- *Malvastrum americanum*
- *Echinochloa colona*
- *Cenchrus ciliaris*
- *Rumex vesicarius*
- *Setaria verticillata*
- *Stylosanthes hamata*
- *Vachellia farnesiana*

FMG Priority Weeds

- *Aerva javanica*
- *Cenchrus setiger*
- *Chloris virgata*
- *Malvastrum americanum*
- *Echinochloa colona*
- *Cenchrus ciliaris*
- *Rumex vesicarius*
- *Setaria verticillata*
- *Stylosanthes hamata*
- *Vachellia farnesiana*

Other Introduced Flora

- *Argemone ochroleuca*
- *Bidens* spp.
- *Citrullus amarus*
- *Citrullus colocynthis*
- *Datura leichhardtii*
- *Flaveria trinervia*
- *Portulaca pilosa*
- *Pseudognaphalium luteoalbum*
- *Sisymbrium orientale*
- *Solanum nigrum*
- *Tribulus terrestris*

DATASOURCES:
SOURCE DATA: TRANSPORT ROAD CENTRELINES (MRWA 2012)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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PRIORITY WEEDS

NYIDINGHU TARGETED FLORA AND VEGETATION SURVEY

FMG Fortescue The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:200,000 @ A3

0 2 4 6 8 km

PROJECT NO: 4610-21

REV	AUTHOR	APPROVED	DATE
0	KP	SB	13/08/2021

MAP 05

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 8: EPBC Act categories for flora, fauna and ecological communities

Category	Threatened species	Threatened Ecological Communities
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.	n/a
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.	n/a
Critically Endangered (CE)	A native species is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria
Endangered (EN)	A native species is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.	n/a

Table 9: Conservation codes for Western Australian flora and fauna (DBCA 2019)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. **The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
T	**Threatened species** 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 fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of 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 species** Threatened species 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*". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
EN	**Endangered species** Threatened species 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*". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
VU	**Vulnerable species** Threatened species 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*". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** 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 schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	Extinct in the wild species 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 25of the BC Act). Currently there are no threatened fauna or 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.
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	

Conservation Codes for Western Australian Flora and Fauna	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.*
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18of the BC Act). Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority 1: Poorly-known species** 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. Such species are in urgent need of further survey.
2	**Priority 2: Poorly-known species** 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. Such species are in urgent need of further survey.
3	**Priority 3: Poorly-known species** 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. Such species are in need of further survey.
4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (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.

[1] The definition of flora includes algae, fungi and lichens.
[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Table 10: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. 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 (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. 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 (A, B or C): A. 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 (i or ii): i. 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 10 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. 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 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. 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. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. 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 (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated 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 future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. 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 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Criteria	Definition
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. 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 or significant modification 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 (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C. The ecological community may be still 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.
Priority ecological communities	
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.
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.
Priority Three	*Poorly known ecological communities* i. 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; ii. 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; iii. Communities made up of large, and/or widespread occurrences, that may or may 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.
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. i. 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. ii. 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. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.
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.

APPENDIX TWO DESKTOP ASSESSMENT RESULTS AND LIKELIHOOD ASSESSMENTS

Table 11: Flora database search results, habitat and likelihood assessment

Blue shading indicates high likelihood; dark blue indicates species is known (recorded) from the survey area

DBCA	FMG*	Species name	Habitat	Flowering	Distance (km)**	Likelihood of occurrence	
						Desktop	Post-survey
		Threatened Flora					
WAH	X	*Seringia exastia*	Sandplains with red sand. Pindan Plain. Sand dunes and gravel plains	Apr – Dec	0	Known	Known
		DBCA Priority 1					
WAH	X	*Calotis squamigera*	Pebbly loam	Jul	0	Known	Known
WAH		*Dipteracanthus chichesterensis*	Red/brown (cracking) clay	Sep	48	Unlikely	Very Unlikely
WAH, TP		*Eremophila pilosa*	Red sandy loam	-	23	May occur	Unlikely
WAH		*Eremophila* sp. West Angelas (S. van Leeuwen 4068)	Brown silty loam. Slopes	Aug-Nov	42	Unlikely	Very Unlikely
WAH, TP		*Helichrysum oligochaetum*	Red clay. Alluvial plains	-	46	Unlikely	Unlikely
WAH		*Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)	Edge of water features on clay	-	0	Known	Known
WAH, TP	X	*Myriocephalus scalpellus*	Clay. Depression on flood plain	-	0	Known	Known
WAH		*Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)	Riparian slope at water's edge	-	0	Known	Known
WAH	X	*Samolus* sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	Sandy clay loam soil. Floodplain/marsh	-	5	Likely	May occur
WAH	X	*Stemodia* sp. Battle Hill (A.L. Payne 1006)	Cracking clay. Floodplain	-	42	Unlikely	Very Unlikely
WAH	X	*Synostemon hamersleyensis*	Brown sandy loam. Rocky ironstone hills	-	3	Likely	May occur
WAH, TP	X	*Tecticornia globulifera*	Brown clayey loam. saline flat / marsh	-	3	Likely	Known
WAH	X	*Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	Red-orange/white sandy clay/sandy loam. Plains	-	9	Likely	Known
WAH		*Triodia* sp. Karijini (S. van Leeuwen 4111)	Sandy loam. Slopes	-	48	Unlikely	Very Unlikely
WAH		*Triodia veniciae*	Clay loam. Gentle slopes/small hills	-	38	Unlikely	Very Unlikely
WAH	X	*Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684)	Red-brown sandy clay. Plains/low hills	-	30	Unlikely	Unlikely

DBCA	FMG*	Species name	Habitat	Flowering	Distance (km)**	Likelihood of occurrence	
						Desktop	Post-survey
		DBCA Priority 2					
WAH		*Adiantum capillus-veneris*	Moist, sheltered sites in gorges and on cliff walls	-	34	Very unlikely	Very unlikely
WAH	X	*Aristida lazaridis*	Sand or loam	Apr	19	May occur	Unlikely
WAH	X	*Cladium procerum*	Perennial pools	-	48	Unlikely	Unlikely
WAH	X	*Eremophila pusilliflora*	Red / brown loamy soil. Plains	Feb-Mar	45	Unlikely	Unlikely
WAH	X	*Euphorbia inappendiculata* var. *inappendiculata*	Red-brown sandy/loamy clay. Plains / claypan	May	0	Known	Known
WAH	X	*Euphorbia inappendiculata* var. *queenslandica*	Brownish loamy clay. Cracking claypan or plain	-	38	May occur	Known
WAH	X	*Gompholobium karijini*	Plateau, flat to gently undulating or on top of hills / slopes	Aug-Sep	20	May occur	Unlikely
WAH		*Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	Riparian zones. Gorges	Apr	20	May occur	Unlikely
WAH	X	*Ipomoea racemigera*	Brown silty loam. Drainage lines or flats	Apr-Jun	27	Unlikely	Unlikely
WAH	X	*Isotropis parviflora*	Valley slope or ironstone plateau	Mar	0	Known	Known
WAH		*Kohautia australiensis*	Brown sandy loam. Calcrete plains or hills	-	31	Unlikely	Unlikely
WAH		*Oxalis* sp. Pilbara (M.E. Trudgen 12725)	Sandy loam. In gorges, gullies or creek lines	-	33	Unlikely	Unlikely
WAH		*Scaevola* sp. Hamersley Range basalts (S. van Leeuwen 3675)	Skeletal, brown gritty soil over basalt. Summits of hills, steep hills	Jul-Aug	43	Very unlikely	Very unlikely
WAH	X	*Teucrium pilbaranum*	Crab hole plain in a river floodplain, margin of calcrete table	May or Sep	37	Unlikely	Unlikely
		DBCA Priority 3					
WAH		*Abutilon* sp. Pritzelianum (S. van Leeuwen 5095)	Plains, floodplains, sand dunes. Red-brown or orange-brown sandy or loamy soil. Open *Acacia* shrubland over *Triodia* grassland	Apr-Sep	47	Very unlikely	Very unlikely
WAH, TP		*Acacia effusa*	Scree slopes of low ranges, undulating stony plains. Stony red-brown loam soil	May-Aug	45	Very unlikely	Very unlikely
WAH, TP	X	*Acacia subtiliformis*	Rocky ridges, calcrete hills, undulating plains. Light brown rocky loam or brown clay soils. *Acacia* shrubland over *Triodia* grassland with scattered *Eucalyptus* and *Corymbia* trees	Apr-Jun	0	Known	Unlikely
WAH		*Amaranthus centralis*	Sand plains, granite outcrops, river banks, flats. Clay loam or sandy soil. Open woodland of *Acacia/Eucalyptus/Corymbia* over mixed shrubland with *Triodia* spp	May	18	May occur	Unlikely
WAH	X	*Aristida jerichoensis* var. *subspinulifera*	Hardpan plains. Mulga/open *Acacia* shrubland over open*Triodia* grassland and/or tussock grassland with scattered *Eucalyptus* trees	Mar-Jul	31	Unlikely	Unlikely
WAH	X	*Atriplex flabelliformis*	Saline flats or marshes with red-brown clay loam soil. Samphire vegetation	-	0	Known	Known

DBCA	FMG*	Species name	Habitat	Flowering	Distance (km)**	Likelihood of occurrence	
						Desktop	Post-survey
WAH		*Crotalaria smithiana*	Floodplain. Orange brown loam	May-Jun	49	Unlikely	Very unlikely
WAH, TP		*Dampiera metallorum*	Steep slopes, summits of hills. Skeletal red-brown gravelly soil over banded ironstone	Apr-Oct	32	Unlikely	Unlikely
WAH		*Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)	Crabhole plains, drainage lines, gentle slopes. Clay or loam soil	Mar	33	Unlikely	Very unlikely
WAH	X	*Dysphania congestiflora*	Saline floodplains. Red-brown saline clay soils	Jul	13	Likely	May occur
WAH	X	*Eleocharis papillosa*	Claypans, open clay flats. Red/brown clay soil	Nov	18	May occur	Unlikely
WAH	X	*Eragrostis crateriformis*	Creek banks, depressions. Clayey loam or clay	Jan-Jul	0	Known	Unlikely
WAH		*Eragrostis* sp. Erect spikelets (P.K. Latz 2122)	Low calcrete rise	-	23	Unlikely	Unlikely
WAH		*Eremophila* sp. Hamersley Range (K. Walker KW 136)	Rocky hill slopes, hill crests, gullies. Skeletal red-brown clay loam, sandy loam soil	Jun-Sep	12	May occur	Unlikely
WAH, TP	X	*Eremophila spongiocarpa*	Weakly saline alluvial plains on margins of marsh.	May-Sep	2	Known	Known
WAH	X	*Eucalyptus rowleyi*	Edges of drainage lines, rocky slopes, plains. Red loamy soil	Mar-Jun	26	Unlikely	Unlikely
WAH	X	*Euphorbia australis* var. *glabra*	Plains and floodplains. Occasionally on cracking clay	May-Sep	0	Known	Known
WAH, TP	X	*Fimbristylis sieberiana*	Pool edges, sandstone cliffs. Mud, skeletal soil pockets	May-Jun	12	May occur	Unlikely
WAH, TP	X	*Glycine falcata*	Black clayey sand. Along drainage depressions in crabhole plains on river floodplains	May-Jul	33	Unlikely	Unlikely
WAH, TP	X	*Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727)	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains	Sep	16	May occur	Unlikely
WAH		*Grevillea saxicola*	Rocky hill tops and slopes	Feb-Jul	23	May occur	Unlikely
WAH	X	*Gymnanthera cunninghamii*	Creek beds, drainage lines, on margins of mound springs. Sandy soils	Dec-Jan	14	May occur	Unlikely
WAH	X	*Indigofera gilesii*	Pebbly loam. Amongst boulders and outcrops, hills	May-Aug	21	May occur	Unlikely
WAH	X	*Iotasperma sessilifolium*	Cracking clay, black loam. Edges of waterholes, plains	Jul-Sep	40	Unlikely	Unlikely
WAH		*Pilbara trudgenii*	Hill summits, steep slopes, screes and cliff faces. Skeletal red soil over ironstone	Sep	47	Unlikely	Unlikely
WAH, TP	X	*Rhagodia* sp. Hamersley (M. Trudgen 17794)	Plains with red-brown clay loams over ironstone	Mar-Nov	2	Likely	May occur
WAH	X	*Rostellularia adscendens* var. *latifolia*	Ironstone soils. Near creeks, rocky hills	Apr-May	17	May occur	May occur
WAH	X	*Sida* sp. Barlee Range (S. van Leeuwen 1642)	Skeletal red-brown soils. On rocky slopes and in gullies	Aug	6	Likely	May occur
WAH		*Stackhousia clementii*	Skeletal soils. Sandstone hills	Feb-Nov	10	Likely	May occur

DBCA	FMG*	Species name	Habitat	Flowering	Distance (km)**	Likelihood of occurrence	
						Desktop	Post-survey
WAH, TP	X	*Stylidium weeliwolli*	Gritty sand soil, sandy clay. Edge of watercourses	-	0	Known	Unlikely
WAH	X	*Swainsona thompsoniana*	Cracking clay floodplains and gentle slopes	Apr-Aug	33	Unlikely	Unlikely
WAH	X	*Tecticornia medusa*	Clay pans, floodplains, edges of salt lakes. Red clay loam soil	Nov	0	Known	Unlikely
WAH	X	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431)	Clay pan, grass plain	Aug	4	Likely	May occur
WAH		*Triodia basitricha*	Hill tops, rocky plains and in gullies. Gravelly soils, red-brown clay loam over ironstone	May-Jul	43	Unlikely	Unlikely
WAH	X	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)	Amongst rocks and outcrops, gully slopes. Light orange-brown pebbly loam	Sep	20	May occur	Unlikely
WAH		*Xerochrysum boreale*	Stony plains, flats. Red-brown clay	Sep	30	Unlikely	Unlikely
		DBCA Priority 4					
WAH, TP	X	*Acacia bromilowiana*	Rocky hills, breakaways, scree slopes, gorges, creek beds	Jul - Aug	26	Unlikely	Unlikely
WAH, TP	X	*Bulbostylis burbidgeae*	Granite outcrops, cliff bases, slopes. Brown skeletal clay-loam soils	Mar-Aug	50	Very unlikely	Very unlikely
WAH	X	*Eremophila magnifica* subsp. *magnifica*	Skeletal soils over ironstone. Rocky screes	Aug - Nov	11	May occur	Unlikely
WAH	X	*Eremophila youngii* subsp. *lepidota*	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats.		0	Known	Known
WAH, TP	X	*Goodenia nuda*	Seasonally inundated clay soils and drainage lines	Apr-Aug	0	Known	Known
WAH, TP	X	*Lepidium catapycnon*	Skeletal soils. Hillsides		0	Known	Known
WAH	X	*Ptilotus mollis*	Stony hills and screes	May or Sep	38	Unlikely	Unlikely
WAH	X	*Rhynchosia bungarensis*	Rock piles, gorges, river beds and alluvial soils	May-Nov	10	Likely	Unlikely

WAH = herbarium record (vouchered specimen)

TP = Threatened and Priority Flora Report Form record; may be unconfirmed i.e. without vouchered specimen

* Fortescue Metals Group database

** distance from survey area

APPENDIX THREE RELEVÉ DATA

PEC2101

Staff SOK **Date** 19/07/2021 **Season** E

Revisit

Type R 50 m x 50 m

Location Outside target area

MGA Zone 50 745723 **mE** 7484161 **mN** **Lat.** -22.7320 **Long.** 119.3925

Habitat Dunes

Aspect N/A **Slope** N/A

Soil Type Red sand

Rock Type Nil

Loose Rock 0 % cover **Litter** 2 % cover ; 0-2 cm in depth

Bare ground 60 % cover **Weeds** <1 % cover

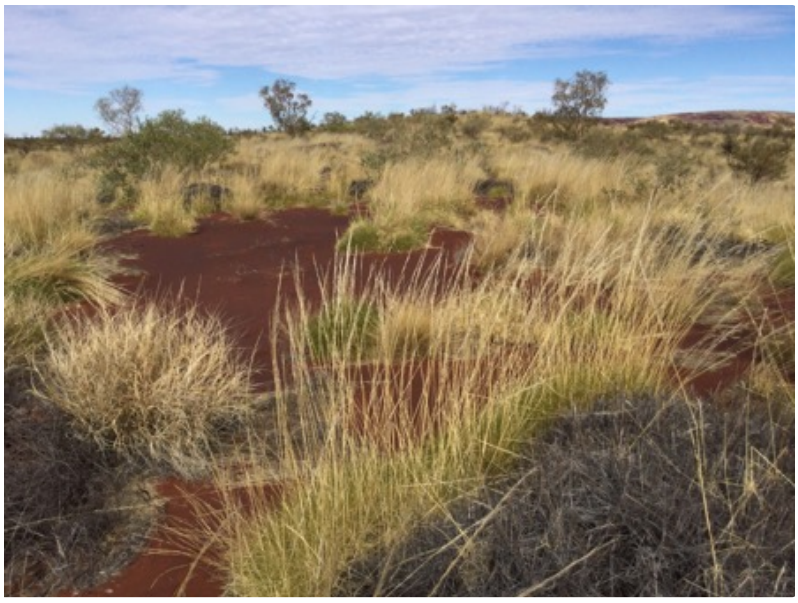
Vegetation M+ ^*Acacia dictyophleba*,^*Acacia pachyacra*\^shrub\3\r;G ^^*Triodia schinzii*,*Triodia basedowii*, *Aristida holathera* var. *holathera*\^hummock grass,tussock grass\2\c

Veg. Condition Excellent

Disturbance Minimal

Fire Age >5 years

Notes Linear dunes that starts from ironstone outcropping at east end



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia dictyophleba		2	4	
Acacia pachyacra		2	1	
Aristida holathera var. *holathera*		0.5	5	
Eriachne gardneri		0.5	<1	
Petalostylis cassioides		0.8	<1	

Trianthema pilosum	0.2	<1
Trichodesma zeylanicum var. *grandiflorum*	1	<1
Triodia basedowii	0.7	5
Triodia schinzii	0.7	25

PEC2102

Staff SOK **Date** 19/07/2021 **Season** E

Revisit

Type R 50 m x 50 m

Location

MGA Zone 50 757264 **mE** 7482947 **mN** **Lat.** -22.7413 **Long.** 119.5050

Habitat Dunes

Aspect N/A **Slope** N/A

Soil Type Red brown sand

Rock Type Nil

Loose Rock 0 % cover **Litter** 5 % cover ; 0-2 cm in depth

Bare ground 75 % cover **Weeds** 2 % cover

Vegetation M ^*Crotalaria cunninghamii*\^shrub\3\r;G+ ^^*Triodia pungens*,*Aristida holathera* var. *holathera*, *Corchorus* aff. *tectus*\^hummock grass,tussock grass,shrub\1\i

Veg. Condition Very Good

Disturbance Weeds

Fire Age 2-5 years

Notes Small patch of linear dunes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia pachyacra		2	<1	
Aristida holathera var. *holathera*		0.4	5	
**Cenchrus ciliaris*		0.5	2	
Corchorus aff. *tectus*		0.5	3	
Crotalaria cunninghamii		1.5	2	

Triodia pungens	0.5	5
Triodia schinzii	0.5	2

PEC2103

Staff SOK **Date** 19/07/2021 **Season** E

Revisit

Type R 50 m x 50 m

Location

MGA Zone 50 756315 **mE** 7484463 **mN** **Lat.** -22.7277 **Long.** 119.4955

Habitat Dunes

Aspect N/A **Slope** N/A

Soil Type Red brown sand

Rock Type Nil

Loose Rock 0 % cover **Litter** 4 % cover ; 0-2 cm in depth

Bare ground 55 % cover **Weeds** <1 % cover

Vegetation M+ ^*Acacia dictyophleba*,^*Acacia pachyacra*\^shrub\3\r;G ^^*Triodia pungens*,*Triodia schinzii*, *Aristida holathera* var. *holathera*\^hummock grass,tussock grass\2\c

Veg. Condition Excellent

Disturbance Minimal

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia dictyophleba		2	7	
Acacia pachyacra		2	2	
Aristida holathera var. *holathera*		0.5	5	
Eragrostis eriopoda		0.4	<1	
Eriachne aristidea		0.4	<1	

Eriachne gardneri	0.5	2
Triodia pungens	0.6	30
Triodia schinzii	0.6	10