Appendix 17 Threatened Flora and Declared Weeds – Huntly Mine Pre-clearance survey 2023

MAY 2024

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HUNTLY MINE PRE-CLEARANCE SURVEYS - THREATENED FLORA AND DECLARED WEEDS 2023 – DESKTOP ASSESSMENT AND MEMO REPORT

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EXECUTIVE SUMMARY

Alcoa of Australia Limited's (Alcoa) Western Australian (WA) mining operations comprise the Huntly and Willowdale bauxite mines, which are located in Alcoa's Mining Lease 1SA (ML1SA) within the Northern Jarrah Forest (NJF) IBRA subregion. Alcoa has committed to undertaking pre-clearance ecological surveys for the Huntly Mine, Myara region and Willowdale Mine, Larego region as part its MMP assessment by the MMPLG. These surveys will be based on conceptual clearing alignments which will be submitted as part of the MMP. Ecologia Environment (ecologia) was engaged by Alcoa to undertake targeted flora surveys for the Huntly Mine survey area in 2023, totalling 673.81 ha, which were undertaken over 25 days primarily in spring 2023 (late August and early December).

Based on the proximity of previous records and the potential presence of suitable habitat, 29 conservation significant plant species were assessed as potentially occur within the survey area. Targeted searches for these species, as well as Weeds of National Significance (WONS) and Declared Pests, were conducted along systematic transects at 20 m or 10 m spacings within the survey area.

Three DBCA listed Priority species were recorded within the survey area: *Tetratheca phoenix* (P2), *Senecio leucoglossus* (P4), and *Stylidium ireneae* (P4). The likelihood of occurrence of the remaining species identified during the desktop assessment was reassessed for the surveyed areas based on survey effort, the presence of suitable habitat, and vegetation condition, and all species initially assessed with a 'High' or 'Moderate' likelihood of occurrence were reassessed as 'Low'. There were no WONS or Declared Pests recorded.

TABLE OF CONTENTS

TABLES

FIGURES

MAP FIGURES

APPENDICES

ABBREVIATIONS

BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
BOM	Bureau of Meteorology
CALM	Department of Conservation and Land Management (now DBCA and DWER)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water and the Environment (now DCCEEW)
DAWR	Department of Agriculture and Water Resources (now DCCEEW)
DBCA	Department of Biodiversity, Conservation and Attractions (previously DPaW)
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEC	Department of Environment and Conservation (now DBCA)
DER	Department of Environment Regulation (now DWER)
DWER	Department of Water and Environmental Regulation
DoEE	Department of Environment and Energy (previously DSEWPaC, now DAWE)
DPaW	Department of Parks and Wildlife (now DBCA)
DPIRD	Department of Primary Industry and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now DAWE)
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESCAVI	Executive Steering Committee for Australian Vegetation Information
Ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
m	Metre
P	Priority
WA	Western Australia
WAOL	Western Australian Organism List
WC Act	*Wildlife Conservation Act 1950*
WAOL	Western Australian Organism List
WONS	Weed of National Significance

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Alcoa of Australia Limited's (Alcoa) Western Australian (WA) mining operations comprise the Huntly and Willowdale bauxite mines, which are located in Alcoa's Mining Lease 1SA (ML1SA) within the Northern Jarrah Forest (NJF) IBRA subregion. Alcoa has approval to mine within ML1SA subject to submitting draft five-year mine plans and associated environmental management programmes known as the Mining and Management Program (MMP). The MMP is submitted to the State's Mining and Management Program Liaison Group (MMPLG) on an annual basis.

Alcoa has committed to undertaking pre-clearance ecological surveys for the Huntly Mine, Myara region and Willowdale Mine, Larego region as part its MMP assessment by the MMPLG. These surveys will be based on conceptual clearing alignments which will be submitted as part of the MMP and will be used to:

- Amend the conceptual alignment to avoid significant flora and vegetation.
- Create management plans to ensure any identified Weeds of National Significance (WONS) or declared and invasive weeds are not spread.
- Inform translocation and environmental management plans as required.
- Assist Alcoa in preparing MMP submission to the MMPLG.

1.2 SCOPE OF WORK

Alcoa required a suitably qualified consultant to undertake targeted surveys for Threatened and Priority Flora and significant weeds species (primarily Weeds of National Significance and Declared Pests) within the Huntly Mine survey area, which, as of December 2023, occupies an area of 673.81 ha (Map 1).

The following were provided as part the biological assessment of the survey area:

- A desktop assessment to evaluate biological values of the survey area and surrounds, relating to significant plants species and weeds.
- Targeted surveys within designated survey areas as per EPA guidance:
    - In 10 or 20 m traverses in a grid pattern to identify Threatened and Priority species presence or absence. If a Threatened or Priority species is found, the survey effort is modified to delineate the impacted population.
    - Other conservation significant flora species will be recorded when identified.
    - Record any WONS, Declared Pests, and invasive weeds.

1.3 DEFINITIONS

1.3.1 Significant Flora

According to the *EPA Factor Guideline: Flora and Vegetation* (EPA 2016a), plant taxa (or records) may be considered significant for reasons including, but not restricted to, the following:

- A taxon listed as Threatened under Western Australia's *Biodiversity Conservation Act 2016* (BC Act) or the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- A taxon on the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Flora List.
- Locally endemic species or those associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems).
- New species or those having anomalous features that indicate a potential new species.
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range).
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids.

- Being representative of taxonomic groups that no longer occur widely in the broader landscape (relictual species/populations).

1.3.2 Introduced Plants

Weeds of National Significance

Under the Australian Weeds Strategy there are 32 introduced plant species listed as Weeds of National Significance (WONS) that are "causing major economic, environmental and/or social impacts in a number of states or territories with strong potential for further spread" (DAWR 2017). These species require "coordinated and strategic management along with shared stakeholder investment to develop and implement best practice to prevent, eradicate, contain and/or minimise [their] impacts in different parts of the nation" (DAWR 2017).

Biosecurity and Agriculture Management Act 2007

The purpose of Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act) is to prevent serious animal and plant pests and diseases from entering Western Australia and becoming established, and to minimise the spread and impact of those that are already present. The Western Australian Organism List (WAOL) lists organisms that are categorised under the BAM Act into five legal categories: 'Declared Pest, Prohibited -s12', 'Declared Pest -s22(2)', 'Permitted -s11', 'Permitted, Requires Permit -r73', and 'Unlisted -s14'. A Declared Pest may be subject to control and keeping requirements once within Western Australia.

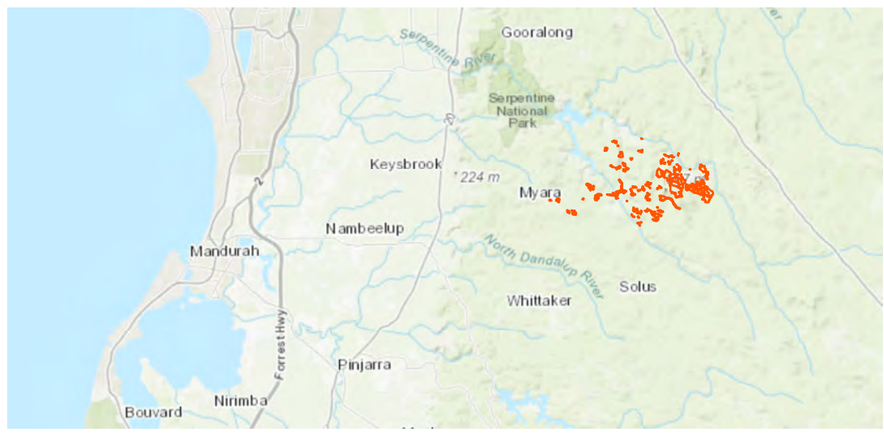
Regional Weed Prioritisation Process

At a regional level in Western Australia, introduced plant species are ranked using the Weed Prioritisation Process (DPaW 2013). The process is intended to "highlight the species that have the highest ecological impact, most extensive potential distribution, highest invasiveness, lowest current distribution and highest feasibility of control within a regional context based on the information available at the time" (DPaW 2013).

415000 417500 420000 422500 425000 427500 430000 432500

6412500 6410000 6407500 6405000

Survey area



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Author: AC
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Projection: Transverse Mercator
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Map 1: Location of the Huntly Mine survey area.

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Kilometers

2 DESKTOP ASSESSMENT

2.1 DESKTOP METHODOLOGY

The methodology adopted for the desktop assessment was in accordance with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016b) and *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020). A review of background environmental information for the survey area was undertaken, including, but not limited to, climate (Bureau of Meteorology, BOM), biogeography (IBRA 7) (DSEWPaC 2012), soil-landscape systems (land systems) (DPIRD 2016), the Surface Geology of Australia 1:1M spatial dataset (Geoscience Australia 2012), the Atlas of Australian Soils (Northcote *et al.* 1960-1968), and pre-European native vegetation of Western Australia (Shepherd *et al.* 2002).

Searches of the databases listed in Table 1 were undertaken to determine the significant species and ecological communities previously recorded within 20 km of the survey area. The criteria listed in Table 2 were then applied to determine the likelihood of occurrence of these species and communities within the survey area. Habitat preferences were sourced, where available, from relevant taxonomic literature, FloraBase records (Western Australian Herbarium 1998–), Threatened Species Profiles (SPRATs), or specimen data from the Australasian Virtual Herbarium (AVH) database (CHAH 2017). The presence of potentially suitable habitat within the survey area was determined using broad landforms, soils, and vegetation associations in comparison to cited preferred habitat (if available) for each species.

Table 1: Databases queried for the desktop assessment.

Database	Search details
EPBC Act Protected Matters database	Records of matters of national significance under the EPBC Act within 20 km of the survey area
DBCA Threatened and Priority Ecological Communities Database	Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) within 20 km of the survey area
DBCA Threatened and Priority Flora (TPFL) and WAHERB database	Significant plant species records within 20 km of the survey area

Table 2: Criteria used to assess the likelihood of occurrence of significant species and communities.

Rating	Criterion
Recorded	The species/community has been recorded within the survey area previously or during the current survey.
High	The species/community is likely to occur within the survey area as suitable habitat is known to be present and there are existing records very close to the survey area (within 5 km).
Moderate	The species/community possibly occurs within the survey area as there are existing records in the vicinity of the survey area (ca. 6 – 20 km) and suitable habitat is likely to be present; or The species/community possibly occurs within the survey area as there is insufficient information available to exclude the possibility of occurrence.
Low	The species/community is unlikely to occur within the survey area as suitable habitat is not present or is not likely to be present; or Suitable habitat is present within the survey area, but the taxon/community has not been recorded despite reasonable survey effort.
Does not occur	The community is an existing regionally mapped vegetation association (e.g. Shepherd et al. 2002) or land system which does not occur within the survey area; or The species is recognised as being locally extinct or extinct in the wild and does not occur within the survey area.

2.2 CLIMATE

The survey area is in the Jarrah Forest region of Western Australia, which experiences Mediterranean climate with two distinct seasons: a warm to hot dry summer from December to February and a mild to cool wet winter from June to August. Rainfall data from the nearest long-term Bureau of Meteorology (BOM) weather station (since 1963) were obtained from Karnet (Station No. 9111), located approximately 7 km to the west of the survey area. Winter rainfall at Karnet in 2023 was approximately 35% lower than average (Figure 1). Temperature data were also obtained from Karnet (Station No. 9111) (BoM 2023) which is located 7 km to the west of the survey area (Figure 1). Maximum daytime temperature at Karnet is frequently above 30°C between January and February, and minimum temperatures can drop below 7°C between July and August.

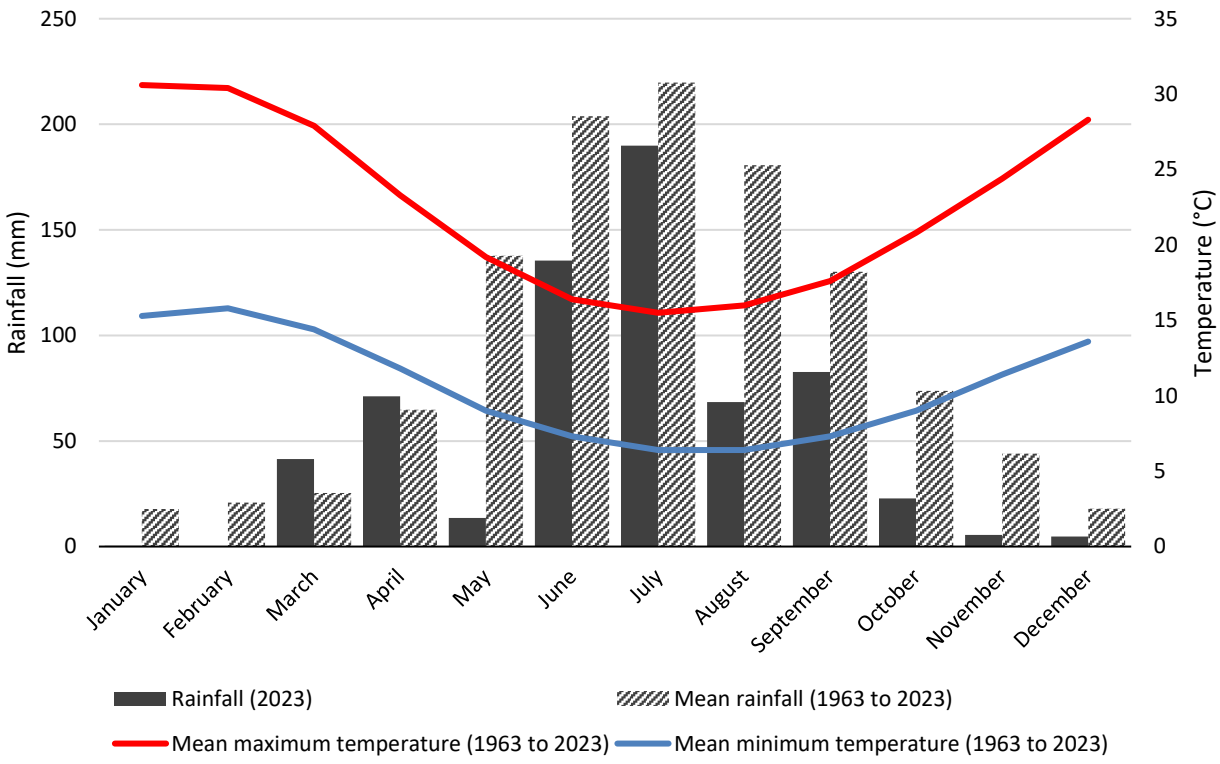

Figure 1: Monthly mean rainfall and temperature for Karnet (rainfall and temperature).

2.3 INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into bioregions on the basis of similar geology, landform, vegetation, fauna and climate characteristics (DSEWPaC 2012). The survey area is in the Jarrah Forest bioregion according to IBRA 7. The Jarrah Forest region is further divided into two subregions: Northern Jarrah Forest and Southern Jarrah Forest. The survey area is in the Northern Jarrah Forest subregion.

A description of the Northern Jarrah Forest from *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002* (Williams and Mitchell 2001) is as follows:

"The Northern Jarrah Forest incorporates the area east of the Darling Scarp, overlying Archaean granite and metamorphic rocks of an average elevation of 300 m, capped by an extensive lateritic duricrust, dissected by later drainage and broken by occasional granite hills. In the east the laterite becomes deeply dissected until it compresses isolated remnants. Rainfall is from 1300 mm on the scarp to approximately 700 mm in the east and north. Vegetation comprises Jarrah-Marri forest in the west with Bullich and Blackbutt in the valleys grading to Wandoo and Marri woodlands in the east with Powder bark on breakaways. There are extensive but localised sand sheets with *Banksia* low woodlands. Heath is found on granite rocks and as a common understorey of forests and woodlands in the north and east. Most the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions. Subregional area for JF1 is 2,255,904 ha."

2.4 LAND SYSTEMS

In 2016 the Department of Primary Industries and Regional Development consolidated soil-landscape mapping of Western Australia from two technical reports created by the Department of Agriculture and Food (Department of Agriculture Resource Management Technical Reports RMTR No. 280 (Purdie *et al.* 2016) and RMTR No. 313 (Tille 2006)). The resulting spatial dataset, *Soil Landscape Mapping - Best Available (Version 05.01)* (DPIRD-027) (DPIRD 2022), is a compilation of various surveys at different scales varying between 1:20,000 and 1:3,000,000. Mapping conforms to a nested hierarchy established to deal with the varying levels of information resulting from the variety of scales in mapping to provide soil-landscape data for all Western Australia. Five soil-landscape units are associated with the survey area (Table 3, Map 2).

2.5 SURFACE GEOLOGY

The Surface Geology of Australia 1:1,000,000 scale spatial dataset is a seamless national coverage of outcrop and surficial geology (Geoscience Australia 2012). Three surface geological units are associated with the survey area (Table 4, Map 3).

2.6 SOILS

The Atlas of Australian Soils (Northcote *et al.* 1960-1968) was compiled by the CSIRO in the 1960's to provide a consistent national description of Australia's soils. The original maps used scales from 1:250,000 to 1:500,000. In 1991 the National Resource Information Centre used these maps to create the Digital Atlas of Australian Soils which describes over 14,000 soil units and their distribution across Australia. Three soil types of the Atlas of Australian Soils are associated with the survey area (Table 5, Map 4).

Table 3: Land systems associated with the survey area (DPIRD-027).

Unit name	Description	Extent within survey area (ha)	Percent of survey area
Cooke subsystem	Crests and upper slopes dominated by granite outcrop and very shallow yellow duplex soils, and yellow and brown massive earths	208.89	31.00
Dwellingup subsystem	Divides, lower to upper slopes and hillcrests. Duplex sandy gravels and loamy gravels with minor areas of shallow gravels, deep sandy gravels, yellow deep sands and yellow and pale deep sands, often gravelly	332.25	49.31
Murray subsystem	Deeply incised valley of the Murray River; red and yellow earths and minor duplex soils; occasional rock outcrops; narrow sandy terrace	26.78	3.97
Yarragil DpYGh phase	Very gentle to moderately inclined (<20%) concave valley sideslopes. Moderately well drained yellow duplex soils and yellow and brown massive earths	6.16	0.91
Yarragil subsystem	Shallow, narrow, upper valleys of the deeply dissected Murray, Bindoon and Helena units. Alluvial, clay and loam soils, moderately well drained, often gravelly, with some sands and loams. Salt prone. Woodland of E. wandoo, E. accedens	99.73	14.81
Total		673.81	100

Table 4: Surface geology associated with the survey area (Geoscience Australia 2012).

Map Symbol	Soil unit	Description	Extent within survey area (ha)	Percent of survey area
Ag	felsic intrusives 74292	Undifferentiated felsic intrusive rocks, including monzogranite, granodiorite, granite, tonalite, quartz monzonite, syenogranite, diorite, monzodiorite, pegmatite. Locally metamorphosed, foliated, gneissic. Local abundant mafic and ultramafic inclusions	415.32	61.64
An	gneiss, granulite, migmatite 74310	Banded granitic gneiss (monzogranitic to granodioritic), quartzofeldspathic gneiss with mafic bands, migmatite, granofels, mafic and felsic granulites, hypersthene-plagioclase-quartz granulite; schist, pelitic or mafic granofels	0.19	0.03
Czl	ferruginous duricrust 38498	Ferruginous duricrust, laterite; pisolitic, nodular, vuggy; may include massive to pisolitic ferruginous subsoil, mottled clays, magnesite, reworked products of ferruginous and siliceous duricrusts, calcrete, gossan; residual ferruginous saprolite	258.3	38.33
Total			673.81	100

Table 5: Atlas of Australian Soil units associated with the survey area (Northcote *et al*. 1960-1968).

Name	Description	Extent within survey area (ha)	Percent of survey area
JJ14	Steep granitic ranges and hills with bare rock walls: chief soils are shallow sands (Uc4.11) and leached sands (Uc2.2) in colluvial positions.	34.6	5.14
JZ1	Dissected plateau having a strongly undulating relief, and with some moderately incised valleys. The unit comprises much of the western part of the Darling Range south of the Swan River. It is characterized by lateritic gravels and block laterite.	634.56	94.17
Mw31	Deeply incised, steep scarp and valley side slopes of the Darling scarp and its more deeply incised tributary valleys: chief soils of the steep scarp and valley side slopes, on which massive rock outcrops are a feature, seem to be acid red earths (Gn2.14) on the colluvial slope deposits.	4.65	0.69
Total		673.81	100

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Survey area

Soil-landcape system

- Cooke subsystem
- Dwellingup subsystem
- Murray subsystem
- Pindalup hillslope phase
- Pindalup subsystem
- Pindalup swampy valley floor phase
- Yarragil DpYGh phase
- Yarragil Swamp phase
- Yarragil subsystem

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Map 2: Soil-landscape systems within the survey area (DPIRD-027).

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6412500 6410000 6407500 6405000 6402500

ferruginous duricrust 38498

felsic intrusives 74292

ferruginous duricrust 38498

felsic intrusives 74292

colluvium 38491

ferruginous duricrust 38498

felsic intrusives 74292

felsic intrusives 74292

felsic intrusives 74292

gneiss, granulite, migmatite 74310

felsic intrusives 74292

ferruginous duricrust 38498

Survey area

Unit

- colluvium 38491
- felsic intrusives 74292
- ferruginous duricrust 38498
- gneiss, granulite, migmatite 74310

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Map 3: Surface geology (1:1,000,000) of the survey area (Geoscience Australia 2012).

Service Layer Credits:

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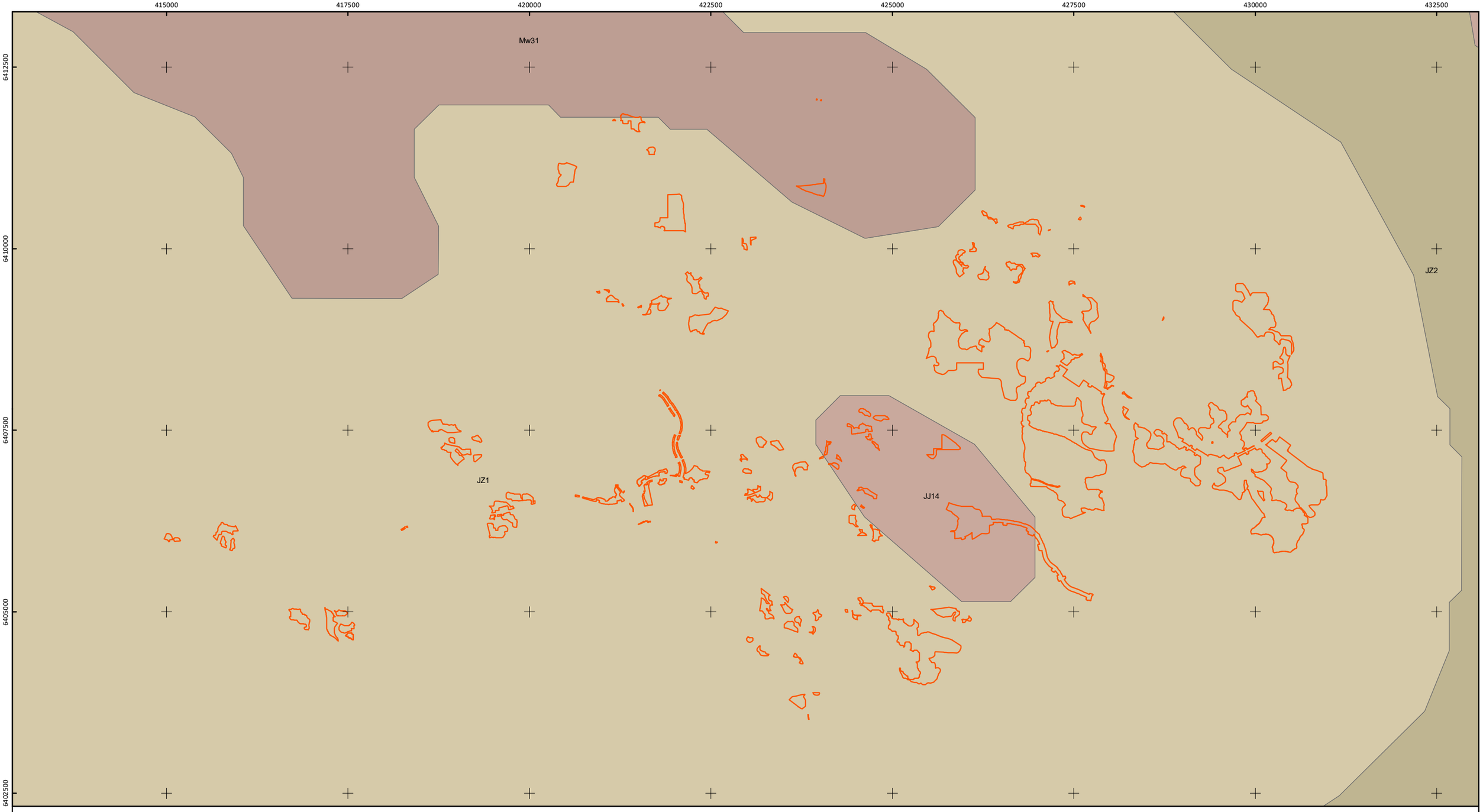
Kilometers



Survey area

Map unit

- JJ14
- JZ1
- JZ2
- Mw31

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Map 4: Atlas of Australian Soils map units associated with the survey area (Northcote et al. 1960-1968).

Service Layer Credits:

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Kilometers

2.7 VEGETATION

2.7.1 Pre-European Vegetation

The Western Australian Land Use and Vegetation Data Project produced a 1:250,000 scale digital spatial dataset of the pre-European native vegetation of Western Australia, compiled from previous vegetation mapping exercises, primarily by J.S. Beard from 1964 to 1981, with updates reflecting the National Vegetation Information System (NVIS) standards (Shepherd et al. 2002). One vegetation association (Association 3, *Eucalyptus marginata*, *Corymbia calophylla*, *Allocasuarina fraseriana* mid open forest) is mapped within the survey area (Table 6, Map 5).

2.7.2 Vegetation mapping of Mattiske (2022)

Vegetation for the Myara area was mapped by Mattiske (spatial data and descriptions provided by Alcoa in 2023). Twenty-two of these units (including cleared and rehabilitated areas) are present within the survey area (Table 7, Map 6). These consists primarily of *Eucalyptus marginata* and/or *Corymbia calophylla* dominated forests with a variable understorey occurring on steep slopes and plains, accounting for over 90% of the survey area (Table 7).

Two units representing vegetation fringing granite outcrops account for 1.11 ha (0.17%) of the survey area:

- G and G1 (Mosaic of Open Woodland of *Eucalyptus marginata* – *Corymbia calophylla* on the fringes of outcrops ranging to open heath communities of Proteaceae-Myrtaceae species and lithic complexes on the outcrop areas, 1.02 ha, 0.16%)

Two vegetation units accounting for 4.37 ha (0.66% of the survey area) are associated with creeks and water courses:

- CW (Woodland to Open Forest of *Eucalyptus patens* – *Eucalyptus megacarpa* - *Corymbia calophylla* - *Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses, 3.23 ha, 0.47%).
- AC (Open Woodland of *Eucalyptus rudis* – *Melaleuca preissiana* – *Eucalyptus patens* - *Banksia* littoralis with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on broad swamps and water-courses, 1.04 ha, 0.15%).

Note that the provided description of vegetation unit T (Table 7), which accounts for 2.28% of the survey area, appears to be erroneous as the mapped areas are not consistent with creeks or water-courses, and are more likely to represent typical *Eucalyptus marginata* – *Corymbia calophylla* forest or similar.

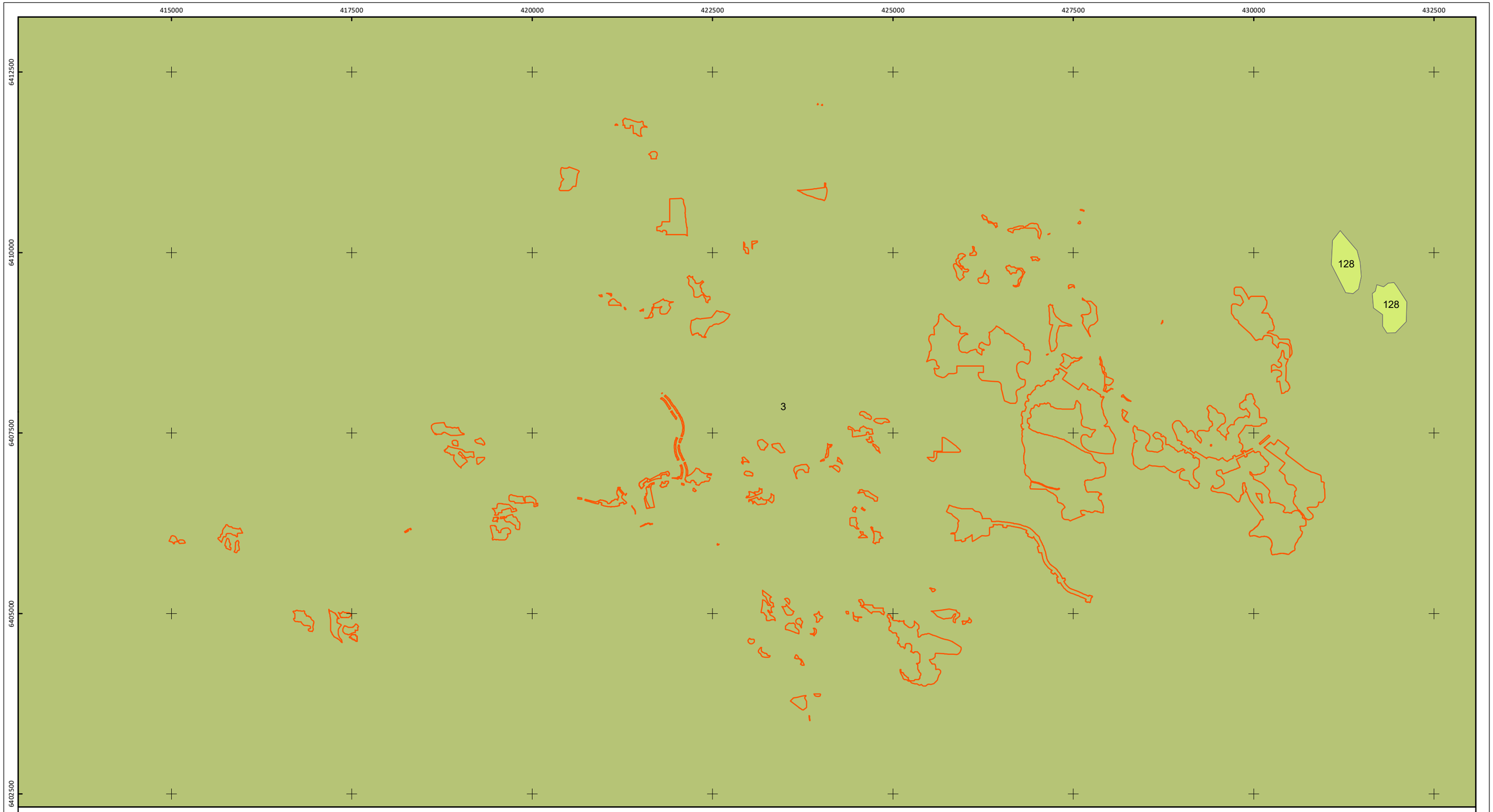
Table 6: Pre-European vegetation associations mapped with the survey area (Shepherd *et al.* 2002).

Association	Description	NVIS V	Extent within survey area (ha)	Percent of survey area
3	Medium forest; jarrah-marri	U *Eucalyptus marginata*,^*Corymbia calophylla*, *Allocasuarina fraseriana*\tree\7\c;M *Acacia urophylla*, *Bossiaea aquifolium*, *Hakea cyclocarpa*\shrub\4\i;G *Macrozamia riedlei*, *Styphelia tenuiflora*, *Lepidosperma angustatum*\cycad,forb,shrub,sedge\2\i	673.81	100.00

Table 7: Myara vegetation association mapped with the survey area (Mattiske 2022).

Code	Description	Extent within survey area (ha)	Percent of survey area
A	Tall shrubland of *Melaleuca lateritia*, *Hakea varia*, *Melaleuca viminea* and *Melaleuca incana* subsp. *incana* on clay-loams in seasonally wet valley floors.	1.37	0.2
AC	Open Woodland of *Eucalyptus rudis – Melaleuca preissiana – Eucalyptus patens - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on broad swamps and water-courses.	1.15	0.17
CL	Cleared	1.14	0.17
CW	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	3.24	0.48
D	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Hakea prostrata* on lower slopes with mixed low understorey species, including *Babingtonia camphorosmae* and *Acacia extensa* on clay loams to gravelly clay-loams.	5.35	0.8
DG	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha*, *Macrozamia riedlei*, *Pericalymma ellipticum*, *Grevillea bipinnatifida*, *Allocasuarina humilis*, *Acacia alata*, *Babingtonia camphorosmae*, *Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes with localized patches of outcropping.	0	0
E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona*, *Kingia australis*, *Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.	17.14	2.54
G	Mosaic of Open Woodland of *Eucalyptus marginata – Corymbia calophylla* on the fringes of outcrops ranging to open heath communities of Proteaceae-Myrtaceae species and lithic complexes on the outcrop areas.	0.2	0.03
G1	Mosaic of Open Woodland of *Eucalyptus marginata – Corymbia calophylla* on the fringes of outcrops ranging to open heath communities of Proteaceae-Myrtaceae species and lithic complexes on the outcrop areas.	0.92	0.14
P	Open Forest of *Allocasuarina fraseriana – Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger*, *Styphelia nitens*, *Grevillea wilsonii*, *Leucopogon capitellatus* on sandy gravels.	55.4	8.22

Code	Description	Extent within survey area (ha)	Percent of survey area
PS	Open Forest of *Allocasuarina fraseriana – Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger*, *Leucopogon capitellatus* on gravels and sandy gravels.	175.83	26.1
PT	Open Forest of *Allocasuarina fraseriana – Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger*, *Leucopogon verticillatus*, *Pteridium esculentum* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravels.	5.75	0.85
PW	Open Forest of *Allocasuarina fraseriana – Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii*, *Adenanthos barbiger*, *Babingtonia camphorosmae* and *Hypocalymma angustifolium* on sandy gravels.	92.34	13.7
R	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* on fringes of granite outcrops or shallow soils over mixed understorey species reflecting shallow soils over granite.	4.69	0.7
Rehab	Rehabilitation Areas	0.08	0.01
S	Open Forest of *Eucalyptus marginata - Banksia grandis – Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger*, *Leucopogon capitellatus* and *Styphelia tenuiflora* on gravels and sandy gravels.	213.26	31.65
SP	Open Forest of *Allocasuarina fraseriana – Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger*, *Grevillea wilsonii* and *Leucopogon capitellatus* on sandy-gravels to gravelly soils.	38.89	5.77
ST	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon capitellatus*, *Leucopogon verticillatus*, *Pteridium esculentum*, *Lasiopetalum floribundum* and *Styphelia tenuiflora* on sandy-gravelly soils.	6.04	0.9
SW	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Adenanthos barbiger*,	12.26	1.82
T	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	16.78	2.49
TS	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus*, *Pteridium esculentum*, *Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.	18.17	2.7
W	Open Forest of *Eucalyptus megacarpa - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Acacia extensa* and *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.	3.81	0.56
Total		673.81	100



Survey area

Vegetation association

3: Medium forest; jarrah-marri

128: Bare areas; rock outcrops

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Map 5: Pre-European vegetation associations (Shepherd et al. 2002).

Service Layer Credits:

0 0.5 1 2 3
Kilometers

415000 417500 420000 422500 425000 427500 430000 432500

6412500 6410000 6407500 6405000 6402500

Survey area

Granite
- G
- G1

Creeks
- AC
- CW

Hills/flats/valleys
- A
- C
- D
- DA
- DAM
- DG
- E
- P
- PG
- PS
- PT
- PW
- Q
- R
- S
- SP
- ST
- SW
- T
- TP
- TS
- W

Cleared/rehab
- CL
- CL_Other
- Rehab

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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:50,000 @A3

Map 6: Vegetation associations mapped by Mattiske (2022).

Service Layer Credits:

0 0.5 1 2 3
Kilometers

2.8 FLORA

2.8.1 Significant Species

DBCA database searches identified 58 significant plant taxa within 20 km of the survey area (excluding records from the Swan Coastal Plain), including six Threatened taxa, six Priority 1 taxa, six Priority 2 taxa, 22 Priority 3 taxa, and 18 Priority 4 taxa (Appendix A, Map 7, Map 8).

Based on the proximity of previous records and the potential presence of suitable habitat, 29 taxa were assessed as potentially occurring within the survey area ('High' and 'Moderate' ratings) (Appendix A). Taxa were considered unlikely to occur ('Low' rating) within the survey area if suitable habitat was considered unlikely to be present. These include taxa confined to granite outcrops, of which only 1.02 ha has been mapped within the survey area. Twenty-nine taxa were assessed with a 'Low' likelihood of occurrence (Appendix A).

The optimal targeted search period for most 'High' and 'Moderate' taxa is from approximately August to December, during their cited flowering periods, when they are likely to be most visible. However, while flowering material would be required to confidently identify many of these taxa, non-flowering material is likely to be suitable for identifying material at least tentatively. Therefore, spring surveys (September to November) are preferable for detecting all these species, regardless of flowering period.

2.8.2 Introduced Species

A search of the Atlas of Living Australia database (ALA 2023) identified eighty-five introduced plant species within 20 km of the survey area (Table 8). *Rubus anglocandicans* (part of the *Rubus fruticosus* aggregate) is a Weed of National Significance (WONS) (DAWR 2017). Two species (*Gomphocarpus fruticosus* and *Rubus anglocandicans*) are Declared Pests according to the BAM Act and listed on the WAOL (DPIRD 2007–). Six species have high ecological impact rating and rapid invasiveness rating according to the Weed Prioritisation Process for the region (*Avena barbata, Bromus diandrus, Bromus hordeaceus, Centranthus macrosiphon, Chamaecytisus palmensis,* and *Pittosporum undulatum*).

Table 8: Introduced plant species recorded within 20 km of the survey area including BAM Act status and Weed Prioritisation Process rating.

Species	Common name	BAM Act status and WONS	Ecological impact	Invasiveness
Acacia baileyana	Cootamundra wattle	Permitted - s11	Low	Slow
Acacia decurrens	Black wattle	Permitted - s11	Low	Slow
Acacia iteaphylla	Flinders range wattle	Permitted - s11	Unknown	Rapid
Acacia longifolia	Sydney golden wattle	Permitted - s11	Unknown	Moderate
Acacia podalyriifolia	Queensland silver wattle	Permitted - s11	Low	Slow
Acaena echinata	Sheep's burr	Permitted - s11	Unknown	Unknown
Aira caryophyllea	Silvery hairgrass	Permitted - s11	Unknown	Rapid
Aira cupaniana	Hairgrass	Permitted - s11	Unknown	Rapid
Allium neapolitanum	Naples onion	Permitted - s11	Unknown	Unknown
Arctotheca calendula	Capeweed, cape weed	Permitted - s11	Moderate	Moderate
Aristida ramosa	Purple wiregrass	Permitted - s11	Unknown	Unknown
Avena barbata	Bearded oat	Permitted - s11	High	Rapid
Bellardia trixago	Bartsia	Permitted - s11	Unknown	Rapid
Bellardia viscosa	Yellow glandweed	Permitted - s11	Unknown	Unknown
Brachypodium distachyon	False brome	Permitted - s11	Unknown	Unknown
Briza maxima	Blowfly grass	Permitted - s11	Unknown	Rapid
Briza minor	Shivery grass	Permitted - s11	Unknown	
Bromus diandrus	Great brome	Permitted - s11	High	Rapid
Bromus hordeaceus	Soft brome	Permitted - s11	High	Rapid
Buddleja madagascariensis	Smokebush or Madagascan butterfly bush	Permitted - s11	Unknown	Unknown
Cannabis sativa	Hemp	Permitted, Requires Permit - r73	Unknown	Unknown
Centaurium erythraea	Centaury, common centaury	Permitted - s11	Unknown	Rapid
Centranthus macrosiphon	Pretty Betsy	Permitted - s11	High	Rapid
Chamaecytisus palmensis	Tree lucerne, tagasaste	Permitted - s11	High	Rapid
Chasmanthe floribunda	African cornflag	Permitted - s11	High	Slow
Cicendia filiformis	Cicendia, slender cicendia	Permitted - s11	Low	Rapid
Cotula coronopifolia	Waterbuttons	Permitted - s11	Unknown	Rapid
Cotula turbinata	Funnel weed	Permitted - s11	Unknown	Rapid
Cyathea cooperi	Rough tree fern	Permitted - s11	Moderate	Rapid
Cyperus brevifolius	Mullumbimby couch, kyllinga weed	Permitted - s11	High	Moderate
Cyperus tenellus	Tiny flat sedge, tiny flatsedge	Permitted - s11	Unknown	Rapid
Digitaria sanguinalis	Crabgrass, crab grass	Permitted - s11	Low	Rapid
Disa bracteata	South African orchid	Permitted - s11	Unknown	Rapid
Ehrharta longiflora	Annual veldtgrass, annual veldt grass	Permitted - s11	Unknown	Rapid
Erigeron sumatrensis	Tall fleabane	Permitted - s11	Unknown	Unknown
Fumaria capreolata	Climbing fumitory, whiteflower fumitory	Permitted - s11	Moderate	Unknown
Galium divaricatum	Slender goosegrass	Permitted - s11	Low	Unknown

Species	Common name	BAM Act status and WONS	Ecological impact	Invasiveness
Gladiolus caryophyllaceus	Pink gladiolus	Permitted - s11	Unknown	Unknown
Glyceria declinata	Sweetgrass	Permitted - s11	Moderate	Rapid
Gomphocarpus fruticosus	Swan plant, narrowleaf cottonbush	Declared Pest - s22(2)	Unknown	Rapid
Gomphocarpus physocarpus	Balloon cottonbush	Permitted - s11	Unknown	Rapid
Hedera helix	Ivy	Permitted - s11	Low	Slow
Hypochaeris glabra	Flatweed, smooth catsear	Permitted - s11	Moderate	Rapid
Ixia polystachya	Variable ixia	Permitted - s11	Low	Moderate
Jacaranda mimosifolia	Blue jacaranda	Permitted - s11	Unknown	Unknown
Juncus articulatus	Jointed rush	Permitted - s11	Unknown	Unknown
Juncus bufonius	Toadrush, toad rush	Permitted - s11	Low	Rapid
Juncus capitatus	Capitate rush	Permitted - s11	Low	Rapid
Juncus microcephalus	Weedy rush	Permitted - s11	Low	Rapid
Lagurus ovatus	Hare's tail grass	Permitted - s11	Unknown	Moderate
Lathyrus tingitanus	Tangier pea	Permitted - s11	Low	Slow
Linum trigynum	French flax	Permitted - s11	Low	Unknown
Lolium perenne	Ryegrass	Permitted - s11	Moderate	Rapid
Lonicera japonica	Japanese honeysuckle	Permitted - s11	Unknown	Slow
Lotus angustissimus	Slender birdsfoot trefoil, narrowleaf trefoil	Permitted - s11	Unknown	Rapid
Lotus subbiflorus	Hairy birdsfoot trefoil	Permitted - s11	Unknown	Rapid
Lysimachia arvensis	Scarlet pimpernel, blue pimpernel	Permitted - s11	Unknown	Rapid
Moenchia erecta	Erect chickweed	Permitted - s11	Unknown	Unknown
Orobanche minor	Broom rape, lesser broomrape	Permitted - s11	Unknown	Rapid
Parentucellia latifolia	Red bartsia, common bartsia	Permitted - s11	Unknown	Rapid
Passiflora filamentosa	Passionflower	Permitted - s11	Low	Slow
Pentameris airoides	False hairgrass	Permitted - s11	Unknown	Unknown
Pittosporum undulatum	Sweet pittosporum	Permitted - s11	High	Rapid
Populus alba	White poplar	Permitted - s11	High	Slow
Prunus cerasifera	Cherry plum	Permitted - s11	Low	Slow
Romulea rosea	Guildford grass	Permitted - s11	High	Unknown
Rubus anglocandicans	European blackberry	Declared Pest - s22(2) (WONS)	High	Moderate
Rubus x loganobaccus	Loganberry	Permitted - s11	High	Moderate
Rumex acetosella	Red sorrel	Permitted - s11	Unknown	Unknown
Senecio diaschides	Shingle fireweed	Permitted - s11	Unknown	Unknown
Sonchus oleraceus	Common sowthistle	Permitted - s11	Moderate	Rapid
Symphyotrichum squamatum	Bushy starwort	Permitted - s11	Unknown	Rapid
Tolpis barbata	Tolpis, yellow hawkweed	Permitted - s11	Unknown	Rapid
Tribulus terrestris	Bindii	Permitted - s11	Unknown	Unknown
Trifolium campestre	Hop trefoil	Permitted - s11	Unknown	Unknown

Species	Common name	BAM Act status and WONS	Ecological impact	Invasiveness
Trifolium dubium	Suckling clover	Permitted - s11	Unknown	Unknown
Trifolium hirtum	Rose clover	Permitted - s11	Unknown	Unknown
Trifolium ligusticum	Ligurian clover	Permitted - s11	Unknown	Unknown
Tritonia gladiolaris	Tritonia, lined tritonia	Permitted - s11	Unknown	Unknown
Ursinia anthemoides	Ursinia	Permitted - s11	Unknown	Rapid
Vellereophyton dealbatum	White cudweed	Permitted - s11	Moderate	Rapid
Vinca major	Blue periwinkle	Permitted - s11	High	Slow
Viola odorata	Violet	Permitted - s11	Low	Slow
Vulpia bromoides	Squirrel's tail fescue, squirrel tail fescue	Permitted - s11	Unknown	Rapid
Vulpia myuros	Rat's-tail fescure	Permitted - s11	Unknown	Rapid
Ursinia anthemoides	Ursinia	Permitted - s11	Unknown	Rapid
Vellereophyton dealbatum	White cudweed	Permitted - s11	Moderate	Rapid
Vinca major	Blue periwinkle	Permitted - s11	High	Slow
Viola odorata	Violet	Permitted - s11	Low	Slow
Vulpia bromoides	Squirrel's tail fescue, squirrel tail fescue	Permitted - s11	Unknown	Rapid
Vulpia myuros	Rat's-tail fescure	Permitted - s11	Unknown	Rapid

Significant species

- T, *Andersonia* sp. Saxatilis
- T, *Anthocercis gracilis*
- T, *Grevillea flexuosa*
- T, *Grevillea thelemanniana*
- T, *Lasiopetalum pterocarpum*
- T, *Morelotia australiensis*
- P1, *Darwinia hortiorum*
- P1, *Hibbertia acrotoma*
- P1, *Hibbertia hortiorum*
- P1, *Paracaleana gracilicordata*
- P1, *Paracaleana granitica*
- P1, *Thysanotus formosus*
- P1, *Xanthoparmelia darlingensis*
- P1, *Xanthoparmelia sammyi*
- P2, *Banksia recurvistylis*
- P2, *Bossiaea modesta*
- P2, *Grevillea ornithopoda*
- P2, *Lepyrodia curvescens*
- P2, *Millotia tenuifolia* var. *laevis*
- P2, *Tetratheca phoenix*
- Survey area

400000 405000 410000 415000 420000 425000 430000 435000 440000 445000 450000

6430000 6425000 6420000 6415000 6410000 6405000 6400000 6395000 6390000 6385000

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Map 7: Significant plant species recorded within 20 km of the survey area (Threatened, Priority 1, and Priority 2).

0 2 4 8 12
Kilometers

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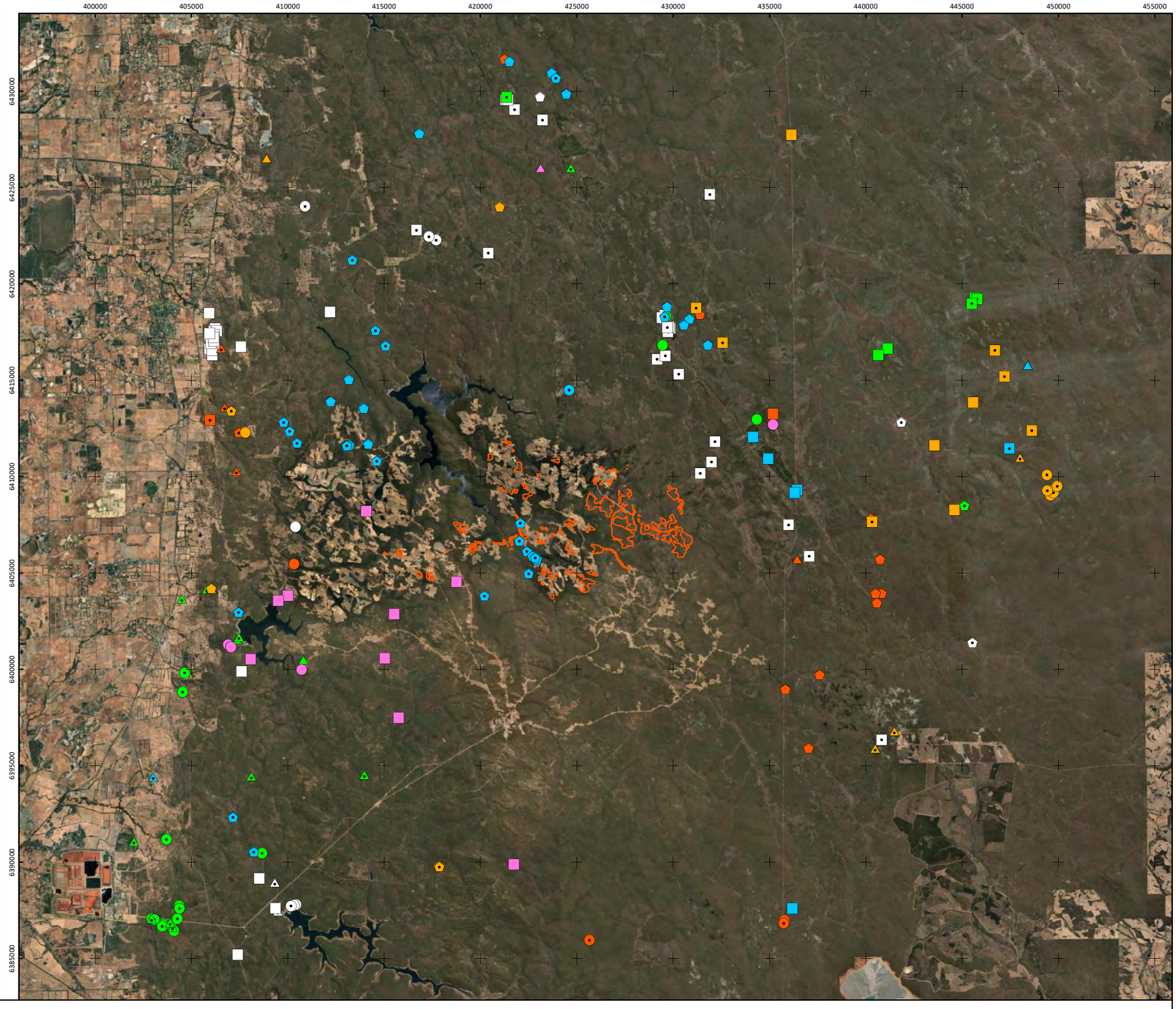
Significant species

- P3, *Acacia drummondii* subsp. *affinis*
- P3, *Acacia horridula*
- P3, *Acacia oncinophylla* subsp. *oncinophylla*
- P3, *Amanita fibrillopes*
- P3, *Amanita kalamundae*
- P3, *Andersonia* sp. Audax
- P3, *Boronia capitata* subsp. *gracilis*
- P3, *Byblis gigantea*
- P3, *Cyathochaeta teretifolia*
- P3, *Dicrastylis reticulata*
- P3, *Gastrolobium* sp. Asperum
- P3, *Grevillea dissectifolia*
- P3, *Hakea oldfieldii*
- P3, *Halgania corymbosa*
- P3, *Lasiopetalum glutinosum* subsp. *glutinosum*
- P3, *Lepyrodia heleocharoides*
- P3, *Meionectes tenuifolia*
- P3, *Petrophile filifolia* subsp. *laxa*
- P3, *Pithocarpa corymbulosa*
- P3, *Stackhousia* sp. Red-blotched corolla
- P3, *Stylidium marradongense*
- P3, *Synaphea pandurata*
- P3, *Tetratheca similis*
- P3, *Thysanotus anceps*
- P3, *Xanthoparmelia subimitatrix*
- P4, *Acacia cuneifolia*
- P4, *Acacia oncinophylla* subsp. *oncinophylla*
- P4, *Caladenia speciosa*
- P4, *Calothamnus graniticus* subsp. *leptophyllus*
- P4, *Chorizema ulotropis*
- P4, *Cyanothamnus tenuis*
- P4, *Darwinia thymoides* subsp. St Ronans
- P4, *Darwinia* sp. Dryandra
- P4, *Drosera occidentalis*
- P4, *Eucalyptus exilis*
- P4, *Grevillea pimeleoides*
- P4, *Hemigenia platyphylla*
- P4, *Lasiopetalum bracteatum*
- P4, *Parsonsia diaphanophleba*
- P4, *Pimelea rara*
- P4, *Senecio leucoglossus*
- P4, *Stylidium ireneae*
- P4, *Tripterococcus* sp. Brachylobus
- Survey area



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Projection: Transverse Mercator
Absolute Scale: 1:194,608 @A3

Map 8: Significant plant species recorded within 20 km of the survey area (Priority 3 and Priority 4).

0 2.25 4.5 9 13.5
Kilometers

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

3 METHODOLOGY

3.1 FIELD SURVEY TIMING

The targeted flora assessment of the survey area was conducted by four *ecologia* botanists over five separate field surveys in 2023, totalling 25 days: 28 August – 1 September; 4 – 8 September; 23 – 27 October; 20 -24 November; and 27 October – 1 December.

3.2 TARGETED FLORA SURVEY

Targeted searches for conservation significant plant species, Weeds of National Significance, and Declared Pests were conducted along systematic transects within the survey area. Transect were walked at approximately 20 m spacings, but 10 m infill spacings were done in some cases to record additional plants within detected populations. Approximately 673.81 ha of the Huntly mine area was surveyed in 2023 (Map 9). Specimens of all species that resembled potential significant species were collected for confirmation.

When significant or potentially significant species were observed the following information was recorded:

- GPS location.
- Number of plants (count, for individual or localised plants) or estimated number of plants for more extensive populations.
- Reproductive state.
- Reference collection and photograph of representative specimens.

3.3 SPECIMEN IDENTIFICATION

Specimen identification was undertaken by Dr Andrew Craigie with reference to current taxonomic literature and reference specimens. Scientific names used in this report follow the species concepts currently adopted by the Western Australian Herbarium.

3.4 STUDY TEAM AND LICENCES

The personnel undertaking this assessment and project roles are listed in Table 9.

3.5 LIMITATIONS AND CONSTRAINTS

An assessment of survey-specific issues and limitations is shown in Table 10.

Table 9: Project staff and licences.

Project staff				
Name	**Qualification**	**Role**	Project role	Experience
Shaun Grein	B.App. Sc (Biol.); Grad. Dip. Nat. Resources; MBA	Managing Director/Senior Principal Scientist	Project management, field survey, QA	30+
Andrew Craigie	B.Sc (Hons.) (Botany); PhD (Botany)	Principal Botanist and Taxonomist	Field survey, specimen identification, reporting	15+
Sam Hall	B.Sc. (Hons.) (Botany and Cons. Biol.)	Level 2 Botanist	Field survey	5+
Lydia Ellwood	B.Sc (Env. Mgmt. & Sust., Cons. & WildlifeBiol.)	Level 1 Botanist	Field survey	2+
Sandra Ng	B.Sc. (Cons. & WildlifeBiol., Marine Biol.)	Level 1 Botanist	Field survey, desktop assessment	1+
Licences				
Lydia Ellwood	Flora Taking (Biological Assessment) Licence: FB62000392 (exp. 06/02/2025); Authorisation to Take or Disturb Threatened Species: TFL 135-21221 (exp. 28/02/2025)			
Andrew Craigie	Flora Taking (Biological Assessment) Licence: FB62000135-2 (exp. 30/04/2025); Authorisation to Take Threatened Flora: TFL 54-1920 (exp. 30/4/2026)			
Shaun Grein	Flora Taking (Biological Assessment) Licence: FB62000085-2 (exp. 09/05/2026); Authorisation to Take or Disturb Threatened Species: TFL 55-1920 (exp. 15/12/2022)			
Sam Hall	Flora Taking (Biological Assessment) Licence: FB62000450 (exp. 3/07/2025)			
Sandra Ng	Flora Taking (Biological Assessment) Licence: FB62000543 (exp. 23/03/2026)			

Table 10: Flora and vegetation survey limitations.

Aspect	Assessment	Constraint
Availability of contextual information at a regional and local scale	Vegetation, land system, soil, and geology mapping, and significant species records, were available for the survey area. This information was adequate to provide appropriate contextual information for the survey.	Nil
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	Key personnel leading the field survey and undertaking specimen identification have extensive experience undertaking flora surveys in the South-West, including in the Jarrah Forest bioregion.	Nil
Proportion of flora recorded and/or collected, any identification issues	Representative specimens of all significant species and potentially significant species recorded in the field were collected for confirmation. There were no identification issues.	Nil
Was the appropriate area fully surveyed (effort and extent)	The survey area was sufficiently surveyed.	Nil
Access restrictions within the survey area	Although fires prevented access to parts of the survey area in 2023, the project is ongoing, and these areas will be surveyed in 2024.	Nil
Survey timing, rainfall, season of survey	The survey was undertaken primarily in spring 2023 (late August to early December), during the primary survey season for botanical surveys in the South-West botanical province. Conditions were dryer than average (mean winter rainfall for 2023 was approximately 35% lower than average), although rainfall in July, just prior to the first survey, was close to average. Lower winter rainfall may reduce the prevalence of ephemeral species, including perennial geophytes. However, there are no geophytic perennials (including orchids) considered likely to occur in the survey area, and of the two annual herbs considered 'likely' to occur within the survey area, *Senecio leucoglossus* was recorded at numerous locations and was often flowering. Consequently, the dryer than average conditions is not considered to be a significant limitation.	Nil
Disturbance that may have affected the results of survey such as fire, flood or clearing	No parts of the surveyed area were significantly disturbed or affected by recent fires.	Nil

4 RESULTS AND DISCUSSION

4.1 SIGNIFICANT SPECIES

Three DBCA listed Priority species were recorded within the survey area: *Tetratheca phoenix* (P2), *Senecio leucoglossus* (P4), and *Stylidium ireneae* (P4) (Table 11, Figure 2, Map 9).

Tetratheca phoenix (Elaeocarpaceae) (P2) was recorded from a localised area immediately east of Solus Road on mid-slopes and foot-slopes in brown sandy loam with laterite (Map 9). Approximately 151 individuals were recorded within the survey area, primarily from vegetation unit PW (Open Forest of *Allocasuarina fraseriana – Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii*, *Adenanthos barbiger*, *Babingtonia camphorosmae* and *Hypocalymma angustifolium* on sandy gravels) and within the Dwellingup subsystem (Table 11). *Tetratheca phoenix* has been recorded close to the survey area previously (Map 7) and it is likely to occur more widely outside the survey area in similar suitable habitat.

Senecio leucoglossus (Asteraceae) (P4) was recorded sporadically across the survey area, primarily on lateritic slopes, within six vegetation units of Mattiske (2022) (mostly *Eucalyptus marginata* and *Corymbia calophylla* forest/woodland), and primarily within the Dwellingup subsystem (Table 11). Individual plants were usually isolated, occurring as solitary or few plants at each location; twenty-nine individuals were recorded within the survey area . *Senecio leucoglossus* has been recorded close to the survey area previously (the previous closest records are ca. 6 km from the survey area), and it is likely to occur more widely outside the survey area in similar suitable habitat.

Stylidium ireneae (Stylidiaceae) (P4) was recorded from a single location within the survey area from a sandy loam bank of a small stream (approx. 10 individuals) (Map 9). A second group of approximately 20 plants was recorded opportunistically outside of the survey area. There are numerous records of this species just to the to the west of the survey area and is likely to occur more frequently outside of the survey area along creeks. This habitat is not common within the survey area.

The likelihood of occurrence of the remaining species identified during the desktop assessment was reassessed for the surveyed areas based on survey effort, the presence of suitable habitat, and vegetation condition (Appendix A). Seasonal conditions were suitable for detecting annual and ephemeral species, vegetation was mostly in 'Excellent' condition, and the areas surveyed had not been affected by recent fires. All areas were systematically surveyed at 20 m or 10 m intervals. Consequently, all species initially assessed with a 'High' or 'Moderate' likelihood of occurrence were reassessed as 'Low'.

Table 11: Summary of significant plant species recorded within the survey area and distribution within vegetation associations and land systems.

Name	Vegetation association (Mattiske 2022)								Total
	AC	**CL**	**E**	**PS**	**PW**	**S**	**T**	**TS**	
Tetratheca phoenix (P2)	-	-	17	20	114	-	-	-	151
Senecio leucoglossus (P4)	-	2	-	1	7	2	12	5	29
Stylidium ireneae (P4)	10	-	-	-	-	-	-	-	10

Name	Landform	Soil-landscape system				Total
		Cooke subsystem	Dwellingup subsystem	Murray subsystem	Yarragil subsystem	
Tetratheca phoenix (P2)	Midslopes, footslopes	1	150	-	-	151
Senecio leucoglossus (P4)	Slopes	4	18	3	4	29
Stylidium ireneae (P4)	Creek banks	-	-	10	-	10

4.2 INTRODUCED SPECIES

There were no Weeds of National Significance or Declared Pests recorded within the survey area.

4.3 ADDITIONAL AREAS – LIKELIHOOD OF OCCURRENCE ASSESSMENT

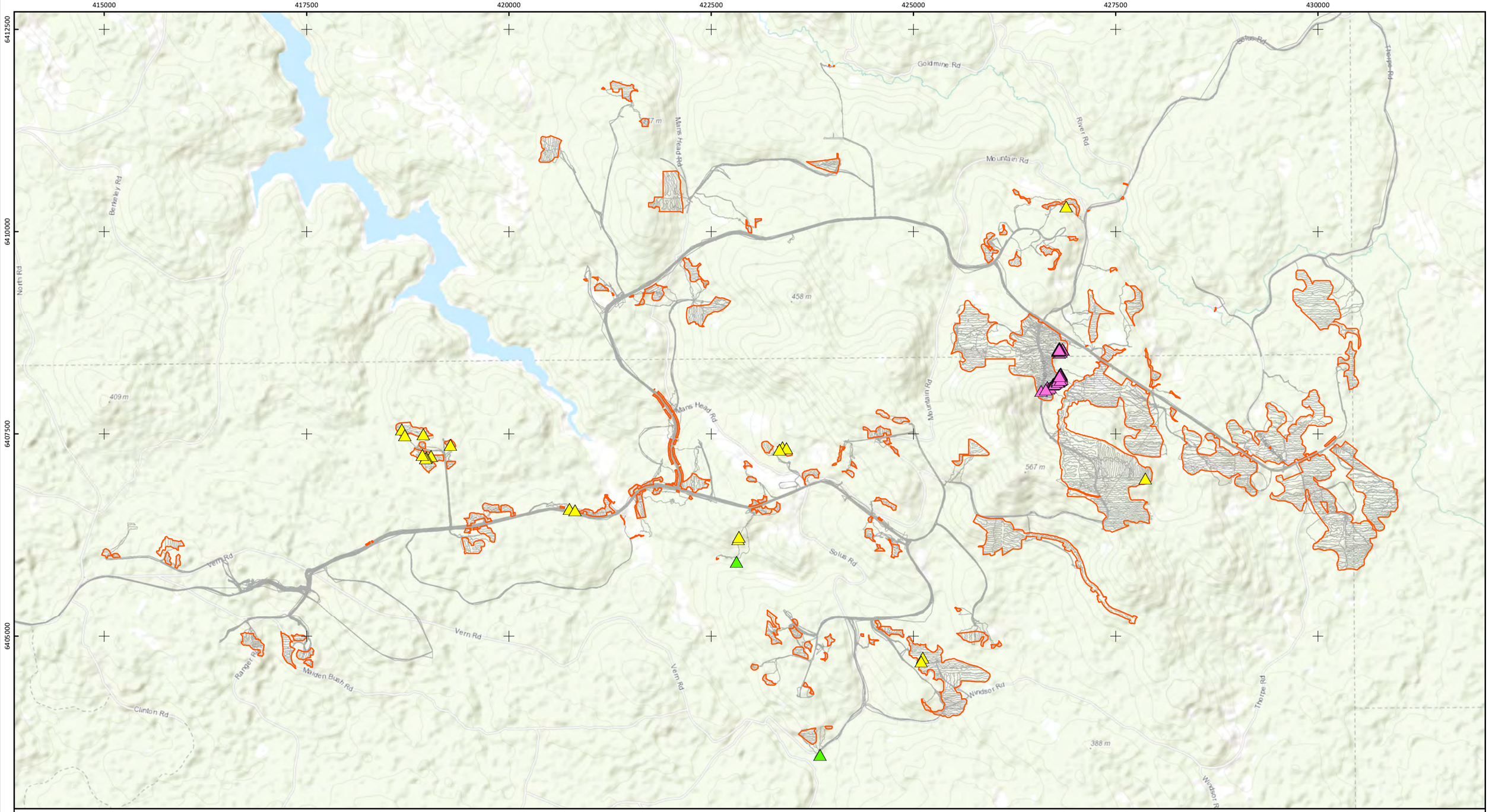
Spatial data for several additional areas were provided in February 2024 for a likelihood of occurrence assessment (Map 10). These areas are all immediately adjacent to areas that were surveyed in 2023. Many of these are of negligible size (<0.02 ha) and were therefore excluded from further assessment. Based on their proximity to significant species records from 2023 (within ca. 500 m), 18 areas that were individually greater than 0.02 ha potentially contain either *Senecio leucoglossus* or *Tetratheca phoenix* (Table 12). *Senecio leucoglossus* has already been recorded in one of these areas (E23_088). None of the areas are likely to support *Stylidium ireneae*, which is typically restricted to the banks of creeks.

Table 12: Likelihood of occurrence assessment for additional survey areas.

Asset name	Likelihood of occurrence	Area (ha)
B23_176a	*Senecio leucoglossus* - moderate	0.02
B23_176b	*Senecio leucoglossus* - moderate	0.02
B23_189	*Senecio leucoglossus* - moderate	0.02
B23_191a	*Senecio leucoglossus* - moderate	0.02
B23_191b	*Senecio leucoglossus* - moderate	0.04
B23_162	*Senecio leucoglossus* - moderate	0.11
E23_019	*Senecio leucoglossus* - moderate	0.12
B23_163a	*Senecio leucoglossus* - moderate	0.15
E23_059	*Senecio leucoglossus* - moderate	0.25
E23_123	*Senecio leucoglossus* - moderate	0.32
B23_163b	*Senecio leucoglossus* - moderate	0.37
E23_086	*Senecio leucoglossus* - moderate	0.48
E23_017	*Senecio leucoglossus* - moderate	0.49
E23_089	*Senecio leucoglossus* - moderate	0.52
E23_040	*Senecio leucoglossus* - moderate	0.58
E23_016	*Senecio leucoglossus* - moderate	0.74
E23_088	*Senecio leucoglossus* - moderate	0.98
E23_074	*Tetratheca phoenix* - moderate	0.43

Figure 2: Photographs of significant species recorded within the survey area.

Top left, *Tetratheca phoenix* (P2); top right, *Senecio leucoglossus* (P4); bottom left, *Stylidium ireneae* (P4).



Targeted survey GPS track log

Survey area

Species

- *Senecio leucoglossus* (P4)
- *Stylidium ireneae* (P4)
- *Tetratheca phoenix* (P2)

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Project No.: 1979
Date: 6 February 2024
Author: AC
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:45,000 @A3

Map 9: Locations of significant plant species recorded within the survey area.

0 0.5 1 2 3
Kilometers

415000 420000 425000 430000

6410000

6405000

North Rd Berkeley Rd Mans Head Rd Goldmine Rd River Rd Solus Rd Thorpe Rd Mountain Rd Vern Rd Ranger Rd Maiden Bush Rd Clinton Rd Windsor Rd

409 m 458 m 567 m 388 m

E23_089 E23_088 E23_086 E23_074a

B23_191a B23_191b B23_189 B23_176b B23_176a

B23_163b B23_162 B23_163a

E23_059 E23_040 E23_059 E23_017 E23_017 E23_123 E23_123 E23_123

Survey area

Significant species

- *Senecio leucoglossus*
- *Stylidium ireneae*
- *Tetratheca phoenix*
- Signficant species 500 m buffer

Additional areas - likelihood of signficant species occurrence

- Low
- *Senecio leucoglossus* - moderate
- *Tetratheca phoenix* - moderate

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Project No.: 1979
Date: 8 February 2024
Author: AC
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:45,000 @A3

Map 10: Additional areas - likelihood of occurrence assessment.

0 0.4 0.8 1.6 2.4
Kilometers

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6 APPENDICES

Appendix A Likelihood of Occurrence Assessment.

Taxon	WA status	Habitat	Approximate flowering period	Growth form	Records in close vicinity of survey area (5 km)	**Desktop assessment**	Desktop likelihood of occurrence	Post-survey likelihood of occurrence[1]
Acacia drummondii subsp. *affinis*	P3	Lateritic gravelly soils.	------JA----	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Acacia oncinophylla subsp. *patulifolia*	P4	Granitic soils, occasionally on laterite.	-------ASOND	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Cyanothamnus tenuis	P4	Gritty brown sandy clay over granite. Creeks, slopes.	-------ASON-	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Grevillea pimeleoides	P4	Gravelly soils over granite. Valleys, hillsides.	----MJJASON-	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Hemigenia platyphylla	P4	Sandy & loamy soils. Slopes.	--------SON-	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Hibbertia hortiorum	P1	Jarrah–marri forests over laterite.	--------SO--	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Lasiopetalum pterocarpum	T	On sloping banks near creeks.	-------ASOND	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Morelotia australiensis	T	Flat. Light brown sand clay loam.	----------D	Perennial herb	YES	Suitable habitat possibly present.	HIGH	LOW
Pimelea rara	P4	Lateritic soils.	J----------D	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	LOW
Senecio leucoglossus	P4	Gravelly lateritic or granitic soils. Granite slopes.	-------ASOND	Annual herb	YES	Suitable habitat possibly present.	HIGH	RECORDED
Stylidium ireneae	P4	Sandy loam. Valleys near creeks.	---------OND	Perennial herb	YES	Suitable habitat possibly present.	HIGH	RECORDED
Tetratheca phoenix	P2	Brown gravelly loam over granite. Mid-upper slopes.	--------SOND	Perennial shrub	YES	Suitable habitat possibly present.	HIGH	RECORDED
Acacia horridula	P3	Gravelly soils over granite, sand. Rocky hillsides.	----MJJA----	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Bossiaea modesta	P2	Soils derived from granite. Damp areas close to streams.	---------OND	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Calothamnus graniticus subsp. *leptophyllus*	P4	Clay over granite, lateritic soils. Hillsides.	-----JJA----	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Chorizema ulotropis	P4	White sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats.	------JAS---	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Gastrolobium sp. Asperum (F. Hort 2864)	P3	Slope, flat. Dry, brown loam, gravel over laterite.	--------S---	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Grevillea dissectifolia	P3	Sand/loam and laterite along creeks and road verges.	-----J--S-N-	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Grevillea flexuosa	T	Red-brown sand with laterite & gravel, sand over granite. Ridgetops, breakaways.	------JASO--	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Halgania corymbosa	P3	Gravelly soils, soils over granite.	-------ASON-	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Lasiopetalum bracteatum	P4	Sandy clay, clay, lateritic gravel. Along drainage lines, creeks, gullies, granite outcrops.	J------ASOND	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Millotia tenuifolia var. *laevis*	P2	Granite or laterite soils.	--------SO--	Annual herb		Suitable habitat possibly present.	MODERATE	LOW
Petrophile filifolia subsp. *laxa*	P3	Winter-wet sites, flats, slopes, swamps, drainage lines.	J---------ND	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Stackhousia sp. Red-blotched corolla (A. Markey 911)	P3	Light grey gritty clay, with surface granitic cobbles, on a gentle southern upper slope.	-----JJAS---	Perennial herb		Suitable habitat possibly present.	MODERATE	LOW
Stylidium marradongense	P3	Sand over laterite. Jarrah-Marri forest.	--------SON-	Perennial herb		Suitable habitat possibly present.	MODERATE	LOW
Synaphea pandurata	P3	Yellowish sands and sandy loams, dark brown loam, laterite gravel, granite.	--------SOND	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Tetratheca similis	P3	Sandy clay with lateritic boulders.	-------AS---	Perennial shrub		Suitable habitat possibly present.	MODERATE	LOW
Thysanotus anceps	P3	White or grey sand, lateritic gravel, laterite.	---------OND	Perennial herb		Suitable habitat possibly present.	MODERATE	LOW
Thysanotus formosus	P1	Clayey sand, sandy loam.	J---------ND	Perennial herb		Suitable habitat possibly present.	MODERATE	LOW
Acacia cuneifolia	P4	Sand, clay or loam over granite. Granite outcrops.	------JASO--	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW
Acacia oncinophylla subsp. *oncinophylla*	P3	Fringing granite outcrops.	-------ASO--	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW
Andersonia sp. Audax (F. Hort, B. Hort …)	P3	Granitic heath. Granite outcrops.	J--------OND	Perennial shrub	YES	Suitable habitat unlikely to be present.	LOW	LOW
Andersonia sp. Saxatilis (F. & J. Hort 3324)	T	Granitic heath. Granite outcrops.	--------SO--	Perennial shrub	YES	Suitable habitat unlikely to be present.	LOW	LOW
Anthocercis gracilis	T	Sandy or loamy soils. Granite outcrops.	--------SO--	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW
Banksia recurvistylis	P2	Granite outcrops.	----------N-	Perennial shrub	YES	Suitable habitat unlikely to be present.	LOW	LOW
Boronia capitata subsp. *gracilis*	P3	White/grey or black sand. Winter-wet swamps, hillslopes.	-----JJASON-	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW
Byblis gigantea	P3	Sandy-peat swamps.	J-------SOND	Perennial herb		Suitable habitat unlikely to be present.	LOW	LOW
Caladenia speciosa	P4	White, grey or black sand. Sandplains.	--------SO--	Perennial herb		Suitable habitat unlikely to be present.	LOW	LOW
Cyathochaeta teretifolia	P3	Grey sand, sandy clay. Swamps, creeks.	UNKNOWN	Perennial herb	YES	Suitable habitat unlikely to be present.	LOW	LOW
Darwinia hortiorum	P1	Brown loam/clay/gravel laterite. Granite outcrops.	-------ASON-	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW
Darwinia sp. Dryandra (G.J. Keighery 9295)	P4	Lateritic outcrops.	----M-J---N-	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW
Darwinia thymoides subsp. St Ronans	P4	Sandy or gravelly clay-loam soils. Slopes and Flats. Granite outcrops.	J---------N-	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW
Dicrastylis reticulata	P3	Granite outcrops, heath.	--------SOND	Perennial shrub		Suitable habitat unlikely to be present.	LOW	LOW

Taxon	WA status	Habitat	Approximate flowering period	Growth form	Records in close vicinity of survey area (5 km)	**Desktop assessment**	Desktop likelihood of occurrence	Post-survey likelihood of occurrence[1]
Drosera occidentalis	P4	White-yellow sand, clayey soils. Swamps, seasonally wet depressions and slopes.	J--------OND	Perennial herb	YES	Suitable habitat unlikely to be present.	**LOW**	**LOW**
Eucalyptus exilis	P4	Grey sand, gravelly loam. Lateritic ridges.	-------ASO--	Perennial shrub		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Grevillea ornithopoda	P2	Riverbanks. Primarily Swan Coastal Plain.	--------SOND	Perennial shrub		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Grevillea thelemanniana	T	Sand, sandy clay. Winter-wet low-lying flats.	----MJJASON-	Perennial shrub		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Hakea oldfieldii	P3	Red clay or sand over laterite. Seasonally wet flats.	-------ASO--	Perennial shrub		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Hibbertia acrotoma	P1	Brown loam. Granite outcrops.	-------AS---	Perennial shrub		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Lasiopetalum glutinosum subsp. *glutinosum*	P3	Granite outcrops and creeks.	--------SOND	Perennial shrub	YES	Suitable habitat unlikely to be present.	**LOW**	**LOW**
Lepyrodia curvescens	P2	Wetlands and swamps.	--------SON-	Perennial herb		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Lepyrodia heleocharoides	P3	Moist peaty sand. Wetlands and swamps.	----------D	Perennial herb	YES	Suitable habitat unlikely to be present.	**LOW**	**LOW**
Meionectes tenuifolia	P3	Sand or clay. Wetlands and swamps.	--------SOND	Annual herb	YES	Suitable habitat unlikely to be present.	**LOW**	**LOW**
Paracaleana gracilicordata	P1	Moss mats on granite outcrops.	---------ON-	Perennial herb	YES	Suitable habitat unlikely to be present.	**LOW**	**LOW**
Paracaleana granitica	P1	Moss mats on granite outcrops.	---------OND	Perennial herb	YES	Suitable habitat unlikely to be present.	**LOW**	**LOW**
Parsonsia diaphanophleba	P4	Alluvial soils. Along rivers.	JF-AMJ--S---	Perennial climber		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Pithocarpa corymbulosa	P3	Gravely or sandy loam. Granite outcrops.	JFMA--------	Perennial herb		Suitable habitat unlikely to be present.	**LOW**	**LOW**
Tripterococcus sp. Brachylobus (A.S. George 14234)	P4	Grey, black, or peaty sand. Winter-wet flats.	---------ON-	Perennial herb		Suitable habitat unlikely to be present.	**LOW**	**LOW**

[1]Post-survey likelihood of occurrence rating is for surveyed areas only.