FLORA & VEGETATION ASSESSMENT

ALCOA WAGERUP FARMLANDS

Prepared By

Mattiske Consulting Pty Ltd

Prepared For

Alcoa of Australia Limited

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Mattiske Consulting Pty Ltd

(ACN 063 507 175, ABN 39 063 507 175)

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LIST OF ABBREVIATIONS

Alcoa	Alcoa of Australia Limited
ANOSIM:	Analysis of similarity
BAM Act:	*Biosecurity and Agriculture Management Act 2007* (WA)
BC Act:	*Biodiversity Conservation Act 2016* (WA)
BOM:	Bureau of Meteorology
CLUSTER:	Hierarchical clustering
DotEE:	Department of the Environment and Energy
DAWE	Department of Agriculture, Water and the Environment
DBCA:	Department of Biodiversity, Conservation and Attractions
DWER:	Department of Water and Environmental Regulation
DPIRD:	Department of Primary Industries and Regional Development (includes Agriculture and Food)
EP Act:	*Environmental Protection Act 1986* (WA)
EPA:	Environmental Protection Authority
EPBC Act:	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ESCAVI:	Executive Steering Committee for Australian Vegetation Information
IBRA:	Interim Biogeographical Regionalisation for Australia
Mattiske Consulting	Mattiske Consulting Pty Ltd
NVIS:	Native Vegetation Information System
PEC:	Priority ecological community
PRIMER:	Plymouth Routines in Multivariate Ecological Research
SIMPER:	Similarity percentages
SIMPROF:	Similarity profile
TEC:	Threatened ecological community
TSSC:	Threatened Species Scientific Committee
WAH:	Western Australian Herbarium (PERTH)
WAOL:	Western Australian Organism List
WC Act:	*Wildlife Conservation Act 1950* (WA) (superseded by BC Act as of 01 January 2019)

EXECUTIVE SUMMARY

Alcoa of Australia Limited (Alcoa) processes bauxite ore at its Wagerup Refinery. Alcoa proposes to expand its existing Wagerup Refinery Residue Storage Areas (RSA) into the adjacent Alcoa Farmland and remnant vegetation corridors. Mattiske Consulting Pty Ltd was commissioned in November 2021 by Alcoa to update and expand historical flora and vegetation surveys of the Wagerup Farmlands.

A total of 107 vascular plant taxa, representative of 63 genera and 35 families, were recorded within the survey area. The majority of taxa recorded were representative of the Poaceae (24 taxa), Myrtaceae (18 taxa) and Fabaceae (11 taxa) families.

A total of 59 introduced (weed) species were recorded within the survey area many of which are short lived annuals and form part of the farmland pasture. Two of these are declared pest organisms pursuant and should be controlled: **Gomphocarpus fruticosus* and **Zantedeschia aethiopica.*

No threatened or priority flora species were recorded within the survey area.

Two Threatened Ecological Communities (TECs) were recorded within the Alcoa Farmlands represented by the M2 and M3 vegetation communities, the *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain and *Corymbia calophylla* - *Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain TECs, respectively.

Broadly, the vegetation within the survey area can be described as cleared paddocks with pasture species intersected by remnant corridors of *Corymbia calophylla, Eucalyptus marginata, Melaleuca rhaphiophylla* and *Melaleuca preissiana* woodlands, and planted **Eucalyptus camaldulensis* and **Eucalyptus botryoides* corridors.

1. INTRODUCTION

Alcoa of Australia Limited (Alcoa) processes bauxite ore at its Wagerup Refinery. Alcoa proposes to expand its existing Wagerup Refinery Residue Storage Areas (RSA) into the adjacent Alcoa Farmland and remnant vegetation corridors. Mattiske Consulting Pty Ltd (Mattiske Consulting) was commissioned in November 2021 by Alcoa to update and expand historical flora and vegetation surveys of the Wagerup Farmlands.

1.1. Location and Scope of Project

Alcoa's Wagerup refinery is located approximately eight km south of Waroona (Figure 1) on the Swan Coastal Plain, adjacent to the Willowdale and Arundel Operations on the Darling Plateau. Surrounding the Wagerup Refinery, Alcoa owns and operates farmlands (survey area). Mattiske Consulting was commissioned to update and expand historical flora and vegetation mapping, and compare changes in vegetation between this survey and historical vegetation mapping (Mattiske Consulting 2011). Alcoa supplied Mattiske Consulting with shapefiles of the survey area boundary and activity notice area (impact area) in July 2021, to define the survey area.

Native vegetation in the Wagerup area is represented primarily by remnant corridors, between 5m and 30m wide. Buller Nature Reserve is located approximately 1.3 km west of the survey area, and represents some of the most intact Swan Coastal Plain vegetation in the area.

1.2. Environmental Legislation and Guidelines

The following key Commonwealth (federal) legislation relevant to this survey is the:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

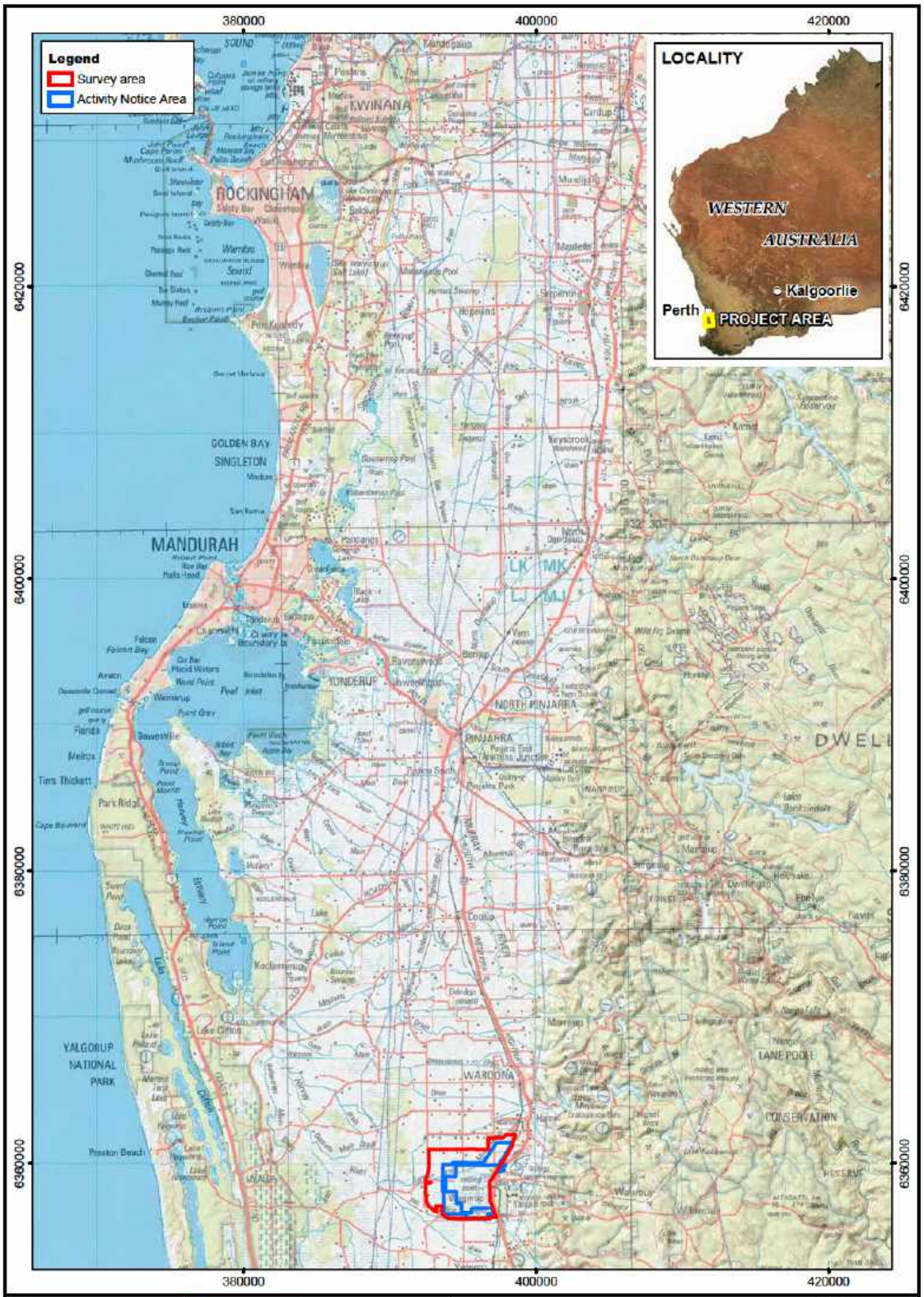
The following key Western Australian (state) legislation relevant to this survey include the:

- *Biodiversity Conservation Act 2016* (BC Act);
- *Biosecurity and Agriculture Management Act 2007* (BAM Act);
- *Environmental Protection Act 1986* (EP Act); and
- *Environmental Protection (Environmentally Sensitive Areas) Notice 2005.*

Furthermore, key Western Australian guidelines relevant to this survey are the:

- *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority [EPA] 2016a); and
- *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b).

Definitions of flora and vegetation terminology commonly used throughout this report are provided in Appendix A1-4.



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Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 – Tel: 9257 1629 – Fax: 9257 1640

Author: E M Mattiske | MCPL Ref: ALC2103/28/21

Drawn: CAD Resources – www.cadresources.com.au
Tel: (08) 9246 3242 – Fax (08) 9246 3202

Alcoa Wagerup Farmlands
Flora and Vegetation

Figure:

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2. BACKGROUND

2.1. Regional Context

The survey area lies on the eastern edge of the Swan Coastal Plain (IBRA), where a belt of heavier alluvial soil constituting the Pinjarra Plain unit occurs (Beard 1990). The survey area lies within the Pinjarra and Bassendean system (Beard 1990), and the Guildford, Forrestfield, and Darling Scarp complexes (Heddle *et al.* 1980).

2.2. Climate

The survey area lies at the southern end of the Northern Jarrah Forest IBRA subregion (DAWE 2021). Beard (1990) described the climate of this area as being warm Mediterranean, with rainfall of 600 – 1200 mm per annum and 5 – 6 dry months per year.

Wagerup Refinery is the closest active Bureau of Meteorology (BOM) station monitoring rainfall and receives mean annual rainfall of 844.4 mm. Dwellingup is the closest active Bureau of Meteorology (BOM) station monitoring temperature. Rainfall and temperature data for these weather stations are illustrated in Figure 2. Rainfall in the three months preceding the November 2021 survey was 114% of the long-term average rainfall for the corresponding period (BoM 2022).

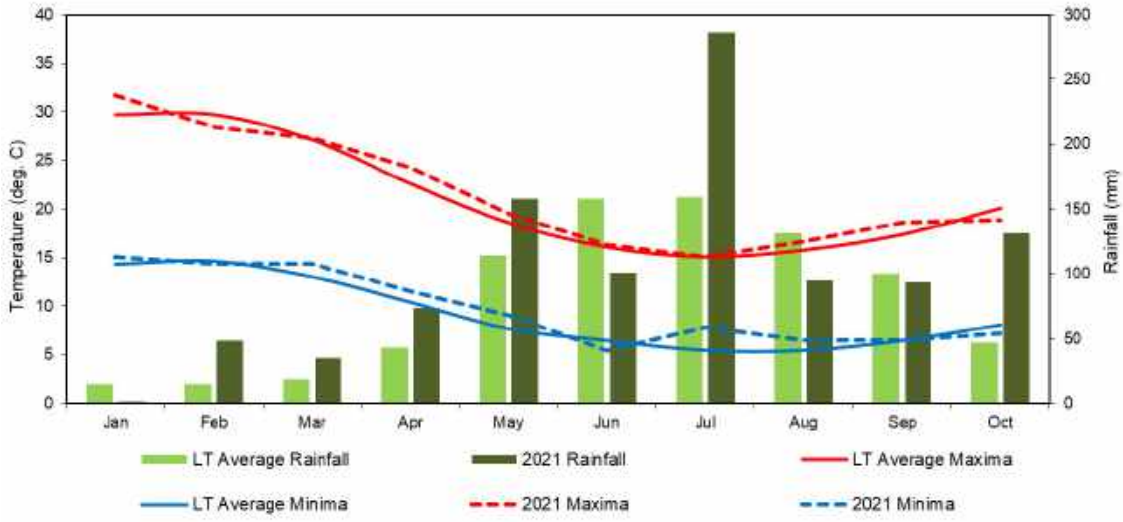


Figure 2: Rainfall data for Wagerup Refinery (Station No. 9894) and Temperature Data for Dwellingup (Station No. 9538)
Note: Minima and maxima refer to mean monthly maximum and minimum temperatures, respectively.

2.3. Geology, Soils and Topography

The Swan Coastal Plain comprises five major geomorphological systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward and McArthur 1980; Gibson et al. 1994). Each major system is composed of further subdivisions in the form of detailed geomorphological units (Churchward and McArthur 1980 and Gibson et al. 1994).

The Wagerup Refinery area is situated on the Pinjarra Plain geomorphic system. The Pinjarra Plain is an alluvial plain, the older layers of which have been laterised and stripped and generally consist of a sandy surface over a poorly structured sub soil clay (Beard 1981).

The Wagerup farmlands includes three main landform and soil units as defined and mapped by Churchward and McArthur (1980):

- Guildford - "Flat plain with medium textured deposits; yellow duplex soils".
- Forrestfield - "Laterised foothills of the Darling Scarp dominated by gravelly and sandy soils".
- Darling Scarp - "Very steep slopes with shallow red and yellow earths and much rock outcrop".

2.4. Regional Vegetation

The Wagerup Refinery and associated RSA areas were established on former farmlands and as such lies on the Drummond Botanical Sub-district of the South-west Botanical Province (Beard 1979, 1980 and 1990). The Drummond Botanical Subdistrict is characterised by low *Banksia* woodlands on leached sands, *Melaleuca* swamps on poorly drained depressions and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

Regional scale vegetation complex mapping by Heddle *et al*. (1980) indicates that vegetation within the Wagerup Refinery site is likely to belong to three broad vegetation complexes that occur on the underlying landform and soils units. A brief description of each vegetation complex is provided below:

- **Guildford**: Dominated by a mixture of an Open Forest, in sections a Tall Open Forest of *Corymbia calophylla* (Marri) – *Eucalyptus wandoo* (Wandoo) – *Eucalyptus marginata* (Jarrah) and Woodland of *Eucalyptus wandoo* (Wandoo).

- **Forrestfield**: Dominated by an Open Forest of *Corymbia calophylla* (Marri) – *Eucalyptus wandoo* (Wandoo) – *Eucalyptus marginata* subsp. *marginata* (Jarrah) on the heavier gravelly soils and of *Eucalyptus marginata* (Jarrah) – *Corymbia calophylla* (Marri) – *Allocasuarina fraseriana* (Sheoak) on sandier soils."

- **Darling Scarp**: Mosaic of Open Forest of *Eucalyptus marginata* (Jarrah) – *Corymbia calophylla* (Marri), with some admixtures with *Eucalyptus laeliae* in the north, with some *Eucalyptus marginata* (Jarrah) and *Corymbia haematoxylon* in the south on deeper soils adjacent to outcrops. Woodland of *Eucalyptus wandoo* (Wandoo), low woodland of *Allocasuarina huegeliana* (Rock Sheoak) on shallow soils over granite outcrops, closed heath of Myrtaceae – Proteaceae species and the lithic complex on or near granite outcrops in all climate zones.

Buller Nature Reserve (Class A) is located 1.3 km west of the survey area and represents some of the most intact native vegetation on the Swan Coastal Plain, in the region. Vegetation data specific to Buller Nature Reserve is not publicly available.

2.5. Previous Surveys

Mattiske Consulting have previously undertaken several flora and vegetation mapping and monitoring surveys associated with the Wagerup Refinery and adjacent Farmlands (Mattiske Consulting 2001, 2003, 2011, 2018). Most relevant to the current survey is the vegetation mapping undertaken by Mattiske Consulting (2011) within the current survey area, and vegetation mapping undertaken by Mattiske Consulting (2003) immediately to the east of the survey area.

Mattiske Consulting (2003) mapped vegetation to the east of the current survey, surrounding the Wagerup Refinery and rail loop. Eleven vegetation communities were delineated, four of which were 'Degraded' in condition (Keighery 1994) — this was represented by '(d)' in the vegetation community code. Two

vegetation communities, M2 (d) and M3 (d), represented the threatened ecological communities (TECs) *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain, and *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain, respectively. Mattiske Consulting (2003) identified 34 introduced species and no threatened or priority flora within the survey area.

Mattiske Consulting (2011) mapped vegetation in most parts of the northern half of the current survey area and delineated ten vegetation communities, two of which, M2 and M3, were identified as representing the same TECs as were recorded by Mattiske Consulting (2003) but in better condition. During the 2016 Yarloop fires, much of the vegetation mapped by Mattiske Consulting (2011) was burnt. Mattiske Consulting (2011) identified 45 introduced species and no threatened or priority species within their survey area.

Due to the close proximity of the Mattiske Consulting (2003) and Mattiske Consulting (2011) survey areas, the same vegetation mapping units were used to define the vegetation during the present survey.

3. OBJECTIVES

The objective of this survey was to undertake a flora and vegetation assessment of the Alcoa Wagerup Farmlands, more specifically:

- Undertake a desktop study of the flora and vegetation of the survey area, with an emphasis on threatened and priority flora, and threatened and priority ecological communities;
- Review the historical literature of the survey area and the broader area;
- Define and map the vegetation communities in the survey area;
- Define and map the location of any threatened and priority flora located within the survey area;
- Define any management issues related to flora and vegetation values;
- Provide recommendations on the local and regional significance of the vegetation communities; and
- Prepare a report summarising the findings.

4. METHODS

4.1. Desktop Assessment

A desktop assessment was conducted using FloraBase (WAH 1998-) and the Protected Matters Search Tool (PMST) Databases (DAWE 2022a) to identify the possible occurrence of threatened and priority flora and threatened and priority ecological communities within the survey area.

The PMST search parameters used were a 10 km radius 'by circle' centred on the coordinates - 32.905697, 115.880407. The 10km radius was used as the geomorphological and associated flora and vegetation values tend to narrower running north south on the Swan Coastal Plain. At the time of writing, the DBCA had discontinued the NatureMap database and it was not available for use in this desktop assessment.

In addition, historical documentation and vegetation mapping of the region, principally that of Mattiske Consulting (2001, 2003, 2011, 2018), and Heddle *et al.* (1980), that provide extensive resource material for the floristics and vegetation of the survey area, was reviewed.

4.2. Field Survey

A detailed field assessment of the flora and vegetation of the survey area was undertaken by two experienced botanists from Mattiske Consulting, for three field days between the 10th and 15th November 2021, in accordance with methods outlined in *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b). All botanists held valid collection licences to collect flora for scientific purposes, issued under the BC Act.

A shapefile defining the survey area and impact area were supplied by Alcoa prior to the field survey. Aerial photographic maps of the survey area were prepared and supplied by CAD Resources. During the field surveys, botanists had access to all relevant data in the Esri iOS application, Collector for ArcGIS on Apple iPads (provided and maintained by CAD Resources). Data layers accessible in the field included survey area and impact area boundaries and historical vegetation mapping (Mattiske Consulting 2011). Survey sites were selected using aerial imagery, historical mapping (Mattiske Consulting 2011) and field observations. A total of 30 survey sites were selected to sample all vegetation types, with replication, within the survey area.

Survey sites consisted of un-marked 10 x 10 metre quadrats, or an equivalent 100 m^2 area in narrow vegetation corridors.

Flora and vegetation were described and sampled systematically at each survey site, and additional opportunistic collections were undertaken wherever previously unrecorded plants were observed. At each quadrat the following floristic and environmental parameters were recorded:

- GPS location (GDA94 datum, zone 50);
- Photograph of the site from the northwest corner facing southeast;
- Local site topography;
- Soil type and colour;
- Outcropping rocks and their type;
- Percentage litter cover and percentage bare ground;
- Approximate time since fire;
- Vegetation condition (based on Keighery 1994); and

- For each vascular plant species, the average height and the percentage cover (of both alive and dead material) over the survey site.

All plant specimens collected during the field surveys were dried and processed in accordance with the requirements of the WAH. The plant species were identified based on taxonomic literature and through comparison with pressed specimens housed at the WAH. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the WAH (1998-).

4.3. Survey Timing

Technical guidance – Flora and vegetation surveys for environmental impact assessment (EPA 2016b) states that the primary survey timing for the Southwest Botanical Province is Spring (September-November). The November 2021 survey of the Wagerup Farmlands was undertaken within this recommended timing when the highest proportion of perennial species were likely to be flowering, and the highest number of annual species were likely to be present.

4.4. Analysis of Site Data

A species accumulation curve, based on accumulated species versus sites surveyed was prepared to indicate the level of adequacy of the survey effort (*EstimateS* – Colwell 2013). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness (Chao 2004). When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

Plymouth Routines in Multivariate Ecological Research v7 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites on the basis of their species composition (Clarke and Gorley 2015). Introduced species, annual species, specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component) were excluded from the data set, and presence-absence transformation applied to the remaining species prior to analysis. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER), Analysis of Similarity (ANOSIM) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography, field observations, and delineation of individual plant communities. In some cases, statistically grouped quadrats were defined as different vegetation communities based on landform observation (i.e., artificial drainage channels and flats; planted *Eucalyptus rudis* woodlands and remnant *Eucalyptus rudis* woodlands).

4.5. Vegetation Descriptions

Vegetation descriptions were based on Aplin's (1979) modification of the vegetation classification system of Specht (1970), to align with the National Vegetation Information System (NVIS). Vegetation communities were described at the association level of the NVIS classification framework, as defined by the Executive Steering Committee for Australian Vegetation Information (ESCAVI 2003).

5. DESKTOP ASSESSMENT RESULTS

5.1. Potential Flora

A total of 390 vascular plant taxa, representative of 193 genera and 63 families, were recorded within the survey area. The majority of taxa recorded were representative of the Fabaceae (46 taxa), Proteaceae (37 taxa) and Myrtaceae (27 taxa) families (see Appendix B).

5.1.1. Potential Threatened and Priority Flora

Fourteen threatened flora species pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by the Department of Biodiversity, Conservation and Attractions (DBCA 2018a) have the possibility of occurring within the survey area. All of these species are also pursuant to section 179 of the EPBC Act or listed by the DAWE (2022b). The 14 threatened flora species recognised as potentially occurring within the survey area are set out in Table 1. No priority flora species as listed by DBCA (2018a) were determined to have potential to occur within the survey area.

An assessment of the likelihood of the 14 threatened species having potential to occur within the survey area is set out in Appendix C and summarised in Table 1. Four species were identified as having a medium likelihood of occurring within the survey area given the proximity of WAH records of these taxa to the boundary of the survey area (WAH 1998-). This occurrence potential was mitigated by the lack of suitable undisturbed vegetation types likely to be present within the survey area.

Table 1: Threatened flora species potentially occurring within the survey area (see Appendix C for more detail).

Family	Species	EPBC Act Cons. Code	Potential to Occur in Survey Area
Ericaceae	*Andersonia gracilis* (T)	Endangered	Low
Solanaceae	*Anthocercis gracilis* (T)	Vulnerable	Low
Orchidaceae	*Caladenia huegelii* (T)	Endangered	Low
Orchidaceae	*Diuris drummondii* (T)	Vulnerable	Low
Orchidaceae	*Diuris micrantha* (T)	Vulnerable	Low
Orchidaceae	*Diuris purdiei* (T)	Endangered	Low
Orchidaceae	*Drakaea elastica* (T)	Vulnerable	Low
Cyperaceae	*Eleocharis keigheryi* (T)	Vulnerable	Low
Proteaceae	*Lambertia echinata* subsp. *occidentalis* (T)	Endangered	Low
Proteaceae	*Synaphea* sp. Fairbridge Farm (D. Papenfus 696) (T)	Critically Endangered	Low
Proteaceae	*Synaphea* sp. Pinjarra Plain (A.S. George 17182) (T)	Endangered	Medium
Proteaceae	*Synaphea* sp. Serpentine (G.R. Brand 103) (T)	Critically Endangered	Medium
Proteaceae	*Synaphea stenoloba* (T)	Endangered	Medium
Cyperaceae	*Tetraria australiensis* (T)	Vulnerable	Medium

5.1.2. Potential Introduced (Weed) Species and Declared Pest (Plant) Organisms

Excluding planted tree taxa and taxa not identified to species level, 24 introduced species were identified as potentially occurring within the survey area during the desktop assessment (Mattiske Consulting 2003, 2011) [Appendix B]. None of these 24 species are declared pest organisms pursuant to section 22 of the BAM Act.

5.2. Potential Threatened and Priority Ecological Communities

Six TECs as listed by the EPBC Act and DBCA (2018b) were recorded during the desktop assessment as having the potential to occur within the survey area (Table 2). The likelihood of these six TECs occurring within the survey area is assessed in Table 2 below.

The *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain (T, EN) TEC was previously recorded within the survey area as the M2 vegetation community, occurring in narrow corridors in the northeast of the current survey area (Mattiske Consulting 2011). Health condition of this TEC was recorded as varying between 'Good' and 'Degraded' (Keighery 1994), with weeds dominating some areas.

The *Corymbia calophylla* - *Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain (T, VU) TEC was also previously recorded within the survey area as the M3 vegetation community. Health condition of this TEC was recorded as 'Good' (Keighery 1994), with weed species present in large numbers.

No Priority Ecological Communities (PECs) as listed by DBCA (2021) were recorded during the desktop assessment as having potential to occur within the survey area.

Table 2: Likelihood of TECs identified during the desktop study occurring within the survey area.

TEC	Cons. Codes[1]	Likelihood of Occurring	Justification
Banksia Woodlands of the Swan Coastal Plain ecological community	EN, T	Low	Based on previous flora and vegetation surveys within, and immediately surrounding, the survey area (Mattiske Consulting 2011, 2018), *Banksia* woodland are not widespread in the area, and unlikely to occur within the survey area
Corymbia calophylla - Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain	VU, T	High	This TEC has previously been recorded within the survey area (Mattiske Consulting 2011).
Clay Pans of the Swan Coastal Plain	CE, P1	Low	Based on previous flora and vegetation surveys within and immediately surrounding the survey area (Mattiske Consulting 2011, 2018), clay pans are unlikely to occur within the survey area.
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	EN, T	High	This TEC has previously been recorded within the survey area (Mattiske Consulting 2011).
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	EN, T	Low	While both of the species defining this TEC have been recorded within the survey, they have not been recorded in combination forming dominant components of the vegetation. This TEC was not recorded by Mattiske Consulting (2011) and is unlikely to occur within the survey area.
Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain	CE, P3	Low	Based on previous flora and vegetation surveys within and immediately surrounding the survey area (Mattiske Consulting 2011, 2018), *Eucalyptus gomphocephala* is unlikely to occur within the survey area.

[1]Conservation codes as list by EPBC Act, then as listed under the BC Act.

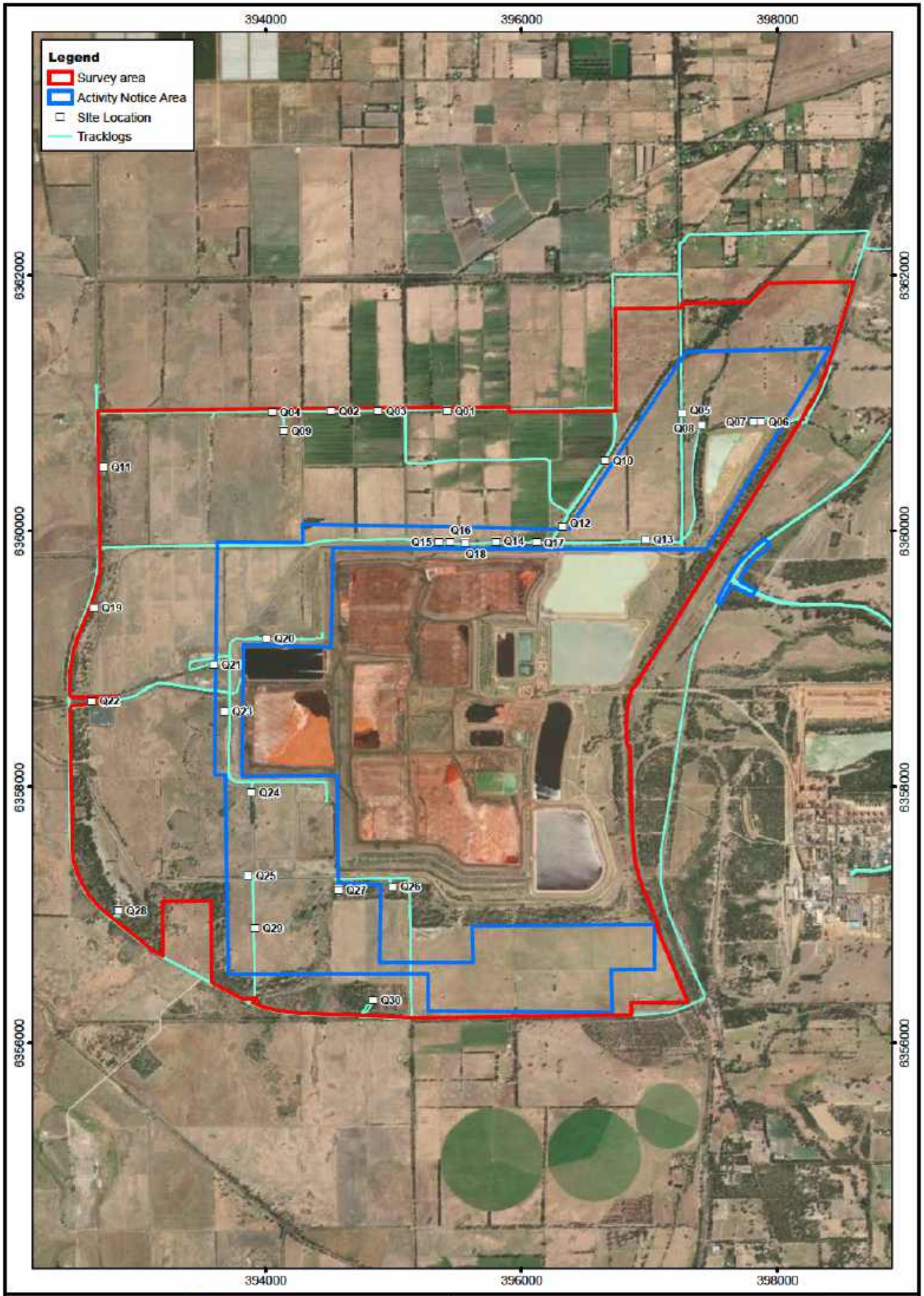
6. FIELD SURVEY RESULTS

6.1. Field Survey Coverage, Limitations and Constraints

The coverage of the survey area, based on survey quadrat locations, tracks and foot traverses is illustrated in Figure 3. The geographical coordinates of the north-west corner of the survey quadrats are set out in Table 3. An assessment of the survey against a range of factors which may have had an impact on the outcomes of the present survey was prepared (Table 4). Based on this assessment, the survey has not been subject to constraints which would affect the thoroughness of the survey and the conclusions which have been formed.

Table 3: Survey quadrat locations (north-west corner) in GDA94.

Quadrat	Easting	Northing
Q01	395421	6360940
Q02	394515	6360936
Q03	394882	6360936
Q04	394053	6360930
Q05	397261	6360922
Q06	397872	6360853
Q07	397817	6360852
Q08	397411	6360829
Q09	394143	6360784
Q10	396656	6360552
Q11	392735	6360502
Q12	396322	6360038
Q13	396973	6359933
Q14	395805	6359919
Q15	395359	6359918
Q16	395445	6359917
Q17	396119	6359916
Q18	395564	6359913
Q19	392660	6359401
Q20	394011	6359160
Q21	393596	6358957
Q22	392642	6358671
Q23	393682	6358593
Q24	393893	6357956
Q25	393866	6357308
Q26	394995	6357218
Q27	394572	6357197
Q28	392853	6357033
Q29	393920	6356898
Q30	394843	6356332



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Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 – Tel: 9257 1629 – Fax: 9257 1640

Author: E M Mattiske | MCPL Ref: ALC2103/22/21

Drawn: CAD Resources – www.cadresources.com.au
Tel: (08) 9246 3242 – Fax (08) 9246 3202

Alcoa Wagerup Farmlands

Flora and Vegetation

Tracks and Foot Traverses

Figure:

3

Table 4: Potential flora and vegetation survey limitations for the survey area

Potential Survey Limitations	Impact on Current Survey
Availability of contextual information at a regional and local scale	**Not a constraint.** Reference resources such as Beard (1990) mapping, Heddle *et al.* (1980) mapping, historical survey data in both the vicinity of the survey area (Mattiske Consulting 2001, 2003, 2011, 2018), together with online flora and vegetation information DAWE 2022a, WAH 1998-), has provided an appropriate level of information for the current survey.
Competency/experience of team carrying out survey; experience in the bioregion surveyed	**Not a constraint.** Both botanists had extensive experience with the flora of Swan Coastal Plain.
Access	**Minor constraint.** Access to the South Eastern portion of the survey area was restricted due to the heritage/cultural values associated with the area. Quadrats could not be established in this area and vegetation notes were made from the perimeter of the vegetation.
Proportion of flora collected and identification issues	**Not a constraint.** The November 2021 survey was undertaken in the recommended survey period (EPA 2016a) when the highest proportion of species were likely to be flowering, and the highest number of annual species were likely to be present. Based on the survey quadrat data, it was estimated that approximately 63.02% of the potential flora species that may be present were recorded (refer to Section 6.1 of this report). Given the extent of clearing and planted species within the survey area, this is considered an adequate proportion.
Survey effort, timing, rainfall, season of survey	**Not a constraint**. The EPA (2016a) recommends that flora and vegetation surveys in the Southwest region should be undertaken in Spring (September-November). Rainfall in the three months preceding the November 2021 was above average (Figure 1), with the area experiencing approximately 114% of the long-term average for the corresponding period. From a seasonal perspective, the majority of all flora present were either in flower or were towards the end of their flowering period. Consequently, it was possible to collect excellent specimens (fertile and many with fruit) of the majority of flora for identification purposes. Quadrats were adequately spread across the survey area given access restrictions in the southeast of the survey area (Figure 3).
Disturbances (fire/flood/clearing)	**Not a constraint.** Some of the vegetation within the survey area was last burnt in 2016 in the Yarloop fires. As a result, vegetation burnt during the 2016 fire had been altered in terms of structure and composition but has since matured and most species could be identified.
Data and statistical analysis	**Minor constraint.** As a result of the 2016 fire, understorey diversity had decreased, and hence the number of perennial species, on which statistical analysis was based, was reduced when compared to those present in Mattiske Consulting (2011). The subsequent reliance on overstorey species in the statistical analysis resulted in no significant differences being found between the 30 quadrats. This lack of statistically significant differences between the quadrats meant manual groupings based on the cluster analyses was necessary to define vegetation communities.

6.2. Flora

A total of 107 vascular plant taxa, representative of 63 genera and 35 families, were recorded within the survey area. The majority of taxa recorded were representative of the Poaceae (24 taxa), Myrtaceae (18 taxa) and Fabaceae (11 taxa) families (Appendix B). A list the species recorded at each quadrat is set out in Appendix D.

A species accumulation curve was used to evaluate the sampling adequacy and is presented in Figure 4. The incidence-based coverage estimator (ICE) of species richness was 168. Based on this value and the total of 107 species recorded (in vegetation mapping sites *only*), approximately 63.02% of the flora species potentially present within the survey area were recorded.

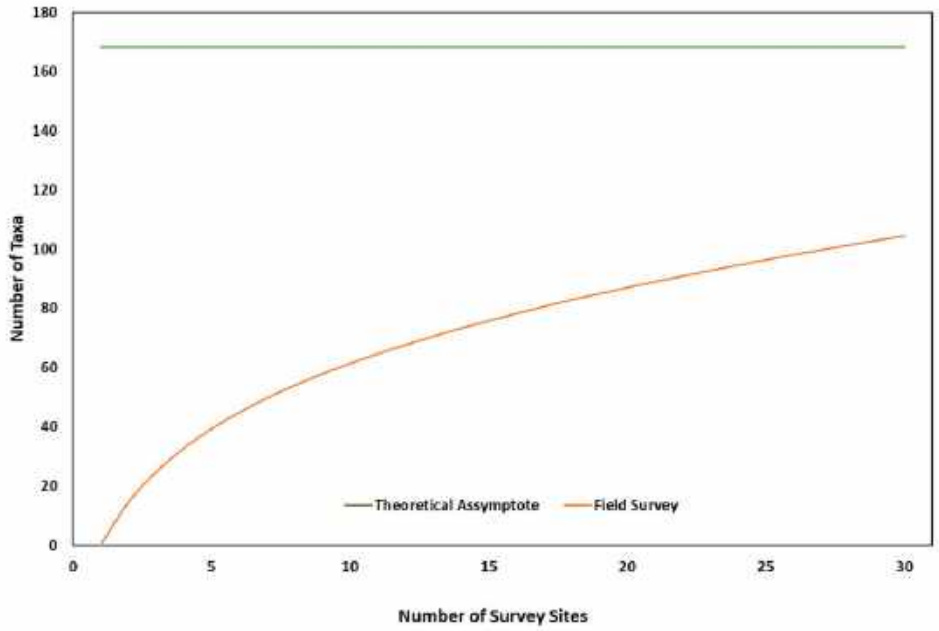

Figure 4. Average randomised species accumulation curve

6.2.1. Threatened and Priority Flora

No threatened flora species pursuant to pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by DBCA (2018a), or pursuant to section 179 of the EPBC Act or listed by the DAWE (2022b), were recorded during the field studies within the survey area.

No priority flora species, as listed by DBCA (2018a) were recorded during the field studies within the survey area. One flowering specimen was tentatively identified by WAH taxonomist Mike Hislop as *Rumex* ?*plucher*. To confidently identify species of *Rumex* fruiting specimens are needed. Because of the lack of fruiting material, the possibility of this specimen being the priority taxon *Rumex drummondii* (P4) could not be ruled out (Mike Hislop pers. comm.).

6.2.2. Introduced (Weed) Species and Declared Pest (Plant) Organisms

A total of 60 introduced (weed) species were recorded within the survey area (see Appendix B). Many of these weeds are short lived annuals, and form part of the pasture. Two of these are declared pest organisms pursuant to section 22 of the BAM Act and are set out in Table 5. **Zantedeschia aethiopica* is exempt from any control categories under the BAM Act. **Gomphocarpus fruticosus* is subject to Control

Category C3 under the BAM Act (see Appendix A3 for Management Categories). The remaining 58 weeds are permitted under section 11 of the BAM Act.

Table 5: **Declared weed species recorded within the Alcoa Farmlands survey area.** **Note:** Coordinates in GDA94.

Species	Site	Easting	Northing	WONS[1]	EPBC Act
* *Gomphocarpus fruticosus* (Narrow-leaf Cotton Bush)	Q25	393866	6357308	No	Declared Pest – s22(2)
* *Zantedeschia aethiopica* (Arum Lily)	Q27	394572	6357197	No	Declared Pest – s22(2)
	Q11	392735	6360502	No	Declared Pest – s22(2)

[1] Weeds of National Significance (DAWE 2022c)

6.3. Vegetation

6.3.1. Statistical Analysis

Annual taxa, introduced species, and singletons were removed from the dataset prior to undertaking multivariate statistical analysis. The final data set comprised perennial natives which define the vegetation communities. This left 21 of the initial 107 species for analysis with between 3 and 5 defining species remaining in each quadrat. Consequently, SIMPROF analysis did not identify any significantly associated groups of vegetation quadrats.

Non-significant groupings of quadrats were manually split based on field observations, quadrat photographs, topography, aerial imagery, and historical mapping within the survey area (Mattiske Consulting 2011).

Fifteen dissimilar vegetation communities were delineated within the survey area, five of which contained just one quadrat (Figure 5). Broadly, quadrats were grouped into *Corymbia, Eucalyptus*, and *Melaleuca* dominated groups, with further splitting occurring based on the presence or absence of *Kingia australis* (*Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain TEC). Quadrats which had similar vegetation but different landforms (i.e., P2 and D1, M6 and P3) were split into different vegetation communities.

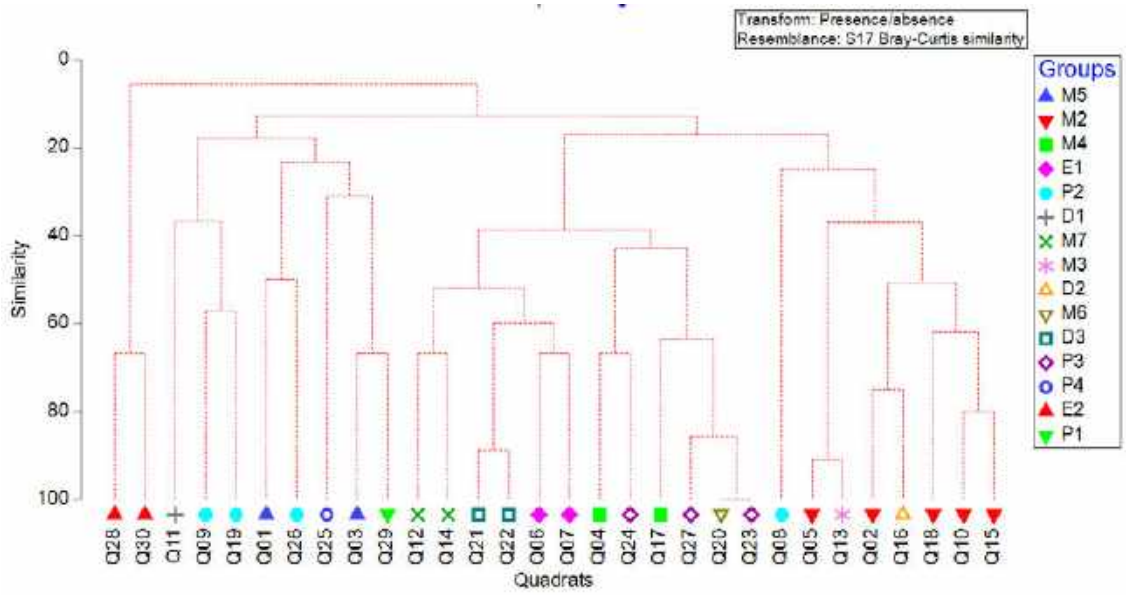

Figure 5: Dendrogram of SIMPROF analysis quadrat groupings

6.3.2. Vegetation Communities and Mapping

Broadly, the vegetation within the survey area can be described as cleared paddocks with pasture species intersected by remnant corridors of *Corymbia calophylla, Eucalyptus marginata, Melaleuca rhaphiophylla* and *Melaleuca preissii* woodland, and planted **Eucalyptus camaldulensis* and **Eucalyptus botryoides* corridors. The extent and proportion of each vegetation community within the survey area and impact area are set out in Table 6. Vegetation communities were described in line with those described by Mattiske Consulting (2003, 2011). New vegetation communities were added only when similar vegetation was not previously described, and vegetation community descriptions were updated to reflect the species present during this survey. The vegetation mapping is presented in Figure 6. A summary of the 15 vegetation communities in NVIS level four format (ESCAVI 2003) is presented below:

D1

Planted *Eucalyptus camaldulensis* mid woodland over *Melaleuca osullivanii* low sparse shrubland over *Eleocharis acuta* and *Typha orientalis* open rushland and mixed weed species on clay-loam in artificial drainage channels.

D2

Melaleuca lateritia low shrubland over **Watsonia meriana* var. *bulbillifera*, **Cenchrus clandestinus*, **Lolium perenne* open grassland and mixed weed species on sandy-loam in artificial drainage channels.

D3

Eucalyptus rudis and *Melaleuca rhaphiophylla* mid open woodland over *Acacia pulchella*, *Viminaria juncea* mid sparse shrubland and mixed weed species on sandy-loam in artificial drainage channels.

E1

Eucalyptus rudis, Melaleuca rhaphiophylla and *Corymbia calophylla* mid woodland over *Juncus pallidus* mid sparse rushland and mixed weed species on loam in drainage channels.

E2

Planted *Eucalytpus rudis* mid woodland over *Calothamnus quadrifidus* subsp. *quadrifidus* mid sparse shrubland over mixed weed species on sandy loam on flats.

M2

Corymbia calophylla mid open forest over *Kingia australis* and *Acacia pulchella* over mixed weed species on clayey-loam on flats.

M3

Corymbia calophylla and *Eucalyptus marginata* mid closed forest over *Acacia pulchella* and *Xanthorrhoea preissii, Xanthorrhoea gracilis* mid sparse shrubland over *Desmocladus fasciculatus* and *Conostylis aculeata* subsp. *preissii* low sedgeland on sandy-loam on flats.

M4

Melaleuca rhaphiophylla low woodland over *Xanthorrhoea preissii* and **Callistemon phoeniceus* over mixed weed species on sandy-loam on flats.

M5

Melaleuca preissiana low open forest over *Acacia pulchella* over mixed weed species on sandy-loam on flats.

M6

Melaleuca rhaphiophylla mid shrubland over *Juncus pallidus* low rushland over *Eleocharis acuta* low sparse sedgeland on clay in artificially seasonally inundated areas.

M7

Corymbia calophylla and *Melaleuca rhaphiophylla* mid open forest over *Acacia pulchella* and *Xanthorrhoea preissii* over mixed weed species on loamy clay in artificial drainage channels.

P1

Juncus pallidus low sparse sedgeland over* *Lotus angustissimus*, **Lolium perenne*, **Cynodon dactylon* low grassland on sandy-loam on flats.

P2

Planted *Eucalyptus camaldulensis* and **Eucalyptus botryoides* over mixed weed and pasture species on sandy-loam on flats.

P3

Melaleuca rhaphiophylla low open woodland over *Juncus pallidus* and *Eleocharis acuta* low sparse rushland over mixed weed and pasture species on sandy-loam on flats.

P4

Planted *Allocasuarina huegeliana and Eucalyptus rudis, Corymbia calophylla* mid open woodland over *Melaleuca preissiana*, **Callistemon phoeniceus* and *Melaleuca lateritia* mid closed shrubland over mixed weed species on sandy-loam on flats.

Table 6: Extent of vegetation communities within the Alcoa Farmlands survey area

Community Code	Area (ha)	Percentage of Survey area	Percentage of Impact Area
D1	5.21	0.23	0
D2	29.08	1.28	1.61
D3	5.97	0.26	0.07
E1	3.93	0.17	0.61
E2	81.35	3.58	0.68
M2	35.11	1.55	0.64
M3	2.37	0.10	0.42
M4	27.62	1.22	1.97
M5	4.45	0.20	0
M6	5.68	0.25	1.00
M7	1.21	0.05	0.09
P1	964.04	42.48	67.07
P2	125.78	5.54	3.42
P3	229.33	10.11	13.62
P4	13.93	0.61	0.40
Cleared Land	734.43	32.36	8.43
Total	2269.49	100	100

6.3.3. Threatened and Priority Ecological Communities

Two TECs were recorded within the survey area represented by the M2 and M3 vegetation communities, the *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain, and *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain TECs, respectively (Gibson *et al.* 1994).

The M2 vegetation community was previously mapped by Mattiske Consulting (2011) along Fawcett Road. The current survey area encompassed more areas of M2 vegetation along the north-eastern boundary of the survey area, not previously mapped. The condition of this vegetation community varied from 'Good' to 'Degraded' (Keighery 1994). Some areas, likely burnt in the 2016 Yarloop fires, were dominated by weed species in the understorey. 3.61 ha of this M2 TEC was mapped within the proposed impact area.

The M3 vegetation community was previously mapped by Mattiske Consulting (2011) along Kubank Road, parallel to the northern boundary of the tailings ponds. No new areas of this M2 TEC were identified in the current survey area. Weed species were present in relatively low numbers in this community, and it was in 'Good' condition (Keighery 1994). 2.37 ha of this M3 TEC was mapped in within the proposed impact area.

6.3.4. Vegetation Condition

Vegetation condition was recorded as being between 'Good', in some remnant corridors, to 'Completely Degraded', in the cleared paddocks (Keighery 1994). Vegetation condition across the survey area is illustrated in Figure 7. The percentage of the survey area falling into each condition category is set out in Table 7.

Table 7: Vegetation condition extents within the survey area

Vegetation Condition[1]	Area (ha)	Percentage of survey area[2]
Pristine	0	0
Excellent	0	0
Very Good	0	0
Good	58.59	3.81
Degraded	478.88	31.19
Completely Degraded	997.59	64.99
Cleared Land	734.43	N/A

[1]Keighery 1994

[2]As a percentage of the survey area excluding Cleared Land (i.e. the tailing storage ponds and dam)

394000 396000 398000 400000

6362000 6360000 6358000 6356000

Vegetation Descriptions

D1 - Planted *Eucalyptus camaldulensis* mid woodland over *Melaleuca osullivanii* low sparse shrubland over *Eleocharis acuta* and *Typha orientalis* open rushland and mixed weed species on clay-loam in artificial drainage channels.

D2 - *Melaleuca lateritia* low shrubland over **Watsonia meriana* var. *bulbillifera*, **Cenchrus clandestinus*, **Lolium perenne* open grassland and mixed weed species on sandy-loam in artificial drainage channels

D3 - *Eucalyptus rudis* and *Melaleuca rhaphiophylla* mid open woodland over *Acacia pulchella*, *Viminaria juncea* mid sparse shrubland and mixed weed species on sandy-loam in artificial drainage channels.

E1 - *Eucalyptus rudis*, *Melaleuca rhaphiophylla* and *Corymbia calophylla* mid woodland over *Juncus pallidus* mid sparse rushland and mixed weed species on loam in drainage channels.

E2 - Planted *Eucalytpus rudis* mid woodland over *Calothamnus quadrifidus* subsp. *quadrifidus* mid sparse shrubland over mixed weed species on sandy loam on flats.

M2 - *Corymbia calophylla* mid open forest over *Kingia australis* and *Acacia pulchella* over mixed weed species on clayey-loam on flats.

M3 - *Corymbia calophylla* and *Eucalyptus marginata* mid closed forest over *Acacia pulchella* and *Xanthorrhoea preissii*, *Xanthorrhoea gracilis* mid sparse shrubland over *Desmocladus fasciculatus* and *Conostylis aculeata* subsp. *preissii* low sedgeland on sandy-loam on flats.

M4 - *Melaleuca rhaphiophylla* low woodland over *Xanthorrhoea preissii* and **Callistemon phoeniceus* over mixed weed species on sandy-loam on flats.

M5 - *Melaleuca preissiana* low open forest over *Acacia pulchella* over mixed weed species on sandy-loam on flats.

M6 - *Melaleuca rhaphiophylla* mid shrubland over *Juncus pallidus* low rushland over *Eleocharis acuta* low sparse sedgeland on clay in artificially seasonally inundated areas.

M7 - *Corymbia calophylla* and *Melaleuca rhaphiophylla* mid open forest over *Acacia pulchella* and *Xanthorrhoea preissii* over mixed weed species on loamy clay in artificial drainage channels.

P1 - *Juncus pallidus* low sparse sedgeland over**Lotus angustissimus*, **Lolium perenne*, **Cynodon dactylon* low grassland on sandy-loam on flats.

P2 - Planted *Eucalyptus camaldulensis* and **Eucalyptus botryoides* over mixed weed and pasture species on sandy-loam on flats.

P3 - *Melaleuca rhaphiophylla* low open woodland over *Juncus pallidus* and *Eleocharis acuta* low sparse rushland over mixed weed and pasture species on sandy-loam on flats

P4 - Planted *Allocasuarina huegeliana and Eucalyptus rudis*, *Corymbia calophylla* mid open woodland over *Melaleuca preissiana*, **Callistemon phoeniceus* and *Melaleuca lateritia* mid closed shrubland over mixed weed species on sandy-loam on flats.

CL – Cleared Land

Legend

Site Location
Survey Area
Activity Notice Area

Vegetation
CL, D1, D2, D3, E1, E2, M2, M3, M4, M5, M6, M7, P1, P2, P3, P4

0 300 600 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a1992_F003_04
Date: Jan 2022 | Rev: A | A3

Mattiske Consulting Pty Ltd
28 Central Road, Kalamunda WA 6076 ~ Tel: 9257 1625 ~ Fax: 9257 1640
Author: E M Mattiske | MCPL Ref: ALC2103/28/21
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Alcoa Wagerup Farmlands
Vegetation

Figure: **6**

392000 394000 396000 398000 400000

6362000 6360000 6358000 6356000

Q01 Q02 Q03 Q04 Q05 Q06 Q07 Q08 Q09 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27 Q28 Q29 Q30

Legend

- Site Location
- Survey Area
- Activity Notice Area

Condition

- Cleared Land
- Completely Degraded
- Degraded
- Good
- Very Good
- Pristine

0 300 600 m

Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a1992_F003_05

Date: Jan 2022 | Rev: A | A3

Mattiske Consulting Pty Ltd
28 Central Road, Kalamunda WA 6076 ~ Tel: 9257 1625 ~ Fax: 9257 1640
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Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Alcoa Wagerup Farmlands
Vegetation Condition

Figure: **7**

7. DISCUSSION

Alcoa of Australia Limited (Alcoa) processes bauxite ore at its Wagerup Refinery. Alcoa proposes to expand its Wagerup Refinery Residue Storage Area (RSA) into the adjacent Alcoa Farmland and remnant vegetation corridors. Mattiske Consulting Pty Ltd was commissioned in November 2021 by Alcoa to update and expand historical flora and vegetation surveys of the Wagerup Farmlands.

7.1. Flora

7.1.1. Threatened and Priority Flora

No threatened or priority flora species were recorded during this survey. This was largely expected given the desktop review of Mattiske Consulting (2003, 2011, 2018) which showed that areas of undisturbed, intact vegetation were extremely restricted in area and unlikely to be present within the survey area. Further, the threatened species in question (see Table 1) are restricted to seasonally wet areas and swamps. Undisturbed (fenced to exclude cattle and grazing) and native areas of swamp or seasonally flooded vegetation to support these threatened species were not recorded within the survey area.

Rumex ?*plucher,* collected at site Q24 (and present at sites Q25, Q26, Q27,Q29) could not be ruled as potentially being *Rumex drummondii* (P4) without fruiting material (Mike Hislop pers. comm.). Given that *Rumex drummondii* (P4) is distributed across four IBRA regions between Dalwallinu and Albany, any potential impacts associated with the Wagerup Refinery expansion are unlikely to adversely impact this taxon.

7.1.2. Introduced (Weed) Species and Declared Pest (Plant) Organisms

A total of 59 introduced (weed) species were recorded within the survey area (Appendix B), 35 of which had not previously been recorded by Mattiske Consulting (2003, 2011). At least three of these introduced species, **Callistemon phoeniceus* **Eucalyptus botryoides*, and **Eucalyptus camaldulensis* were planted to give visual amenity to the farmland and preclude the tailings ponds from being visible from the road. **Callistemon phoeniceus* and **Eucalyptus camaldulensis* are native to Western Australia in part of their range and naturalised elsewhere, but neither occur naturally on the Swan Coastal Plain (WAH 1998-). **Eucalyptus botryoides* is an eastern states taxon, with no native range in Western Australia.

Most weeds recorded within the survey area were common species of agricultural lands and were expected within an agricultural operation on the Swan Coastal Plain. Some weeds (e.g., **Lolium perenne*) form part of the pasture grazed by cattle.

Two declared weed species were recorded at three locations in the survey area, **Gomphocarpus fruticosus* and **Zantedeschia aethiopica.* **Zantedeschia aethiopica* is exempt from any control categories under the BAM Act. **Gomphocarpus fruticosus* is subject to Control Category C3 under the BAM Act, see Appendix A3.

**Gomphocarpus fruticosus* should be controlled to prevent it's spread into native, undisturbed bushland where it may outcompete native understorey species. Recommended control methods for **Gomphocarpus fruticosus* constitute hand pulling of immature plants and glyphosate application to mature plants (WAH 1998-).

7.2. Vegetation

Fifteen vegetation communities were delineated and mapped across the survey area, including five vegetation communities not previously delineated by Mattiske Consulting (2003, 2011): D3, E2, M6, M7, and P4.

The D3 vegetation community is represented by an artificial drainage line in the west of the survey area, and was previously mapped as D2 by Mattiske Consulting (2011). Since 2011, vegetation within the drainage channel has matured and constitutes large *Eucalyptus rudis* and *Melaleuca rhaphiophylla* species (Plate 1). Vegetation of this maturity in artificial drainage channels is not represented in another part of the survey or in the Mattiske Consulting (2011) mapping, and was therefore delineated as a new community.

Plate 1: D3 vegetation as recorded at site Q22.

The M6 vegetation community represents emergent *Melaleuca rhaphiophylla* shrublands in areas that, due to the altered hydrology surrounding the tailings ponds, hold more water than the area would naturally. This vegetation was not delineated by Mattiske Consulting (2011) likely because either the altered hydrology was caused by more recent changes to the landforms, or because of the lag in water accumulation after the landform changes.

The M7 vegetation community represent *Corymbia calophylla* and *Melaleuca rhaphiophylla* mid open forest in artificial drainage channels, and is restricted to the area surround the intersection of Kubank Road and the Farmland Office Road. This combination of species at their mature age (Plate 2) is not present elsewhere in the survey area and was therefore delineated as a new community. Vegetation quadrats were not established in this area during the Mattiske Consulting (2011) survey.

Plate 2: M7 vegetation as recorded at site Q14.

The E2 and P4 vegetation communities were restricted to areas outside of the Mattiske Consulting (2011) survey area and were considered to be different to any community described by Mattiske Consulting (2011).

The M4 vegetation unit in the northwest of the survey area (along John Road) was previously mapped as the M2 vegetation representing the *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain TEC (Mattiske Consulting 2011). This area was burnt in the 2016 Yarloop fires and subsequently the *Kingia australis* individuals in this area have died (Plate 3). *Kingia australis* is a community defining species for this TEC and the M2 vegetation, and this vegetation was mapped as M4.

Plate 3: M4 vegetation as recorded at Q04, previously mapped as M2 vegetation (Mattiske Consulting 2011) prior to being burnt in 2016.

Some of the species defining the previously mapped vegetation units have also changed, likely as a result of the 2016 Yarloop fires. The M5 vegetation unit along John Road was mapped by Mattiske Consulting (2011) as:

"Woodland of *Melaleuca preissiana* with occasional *Eucalyptus marginata* over *Banksia littoralis* and *Taxandria linearifolia* over mixed weed species on flat sandy soil."

During this survey, just one *Banksia littoralis* individual was observed in the entire extent of the M5 vegetation unit, and *Taxandria linearifolia* was not recorded. It is likely that fire killed the *Banksia littoralis*, and the weeds that moved in post fire likely out competed the *Taxandria linearifolia.*

Similarly, *Hakea varia*, previously a defining species of the M4 vegetation (Mattiske Consulting 2011), was recorded at just one location (Q11, D1) in planted vegetation during this survey. This species was likely killed by the fire and/or outcompeted by the subsequent weed encroachment. *Banksia dallanneyi* var. *dallaneyi* was previously a defining species of the M3 vegetation (Mattiske Consulting 2011), but was not recorded during this survey. The absence of these once common native perennials represents a decline in vegetation condition.

The M2 and M3 vegetation communities representing the *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain and *Corymbia calophylla* - *Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain TECs, respectively. These vegetation units represent regionally restricted assemblages. Several large trees were also observed in these communities, represent potential Black Cockatoo nesting sites.

7.3. Clearing Principles

The potential project impacts measured against the Department of Water and Environmental Regulation's (DWER) clearing principles (under the EP Act 1986) are summarised in Table 8. The proposed project development within the impact area may be at variance with Clearing Principles 2, 4, 5 and 6. In assessing these matters this general assessment does not concentrate on specific areas that may be disturbed and therefore the following provides a precautionary approach to the clearing principles. To assist in checking where the specific principles apply in sections of the survey area there is a need to rely on the vegetation map (M2, M3 and E1 mapping types) and the condition maps as values decrease when the condition is well below good or very good which is the case in many sections of the expansion areas.

The majority of the survey area and the wetland areas have been in most instances modified by previous agriculture activities and hence there is a need for the consideration of the vegetation condition maps when reviewing the specific local areas for principles 5 and 6.

Table 8: Assessment of proposal against the ten clearing principles

No.	Principle and Assessment
1	**Native vegetation should not be cleared if it comprises a high level of biological diversity** The eastern side of the Swan Coastal Plain is known to be an area of high species or ecosystem diversity (Mitchell *et al.* 2002). However, the survey area consists largely of cleared agricultural pasture and planted trees, with the majority of remnant vegetation confined to the road verges and heavily infested with weed species. Of the total 107 different vascular plant taxa recorded within the survey area, 59 were introduced (exotic). **Assessment:** The proposal is not at variance with this principle
2	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia** Mature *Corymbia calophylla, Eucalyptus marginata,* and *Eucalyptus rudis* woodlands present within the survey area (M2, M3, and E1 vegetation communities) represent potential Black Cockatoo nesting and foraging sites. Previous surveys at the Alcoa Wagerup Farmlands have identified 69 trees with diameter-breast height of more than 500 mm, seven of which had hollows potentially suitable for Black Cockatoo nesting (Mattiske Consulting 2011). These corridors of mature, hollow bearing trees also represent potential *Phascogale tapoafata* habitat and/or movement corridors between remnant pockets of vegetation such as Buller Nature Reserve. **Assessment:** The proposal may be at variance with this principle
3	**Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora** No threatened flora species pursuant to pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by DBCA (2018a), or pursuant to section 179 of the EPBC Act or listed by the DAWE (2022b), were recorded within the survey area. No priority flora species, as listed by DBCA (2018a) were recorded within the survey area. **Assessment:** The proposal is not at variance with this principle
4	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community** Two TECs were recorded within the survey area represented by the M2 and M3 vegetation communities, the *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain, and *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain TECs, respectively (Gibson *et al.* 1994). Both TECs are confined to road verges in the central and north eastern areas of the Wagerup Farmlands survey area and are heavily impacted by weed species, their condition ranging from Good to Degraded. **Assessment:** The proposal may be at variance with this principle
5	**Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared** The survey area consists largely of cleared agricultural pasture, with the majority of remnant vegetation confined to the road verges and infested with weed species. The remnant vegetation located along Fawcett Road and the railway, including the natural creek line in the north eastern corner of the survey area (Black Tom Brook), are areas where there is there is the greatest proportion of native species and the presence of potential habitat trees. **Assessment:** The proposal may be at variance with this principle
6	**Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland** There are several artificial drains and one natural creek line present in the survey area. The main drain in the north east of the survey area is dominated by introduced (exotic) species and fringed by planted riparian vegetation consisting of native and non-native plantings with little understorey. As such this is unlikely to provide much ecological value. The second drain, in the central west of the survey area, appears to be a modified natural drainage channel which ends in a seasonally wet area supporting wetland sedge species. The natural creek line in the north eastern corner of the survey area (Black Tom Creek) is a remnant Woodland of *Eucalyptus rudis, Melaleuca rhaphiophylla* and *Corymbia calophylla* mid woodland over *Juncus pallidus* mid sparse rushland and mixed weed species on loam in drainage channels. This community may provide habitat trees.

	Assessment: The proposal may be at variance with this principle

Table 8: Assessment of proposal against the ten clearing principles

No.	Principle and Assessment
7	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation** The vast majority of the survey area is degraded or completely degraded pasture and as such clearing of the remaining native vegetation is unlikely to cause appreciable land degradation. **Assessment:** The proposal is not at variance with this principle
8	**Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area** Buller Nature Reserve is located approximately 1.3 km west of the survey area, and represents some of the most intact Swan Coastal Plain vegetation in the area. Buller Nature Reserve is surrounded by Degraded or Completely Degraded pasture, similar to that present within the survey area. Any development within the survey area is unlikely to impact Buller Nature Reserve. **Assessment:** The proposal is not at variance with this principle
9	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.** As there is little native vegetation remaining in the survey area, clearing it is unlikely to cause deterioration in the quality of surface and underground water. **Assessment:** The proposal is not at variance with this principle
10	**Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.** As there is little native vegetation remaining in the survey area, clearing it is unlikely to cause, or exacerbate, the incidence or intensity of flooding. **Assessment:** The proposal is not at variance with this principle

8. CONCLUSION AND RECOMMENDATIONS

Vegetation within the Alcoa Farmlands survey area can broadly be described as cleared paddocks with pasture species intersected by remnant corridors of *Corymbia calophylla, Eucalyptus marginata, Melaleuca rhaphiophylla* and *Melaleuca preissii* woodland, and mature planted **Eucalyptus camaldulensis* and **Eucalyptus botryoides* corridors.

No threatened flora species pursuant to pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by DBCA (2018), or pursuant to section 179 of the EPBC Act or listed by the DAWE (2022b), were recorded within the survey area. No priority flora species, as listed by DBCA (2018) were recorded within the survey area.

Two TECs were recorded within the RSA Infrastructure expansion area; the M2 and M3 vegetation represent the *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain and *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain TECs, respectively. 3.61 ha of this M2 TEC was mapped within the proposed impact area and 2.37 ha of this M3 TEC was mapped in within the proposed impact area. If clearing this regionally restricted vegetation could be avoided then this issue will be less constraining on the proposed expansion of the refinery infrastructure.

Vegetation condition, when compared to the previous surveys of the Alcoa Wagerup Farmlands, has declined, most likely as a result of the 2016 fire and the subsequent encroachment of weeds. Two declared weeds, **Gomphocarpus fruticosus* and **Zantedeschia aethiopica* were recorded within the survey area. These weeds had not previously been recorded at the Alcoa Wagerup Farmlands. Controlling these weeds to prevent their spread into native vegetation, where they could outcompete native understorey species, is recommended.

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10. PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

NAME	POSITION	PROJECT INVOLVEMENT	FLORA COLLECTION PERMITS
Dr EM Mattiske	Managing Director & Principal Ecologist	Planning, managing, editing, reporting	N/A
Mr Zac Sims	Experienced Botanist	Fieldwork, plant identifications, data analysis, reporting	Permit to Take Declared Rare Flora TFL 167-2021; FB62000025-2
Mr David Angus	Senior Botanist	Planning, fieldwork, plant identifications	Permit to Take Declared Rare Flora TFL 25-1920; FB62000022-2

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APPENDIX A1: THREATENED AND PRIORITY FLORA DEFINITIONS

Under section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), **threatened flora** are categorised as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent (Table A1.1).

Table A1.1 Federal definition of threatened flora species

Note: Adapted from section 179 of the EPBC Act.

CODE	CATEGORY	DEFINITION
Ex	**Extinct**	Species which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild**	Species which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.
CE	**Critically Endangered**	Species which 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.
E	**Endangered**	Species which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable**	Species which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent**	Species which at a particular time if, at that time, 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 within a period of 5 years.

The *Biodiversity Conservation Act 2016* (BC Act) provides for (amongst other things) the protection of flora that is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future in Western Australia under Part 10 (Division 2).

Threatened flora are listed in the *Wildlife Conservation (Rare Flora) Notice 2018* (under Part 2, Division 1, Subdivision 2 of the BC Act; Department of Biodiversity, Conservation and Attractions (DBCA,2021a) and are categorised under Schedules 1-3. A flora species is defined as **threatened** if it is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future, pursuant to sections 20, 21 and 22 of the BC Act. Threatened species are categorised as critically endangered, endangered, and vulnerable (Table A1.2).

Table A1.2 State definition of threatened flora species

Note: Adapted from DBCA (2021b).

CODE	CATEGORY	DEFINITION
CR	**Critically endangered**	Species considered to be facing an extremely high risk of becoming extinct in the wild (listed under Schedule 1 of the *Wildlife Conservation (Rare Flora) Notice 2018*).
EN	**Endangered**	Species considered to be facing a very high risk of becoming extinct in the wild (listed under Schedule 2 of the *Wildlife Conservation (Rare Flora) Notice 2018*).
VU	**Vulnerable**	Species considered to be facing a high risk of becoming extinct in the wild (listed under Schedule 3 of the *Wildlife Conservation (Rare Flora) Notice 2018*).

Priority flora species are defined as "possibly threatened species that do not meet the survey criteria, or are otherwise data deficient" or species that are "adequately known, are rare but not threatened, meet criteria for near threatened or have recently been removed from the threatened species list" for other than taxonomic reasons" (DBCA 2018b). Priority species are not afforded the same level of protection under state or federal legislation as the listed Threatened species, however are considered significant under the Environmental Protection Authority's *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a). The Department of Biodiversity, Conservation and Attractions categorises priority flora into four categories: Priority 1; Priority 2, Priority 3 and Priority 4 (Table A1.3).

Table A1.3: State definition of priority flora species

Note: Adapted from DBCA (2021b).

CODE	CATEGORY	DEFINITION
P1	**Priority 1:** Poorly-known species	Known from one or a few locations (< 5) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation; or are otherwise under threat of habitat destruction or degradation. In urgent need of further survey.
P2	**Priority 2:** Poorly-known species	Known from one or a few locations (< 5). Some occurrences are on lands managed primarily for nature conservation. In urgent need of further survey.
P3	**Priority 3:** Poorly-known species	Known from several locations and the species does not appear to be under imminent threat; or from few but widespread locations with either a large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. In need of further survey.
P4	**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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. **c) Other -** Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX A2: THREATENED AND PRIORITY ECOLOGICAL COMMUNITY DEFINITIONS

Under section 181 of the EPBC Act, **threatened ecological communities** are categorised as critically endangered, endangered and vulnerable (Table A2.1).

Table A2.1 Federal definition of threatened ecological communities

Note: Adapted from section 181 and section 182 of the EPBC Act.

CATEGORY	DEFINITION
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Threatened ecological communities (TECs) are listed in the *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (28 June 2018)* (under Part 2, Division 2, Subdivision 1 of the BC Act; DBCA 2021c). An ecological community is defined as **threatened** if it is facing an extremely high risk of collapse in the immediate, near or medium-term future, pursuant to sections 28, 29 and 30 of the BC Act. Threatened ecological communities are categorised as critically endangered, endangered, and vulnerable (Table A2.2).

Currently there is no Western Australian legislation covering the conservation of state listed **threatened ecological communities** (TECs), however, a non-statutory process is in place, whereby the DBCA (and former equivalent departments) have been identifying and informally listing TECs since 1994. Some of these TECs are also endorsed by the Federal Minister as threatened, and some of these are listed under the EPBC Act and therefore afforded legislative protection at the Commonwealth level.

Table A2.2 State definition of threatened ecological communities

Note: Adapted from DBCA (2021b).

CODE	CATEGORY	DEFINITION
CR	**Critically Endangered**	An ecological community will be listed as CR when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting **any one or more of** the following criteria: **1.** The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; **2.** The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or **3.** The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	**Endangered**	An ecological community will be listed as EN when it has been adequately surveyed and is not CR, but is facing a very high risk of total destruction in the near future. The ecological community must meet **any one or more of** the following criteria: **1.** The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; **2.** The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or **3.** The ecological community is highly modified with potential of being rehabilitated in the short term future.
VU	**Vulnerable**	An ecological community will be listed as VU when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet **any one or more of** the following criteria: **1.** The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; **2.** The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; or **3.** The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

Priority ecological communities (PECs) are defined as possible threatened ecological communities that do not meet the stringent survey criteria for the assessment of threatened ecological communities, and are listed by the DBCA (2021d) in the *Priority Ecological Communities for Western Australia – Version 28 (17 January 2019)*. Similarly to priority flora, PECs are not afforded legislative protection, however are considered significant under the Environmental Protection Authority's (2016a) *Environmental Factor Guideline: Flora and Vegetation*. The Department of Biodiversity, Conservation and Attractions categorises priority ecological communities into five categories: Priority 1; Priority 2, Priority 3, Priority 4 and Priority 5 (Table A2.3).

Table A2.3 State definition of priority ecological communities

Note: Adapted from DBCA (2021b).

CODE	CATEGORY	DEFINITION
P1	**Priority 1** (Poorly known ecological communities)	Ecological communities that are known from very few, restricted occurrences (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Most of these occurrences are not actively managed for conservation (e.g. located within agricultural or pastoral lands, urban areas, or active mineral leases) and for which immediate threats exist.
P2	**Priority 2** (Poorly known ecological communities)	Communities that are known from few small occurrences (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation.
P3	**Priority 3** (Poorly known ecological communities)	**1.** 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; **2.** 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 **3.** Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	**Priority 4** (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)	**1.** Rare – Communities known from few occurrences that are considered to have been adequately surveyed, sufficient knowledge is available, and are considered not to be currently threatened. **2.** Near Threatened – Communities considered to have been adequately surveyed and do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable. **3.** Communities that have been removed from the list of threatened communities during the past five years.
P5	**Priority 5** (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 A3: CATEGORIES AND CONTROL MEASURES OF DECLARED PEST (PLANT) ORGANISMS IN WESTERN AUSTRALIA

Section 22 of Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act) makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the BAM Act, a declared pest is defined as a prohibited organism (section 12), or an organism for which a declaration under section 22 (2) of the Act is in force.

Under the *Biosecurity and Agriculture Management Regulations 2013* (WA), declared pest plants are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Table A4.1). The current listing of declared pest organisms and their control category is through the Western Australian Organism List (Department of Primary Industries and Regional Development 2021).

Table A3.1 Categories and control measures of declared pest (plant) organisms

Note: Adapted from *Biosecurity and Agriculture Management Regulations 2013*.

CONTROL CATEGORY	CONTROL MEASURES
C1 (Exclusion) '(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented.' Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.	In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C2 (Eradication) '(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible.' Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.	In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C3 (Management) '(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to: **(i)** alleviate the harmful impact of the declared pest in the area; or **(ii)** reduce the number or distribution of the declared pest in the area; or **(iii)** prevent or contain the spread of the declared pest in the area.' Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.	In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to: **(a)** alleviate the harmful impact of the declared pest in the area for which it is declared; or **(b)** reduce the number or distribution of the declared pest in the area for which it is declared; or **(c)** prevent or contain the spread of the declared pest in the area for which it is declared.

APPENDIX A4: OTHER DEFINITIONS

Environmentally sensitive areas

Environmentally sensitive areas are declared by the State Minister under section 51B of the *Environmental Protection Act 1986* (EP Act) and are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, gazetted 8 April 2005. Specific environmentally sensitive areas relevant to this report include: a defined wetland and the area within 50 metres of the wetland; the area covered by vegetation within 50 metres of rare flora; the area covered by a threatened ecological community; a Bush Forever site – further areas and information are described in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*.

Conservation significant flora

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), flora may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority species;
- locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- new species or anomalous features that indicate a potential new species;
- representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids; or
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Conservation significant vegetation

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), vegetation may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority ecological communities;
- restricted distribution;
- degree of historical impact from threatening processes;
- a role as a refuge; or
- providing an important function required to maintain ecological integrity of a significant ecosystem.

APPENDIX A5: DEFINITION OF VEGETATION CONDITION SCALE FOR THE SOUTH WEST AND INTERZONE BOTANICAL PROVINCES

Vegetation condition ratings relate to vegetation structure, level of disturbance at each structural layer and the ability of the vegetation unit to regenerate (Table A5.1). Vegetation condition provides complementary information for assessing the significance of potential impacts.

Table A5.1 Definition of vegetation condition categories

Note: Adapted from Keighery (1994).

CATEGORY	DEFINITION
1	Pristine or nearly so, no obvious sign of disturbance or damage caused by human activities since European settlement.
2	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
3	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
5	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
6	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX A6: NVIS STRUCTURAL FORMATION TERMINOLOGY

Note: Adapted from Environmental Steering Committee for Australian Vegetation Information (2003).

COVER CHARACTERISTICS							
Foliage cover*	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover**	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% cover***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

GROWTH FORM	HEIGHT RANGES (m)	STRUCTURAL FORMATION CLASSES						
tree, palm	<10, 10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad, grass-tree, tree-fern	<1, 1-2, >2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
heath shrub	<1, 1-2, >2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	<1, 1-2, >2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	<0.5, >0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	spare samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	<2, >2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	<0.5, >0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grassland	isolated clumps of tussock grasses	tussock grasses
other grass	<0.5, >0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	<0.5, >0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	<0.5, >0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	<0.5, >0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	<1, 1-2, >2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
bryophyte	<0.5	closed bryophyteland	bryophyte land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	<10, 10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	0-0.5, <1	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	0-0.5, <1	closed seagrass bed	seagrass bed	open seagrass bed	sparse seagrasses	isolated seagrasses	isolated clumps of seagrasses	seagrasses

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED AT ALCOA WAGERUP FARMLANDS, WAGERUP, NOVEMBER 2021

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Alliaceae	* *Allium triquetrum*				X
	* *Nothoscordum gracile*	X			
Amaranthaceae	*Alternanthera nodiflora*		X		
Anarthriaceae	*Anarthria* sp.	X			
	Lyginia barbata	X			
Apiaceae	* *Foeniculum vulgare*		X		X
	Homalosciadium homalocarpum	X			
	Pentapeltis peltigera	X			
	Platysace compressa	X			
	Xanthosia candida	X			
	Xanthosia huegelii	X			
Apocynaceae	* *Gomphocarpus fruticosus*				X
Araceae	* *Zantedeschia aethiopica*				X
Asparagaceae	*Chamaescilla corymbosa*	X			
	Dichopogon capillipes	X			
	Dichopogon sp.	X			
	Laxmannia ramosa	X			
	Lomandra brittanii	X			
	Lomandra caespitosa	X			
	Lomandra hermaphrodita	X			
	Lomandra integra	X			
	Lomandra micrantha	X			
	Lomandra ?micrantha	X			
	Lomandra nigricans	X			
	Lomandra preissii	X			
	Lomandra purpurea	X			
	Lomandra sericea	X			
	?*Lomandra spartea*	X			
	Sowerbaea laxiflora	X			
	Thysanotus dichotomus	X			
	Thysanotus multiflorus	X			
	Thysanotus patersonii	X			
	Thysanotus thyrsoideus	X			
Asteraceae	* *Arctotheca calendula*	X	X		X
	* *Conzya* sp.	X			
	* *Cotula coronopifolia*				X
	Craspedia variabilis	X			
	* *Dittrichia graveolens*				X
	* *Erigeron bonariensis*	X			
	* *Hypochaeris glabra*	X			X

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Asteraceae	* *Hypochaeris radicata*				X
(continued)	*Lagenophora huegelii*	X			
	Olearia paucidentata	X			
	Senecio sp.	X			
	* *Sonchus asper*	X			X
	* *Sonchus oleraceus*	X	X		X
	* *Sonchus* sp.		X		
	* *Ursinia anthemoides*	X			X
	Asteraceae sp.				X
Boryaceae	*Borya nitida*	X			
Campanulaceae	*Lobelia tenuior*	X			
	* *Monopsis debilis* var. *depressa*				X
Caryophyllaceae	* *Petrorhagia dubia*	X			
	* *Spergula arvensis*				X
Casuarinaceae	*Allocasuarina huegeliana*	X			X
	Allocasuarina humilis	X			
	Allocasuarina sp.		X		
	Casuarina obesa		X		
Celastraceae	*Stackhousia monogyna*	X			
	Tripterococcus brunonis	X			
Colchicaceae	*Burchardia umbellata*	X			
Cyperaceae	*Cyathochaeta avenacea*	X			X
	Cyathochaeta clandestina	X			
	* *Cyperus eragrostis*		X		X
	* *Cyperus laevigatus*				X
	* *Cyperus tenellus*				X
	Eleocharis acuta				X
	Eleocharis keigheryi (T)			X	
	Isolepis cernua var. *setiformis*				X
	* *Isolepis prolifera*		X		
	Lepidosperma longitudinale		X		
	Lepidosperma sp.	X			
	Lepidosperma squamatum	X			
	Lepidosperma squamatum (narrow form)	X			
	Lepidosperma tenue	X			
	Lepidosperma tetraquetrum	X			
	Mesomelaena tetragona	X			
	Morelotia australiensis (T)			X	
	Morelotia octandra	X	X		

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Cyperaceae	*Netrostylis capillaris*	X			
	?*Schoenus curvifolius*	X			
Dasypogonaceae	*Dasypogon bromeliifolius*	X			
	Kingia australis	X	X		X
Dennstaedtiaceae	*Pteridium esculentum*	X			
Dilleniaceae	*Hibbertia acerosa*	X			
	Hibbertia amplexicaulis	X			
	Hibbertia commutata	X			
	Hibbertia huegelii	X			
	Hibbertia hypericoides	X			
	Hibbertia lasiopus	X			
	Hibbertia stellaris	X			
	Hibbertia subvaginata	X			
	Hibbertia sp.	X			
Droseraceae	*Drosera erythrorhiza*	X			
	Drosera glanduligera	X			
	Drosera macrantha	X			
	Drosera macrophylla	X			
	Drosera stolonifera	X			
Elaeocarpaceae	*Tetratheca hirsuta*	X			
Ericaceae	*Andersonia gracilis* (T)			X	
	Andersonia sprengelioides	X			
	Astroloma ciliatum	X			
	Astroloma pallidum	X			
	Astroloma sp.	X			
	Conostephium pendulum	X			
	Leucopogon capitellatus	X			
	Leucopogon propinquus	X			
	Leucopogon verticillatus	X			
	Styphelia tenuiflora	X			
Euphorbiaceae	* *Euphorbia terracina*		X		
	Monotaxis grandiflora	X			
	Stachystemon vermicularis	X			
Fabaceae	*Acacia barbinervis*	X			
	Acacia crassistipula	X			
	* *Acacia decurrens*				X
	Acacia drummondii	X			
	Acacia ?extensa				X
	Acacia huegelii	X			

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Fabaceae (continued)	*Acacia lateriticola*	X			
	Acacia nervosa				X
	Acacia oncinophylla	X			
	Acacia preissiana	X			
	Acacia pulchella	X	X		X
	Acacia saligna	X	X		X
	Acacia scabra	X			
	Acacia stenoptera	X			
	Acacia truncata	X			
	Acacia urophylla	X			
	Acacia willdenowiana	X			
	Aotus ericoides	X			
	Bossiaea aquifolium	X			
	Bossiaea eriocarpa	X			
	Bossiaea ornata	X			
	Chorizema dicksonii	X			
	Chorizema ilicifolium	X			
	Chorizema rhombeum	X			
	Daviesia cordata	X			
	Daviesia decurrens	X			
	Daviesia divaricata	X			
	Daviesia horrida	X			
	Daviesia incrassata	X			
	Daviesia nudiflora	X			
	Daviesia preissii	X			
	Daviesia rhombifolia	X			
	* *Dipogon lignosus*		X		X
	* *Erythrina x sykesii*		X		
	Gompholobium capitatum	X			
	Gompholobium knightianum	X			
	Gompholobium polymorphum	X			
	Gompholobium tomentosum	X			
	Hovea chorizemifolia	X			
	Hovea trisperma	X			
	Jacksonia furcellata	X			
	Jacksonia sternbergiana	X	X		
	Kennedia coccinea	X			
	Kennedia prostrata	X			
	Labichea punctata	X			
	* *Lotus angustissimus*	X	X		X
	* *Lupinus angustifolius*				X
	* *Lupinus cosentinii*	X			
	Mirbelia dilatata	X			
	Gastrolobium capitata	X			
	Paraserianthes lophantha	X			
	Sphaerolobium vimineum	X			

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Fabaceae	* *Trifolium angustifolium*				X
(continued)	* *Trifolium arvense*	X			
	* *Trifolium fragiferum*		X		
	* *Trifolium repens*				X
	Viminaria juncea		X		X
Gentianaceae	* *Centaurium erythraea*	X			
Geraniaceae	* *Erodium botrys*				X
	Erodium ?botrys	X			
	Geranium sp.	X			
Goodeniaceae	*Dampiera coronata*	X			
	Dampiera linearis	X			
	Dampiera sp.	X			
	Lechenaultia biloba	X			
	Scaevola calliptera	X			
	Scaevola repens	X			
	Scaevola striata	X			
Haemodoraceae	*Anigozanthos manglesii*	X			
	Conostylis aculeata	X			
	Conostylis aculeata subsp. *preissii*				X
	Conostylis juncea	X			
	Conostylis serrulata	X			
	Conostylis setigera	X			
	Conostylis setosa	X			
	Haemodorum discolor	X			
	Haemodorum laxum	X			
	Haemodorum paniculatum	X			
	Haemodorum ?simulans	X			
	Haemodorum spicatum	X			
	Phlebocarya ciliata	X			
Haloragaceae	*Gonocarpus cordiger*	X			
Hemerocallidaceae	*Agrostocrinum scabrum*	X			
	Caesia micrantha	X			
	Dianella revoluta	X			
	Stypandra glauca	X			
	Tricoryne elatior	X			X
Iridaceae	* *Gladiolus* sp.		X		
	* *Moraea flaccida*	X			X
	Orthrosanthus laxus	X			
	Patersonia occidentalis	X			
	Patersonia pygmaea	X			

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Iridaceae	* *Romulea rosea*	X	X		X
(continued)	*Watsonia meriana* var. *bulbillifera*		X		X
Juncaceae	* *Juncus articulatus*		X		
	* *Juncus bufonius*				X
	Juncus pallidus	X	X		X
	Juncus subsecundus	X			
Juncaginaceae	*Cycnogeton lineare*				X
Lamiaceae	*Hemiandra pungens*	X			
	Hemigenia incana	X			
	* *Mentha pulegium*		X		
	Mentha sp.				X
Lauraceae	*Cassytha aurea*	X			
	Cassytha glabella	X			
	Cassytha ?glabella				X
	Cassytha racemosa		X		
	Cassytha sp.	X			
Linaceae	* *Linum trigynum*	X			
Loganiaceae	*Logania serpyllifolia*	X			
	Logania vaginalis	X			
Loranthaceae	*Nuytsia floribunda*	X	X		
Lythraceae	* *Lythrum hyssopifolia*		X		
Malvaceae	* *Brachychiton populneus*	X			
	Lasiopetalum floribundum	X			
	Thomasia sp.	X			
Moraceae	* *Ficus carica*		X		
	Ficus sp.				X
Myrtaceae	*Agonis flexuosa*				X
	Astartea fascicularis	X			
	Baeckea camphorosmae	X			
	Callistemon phoeniceus				X
	Calothamnus quadrifidus subsp. *quadrifidus*				X
	Calothamnus sp.	X			
	Corymbia calophylla	X	X		X
	Darwinia citriodora	X			X
	* *Eucalyptus botryoides*		X		X
	* *Eucalyptus camaldulensis*		X		X

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Myrtaceae	*Eucalyptus citriodora*	X			
(continued)	*Eucalyptus ?maculata*	X			
	Eucalyptus marginata	X	X		X
	Eucalyptus nicholii		X		
	Eucalyptus rudis	X			X
	Eucalyptus rudis subsp. *rudis*		X		
	Eucalyptus sp.		X		X
	Homalospermum firmum		X		
	Hypocalymma angustifolium	X			
	Hypocalymma cordifolium	X			
	Hypocalymma robustum	X	X		
	Kunzea baxteri	X			
	Kunzea glabrescens		X		
	Kunzea recurva	X	X		
	Leptospermum erubescens	X			
	* *Melaleuca armillaris* subsp. *armillaris*				X
	Melaleuca densa		X		
	Melaleuca incana	2			
	Melaleuca lateritia		X		X
	Melaleuca nesophila		X		
	Melaleuca osullivanii		X		X
	Melaleuca preissiana	X	X		X
	Melaleuca rhaphiophylla	X	X		X
	Melaleuca scabra	X			
	Melaleuca aff. *scabra* (Perth Region)	X			
	Melaleuca thymoides	X			
	Melaleuca trichophylla	X			
	Melaleuca viminea		X		
	Melaleuca viminea subsp. *viminea*				X
	Melaleuca sp.				X
	Pericalymma ellipticum	X			
	Scholtzia involucrata	X			
	Taxandria linearifolia	X	X		X
	Verticordia densiflora		X		
	Verticordia pennigera	X			
Oleaceae	* *Olea europaea*	X			
Orchidaceae	*Caladenia flava*	X			
	Caladenia longicauda	X			
	Caladenia huegelii (T)	X		X	
	* *Disa bracteata*				X
	Diuris longifolia	X			
	Diuris drummondii (T)			X	
	Diuris micrantha (T)			X	
	Diuris purdiei (T)			X	
	Drakaea elastica (T)			X	

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Orchidaceae (continued)	*Elythranthera brunonis*	X			
	Elythranthera emarginata	X			
	Microtis sp.	X			
	Pterostylis barbatus	X			
	Prasophyllum sp.	X			
	Pyrorchis nigricans	X			
	Thelymitra crinita	X			
	Orchidaceae sp.	X			
Orobanchaceae	* *Orobanche minor*	X			X
Oxalidaceae	* *Oxalis corniculata*	X			
	* *Oxalis purpurea*	X			
	Oxalis sp.	X			
Papaveraceae	* *Fumaria capreolata*				X
Phyllanthaceae	*Phyllanthus calycinus*	X			
Pinaceae	* *Pinus pinaster*				X
	* *Pinus radiata*		X		
	* *Pinus* sp.		X		
Pittosporaceae	*Billadieria fraseri*	X			
	?*Billardiera fusiformis*	X			
	Billardiera variifolia	X			
	Billardiera sp.	X			
Plantaginaceae	* *Callitriche stagnalis*				X
Poaceae	* *Aira caryophyllea*	X	X		X
	Amphibromus nervosus				X
	* *Arundo donax*		X		
	Austrodanthonia caespitosa	X			
	Austrostipa sp.	X			
	* *Avena barbata*	X	X		
	* *Avena fatua*				X
	* *Brachypodium distachyon*				X
	* *Briza maxima*	X	X		X
	* *Briza minor*	X	X		X
	* *Bromus diandrus*		X		X
	Bromus ?rubens				X
	* *Cenchrus clandestinus*				X
	* *Cenchrus setaceus*				X
	* *Cortaderia selloana*		X		
	* *Cynodon dactylon*		X		X
	* *Ehrharta calycina*		X		

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Poaceae	* *Ehrharta longiflora*	X			X
(continued)	*Eragrostis cumingii*				X
	* *Eragrostis curvula*		X		X
	* *Hordeum hystrix*				X
	* *Hordeum marinum*		X		
	Lachnagrostis filiformis				X
	* *Lagurus ovatus*		X		
	* *Lolium perenne*				X
	* *Lolium temulentum*		X		
	Neurachne alopecuroidea	X			
	* *Paspalum dilatatum*		X		X
	* *Pennisetum clandestinum*		X		
	* *Pennisetum macrourum*		X		
	* *Phalaris angusta*		X		X
	* *Phalaris aquatica*				X
	Poa poiformis	X			
	* *Polypogon monspeliensis*		X		X
	Tetrarrhena laevis	X			
	Vulpia myuros				X
	Vulpia sp.	X			X
	Poaceae sp.	X	X		X
Polygalaceae	*Comesperma scoparium*	X			
	Comesperma virgatum	X			
	Comesperma volubile	X			
	Persicaria decipiens		X		
	Persicaria hydropiper				X
	Persicaria ?hydropiper		X		
	* *Polygonum arenastrum*		X		
	* *Rumex conglomeratus*				X
	* *Rumex crispus*		X		
	* *Rumex ?crispus*	X			
	* *Rumex pulcher*		X		
	* *Rumex ?pulcher*				X
	* *Rumex* sp.	X			
Primulaceae	* *Lysimachia arvensis*	X			X
Proteaceae	*Adenanthos barbiger*	X			
	Adenanthos meisneri	X			
	Banksia attenuata	X			
	Banksia dallanneyi var. *dallanneyi*		X		
	Banksia grandis	X			
	Banksia littoralis	X	X		X
	Banksia menziesii	X			
	Banksia armata	X			
	Banksia bipinnatifida	X			

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FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Proteaceae (continued)	*Banksia dallanneyi*	X			
	Conospermum stoechadis	X			
	Grevillea bipinnatifida	X			
	Grevillea pilulifera	X			
	Grevillea quercifolia	X			
	Grevillea wilsonii	X			
	Hakea amplexicaulis	X			
	Hakea ceratophylla	X			
	Hakea cyclocarpa	X			
	Hakea lissocarpha	X			
	Hakea ruscifolia	X			
	Hakea stenocarpa	X			
	Hakea trifurcata	X			
	Hakea varia		X		X
	Isopogon asper	X			
	Isopogon dubius	X			
	Lambertia echinata subsp. *occidentalis* (T)			X	
	Persoonia elliptica	X			
	Persoonia longifolia	X			
	Persoonia saccata	X			
	Petrophile linearis	X			
	Petrophile media	X			
	Petrophile seminuda	X			
	Petrophile striata	X			
	Synaphea petiolaris	X			
	Synaphea stenoloba (T)			X	
	Synaphea sp. Fairbridge Farm (D. Papenfus 696) (T)			X	
	Synaphea sp. Pinjarra Plain (A.S. George X7X82) (T)			X	
	Synaphea sp. Serpentine (G.R. Brand X03) (T)			X	
	Xylomelum occidentale	X			
Pteridaceae	*Cheilanthes austrotenuifolia*	X			
	Cheilanthes distans	X			
Ranunculaceae	*Clematis pubescens*	X			
	Ranunculus colonorum	X			
	* *Ranunculus muricatus*				X
	Ranunculus sp.	X			
Restionaceae	*Desmocladus fasciculatus*	X			X
	Hypolaena exsulca	X			
	Lepidobolus preissianus	X			
	Leptocarpus scariosus	X			
	Loxocarya striata	X			
	Loxocarya sp.	X			
	Leptocarpus coangustatus		X		

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED AT ALCOA WAGERUP FARMLANDS, WAGERUP, NOVEMBER 2021

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DPaW 2018). ** PMST - Protected Matter Search Tool using 10 km radius centred on survey area (DAWE 2022a)

FAMILY	SPECIES	MCPL (2003)	MCPL (2011)	PMST**	2021
Rhamnaceae	*Trymalium floribundum*	X			
	Trymalium ledifolium	X			
Rosaceae	* *Rubus laudatus*				X
Rubiaceae	*Opercularia apiciflora*	X			
	Opercularia hispidula	X			
	Opercularia vaginata	X			
	Opercularia echinocephala	X			
Rutaceae	*Boronia denticulata*	X			
	Philotheca spicata	X			
Sapindaceae	*Dodonaea ceratocarpa*	X			
Scrophulariaceae	* *Bellardia viscosa*				X
Solanaceae	*Anthocercis gracilis* (T)			X	
	* *Solanum linnaeanum*	X			
	* *Solanum nigrum*	X			X
Stylidiaceae	*Stylidium amoenum*	X			
	Stylidium brunonianum	X			
	Stylidium bulbiferum	X			
	Stylidium calcaratum	X			
	Stylidium carnosum	X			
	Stylidium hispidum	X			
	Stylidium piliferum	X			
	Stylidium schoenoides	X			
Thymelaeaceae	*Pimelea ciliata*	X			
	Pimelea imbricata	X			
	Pimelea rosea	X			
	Pimelea suaveolens	X			
	Pimelea sulphurea	X			
Typhaceae	*Typha domingensis*		X		
	Typha orientalis				X
Violaceae	*Hybanthus floribundus*	X			
	Hybanthus sp.	X			
Xanthorrhoeaceae	*Xanthorrhoea gracilis*	X			X
	Xanthorrhoea preissii	X	X		X
Zamiaceae	*Macrozamia riedlei*	X			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT WITHIN THE SURVEY AREA

Refer to Appendix A for BC Act / DBCA Priority List and EPBC Act conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; GES – Geraldton Sandplains; JAF – Jarrah Forest; WAR – Warren

TAXON	FAMILY	CONSERVATION STATUS		DESCRIPTION AND HABITAT	POTENTIAL TO OCCUR IN SURVEY AREA
		BC ACT / DBCA PRIOIRTY LIST	EPBC ACT		
Andersonia gracilis	Ericaceae	T	EN	Habit: Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Flowers: white-pink-purple Flowering period (indicated in green): J F M A M J J A **S O N** D Soils & habitat: White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps. IBRA Distribution: GES, SCP Florabase records: 31	Low Undisturbed preferred soil and habitat combination not expected within survey area. The nearest record of the taxon is approximately 110km north of the survey area.
Anthocercis gracilis	Solonaceae	T	VU	Habit: Erect, spindly shrub, to 0.6(-1) m high. Flowers: Yellow-green Flowering period (indicated in green): J F M A M J J A **S O** N D Soils & habitat: sand or loam, granite outcrops IBRA Distribution: AW, JAF Florabase records: 29	Low Preferred soil and habitat combination not expected within survey area.
Caladenia huegelii (T)	Orchidaceae	T	EN	Habit: Tuberous, perennial, herb, 0.25-0.6 m high Flowers: green, cream and red Flowering period (indicated in green): J F M A M J J A **S O** N D Soils & habitat: Grey or brown sand, clay loam. *Banksia* woodland with dense understorey (DAWE 2008) IBRA Distribution: JAF, SCP Florabase records: 41	Low Preferred soil and vegetation type not expected within the survey area.

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT WITHIN THE SURVEY AREA

Refer to Appendix A for BC Act / DBCA Priority List and EPBC Act conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; GES – Geraldton Sandplains; JAF – Jarrah Forest; WAR – Warren

TAXON	FAMILY	CONSERVATION STATUS		DESCRIPTION AND HABITAT	POTENTIAL TO OCCUR IN SURVEY AREA
		BC ACT / DBCA PRIOIRTY LIST	EPBC ACT		
Diuris drummondii	Orchidaceae	T	VU	Habit: Tuberous, perennial, herb, 0.5-1.05 m high. Flowers: yellow Flowering period (indicated in green): J F M A M J J A S O **N** **D** Soils & habitat: Low lying depressions, swamps IBRA Distribution: AVW, JAF, SCP, WAR Florabase records: 53	Low Undisturbed preferred soil and habitat combination not expected within survey area.
Diuris micrantha	Orchidaceae	T	VU	Habit: Tuberous, perennial, herb, 0.3-0.6 m high Flowers: Yellow and brown Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils & habitat: Brown loamy clay. Winter-wet swamps, in shallow water IBRA Distribution: JAF, SCP Florabase records: 8	Low Undisturbed preferred soil and habitat combination not expected within survey area.
Diuris purdiei	Orchidaceae	T	EN	Habit: Tuberous, perennial, herb, 0.15-0.35 m high Flowers: yellow Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils & habitat: Grey-black sand, moist. Winter-wet swamps. IBRA Distribution: JAF, SCP Florabase records: 26	Low Undisturbed preferred soil and habitat combination not expected within survey area.

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT WITHIN THE SURVEY AREA

Refer to Appendix A for BC Act / DBCA Priority List and EPBC Act conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; GES – Geraldton Sandplains; JAF – Jarrah Forest; WAR – Warren

TAXON	FAMILY	CONSERVATION STATUS		DESCRIPTION AND HABITAT	POTENTIAL TO OCCUR IN SURVEY AREA
		BC ACT / DBCA PRIOIRTY LIST	EPBC ACT		
Drakaea elastica	Orchidaceae	T	VU	Habit: uberous, perennial, herb, 0.12-0.3 m high. Flowers: red, green and yellow Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils & habitat: White or grey sand. Low-lying situations adjoining winter-wet swamps. IBRA Distribution: SCP Florabase records: 19	Low Undisturbed preferred soil and habitat combination not expected within survey area.
Eleocharis keigheryi	Cyperaceae	T	VU	Habit: Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flowers: green Flowering period (indicated in green): J F M A M J J **A** **S** **O** **N** D Soils & habitat: Clay, sandy loam. Emergent in freshwater: creeks, claypans. IBRA Distribution: AVW, GES, JAF, SCP Florabase records: 57	Low Undisturbed preferred soil and habitat combination not expected within survey area.
Lambertia echinata subsp. *occidentalis*	Proteaceae	T	EN	Habit: Prickly, much-branched, non-lignotuberous shrub, to 3 m high Flowers: yellow Flowering period (indicated in green): J **F** M **A** M J J A S O N **D** Soils & habitat: White sandy soils over laterite, orange/brown-red clay over ironstone. Flats to foothills, winter-wet sites IBRA Distribution: SCP Florabase records: 13	Low Preferred soil and habitat combination not expected within survey area. The nearest record of this taxon is approximately 85 km south of the survey area.

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT WITHIN THE SURVEY AREA

Refer to Appendix A for BC Act / DBCA Priority List and EPBC Act conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; GES – Geraldton Sandplains; JAF – Jarrah Forest; WAR – Warren

TAXON	FAMILY	CONSERVATION STATUS		DESCRIPTION AND HABITAT	POTENTIAL TO OCCUR IN SURVEY AREA
		BC ACT / DBCA PRIOIRTY LIST	EPBC ACT		
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Proteaceae	T	CE	Habit: Dense, clumped shrub, to 0.3 m high, to 0.4 m wide Flowers: yellow Flowering period (indicated in green): J F M A M J J A S **O** N D Soils & habitat: Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses. IBRA Distribution: JAF, SCP Florabase records: 31	Low Preferred soil and habitat combination not expected within survey area.
Synaphea sp. Pinjarra Plain (A.S. George 17182) (T)	Proteaceae	T	EN	Habit: Erect, clumped shrub (sub-shrub), to 0.8 m high Flowers: yellow Flowering period (indicated in green): J F M A M J J A **S O N** D Soils & habitat: Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains. IBRA Distribution: SCP Florabase records: 63	Medium Preferred soil and habitat potentially present within the survey area but not previously recorded in local surveys (MCPL 2001, 2003, 2011, 2018)
Synaphea sp. Serpentine (G.R. Brand 103) (T)	Proteaceae	T	CE	Habit: Erect compact shrub, 0.3 – 0.6 m high (unconfirmed) Flowers: yellow Flowering period (unknown): J F M A M J J A S O N D Soils & habitat: clay-loam, wetland, seasonally inundated areas (unconfirmed) IBRA Distribution: SCP Florabase records: 36	Medium Preferred soil and habitat potentially present within the survey area. One record of this taxon exists within 500 m of the south eastern boundary of the survey area.

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT WITHIN THE SURVEY AREA

Refer to Appendix A for BC Act / DBCA Priority List and EPBC Act conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; GES – Geraldton Sandplains; JAF – Jarrah Forest; WAR – Warren

TAXON	FAMILY	CONSERVATION STATUS		DESCRIPTION AND HABITAT	POTENTIAL TO OCCUR IN SURVEY AREA
		BC ACT / DBCA PRIOIRTY LIST	EPBC ACT		
Synaphea stenoloba	Proteaceae	T	EN	Habit: Caespitose shrub, 0.3-0.45 m high. Flowers: yellow Flowering period (indicated in green): J F M A M J J **A S O** N D Soils & habitat: Sandy or sandy clay soils. Winter-wet flats, granite. IBRA Distribution: SCP Florabase records: 51	Medium Preferred soil and habitat potentially present within the survey area. Records of this taxon exists within 500 m of the south eastern boundary of the survey area.
Morelotia australiensis	Cyperaceae	T	VU	Habit: Perennial (short-lived) tufted herb, 0.3–1.3 m high; Flowers: yellow-green to pinkish-brown Flowering period (unknown): J F M A M J J A S O N D Soils & habitat: Usually in winter-wet swampy depressions, drainage lines or sandy rises adjacent swamps, growing in grey sand over clay or clayey lateritic soils. In open *Corymbia calophylla* or *Eucalyptus marginata* woodland over low shrubs, herbs and sedges. IBRA Distribution: JAF, SCP Florabase records: 36	Medium Preferred soil and habitat potentially present within the survey area. One record of this taxon exists within 500 m of the south eastern boundary of the survey area.

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED BY SITE AT ALCOA WAGERUP FARMLANDS, WAGERUP, NOVEMBER 2021

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2018).

FAMILY	SPECIES	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	OPPO
Alliaceae	* *Allium triquetrum*						X																									
Apiaceae	* *Foeniculum vulgare*			X																												
Apocynaceae	* *Gomphocarpus fruticosus*											X														X		X				
Araceae	* *Zantedeschia aethiopica*											X																X				
Asteraceae	* *Arctotheca calendula*	X	X																											X	X	
	* *Cotula coronopifolia*																X							X	X			X				
	* *Dittrichia graveolens*																X															
	* *Hypochaeris glabra*					X			X				X										X						X			
	* *Hypochaeris radicata*	X	X					X			X																			X		
	* *Sonchus asper*	X	X	X				X			X		X		X	X	X		X		X		X			X				X		
	* *Sonchus oleraceus*	X	X		X	X		X			X		X		X			X	X		X									X		
	* *Ursinia anthemoides*																												X			
	Asteraceae sp.											X																				
Brachypodium	* *Brachypodium distachyon*	X		X																												
Campanulaceae	* *Monopsis debilis* var. *depressa*										X																				X	
Caryophyllaceae	* *Spergula arvensis*			X																												
Casuarinaceae	*Allocasuarina huegeliana*									X																X						
Cyperaceae	*Cyathochaeta avenacea*					X								X																		
	* *Cyperus eragrostis*			X			X				X		X		X	X	X		X		X		X					X				
	* *Cyperus laevigatus*					X					X											X										
	* *Cyperus tenellus*		X																													
	Eleocharis acuta											X									X			X		X		X				
	Isolepis cernua var. *setiformis*											X												X				X		X		

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED BY SITE AT ALCOA WAGERUP FARMLANDS, WAGERUP, NOVEMBER 2021

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2018).

FAMILY	SPECIES	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	OPPO
Dasypogonaceae	*Kingia australis*		X			X					X					X	X		X												
Fabaceae	* *Acacia decurrens*															X						X										X
	Acacia ?extensa															X																
	Acacia nervosa																						X									
	Acacia pulchella	X				X							X	X	X				X			X	X									
	Acacia saligna								X		X																				X	
	* *Dipogon lignosus*										X																					
	* *Lotus angustissimus*	X	X		X	X		X	X	X	X	X			X		X			X		X	X	X		X		X		X	X	
	* *Lupinus angustifolius*																												X			
	* *Trifolium angustifolium*																						X						X			
	* *Trifolium repens*	X	X			X																X	X					X	X			
	Viminaria juncea																					X	X									
Geraniaceae	* *Erodium botrys*																						X									
Haemodoraceae	*Conostylis aculeata* subsp. *preissii*													X																		
Hemerocallidaceae	*Tricoryne elatior*													X																		
Iridaceae	* *Romulea rosea*								X								X			X									X			
	* *Watsonia meriana* var. *bulbillifera*				X								X		X	X	X	X				X	X									
Iridaceae	* *Moraea flaccida*																										X					
Juncaceae	* *Juncus bufonius*																							X								
	Juncus pallidus		X	X			X								X		X	X	X	X	X			X		X		X		X		
Juncaginaceae	*Cycnogeton lineare*																								X							
Lamiaceae	* *Mentha* sp.		X									X																X				

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED BY SITE AT ALCOA WAGERUP FARMLANDS, WAGERUP, NOVEMBER 2021

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2018).

FAMILY	SPECIES	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	OPPO
Lauraceae	*Cassytha ?glabella*																								X			X				
Moraceae	* *Ficus* sp.						X	X																								
Myrtaceae	*Agonis flexuosa*																														X	
	* *Callistemon phoeniceus*				X																					X						
	Calothamnus quadrifidus subsp. *quadrifidus*																												X		X	
	Corymbia calophylla		X			X		X	X		X		X	X	X	X			X			X				X					X	
	Darwinia citrodora						X																									
	* *Eucalyptus botryoides*								X	X										X												
	* *Eucalyptus camaldulensis*									X		X								X							X					
	Eucalyptus marginata		X			X								X																		
	Eucalyptus rudis						X	X														X	X			X			X		X	
	Eucalyptus sp.																												X			
	* *Melaleuca armillaris* subsp. *armillaris*									X								X														
	Melaleuca lateritia		X												X		X									X		X				
	Melaleuca osullivanii											X																				
	Melaleuca preissiana	X		X							X															X	X					
	Melaleuca rhaphiophylla				X		X	X					X								X	X	X	X	X			X				
	Melaleuca viminea subsp. *viminea*																			X												
	Melaleuca rhaphiophylla														X																	
	*Melaleuca s*p.																									X						
	Taxandria linearifolia						X																									
Orchidaceae	* *Disa bracteata*																												X			
Orobanchaceae	* *Bellardia viscosa*																									X						
	* *Orobanche minor*																									X			X			
Papaveraceae	* *Fumaria capreolata*			X							X																					
Pinaceae	* *Pinus pinaster*																X															

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED BY SITE AT ALCOA WAGERUP FARMLANDS, WAGERUP, NOVEMBER 2021

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2018).

FAMILY	SPECIES	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	OPPO
Plantaginaceae	* *Callitriche stagnalis*																								X			X				
Poaceae	* *Aira caryophyllea*																						X									
	Amphibromus nervosus																											X				
	* *Avena fatua*		X	X				X			X		X		X	X	X		X	X	X		X			X			X			
	* *Brachypodium distachyon*	X	X										X		X	X	X	X	X						X							
	* *Briza maxima*	X	X	X	X	X			X					X	X	X		X	X				X										
	* *Briza minor*	X	X		X				X						X		X					X	X			X						
	* *Bromus diandrus*		X	X	X	X		X	X		X				X	X	X	X	X	X	X	X					X		X		X	
	* *Bromus ?rubens*								X																							
	* *Cenchrus clandestinus*				X			X	X	X	X				X	X	X	X	X		X	X									X	
	* *Cenchrus setaceus*	X	X	X	X	X			X		X		X	X			X					X										
	* *Cynodon dactylon*		X	X											X		X				X											
	* *Ehrharta longiflora*	X	X	X				X			X		X		X	X						X			X	X			X			
	Eragrostis cumingii																X															
	* *Eragrostis curvula*	X			X				X					X									X	X					X			
	* *Hordeum hystrix*	X											X			X								X	X		X	X		X		X
	* *Lachnagrostis filiformis*		X																													
	* *Lolium perenne*																X															
	* *Paspalum dilatatum*																									X		X				
	* *Phalaris angusta*												X																			
	* *Phalaris aquatica*																												X			
	* *Polypogon monspeliensis*																						X									
	* *Vulpia myuros*												X																			
	* *Vulpia* sp.																															
	Poaceae sp.		X																					X		X						
Polygonaceae	*Persicaria hydropiper*										X																					
	* *Rumex conglomeratus*						X			X														X		X		X				
	Rumex ?pulcher																								X	X	X	X		X		
Primulaceae	* *Lysimachia arvensis*	X		X							X											X	X									

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED BY SITE AT ALCOA WAGERUP FARMLANDS, WAGERUP, NOVEMBER 2021

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2018).

FAMILY	SPECIES	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	OPPO
Proteaceae	*Banksia littoralis*	X																														
	Hakea varia											X																				
Ranunculaceae	* *Ranunculus muricatus*																							X	X			X		X		
Restionaceae	*Desmocladus fasciculatus*													X																		
Rosaceae	* *Rubus laudatus*			X																												
Solanaceae	* *Solanum nigrum*	X	X	X				X			X		X		X																	
Typhaceae	*Typha orientalis*											X																				
Xanthorrhoeaceae	*Xanthorrhoea gracilis*					X								X																		
	Xanthorrhoea preissii					X								X	X			X														