ASSESSMENT OF FLORA AND VEGETATION ON WORSLEY MINE EXPANSION PRIMARY ASSESSMENT AREA

Prepared for

South32 Worsley Alumina Pty Ltd

Prepared by

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Mattiske Consulting Pty Ltd

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ABBREVIATIONS

The following abbreviations are used throughout this document:

BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity and Conservation Act 2016*
BOM	Commonwealth Bureau of Meteorology
BTC	Bauxite Transport Corridor
CALM	Department of Conservation and Land Management
CBME	Contingency Bauxite Mining Envelope
DAFWA	Department of Agriculture and Food, Western Australia
DAWE	Department of Agriculture, Water and the Environment (formerly the Department of the Environment and Energy)
DBCA	Department of Biodiversity, Conservation and Attractions
DPaW	Department of Parks and Wildlife, Western Australia
DPIRD	Department of Primary Industries and Regional Development
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
ESCAVI	Executive Steering Committee for Australian Vegetation Information
IBRA	Interim Biogeographical Regionalisation for Australia
Mattiske	Mattiske Consulting Pty Ltd
NVIS	National Vegetation Information System
PAA	Primary Assessment Area
PEC	Priority Ecological Community
RFA	Regional Forest Agreement Area
RLA	Refinery Lease Area
South32	South32 Worsley Alumina Pty Ltd
SVT	Site-Vegetation Type
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
WAH	Western Australian Herbarium
WAOL	Western Australian Organism List
WMDE	Worsley Mining Development Envelope

1. SUMMARY

South32 Worsley Alumina (Worsley) is proposing an expansion to current mining operations, as shown in Figure 1. Bauxite is mined and crushed at the Boddington Bauxite Mine (BBM) and transported by overland conveyor to the Collie Refinery. At the Refinery, the crushed bauxite is processed into white alumina powder and then transported by rail to Bunbury Port, where it is shipped to smelters around the world.

The Worsley Mine Expansion Primary Assessment Area (PAA) for the flora and vegetation assessment includes the expansion of the existing mining areas at the BBM within the Worsley Mining Development Envelope (WMDE); the development of a Bauxite Transport Corridor (BTC), the development of a Contingency Bauxite Mining Envelope (CBME) and maintenance work at the Refinery near Collie (ML1SA) and the development of associated mine/support infrastructure. This proposal area includes extensive areas previously surveyed for the flora and vegetation values over some 40 years by Dames and Moore (1981) and the E.M. Mattiske and Associates (1985 to 1994) and Mattiske Consulting Pty Ltd teams (1994 to 2019). During this time the botanists have undertaken botanical studies including baseline flora and vegetation mapping, targeted searches, and monitoring of control and rehabilitated areas with a minimum of 100 to 120 person days or 1000 to 1200 hours in the field each year by the Mattiske team alone over the 40 years which was exceeded when targeted flora and vegetation mapping efforts were undertaken. As the early baseline work was undertaken before the regular use of GPS units it is only possible to estimate the distance of the foot traverses. This work also includes multiple assessments of representative control and rehabilitation plots (initially 40m x 40m for trees and 4 x 5m quadrats for understorey in the initial flora and vegetation studies (Phase 1 and 2, Dames and Moore 1981 and Worsley Alumina Pty Ltd 1985) and then initially 50m x 50m tree plots (pre 1994) and understorey transects (quadrats every 5m on transects varying from 50m to 100m) and later 20m x 20m for trees and 20 x 2m x 2m quadrats in 20m x 20m plots post 1993). Each year the foot traverses would exceed some 100 to 120 person days over 40 years multiplied by 4 to 5 kilometres per day. The estimated traverses covering flora and vegetation studies would be in the range of 16,000km to 24,000km and as such would be far more if the targeted flora and vegetation studies and the vegetation gridding work was included which alone exceeded 3000km (based on an average of 200m spacing). The gridding work was a minimum of 200m grid lines ranging down to 25m gridline spacing in the main footprint of the Boddington Gold Mine. This multiple approach of plots, regular grid recordings and targeted searching pre-dated the EPA expectations and as such exceeded expectations as much as 35 years or more before regulators introduced standards. The results presented in this report consolidate the key flora and vegetation values within the proposed WMDE, BTC and CBME.

Previously unsurveyed areas within the WMDE and BTC were surveyed in November 2018 and the results were combined with the extensive findings over the four decades in the area. The wider mapped areas in the Boddington area covered 54241.66ha, the larger WMDE areas covered 27796.26ha, the BTC covered 4145.54ha. At the same time the background information available on the CBME (746.55ha) was updated to align with current taxonomic nomenclature and listings of species and communities.

This assessment supplements earlier baseline flora and vegetation surveys of the Mt Saddleback area since the 1980's (Worsley Alumina Pty Ltd 1985), more recent studies on the Quindanning Timber Reserve (Mattiske Consulting Pty Ltd 1993), Marradong Timber Reserve (Mattiske Consulting Pty Ltd 1990), the Collie Refinery area (1999, 2014) and other areas of agricultural holdings, State Forest and forested areas near the Boddington operations. Additional studies were undertaken on the heath communities, the Quindanning Timber Reserve, the Collie area and the rehabilitation areas.

Flora

Since the early 1980's, a total of 1031 vascular plant taxa from 83 families and 319 genera have been recorded on the wider Boddington surveyed areas and 289 vascular plant species from 54 plant families and 149 genera have been recorded in the main baseline studies undertaken in the Collie RLA, Appendices G and H, Table 3. The latter total numbers included 132 introduced species and 5 planted species in the Boddington area and 15 introduced species and 1 planted species in the Collie RLA.

Potential Threatened and Priority Flora

Desktop searches of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database, the Department of Biodiversity, Conservation and Attractions (DBCA) *NatureMap* database, and where available the Western Australian Herbarium (WAH) and Threatened and Priority Flora (TPFL) databases, have identified the potential occurrence of 87 conservation significant flora species within 20km of the WMDE and BTC, and 33 conservation significant flora species within 20km of the CBME. This information, together with a literature review of all available datasets from previous flora and vegetation surveys for the Worsley BBM and Refinery, has formed the basis of a likelihood assessment for conservation significant flora within the proposed PAA.

Recorded Threatened and Priority Flora

One threatened flora (*Caladenia hopperiana*) pursuant to Schedule 1 of the BC Act and the EPBC Act has been recorded within the WMDE. Currently this species is relatively restricted within the proposed PAA to a localised area in the south-eastern section of the WMDE. The *Caladenia hopperiana* was formerly recorded as *Caladenia* sp. Quindanning (K. Smith & P. Johns 231) (DBCA 2019a). These latter populations will be protected from clearing by the designation of Protected Areas by Worsley.

Of the identified potential conservation significant species, 21 (one Threatened and 20 Priority flora species) have been recorded within the proposed WMDE and BTC. One Priority flora species has been recorded previously within the RLA and one occurred on the fringes of the CBME. Of the Priority species, the most significant species include the *Gastrolobium* sp. Prostrate Boddington (M. Hislop 2130) (Priority 1), which is mainly concentrated on the lower slopes near the Hotham River (which overlaps with the BTC and the WMDE) and the eastern anomaly north of the current Boddington Gold Mine camp on the lower valley slopes (located outside the PAA), and the twelve Priority flora species which are associated with the heath communities. In relation to the Priority flora species, the most significant species in the heath communities is the very localised and restricted *Papistylus intropubens* (P1), with this species only recorded from the Tunnell Road heath community. The Tunnell Road heath community is located within a designated Protected Area from mining operations. The latter group of Priority flora species in the heath communities may occur within a range of heath communities that have some affinities with the Priority Ecological Community (PEC) (Priority 1) – Mt Saddleback Heath Communities as delineated by DBCA. The Mt Saddleback Heath Communities PEC was listed after mining commenced within the Saddleback Timber Reserve and was initially only associated with the Tunnell Road Heath community. Some of the species within the heath communities extend into other heath communities well beyond the boundary of the PAA and others such as the *Papistylus intropubens* (P1) are restricted to localised areas such as Tunnell Road heath. There is an association between the heath communities on the granite outcrop areas and the Cooke vegetation complex as defined by Heddle *et al*. (1980) and Mattiske and Havel (1998) where more extensive outcropping occurs.

Of the recorded species the geographically restricted species were the Threatened species (*Caladenia hopperiana*) and Priority species (*Gastrolobium* sp. Prostrate Boddington (M Hislop 2130) (P1), *Isopogon* sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin) (P1), *Papistylus intropubens* (P1), *Banksia subpinnatifida* var*. subpinnatifida* (P2), *Goodenia katabudjar* (P3) and *Stylidium marradongense* (P3)). The species recorded near and within the RLA at Collie are more widespread in the northern and central Jarrah forests and the potential threatened and priority flora species near the Collie RLA are not restricted to the local area.

A comparison of species recorded in forest control plots and rehabilitation areas on the Boddington mining operational areas has been undertaken. To date 408 taxa have been recorded on both the control and rehabilitation areas and as such this represents some 81.77% of the species on the rehabilitation areas that are in common with the control areas. The number on the rehabilitation areas exceeds that on the control areas largely as more sampling has been undertaken on the rehabilitated areas and also many taxa were only identified to the genus level (due to seedling size or lack of flowering and fruiting material).

A total of 132 introduced flora species have been recorded in the wider lease areas near Boddington and Collie. A total of 115 introduced species have been recorded since 1980 on agricultural and rehabilitated

areas in the WMDE and BTC and 37 introduced species on control areas in the WMDE and BTC areas. The range of species on the control areas includes remnant vegetation areas on private properties and the less disturbed areas within the WMDE and BTC. A total of 15 introduced flora species have been recorded within the CBME area.

The majority of the weeds are short term annual species that establish on disturbed agricultural lands and although some establish in the early phase of rehabilitation, the majority are quickly outgrown by more perennial and larger native shrub and tree species. The number of weed species is influenced by the inclusion of agricultural lands in the Boddington area which have been cleared and highly modified for generations.

Of the potential introduced flora species the following are Declared Plants under the *Biodiversity and Agricultural Management Act 2007* (BAM Act) (Department of Primary Industries and Regional Development (DPIRD) 2020), namely:

- **Gomphocarpus fruticosus* – near Collie Refinery on previously cleared agricultural lands (DPAW 2020a; DAWE 2020a) and in survey areas by Bennett (2008).
- **Silybum marianum* – near Collie Refinery in Phase One (Danes and Moore 1981); although not recorded in recent assessments of CBME by Mattiske Consulting.
- **Asparagus asparagoides*– near Boddington and Collie areas on previously cleared agricultural lands and on disturbed areas on fringes of cleared land, plantations and roadsides on fringes of roadside. (DPAW 2020a; DAWE 2020a); and not recorded in recent 2019 assessments of CBME by Mattiske Consulting (2020c).
- *Moraea flaccida* – was recorded at 6 locations near Boddington on agricultural areas westwards and outside the WMDE and BTC areas; most records were made in 2009 with a few in 2012 and 2013.

With the exception of the *Moraea flaccida* on Hotham Farm and cleared agricultural lands south of the Pinjarra-Williams Road, the latter declared plants have not been recorded in the assessments on the surveyed areas in recent assessments (2019).

At a regional scale Heddle *et al.* (1980) and Mattiske and Havel (1998) defined and mapped a series of vegetation complexes that enabled a refinement of the vegetation mapping of Beard (1979) and Smith (1974) for Pinjarra and Collie areas respectively. The latter work of Beard has been updated recently into Beard *et al.* (2013) for the State of Western Australia. The approach developed by Heddle *et al.* (1980) and Mattiske and Havel (1998) enabled relationships to be defined between the resulting regional patterns of vegetation and the underlying landforms, soils and climatic trends in the southwest forests. In the three areas assessed for the Proposal, the following vegetation complexes were recorded:

- **WMDE** – 9 vegetation complexes, Cooke, Coolakin, Dwellingup 4, Michibin, Pindalup, Swamp, Williams, Yalanbee 5 and Yalanbee 6. Of these complexes the Michibin and Williams complex areas are less represented (<10%) in all DBCA managed lands (5.1% and 0.3% respectively) (Government of Western Australia 2019). The latter mainly relates to their occurrence in valley systems that have been developed for agriculture on the eastern fringes of the Darling Ranges.
- **BTC** – 5 vegetation complexes, Cooke, Dwellingup 4, Michibin, Pindalup and Williams. Of these complexes the Michibin and Williams complex areas are less represented (<10%) in all DBCA managed lands (5.1% and 0.3% respectively) (Government of Western Australia 2019). The latter mainly relates to their occurrence in valley systems that have been developed for agriculture on the eastern fringes of the Darling Ranges.
- **CBME** – 3 vegetation complexes, Dwellingup 1, Murray 1 and Yarragil 1. All of these complexes are represented in all DBCA managed lands >10% (Government of Western Australia 2019).

At a finer scale of local mapping the following presents the site-vegetation types for the WMDE, BTC and CBME. This method of mapping was developed based on the earlier ecological studies of Havel (1975a

and 1975b) who delineated a series of site-vegetation types that integrated the structural and floristic components (including key indicator species) with the underlying soil and site conditions. This approach was developed further by initially Dames and Moore (1981) and later Mattiske (1985 to 2018). In the three areas assessed for the Proposal, the following site-vegetation types were recorded:

- **WMDE** – 34 site-vegetation types were defined for the WMDE area. The dominant site-vegetation types (>200ha) were M, P, PS, S, H, H2, ST, Y, Z AY and D. Large sections of the WMDE have been cleared for agriculture and plantations. The majority of the WMDE area is either completely degraded (45.41%) or degraded (14.99%). The restricted site-vegetation types include swamp vegetation types (A1, A2), on the lower slopes (AD, AY/D, B, DG), on the outcropping areas (G1, G2, G4, R) and on the moister slopes (PW, SW, W, YG).
- **BTC** – 25 site-vegetation types were defined for the BTC area. The dominant site-vegetation types (>100ha) were H and M. Large sections of the BTC have been cleared for agriculture and plantations. A large portion of the BTC is either completely degraded (27.38%) or degraded (5.84%). The restricted site-vegetation types include specific types on the slopes (H2, M2), on the lower slopes (AD, AY/D, DG), on the outcropping areas (G1, G3, G4) and on the moister slopes (PW).
- **CBME** – 10 site-vegetation types were defined for the CBME. The dominant site-vegetation types (>100ha) were S and ST. The majority of the CBME was relatively undisturbed, with the exception of the dam, rehabilitated and completely degraded cleared areas (31.64%). The restricted site-vegetation types include specific types on the lower slopes (CQ), flats (E) and slopes (SP). All site-vegetation types in the CBME are well represented in nearby State Forest areas and conservations areas (e.g., Wellington National Park).

Locally significant communities within the WMDE, BTC and CBME areas include the following:

- The Priority 1 PEC - Mt Saddleback Heath Communities, as delineated by DBCA, occurs in the Saddleback area near Boddington within the WMDE but not within the BTC. This PEC community on Mt Saddleback has affinities with selected components of the site-vegetation type G as defined by Havel (1975b) and as refined and split into site-vegetation types G1, G2, G3, G4 and G5 by Mattiske in the northern Jarrah Forest areas and more specifically G1, G3 and G4 in the PAA areas by Mattiske (Worsley Alumina Pty Ltd 1985 to Mattiske in prep 2020). Some of these site-vegetation types extend well beyond the Mt Saddleback area, e.g., north of the Boddington Gold Mine and on the eastern fringes of the State Forest. The occurrence of the majority of the Priority species in the heath communities reinforces the significance of these areas and in particular Tunnell Road Heath and heath communities on Forty-Hollow Road and Mt Saddleback. There remain differences in the various G site-vegetation types and hence variations related to the occurrence and dominance of different structural components and species in the heath communities (G1 and G3) and those (G4 and G5) that also have patches of mallee *Eucalyptus* species (*Eucalyptus latens, Eucalyptus drummondii* and *Eucalyptus aspersa*). The predominantly heath community in the Tunnell Road heath area for example also supports a few stands of *Melaleuca preissiana* and *Corymbia calophylla* trees and a few patches of *Eucalyptus drummondii.*
- The G2 site-vegetation type that occurs on granite in association with Rock Sheoak (*Allocasuarina huegeliana*), heath communities and lithic complexes occurs on the WMDE and the wider mapped areas near Boddington.
- The communities that are a mixture of different site-vegetation types over shallow granites (DG, HG, YG and MG) occur in the WMDE and the wider mapped areas near Boddington.
- The M2 site-vegetation type which supports woodlands of *Eucalyptus accedens*, *Eucalyptus wandoo, Eucalyptus marginata* and *Corymbia calophylla* on eastern breakaways. The M2 site-vegetation type occurs in the WMDE, BTC and the wider mapped areas near Boddington. This site-vegetation type occurs eastwards on the upper slopes and ridges of the Eastern Jarrah Forest.
- A, AY, AX, AC Types – Woodlands of *Eucalyptus rudis* and *Melaleuca* species on the swamps and creeklines that provide linkages for fauna species and a variety of plant species on variable

soils in the survey areas. These site-vegetation types occur in the WMDE, BTC and the wider mapped areas near Boddington

- The restricted L site-vegetation type that supports a woodland of *Eucalyptus patens* and *Eucalyptus wandoo* occurs in the WMDE and WMDE/BTC overlap areas and the wider mapped areas near Boddington.
- The Y site-vegetation type that is often associated with the occurrence of the *Gastrolobium* sp. Prostrate Boddington (M. Hislop 2130), particularly on the lower slopes near the Hotham River and north on broader clay loam valley lower slopes. This site-vegetation type is well represented in the wider areas and occurs in the WMDE, BTC and the wider mapped areas near Boddington.

The majority of the site-vegetation types that occur on the Collie RLA are locally well represented in State Forest and conservations areas (e.g., Wellington National Park).

Overall, the vegetation communities mapped and species recorded in the WMDE, BTC and CBME were consistent with the historical mapping of Mattiske as reflected in the earlier work of Havel (1975a and 1975b) in the northern Jarrah Forest and also the more recent mapping by Mattiske since the Phase Two studies on the Mt Saddleback area (Worsley Alumina Pty Ltd 1985; E.M. Mattiske and Associates 1986 to 1993; Mattiske Consulting ty Ltd 2012a to 2012c). As sections of the PAA are either completely degraded or degraded, the potential impact on local flora values should be minimal in a regional context as the heath and valley communities that support the majority of the conservation significant species will not be impacted directly by most proposed expansion activities.

2. BACKGROUND

Mattiske Consulting Pty Ltd (Mattiske) was commissioned in 2019 by South32 Worsley Alumina Pty Ltd (South32) to summarise previous flora and vegetation surveys for the proposed Worsley Mine Expansion Primary Assessment Area (PAA) (the Proposal). The PAA consists of the Worsley Mining Development Envelope (WMDE) and the Bauxite Transport Corridor (BTC) in the Boddington area and the Contingency Bauxite Mining Envelope (CBME) in the Collie area at the South32 Worsley Refinery. This scope of work also involved an updated desktop re-assessment of areas in the Boddington and Collie areas that had already been assessed on numerous occasions (see Appendix A). The amalgamation of the previous baseline flora and vegetation surveys was undertaken in the spring months of 2019 and in January 2020 as part of this reporting to enable an overview and update of the flora and vegetation values to assist in the assessment process.

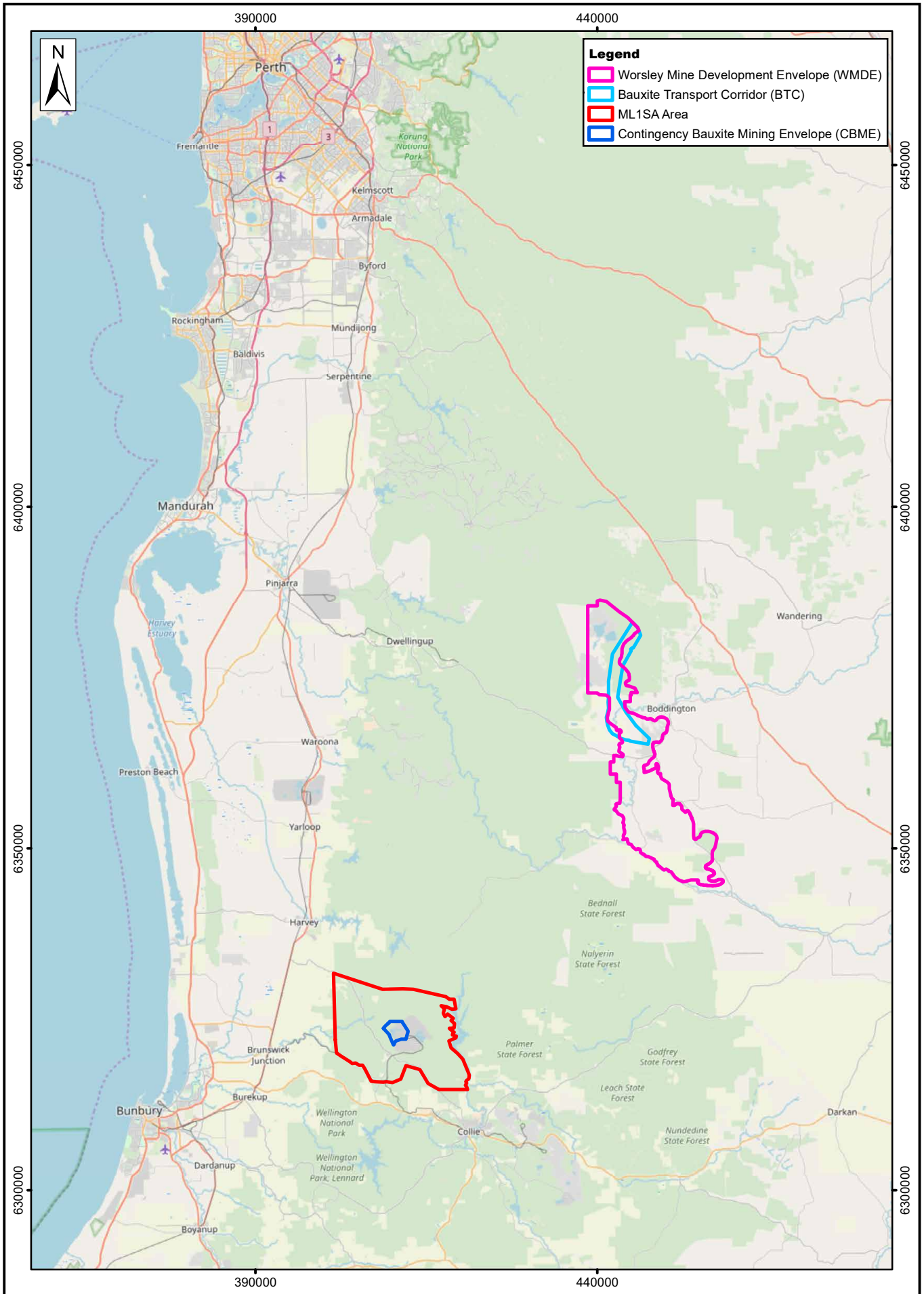
2.1 Location and Scope of Proposal

The proposed PAA is located approximately 120 km south east of Perth and is situated across multiple properties located between Boddington, the eastern edge of the Boddington Bauxite Mine (BBM) and just north of Quindanning to the Refinery northwest of Collie, Western Australia (Figure 1).

2.2 Climate

Havel (1975a) characterised the climate of the Northern Jarrah Forest as typically Mediterranean with a predominance of winter rainfall. Beard (1990) subsequently described the climate of the Dale Botanical Subdistrict (within the Northern Jarrah Forest subregion) as somewhat drier than the Southern Jarrah Forest which has an average rainfall of 600 – 1200 mm per annum.

The average maximum and minimum temperature for Wandering and Wokalup (near Collie) generally followed seasonal patterns of cool winters and hot summers. Average rainfall for Marradong and Collie reflected higher rainfalls in the more westerly Collie area when compared with the easterly Marradong/Boddington area. There was a seasonal peak of rainfall in the winter months and lower rainfall recordings in the summer months.



Basemap: OpenStreetMap

0 7.5 15 km

Scale: 1:750,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_01

Date: February 2020 | Rev: A | A4

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Locality

Figure: **1**

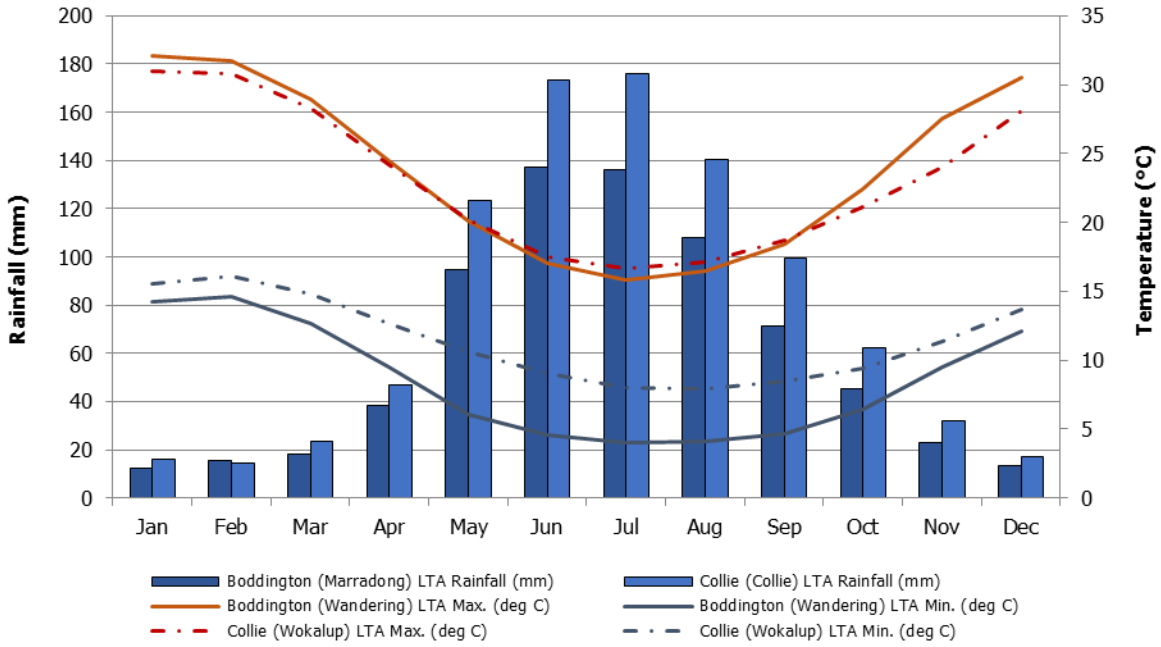


Figure 2: Rainfall (Collie and Marradong) and temperature (Wokalup and Wandering) data for the respective Boddington and Collie areas (Bureau of Meteorology 2020)

2.3 Soils and Topography

The soils of the Dale Botanical Subdistrict can be broadly defined as lateritic gravels consisting of up to 5 m or more of ironstone gravels in a yellow, sandy matrix. Related to these are the lateritic podzolic soils with ironstone gravels in a sandy surface horizon, overlying a mottled yellow-brown clay subsoil (Beard 1990). The region overlies an ancient plateau landform and has an average elevation of 300 m which is broken sporadically by nonconforming monadnocks such as Mt Cooke, Mt Dale and Mt Saddleback which reach up to 582 m (Havel 1975a; Beard 1990).

Churchward and McArthur (1980) defined a series of landform and soil mapping units for the Darling System which included the northern and central Jarrah Forest. As a result the following landform and soil units were defined and occurred in the Boddington and Collie areas respectively, namely:

Boddington Area (WMDE and BTC)

Cooke (Ce) – Hills rising above general plateau level; mainly mantled by laterite but with some rock outcrop.

Dwellingup (D) – Gently undulating landscape with duricrust on ridges, sand and gravels in shallow depressions.

Yalanbee (Y) – Gently undulating landscape dominated by fine gravels; some duricrust on ridges.

Michibin (Mn) – Moderate slopes with yellow duplex soils and some rock outcrop.

Coolakin (Ck) – Valleys of the eastern part of the plateau; sandy and gravelly duplex soils on the slopes, narrow valley floors, some rock outcrop.

Pindalup (Pn) – Valleys of the central part of the plateau; gravelly duplex soils on slopes; some rock outcrop; grey sands, duplex yellow soils and orange earths in broad floors.

Williams (W) – Terraces with yellow duplex soils.

Collie Area (CBME)

Dwellingup (D) – Gently undulating landscape with duricrust on ridges, sand and gravels in shallow depressions.

Murray (My) – Deeply incised valleys with red and yellow earths on slopes; narrow alluvial terraces.

Yarragil (Yg) – Valleys of the western part of the plateau; sandy gravels on the slopes; orange earths in swampy floors.

The vegetation complexes as delineated by Heddle *et al.* (1980) and Mattiske and Havel (1998) were linked to these latter landforms and soils as there were strong relationships between the resulting vegetation and the underlying landform and soil types at a regional scale.

2.4 Regional Vegetation

The Northern Jarrah Forest, specifically the Dale Botanical Subdistrict has been extensively described over the past 100 years by several authors (Diels 1906; Speck 1958; Havel 1975a; Beard 1979; Beard 1990, Smith 1974). Smith defined and mapped the vegetation on the Collie sheet at a scale of 1:250,000 and Beard defined and mapped the vegetation on the Pinjarra sheet at a scale of 1:250,000.

Havel (1975a, 1975b) summarised a number of the major ecological projects undertaken within the area, from Diels's (1906) original plant geography work in 1906 through to Kimber's study of the relationship between the root systems of the Jarrah plant and non-seasonal water loss in 1974. Beard (1990) again built on this framework and further defined the vegetation of this region in his botanical survey of Western Australia.

Diels (1906) and Speck (1958) both recognised that the Eastern range of the Jarrah Forest (in which the BBM, and hence the WMDE and BTC, is located) contains a comparatively poorer range of species when compared to the Western reaches of the forest. This poorer range of species across the Eastern range can be related to a decrease in rainfall from West to East. Speck (1958) split the Jarrah Forest into two broad vegetation systems; The Darling System and the Bannister System. The Darling System was described as "prime" Jarrah Forest which covers the Darling Scarp and contains youthful streams with an average annual rainfall of over 890 mm. The Bannister System which covers the Eastern Jarrah Forest, in comparison was associated with a mean annual rainfall of 520 – 1000 mm and no youthful streams.

Comparisons between climatic and edaphic factors and their relationships with trees within the region have been made since Lange (1960) attempted to relate these factors to the distribution of tree species within the Narrogin district. Additional work by Churchill (1961; 1968) addressed the influence of climatic conditions on the distribution of species, also undertaken more recently as part of the regional vegetation mapping program for the Regional Forest Agreement by Mattiske and Havel (1998). The latter studies relied on the conceptual climatic zoning developed by Gentilli (1989) for the Jarrah Forest areas.

Beard (1990) described the Jarrah Forest as one of only two forest formations in Western Australia. As would be expected, Jarrah (*Eucalyptus marginata*) is the dominant tree species within this area and is commonly found in association with Marri (*Corymbia calophylla*) in varying proportions. Maximum forest heights range from less than 25 m in the Eastern range of the Jarrah Forest to heights of greater than 30m in the Western range (Havel 1975a; Abbott & Loneragan 1986). Beard, as well as other researchers noticed that with the exception of creeklines and areas with significantly higher/lower than average rainfall amounts, no other tree species enters the canopy of the forest. Several smaller tree species (10 – 15 m tall) occur in the forest including, Bull Banksia (*Banksia grandis*), Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*).

The forest understorey is comprised of a variety of shrub species which range from 1 – 2 m in height and have an average density of 185 plants/ha. Commonly occurring species include; *Adenanthos barbiger*, *Grevillea wilsonii*, *Trymalium ledifolium*, *Xanthorrhoea preissii*, *Macrozamia riedlei* and *Hypocalymma angustifolium*. Beard (1990) described the Eastern range of the Jarrah Forest as being

typically lower and more open woodland, with *Allocasuarina huegeliana* and *Acacia acuminata* occurring amongst the tree species. An association between tree species and the 500 mm isohyet line was also made obvious in this study with Beard noting the absence of Jarrah and the presence of Powderbark Wandoo (*Eucalyptus accedens*) east of this line. Understorey species also vary in these areas with *Gastrolobium spinosum*, *Calothamnus quadrifidus* and *Leptospermum erubescens* becoming more common.

Species which occur within the northern Jarrah Forest were analysed by Havel (1975a and 1975b) and as a result a range of indicator species were delineated in relationship with particular site parameters that subsequently led to a classification of 21 site-vegetation types which are relevant for the northern Jarrah Forest area.

The vegetation occurring within the South32 Worsley Alumina Pty Ltd tenements have been defined at different scales since 1981. The regional scale of definition includes the vegetation complexes as defined by Heddle *et al*. (1980) and Mattiske and Havel (1998); which were linked to the series of landform and soil mapping units as developed by Churchward and McArthur (1980) as summarised in Section 2.3 above. There is a change from west to east in terms of climatic conditions and underlying landforms and soils and the latter is reflected in the shift from taller denser forests within the CBME area on clay loams to more open and lower forests and woodlands on the clay loams and lateritic soils in the WMDE and BTC areas. The rainfall is lower in the eastern WMDE and BTC areas as compared with the western CBME areas. This decrease in rainfall and hence availability of soil moisture influences the resulting structure and composition of the forests and woodlands.

2.5 Site-Vegetation Types

A range of site-vegetation types have been defined and mapped by Mattiske for Worsley Alumina Pty Ltd (Dames and Moore 1981; Worsley Alumina Pty Ltd 1985; E.M. Mattiske and Associates (1985 to 1993) and Mattiske Consulting Pty Ltd (1994 to 2018). These site-vegetation types have been related to the site-vegetation types as defined by Havel (1975a and 1975b). The majority of the species which occur within the mining areas fall into the Proteaceae, Fabaceae, Myrtaceae and Asteraceae families (Worsley Alumina Pty Ltd 1985). With specific reference to trees, the areas in which the mining areas fall into are expected to have stand densities of approximately 300 trees/ha which increases to 500 – 600 trees/ha if seedlings are included.

2.6 Western Australia's Flora – A Legislative Perspective

Western Australia has a unique and diverse flora, and is recognised as one of the world's 34 biodiversity hotspots (Myers et al. 2000). In this context, Western Australia possesses a high degree of species richness and endemism. This is particularly pronounced in the south-west region of the state. The Department of Biodiversity, Conservation and Attractions (DBCA) flora statistics indicate that there are currently over 12,000 native plant species known to occur within Western Australia (DBCA 2020a). Scientific knowledge of many of these species is limited.

The legislative protection of flora within Western Australia is principally governed by three Acts. These are the:

- *Biodiversity Conservation Act 2016* (BC Act; replaced the *Wildlife Conservation Act 1950*);
- *Environmental Protection Act 1986* (EP Act); and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The unique flora of Western Australia is potentially under threat due to historical clearing practices associated with agricultural, mining and human habitation activities. As a consequence of these historical clearing practices a number of flora species have become threatened or have the potential to become threatened as their habitat is impacted by human activity. Some areas of the State have been

affected by past clearing practices such that entire ecological communities are under threat. The following sections describe these threatened and priority flora and ecological communities, and outline the legislative protection afforded to them.

At the State level, the BC Act provides for taxa of native flora (and fauna) to be specially protected because they are subject to identifiable threats. Protection of these taxa has been identified as being warranted because they may become extinct, are threatened, or are otherwise in need of special protection. Ecological communities that are deemed to be threatened are afforded protection under the EP Act. Listings of threatened species and communities are reviewed annually by the Western Australian Threatened Species Scientific Committee (TSSC). The TSSC reviews threatened and specially protected flora (and fauna) listings on an annual basis. Recommendation for additions or deletions to the listings of specially protected flora (and fauna) is made to the Minister for the Environment by the TSSC, via the Director General of the DBCA, and the WA Conservation Commission. Under Schedules 1-3 of the BC Act 2016, the Minister for the Environment may declare a class or description of flora to be threatened flora throughout the State, by notice published in the *Government Gazette* (DBCA 2020b).

At the Commonwealth level, under the EPBC Act, a nomination process exists to list a threatened species or ecological community. Additions or deletions to the lists of threatened species and communities are made by the Minister for the Environment, on advice from the Federal Threatened Species Scientific Committee. The EPBC Act lists threatened flora and ecological communities published on the Department of Agriculture, Water and the Environment (DAWE) website (2020a).

2.7 Threatened and Priority Flora

In December 2016, the new *BC Act* was proclaimed and enacted to replace the *Sandalwood Act 1929* and the *Wildlife Conservation Act 1950* in 2019.

Flora within Western Australia that is considered to be under threat may be classed as either threatened flora or priority flora. Where flora has been gazetted as threatened flora under the BC Act, it is an offence "to take" such flora without the written consent of the Minister. The BC Act states that "to take" flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora constitute species which are considered to be under threat, but where there is insufficient information available concerning their distribution and/or populations to make an evaluation of their conservation status. The DBCA categorises Priority flora according to their conservation priority, using four categories, P1 to P4, to denote the conservation priority status of such species, with P1 listed species being the most threatened, and P4 the least. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Appendices B1.2 and B1.3 sets out definitions of both threatened and Priority flora (DBCA 2020a, 2020b).

At the Commonwealth level, under the EPBC Act, threatened species can be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent, by the Commonwealth Minister of the Environment. Refer to Appendix B1.1 for a description of each of these categories of threatened species. Under the EPBC Act, a person must not take an action that has or will have a significant impact on a listed threatened species without approval from the Commonwealth Minister of the Environment, unless those actions are not prohibited under the Act.

The current EPBC Act list of threatened flora may be found on the Department of Agriculture, Water and the Environment website (DAWE 2020a).

2.8 Threatened and Priority Ecological Communities

An ecological community is defined as a naturally occurring biological assemblage that occurs in a particular type of habitat composed of specific abiotic and biotic factors. At the State level, ecological

communities may be considered as threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. Threatened Ecological Communities (TECs) are gazetted as such under the BC Act. There are three State categories of threatened ecological communities, or TECs: critically endangered (CR); endangered (EN); and vulnerable (VU) (DBCA 2020c). A description of each of these categories of TECs is presented in Appendix B2.2. At the Commonwealth level, some Western Australian TECs are listed as threatened, under the EPBC Act. Under the EPBC Act, a person must not take an action that has or will have a significant impact on a listed TEC without approval from the Commonwealth Minister of the Environment, unless those actions are not prohibited under the Act. A description of each of these categories of TECs is presented in Appendix B2.1. The current EPBC Act list of TECs can be located on the DAWE (2020a, 2020b) website.

Ecological communities identified as threatened, but not listed as TECs, can be classified as Priority Ecological Communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. The DBCA categorises PECs according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such ecological communities, with P1 communities being the most threatened and P5 the least. Appendix B2.3 sets out definitions of PECs (DBCA 2020d). A list of current PECs can be viewed at the DBCA (2020d) website.

2.9 Clearing of Native Vegetation

Under the EP Act, the clearing of native vegetation requires a permit to do so, from the Department of Water and Environment Regulation or the Department of Mines, Industry Regulation and Safety, unless that clearing is exempted under specific provisions listed in Schedule 6 of the Act, or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Under the EP Act, "native vegetation" means indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation. Under the EP Act, Section 51A, "clearing" means the killing or destruction of, the removal of, the severing or ringbarking of trunks or stems of, or the doing of any other substantial damage to, some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock, or any other act or activity, that causes any of the aforementioned consequences or results.

The EP Act sets out ten principles, under which native vegetation should not be cleared. These principles state that native vegetation should not be cleared, if:

a. it comprises a high level of biological diversity;

b. it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;

c. it includes, or is necessary for the continued existence of, threatened flora;

d. it comprises the whole or a part of, or is necessary for the maintenance of, a TEC;

e. it is significant as a remnant of native vegetation in an area that has been extensively cleared;

f. it is growing in, or in association with, an environment associated with a watercourse or wetland;

g. the clearing of the vegetation is likely to cause appreciable land degradation;

h. the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;

i. the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or

j. the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 5, sets out prescribed clearing actions that do not require a clearing permit, as defined in Section 51C of the EP Act. However, exemptions under these Regulations do not apply in Environmentally Sensitive Areas (ESA's).

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 6 – "Environmentally sensitive areas" include "the area covered by vegetation within 50 m of threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the threatened flora is located". Similarly, "the area covered by a TEC" is listed as an environmentally sensitive area under Regulation 6.

2.10 Declared (Plant) Pest Organisms

The *Biosecurity and Agriculture Management Act 2007* (BAM Act), Section 22, 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 section 26 (1) of the BAM Act, a person who finds a declared plant pest must report, in accordance with subsection (2), the presence or suspected presence of the declared pest to the Director General or an inspector of the Department of Primary Industries and Regional Development (DPIRD) Western Australia.

Under the *Biosecurity and Agriculture Management Regulations 2013*, declared plant pests 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 (DPIRD 2020). According to section 30 (3) of the BAM Act, the owner or occupier of land, or a person who is conducting an activity on the land, must take the prescribed control measures to control the declared pest if it is present on the land. The current listing of declared pest organisms and their control category is available on the Western Australian Organism List (WAOL), at the Biosecurity and Agriculture Management website of DPIRD (DPIRD 2020).

Weeds of National Significance are listed under the EPBC Act (1999) (DAWE 2020c).

2.11 Local and Regional Significance

Flora or vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government (Environment Protection Authority (EPA) 2004, DBCA 2020b, 2020c, 2020d, DAWE 2020a, 2020b). The updated documents published by the EPA in 2016 (2016a and 2016b) were used in defining factors and values of significance of the findings in 2016.

In regards to flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as Threatened flora or Priority flora, for a variety of reasons, including:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status;
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and
- being poorly reserved.

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

- scarcity;
- unusual species;
- novel combinations of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range); and
- a restricted distribution (EPA 2004).

Vegetation communities are locally significant if they contain Priority flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are restricted to one or two locations or occur as small isolated communities. Vegetation communities that exhibit unusually high structural and species diversity are also locally significant.

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of threatened flora.

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

3. OBJECTIVES

This survey aimed to summarise the flora and vegetation values on the respective areas that have been assessed on multiple occasions throughout the Boddington and Collie areas that overlap with the main mining areas, the mining development areas (WMDE), the transport corridor north of the Mt Saddleback area (BTC) and the contingency area near the Collie Refinery (CBME). The respective areas are delineated in Figure 1 and cover the following respective areas:

- the BBM (BBM - survey area to date near the mining area) of 54241.66 ha;
- the Worsley Mining Development Envelope (WMDE) of 27796.26 ha;
- the Bauxite Transport Corridor (BTC) of 4145.74 ha;
- the Bauxite Contingency Region within the Collie RLA of 2494.33 ha; and
- the Contingency Bauxite Mining Envelope (CBME) of 746.55 ha.

Specifically, the objectives included:

- Undertake a desktop assessment to evaluate the botanical values of the local and broader area associated with the proposed PAA to identify any matters of botanical or conservation significance;
- Review previous literature and current databases associated with the proposed PAA;
- Summarise the flora, vegetation and vegetation condition values as recorded in the PAA in the period from 1980 to 2019;
- Update the status of any conservation significant species and communities;
- Identify and summarise the locations of any declared pest organisms (weeds) within the PAA;

- Review the conservation status of the vascular plant species recorded by reference to current literature and current listings (DPAW 2020a; DBCA 2020b) and plant collections held at the Western Australian State Herbarium, and listed by the Department of Agriculture, Water and the Environment (DAWE 2020a) under the EPBC Act;
- Define and prepare a vegetation map of the vegetation communities within the proposed PAA;
- Define and prepare a vegetation condition map within the proposed PAA;
- Evaluate the distributions of any conservation significant flora recorded within the proposed PAA, and evaluate their local and regional significance;
- Provide descriptions of the vegetation communities present within the proposed PAA, and evaluate their local and regional significance;
- Review the potential presence of old growth forest within the proposed PAA; and
- Prepare a report summarising the findings.

This report is a consolidation of all data from the desktop survey, numerous field surveys (detailed and targeted) and the extensive monitoring program on native vegetation areas and rehabilitation areas over some 40 years. During foot traverses undertaken on regular grid systems associated with the detailed surveys any potential novel or conservation significant (threatened or priority flora) species were collected and identified. The latter exceeded standards and community expectations prior to the EPA guidelines and guidance statements (2016a and 2016b). This report also incorporates the results of surveys undertaken in 2019 and 2020 to provide more complete coverage of the PAA (Mattiske Consulting, 2018) and targeted searches for the recently described Priority 1 *Hibbertia ambita* and Priority flora species in the heath communities. The report also includes the results from the recent 2021 targeted old growth forest desktop assessment and field verification surveys.

4. METHODS

4.1 Desktop Survey

The desktop assessment for the proposed PAA near Boddington and Collie (WMDE, BTC and CBME) was conducted using the DPAW (2020a), DBCA (2020a), and Western Australian Herbarium (database searches and DAWE (2020a) databases. A 20 km search radius about the approximate central point near Boddington Mt Saddleback and Collie Refinery were used as search reference points. The search points for the EPBC Protected Matters Report for the respective areas is summarised below. In view of the extent of the area, the Boddington area was split into two searches in January 2020 and as such slightly different results were extracted when compared with 2018 searches for South 32 Worsley Alumina Pty Ltd.

- Boddington North January 8th 2020 – 116° 24' 46"E 32° 45' 41"S
- Boddington South January 8th 2020 – 116° 27' 54"E 32° 56' 32"S
- Collie January 8th 2020 – 116° 02' 03"E 33° 12' 37"S

The database searches are undertaken regularly as required prior to survey work and monitoring. These databases were utilised to identify the possible occurrence of Threatened and Priority flora, TECs and PECs and any other significant environmental matters within the vicinity of the PAA. In addition to data accessed through NatureMap and Protected Matters Search (DAWE 2020a), results from previous vegetation assessments conducted by Dames and Moore (1981), Bennett Environmental Consulting (2004) and Mattiske (1985 to 2018) were reviewed to provide more detailed information on the local flora and vegetation. Coverage of the Threatened and Priority flora and vegetation community changes over time, both due to natural influences and anthropogenic disturbances, and the currency of species and communities has evolved over the 40 years of botanical studies. It should be noted that some of the historical DBCA records identified from the desktop survey are no longer present as they have been

subject to clearing for agricultural and mining activities. The currency of all plant taxa nomenclature for this current report was verified using FloraBase (DBCA 2020a). Since this report was completed, additional searches have been undertaken on South32 projects and will be integrated into future reporting processes, as the results are finalised.

The database searches enable updates on the recorded species and communities in the respective WMDE, BTC and the CBME. As indicated in Appendix A, there has been substantial baseline studies undertaken over decades near Boddington and Collie. The vast majority of these were recorded regularly in the forest control areas at both sites and have been used to refine and update the seeding and planting of native species in the rehabilitation areas since 1986.

4.2 Detailed Field Survey (Grid Recording Sites, Plots and Quadrats)

The majority of the proposed PAA (WMDE, BTC and CBME) have been previously surveyed and assessed over the period from the early 1980's to 2020 (Figures 3-1 to 3-4). Permanent plots have been assessed also as part of ongoing biological monitoring programs, see Figure 3-2. The majority of the areas were also assessed on a regular grid basis ranging from a 25m x 100m grid to a 100m x 100m grid to a 100m x 200m grid basis, see Figure 3-3 for WMDE and BTC areas. The data presented in Figure 3-3 does not include the survey work on Mt Saddleback as this area was surveyed and mapped undertaken on local grids and prior to the use of GPS equipment in the field. The vegetation of the Mt Saddleback area was mapped and published by Worsley Alumina Pty Ltd (1985) and was based on transects, permanent plots (see control plots on Figure 3-2) and aerial photographic interpretations. Since this earlier work the Mt Saddleback area has included monitoring of permanent control plots (each plot included quadrats, see Appendix C) as well as multiple plots and transects in the rehabilitation areas (with more than 500 quadrats in total per year since 1987 in the transects and plots). As such between the regular grid sampling sites, the plots (with associated quadrats) for the baseline studies and the permanent plots and associated quadrats (for monitoring) and repeating measurement of the plots in most areas the survey effort exceeds the current guidance statement suggestions for detailed studies of the flora and vegetation assessments as defined by the EPA (2016a, 2016b).

The Mattiske Consulting teams have been involved with recording of progress on rehabilitation areas in most years since 1987 at 9 months, 15 months and at 2, 4, 7, 10, 15, 20 and 30 years, as well as monitoring of the forest monitoring plots, baseline control plots and the Tunnell Road heath communities. The botanical studies have been based on monitoring of 114 control plots on the Mt Saddleback Area, 14 plots on the Quindanning Area and 20 plots on the Marradong Area, as well as plots and transects in the additional area to the north that were assessed by Mattiske and the team in the period from 1980 to 2020. More than 740 plots and transects within the rehabilitation areas of the Bauxite Mine operations and the Newmont Boddington Gold Mine have been assessed at different times during the period from 1981 to 2019. Both the control and rehabilitation plots and transects have been regularly assessed on multiple occasions and as such easily exceed the current EPA guidance standards (2016a and 2016b).

Targeted searches for threatened and priority flora have been undertaken during all the surveys and in additional targeted areas that are more likely to support such species (e.g. particular site-vegetation types, in swamps and near granite outcrops). All surveys undertaken have been undertaken in accordance with the Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b) and exceeded current standards well before these standards were introduced. The main gap relates to the lack of population numbers from historical databases as previous records (pre-1980's) did not include or define population numbers. Whilst some of the locations of previous records have been located, many have been lost to agricultural and grazing activities which are well beyond the control of South32.

Additional assessments of flora and vegetation values were undertaken in the spring months of 2019 on the heath communities and in the Quindanning Timber Reserve. The latter involved additional searching for threatened and priority flora and the re-assessment of permanent plots in the Quindanning Timber Reserve. These studies have reinforced the extent of the knowledge in these respective areas and as

such have assisted in updating local information on the heaths and the Quindanning Timber Reserve (Mattiske Consulting Pty Ltd, in preparation). Targeted studies in 2019 and 2020 were undertaken on Priority flora species in the Mt Saddleback, Quindanning, Tunnell Road heath and near the Hotham River.

Additional targeted studies were also undertaken on the potential Threatened and Priority flora in the Collie (CBME) area in the spring months of 2019 and as such supplement earlier extensive flora and vegetation studies on the CBME. In recent years the vegetation studies in this section of the Collie areas have relied on grid surveys and also targeted foot traverses.

Therefore, the Boddington and Collie areas have been studied over decades in multiple seasons. The location of vegetation survey plots or transects (beyond the regular grid sites) of the proposed PAA was selected primarily on the basis of aerial photographic maps and imagery. Additional survey sites were selected *in situ*, based on observations of vegetation types during the field survey.

Wherever possible, a minimum of three vegetation survey plots or transects were established in the same, but discontinuous vegetation site type to enable replication. This enabled the visual confirmation of site-vegetation type boundaries during the field survey, in addition to providing the opportunity to record species that were not located within established survey sampling sites; with particular attention to Threatened and Priority species or other species of conservation significance.

In summary, during the survey period of 1980 to 2020, botanists have undertaken studies including baseline flora and vegetation mapping, targeted searches, monitoring of control and rehabilitated areas with a minimum of 100 to 120 person days or 1000 to 1200 hours in the field each year by the Mattiske team alone over the 40 years. As much of this baseline work was undertaken before the regular use of GPS units it is only possible to estimate the distance of the foot traverses. Each year the foot traverses would exceed some 100 to 120 person days per year over 40 years multiplied by 4 to 5 kilometres per day. The estimated traverses covering flora and vegetation studies would be in the range of 16,000km to 24,000km and as such would be far more if the targeted flora and vegetation studies and the vegetation gridding work was included, which alone exceeded 3000km (based on an average of 200m spacing). The gridding work was a minimum of 200m grid lines ranging down to 25m gridline spacing in the main footprint of the Boddington Gold Mine. The survey effort on the grid systems for the WMDE, the BTC and adjacent areas is summarised in Figure 3-3.

4.3 Grid Recording Sites

As discussed above, a regular grid recording site assessment has been undertaken across the majority of the PAA, as shown in Figure 3-3 (noting the Mt Saddleback domain was also surveyed, although prior to GPS). The grid spacing ranged from a 25m x 100m grid to a 100m x 100m grid to a 100m x 200m grid basis.

The flora and vegetation values were recorded and sampled systematically at each survey recording site on the gridded areas, and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site, a comprehensive range of floristic and environmental parameters were recorded (see Appendix C).

The vegetation condition mapping was based on Keighery (1994) vegetation condition categories. The condition of the areas was based on aerial photographic interpretations and field recordings.

All plant specimens collected during the field survey were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. Plant species were identified through comparisons with pressed specimens housed either at the Mattiske Consulting internal herbarium (which is regularly audited by experienced botanists) or the Western Australian Herbarium. Where required, specialist plant taxonomists were consulted. Nomenclature of species recorded is in accordance with the Western Australian Herbarium (DBCA 2020a). Vouchering of specimens of collections are regularly lodged at the State Herbarium and all potential novel species, threatened and priority flora species are submitted to State Herbarium specialists for re-confirmation and processing at the State Herbarium. The latter is

evident from the Western Australian collections and the species that have been submitted by botanists working on the South32 lease areas.

4.4 Flora and Vegetation Monitoring Plots and Transects

Extensive flora and vegetation monitoring programs have been undertaken over the 40 years ranging from assessing conservation flora species to regular and extensive monitoring of trees and understorey species in the control and rehabilitation areas. This work has included multiple assessments of representative control and rehabilitation plots (initially 40m x 40m for trees and 4 x 5m quadrats for understorey in the initial flora and vegetation studies (Phase 1 and 2, Dames and Moore 1981 and Worsley Alumina Pty Ltd 1985) and then initially 50m x 50m tree plots (pre 1994) and understorey transects (quadrats every 5m on transects varying from 50m to 100m) and later 20m x 20m for trees and 20 x 2m x 2m quadrats in 20m x 20m plots post 1993) (Figure 3-2), Appendix C. Tree data has included measurements on species, diameter at breast height, heights and condition. Understorey data has included measurements on species, density of each species, foliage cover of each species and condition. This data collection included all native and weed species. The weed occurrences were then extracted and mapped in relation to the PAA from the variety of databases for South32.

To date, FMP 147 Control Plots (trees and understorey), MP 398 Rehabilitation Plots (trees and understorey), TP 187 plots (trees only), UT 101 understorey only transects) have been established in the monitoring program. The plots cover the various site-vegetation types in the control areas. In selecting sampling rates in rehabilitated areas the number of plots monitored each year are based on a ratio of approximately 1 plot per 5 hectares of rehabilitation.

(Note: FMP – Forest Monitoring Plot; MP – Monitoring Plot; TP – Tree Plot; UT – Understorey Transect)

The flora and vegetation monitoring data has provided details on both the species and the communities and in particular their site preferences, their regeneration strategies and local knowledge that has assisted in increasing specific knowledge on the respective species and assisted in the management of operational areas. The latter has assisted in targeting the more restricted species such as threatened and priority flora species. In addition, the temporal re-monitoring data has assisted in understanding changes in species and community values in both control and rehabilitation areas.

4.5 Targeted Flora Searches

Targeted flora searches have relied on collation of potential species lists, specific search methodologies for flora species, increasing an understanding of site preferences of flora in relation to underlying landforms and soils, site conditions and also their lifeforms. Over the 40 years, the databases on the respective species have increased substantially as a result of foot traverses, literature and longer-term monitoring programs. Understanding the specific species and where they occur, how they regenerate and distribution patterns is critical to undertaking targeted surveys. In many instances, limited information is available from the literature and Herbarium databases and as such, the amount of effort over the 40 years on specific foot traverses, targeted searches and regular monitoring have increased the knowledge base of the various species.

During foot traverses undertaken on regular grid systems associated with the detailed surveys, any potential novel or threatened species were collected and identified, and recorded. Population numbers relied on both counts in the quadrats, plots and transects as well as extracted presence data from the extensive gridding survey sites in all the areas which relied on ranking scales (see Section 4.2 above) and additional location and presence of species records. The foot traverses during baseline flora and vegetation studies and targeted flora surveys have enabled greater coverage of the flora values over some 40 years. The requirement for population numbers is a recent specification in the guidance statement. As a result of the latter, numbers extracted from earlier results are an under estimate of the population numbers. As ranking of species was undertaken at all recorded sites on grid systems (see Section 4.2 rankings ranged from 0 to 5). As a result of the rankings, it was possible to convert the rankings from 0 to 5 to a minimum conservative population estimate. Earlier Herbarium records at the

State Herbarium provide locality data but not necessarily numbers of plants. The latter effort exceeded standards and community expectations at the time of the various surveys and prior to the EPA guidelines and guidance statements (2016a and 2016b).

Targeted searches have included the systematic searching of the survey area with parallel foot traverses. Botanists walk parallel recording location of plants and number of plants. Where identified, GPS locations were recorded along with number (or density categories), condition and reproductive state of the species.

This approach aligns with other scientific endeavours in Western Australia. The earlier recognition of the relationships of plant species to underlying landforms and soils is reflected in the early settler's ability to select agricultural areas on more fertile soils (e.g., Blackbutt and York Gum in the eastern forests and in the western fringes of the Wheatbelt). One of the challenges met in the South32 lease areas relates to its geographical position on the eastern side of the relatively uncleared Jarrah Forest which interfaces with the largely cleared woodlands of the Wheatbelt to the east. Further many of the flora species of significance reflect the diversity of landforms and soils in the lease areas; many of which have not and will not be subject to the majority of direct or indirect impacts.

The assessment of the likelihood of the threatened and priority flora species occurring in the Boddington and Collie areas was based on FloraBase (DBCA 2020a), experience in the Boddington and Collie areas by the authors and data collected over 40 years in the respective areas.

4.6 Weeds and Introduced Species

All weeds are recorded as part of the baseline surveys and also in the monitoring programs. The weed occurrences were then extracted and mapped in relation to the PAA from the variety of databases, which included baseline mapping, monitoring datasets and observations from South32. These results were then collated, tabulated and mapped for this report. Any species listed under the *Biosecurity and Agriculture Management Regulations 2013 as* declared plant pests were designated on the weed maps prepared (DPIRD 2020) as Declared Pests (s22(2) of the *Biosecurity and Agriculture Management Act 2007* (BAM Act)). Weeds of National Significance are listed by DAWE (2020c) under Federal legislation in the EPBC Act 1999 were also designated on the weed maps. Other species were designated as high ecological impacts on the maps to enable coverage of their representation (i.e., dense or extensive population), although they differ in their invasiveness.

4.7 Vegetation Mapping

The site-vegetation types were defined based on key indicator species, overstorey species and local site parameters (i.e., soil, outcropping, landscape position), as informed by the data collected during the detailed field surveys (refer to Section 4.2). The site-vegetation types as defined and mapped in the eastern Jarrah forests near Mt Saddleback by Mattiske were based on the earlier studies by Havel (1975a, 1975b).

This approach aligns with extensive studies undertaken by Havel and Mattiske over the last 40 years in the southwest forests and in particular, the northern jarrah forest. This approach enabled a more detailed interpretation of not only the flora and vegetation, but also the site parameters that assisted in underpinning our understanding of the site preferences of the respective species. The approach is also aligned with the EPA's guidance on flora and vegetation surveys (EPA 2016c) and builds on more detailed studies in multiple areas within the region which have not been undertaken at localised areas.

The site-vegetation types are defined on the relative proportion (from ranking or abundance data) of key indicator species and then integrated with site parameters. This approach was based on the earlier work by Dr Havel (former Forest Department, pre-CALM, DPAW and DBCA) and Dr Goodall (CSIRO) in order to differentiate the subtle differences in the broader structural types within the southwest forest as defined by Beard (1979, 1990) and Smith (1974) to enable a clearer definition of subtle local changes within the broader forest continuum. The site-vegetation types differ from the floristic association

approach which relies on the flora only. An example of the latter is the subtle differences of the different *Eucalyptus wandoo* (Wandoo) communities, where the presence of Wandoo in the upper layer is only part of the differentiation and using the earlier work of Havel (1975a and 1975b) with the concept simplified to "species must be present", "species may be present" and "species absent" along with the site conditions it is possibly to split the Wandoo community into three main types M, L and Y. The M site-vegetation type occurs on the drier upper slopes with clay loam gravels and associated trees and understorey species that tolerate the drier soil types, L site-vegetation type occurs on the moisture clay-loam soils on lower slopes with *Eucalyptus patens* as a co-dominant tree species in the upper layer and understorey species that reflect the local site conditions and then the Y site-vegetation type that occurs on the moister clay loam-gravel soils on the valley floors and lower slopes which are seasonally moist and understorey species that reflect the local site conditions. This differentiation is defined in greater detail in Figure 20 and Appendix A of Havel's publication (1975a) where groups within the main site-vegetation types are defined. Over the last 40 years Mattiske has refined the original 24 site-vegetation types into a larger number of site-vegetation types with the first letter of those with two letters reflecting the more dominant influence, for example MG reflects the dominance of a Wandoo woodland on the upper slopes with localised patches of outcrop (G type) which have influenced the resulting associated understorey species. The delineation of the other site-vegetation types follows a similar determination process based on Havel (1975a and 1975b).

The latter use of site-vegetation types reflects the need to subdivide the "continuum" within the forest that was not mapped by the earlier botanical researches in the south-west forests such as Beard (1979. 1990) and Smith (1974). The significance of underlying landforms, soils and climatic conditions in determining the vegetation patterns in the south-west forest areas has been addressed in Havel (2000).

4.8 Vegetation Condition Mapping

The condition of the vegetation was based on various layers including data from recording sites, aerial photographic imagery, site-vegetation mapping, dieback layers, old growth layers, harvesting records (DBCA), agricultural activities (including grazing by sheep and clearing for crops), previous clearing for agricultural activities, pine plantations and mining activities and rehabilitation areas on both previously mined areas and agricultural areas. This influenced the resulting determination of boundaries for the condition mapping layers.

4.9 Potential Old Growth Forest

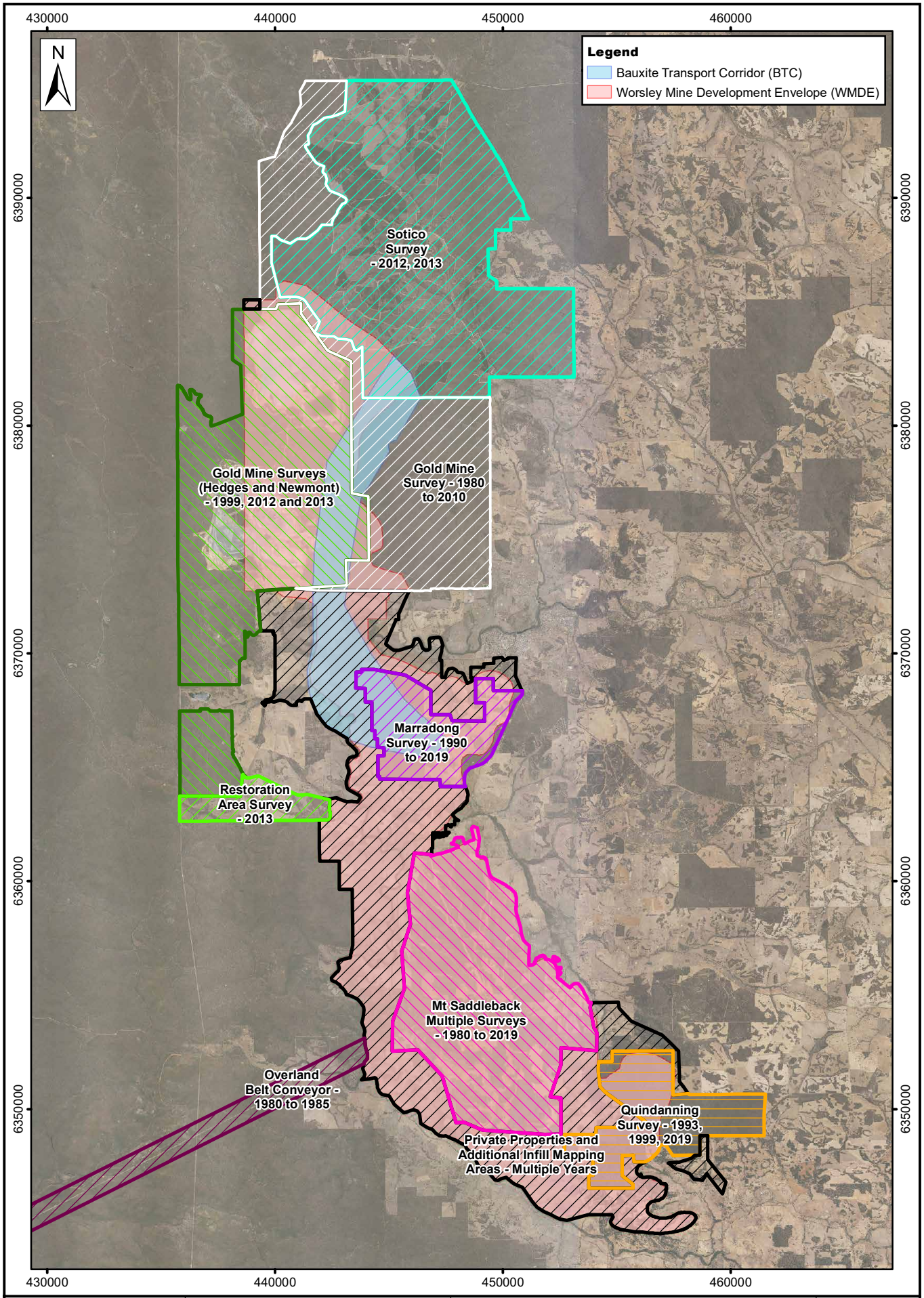
The mapping of potential Old Growth Forest was based on the data layers of site-vegetation type mapping, the vegetation condition mapping, the harvest data (as supplied by DBCA) and Old Growth Forest data (supplied by DBCA, 2020) and previous logging data (collected by Mattiske on the amount of logging debris and number of stumps). Additional data was also considered and included the known occurrence of dieback, fire history and topography (i.e., the steeper slopes that may not have been harvested due to the timber harvesting access difficulties). Although the data varied in collection times, all the layers were combined to inform the assessment of potential Old Growth Forest. The approach was discussed with DBCA prior to the delineation of the boundaries based on the latter databases.

To assist in mapping the coverage of potential Old Growth Forest within the PAA a series of categories were delineated to cover the potential Old Growth Forest areas, namely:

- **Negligible Potential** – areas that have been cleared and rehabilitated or planted with Pines or Eucalypts in plantations.
- **Low** – unlikely to support Eucalypt forests, previous disturbance and degraded native vegetation values. Included pockets of remnant vegetation in farming areas that have been subject to grazing by sheep and cattle.
- **Low – Medium** – areas that have been subject to recent and multiple harvesting activities, with logs and stumps present from previous harvesting activities.

- **Medium** – areas that have some localized pockets that support mature stand and only occasional logs and/or stumps.
- **Medium – High** – areas that have not been subject to obvious recent or frequent harvesting activities, infrequent logs or that are on steeper slopes that may have some potential Old Growth Forest areas. These Medium to High areas require additional ground-truthing.
- **High** – areas that have been designated by DBCA (2020) as Old Growth Forest areas.

Since the earlier drafts of this report, additional targeted work has been undertaken on some of the remnant areas of native vegetation to verify the data layers, the development of the stands and also to compare with previous logging datasets. Currently an interpretation of the Quindanning forest areas in the south-east section of the PAA has progressed and will be reported separately in a brief report. The initial findings from Quindanning have confirmed the Old Growth Forest values in the south-east corner as designated by DBCA (2020) and have also highlighted the lower level of recent disturbance of some Wandoo areas.



Basemap: OpenStreetMap

0 2 4 km

Scale: 1:225,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_03_01

Date: March 2020 | Rev: A | A4

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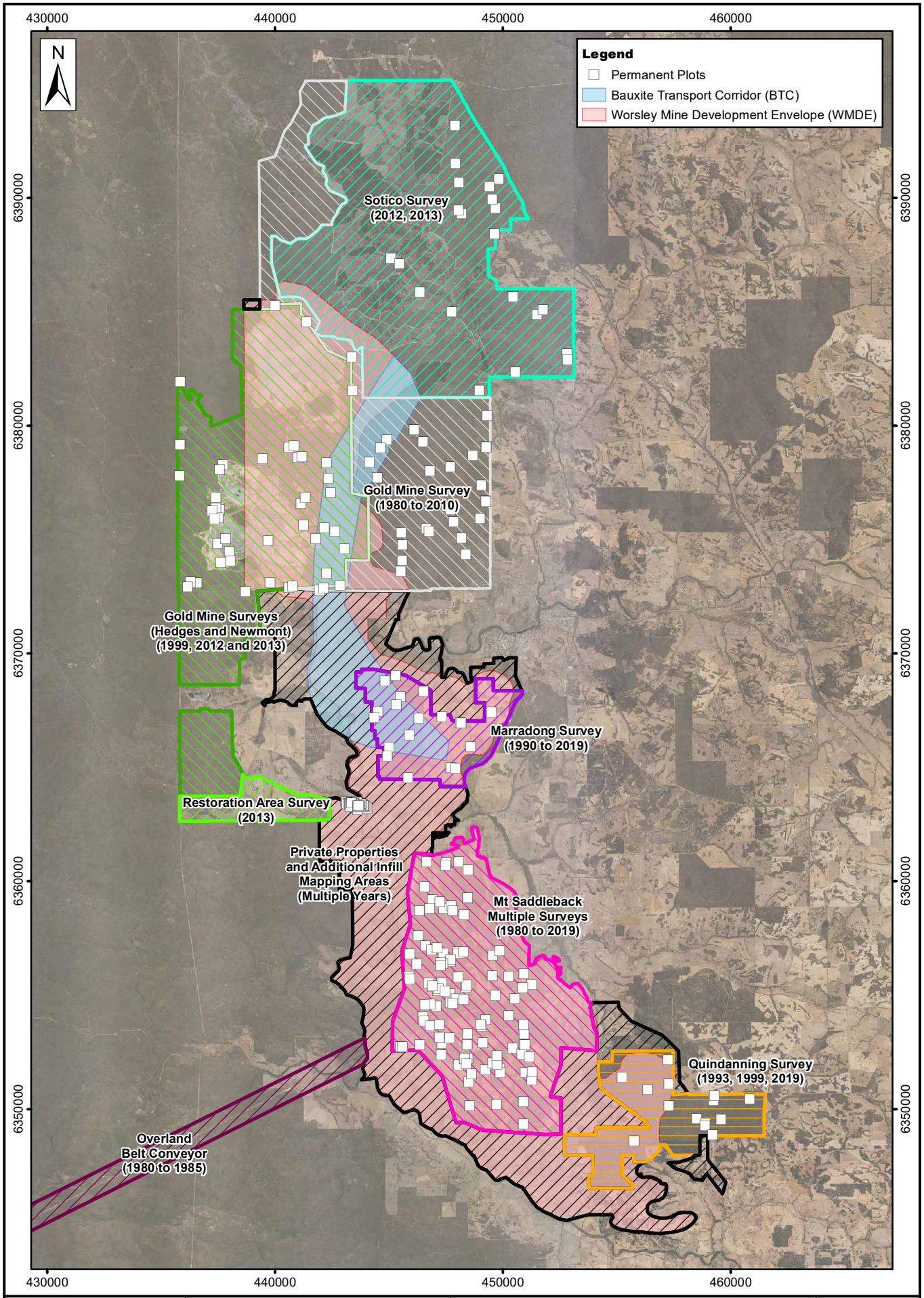
Survey Effort on Primary Assessment Area (PAA)

Figure: **3.1**



Basemap: OpenStreetMap

0 2 4 km

Scale: 1:225,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_03_02

Date: March 2020 | Rev: B | A4

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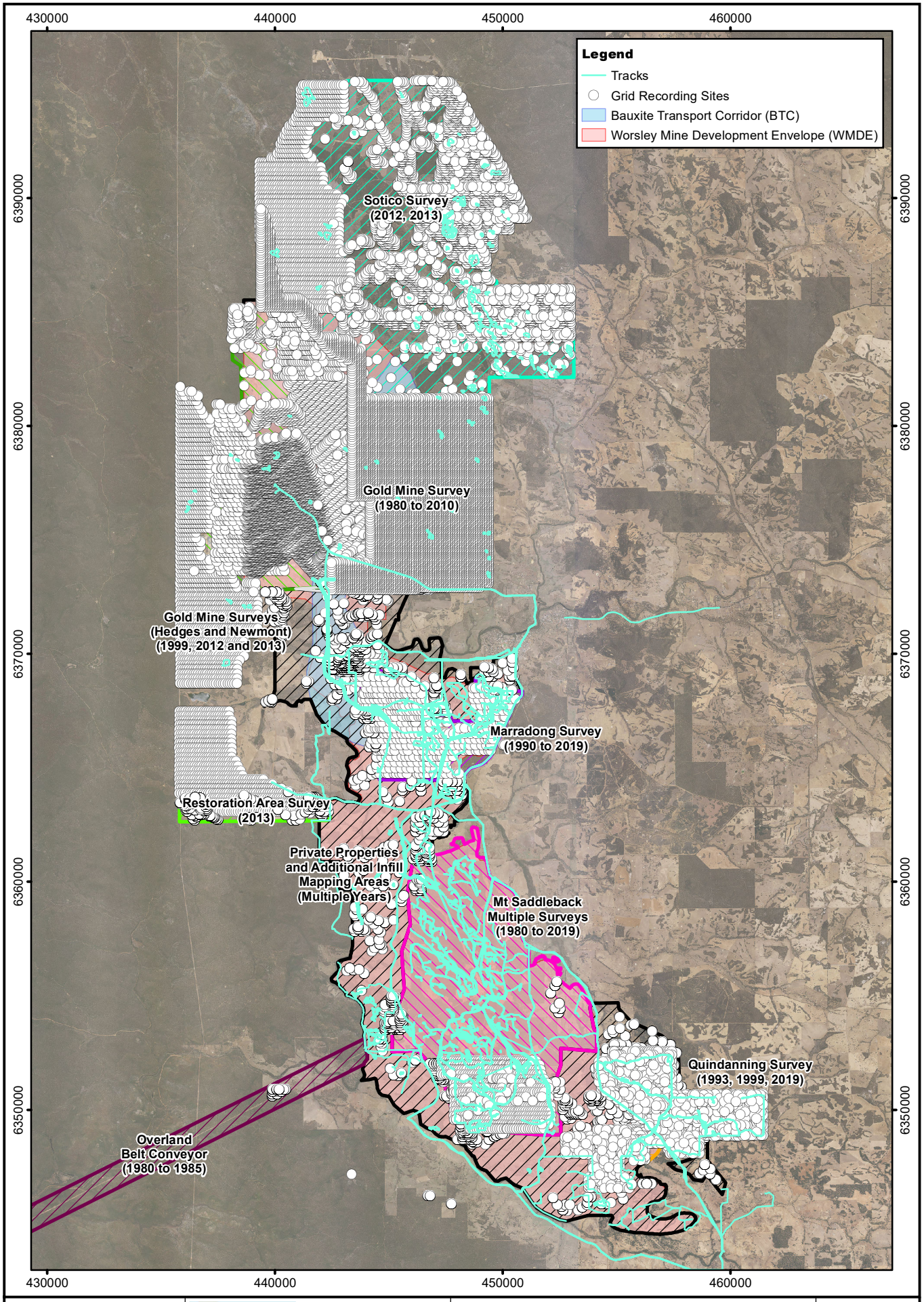
Permanent Plot Locations on Main Remnant areas within and near WMDE and BTC

Figure: **3.2**



N

0 2 4 km

Scale: 1:225,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_24

Date: August 2021 | Rev: A | A4

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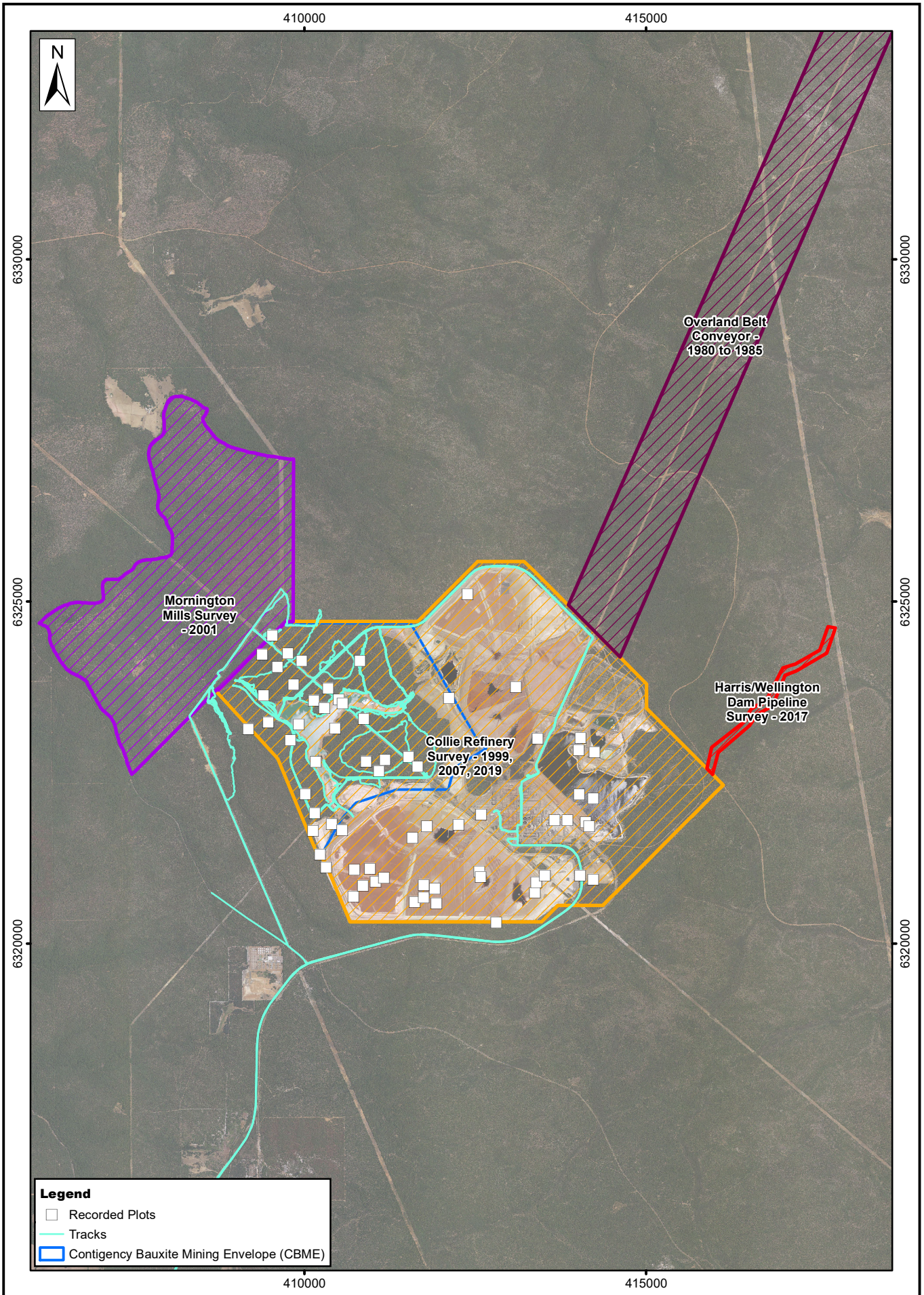
Grid Recording Site Locations on Main Remnant areas within and near WMDE and BTC

Figure: **3.3**



Basemap: OpenStreetMap

0 0.75 1.5 km

Scale: 1:75,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_03_03

Date: August 2021 | Rev: A | A4

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Survey Effort on - Collie Worsley Mine Expansion

Figure: **3.4**

4.10 Survey Limitations and Constraints

An assessment of the survey efforts (see Appendix A) over the period from 1980 to 2020 is presented in Table 1. The objectives of the surveys have varied to reflect specific scopes and factors and this has in turn influenced the survey design. As discussed above, the survey effort has comprised of multiple detailed surveys, targeted flora searches, traverses of the area and vegetation monitoring. This approach has resulted in a well-rounded dataset. This multiple approach pre-dated the EPA expectations and as such exceeded expectations as much as 35 years or more before regulators introduced standards. The flora and vegetation studies undertaken to date exceed the standards currently defined by the EPA, both in terms of coverage, comprehensiveness and methodology (2016a and 2016b). The surveys provide a detailed and robust understanding of the flora and vegetation values within the PAA, particularly those of conservation significance. The surveys also provide adequate local and regional context relative to the values of the flora and vegetation within the PAA.

The timing of the key baseline surveys undertaken on the flora and vegetation is summarised in Appendix A. The seasonal timing of the surveys undertaken to date on the WMDE, BTC, CBME and wider mapping areas near Boddington and Collie are also summarised in Figure 4. The results support compliance with the expectations that the majority of the surveys are undertaken in the optimum flowering times for most species (i.e., in the spring months). The results for the rehabilitation areas are different as the work has been split between the 9-month monitoring in the autumn months to assess initial establishment, through the tree assessments for the majority of the plots in the winter months and then the understorey assessments and the younger trees (15-month growth) in the spring months.

During the survey period of 1980 to 2020, botanists have undertaken studies including baseline flora and vegetation mapping, targeted searches, monitoring of control and rehabilitated areas with a minimum of 100 to 120 person days or 1000 to 1200 hours in the field each year by the Mattiske team alone over the 40 years. As much of this baseline work was undertaken before the regular use of GPS units it is only possible to estimate the distance of the foot traverses. Each year the foot traverses would exceed some 100 to 120 person days per year over 40 years multiplied by 4 to 5 kilometres per day. The estimated traverses covering flora and vegetation studies would be in the range of 16,000km to 24,000km and as such would be far more if the targeted flora and vegetation studies and the vegetation gridding work was included, which alone exceeded 3000km (based on an average of 200m spacing). The gridding work was a minimum of 200m grid lines ranging down to 25m gridline spacing in the main footprint of the Boddington Gold Mine. The survey effort on the grid systems for the WMDE, the BTC and adjacent areas is summarized in Figure 3-3.

Based on this assessment, there have been minimal limitations associated with the work to delineate the flora and vegetation values in the PAA. These few limitations associated with older locational and population numbers was significantly reduced by the aerial coverage of the areas at Boddington and Collie. In this context, it is important to recognise that some species have been removed from the Priority flora list as a result of the amount of local and regional work by botanists. The latter is apparent if one compares the earlier summaries on the conservation significant species on the Boddington Bauxite Mine (Worsley Alumina Pty Ltd 1985) and Boddington Gold Mine (Worsley Alumina Pty Ltd 1999) with the current summaries. In considering the survey limitations it is also important to recognise the extensive work undertaken by a large range of authors on the northern Jarrah Forest over some 50 or so years.

In summary the flora and vegetation surveys and studies (including monitoring) undertaken in the PAA:

- Provide comprehensive coverage to adequately characterise the site-vegetation types to a fine, local scale of mapping (including the Mount Saddleback Heath Communities Priority Ecological Community), and determine the presence and distribution of conservation significant flora
- Provide an informed assessment of the number and location of conservation significant flora within the PAA. The grid recording sites, plots, transects and flora and vegetation baseline studies, combined with the targeted searches, have collectively provided extensive survey

coverage of the PAA and hence a large portion of the area has been surveyed for conservation significant flora. The targeted flora searches cover a representative portion of the PAA, were undertaken predominantly in the spring months, or suitable periods for the specific species, and targeted suitable habitats. In summary, there is a high level of confidence regarding the presence/absence of conservation significant flora within the PAA.

- The targeted flora searches cover a representative portion of the PAA, were undertaken predominantly in the spring months, or suitable periods for the specific species, and targeted suitable habitats.
- Applied a systematic and well-defined, repeatable survey design and approach that is consistent with the requirements of the current EPA guidance (2016a and 2016b)
- Provide a detailed understanding of flora and vegetation values within the PAA, as a result of the extensive and long-term survey effort (Appendix A), which supports a robust and informed assessment of impacts.

Overall, the surveys (both historical and recent, as presented in Appendix A) are considered adequate to provide an informed assessment on the flora and vegetation values within the PAA, particularly those of conservation significance. This is due the extensive nature of the survey effort and the use of methods and survey design that meet (or are equivalent to) the requirements of the EPA guidelines.

Table 1: Potential Flora and Vegetation Survey Limitations for the Bauxite Mine Expansion Primary Assessment Area

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (i.e., pre-existing background versus new material).	**Not a constraint:** Multiple surveys have previously been conducted by Mattiske and the teams at E.M. Mattiske and Associates and Mattiske Consulting Pty Ltd over some 40 years. This, together with reference to resources such as Havel (1975a; 1975b), Heddle *et al.* (1980) and Mattiske and Havel (1998), previous mapping of site-vegetation types by Mattiske for the Worsley sites, online flora and vegetation information, has provided a comprehensive summary of the flora and vegetation values in the PAA. **Minor constraints:** A minor constraint was related to the lack of population numbers for some of the flora species as some older records held at the State Herbarium and the earlier work of Mattiske were based on data collected prior to the introduction of the GPS units. In earlier periods there was a need to rely on compasses, maps, aerials and foot traverses. The details on some of the State Herbarium records were very general in terms of locational and plant number details. An additional minor constraint was related to the time since the assessment of logging debris and number of stumps due to the timing of historical mapping. The latter data assists in the determination of potential Old Growth Forest areas.
Scope (i.e., what life forms, etc., were sampled).	**Not a constraint:** Due to the timing of the surveys (see Appendix A), all life forms were sampled adequately during the surveys. All site characteristics were adequately sampled during the surveys.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint:** The surveys were conducted in multiple seasons with a greater effort in the spring months. These surveys have therefore been undertaken in appropriate times to align with suggested optimum times for flora and vegetation studies.

Table 1: Potential Flora and Vegetation Survey Limitations for the Bauxite Mine Expansion Primary Assessment Area (continued)

Potential Survey Limitation	Impact on Survey
Completeness and further work which might be needed (i.e., was the relevant survey area fully surveyed).	**Not a constraint:** Multiple surveys have previously been conducted by Mattiske and the teams at E.M. Mattiske and Associates and Mattiske Consulting Pty Ltd over some 40 years in the PAA. Although there have been minor limitations on some private properties, these have been addressed largely through South32 arranging access for the botanists. As the flora and vegetation areas on the private properties have been highly modified by historical grazing and cropping activities any issues that have arisen in terms of access are negligible as the values of the native flora and vegetation values remains very low in the local and regional context. The previous mapping of site-vegetation types by Mattiske for the Worsley sites, online flora and vegetation information, has provided a comprehensive summary of the flora and vegetation values in the PAA, including conservation significant flora. In earlier phases of field studies, populations of conservation species were not counted in detail; whilst this may appear a limitation, the extent of transects and ground-truthing survey work reduced the risks of coverage. **Minor constraints:** A minor constraint was related to the time since the assessment of logging debris and number of stumps due to the timing of historical mapping. The latter data assists in the determination of potential Old Growth Forest areas. Whilst the supply of DBCA Old Growth Forest and Harvesting datasets assisted in reducing this constraint several areas highlighted as medium – high may need re-assessment.
Mapping reliability.	**Not a constraint:** Supplied aerial photographic maps, grid survey sites, foot traverses, survey quadrats and permanent plots have enabled a comprehensive coverage of the flora and vegetation values and assisted in boundary definitions of the vegetation and the vegetation condition maps on the respective areas.
Timing, weather, season, cycle.	**Not a constraint:** The surveys were conducted in multiple seasons with a greater effort in the spring months. These surveys have therefore been undertaken in appropriate times to align with suggested optimum times for flora and vegetation studies.
Disturbances (fire flood, accidental human intervention, etc.).	**Not a constraint:** No disturbances impacted upon the survey. Although there have been some fire occurrences in the respective areas, the sampling of these areas after three years has enabled coverage of any short-term impacts on the coverage of flora values.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint:** Supplied aerial photographic maps, grid survey sites, foot traverses, survey quadrats and permanent plots have enabled a comprehensive coverage of the flora and vegetation values and assisted in boundary definitions of the vegetation and the vegetation condition maps on the respective areas. The survey effort in the PAA has always exceeded the current EPA (2016a and 2016b) standards due to the range of coverage of sampling approaches, the regularity of the coverage of survey quadrats, permanent plots and transects and the replication of the sampling within the respective site-vegetation types in the PAA.
Resources (i.e., were there adequate resources to complete the survey to the required standard).	**Not a constraint:** Adequate resources were provided for the completion of the survey work.
Access problems (i.e., ability to access survey area).	**Not a constraint:** Multiple surveys have previously been conducted by Mattiske and the teams at E.M. Mattiske and Associates and Mattiske Consulting Pty Ltd over some 40 years in the PAA. Although there have been minor limitations on some private properties, these have been addressed largely through South32 arranging access for the botanists. As the flora and vegetation areas on the private properties have been highly modified by historical grazing and cropping activities any issues that have arisen in terms of access are negligible as the values of the native flora and vegetation values remains very low in the local and regional context. The previous mapping of site-vegetation types by Mattiske for the Worsley sites, online flora and vegetation information, has provided a comprehensive summary of the flora and vegetation values in the PAA.

Table 1: Potential Flora and Vegetation Survey Limitations for the Bauxite Mine Expansion Primary Assessment Area (continued)

Potential Survey Limitation	Impact on Survey
Experience levels (e.g., degree of expertise in plant identification to taxon level).	**Not a constraint:** Dr Mattiske and team of botanists have extensive experience both on the South32 lease areas, as well as the northern Jarrah forests for a range of clients and as such have included the most comprehensive teams to undertake these studies. Both field personnel have the appropriate training in sampling and identifying the flora of the region. A field herbarium was developed by Mrs B Koch and Dr E Mattiske and is held by South32 at the Boddington Bauxite Mine. This field herbarium has been audited to ensure any changes of taxonomic nomenclature align with current standards of the Western Australian State Herbarium and FloraBase (DBCA 2020a). At all times any plants not identifiable in the field or by the Mattiske botanists were processed and identified by specialist taxonomists at the WAH.

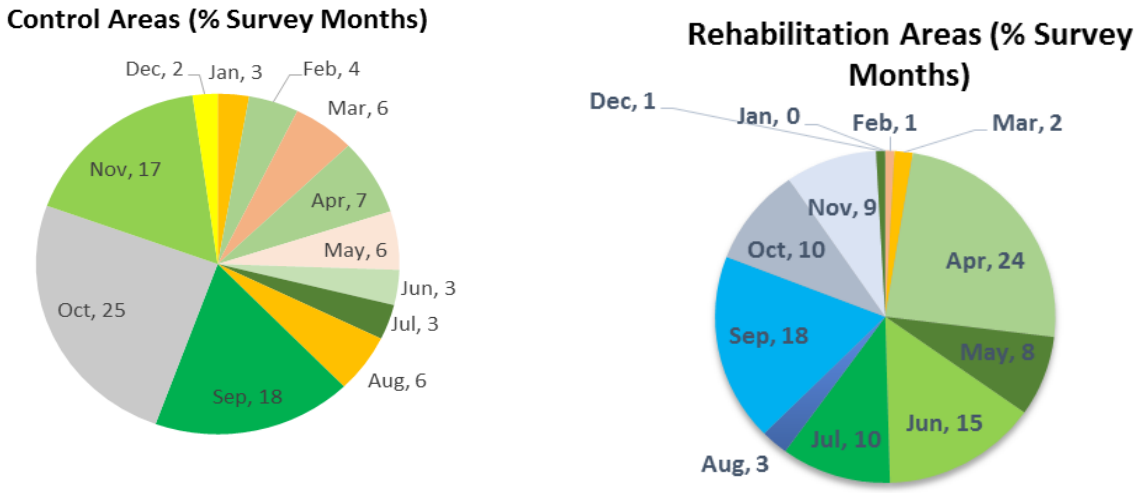


Figure 4: Summary of Survey Effort Times on Control (Baseline) and Rehabilitation Areas 1980 to 2018 (Note: 9-month assessments of rehabilitation areas in April/May, Tree assessments in June/July, and Spring Understorey and Trees in September to November on Rehabilitation Areas)

The survey effort has been concentrated in the spring months, with 60% of baseline and targeted work being undertaken in spring months (September to November) and 37% of assessment of understorey species in rehabilitation plots in spring months (September to November), Figure 4. The effort over the years has been repeated on multiple occasions on all of the areas south of the Albany Highway and south of Mt Saddleback and westwards to Collie. These studies have also been supported by more regional studies over the southwest forest areas over some 40 years including regional studies undertaken during the regional forest agreement (Mattiske and Havel 1998) and through more specific targeted and detailed work undertaken for a range of clients.

5. RESULTS

5.1 Overview

The PAA supports native, rehabilitated and plantation vegetation, as well as cleared areas (e.g. pasture) and water bodies (e.g. dams and the Hotham and Williams Rivers). The PAA covers a total of 29,356.39ha, with the WMDE, BTC and CBME development envelopes comprising 27,796.26ha, 4,145.74ha and 746.55 ha, respectively. Of the total PAA, 12,979.92ha consists of native vegetation, which is 44.21% of the PAA. The extent of each of the land use types within the PAA are provided in Table 2.

Table 2: Land Use Types within the Wider Total Area Mapped (WTAM, PAA, WMDE, BTC, CBME and Associated IDF areas)

Land Type	Wider Total Mapped Area (ha)	PAA All Areas (ha)	WMDE (ha)	BTC (ha)	PAA All Areas IDF (ha)	WMDE IDF (ha)	BTC IDF (ha)	CBME (ha)	CBME IDF (ha)
Native vegetation	30722.07	12979.92	11838.25	2855.64	6776.68	6316.78	211.02	510.33	248.87
Plantation	275.29	229.00	229.00	0.41	87.61	87.21	0.41	0.00	0.00
Plantation Agriculture	4499.86	185.42	184.57	0.92	0.00	0.00	0.00	0.00	0.00
Rehabilitation	3163.60	3163.57	3152.99	127.58	616.62	598.44	11.17	10.58	7.01
Rehabilitation Agriculture (Ag)	335.57	26.942	2.62	26.20	0.16	0.16	0.00	0.00	0.00
Cleared Agriculture (Ag)	9282.15	6559.52	6402.45	759.42	2062.44	1897.56	164.89	0.00	0.00
Cleared	2903.96	2899.18	2899.18	335.49	0.78	0.78	0.00	0.00	0.00
Cleared Other	5486.62	3249.45	3085.77	40.10	0.51	0.10	0.38	163.68	0.03
Water bodies	66.92	63.39	1.43	0.00	0.00	0.00	0.00	61.96	0.00
Total Area (ha)	56735.99	29356.39	27796.26	4145.74	9544.80	8901.02	387.87	746.55	255.91

5.2 Flora

Desktop searches of the EPBC Act Protected Matters database (DAWE 2020a), the DPAW *NatureMap* (2020a) and DBCA databases (2020a), and the WAH and Threatened and Priority Flora (TPFL) databases have identified the potential occurrence of 87 conservation significant flora species within 20 km of the WMDE and BTC and 33 conservation significant flora species within 20 km of the CBME, see Appendices C to F and Figures 5-1 and 5-2. This information, together with a literature review of all available datasets from previous flora and vegetation surveys for the Project, has formed the basis of a likelihood assessment for conservation significant flora within the areas the subject of the Proposal. The likelihood of the Threatened and Priority species for the respective Boddington and Collie areas is summarised in Appendices D and F. The likelihood of a species being recorded within the PAA was based on previous known recordings from survey work, previous collections from DBCA and DAWE data records, and from site preferences for the respective species.

Since the early 1980's, a total of 1031 vascular plant taxa from 83 families and 319 genera have been recorded on the wider Boddington surveyed areas and 289 vascular plant species from 54 plant families and 149 genera have been recorded in the main baseline studies undertaken in the Collie RLA, Appendices G and H, Table 3. The latter total numbers included 132 introduced species and 5 planted species in the Boddington area and 15 introduced species and 1 planted species in the Collie RLA. A total of 115 introduced species have been recorded since 1980 on agricultural and rehabilitated areas in the WMDE and BTC and 37 introduced species on control areas in the WMDE and BTC areas. The range of species on the control areas includes remnant vegetation areas on private properties and the less disturbed areas within the WMDE and BTC.

Of the recorded species the geographically restricted species were the threatened species (*Caladenia hopperiana*) and Priority species (*Gastrolobium* sp. Prostrate Boddington (M Hislop 2130) (P1), *Isopogon* sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin) (P1), *Papistylus intropubens* (P1), *Banksia subpinnatifida* var. *subpinnatifida* (P2), *Goodenia katabudjar* (P3) and *Stylidium marradongense* (P3)), Table 4. The species recorded near and within the RLA at Collie are more widespread in the northern and central Jarrah forests.

A comparison was made in Appendix H on the main BBM areas in order to determine the numbers of species identified in the control and rehabilitation areas. To date 408 taxa have been recorded on both the control and rehabilitation areas and as such this represents some 81.77% of the species on the rehabilitation areas that are in common with the control areas. The number on the rehabilitation areas exceeds that on the control areas largely as more sampling has been undertaken on the rehabilitated areas and also many taxa were only identified to the genus level (due to seedling size or lack of flowering and fruiting material).

The various studies have added taxa when additional targeted searches, baseline and monitoring studies have been undertaken. Several of the taxa have undergone taxonomic changes since the earlier studies and several species have been excluded, been changed from introduced to naturalised and been changed from priority species to non-threatened species.

Table 3: Summary of the Native and Introduced Taxa recorded in the respective areas

Summary of Taxa, Genera and Families	Total Mapped Area, PAA, RLA and nearby areas	PAA	WMDE & BTC	RLA & CBME
Native Plant Taxa	899	873	499	289
Planted Taxa	5	5	0	1
Introduced Plant Taxa	132	121	37	15
Genera	319	295	191	149
Families	83	79	57	54

5.3 Threatened and Priority Flora

A database search of DBCA (2020a) and DAWE (2020a) highlighted 114 vascular Threatened and Priority plant species that are known from the wider area near the Boddington lease areas which included areas beyond the PAA, WMDE, BTC and CBME. Many of the species occur on the western fringes of the southwest forests near Collie or on the western fringes of the Western Australian Wheatbelt and also in the extreme sites such as the granite outcrop areas and the swamps. By reviewing the databases, 87 conservation significant species have potential to occur in the WMDE and BTC areas and 33 conservation significant species have the potential to occur in the CBME area, Appendices E and G. Of these 87 species in the Boddington area, 21 conservation significant species have been recorded during field surveys near or within the WMDE and BTC areas (Appendix H, Table 4 and Figures 8-1 to 8-13). Of the 33 potential species in the RLA and CBME area, none of these conservation significant species have been recorded during field surveys within the CBME. The actual location or numbers of the respective species was not recorded in the Phase One studies and in some of the earlier studies. It is only in the permanent plots and rehabilitation plots and survey quadrats that population numbers of conservation species have been recorded in more detail. In the vegetation mapping programs in the last decade the population numbers of conservation species have been recorded in more detail.

In Table 4 in collating older records, if plant numbers were not recorded then a conservative approach of 1 plant was recorded to minimise over estimates. In other instances, substantial numbers have been recorded in detail for specific project areas within the WMDE and BTC areas. An example of the latter was the threatened *Caladenia hooperiana* in the last few years by South32 and Mattiske teams and the geographically restricted *Gastrolobium* sp. Prostrate Boddington (M Hislop 2130).

Four threatened flora species have been recorded in proximity to the WMDE and BTC by a range of botanists (see Figures 5-1 and 5-2 (DBCA records) and Figures 8-1 to 8-13). As indicated below and on the site-vegetation type maps (Figures 8-1 to 8-13) *Caladenia hopperiana* is the only one of the four potential threatened species recorded in the WMDE (see Table 4) and no threatened species were recorded within the BTC.

- *Anthocercis gracilis* is Threatened occurred outside and north-east of the WMDE and BTC areas in granite areas;
- *Caladenia hopperiana* (formerly known as *Caladenia* sp. Quindanning) is Threatened under the BC Act and Endangered under the EPBC Act – occurs within and outside of the WMDE in the south eastern section of the mapping (see Figures 8-12 and 8-13).
- *Caladenia dorrienii* is Threatened under the BC Act 2016 and Endangered under the EPBC Act – occurs outside and to the east of the PAA (see Figure 8-10).
- *Eleocharis keigheryi* is Threatened under the BC Act and Vulnerable under the EPBC Act – occurs outside of PAA on swamp and seasonally wetter sites.
- The likelihood of all potential conservation significant species occurring within the WMDE, BTC and CBME are summarised in Appendices E and G. The likelihood of the Threatened and Priority flora species occurring in the WMDE and BTC is reduced by the extent of the agricultural areas (including completely degraded and degraded from a perspective of the condition of the native vegetation). Many of the species summarised in Table 4 occur in heath communities and valley floors which are less likely to be disturbed by bauxite mining activities, however they are at risk of being impacted in localised areas by proposed infrastructure such as haul roads, see Figures 8-1 to 8-13. Most remnant areas on the agricultural areas supported a lower proportion of understorey species due to grazing and disturbance activities.
- A small number of the Priority flora species were recorded in the rehabilitation areas; albeit in restricted numbers. These include *Calytrix simplex* subsp. *simplex* (P1), *Isopogon* sp. Canning reservoir (M.D. Tindale 121 & B.R. Maslin) (P1), *Hibbertia ambita* (P1), *Banksia subpinnatifida* var. *subpinnatifida* (P2), *Acacia horridula* (P3), *Banksia subpinnatifida* var. *imberbis* (P3), *Calothamnus quadrifidus* subsp. *teretifolius* (P4), *Lasiopetalum cardiophyllum* (P4), *Halgania*

corymbosa (P4), *Goodenia katabudjar* (P3), *Stylidium marradongense* (P3) and *Senecio leucoglossus* (P4).

The results summarised in Table 4 reflect the significance of the heath communities, which are associated with the granite outcrops, with the following conservation significant species occurring in the heath communities or on shallow soils associated with outcropping of various types:

- *Calytrix simplex* subsp. *simplex* (P1);
- *Gastrolobium* sp. Prostrate Boddington (M Hislop 2130) (P1);
- *Isopogon* sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin) (P1);
- *Papistylus intropubens* (P1);
- *Synaphea panhesyi* (P1);
- *Banksia subpinnatifida* var. *subpinnatifida* (P2);
- *Acacia horridula* (P3);
- *Asteridea gracilis* (P3);
- *Banksia subpinnatifida* var. *imberbis* (P3);
- *Grevillea manglesii* subsp. *dissectifolia* (P3);
- *Halgania corymbosa* (P3); and
- *Calothamnus quadrifidus* subsp. *teretifolius* (P4).

The most significant species in the heath communities is the very localised and restricted *Papistylus intropubens* (P1), with the species only recorded from the Tunnell Road heath communities. The Tunnell Road heath community will not be directly disturbed by this Project.

5.4 Potential Impacts on Threatened and Priority Flora

In reviewing the potential threatened and priority flora species the location of the survey areas near the eastern fringes of the northern Jarrah Forest and the Collie Basin led to some species that are less likely to occur in the survey areas. The likelihood was based on FloraBase and experience in the Boddington and Collie areas by the authors. Of the threatened species that have been recorded or have the potential to occur, the majority will not be impacted by the proposed expansions, Table 4 and 5, Appendices D to I.

- *Anthocercis gracilis* (T) has been recorded north-east of the WMDE and BTC areas in granite areas;
- *Caladenia dorrienii* (T) occurs outside the PAA, as per Figure 8.10.
- *Caladenia hopperiana* (T) occurs in the Quindanning Timber Reserve in valley systems occurs in a small section of the proposed south-eastern section of the WMDE. The plants within the WMDE will be protected under the Protected Area procedure.
- *Eleocharis keigheryi* (T) is Threatened under the BC Act and Vulnerable under the EPBC Act – occurs outside of PAA on swamp and seasonally wetter sites.
- *Pultenaea pauciflora* (T) is Threatened under the BC Act and Vunerable under the EPBC Act – occurs primarily in Luptons forest area north-east of Boddington, eastwards of Quindanning to Narrogin and in Dale Forest block north-west of Boddington. The occurrence of this species is mainly on sandy and clay soils and appears to be primarily a Wheatbelt species.
- *Diuris micrantha* (T) is Threatened under the BC Act and Vunerable under the EPBC Act – occurs near the Darkan-Quindanning Road to the south of the current survey areas. This species also occurs on the Swan Coastal Plain (DBCA 2020a).

Of the remaining priority flora species, the following may be impacted to some degree by the proposed activities in the PAA, Tables 4 and 5, namely:

- *Gastrolobium sp. Prostrate Boddington (M Hislop 2130) (P1) o*ccurs in the valley floors and valley near Hotham River and its tributaries. This species is largely located in the Wandoo woodlands north of the current Newmont Boddington Gold Mine camp and in an area which will not be disturbed by this proposal (Table 4). Although this species occurs near the Hotham River the majority of plants occur outside of the PAA.
- *Hemigenia rigida (P1)* – now re-identified as *Hemigenia pritzelii*, which is not a threatened or priority species and is common and widespread in the southwest region.
- *Isopogon* sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin) (P1) occurs mainly in swamps and heath areas. It has been recorded in Tunnell Road heath and in rehabilitation areas; although to date in low numbers. This taxon is not expected to be impacted from this proposal
- *Hibbertia ambita* (P1) occurs in a range of sites from lower valley slopes to rehabilitated areas. The recent taxonomic studies by Thiele (2019) re-classified a range of species previously identified as *Hibbertia commutata*. Further field studies and collections of *Hibbertia* species have been undertaken in 2020 since this publication was released. The records in Table 4 area based on confirmed locations and it is expected that more locations will be confirmed in coming years. The *Hibbertia commutata* group of plants has been recorded regularly in the northern Jarrah Forest and in the Boddington and Collie areas. One of the main constraints relates to the need to have flowering material to separate this species.
- *Goodenia katabudjar* (P3) occurs in WMDE area; however, is known from wider lateritic hills in Jarrah and Wandoo woodlands. This species occurs as scattered plants in small patches and therefore numbers may be higher and the impact is potentially substantially lower.
- *Stylidium marradongense* (P3) occurs on gravelly soils and heath areas, including Tunnell Road heath. Relatively restricted to Boddington and local eastern Jarrah Forest areas.
- *Lasiopetalum cardiophyllum* (P4) occurs mainly in eastern areas of Jarrah-Sheoak forests near Boddington. Although plants may be impacted in the WMDE and BTC areas, the estimate of numbers is much lower as earlier studies did not record population numbers and the estimate of impact is expected to be much lower. Earlier observations undertaken by Mattiske and B. Koch reflected populations in the State Forest areas to the south and southwest of Boddington.
- *Senecio leucoglossus* (P4) occurs widely in low numbers throughout the northern Jarrah Forest and as such is better known than other P4 species. From extensive studies throughout the northern Jarrah Forest this species is known to be more widespread and therefore the impacts are expected to be a lot lower.

The most significant of the other priority species in the heath communities is the very localised and restricted *Papistylus intropubens* (P1), with the species only recorded from the Tunnell Road heath communities. The Tunnell Road heath community will not be directly disturbed by this Project.

Table 4: Conservation Significant Flora located within the Boddington Area, WMDE and BTC

(Note: ^ Total numbers based on database search of WAH and also Mattiske results; where numbers not collected in earlier recordings the estimates were supplied as 1 for each location. Distribution patterns of the species, which reflect the known extent of the species populations outside the PAA, have been informed by review of available information from the WAH, database searches and Mattiske results. Populations for the respective species have not sought to be defined within the PAA in recognition that a 'population' is open to interpretation and species dependent. For example some plants are interconnected and not individuals (e.g. plants with rhizomes)).

Species	Status under EPBC Act	Status under BC Act	Total Nos. in Wider Boddington areas Mapped and Remaining ^	No. in WMDE	No.in BTC	No. in PAA IDF	Potential Impacts and Distribution Patterns (see Appendix D to F also)	No. Records WAH
Anthocercis gracilis	V	T	1	0	0	0	Mainly on granite outcrops through the northern Jarrah Forest (records from WAH searches). Individuals recorded outside the project area to the north-east of the PAA, individuals are mainly on outcrop areas. Although one plant was recorded in the wider area near Boddington, the WA Herbarium database records illustrate that this species occurs in the Avon Wheatbelt and most locations occur on the western fringes of the Jarrah Forest (WAH 1998-). None were recorded within the PAA. As this species is associated in most cases with granite outcrops the impacts will be minimal.	29
Caladenia hopperiana	E	T	214	46	0	7	Direct impacts managed through Protection areas and minimum 50m buffer. Indirect impacts due to potential changes in groundwater levels should be minimal as shallow rooted species that appears to rely on seasonal rains and soil moisture levels in clay loams in mainly AY and Y site-vegetation types. Records reconfirmed and expanded in 2018 and 2019. This species is more geographically restricted, with WA Herbarium database records all within the Jarrah Forest region (WAH 1998-), however it occurs in areas that South32 has included in protected valley systems in the Quindanning area which will not be impacted.	4
Diuris micrantha	V	T	1	0	0	0	This species occurs near the Darkan-Quindanning Road to the south of the current survey areas. This species also occurs on the Swan Coastal Plain (DBCA 2020a). This species occurs on lower wetter sites and has not been recorded in the PAA.	8
Pultenaea pauciflora	V	T	77	0	0	0	This species occurs primarily in Luptons forest area north-east of Boddington, eastwards of Quindanning to Narrogin and in Dale Forest block north-west of Boddington. The occurrence of this species is mainly on sandy and clay soils and appears to be primarily a Wheatbelt species. This species has been recorded from multiple locations on the eastern fringes of the Jarrah Forest and also near Narrogin in the Wheatbelt (WAH 1998-). This species has not been recorded in the PAA.	50
Calytrix simplex subsp. *simplex*	-	P1	2211	2409	0	402	Known from areas west of Boddington in northern Jarrah Forest, occurs in swamps, Forty-Hollow Road heath areas. Although in WMDE, individuals are mainly on outcrop areas that are unlikely to be directly disturbed and therefore impacts are expected to limited. This species also been recorded near Armadale, WA. 202 plants in the PAA IDF are outside cleared, rehabilitated and plantation areas. Most of the plants in IDF are in heath communities that should not be disturbed. The numbers recorded in the WMDE manly reflect the survey effort on these areas.	5
Hemigenia rigida (P1) (now re-identified as *Hemigenia pritzelii* in Boddington area and not Priority)	-	-	207	234	0	30	This Priority species was recorded in the earlier assessments, however recent collections have been confirmed as *Hemigenia pritzelii*, which is not listed as priority flora. *Hemigenia rigida* appears to be applied to taxa that are restricted to localised areas south of Boddington at 4 known locations. *Hemigenia pritzelii* is not a Priority flora species and hence this species is not of conservation significance as this species is widespread in the southwest forests and extends to north of Albany in the Wheatbelt (WAH 1998-)	115

Table 4: Conservation Significant Flora located within the Boddington Area, WMDE and BTC

(Note: ^ Total numbers based on database search of WAH and also Mattiske results; where numbers not collected in earlier recordings the estimates were supplied as 1 for each location. Distribution patterns of the species, which reflect the known extent of the species populations outside the PAA, have been informed by review of available information from the WAH, database searches and Mattiske results. Populations for the respective species have not sought to be defined within the PAA in recognition that a 'population' is open to interpretation and species dependent. For example some plants are interconnected and not individuals (e.g. plants with rhizomes)).

Species	Status under EPBC Act	Status under BC Act	Total Nos. in Wider Boddington areas Mapped and Remaining ^	No. in WMDE	No.in BTC	No. in PAA IDF	Potential Impacts and Distribution Patterns (see Appendix D to F also)	No. Records WAH
Gastrolobium sp. Prostrate Boddington (M Hislop 2130)	-	P1	25757	15288	15242	4391	Restricted to the Boddington area in the south-west of WA. Vast majority of plants occur in the Wandoo valley systems north of the Newmont Boddington Gold Mine camp and outside the PAA. 35 plants on Camballing Reserve, a few on road side verges and in heath areas and significant numbers on Hotham River. As it occurs on disturbed areas, studies underway to investigate propagation techniques. The numbers associated with haul road options near Hotham River and Marradong are included in the WMDE numbers and are not in the IDF based on boundaries of WMDE and IDF. Records based on data from 2006 to 2018; including additional data from work within the PAA in 2018. This species is geographically restricted and the majority of the plants occur in patches on lower slopes and seasonally moister soils in Wandoo woodlands which are less likely to be impacts by the proposed activities. There are three main patches in the Boddington area, and a seeder in significant numbers in two of these three main patches. The patch of *Gastrolobium* sp. Prostrate Boddington (M Hislop 2130) that may be impacted occurs on the fringes of the Hotham River; although the disturbed railway line embankment supports significant numbers and the impacts will be restricted to localised transport corridors rather than main operational areas.	6
Hibbertia ambita	-	P1	33	65	2	11	Mainly in lower slopes and a few in rehabilitated areas. It is expected that numbers will be increased following further collections in both control and rehabilitation areas in future monitoring. One restriction is the need to collect flowering material (as undertaken in 2020) to confirm this species. Historically this species was recorded as *Hibbertia commutata* which has recently been split into multiple species by K Thiele; (2019) so it is not possible to separate this species from the *Hibbertia commutata* for the previous mapping, targeted studies and monitoring studies. Whilst most specimens have been collected by botanists for South32 and botanists from DBCA, there is a high probability that more locations outside the PAA will be recorded in coming years. Several of the recording locations (e.g. near Hotham River) are outside operational areas.	15
Isopogon sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin)	-	P1	5	6	0	0	Mainly in swamps and heaths ranging to shrubs under Jarrah Forest areas. Recorded (3 of the 4 occurrences in WMDE), albeit to date in low numbers. Recorded in Tunnell Road Heath in 2019 and also in rehabilitation areas as part of monitoring program. Direct impacts managed through Protection area in Tunnell Road heath.	7
Papistylus intropubens	-	P1	1	3	0	0	3 plants, although in the WMDE the individuals have been recorded in the Tunnell Road heath and therefore will not be directly disturbed. Direct impacts not expected. Direct impacts managed through Protection area in Tunnell Road heath. Additional searches undertaken in spring 2020 for this taxon in Tunnell Road heath (foot traverses).	1
Synaphea panhesya	-	P1	2	2	0	2	Mainly in Wandoo and Powder-bark Wandoo woodlands and near granites. Occurs in mainly northern Jarrah Forest areas and is known from other areas well beyond the proposed activities (e.g. Dandaragan Plateau sub-region on the Swan Coastal Plain).	15

Table 4: Conservation Significant Flora located within the Boddington Area, WMDE and BTC (continued)

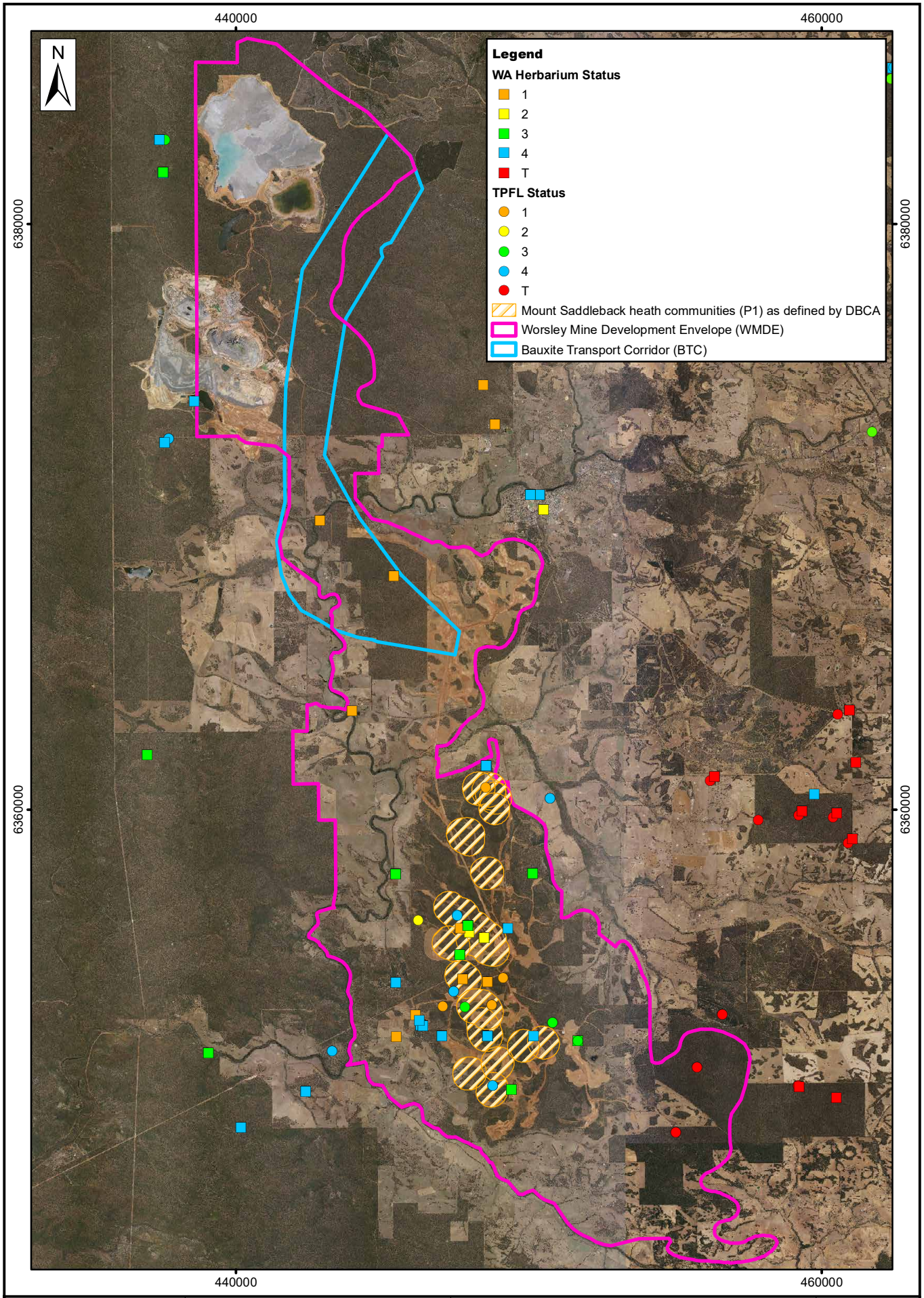
(Note: ^ Total numbers based on database search of WAH and also Mattiske results; where numbers not collected in earlier recordings the estimates were supplied as 1 for each location Distribution patterns of the species, which reflect the known extent of the species populations outside the PAA, have been informed by review of available information from the WAH, database searches and Mattiske results. Populations for the respective species have not sought to be defined within the PAA in recognition that a 'population' is open to interpretation and species dependent. For example some plants are interconnected and not individuals (e.g. plants with rhizomes)).

Species	Status under EPBC Act	Status under BC Act	Total Nos. in Wider Boddington areas Mapped and Remaining ^	No. in WMDE	No. in BTC	No. in PAA IDF	Potential Impacts and Distribution Patterns (see Appendix D to F also)	No. Records WAH
Banksia subpinnatifida var. subpinnatifida	-	P2	1	1	0	1	Mainly recorded in shallow soils associated with outcrops and valley floors. Occurs in Tunnell Road Heath and Forty-Hollow heath area which are protected from direct impacts as in protected areas. Extends further east into Wheatbelt reserves. This species has been recorded within the Dryandra Woodland and further east of Wickepin. The population in the WMDE is a western extension of the known populations. Recorded in Tunnell Road Heath in 2019 and 2020 by Mattiske. Direct impacts managed through Protection area in Tunnell Road heath.	22
Acacia horridula	-	P3	4	1	0	0	Recorded in rehabilitation area (3 outside of cleared, rehabilitated and plantation areas); potential for seeding in future rehabilitation areas. Occurs on shallow soils over granites and in damplands, in northern Jarrah Forest and extends to Swan Coastal Plain. This species is known from some 33 records over several IBRA regions and therefore impacts will be negligible.	33
Asteridea gracilis	-	P3	0	2	0	0	Mainly on granite outcrops through the northern Jarrah Forest and near Albany. As the outcrop areas are not proposed to be directly disturbed, impacts should be minimal. Occurred near Forty-Hollow Road heath areas.	11
Banksia subpinnatifida var. imberbis	-	P3	3	4	0	0	Mainly recorded in shallow soils associated with outcrops and valley floors on eastern fringes of the Jarrah Forest. Occurs in Tunnell Road Heath and other heath areas which are protected from direct impacts as they are in Protected areas nominated by Worsley. Extends southwards to Mt Barker area on eastern fringes of southwest forests. Recorded in rehabilitation areas and in Tunnell Road heath in 2020. This population occurs in the north-western section of its distribution.	17
Goodenia katabudjar	-	P3	35	29	0	3	On eastern lateritic hills mainly in Jarrah, Wandoo woodlands. Recorded in control and rehabilitation areas. This species extends north-east and south-east of Mt Saddleback and is not restricted in populations to the WMDE.	11
Grevillea manglesii subsp. *dissectifolia*	-	P3	38	0	0	0	Occurs in loam soils over granites and in creeks, including further west in Jarrah Forest. This species was not recorded within the PAA.	27
Halgania corymbosa	-	P3	42	37	6	36	Associated with granite outcrops, but does extend to Jarrah Forest areas, mainly in the northern Jarrah forests. As plants occur on some of the outcrop areas the impacts should be minimal. This species occurs in the Jarrah forest and extends into the Swan Coastal Plain and mainly just east and north-east of Perth on the Darling Scarp.	18
Stylidium marradongense	-	P3	196	232	0	25	Some plants in rehabilitation areas. Occurs on gravelly soils and heath areas including Tunnell Road Heath and areas with lateritic boulders. Relatively locally restricted to Boddington and local eastern Jarrah Forest areas. The numbers appear to reflect the survey effort near Boddington rather than its distribution and spatial extent.	12

Table 4: Conservation Significant Flora located within the Boddington Area, WMDE and BTC (continued)

(Note: ^ Total numbers based on database search of WAH and also Mattiske results; where numbers not collected in earlier recordings the estimates were supplied as 1 for each location. Distribution patterns of the species, which reflect the known extent of the species populations outside the PAA, have been informed by review of available information from the WAH, database searches and Mattiske results. Populations for the respective species have not sought to be defined within the PAA in recognition that a 'population' is open to interpretation and species dependent. For example some plants are interconnected and not individuals (e.g. plants with rhizomes))

Species	Status under EPBC Act	Status under BC Act	Total Nos. in Wider Boddington areas Mapped and Remaining ^	No. in WMDE	No.in BTC	No. in PAA IDF	Potential Impacts and Distribution Patterns (see Appendix D to F also)	No. Records WAH
Tetratheca pilifera	-	P3	2	2	0	0	Mainly in Wandoo woodlands within northern Jarrah Forest. Occurs westwards to Darling Scarp and areas north of Avon River as well as on the northern coastal plain. The occurrence is a south-easterly extension of the species distribution. Its presence appears to reflect the survey efforts in the local area.	33
Calothamnus quadrifidus subsp. *teretifolius*	-	P4	3	3	0	1	Occurs in moister sites and in heath areas. Main occurrence in Donnybrook Sunklands with localised occurrence in central Jarrah Forest. Recorded in rehabilitated areas. The main populations and occurrences occur on the southern Swan Coastal Plain to the south of Bunbury.	39
*Lasiopetalum cardiophyllum ** see note above*	-	P4	1016	1353	56	496	Also occurs in rehabilitation areas, albeit in relatively low numbers. This species is planted in rehabilitation as a research species. This species mainly occurs in Jarrah-Shoeak forests on sandy-gravels. It extends into Stene and George blocks and then southwards on the eastern fringes of the southwest forests. The main patches of this species occur on the eastern fringes of the northern and central Jarrah forest well beyond the proposed operations. Other patches occur south-and south-east of Boddington in the Wheatbelt. Numbers are extensively higher than those extracted as earlier surveys did not include counting of individual species. Therefore the numbers in the forests are underestimated (particularly in the Boddington Gold Mine area in the P and PS site-vegetation types). Recorded in low numbers most years as reflected by recent expansion studies and the monitoring datasets.	34
Senecio leucoglossus	-	P4	140	198	0	47	Widespread in northern Jarrah Forest and occurs in small patches. Regularly recorded in northern Jarrah Forest surveys. Recorded in low numbers most years as reflected by recent expansion studies and the monitoring datasets. The species also occurs in the Southern Jarrah Forest and on the Swan Coastal Plain.	43



Basemap: Landgate (2017)

0 2 4 km

Scale: 1:175,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_04_01

Date: November 2020 | Rev: A | A4

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Primary Assessment Area (PAA)

DBCA Threatened Flora and PEC

Figure:

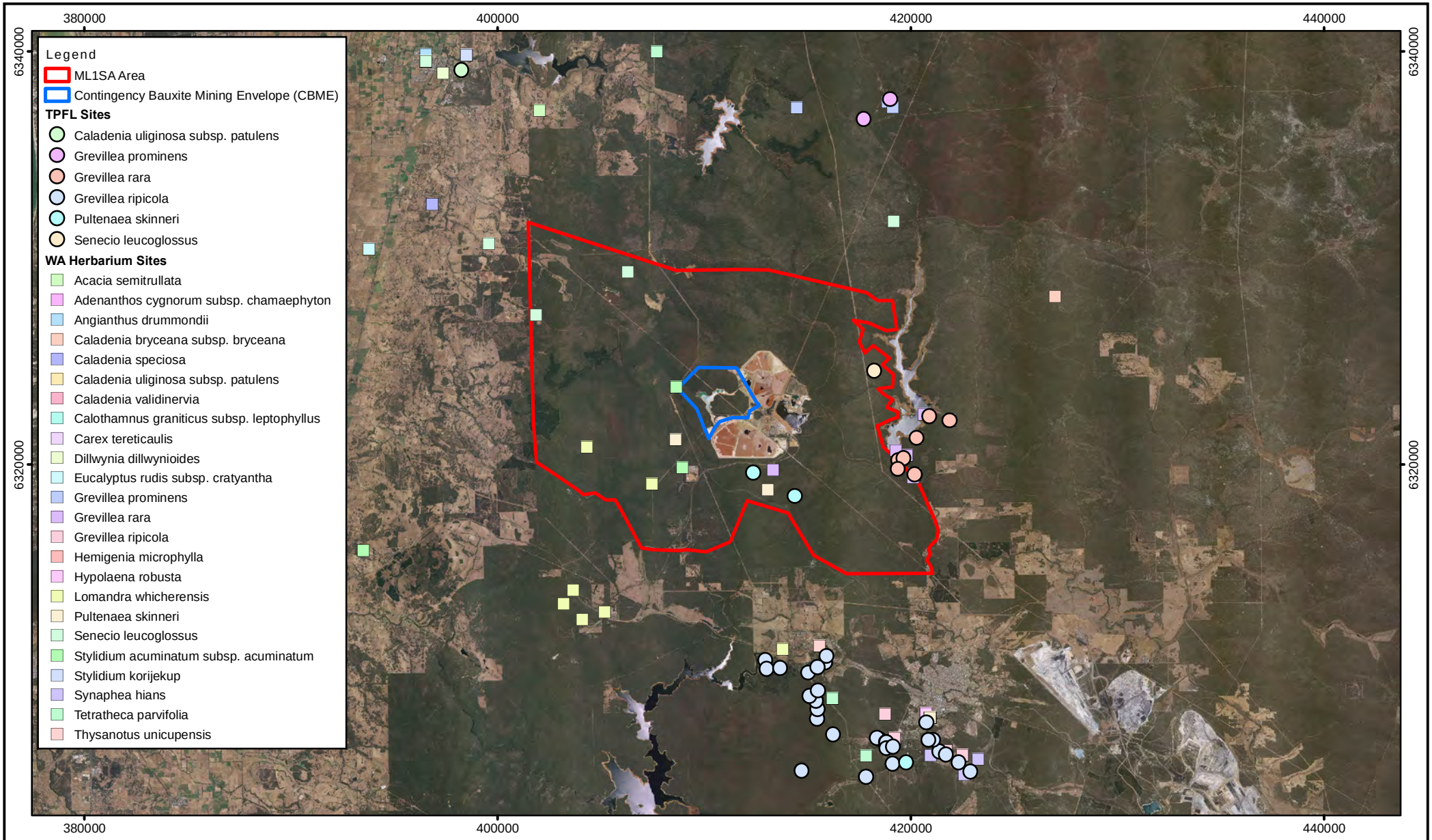
5.1

Of the potential 33 conservation significant species that have been recorded near the CBME, 1 conservation significant species has been recorded in the CBME based on the database search results (Table 5). *Pultenaea skinneri* (P4) was recorded in the valley systems and lower slopes on the southern fringes of the CBME in earlier studies of the CBME; although recent targeted studies in 2019 have not located any conservation significant species in the north-western area of the RLA. *Stylidium acuminatum* subsp. *acuminatum* (P2) occurs on the north-western edge of the CBME (see Figure 5-2). In the Phase One study of the Worsley lease areas (Dames and Moore (1980), one threatened orchid species was recorded during the field survey; *Drakaea elastic*a, which is listed as Critically Endangered under the EPBC Act. This species appeared to be an opportunistic collection at the time and may be a miss-identification. This species occurs on the Swan Coastal Plain, has not been identified in surveys of the CMBE and is unlikely to be present in the PAA area.

Table 5: Conservation Significant Flora located within the RLA and CBME

Species	Status under EPBC Act	Status under BC Act	Total Nos. in RLA	No. in CBME	No. in CBME IDF	Potential Impacts	No. Records WAH
Pultenaea skinneri	-	P4	11	0	0	Recorded in earlier studies in the southern sections of the RLA in CW, D and SW site-vegetation types on lower slopes. Largely southwest of Collie in creeklines and moister soils. Not recorded in recent studies of the north-western section in the CBME area.	38

Source:



Notes:

N

0 3 6km

Scale: 1:250,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_04_02

Date: August 2021 | Rev: A | A4

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Collie - Worsley Mine Expansion
DBCA Threatened Flora

Figure:

5.2

5.5 Introduced Plant Species

Flora and vegetation surveys undertaken to date indicate introduced species presence is variable with greater presence in forest areas adjacent to cleared agricultural areas and within agricultural areas. Whilst some weeds occur in the rehabilitation areas, these species tend to be less aggressive ecologically and tend to persist only for a short period until the native species start to dominate the rehabilitated areas. Weed control is mostly achieved through hygiene procedures.

A total of 132 introduced flora species have been recorded in the wider lease areas near Boddington and Collie, Figures 6-1 to 6-14, Table 3 and Appendices H and I. The latter total numbers included 132 introduced species and 5 planted species in the Boddington area and 15 introduced species and 1 planted species in the Collie RLA. A total of 115 introduced species have been recorded since 1980 on agricultural and rehabilitated areas in the WMDE and BTC and 37 introduced species on control areas in the WMDE and BTC areas. The range of species on the control areas includes remnant vegetation areas on private properties and the less disturbed areas within the WMDE and BTC.

The majority of these occur off the remnant vegetation areas and within the agricultural areas. The majority of the weeds are short term annual species that establish on disturbed agricultural lands and although some establish in the early phase of rehabilitation, the majority are quickly outgrown by more perennial and larger native shrub and tree species. Therefore the occurrence of the majority of the weeds in the rehabilitation areas is temporary and short-lived (e.g. **Hypochaeris glabra* and **Aira caryophyllea*). The number of weed species is influenced by the inclusion of agricultural lands in the Boddington area which have been cleared and highly modified for many decades.

The dominant weeds included **Avena barbata, *Avena* sp.*, *Bellardia trixago, *Bromus diandrus, *Bromus* sp., **Centaurium erythraea, *Cynodon dactylon, *Cyperus tenellus, **Leptospermum laevigatum, Lolium perenne, *Oxalis corniculata* and **Romulea rosea.* The weeds were located (see Figures 6-1 to 6-14) in most areas on the rehabilitation areas in the early phases (31.59%), on the lower valley floors in the swamps and creeklines (23.55%) or in cleared areas (12.9%). The other areas in the site-vegetation types on the valleys (12.9%), near granites (4.3%), and slopes (14.76%).

Of the potential introduced flora species the following are Declared plants under the *Biodiversity and Agricultural Management Act 2007* (BAM Act) (Department of Primary Industries and Regional Development (DPIRD) 2020), namely:

- **Gomphocarpus fruticosus* – near Collie Refinery on previously cleared agricultural lands (DPAW 2020a; DAWE 2020a) and in survey areas by Bennett (2008).
- **Silybum marianum* – near Collie Refinery in Phase One (Dames and Moore 1981) (Figure 6.14); although not recorded in recent assessments of CBME by Mattiske Consulting.
- **Asparagus asparagoides*– near Boddington and Collie areas on previously cleared agricultural lands and on disturbed areas (Figures 6.5, 6.7 and 6.8) on fringes of cleared land, plantations and roadsides on fringes of roadside. (DPAW 2020a; DAWE 2020a); and not recorded in recent assessments of CBME by Mattiske Consulting.
- *Moraea flaccida* – was recorded at 6 locations near Boddington on agricultural areas westwards and outside the WMDE and BTC areas (Figure 6.3); most records were made in 2009 with a few in 2012 and 2013.

With the exception of the *Moraea flaccida* on the areas west of the WMDE and BTC (Hotham Farm and cleared agricultural lands south of the Pinjarra-Williams Road), the latter Declared plants have not been recorded in the assessments on the surveyed areas in recent assessments.

Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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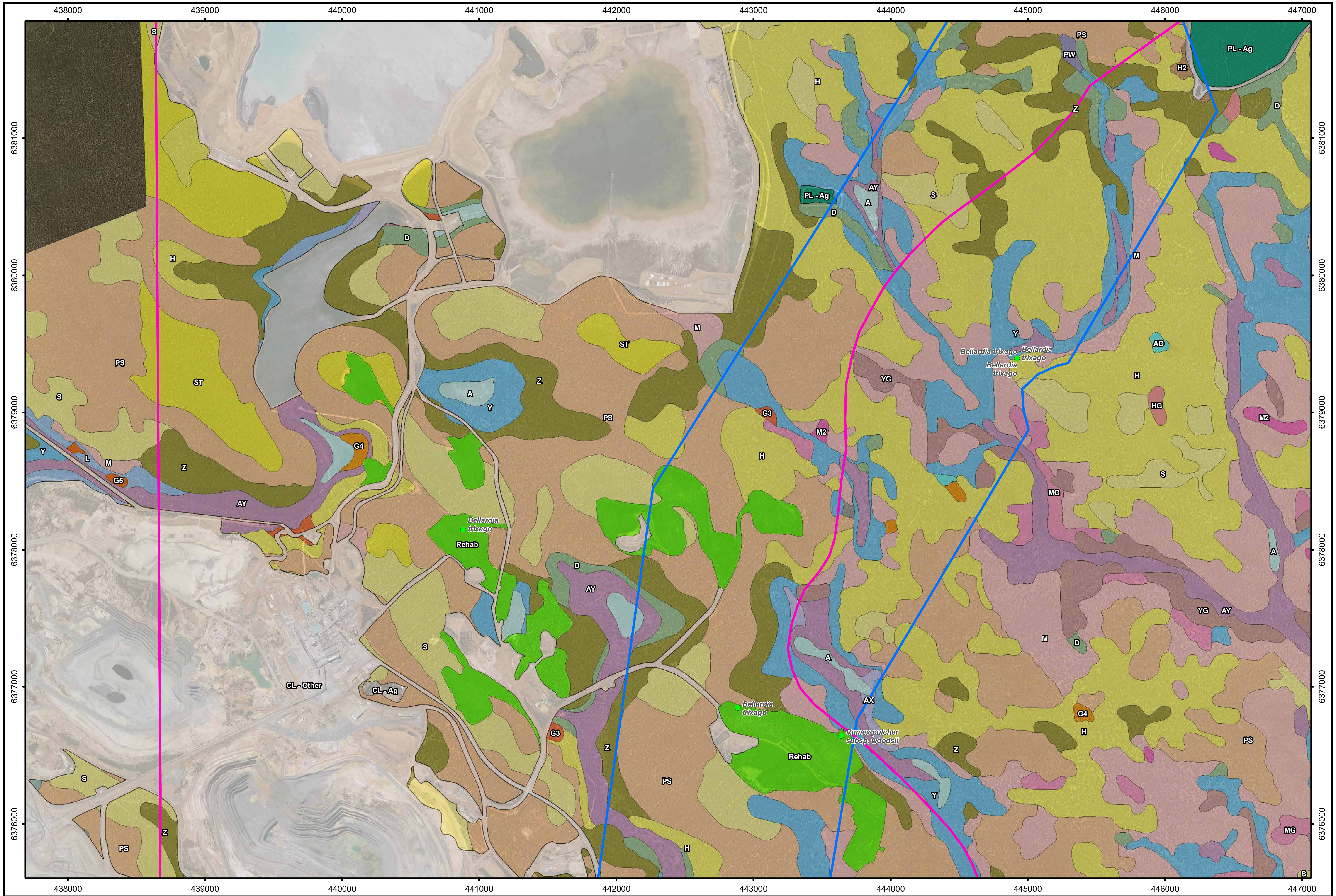
Primary Assessment Area (PAA)

Weeds

Sheet 1 of 13

Figure: **6.1**



Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F009_01

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Primary Assessment Area (PAA)

Weeds

Sheet 2 of 13

Figure: 6.2


438000
439000
440000
441000
442000
443000
444000
445000
446000
447000
6375000
6374000
6373000
6372000
6371000
6370000
CL - Other
Rehab - Ag
CL - Ag
Moraea flaccida
Bromus diandrus
Avena barbata
Centaurium erythraea
Bellardia trixago
Juncus acutus subsp. acutus
Juncus bufonius
Juncus usitatus
Rumex pulcher subsp. woodsii
Cynodon dactylon
Avena fatua
AY/D
Legend
Declared Pest - s22(2) Site
High Ecological Impacted Site
Weed of National Significance Area
Declared Pest - s22(2) Area
Highly Ecological Impacted Area
Worsley Mine Development Envelope (WMDE)
Bauxite Transport Corridor (BTC)
Client:
SOUTH32
N
0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)
CAD Ref: g1881_F009_01
Date: Nov 2020
Rev: A
A3
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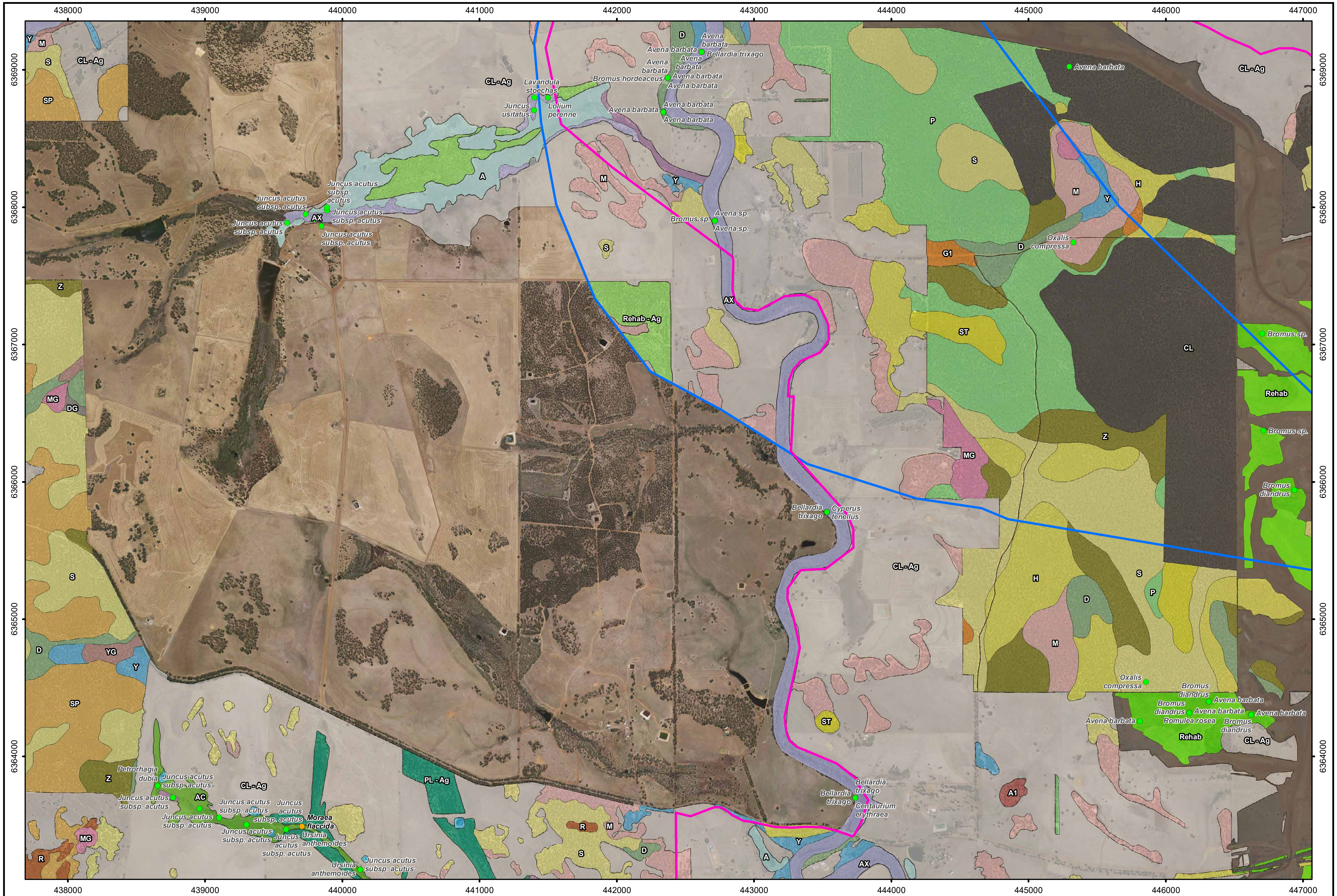
Primary Assessment Area (PAA)
Weeds
Sheet 3 of 13
Figure:
6.3



Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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Primary Assessment Area (PAA)

Weeds

Sheet 4 of 13

Figure: **6.4**

448000 449000 450000 451000 452000 453000 454000 455000 456000

6369000 6368000 6367000 6366000 6365000 6364000

Y Z P AY PL CL-Ag Rehab *Avena sp.* PL H *Pelargonium capitatum* M W *Avena barbata* *Avena sp.* *Avena sp.* M Y *Avena barbata* *Avena barbata* S *Avena barbata* *Bromus diandrus* CL Z Y M ST *Asparagus asparagoides* *Avena barbata* *Avena barbata* Rehab *Avena sp.* *Avena barbata* S P CL-Ag H

448000 449000 450000 451000 452000 453000 454000 455000 456000

Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)

Client: SOUTH32

N

0 250 500 m

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

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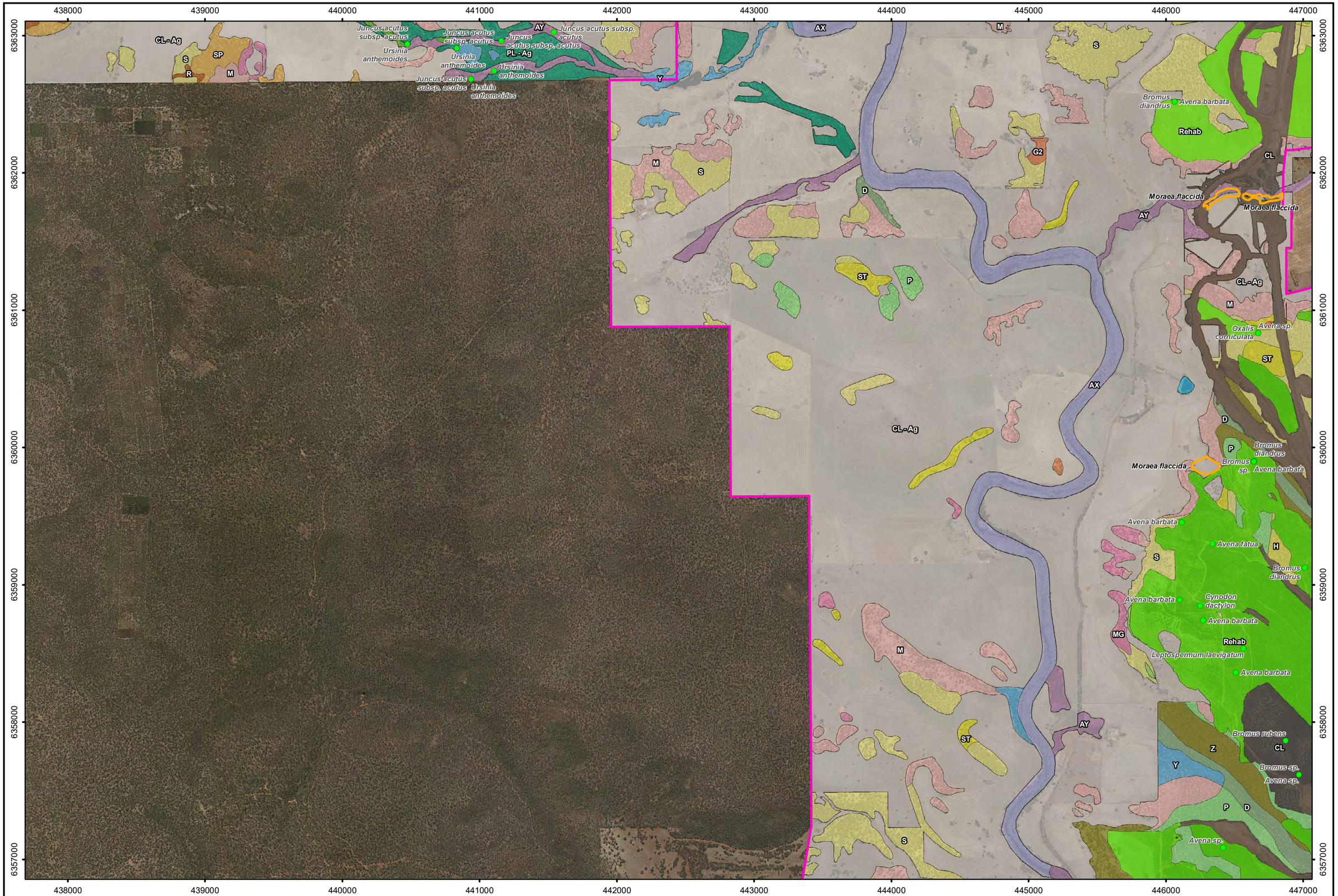
Primary Assessment Area (PAA)

Weeds

Sheet 5 of 13

Figure: **6.5**



Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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Primary Assessment Area (PAA)

Weeds

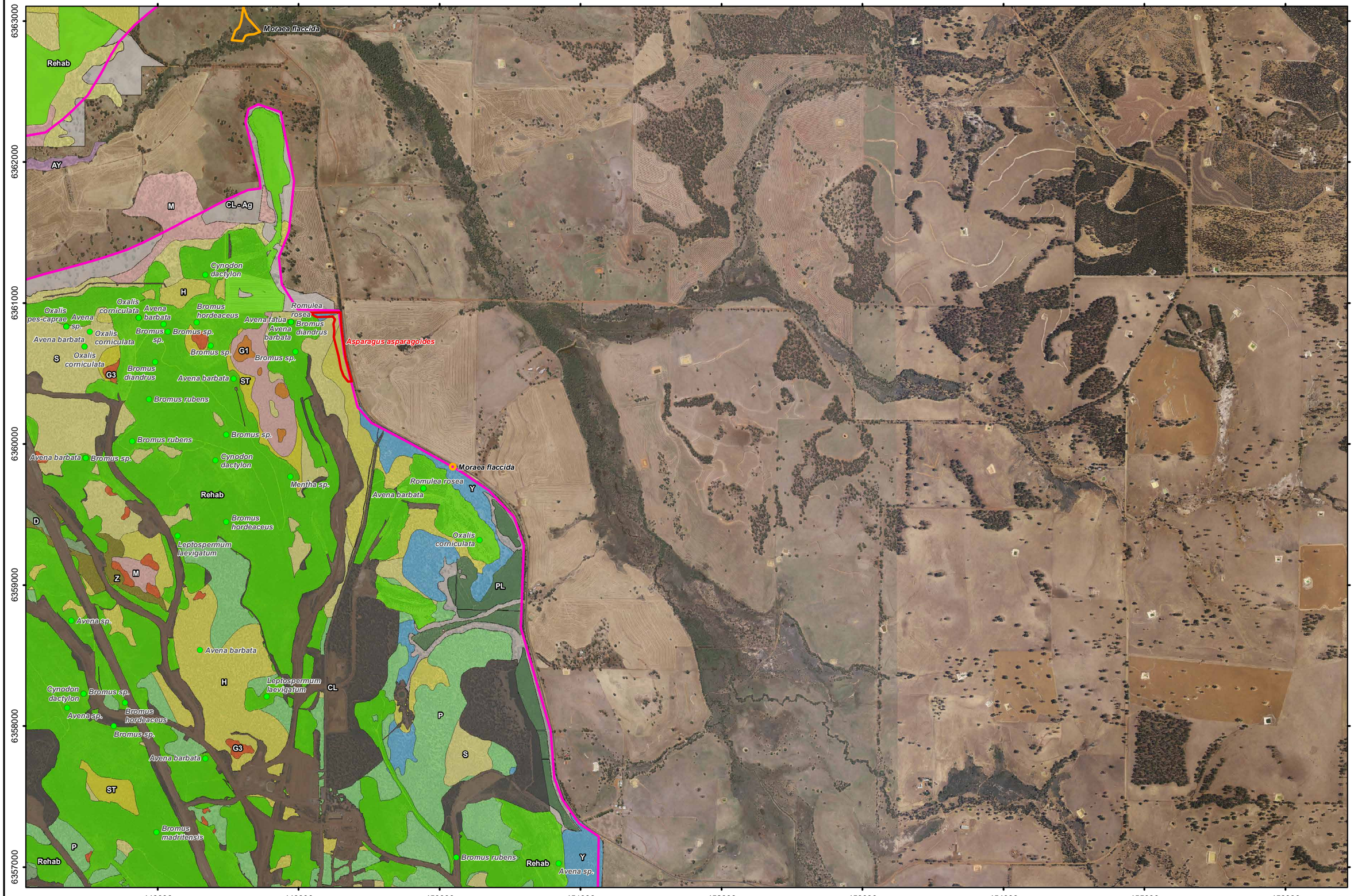
Sheet 6 of 13

Figure: **6.6**

448000 449000 450000 451000 452000 453000 454000 455000 456000

6363000 6362000 6361000 6360000 6359000 6358000 6357000

Moraea flaccida
Rehab
AY
M
CL-Ag
Cynodon dactylon
H
Oxalis corniculata
Avena barbata
Bromus hordeaceus
Romulea rosea
Avena sp.
Oxalis pes-caprae
Bromus sp.
Avena fatua
Bromus diandrus
Asparagus asparagoides
G1
S
G3
ST
Bromus rubens
Mentha sp.
Y
D
Leptospermum laevigatum
Z
PL
CL
P
Bromus madritensis



Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F009_01
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Primary Assessment Area (PAA)

Weeds

Sheet 7 of 13

Figure: **6.7**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6356000 6355000 6354000 6353000 6352000 6351000

Oxalis pes-caprae
Avena barbata
Avena barbata
Rehab
ST
S
Z
Avena barbata
CL
AY
M2
CL-Ag
H
PL
M
Y
H
Asparagus asparagoides
MG
P
S
Bromus hordeaceus
G1
Avena barbata
Rehab
CL
D
Avena barbata
G3
Z
PL
Y
ST
M
CL-Ag
AY
DG
AC
H

Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F009_01
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Primary Assessment Area (PAA)

Weeds

Sheet 8 of 13

Figure: **6.8**

448000 449000 450000 451000 452000 453000 454000 455000 456000

6356000 6355000 6354000 6353000 6352000 6351000

Leptospermum laevigatum
Bromus diandrus
Bromus hordeaceus
Romulea rosea
Oxalis corniculata
Bromus sp.
Avena barbata
Avena fatua
Avena sp.
Cynodon dactylon
Oxalis pes-caprae
Pelargonium capitatum
Rehab
CL - Ag
PL - Ag

Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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Primary Assessment Area (PAA)

Weeds

Sheet 9 of 13

Figure: **6.9**

457000 458000 459000 460000 461000 462000 463000 464000 465000

6356000 6355000 6354000 6353000 6352000 6351000

H2
YG
DG
PL - Ag
Bromus sp.
M
P
H1
Y
MG
HG
H2
CL - Ag
P

Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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Primary Assessment Area (PAA)

Weeds

Sheet 10 of 13

Figure: **6.10**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6350000 6349000 6348000 6347000 6346000 6345000

H
CL - Ag
AY
M
G1
AD

Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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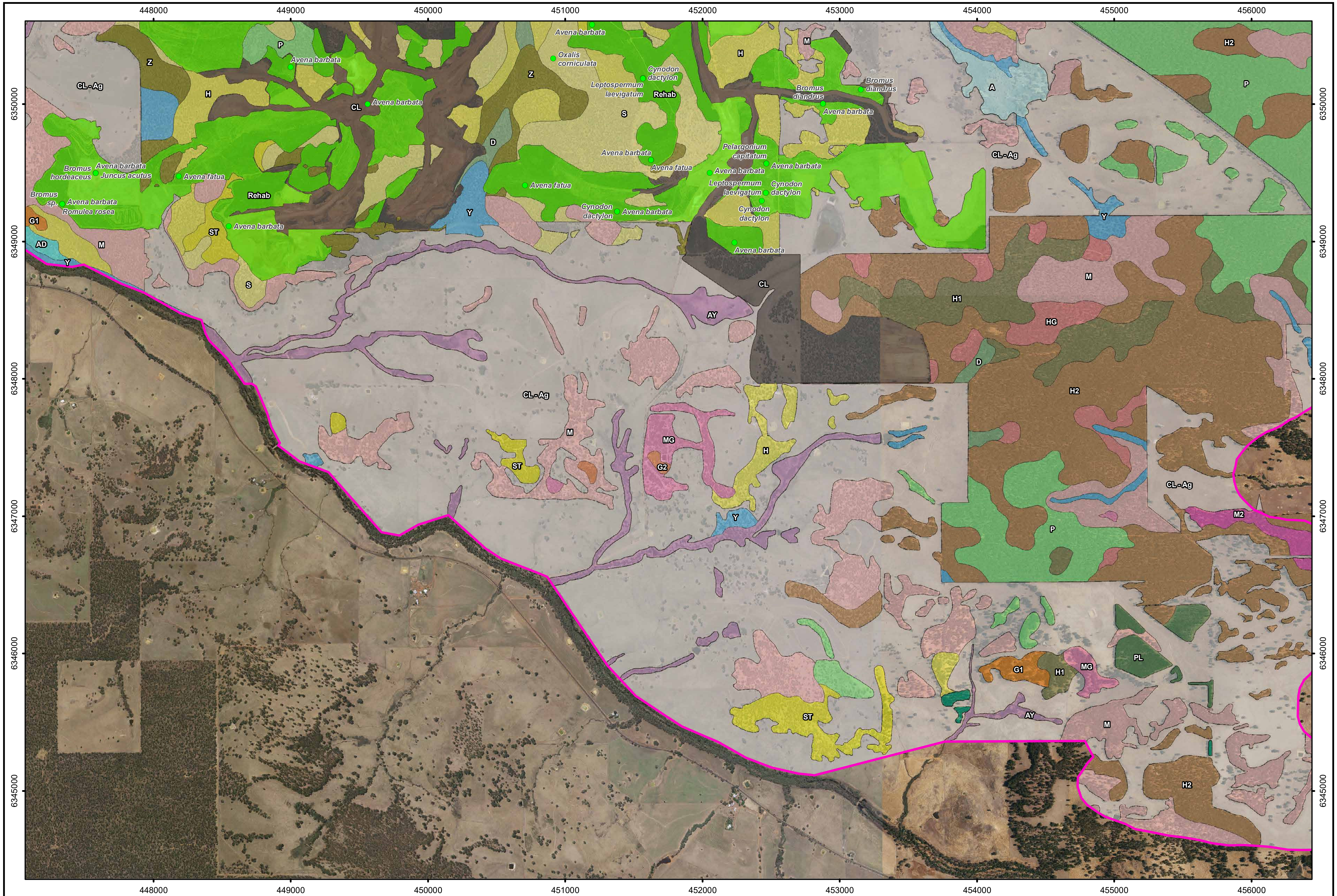
Primary Assessment Area (PAA)

Weeds

Sheet 11 of 13

Figure: **6.11**



Legend
- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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Primary Assessment Area (PAA)

Weeds

Sheet 12 of 13

Figure:

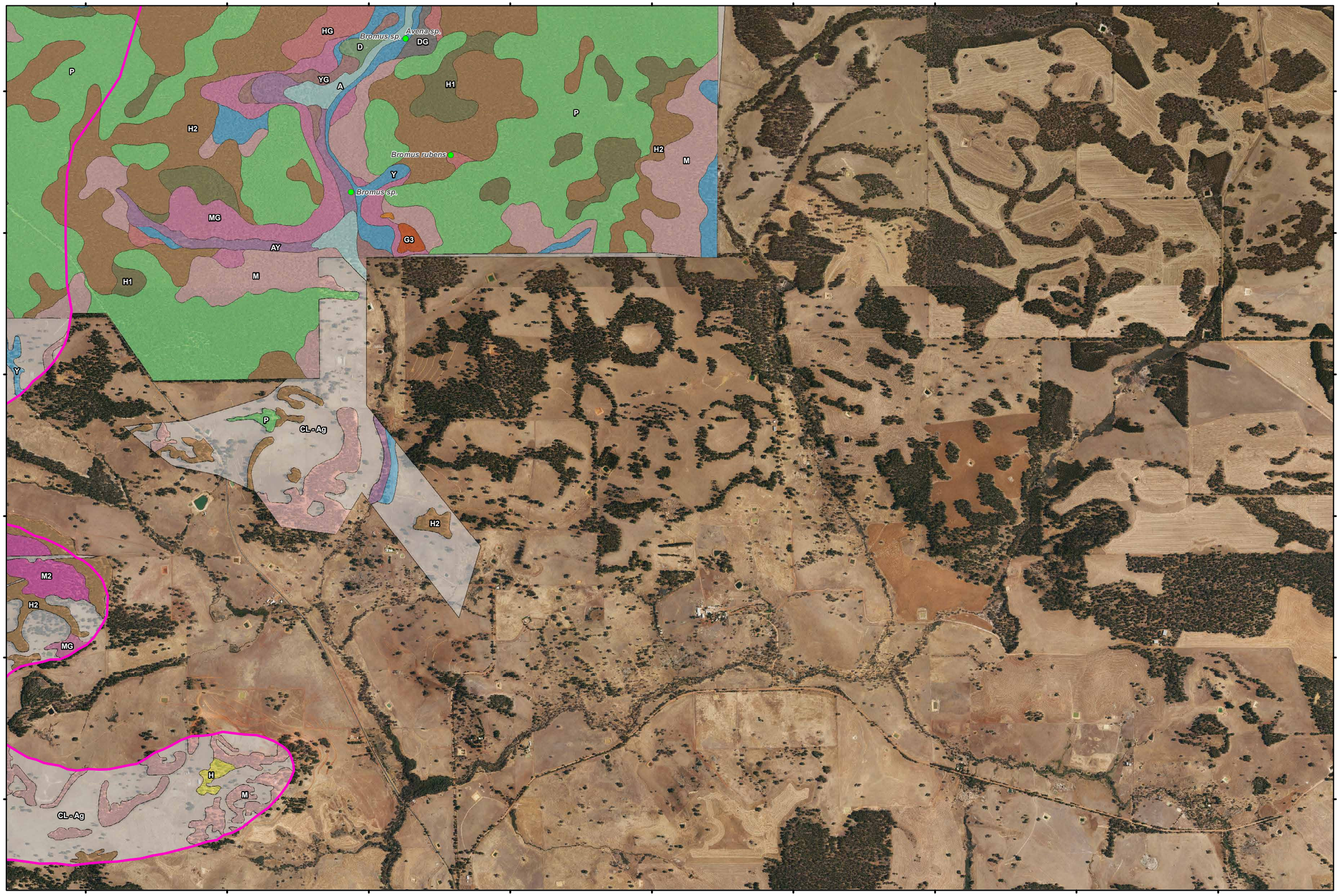
6.12

457000 458000 459000 460000 461000 462000 463000 464000 465000

6350000 6349000 6348000 6347000 6346000 6345000

HG D DG YG A H1 P H2 M Y G3 MG AY CL-Ag

Bromus sp. *Avena sp.* *Bromus rubens* *Bromus sp.*



457000 458000 459000 460000 461000 462000 463000 464000 465000

Legend

- Declared Pest - s22(2) Site
- High Ecological Impacted Site
- Weed of National Significance Area
- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Worsley Mine Development Envelope (WMDE)

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F009_01

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Primary Assessment Area (PAA)

Weeds

Sheet 13 of 13

Figure: **6.13**

407500 410000 412500 415000

6325000 6322500 6320000

Silybum marianum
Cortaderia selloana.
Rubus ulmifolius
CL - Other
Rehab
DAM

Legend

- Declared Pest - s22(2) Area
- Highly Ecological Impacted Area
- Contingency Bauxite Mining Envelope (CBME)
- CL - Other
- CQ
- CW
- D
- DAM
- E
- Q
- R
- Rehab
- S
- SP
- ST
- SW
- T
- TS
- W

Client: SOUTH32

N

0 500m

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

CAD Ref: g1881_F009_02

Date: Aug 2021 | Rev: A | A3

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Collie - Worsley Mine Expansion
Weeds

Figure: **6.14**

5.6 Vegetation Complexes

At a regional scale Heddle *et al*. (1980) and Mattiske and Havel (1998) defined and mapped a series of vegetation complexes that enabled a refinement of the vegetation mapping of Beard (1979) and Smith (1974) for Pinjarra and Collie areas respectively (Tables 6 and 7; and Figures 7-1 and 7-2). The latter work of Beard has been updated recently into Beard *et al.* (2013) for the State of Western Australia. The approach developed by Heddle *et al.* (1980) and Mattiske and Havel (1998) enabled relationships to be defined between the resulting regional patterns of vegetation and the underlying landforms, soils and climatic trends in the southwest forests.

A total of 12 vegetation complexes were recorded in the PAA. These vegetation complexes comprise Jarrah and Marri dominated forests and woodlands on uplands, Wandoo woodlands on valley slopes and a mixture of woodlands, forests and tall shrublands on major valley systems (valley floor swamp).

In the three areas assessed for the Proposal, the following vegetation complexes were recorded:

WMDE – 9 vegetation complexes, Cooke, Coolakin, Dwellingup 4, Michibin, Pindalup, Swamp, Williams, Yalanbee 5 and Yalanbee 6. Of these complexes the Michibin and Williams complex areas are less represented (<10%) in all DBCA managed lands (5.1% and 0.3% respectively) (Government of Western Australia 2019). The latter mainly relates to their occurrence in valley systems that have been developed for agriculture on the eastern fringes of the Darling Ranges.

BTC – 5 vegetation complexes, Cooke, Dwellingup 4, Michibin, Pindalup and Williams. Of these complexes the Michibin and Williams complex areas are less represented (<10%) in all DBCA managed lands (5.1% and 0.3% respectively) (Government of Western Australia 2019). The latter mainly relates to their occurrence in valley systems that have been developed for agriculture on the eastern fringes of the Darling Ranges.

CBME – 3 vegetation complexes, Dwellingup 1, Murray 1 and Yarragil 1. All of these complexes are represented in all DBCA managed lands >10% (Government of Western Australia 2019).

All three areas occur in the RFA area and as such the value of this overlap was evident in the DAWE (2020a) protected matters database search. The RFA area was subjected to intensive community and scientific rigour and the vegetation mapping as undertake by Mattiske and Havel (1998) was a key component of this study in delineating the wider regional values in the southwest forest and as such increased the importance of relying on the vegetation complex mapping rather than the NVIS system as defined by the Executive Steering Committee for Australian Vegetation Information (2003) or the previous Smith and Beard mapping efforts (Smith 1974, Beard 1979; Beard *et al.* 2013).

Table 6: Extent of Vegetation Complexes on the WMDE and BTC as compared with Southwest Forest extent

Vegetation Complex	Description	Pre-European Extent (ha)	Current Extent (ha)	Pre-European Extent Remaining (%)	Current Extent Remaining within All DBCA Managed Land (%)	Extent within PAA (ha)	Extent within WMDE (ha)	Extent within BTC (ha)	Extent within PAA IDF (ha) (% of current extent)	Extent within WMDE IDF (ha) (% of current extent)	Extent within BTC IDF (% of current extent)
Ce	Cooke - Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* (subhumid zone) and open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* (semiarid and arid zones) and on deeper soils adjacent to outcrops, closed heath of Myrtaceae – Proteaceae species and lithic complex on granite rocks and associated soils in all climatic zones, with some *Eucalyptus laeliae* (semiarid), and *Allocasuarina huegeliana* and *Eucalyptus wandoo* (mainly semiarid and perarid zones).	36,779	30,304	82.4%	62.6%	2595.04	2595.04	189.01	725.37 (2.4%)	717.04 (2.4%)	8.3 (0.03%)
Ck	Coolakin - Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens, Eucalyptus marginata* subsp*. thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.	163,992	64,205	39.2%	20.1%	3622.33	3621.17	153.94	949.50 (1.5%)	923.89 (1.4%)	25.61 (0.04%)
D4	Dwellingup 4 – Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on lateritic uplands in semiarid and arid zones.	132,416	115,662	87.3%	70.1%	9438.08	9021.16	1356.03	3849.01 (3.3%)	3794.26 (3.28%)	54.75 (0.05%)
Mi	Michibin - Open woodland of *Eucalyptus wandoo* over *Acacia acuminata* with some *Eucalyptus loxophleba* on valley slopes, with low woodland of *Allocasuarina huegeliana* on or near shallow granite outcrops in arid and perarid zones.	168,040	42,996	25.6%	5.1%	4803.91	4707.52	885.41	1237.13 (2.9%)	1042.16 (2.4%)	194.97 (0.4%)
Pn	Pindalup – Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.	167,151	128,358	76.8%	60.1%	2248.47	1998.16	690.09	833.63 (0.6%)	807.38 (0.6%)	26.25 (0.02%)
S	Swamp - Mosaic of low open woodland of *Melaleuca preissiana – Banksia littoralis,* closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.	53,658	40,613	75.7%	64.2%	872.77	872.77	85.69	98.09 (0.2%)	69.94 (0.2%)	28.15 (0.07%)

Source: Government of Western Australia. (2019). 2018 South West Vegetation Complex Statistics. Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca

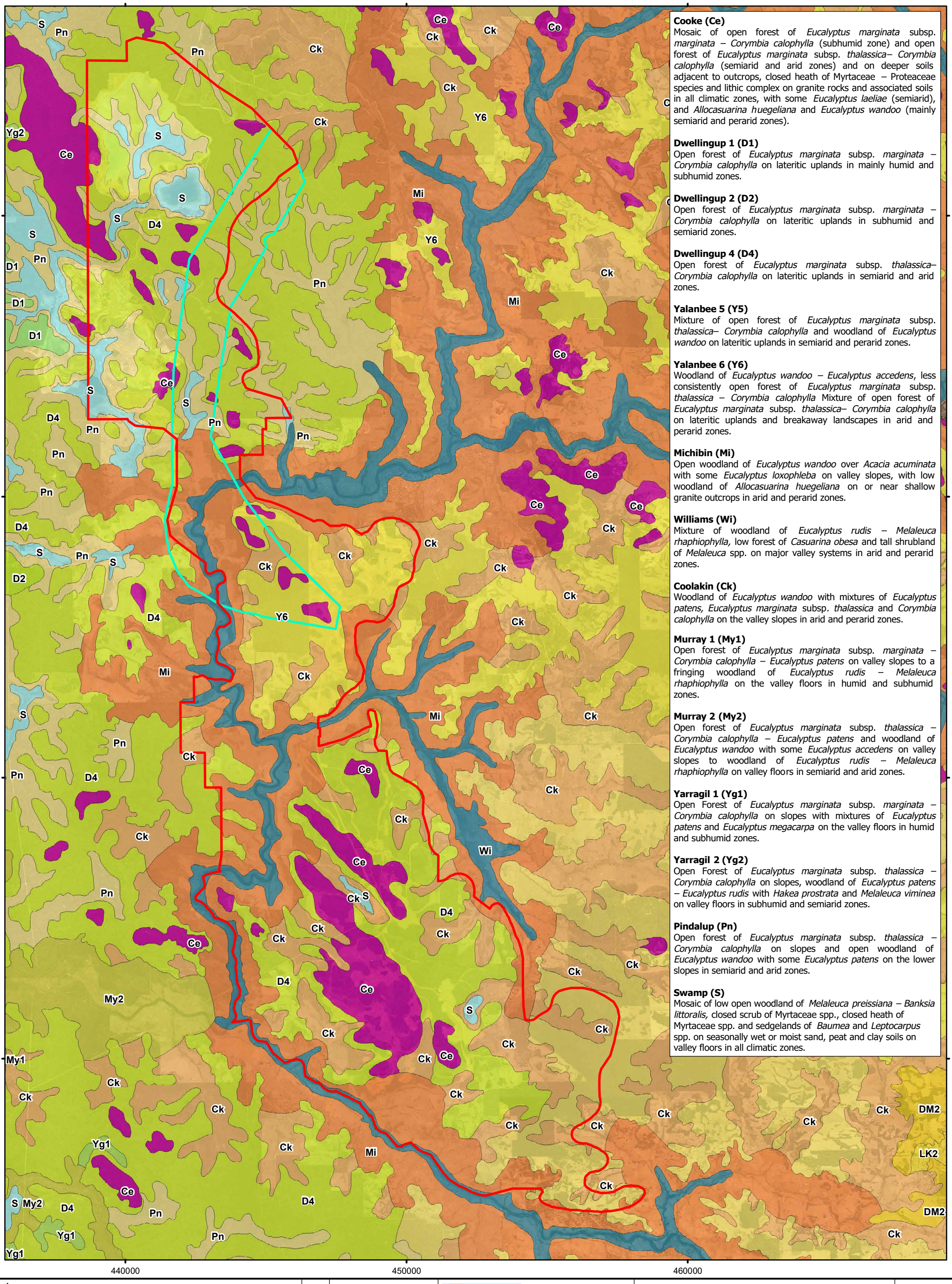
Notes: 2018 South West Vegetation Complex Statistics -DBCA-047 does not take into account detailed site rehabilitation, plantation and pasture areas, these are derived from Mattiske, 2020.

Table 6: Extent of Vegetation Complexes on the WMDE and BTC as compared with Southwest Forest extent *(continued)*

Vegetation Complex	Description	Pre-European Extent (ha)	Current Extent (ha)	Pre-European Extent Remaining (%)	Current Extent Remaining within All DBCA Managed Land (%)	Extent within PAA (ha)	Extent within WMDE (ha)	Extent within BTC (ha)	Extent Within PAA IDF (ha) (% of current extent)	Extent Within WMDE IDF (ha) (% of current extent)	Extent Within BTC IDF (% of current extent)
Wi	*Williams* - Mixture of woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla,* low forest of *Casuarina obesa* and tall shrubland of *Melaleuca* spp. on major valley systems in arid and perarid zones.	28,984	7,517	25.9%	0.3%	1242.82	1194.03	254.00	73.70 (1.0%)	39.46 (0.5%)	34.24 (0.5%)
Y5	*Yalanbee 5* - Mixture of open forest of *Eucalyptus marginata* subsp. *thalassica– Corymbia calophylla* and woodland of *Eucalyptus wandoo* on lateritic uplands in semiarid and perarid zones.	126,610	83,829	66.2%	38.8%	1457.03	1457.03	0.00	1014.85 (1.2%)	1014.85 (1.2%)	0.00 (0.00%)
Y6	*Yalanbee 6* - Woodland of *Eucalyptus wandoo – Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla*.	197,849	92,081	46.5%	21.1%	2329.39	2329.39	531.57	507.61 (0.5%)	492.05 (0.5%)	15.57 (0.02%)

Table 7: Extent of Vegetation Complexes on the CBME as compared with Southwest Forest extent (Government of Western Australia 2019)

Vegetation Complex	Description	Pre-European Extent (ha)	Current Extent (ha)	Pre-European Extent Remaining (%)	Current Extent Remaining within All DBCA Managed Land (%)	Extent Within CBME (ha)	Extent Within CBME - IDF (ha) (% of current extent)
D1	Dwellingup 1 - Open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.	208,491	181,039	86.8%	82.3%	313.84	140.88 (0.08)
My1	Murray 1 - Open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla – Eucalyptus patens* on valley slopes to a fringing woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.	68,695	52,296	76.1%	64.7%	391.97	108.35 (0.2%)
Yg1	Yarragil 1 - Open Forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.	80,203	64,927	81.0%	73.6%	40.74	6.68 (0.01%)



Cooke (Ce)
Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* (subhumid zone) and open forest of *Eucalyptus marginata* subsp. *thalassica– Corymbia calophylla* (semiarid and arid zones) and on deeper soils adjacent to outcrops, closed heath of Myrtaceae – Proteaceae species and lithic complex on granite rocks and associated soils in all climatic zones, with some *Eucalyptus laeliae* (semiarid), and *Allocasuarina huegeliana* and *Eucalyptus wandoo* (mainly semiarid and perarid zones).

Dwellingup 1 (D1)
Open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.

Dwellingup 2 (D2)
Open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.

Dwellingup 4 (D4)
Open forest of *Eucalyptus marginata* subsp. *thalassica– Corymbia calophylla* on lateritic uplands in semiarid and arid zones.

Yalanbee 5 (Y5)
Mixture of open forest of *Eucalyptus marginata* subsp. *thalassica– Corymbia calophylla* and woodland of *Eucalyptus wandoo* on lateritic uplands in semiarid and perarid zones.

Yalanbee 6 (Y6)
Woodland of *Eucalyptus wandoo – Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* Mixture of open forest of *Eucalyptus marginata* subsp. *thalassica– Corymbia calophylla* on lateritic uplands and breakaway landscapes in arid and perarid zones.

Michibin (Mi)
Open woodland of *Eucalyptus wandoo* over *Acacia acuminata* with some *Eucalyptus loxophleba* on valley slopes, with low woodland of *Allocasuarina huegeliana* on or near shallow granite outcrops in arid and perarid zones.

Williams (Wi)
Mixture of woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla,* low forest of *Casuarina obesa* and tall shrubland of *Melaleuca* spp. on major valley systems in arid and perarid zones.

Coolakin (Ck)
Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens, Eucalyptus marginata* subsp*. thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.

Murray 1 (My1)
Open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla – Eucalyptus patens* on valley slopes to a fringing woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.

Murray 2 (My2)
Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla – Eucalyptus patens* and woodland of *Eucalyptus wandoo* with some *Eucalyptus accedens* on valley slopes to woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* on valley floors in semiarid and arid zones.

Yarragil 1 (Yg1)
Open Forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.

Yarragil 2 (Yg2)
Open Forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes, woodland of *Eucalyptus patens – Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones.

Pindalup (Pn)
Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.

Swamp (S)
Mosaic of low open woodland of *Melaleuca preissiana – Banksia littoralis,* closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.

Legend
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)

N

0 1 2 km
Scale: 1:125,000
MGA94 (Zone 50)
CAD Ref: g1881_F006_05_01
Date: Feb 2020 | Rev: A | A3

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Primary Assessment Area (PAA)

Vegetation Complexes

Figure: **7.1**

400000 410000 420000

6330000

6320000

Darling Scarp (DS2)
Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla*, with some admixture of *Eucalyptus laeliae* in the north (subhumid zone), with *Corymbia haematoxylon* in the south (humid zone) on deeper soils adjacent to outcrops, woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae – Proteaceae species and lithic complex on or near granite outcrops in all climatic zones.

Dwellingup 1 (D1)
Open forest of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.

Yarragil 1 (Yg1)
Open Forest of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.

Yarragil 2 (Yg2)
Open Forest of *Eucalyptus marginata* subsp. *thalassica* – *Corymbia calophylla* on slopes, woodland of *Eucalyptus patens* – *Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones.

Murray 1 (My1)
Open forest of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla* – *Eucalyptus patens* on valley slopes to a fringing woodland of *Eucalyptus rudis* – *Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.

Lowdon (Lo)
Open forest of *Corymbia calophylla* – *Eucalyptus marginata* subsp. *marginata* – *Agonis flexuosa* with some *Eucalyptus wandoo* and occasional *Corymbia haematoxylon* on slopes, and woodland of *Eucalyptus rudis* – *Melaleuca rhaphiophylla* on valley floors in humid zone.

Goonaping (G)
Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* (humid zones) and *Eucalyptus marginata* subsp. *thalassica* (semiarid and perarid zones) on the sandy -gravels, low woodland of *Banksia attenuata* on the drier sandier soils (humid to perarid zones) with some *Banksia menziesii* (northern arid and perarid zones) and low open woodland of *Melaleuca preissiana* – *Banksia littoralis* on the moister sandy soils (humid to perarid zones).

Swamp (S)
Mosaic of low open woodland of *Melaleuca preissiana* – *Banksia littoralis*, closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.

Legend
- ML1SA Area
- Contingency Bauxite Mining Envelope (CBME)
- D1 , Dwellingup
- DS2 , Darling Scarp
- G , Goonaping
- Lo , Lowdon
- My1 , Murray 1
- S , Swamp
- Yg1 , Yarragil 1
- Yg2 , Yarragil 2

Client: SOUTH32

N

0 1.5km
Scale: 1:75,000
MGA94 (Zone 50)
CAD Ref: g1881_F006_05_02
Date: Aug 2021 | Rev: A | A3

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Collie - Worsley Mine Expansion
Vegetation Complexes

Figure: **7.2**

5.7 Site-Vegetation Types

The field survey consisted of a detailed assessment of all remnant vegetation areas near Boddington within the WMDE and BTC. At a finer scale of local mapping the site-vegetation types for the WMDE, BTC and CBME by initially Dames and Moore (1981) and later Mattiske (1985 to 2018) were based on the earlier ecological studies of Havel (1975a and 1975b) who delineated a series of site-vegetation types that integrated the structural and floristic components (including key indicator species) with the underlying soil and site conditions (Tables 8 and 9; Figures 8-0 to 8-14). It is not feasible to place the representation in these respective areas into the regional context as the degree of detailed mapping has not been funded by the wider community. The interpretations on representation within the respective PAA areas is based on aerial extent and condition, the interpretation of regional extent is based on over 40 years of Jarrah Forest mapping by Dr Mattiske.

WMDE – 34 site-vegetation types were defined for the WMDE area. The dominant site-vegetation types (>300ha) were M, P, PS, S, H, H2, ST, Y, Z AY and D. Large sections of the WMDE have been cleared for agriculture and plantations. The majority of the WMDE area is either completely degraded (45.41%) or degraded (14.99%). The restricted site-vegetation types include swamp vegetation types (A1, A2), on the lower slopes (AD, AY/D, B, DG), on the outcropping areas (G1, G2, G4, R) and on the moister slopes (PW, SW, W, YG).

BTC – 25 site-vegetation types were defined for the BTC area (noting that 3332.15ha overlaps with the WMDE). The dominant site-vegetation types (>300ha) were H, M, PS and S. Large sections of the BTC have been cleared for agriculture and plantations. A large portion of the BTC is either completely degraded (27.38%) or degraded (5.84%). The restricted site-vegetation types include specific types on the slopes (H2, M2), on the lower slopes (AD, AY/D, DG), on the outcropping areas (G2, G3, G4) and on the moister slopes (PW).

CBME – 10 site-vegetation types were defined for the CBME. The dominant site-vegetation types (>100ha) were S and ST. The majority of the CBME was relatively undisturbed, with the exception of the dam, rehabilitation and completely degraded cleared areas (31.64%). The restricted site-vegetation types include specific types on the lower slopes (CQ), flats (E) and slopes (SP). All site-vegetation types in the CBME are well represented in nearby State Forest areas and conservations areas (e.g., Wellington National Park).

On the basis of aerial extent, condition and significant values related to the presence of variable structural and floristic components and the presence of significant conservation flora species a total of 15 locally significant communities are considered to occur within the PAA include the following:

- **The Priority 1 PEC - Mt Saddleback Heath Communities**, as delineated by DBCA, occurs in the Saddleback area near Boddington within the WMDE but not within the BTC. This PEC community on Mt Saddleback has affinities with selected components of the site-vegetation type G as defined by Havel (1975b) and as refined and split into site-vegetation types G1, G2, G3, G4 and G5 by Mattiske in the northern Jarrah Forest areas and more specifically G1, G2, G3 and G4 in the PAA areas by Mattiske (Worsley Alumina Pty Ltd 1985 to Mattiske in prep 2020). Some of these site-vegetation types extend well beyond the Mt Saddleback area, e.g., north of the Boddington Gold Mine and on the eastern fringes of the State Forest. The occurrence of the majority of Priority species in the heath communities reinforces the significance of these areas and in particular Tunnell Road Heath and heath communities on Forty-Hollow Road and Mt Saddleback. There remain differences in the various G site-vegetation types and hence variations related to the occurrence and dominance of different structural components and species in the heath communities (G1 and G3) and those (G4 and G5) that also have patches of mallee *Eucalyptus* species (*Eucalyptus latens, Eucalyptus drummondii* and *Eucalyptus aspersa*) and a few stands of *Melaleuca preissiana* and *Corymbia calophylla* trees in the Tunnell Road heath area.

- The G1, G3, G4 and G5 site-vegetation types as defined by Mattiske in following areas:
    - 73.93ha of G1 in the WMDE area, 6.51ha of G1 within the BTC area, 4.50ha of G1 within the PAA (WMDE/BTC) IDF; and 194.48ha of G1 in the wider areas mapped.
    - 75.53ha of G3 in the WMDE area, 3.28ha of G3 within the BTC area, 13.17ha of G3 within the PAA (WMDE/BTC) IDF; and 137.59ha of G3 in the wider areas mapped.
    - 12.07ha of G4 in the WMDE area, 2.07ha of G4 within the BTC area, 14.14ha of G4 within the PAA (WMDE/BTC) area and 3.41ha of G4 within the PAA (WMDE/BTC) IDF; and 15.66ha of G4 in the wider areas mapped.
    - The G5 was not recorded within the PAA (WMDE/BTC) area; although 5.98ha was recorded in the wider areas mapped.
- The G2 site-vegetation type that occurs on granite in association with Rock Sheoak (*Allocasuarina huegeliana*), heath communities and lithic complexes occurs in the following areas:
    - 7.60ha of G2 in the WMDE area and the PAA (WMDE/BTC) area, 1.91ha within the PAA (WMDE/BTC) area; and
    - 186.89ha of type G2 in the wider areas mapped.
- The communities that are a mixture of different site-vegetation types over shallow granites (DG, HG, LG, MG and YG) occur in the following areas:
    - 7.93ha of DG in the WMDE area, 8.73ha within the PAA (EMDE/BTC) area, 5.06ha of DG within the BTC area, 2.07ha of DG within the PAA (WMDE/BTC) IDF; and 51.67ha of DG in the wider area surveyed;
    - 50.97ha of HG in the WMDE area and the PAA (WMDE/BTC) area, 25.53ha of HG within the PAA (WMDE/BTC) IDF; and 150.23ha of HG in the wider area surveyed;
    - 1.90ha of LG in the wider area surveyed;
    - 218.53ha of MG in the WMDE area, 28.35ha of MG within the BTC area, 220.47ha within the PAA (WMDE/BTC) area, 39.30ha of MG within the PAA (WMDE/BTC) area, and 501.24ha of MG in the wider area surveyed;
    - 11.95ha of YG in the WMDE area, 20.71ha of YG within the BTC area, 31.15ha of YG within the PAA (WMDE/BTC) area, 3.20ha of YG within the PAA (WMDE/BTC) IDF; and 456.38ha of YG in the wider area surveyed;
- The M2 site-vegetation type which supports woodlands of *Eucalyptus accedens*, *Eucalyptus wandoo, Eucalyptus marginata* and *Corymbia calophylla* on eastern breakaways. The M2 site-vegetation type occurs in the BTC, the WMDE and the wider mapped areas near Boddington. This site-vegetation type occurs eastwards on the upper slopes, ridges and breakaways of the fringes of the eastern Jarrah Forest. This site-vegetation type occurs in the following areas:
    - 45.43ha of M2 in the WMDE area, 1.38ha of M2 within the BTC area, 45.43ha of M2 within the PAA (WMDE/BTC) area, 16.29ha of M2 within the PAA (WMDE/BTC) IDF; and 544.20ha of M2 in the wider areas mapped.
- A, AY, AX, AC Types – Woodlands of *Eucalyptus rudis* and *Melaleuca* species on the swamps and creeklines that provide linkages for fauna species and a variety of plant species on variable soils in the survey areas. These site-vegetation types occur in the following areas:
    - 121.40ha of A in the WMDE area, 39.79ha of A within the BTC area, 130.06ha of A within the PAA (WMDE/BTC) area, 39.61ha of A within the PAA (WMDE/BTC) IDF; and 625.86ha of A in the wider area surveyed;
    - 404.53ha of AY in the WMDE area, 153.96ha of AY within the BTC area, 434.28ha of AY within the PAA (WMDE/BTC) area, 164.26ha of AY within the PAA (WMDE/BTC) IDF; and 907.69ha of AY in the wider area surveyed;
    - 196.70ha of AX in the WMDE area, 98.92ha of AX within the BTC area, 224.68ha within the PAA (WMDE/BTC) area, 25.95ha of AX within the PAA (WMDE/BTC) IDF; and 516.87ha of AX in the wider area surveyed;
    - 34.15ha of AC in the WMDE and the wider PAA (WMDE/BTC) areas, and 0.0002ha of AC within the PAA (WMDE/BTC) IDF; and 58.52ha of AC in the wider areas mapped.
- The restricted L site-vegetation type that supports a woodland of *Eucalyptus patens* and *Eucalyptus wandoo* on the lower slopes of the valley floors.

- 32.90ha of L in the WMDE and PAA (WMDE/BTC) areas, 27.02ha of L within the BTC area, 18.63ha of L within the PAA (WMDE/BTC) IDF; and 264.37ha of L in the wider areas mapped.

- The Y site-vegetation types that is often associated with the occurrence of the *Gastrolobium* sp. Prostrate Boddington (M. Hislop 2130), particularly on the lower slopes near the Hotham River and north on broader clay loam valley lower slopes. This site-vegetation type is well represented in the wider areas and occurs in the following areas:
  - 623.79ha of Y in the WMDE area; 194.47ha of Y within the BTC area, 720.56ha within the PAA (WMDE/BTC) area and 189.41ha of Y within the PAA (WMDE/BTC) IDF; and 2052.77ha of Y in the wider areas mapped.

The majority of the site-vegetation types that occur on the Collie Refinery lease areas, and therefore within the CBME, are locally well represented in State Forest and conservations areas (e.g., Wellington National Park) and therefore are locally not significant.

Table 8: Extent of the Site-Vegetation Types (SVT) on the Wider Total Area Mapped (WTAM) and PAA, WMDE, BTC and PAA (WMDE/BTC) IDF near Boddington

SVT Code	Description	Wider Total Area Mapped (WTAM)	PAA (ha)	WMDE (ha)	BTC (ha)	PAA (WMDE /BTC) IDF (ha)
A	Tall shrubland of *Melaleuca lateritia, Hakea varia, Melaleuca viminea* and *Melaleuca incana* subsp. *incana* on clay-loams in seasonally wet valley floors.	625.86	130.06	121.40	39.79	39.61
A1	Mixed tall shrubland of *Melaleuca viminea, Melaleuca lateritia, Taxandria linearifolia, Astartea scoparia* over *Baumea juncea* and *Lepidosperma tetraquetrum* with occasional patches of *Banksia littoralis* and *Melaleuca rhaphiophylla* over low herbs on seasonally water-logged clays and clay loams on valley floors.	45.47	2.88	2.88	0.00	0.00
A2	Low open woodland of *Melaleuca rhaphiophylla* over *Astartea scoparia* and low herbs on seasonally water-logged clays and clay loams in seasonally wet valley floors.	8.88	1.66	1.66	0.00	0.00
A3	Open woodland of *Eucalyptus rudis, Eucalyptus patens* and *Eucalyptus wandoo* over *Melaleuca lateritia, Hakea varia, Taxandria linearifolia* and *Hypocalymma angustifolium* over herbs and sedges on clay-loams in seasonally wetter valley floors.	13.35	0.00	0.00	0.00	0.00
AC	Open woodland of *Eucalyptus wandoo* and *Eucalyptus rudis* over *Juncus pallidus, Astartea scoparia, Taxandria linearifolia* and *Lepidosperma tetraquetrum* over herbs on clay loams in seasonally wet valley floors.	58.52	34.15	34.15	0.00	0.00
AD	Low open woodland of *Eucalyptus rudis* and *Eucalyptus marginata* over *Banksia littoralis, Hakea prostrata* and *Pericalymma ellipticum* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.	14.09	5.62	4.73	0.89	0.00
AX	Open woodland of *Eucalyptus rudis* over *Acacia saligna, Melaleuca incana* subsp. *incana* and *Hypocalymma angustifolium* on clay- loams on valley floors.	516.87	224.68	196.70	98.92	25.95
AY	Open woodland of *Eucalyptus rudis* and *Eucalyptus wandoo* over *Acacia saligna, Hakea prostrata* and *Hypocalymma angustifolium* on clay- loams on valley floors.	907.69	434.28	404.53	153.96	164.26
AY/D	Mosaic of AY and D	5.35	5.35	5.35	5.35	1.33
B	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Adenanthos obovatus* and *Babingtonia camphorosmae* on lower sandier soils on fringes of swamps and valley floors.	6.22	0.47	0.47	0.00	0.00
CQ	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* on lower slopes with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum, Agonis linearifolia* and *Astartea scoparia* along the edges of the deeper incised valleys near the creek-lines.	12.12	9.62	0.00	0.00	0.00

Table 8: Extent of the Site-Vegetation Types (SVT) on the Wider Total Area Mapped (WTAM) and PAA, WMDE, BTC and PAA (WMDE/BTC) IDF near Boddington (continued)

SVT Code	Description	Wider Total Area Mapped (WTAM)	PAA (ha)	WMDE (ha)	BTC (ha)	PAA (WMDE/BTC) IDF (ha)
CW	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	32.64	17.90	0.00	0.00	9.83
D	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes.	976.09	400.67	391.41	146.77	198.39
DG	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Pericalymma ellipticum, Grevillea bipinnatifida, Allocasuarina humilis, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes with localized patches of outcropping.	51.67	8.72	7.93	5.06	2.07
E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Kingia australis, Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.	14.07	0.00	0.00	0.00	0.00
G1	Mosaic of open heath of Proteaceae - Myrtaceae spp. with emergent patches of *Eucalyptus drummondii* on shallow soils on slopes.	194.48	73.93	73.93	6.51	4.50
G2	Mosaic of open woodland of *Allocasuarina huegeliana* and closed heath of Proteaceae Myrtaceae spp. to Lithic Complex on exposed or shallow granite outcrops.	186.89	7.60	7.60	0.00	1.91
G3	Open heath of *Banksia squarrosa* subsp. *squarrosa, Hakea incrassata, Hakea undulata, Petrophile heterophylla* and *Petrophile serruriae* on shallow soils over granite outcrops on slopes with occasional emergent *Eucalyptus drummondii.*	137.59	75.53	75.53	3.28	13.17
G4	Open scrub and tall shrubland of *Hakea trifurcata* and *Hakea undulata* with admixtures of mallee species including *Eucalyptus latens* and *Eucalyptus aspersa* on clay to clay-loam soils over outcrops on slopes.	15.66	14.14	12.07	2.07	3.41
G5	Low woodland of Eucalypt mallee species including *Eucalyptus aspersa, Eucalyptus latens, Eucalyptus longicornis* and *Eucalyptus drummondii* with occasional *Eucalyptus wandoo* over low shrubs of *Allocasuarina humilis, Hakea incrassata*, *Synaphea damopsis* and herbs on clay loams and sandy-loams on slopes.	5.98	0.00	0.00	0.00	0.00
H	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Petrophile striata, Daviesia decurrens, Daviesia longifolia* and *Daviesia rhombifolia* on sandy loam to sandy gravels on slopes and ridges.	5422.58	1812.48	1590.05	501.51	921.42
H1	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Petrophile striata, Daviesia decurrens* and *Daviesia longifolia* on sandy-gravel soils of slopes and less undulating hills.	212.43	138.16	138.16	0.00	70.11
H2	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* with occasional admixtures of *Banksia grandis* and *Persoonia longifolia* over *Acacia celastrifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on gravel and sandy-gravel soils of slopes and less undulating hills.	1045.46	581.73	579.52	2.21	318.83
HG	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Petrophile striata, Lepidosperma squamatum, Styphelia tenuiflora, Daviesia preissii,* and *Daviesia decurrens. Grevillea bipinnatifida, Allocasuarina humilis* and *Hakea undulata* on shallower sandy-gravel soils over granites or secondary laterisation areas on slopes and less undulating hills.	150.23	50.97	50.97	0.00	25.53
J	Open woodland of *Eucalyptus marginata, Corymbia calophylla* and *Eucalyptus patens* with occasional patches of *Banksia attenuata* over *Stirlingia latifolia, Mesomelaena tetragona* and *Babingtonia camphorosmae* on sandy lower slopes.	3.67	0.00	0.00	0.00	0.00

Table 8: Extent of the Site-Vegetation Types (SVT) on the Wider Total Area Mapped (WTAM) and PAA, WMDE, BTC and PAA (WMDE/BTC) IDF near Boddington (continued)

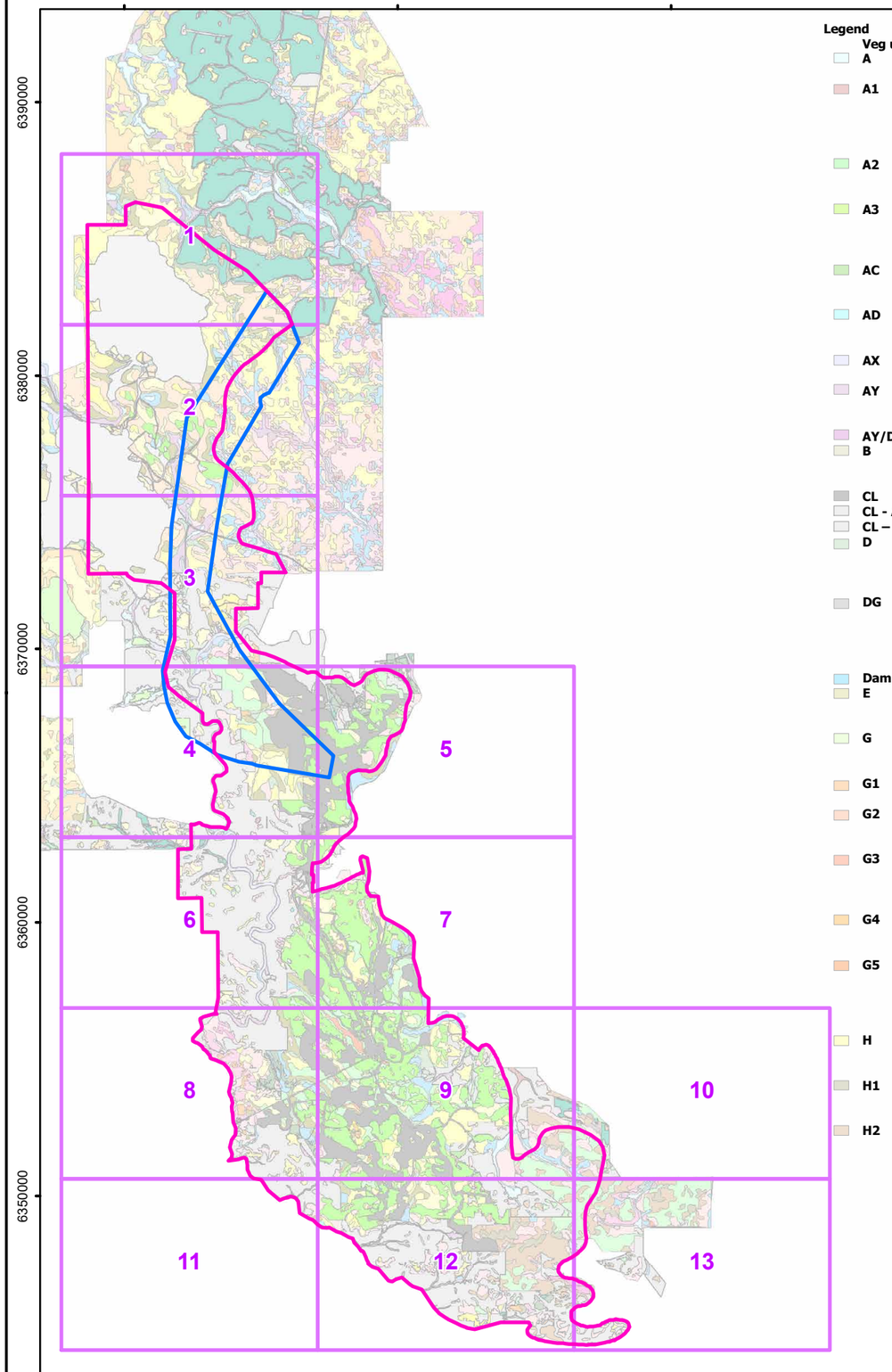
SVT Code	Description	Wider Total Area Mapped (WTAM)	PAA (ha)	WMDE (ha)	BTC/WMDE (ha)	PAA (WMDE/BTC) IDF (ha)
L	Open woodland of *Eucalyptus patens* with some *Eucalyptus wandoo* over *Xanthorrhoea preissii, Macrozamia riedlei, Trymalium ledifolium, Acacia saligna* and *Hakea prostrata* on clay and clay loam soils on lower slopes.	264.37	32.90	32.90	27.02	18.63
LG	Open woodland of *Eucalyptus patens* and *Eucalyptus wandoo* over *Hypocalymma angustifolium, Xanthorrhoea preissii, Grevillea bipinnatifida, Allocasuarina humilis* and *Babingtonia camphorosmae* over herbs and sedges on clay-loams on seasonally moister lower slopes underlain by outcrops.	1.90	0.00	0.00	0.00	0.00
M	Open woodland of *Eucalyptus wandoo* over *Trymalium ledifolium, Macrozamia riedlei* and *Hakea lissocarpha* on clay loams with some gravel on mid to upper slopes and ridges.	4139.75	1669.03	1538.46	334.06	589.39
M2	Woodland to open woodland of *Eucalyptus accedens*, *Eucalyptus wandoo, Eucalyptus marginata, Corymbia calophylla* over *Hakea lissocarpha, Macrozamia riedlei, Banksia squarrosa* subsp. *squarrosa, Hypocalymma angustifolium, Babingtonia camphorosmae, Grevillea bipinnatifida* and *Allocasuarina humilis* on clay-loams over shallow granites on mid to upper slopes.	544.20	45.43	45.43	1.38	16.29
MG	Open woodland of *Eucalyptus wandoo* over *Trymalium ledifolium, Macrozamia riedlei, Pericalymma ellipticum, Hypocalymma angustifolium, Grevillea bipinnatifida, Allocasuarina humilis* and *Hakea lissocarpha* on clay-loams over shallow granite on mid to upper slopes and ridges.	501.24	220.47	218.53	28.35	39.30
O	Open forest to woodland *of Eucalyptus marginata* and *Corymbia calophylla over Daviesia decurrens, Daviesia preissii* and *Bossiaea ornata* on sandy-gravels on slopes.	8.13	0.00	0.00	0.00	0.00
P	Open forest of *Eucalyptus marginata* and *Allocasuarina fraseriana with admixtures of Corymbia calophylla* and *Banksia grandis* over *Lasiopetalum cardiophyllum* (P4), *Lasiopetalum floribundum, Lechenaultia biloba* and *Ptilotus drummondii* var. *drummondii* on sandy gravels on slopes and ridges.	1879.47	1480.27	1480.27	259.08	945.27
PS	Open forest of *Allocasuarina fraseriana, Eucalyptus marginata, Corymbia calophylla* and *Banksia grandis* over *Adenanthos barbiger, Leucopogon capitellatus* on gravels and sandy gravels on slopes and ridges.	2545.25	1272.87	1248.05	453.01	1120.65
PW	Open forest of *Allocasuarina fraseriana, Eucalyptus marginata, Corymbia calophylla*, and *Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Leucopogon capitellatus* and *Hypocalymma angustifolium* on seasonally moister and sandy gravels on slopes.	12.95	2.54	2.54	2.54	0.05
Q	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum*, *Acacia extensa* and *Phyllanthus calycinus* on loam soils on lower slopes.	66.31	64.88	0.00	0.00	13.64
R	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Trymalium ledifolium, Phyllanthus calycinus* and *Hypocalymma angustifolium* on sandy-gravels associated with nearby shallow outcropping.	28.15	1.29	1.29	0.00	0.48
S	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Banksia grandis* and *Persoonia longifolia over Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on sandy-gravels on slopes and ridges.	3651.55	1748.35	1648.32	301.20	1057.60
SP	Open forest of *Eucalyptus marginata, Corymbia calophylla* and *Allocasuarina fraseriana* with admixtures of *Banksia grandis* over *Lasiopetalum cardiophyllum, Acacia celastrifolia, Styphelia tenuiflora, Daviesia decurrens* and *Trymalium ledifolium* on sandy-gravel to gravel soils on slopes and ridges.	1373.10	96.32	90.59	28.93	72.37

Table 8: Extent of the Site-Vegetation Types (SVT) on the Wider Total Area Mapped (WTAM) and PAA, WMDE, BTC and PAA (WMDE/BTC) IDF near Boddington (continued)

SVT Code	Description	Wider Total Area Mapped (WTAM)	PAA (ha)	WMDE (ha)	BTC/WMDE (ha)	PAA (WMDE/BTC) IDF (ha)
ST	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Persoonia longifolia* and *Banksia grandis* over *Stylidium dichotomum, Acacia urophylla, Acacia celastrifolia, Leucopogon verticillatus, Clematis pubescens* and *Leucopogon capitellatus* on sandy-loam gravel soils on slopes and ridges.	877.10	608.23	378.87	20.65	373.12
SW	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hypocalymma angustifolium, Babingtonia camphorosmae, Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on seasonally moister sandy-gravels on slopes.	143.12	26.85	9.17	0.00	13.37
T	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils on slopes and ridges.	17.29	14.04	0.00	0.00	11.87
TS	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.	72.02	68.95	0.00	0.00	17.60
W	Open forest of *Corymbia calophylla, Eucalyptus marginata* and *Eucalyptus patens over Hakea lissocarpha, Hypocalymma angustifolium, Acacia extensa* and *Synaphea petiolaris* on loam soils on lower slopes.	48.23	0.82	0.82	0.00	0.00
Y	Open woodland of *Eucalyptus wandoo* over *Gompholobium marginatum, Acacia nervosa, Babingtonia camphorosmae, Hypocalymma angustifolium, Macrozamia riedlei, Phyllanthus calycinus* and *Gastrolobium calycinum* on clay and clay-loam soils on lower slopes.	2052.77	720.56	623.79	194.47	189.41
YG	Open woodland of *Eucalyptus wandoo* over *Gompholobium marginatum, Acacia nervosa, Babingtonia camphorosmae, Hypocalymma angustifolium, Macrozamia riedlei, Pericalymma ellipticum, Grevillea bipinnatifida, Allocasuarina humilis, Phyllanthus calycinus* and *Gastrolobium calycinum* on clay and clay-loam soils with localized outcropping on lower slopes.	456.38	31.15	11.95	20.71	3.20
Z	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Macrozamia riedlei, Xanthorrhoea preissii, Hakea lissocarpha* and *Phyllanthus calycinus* on sandy-loam to sandy-loam gravel soils on slopes.	1374.93	844.37	808.22	217.92	494.11
CL	Cleared	2903.96	2899.18	2899.18	335.49	0.78
CL – Ag	Cleared Agricultural Areas	9282.15	6559.52	6402.45	759.42	2062.44
CL-Other	Cleared other areas (e.g. Boddington Gold Mine)	5486.62	3249.45	3085.77	40.10	0.51
Dam	Dam	66.92	63.39	1.43	0.00	0.00
PL	Plantations	275.29	229.00	229.00	0.41	87.61
PL – Ag	Plantations Agricultural Areas	4499.86	185.42	184.57	0.92	0.00
Rehab	Rehabilitation Areas	3163.60	3163.57	3152.99	127.58	616.62
Rehab – Ag	Rehabilitation Areas Agricultural Areas	335.57	26.94	2.62	26.20	0.16

Table 9: Extent of the Site-Vegetation Types (SVT) on the CBME and mapped Refinery Lease Area

SVT Code	Description	Total Mapped Area in RLA (ha)	Extent within the CBME (ha)	Extent within the CBME IDF (ha)
CQ	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* on lower slopes with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum, Agonis linearifolia* and *Astartea scoparia* along the edges of the deeper incised valleys near the creek-lines.	12.12	9.62	0.00
CW	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	32.64	17.90	9.83
D	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes.	10.29	0.00	0.00
E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Kingia australis, Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.	3.93	0.002	0.002
Q	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum, Acacia extensa* and *Phyllanthus calycinus* on loam soils on lower slopes.	66.31	64.88	13.64
R	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Trymalium ledifolium, Phyllanthus calycinus* and *Hypocalymma angustifolium* on sandy-gravels associated with nearby shallow outcropping.	1.43	0.00	0.00
S	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Banksia grandis* and *Persoonia longifolia over Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on sandy-gravels on slopes and ridges.	128.88	82.16	59.33
SP	Open forest of *Eucalyptus marginata, Corymbia calophylla* and *Allocasuarina fraseriana* with admixtures of *Banksia grandis* over *Lasiopetalum cardiophyllum, Acacia celastrifolia, Styphelia tenuiflora, Daviesia decurrens* and *Trymalium ledifolium* on sandy-gravel to gravel soils on slopes and ridges.	18.54	5.73	0.00
ST	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Persoonia longifolia* and *Banksia grandis* over *Stylidium dichotomum, Acacia urophylla, Acacia celastrifolia, Leucopogon verticillatus, Clematis pubescens* and *Leucopogon capitellatus* on sandy-loam gravel soils on slopes and ridges.	315.50	229.36	123.74
SW	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hypocalymma angustifolium, Babingtonia camphorosmae, Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on seasonally moister sandy-gravels on slopes.	46.91	17.68	12.86
T	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils on slopes and ridges.	17.29	14.04	11.87
TS	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.	72.02	68.95	17.60
W	Open forest of *Corymbia calophylla, Eucalyptus marginata* and *Eucalyptus patens over Hakea lissocarpha, Hypocalymma angustifolium, Acacia extensa* and *Synaphea petiolaris* on loam soils on lower slopes.	40.63	0.00	0.00
CL – Other	Cleared	1655.03	163.68	0.03
Dam	Dam	72.81	61.96	0.00
Rehab	Rehabilitation	N/A	10.58	7.01



Legend

Veg unit	Description
A	Tall shrubland of *Melaleuca lateritia, Hakea varia, Melaleuca viminea* and *Melaleuca incana* subsp. *incana* on clay-loams in seasonally wet valley floors.
A1	Mixed tall shrubland of *Melaleuca viminea, Melaleuca lateritia, Taxandria linearifolia, Astartea scoparia* over *Baumea juncea* and *Lepidosperma tetraquetrum* with occasional patches of *Banksia littoralis* and *Melaleuca rhaphiophylla* over low herbs on seasonally water-logged clays and clay loams on valley floors.
A2	Low open woodland of *Melaleuca rhaphiophylla* over *Astartea scoparia* and low herbs on seasonally water-logged clays and clay loams in seasonally wet valley floors.
A3	Open woodland of *Eucalyptus rudis, Eucalyptus patens* and *Eucalyptus wandoo* over *Melaleuca lateritia, Hakea varia, Taxandria linearifolia* and *Hypocalymma angustifolium* over herbs and sedges on clay-loams in seasonally wetter valley floors.
AC	Open woodland of *Eucalyptus wandoo* and *Eucalyptus rudis* over *Juncus pallidus, Astartea scoparia, Taxandria linearifolia* and *Lepidosperma tetraquetrum* over herbs on clay loams in seasonally wet valley floors.
AD	Low open woodland of *Eucalyptus rudis* and *Eucalyptus marginata* over *Banksia littoralis, Hakea prostrata* and *Pericalymma ellipticum* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.
AX	Open woodland of *Eucalyptus rudis* over *Acacia saligna, Melaleuca incana* subsp. *incana* and *Hypocalymma angustifolium* on clay- loams on valley floors.
AY	Open woodland of *Eucalyptus rudis* and *Eucalyptus wandoo* over *Acacia saligna, Hakea prostrata* and *Hypocalymma angustifolium* on clay- loams on valley floors.
AY/D	Mosaic of AY and D
B	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Adenanthos obovatus* and *Babingtonia camphorosmae* on lower sandier soils on fringes of swamps and valley floors.
CL	**Cleared Land**
CL - Ag	**Cleared Agricultural Land**
CL – Other	**Cleared Land – Other than Agriculture**
D	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes.
DG	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Pericalymma ellipticum, Grevillea bipinnatifida, Allocasuarina humilis, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes with localized patches of outcropping.
Dam	**Dam**
E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Kingia australis, Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.
G	Open Heath of *Grevillea bipinnatifida, Hakea undulata, Banksia squarrosa* subsp. *squarrosa, Hakea incrassata, Hakea undulata* and *Petrophile serruriae* over *Borya sphaerocephala* on shallow soils and outcrops.
G1	Mosaic of open heath of Proteaceae - Myrtaceae spp. with emergent patches of *Eucalyptus drummondii* on shallow soils on slopes.
G2	Mosaic of open woodland of *Allocasuarina huegeliana* and closed heath of Proteaceae Myrtaceae spp. to Lithic Complex on exposed or shallow granite outcrops.
G3	Open heath of *Banksia squarrosa* subsp. *squarrosa, Hakea incrassata, Hakea undulata, Petrophile heterophylla* and *Petrophile serruriae* on shallow soils over granite outcrops on slopes with occasional emergent mallee species including *Eucalyptus drummondii.*
G4	Open scrub and tall shrubland of *Hakea trifurcata* and *Hakea undulata* with admixtures of mallee species including *Eucalyptus latens* and *Eucalyptus aspersa* on clay to clay-loam soils over outcrops on slopes.
G5	Low woodland of Eucalypt mallee species including *Eucalyptus aspersa, Eucalyptus latens, Eucalyptus longicornis* and *Eucalyptus drummondii* with occasional *Eucalyptus wandoo* over low shrubs of *Allocasuarina humilis, Hakea incrassata, Synaphea damopsis* and herbs on clay loams and sandy-loams on slopes.
H	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Petrophile striata, Daviesia decurrens, Daviesia longifolia* and *Daviesia rhombifolia* on sandy loam to sandy gravels on slopes and ridges.
H1	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Petrophile striata, Daviesia decurrens* and *Daviesia longifolia* on sandy-gravel soils of slopes and less undulating hills.
H2	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* with occasional admixtures of *Banksia grandis* and *Persoonia longifolia* over *Acacia celastrifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on gravel and sandy-gravel soils of slopes and less undulating hills.
HG	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Petrophile striata, Lepidosperma squamatum, Styphelia tenuiflora, Daviesia preiss ii, Daviesia decurrens. Grevillea bipinnatifida, Allocasuarina humilis* and *Hakea undulata* on shallower sandy-gravel soils over granites or secondary laterisation areas on slopes and less undulating hills.
J	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Conospermum stoechadis, Patersonia rudis* and *Babingtonia camphorosmae* on sandier soils on lower to mid slopes.
L	Open woodland of *Eucalyptus patens* with some *Eucalyptus wandoo* over *Xanthorrhoea preissii, Macrozamia riedlei, Trymalium ledifolium, Acacia saligna* and *Hakea prostrata* on clay and clay loam soils on lower slopes.
LG	Open woodland of *Eucalyptus patens* and *Eucalyptus wandoo* over *Hypocalymma angustifolium, Xanthorrhoea preissii, Grevillea bipinnatifida, Allocasuarina humilis* and *Babingtonia camphorosmae* over herbs and sedges on clay-loams on seasonally moister lower slopes underlain by outcrops.
M	Open woodland of *Eucalyptus wandoo* over *Trymalium ledifolium, Macrozamia riedlei* and *Hakea lissocarpa* on clay loams with some gravel on mid to upper slopes and ridges.
M2	Woodland to open woodland of *Eucalyptus accedens, Eucalyptus wandoo, Eucalyptus marginata, Corymbia calophylla* over *Hakea lissocarpha, Macrozamia riedlei, Banksia squarrosa* subsp. *squarrosa, Hypocalymma angustifolium, Babingtonia camphorosmae, Grevillea bipinnatifida* and *Allocasuarina humilis* on clay-loams over shallow granites on mid to upper slopes.
MG	Open woodland of *Eucalyptus wandoo* over *Trymalium ledifolium, Macrozamia riedlei, Pericalymma ellipticum, Hypocalymma angustifolium, Grevillea bipinnatifida, Allocasuarina humilis* and *Hakea lissocarpha* on clay-loams over shallow granite on mid to upper slopes and ridges.
O	Open forest to woodland *of Eucalyptus marginata* and *Corymbia calophylla over Daviesia decurrens, Daviesia preissii* and *Bossiaea ornata* on sandy-gravels on slopes.
P	Open forest of *Eucalyptus marginata* and *Allocasuarina fraseriana with admixtures of Corymbia calophylla* and *Banksia grandis* over *Lasiopetalum cardiophyllum* (P4), *Lasiopetalum floribundum, Lechenaultia biloba* and *Ptilotus drummondii* var. *drummondii* on sandy gravels on slopes and ridges.
PL	**Plantation and Planted Trees**
PL - Ag	**Plantation and Planted Trees on Agricultural Lands**
PS	Open forest of *Allocasuarina fraseriana, Eucalyptus marginata, Corymbia calophylla* and *Banksia grandis* over *Adenanthos barbiger, Leucopogon capitellatus* on gravels and sandy gravels on slopes and ridges.
PW	Open forest of *Allocasuarina fraseriana, Eucalyptus marginata, Corymbia calophylla, Banksia grandis* with scattered understorey, includin g *Adenanthos barbiger, Leucopogon capitellatus and Hypocalymma angustifolium* on seasonally moister and sandy gravels on slopes.
R	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Trymalium ledifolium, Phyllanthus calycinus* and *Hypocalymma angustifolium* on sandy-gravels associated with nearby shallow outcropping.
Rehab	**Rehabilitation Areas**
Rehab - Ag	**Rehabilitation on Agricultural Lands**
S	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Banksia grandis* and *Persoonia longifolia over Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on sandy-gravels on slopes and ridges.
SP	Open forest of *Eucalyptus marginata, Corymbi a calophylla* and *Allocasuarina fraseriana* with admixtures of *Banksia grandis* over *Lasiopetalum cardiophyllum, Acacia celastrifolia, Styphelia tenuiflora, Daviesia decurrens* and *Trymalium ledifolium* on sandy-gravel to gravel soils on slopes and ridges.
ST	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Persoonia longifolia* and *Banksia grandis* over *Stylidium dichotomum, Acacia urophylla, Acacia celastrifolia, Leucopogon verticillatus, Clematis pubescen s* and *Leucopogon capitellatus* on sandy-loam gravel soils on slopes and ridges.
SW	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hypocalymma angustifolium, Babingtonia camphorosmae, Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on seasonally moister sandy-gravels on slopes.
W	Open forest of *Corymbia calophylla, Eucaly ptus marginata* and *Eucalyptus patens over Hakea lissocarpha, Hypocalymma angustifolium, Acacia extensa* and *Synaphea petiolaris* on loam soils on lower slopes.
Y	Open woodland of *Eucalyptus wandoo* over *Gompholobium marginatum, Acacia nervosa, Babingtonia camphorosmae, Hypocalymma angustifolium, Macrozamia riedlei, Phyllanthus calycinus* and *Gastrolobium calycinum* on clay and clay-loam soils on lower slopes.
YG	Open woodland of *Eucalyptus wandoo* over *Gompholobium marginatum, Acacia nervosa, Babingtonia camphor osmae, Hypocalymma angustifolium, Macrozamia riedlei, Pericalymma ellipticum, Grevillea bipinnatifida, Allocasuarina humilis, Phyllanthus calycinus* and *Gastrolobium calycinum* on clay and clay-loam soils with localized outcropping on lower slopes.
Z	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Macrozamia riedlei, Xanthorrhoea preissii, Hakea lissocarpha* and *Phyllanthus calycinus* on sandy-loam to sandy-loam gravel soils on slopes.

Legend
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- 1:25,000 A3 Sheet Layout

Client: SOUTH32

N

0 2 4km
Scale: 1:150,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_06
Date: Feb 2020 | Rev: A | A3

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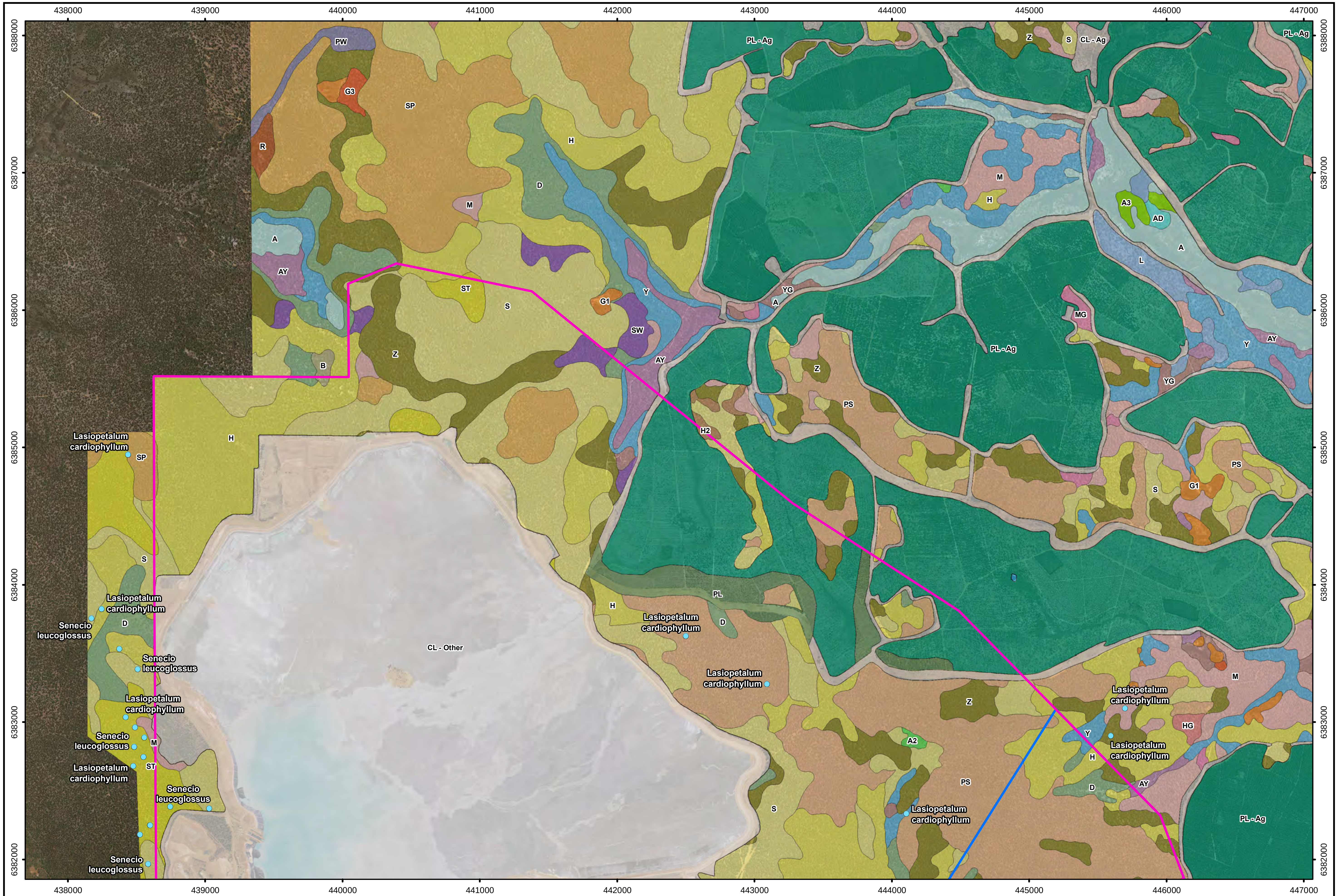
Vegetation Legend

Figure: **8.0**



Legend

- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- A
- A2

A3	CL - Other	H	M2	PW	SW
AD	D	H2	MG	R	Y
AY	DAM	HG	PL	S	YG
B	G1	L	PL - Ag	SP	Z
CL - Ag	G3	M	PS	ST	

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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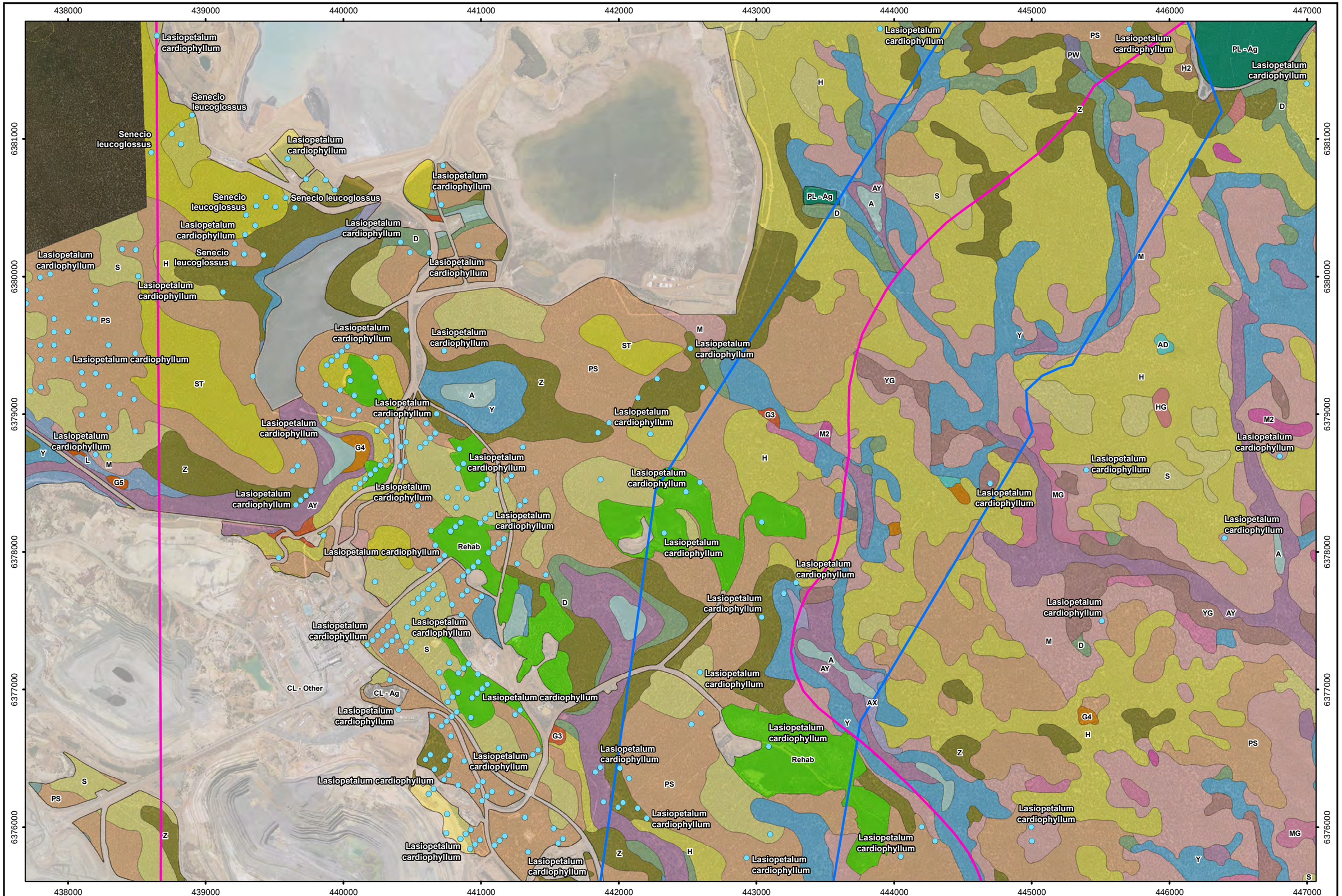
Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 1 of 13

Figure:

8.1



Legend

- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- A
- AD
- AX
- AY
- CL - Ag
- CL - Other
- D
- DG
- G3
- G4
- G5
- H
- H2
- HG
- L
- M
- M2
- MG
- PL - Ag
- PS
- PW
- Rehab
- S
- ST
- W
- Y
- YG
- Z

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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Primary Assessment Area (PAA)

Site-vegetation Types

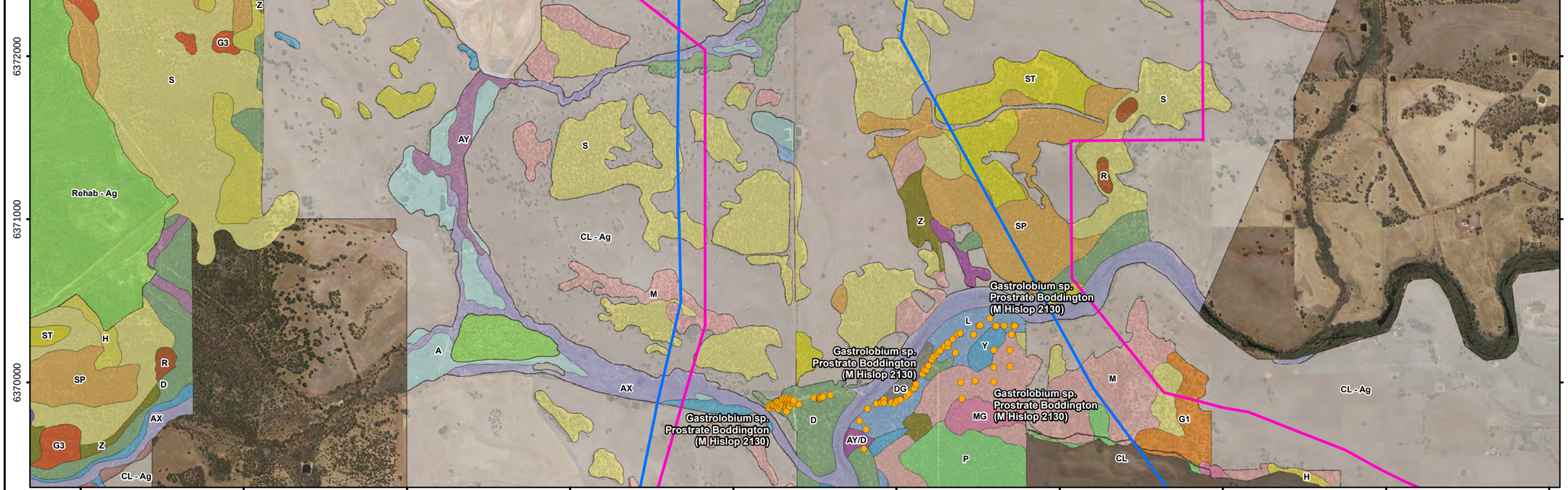
Sheet 2 of 13

Figure: **8.2**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6375000 6374000 6373000 6372000 6371000 6370000

Lasiopetalum cardiophyllum
Halgania corymbosa
CL - Other
CL - Ag
Rehab - Ag
Gastrolobium sp. Prostrate Boddington (M Hislop 2130)



Legend

- Priority 1
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)

A, AD, AX, AY, AY/D, CL, CL - Ag, CL - Other, D, DG, G1, G3, G5, H, HG, L, M, MG, P, PS, R, Rehab - Ag, S, SP, ST, SW, Y, YG, Z

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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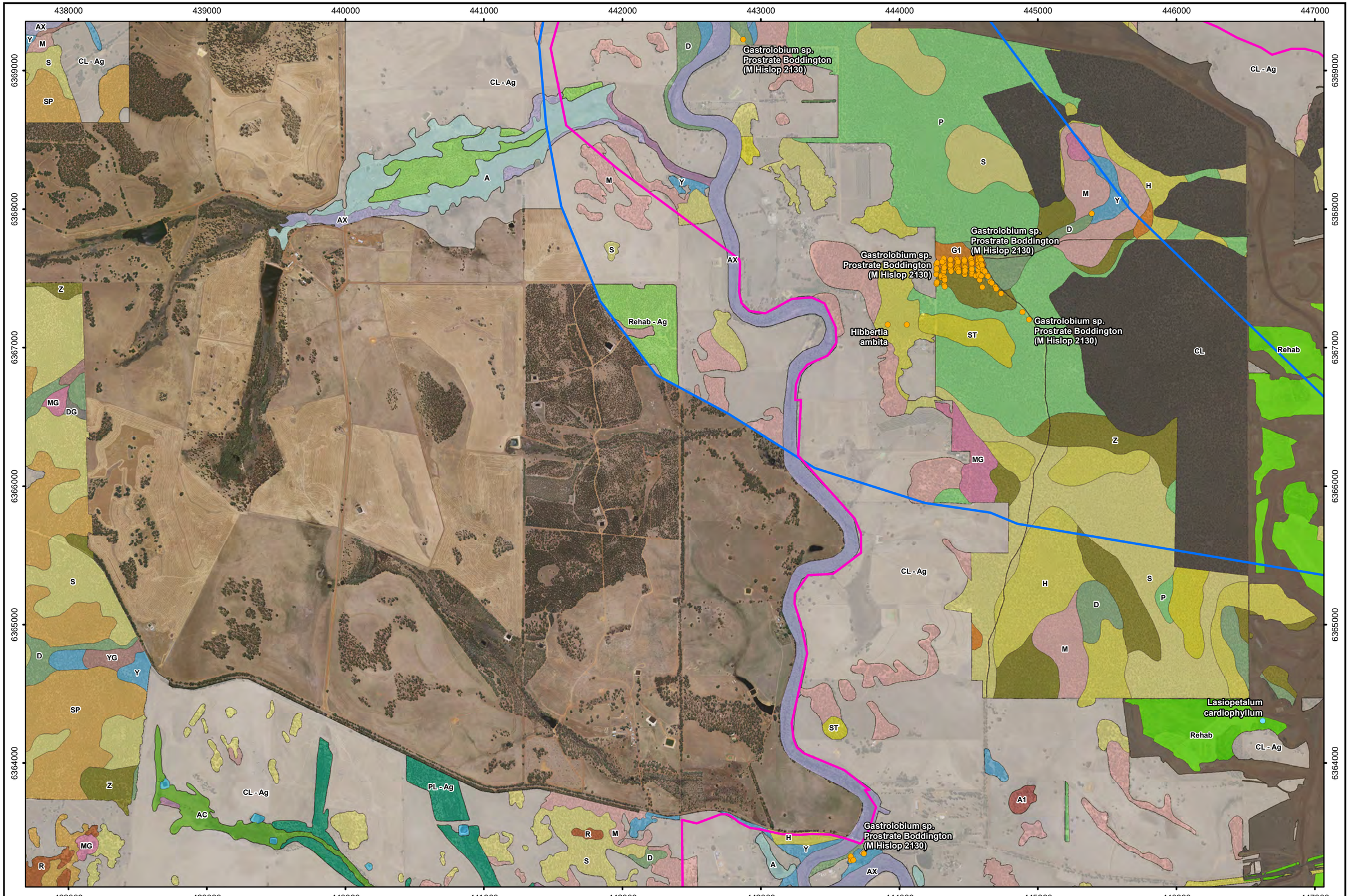
Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 3 of 13

Figure: **8.3**



Legend

- Priority 1
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- A

A1, AC, AX, AY, CL, CL - Ag, D, DAM, DG, G1, H, L, M, MG, P, PL, PL - Ag, R, Rehab, Rehab - Ag, S, SP, ST, Y, YG, Z

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 4 of 13

Figure: **8.4**

448000 449000 450000 451000 452000 453000 454000 455000 456000

6369000 6368000 6367000 6366000 6365000 6364000

Y Z P AY PL CL - Ag Rehab PL H M W M Y S CL Z Y M ST Rehab S P CL - Ag H

Legend

- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- AY
- CL
- CL - Ag
- H
- M
- MG
- P
- PL
- PL - Ag
- Rehab
- S
- ST
- W
- Y
- Z

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

Date: Sep 2021 | Rev: A | A3

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 5 of 13

Figure: **8.5**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6363000 6362000 6361000 6360000 6359000 6358000 6357000

CL - Ag
S
SP
R
M
AY
PL - Ag
Y
AX
M
S
G2
Rehab
CL
M
S
D
AY
ST
P
CL - Ag
M
ST
AX
CL - Ag
D
P
Senecio leucoglossus
S
H
MG
Rehab
Senecio leucoglossus
M
Senecio leucoglossus
AY
ST
CL
Z
Y
P
D
S
Hibbertia ambita

Legend

- Priority 1
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- AC
- AX
- AY
- CL
- CL - Ag
- D
- DAM
- G2
- G3
- H
- M
- MG
- P
- PL - Ag
- R
- Rehab
- Rehab - Ag
- S
- SP
- ST
- Y
- Z

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 6 of 13

Figure: **8.6**

448000 449000 450000 451000 452000 453000 454000 455000 456000

6363000 6362000 6361000 6360000 6359000 6358000 6357000

Rehab
AY
M
CL - Ag
Lasiopetalum cardiophyllum
H
Senecio leucoglossus
Calytrix simplex subsp. simplex
Stylidium marradongense
S
G1
Calytrix simplex G3 subsp. simplex
ST
Rehab
Y
D
Stylidium marradongense
Lasiopetalum cardiophyllum
Senecio leucoglossus
Halgania corymbosa
Z
M
PL
Stylidium marradongense
Stylidium marradongense
H
CL
Senecio leucoglossus
P
Lasiopetalum cardiophyllum
Stylidium marradongense
S
G3
Lasiopetalum cardiophyllum
ST
Senecio leucoglossus
Stylidium marradongense
P
Lasiopetalum cardiophyllum
Rehab
Lasiopetalum cardiophyllum
Rehab
Y
Senecio leucoglossus
Pultenaea pauciflora

448000 449000 450000 451000 452000 453000 454000 455000 456000

Legend

- Priority T
- Priority 1
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- AY
- CL
- CL - Ag
- D
- G1
- G3
- H
- M
- P
- PL
- Rehab
- S
- ST
- Y
- Z

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 7 of 13

Figure: **8.7**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6356000 6355000 6354000 6353000 6352000 6351000

Lasiopetalum cardiophyllum
Rehab
ST
S
AY
Banksia subpinnatifida var. imberbis
Senecio leucoglossus
Z
M2
CL - Ag
CL
H
PL
M
Y
H
MG
P
S
G1
Hibbertia ambita
Rehab
Stylidium marradongense
CL
D
Lasiopetalum cardiophyllum
Lasiopetalum cardiophyllum
G3
Z
PL
Y
ST
Byblis gigantea
Boronia tenuis
M
CL - Ag
AY
DG
AC
H

Legend

- Priority 1
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- AC
- AY
- CL
- CL - Ag
- D
- DAM
- DG
- G1
- G3
- H
- M
- M2
- MG
- P
- PL
- PL - Ag
- Rehab
- S
- ST
- Y
- Z

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_06_01

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 8 of 13

Figure: **8.8**

448000 449000 450000 451000 452000 453000 454000 455000 456000

6356000 6355000 6354000 6353000 6352000 6351000

Stylidium marradongense
Lasiopetalum cardiophyllum
Isopogon sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin)
Senecio leucoglossus
Calothamnus quadrifidus subsp. teretifolius
Banksia subpinnatifida var. subpinnatifida
Papistylus intropubens
Banksia subpinnatifida var. imberbis
Goodenia katabudjar
Calytrix simplex subsp. simplex
Synaphea panhesya
Acacia horridula
Tetratheca pilifera
Caladenia hopperiana (sp. Quindanning)
Rehab
CL - Ag
PL - Ag

Legend

- Priority T
- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- A, A1, AC, AY
- CL, CL - Ag, D, G1, G2, G3, G4, H, H1, H2, HG, M, MG, P, PL, PL - Ag, Rehab, S, ST, Y, YG, Z

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_06_01
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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 9 of 13

Figure: **8.9**

457000 458000 459000 460000 461000 462000 463000 464000 465000

6356000 6355000 6354000 6353000 6352000 6351000

H2
Caladenia dorrienii
YG
DG
PL - Ag
M
P
H1
Y
MG
HG
H2
CL - Ag
Caladenia hopperiana (sp. Quindanning)
P

Legend

- Priority T
- Worsley Mine Development Envelope (WMDE)
- A
- CL - Ag
- DG
- H1
- H2
- HG
- M
- MG
- P
- PL - Ag
- Y
- YG

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_06_01
Date: Sep 2021 | Rev: A | A3

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 10 of 13

Figure: **8.10**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6350000 6349000 6348000 6347000 6346000 6345000

Boronia tenuis

Senecio leucoglossus

CL - Ag

AY

H

M

G1

AD

Legend

- Priority 4
- Worsley Mine Development Envelope (WMDE)
- AC
- AD
- AY
- CL - Ag
- G1
- H
- M
- Y

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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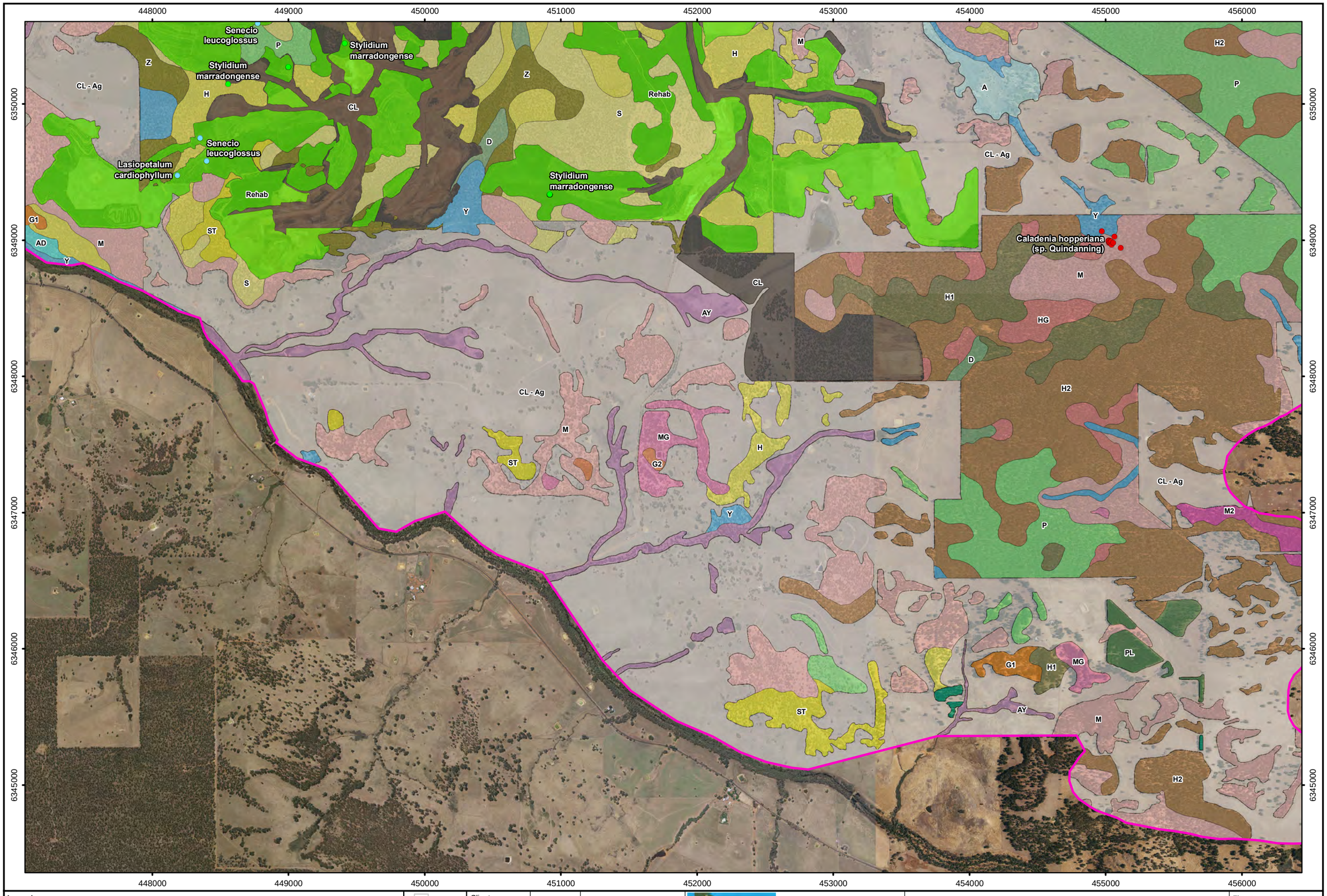
Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 11 of 13

Figure: **8.11**



Legend

- Priority T
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- A
- AD, AY, CL, CL - Ag, D, G1, G2, H, H1, H2, HG, M, M2, MG, P, PL, PL - Ag, Rehab, S, ST, Y, Z

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 12 of 13

Figure: **8.12**

457000 458000 459000 460000 461000 462000 463000 464000 465000

6350000 6349000 6348000 6347000 6346000 6345000

H1 HG DG D P YG A H1 H2 P H2 M Y G3 MG AY M Y P CL - Ag H2 M2 H2 MG H CL - Ag M

Caladenia hopperiana (sp. Quindanning)

Lasiopetalum cardiophyllum

457000 458000 459000 460000 461000 462000 463000 464000 465000

Legend

- Priority T
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- A
- AY
- CL - Ag
- D
- DG
- G1
- G3
- H
- H1
- H2
- HG
- M
- M2
- MG
- P
- Y
- YG

Client: SOUTH32

N

0 250 500 m

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

CAD Ref: g1881_F006_06_01

Date: Sep 2021 | Rev: A | A3

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Primary Assessment Area (PAA)

Site-vegetation Types

Sheet 13 of 13

Figure: **8.13**

407500 410000 412500 415000

6325000 6322500 6320000

Legend

Veg unit	Description
CL	Cleared Land - Other than Agriculture
CQ	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* on lower slopes with mixed understorey species, including *Trymalium floribundum, Agonis linearifolia* and *Astartea fascicularis* along the edges of the deeper incised valleys near the creek -lines.
CW	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.
D	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes.
E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Kingia australis, Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.
Q	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* with mixed understorey species, including *Trymalium floribundum*, *Acacia extensa* and *Phyllanthus calycinus* on loam soils on lower slopes.
R	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Trymalium ledifolium, Phyllanthus calycinus* and *Hypocalymma angustifolium* on sandy-gravels associated with nearby shallow outcropping.
RE	Rehabilitation Areas
S	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana*, *Banksia grandis* and *Persoonia longifolia over Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on sandy-gravels on slopes and ridges.
SP	Open forest of *Eucalyptus marginata, Corymbia calophyl la* and *Allocasuarina fraseriana* with admixtures of *Banksia grandis* over *Lasiopetalum cardiophyllum, Acacia celastrifolia, Styphelia tenuiflora, Daviesia decurrens* and *Trymalium ledifolium* on sandy-gravel to gravel soils on slopes and ridges.
ST	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Persoonia longifolia* and *Banksia grandis* over *Stylidium dichotomum, Acacia urophylla, Acacia celastrifolia, Leucopogon verticillatus, Clematis pubescens* and *Leucopogon capitellatus* on sandy-loam gravel soils on slopes and ridges.
SW	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hypocalymma angustifolium, Babingtonia camphorosmae, Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on seasonally moister sandy-gravels on slopes.
T	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescen s* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils on slopes and ridges.
TS	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.
W	Open forest of *Corymbia calophylla, Eucalyptus marginata* and *Eucalyptus patens over Hakea lissocarpha, Hypocalymma angustifolium, Acacia extensa* and *Synaphea petiolaris* on loam soils on lower slopes.

Legend
- Contingency Bauxite Mining Envelope (CBME)
- CL - Other
- CQ
- CW
- D
- DAM
- E
- Q
- R
- Rehab
- S
- SP
- ST
- SW
- T
- TS
- W

Client: SOUTH32

N

0 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_06_02
Date: Aug 2021 | Rev: A | A3

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Collie - Worsley Mine Expansion
Site-vegetation Types

Figure: **8.14**

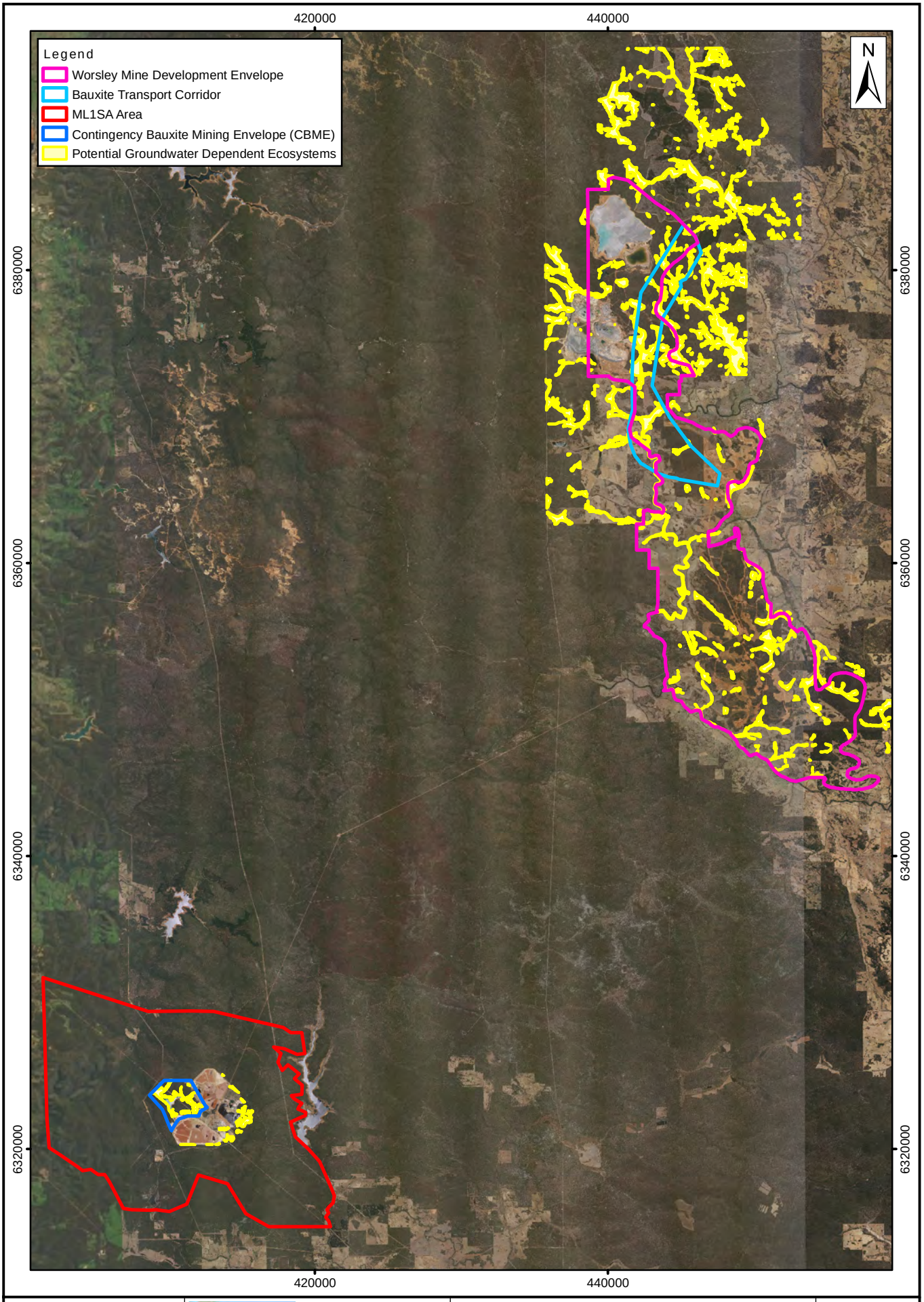
5.8 Potential Groundwater Dependent Ecosystems

The potential groundwater dependent ecosystems were determined on the basis of the extent of the site-vegetation types that occurred in watershed areas and that supported flora species that are known from wider botanical studies in the northern Jarrah Forest to prefer and occur on seasonally moister and wetter soils. This approach was considered to represent a precautionary approach in the absence of detailed groundwater level data at the time of selecting the potential groundwater dependent ecosystems for the PAA areas.

Previous studies undertaken on the Newmont Boddington Gold Mine by Woodman Environmental Consulting Pty Ltd (2019) selected and defined a series of communities that occurred in areas within 10m of the groundwater level. At the time, Woodman recognised that Round Swamp, Pillow Swamp and Boomerang Swamp occurred on areas associated with the surface soil water holding capacity. The selection of the site-vegetation types as mapped by Mattiske in the Newmont area were compared with these 10m contours and the alignment was relatively reliable, despite the decrease in annual rainfall in recent years near Boddington. As a result a range of site-vegetation types were selected and mapped for the Boddington areas of the PAA. Any watershed areas that may have the potential to be a groundwater dependent ecosystem were included as a precaution. Tunnell Road heath communities were included in this latter category of potential groundwater dependent ecosystems, although previous studies by various hydrologists, including the most recent studies by Parsons Brinckerhoff (2003), summarised a perched aquifer associated with a lateritic cap that was separated from groundwater by a layer of upper clay. These studies also recognised flows between the surface clay layers and the subsurface layers and the main aquifer below 5m.

Key indicator plant species that are generally accepted as indicators of moister soils and, hence, potential groundwater dependent ecosystems include – *Banksia littoralis, Hakea varia, Acacia divergens, Pultenaea skinneri, Boronia molloyae, Thomasia paniculata, Astartea scoparia, Babingtonia camphorosmae, Calothamnus lateralis, Eucalyptus rudis, Hypocalymma angustifolium, Hypocalymma cordifolium, Melaleuca preissiana, Melaleuca rhaphiophylla, Melaleuca lateritia, Melaleuca viminea, Regelia ciliata* and *Taxandria linearifolia.*

On the basis of the key indicator plant species, soil types and the associated resulting site-vegetation types the following types within the PAA were selected as representing potential groundwater dependent ecosystems, namely A, A1, A2, AC, AD, AX, AY, AY/D, B, D, DG, L, LG, SW, PW, Y and YG (Figure 9). The G types associated with the low-lying watershed areas in the valleys for Boomerang Swamp (just north of the PAA and Newmont Boddington Gold Mine operational pit) and the heath in the valley north of the Mt Saddleback crusher site known as Tunnell Road Heath. The inclusion of the latter areas within watershed and valley areas was considered a precautionary approach as these areas are considered to have surface aquifers in wetter seasons and may be reliant on water within 10m below ground level. The interpretation in Woodman Environmental (2019) for the Newmont Boddington Gold Mine included a reliance on previous mapping by Mattiske Consulting (2005 and 2012) in the gold mine area and used the series of site-vegetation types in a similar way to define the potential groundwater dependent vegetation. One main difference related to the exclusion of the R site-vegetation types in the Mattiske (2020) potential groundwater dependent ecosystem definition in the PAA areas. The R site-vegetation type is associated with fringes of granite outcrops and as such may occur on ridges. Considering this location in the landscape and soil type, the R site-vegetation type is unlikely to be reliant on groundwater. The inclusion of site-vegetation types such as SW and PW are considered less reliable as these site-vegetation types occur on the fringes of the valley slopes and may relate to surface water flows and localised soil types capable of holding seasonal water rather than consistently any link with groundwater. Some of these aspects are still open to interpretation as the source of the water for the plants may vary from site to site depending on the local conditions. Another key aspect that occurs in some valley systems and swamps is the development of secondary laterisation and lenses of impervious layers thereby holding water in soil profiles with associated soil moisture plant indicators.



0 3.5 7 km

Scale: 1:350,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_09

Date: August 2021 | Rev: A | A4

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Potential Groundwater Dependent Ecosystems

Figure: **9**

Old Growth Forest: DBCA (Oct 2019)

The complexity of the determining factors from aerial imagery and infra-red images is not always apparent. As indicated in the recent review by Woodman Environmental (2019) there are many factors that can influence the condition of the vegetation, including seasonal conditions, salinity, dieback, insect attacks and changing fire regimes.

5.9 Condition of the Vegetation

The condition of the vegetation in the respective areas (see Table 11) ranges from Excellent to Completely Degraded based on the Keighery (1994) vegetation condition scale (Table 10) and as illustrated in Figures 10-1 to 10-13 for the Boddington area. The condition of the Collie RLA area is either completely degraded or excellent where native vegetation persists for the Collie CBME area (Figure 10-14).

Table 10: Definition of Vegetation Condition Categories
(note: adapted from Keighery (1994))

CATEGORY	DEFINITION
Pristine	Pristine or nearly so, no obvious sign of disturbance or damage caused by human activities since European settlement.
Excellent	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.
Very Good	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.
Good	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.
Degraded	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.
Completely Degraded	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.

The results presented in Table 11 reflect the degraded condition of areas within the WMDE, the BTC and the CBME, as follows:

- 45.41%, 27.38% and 31.64% completely degraded areas respectively within the WMDE, the BTC and the CBME areas; and
- 14.99%, 5.84% and 0.00% degraded areas respectively within the WMDE, the BTC and the CBME areas.

The latter condition results reflect the degree of clearing already undertaken for a range of activities, such as agricultural activities, mining, rehabilitation and dams.

Table 11: Vegetation Condition on the WMDE, BTC, CBME and IDF within WMDE, BTC and CBME

Vegetation Condition	Extent within WMDE (ha)	Extent within WMDE (%)	Extent within WMDE IDF (ha)	Extent within WMDE IDF (%)
Excellent	10224.76	36.78	5827.92	65.47
Very Good	662.47	2.38	167.96	1.89
Good	119.32	0.43	67.47	0.76
Degraded	4166.37	14.99	899.79	10.11
Completely Degraded	12623.34	45.41	1937.88	21.77
Total	27796.26	100.00	8901.02	100.00
Vegetation Condition	**Extent within BTC (ha)**	**Extent within BTC (%)**	**Extent within BTC IDF (ha)**	**Extent within BTC IDF (%)**
Excellent	2582.23	62.29	176.06	45.39
Very Good	181.43	4.38	28.92	7.46
Good	4.50	0.11	0.00	0.00
Degraded	242.28	5.84	17.32	4.47
Completely Degraded	1135.29	27.38	165.56	42.69
Total	4145.74	100.00	1442.01	100.00
Vegetation Condition	**Extent within CBME (ha)**	**Extent within CBME (%)**	**Extent within CBME IDF (ha)**	**Extent within CBME IDF (%)**
Excellent	510.33	68.36	248.87	97.25
Very Good	0.00	0.00	0.00	0.00
Good	0.00	0.00	0.00	0.00
Degraded	0.00	0.00	0.00	0.00
Completely Degraded	236.22	31.64	7.04	2.75
Total	746.55	100.00	255.91	100.00

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6388000 6387000 6386000 6385000 6384000 6383000 6382000

Lasiopetalum cardiophyllum
Lasiopetalum cardiophyllum
Senecio leucoglossus
Lasiopetalum cardiophyllum
Senecio leucoglossus
Lasiopetalum cardiophyllum
Senecio leucoglossus
Lasiopetalum cardiophyllum
Senecio leucoglossus
Senecio leucoglossus
Lasiopetalum cardiophyllum
Lasiopetalum cardiophyllum
Lasiopetalum cardiophyllum
Lasiopetalum cardiophyllum

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

Legend
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- Excellent
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_07_01
Date: Sep 2021 | Rev: A | A3

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 1 of 13

Figure: **10.1**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6381000 6380000 6379000 6378000 6377000 6376000

Lasiopetalum cardiophyllum
Senecio leucoglossus

Legend
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- Excellent
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_07_01
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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 2 of 13

Figure: 10.2

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6375000 6374000 6373000 6372000 6371000 6370000

Lasiopetalum cardiophyllum
Halgania corymbosa
Gastrolobium sp. Prostrate Boddington (M Hislop 2130)

Legend

- Priority 1
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 3 of 13

Figure: **10.3**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6369000 6368000 6367000 6366000 6365000 6364000

Gastrolobium sp.
Prostrate Boddington
(M Hislop 2130)

Gastrolobium sp.
Prostrate Boddington
(M Hislop 2130)

Gastrolobium sp.
Prostrate Boddington
(M Hislop 2130)

Gastrolobium sp.
Prostrate Boddington
(M Hislop 2130)

Hibbertia
ambita

Gastrolobium sp.
Prostrate Boddington
(M Hislop 2130)

Lasiopetalum
cardiophyllum

Gastrolobium sp.
Prostrate Boddington
(M Hislop 2130)

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

Legend

- Priority 1
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- Excellent
- Very Good
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 4 of 13

Figure:
10.4

448000 449000 450000 451000 452000 453000 454000 455000 456000

6369000 6368000 6367000 6366000 6365000 6364000

Legend

- Worsley Mine Development Envelope (WMDE)
- Bauxite Transport Corridor (BTC)
- Excellent
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_07_01

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 5 of 13

Figure: **10.5**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6363000 6362000 6361000 6360000 6359000 6358000 6357000

Senecio leucoglossus

Senecio leucoglossus

Senecio leucoglossus

Hibbertia ambita

Legend

- Priority 1
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Excellent
- Very Good
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 6 of 13

Figure:
10.6

448000 449000 450000 451000 452000 453000 454000 455000 456000

6363000 6362000 6361000 6360000 6359000 6358000 6357000

Lasiopetalum cardiophyllum
Senecio leucoglossus
Calytrix simplex subsp. simplex
Stylidium marradongense
Calytrix simplex subsp. simplex
Stylidium marradongense
Lasiopetalum cardiophyllum
Senecio leucoglossus
Halgania corymbosa
Stylidium marradongense
Stylidium marradongense
Senecio leucoglossus
Lasiopetalum cardiophyllum
Stylidium marradongense
Lasiopetalum cardiophyllum
Senecio leucoglossus
Stylidium marradongense
Senecio leucoglossus
Lasiopetalum cardiophyllum
Lasiopetalum cardiophyllum
Senecio leucoglossus
Pultenaea pauciflora

448000 449000 450000 451000 452000 453000 454000 455000 456000

Legend

- Priority T
- Priority 1
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Excellent
- Very Good
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 7 of 13

Figure: **10.7**

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6356000 6355000 6354000 6353000 6352000 6351000

Lasiopetalum cardiophyllum

Banksia subpinnatifida var. imberbis

Senecio leucoglossus

Hibbertia ambita

Lasiopetalum cardiophyllum

Stylidium marradongense

Lasiopetalum cardiophyllum

Byblis gigantea

Boronia tenuis

Legend

- Priority 1
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Excellent
- Very Good
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 8 of 13

Figure:
10.8

448000 449000 450000 451000 452000 453000 454000 455000 456000

6356000 6355000 6354000 6353000 6352000 6351000

Stylidium marradongense
Lasiopetalum cardiophyllum
Senecio leucoglossus
Isopogon sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin)
Calothamnus quadrifidus subsp. teretifolius
Banksia subpinnatifida var. subpinnatifida
Papistylus intropubens
Banksia subpinnatifida var. imberbis
Goodenia katabudjar
Calytrix simplex subsp. simplex
Synaphea panhesya
Acacia horridula
Tetratheca pilifera
Caladenia hopperiana (sp. Quindanning)

Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 9 of 13

Figure:
10.9

457000 458000 459000 460000 461000 462000 463000 464000 465000

6356000
6355000
6354000
6353000
6352000
6351000

Caladenia dorrienii

Caladenia hopperiana (sp. Quindanning)

457000 458000 459000 460000 461000 462000 463000 464000 465000

Legend

- Priority T
- Worsley Mine Development Envelope (WMDE)
- Excellent
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 10 of 13

Figure:
10.10

438000 439000 440000 441000 442000 443000 444000 445000 446000 447000

6350000 6349000 6348000 6347000 6346000 6345000

Boronia tenuis

Senecio leucoglossus

Legend

- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Excellent
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 11 of 13

Figure:
10.11

448000 449000 450000 451000 452000 453000 454000 455000 456000

6350000 6349000 6348000 6347000 6346000 6345000

Senecio leucoglossus
Stylidium marradongense
Stylidium marradongense
Senecio leucoglossus
Lasiopetalum cardiophyllum
Stylidium marradongense
Caladenia hopperiana (sp. Quindanning)

448000 449000 450000 451000 452000 453000 454000 455000 456000

Legend

- Priority T
- Priority 3
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 12 of 13

Figure:
10.12

457000 458000 459000 460000 461000 462000 463000 464000 465000

6350000 6349000 6348000 6347000 6346000 6345000

Caladenia hopperiana (sp. Quindanning)

Caladenia hopperiana (sp. Quindanning)

Caladenia hopperiana (sp. Quindanning)

Caladenia hopperiana (sp. Quindanning)

Lasiopetalum cardiophyllum

Caladenia hopperiana (sp. Quindanning)

Caladenia hopperiana (sp. Quindanning)

Caladenia hopperiana (sp. Quindanning)

Caladenia hopperiana (sp. Quindanning)

457000 458000 459000 460000 461000 462000 463000 464000 465000

Legend

- Priority T
- Priority 4
- Worsley Mine Development Envelope (WMDE)
- Excellent
- Good
- Degraded
- Completely Degraded

Note
Aerial photography: Landgate (2017)

Client: SOUTH32

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_07_01
Date: Sep 2021 | Rev: A | A3

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Primary Assessment Area (PAA)
Site-vegetation Condition
Sheet 13 of 13

Figure:
10.13

407500 410000 412500 415000

6325000

6322500

6320000

Legend
- Contingency Bauxite Mining Envelope (CBME)
- Excellent
- Completely Degraded

Client: SOUTH32

N

0 500 m

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

CAD Ref: g1881_F006_07_02

Date: Aug 2021 | Rev: A | A3

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Collie - Worsley Mine Expansion
Site-vegetation Condition

Figure:

10.14

5.10 Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) are known to occur within the areas the subject of the proposal under either State or Federal listings. It is recognised from database searches that the Federal TEC – "Eucalypt Woodlands of the Western Australian Wheatbelt" has the potential to occur near the WMDE and BTC – it was listed in the database search (DAWE 2020) with a radius from the central points of the PAA areas, however not within them. None of the site-vegetation communities mapped within the WMDE and BTC are considered representative of this TEC.

The Federally listed TEC "Banksia Woodlands of the Swan Coastal Plain" has been mapped in the vicinity of the CBME (DBCA 2020c, DAWE 2020b), however as the CBME is located within the Darling Ranges there is no expectation that this TEC which is on the Swan Coastal Plain will occur within the CBME. None of the site-vegetation communities or vegetation complexes mapped within the CBME are considered representative of this TEC.

The desktop review highlighted the overlap with the Regional Forest Agreement (RFA) area (DAWE 2020a) and the Forest Management Plans (Conservation Commission 2003, 2013). This process enabled an update on land uses in the southwest forests as well as a comprehensive summary of biological values. The areas near Boddington and Collie in most instances overlap in management operations with the RFA area (Conservation Commission 2013).

The vegetation mapping undertaken by Heddle *et al.* (1980) and the updated vegetation complex mapping by Mattiske and Havel (1998) aligns with the RFA areas in the southwest forest area of Western Australia. This regional approach enabled a wider assessment of the values within the PAA areas including the Boddington and Collie areas.

One Priority Ecological Community (PEC) occurs within the WMDE, namely - The *Mount Saddleback Heath Communities* (PEC - P1) (DBCA 2020d). This community was not defined during the Phase One and Two studies undertaken by Worsley Alumina Pty Ltd in the early 1980's (Dames and Moore 1980; Worsley Alumina Pty Ltd 1985) and was initially assigned to the heath community on Tunnell Road. In recent years it has been extended to the wider Mt Saddleback Heath Community by DBCA (2020d). The PEC as defined by DBCA has some affinities with the site-vegetation types within the areas of heath, open scrub and mallee communities that have been defined and mapped as subsets of the G site-vegetation type (as initially defined by Havel 1975b) on the Mt Saddleback area as defined and mapped by Mattiske (i.e. G1, G3, G4 and G5). The heath communities within the northern and eastern Jarrah forests extend well beyond those defined and mapped in the Mt Saddleback area; however the PEC as defined by DBCA relates to the some of the communities in the Mt Saddleback area. The coverage of the heath communities as defined by DBCA is not consistent with previous mapping by Mattiske in both a local and regional context and in the absence of data from DBCA it is difficult to determine how the areas were defined by DBCA. This inconsistency in area designation of the *Mount Saddleback Heath Communities* (PEC - P1) polygons as supplied by DBCA (without any buffer) are summarized in Table 12.

The heath communities that have the closest affinities with the PEC community are the G1 and G3 site-vegetation types. The G4 and G5 site-vegetation types have some affinities with the PEC community but differ in key structural or floristic attributes, namely:

- Site-vegetation Type G1: Mosaic of open heath of Proteaceae – Myrtaceae spp. with emergent patches of *Eucalyptus drummondii* on shallow soils on slopes.
- Site-vegetation Type G3: Open heath of *Banksia squarrosa* subsp. *squarrosa, Hakea incrassata, Hakea undulata, Petrophile heterophylla* and *Petrophile serruriae* on shallow soils over granite outcrops on slopes with occasional emergent *Eucalyptus drummondii.*
- Site-vegetation Type G4: Open scrub and tall shrubland of *Hakea trifurcata* and *Hakea undulata* with admixtures of mallee species including *Eucalyptus latens* and *Eucalyptus aspersa* on clay to clay-loam soils over outcrops on slopes.

- Site-vegetation Type G5: Low woodland of Eucalypt mallee species including *Eucalyptus aspersa, Eucalyptus latens, Eucalyptus longicornis* and *Eucalyptus drummondii* with occasional *Eucalyptus wandoo* over low shrubs of *Allocasuarina humilis, Hakea incrassata*, *Synaphea damopsis* and herbs on clay loams and sandy-loams on slopes.

Table 12: Comparison of DBCA PEC Mount Saddleback Heath Communities PEC (P1) with site-vegetation types (SVT) as defined and mapped by Mattiske on the basis of grid mapping and plot data

SVT within DBCA polygons	Site-Vegetation Type	Area (ha	% of PEC polygons
CL	Cleared Areas	0.71	0.90
D	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes.	0.02	0.03
G1	Mosaic of open heath of Proteaceae - Myrtaceae spp. with emergent patches of *Eucalyptus drummondii* on shallow soils on slopes.	**4.76**	6.00
G2	Mosaic of open woodland of *Allocasuarina huegeliana* and closed heath of Proteaceae Myrtaceae spp. to Lithic Complex on exposed or shallow granite outcrops.	0.58	0.73
G3	Open heath of *Banksia squarrosa* subsp. *squarrosa, Hakea incrassata, Hakea undulata, Petrophile heterophylla* and *Petrophile serruriae* on shallow soils over granite outcrops on slopes with occasional emergent *Eucalyptus drummondii.*	**46.86**	59.10
G4	Open scrub and tall shrubland of *Hakea trifurcata* and *Hakea undulata* with admixtures of mallee species including *Eucalyptus latens* and *Eucalyptus aspersa* on clay to clay-loam soils over outcrops on slopes.	5.14	6.48
H	Open forest to woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Petrophile striata, Daviesia decurrens, Daviesia longifolia* and *Daviesia rhombifolia* on sandy loam to sandy gravels on slopes and ridges.	6.29	7.93
M	Open woodland of *Eucalyptus wandoo* over *Trymalium ledifolium, Macrozamia riedlei* and *Hakea lissocarpha* on clay loams with some gravel on mid to upper slopes and ridges.	5.09	6.42
P	Open forest of *Eucalyptus marginata* and *Allocasuarina fraseriana with admixtures of Corymbia calophylla* and *Banksia grandis* over *Lasiopetalum cardiophyllum* (P4), *Lasiopetalum floribundum, Lechenaultia biloba* and *Ptilotus drummondii* var. *drummondii* on sandy gravels on slopes and ridges.	6.28	7.92
R	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Trymalium ledifolium, Phyllanthus calycinus* and *Hypocalymma angustifolium* on sandy-gravels associated with nearby shallow outcropping.	0.0002	0.00
S	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* with admixtures of *Allocasuarina fraseriana, Banksia grandis* and *Persoonia longifolia over Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on sandy-gravels on slopes and ridges.	0.23	0.29
SW	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hypocalymma angustifolium, Babingtonia camphorosmae, Acacia celastrifolia, Hovea chorizemifolia, Daviesia preissii, Leucopogon capitellatus* and *Styphelia tenuiflora* on seasonally moister sandy-gravels on slopes.	1.81	2.28
Y	Open woodland of *Eucalyptus wandoo* over *Gompholobium marginatum, Acacia nervosa, Babingtonia camphorosmae, Hypocalymma angustifolium, Macrozamia riedlei, Phyllanthus calycinus* and *Gastrolobium calycinum* on clay and clay-loam soils on lower slopes.	0.02	0.03
Z	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Macrozamia riedlei, Xanthorrhoea preissii, Hakea lissocarpha* and *Phyllanthus calycinus* on sandy-loam to sandy-loam gravel soils on slopes.	1.5	1.89
Total		**79.2902**	**100.00**

These site-vegetation types are variants of the site-vegetation type G, as defined by Havel (1975a and 1975b), and are associated with shallow soils and granite outcrops. Several have some low mallee *Eucalyptus* species (G3, G4 and G5 as components) which provide patches of low woodlands and hence it could be argued that from a structural perspective the closest consistent site types to the PEC as defined by DBCA are G1 and G3; however in the absence of data from DBCA this alignment is not confirmed by detailed analyses of the data from DBCA and Mattiske. As the heath communities are associated with the granite outcrops in areas that have not been cleared for infrastructure the condition remains excellent.

In some areas the heath communities are restricted in spatial extent (<1ha) and therefore small patches pose additional issues for definition and management.

The G2 site-vegetation type differs from the G1, G3, G4 and G5 in the dominance of *Allocasuarina huegeliana* and lithic complexes on exposed and shallow granite outcrops. As such this site-vegetation type is not dominated by heaths.

5.11 Significant Vegetation Communities

The following vegetation complexes and site-vegetation types are considered to be significant for their restricted representation in the conservation estate (less than 10% representation in formal and informal reserves) and also as potential wildlife corridors along creeklines.

Vegetation Complexes

- Williams – Along the major creeklines and rivers – less than 0.3% in formal and informal reserves, provides corridors and protects riparian areas (Government of Western Australia 2019).
- Michibin – On Valley slopes in eastern areas of Jarrah Forest – less than 5.1% in formal and informal reserves (Government of Western Australia 2019).

Both these vegetation complexes have been highly modified by agricultural activities in the areas near Boddington for many decades and hence any remnants of native vegetation on these complexes within the PAA is limited. The Williams complex is associated with the riverine vegetation associated with the banks of creeks and rivers and the Michibin complex is associated with clay-loam soils that have been cleared and grazed or cropped for many decades for agricultural purposes.

Site-Vegetation Types

A total of 15 locally significance communities occur in the PAA, with 15 being in the WMDE and 12 being in the BTC and none in the CBME.

- The G site-vegetation type as defined by Havel (1975b) has been subdivided and refined as G1, G2, G3 and G4 in the PAA areas. The G5 site-vegetation types was not recorded in the PAA. As such these site-vegetation types within this broader G site-vegetation type vary from lithic complexes to heath to shrublands to open scrubs and woodland communities associated with shallow soils over granite and exposed granite outcrop areas. Some of these areas (G1 and G3 in particular within the Mt Saddleback area) overlap with the PEC (Priority 1) Mt Saddleback Heath Communities (DBCA 2020d and as supplied by DBCA).
- Types DG, HG, MG and YG that are a mixture of different site-vegetation types over shallow granites in the WMDE and the wider mapped areas near Boddington. The LG site-vegetation types were not recorded in the PAA. These types have an overstorey of Jarrah or Wandoo and as such are not heath communities, although some understorey species may reflect the shallow granites below the soil surface.

- L Type – Open woodland of *Eucalyptus patens* with some *Eucalyptus wandoo* on lower slopes. This site-vegetation type has been cleared in sections of the eastern Jarrah Forest for agriculture activities as the earlier land holders recognised the alluvial soils associated with the occurrence of the *Eucalyptus patens* communities.

- The M2 site-vegetation type which supports woodlands of *Eucalyptus accedens*, *Eucalyptus wandoo, Eucalyptus marginata* and *Corymbia calophylla* on eastern breakaways. The M2 site-vegetation type occurs in the WMDE, BTC and the wider mapped areas near Boddington. This site-vegetation type occurs eastwards on the upper slopes and ridges of the Eastern Jarrah Forest.

- A, AY, AX, AC Types – Woodlands of *Eucalyptus rudis* and *Melaleuca* species on the swamps and creeklines that provide linkages for fauna species and also for variety of plant species on variable soils.

The site-vegetation types in the wider areas that support threatened and Priority flora species include the Jarrah – Sheoak communities supporting *Lasiopetalum cardiophyllum* (P4), the lower slopes near the Hotham River and swamps (site-vegetation types A, AY, AX, AC, SW and Y), the heath communities (G1 and G3) and open forests of *Eucalyptus marginata* subsp*. thalassica – Corymbia calophylla – Allocasuarina fraseriana* (site-vegetation types P and PS). The CW site-vegetation type in the western Jarrah Forest supports the *Pultenaea skinneri* (P4) in other areas near Collie.

5.12 Potential Old Growth Forest in PAA

The potential for defining areas of Old Growth Forest is limited as the interpretation of the older Aerial Photographic Interpretations (API) from the 1950's and the earlier mapping from the 1980's and 1990's in some areas may not reflect recent impacts of harvesting. In interpreting the data, some areas can be deleted from consideration as significant sections have been cleared for many decades for agricultural and plantation activities as well as for mining and rehabilitation activities since the mid 1980's. As indicated in Table 2, 54.20% of the wider total area mapped remains as native vegetation and 44.20% of the total PAA area remains as native vegetation. These figures reflect the degree of disturbance in the respective areas.

The potential for Old Growth Forest to occur in the WMDE and BTC and CBME areas (excluding cleared, rehabilitated, dams and plantation areas), as mapped based on the categories defined in **Section 4.9**, is summarised below:

- Negligible Potential – 5,518 ha, representing 44.3% of the WMDE and BTC area and 236 ha, representing 31.9% of the CBME area with vegetative cover (excluding cleared areas, the dam area and the rehabilitation areas).

- Low – 2,419 ha, representing 19.4% of the remnant vegetation WMDE and BTC and 9ha, representing 1.2% of the CBME area with vegetative cover (excluding cleared areas, the dam area and the rehabilitation areas).

- Low – Medium – 3,604 ha, representing 28.9% of the remnant vegetation WMDE and BTC and 187ha, representing 25.3% of the remnant vegetation/rehabilitation within the CBME.

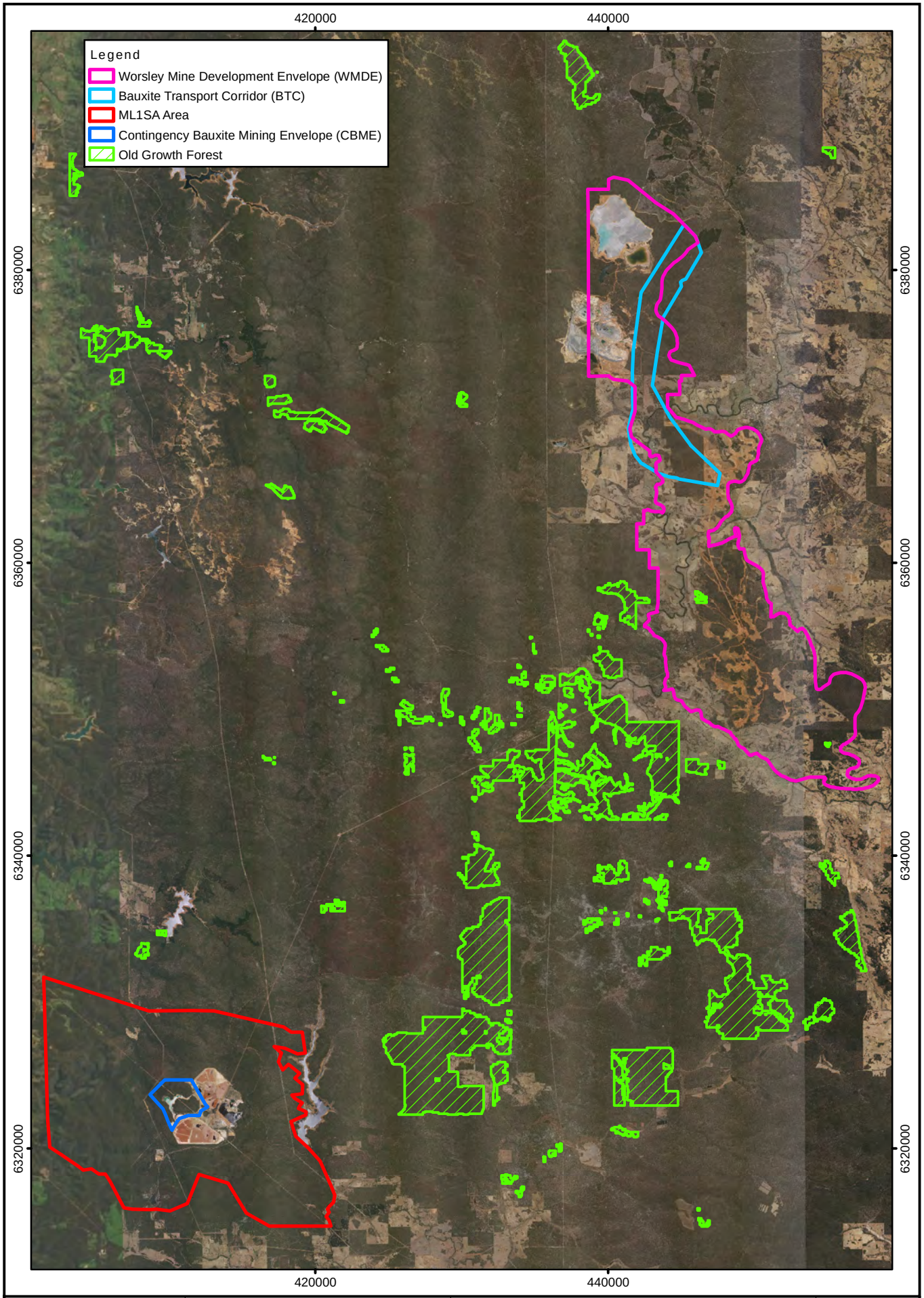
- Medium – 2335 ha, representing 18.7% of the remnant vegetation WMDE and BTC and 308 ha, representing 41.6% of the CBME area with vegetative cover (excluding cleared areas, the dam area and the rehabilitation areas).

- Medium – High – 1767 ha, representing 14.1% of the remnant vegetation WMDE and BTC and 0 ha, representing 70.0% of the CBME area with vegetative cover (excluding cleared areas, the dam area and the rehabilitation areas).

- High – 34 ha representing 0.27% of the remnant vegetation WMDE and BTC and 0 ha, representing 0.0% of the CBME area with vegetative cover (excluding cleared areas, the dam area and the rehabilitation areas).

The latter data reflects the low percentage of High Old Growth Forest as defined by DBCA (2020) and the Medium – High potential Old Growth Forest in the Boddington area.

In response to more recent comments from regulators, additional data was collated on areas that may support potential Old Growth Forest areas beyond that defined by DBCA (2020, see Figure 11-1). The areas were then ranked according to the potential for additional patches of Old Growth Forest values. In defining these areas the interpretation requires additional targeted work prior to operations and with this in consideration greater priority should be placed on initially high and then medium-high areas (Figures 11-2 and 11-3). Such an approach is currently being tested at a more local scale currently by the Mattiske team on the Quindanning area. The interpretation was based on reviewing the condition maps as presented in this report, the site-vegetation type maps, the known occurrence of dieback, DBCA Old Growth Forest data and harvest information and the steeper slopes that may not have been harvested due to the harvesting access constraints. This resulted in the definition of some areas of Negligible Potential, Low, Low-Medium, Medium, Medium-High and High potential, Figures 11-2 and 11-3 for the WMDE/BTC and CBME areas respectively.



Old Growth Forest: DBCA (Oct 2019)

N

0 3.5 7 km

Scale: 1:350,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_08

Date: August 2021 | Rev: A | A4

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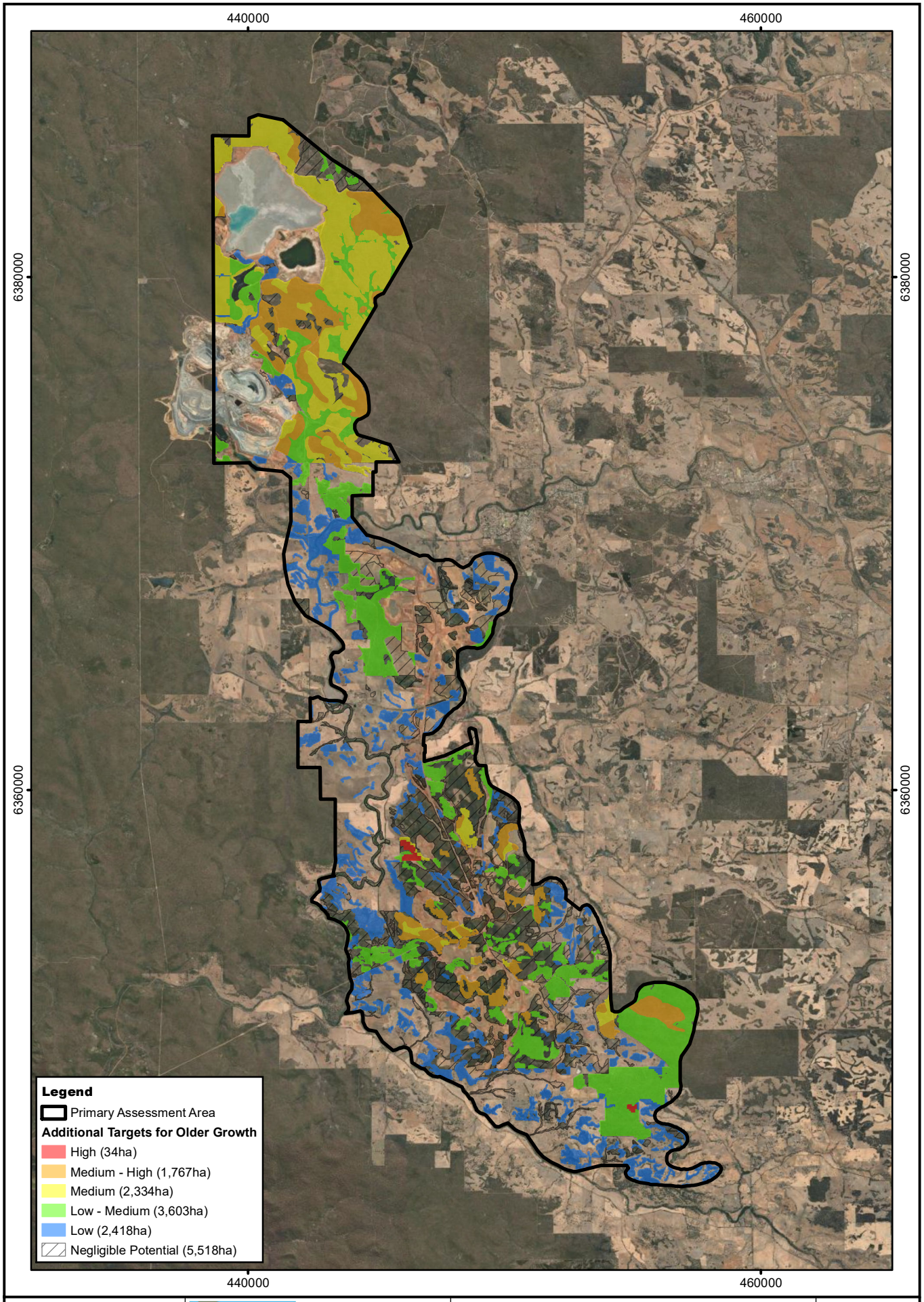
Old Growth Forest (DBCA, supplied in January 2020)

Figure: **11.1**



N

0 1 2 3 km

Scale: 1:200,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_25

Date: July 2021 | Rev: A | A4

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Additional target areas for Older Growth > 2ha

Figure:

11.2

410000
412500
415000
6325000
6322500
6320000

Legend
- Contingency Bauxite Mining Envelope (CBME)
- Medium (456.96ha)
- Low - Medium (259.28ha)
- Low (50.23ha)
- Negligible Potential (1727.84ha)

Client: SOUTH32

N

0 500m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: g1881_F006_26

Date: Aug 2021 | Rev: A | A3

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Collie - Worsley Mine Expansion
Additional target areas for Older Growth

Figure: **11.3**

6. DISCUSSION

This report represents a consolidation of recent assessments of the flora and vegetation values in the PAA and surrounds near Boddington and Collie. This assessment supplements earlier baseline flora and vegetation surveys of the Mt Saddleback area since the 1980's (Worsley Alumina Pty Ltd 1985) more recent studies on the Quindanning Timber Reserve (Mattiske Consulting Pty Ltd 1993, 1999a, 1999b, 2020 in prep), Marradong Timber Reserve (Mattiske Consulting Pty Ltd 1990), the Collie Refinery area (1999, 2014) and other areas of agricultural holdings, State Forest and forested areas near the Boddington operations.

6.1 Survey Effort and Potential Limitations

The various studies have added taxa when additional targeted searches, baseline and monitoring studies have been undertaken. Several of the taxa have undergone taxonomic changes since the earlier studies and several species have been excluded, been changed from introduced to naturalised and been changed from Priority species to non-threatened species.

The survey effort on the various lease areas over some 40 years reflects the range of biodiversity values. The report summarises the key areas in relation to the flora species, the site-vegetation types and the vegetation complexes. The comprehensive nature of the survey work exceeds the current requirements of the EPA (2016a and 2016b). Although it may differ slightly in approach on the vegetation, the adoption of the alignment of methodology and interpretation with the extensive work by Havel (1975a and 1975b) in defining the site-vegetation types, including the extension of this work by Dr Mattiske and her team over some 40 years, enables a more comprehensive approach than other methods on the total survey area of 56,735.99ha. The combination of detailed gridding with regular recordings when combined with the permanent plots and regular monitoring supports the comprehensive nature of the sampling. The foot traverses during baseline flora and vegetation studies and targeted flora surveys have enabled greater coverage of the flora values over some 40 years. The requirement for population numbers is a recent specification in the guidance statement. As a result of the latter, numbers extracted from earlier results are an under estimate of the population numbers. As ranking of species was undertaken at all recorded sites on grid systems (see Section 4.2 rankings ranged from 0 to 5). As a result of the rankings, it was possible to convert the rankings from 0 to 5 to a minimum conservative population estimate. This level of effort is difficult to match on any other development area in the State of Western Australia. The occurrence of the proposed PAA in the Boddington area raises additional challenges in view of the diversity of flora and vegetation associated with the eastern Jarrah Forest and the Wheatbelt to the east. As indicated above there are few key areas supporting conservation significant flora and vegetation and these are in the main area already being managed by South 32 Worsley Alumina Pty Ltd through a series of protected areas and on-going research activities.

A minor constraint was related to the lack of population numbers for some of the flora species as some older records held at the State Herbarium and the earlier work of Mattiske were based on data collected prior to the introduction of the GPS units. In earlier periods there was a need to rely on compasses, maps, aerials and foot traverses. The details on some of the State Herbarium records were very general in terms of locational and plant number details. The coverage of flora in the Boddington and Collie areas has also been influenced by other changes in agricultural activities since settlement. This latter agricultural and clearing activities, along with the previous approved mining activities in some of these areas has resulted in some loss of historical records. Based on this assessment, there have been minimal limitations associated with the work to delineate the flora and vegetation values in the PAA. These few limitations associated with older locational and population numbers was significantly reduced by the aerial coverage of the areas at Boddington and Collie and the intensive survey and targeted survey work undertaken in the respective areas.

In this context, it is important to recognize that over the last 50-year period a range of species and taxa have undergone taxonomic reviews leading to changes in names and distribution. Some species have been removed from the Priority flora list as a result of the amount of local and regional work by botanists. The latter is apparent if one compares the earlier summaries on the conservation significant species on the Boddington Bauxite Mine (Worsley Alumina Pty Ltd 1985) and Boddington Gold Mine (Worsley Alumina Pty Ltd 1999) with the current summaries.

In considering the survey limitations it is also important to recognize the extensive work undertaken by a large range of authors on the northern Jarrah Forest over some 50 or so years. In most instances, flora and vegetation datasets are collected over a shorter time frame and have not been through such changes during a project. To this end Mattiske Consulting Pty Ltd has undertaken an annual review of all South32 datasets to review the currency of the taxon. This effort takes several weeks each year to maintain the integrity of the datasets.

6.2 Flora

Since the early 1980's, a total of 1031 vascular plant taxa from 83 families and 319 genera have been recorded on the wider Boddington surveyed areas and 289 vascular plant species from 54 plant families and 149 genera have been recorded in the main baseline studies undertaken in the Collie RLA, Appendices H and I, Table 3. The latter total numbers included 132 introduced species and 5 planted species in the Boddington area and 15 introduced species and 1 planted species in the Collie RLA. A total of 115 introduced species have been recorded since 1980 on agricultural and rehabilitated areas in the WMDE and BTC and 37 introduced species on control areas in the WMDE and BTC areas. The range of species on the control areas includes remnant vegetation areas on private properties and the less disturbed areas within the WMDE and BTC.

To date 408 taxa have been recorded on both the forest control areas and rehabilitation areas and as such this represents 81.77% of the species on the rehabilitation areas that are in common with the control areas. The number on the rehabilitation areas exceeds that on the control areas largely as more sampling has been undertaken on the rehabilitated areas and also many taxa were only identified to the genus level (due to seedling size or lack of flowering and fruiting material.

6.3 Threatened and Priority Flora

In reviewing the potential threatened and priority flora species the location of the survey areas near the eastern fringes of the norther Jarrah Forest and the Collie Basin led to some species that less likely to occur in the survey areas. The likelihood was based on Florabase, experience in the Boddington and Collie areas by the authors. Of the threatened species that have been recorded or have the potential to occur, the majority will not be impacted by the proposed expansions, Table 4 and 5, Appendices D to I.

- *Anthocercis gracilis* (T) occurred outside and north-east of the WMDE and BTC areas in granite areas;
- *Caladenia dorrienii* (T) occurs outside the PAA, as per Figures 8.10.
- *Caladenia hopperiana* (T) occurs in the Quindanning Timber Reserve in valley systems occurs in a small section of the proposed south-eastern section of the WMDE. The plants within the WMDE will be protected under the Protected Area procedure.
- *Eleocharis keigheryi* (T) is Threatened under the BC Act and Vulnerable under the EPBC Act – occurs outside of PAA on swamp and seasonally wetter sites.
- *Pultenaea pauciflora* (T) is Threatened under the BC Act and Vunerable under the EPBC Act – occurs primarily in Luptons forest area north-east of Boddington, eastwards of Qundanning to Narrogin and in Dale Forest block north-west of Boddington. The occurrence of this species is mainly on sandy and clay soils and appears to be primarily a Wheatbelt species.

- *Diuris micrantha* (T) is Threatened under the BC Act and Vunerable under the EPBC Act – occurs near the Darkan-Quindanning Road to the south of the current survey areas. This species also occurs on the Swan Coastal Plain (DBCA 2020a).

Of the remaining priority flora species, the following may be impacted to some degree by the proposed activities in the PAA, namely:

- *Gastrolobium* sp. Prostrate Boddington (M Hislop 2130) (P1) occurs in the valley floors and valley near Hotham River and its tributaries. This species is largely located in the Wandoo woodlands north of the current Newmont Boddington Gold Mine camp and in an area which will not be disturbed by this proposal (Table 4). Although this species occurs near the Hotham River the majority of plants occur outside of the PAA.
- *Hemigenia rigida (P1)* – now re-identified as *Hemigenia pritzelii*, which is not a threatened or priority species and is common and widespread in the southwest region.
- *Isopogon* sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin) (P1) occurs mainly in swamps and heath areas. It has been recorded in Tunnell Road heath and in rehabilitation areas; although to date in low numbers. This taxon is not expected to be impacted from this proposal
- *Hibbertia ambita* (P1) occurs in a range of sites from lower valley slopes to rehabilitated areas. The recent taxonomic studies by Thiele (2019) re-classified a range of species previously identified as *Hibbertia commutata*. Further field studies and collections of *Hibbertia* species have been undertaken in 2020 since this publication was released. The records in Table 4 area based on confirmed locations and it is expected that more locations will be confirmed in coming years. The *Hibbertia commutata* group of plants has been recorded regularly in the northern Jarrah Forest and in the Boddington and Collie areas. One of the main constraints relates to the need to have flowering material to separate this species.
- *Goodenia katabudjar* (P3) occurs in WMDE area; however, is known from wider lateritic hills in Jarrah and Wandoo woodlands. This species occurs as scattered plants in small patches and therefore numbers may be higher and the impact is potentially substantially lower.
- *Stylidium marradongense* (P3) occurs on gravelly soils and heath areas, including Tunnell Road heath. Relatively restricted to Boddington and local eastern Jarrah Forest areas.
- *Lasiopetalum cardiophyllum* (P4) occurs mainly in eastern areas of Jarrah-Sheoak forests near Boddington. Although plants may be impacted in the WMDE and BTC areas, the estimate of numbers is much lower as earlier studies did not record population numbers and the estimate of impact is expected to be much lower. Earlier observations undertaken by Mattiske and B. Koch reflected populations in the State Forest areas to the south and southwest of Boddington.
- *Senecio leucoglossus* (P4) occurs widely in low numbers throughout the northern Jarrah Forest and as such is better known than other P4 species. From extensive studies throughout the northern Jarrah Forest this species is known to be more widespread and therefore the impacts are expected to be a lot lower.

Specific heath communities are to be protected through the designation of Protected Areas reducing the potential of direct impacts to the associated species. Of the latter species the most significant species in the heath communities is the very localised and restricted *Papistylus intropubens* (P1). The species has only been recorded from Tunnell Road heath communities, which is not going to be directly disturbed under this operation expansion.

Of the recorded species the geographically restricted species were the threatened species (*Caladenia hopperiana*) and priority species (*Gastrolobium* sp. Prostrate Boddington (M Hislop 2130) (P1), *Isopogon* sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin) (P1), *Papistylus intropubens* (P1), *Banksia subpinnatifida* var. *subpinnatifida* (P2), *Goodenia katabudjar* (P3) and *Stylidium marradongense* (P3)). The species recorded near and within the RLA at Collie are more widespread in the northern and central Jarrah forests.

6.4 Introduced Flora

A total of 132 introduced flora species have been recorded in the wider lease areas near Boddington and Collie. The latter total numbers included 132 introduced species and 5 planted species in the Boddington area and 15 introduced species and 1 planted species in the Collie RLA. A total of 115 introduced species have been recorded since 1980 on agricultural and rehabilitated areas in the WMDE and BTC and 37 introduced species on control areas in the WMDE and BTC areas. The range of species on the control areas includes remnant vegetation areas on private properties and the less disturbed areas within the WMDE and BTC.

The majority of these occur off the remnant vegetation areas and within the agricultural areas. The majority of the weeds are short term annual species that establish on disturbed agricultural lands and although some establish in the early phase of rehabilitation, the majority are quickly outgrown by more perennial and larger native shrub and tree species. Therefore the occurrence of the majority of the weeds in the rehabilitation areas is temporary and short-lived. The number of weed species is influenced by the inclusion of agricultural lands in the Boddington area which have been cleared and highly modified for manhy decades. The number of weeds within the rehabilitation areas is lower than in the remnant areas on private properties that have been grazed or the cleared agricultural areas.

Of the potential introduced flora species the following are Declared Plants under the *Biodiversity and Agricultural Management Act 2007* (BAM Act) (Department of Primary Industries and Regional Development (DPIRD) 2020), namely:

- **Gomphocarpus fruticosus* – near Collie Refinery on previously cleared agricultural lands (DPAW 2020a; DAWE 2020a) and in survey areas by Bennett (2008).
- **Silybum marianum* – near Collie Refinery in Phase One (Danes and Moore 1981); although not recorded in recent assessments of CBME by Mattiske Consulting.
- **Asparagus asparagoides*– near Boddington and Collie areas on previously cleared agricultural lands and on disturbed areas on fringes of cleared land, plantations and roadsides on fringes of roadside. (DPAW 2020a; DAWE 2020a); and not recorded in recent assessments of CBME by Mattiske Consulting.
- *Moraea flaccida* – was recorded at 6 locations near Boddington on agricultural areas westwards and outside the WMDE and BTC areas; most records were made in 2009 with a few in 2012 and 2013.

With the exception of the *Moraea flaccida* on Hotham Farm and cleared agricultural lands south of the Pinjarra-Williams Road, the latter declared plants have not been recorded in the assessments on the surveyed areas in recent assessments.

6.5 Vegetation

At a regional scale Heddle *et al.* (1980) and Mattiske and Havel (1998) defined and mapped a series of vegetation complexes that enabled a refinement of the vegetation mapping of Beard (1979) and Smith (1974) for Pinjarra and Collie areas respectively. The latter work of Beard has been updated recently into Beard *et al.* (2013) for the State of Western Australia. The approach developed by Heddle *et al.* (1980) and Mattiske and Havel (1998) enabled relationships to be defined between the resulting regional patterns of vegetation and the underlying landforms, soils and climatic trends in the southwest forests. In the areas assessed for the Proposal, the following vegetation complexes were recorded:

WMDE – 9 vegetation complexes, Cooke, Coolakin, Dwellingup 4, Michibin, Pindalup, Swamp, Williams, Yalanbee 5 and Yalanbee 6.

BTC - 8 vegetation complexes, Cooke, Coolakin, Dwellingup 4, Michibin, Pindalup, Swamp, Williams and Yalanbee 6.

CBME – 3 vegetation complexes, Dwellingup 1, Murray 1 and Yarragil 1.

Significant vegetation complexes within the WMDE, BTC and CBME areas include the following:

- Within the Boddington lease areas, the Michibin and Williams vegetation complexes are less well represented (<10%) in all DBCA managed lands (5.1% and 0.3% respectively) (Government of Western Australia 2019). The latter mainly relates to their occurrence in valley systems that have been developed for agriculture on the eastern fringes of the Darling Ranges.
- All of the vegetation complexes associated with the CBME are well represented in formal and informal reserves in areas >10% (Government of Western Australia 2019).

The presence of a range of Priority flora species in the series of site vegetation types associated with granite outcrops (variants of the former G site vegetation type as defined by Havel (1975) also highlight the Cooke vegetation complex as mapped by Heddle et al. 1980) and Mattiske and Havel (1998). The Cooke complex is relatively restricted in the PAA area as the mapping was undertaken at a different regional scale to the more detailed and local site-vegetation type mapping (Section 6.5). The reduction during the vegetation complex mapping from 1:25,000 and 1:50,000 to 1:250,000 restricted the coverage of some of the smaller outcrop areas in this regional mapping project. As such the Cooke vegetation complex was not highlighted in this report as in a regional context it is well represented in formal and informal reserves (62.6% in all DBCA managed lands (Government of Western Australia 2019).

6.6 Site-Vegetation Types

At a finer scale of local mapping the following presents the site-vegetation types for the WMDE, BTC and CBME. This method of mapping was developed based on the earlier ecological studies of Havel (1975a and 1975b) who delineated a series of site-vegetation types that integrated the structural and floristic components (including key indicator species) with the underlying soil and site conditions. This approach was developed by Havel (1975a, 1975b) and has been applied over extensive areas in the Jarrah Forest by Havel and Mattiske since these earlier studies (1979 to 2019). In the South32 lease areas, the utilisation of this approach exceeds the floristic community approach as it integrates site conditions, structural components and floristic components. The initial vegetation as part of Phase I on the South32 lease was undertaken by Dames and Moore (1981) and later Mattiske (1985 to 2019).

WMDE – 34 site-vegetation types were defined for the WMDE area. The dominant site-vegetation types (>200ha) were M, P, PS, S, H, H2, ST, Y, Z AY and D. Large sections of the WMDE have been cleared for agriculture and plantations. The majority of the WMDE area is either completely degraded (45.41%) or degraded (14.99%). The restricted site-vegetation types include swamp vegetation types (A1, A2), on the lower slopes (AD, AY/D, B, DG), on the outcropping areas (G1, G2, G4, R) and on the moister slopes (PW, SW, W, YG).

BTC – 25 site-vegetation types were defined for the BTC area. The dominant site-vegetation types (>100ha) were H and M. Large sections of the BTC have been cleared for agriculture and plantations. A large portion of the BTC is either completely degraded (27.38%) or degraded (5.84%). The restricted site-vegetation types include specific types on the slopes (H2, M2), on the lower slopes (AD, AY/D, DG), on the outcropping areas (G1, G3, G4) and on the moister slopes (PW).

CBME – 10 site-vegetation types were defined for the CBME. The dominant site-vegetation types (>100ha) were S and ST. The majority of the CBME was relatively undisturbed, with the exception of the dam and completely degraded cleared areas (31.64%). The restricted site-vegetation types include specific types on the lower slopes (CQ), flats (E) and slopes (SP). All site-vegetation types in the CBME are well represented in nearby State Forest areas and conservations areas (e.g., Wellington National Park).

While remnant vegetation areas still remain within the WMDE and BTC, they are largely fragmented, with the majority of the remaining patches being small (<2ha). The larger areas of native vegetation vary from forests to woodlands to mallees to open scrub to heath and lithic complexes. Whilst many of these areas are not Pristine, sections of the less disturbed native vegetation include 33.52%, 60.57% and 69.33% in the WMDE, WMDE/BTC overlap and BTC areas in excellent condition. The dominant site-vegetation types are S, SP, P, PS, H, H2, M and Z in the PAA. In the current bauxite mining areas the S, SP, P, PS, H and H2 site-vegetation types are associated with the bauxite mining activities.

The communities that support higher species richness levels tend to be associated with the granites and shallow soils over the granites. The valley systems (creeklines and lower slopes) when combined with the site-vegetation types on the granite outcrops increase the range of structural and floristic components of the Boddington PAA areas. As indicated previously in the discussion on the flora, the majority of the Priority flora species are associated with granite outcrop areas. The threatened orchid species (*Caladenia hopperiana*) is associated with the clay loams within the moister watershed areas of the south-eastern valleys in the Quindanning Timber Reserve. In general, the vegetation within the CBME is more intact and hence is in better condition.

Locally significant communities within the WMDE, BTC and CBME areas include the following:

- The Priority 1 PEC - Mt Saddleback Heath Communities, as delineated by DBCA, occurs in the Saddleback area near Boddington within the WMDE but not within the BTC. This PEC community on Mt Saddleback has affinities with selected components of the site-vegetation type G as defined by Havel (1975b) and as refined and split into site-vegetation types G1, G2, G3, G4 and G5 by Mattiske in the northern Jarrah Forest areas and more specifically G1, G3 and G4 in the PAA areas by Mattiske (Worsley Alumina Pty Ltd 1985 to Mattiske in prep 2020). Some of these site-vegetation types extend well beyond the Mt Saddleback area, e.g., north of the Boddington Gold Mine and on the eastern fringes of the State Forest. The occurrence of the majority of the Priority species in the heath communities reinforces the significance of these areas and in particular Tunnell Road Heath and heath communities on Forty-Hollow Road and Mt Saddleback. There remain differences in the various G site-vegetation types and hence variations related to the occurrence and dominance of different structural components and species in the heath communities (G1 and G3) and those (G4 and G5) that also have patches of mallee *Eucalyptus* species (*Eucalyptus latens, Eucalyptus drummondii* and *Eucalyptus aspersa*). The predominantly heath community in the Tunnell Road heath area for example also supports a few stands of *Melaleuca preissiana* and *Corymbia calophylla* trees and a few patches of *Eucalyptus drummondii.*
- The G2 site-vegetation type that occurs on granite in association with Rock Sheoak (*Allocasuarina huegeliana*), heath communities and lithic complexes occurs on the WMDE and the wider mapped areas near Boddington.
- The communities that are a mixture of different site-vegetation types over shallow granites (DG, HG, YG and MG) occur in the WMDE and the wider mapped areas near Boddington.
- The M2 site-vegetation type which supports woodlands of *Eucalyptus accedens*, *Eucalyptus wandoo, Eucalyptus marginata* and *Corymbia calophylla* on eastern breakaways. The M2 site-vegetation type occurs in the WMDE, BTC and the wider mapped areas near Boddington. This site-vegetation type occurs eastwards on the upper slopes and ridges of the Eastern Jarrah Forest.

- A, AY, AX, AC Types – Woodlands of *Eucalyptus rudis* and *Melaleuca* species on the swamps and creeklines that provide linkages for fauna species and a variety of plant species on variable soils in the survey areas. These site-vegetation types occur in the WMDE, BTC and the wider mapped areas near Boddington
- The restricted L site-vegetation type that supports a woodland of *Eucalyptus patens* and *Eucalyptus wandoo* occurs in the WMDE and WMDE/BTC overlap areas and the wider mapped areas near Boddington.
- The Y site-vegetation type that is often associated with the occurrence of the *Gastrolobium* sp. Prostrate Boddington (M. Hislop 2130), particularly on the lower slopes near the Hotham River and north on broader clay loam valley lower slopes. This site-vegetation type is well represented in the wider areas and occurs in the WMDE, BTC and the wider mapped areas near Boddington.

The majority of the site-vegetation types that occur on the Collie RLA are locally well represented in State Forest and conservations areas (e.g., Wellington National Park).

Overall, the vegetation communities mapped and species recorded in the WMDE, BTC and CBME were consistent with the historical mapping of Mattiske as reflected in the earlier work of Havel (1975a and 1975b) in the northern Jarrah Forest and also the more recent mapping by Mattiske since the Phase Two studies on the Mt Saddleback area (Worsley Alumina Pty Ltd 1985; E.M. Mattiske and Associates 1986 to 1993; Mattiske Consulting ty Ltd 2012a to 2012c). As sections of the PAA are either completely degraded or degraded, the potential impact on local flora values should be minimal in a regional context as the heath and valley communities that support the majority of the conservation significant species will not be impacted directly by most proposed expansion activities.

6.7 Threatened and Priority Ecological Communities

No TECs are known to occur within the areas the subject of the proposal under either State or Federal listings.

The desktop search highlighted the presence of the Mt Saddleback Heath Community Priority Ecological Community P1. This community was not defined during the Phase One and Two studies undertaken by Worsley Alumina Pty Ltd and was initially assigned to the heath community on Tunnell Road. In recent years it has been extended to the wider Mt Saddleback Heath Community.

The desktop highlighted the overlap with the RFA area (DAWE 2020a). The vegetation mapping undertaken by Heddle *et al*. (1980) and the updated vegetation complex mapping by Mattiske and Havel (1998) aligns with the RFA areas in the Boddington and Collie areas. The vegetation complex mapping of the RFA by Mattiske and Havel (1998) assisted in assessing the vegetation at a regional level when complexes within the PAA were compared with extent within the southwest forest area of the RFA.

6.8 Potential Groundwater Dependent Ecosystems

On the basis of the key indicator plant species, soil types and the associated resulting site-vegetation types the following vegetation within the PAA is considered to represent potential groundwater dependent ecosystems; A1, A2, AC, AD, AX, AY, AY/D, B, D, DG, L, LG, SW, PW, Y and YG. The G types associated with the low-lying watershed areas in the valleys for Boomerang Swamp (to the north of the PAA and Newmont Boddington Gold Mine operational pit) and the heath in the valley north of the Mt Saddleback crusher site known as Tunnell Road Heath. The inclusion of the latter areas within watershed and valley areas was considered a precautionary approach as these areas are considered to have surface aquifers in wetter seasons and may be reliant on water within 10m below ground level.

The interpretation in Woodman Environmental (2019) for the Newmont Boddington Gold Mine included a reliance on previous mapping by Mattiske Consulting (2005 and 2012) in the gold mine area and used the series of site-vegetation types in a similar way to define the potential groundwater dependent vegetation. One main difference related to the exclusion of the R site-vegetation types in the Mattiske (2020) potential groundwater dependent ecosystem definition in the PAA areas. The R site-vegetation type is associated with fringes of granite outcrops and as such may occur on ridges. Considering this location in the landscape and soil type, the R site-vegetation type is unlikely to be reliant on groundwater.

The inclusion of site-vegetation types such as SW and PW are considered less reliable as these site-vegetation types occur on the fringes of the valley slopes and may relate to surface water flows and localised soil types capable of holding seasonal water rather than consistently any link with groundwater. Some of these aspects are still open to interpretation as the source of the water for the plants may vary from site to site depending on the local conditions. Another key aspect that occurs in some valley systems and swamps is the development of secondary laterisation and lenses of impervious layers thereby holding water in soil profiles with associated soil moisture plant indicators. The complexity of these determining factors is not always apparent from aerial imagery. As indicated in the recent review by Woodman Environmental (2019) there are many factors that can influence the condition of the vegetation, including seasonal conditions, salinity, dieback, insect attacks and changing fire regimes.

6.9 Potential Old Growth Forest

The potential for defining areas of old growth forest is limited as the interpretation of the older Aerial Photographic Interpretations from the 1950's and the earlier mapping from the 1980's and 1990's in some areas may not reflect recent impacts of local harvesting. The Old Growth data provided by DBCA (January 2020) may not reflect the current situation as some local wood extraction activities may not have been included in the data as supplied. The spatial and temporal accuracy of old growth forest data is influenced by previous activities and hence a review was undertaken in early 2021 to assess additional areas that may require re-assessment on a local scale prior to any operational activities. To assist in this process the latter review enabled a categorisation of potential old growth of Negligible Potential, Low, Low-Medium, Medium, Medium to High and High. The first four categories (Negligible Potential, Low, Low-Medium and Medium) are considered a lower potential due to the degree of disturbance from a range of historical activities such as agriculture and grazing and previous clearing. This enabled a delineation of priority areas that were summarized in Figures 11-2 and 11-3 for the WMDE/BTC and CBME areas respectively in Section 5.12.

6.10 Summary of Cumulative Impact Assessment

The cumulative impacts of the proposed expansions are summarized in Table 12 and 13. The results reflect the key issues related to the threatened and priority species in the respective site-vegetation types and again re-stress the importance of the heath communities and some of the other communities supporting specific geographically restricted species.

The impacts on the spatial extent of the vegetation complexes in the proposal area can be compared with the pre-European extent based on the 2018 Government of Western Australia (2019) database. The percentage of proposed clearing in relation to the vegetation complexes within the PAA IDF remains very low in the regional context (Table 13).

The impacts of the spatial extent of the site-vegetation types in the proposal area can only be compared with the wider surveyed areas near the Boddington and Collie areas of potential impact. This relates to the lack of detailed mapping at this scale over all of the southwest forests. In this context there is a need to rely on the interpretations of Dr Mattiske and her teams who have undertaken extensive work in the northern Jarrah Forest to interpret the local significance and regional significance of some of these communities.

The occurrence of the Priority Ecological Community has been discussed above and until the DBCA accept the proposed coverage of the Mt Saddleback Heath Community PEC there is little that can be added in terms of cumulative impact.

The results presented in Table 14 provide an oversight of the potential impacts on the key values within the different site-vegetation types in the context of the local extent of the site vegetation types that support a range of Threatened and Priority flora species.

Table 13: Cumulative Impact Assessment per Vegetation Complex

AREA	Vegetation Complex	Pre-European Extent (ha)	Current Extent (ha)	Pre-European Extent Remaining (%)	Current Extent Remaining within All DBCA Managed Land (%)	Extent Within PAA (ha)	Extent Within PAA-IDF (ha)	Extent of Worsley Clearing inside the PBA as of Dec-2018 (ha)	Cumulative (Approved and Proposed Areas) (ha)	Cumulative Worsley Clearing against Current Extent (%)
WMDE and BTC	Cooke (Ce)	36,779	30,304	82.4%	62.6%	2,595	725	1,479	2,204	7.3%
	Coolakin (Ck)	163,992	64,205	39.2%	20.1%	3,622	949	501	1,450	2.2%
	Dwellingup 4 (D4)	132,416	115,662	87.3%	70.1%	9,438	3,849	1,868	5,717	4.9%
	Michibin (Mi)	168,040	42,996	25.6%	5.1%	4,804	1,237	270	1,507	3.5%
	Pindalup (Pn)	167,151	128,358	76.8%	60.1%	2,248	834		834	0.6%
	Swamp (S)	53,658	40,613	75.7%	64.2%	873	98	2	100	0.2%
	Williams (Wi)	28,984	7,517	25.9%	0.3%	1,243	74		74	1.0%
	Yalanbee 5 (Y5)	126,610	83,829	66.2%	38.8%	1,457	1,015		1,015	1.2%
	Yalanbee 6 (Y6)	197,849	92,081	46.5%	21.1%	2,329	508	1,035	1,543	1.7%
CBME	Dwellingup 1 (D1)	208,491	181,039	86.8%	82.3%	314	141		141	0.1%
	Murray 1 (My1)	68,695	52,296	76.1%	64.7%	392	108		108	0.2%
	Yarragil 1 (Yg1)	80,203	64,927	81.0%	73.6%	41	7		7	0.01%
Mattiske, 2020		Rehabilitation				3,190	617		617	
		Cleared Lands				12,708	2,064		2,064	
		Plantations				414	87		87	
		Total Native Vegetation				12,980	6,777	5,155	11,932	

Source: Government of Western Australia. (2019). 2018 South West Vegetation Complex Statistics. Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca

Notes:

Calculations conducted on 2018 South West Vegetation Complex Statistics -DBCA-047. With Rehabilitation, Plantations and Cleared Lands (Pasture and other) calculated on Mattiske, 2020.

2018 South West Vegetation Complex Statistics -DBCA-047 does not take into account detailed site rehabilitation, plantation and Cleared areas (pasture and other), these are derived from Mattiske, 2020.

Table 14: Cumulative Impact Assessment per Site-Vegetation Type

SVT Code (see Table 8 for full description)	Conservation or Other Significance	Wider Total Area Mapped (WTAM)	PAA (ha)	WMDE & BTC & CBME IDF	
				Area (ha)	% of WTAM
A	Locally significant Support a number priority flora (species or individuals)	625.86	130.06	39.61	6.33%
A1	-	45.47	2.88	0.00	0.00%
A2	-	8.88	1.66	0.00	0.00%
A3	-	13.35	0.00	0.00	0.00%
AC	Locally significant Support a number priority flora (species or individuals)	58.52	34.15	0.00	0.00%
AD	-	14.09	5.62	0.00	0.00%
AX	Locally significant Support a number priority flora (species or individuals)	516.87	224.68	25.95	5.02%
AY	Locally significant Support a number priority flora (species or individuals)	907.69	434.28	164.26	18.10%
AY/D	-	5.35	5.35	1.33	24.92%
B	-	6.22	0.47	0.00	0.00%
CQ	-	12.12	9.62	0.00	0.00%
CW	Support a number priority flora (species or individuals)	32.64	17.90	9.83	30.12%
D	Support a number priority flora (species or individuals)	976.09	400.67	198.39	20.33%
DG	Locally significant	51.67	8.72	2.07	4.00%
E	-	14.07	0.002	0.002	0.02%
G1	Representative of the PEC Mt Saddleback Heath Communities (Priority 1) Support a number priority flora (species or individuals)	194.48	73.93	4.50	2.32%
G2	Potentially some localized components representative of the PEC Mt Saddleback Heath Communities (Priority 1)	186.89	7.60	1.91	1.02%
G3	Representative of the PEC Mt Saddleback Heath Communities (Priority 1) Support a number priority flora (species or individuals)	137.59	75.53	13.17	9.57%
G4	Potentially representative of the PEC Mt Saddleback Heath Communities (Priority 1)	15.66	14.14	3.41	21.76%
G5	Potentially representative of the PEC Mt Saddleback Heath Communities (Priority 1)	5.98	0.00	0.00	0.00%

Table 14: Cumulative Impact Assessment per Site-Vegetation Type (continued)

SVT Code (see Table 8 for full description)	Conservation or Other Significance	Wider Total Area Mapped (WTAM)	PAA (ha)	PAA IDF	
				Area (ha)	% of WTAM
H	-	5422.58	1812.48	921.42	16.99%
H1	-	212.43	138.16	70.11	33.00%
H2	-	1045.46	581.73	318.83	30.50%
HG	Locally significant	150.23	50.97	25.53	16.99%
J	-	3.67	0.00	0.00	0.00%-
L	Locally significant	264.37	32.90	18.63	7.05%
LG	-	1.90	0.00	0.00	0.00%
M	-	4139.75	1669.03	589.39	14.24%
M2	Locally significant	544.20	45.43	16.29	2.99%
MG	Locally significant	501.24	220.47	39.30	7.84%
O	-	8.13	0.00	0.00	0.00%
P	Support a number priority flora (species or individuals)	1879.47	1480.27	945.27	50.29%
PS	Support a number priority flora (species or individuals)	2545.25	1272.87	1120.65	44.03%
PW	-	12.95	2.54	0.05	0.39%
Q	-	66.31	64.88	13.64	20.57%
R	-	28.15	1.29	0.48	1.71%
S	-	3651.55	1748.35	1057.60	28.96%
SP	-	1373.10	96.32	72.37	5.27%
ST	-	877.10	608.23	373.12	42.54%
SW	Support a number priority flora (species or individuals)	143.12	26.85	13.37	9.34%
T	-	17.29	14.04	11.87	68.62%
TS	-	72.02	68.95	17.60	24.44%
W	-	48.23	0.82	0.00	0.00%
Y	Support a number priority flora (species or individuals)	2052.77	720.56	189.41	9.23%
YG	Locally significant	456.38	31.15	3.13	0.70%
Z	-	1374.93	844.37	494.11	35.94%
CL	-	2903.96	2899.18	0.78	0.03%
CL – Ag	-	9282.15	6559.52	2062.44	22.22%
CL- Other	-	5486.62	3249.45	0.51	0.01%
Dam	-	66.92	63.39	0.00	0.00%
PL	-	275.29	229.00	87.61	31.82%
PL – Ag	-	4499.86	185.42	0.00	0.00%
Rehab	-	3163.60	3163.57	616.62	19.49%
Rehab – Ag	-	335.57	26.94	0.16	0.05%

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8. PERSONNEL

A range of experienced botanists that have worked on the Boddington and Collie areas with the Mattiske teams over the 40 years have assisted in the collection of the datasets. Foremost among these was Mrs Beverley Koch who assisted for many years on the botanical studies.

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

Name	Position	Project Involvement	Flora Collection Permit
Dr E.M. Mattiske	Managing Director & Principal Ecologist	Planning, management, data interpretation & reporting	SL012274
Mr R. Dharmarajan	Experienced Botanist	Planning, fieldwork, data interpretation and report preparation	SL012281
Mr A. Barrett	Experienced Botanist	Fieldwork	SL012280
Mr B. Ellery	Senior Botanist	Plant identification	N/A
Ms K. Lambert	Botanist	Fieldwork	SL012313
Ms E. Chetwin	Botanist	Fieldwork	SL012294
Mr L. Rowles	Botanist	Fieldwork	SL012277

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APPENDIX A: SUMMARY OF KEY BASELINE ASSESSMENTS OF THE SOUTH32 LEASE AREAS, 1980 TO 2018

Report	Consultant	Survey Area	Survey Date	Purpose of Survey/Study and Details
Vegetation Complexes of the Darling System, Western Australia. In: Atlas of Natural Resources of the Darling System, Western Australia, Chapter 3, Department of Conservation and Environment, Perth (Heddle *et al*. 1980)	(Mattiske (nee Heddle))	Darling System	1980	Vegetation Complexes of the Darling System, based on broad relationships with underling geology, landforms and soils and climatic zones with reference to key structural and floristic components of regional vegetation patterns.
Mattiske Consulting Pty Ltd Flora and Vegetation Studies in Worsley Alumina Project, Flora and Fauna studies, Phase Two (Worsley Alumina Pty Ltd, 1985)	Mattiske	Mt Saddleback and surrounds	1985	Site Vegetation Type classification, description and mapping based on grid mapping and also plots. Undertaken in early 1980's. Also extensive targeted searching for Threatened and Priority Flora species. Supplemented earlier studies by by Worsley Alumina Pty Ltd and Dames and Moore (1981) for Phase One areas.
Flora and Vegetation Marradong Timber Reserve (E.M. Mattiske and Associates 1990)	Mattiske	Marradong Timber Reserve	Spring 1989	Botanical survey to characterise the vegetation and flora of the Marradong Timber Reserve. Specifically, review the local and regional significance of the vegetation communities identified, review the conservation status of the flora, record a range of botanical and physical parameters, and establish and monitor a series of permanent vegetation plots.
Flora and Vegetation, Eastern Anomaly, Boddington Gold Mine (E.M. Mattiske and Associates 1992).	Mattiske	Boddington Gold Mine	1992	Site Vegetation Type classification, description and mapping based on grid mapping and also plots. Also extensive targeted searching for Threatened and Priority Flora species (in particular *Gastrolobium* sp. Prostrate Boddington (M. Hislop 2130))
Flora and Vegetation Studies on the Mount Saddleback Survey Area (E.M. Mattiske and Associates 1993)	Mattiske	Mount Saddleback	1993	Site Vegetation Type classification, description and mapping
Assessment of Tunnell Road Heath Communities (E.M. Mattiske and Associates 1993)	Mattiske	Tunnell Road Heath	1993	Site Vegetation Type classification, description and mapping
Flora and Vegetation Study , Fawcett Property (E M Mattiske and Associates 1994)	Mattiske	Fawcett Property	1994	Flora and Vegetation of the Fawcett Property. Flora and vegetation in remnant areas on the Fawcett Property. Targeted flora and vegetation type mapping.
Vegetation Complexes of the Darling System, Western Australia. Regional Forest Agreement (RFA) Vegetation Complexes, Pinjarra, Western Australia. (Mattiske and Havel 1998)	Mattiske and Havel	Pinjarra component of RFA Vegetation Mapping	1998	Vegetation Complexes of the Darling System, based on broad relationships with underling geology, landforms and soils and climatic zones with reference to key structural and floristic components of regional vegetation patterns.

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Report	Consultant	Survey Area	Survey Date	Purpose of Survey/Study and Details
Assessment of Tunnell Road heath communities, Boddington Bauxite Mine (Mattiske Consulting Pty Ltd 1998)	Mattiske	Tunnell Road heath, Mt Saddleback operations	1998	Assessment of heath communities, monitoring of quadrats in plots and transects.
Flora and Vegetation component (Mattiske Consulting Pty Ltd) in Worsley Alumina Boddington Gold Mine Project Flora and Fauna studies (Worsley Alumina Pty Ltd, 1999)	Mattiske	Hotham North	Surveyed in 1999 Further studies proposed prior to mining operations	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation of the Boddington Gold Mine (Mattiske Consulting Pty Ltd)	Mattiske	Boddington Gold Mine	1999	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation Flora and Vegetation Survey of the Collie Refinery Lease Area. (Mattiske Consulting Pty Ltd)	Mattiske	Collie Refinery	1999	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation of the Bunnings (Sotico) Survey Area (Mattiske Consulting Pty Ltd 1999)	Mattiske	Sotico/Bunnings/Saddleback Tree Farm	1999	Site Vegetation Type classification, description and mapping, Threatened and Priority flora.
Flora and Vegetation of the Quindanning Timber Reserve (E.M. Mattiske and & Associates 1993a, 1993b, 1999)	Mattiske	Quindanning Timber Reserve	1993a, 1993b, 1999, 2020 in prep	Site Vegetation Type classification, description and mapping, Threatened and Priority flora based on gridding of areas and regular recordings and plots and targeted searching for flora.
Flora and Vegetation Survey Remnant Vegetation Devereux, Nichols and Veitch Properties - Boddington Bauxite Mine (Mattiske Consulting Pty Ltd 2002)	Mattiske	Devereux, Nichols and Veitch properties, Boddington	2002	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation of the Boddington Gold Mine (Mattiske Consulting Pty Ltd)	Mattiske	Boddington Gold Mine	2002	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Review of declared rare and priority flora species located in the Worsley Alumina Boddington Bauxite Mine lease areas (Mattiske Consulting Pty Ltd 2003)	Mattiske	Boddington lease areas	2003	Review of threatened and priority flora status and taxonomy.
Rare and Priority Flora Re-assessment of Hotham Valley Railway (Mattiske Consulting Pty Ltd 2004)	Mattiske	Hotham Valley	2004	Targeted searches for Threatened and Priority Flora
Assessment of Tunnell Road heath communities, Boddington Bauxite Mine (Mattiske Consulting Pty Ltd 2004)	Mattiske	Tunnell Road heath, Mt Saddleback operations	2004	Assessment of heath communities, monitoring of quadrats in plots and transects.

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Report	Consultant	Survey Area	Survey Date	Purpose of Survey/Study and Details
Bennett Environmental Consulting (2004)	Bennett	Brookton and Central mining envelopes	2004	Define the flora and vegetation values of Brookton and Central mining envelopes.
Review of Flora and Vegetation located in the Boddington Gold Mine and Hedges Lease Areas (Mattiske Consulting Pty Ltd 2005)	Mattiske	Newmont Boddington Gold Mine	2005	Flora and Vegetation Review of Boddington Gold Mine and Hedges Lease Area
Review of Flora and Vegetation located in the Boddington Gold Mine and Hedges lease areas (Mattiske Consulting Pty Ltd 2005)	Mattiske	Boddington Gold Mine and Hedges Lease areas	2005	Extension and update of earlier Flora and Vegetation Studies on the Boddington Gold Mine and Hedges areas. Recording on grids and in plots and targeted flora searches.
Flora and Vegetation on the Collie refinery lease area (Mattiske Consulting Pty Ltd 2007)	Mattiske	Collie Refinery Lease Area	2007	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation Survey of Nichols, Black, Gibbs, Karafils, Nichols and Veitch properties, Boddington (Mattiske Consulting Pty Ltd 2010)	Mattiske	Dobrowolskyi, Farmer, Hulls 1, Hulls 2, Nullaga, Pringles, Robins, Nichols, Salmeri and Spencer properties, Boddington	2007	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation on Marradong Forest Block Boddington (Mattiske Consulting Pty Ltd 2008)	Mattiske	Marradong Timber Reserve Within the PBA	2007	Update earlier botanical studies on the Marradong Timber Reserve as undertaken Mattiske (1990). Specifically, update flora records with recent taxonomic name changes, establish vegetation monitoring sites and extend the vegetation mapping program to include nearby and adjacent private land holdings.
Flora and Vegetation on the Collie refinery lease area (Mattiske Consulting Pty Ltd 2007)	Mattiske	Collie Refinery	2007	Update earlier botanical studies on the Collie Refinery.
Flora and Vegetation on Nichols Property-Boddington (Mattiske Consulting Pty Ltd 2008)	Mattiske	Nichols Property	2008	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation on Marradong Forest Block Boddington (Mattiske Consulting Pty Ltd 2008)	Mattiske	Marradong Forest Block	2008	Site Vegetation Type classification, description and mapping, Threatened and Priority flora

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Report	Consultant	Survey Area	Survey Date	Purpose of Survey/Study and Details
Flora and Vegetation on Veitch Property-Boddington (Mattiske Consulting Pty Ltd 2008)	Mattiske	Veitch Property	2008	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation on Karafils Property-Boddington (Mattiske Consulting Pty Ltd 2008)	Mattiske	Karafils Property	2008	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation on Gibbs Property (Mattiske Consulting Pty Ltd 2008)	Mattiske	Gibbs Property	2008	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Review of Flora And Vegetation On Hotham River And Thirty-Four Mile Brook (Mattiske Consulting Pty Ltd 2010)	Mattiske	Hotham and 34 Mile Brook	2010	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
2009 Assessment of Flora And Vegetation Values On RDA Expansion Area At Newmont Boddington Gold Mine (Mattiske Consulting Pty Ltd 2010)	Mattiske	Expansion Area Boddington Gold Mine	2010	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation of Littleton's Cut Area (Mattiske Consulting Pty Ltd 2010)	Mattiske	Littleton's Cut	2010	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation Survey of Dobrowolskyi, Farmer, Hulls 1, Hulls 2, Nullaga, Pringles, Robins, Nichols, Salmeri and Spencer properties, Boddington (Mattiske Consulting Pty Ltd 2010)	Mattiske	Private Properties	2010	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation Survey of Dobrowolskyi, Farmer, Hulls 1, Hulls 2, Nullaga, Pringles, Robins, Nichols, Salmeri and Spencer properties, Boddington (Mattiske Consulting Pty Ltd 2010)	Mattiske	Dobrowolskyi, Farmer, Hulls 1, Hulls 2, Nullaga, Pringles, Robins, Nichols, Salmeri and Spencer properties, Boddington	2010	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Vegetation Monitoring Plots Sotico Property (Mattiske Consulting Pty Ltd 2012)	Mattiske	Sotico, north of Boddington Gold Mine	November 2011	Nine permanent plots established in representative site-vegetation types on Sotico property.
Flora and Vegetation of the Sotico Survey Area (Mattiske Consulting Pty Ltd 2012)	Mattiske	Sotico/Bunnings/Saddleback Tree Farm	2012	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Flora and Vegetation on Nullaga Property adjacent to Marradong section of the Boddington Bauxite Mine (Mattiske Consulting Pty Ltd 2012)	Mattiske	Nullaga	2012	Site Vegetation Type classification, description and mapping, Threatened and Priority flora

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Report	Consultant	Survey Area	Survey Date	Purpose of Survey/Study and Details
Threatened and Priority Flora Assessment of the Hotham Pipeline and Hedges Dam, Newmont Boddington Gold Mine (Mattiske Consulting Pty Ltd 2012)	Mattiske	Newmont Boddington Gold Mine	2012	Threatened and Priority Flora Assessment
Flora and Vegetation Survey of Hotham Farm Survey Area (Mattiske Consulting Pty Ltd 2013)	Mattiske	Hotham Farm totalling 196.71 ha.	30th October to 1st November 2012	Define the flora and vegetation values of Hotham Farm. Specifically, characterise the vegetation communities, their condition and vascular flora present, provide counts and locations of any Threatened and Priority flora, review the local and regional significance of the vegetation communities identified and review the conservation status of the flora. The survey included sampling from 22 sites to sample all vegetation types within the area.
Flora and Vegetation Survey of Nullaga Property Adjacent to Marradong Section of the Boddington Bauxite Mine (Mattiske Consulting Pty Ltd 2012)	Mattiske	Nullaga Property totalling 721.12 ha Intersects the PBA	30th October to 1st November 2012	Define the flora and vegetation values of Nullaga Property. Specifically, characterise the vegetation communities, their condition and vascular flora present and review the conservation status of the flora. The survey included sampling from 55 sites to sample all vegetation types within the area.
Flora and Vegetation of the Sotico Survey Area (Mattiske Consulting Pty Ltd 2012)	Mattiske	Sotico, north of Boddington Gold Mine	January 2012 to July 2012	Site Vegetation Type classification, description and mapping, Threatened and Priority flora. Recordings at 5847 sites.
Assessment of Flora and Vegetation Values on the Proposed WRL, the Potential Land Swap Area and the Southern Section of Hotham Farm, Boddington Gold Mine (Mattiske Consulting Pty Ltd 2013)	Mattiske	Newmont Boddington Gold Mine	2013	Site Vegetation Type classification, description and mapping, Threatened and Priority flora
Vegetation Monitoring Plots Sotico Property (Mattiske Consulting Pty Ltd 2013)	Mattiske	Sotico, north of Boddington Gold Mine	November 2013	Re-assessment of nine permanent plots and an additional 12 permanent plots established in representative site-vegetation types on Sotico property.
Assessment of Flora and Vegetation of Private Properties within the Extension Survey Areas (Mattiske Consulting Pty Ltd 2014)	Mattiske	PBA Extension Survey Areas totalling 3,144.56 ha. Within PBA.	30th September to 9th October 2014	Define the flora and vegetation values of the private properties located within PBA Extension Area. The survey included sampling from 207 sites to sample all vegetation types within the PBA Extension Areas.

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Report	Consultant	Survey Area	Survey Date	Purpose of Survey/Study and Details
Assessment of Flora and Vegetation of Private Properties within the Extension Survey Areas (Mattiske Consulting Pty Ltd 2017)	Mattiske	Bauxite Mine Expansion Area totalling 6,317.71 ha. Equivalent to the HME	15th – 18th November 2016	Define the flora and vegetation values of the private properties located within proposed expansion areas. The survey included sampling from 25 vegetation sites.
Assessment of Flora and Vegetation within Expansion Survey Areas (Mattiske Consulting Pty Ltd 2018)	Mattiske	WMDE 27793.27ha, Transport Corridor 4145.69ha and CBME 730.28ha	19th – 22nd November 2018	Define the flora and vegetation values of the private properties located within proposed expansion areas. The survey included sampling from 67 vegetation sites in the Mt Saddleback and Boddington areas with infill areas (3347.55ha). The work also entailed an update of flora and vegetation values on these expansion areas and the Collie Refinery.
Assessment of Flora and Vegetation on the Tunnell Road Heath and other Heath Areas (Mattiske Consulting Pty Ltd in prep)	Mattiske	Heaths	2019	Targeted transects and plots on the various heath areas in the Expansion Areas and integration with other heath areas.
Targeted searches for Threatened and Priority Flora, Collie (Mattiske Consulting Pty Ltd in prep)	Mattiske	Collie	2019	Targeted searches for Threatened and Priority flora species.

APPENDIX B1: 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 B1.1).

Table B1.1 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 likely to become extinct or are otherwise in need of special protection in Western Australia under Part 10 (Division 2).

Threatened flora are listed in the *Wildlife Conservation (Rare Flora) Notice 2018* (under Part 2 of the BC Act; Department of Biodiversity, Conservation and Attractions (DBCA 2020b) 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* (Department of Biodiversity, Conservation and Attractions 2020b). Threatened species are categorised as critically endangered, endangered, and vulnerable (Table B1.2).

Table B1.2 State definition of Threatened Flora Species

Note: Adapted from Department of Biodiversity, Conservation and Attractions (2020b).

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" (Department of Biodiversity, Conservation and Attractions 2020b). **Priority** species 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 B1.3).

Table B1.3: State definition of Priority Flora Species

Note: Adapted from Department of Biodiversity, Conservation and Attractions (2020b).

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 B2: 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 B2.1).

Table B2.1 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.

The *Biodiversity Conservation Act 2016* (BC Act) provides for (amongst other things) some protection of ecological communities at risk of collapse in Western Australia under Part 3 (Division 2).

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 of the *BC Act*; Department of Biodiversity, Conservation and Attractions 2020c). 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 B2.2). 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 B2.2 State definition of Threatened Ecological Communities

Note: Adapted from Department of Environment and Conservation (2013).

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 Department of Biodiversity, Conservation and Attractions (2020d) in the *Priority Ecological Communities for Western Australia*. Priority ecological communities 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 B2.3).

Table B2.3 State definition of Priority Ecological Communities

Note: Adapted from Department of Environment and Conservation (2013).

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 B3: 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 B3.1). 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 2020).

Table B3.1 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 B4: 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 C: SUMMARY OF SAMPLING METHODOLOGIES

C1. INTRODUCTION

The majority of the proposed PAA (WMDE, BTC and CBME) have been previously surveyed and assessed over the period from the early 1980's to 2020. Sampling has involved a range of approaches to baseline surveys, namely:

- **Recording regularly on a grid system** using foot traverses and regular plots 20m radius for trees and 5m radius for understorey based on the system adopted by Havel (1975a and 1975b) as applied for the wider northern Jarrah forest over some 50 years by Havel and Mattiske.
- **Permanent Baseline Plots** in native vegetation areas varying in size from 40m x 40m to 20m x 20m for trees and 5m x 5m for quadrats and 2m x 2m for understorey.
- **Permanent Plots and Transects** in rehabilitation areas (1987 to 2020) for South32 and Newmont and Alcoa of Australia. Plots varied from 50m x 50m to 20m x 20m for trees and transects varied from 50 to 100m transects with regular (every 5m along transect) quadrats (2m x 2m) and also 20 – 2m x 2m quadrats within the tree plots.
- **Targeted Searches** for Threatened and Priority Flora undertaken on all foot traverses on both grids, transects, within the plots and in specific areas within particular site conditions (e.g. heaths, swamps, particular forests or woodlands).
- In the Mt Saddleback area, transects were recorded to assist in the baseline mapping of the area. As this work was undertaken in the central part of Mt Saddleback before GPS units were available these are not illustrated in this report.
- **Aerial photographic interpretation**, particularly for defining and mapping the structurally different vegetation types such as the heaths, swamps, woodlands, pine plantations, rehabilitation areas and cleared areas.

As such between the regular grid sampling sites, the plots (with associated quadrats) for the baseline studies and the permanent plots and associated quadrats (for monitoring), repeated measurement of the plots and targeted searches while traversing the area on foot, the survey effort exceeds the current guidance statement suggestions for detailed studies of the flora and vegetation assessments as defined by the EPA (2016a, 2016b).

The following provides more specific detail on data recorded in the survey areas.

APPENDIX C: SUMMARY OF SAMPLING METHODOLOGIES

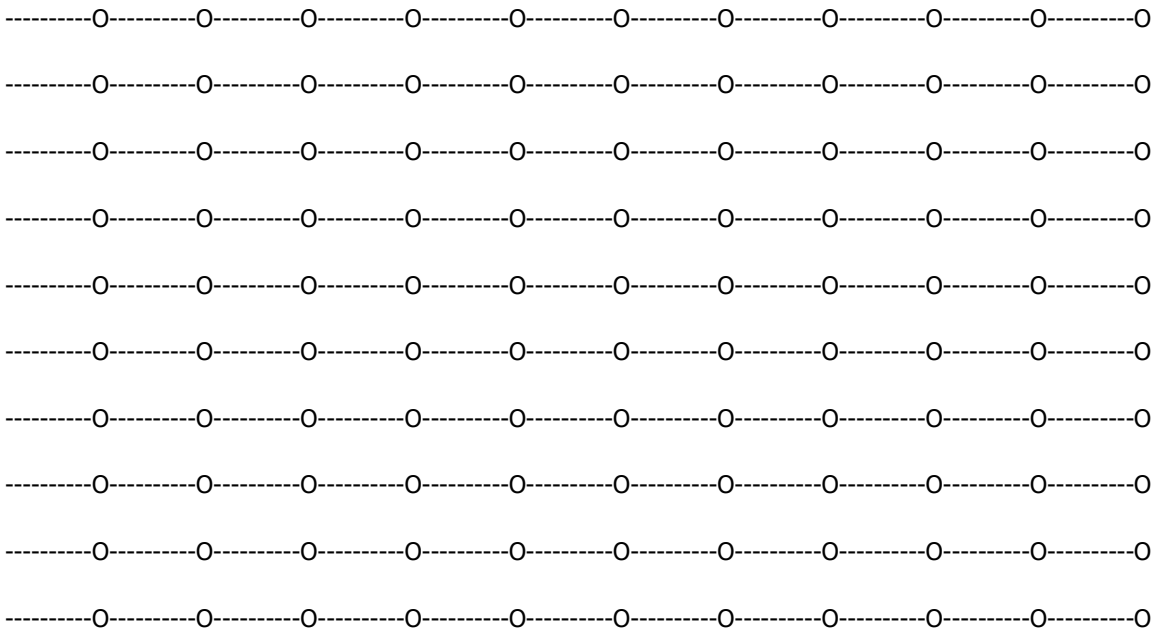
C2. GRID RECORDING SITES

The majority of the proposed PAA (WMDE, BTC and CBME) has been previously surveyed and assessed over the period from the early 1980s to 2020.

The flora and vegetation values were recorded and sampled systematically at the survey recording sites on the gridded areas, and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site, the following floristic and environmental parameters were recorded:

- GPS location (GDA94 datum);
- soil type, colour and any additional observations;
- local site topography;
- presence of any outcropping rocks and their type;
- aspect of the hill-slopes;
- percentage of litter cover (logs, twigs and/or leaves);
- percentage of bare ground;
- time since fire;
- dieback presence and impact;
- forest management harvesting activity as reflected through number of stumps, log debris and harvesting intensity;
- condition of the vegetation, based on Keighery's (1994) condition ratings;
- alive and dead percentage of foliage cover; and
- average height of each species recorded.

The majority of the areas were assessed on regular grids ranging from a 25m x 100m to a 100m x 100m to 100m x 200m. Refer to the indicative schematic below that shows the systematic grid recording method.



Note:
----- denotes transects
O denotes grid recording site

Tree species assessments were undertaken within a **20 m radius** from the observation point based on Havel (1975a and 1975b), with each tree species present being ranked by abundance:

0 absent;
1 one or two trees;
2 three to five trees;
3 more than five trees, but contributing less than one third of the total stand;
4 between one third and one half of the total stand; and
5 more than one half of the total stand.

Understorey species assessments were undertaken within a **5 m radius** from the observation point based on Havel (1975a and 1975b), with each understorey species being ranked by abundance:

0 absent;
1 very rarely seen, only after careful search;
2 present, observable, but in small numbers only;
3 common locally, but not uniformly over the whole area;
4 common over the whole area; and
5 completely dominating the understorey.

The physiological stress was determined for each species within a **5 m and 20 m** radius (for understorey and tree species respectively) from the observation point and ranked according to the following scale.

This stress assessment system has been previously used in the northern Jarrah forest, with site-vegetation type mapping surveys undertaken in the Boddington bauxite and gold mining leases by E. M Mattiske and Associates (1981 to 1994) and Mattiske Consulting Pty Ltd (1994 to 2018) (see Appendix A).

0 healthy, no evidence of stress;
1 odd plant showing signs of stress, not dead;
2 one or two stressed plants, near death;
3 scattered stressed (2 – 4) dead plants around plot;
4 susceptible plants dying or dead (> 4 plants); and
5 "graveyard" death.

C3. Plots and Transects

Extensive flora and vegetation monitoring programs have been undertaken over the 40 years ranging from assessing conservation flora species to regular and extensive monitoring of trees and understorey species in the control and rehabilitation areas. This work has included multiple assessments of representative control and rehabilitation plots (initially 40m x 40m for trees and 4 x 5m quadrats for understorey in the initial flora and vegetation studies (Phase 1 and 2, Dames and Moore 1981 and Worsley Alumina Pty Ltd 1985) and then initially 50m x 50m tree plots (pre 1994) and understorey transects (quadrats every 5m on transects varying from 50m to 100m) and later 20m x 20m for trees and 20 x 2m x 2m quadrats in 20m x 20m plots post 1993).

Tree data has included measurements on species, diameter at breast height, heights and condition.

Understorey data has included measurements on species, density of each species, foliage cover of each species and condition. This data collection included all native and weed species.

To date, 147 – Forest Monitoring Plots; 398 - Monitoring Plots; 187 – Tree Plots and 101 – Understorey Transects have been established in the monitoring program. The plots cover the various site-vegetation types in the control areas.

In selecting sampling rates in rehabilitated areas, the number of plots monitored each year are based on a ratio of approximately 1 plot per 5 hectares of rehabilitation.

APPENDIX C: SUMMARY OF SAMPLING METHODOLOGIES

The designs of the various Plots and Transects are summarized in the following page.

Tree Sampling

The following features were recorded for each individual tree encountered within each monitoring plot:

- tree/seedling species;
- tree/seedling height (cm);
- diameter of each stem at breast height in centimetres (DBH: 130 cm from base of tree);
- number of stems per tree;
- bole height (cm) within 1989 and 1999 rehabilitation areas only (i.e., ≥15 years old);
- condition of each tree/seedling (Healthy, Slightly Stressed, Stressed, Very Stressed, Dead Recent, Dead Moderate or Dead Old); and
- potential cause of any physiological stress (e.g., water stress, *Phytophthora cinnamomi* infection, insect attack, shading by other plants).

The presence of seedlings (defined as individuals below 130 cm in height) and the height and health of each seedling was also recorded. For seedlings, the DBH and number of stems were not recorded.

Alive trees were recorded according to one of four alive health categories:

- Healthy (H) - healthy, green foliage
- Slightly Stressed (SS) - slight discolouration in foliage, majority of foliage healthy
- Stressed (S) - marked foliage discolouration, with some loss of foliage
- Very Stressed (VS) - majority of foliage discoloured, desiccation/loss of foliage occurring

Dead trees were recorded on the basis of one of three broadly approximated time since death health condition categories:

- Dead recent (DR) - any foliage remaining is brown and desiccated, bark still remains
- Dead moderate (DM) - foliage is absent, bark and fine twigs present
- Dead old (DO) - foliage and fine twigs absent, bark may still remain

Understorey Sampling

The data gathered from each understorey quadrat was as follows:

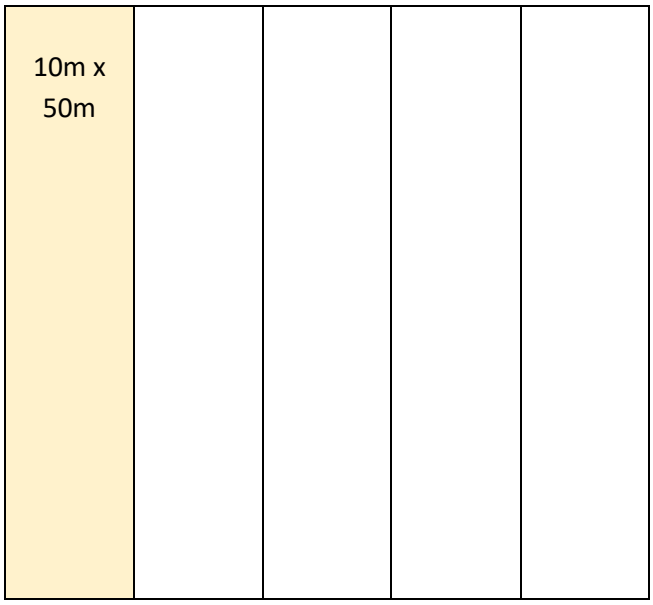
- species (or a collection if unknown);
- number of alive and dead individuals of each species (including only those rooted within the quadrat);
- alive and dead percentage foliage cover of each species (including species rooted outside the quadrat, but with foliage overhanging it); and
- any anecdotal observations.

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-).

APPENDIX C: SUMMARY OF SAMPLING METHODOLOGIES

Tree Plots (Rehabilitation pre-1993) - 50m x 50m – Trees (using strips of 10m x 50m for tree recordings)

NW----------50m----------NE



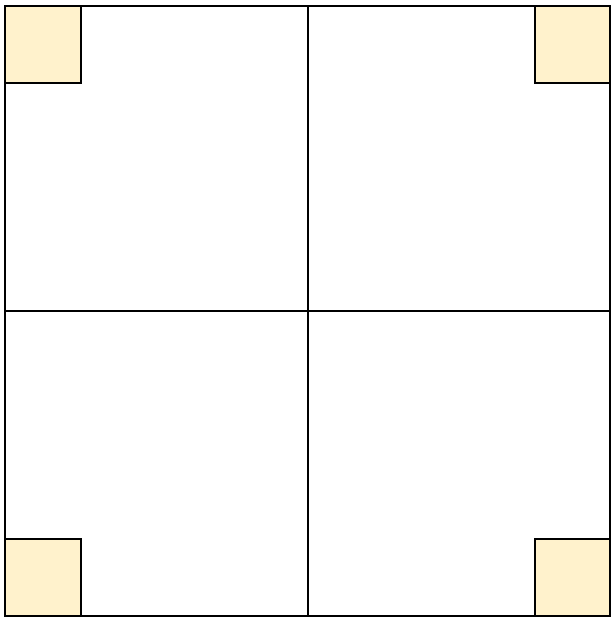
-----10m------

Baseline Plot (**Baseline Control)** – 40m x 40m (Trees) plots with 20m x 20m (Trees) subplots and 5 x 5m (Understorey) quadrats in corners

NW----------40m----------NE

----------20m----------

--5m--

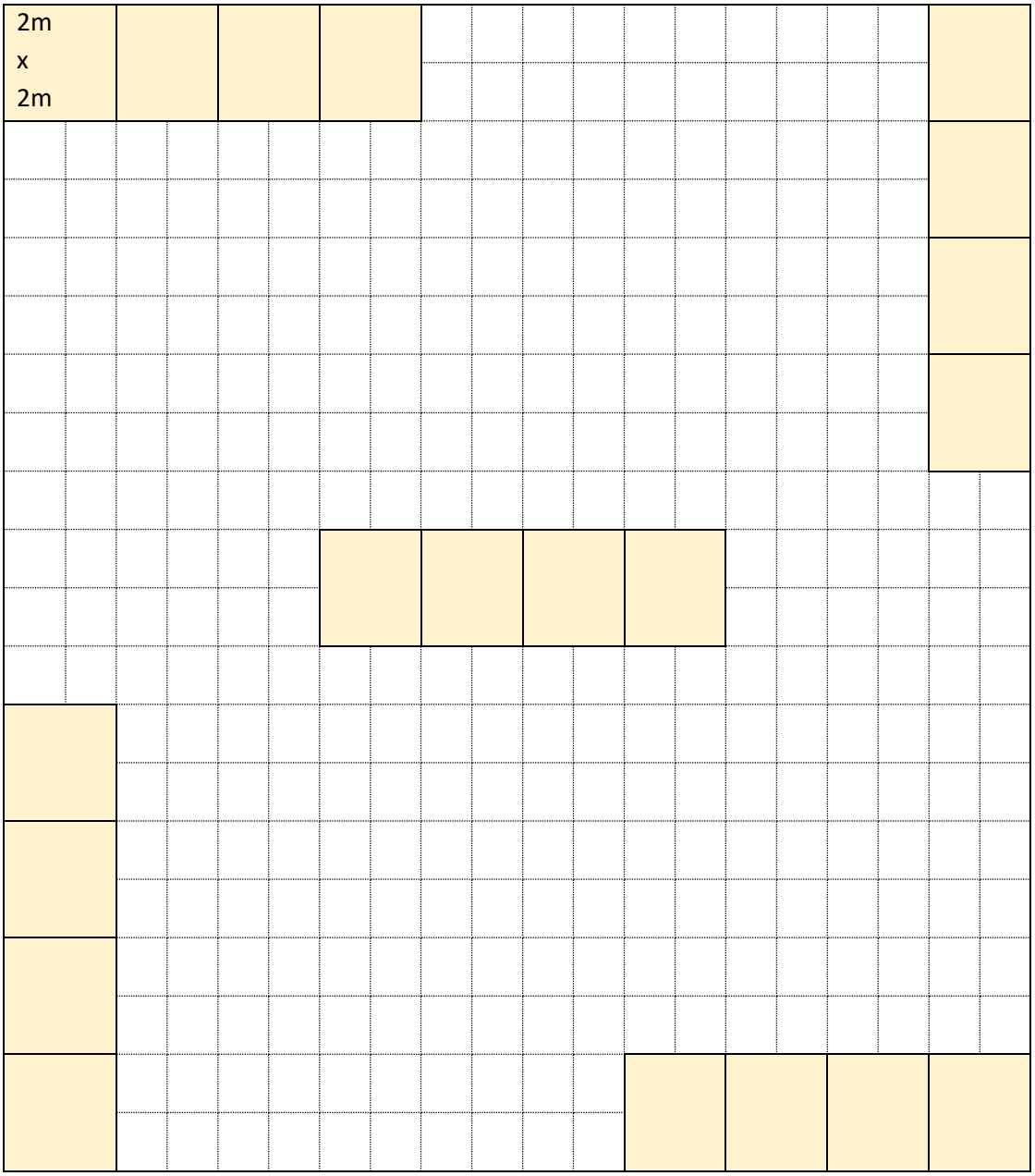


APPENDIX C: SUMMARY OF SAMPLING METHODOLOGIES

Monitoring Plots (Baseline Control and Rehabilitation – post-1993) – 20m x 20m (Trees) plots and 20 – 2m x 2m (Understorey) quadrats in corners

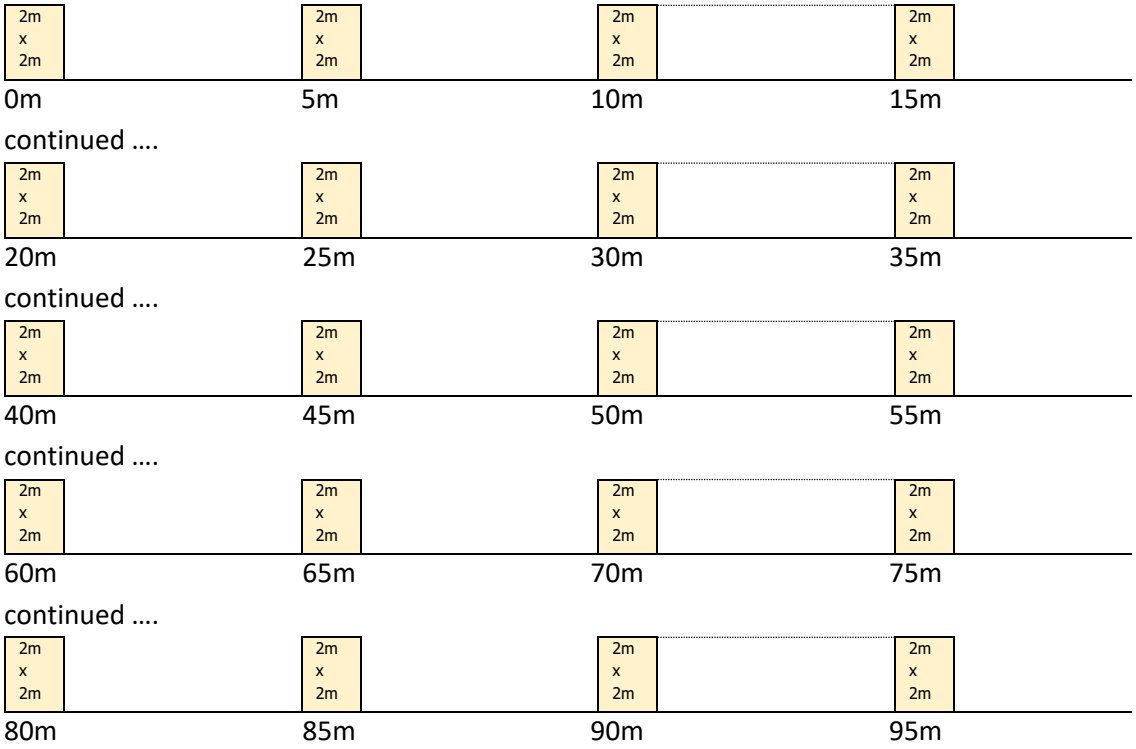
NW----------20m----------NE

--2m --



APPENDIX C: SUMMARY OF SAMPLING METHODOLOGIES

Transects (Rehabilitation – pre-1993) – variable lengths 50m to 100m with 2m x 2m quadrats every 5m for recording understorey (located on narrow linear areas and former tracks/roads mainly) on side of transect



C4. Targeted Flora Searches

Targeted flora searches have relied on collation of potential species lists, specific searching flora species, increasing an understanding of site preferences of flora in relation to underlying landforms and soils and site conditions and also their lifeforms. Over the 40 years, the databases on the respective species have increased substantially as a result of foot traverses, literature and longer-term monitoring programs. Understanding the specific species and where they occur, how they regenerate and distribution patters is critical to undertaking targeted surveys. In many instances, limited information is available from the literature and Herbarium databases and as such the amount of effort over the 40 years on specific foot traverses, targeted searches and regular monitoring have increase the knowledge base of the species.

During foot traverses undertaken on regular grid systems associated with the detailed surveys any potential novel or threatened species were collected and identified and recorded. Population numbers relied on both counts in the quadrats, plots and transects as well as extracted presence data from the extensive gridding survey sites in all the areas which relied on ranking scales and additional location and presence of species records. The foot traverses during baseline flora and vegetation studies and targeted flora surveys have enabled greater coverage of the flora values over some 40 years. The requirement for population numbers is a recent specification in the guidance statement. As a result of the latter, numbers extracted from earlier results are an under estimate of the population numbers. As ranking of species was undertaken at all recorded sites on grid systems (rankings ranged from 0 to 5). As a result of the rankings, it was possible to convert the rankings from 0 to 5 to a minimum conservative population estimate. Earlier Herbarium records at the State Herbarium provide locality data but not necessarily numbers of plants. The latter effort exceeded standards and community expectations at the time of the various surveys and prior to the EPA guidelines and guidance statements (2016a and 2016b).

Additionally, during the survey period of 1980 to 2020, botanists have undertaken targeted searches during other baseline and monitoring programs and entails not only recordings at sites but findings from foot traverses.

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS NEAR BODDINGTON

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2020a). SCC = State conservation code; FCC = Federal conservation code; E = Endangered, V = Vulnerable (EPBC Act); o - designates WAH (2020) database search, Nature Map (DPAW 2020a).

Family	Species	SCC	FCC	Nature Map & WAH
PTERIDACEAE	*Cheilanthes austrotenuifolia*			x
DENNSTAEDTIACEAE	*Pteridium esculentum* subsp. *esculentum*			x
ZAMIACEAE	*Macrozamia riedlei*			x
PODOCARPACEAE	*Podocarpus drouynianus*			x
JUNCAGINACEAE	*Triglochin striata*			x
POACEAE	* *Aira caryophyllea*			x
	Austrostipa flavescens			x
	Austrostipa sp.			x
	Austrostipa sp. Marchagee (B.R. Maslin 1407)			x
	Austrostipa variabilis			x
	* *Avena barbata*			x
	* *Briza minor*			x
	* *Bromus diandrus*			x
	* *Cortaderia selloana* subsp. *selloana*			x
	* *Digitaria ciliaris*			x
	* *Digitaria sanguinalis*			x
	Lolium sp.			x
	Neurachne alopecuroidea			x
	* *Paspalum dilatatum*			x
	Poa drummondiana			x
	Poa homomalla			x
	Poa porphyroclados			x
	Rytidosperma caespitosum			x
	Rytidosperma setaceum			x
	Tetrarrhena laevis			x
	Themeda triandra			x
	* *Vulpia myuros* forma *megalura*			x
CYPERACEAE	*Baumea juncea*			x
	Carex fascicularis			x
	Chorizandra enodis			x
	Cyathochaeta avenacea			x
	Eleocharis acuta			x
	Eleocharis keigheryi	T	V	x
	Gahnia aristata			x
	Gahnia decomposita			x
	Isolepis producta			x
	Lepidosperma apricola			x
	Lepidosperma asperatum			x
	Lepidosperma leptostachyum			x
	Lepidosperma pruinosum			x
	Lepidosperma pubisquameum			x
	Lepidosperma squamatum			x
	Lepidosperma sp.			x
	Lepdosperma sp. P1 small head (M.D. Tindale 166A)			x

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Family	Species	SCC	FCC	Nature Map & WAH
CYPERACEAE	*Mesomelaena tetragona*			x
(continued)	*Morelotia australiensis*	T	V	o
	Morelotia octandra			x
	Nerostylis sp. Jarrah Forest (R. Davis 7391)			x
	Schoenus armeria			x
	Schoenus bifidus			x
	Schoenus natans	P4		o
RESTIONACEAE	*Chaetanthus leptocarpoides*			x
	Chordifex gracilior	P3		x
	Chordifex stenandrus			x
	Desmocladus asper			x
	Desmocladus fasciculatus			x
	Desmocladus flexuosus			x
	Hypolaena exsulca			x
	Lepidoboluis preissianus			x
	Leptocarpus laxus			x
	Leptocarpus tenax			x
	Lepyrodia glauca			x
	Loxocarya striata			x
CENTROLEPIDACEAE	*Centrolepis aristata*			x
	Centrolepis glabra			x
HYDATELLACEAE	*Trithuria bibracteata*			x
JNACACEAE	* *Juncus acutus* subsp. *acutus*			x
ASPARAGACEAE	*Chamaescilla corymbosa*			x
	Chamaescilla corymbosa var. *corymbosa*			x
	Dichopogon capillipes			x
	Laxmannia squarrosa			x
	Lomandra brittanii			x
	Lomandra caespitosa			x
	Lomandra hermaphrodita			x
	Lomandra integra			x
	Lomandra micrantha			x
	Lomandra micrantha subsp. *micrantha*			x
	Lomanda nigricans			x
	Lomandra preissii			x
	Lomandra purpurea			x
	Lomandra sericea			x
	Lomandra sonderi			x
	Lomandra spartea			x
	Lomandra suaveolens			x
	Lomandra sp.			x
	Sowerbaea laxiflora			x
	Thysanotus anceps	P3		o
	Thysanotus manglesianus			x
	Thysanotus patersonii			x

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Family	Species	SCC	FCC	Nature Map & WAH
ASPARAGACEAE (continued)	*Thysanotus sparteus*			x
	Thysanotus tenellus			x
	Thysanotus thyrsoideus			x
XANTHORRHOEACEAE	*Xanthorrhoea gracilis*			x
	Xanthorrhoea preissii			x
COLCHICACEAE	*Burchardia monantha*			x
	Burchardia multiflora			x
	Wurmbea dioica subsp. *alba*			x
	Wurmbea tenella			x
BORYACEAE	*Borya scirpoidea*			x
	Borya sphaerocephala			x
HEMEROCALLIDACEAE	*Agrostocrinum hirsutum*			x
	Agrostocrinum scabrum subsp. *scabrum*			x
	Caesia micrantha			x
	Dianella revoluta			x
	Dianella revoluta var. *divaricata*			x
	Stypandra glauca			x
	Tricoryne elatior			x
	Tricoryne humilis			x
HAEMODORACEAE	*Anigozanthos bicolor*			x
	Anigozanthos bicolor subsp. *decrescens*			x
	Anigozanthos manglesii subsp. *manglesii*			x
	Conostylis aculeata subsp. *aculeata*			x
	Conostylis caricina subsp. *caricina*			x
	Conostylis pusilla			x
	Conostylis serrulata			x
	Conostylis setigera			x
	Conostylis setigera subsp. *setigera*			x
	Conostylis setosa			x
	Conostylis sp.			x
	Haemodorum laxum			x
	Haemodorum paniculatum			x
	Haemodorum simplex			x
	Tribonanthes longipetala			x
	Tribonanthes purpurea	T	V	o
AMARYLLIDACEAE	* *Leucojum aestivum*			x
	* *Narcissus tazetta* subsp. *aureus*			x
	* *Narcissus tazetta* subsp. *tazetta*			x
HYPOXIDACEAE	*Pauridia gardneri*			x
	Pauridia occidentalis var. *occidentalis*			x

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Family	Species	SCC	FCC	Nature Map & WAH
IRIDACEAE	* *Gladiolus tristis*			x
	* *Moraea flaccida*			x
	Patersonia juncea			x
	Patersonia occidentalis			x
	Patersonia occidentalis var. *latifolia*			x
	Patersonia pygmaea			x
	Patersonia rudis			x
	Patersonia rudis subsp. *rudis*			x
ORCHIDACEAE	*Caladenia barbarossa*			x
	Caladenia caesarea subsp. *caesarea*			x
	Caladenia dorrienii	T	E	x
	Caladenia falcata			x
	Caladenia flava			x
	Caladenia flava subsp. *flava*			x
	Caladenia flava subsp. *sylvestris*			x
	Caladenia fluvialis			x
	Caladenia hirta subsp. *hirta*			x
	Caladenia hopperiana	T	E	x
	Caladenia integra	P4		x
	Caladenia longicauda			x
	Caladenia longicauda subsp. *eminens*			x
	Caladenia macrostylis			x
	Caladenia nana subsp. *nana*			x
	Caladenia paradoxa			x
	Caladenia polychroma			x
	Caladenia reptans subsp. *reptans*			x
	Caladenia serotina			x
	Caladenia speciosa	P4		o
	Caladenia uliginosa subsp. *candicans*			x
	Caladenia uliginosa subsp. *uliginosa*			x
	Caladenia xantha			x
	Caladenia sp.			x
	Cyanicula gemmata			x
	Cyanicula sericea			x
	Cyrtostylis huegelii			x
	Diuris decrementa			x
	Diuris laxiflora			x
	Diuris longifolia			x
	Diuris micrantha	T	V	x
	Diuris porrifolia			x
	Diuris purdiei	T	E	x
	Diuris setacea			x
	Elythranthera brunonis			x
	Elythranthera emarginata			x
	Eriochilus dilatatus subsp. *multiflorus*			x
	Eriochilus scaber subsp. *scaber*			x
	Leptoceras menziesii			x
	Lyperanthus serratus			x
	Microtis alba			x

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Family	Species	SCC	FCC	Nature Map & WAH
ORCHIDACEAE (continued)	*Microtis alboviridis*			x
	Microtis atrata			x
	Microtis orbicularis			x
	Microtis quadrata	P4		o
	Paracaleana nigrita			x
	Prasophyllum cyphochilum			x
	Prasophyllum fimbria			x
	Prasophyllum hians			x
	Prasophyllum macrostachyum			x
	Pterostylis barbata			x
	Pterostylis concava			x
	Pterostylis glebosa			x
	Pterostylis pyramidalis			x
	Pterostylis recurva			x
	Pterostylis vittata			x
	Pterostylis sp. crinkled leaf (G.J. Keighery 13426)			x
	Pterostylis sp.			x
	Pyrorchis nigricans			x
	Thelymitra antennifera			x
	Thelymitra benthamiana			x
	Thelymitra crinita			x
	Thelymitra dedmaniarum	T	E	x
	Thelymitra flexuosa			x
	Thelymitra stellata	T	E	o
CASUARINACEAE	*Allocasuarina fraseriana*			x
	Allocasuarina huegeliana			x
	Allocasuarina humilis			x
	Allocasuarina microstachya			x
PROTEACEAE	*Adenanthos cygnorum* subsp. *cygnorum*			x
	Banksia bipinnatifida subsp. *bipinnatifida*			x
	Banksia dallanneyi subsp. *sylvestris*			x
	Banksia dallanneyi var. *dallanneyi*			x
	Banksia fraseri var. *fraseri*			x
	Banksia grandis			x
	Banksia insulanemorecincta	P4		o
	Banksia littoralis			x
	Banksia meganotia	P3		o
	Banksia nivea subsp. *nivea*			x
	Banksia recurvistylis	P2		x
	Banksia sessilis var. *sessilis*			x
	Banksia sphaerocarpa			x
	Banksia sphaerocarpa var. *sphaerocarpa*			x
	Banksia squarrosa subsp. *squarrosa*			x
	Banksia subpinnatifida var. *imberbis*	P3		x
	Banksia subpinnatifida var. *subpinnatifida*	P2		x
	Banksia undata var. *splendens*			x
	Conospermum acerosum			x
	Conospermum amoenum subsp. *amoenum*			x

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Family	Species	SCC	FCC	Nature Map & WAH
PROTEACEAE	*Conospermum caeruleum*			x
(continued)	*Conospermum filifolium* subsp. *filifolium*			x
	Conospermum scaposum	P3		o
	Grevillea bipinnatifida subsp. *bipinnatifida*			x
	Grevillea cirsiifolia			x
	Grevillea crowleyae	P2		o
	Grevillea leptobotyrs			x
	Grevillea manglesii subsp. *dissectifolia*	P3		o
	Grevillea monticola			x
	Grevillea pimeleoides	P4		o
	Grevillea quercifolia			x
	Greviilea saccata	P4		x
	Grevillea tenuiflora			x
	Grevillea thelemanniana	T	CE	o
	Grevillea trifida			x
	Hakea cyclocarpa			x
	Hakea gilbertii			x
	Hakea incrassata			x
	Hakea lissocarpha			x
	Hakea oldfieldii	P3		x
	Hakea petiolaris subsp. *petiolaris*			x
	Hakea prostrata			x
	Hakea ruscifolia			x
	Hakea stenocarpa			x
	Hakea trifurcata			x
	Hakea undulata			x
	Hakea varia			x
	Isopogon crithmifolius			x
	Isopogon dubius			x
	Isopogon teretifolius			x
	Isopogon sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin)	P1		x
	Persoonia longifolia			x
	Persoonia quinquenervis			x
	Petrophile antecedens			x
	Petrophile heterophylla			x
	Petrophile imbricata			x
	Petrophile seminuda			x
	Petrophile serruriae			x
	Petrophile squamata subsp. *squamata*			x
	Petrophile striata			x
	Stirlingia simplex			x
	Synaphea boyaginensis	P2		o
	Synaphea cuneata			x
	Synaphea damopsis			x
	Synaphea decorticans			x
	Synaphea gracillima			x
	Synaphea obtusata			x
	Synaphea panhesya	P1		x
	Xylomelum occidentale			x

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Family	Species	SCC	FCC	Nature Map & WAH
SANTALACEAE	*Exocarpos sparteus*			x
	Leptomeria cunninghamii			x
	Leptomeria ellytes			x
OLACACEAE	*Olax benthamiana*			x
LORANTHACEAE	*Amyema miraculosa* subsp. *miraculosa*			x
APODANTHACEAE	*Pilostyles hamiltonii*			x
POLYGONACEAE	*Persicaria prostrata*			x
	* *Polypogon aviculare*			x
	* *Rumex crispus*			x
	* *Rumex obtusifolius* subsp. *obtusifolius*			x
CHENOPODIACEAE	* *Atriplex prostrata*			x
	* *Chenopodium glaucum*			x
AMARANTHACEAE	*Ptilotus declinatus*			x
	Ptilotus drummondii var. *drummondii*			x
	Ptilotus gaudichaudii			x
	Ptilotus manglesii			x
	Ptilotus sp. Beaufort River (G.J. Keighery 16554)			x
CARYOPHYLLACEAE	* *Cerastium glomeratum*			x
RANUNCULACEAE	*Clematis pubescens*			x
	Ranunculus colonorum			x
	* *Ranunculus muricatus*			x
LAURACEAE	*Cassytha glabella* forma *glabella*			x
RESEDACEAE	* *Reseda luteola*			x
DROSERACEAE	*Drosera barbigera*			x
	Drosera bulbosa			x
	Drosera bulbosa subsp. *bulbosa*			x
	Drosera erythrorhiza			x
	Drosera gigantea			x
	Drosera hyperostigma			x
	Drosera macrantha			x
	Drosera menziesii			x
	Drosera occidentalis	P4		x
	Drosera pallida			x
	Drosera platystigma			x
	Drosera subhirtella			x
	Drosera silvicola			x
	Drosera sp.			x
	Drosera sp. Branched styles (S.C. Coffey 193)			x

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PITTOSPORACEAE	*Billardiera fraseri*			x
	Billardiera fusiformis			x
	Billardiera variifolia			x
	Billardiera venusta			x
	Cheiranthera preissiana			x
	Marianthus bicolor			x
	Marianthus drummondianus			x
BYBLIDACEAE	*Byblis gigantea*	P3		x
ROSACEAE	*Acaena echinata*			x
FABACEAE	*Acacia adjutrices*	P3		o
	Acacia alata var. *platyptera*	P4		x
	Acacia alata var. alata			x
	Acacia applanata			x
	Acacia barbinervis subsp. *barbinervis*			x
	Acacia brachypoda	T	E	o
	Acacia browniana var. *endlicheri*			x
	Acacia celastrifolia			x
	Acacia cuneifolia	P4		o
	Acacia dentifera			x
	Acacia drummondii subsp. *candolleana*			x
	Acacia drummondii subsp. *drummondii*			x
	Acacia extensa			x
	Acacia gemina			x
	Acacia gilbertii			x
	Acacia horridula	P3		o
	Acacia incurva			x
	Acacia insolita subsp. *insolita*			x
	Acacia leptospermoides subsp. *leptospermoides*			x
	Acacia microbotrya			x
	Acacia oncinophylla subsp. *patulifolia*	P4		o
	Acacia nervosa			x
	Acacia preissiana			x
	Acacia pulchella			x
	Acacia pulchella var. *glaberrima*			x
	Acacia pulchella var. *pulchella*			x
	Acacia pycnocephala			x
	Acacia saligna			x
	Acacia saligna subsp. *lindleyi*			x
	Acacia saligna subsp. pruinescens			x
	Acacia saligna subsp. *stolonifera*			x
	Acacia spathulifolia			x
	Acacia stenoptera			x
	Acacia urophylla			x
	Acacia varia var. *crassinervis*			x
	Aotus procumbens			x
	Bossiaea angustifolia			x
	Bossiaea disticha			x

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Family	Species	SCC	FCC	Nature Map & WAH
FABACEAE	*Bossiaea eriocarpa*			x
(continued)	*Bossiaea modesta*	P2		o
	Bossiaea ornata			x
	Bossiaea pulchella			x
	Bossiaea rufa			x
	Chorizema aciculare subsp. *laxum*			x
	Chorizema dicksonii			x
	Chorizema rhombeum			x
	Chorizema ulotropis	P4		o
	Daviesia cardiophylla			x
	Daviesia cordata			x
	Daviesia costata			x
	Daviesia decurrens subsp. *decurrens*			x
	Daviesia hakeoides subsp. *subnuda*			x
	Daviesia incrassata			x
	Daviesia incrassata subsp. *incrassata*			x
	Daviesia longifolia			x
	Daviesia pedunculata			x
	Daviesia physodes			x
	Daviesia preissii			x
	Daviesia rhombifolia			x
	Dillwynia laxiflora			x
	Euchilopsis linearis			x
	Gastrolobium asperum			x
	Gastrolobium bilobum			x
	Gastrolobium calycinum			x
	Gastrolobium glabratum			x
	Gastrolobium hookeri			x
	Gastrolobium ovalifolium	P4		o
	Gastrolobium parviflorum			x
	Gastrolobium retusum			x
	Gastrolobium spinosum			x
	Gastrolobium sp. Prostrate Boddington (M. Hislop 2130)	P1		x
	Gompholobium burtonioides			x
	Gompholobium confertum			x
	Gompholobium cyaninum			x
	Gompholobium marginatum			x
	Gompholobium polymorphum			x
	Gompholobium preissii			x
	Hovea chorizemifolia			x
	Hovea trisperma			x
	Isotropis cuneifolia			x
	Isotropis cuneifolia subsp. *cuneifolia*			x
	Jacksonia alata			x
	Jacksonia furcellata			x
	Kennedia coccinea			x
	Kennedia prostrata			x
	Labichea punctata			x
	Mirbelia dilatata			x
	Mirbelia floribunda			x

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Family	Species	SCC	FCC	Nature Map & WAH
FABACEAE	*Phyllota gracilis*			x
(continued)	*Pultenaea ericifolia*			x
	Pultenaea pauciflora	T	V	x
	Pultenaea reticulata			x
	Sphaerolobium medium			x
	Templetonia drummondii			x
	* *Vicia benghalensis*			x
	* *Vicia sativa subsp. sativa*			x
	Viminaria juncea			x
GERANIACEAE	*Geranium solanderi*			x
	Pelargonium littorale			x
OXALIDACEAE	*Oxalis exilis*			x
LINACEAE	*Linum marginale*			x
RUTACEAE	*Asterolasia pallida*			x
	Boronia busselliana			x
	Boronia crenulata			x
	Boronia crenulata var. *crenulata*			x
	Boronia fastigiata			x
	Boronia ovata			x
	Boronia ramosa subsp. *anethifolia*			x
	Boronia tenuis	P4		x
	Diplolaena microcephala			x
POLYGALACEAE	*Comesperma virgatum*			x
	Comesperma volubile			x
PHYLLANTHACEAE	*Phyllanthus calycinus*			x
	Poranthera huegelii			x
	Poranthera microphylla			x
CELASTRACEAE	*Stackhousia pubescens*			x
	Stackhousia scoparia			x
	Tripterococcus brunonis			x
SAPINDACEAE	*Dodonaea ceratocarpa*			x
	Dodonaea viscosa subsp. *angustissima*			x
RHAMNACEAE	*Cryptandra arbutiflora* var. *arbutiflora*			x
	Cryptandra nutans			x
	Papistylus intropubens	P1		x
	Stenanthemum coronatum			x
	Stenanthemum nanum			x
	Stenanthemum pumilum subsp. *majus*			x
	Trymalium angustifolium			x
	Trymalium ledifolium var. *rosmarinifolium*			x

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Family	Species	SCC	FCC	Nature Map & WAH
RHAMNACEAE	*Trymalium odoratissimum* subsp. *odoratissimum*			x
(continued)	*Trymalium odoratissimum* subsp. *trifidum*			x
ELAEOCARPACEAE	*Platytheca galioides*			x
	Tetratheca hirsuta			x
	Tetratheca hirsuta subsp. *hirsuta*			x
	Tetratheca hirsuta subsp. *viminea*			x
	Tetratheca pilifera	P3		x
	Tetratheca setigera			x
	Tetratheca similis	P3		o
	Tetratheca virgata			x
MALVACEAE	*Lasiopetalum cardiophyllum*	P4		x
	Lasiopetalum caroliae	P3		o
	Lasiopetalum floribundum			x
	Lasiopetalum glutinosum subsp. *latifolium*			x
	Lasiopetalum pterocarpum	T	E	
	Thomasia foliosa			x
	Thomasia macrocalyx			x
DILLENIACEAE	*Hibbertia acerosa*			x
	Hibbertia amplexicaulis			x
	Hibbertia commutata			x
	Hibbertia diamesogenos			x
	Hibbertia glomerata subsp. *darlingensis*			x
	Hibbertia glomerata subsp. *wandoo*	P3		o
	Hibbertia hypericoides			x
	Hibbertia hypericoides subsp. *hypericoides*			x
	Hibbertia microphylla			x
	Hibbertia montana	P4		o
	Hibbertia ovata			x
	Hobbertia pilosa			x
	Hibbertia quadricolor			x
	Hibbertia serrata			x
	Hibbertia silvestris			x
	Hibbertia spicata			x
	Hibbertia stellaris			x
	Hibbertia subvaginata			x
	Hibbertia vaginata			x
	Hibbertia sp.			x
VIOLACEAE	*Hybanthus floribundus*			x
	Hybanthus floribundus subsp. *floribundus*			x
THYMELAEACEAE	*Pimelea argentea*			x
	Pimelea ciliata subsp. *ciliata*			x
	Pimelea imbricata var. *piligera*			x
	Pimelea preissii			x
	Pimelea rara	P4		o
	Pimelea suaveolens subsp. suaveolens			x

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS NEAR BODDINGTON

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2020a). SCC = State conservation code; FCC = Federal conservation code; E = Endangered, V = Vulnerable (EPBC Act); o - designates WAH (2020) database search, Nature Map (DPAW 2020a).

Family	Species	SCC	FCC	Nature Map & WAH
MYRTACEAE	*Astartea scoparia*			x
	Babingtonia camphorosmae			x
	Beaufortia macrostemon			x
	Calothamnus graniticus subsp. *leptophyllus*	P4		o
	Calothamnus planifolius var. *planifolius*			x
	Calothamnus quadrifidus subsp. *quadrifidus*			x
	Calothamnus quadrifidus subsp. *teretifolius*	P4		x
	Calothamnus sanguineus			x
	Calytrix simplex subsp. *simplex*	P1		x
	Calytrix simplex subsp. *suboppositifolia*			x
	Corymbia calophylla			x
	Darwinia citriodora			x
	Darwinia pimelioides	P4		x
	Darwinia thymoides			x
	Darwinia thymoides subsp. St Ronans (J.J. Alford & G.J. Keighery 64)	P4		x
	Darwinia F664. Dryandra (G.J. Keoghery 9295)	P4		o
	Darwinia sp. Westdale (F. Hort 864)	P2		o
	Eucalyptus accedens			x
	Eucalyptus aspersa			x
	Eucalyptus decurva			x
	Eucalyptus drummondii			x
	Eucalyptus exilis	P4		o
	Eucalyptus laeliae			x
	Eucalyptus latens			x
	Eucalyptus marginata			x
	Eucalyptus marginata subsp. *marginata*			x
	Eucalyptus patens			x
	Eucalyptus rudis			x
	Eucalyptus rudis subsp. *rudis*			x
	Eucalyptus wandoo subsp. *wandoo*			x
	Epilobium hirtigerum			x
	Hypocalymma angustifolium			x
	Kunzea preissiana			x
	Kunzea recurva			x
	Leptospermum erubescens			x
	Melaleuca incana subsp. *incana*			x
	Melaleuca lecanantha			x
	Melaleuca preissiana			x
	Melaleuca rhaphiophylla			x
	Melaleuca tuberculata var. *tuberculata*			x
	Rinzia fumana			x
	Taxandria linearifolia			x
	Verticordia densiflora var. *cespitosa*			x
	Verticordia fimbrilepis subsp. *fimbrilepis*	T	E	x
	Verticordia huegelii var. decumbens			x
	Verticordia huegelii var. *stylosa*			x
	Verticordia lindleyi subsp. lindleyi	P4		o
	Verticordia pennigera			x

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Family	Species	SCC	FCC	Nature Map & WAH
MYRTACEAE	*Verticordia picta*			x
(continued)	*Verticordia plumosa* var. *brachyphylla*			x
	Verticordia serrata var. *serrata*			x
HALORAGACEAE	*Glischrocaryon aureum*			x
	Gonocarpus cordiger			x
	Haloragis aculeolata	P2		o
	Meionectes tenuifolia	P3		x
ARALIACEAE	*Hydrocotyle diantha*			x
	Hyrdocotyle lemnoides	P4		o
	Trachymene pilosa			x
APIACEAE	*Daucus glochidiatus*			x
	Pentapeltis peltigera			x
	Platysace juncea			x
	Xanthosia atkinsoniana			x
	Xanthosia candida			x
	Xanthosia cliliata			x
	Xanthosia huegelii			x
	Xanthosia singuliflora			x
ERICACEAE	*Andersonia aristata*			x
	Andersonia caerulea subsp. *concinna* (F. Hort 2144)			x
	Andersonia latiflora			x
	Andersonia lehmanniana subsp. *lehmanniana*			x
	Andersonia sp. Saxatilis (F. & J. Hort 3324)	P1		o
	Astroloma acervatum			x
	Astroloma ciliatum			x
	Astroloma compactum			x
	Astroloma epacridis			x
	Astroloma glaucescens			x
	Astroloma pallidum			x
	Astroloma serratifolium			x
	Leucopogon capitellatus			x
	Leucopogon concinnus			x
	Leucopogon cordatus			x
	Leucopogon darlingensis			x
	Leucopogon fimbriatus			x
	Leucopogon florulentus	P3		x
	Leucopogon glabellus			x
	Leucopogon nutans			x
	Leucopogon obtusatus			x
	Leucopogon propinquus			x
	Leucopogon pubescens			x
	Leucopogon pulchellus			x
	Leucopogon strictus			x
	Leucopogon verticillatus			x

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Family		Species	SCC	FCC	Nature Map & WAH
ERICACEAE		*Leucopogon* sp. Boddington (D. Halford 80746)			x
(continued)		*Lysinema pentapetalum*			x
		Styphelia tenuiflora			x
PRIMULACEAE	*	*Lysimachia arvensis*			x
		Samolus junceus			x
LOGANIACEAE		*Logania sylvicola*	P2		x
		Orianthera serpyllifolia subsp. *serpyllifolia*			x
GENTIANACEAE		*Schenkia australis*			x
MENYANTHACEAE		*Ornduffia albiflora*			x
		Ornduffa submersa	P4		o
APOCYNACEAE		*Parsonsia diaphanophleba*	P4		x
BORAGINACEAE		*Halgania corymbosa*	P3		x
		Halgania cyanea			x
LAMIACEAE		*Hemiandra pungens*			x
		Hemigenia argentea			x
		Hemigenia humilis			x
		Hemigenia incana			x
		Hemigenia microphylla	P3		x
		Hemigenia platyphylla	P4		o
		Hemigenia pritzelii			x
		Hemigenia rigida	P1		o
		Hemigenia viscida			x
		Hemigenia wandooana			x
		Lachnostachys verbascifolia var. *verbascifolia*			x
		Microcorys exserta			x
		Microcorys obovata			x
SOLANACEAE		*Anthocercis gracilis*	T	V	x
LENTIBULARIACEAE		*Utricularia multifida*			x
PLANTAGINACEAE	*	*Kickxia spuria*			x
		Plantago exilis			x
RUBIACEAE	*	*Galium divaricatum*			x
	*	*Galium tricornutum*			x
		Opercularia apiciflora			x
		Opercularia echinocephala			x
		Opercularia hispidula			x
		Opercularia vaginata			x
CAPRIFOLIACEAE	*	*Centranthus ruber* subsp. *ruber*			x

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Family	Species	SCC	FCC	Nature Map & WAH
CAMPANULACEAE	*Lobelia heterophylla*			x
	Lobelia rhombifolia			x
	* *Monopsis debilis* var. *depressa*			x
	Wahlenbergia sp.			x
GOODENIACEAE	*Dampiera alata*			x
	Dampiera lavandulacea			x
	Dampiera linearis			x
	Goodenia arthrotricha	T	E	x
	Goodenia coerulea			x
	Goodenia convexa			x
	Goodenia katabudjar	P3		x
	Goodenia pulchella subsp. Wheatbelt (L.W. Sage & F. Hort 795)			x
	Goodenia pusilla			x
	Lechenaultia biloba			x
	Lechenaultia laricina	T	E	o
	Lechenaultia pulvinaris	P4		o
	Scaevola calliptera			x
	Scaevola glandulifera			x
	Scaevola pilosa			x
	Scaevola platyphylla			x
	Velleia trinervis			x
	Verreauxia verreauxii	P4		o
STYLIDIACEAE	*Levenhookia pusilla*			x
	Stylidium affine			x
	Stylidium amoenum			x
	Stylidium androsaceum			x
	Stylidium brunonianum			x
	Stylidium caricifolium			x
	Stylidium carnosum			x
	Stylidium ciliatum			x
	Stylidium crassifolium			x
	Styliidium hirsutum			x
	Stylidium junceum			x
	Stylidium lateriticola			x
	Stylidium leptocalyx	P4		o
	Stylidium lineatum			x
	Stylidium longitubum	P4		o
	Stylidium marradongense	P3		x
	Stylidium paulineae			x
	Stylidium petiolare			x
	Stylidium pubigerum			x
	Stylidium pycnostachyum			x
	Styliidium rhynchocarpum			x
	Stylidium scandens			x
	Stylidium scariosum			x

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Family	Species	SCC	FCC	Nature Map & WAH
STYLIDIACEAE	*Stylidium striatum*	P4		o
(continued)	*Stylidium uniflorum* subsp. *uniflorum*			x
	Stylidium sp. Boulder Rock (A.H. Burbidge 2536)			x
ASTERACEAE	*Asteridea gracilis*	P3		x
	Asteridea pulverulenta			x
	Brachyscome iberdifolia			x
	* *Chrysanthemoides monilifera*			x
	* *Chrysanthemoides monilifera* subsp. *monilifera*			x
	* *Conyza sumatrensis*			x
	Craspedia variabilis			x
	* *Crepis foetida* subsp. *foetida*			x
	Euchiton collinus			x
	Gnephosis drummondii			x
	* *Hypochaeris glabra*			x
	* *Hypochaeris radicata*			x
	Lactuca serriola forma *serriola*			x
	Lagenophora huegelii			x
	Millotia tenuifolia			x
	Myriocephalus occidentalis			x
	Olearia paucidentata			x
	Podolepis lessonii			x
	Podotheca angustifolia			x
	Pseudognaphalium luteoalbum			x
	Pterochaeta paniculata			x
	Rhodanthe manglesii			x
	Senecio glossanthus			x
	Senecio leucoglossus	P4		x
	Senecio multicaulis subsp. *multicaulis*			x
	Senecio multicaulis subsp. *stirlingensis*			x
	Senecio pinnatifolius var. *pinnatifolius*			x
	* *Sonchus oleraceus*			x
	* *Symphyotrichum squamatum*			x
	Trichocline spathulata			x
	Waitzia suaveolens var. *suaveolens*			x

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Acacia brachypoda	Fabaceae	T	Endangered	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Dense, rounded, slightly aromatic shrub, 1-3 m high, 1-4 m wide Yellow May to Jul Sandy clay or loam. Low-lying seasonal swampy areas AVW 9	Low
Anthocercis gracilis	Solanaceae	T	Vulnerable	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect, spindly shrub, to 0.6(-1) meters high Yellow-green Sep to Oct Sandy or loamy soils. Granite outcrops AVW, JAF 29	Medium
Caladenia dorrienii	Orchidaceae	T	Endangered	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tuberous, perennial, herb, 0.1-0.2 m high white- -cream-yellow Sep to Nov Clayey loam, Moist sites adjacent to rivers and seasonal creeks AVW, JAF 16	Medium
Caladenia hopperiana	Orchidaceae	T	Endangered	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect herb Cream Oct Low lying, winter wet impassable swampland JAF 4	High
Diuris micrantha	Orchidaceae	T	Vulnerable	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tuberous, perennial, herb, 0.3-0.6 meters high yellow & brown Sep to Oct Brown loamy clay. Winter-wet swamps, in shallow water JAF,SWA 6	Low
Diuris purdiei	Orchidaceae	T	Endangered	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tuberous, perennial, herb, 0.15-0.35 meters high Yellow Sep to Oct Grey-black sand, moist. Winter-wet swamps. JAF, SWA 23	Low

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Eleocharis keigheryi	Cyperaceae	T	Vulnerable	Habit: Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 meters high Flower colour: Green Flowering period: Aug to Nov Soils: Clay, sandy loam. Emergent in freshwater: creeks, clay pans IBRA Distribution: AVW, GES, JAF, SWA Florabase records: 54	Low
Goodenia arthrotricha	Goodeniaceae	T	Endangered	Habit: Erect, perennial herb to 0.4 m high Flower colour: blue Flowering period: Oct to Nov Soils: Gravel. Granite rocks, slopes. IBRA Distribution: AVW, JAF, SWA Florabase records: 20	Medium
Grevillea thelemanniana	Proteaceae	T	Critically Endangered	Habit: Spreading, lignotuberous shrub, 0.3-1.5 meters high Flower colour: Pink/red Flowering period: May to Nov Soils: Sand, sandy clay. Winter-wet low-lying flats IBRA Distribution: JAF, SWA Florabase records: 37	Low
Lasiopetalum pterocarpum	Malvaceae	T	Endangered	Habit: Open, multi-stemmed shrub (with distinctly winged fruit), to 1.2 meters high Flower colour: Pink Flowering period: Aug to Dec Soils: Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines IBRA Distribution: JAF Florabase records: 11	Low
Lechenaultia laricina	Goodeniaceae	T	Endangered	Habit: Diffuse, ascending shrub, 0.15-0.7 m high Flower colour: Red/red-orange Flowering period: Sep to Dec or Jan Soils: Sand, gravelly loam IBRA Distribution: AVW, JAF, MAL Florabase records: 20	Low
Pultenaea pauciflora	Fabaceae	T	Vulnerable	Habit: Dense, much-branched shrub, to 0.8 m high Flower colour: Yellow Flowering period: Oct to Nov Soils: Sandy & clay lateritic soils. Undulating country IBRA Distribution: AVW, JAF Florabase records: 50	Medium

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Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Tetraria australiensis	Cyperaceae	T	Vulnerable	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 meters high Brown Nov to Dec Sandy clay or loam. Low-lying seasonal swampy areas JAF, SWA 34	Low
Thelymitra dedmaniarum	Orchidaceae	T	Endangered	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tuberous, perennial, herb, to 0.8 m high. Yellow Nov to Dec or Jan Granite JAF 4	Medium
Thelymitra stellata	Orchidaceae	T	Endangered	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tuberous, perennial, herb, 0.15-0.25 meters high. Yellow and brown Oct to Nov Sand, gravel, lateritic loam. GES, JAF, SWA 20	Medium
Tribonanthes purpurea	Haemodoraceae	T	Vulnerable	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Dense, rounded, slightly aromatic shrub, 1-3 meters high, 1-4 m wide Yellow May to Jul Sandy clay or loam. Low-lying seasonal swampy areas AVW, ESP, JAF, MAL 21	Low
Verticordia fimbrilepis subsp. *fimbrilepis*	Myrtaceae	T	Endangered	Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Shrub, 0.3-0.7 meters high. Pink white Oct to Dec or Jan Gravelly sandy or clayey soils. Flats, road verges AVW, JAF 39	Medium
Andersonia sp. Saxatilis (F. & J. Hort 3324)	Ericaceae	P1		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect, single stemmed shrub 15-60 cm high Pink white Sep, Oct Slope. Outcrop. Moist/dry brown sand/loam. Sheet/boulder JAF 6	Medium

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Calytrix simplex subsp. *simplex*	Myrtaceae	P1		Habit: Shrub, ca 0.2 meters high Flower colour: Purple Flowering period: Oct to Nov Soils: Flat and slope on laterite on red-brown gravelly loam, well drained. IBRA Distribution: AVW, JAF Florabase records: 5	High
Gastrolobium sp. Prostrate Boddington (M. Hislop 2130)	Fabaceae	P1		Habit: Prostrate, mat-like shrub, to 0.05 meters high Flower colour: Yellow/red Flowering period: Oct Soils: Littered brown loam, clay, laterite. Lower slopes and rises, valley bottoms IBRA Distribution: JAF Florabase records: 5	High
Isopogon sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin)	Proteaceae	P1		Habit: Erect, spreading, single-stemmed shrub, to 1.2 m high Flower colour: cream-pink Flowering period: Jun Soils: Brown, yellow or grey sand over laterite. Flats and low plains IBRA Distribution: JAF Florabase records: 7	High
Papistylus intropubens	Rhamnaceae	P1		Habit: Erect, slender shrub, to 0.5 m high Flower colour: - Flowering period: - Soils: - IBRA Distribution: JAF Florabase records: 1	High
Synaphea panhesya	Proteaceae	P1		Habit: Erect shrub, 0.3-0.6 m high Flower colour: yellow Flowering period: Aug to Sep Soils: Gravelly loam & sandy gravel IBRA Distribution: JAF, SWA Florabase records: 15	Medium
Banksia recurvistylis	Proteaceae	P2		Habit: Erect or spreading shrub, 1.5-2.2 m high Flower colour: yellow Flowering period: Jan, Nov or Dec Soils: Clay-loam-sand over granite or laterite IBRA Distribution: JAF Florabase records: 7	High

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Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Banksia subpinnatifida var. *imberbis*	Proteaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect or straggling, non-lignotuberous shrub, 0.3-1.5 m high yellow Sep to Oct Laterite AVW, JAF 16	High
Banksia subpinnatifida var. *subpinnatifida*	Proteaceae	P2		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect or straggling, non-lignotuberous shrub, 0.3-1.5 m high yellow Sep to Oct Gravelly loam AVW, JAF 21	High
Bossiaea modesta	Fabaceae	P2		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Slender, trailing & twining shrub yellow & red Oct to Dec Soils derived from granite. Damp areas close to stream JAF, SWA 21	Low
Darwinia sp. Westdale (F. Hort 864)	Myrtaceae	P2		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Decumbent to prostrate shrub, 0.5-1.2 m high red Dec Dry lateritic soils. High on steep slopes JAF 2	Medium
Grevillea crowleyae	Proteaceae	P2		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Dense & spreading shrub, 0.5-1.5 m high - Aug to Nov Gravel JAF 9	Medium
Haloragis aculeolata	Haloragaceae	P2		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Slender, erect perennial, herb, to 0.4 m high green Sep or Dec Black sand or clay over limestone. Winter-wet areas JAF, SWA 6	Low

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Logania sylvicola	Loganiaceae	P2		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	shrub to 0.3 m high, 0.4 m wide white-cream Aug, Sep silty loam, gravelly clay, clayey sand. Low-mid slopes, flats, winter-wet areas JAF 7	Low
Synaphea boyaginensis	Proteaceae	P2		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Shrub, to 0.25 m high yellow Sep to Oct Gravelly clay-loam AVW, JAF, MAL 22	Medium
Acacia adjutrices	Fabaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Sub-shrub 0.3-0.7 m high yellow/golden Jul to Aug Loam, clay on laterite hills, sandplains AVW, JAF 23	Medium
Acacia horridula	Fabaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Harsh, slender, single-stemmed shrub, 0.3-0.6(-1) m high yellow May to Aug Gravelly soils over granite, sand. Rocky hillsides JAF, SWA 32	High
Asteridea gracilis	Asteraceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Annual, herb, 0.15-0.35 m high white-pink Sep to Dec Sand, clay, gravelly soils ESP, JAF, SWA 11	Medium
Banksia meganotia	Proteaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Straggly or erect, prickly, lignotuberous shrub, 0.3-1 m high yellow Oct Sand, sandy loam or clay loam over laterite AVW, MAL 37	Medium

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Byblis gigantea	Byblidaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Small, branched perennial, herb (or sub-shrub), to 0.45 m high pink-purple/white Sep to Dec or Jan Sandy-peat swamps. Seasonally wet areas JAF, SWA 40	Low
Chordifex gracilior	Restionaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Rhizomatous, erect perennial, herb, 0.3-0.5 m high brown Sep to Dec Peaty sand. Swamps JAF, SWA, WAR 31	Low
Conospermum scaposum	Proteaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect shrub, 0.2-0.45(-0.75) m high blue Oct to Dec or Jan to Feb White-grey sand, sandy clay. Low swampy areas, road verges AVW, GES, JAF, SWA 43	Medium
Goodenia katabudjar	Goodeniaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Shrub (subshrub), 0.1-0.2 m high blue-pink/white Dec Sandy gravel. Upland areas of open wandoo woodland JAF 11	High
Grevillea manglesii subsp. *dissectifolia*	Proteaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Spreading, virgate shrub, 1.5-3(-5) m high, up to 3 m wide white & red & brown Jun or Sep or Nov Gravelly loam, moist. Roadsides JAF 27	High
Hakea oldfieldii	Proteaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Open, straggling shrub, up to 2.5 m high white-cream/yellow Aug to Oct Red clay or sand over laterite. Seasonally wet flats AVW, ESP, JAF, MAL, SWA 57	Low

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Halgania corymbosa	Boraginaceae	P3		Habit: Erect shrub, 0.35-1 m high Flower colour: blue-purple Flowering period: Aug to Nov Soils: Gravelly soils, soils over granite IBRA Distribution: JAF, SWA Florabase records: 18	High
Hemigenia microphylla	Lamiaceae	P3		Habit: Slender shrub, 0.4-1.8 m high Flower colour: blue-purple Flowering period: Sep to Dec Soils: Sandy clay, peaty clay, granite. Winter-wet depressions IBRA Distribution: JAF, SWA, WAR Florabase records: 25	Medium
Hibbertia glomerata subsp. *wandoo*	Dilleniaceae	P3		Habit: Erect, much-branched shrub, to 0.6 m high Flower colour: yellow Flowering period: Feb or Apr or Aug or Oct Soils: Lateritic soils IBRA Distribution: AVW, JAF Florabase records: 17	Medium
Lasiopetalum caroliae	Malvaceae	P3		Habit: Procumbent, sprawling subshrub, 0.08–0.4 m high, 0.15–0.2 m wide Flower colour: pale to bright mauve-pink & dark red Flowering period: Sep to Nov Soils: yellow-brown, sandy loam and lateritic gravel soils, mid-slope IBRA Distribution: JAF, SWA Florabase records: 17	Medium
Leucopogon florulentus	Ericaceae	P3		Habit: Erect slender shrub, 0.3-0.8 m high Flower colour: white Flowering period: Jun to Nov Soils: White/grey or yellow sand, sandy clay, gravelly lateritic soils. Sandplains, gentle slopes IBRA Distribution: AVW, ESP, MAL Florabase records: 31	Medium
Meionectes tenuifolia	Haloragaceae	P3		Habit: Erect or prostrate annual, herb, 0.05-0.5 m high Flower colour: brown-red period: Sep or Nov to Dec Soils: Grey sand, clay. Winter wet flats IBRA Distribution: JAF, SWA Florabase records: 24	Low

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Stylidium marradongense	Stylidiaceae	P3		Habit: Erect perennial, herb, 0.15-0.5 m high Flower colour: white/pink Flowering period: Sep to Nov Soils: Sand over laterite. Jarrah-Marri forest IBRA Distribution: JAF Florabase records: 12	High
Tetratheca pilifera	Elaeocarpaceae	P3		Habit: Spreading shrub, 0.1-0.3 m high Flower colour: purple Flowering period: Aug to Oct Soils: Gravelly IBRA Distribution: JAF, SWA Florabase records: 33	Medium
Tetratheca similis	Elaeocarpaceae	P3		Habit: Spreading shrub, to 0.3 m high Flower colour: pink Flowering period: Aug to Sep Soils: Sandy clay with lateritic boulders IBRA Distribution: AVW, JAF Florabase records: 20	Medium
Thysanotus anceps	Asparagaceae	P3		Habit: Rhizomatous, leafless perennial, herb, to 0.4 m high Flower colour: purple Flowering period: Oct to Dec Soils: White or grey sand, lateritic gravel, laterite IBRA Distribution: GES, JAF, SWA Florabase records: 17	Medium
Acacia alata var. *platyptera*	Fabaceae	P4		Habit: Dense shrub, 0.5-1 m high Flower colour: yellow Flowering period: Jun to Aug Soils: Clay, gravelly sandy clay. Lateritic ridges, clay flats. IBRA Distribution: AVW, JAF, SWA Florabase records: 31	Medium
Acacia cuneifolia	Fabaceae	P4		Habit: Erect or straggly shrub, 1-3 m high Flower colour: yellow Flowering period: Jul to Oct Soils: Sand, clay or loam over granite. Granite outcrops & hills, rocky watercourses IBRA Distribution: AVW, JAF Florabase records: 40	High

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Acacia oncinophylla subsp. *patulifolia*	Fabaceae	P4		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Shrub, 0.5-2.5(-3) m high, 'minni-ritchi' bark, phyllodes 4-9 cm long, 3-6 mm wide yellow Aug to Nov or Nov to Dec Granitic soils, occasionally on laterite JAF, SWA 31	Medium
Banksia insulanemorecincta	Proteaceae	P4		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Non-lignotuberous shrub, to 1 m high cream Jun to Sep Yellow sand, clay, gravel, laterite, granite. Open scrubby flat, slopes, low heath. JAF 19	Medium
Boronia tenuis	Rutaceae	P4		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Procumbent or erect & slender shrub, 0.1-0.5 m high blue/pink-white Aug to Nov Laterite, stony soils, granite JAF, SWA 43	Medium
Caladenia integra	Orchidaceae	P4		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tuberous, perennial, herb, 0.2-0.5 m high green & red Sep to Oct Clayey loam. Granite outcrops, rocky slopes. AVW, ESP, GES, JAF, MAL 46	Medium
Caladenia speciosa	Orchidaceae	P4		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tuberous, perennial, herb, 0.35-0.6 meters high White-pink September to October White, grey or black sand. Loam flat swampy terrain JAF, SWA 59	Low
Calothamnus graniticus subsp. *leptophyllus*	Myrtaceae	P4		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect, multi-stemmed shrub, 1-2 m high Red June to August Clay over granite, lateritic soils. Hillsides. JAF, SWA 27	Medium

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Calothamnus quadrifidus subsp. *teretifolius*	Myrtaceae	P4		Habit: Erect shrub, 2-4 m high Flower colour: Red Flowering period: Oct to Jan Soils: Grey clay-sand or brown loam. Damplands and disturbed slopes. IBRA Distribution: JAF, SWA Florabase records: 39	Medium
Chorizema ulotropis	Fabaceae	P4		Habit: Sprawling, open, semi-prostrate shrub, to 0.45 m high Flower colour: orange-yellow Flowering period: Jul to Sep Soils: Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats. IBRA Distribution: ESP, JAF, MAL Florabase records: 24	Medium
Darwinia pimelioides	Myrtaceae	P4		Habit: Erect shrub, 0.25-0.5(-1) m high Flower colour: red/pink & green Flowering period: Sep to Oct Soils: Loam, sandy loam. Granite outcrops IBRA Distribution: JAF, SWA Florabase records: 25	Medium
Darwinia sp. Dryandra (G.J. Keighery 9295)	Myrtaceae	P4		Habit: Dense shrub, 0.1-0.45 m high Flower colour: white Flowering period: May or Jul or Nov Soils: Gravelly clay. Lateritic ridges. IBRA Distribution: AVW, JAF Florabase records: 16	Low
Darwinia thymoides subsp. St Ronans (J.J. Alford & G.J. Keighery 64)	Myrtaceae	P4		Habit: Low shrub, 0.3-0.6 m high, 0.2-1 m wide Flower colour: Orange-red, red Flowering period: Oct to Dec or Jan Soils: sandy or gravelly clay-loam soils. Slopes and Flats. Granite outcrops. IBRA Distribution: AVW, JAF Florabase records: 21	High
Drosera occidentalis	Droseraceae	P4		Habit: Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Flower colour: White-pink Flowering period: October to December or January Soils: Swampy flats, grey clayey sand IBRA Distribution: JAF, SWA Florabase records: 19	Medium

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Eucalyptus exilis	Myrtaceae	P4		Habit: (Whipstick mallee), 2-6 m high, bark smooth Flower colour: white Flowering period: Aug to Oct Soils: Grey sand, gravelly loam. Lateritic ridges. IBRA Distribution: AVW, GES, JAF Florabase records: 45	Low
Gastrolobium ovalifolium	Fabaceae	P4		Habit: Prostrate, spreading shrub, to 0.1 m high Flower colour: orange & purple & yellow & red Flowering period: Aug to Sep Soils: Sandy clay. Gravelly hills. IBRA Distribution: AVW, JAF Florabase records: 26	Low
Grevillea pimeleoides	Proteaceae	P4		Habit: Non-lignotuberous shrub, 0.4-2.4 m high Flower colour: yellow-orange Flowering period: May to Nov Soils: Gravelly soils over granite. Rocky hillsides. IBRA Distribution: JAF Florabase records: 36	Medium
Hemigenia platyphylla	Lamiaceae	P4		Habit: Spreading shrub, 0.2-1.5 m high Flower colour: blue-purple Flowering period: Sep to Nov Soils: Sandy & loamy soils. Granite rocks, slopes. IBRA Distribution: AVW, ESP, JAF, MAL Florabase records: 19	Low
Hibbertia montana	Dilleniaceae	P4		Habit: Erect, straggling or sprawling shrub, 0.1-0.7 m high Flower colour: yellow Flowering period: Jul to Oct Soils: Loam over granite, lateritic soils, gravel. Granite rocks, lateritic ridges & boulders, hills. IBRA Distribution: AVW, JAF, SWA Florabase records: 93	Low
Hydrocotyle lemnoides	Araliaceae	P4		Habit: Aquatic, floating annual, herb Flower colour: purple Flowering period: Aug to Oct Soils: Swamps IBRA Distribution: AVW, GES, JAF, SWA Florabase records: 26	Low

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Lasiopetalum cardiophyllum	Malvaceae	P4		Habit: Erect, multi-stemmed shrub, 0.2-0.5 m high Flower colour: pink Flowering period: Aug to Dec or Jan Soils: Lateritic gravelly soils, sandy clay. Flats, hillslopes IBRA Distribution: AVW, JAF Florabase records: 33	High
Lechenaultia pulvinaris	Goodeniaceae	P4		Habit: Hemispherical, procumbent shrub, 0.03-0.2 m high Flower colour: blue Flowering period: Oct to Dec Soils: White/grey sand. IBRA Distribution: AVW, JAF Florabase records: 35	Low
Microtis quadrata	Orchidaceae	P4		Habit: Herb to 0.4 m high Flower colour: cream/white-green Flowering period: Oct to Dec Soils: Sand, sandy clay-loam, peaty soil. Lower slope, flat, swamp IBRA Distribution: COO, ESP, JAF, SWA, WAR Florabase records: 8	Low
Ornduffia submersa	Menyanthaceae	P4		Habit: Aquatic herb Flower colour: white Flowering period: Aug to Oct Soils: claypan, wet sandy clay. seasonally inundated wetland IBRA Distribution: AVW, ESP, JAF, SWA, WAR Florabase records: 60	Low
Parsonsia diaphanophleba	Apocynaceae	P4		Habit: Woody climber to 10 m high Flower colour: white/cream and pink Flowering period: Jan to Feb or Apr to Jun or Sep Soils: Alluvial soils. Along rivers. IBRA Distribution: JAF, SWA Florabase records: 28	Low
Pimelea rara	Thymelaeaceae	P4		Habit: Shrub, 0.2-0.35 m high Flower colour: White Flowering period: Dec or Jan Soils: Lateritic soils IBRA Distribution: JAF Florabase records: 52	Low

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Schoenus natans	Cyperaceae	P4		Habit: Aquatic annual, grass-like or herb (sedge), 0.3 m high Flower colour: brown Flowering period: Oct Soils: Winter-wet depressions IBRA Distribution: AVW, JAF, SWA, WAR Florabase records: 61	Low
Senecio leucoglossus	Asteraceae	P4		Habit: Erect annual, herb, to 1.3 meters high Flower colour: White Flowering period: August to December Soils: Gravelly lateritic or granitic soils. Granite outcrops, slopes IBRA Distribution: JAF, SWA, WAR Florabase records: 41	High
Stylidium leptocalyx	Stylidiaceae	P4		Habit: Rosetted perennial, herb, 0.08-0.4 m high Flower colour: pink Flowering period: Oct to Nov Soils: Laterite soils. Upland, breakaways. Eucalypt woodland or shrubland IBRA Distribution: JAF Florabase records: 14	Medium
Stylidium longitubum	Stylidiaceae	P4		Habit: Erect annual (ephemeral), herb, 0.05-0.12 m high Flower colour: pink Flowering period: Oct to Dec Soils: Sandy clay, clay. Seasonal wetlands IBRA Distribution: GES, JAF, SWA Florabase records: 43	Low
Stylidium striatum	Stylidiaceae	P4		Habit: Rosetted perennial, herb, 0.15-0.55 m high Flower colour: yellow Flowering period: Oct to Nov Soils: Brown clay loam over laterite. Hill slopes IBRA Distribution: JAF Florabase records: 28	Low
Verreauxia verreauxii	Goodeniaceae	P4		Habit: Perennial, herb, to 0.5 m high Flower colour: yellow Flowering period: Nov to Dec or Jan Soils: White/grey or yellow sand. Flats IBRA Distribution: AVW, JAF Florabase records: 44	Low

APPENDIX E: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR ON WMDE AND BAUXITE TRANSPORT CORRIDOR AREAS

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Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Verticordia lindleyi subsp. *lindleyi*	Myrtaceae	P4		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Erect shrub, 0.2-0.75 m high pink May or Nov to Dec or Jan Sand, sandy clay. Winter-wet depressions AVW, GES, JAF, SWA 81	Low

APPENDIX F: SUMMARY OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR AT COLLIE REFINERY

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2020a). Scc = State conservation code; FCC = Federal conservation code; E = Endangered, V = Vulnerable; o - designates WAH (2020) database search, Nature Map (DPAW 2020a).

Family	Species	SCC	FCC	Nature Map & WAH
LYCOPODIACEAE	*Phylloglossum drummondii*			x
ISOETACEAE	*Isoetes drummondii*			x
SCHIZAEACEAE	*Schizaea rupestris*	P2		x
PTERIDACEAE	*Adiantum aethiopicum*			x
	Cheilanthes austrotenuifolia			x
	Pteris tremula			x
DENNSTAEDTIACEAE	*Pteridium esculentum* subsp. *esculentum*			x
ASPLENIACEAE	*Asplenium aethiopicum*			x
MARSILEACEAE	*Marsilea* sp.			x
	Pilularia novae-hollandiae			x
SALVINACEAE	*Azolla rubra*			x
	* *Salvinia molesta*			x
ZAMIACEAE	*Macrozamia riedlei*			x
CUPRESSACEAE	*Callitris pyramidalis*			x
TYPHACEAE	*Typha domingensis*			x
	Typha orientalis			x
POTAMOGETONACEAE	*Potamogeton ochreatus*			x
RUPPIACEAE	*Ruppia polycarpa*			x
JUNCAGINACEAE	*Cycnogeton lineare*			x
	Triglochin mucronata			x
	Triglochin nana			x
ALISMATACEAE	* *Alisma lanceolatum*			x
HYDRICHARITACEAE	*Ottelia ovalifolia*			x
POACEAE	* *Aira caryophyllea*			x
	* *Aira cupaniana*			x
	* *Aira elegantissima*			x
	Amphipogon amphipogonoides			x
	Amphipogon laguroides			x
	Amphipogon laguroides subsp. *laguroides*			x
	* *Anthoxanthum odoratum*			x
	* *Arrhenatherum elatius var. bulbosum*			x
	Austrostipa caampylachne			x
	Austrostipa elegantissima			x
	Austrostipa mollis			x
	Austrostipa semibarbata			x

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Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2020a). Scc = State conservation code; FCC = Federal conservation code; E = Endangered, V = Vulnerable; o - designates WAH (2020) database search, Nature Map (DPAW 2020a).

Family	Species	SCC	FCC	Nature Map & WAH
POACEAE	* *Avena barbata*			x
(continued)	* *Briza maxima*			x
	* *Briza minor*			x
	* *Bromus hordeaceus*			x
	* *Cortaderia selloana* subsp. *selloana*			x
	* *Cynodon dactylon*			x
	* *Cynosurus echinatus*			x
	Deyeuxia quadriseta			x
	* *Echinochloa crus-galli*			x
	* *Echinochloa telmatophila*			x
	* *Ehrharta calycina*			x
	* *Ehrharta longiflora*			x
	Eragrostis elongata			x
	* *Glyceria declinata*			x
	* *Holcus lanatus*			x
	* *Holcus setiger*			x
	* *Hordeum marinum*			x
	Hyparrhenia hirta			x
	Lachnagrostis filiformis			x
	* *Lolium perenne*			x
	* *Lolium x hybridum*			x
	Neurachne alopecuroidea			x
	* *Paspalum dilatatum*			x
	* *Paspalum distichum*			x
	* *Phalaris aquatica*			x
	* *Phalaris minor*			x
	Poa porphyroclados			x
	* *Polypogon arenastrum*			x
	* *Polypogon aviculare*			x
	* *Polypogon monspeliensis*			x
	* *Puccinella ciliata*			x
	Rytidosperma acerosum			x
	Rytidosperma caespitosum			x
	Rytidosperma pilosum			x
	Rytidosperma setaceum			x
	* *Setaria pumila* subsp. *pumila*			x
	* *Sorghum bicolor*			x
	* *Sorghum halepense*			x
	* *Sporobolus africanus*			x
	Tetrarrhena laevis			x
	Themeda triandra			x
	* *Vulpia bromoides*			x
CYPERACEAE	*Baumea vaginalis*			x
	Bolboschoenus caldwellii			x
	Carex inversa			x
	Carex tereticaulis	P3		x
	Cyathochaeta avenacea			x
	* *Cyperus congestus*			x
	* *Cyperus eragrostis*			x
	Cyperus polystachyos			x

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Family	Species	SCC	FCC	Nature Map & WAH
CYPERACEAE	*Eleocharis acuta*			x
(continued)	*Eleocharis keigheryi*	T	V	x
	Gahnia decomposita			x
	Isolepis cernua var. *cernua*			x
	Isolepis marginata			x
	* *Isolepis prolifera*			x
	Isolepis stellata			x
	Lepidosperma leptostachyum			x
	Lepidosperma longitudinale			x
	Lepidosperma persecans			x
	Lepidosperma pubisquameum			x
	Lepidosperma scabrum			x
	Lepidosperma sp.			x
	Lepidosperma squamatum			x
	Lepidosperma tenue			x
	Lepidosperma tetraquetrum			x
	Lepidosperma tuberculatum			x
	Mesomelaena graciliceps			x
	Mesomelaena tetragona			x
	Morelotia octandra			x
	Nerostylis sp. Jarrah Forest (R. Davis 7391)			x
	Netrosytlis capillaris			x
	Schoenus bifidus			x
	Schoenus curvifolius			x
	Schoenus nanus			x
	Schoenus sublateralis			x
	Tricostularia neesii			x
ARACEAE	*Lemna disperma*			x
RESTIONACEAE	*Cytogonidium leptocarpoides*			x
	Desmocladus fasciculatus			x
	Desmocladus flexuosus			x
	Hypolaena exsulca			x
	Hypolaena fastigiata			x
	Leptocarpus decipiens			x
	Leptocarpus laxus			x
	Leptocarpus roycei			x
	Leptocarpus thysananthus			x
	Lepyrodia glauca			x
	Lepyrodia riparia			x
	Loxocarya cinerea			x
	Tyrbastes glaucescens			x
ANARTHRIACEAE	*Anarthria gracilis*			x
	Lyginia imberbis			x
CENTROLEPIDACEAE	*Aphelia drummondii*			x
	Aphelia sp. Albany (B.G. Briggs 596)			x
	Centrolepis aristata			x

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Family	Species	SCC	FCC	Nature Map & WAH
CENTROLEPIDACEAE	*Centrolepis glabra*			x
(continued)	*Centrolepis pilosa*			x
HYDATELLACEAE	*Trithuria bibracteata*			x
	Trithuria submersa			x
XYRIDACEAE	*Xyris atrovirida*			x
	Xyris lacera			x
PHILYDRACEAE	*Philydrella pygmaea*			x
JUNCACEAE	*Juncus aridicolia*			x
	* *Juncus bufonius*			x
	* *Juncus capitatus*			x
	Juncus gregiflorus			x
	Juncus holoschoenus			x
	Juncus pallidus			x
	Juncus planifolius			x
	* *Juncus polyanthemus*			x
	Juncus subsecundus			x
	* *Juncus usitatus*			x
	Luzula meridionalis			x
ASPARAGACEAE	* *Asparagus asparagoides*			x
	* *Asparagus officinalis*			x
	Chamaescilla corymbosa			x
	Chamaescilla corymbosa var. *corymbosa*			x
	Chamaescilla gibsonii	P3		x
	Laxmannia ramosa subsp. *ramosa*			x
	Laxmannia squarrosa			x
	Lomandra brittanii			x
	Lomandra caespitosa			x
	Lomandra drummondii			x
	Lomandra hermaphrodita			x
	Lomandra integra			x
	Lomandra micrantha subsp. *micrantha*			x
	Lomandra nigricans			x
	Lomandra odora			x
	Lomandra pauciflora			x
	Lomandra preissii			x
	Lomandra purpurea			x
	Lomandra sericea			x
	Lomandra sonderi			x
	Lomandra sp.			x
	Lomandra whicherensis	P3		x
	Sowerbaea laxiflora			x
	Thysanotus dichotomus			x
	Thysanotus manglesianus			x
	Thysanotus multiflorus			x
	Thysanotus pseudojunceus			x
	Thysanotus tenellus			x

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Family	Species	SCC	FCC	Nature Map & WAH
ASPARAGACEAE	*Thysanotus thyrsoideus*			x
(continued)	*Thysanotus unicupensis*	P3		x
DASYPOGONACEAE	*Kingia australis*			x
ZANTHORRHOEACEAE	*Xanthorrhoea acanthostachya*			x
	Xanthorrhoea gracilis			x
	Xanthorrhoea nana			x
	Xanthorrhoea preissii			x
COLCHICACEAE	*Burchardia congesta*			x
	Burchardia multiflora			x
	Wurmbea dioica subsp. *alba*			x
HEMEROCALLIDACEAE	*Agrostocrinum hirsutum*			x
	Caesia micrantha			x
	Dianella revoluta			x
	Dianella revoluta var. *divaricata*			x
	Johnsonia acaulis			x
	Johnsonia lupulina			x
	Tricoryne elatior			x
	Tricoryne humilis			x
	Tricoryne tenella			x
HAEMODORACEAE	*Anigozanthos flavidus*			x
	Anigozanthos manglesii subsp. *manglesii*			x
	Conostylis aculeata			x
	Conostylis aculeata subsp. *aculeata*			x
	Conostylis juncea			x
	Conostylis pusilla			x
	Conostylis serrulata			x
	Conostylis setigera			x
	Conostylis setigera subsp. *setigera*			x
	Haemodorum discolor			x
	Haemodorum laxum			x
	Haemodorum paniculatum			x
	Haemodorum simplex			x
	Haemodorum sparsiflorum			x
	Haemodorum spicatum			x
	Phlebocarya ciliata			x
	Tribonanthes australis			x
	Tribonanthes brachypetala			x
	Tribonanthes violacea			x
AMARYLLIDACEAE	* *Crinum moorei*			x
	* *Leucojum aestivum*			x
	* *Narcissus tazetta* subsp. *tazetta*			x
HYPOXIDACEAE	*Pauridia occidentalis* var. *occidentalis*			x
	Pauridia occidentalis var. *quadroloba*			x

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Family	Species	SCC	FCC	Nature Map & WAH
IRIDACEAE	* *Babiana angustifolia*			x
	* *Freesia alba x leichtlinii*			x
	* *Moraea lewisiae*			x
	Orthrosanthus laxus var. *laxus*			x
	Patersonia babianoides			x
	Patersonia occidentalis			x
	Patersonia pygmaea			x
	Patersonia rudis			x
	Patersonia umbrosa			x
	Patersonia umbrosa var. *xanthina*			x
	* *Tritonia gladiolaris*			x
	* *Watsonia borbonica*			x
	* *Watsonia marginata*			x
	* *Watsonia meriana var. meriana*			x
ORCHIDACEAE	*Caladenia attingens* subsp. *attingens*			x
	Caladenia bryceana subsp. *bryceana*	T	E	x
	Caladenia cairnsiana			x
	Caladenia discoidea			x
	Caladenia ferruginea			x
	Caladenia flava subsp. *flava*			x
	Caladenia longicauda subsp. clivicola			x
	Caladenia longiclavata			x
	Caladenia macrostylis			x
	Caladenia nana subsp. *nana*			x
	Caladenia nana subsp. *unita*			x
	Caladenia paludosa			x
	Caladenia reptans subsp. *reptans*			x
	Caladenia sp.			x
	Caladenia speciosa	P4		x
	Caladenia splendens			x
	Caladenia straminichila			x
	Caladenia uliginosa subsp. *patulens*	P1		x
	Caladenia uliginosa subsp. *uliginosa*			x
	Corybas recurvus			x
	Cyrtostylis huegelii			x
	Diuris longifolia			x
	Diuris micrantha	T	V	x
	Diuris porrifolia			x
	Diuris purdiei	T	E	x
	Drakaea glyptodon			x
	Drakaea livida			x
	Drakaea micrantha	T	V	x
	Elythranthera brunonis			x
	Elythranthera emarginata			x
	Eriochilus dilatatus subsp. *multiflorus*			x
	Leporella fimbriata			x
	Microtis alba			x
	Prasophyllum drummondii			x
	Prasophyllum ovale			x
	Pterostylis barbata			x

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Family	Species	SCC	FCC	Nature Map & WAH
ORCHIDACEAE	*Pterostylis recurva*			x
(continued)	*Pterostylis* sp.			x
	Pterostylis sp. crinkled leaf (G.J. Keighery 13426)			x
	Pterostylis vittata			x
	Pyrorchis nigricans			x
	Thelymitra antennifera			x
	Thelymitra crinita			x
	Thelymitra graminea			x
	Thelymitra mucida			x
	Thelymitra sp.			x
	Thelymitra vulgaris			x
CASUARINACEAE	*Allocasuarina fraseriana*			x
	* *Casuarina equisetifolia*			x
PROTEACEAE	*Adenanthos cygnorum* subsp. *chamaephyton*	P3		x
	Adenanthos obovatus			x
	Banksia armata			x
	Banksia attenuata			x
	Banksia bipinnatifida subsp. *bipinnatifida*			x
	Banksia dallanneyi			x
	Banksia dallanneyi subsp. *sylvestris*			x
	Banksia dallanneyi var. *dallanneyi*			x
	Banksia dallanneyi var. *mellicula*			x
	Banksia grandis			x
	Banksia littoralis			x
	Banksia meisneri subsp. *meisneri*			x
	Banksia sessilis var. *sessilis*			x
	Conospermum capitatum subsp. *capitatum*			x
	Conospermum capitatum subsp. *glabratum*			x
	Grevillea bipinnatifida			x
	Grevillea bipinnatifida subsp. *bipinnatifida*			x
	Grevillea centristigma			x
	Grevillea diversifolia subsp. *diversifolia*			x
	Grevillea pilulifera			x
	Grevillea prominens	P3		x
	Grevillea quercifolia			x
	Grevillea rara	T	E	x
	Grevillea ripicola	P4		x
	Grevillea wilsonii			x
	Hakea amplexicaulis			x
	Hakea ceratophylla			x
	Hakea cyclocarpa			x
	Hakea lasianthoides			x
	Hakea lissocarpha			x
	Hakea marginata			x
	Hakea ruscifolia			x
	Hakea trifurcata			x
	Isopogon crithmifolius			x
	Isopogon sphaerocephalus			x
	Personnia saccata			x

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Family	Species	SCC	FCC	Nature Map & WAH
PROTEACEAE	*Persoonia elliptica*			x
(continued)	*Persoonia longifolia*			x
	Petrophile linearis			x
	Synaphea gracillima			x
	Synaphea petiolaris			x
	Synaphea petiolariss subsp. *triloba*			x
	Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T	CE	x
	Synaphea sp. Serpentine	T	CE	x
	Synaphea stenoloba	T	E	x
SANTALACEAE	*Choretrum lateriflorum*			x
	Leptomeria cunninghamii			x
OLACACEAE	*Olax benthamiana*			x
POLYGONACEAE	*Persicaria decipiens*			x
	Persicaria hydropiper			x
	Persicaria prostrata			x
	* *Rumex acetosella*			x
	* *Rumex brownii*			x
	* *Rumex conglomeratus*			x
	* *Rumex crispus*			x
CHENOPODIACEAE	* *Dysphania multifida*			x
AMARANTHACEAE	*Alternanthera denticulata*			x
	Alternanthera nodiflora			x
	* *Amarylis belladonnna*			x
	Ptilotus esquamatus			x
	Ptilotus manglesii			x
PHYTOLACCACEAE	* *Phytolacca octandra*			x
PORTULACACEAE	*Portulaca oleracea*			x
BASELLACEAE	* *Anredera cordifolia*			x
CARYOPHYLLACEAE	* *Gypsophila vaccaria*			x
	* *Petrorhagia dubia*			x
RANUNCULACEAE	*Clematis pubescens*			x
	Ranunculus colonorum			x
	* *Ranunculus muricatus*			x
	Ranunculus sessiliflorus var. sessiliflorus			x
RHAMNACEAE	* *Rhamnus alaternus*			x
LAURACEAE	*Cassytha glabella*			x
	Cassytha pomiformis			x
	Cassytha racemosa			x
	Cassytha racemosa forma *racemosa*			x

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Family	Species	SCC	FCC	Nature Map & WAH
PAPAVERACEAE	* *Fumaria muralis* subsp. *muralis*			x
	* *Papaver somniferum*			x
BRASSICACEAE	* *Brassica barrelieri subsp. oxyrrhina*			x
	* *Cakile maritima*			x
	* *Lepidium africanum*			x
	* *Raphanus raphanistrum*			x
DROSERACEAE	*Drosera bulbosa*			x
	Drosera bulbosa subsp. *bulbosa*			x
	Drosera collina			x
	Drosera drummondii			x
	Drosera gigantea			x
	Drosera huegelii			x
	Drosera indumenta			x
	Drosera intricata			x
	Drosera marchantii			x
	Drosera menziesii			x
	Drosera modesta			x
	Drosera pulchella			x
	Drosera sp. Branched styles (S.C. Coffey 193)			x
	Drosera stolonifera			x
CRASSULACEAE	*Crassula alata var. alata*			x
	Crassula colorata var. colorata			x
	Crassula decumbens			x
	* *Crassula natans*			x
	* *Crassula natans* var. *minus*			x
PITTOSPORACEAE	*Billardiera floribunda*			x
	Billardiera fusiformis			x
	Billardiera laxiflora			x
	Billardiera variifolia			x
	Billardiera venusta			x
	Cheiranthera preissiana			x
	Marianthus candidus			x
	Marianthus drummondianus			x
ROSACEAE	*Acaena echinata*			x
	* *Rosa rubiginosa*			x
	* *Rubus anglocandicans*			x
	* *Rubus laudatus*			x
	* *Rubus loganobaccus*			x
	* *Rubus ulmifolius*			x
	* *Rubus ulmifolius var. ulmifolius*			x
FABACEAE	*Acacia alata*			x
	Acacia alata var. *alata*			x
	Acacia applanata			x
	Acacia celastrifolia			x
	* *Acacia decurrens*			x

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Family	Species	SCC	FCC	Nature Map & WAH
FABACEAE	*Acacia dentifera*			x
	Acacia divergens			x
	Acacia drummondii subsp. *candolleana*			x
	Acacia drummondii subsp. *elegans*			x
	Acacia extensa			x
	Acacia incurva			x
	Acacia insolita subsp. *insolita*			x
	Acacia lasiocarpa var. bracteolata			x
	Acacia lateriticola			x
	Acacia microbotyra			x
	Acacia nervosa			x
	Acacia paradoxa			x
	Acacia pulchella			x
	Acacia pulchella var. *glaberrima*			x
	Acacia pulchella var. *pulchella*			x
	* *Acacia pycnantha*			x
	Acacia saligna			x
	Acacia saligna subsp. *pruinescens*			x
	Acacia saligna subsp. *saligna*			x
	Acacia saligna subsp. *stolonifera*			x
	Acacia semitrullata	P4		x
	Acacia stenoptera			x
	Acacia teretifolia			x
	Acacia urophylla			x
	Acacia varia var. *crassinervis*			x
	Acacia willdenowiana			x
	Aotus sp. Diffusa (W.E. Blackall & C.A. Gardner 1739)			x
	Bossiaea angustifolia			x
	Bossiaea aquifolium subsp. *aquifolium*			x
	Bossiaea eriocarpa			x
	Bossiaea linophylla			x
	Bossiaea ornata			x
	Bossiaea rufa			x
	Callistachys lanceolata			x
	Chorizema aciculare			x
	Chorizema cordatum			x
	Chorizema nanum			x
	Chorizema retrorsum			x
	Chorizema rhombeum			x
	* *Cicer arietinum*			x
	Daviesia cordata			x
	Daviesia decurrens subsp. *decurrens*			x
	Daviesia horrida			x
	Daviesia incrassata subsp. *incrassata*			x
	Daviesia inflata			x
	Daviesia longifolia			x
	Daviesia rhombifolia			x
	Dillwynia dillwynioides	P3		x
	* *Dipogon lignosus*			x
	* *Erythrina x sykesii*			x

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Family	Species	SCC	FCC	Nature Map & WAH
FABACEAE (continued)	*Gastrolobium bilobum*			x
	Gastrolobium capitatum			x
	Gastrolobium ebracteolatum			x
	Gastrolobium praemorsum			x
	Gastrolobium spinosum			x
	* *Gleditsia triacanthos*			x
	Gompholobium capitatum			x
	Gompholobium marginatum			x
	Gompholobium ovatum			x
	Gompholobium polymorphum			x
	Gompholobium preissii			x
	Gompholobium scabrum			x
	Gompholobium tomentosum			x
	Gopholobium shuttleworthii			x
	Hovea chorizemifolia			x
	Hovea trisperma			x
	Hovea trisperma var. *grandiflora*			x
	Isotropis cuneifolia			x
	Isotropis cuneifolia subsp. *cuneifolia*			x
	Jacksonia furcellata			x
	Jacksonia horrida			x
	Jacksonia sterbergiana			x
	Kennedia carinata			x
	Kennedia coccinea			x
	Kennedia nigricans			x
	Kennedia prostrata			x
	Labichea punctata			x
	* *Lathyrus latifolius*			x
	* *Lathyrus tingitanus*			x
	* *Lotus angustissimus*			x
	* *Lotus subbiflorus*			x
	* *Lupinus albus*			x
	* *Medicago intertexta*			x
	* *Medicago polymorpha*			x
	Mirbelia dilatata			x
	* *Ornithopus compressus*			x
	* *Ornithopus sativus*			x
	Paraserianthes lophantha			x
	Paraserianthes lophantha subsp. *lophantha*			x
	* *Podalyria sericea*			x
	Pultenaea skinneri	P4		x
	Sphaerolobium drummondii			x
	Sphaerolobium medium			x
	* *Trifolium campestre* var. *campestre*			x
	* *Trifolium fragiferum var. fragiferum*			x
	* *Trifolium glomeratum*			x
	* *Trifolium ligusticum*			x
	* *Trifolium subterraneum*			x
	Viminaria juncea			x

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GERANIACEAE	* *Erodium moschatum*			x
	Geranium retrorsum			x
	Geranium solanderi			x
	Pelargonium littorale			x
OXALIDACEAE	*Oxalis exilis*			x
	* *Oxalis pes-caprae*			x
	* *Oxalis purpurea*			x
TROPAEOLACEAE	* *Tropaeolum majus*			x
LINACEAE	* *Linum trigynum*			x
RUTACEAE	*Asterolasia pallida*			x
	Boronia crenulata			x
	Boronia crenulata var. *crenulata*			x
	Boronia fastigiata			x
	Boronia megastigma			x
	Boronia molloyae			x
	Boronia ramosa subsp. *anethifolia*			x
	Boronia tenuis	P4		x
	* *Coleonema pulchellum*			x
	Diplolaena dampieri			x
	Diplolaena drummondii			x
	Diplolaena graniticola			x
	Diplolaena microcephala			x
	Philotheca spicata			x
POLYGALACEAE	*Comesperma confertum*			x
	Comesperma polygaloides			x
	Comesperma virgatum			x
EUPHORBIACEAE	*Amperea simulans*			x
	Calycopeplus oligandrus			x
	Monotaxis occidentalis			x
	Stachystemon vermicularis			x
PHYLLANTHACEAE	*Phyllanthus calycinus*			x
	Poranthera huegelii			x
	Poranthera microphylla			x
CELASTRACEAE	*Stackhousia huegelii*			x
RHAMNACEAE	*Trymalium ledifolium*			x
	Trymalium ledifolium var. *rosmarinifolium*			x
	Trymalium odoratissimum subsp. *trifidum*			x

APPENDIX F: SUMMARY OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR AT COLLIE REFINERY

Note: * denotes introduced species; T denotes threatened flora and P1-P4 denote priority flora species (DBCA 2020a). Scc = State conservation code; FCC = Federal conservation code; E = Endangered, V = Vulnerable; o - designates WAH (2020) database search, Nature Map (DPAW 2020a).

Family	Species	SCC	FCC	Nature Map & WAH
ELAEOCARPACEAE	*Platytheca galioides*			x
	Tetratheca hirsuta subsp. *viminea*			x
	Tetratheca parvifolia	P3		x
	Tremandra stelligera			x
MALVACEAE	*Lasiopetalum floribundum*			x
	Thomasia grandiflora			x
	Thomasia macrocarpa			x
	Thomasia pauciflora			x
	Thomasia sp. Big Brook (M. Koch 2373)			x
DILLENIACEAE	*Hibbertia amplexicaulis*			x
	Hibbertia commutata			x
	Hibbertia cunninghamii			x
	Hibbertia diamesogenos			x
	Hibbertia hypericoides subsp. *hypericoides*			x
	Hibbertia mylnei			x
	Hibbertia pilosa			x
	Hibbertia racemosa			x
	Hibbertia serrata			x
	Hibbertia silvestris			x
	Hibbertia stellaris			x
	Hibbertia vaginata			x
	Hibbertia sp.			x
HYPERICACEAE	*Hypericum gramineum*			x
	* *Hypericum perforatum*			x
VIOLACEAE	*Hybanthus calycinus*			x
	Hybanthus debilissimus			x
	Hybanthus floribundus subsp. *floribundus*			x
THYMELAEACEAE	*Pimelea ciliata* subsp. *ciliata*			x
	Pimelea imbricata var. *piligera*			x
	Pimelea lehmanniana			x
	Pimelea lehmanniana subsp. *nervosa*			x
	Pimelea suaveolens subsp. *suaveolens*			x
	Pimelea sylvestris			x
MYRTACEAE	*Agonis flexuosa* var. *flexuosa*			x
	Astartea scoparia			x
	Astratea zephyra			x
	Babingtonia camphorosmae			x
	Calothamnus graniticus subsp. *leptophyllus*	P4		x
	Calothamnus lateralis			x
	Calothamnus rupestris			x
	Calothamnus sanguineus			x
	Calytrix glutinosa			x
	Calytrix leschenaultii			x
	Calytrix tetragona			x
	Calytrix variabilis			x

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Family	Species	SCC	FCC	Nature Map & WAH
MYRTACEAE	*Corymbia calophylla*			x
	Corymbia haematoxylon			x
	Darwinia citriodora			x
	Eucalyptus drummondii			x
	Eucalyptus laeliae			x
	Eucalyptus marginata subsp. *marginata*			x
	Eucalyptus megacarpa			x
	Eucalyptus patens			x
	Eucalyptus rudis			x
	Eucalyptus rudis subsp. *cratyantha*	P4		x
	Eucalyptus wandoo subsp. *wandoo*			x
	Hypocalymma angustifolium			x
	Hypocalymma cordifolium			x
	Hypocalymma robustum			x
	Kunzea ericifolia			x
	Kunzea glabrescens			x
	Kunzea recurva			x
	Melaleuca acutifolia			x
	Melaleuca incana subsp. *incana*			x
	Melaleuca lateritia			x
	Melaleuca microphylla			x
	Melaleuca parviceps			x
	Melaleuca pauciflora			x
	Melaleuca rhaphiophylla			x
	Melaleuca thymoides			x
	Melaleuca trichophylla			x
	Melaleuca viminea subsp. *viminea*			x
	Paragonis grandiflora			x
	Pericalymma ellipticum var. *floridum*			x
	Pericalymma spongiocaule			x
	Regelia ciliata			x
	Rinzia fumana			x
	Taxandria fragansia			x
	Taxandria linearifolia			x
	Tetrapora glomerata			x
	Verticordia pennigera			x
	Verticorida nitems			x
ONAGRACEAE	*Epilobium billardiereanum* subsp. *cinereum*			x
	Epilobium hirtigerum			x
	* *Oenothera glazioviana*			x
	* *Oenothera lindheimeri*			x
HALORAGACEAE	*Glischrocaryon angustifolium*			x
	Gonocarpus benthamii			x
	Gonocarpus benthamii subsp. *benthamii*			x
	Myriophyllum crispatum			x
	Myriophyllum drummondii			x
	Myriophyllum tillaeoides			x
	Myriophyllum verrucosum			x

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Family	Species	SCC	FCC	Nature Map & WAH
HALORAGACEAE	*Trihaloragis hexandra* subsp. *hexandra*			x
(continued)	*Trihaloragis hexandra* subsp. *integrifolia*			x
ARALIACEAE	*Hydrocotyle callicarpa*			x
	Trachymene pilosa			x
APIACEAE	*Actinotus glomeratus*			x
	Apium prostratum var. *prostratum*			x
	Centella asiatica			x
	Daucus glochidiatus			x
	* *Foeniculum vulgare*			x
	Homalosciadium homalocarpum			x
	Pentapeltis peltigera			x
	Pentapeltis silvatica			x
	Platysace compressa			x
	Platysace filiformis			x
	Xanthosia candida			x
	Xanthosia huegelii			x
	Xanthosia tasmanica			x
ERICACEAE	*Andersonia aristata*			x
	Andersonia caerulea			x
	Andersonia gracilis	T	E	x
	Andersonia involucrata			x
	Andersonia lehmanniana			x
	Astroloma ciliatum			x
	Astroloma pallidum			x
	Conostephium minus			x
	Conostephium pendulum			x
	Leucopogon capitellatus			x
	Leucopogon conostephioides			x
	Leucopogon glabellus			x
	Leucopogon gracillimus			x
	Leucopogon pendulus			x
	Leucopogon propinquus			x
	Leucopogon pulchellus			x
	Leucopogon sprengelioides			x
	Leucopogon verticillatus			x
	Sphenotoma capitata			x
	Sphenotoma gracilis			x
	Styphelia tenuiflora			x
PRIMULACEAE	* *Lysimachia arvensis*			x
	Samolus junceus			x
LOGANIACEAE	*Orianthera serpyllifolia* subsp. *serpyllifolia*			x
GENTIANACEAE	* *Centaurium erythraea*			x
	* *Centaurium twnuiflorum*			x

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Family	Species	SCC	FCC	Nature Map & WAH
MENYANTHACEAE	*Liparophyllum latifolium*			x
	Ornduffia albiflora			x
	Ornduffia parnassifolia			x
APOCYNACEAE	* *Asclepias curassavica*			x
	* *Gomphocarpus fruticosus*			x
	* *Vinca major*			x
CONVOLVULACEAE	*Convolvulus angustissimus* subsp. *angustissimus*			x
	* *Cuscuta epithymum*			x
	* *Ipomoea indica*			x
VERBENACEAE	* *Verbena rigida* var. *rigida*			x
LAMIACEAE	*Hemiandra pungens*			x
	Hemigenia argentea			x
	Hemigenia incana			x
	Hemigenia microphylla	P3		x
	Hemigenia pritzelii			x
	Lachnostachys albicans			x
	* *Lavandula stoechas* subsp. *stoechas*			x
	* *Mentha pulegium*			x
	* *Mentha spicata*			x
	* *Stachys arvensis*			
SOLANACEAE	*Anthocercis gracilis*	T	V	x
	* *Solanum linnaeanum*			x
	* *Solanum nigrum*			x
SCROPULARIACEAE	*Limosella australis*			x
OROBANCHACEAE	* *Bellardia viscosa*			x
	* *Orobanche minor*			x
	* *Parentucellia latifolia*			x
LENTIBULARIACEAE	*Utricularia multifida*			x
PLANTAGINACEAE	* *Callitriche brutia* subsp. *brutia*			x
	* *Callitriche stagnalis*			x
	Gratiola pubescens			x
	* *Kickxia elatine* subsp. *crnita*			x
	* *Plantago lanceolata*			x
RUBIACEAE	*Opercularia apiciflora*			x
	Opercularia echinocephala			x
	Opercularia hispidula			x
CAPRIFOLIACEAE	* *Centranthus macrosiphon*			x
	* *Centranthus ruber* subsp. *ruber*			x

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Family	Species	SCC	FCC	Nature Map & WAH
CAMPANULACEAE	* *Grammatotheca bergiana* var. *bergiana*			x
	Isotoma hypocrateriformis			x
	Lobelia anceps			x
	Lobelia heterophylla			x
	Lobelia rhombifolia			x
	* *Wahlenbergia capensis*			x
	Wahlenbergia sp.			x
GOODENIACEAE	*Anthotium junciforme*			x
	Dampiera alata			x
	Dampiera hederacea			x
	Dampiera linearis			x
	Dampiera trigona			x
	Goodenia coerulea			x
	Goodenia eatoniana			x
	Goodenia fasciculata			x
	Goodenia pusilla			x
	Lechenaultia biloba			x
	Lechenaultia expansa			x
	Scaevola calliptera			x
	Scaevola glandulifera			x
	Scaevola striata var. *striata*			x
	Velleia trinervis			x
STYLIDIACEAE	*Levenhookia pusilla*			x
	Stylidium acuminatum subsp. *acuminatum*	P2		x
	Stylidium adnatum			x
	Stylidium amoenum			x
	Stylidium amoenum var. *amoenum*			x
	Stylidium androsaceum			x
	Stylidium brunonianum			x
	Stylidium caespitosum			x
	Stylidium ciliatum			x
	Stylidium crassifolium			x
	Stylidium despectum			x
	Stylidium diversifolium			x
	Stylidium inundatum			x
	Stylidium junceum			x
	Stylidium korijekup	P2		x
	Stylidium neurophyllum			x
	Stylidium petiolare			x
	Stylidium piliferum			x
	Stylidium plantagineum			x
	Stylidium pulchellum			x
	Stylidium recurvum			x
	Stylidium rhynchocarpum			x
	Stylidium schoenoides			x
	Stylidium spathulatum			x
	Stylidium tenue subsp. *majusculum*			x
	Stylidium thesioides			x

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Family	Species	SCC	FCC	Nature Map & WAH
STYLIDIACEAE	*Stylidium uniflorum* subsp. *uniflorum*			x
(continued)	*Styliidium calcaratum*			x
ASTERACEAE	*Angianthus drummondii*	P3		
	* *Arctotheca calendula*			x
	Brachyscome iberidifolia			x
	* *Carduus tenuiflorus*			x
	* *Carthamus lanatus*			x
	Centipeda cunninghamii			x
	* *Cirsium vulgare*			x
	* *Conyza bonariensis*			x
	* *Cotula coronopifolia*			x
	Cotula cotuloides			x
	Craspedia variabilis			x
	* *Crepis foetida* subsp. *foetida*			x
	* *Dittrichia graveolens*			x
	Euchiton sphaericus			x
	* *Galinsoga parviflora*			x
	* *Glebionis segetum*			x
	Hyalosperma cotula			x
	Hyalosperma demissum			x
	Hyalosperma pusillum			x
	Hyalosperma simplex subsp. *simplex*			x
	* *Hypochaeris glabra*			x
	* *Lactuca saligna*			x
	Lagenophora huegelii			x
	* *Leontodon saxatilis*			x
	Millotia tenuifolia			x
	Millotia tenuifolia var. *tenuifolia*			x
	Olearia elaeophila			x
	Olearia paucidentata			x
	Pithocarpa pulchella			x
	Pithocarpa ramosa			x
	Podotheca angustifolia			x
	Pseudognaphalium luteoalbum			x
	Rhodanthe citrina			x
	Rhodanthe pyrethrum			x
	Senecio diaschides			x
	Senecio leucoglossus	P4		x
	Senecio multicaulis subsp. *multicaulis*			x
	Siloxerus filifolius			x
	Siloxerus humifusus			x
	Siloxerus multiflorus			x
	* *Silybum marianum*			x
	* *Soliva sessilis*			x
	* *Sonchus asper*			x
	* *Sonchus oleraceus*			x
	* *Symphyotrichum squamatum*			x
	* *Tolpis barbata*			x
	Trichocline spathulata			x
	* *Vellereophyton dealbatum*			x
	Waitzia nitida			x
	Waitzia suaveolens			x

APPENDIX G: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR AT COLLIE REFINERY

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Caladenia bryceana subsp. *bryceana*	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.05-0.1 m high Flower colour: green-yellow Flowering period: Aug to Oct Soils: Sand, loam. Adjacent to watercourses, winter-wet sites IBRA Distribution: ESP, JAF, MAL Florabase records: 16	Low
Caladenia leucochila	Orchidaceae	T	Endangered	Habit: Leaf 12-20 cm long, scape to 40 cm high Flower colour: pale yellow to greenish cream and white with faint to prominent dull red stripes Flowering period: Sep to Oct Soils: Dry sand/ laterite IBRA Distribution: JAF, SWA Florabase records: 7	Medium
Diuris micrantha	Orchidaceae	T	Vulnerable	Habit: Tuberous, perennial, herb, 0.3-0.6 meters high Flower colour: Yellow/brown Flowering period: September to October Soils: Brown loamy clay. Winter-wet swamps, in shallow water IBRA Distribution: JAF, SWA Florabase records: 6	Low
Eleocharis keigheryi	Cyperaceae	T	Vulnerable	Habit: Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 meters high Flower colour: Green Flowering period: August to November Soils: Clay, sandy loam. Emergent in freshwater: creeks, clay pans IBRA Distribution: AVW, GES, JAF, SWA Florabase records: 54	Low
Grevillea rara	Proteaceae	T	Endangered	Habit: Dense, prickly shrub, to 2 meters high. Flower colour: White-pink Flowering period: October Soils: Lateritic loam and creeklines. IBRA Distribution: JAF Florabase records: 11	Medium

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Caladenia uliginosa subsp. *patulens*	Orchidaceae	P1		Habit: Tuberous, perennial, herb, 0.2-0.35 m high Flower colour: Green-cream Flowering period: September to October Soils: Clay loam and gravel. Well drained soils amongst dense shrubs. IBRA Distribution: JAF, SWA Florabase records: 4	Medium
Caladenia validinervia	Orchidaceae	P1		Habit: Rhizomatous, flowers white-maroon. Upright single stem herb 15-30 cm high, scattered and clumping Flower colour: White-pink-purple Flowering period: September to November Soils: Undulating, brown-black laterite sand over laterite IBRA Distribution: AVW, SWA Florabase records: 8	Medium
Leucopogon extremus	Ericaceae	P2		Habit: Low spreading shrub Flower colour: - Flowering period: - Soils: Dark grey sandy loam. IBRA Distribution: JAF Florabase records: 5	Medium
Stylidium korijekup	Stylidiaceae	P2		Habit: Perennial, herb, 0.18-0.34 m high Flower colour: - Flowering period: - Soils: Well-drained grey-brown sandy loam with laterite. Upland ridges. IBRA Distribution: JAF, SWA Florabase records: 3	Medium
Stylidium acuminatum subsp. *acuminatum*	Stylidiaceae	P2		Habit: Basally rosetted. Scape to 40 cm long. Short stem below rosette. Flower colour: Pale yellow Flowering period: - Soils: Brown gravelly clay/loam IBRA Distribution: JAF Florabase records: 8	Medium

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Adenanthos cygnorum subsp. *chamaephyton*	Proteaceae	P3		Habit: Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high Flower colour: White-cream-pink-green/green Flowering period: July or September to December or January Soils: Grey sand, lateritic gravel. IBRA Distribution: AVW, JAF, SWA Florabase records: 21	Medium
Angianthus drummondii	Asteraceae	P3		Habit: Erect annual, herb, to 0.1 m high Flower colour: Yellow Flowering period: October to December Soils: Grey or brown clays soils, ironstone. Seasonally wet flats. IBRA Distribution: JAF, SWA Florabase records: 18	Medium
Carex tereticaulis	Cyperaceae	P3		Habit: Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.7 m high Flower colour: Brown Flowering period: September to October Soils: Black peaty sand. IBRA Distribution: JAF, SWA, WAR Florabase records: 18	Low
Dillwynia dillwynioides	Fabaceae	P3		Habit: Decumbent or erect, slender shrub, 0.3-1.2 m high Flower colour: Red & yellow/orange Flowering period: August to December Soils: Sandy soils. Winter-wet depressions. IBRA Distribution: SWA Florabase records: 38	Low
Grevillea prominens	Proteaceae	P3		Habit: Spreading shrub, 0.5-1.7 meters high, 0.3-1 meters wide Flower colour: cream-white Flowering period: September to October Soils: Gravelly loam. Along creeklines IBRA Distribution: JAF Florabase records: 9	Low
Hemigenia microphylla	Lamiaceae	P3		Habit: Slender shrub, 0.4-1.8 m high Flower colour: blue-purple Flowering period: September to December Soils: Sandy clay, peaty clay, granite. Winter-wet depressions. IBRA Distribution: JAF, SWA, WAR Florabase records: 25	Low

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Species	Family	SCC	FCC	Description and Habitat		Likelihood of Occurrence
Juncus meianthus	Juncaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Tufted perennial, herb, 0.05-0.2 meters high, to 0.4 meters wide Brown November to December or January Wetland, black clay-loam, saturated soils. ESP, JAF, WAR 23	Low
Lomandra whicherensis	Asparagaceae	P3		Habit: Flower colour: Soils: IBRA Distribution: Florabase records:	Tufted rhizomatous erect herb, 20 - 40 cm high. Female inflorescence very short compared to male. purple Lateritic sandy clay. JAF 16	Medium
Synaphea decumbens	Proteaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	slender erect or open straggly shrub to 0.5 metres high Yellow September or October Grey-brown loam/clayey sand over laterite JAF 28	Medium
Synaphea hians	Proteaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Prostrate or decumbent shrub Yellow July or September to November Sandy soils. Rises JAF, SWA 52	Low
Tetratheca parvifolia	Elaeocarpaceae	P3		Habit: Flower colour: Flowering period: Soils: IBRA Distribution: Florabase records:	Small shrub, 0.2-0.3 meters high Pink October Dry, shallow, pale brown sandy-loam over granite JAF, SWA 15	Low
Thysanotus unicupensis	Asparagaceae	P3		Habit: Flower colour: Soils: IBRA Distribution: Florabase records:	Erect herb Purple Grey sandy loam over laterite JAF 14	Low

APPENDIX G: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR AT COLLIE REFINERY

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Acacia semitrullata	Fabaceae	P4		Habit: Slender, erect, pungent shrub, (0.1-)0.2-0.7(-1.5) meters high Flower colour: Cream/white Flowering period: May to October Soils: White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas. IBRA Distribution: JAF, SWA, WAR Florabase records: 86	Low
Boronia tenuis	Rutaceae	P4		Habit: Procumbent or erect & slender shrub, 0.1-0.5 meters high Flower colour: blue/pink-white Flowering period: August to November Soils: Laterite, stony soils, granite. IBRA Distribution: JAF, SWA Florabase records: 43	Medium
Caladenia speciosa	Orchidaceae	P4		Habit: Tuberous, perennial, herb, 0.35-0.6 meters high Flower colour: White-pink Flowering period: September to October Soils: White, grey or black sand. Loam flat swampy terrain IBRA Distribution: JAF, SWA Florabase records: 59	Low
Calothamnus graniticus subsp. *leptophyllus*	Myrtaceae	P4		Habit: Erect, multi-stemmed shrub, 1-2 m high Flower colour: Red Flowering period: June to August Soils: Clay over granite, lateritic soils. Hillsides IBRA Distribution: JAF, SWA Florabase records: 27	Medium
Drosera occidentalis	Droseraceae	P4		Habit: Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Flower colour: White-pink Flowering period: October to December or January Soils: Swampy flats, grey clayey sand IBRA Distribution: JAF, SWA Florabase records: 19	Low
Eucalyptus rudis subsp. *cratyantha*	Myrtaceae	P4		Habit: Tree, 5-20 m high, bark rough, box-type Flower colour: White Flowering period: July to September Soils: Loam. Flats, hillsides. IBRA Distribution: JAF, SWA, WAR Florabase records: 17	Medium

APPENDIX G: LIKELIHOOD OF VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR AT COLLIE REFINERY

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2018a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Medium or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Grevillea ripicola	Proteaceae	P4		Habit: Spreading, much-branched, non-lignotuberous shrub, 0.6-2(-3) meters high, to 4 meters wide Flower colour: Red/red-orange Flowering period: Jan or Mar to Apr or Nov to Dec Soils: Sandy clay, clay or gravelly loam. Swampy flats, granite outcrops, along watercourses IBRA Distribution: JAF Florabase records: 22	Low
Hypolaena robusta	Restionaceae	P4		Habit: Dioecious rhizomatous, perennial, herb, ca 0.5 m high Flowering period: September to October Soils: White sand, laterite granite IBRA Distribution: GES, JAF,SWA Florabase records: 46	Medium
Pultenaea skinneri	Fabaceae	P4		Habit: Slender shrub, 1-2 m high Flower colour: Yellow/orange & red Flowering period: Jul to Sep Soils: Sandy or clayey soils. Winter-wet depressions IBRA Distribution: JAF, SWA, WAR Florabase records: 38	High
Senecio leucoglossus	Asteraceae	P4		Habit: Erect annual, herb, to 1.3 meters high Flower colour: White Flowering period: August to December Soils: Gravelly lateritic or granitic soils. Granite outcrops, slopes IBRA Distribution: JAF, SWA, WAR Florabase records: 41	High

APPENDIX H: VASCULAR PLANT SPECIES RECORDED ON SOUTH32 LEASES AND DURING THE RECENT ASSESSMENT OF WMDE INFILL AREAS AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
PTERIDACEAE	*Adiantum aethiopicum*	x			
	Cheilanthes austrotenuifolia	x			
	Cheilanthes sieberi	x	x		
	Cheilanthes sp.	x			
DENNSTAEDTIACEAE	*Pteridium esculentum*	x	x	x	x
LINDSAEACEAE	*Lindsaea linearis*	x			
ZAMIACEAE	*Macrozamia riedlei*	x	x	x	x
PODOCARPACEAE	*Podocarpus drouynianus*	x			
TYPHACEAE	*Typha domingensis*	x		x	
	Typha orientalis	x	x		
JUNCAGINACEAE	*Triglochin centrocarpa*	x			
POACEAE	* *Aira caryophyllea*	x	x	x	x
	* *Aira cupaniana*	x		x	x
	Amphibromus nervosus	x	x		
	Amphipogon amphipogonoides	x		x	x
	Amphipogon caricinus	x		x	
	Amphipogon laguroides	x			
	Amphipogon turbinatus	x			
	Austrostipa campylachne	x	x	x	
	Austrostipa compressa	x			x
	Austrostipa elegantissima	x	x	x	x
	Austrostipa hemipogon	x			x
	Austrostipa semibarbata	x		x	x
	Austrostipa tenuifolia	x			
	Austrostipa trichophylla	x	x		x
	Austrostipa variabilis	x			x
	Austrostipa sp.	x		x	x
	* *Avellinia michelii*	x			x
	* *Avena barbata*	x	x	x	x
	* *Avena fatua*	x			x
	* *Brachypodium distachyon*	x	x		x
	* *Briza maxima*	x	x	x	x
	* *Briza minor*	x	x	x	x
	* *Bromus diandrus*	x	x		x
	* *Bromus hordeaceus*	x			x
	* *Bromus madritensis*	x	x		x
	* *Bromus rubens*	x		x	x
	* *Bromus* sp.	x		x	x
	* *Catapodium rigidum*	x			x
	* *Cynodon dactylon*	x			x
	Dichelachne crinita	x		x	
	* *Ehrharta calycina*	x	x	x	x
	* *Ehrharta longiflora*	x	x		x
	* *Eragrostis curvula*	x			
	* *Holcus lanatus*	x			x
	* *Holcus setiger*	x		x	x
	* *Hordeum hystrix*	x	x		x
	* *Hordeum leporinum*	x			x
	* *Lagurus ovatus*	x			x
	* *Lolium multiflorum*	x			x
	* *Lolium perenne*	x	x		x
	* *Lolium rigidum*	x	x		x
	* *Lolium temulentum*	x			x
	* *Lolium* sp.	x			x
	Microlaena stipoides	x		x	x
	Neurachne alopecuroidea	x	x	x	x
	* *Pentameris airoides*	x		x	x
	Phalaris sp.	x			x

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Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
POACEAE	* *Poa annua*	x		x	x
(continued)	*Poa drummondiana*	x		x	x
	Poa porphyroclados	x		x	
	* *Polypogon monspeliensis*	x	x	x	x
	* *Rostraria pumila*	x			x
	Rytidosperma acerosum	x		x	x
	Rytidosperma caespitosum	x	x	x	x
	Rytidosperma occidenatle	x		x	x
	Rytidosperma setaceum	x		x	x
	Rytidosperma sp.	x		x	x
	Sporobolus virginicus	x			
	Tetrarrhena laevis	x	x	x	x
	Themeda triandra	x			
	* *Triticum aestivum*	x		x	x
	* *Vulpia bromoides*	x		x	x
	* *Vulpia fasciculata*	x			x
	* *Vulpia myuros*	x	x	x	x
	* *Vulpia myuros* forma *megalura*	x			x
	* *Vulpia myuros* forma *myuros*	x			x
	* *Vulpia* sp.	x		x	x
	Poaceae sp.	x	x	x	x
CYPERACEAE	*Baumea ?acuta*	x		x	
	Baumea juncea	x			
	Baumea rubiginosa	x			
	Baumea vaginalis	x			
	Baumea sp.	x			x
	Bolboschoenus caldwellii	x			
	Carex fascicularis	x			
	Chorizandra enodis	x		x	
	Cyathochaeta avenacea	x		x	x
	* *Cyperus tenellus*	x			x
	Fimbristylis sp.	x			
	Gahnia ancistrophylla	x			
	Gahnia aristata	x		x	x
	Gahnia decomposita	x			
	Gahnia trifida	x			
	Gahnia sp.	x			
	Isolepis cernua	x			x
	Isolepis cernua var. *setiformis*	x			
	Isolepis marginata	x		x	x
	Lepidosperma angustatum	x			
	Lepidosperma drummondii	x		x	
	Lepidosperma gracile	x			
	Lepidosperma aff. *gracile*	x			
	Lepidosperma leptostachyum	x	x	x	x
	Lepidosperma longitudinale	x		x	
	Lepidosperma pubisquameum	x		x	x
	Lepidosperma scabrum	x			
	Lepidosperma squamatum	x	x	x	x
	Lepidosperma squamatum (narrow leaf form)	x		x	
	Lepidosperma tenue	x		x	x
	Lepidosperma tetraquetrum	x			
	Lepidosperma tuberculatum	x			
	Lepidosperma sp.	x	x	x	x
	Mesomelaena graciliceps	x			
	Mesomelaena tetragona	x		x	x
	Morelotia octandra	x	x	x	x
	Netrostylis capillaris	x		x	x
	Netrostylis sp.	x		x	x
	Netrostylis sp. Jarrah Forest (R. Davis 7391)	x		x	x
	Schoenus ?unispiculatus	x		x	
	Schoenus armeria	x			
	Schoenus bifidus	x		x	

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
CYPERACEAE	*Schoenus nanus*	x		x	x
(continued)	*Schoenus* sp.	x		x	x
	Cyperaceae sp.	x		x	x
RESTIONACEAE	*Desmocladus asper*	x			
	Desmocladus fasciculatus	x	x	x	x
	Desmocladus flexuosus	x	x	x	x
	Desmocladus sp.	x			x
	Empodisma gracillimum	x			
	Hypolaena exsulca	x			
	Lepidobolus preissianus	x		x	
	Lepidobolus preissianus subsp. *preissianus*	x		x	
	Lepidobolus sp.	x		x	x
	Leptocarpus coangustatus	x			
	Leptocarpus tenax	x			
	Lepyrodia macra	x			
	Loxocarya cinerea	x			
	Loxocarya striata	x			
	Loxocarya sp.	x		x	
	Restionaceae sp.	x		x	x
ANARTHRIACEAE	*Lyginia barbata*	x		x	
CENTROLEPIDACEAE	*Aphelia cyperoides*	x			x
	Centrolepis aristata	x			x
	Centrolepis drummondiana	x			x
	Centrolepis inconspicua	x			x
	Centrolepis sp.	x			x
PHILYDRACEAE	*Philydrella pygmaea*	x			
	Philydrella pygmaea subsp. *pygmaea*	x		x	
JUNCACEAE	* *Juncus acutus*	x			x
	* *Juncus acutus* subsp. *acutus*	x			x
	* *Juncus bufonius*	x			x
	Juncus pallidus	x			x
	* *Juncus usitatus*	x			
	Luzula meridionalis	x			x
LILIACEAE	Liliaceae sp.	x			x
ASPARAGACEAE	* *Asparagus asparagoides*	x			
	Chamaescilla corymbosa	x	x	x	x
	Chamaescilla corymbosa var. *corymbosa*	x		x	x
	Dichopogon capillipes	x		x	x
	Laxmannia grandiflora	x			x
	Laxmannia ramosa	x			x
	Laxmannia sessiliflora	x		x	
	Laxmannia squarrosa	x		x	x
	Laxmannia sp.	x			x
	Lomandra brittanii	x		x	x
	Lomandra caespitosa	x		x	x
	Lomandra drummondii	x		x	x
	Lomandra hermaphrodita	x	x	x	x
	Lomandra integra	x		x	x
	Lomandra micrantha	x		x	x
	Lomandra micrantha subsp. *micrantha*	x		x	x
	Lomandra nigricans	x		x	x
	Lomandra odora	x		x	
	Lomandra pauciflora	x			
	Lomandra preissii	x	x	x	x
	Lomandra purpurea	x		x	x
	Lomandra sericea	x	x	x	x
	Lomandra sonderi	x		x	x

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	*Species*	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
ASPARAGACEAE	*Lomandra spartea*	x	x	x	x
(continued)	*Lomandra suaveolens*	x			
	Lomandra sp. (JK12)	x			
	Lomandra sp.	x			x
	Sowerbaea laxiflora	x		x	x
	Thysanotus arbuscula	x			x
	Thysanotus dichotomus	x	x	x	x
	Thysanotus fastigiatus	x		x	x
	Thysanotus manglesianus	x		x	x
	Thysanotus multiflorus	x		x	x
	Thysanotus patersonii	x		x	x
	Thysanotus tenellus	x		x	x
	Thysanotus thyrsoideus	x		x	x
	Thysanotus sp.	x		x	x
DASYPOGONACEAE	*Dasypogon bromeliifolius*	x			x
	Kingia australis	x			
XANTHORRHOEACEAE	*Xanthorrhoea gracilis*	x	x	x	x
	Xanthorrhoea preissii	x	x	x	x
	Xanthorrhoea sp.	x			x
COLCHICACEAE	*Burchardia congesta*	x		x	x
	Burchardia multiflora	x		x	
	Burchardia sp.	x		x	x
	Wurmbea dioica	x			
	Wurmbea tenella	x			
	Wurmbea sp.	x			x
BORYACEAE	*Borya sphaerocephala*	x		x	x
HEMEROCALLIDACEAE	*Agrostocrinum hirsutum*	x		x	x
	Agrostocrinum scabrum	x	x	x	x
	Caesia micrantha	x		x	x
	Corynotheca micrantha	x		x	x
	Dianella revoluta	x			
	Dianella revoluta var. *divaricata*	x		x	x
	Johnsonia lupulina	x			x
	Stypandra glauca	x		x	x
	Tricoryne elatior	x		x	x
	Tricoryne humilis	x		x	x
	Tricoryne sp.	x		x	x
HAEMODORACEAE	*Anigozanthos flavidus*	x			
	Anigozanthos manglesii	x		x	x
	Anigozanthos sp.	x			x
	Conostylis aculeata	x			
	Conostylis aculeata subsp. *aculeata*	x			x
	Conostylis pusilla	x		x	
	Conostylis seminuda	x			
	Conostylis serrulata	x		x	x
	Conostylis setigera	x	x	x	x
	Conostylis setigera subsp. *setigera*	x		x	x
	Conostylis setosa	x		x	x
	Conostylis sp.	x		x	x
	Haemodorum discolor	x		x	
	Haemodorum laxum	x	x	x	
	Haemodorum simplex	x	x		
	Haemodorum spicatum	x		x	
	Haemodorum sp.	x	x	x	x
	Phlebocarya ciliata	x			
	Tribonanthes longipetala	x		x	x
HYPOXIDACEAE	*Pauridia glabella*				
	Pauridia occidentalis	x			

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy		*Species*	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
IRIDACEAE		*Orthrosanthus laxus*	x			
		Patersonia babianoides	x			
		Patersonia juncea	x			x
		Patersonia occidentalis	x		x	x
		Patersonia pygmaea	x		x	x
		Patersonia rudis	x		x	x
		Patersonia sp.	x		x	x
	*	*Romulea rosea*	x		x	x
		Iridaceae sp.	x			x
ORCHIDACEAE		*Caladenia dorrienii* (T)	x			
		Caladenia flava	x		x	x
		Caladenia flava subsp. *flava*	x		x	x
		Caladenia hopperiana (T)	x		x	
		Caladenia latifolia	x			
		Caladenia longicauda	x			
		Caladenia macrostylis	x			
		Caladenia nana	x			
		Caladenia reptans	x		x	
		Caladenia reptans subsp. *reptans*	x		x	
		Caladenia sp.	x		x	x
		Cryptostylis ovata	x		x	x
		Cyanicula gemmata	x			
		Cyanicula sericea	x		x	
		Cyrtostylis huegelii	x		x	x
		Cyrtostylis robusta	x		x	x
		Cyrtostylis sp.	x		x	x
	*	*Disa bracteata*	x	x		x
		Diuris corymbosa	x		x	x
		Diuris longifolia	x			x
		Diuris sp.	x		x	x
		Drakaea elastica (T)	x			
		Drakaea sp.	x		x	x
		Elythranthera brunonis	x		x	
		Eriochilus dilatatus	x		x	x
		Leporella fimbriata	x		x	x
		Leptoceras menziesii	x			x
		Microstis media subsp. *media*	x		x	x
		Paracaleana nigrita	x			
		Pheladenia deformis	x			
		Prasophyllum hians	x			
		Prasophyllum parvifolium	x			
		Prasophyllum sp.	x		x	x
		Pterostylis barbata	x			x
		Pterostylis pyramidalis	x			x
		Pterostylis recurva	x		x	x
		Pterostylis vittata	x		x	x
		Pterostylis sp.	x		x	x
		Pyrorchis nigricans	x		x	x
		Thelymitra antennifera	x			
		Thelymitra canaliculata	x		x	
		Thelymitra crinita	x		x	x
		Thelymitra sp.	x		x	x
		Orchidaceae sp.	x	x	x	x
CASUARINACEAE		*Allocasuarina fraseriana*	x	x	x	x
		Allocasuarina huegeliana	x	x	x	x
		Allocasuarina humilis	x		x	x
		Allocasuarina microstachya	x			
		Allocasuarina sp.	x			
URTICACEAE		*Parietaria* sp.	x			x

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	*Species*	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
PROTEACEAE	*Adenanthos barbiger*	x	x		
	Adenanthos cygnorum	x			x
	Adenanthos cygnorum subsp. *cygnorum*	x			x
	Adenanthos obovatus	x			
	Banksia armata	x			x
	Banksia bipinnatifida	x		x	
	Banksia dallanneyi	x		x	x
	Banksia dallanneyi var. *dallanneyi*	x	x	x	x
	Banksia dallanneyi subsp. *sylvestris*	x		x	
	Banksia fraseri var. *fraseri*	x			x
	Banksia grandis	x	x	x	x
	Banksia littoralis	x			
	Banksia nivea subsp. *nivea*	x			x
	Banksia nobilis	x			x
	Bankisa nobilis	x			
	Banksia seminuda	x			
	Banksia sessilis	x	x	x	x
	Banksia sphaerocarpa	x		x	x
	Banksia sphaerocarpa var. *sphaerocarpa*	x		x	x
	Banksia squarrosa subsp. *squarrosa*	x		x	x
	Banksia subpinnatifida	x			x
	Banksia subpinnatifida var. *imberbis* (P3)	x		x	
	Banksia subpinnatifida var. *subpinnatifida* (P2)	x		x	
	Conospermum amoenum	x			
	Conospermum capitatum	x			
	Conospermum capitatum subsp. *capitatum*	x			
	Conospermum sp.	x		x	
	Grevillea bipinnatifida	x		x	x
	Grevillea monticola	x			x
	Grevillea quercifolia	x		x	x
	Grevillea synapheae	x			
	Grevillea trifida	x			
	Grevillea sp.	x		x	x
	Hakea amplexicaulis	x		x	x
	Hakea cyclocarpa	x		x	
	Hakea gilbertii	x		x	x
	Hakea incrassata	x			x
	Hakea lissocarpha	x	x	x	x
	*Hakea petiolaris s*ubsp. *petiolaris*	x			x
	Hakea prostrata	x	x	x	x
	Hakea ruscifolia	x		x	x
	Hakea stenocarpa	x		x	x
	Hakea sulcata	x			x
	Hakea trifurcata	x		x	x
	Hakea undulata	x		x	x
	Hakea varia	x		x	x
	Isopogon buxifolius	x			x
	Isopogon crithmifolius	x			x
	Isopogon dubius	x			x
	Isopogon formosus	x			x
	Isopogon sphaerocephala	x			x
	Isopogon sp. Canning Reservoir (M.D. Tindale 121 & B.R. Maslin) P1	x			x
	Isopogon sp.	x			x
	Lambertia multiflora	x			x
	Persoonia angustiflora	x		x	x
	Persoonia elliptica	x			
	Persoonia longifolia	x	x	x	x
	Persoonia quinquenervis	x			
	Persoonia saccata	x			x
	Petrophile drummondii	x			x
	Petrophile ericifolia	x			x
	Petrophile heterophylla	x			x
	Petrophile linearis	x		x	x
	Petrophile macrostachya	x		x	x

APPENDIX H: VASCULAR PLANT SPECIES RECORDED ON SOUTH32 LEASES AND DURING THE RECENT ASSESSMENT OF WMDE INFILL AREAS AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
PROTEACEAE	*Petrophile ?seminuda*	x			
(continued)	*Petrophile serruriae*	x		x	x
	Petrophile squamata	x			
	Petrophile striata	x			
	Petrophile sp.	x			
	Stirlingia simplex	x		x	x
	Synaphea cuneata	x		x	x
	Synaphea damopsis	x		x	x
	Synaphea gracillima	x		x	x
	Synaphea panhesya (P1)	x		x	
	Synaphea petiolaris	x		x	x
	Synaphea aff. *petiolaris*	x			
	Synaphea spinulosa	x			x
	Synaphea sp.	x			x
	Xylomelum occidentale	x			x
SANTALACEAE	*Exocarpos sparteus*	x		x	
	Leptomeria cunninghamii	x		x	x
	Santalum acuminatum	x		x	
OLACACEAE	*Olax benthamiana*	x			
POLYGONACEAE	*Muehlenbeckia adpressa*	x			x
	* *Rumex acetosella*	x			
	* *Rumex crispus*	x			x
	* *Rumex obtusifolius*	x			x
CHENOPODIACEAE	* *Chenopodium glaucum*	x			
	Chenopodiaceae sp.	x		x	
AMARANTHACEAE	*Ptilotus declinatus*	x		x	x
	Ptilotus drummondii	x		x	x
	Ptilotus drummondii var. *drummondii*	x		x	x
	Ptilotus manglesii	x	x	x	x
	Ptilotus polystachyus	x			x
	Ptilotus sp.	x		x	x
PHYTOLACCACEAE	* *Phytolacca octandra*	x			x
MONTIACEAE	*Calandrinia quadrivalvis*	x			
	Calandrinia sp.	x			x
CARYOPHYLLACEAE	* *Cerastium glomeratum*	x		x	x
	* *Moenchia erecta*	x			x
	* *Petrorhagia dubia*	x	x	x	x
	* *Polycarpon tetraphyllum*	x			x
	* *Sagina apetala*	x			x
	* *Silene gallica*	x			x
RANUNCULACEAE	*Clematis pubescens*	x	x	x	x
	Ranunculus colonorum	x	x		x
	* *Ranunculus muricatus*	x			
LAURACEAE	*Cassytha glabella*	x			
	Cassytha racemosa	x		x	x
	Cassytha sp.	x		x	x
PAPAVERACEAE	* *Fumaria capreolata*	x			x
	* *Fumaria muralis*	x			x
BRASSICACEAE	* *Brassica barrelieri* subsp. *oxyrrhina*	x			x
	* *Brassica tournefortii*	x			x
	* *Cardamine occulta*	x			x
	* *Cardamine* sp.	x			x

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Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
BRASSICACEAE	* *Raphanus raphanistrum*	x			x
(continued)	* Brassicaceae sp.	x			x
RESEDACEAE	* *Reseda luteola*	x			x
DROSERACEAE	*Drosera barbigera*	x			x
	Drosera bulbosa	x		x	x
	Drosera erythrorhiza	x		x	
	Drosera gigantea	x			
	Drosera glanduligera	x			x
	Drosera heterophylla	x			
	Drosera leucoblasta	x			x
	Drosera macrantha	x		x	x
	Drosera menziesii	x		x	
	Drosera pallida	x		x	x
	Drosera platystigma	x		x	x
	Drosera pulchella	x			
	Drosera stolonifera	x		x	
	Drosera stricticaulis	x			
	Drosera sp. Climbing	x		x	x
	Drosera sp.	x	x	x	x
CRASSULACEAE	*Crassula colorata*	x			x
	Crassula decumbens	x			x
	Crassula decumbens var. *decumbens*	x			x
	Crassula peduncularis	x		x	
	Crassula sp.	x		x	x
PITTOSPORACEAE	*Billardiera fraseri*			x	
	Billardiera floribunda	x			
	Billardiera fusiformis	x	x	x	x
	Billardiera heterophylla	x			
	Billardiera variifolia	x		x	x
	Billardiera sp.	x			x
	Chaeiranthera preissiana	x			x
	Marianthus bicolor	x			x
	Marianthus drummondianus	x		x	x
	Marianthus sp.	x			x
BYBLIDACEAE	*Byblis gigantea* (P3)	x		x	
ROSACEAE	*Acaena echinata*	x	x		
FABACEAE	*Acacia alata*	x		x	x
	Acacia alata var. *alata*	x		x	x
	Acacia applanata			x	
	Acacia barbinervis subsp. *barbinervis*	x		x	x
	Acacia browniana	x	x	x	x
	Acacia browniana var. *browniana*	x			x
	Acacia browniana var. *endlicheri*	x		x	x
	Acacia browniana var. *intermedia*	x			x
	Acacia celastrifolia	x	x	x	x
	Acacia deflexa (P3)	x			
	Acacia dentifera	x			x
	Acacia dilatata	x			x
	Acacia divergens	x			x
	Acacia drummondii	x			
	Acacia drummondii subsp. *candolleana*	x		x	x
	Acacia drummondii subsp. *drummondii*	x	x	x	x
	Acacia drummondii subsp. *elegans*	x			x
	Acacia ericifolia	x			x
	Acacia extensa	x			x
	Acacia gemina	x			x
	Acacia gilbertii	x		x	x
	Acacia horridula (P3)	x			x

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
FABACEAE	*Acacia huegelii*	x			x
(continued)	*Acacia incurva*	x		x	
	* *Acacia iteaphylla*	x			
	Acacia lasiocarpa	x			x
	Acacia lateriticola	x	x	x	x
	Acacia leptospermoides	x			
	Acacia microbotrya	x			
	Acacia myrtifolia	x			x
	Acacia nervosa	x		x	x
	Acacia obovata	x		x	
	Acacia preissiana	x		x	x
	Acacia pulchella	x	x	x	x
	Acacia pulchella var. *glaberrima*	x		x	x
	Acacia pulchella var. *pulchella*	x			x
	* *Acacia pycnantha*	x			
	Acacia saligna	x	x	x	x
	Acacia stenoptera	x		x	x
	Acacia urophylla	x			x
	Acacia willdenowiana	x		x	x
	Acacia sp.	x		x	x
	Aotus sp.	x			x
	Bossiaea aquifolium	x			x
	Bossiaea aquifolium subsp. aquifolium	x			x
	Bossiaea eriocarpa	x		x	x
	Bossiaea linophylla	x			
	Bossiaea ornata	x	x	x	x
	Bossiaea pulchella	x			x
	Bossiaea rufa	x			
	Bossiaea spinescens	x			x
	Bossiaea sp.	x		x	x
	Callistachys lanceolata	x			
	Chorizema aciculare	x			x
	Chorizema cordatum	x		x	x
	Chorizema dicksonii	x			x
	Chorizema ilicifolium	x		x	x
	Chorizema rhombeum	x		x	
	Chorizema sp.	x			x
	Daviesia cordata	x			x
	Daviesia costata	x			
	Daviesia decurrens	x		x	x
	Daviesia divaricata	x			
	Daviesia incrassata	x		x	x
	Daviesia incrassata subsp. *incrassata*	x		x	x
	Daviesia longifolia	x		x	x
	Daviesia nudiflora	x		x	x
	Daviesia physodes	x			x
	Daviesia polyphylla	x			
	Daviesia preissii	x	x	x	x
	Daviesia rhombifolia	x		x	x
	Daviesia sp.	x		x	x
	Dillwynia laxiflora	x		x	x
	Gastrolobium bilobum	x		x	x
	Gastrolobium calycinum	x		x	x
	Gastrolobium dilatatum	x			x
	Gastrolobium hookeri	x			x
	Gastrolobium retusum	x			x
	Gastrolobium sp. Prostrate Boddington (M. Hislop 2130) (P1)	x	x	x	
	Gastrolobium sp.	x		x	x
	Gastrolobium spinosum	x	x	x	x
	Gompholobium capitatum	x		x	x
	Gompholobium confertum	x			x
	Gompholobium cyaninum	x			x
	Gompholobium knightianum	x		x	x
	Gompholobium marginatum	x	x	x	x

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Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
FABACEAE	*Gompholobium ovatum*	x			
(continued)	*Gompholobium polymorphum*	x	x	x	x
	Gompholobium preissii	x	x	x	x
	Gompholobium scabrum	x			x
	Gompholobium tomentosum	x		x	x
	Gompholobium venustum	x		x	x
	Gompholobium sp.	x		x	x
	Hardenbergia comptoniana	x	x	x	x
	Hovea chorizemifolia	x	x	x	x
	Hovea elliptica	x			
	Hovea pungens	x		x	
	Hovea trisperma	x	x	x	x
	Hovea sp.	x			x
	Isotropis cuneifolia	x		x	x
	Isotropis cuneifolia subsp. *cuneifolia*	x			
	Jacksonia alata	x			x
	Jacksonia furcellata	x			
	Jacksonia racemosa	x			
	Kennedia coccinea	x		x	x
	Kennedia microphylla	x			
	Kennedia prostrata	x	x	x	x
	Kennedia sp.	x		x	x
	Labichea lanceolata	x			x
	Labichea punctata	x	x	x	x
	* *Lotus angustissimus*	x			x
	* *Lotus subbiflorus*	x	x		x
	* *Lotus uliginosus*	x			
	* *Lotus* sp.	x			x
	* *Lupinus* sp.	x			x
	* *Medicago polymorpha*	x			x
	* *Medicago* sp.	x		x	x
	Mirbelia dilatata	x			
	Mirbelia floribunda	x			
	Mirbelia spinosa	x			x
	Nemcia sp.	x			x
	Paraserianthes lophantha	x			x
	Pultenaea ericifolia	x			x
	Pultenaea pauciflora (T, V)	x		x	
	Pultenaea reticulata	x			x
	Pultenaea skinneri (P4)	x			
	Sphaerolobium medium	x		x	x
	Sphaerolobium vimineum	x		x	x
	Sphaerolobium sp.	x			x
	Templetonia drummondii	x		x	x
	* *Trifolium angustifolium*	x	x		x
	* *Trifolium arvense*	x			x
	* *Trifolium arvense* var. *arvense*	x	x		x
	* *Trifolium campestre*	x		x	x
	* *Trifolium campestre* var. *campestre*	x	x	x	x
	* *Trifolium dubium*	x		x	x
	* *Trifolium glomeratum*	x			x
	* *Trifolium hirtum*	x			x
	* *Trifolium* ?*incarnatum*	x			
	* *Trifolium subterraneum*	x			x
	* *Trifolium* sp.	x	x	x	x
	Viminaria juncea	x		x	x
	Fabaceae sp.	x		x	x
GERANIACEAE	* *Erodium botrys*	x			x
	* *Erodium cicutarium*	x			x
	Erodium cygnorum	x			x
	* *Erodium moschatum*	x			
	Erodium sp.	x			x
	* *Geranium molle*	x	x		
	Geranium retrorsum	x			

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy		*Species*	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
GERANIACEAE		*Geranium solanderi*	x			
(continued)		*Geranium* sp.	x			x
		Pelargonium ?havlasae	x			x
		Pelargonium littorale	x			x
		Pelargonium sp.	x			x
OXALIDACEAE	*	*Oxalis compressa*	x		x	
		Oxalis corniculata	x		x	x
	*	*Oxalis pes-caprae*	x			x
		Oxalis sp.	x	x	x	x
LINACEAE		*Linum marginale*	x		x	x
RUTACEAE		*Asterolasia pallida*	x		x	
		Boronia aff. *busselliana*	x			
		Boronia crenulata	x		x	x
		Boronia crenulata var. *crenulata*	x			
		Boronia aff. *defoliata*	x			
		Boronia fastigiata	x		x	x
		Boronia molloyae	x			
		Boronia ovata	x			x
		Boronia tenuis (P4)	x		x	
		Boronia sp.	x		x	x
		Diplolaena drummondii	x			
		Diplolaena microcephala	x			
		Philotheca spicata	x		x	x
		Rutaceae sp.	x			x
POLYGALACEAE		*Comesperma calymega*	x		x	x
		Comesperma ciliatum	x		x	
		Comesperma flavum	x			x
		Comesperma polygaloides	x		x	
		Comesperma virgatum	x		x	x
		Comesperma volubile	x			
		Comesperma sp.	x		x	x
EUPHORBIACEAE		*Amperea ericoides*	x			
		Monotaxis bracteata	x			x
		Monotaxis grandiflora var. *grandiflora*	x		x	x
		Monotaxis occidentalis	x		x	x
		Monataxis sp.	x			
		Euphorbiaceae sp.	x			x
PHYLLANTHACEAE		*Phyllanthus calycinus*	x	x	x	x
		Poranthera huegelii	x		x	
		Poranthera microphylla	x		x	x
CELASTRACEAE		*Stackhousia huegelii*	x			
		Stackhousia monogyna	x	x	x	x
		Stackhousia pubescens	x			
		Stackhousia scoparia	x			
		Stackhousia sp.	x			
		Tripterococcus brunonis	x		x	x
SAPINDACEAE		*Dodonaea ceratocarpa*	x			x
		Dodonaea pinifolia	x			
		Dodonaea viscosa	x			x
		Dodonaea viscosa subsp. *angustissima*	x			x
RHAMNACEAE		*Cryptandra arbutiflora*	x		x	x
		Cryptandra nutans	x			
		Cryptandra aff. *polyclada*	x			
		Papistylus intropubens (P1)	x		x	
		Stenanthemum coronatum	x		x	
		Stenanthemum ?nanum	x			x

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	*Species*	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
RHAMNACEAE	*Stenanthemum tridentatum*	x			x
(continued)	*Trymalium odoratissimum* subsp. *odoratissimum*	x	x		x
	Trymalium ledifolium	x	x	x	x
	Trymalium sp.	x		x	
ELAEOCARPACEAE	*Platytheca galioides*	x			
	Tetratheca confertifolia	x			x
	Tetratheca hirsuta	x	x	x	x
	Tetratheca hispidissima	x		x	x
	Tetratheca nuda	x		x	x
	Tetratheca pilifera (P3)	x		x	
	Tetratheca virgata	x		x	
	Tetratheca sp.	x		x	x
	Tremandra diffusa	x			
	Tremandra stelligera	x			
MALVACEAE	*Lasiopetalum cardiophyllum* (P4)	x		x	x
	Lasiopetalum floribundum	x	x		x
	Lasiopetalum glabratum	x			x
	Lasiopetalum glutinosum	x			
	Lasiopetalum sp.	x		x	x
	Thomasia foliosa	x		x	x
	Thomasia grandiflora	x			
	Thomasia paniculata	x			
	Thomasia pauciflora	x			
	Malvaceae sp.	x			x
DILLENIACEAE	*Hibbertia acerosa*	x		x	x
	Hibbertia amplexicaulis	x	x	x	x
	Hibbertia commutata	x	x	x	x
	Hibbertia aff. *commutata* (hairy form)	x		x	x
	Hibbertia cunninghamii	x			
	Hibbertia diamesogenos	x	x		x
	Hibbertia glomerata	x			
	Hibbertia glomerata subsp. glomerata	x		x	x
	Hibbertia huegelii	x			x
	Hibbertia hypericoides	x	x	x	x
	Hibbertia lasiopus	x		x	x
	Hibbertia microphylla	x		x	
	Hibbertia mylnei	x			x
	Hibbertia ovata	x			x
	Hibbertia perfoliata	x		x	x
	Hibbertia pilosa	x	x		x
	Hibbertia polystachya	x			
	Hibbertia quadricolor	x			x
	Hibbertia serrata	x		x	x
	Hibbertia silvestris	x			
	Hibbertia spicata	x		x	x
	Hibbertia spicata subsp. *spicata*	x		x	x
	Hibbertia subvaginata	x		x	x
	Hibbertia vaginata	x			
	Hibbertia sp. (JK150)	x			x
	Hibbertia sp.	x		x	x
VIOLACEAE	*Hybanthus floribundus*	x		x	x
THYMELAEACEAE	*Pimelea argentea*	x			
	Pimelea ciliata	x	x	x	x
	Pimelea imbricata	x	x		
	Pimelea imbricata var. *piligera*	x		x	
	Pimelea rosea	x			x
	Pimelea suaveolens	x	x	x	x
	Pimelea sylvestris	x			
	Pimelea sp.	x	x		x

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Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
MYRTACEAE	*Agonis flexuosa*	x			
	Astartea scoparia	x			x
	Babingtonia camphorosmae	x		x	
	Beaufortia macrostemon	x			x
	Beaufortia sp.	x			
	Calothamnus lateralis	x			x
	Calothamnus planifolius	x		x	x
	Calothamnus quadrifidus	x		x	x
	Calothamnus quadrifidus subsp. *angustifolius*	x			
	Calothamnus quadrifidus subsp. *teretifolius* (P4)	x			x
	Calothamnus sanguineus	x			x
	Calothamnus sp.	x		x	x
	Calytrix flavescens	x			
	Calytrix leschenaultii	x			
	Calytrix simplex subsp. *simplex* (P1)	x		x	
	Corymbia calophylla	x	x	x	x
PL	*Corymbia maculata*	x			
	Darwinia citriodora	x			x
	Darwinia thymoides	x			
	Ericomyrtus serpyllifolia	x			
	Eucalyptus accedens	x	x		x
	Eucalyptus aspersa	x		x	x
PL	*Eucalyptus diversicolor*	x			
	Eucalyptus drummondii	x		x	x
PL	*Eucalyptus laeliae*	x			x
	Eucalyptus latens	x		x	
	Eucalyptus marginata	x	x	x	x
	Eucalyptus megacarpa	x			
	Eucalyptus patens	x	x	x	x
PL	*Eucalyptus resinifera*	x			x
	Eucalyptus rudis	x	x	x	x
PL	*Eucalyptus sideroxylon*	x			x
	Eucalyptus wandoo	x	x	x	x
	Eucalyptus sp.	x		x	x
	Hypocalymma angustifolium	x		x	x
	Hypocalymma cordifolium	x			x
	Hypocalymma robustum	x			x
	Hypocalymma sp.	x			x
	Kunzea baxteri	x			x
	Kunzea ericifolia	x			x
	Kunzea glabrescens	x			x
	Kunzea recurva	x			x
	Kunzea sp.	x			x
	Leptospermum erubescens	x	x		x
*	*Leptospermum laevigatum*	x			x
	Leptospermum sp.	x			x
	Melaleuca acutifolia	x			x
	Melaleuca aspalathoides	x			x
	Melaleuca fulgens	x			x
	Melaleuca holosericea	x			x
	Melaleuca incana subsp. *incana*	x			x
	Melaleuca lateriflora	x			
	Melaleuca lateritia	x	x		x
	Melaleuca parviceps	x		x	x
	Melaleuca preissiana	x			x
	Melaleuca radula	x			x
	Melaleuca rhaphiophylla	x	x	x	
	Melaleuca trichophylla	x			x
	Melelauca tuberculata var. *tuberculata*	x			x
	Melaleuca viminea	x		x	x
	Melaleuca viminea subsp. *viminea*	x		x	x
	Melaleuca sp.	x		x	x
	Pericalymma ellipticum	x		x	x
	Pericalymma ellipticum var. *ellipticum*	x		x	x
	Regelia ciliata	x			x

APPENDIX H: VASCULAR PLANT SPECIES RECORDED ON SOUTH32 LEASES AND DURING THE RECENT ASSESSMENT OF WMDE INFILL AREAS AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	*Species*	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
MYRTACEAE	*Taxandria linearifolia*	x			x
(continued)	*Verticordia densiflora*	x			
	Verticordia huegelii	x			
	Verticordia pennigera	x		x	
	Verticordia picta	x			
	Verticordia plumosa	x			x
	Verticorida plumosa var. *plumosa*	x			x
	Verticordia serrata	x			
	Verticordia sp.	x			x
	Myrtaceae sp.	x			x
ONAGRACEAE	*Epilobium billardiereanum*	x			x
HALORAGACEAE	*Glischrocaryon aureum*	x	x	x	x
	Gonocarpus benthamii	x			
	Gonocarpus cordiger	x		x	x
	Gonocarpus diffusus	x			
	Haloragis sp. (QMP28)	x		x	
ARALIACEAE	*Hydrocotyle callicarpa*	x		x	x
	Hydrocotyle sp.	x		x	x
	Trachymene ornata	x			
	Trachymene pilosa	x	x	x	x
APIACEAE	*Apium prostratum*	x			
	Daucus glochidiatus	x	x	x	x
	Eryngium pinnatifidum	x		x	
	Eryngium pinnatifidum subsp. *pinnatifidum*	x		x	
	Pentapeltis peltigera	x		x	x
	Pentapeltis silvatica	x			
	Platysace commutata				
	Platysace compressa	x			
	Platysace filiformis	x			
	Platysace juncea	x			
	Platysace tenuissima	x			x
	Platysace teres	x			
	Platysace sp.	x			
	Trachymene pilosa	x			
	Xanthosia atkinsoniana	x		x	x
	Xanthosia candida	x	x	x	x
	Xanthosia huegelii	x		x	x
	Xanthosia sp. (KA257)	x		x	x
	Apiaceae sp.	x		x	x
ERICACEAE	*Andersonia caerulea*	x			x
	Andersonia involucrata	x			x
	Andersonia latiflora	x		x	x
	Andersonia lehmanniana	x		x	x
	Andersonia sp. (DAH80131)	x			
	Andersonia sp.	x		x	x
	Astroloma ciliatum	x		x	x
	Astroloma compactum	x		x	
	Astroloma drummondii	x		x	x
	Astroloma epacridis	x		x	x
	Astroloma pallidum	x	x	x	x
	Astroloma aff. *pallidum* (ASW 12516)	x			
	Astroloma prostratum	x			x
	Astroloma sp.	x	x	x	x
	Conostephium sp.	x		x	
	Leucopogon australis	x		x	
	Leucopogon capitellatus	x	x	x	x
	Leucopogon conostephioides	x			x
	Leucopogon cordatus	x		x	x
	Leucopogon glabellus	x		x	x
	Leucopogon glabellus (glabrous form)	x		x	

APPENDIX H: VASCULAR PLANT SPECIES RECORDED ON SOUTH32 LEASES AND DURING THE RECENT ASSESSMENT OF WMDE INFILL AREAS AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
ERICACEAE	*Leucopogon glabellus* (hairy form)	x		x	
(continued)	*Leucopogon hirsutus*	x			
	Leucopogon nutans	x	x	x	x
	Leucopogon oxycedrus	x			
	Leucopogon parviflorus	x		x	
	Leucopogon propinquus	x	x	x	x
	Leucopogon pubescens	x			
	Leucopogon pulchellus	x		x	x
	Leucopogon sprengelioides	x			x
	Leucopogon tenuis	x			x
	Leucopogon verticillatus	x		x	
	Leucopogon sp. Boddington (D. Halford 80746)	x			
	Leucopogon sp. (ASW 12691)	x			
	Leucopogon sp. (ASW 12539a)	x			
	Leucopogon sp. (JK 10)	x	x	x	x
	Lysinema ciliatum	x			
	Styphelia tenuiflora	x		x	x
	Ericaceae sp.	x		x	x
PRIMULACEAE	* *Lysimachia arvensis*	x	x	x	x
	Samolus junceus	x			
LOGANIACEAE	*Mitrasacme* sp.	x			x
	Orianthera campanulata	x			
	Orianthera serpyllifolia	x		x	x
	Phyllangium divergens	x			x
	Phyllangium paradoxum	x	x	x	x
GENTIANACEAE	* *Centaurium erythraea*	x		x	x
APOCYNACEAE	* *Gomphocarpus fruticosus*	x			
BORAGINACEAE	*Halgania anagalloides* var. Southern (A.E. Orchard 1609)	x			
	Halgania corymbosa (P3)	x			x
LAMIACEAE	*Hemiandra pungens*	x		x	x
	Hemiandra sp. (DAH 808167)	x			
	Hemiandra sp.	x			x
	Hemigenia pritzelii	x		x	x
	Hemigenia rigida (P1)	x		x	
	Hemigenia sericea	x			
	* *Mentha suaveolens*	x			x
	* *Stachys arvensis*	x			x
SOLANACEAE	* *Solanum nigrum*	x			x
	* *Solanum* sp.	x			x
OROBANCHACEAE	* *Bellardia trixago*	x		x	x
	* *Bellardia viscosa*	x			
	* *Orobanche minor*	x			x
	* *Parentucellia latifolia*	x			x
PLANTAGINACEAE	* *Plantago* sp.	x			x
	* *Veronica* sp.	x			x
LENTIBULARIACEAE	*Utricularia multifida*	x			
	Utricularia menziesii	x			
RUBIACEAE	* *Galium divaricatum*	x		x	x
	* *Galium murale*	x		x	x
	Opercularia apiciflora	x		x	x
	Opercularia echinocephala	x	x	x	x
	Opercularia hispidula	x		x	x
	Opercularia vaginata	x		x	x
	Opercularia sp.	x		x	x

APPENDIX H: VASCULAR PLANT SPECIES RECORDED ON SOUTH32 LEASES AND DURING THE RECENT ASSESSMENT OF WMDE INFILL AREAS AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
CAMPANULACEAE	*Isotoma hypocrateriformis*	x	x	x	x
	Lobelia anceps	x		x	x
	Lobelia gibbosa	x			x
	Lobelia heterophylla	x		x	x
	Lobelia rhombifolia	x		x	x
	Lobelia rhytidosperma	x			x
	Lobelia sp. (DAH 80593)	x			
	Lobelia sp.	x		x	x
	* *Monopsis debilis*	x			x
	* *Wahlenbergia capensis*	x			x
	Wahlenbergia multicaulis	x			
	Wahlenbergia preissii	x		x	x
	Wahlenbergia sp.	x			x
GOODENIACEAE	*Dampiera alata*	x	x	x	x
	Dampiera eriocephala	x			
	Dampiera hederacea	x			
	Dampiera linearis	x		x	x
	Dampiera spicigera	x		x	
	Dampiera lavandulacea	x			
	Dampiera sp.	x			x
	Goodenia coerulea	x		x	
	Goodenia convexa	x			x
	Goodenia eatoniana	x			
	Goodenia aff. *hassallii* (JK 36)	x			
	Goodenia incana	x			
	Goodenia katabudjar (P3)	x		x	x
	Goodenia pusilla	x			
	Goodenia sp. (DAH 808129)	x			
	Goodenia sp. (DAH 810182)	x			
	Lechenaultia biloba	x	x	x	x
	Lechenaultia expansa	x			
	Lechenaultia sp.	x			x
	Scaevola calliptera	x	x	x	x
	Scaevola glandulifera	x		x	
	Scaevola pilosa	x		x	
	Scaevola platyphylla	x		x	x
	Scaevola striata	x			
	Scaevola sp.	x		x	
	Velleia trinervis	x		x	x
	Goodeniaceae sp.	x		x	x
STYLIDIACEAE	*Levenhookia dubia*	x			x
	Levenhookia pusilla	x	x	x	x
	Levenhookia stipitata	x		x	x
	Levenhookia sp.	x		x	x
	Stylidium adnatum	x			
	Stylidium affine	x	x	x	x
	Stylidium amoenum	x	x	x	x
	Stylidium brunonianum	x		x	x
	Stylidium bulbiferum	x		x	x
	Stylidium calcaratum	x		x	x
	Stylidium caricifolium	x			
	Stylidium ciliatum	x	x	x	x
	Stylidium crassifolium	x		x	
	Stylidium dichotomum	x		x	x
	Stylidium diversifolium	x			
	Stylidium glaucum	x			
	Stylidium hispidum	x			x
	Stylidium imbricatum	x			
	Stylidium junceum	x		x	x
	Stylidium lateriticola	x			x
	Stylidium lineatum	x			x
	Stylidium marradongense (P3)	x		x	x
	Stylidium petiolare	x			

APPENDIX H: VASCULAR PLANT SPECIES RECORDED ON SOUTH32 LEASES AND DURING THE RECENT ASSESSMENT OF WMDE INFILL AREAS AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species; PL denotes planted trees; T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)
Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	Species	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
STYLIDIACEAE	*Stylidium piliferum*	x	x	x	x
(continued)	*Stylidium pulchellum*	x			
	Stylidium repens	x		x	x
	Stylidium rhynchocarpum	x			
	Stylidium schoenoides	x		x	x
	Stylidium spathulatum	x			
	Stylidium tenue	x			x
	Stylidium uniflorum	x		x	
	Stylidium sp.	x	x	x	x
ASTERACEAE	* *Arctotheca calendula*	x	x	x	x
	Asteridea gracilis (P3)	x			
	Asteridea pulverulenta	x			x
	Blennospora drummondii	x			
	Brachyscome iberidifolia	x			x
	* *Carduus pycnocephalus*	x			x
	* *Carduus* sp.	x			
	* *Cirsium vulgare*	x			x
	* *Conyza bonariensis*	x			x
	* *Conyza sumatrensis*	x			x
	* *Conzya* sp.	x			x
	* *Cotula bipinnata*	x			x
	* *Cotula coronopifolia*	x		x	x
	Craspedia variabilis	x		x	x
	* *Dittrichia graveolens*	x			x
	Euchiton sphaericus	x			x
	Gnaphalium sp.	x			x
	Gnephosis drummondii	x			
	Gnephosis tenuissima	x			x
	Helichrysum leucopsideum	x		x	
	Helichrysum luteoalbum	x	x	x	x
	Hyalosperma cotula	x	x	x	x
	Hyalosperma demissum	x			x
	Hyalosperma simplex subsp. *simplex*	x			x
	* *Hypochaeris glabra*	x	x	x	x
	* *Hypochaeris radicata*	x	x		x
	* *Lactuca serriola*	x			x
	Lagenophora huegelii	x	x	x	x
	Millotia tenuifolia	x		x	x
	Millotia tenuifolia var. *tenuifolia*	x		x	x
	Olearia paucidentata	x		x	
	Pithocarpa ramosa	x			
	Podolepis capillaris	x		x	x
	Podolepis gracilis	x	x	x	x
	Podolepis lessonii	x	x	x	x
	Podolepis sp.	x		x	x
	Podotheca angustifolia	x		x	x
	Podotheca chrysantha	x		x	
	Podotheca gnaphalioides	x		x	x
	Podotheca sp.	x		x	x
	Pogonolepis stricta	x			x
	Pterochaeta paniculata	x		x	x
	Quinetia urvillei	x			x
	Rhodanthe citrina	x		x	x
	Rhodanthe corymbosa	x		x	x
	Rhodanthe manglesii	x		x	x
	Rhodanthe sp.	x		x	x
	Senecio diaschides	x	x	x	x
	Senecio hispidulus	x		x	x
	Senecio leucoglossus (P4)	x		x	x
	Senecio pinnatifolius	x		x	x
	Senecio quadridentatus	x		x	x
	* *Senecio vulgaris*	x			x
	Senecio sp. (ASW 12618)	x			
	Senecio sp. (JK 163)	x			

APPENDIX H: VASCULAR PLANT SPECIES RECORDED ON SOUTH32 LEASES AND DURING THE RECENT ASSESSMENT OF WMDE INFILL AREAS AND BAUXITE TRANSPORT CORRIDOR, 2018

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Note: # based on Boddington Bauxite Mine Database (2018)

Familiy	*Species*	WME Boddington & Collie	WMDE and BTC 2018	WMDE and BTC 1980 to 2018 Analogue Areas #	WMDE and BTC 1980 to 2018 Rehabilitation Areas #
ASTERACEAE	*Senecio* sp.	x		x	x
(continued)	*Siloxerus filifolius*	x			
	Siloxerus multiflorus	x			x
	* *Silybum marianum*	x			
	* *Sonchus asper*	x		x	x
	* *Sonchus oleraceus*	x	x	x	x
	* *Sonchus* sp.	x		x	x
	* *Symphyotrichum squamatum*	x			
	Trichocline spathulata	x	x	x	x
	* *Ursinia anthemoides* subsp. *anthemoides*	x	x	x	x
	Vellereophyton dealbatum	x		x	x
	Waitzia acuminata	x			x
	Waitzia nitida	x			
	Waitzia suaveolens	x	x		x
	Waitzia sp.	x			x
	Xerochrysum bracteatum	x			
	Xerochrysum macranthum	x		x	x
	Asteraceae sp.	x		x	x

APPENDIX I: VASCULAR PLANT SPECIES RECORDED ON THE COLLIE REFINERY LEASE

Note: Species listed were extracted from previous baseline studies within the Refinery Lease Area (Mattiske Consulting Pty Ltd 1999, 2014)
* denotes introduced species and ^ denotes planted species

Family	Species		WAR0701 1999	WOR1403 2014
DENNSTAEDTIACEAE	*Pteridium*	*esculentum*	x	x
LINDSAEACEAE	*Lindsaea*	*linearis*	x	x
ZAMIACEAE	*Macrozamia*	*riedlei*	x	x
PODOCARPACEAE	*Podocarpus*	*drouynianus*	x	x
POACEAE	* *Aira*	*caryophyllea*	x	
	Amphipogon	*amphipogonoides*	x	
	* *Briza*	*maxima*	x	
	Neurachne	*alopecuroidea*	x	x
	* *Pentameris*	*airoides*	x	
	Rytidosperma	*caespitosum*	x	
	Rytidosperma	sp.	x	
	Tetrarrhena	*laevis*	x	x
CYPERACEAE	*Baumea*	*rubiginosa*		x
	Cyathochaeta	*avenacea*	x	x
	Gahnia	*decomposita*	x	x
	Gahnia	*trifida*	x	
	Lepidosperma	*squamatum*	x	
	Lepidosperma	*tenue*	x	
	Lepidosperma	*tetraquetrum*	x	
	Lepidosperma	*tuberculatum*	x	
	Mesomelaena	*tetragona*	x	
	Morelotia	*octandra*	x	x
	Netrostylis	*capillaris*	x	
	Netrostylis	sp. Jarrah Forest (R Davis 7391)		x
RESTIONACEAE	*Desmocladus*	*fasciculatus*	x	x
	Hypolaena	*exsulca*	x	x
	Leptocarpus	*tenax*	x	
	Lepyrodia	*macra*	x	
	Loxocarya	*cinerea*	x	
ANARTHRIACEAE	*Lyginia*	*barbata*	x	
JUNCACEAE	*Juncus*	*pallidus*	x	
ASPARAGACEAE	*Chamaescilla*	*corymbosa*	x	x
	Laxmannia	*squarrosa*	x	
	Lomandra	*caespitosa*	x	x
	Lomandra	*drummondii*	x	
	Lomandra	*hermaphrodita*	x	
	Lomandra	*integra*		x
	Lomandra	*micrantha*	x	
	Lomandra	*preissii*	x	x
	Lomandra	? *preissii*	x	
	Lomandra	*purpurea*	x	
	Lomandra	*sericea*	x	x
	Lomandra	*sonderi*	x	
	Lomandra	spartea		x
	Lomandra	sp.	x	x
	Thysanotus	*dichotomus*	x	x
	Thysanotus	*fastigiatus*		x
	Thysanotus	*multiflorus*	x	x
	Thysanotus	*tenellus*	x	
	Thysanotus	*thyrsoideus*	x	

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Note: Species listed were extracted from previous baseline studies within the Refinery Lease Area (Mattiske Consulting Pty Ltd 1999, 2014)
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Family	Species		WAR0701 1999	WOR1403 2014
DASYPOGONACEAE	*Dasypogon*	*bromeliifolius*	x	
	Kingia	*australis*	x	
XANTHORRHOEACEAE	*Xanthorrhoea*	*gracilis*	x	x
	Xanthorrhoea	*preissii*	x	x
HEMEROCALLIDACEAE	*Agrostocrinum*	*scabrum*	x	
	Dianella	*revoluta*	x	
	Johnsonia	*lupulina*	x	
	Tricoryne	*elatior*	x	
HAEMODORACEAE	*Conostylis*	*aculeata*	x	
	Conostylis	*aculeata* subsp. *aculeata*		x
	Conostylis	*seminuda*	x	
	Conostylis	*serrulata*	x	x
	Conostylis	*setigera*	x	x
	Conostylis	*setosa*	x	x
	Haemodorum	*spicatum*	x	
	Haemodorum	sp.	x	
HYPOXIDACEAE	*Pauridia*	*glabella*	x	
IRIDACEAE	*Patersonia*	*babianoides*	x	
	Patersonia	*occidentalis*	x	x
	Patersonia	*pygmaea*	x	
	Patersonia	*rudis*	x	
ORCHIDACEAE	*Caladenia*	*flava*	x	x
	Caladenia	*macrostylis*	x	
	Caladenia	*reptans*		x
	Caladenia	*reptans* subsp. *reptans*	x	
	Caladenia	sp.	x	x
	Cyanicula	*sericea*	x	
	Elythranthera	*brunonis*	x	
	Pterostylis	*pyramidalis*	x	x
	Pterostylis	*recurva*	x	x
	Pterostylis	*vittata*	x	x
	Pyrorchis	*nigricans*	x	x
	Thelymitra	? *crinita*	x	
	Thelymitra	sp.	x	x
	Orchidaceae	sp.	x	x
CASUARINACEAE	*Allocasuarina*	*fraseriana*	x	x
	Allocasuarina	*humilis*	x	
PROTEACEAE	*Adenanthos*	*obovatus*	x	
	Banksia	*dallanneyi*	x	
	Banksia	*dallanneyi* var. *dallanneyi*		x
	Banksia	*grandis*	x	x
	Banksia	*littoralis*	x	x
	Banksia	*seminuda*	x	
	Banksia	*sessilis*	x	
	Banksia	*squarrosa* subsp. *squarrosa*	x	
	Conospermum	*capitatum*	x	
	Conospermum	*capitatum* subsp. *capitatum*		x
	Grevillea	*quercifolia*	x	
	Hakea	*amplexicaulis*	x	x
	Hakea	*cyclocarpa*	x	

APPENDIX I: VASCULAR PLANT SPECIES RECORDED ON THE COLLIE REFINERY LEASE

Note: Species listed were extracted from previous baseline studies within the Refinery Lease Area (Mattiske Consulting Pty Ltd 1999, 2014)
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Family	Species		WAR0701 1999	WOR1403 2014
PROTEACEAE	*Hakea*	*incrassata*	x	
(continued)	*Hakea*	*lissocarpha*	x	x
	Hakea	*prostrata*	x	
	Hakea	*ruscifolia*	x	
	Persoonia	*elliptica*	x	
	Persoonia	*longifolia*	x	x
	Synaphea	*petiolaris*	x	
SANTALACEAE	*Leptomeria*	*cunninghamii*	x	
POLYGONACEAE	* *Rumex*	*crispus*	x	
CHENOPODIACEAE	* *Chenopodium*	*glaucum*	x	
AMARANTHACEAE	*Ptilotus*	*manglesii*	x	
MONTIACEAE	*Calandrinia*	*quadrivalvis*	x	
RANUNCULACEAE	*Clematis*	*pubescens*	x	x
	Ranunculus	*colonorum*	x	
LAURACEAE	*Cassytha*	sp.	x	
DROSERACEAE	*Drosera*	*erythrorhiza*	x	
	Drosera	*macrantha*	x	x
	Drosera	*pallida*	x	
	Drosera	*stolonifera*	x	x
	Drosera	sp.	x	x
PITTOSPORACEAE	*Billardiera*	*floribunda*	x	
	Billardiera	*heterophylla*	x	
	Billardiera	*variifolia*	x	
	Marianthus	*drummondianus*	x	x
FABACEAE	*Acacia*	*alata*	x	x
	Acacia	*browniana*	x	
	Acacia	*celastrifolia*	x	x
	Acacia	*divergens*	x	x
	Acacia	*drummondii*	x	
	Acacia	*drummondii* subsp. *candolleana*	x	
	Acacia	*drummondii* subsp. *drummondii*	x	
	Acacia	*extensa*	x	x
	Acacia	*incurva*	x	
	Acacia	*lateriticola*	x	x
	Acacia	*microbotrya*	x	
	Acacia	*myrtifolia*	x	
	Acacia	*obovata*	x	
	Acacia	*pulchella*	x	x
	* *Acacia*	*pycnantha*		x
	Acacia	*saligna*	x	x
	Acacia	*stenoptera*	x	
	Acacia	*willdenowiana*		x
	Acacia	sp.	x	
	Bossiaea	*aquifolium*		x
	Bossiaea	*aquifolium* subsp. *aquifolium*	x	
	Bossiaea	*eriocarpa*	x	
	Bossiaea	*linophylla*	x	
	Bossiaea	*ornata*	x	x
	Callistachys	*lanceolata*	x	

APPENDIX I: VASCULAR PLANT SPECIES RECORDED ON THE COLLIE REFINERY LEASE

Note: Species listed were extracted from previous baseline studies within the Refinery Lease Area (Mattiske Consulting Pty Ltd 1999, 2014)
* denotes introduced species and ^ denotes planted species

Family	Species		WAR0701 1999	WOR1403 2014
FABACEAE	*Chorizema*	*ilicifolium*	x	
(continued)	*Chorizema*	*rhombeum*	x	x
	Daviesia	*cordata*	x	
	Daviesia	*decurrens*	x	
	Daviesia	*divaricata*	x	
	Daviesia	*incrassata*	x	
	Daviesia	*physodes*	x	
	Daviesia	*preissii*	x	
	Gastrolobium	*bilobum*		x
	Gompholobium	*capitatum*	x	
	Gompholobium	*marginatum*	x	
	Gompholobium	*ovatum*	x	
	Hardenbergia	*comptoniana*	x	
	Hovea	*chorizemifolia*	x	
	Hovea	*elliptica*	x	
	Hovea	*trisperma*	x	x
	Isotropis	*cuneifolia*	x	
	Kennedia	*coccinea*	x	
	Kennedia	*prostrata*	x	
	Labichea	*punctata*	x	x
	Mirbelia	*dilatata*	x	x
	Paraserianthes	*lophantha*	x	
	Pultenaea	*skinneri* (P4)	x	
	Sphaerolobium	*medium*	x	x
	* *Trifolium*	*angustifolium*	x	
RUTACEAE	? *Boronia*	aff. *busselliana*	x	
	Boronia	*crenulata*	x	
	Boronia	*fastigiata*	x	x
	Diplolaena	*drummondii*	x	
	Philotheca	*spicata*	x	
POLYGALACEAE	*Comesperma*	*virgatum*	x	x
PHYLLANTHACEAE	*Phyllanthus*	*calycinus*	x	
CELASTRACEAE	*Tripterococcus*	*brunonis*	x	
RHAMNACEAE	*Trymalium*	*ledifolium*	x	x
	Trymalium	*odoratissimum* subsp. *odoratissimum*	x	x
ELAEOCARPACEAE	*Tetratheca*	*hirsuta*	x	x
	Tremandra	*diffusa*	x	
	Tremandra	*stelligera*	x	
MALVACEAE	*Lasiopetalum*	*floribundum*	x	x
	Lasiopetalum	*glabratum*		x
	Thomasia	*grandiflora*	x	
	Thomasia	*paniculata*	x	
DILLENIACEAE	*Hibbertia*	*acerosa*	x	
	Hibbertia	*amplexicaulis*	x	x
	Hibbertia	*commutata*	x	x
	Hibbertia	*cunninghamii*		x
	Hibbertia	*glomerata*	x	
	Hibbertia	*hypericoides*	x	x
	Hibbertia	*lasiopus*	x	
	Hibbertia	*perfoliata*	x	x
	Hibbertia	*silvestris*	x	

APPENDIX I: VASCULAR PLANT SPECIES RECORDED ON THE COLLIE REFINERY LEASE

Note: Species listed were extracted from previous baseline studies within the Refinery Lease Area (Mattiske Consulting Pty Ltd 1999, 2014)
* denotes introduced species and ^ denotes planted species

Family	Species		WAR0701 1999	WOR1403 2014
VIOLACEAE	*Hybanthus*	*debilissimus*	x	
THYMELAEACEAE	*Pimelea*	*ciliata*	x	
	Pimelea	*suaveolens*	x	
	Pimelea	*sylvestris*	x	
MYRTACEAE	*Agonis*	*flexuosa*		x
	Astartea	*scoparia*	x	x
	Babingtonia	*camphorosmae*	x	
	Calothamnus	*quadrifidus*	x	
	Calothamnus	*quadrifidus* subsp. *angustifolius*		x
	Corymbia	*calophylla*	x	x
	Darwinia	*citriodora*		x
	Eucalyptus	*accedens*	x	
	^ *Eucalyptus*	*diversicolor*	x	
	Eucalyptus	*marginata*	x	x
	Eucalyptus	*megacarpa*	x	
	Eucalyptus	*patens*	x	x
	Eucalyptus	*rudis*	x	
	Eucalyptus	*wandoo*	x	
	Hypocalymma	*angustifolium*	x	x
	Hypocalymma	*cordifolium*	x	x
	Kunzea	*ericifolia*	x	
	Melaleuca	*preissiana*	x	
	Melaleuca	*rhaphiophylla*	x	
	Taxandria	*linearifolia*	x	x
HALORAGACEAE	*Gonocarpus*	*benthamii*	x	
	Gonocarpus	*diffusus*	x	
ARALIACEAE	*Trachymene*	*pilosa*	x	x
APIACEAE	*Apium*	*prostratum*	x	
	Daucus	*glochidiatus*	x	
	Pentapeltis	*peltigera*	x	x
	Pentapeltis	*silvatica*	x	
	Platysace	*commutata*	x	
	Platysace	*compressa*	x	
	Platysace	*filiformis*		x
	Platysace	*tenuissima*	x	
	Xanthosia	*atkinsoniana*	x	
	Xanthosia	*candida*	x	x
	Xanthosia	*huegelii*	x	
ERICACEAE	*Andersonia*	*lehmanniana*	x	
	Astroloma	*ciliatum*	x	
	Astroloma	*pallidum*	x	
	Leucopogon	*australis*	x	
	Leucopogon	*capitellatus*	x	x
	Leucopogon	*nutans*	x	
	Leucopogon	*propinquus*	x	x
	Leucopogon	*pubescens*	x	
	Leucopogon	*verticillatus*	x	x
	Styphelia	*tenuiflora*	x	
PRIMULACEAE	* *Lysimachia*	*arvensis*	x	x
LOGANIACEAE	*Orianthera*	*serpyllifolia*	x	x

APPENDIX I: VASCULAR PLANT SPECIES RECORDED ON THE COLLIE REFINERY LEASE

Note: Species listed were extracted from previous baseline studies within the Refinery Lease Area (Mattiske Consulting Pty Ltd 1999, 2014)
* denotes introduced species and ^ denotes planted species

Family	Species		WAR0701 1999	WOR1403 2014
LAMIACEAE	*Hemigenia*	*pritzelii*	x	
RUBIACEAE	*Opercularia*	*apiciflora*	x	
	Opercularia	*echinocephala*	x	x
	Opercularia	*hispidula*	x	
CAMPANULACEAE	*Isotoma*	*hypocrateriformis*	x	
GOODENIACEAE	*Dampiera*	*hederacea*	x	
	Dampiera	*linearis*	x	
	Goodenia	*eatoniana*	x	
	Goodenia	*pusilla*	x	
	Lechenaultia	*biloba*	x	
	Scaevola	*calliptera*	x	x
STYLIDIACEAE	*Levenhookia*	*pusilla*	x	x
	Stylidium	*adnatum*	x	
	Stylidium	*amoenum*	x	
	Stylidium	*calcaratum*	x	
	Stylidium	*hispidum*	x	x
	Stylidium	*piliferum*	x	x
	Stylidium	*rhynchocarpum*	x	x
	Stylidium	*schoenoides*	x	
ASTERACEAE	* *Arctotheca*	*calendula*	x	
	Brachyscome	*iberidifolia*	x	
	* *Carduus*	*sp.*		x
	* *Conyza*	*bonariensis*	x	
	* *Conyza*	*sumatrensis*	x	x
	Craspedia	*variabilis*	x	x
	Euchiton	*sphaericus*	x	
	Hyalosperma	*cotula*	x	
	* *Hypochaeris*	*glabra*	x	x
	Lagenophora	*huegelii*	x	x
	Millotia	*tenuifolia*	x	
	Pithocarpa	*ramosa*	x	
	Pterochaeta	*paniculata*		x
	Rhodanthe	*citrina*	x	
	Senecio	*diaschides*	x	
	Senecio	*hispidulus*	x	x
	Siloxerus	*filifolius*	x	
	* *Symphyotrichum*	*squamatum*	x	
	Trichocline	*spathulata*	x	x
	* *Ursinia*	*anthemoides*	x	
	Waitzia	*nitida*		x

APPENDIX J: VASCULAR PLANT SPECIES RECORDED ON WMDE AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species;
Note: T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)

	Site -Vegetation Types on WMDE and Bauxite Transport Corridor															
Species	**AC**	**AD**	**AY**	**DG**	**G1**	**G2**	**H**	**H2**	**M**	**M2**	**MG**	**P**	**PL**	**S**	**ST**	**Y**
Acacia browniana								x								
Acacia celastrifolia									x			x		x		
Acacia drummondii subsp. drummondii									x		x			x		
Acacia lateriticola									x					x		
Acacia pulchella		x			x		x	x	x	x	x	x		x	x	x
Acacia saligna	x	x					x				x					
Acaena echinata							x		x							
Adenanthos barbiger							x									
Agrostocrinum scabrum					x			x	x			x				
* *Aira caryophyllea*								x	x		x			x		
Allocasuarina fraseriana		x					x	x	x			x		x		
Allocasuarina huegeliana					x	x			x		x					
Amphibromus nervosus	x															
* *Arctotheca calendula*								x	x							
Astroloma pallidum							x		x					x		
Astroloma sp.					x						x					
Austrostipa campylachne					x		x		x			x		x	x	
Austrostipa elegantissima		x		x			x		x	x	x	x		x		
Austrostipa trichophylla									x					x		
* *Avena barbata*	x		x		x	x	x	x	x	x	x	x	x	x	x	
Banksia dallanneyi var. dallanneyi									x					x		
Banksia grandis														x		
Banksia sessilis							x		x			x		x		x
Billardiera fusiformis							x		x							x
Bossiaea ornata							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	
* *Briza minor*		x		x	x		x	x			x			x		
* *Bromus diandrus*					x		x									
* *Bromus madritensis*								x	x		x		x		x	
Chamaescilla corymbosa									x		x					
Cheilanthes sieberi						x	x				x				x	
Clematis pubescens							x		x		x			x	x	

APPENDIX J: VASCULAR PLANT SPECIES RECORDED ON WMDE AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species;
Note: T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)

	Site -Vegetation Types on WMDE and Bauxite Transport Corridor															
Species	**AC**	**AD**	**AY**	**DG**	**G1**	**G2**	**H**	**H2**	**M**	**M2**	**MG**	**P**	**PL**	**S**	**ST**	**Y**
Conostylis setigera									x					x		
Corymbia calophylla		x		x	x	x	x	x	x	x	x	x		x	x	x
Dampiera alata	x															
Daucus glochidiatus								x	x		x			x		
Daviesia preissii									x					x		
Desmocladus fasciculatus									x							
Desmocladus flexuosus					x	x		x	x		x			x		
* *Disa bracteata*									x							
Drosera sp.		x					x									
* *Ehrharta calycina*					x	x			x							
* *Ehrharta longiflora*		x	x		x		x		x		x			x	x	
Eucalyptus accedens										x						
Eucalyptus marginata		x		x	x		x	x	x	x	x	x		x	x	
Eucalyptus patens				x												
Eucalyptus rudis	x	x	x													
Eucalyptus wandoo			x		x		x		x	x	x					x
Gastrolobium sp. Prostrate Boddington (M. Hislop 2130) (P1)																
Gastrolobium spinosum					x											
* *Geranium molle*					x		x							x	x	
Glischrocaryon aureum									x					x		
Gompholobium marginatum					x				x		x			x		x
Gompholobium polymorphum									x							
Gompholobium preissii														x		
Haemodorum laxum					x	x	x									
Haemodorum simplex						x			x		x				x	
Haemodorum sp.		x														
Hakea lissocarpha								x	x		x			x		
Hakea prostrata		x														
Hardenbergia comptoniana									x							
Hibbertia amplexicaulis									x			x		x		
Hibbertia commutata							x			x						
Hibbertia diamesogenos									x			x		x	x	

APPENDIX J: VASCULAR PLANT SPECIES RECORDED ON WMDE AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species;
Note: T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)

		Site -Vegetation Types on WMDE and Bauxite Transport Corridor															
	Species	**AC**	**AD**	**AY**	**DG**	**G1**	**G2**	**H**	**H2**	**M**	**M2**	**MG**	**P**	**PL**	**S**	**ST**	**Y**
	Hibbertia hypericoides									x							
	Hibbertia pilosa		x			x		x		x		x	x		x		
	Hibbertia trisperma							x									
*	*Hordeum hystrix*	x															
	Hovea chorizemifolia														x		
	Hyalosperma cotula							x		x							
*	*Hypochaeris glabra*	x	x			x		x	x	x	x	x			x	x	
*	*Hypochaeris radicata*									x							
	Isotoma hypocrateriformis														x		
	Kennedia prostrata		x					x		x	x	x			x	x	
	Labichea punctata														x		
	Lagenophora huegelii							x		x					x		x
	Lasiopetalum floribundum											x					
	Lechenaultia biloba									x					x		
	Lepidosperma leptostachyum							X				X					
	Lepidosperma leptostachyum sens. Lat.		x					x				x					
	Lepidosperma sp.							x	x	x					x	x	
	Lepidosperma squamatum						x									x	
	Leptospermum erubescens														x		
	Leucopogon capitellatus								x	x					x		
	Leucopogon nutans							x		x					x		
	Leucopogon propinquus		x					x		x					x	x	x
	Leucopogon sp. (JK 10)																x
	Levehookia pusilla									x							
*	*Lolium perenne*	x				x		x		x							
*	*Lolium rigidum*			x		x			x	x				x	x	x	
	Lomandra hermaphrodita														x		
	Lomandra preissii									x			x		x		
	Lomandra sericea									x							
	Lomandra spartea							x					x				
*	*Lotus subbiflorus*	x								x							
*	*Lysimachia arvensis*	x			x	x				x		x	x				
	Macrozamia riedlei		x			x		x	x	x		x	x		x	x	x

APPENDIX J: VASCULAR PLANT SPECIES RECORDED ON WMDE AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species;
Note: T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)

		Site -Vegetation Types on WMDE and Bauxite Transport Corridor														
	Species	**AC**	**AD**	**AY**	**DG**	**G1**	**G2**	**H**	**H2**	**M**	**M2**	**MG**	**P**	**PL**	**S**	**ST**	**Y**
	Melaleuca lateritia	x															
	Melaleuca rhaphiophylla	x															
	Morelotia octandra		x					x		x		x			x		
	Neurachne alopecuroidea					x		x		x		x	x		x		
	Opercularia echinocephala														x		
	Orchidaceae sp.		x					x									
	Oxalis sp.			x	x			x	x	x		x			x	x	
	Persoonia longifolia									x							
*	*Petrorhagia dubia*											x	x		x		
	Phyllangium paradoxum									x							
	Phyllanthus calycinus					x	x	x	x	x	x	x			x	x	
	Pimelea ciliata									x							
	Pimelea imbricata									x							
	Pimelea sp.														x		
	Pimelea suaveolens									x							
	Poaceae sp.		x					x	x	x	x						
	Podolepis gracilis														x		
	Podolepis lessonii																x
*	*Polypogon monspeliensis*			x					x								
	Pseudognaphalium luteoalbum	x															
	Pteridium esculentum									x							
	Ptilotus manglesii							x		x							
	Ranunculus colonorum												x				
	Rytidosperma caespitosum	x						x		x							x
	Scaevola calliptera							x	x	x							
	Senecio diaschides							x									
*	*Sonchus oleraceus*	x						x	x				x	x			
	Stackhousia monogyna							x		x			x		x		
	Stylidium affine									x		x					
	Stylidium amoenum												x		x		
	Stylidium ciliatum							x		x					x		
	Stylidium piliferum									x			x		x		
	Stylidium sp.									x			x		x		

APPENDIX J: VASCULAR PLANT SPECIES RECORDED ON WMDE AND BAUXITE TRANSPORT CORRIDOR, 2018

Note: * denotes introduced species;
Note: T denotes threatened and P1 to P4 denotes Priority flora species (DBCA 2020a, 2020b)

	Site -Vegetation Types on WMDE and Bauxite Transport Corridor															
Species	**AC**	**AD**	**AY**	**DG**	**G1**	**G2**	**H**	**H2**	**M**	**M2**	**MG**	**P**	**PL**	**S**	**ST**	**Y**
Tetrarrhena laevis			x				x		x		x			x		
Tetratheca hirsuta									x					x		
Thysanotus dichotomus											x			x		
Trachymene pilosa									x					x		
Trichocline spathulata							x							x		
* *Trifolium angustifolium*									x							
* *Trifolium arvense* var. *arvense*														x		
* *Trifolium campestre* var. *campestre*														x		
* *Trifolium* sp.	x						x	x	x							
Trymalium ledifolium					x		x	x	x		x	x		x	x	
Trymalium odoratissimum subsp. odoratissimum					x				x		x	x		x		
Typha orientalis	x															
* *Ursinia anthemoides subsp. anthemoides*		x			x	x	x		x		x	x		x		
* *Vulpia myuros*					x		x		x			x		x		x
Waitzia suaveolens									x							
Xanthorrhoea gracilis									x							
Xanthorrhoea preissii					x		x		x		x	x		x	x	
Xanthosia candida									x							

APPENDIX K: VASCULAR PLANT SPECIES BY SITE-VEGETATION TYPE FOR THE COLLIE REFINERY SURVEY AREA, 1999 AND 2014

Note: * denotes introduced species (DBCA 2020a, DBCA 2020b)

SPECIES	Site-Vegetation Type						
	CQ	CW	SP	ST	SW	TS	W
Acacia alata	x						
Acacia celastrifolia				x	x		
Acacia divergens	x						
Acacia extensa				x			
Acacia lateriticola	x			x	x		
Acacia pulchella		x		x			x
**Acacia pycnantha*					x		
Acacia saligna		x		x	x		
Acacia willdenowiana	x						
Agonis flexuosa			x		x		
Allocasuarina fraseriana			x	x	x		
Astartea scoparia	x						
Banksia dallanneyi var. *dallanneyi*	x				x		x
Banksia grandis			x	x	x		x
Banksia littoralis	x						
Baumea rubiginosa	x						
Boronia fastigiata		x	x	x	x		
Bossiaea aquifolium	x			x	x		x
Bossiaea ornata				x			
Caladenia flava	x			x			
Caladenia reptans				x	x		x
Caladenia sp.					x		
Calothamnus quadrifidus subsp. *angustifolius*				x			x
**Carduus* sp.							x
Chamaescilla corymbosa				x	x		x
Chorizema rhombeum				x			
Clematis pubescens				x	x		x
Comesperma virgatum				x			
Conospermum capitatum subsp. *capitatum*	x						
Conostylis aculeata subsp. *aculeata*						x	
Conostylis serrulata				x			
Conostylis setigera					x		
Conostylis setosa				x			
**Conyza sumatrensis*							x
Corymbia calophylla	x	x	x	x	x		x
Craspedia variabilis				x			
Cyathochaeta avenacea				x			
Darwinia citriodora		x					
Desmocladus fasciculatus				x	x		
Drosera macrantha					x		
Drosera sp.				x	x		
Drosera stolonifera				x			
Eucalyptus marginata	x		x	x	x		x
Eucalyptus patens	x				x		x
Gahnia decomposita	x						
Gastrolobium bilobum					x		x
Hakea amplexicaulis				x			
Hakea lissocarpha				x	x		x
Hibbertia amplexicaulis				x	x		
Hibbertia commutata	x				x		x
Hibbertia cunninghamii	x						
Hibbertia hypericoides	x		x	x	x		
Hibbertia perfoliata	x			x	x		x

APPENDIX K: VASCULAR PLANT SPECIES BY SITE-VEGETATION TYPE FOR THE COLLIE REFINERY SURVEY AREA, 1999 AND 2014

Note: * denotes introduced species (DBCA 2020a, DBCA 2020b)

SPECIES	Site-Vegetation Type						
	CQ	CW	SP	ST	SW	TS	W
Hovea trisperma				x			
Hypocalymma angustifolium	x			x	x		x
Hypocalymma cordifolium	x						
**Hypochaeris glabra*				x			
Hypolaena exsulca				x			
Labichea punctata	x				x		
Lagenophora huegelii	x			x	x		x
Lasiopetalum floribundum	x			x	x		x
Lasiopetalum glabratum					x		
Leucopogon capitellatus	x			x	x		x
Leucopogon propinquus	x			x	x		
Leucopogon verticillatus				x	x		x
Levenhookia pusilla							x
Lindsaea linearis	x				x		
Logania serpyllifolia				x	x		
Lomandra caespitosa	x				x		
Lomandra integra				x			x
Lomandra preissii	x			x			
Lomandra sericea			x	x	x		
Lomandra sp.					x		
Lomandra spartea					x		x
**Lysimachia arvensis*					x		x
Macrozamia riedlei	x			x	x		x
Marianthus drummondianus					x		
Mirbelia dilatata	x			x	x		x
Morelotia octandra				x			
Nerostylis sp. Jarrah Forest (R Davis 7391)	x		x	x	x		x
Neurachne alopecuroidea	x			x	x		x
Opercularia echinocephala				x	x		x
Orchidaceae sp.				x			
Patersonia occidentalis				x	x		
Pentapeltis peltigera	x			x	x		
Persoonia longifolia		x		x	x		x
Platysace filiformis				x	x		x
Podocarpus drouynianus				x			
Pteridium esculentum				x	x		
Pterochaeta paniculata				x			
Pterostylis nana sens. lat.					x		x
Pterostylis recurva	x				x		
Pterostylis vittata					x		
Pyrorchis nigricans					x		
Scaevola calliptera					x		
Senecio hispidulus				x			
Sphaerolobium medium							x
Stylidium hispidum					x		
Stylidium piliferum				x	x		
Stylidium rhynchocarpum				x	x		
Taxandria linearifolia	x	x					
Tetrarrhena laevis	x			x	x		x
Tetratheca hirsuta				x			x
Thelymitra sp.			x	x	x		x
Thysanotus dichotomus	x						
Thysanotus fastigiatus	x						

APPENDIX K: VASCULAR PLANT SPECIES BY SITE-VEGETATION TYPE FOR THE COLLIE REFINERY SURVEY AREA, 1999 AND 2014

Note: * denotes introduced species (DBCA 2020a, DBCA 2020b)

SPECIES	Site-Vegetation Type						
	CQ	CW	SP	ST	SW	TS	W
Thysanotus multiflorus			x	x	x		
Trachymene pilosa	x			x	x		x
Trichocline spathulata				x			
Trymalium ledifolium					x		
Trymalium odoratissimum subsp. odoratissimum							x
Waitzia nitida				x			
Xanthorrhoea gracilis				x	x		
Xanthorrhoea preissii	x			x	x		
Xanthosia candida	x						x