



APPENDIX 1 - NORTHERN GOLDFIELDS
INTERCONNECT PIPELINE PROJECT DETAILED
FLORA AND VEGETATION ASSESSMENT
(FOCUSED VISION CONSULTING, 2020)



NORTHERN GOLDFIELDS INTERCONNECT PIPELINE PROJECT

DETAILED FLORA AND VEGETATION ASSESSMENT

APA NORTHERN GOLDFIELDS CONNECTION PTY LTD

DECEMBER 2020

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EXECUTIVE SUMMARY

APA Northern Goldfields Interconnection Pty Ltd (APA) are planning for a new pipeline within the Mid-West and Goldfields regions of Western Australia, the Northern Goldfields Interconnect (NGI) pipeline. The proposed pipeline is approximately 580 km long, commencing at Ambania, approximately 50 km east of Geraldton, connecting into the existing Goldfields Gas Pipeline approximately 40 km south of Leinster.

Focused Vision Consulting Pty Ltd (FVC) were commissioned to undertake a detailed flora and vegetation assessment of the Ambania compressor station site and NGI pipeline corridor, which also includes supporting aboveground facilities (project area).

The scope of work was to undertake a detailed flora and vegetation assessment, including a desktop assessment and field assessment incorporating identification of flora and vegetation values and targeted surveys for relevant conservation-significant flora species and ecological communities, plus preparation of a comprehensive technical report that documents the findings.

The desktop and field studies for the detailed flora and vegetation assessment were undertaken by experienced botanists and ecologists during spring 2020. The field assessments comprised an initial primary field survey, conducted between 1 to 7 September 2020, consisting of a survey effort of 43 person-days, followed by a supplementary survey of eight person-days, conducted between 29 September to 2 October 2020.

The key findings and conclusions arising from the flora and vegetation assessment within the project area are as follows:

- One Threatened flora (*Eucalyptus beardiana*) listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Biodiversity Conservation Act 2016* was recorded. A total of 55 individuals were recorded in a single population within the western portion of the project area.
- Five Priority flora, *Dicrastylis linearifolia* (Priority 3), *Gnephosis cassiniana* (Priority 3), *Petrophile ?pauciflora* (Priority 3), *Ptilotus beardii* (Priority 3) and *Acacia speckii* (Priority 4) were recorded.
- Five additional flora species of conservation interest, due to being undescribed taxa, were recorded during the field assessments.
- Five flora species were recorded that are considered to be exhibiting an extension beyond their currently documented range, in accordance with their current known extent.
- Of the 501 recorded flora species, 30 are introduced (weeds), with two of these, **Echium plantagineum* and **Rumex hypogaeus*, listed as Declared Pest plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). None of the recorded weeds are listed as Weeds of National Significance. Under the BAM Act, landholders are obliged to carry out specific control measures to prevent the spread of pest weeds (Declared Pests). Any disturbance to such areas should ensure no further degradation of the surrounding environment as a result of further proliferation of these weed species.
- Thirty-two intact vegetation units were described and mapped within the project area, with one additional pasture unit also described and mapped. An additional two units were mapped but only occur outside of the project area.
- One vegetation unit (EkEhW) occurring within the project area is considered representative of the Commonwealth-listed Threatened Ecological Community (TEC) and State-listed Priority Ecological Community (PEC), *Eucalypt Woodlands of the Western Australian Wheatbelt*. The TEC/PEC was mapped as intersecting 31.17 ha of the project area. The condition of the local extent of the Eucalypt woodlands TEC/PEC within the project area ranges from 'Very Good - Excellent' to 'Excellent'.

- One PEC, *Yalgoo vegetation complexes (Banded Ironstone Formation)*, was determined to occur adjacent to the project area, and is unlikely to occur within the project area due to the lack of Banded Ironstone Formation within the defined project area.
- Several of the recorded vegetation units within the project area have been determined to be of significance, as follows:
 - Vegetation units considered to be of State and National significance:
 - EbW due to the presence of a State and Commonwealth listed Threatened flora species (representative of 0.018% of the project area)
 - EkEhW due to being representative of a State and Commonwealth listed TEC (representative of 0.252% of the project area).
 - Vegetation units considered to be of regional significance:
 - EbW due to the presence of Threatened flora (representative of 0.018% of the project area)
 - EcW due to being restricted to specific and limited landforms (representative of 0.042% of the project area)
 - EIW and TspSS due to having limited extent remaining in comparison to their pre-European extent (representative of 0.018% of the project area, and 0.470%, respectively).
 - A number of vegetation units were also considered to be of local significance due to supporting Priority flora (four units), undescribed species (seven units), range-extending species (four units), and having limited representation within the local (project) area (six units).
- The timing of the survey (September/October) was considered optimal for the identification of most flowering flora or annual and ephemeral species for the majority of the project area. However, due to the below average rainfall experienced in the region, particularly in the Murchison IBRA region, the abundance of some annual and ephemeral species was found to be low and some species were not able to be identified to species level due to being sterile. Although some of the collections could not be identified to species level, none are considered likely to represent Threatened or Priority flora, with the exception of *Petrophile ?pauciflora* (P3).
- In order to fully meet the EPA guidance requirements to sample at least three quadrats per vegetation unit, one additional quadrat would require sampling in vegetation units ArEIS and McS at discrete locations to provide a full complement of quadrats. Analysis of survey completeness indicates additional vegetation units, where less than three quadrats have been sampled, however many of these vegetation units have limited distribution or are highly degraded, and therefore, sampling of further quadrats within or in close proximity to the project area may not be possible.
- While the vegetation within the eastern portion of the project area has been well characterised, further targeted follow up survey may be warranted given the inherently dry conditions evident during the survey. Further assessment following rainfall would be required to complement the existing results and allow a more representative suite of species (i.e. annual species) in the portion of the project area within the Murchison region to be documented.

1 INTRODUCTION

1.1 BACKGROUND

APA Northern Goldfields Interconnect Pty Ltd (APA) are proceeding with early planning for a new pipeline within the Mid-West and Goldfields regions of Western Australia. The proposed Northern Goldfields Interconnect (NGI) pipeline is approximately 580 km long, commencing at Ambania, connecting into the existing Goldfields Gas Pipeline south of Leinster (**Figure 1**). The project will initially include compression at the inlet (i.e. the Ambania compressor station), with associated aboveground facilities sparsely located along the route of the pipeline.

Focused Vision Consulting Pty Ltd (FVC) were commissioned by APA to undertake a detailed flora and vegetation assessment of the Ambania compressor station site and NGI pipeline corridor (inclusive of the supporting aboveground facilities), within the Pipeline Licence Area (herein collectively referred to as the 'project area').

1.2 LOCATION

The project area is located approximately 400 km north of Perth at its nearest point. The project area consists primarily of an east-west alignment starting at the Ambania compressor station site, approximately 50 km east of Geraldton, extending for 580 km east, and terminating approximately 40 km south of Leinster (**Figure 1**). In the western section of the project area, the corridor is 50 m wide for the first approximately 82 km where it passes through highly modified agricultural land, after which it expands to 200 m wide for the remaining length. The corridor width is slightly wider than 200 m in discrete areas to accommodate the aboveground facilities.

1.3 SCOPE OF WORK

The scope of work required to be fulfilled was as follows:

- Undertake a desktop assessment of the project area for flora and vegetation values
- Undertake a detailed flora and vegetation assessment to identify flora and vegetation values, including:
 - Targeted searches for and description of populations of conservation significant species (listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act) and/or the Department of Biodiversity, Conservation and Attractions (DBCA) priority list)
 - Targeted searches for and description of populations of introduced plant species, particularly declared species and weeds of national significance
 - Definition and mapping of vegetation types, with a focus on mapping the boundaries of Threatened and Priority ecological communities (TECs and PECs, respectively)
 - Review of local and regional significance of the recorded vegetation types
 - Definition and mapping of vegetation condition
- Prepare a comprehensive technical report that documents the findings of the desktop assessment and field assessment.

2 LEGISLATIVE CONTEXT

The flora and vegetation assessments were conducted in accordance with the following legislation:

- Commonwealth EPBC Act
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian BC Act.

The assessments complied with requirements for environmental survey and reporting in Western Australia, as outlined in:

- Environmental Protection Authority (EPA) (2008) *Guidance Statement No. 33: Environmental Guidance for Planning and Development*
- EPA (2016a) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment
- EPA (2016b) Environmental Factor Guideline – Flora and Vegetation.

2.1 THREATENED AND PRIORITY FLORA

The DBCA assigns conservation status to endemic plant species that are geographically restricted to few known populations or threatened by local processes. Allocating conservation status to plant species assists in protecting populations and conserving species from potential threats (DBCA 2020a, DBCA 2020b).

The BC Act provides a statutory basis for the listing of threatened species, specially protected species, TECs, critical habitat and key threatening processes (DBCA 2020c). Whilst not awarded any statutory protection, DBCA also maintains the Priority flora list, for species of conservation concern. Priority flora are given consideration in environmental impact assessments (EIAs) and in the assessment of clearing permit applications, in accordance with the ten clearing principles (Department of Environment Regulation (DER) 2014). Therefore, both Threatened and Priority flora are important focuses of surveys conducted to inform the EIA process, and their definitions are presented in **Table 1**.

Table 1 - Definitions of Threatened and Priority Flora Species

Conservation Code	Category
T	<p>Threatened Species</p> <p>Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the BC Act.</p> <p>Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice for Threatened Flora.</p>
P1	<p>Priority 1 – Poorly Known Species</p> <p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
P2	<p>Priority 2 – Poorly Known Species</p> <p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>
P3	<p>Priority 3 – Poorly Known Species</p> <p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
P4	<p>Priority 4 – Rare, Near Threatened and other species in need of monitoring</p> <p>(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.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of national environmental significance (MNES) require approval from the Commonwealth Minister for the Environment.

Species at risk of extinction are recognised as Threatened at a Commonwealth level, and are categorised according to the EPBC Act as summarised in **Table 2**.

Table 2 - Categories of EPBC Act Threatened Flora Species

Conservation Code	Category
Ex	<p>Extinct</p> <p>Taxa not definitely located in the wild during the past 50 years.</p>
ExW	<p>Extinct in the Wild</p> <p>Taxa known to survive only in captivity.</p>
CR	<p>Critically Endangered</p> <p>Taxa facing an extremely high risk of extinction in the wild in the immediate future.</p>
EN	<p>Endangered</p> <p>Taxa facing a very high risk of extinction in the wild in the near future.</p>
VU	<p>Vulnerable</p> <p>Taxa facing a high risk of extinction in the wild in the medium term.</p>
CD	<p>Conservation Dependent</p> <p>Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.</p>

Any species listed in State and Commonwealth legislation as being of conservation significance is broadly considered to be a significant species. This incorporates species that are endangered, vulnerable and rare or covered by international conventions. Significance is not limited to species covered by State and Commonwealth legislation and also includes species of local significance and species showing significant range extensions or at the edge of their known range.

2.2 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

TECs are naturally occurring biological assemblages that occur in a particular type of habitat, which are subject to processes that threaten to destroy or significantly modify the assemblage across its range (Department of Environment and Conservation (DEC) 2007).

The Minister may list an ecological community as a TEC in one of the following categories; Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). The categories and the criteria for defining TECs have been described by English and Blyth (1997). A publicly available database, listing TECs within Western Australia is maintained by DBCA.

TECs in WA are protected under the BC Act and some are also are protected under the Commonwealth EPBC Act. The TECs on the Commonwealth register are also listed on the Department of Agriculture, Water and the Environment (DAWE) website, and in the Protected Matters Database.

Additional to TECs, ecological communities that are considered potentially of conservation significance (and potentially TECs) that do not currently meet survey criteria or that are not adequately defined, are rare but not threatened, have been recently removed from the TEC list or require regular monitoring, are considered to be PECs (DEC 2013) and are required to be taken into consideration during environmental impact assessments.

2.3 LOCALLY OR REGIONALLY SIGNIFICANT VEGETATION

Vegetation may be significant in a range of contexts, in addition to significance according to statutory listings.

Vegetation communities are referred to as nationally significant where they:

- support populations of Threatened (EPBC-listed) species
- support TECs listed as nationally (EPBC) significant.

Vegetation communities are referred to as regionally significant where they:

- are limited to specific landform types
- are uncommon or restricted plant community types within the regional context
- are poorly retained in comparison to their pre-European extent (discussed further in the following section)
- support populations of Threatened flora.

Vegetation communities are referred to as locally significant where they:

- support populations of Priority flora species
- extend the geographic range of particular taxa from previously recorded locations
- are restricted to only one or a few locations
- occur as small isolated communities
- exhibit unusually high structural and species diversity.

Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a) also states that vegetation may be considered as significant for a range of reasons, including but not limited to the following:

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

The Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a) also states that flora may be considered significant for the following reasons:

- 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
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

2.4 VEGETATION CLEARING, EXTENT AND STATUS

Clearing of native vegetation is regulated in WA under the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Any clearing of native vegetation is an offence, unless carried out under a clearing permit or if the clearing is for an exempt purpose (Department of Water and Environmental Regulation (DWER) 2020). A clearing permit may be required under Part V of the EP Act, whereby permit applications to clear native vegetation must be assessed against the '10 Clearing Principles' as outlined in the regulations.

Where clearing of native vegetation is proposed to occur, there are several key criteria applied to the assessment of clearing permit applications, in the interests of biodiversity conservation.

The objective of the EPA in relation to flora and vegetation is: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained* (EPA 2016b). This objective is documented in the EPA Factor Guideline - Flora and Vegetation (EPA 2016b). The EPA considers it is important that ecological communities are maintained above the threshold level of 30% of the original pre-clearing extent of the community in unconstrained areas and 10% within 'constrained' areas (EPA 2008).

2.5 ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Areas (ESAs) are areas that require special protection due to aspects such as landscape, wildlife or historical value and are generally considered to be areas of high conservation value. ESAs are declared in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, which was gazetted on 8 April 2005.

There are several types of ESAs relating to flora and vegetation, declared under Part V of the EP Act, which include:

- a defined wetland and the area within 50 m of that wetland
- the area covered by vegetation within 50 m of rare (Threatened) flora, to the extent where the vegetation is continuous with the vegetation in which the rare (Threatened) flora is located
- the area covered by a TEC
- Bush Forever sites (Government of Western Australia 2000)
- areas covered by the following policies:
 - *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*
 - *Environmental Protection (Western Swamp Tortoise) Policy 2002*
 - *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*
 - *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*
- areas of native fringing vegetation in the policy area as defined in *Environmental Protection (Swan and Canning Rivers) Policy 1998*.

2.6 INTRODUCED FLORA

To date, over 1,200 introduced (weed) species have been recognised to occur within Western Australia (EPA 2007). Introduced flora (weeds) are plants that are not indigenous to an area and have been introduced either directly or indirectly through human activity. They establish in natural ecosystems and adversely modify natural processes, resulting in the decline of the invaded community and the habitat value provided for native fauna. Weeds threaten the survival of many native flora because of their rapid growth and the ability to out-compete native plants for available nutrients, water, space and sunlight.

2.6.1 Weeds of National Significance

Under the National Weed Strategy, there are currently 32 weed species listed as Weeds of National Significance (WoNS) (DAWE 2020a). Each weed was considered for inclusion based on the following criteria; invasive tendencies, impacts, potential for spread and socioeconomic and environmental values.

2.6.2 Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests, including pest plants, under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) (Department of Primary Industries and Regional Development (DPIRD) 2020). Under the BAM Act, Declared Pests are listed under one of the following categories:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility
- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage.

2.6.3 Environmental Weeds

Introduced species have also been ranked by a number of attributes, including invasiveness, distribution and environmental impacts in the various regions in the *Environmental Weed Strategy* (Department of Conservation and Land Management 1999). To advance the above categorisation, the Invasive Plant Prioritisation Process for DBCA was developed in 2008 (Department of Parks and Wildlife 2013).

3 EXISTING ENVIRONMENT

3.1 CLIMATE

The project area is situated in two bioregions: the Southwest and Eremaean provinces, with only a small section occurring in the north of the Southwest province. The climate of the Southwest province is described as warm semi-arid to Mediterranean with 400 – 500 mm of rainfall annually (Desmond and Chant 2001). The Eremaean province is vast, encompassing most of Western Australia into eastern Australia. The climate of the Eremaean province relative to this study (western section) is described as arid with bimodal rainfall, usually falling in winter (Desmond *et al.* 2001).

Eradu station (station number 008200) is the closest weather station to the western end (near Geraldton) of the project area. Average monthly rainfall in the months preceding the field survey in the western section of the project area was approximately a third less in June, half less in July and almost double in August compared to the long-term average (**Figure 2**). Mt Magnet Aero station (station number 007600) is the closest weather station to the central section of the project area. Average monthly rainfall in the months preceding the field survey in the central section of the project area was also less than the long-term average, particularly in July when minimal (0.2 mm) of rainfall was recorded. In August, monthly average rainfall was low compared to the long-term average. Leinster Aero station (station number 012314) is the closest weather station to the eastern end of the project area. Average monthly rainfall in the months preceding the field survey in the eastern section of the project area was extremely low compared to the long-term average, with the exception of August (**Figure 2**).

3.2 IBRA REGION

There are 89 recognised Interim Biogeographic Regionalisation for Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (DAWE 2020b). The project area traverses four IBRA regions, which from west to east are Geraldton Sandplains, Avon Wheatbelt, Yalgoo, and Murchison (DAWE 2020b) (**Figure 3**).

The Geraldton Sandplains bioregion consists mainly of Proteaceous scrub-heaths, often with mallees, on sandy soils on an extensive, undulating lateritic sandplain, with many endemic species of flora. Extensive York gum (*Eucalyptus loxophleba*) and acacia woodlands occur on outwash plains associated with drainage (McKenzie *et al.* 2002). The Avon Wheatbelt bioregion consists of a gently undulating landscape of Proteaceous scrub-heaths, rich in endemics on lateritic uplands, and mixed eucalypts, *Allocasuarina huegeliana*, and York gum woodlands on alluvial and eluvial sandplains (Beecham 2001). The Yalgoo bioregion sits at an interzone between the Southwest and Eremaean provinces. It is characterised by Gimlet (*Eucalyptus salubris*), *Callitris* and mulga woodlands over herb-rich understorey on red sandy soils on open plains (McKenzie *et al.* 2002). The Murchison bioregion is large and dissected into eastern and western regions. The eastern region is of relevance to this study. It consists of salt lake systems associated with paleodrainage systems and sandplains with breakaways. Vegetation is dominated by mulga woodlands, generally over grasslands and ephemeral herbs, and alluvial and eluvial soils, with hummock grasslands on sandplains, saltbush shrublands on calcareous soils, and *Tecticornia* low shrublands on saline soils (McKenzie *et al.* 2002).

3.3 Geology and Soils

The soils of the project area have been mapped and described in the Digital Atlas of Australian Soils (National Resource Information Centre (NRIC) 1991) and are presented in **Figure 4**. The project area traverses 13 soil systems. A brief description of each is presented in **Table 3**.

Table 3 – Soil Systems of the Project Area

Soil System	Description
AB5	Sandy outwash plains from granitic areas with some gentle undulations and Wanderie banks. Dominant soils are shallow red earthy sands, shallow red earths, and red earthy loams. Some soils may contain ironstone gravels.
AB6	Sandy outwash plains from granites, gneisses, and allied rocks with numerous small waterways. Dominant soils are shallow red earthy sands with small areas of shallow red earths and red earthy loams. Some ironstone gravels may be present.
AB8	Sandy plains often with low dunes. Dominant soils are red earthy sands.
AC9	Gently undulating plateau underlain by sedimentary rocks with some dune tracts in places and some breakaways at margins. Areas of block laterite may occur. Dominant soils are yellow earthy sands.
BE3	Broken slopes and ridges characterized by breakaways, generally on gneissic granites and allied rocks; ironstone gravel pavement variably present. Dominant soils seem to be shallow earthy loams with some shallow soils, both underlain by a red-brown hardpan. Associated are a variety of soils on outwash areas below the breakaways, often only 15 – 35 cm deep. Some soils on calcrete (kunkar) platforms between shallow drainage-ways on the outwash areas below the breakaways, with some block laterite.
F8	Gently undulating to low hilly areas with gneissic rock outcrops and some low dunes. Dominant soils seem to be shallow loams. Associated are shallow soils with a red-brown hardpan at shallow depths.
F9	Gently undulating to low hilly areas with gneissic rock outcrops. Dominant soils seem to be shallow loams.
Ms12	Undulating plateau area with some low dunes, ironstone gravel pavement. Dominant soils are acidic yellow earths often containing much ironstone gravel and underlain by a red-brown hardpan. Associated usually on low dunes are yellow earthy sands sometimes underlain by a red-brown hardpan.
My46	Plains with occasional dunes and narrow saline flats and creeks. Dominant soils are neutral red earths with some alkaline red earths. Associated are some red earthy sands mainly on and adjacent to dune formations.
My48	Gently undulating to low hilly areas with gneissic rock outcrops dominated by soils of neutral red earths on the flatter portions underlain by a red-brown hardpan. Associated on the slopes are shallow soils.
My49	Plains and their flanking slopes dominated by soils of neutral and alkaline red earths with low rises, all underlain at shallow depths by a red-brown hardpan. Associated are saline flats with calcrete (kunkar) platforms having, and flanking slopes of the soils of the F8 system.
My50	Broad plains with a scatter of surface gravels. Dominant soils are shallow neutral red earths and shallow earthy loams in intimate micro-association. The system is underlain by a red-brown hardpan.
SV4	Saline valleys and salt lakes-salt-lake channels, mostly devoid of true soils, and their fringing areas. Common soils are gypseous and saline loams on riverine wash and usually underlain by clayey or sandy strata by about 30 cm. Associated are small areas of the soils of the adjacent areas, in particular soils often underlain by calcrete (kunkar). Also, dunes and lunettes of sandy soils.

3.4 VEGETATION

Pre-European vegetation in Western Australia has been broadly characterised by Beard (1990). The vegetation is described in three categories (from broad to finer scale) as systems, associations (can occur in multiple systems), or system – association (combined system and vegetation association). The project area supports eight systems consisting of 24 vegetation associations and vegetation-system associations. The remaining extent of the vegetation associations across a range of contexts are presented in **Table 4** and spatially in **Figure 5**.

Table 4 - Pre-European Vegetation of the Project Area

Extent Context	Veg. Association No. (Shepherd <i>et al.</i> 2002)	Broad Vegetation Description	Pre-European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent in all DBCA Managed Land
Western Australia	18	Low woodland; mulga (<i>Acacia aneura</i>)	19,892,306.46	19,843,148.07	99.75	6.62
	39	Shrublands; mulga scrub	6,613,567.48	6,602,578.44	99.83	12.02
	107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex	2,815,387.35	2,813,995.93	99.95	11.54
	142	Medium woodland; York gum & salmon gum	787,948.47	208,347.17	26.44	1.04
	188	Shrublands; mulga and <i>Acacia sclerosperma</i> scrub	25,640.25	25,582.19	99.77	0
	202	Shrublands; mulga, <i>Acacia quadrimarginea</i> scrub	448,529.31	448,343.80	99.96	22.91
	243	Shrublands; bowgada & minnieritchie scrub	148,432.56	148,426.20	100.00	4.00
	326	Low woodland over scrub; mulga over bowgada & minnieritchie scrub	1,034,327.64	1,034,301.01	100.00	32.81
	339	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, <i>Triodia scariosa</i>	27,109.86	27,108.54	100.00	0
	353	Shrublands; mallee & acacia scrub with scattered York gum	97,371.14	7,681.12	7.89	0.54
	361	Shrublands; bowgada & minnieritchie scrub with scattered mulga	87,511.09	87,484.57	99.97	26.66
	364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	510,984.96	506,124.98	99.05	45.73
	372	Mosaic: Shrublands; scrub-heath on deep sandy flats / Shrublands; thicket, acacia-casuarina alliance	82,083.78	31,680.07	38.59	29.50
	380	Shrublands; scrub-heath on sandplain	580,374.88	351,916.10	60.64	24.26
	389	Succulent steppe with open low woodland; mulga over saltbush	642,356.85	640,468.79	99.71	3.57
	404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	206,553.92	198,504.92	96.10	20.88
	415	Succulent steppe with open scrub; scattered mulga and other wattles over saltbush & bluebush	105,976.76	105,976.76	100.00	22.63
	419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket	313,225.36	296,195.63	94.56	38.20
	420	Shrublands; bowgada & jam scrub	859,632.11	830,216.12	96.58	14.11
	676	Succulent steppe; samphire	2,063,413.95	1,963,881.55	95.18	14.69
683	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & snakewood over samphire	50,318.87	49,976.10	99.32	34.51	

Extent Context	Veg. Association No. (Shepherd <i>et al.</i> 2002)	Broad Vegetation Description	Pre-European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent in all DBCA Managed Land
WA (cont.)	686	Medium woodland; York gum & red mallee	13,135.07	8,436.97	64.23	11.20
	687	Shrublands; bowgada and jam scrub with scattered <i>Allocasuarina huegeliana</i> and York gum	56,441.24	15,890.72	28.15	5.15
	1413	Shrublands; acacia, casuarina & melaleuca thicket	1,679,916.32	1,286,855.48	76.60	13.22
Geraldton Sandplain IBRA Region	142	Medium woodland; York gum & salmon gum	8,761.03	933.45	10.65	0.22
	353	Shrublands; mallee & acacia scrub with scattered York gum	96,823.77	7,546.36	7.79	0.54
	364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	1,248.42	1,203.86	96.43	4.38
	372	Mosaic: Shrublands; scrub-heath on deep sandy flats / Shrublands; thicket, acacia-casuarina alliance	82,083.78	31,680.07	38.59	29.50
	380	Shrublands; scrub-heath on sandplain	507,696.88	319,288.64	62.89	24.91
	404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	85.22	17.03	19.99	0
	420	Shrublands; bowgada & jam scrub	1,708.68	1,233.33	72.18	24.07
	687	Shrublands; bowgada and jam scrub with scattered <i>Allocasuarina huegeliana</i> and York gum	17,556.79	5,005.13	28.51	0.61
Avon Wheatbelt IBRA Region	142	Medium woodland; York gum & salmon gum	637,707.53	79,309.95	12.44	0.37
	353	Shrublands; mallee & acacia scrub with scattered York gum	547.37	134.76	24.62	0.70
	364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	2.63	2.63	100.00	100.00
	380	Shrublands; scrub-heath on sandplain	23,170.14	3,444.86	14.87	1.13
	404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	391.86	276.58	70.58	0
	419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket	10,517.64	6,370.07	60.57	31.35
	420	Shrublands; bowgada & jam scrub	44,968.05	17,161.76	38.16	4.03
	676	Succulent steppe; samphire	124,573.10	30,418.61	24.42	0.32
	686	Medium woodland; York gum & red mallee	8,800.29	4,156.84	47.24	5.69
	687	Shrublands; bowgada and jam scrub with scattered <i>Allocasuarina huegeliana</i> and York gum	37,458.98	10,242.84	27.34	7.34
Yalgoo IBRA Region	1413	Shrublands; acacia, casuarina & melaleuca thicket	546,675.55	174,102.84	31.85	2.33
	18	Low woodland; mulga (<i>Acacia aneura</i>)	101,331.17	101,232.93	99.90	19.43
	39	Shrublands; mulga scrub	9,574.62	9,574.62	100.00	52.17
	142	Medium woodland; York gum & salmon gum	9,197.62	9,197.62	100.00	0
	202	Shrublands; mulga and <i>Acacia quadrimarginea</i> scrub	45,096.14	45,011.91	99.81	40.08
	243	Shrublands; bowgada & minnieritchie scrub	40,588.09	40,581.74	99.98	13.87
	326	Low woodland over scrub; mulga over bowgada & minnieritchie scrub	539,810.76	539,784.14	100.00	43.67
361	Shrublands; bowgada & minnieritchie scrub with scattered mulga	76,479.74	76,453.22	99.97	27.30	

Extent Context	Veg. Association No. (Shepherd <i>et al.</i> 2002)	Broad Vegetation Description	Pre-European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent in all DBCA Managed Land
Yalgoo IBRA Region (cont.)	364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	509,047.32	504,231.90	99.05	45.89
	380	Shrublands; scrub-heath on sandplain	15,145.44	14,824.97	97.88	23.34
	389	Succulent steppe with open low woodland; mulga over saltbush	687.19	687.19	100.00	0
	404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	151,772.33	143,906.80	94.82	13.06
	415	Succulent steppe with open scrub; scattered mulga and other wattles over saltbush & bluebush	31,462.20	31,462.20	100.00	67.23
	419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket	302,707.72	289,825.56	95.74	38.44
	420	Shrublands; bowgada & jam scrub	621,396.05	620,265.57	99.82	16.38
	676	Succulent steppe; samphire	28,955.02	28,560.65	98.64	31.06
	683	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & snakewood over samphire	50,075.10	49,732.32	99.32	34.68
	686	Medium woodland; York gum & red mallee	4,334.78	4,280.12	98.74	22.37
	687	Shrublands; bowgada and jam scrub with scattered <i>Allocasuarina huegeliana</i> and York gum	1,425.47	642.75	45.09	3.27
	1413	Shrublands; acacia, casuarina & melaleuca thicket	12,495.12	11,301.19	90.44	3.35
Murchison IBRA Region	18	Low woodland; mulga (<i>Acacia aneura</i>)	12,403,172.30	12,363,252.47	99.68	4.96
	39	Shrublands; mulga scrub	1,148,400.30	1,138,064.63	99.10	3.56
	107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex	2,792,383.45	2,790,992.03	99.95	11.60
	142	Medium woodland; York gum & salmon gum	61.05	61.05	100.00	0
	188	Shrublands; mulga and <i>Acacia sclerosperma</i> scrub	11,922.20	11,864.15	99.51	0
	202	Shrublands; mulga and <i>Acacia quadrimarginea</i> scrub	339,742.69	339,641.41	99.97	21.25
	326	Low woodland over scrub; mulga over bowgada & minnieritchie scrub	494,516.87	494,516.87	100.00	20.95
	339	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, <i>Triodia scariosa</i>	27,109.86	27,108.54	100.00	0
	361	Shrublands; bowgada & minnieritchie scrub with scattered mulga	11,031.35	11,031.35	100.00	22.20
	364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	87.86	87.86	100.00	0
	389	Succulent steppe with open low woodland; mulga over saltbush	493,977.54	492,089.49	99.62	4.65
404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	54,304.50	54,304.50	100.00	42.92	
415	Succulent steppe with open scrub; scattered mulga and other wattles over saltbush & bluebush	74,514.56	74,514.56	100.00	3.79	
420	Shrublands; bowgada & jam scrub	191,449.75	191,445.88	100.00	9.02	

Extent Context	Veg. Association No. (Shepherd <i>et al.</i> 2002)	Broad Vegetation Description	Pre-European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent in all DBCA Managed Land
Murch. (con.t)	676	Succulent steppe; samphire	382,818.77	382,704.49	99.97	2.31
	683	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & snakewood over samphire	243.77	243.77	100.00	0
	1413	Shrublands; acacia, casuarina & melaleuca thicket	29,688.38	29,688.38	100.00	48.44

The objective of the EPA in relation to flora and vegetation is; *To protect flora and vegetation so that biological diversity and ecological integrity are maintained* (EPA 2016b). The EPA considers it is important that ecological communities are maintained above a threshold level of 30% of the original pre-clearing extent of each community (EPA 2008). A level of 30% of pre-clearing extent is considered to be the level below which species loss appears to accelerate exponentially at the ecosystem level (EPA 2008). From purely a biodiversity perspective, a level of 10% of the original extent of a vegetation association is regarded as being a level representing Endangered (EPA 2008) and any clearing which would increase the threat level to a vegetation association should be avoided.

All of the vegetation associations, within the project area with the exception of 142, 353, 372 and 687, exceed the 30% retention threshold in a State context; and therefore, the remaining extents meet the EPA objective of retention for the purpose of biodiversity conservation. The remaining extent of vegetation associations 142, 353, 372 and 687 all fall below the EPA 30% retention target at the State level. The remaining extents of each vegetation association remaining in Western Australia and within each IBRA Region will determine whether each association would be considered to be locally or regionally significant. Vegetation associations of local and regional significance are discussed further in **Section 6.2.4**.

4 METHODOLOGY

4.1 DESKTOP REVIEW

A desktop assessment for Threatened and Priority flora potentially occurring within the project area was undertaken prior to the field studies. The desktop assessment consisted of database searches using NatureMap (DBCA 2020d) (**Appendix A**), DBCA Threatened and Priority flora (DBCA 2020a) and ecological communities (DBCA 2020e) databases and the Commonwealth Protected Matters Search Tool (PMST) for MNES (DAWE 2020c) (**Appendix B**). Online database searches were conducted based on a 5 km buffer (radius) around the project area.

Each species of previously recorded Threatened and Priority flora was evaluated for their likelihood of occurring within the project area or surrounds. Prior to the field assessment, the possible habitats provided were assessed in reference to regional vegetation data, aerial imagery and Google StreetView (where available).

Potential habitats occurring within the project area were found to include; pasture, rivers/riparian areas (including salt lake systems), eucalypt woodlands and *Acacia* scrub (mulga).

The likelihood of occurrence was based on four factors; suitable habitat within the project area, age of previous records, proximity of previous records to the project area and current condition of the project area.

Suitable habitat:

- The likelihood of suitable habitat being present within the project area was based on known habitat information gathered from FloraBase (DBCA 2020f) and literature sourced from the Species Profile and Threats Database (SPRAT) (DAWE 2020d) (e.g. recovery plans, conservation advice).

Age of previous records:

- The age of previous records for significant species recorded within the regions surrounding the project area was evaluated to determine how likely the species was to still occur in the area (i.e. habitat of species recorded decades ago may no longer occur or a species may be locally extinct).

Proximity of previous records:

- Species recorded closer to the project area are considered to have a higher likelihood of occurrence. It is noted that species identified using the PMST have not necessarily been recorded within 5 km of the project area and may have resulted in the search due to habitat possibly occurring within the area.

Current condition of project area:

- The project area is highly modified in the western section, degraded from pastoral activities in the eastern sections and relatively intact in other sections in the central and parts of the eastern portions. Highly modified and degraded environments usually conclude a lower likelihood of the occurrence of significant flora, whilst isolated patches of intact remnants in the context of largely cleared regions are known to harbour significant species and communities that may have otherwise been cleared throughout their range.

4.2 FIELD ASSESSMENT

A detailed flora and vegetation assessment of the project area was undertaken by Principal Ecologists, Kellie Bauer-Simpson, Matthew Macdonald and Mike Braimbridge; Senior Botanist, Catherine Krens; Botanist/Ecologists, Adrian Barrett, Daniel Roberts and Peter Smith and Graduate Botanist, Sam Hall.

The field assessment was carried out during an initial primary field survey, conducted between 1 to 7 September 2020, consisting of a survey effort of 43 person-days, followed by a supplementary survey of eight person-days, conducted between 29 September to 2 October 2020.

Field navigation and documentation was made in reference to kilometre points (KPs) along the proposed NGI pipeline as presented in figures in this report.

Field data were collected using electronic tablet devices with customised data forms and mobile spatial mapping capability, within the software program, Mappt™.

The field survey tasks carried out are described in the following sections.

4.2.1 Quadrats

Field data was collected from a selection of pegged flora and vegetation assessment quadrats, where vegetation was in 'Good' or better condition, representative of the diversity of floristic values of the site. To meet the EPA requirement, at least three quadrats per vegetation unit were established, and more for dominant and widespread units, plus where possible, a proportion of quadrats in the surrounding region were also sampled, to provide regional context.

Consistent with EPA guidance, dependent on IBRA region, quadrats were 10 m x 10 m (within the Geraldton Sandplain IBRA region and for understorey in the Avon Wheatbelt IBRA region) or 20 m x 20 m (within the Yalgoo and Murchison IBRA regions and for overstorey in the Avon Wheatbelt IBRA region).

The following information was collected at each quadrat:

- botanist
- date
- quadrat/site code
- GPS location (MGA94)
- representative photograph from the north-west corner
- landform and soil description
- topography/slope
- time since fire
- comprehensive list of flora species observed, including average height and estimated projected foliage cover of dominant species within each stratum
- vegetation degradation/disturbances (e.g. grazing, weed invasion, fire)
- vegetation condition, assessed against the currently accepted scale; an adaptation of the Keighery (1994) and Trudgen (1988) condition scales.

A total of 137 sample sites, consisting of 128 quadrats and nine relevés of suitable dimension for their respective region, were assessed within the project area (**Figure 6**). Sites were selected using aerial imagery during initial field planning conducted at a desktop level, and adjusted in the field where appropriate, such as where different vegetation units and condition were identified. Sites were selected to provide representative and replicate samples of each vegetation unit.

4.2.2 Relevés

In addition to the selection of quadrats, the vegetation of the survey area was described by a series of relevés. Relevés are a low intensity survey technique for gathering information for flora and vegetation reconnaissance surveys, or as part of detailed surveys, in areas of vegetation that are not in 'Good' or better condition. Information collected at each relevé included:

- botanist
- date
- relevé/site code
- GPS location (MGA94)
- representative photograph
- landform and soil description
- topography/slope
- time since fire
- list of dominant flora species observed
- vegetation degradation/disturbances (e.g. grazing, weed invasion, fire)
- vegetation condition.

4.2.3 Traverses

The flora and vegetation of the project area were also recorded along walked and driven traverses. A traverse is an unmarked route along which data is collected. Traverses gather information for the general characterisation of flora and vegetation, such as identifying the boundaries of vegetation units, selecting sites for detailed survey, and targeting significant flora or vegetation. The information recorded along a traverse was dependant on observations made, which was usually recorded as opportunistic data recorded spatially in point or polygon format, to assist in mapping and other results.

4.2.4 Opportunistic Sampling

Flora and vegetation not recorded through other sampling methods were opportunistically sampled as encountered either from the vehicle or on foot. Opportunistic sampling also included significant species and where there was the likelihood of new species as well as introduced (weed) species.

4.2.5 Targeted Significant Flora Surveys

Prior to the field survey, the locations of all Threatened and Priority flora retrieved from the various database searches and literature reviews was collated. Optimal flowering times vary for the species identified in the desktop assessment, ranging from June/July to December/January.

A proportion of the field assessment time was dedicated to selected targeted searches for relevant flora, in suitable habitats, particularly for those recorded in or in close proximity to the project area. The targeted flora assessment comprised of traverses, opportunistic sampling and systematic gridding for significant flora within areas likely to support Threatened or Priority flora plus a selection of the habitats provided in the project area (**Figure 7**).

Where suspected Threatened or Priority flora were observed, the following data were recorded:

- GPS location of each individual plant allowing an inventory of the plants/population size
- vegetation type and condition at the recorded location
- condition of plants
- reproductive status
- photograph.

4.2.6 Weeds

Targeted searches for and description of populations of introduced plant species, particularly Declared Pest plants and Weeds of National Significance (WoNS) was carried out. Targeted weed surveys focused on areas of remnant vegetation, rather than in cleared areas of pasture, where weeds are widespread and abundant.

Specifically, weed records and mapping of weeds was to be comprised of:

- occurrences of significant weeds (Declared Pests and WoNS) as recorded within quadrats and opportunistically between
- significant infestations of weeds (regardless of significance classification) within remnant vegetation areas as recorded opportunistically.

4.2.7 Flora Inventory

The flora and vegetation data collected from the combination of quadrats, relevés, traverses and continuous opportunistic observations contributed to the flora inventory for the survey, including weeds.

4.2.8 Vegetation Unit and Condition Mapping

The field assessment focused on recording information at a series of locations throughout the project area to enable mapping of vegetation units and condition, following return from the field. This information was collected from quadrats, relevés, traverses and continuous opportunistic observations, as described above.

The information collected from quadrats, relevés, traverses and continuous opportunistic observations was utilised to digitise mapping boundaries for the range of vegetation units present within the project area, with particular focus on mapping the boundaries of TECs and PECs such as the Eucalyptus Woodlands of the Western Australian Wheatbelt. This mapping was refined following return from the field, using GIS mapping software, and based on initial mapping prepared in the field, within the spatial software on mobile/tablet devices.

Vegetation was classified based on the dominant species and vegetation structure. The structural vegetation classifications used meet the requirements of NVIS Level V (association) vegetation descriptions. Definition and mapping of the boundaries of TECs and PECs known to intersect the project area was carried out, also taking into account published guidance on condition, patch size and intactness, including the DoEE (2016) publication: *Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community*. Where identified and mapped within the project area, the approximate extent of the Eucalyptus Woodlands TEC/PEC in the region surrounding the project area was mapped based on a combination of ground-truthing results and aerial imagery. The ground-truthed mapping of the regional extent of the Eucalyptus Woodlands TEC/PEC was utilised a series of sample locations in the broader region which characterised the vegetation present as representative of the significant ecological community, based primarily on the presence of suitable Eucalypt species. Correlating ground-truthed results with the appearance of the Eucalyptus Woodlands TEC/PEC in aerial imagery enabled mapping of the approximate regional extent surrounding the project area.

Once defined and once area extents were known, a review of local and regional significance of the vegetation units recorded was also undertaken.

Vegetation condition was recorded at quadrats and relevés and where other areas of varying condition were observed. The vegetation condition was mapped across the project area at the same scale as the vegetation mapping. Vegetation condition ratings are in accordance with the scale of EPA (2016a), an adaptation of the Keighery (1994) and Trudgen (1988) condition scales.

4.3 DATA PROCESSING AND REPORTING

Flora identifications were undertaken by botanical taxonomists, Shibi Chandran, Margaret Collins and Udani Sirisena, following return from the field. Specialist taxonomists, Kelly Shepherd and Mike Hislop were consulted for challenging specimens and specific flora groups as required. Taxonomy and nomenclature followed the current protocols of the Western Australian Herbarium.

Data analysis was conducted for all flora quadrat data, in order to group the vegetation units defined across the project area utilising PATN™ software. The floristic analysis was completed using the Bray-Curtis measure of distance in PATN Version 3.12 (Belbin and Collins 2009). Flexible unweighted pair group mean average (UPGMA) fusion was used to generate the site classification (beta = -0.1), and to group the quadrat data into clusters, and therefore the separate vegetation units. Data recorded from regional quadrats was also analysed to assist in determination of the regional extent and representation of vegetation, and therefore regional significance.

Once study sites (quadrats) were grouped in clusters of floristic similarity, the suite of vegetation units represented in the project area was determined and descriptions for each of the vegetation types were developed to NVIS Level V (association) (Department of the Environment and Energy (DoEE) 2017), in reference to Muir (1978).

The information collected in the field from quadrats, relevés, traverses and continuous opportunistic observations was utilised to digitise mapping boundaries for the range of vegetation units present within the project area, with particular focus on mapping the boundaries of TECs and PECs. The mapping drafted in the field within the spatial software on mobile/tablet devices, was refined at a desktop level using GIS mapping software.

Definition and mapping of the boundaries of TECs and PECs known to intersect the project area was then carried out, taking into account published guidance on condition, patch size and intactness. A review of local and regional significance of the vegetation units recorded was also undertaken.

Vegetation condition was recorded at quadrats and relevés and where other areas of varying condition were observed. The vegetation condition was mapped across the project area at the same scale as the vegetation mapping. Vegetation condition ratings follow the scale of EPA (2016a), an adaptation of the Keighery (1994) and Trudgen (1991) condition scales.

This technical report has been prepared in accordance with EPA (2016a), for the purposes of supporting the statutory environmental approvals process.

4.4 STUDY LIMITATIONS

The limitations of the flora and vegetation field assessment has been considered in accordance with the Technical Guidance (EPA 2016a) and are summarised in **Table 5**.

Table 5 – Study Limitations

Aspect	Constraint?	Commentary
Availability of local and regional contextual information	Somewhat; although marginally	The project area spans four IBRA regions, with most being thoroughly surveyed and well-understood location in terms of ecological values. However, due to the remoteness of some of the eastern portion of the proposed corridor, thorough and detailed surveys have not been carried out in the area, with limited previous studies and regional data available for comparison. However, also in this region, a significant number of mining developments have proceeded through their life cycle, which would have included biological studies to obtain approvals. This is somewhat apparent in database search results, which provide records in the region. Data relating to regional-scale soils and vegetation as well as biological values of conservation significance are available in public databases and in the literature, and included in the desktop assessment.

Aspect	Constraint?	Commentary
Competency of field personnel	No	The field studies were conducted by personnel working mostly in pairs, with the team lead of each respective pair having at least eight years of biological survey experience. The field personnel, Kellie Bauer–Simpson, Mike Braimbridge, Matthew Macdonald, Adrian Barrett, Dan Roberts, Peter Smith, Catherine Krens and Sam Hall have 21, 24, 11, nine, eight, 35, 13 and three years’ field ecological survey experience, respectively. At all stages of the project, personnel with relevant qualifications and experience contributed to the various study tasks, such as flora identifications and floristic analysis.
Selected scope, survey methods and level of survey detail/intensity	No	The selected scope was a detailed flora and vegetation assessment. The detailed assessment was coupled with selective systematic targeted surveys for Threatened and Priority flora and relevant Threatened and Priority ecological communities. The field surveys consisted of an initial/primary field survey during early spring, followed by a follow-up survey one month later, focused on further targeted surveys and supplementary quadrat sampling. The intensity of survey invested in the eastern portion of the project area was less than in the remaining sections of the study corridor, due to the unfavorable timing for survey in this region, where a survey following rainfall would be optimal. For this reason, this area was not revisited as part of the supplementary survey. This approach was further influenced by lower floristic diversity and poorer condition of the mulga-dominated landscape, where it was determined that further survey effort would be better invested in the more diverse and better condition vegetation of the Yalgoo, Avon Wheatbelt and Geraldton Sandplain regions. Access challenges in the eastern portion further supported investing efforts into more accessible portions which would also provide better value information for the EIA process. The TECs and PECs relevant to the flora survey broadly occurred in the western portion between Pindar and Yalgoo. The majority of Threatened and Priority flora identified in the desktop assessment were recorded in the western section.
Seasonal timing and climatic conditions	No	The field assessments were conducted during spring, which is considered optimal timing for recording biological values in the majority of the project area, particularly the Yalgoo, Avon Wheatbelt and Geraldton Sandplain regions. A large proportion of potentially occurring Threatened and Priority flora are known to flower during the September-October timing of the spring surveys conducted. Rainfall in the months preceding the survey (June, July and particularly August) was above average for the western portions of the project area, however it was below average for the eastern portion around the Mount Magnet and Leinster regions. Field observations indicate that the vegetation is suffering the effects of low rainfall, which is evident in the poor condition of the vegetation and low species diversity.
Accessibility	Somewhat	Some of the project area was readily accessible by vehicle and on foot, however, a large proportion of the corridor traverses remote pastoral stations, a significant distance from accessible public and private roads and tracks. The location of the alignment east of Mount Magnet resulted in challenges in accessing portions of the project area, with a 51 km (approximately 9% of the project area; KP 443-496) not traversed and sampled by only one quadrat along this length, due to inaccessibility. However, quadrats were sampled in accessible locations to the north, within vegetation that aerial imagery suggests is comparable, allowing for extrapolations in the mapping. Furthermore, the homogenous nature of much of the Mulga-dominated vegetation in this region provided better certainty in extrapolation of mapping than other vegetation types might. Access challenges were somewhat overcome by camping along the alignment, rather than commuting to and from accommodation each day. However, existing access along the alignment is limited and walking vast distances each day was not considered logistically feasible, nor worth investing effort where this could be better applied to areas where conservation-significant flora and ecological communities were more likely to occur.

Aspect	Constraint?	Commentary
Mapping reliability/ proportion of values identified and recorded based on extent of survey	No	Mapping within the project area is at a scale based on ground-truthed areas both along the alignment and in accessible areas in the nearby region, extrapolated using aerial imagery, where possible and where necessary. Mapping reliability as well as the proportion of values identified and recorded is considered high in the Geraldton Sandplain and Avon Wheatbelt regions, as well and in the western portion of the Yalgoo region. Mapping reliability and the proportion of values recorded is considered relatively high in the remainder of the Yalgoo and much of the Murchison regions, with limited proportions of the Murchison region portion of the project area represented by lower mapping reliability, due to greater extrapolation having been required, due to access constraints. Due to the low species and floristic diversity as well as poorer condition of the vegetation in the less-accessible Murchison sections of the project area, the proportion of values identified and recorded is considered moderate to high, based on the sampled completed.
Disturbances that may have affected survey results	No	The disturbances to the landscape that the project area traverses are significant and varied. In the west, within the Geraldton Sandplain and Avon Wheatbelt regions, vegetation has been subject to wide-scale clearing, with remaining vegetation remnants often harbouring values of conservation significance as a result of this. The Yalgoo and Murchison regions have been subject to less clearing, however, particularly in the pastoral areas of both regions, impacts from grazing, exacerbated by localised drought effects, particularly in the eastern Murchison portion of the corridor, have affected the quality of the vegetation. Despite the impacts to vegetation from clearing, agricultural and pastoral activities, and drought, the poorer condition of the vegetation is not expected to have affected survey results.
Survey completeness	Somewhat	The majority of the project area was surveyed during the optimal period for undertaking biological surveys within the regions. The detailed flora and vegetation assessment completed a single-phase of survey, across two survey events, which culminated in a satisfactory effort for targeted ecological community surveys and targeted surveys for the majority of potentially occurring Threatened and Priority flora. The results of floristic analysis determined that 16 vegetation units occurring within the project area were not sampled by at least three quadrats each, which is challenging to achieve in the vast project area and surrounds prior to floristic analysis and the limited extent of some the vegetation units (Table 9). For this reason, it would be optimal that supplementary quadrat sampling would be carried out during another phase of survey to achieve at least three quadrats per vegetation unit. Furthermore, field survey during a period following rainfall in the eastern (Murchison) portion of the project areas would complement existing results.

5 RESULTS

5.1 DESKTOP REVIEW

5.1.1 Threatened and Priority Flora

The desktop assessment identified 106 Threatened and Priority flora species previously recorded within or within close proximity to the project area (**Table 6**). Ninety-five of these records were sourced from the DBCA database (**Figure 8**). Of the 106 species, 16 are Threatened species listed under the EPBC Act and BC Act, 25 are Priority 1, nine are Priority 2, 44 are Priority 3 and 12 are Priority 4. Twenty-eight were considered 'likely' to occur in the project area consisting of two Threatened species, 14 Priority 1 species, eight Priority 3 species and four Priority 4 species. Thirty-two were considered as 'possibly' (may) occurring in the project area consisting of one Threatened species, two Priority 1 species, three Priority 2 species, twenty Priority 3 species and seven Priority 4 species. The remaining 46 species were considered 'unlikely' to occur in the project area (**Table 6**).

Table 6 - Threatened and Priority Flora Potentially Occurring within the Project Area

□ indicates potentially flowering during survey period

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Dasymalla axillaris</i>	Critically Endangered	Critically Endangered	Diffuse shrub to 0.3 m high. Flowers vivid red/pale pink to apricot/yellow	Sandy soils in the Yalgoo region. Flats, road reserves	(July in 1927) September - December	Yalgoo	Unlikely to occur - disturbance opportunist, occurs further south	PMST
<i>Grevillea bracteosa</i> subsp. <i>howatharra</i>	Critically Endangered	Critically Endangered	Large shrub to 2.5 m high. Pale pink and white terminal flower heads	Brown sandy loam and gravel, laterite. Hills, undulating plains	August - February	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - historic 1968 collection near Mullewa, other known records occur 20 km west of corridor	DBCA, Naturemap
<i>Gyrostemon reticulatus</i>	Critically Endangered	Critically Endangered	Low dense shrub to 1 m high and 1 m wide. Flowers orange/yellow or white	Sand/loam, gravelly sand. Flats, plains and road reserves	September - November	Avon Wheatbelt	Unlikely to occur - closest record 40 km SE of project area	PMST
<i>Eremophila nivea</i>	Endangered	Critically Endangered	White/grey, tomentose shrub, 1-2 m high. Flowers blue-purple-violet	Sandy clay, clay loam. Undulating plains, road verges	August - October	Avon Wheatbelt, Yalgoo	Unlikely to occur - known distribution south of Morawa	PMST
<i>Grevillea pythara</i>	Endangered	Critically Endangered	Suckering shrub, 0.06-0.3 m high. Flowers orange and red and blue	Sand or sandy loam with gravel	May - October	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - known distribution Dalwallinu area	PMST
<i>Caladenia hoffmanii</i>	Endangered	Endangered	Tuberous, perennial, herb 0.3 m high. Flowers green, yellow and red	Clay, loam, laterite, granite. Rocky outcrops and hillsides, ridges, swamps and gullies	August - October	Geraldton Sandplains	Unlikely to occur - suitable habitat may be present in project area but closest record 45 km WSW	PMST
<i>Eremophila viscida</i>	Endangered	Endangered	Shrub, 1.2-4 m high. Flowers pink with dark red markings	Granitic soils, sandy loam. Stony gullies, sandplains	September - November	Avon Wheatbelt, Coolgardie, Yalgoo	Likely - Previously recorded in project area	DBCA, Naturemap, PMST
<i>Ricinocarpos brevis</i>	Endangered	Endangered	Shrub, to 1.8 m high. Flowers white	Rocky hillslopes, rock outcrops	June - July	Coolgardie, Murchison	Unlikely to occur - suitable habitat unlikely present in project area	PMST

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Styphelia marginata</i> (formerly <i>Leucopogon marginata</i>)	Endangered	Endangered	Shrub 0.8 m high. Flowers white. Leaves horizontally spreading to slightly reflexed	Grey-brown, white or yellow sand. Hillsides, ridges, laterite. Ironstone gravel	May - September	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - suitable habitat likely present in project area but recorded 8 km south 35 years ago	DBCA, PMST
<i>Conostylis dielsii</i> subsp. <i>teres</i>	Endangered	Vulnerable	Shortly rhizomatous, tufted perennial grass-like herb 0.3 m high with terete leaves. Flowers cream-yellow	White, grey or yellow sand, gravel. Low open woodland	July - August	Geraldton Sandplains	Unlikely to occur - suitable habitat may be present in project area, but records occur >30 km south	PMST
<i>Conostylis micrantha</i>	Endangered	Vulnerable	Rhizomatous, tufted perennial grass-like herb 0.25 m high. Flowers yellow-cream/red	White or grey sand. Sandplains	July - August	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - suitable habitat may be present in project area, but records occur >30 km south	PMST
<i>Roycea pycnophylloides</i>	Endangered	Vulnerable	Perennial, herb, forming densely branched, silvery mats to 1 m wide	Sandy soils, clay. Saline flats	September - November	Avon Wheatbelt	Unlikely to occur - suitable habitat unlikely present in project area	PMST
<i>Wurmbea tubulosa</i>	Endangered	Vulnerable	Cormous, perennial, herb, 0.01-0.03 m high. Flowers white/pink	Clay, loam. Riverbanks, seasonally wet places	June - July	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - suitable habitat may be present within corridor but closest known occurrence approx. 25 km WSW	PMST
<i>Caladenia wanosa</i>	Vulnerable	Endangered	Tuberous, perennial herb 0.2 m high. Flowers cream and red	Sand. Sandstone outcrops, edges of gorges. Eucalyptus woodland	August - September	Geraldton Sandplains	Unlikely to occur - suitable habitat may be present but closest record 15 km north	PMST
<i>Eucalyptus beardiana</i>	Vulnerable	Endangered	Mallee to 5 m, bark smooth. Flowers cream-white	Red or yellow sand. Sand dunes and ridges	May, August - September	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	Likely to occur - previously recorded in project area	DBCA, Naturemap, PMST
<i>Eucalyptus synandra</i>	Vulnerable	Vulnerable	Mallee 3.5-10 m high, bark smooth. Flowers cream and pink	Sandy and lateritic soils, gravel loam. Flats, slopes and ridges	August - March	Avon Wheatbelt, Yalgoo	May occur - suitable habitat likely present in project area, recorded 5 km south	DBCA, Naturemap, PMST
<i>Acacia ampliata</i>	-	P1	Shrub or tree 2-5 m high, bark longitudinally finely fissured. Flowers yellow	Red/orange sand, sandy loam, loam. Sandplains, hillsides	April - August or October or December	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	Likely to occur - suitable habitat likely present in project area, recorded 1 km south	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Acacia lineolata</i> subsp. <i>multilineata</i>	-	P1	Dense, rounded shrub 0.5 - 2 m high with phyllodes oblong-oblancoelate to oblong-elliptic. Flowers yellow	Sand, clay, rocky terrain. Sandplains, depressions and hillsides	June - August	Avon Wheatbelt, Geraldton Sandplains	Likely to occur - recorded within 100 m of the project area	DBCA, Naturemap
<i>Aluta teres</i>	-	P1	Shrub to 0.8 m high. Flowers white	Red/orange yellow sands. Beneath BIF, sand dunes, plains	Only known from September	Murchison	Likely to occur - recorded 500 m south of project area	DBCA
<i>Atriplex spinulosa</i>	-	P1	Erect, rounded annual herb 0.2 m high	Grey silty clay/loam. Lower slopes, stony terrain and clay flats	No available information	Geraldton Sandplains	Unlikely to occur - small areas of suitable habitat may be present in project area, but recorded 10 km south	DBCA
<i>Baeckea staminosa</i>	-	P1	Spreading shrub 0.5 m high. Flowers purple/pink	White or light brown sand. Undulating flats and plains.	July or October	Geraldton Sandplains	Unlikely to occur - small areas of suitable habitat may be present in project area, but recorded 8.5 km west	DBCA
<i>Chamelaucium</i> sp. Tenindewa (F. Lullfitz L 3219)	-	P1	Limited data. Shrub(?)	Yellow or white sand. Sandplain	No available information	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - only known in area from 1 historic collection >7 km south	DBCA
<i>Chamelaucium</i> sp. Yalgoo (Y. Chadwick 1816)	-	P1	Multi stemmed, compact or bushy shrub 0.5 m high. Flowers pink/purple and cream/white	Brown loamy clay. Breakaways, slopes, flats, rocky ground, granite outcrops	August - October	Avon Wheatbelt, Yalgoo	Unlikely to occur - only known in area from historic collections	DBCA, Naturemap
<i>Desmocladus ferruginipes</i>	-	P1	Rhizomes spreading, forms compact tussocks to 1 m wide	Sand. Slopes and flats	April - May	Geraldton Sandplains	Likely to occur - suitable habitat may be present in project area, recorded near drainage line 5 km south	DBCA, Naturemap
<i>Drosera eremaea</i>	-	P1	Low ephemeral herb, no basal leaves, numerous tubers producing stolons at base of plant. Flowers white or pink	Red sand, quartz grit over white quartz. Open ground, winter wet creeks, granite outcrops	July - August	Murchison	Likely to occur - suitable habitat likely present in project area, numerous records near Mount Magnet	DBCA

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Drosera pedicellaris</i>	-	P1	Fibrous-rooted perennial, herb 0.15 m high. Flowers white	White, grey sandy soil occasionally with laterite	October - November	Avon Wheatbelt, Geraldton Sandplains	May occur - suitable habitat may be present in project area	DBCA
<i>Enekbatus dualis</i>	-	P1	Doomed shrub to 0.75 m. Flowers pink	Orange-brown silty sand, brown clayey sand, granite. Low hills, mid to upper slopes, rock outcrops, plains.	June - September	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	Likely to occur - previously recorded within 100 m of project area	DBCA, Naturemap
<i>Frankenia bracteata</i>	-	P1	Compact shrub to 0.2 m high and 0.2 m wide. Flowers white/pink	Sand, clay, saline soil. Low sandy rises, swamps, margins of salt lakes	September - November	Avon Wheatbelt	Likely to occur - suitable habitat likely to occur in project area, previously recorded 400 m south	DBCA, Naturemap
<i>Hemigenia</i> sp. Tallering (H. Pringle 3323)	-	P1	Erect shrub 0.5 - 1 m high. Flowers purple	Red loamy sand with BIF outcropping	October	Yalgoo	Unlikely to occur - suitable habitat unlikely present in project area	DBCA
<i>Jacksonia lanicarpa</i>	-	P1	Erect leafless shrub 2-3 m high and 1.5 m wide. Flowers orange and yellow	Sand, red/brown sandy loam, clay loam. Flats, plains, slopes	October - November	Murchison	Unlikely to occur - suitable habitat may be present in project area, but recorded 10 km north	DBCA
<i>Leptospermum exsertum</i>	-	P1	Spreading shrub, 0.6 - 1 m high. Flowers white or pale pink	Sand, sandy clay soils sometimes with gravel. Flats, sandplains and road verges	July - September	Avon Wheatbelt	Likely to occur - suitable habitat likely present in project area, recorded 1 km south	DBCA, Naturemap
<i>Millotia depauperata</i>	-	P1	Slender annual, herb to 0.2 m high. Flowers yellow	Red sand, sandy loam soils sometimes with laterite gravel. Slopes, occasionally granite outcrops	August - September	Geraldton Sandplains, Murchison, Yalgoo	May occur - suitable habitat likely present in project area, recorded 2 km north	DBCA
<i>Philotheca nutans</i>	-	P1	Upright shrub, 0.3-0.9 m high. Flowers pale green-cream to red/pink	Sandy soils. Low plains, undulating rises, edges of salt lakes	April or June - September	Avon Wheatbelt, Murchison, Yalgoo	Likely to occur - suitable habitat likely present in project area, known to occur 1 km south	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Prostanthera pedicellata</i>	-	P1	Open, elongate branched, weakly erect shrub 0.5 - 1 m high. Flowers pendulous, pink/red	Red/brown clay, sandy loam or sandy soils. Plains, roadside and railway line reserves	September - November	Avon Wheatbelt	Likely to occur - suitable habitat likely present in project area, numerous records near Pindan within 200 m of corridor	DBCA, Naturemap
<i>Pterostylis macrocalymma</i>	-	P1	Tuberous, perennial herb 0.25 m high with basal rosette of leaves. Flowers green/brown	Rocky, loamy, sandy and gravelly soil. Slopes, flats and undulating plains	August - October	Avon Wheatbelt, Geraldton Sandplains	Likely to occur - suitable habitat likely present in project area near Mullewa	DBCA, Naturemap
<i>Ptilotus procumbens</i>	-	P1	Spreading procumbent annual, herb 0.1 m high. Flowers pink/white	Red clay, sandy loam with lateritic gravel. Washaways, gravelly plains and flats	October - November	Murchison	Likely to occur - suitable habitat likely present in project area, recorded 3 km south, near Windimurra	DBCA
<i>Scholtzia thinicola</i>	-	P1	Shrub to 1.5 m high and 2 m wide. Flowers white/pale pink	Sandy soil. Ridges and slopes of sand dunes	October - December	Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area, recorded 10 km west	DBCA
<i>Stenanthemum bilobum</i>	-	P1	Small shrub. Flowers white-cream	Limited data. Sandy soil	August	Geraldton Sandplains	Unlikely to occur - known within the region from one historic collection	DBCA
<i>Stenanthemum patens</i>	-	P1	Low or erect shrub, 0.3 to 1 m high. Flowers white	Rocky sandy loam, clay soils. Hills and slopes	April or August - October	Murchison	May occur - suitable habitat likely present in project area but recorded 5 km west	DBCA
<i>Stylidium pendulum</i>	-	P1	Caespitose perennial, herb 0.1 - 0.35 m high. Flowers pale yellow	Clayey sand or sandy loam soil, granite. Upper slopes, often near rock outcrops	September - October	Avon Wheatbelt	Likely to occur - recorded adjacent to project area near Pindar	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Tricoryne</i> sp. Geraldton (G.J. Keighery 10461)	-	P1	Erect, perennial herb 0.6 m high. Flowers cream/yellow.	Sandy soil. Sand dune ridges	December and March	Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area	DBCA, Naturemap
<i>Caladenia pluvialis</i>	-	P2	Limited data. Orchid	Red loam or loamy sand or yellow sand	August	Avon Wheatbelt, Geraldton Sandplains	May occur - suitable habitat likely present in project area, recorded 3 km south	DBCA, Naturemap
<i>Dicrastylis incana</i>	-	P2	Shrub 0.6 - 1 m high. Flowers white	Sand. Slopes and flats	September - October	Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area, recorded >4 km south	DBCA
<i>Grevillea rosieri</i>	-	P2	Erect shrub 0.6 - 1 m high and 0.8 - 1.5 m wide, leaves 3 cm long, pungent. Flowers red	Sand, loam, clay and gravel. Ridges, hilltops, slopes and flats	June - August	Avon Wheatbelt, Yalgoo	May occur - small areas of suitable habitat likely present in project area but recorded 4 km north	DBCA, Naturemap
<i>Homalocalyx inerrabundus</i>	-	P2	Shrub 0.5 - 1 m high. Flowers pink/purple	Sand, sandy loam soils, sandstone or ironstone gravel. Ridges, flats, road reserves	August - October	Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area, recorded 6 km north west	DBCA
<i>Lepidobolus basiflorus</i>	-	P2	Densely tufted perennial sedge 0.3 m high. Flowers brown	Yellow sand. Slopes and rises of dunes	July?	Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area, recorded 6 km south	DBCA
<i>Petrophile pilostyla</i> subsp. <i>syntoma</i>	-	P2	Shrub 1 - 3 m high. Flowers grey with parts of yellow, orange and red	Sand and occasionally clay soil. Plains, crests of dunes	August - September	Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area, recorded 5 km south	DBCA
<i>Psammomoya grandiflora</i>	-	P2	Shrub 1 - 1.5 m. Flowers white, sweetly scented.	Loam, sand, rocky soils. BIF outcrops, sandstone outcrops	June - October	Avon Wheatbelt, Geraldton Sandplains, Murchison	Unlikely to occur - suitable habitat unlikely present in project area, recorded 10 km north west	DBCA

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Scholtzia inaequalis</i>	-	P2	Erect, compact shrub 2 - 3 m high. Flowers pink	Yellow sand, loam. Low plains, slopes, riverbed/gullies	June - October	Geraldton Sandplains	May occur - small areas of suitable habitat likely present in project area but recorded 3.5 km north	DBCA
<i>Thryptomene velutina</i>	-	P2	Erect, multi stemmed shrub 1.2 m high. Flowers pink	Yellow sand/loam sometimes with sandstone gravel. Slopes, sandstone breakaways and ridgetops	June - October	Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area, recorded >8 km north west	DBCA
<i>Acacia burrowsiana</i>	-	P3	Stout small tree to 5 m high. Flowers yellow	Red sandy loam, clay loam, quartz and ironstone rocks. BIF, laterite breakaways, slopes and low rises	October - November	Murchison	Unlikely to occur - suitable habitat likely present in project area but closest record >8 km north	DBCA
<i>Acacia leptospermoides</i> subsp. <i>psammophila</i>	-	P3	Spreading shrub 1 - 1.5 m high. Flowers yellow	Yellow or red sand, sandy loam, gravelly soils. Sandplains, slopes and undulating plains	April - August	Geraldton Sandplains	May occur - small areas of suitable habitat may occur, recorded north and south of project area	DBCA
<i>Acacia scalena</i>	-	P3	Straggly, prickly shrub 1.5 m high. Flowers yellow	Sand, sandy loam, lateritic gravel. Hills, slopes and road verges	June - September	Avon Wheatbelt	May occur - small areas of suitable habitat likely present in project area, recorded 1.7 km south	DBCA, Naturemap
<i>Acacia subsessilis</i>	-	P3	Rounded, straggly, pungent shrub 1 - 2 m high. Flowers yellow	Red sand or stony gravel over ironstone. Rocky hills	July - August	Murchison, Yalgoo	Likely to occur - recorded 250 m north of project area	DBCA, Naturemap
<i>Angianthus micropodioides</i>	-	P3	Erect or decumbent annual herb. Flowers yellow/white	Sand, clay, loam soils. Clay pans, margins of salt lakes, drainage lines	September - February	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - suitable habitat unlikely present in project area	DBCA
<i>Anthotroche myoporoides</i>	-	P3	Erect, densely haired, intricately branched shrub 2 - 3 m high. Flowers white/cream with violet streaks	Sand. Slopes and plains	September - February	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat likely present in project area, recorded 2 km south	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Arnocrinum drummondii</i>	-	P3	Sprawling herb 0.15 m. Flowers purple	Yellow/white sand. Dunes, slopes and flats	October - January	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - small areas of suitable habitat likely present in project area but old record (30 years), 3 km north	DBCA
<i>Baeckea</i> sp. Walkaway (A.S. George 11249)	-	P3	Dense, numerous stemmed, erect shrub 2 m high. Flowers white	Yellow/white sand, sometimes with laterite. Slopes, plains and road verges	November - January	Avon Wheatbelt, Geraldton Sandplains	May occur - small areas of suitable habitat likely present in project area, recorded 1.5 km south	DBCA, Naturemap
<i>Beyeria gardneri</i>	-	P3	Erect, open shrub 0.5 - 1 m high. Flowers white/pale yellow	Yellow sand. Slopes and rises of dunes	September - November	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	Unlikely to occur - small areas of suitable habitat likely present in project area but, recorded 8 km south	DBCA
<i>Calytrix formosa</i>	-	P3	Low shrub 0.5 m high. Flowers pink	Yellow sand. Slopes, flats and sandplains	September - October	Geraldton Sandplains, Yalgoo	Unlikely to occur - small areas of suitable habitat likely present in project area, but recorded 6 km north	DBCA
<i>Comesperma rhadinocarpum</i>	-	P3	Perennial herb, sub-shrub 0.2 - 0.4 m high. Flowers blue	Sand, sandy loam, lateritic gravel. Limestone ridges, dune slopes and undulating plains	October - January	Geraldton Sandplains	Unlikely to occur - small areas of suitable habitat likely present in project area, but 30 year old record and 4 km south	DBCA, Naturemap
<i>Cryptandra nola</i>	-	P3	Erect or spreading, spinescent shrub 1 m high. Flowers white	Sand, gravelly loam. Hillsides, drainage lines, occasionally granite outcrops and disturbed sites	June - August	Avon Wheatbelt, Geraldton Sandplains	May occur - small areas of suitable habitat likely present in project area, multiple records north and south of project area	DBCA, Naturemap
<i>Dampiera krauseana</i>	-	P3	Erect herb or sub-shrub 0.2 - 0.4 m high. Flowers blue	Sand. Slopes and undulating plains	June - September	Geraldton Sandplains	Unlikely to occur - small areas of suitable habitat likely present in project area, but recorded 8 km south	DBCA
<i>Darwinia</i> sp. Morawa (C.A. Gardner 2662)	-	P3	Low, woody, spreading shrub 0.3 m high and 1 m wide with grey foliage. Flowers red	Sand, sandy loam, rocky terrain. Plains, slopes and road verges	August - October	Avon Wheatbelt, Geraldton Sandplains	Likely to occur - recorded 250 m north of project area	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Dicrasyllis linearifolia</i>	-	P3	Many branched, compact shrub 3 m high and 2 - 3 m wide with light green foliage. Flowers white	Yellow or red sand. Sand dunes, plains	August - January	Geraldton Sandplains, Murchison, Yalgoo	Likely to occur - recorded 100 m north of project area	DBCA
<i>Eremophila arachnoides</i> subsp. <i>arachnoides</i>	-	P3	Erect, compact shrub 2 m high. Flowers purple/blue with white throat	Clayey sand, loam, calcrete. Undulating plains	September - December	Murchison	May occur - suitable habitat may occur in project area, recorded 3 km south	DBCA, Naturemap
<i>Euryomyrtus recurva</i>	-	P3	Low, multi stemmed shrub 0.5 m high. Flowers pink/pale pink	Sand, sandy clay. Flats, undulating plains, occasionally breakaways	April - October	Avon Wheatbelt, Murchison, Yalgoo	May occur - suitable habitat may occur in project area, recorded 3.5 km north	DBCA, Naturemap
<i>Gastrolobium propinquum</i>	-	P3	Low, densely straggly shrub 1 m high. Flowers yellow with red parts	Clay, clay loam, sandy clay soils. Hills, flats, drainage lines, winter wet areas	June - September	Avon Wheatbelt, Geraldton Sandplains	May occur - small areas of suitable habitat likely present in project area, recorded 2 km south	DBCA, Naturemap
<i>Gnephosis cassiniana</i>	-	P3	Minute annual herb 0.06 m high. Flowers yellow	Sand, clay or loam. Saline depressions, winter wet depressions	September - October	Avon Wheatbelt, Geraldton Sandplains, Murchison, Yalgoo	May occur - minimal areas of suitable habitat likely present in project area, recorded 0.8 km south	DBCA, Naturemap
<i>Gompholobium cinereum</i>	-	P3	Low shrub 0.3 m high. Flowers purple/mauve	Sand, clayey sand, loam, sandy gravel, laterite. Plains, slopes, road verges	September - November	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat likely present in project area, recorded 1.5 km south	DBCA, Naturemap
<i>Grevillea candicans</i>	-	P3	Large shrub 3 m high. Flowers white/cream	Sand. Flats, undulating plains, drainage lines	September - December	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat likely present in project area, recorded 2 km south	DBCA, Naturemap
<i>Grevillea granulosa</i>	-	P3	Erect shrub 1 m high. Flowers red	Sand, sandy loam, occasionally with lateritic gravel. Flats, slopes, margins of salt lakes	June - November	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	Likely to occur - small areas of suitable habitat likely present in project area, recorded 600 m south	DBCA, Naturemap
<i>Grevillea tenuiloba</i>	-	P3	Low, spreading, straggly shrub 0.6 m high. Flowers orange/brown	Sand, clay loam. Granite outcrops, road verge	July - October	Avon Wheatbelt	Likely to occur - recorded 100 m north of project area	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Malleostemon nephroideus</i>	-	P3	Low spreading, dense rounded shrub 0.4 m high. Flowers small pink	Sand. Undulating dunes	October - December	Avon Wheatbelt, Geraldton Sandplains	May occur - small areas of suitable habitat likely present in project area, recorded 2 km south	DBCA, Naturemap
<i>Malleostemon pentagonus</i>	-	P3	Shrub 2 m high. Flowers white/pale pink	Sand. Slopes and flats of dunes	September - October	Geraldton Sandplains, Yalgoo	Unlikely to occur - small areas of suitable habitat likely present in project area but recorded 4 km south	DBCA, Naturemap
<i>Melaleuca barlowii</i>	-	P3	Shrub 2 - 4 m high. Flowers purple	Sand, clay, loam, gravel. Hills, slopes, BIF and road verges	August - October	Avon Wheatbelt, Yalgoo	Likely to occur - recorded 300 m south of project area	DBCA, Naturemap
<i>Microcorys tenuifolia</i>	-	P3	Low, spreading shrub 1 m high and 1 - 2 m wide. Flowers white	Sand, sandy loam. Slopes and flats	October - February	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - small areas of suitable habitat likely present in project area, but recorded 8 km south	DBCA
<i>Persoonia pentasticha</i>	-	P3	Erect, spreading shrub 1 m high. Flowers yellow	Sandy loam, sandy clay. Slopes and flats	September - November	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	Likely to occur - recorded 300 m south of project area	DBCA, Naturemap
<i>Petrophile pauciflora</i>	-	P3	Open shrub 1 m high and 1 m wide. Flowers yellow/orange	Sandy loam, sandy clay. Breakaways, granite and laterite, slopes and flats	August - September	Avon Wheatbelt, Murchison, Yalgoo	May occur - suitable habitat may occur in project area, recorded 4.5 km north	DBCA
<i>Psammomoya implexa</i>	-	P3	Much branched shrub 1 m high. Flowers white	Sand, loam, sandy clay. Hills, plains, base of BIF or laterite breakaways	August - October	Avon Wheatbelt, Yalgoo	May occur - small areas of suitable habitat may occur in project area, recorded 1.5 km north	DBCA, Naturemap
<i>Ptilotus luteolus</i>	-	P3	Compact shrub 0.3 m high. Flowers pale yellow with green	Sand, loam, clay, laterite. Outcrops, slopes of BIF, rocky hills	August - November	Murchison	Unlikely to occur - suitable habitat unlikely present in project area	DBCA
<i>Rhodanthe collina</i>	-	P3	Erect, bushy annual herb 0.2 m high. Flowers white and yellow	Sandy clay loam. Outcrops, slopes, plains and road verges	September - October	Avon Wheatbelt, Yalgoo	May occur - suitable habitat likely present in project area, recorded 1.5 km south	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Roebuckiella halophila</i>	-	P3	Annual herb 0.15 m high. Flowers purple	Sand. Margins of salt pans, drainage lines	August - October	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	Likely to occur - recorded 100 m north of project area	DBCA, Naturemap
<i>Scaevola globosa</i>	-	P3	Low, prostrate, mat forming shrub 0.3 m high and 1.5 m wide. Flowers yellow	Sand. Flats and undulating plains	September - February	Avon Wheatbelt, Geraldton Sandplains	May occur - small areas of suitable habitat may occur in project area, recorded 2.5 km south	DBCA, Naturemap
<i>Scholtzia prostrata</i>	-	P3	Prostrate shrub 1 m wide. Flowers pale pink	Sand, sometimes with laterite. Slopes and flats	Limited data. November	Geraldton Sandplains	Unlikely to occur - suitable habitat may be present in project area, but recorded 7 km south west	DBCA
<i>Scholtzia</i> sp. Geraldton (F. Lullfitz L 3216)	-	P3	Low, spreading shrub 0.3 m high and 1 m wide. Flowers pink	Sand. Dune swales, slopes and flats	October - December	Geraldton Sandplains, Yalgoo	Unlikely to occur - suitable habitat may be present in project area, but recorded 8 km south	DBCA
<i>Thryptomene hubbardii</i>	-	P3	Spreading open shrub 1 m high and 1 m wide. Flowers white or pale pink	Sand, sandy clay. Slopes, depressions and plains	August - November	Avon Wheatbelt, Geraldton Sandplains	May occur - small areas of suitable habitat may occur in project area, recorded 2.5 km south	DBCA, Naturemap
<i>Thryptomene orbiculata</i>	-	P3	Erect to spreading shrub 1 m high. Flowers pink	Sand. Slopes and undulating plains	July - September	Avon Wheatbelt, Geraldton Sandplains	May occur - small areas of suitable habitat may occur in project area, recorded 2.5 km south	DBCA, Naturemap
<i>Thryptomene</i> sp. Wandana (M.E. Trudgen MET 22016)	-	P3	Shrub 0.8 m high. Flowers pink	Sand. Slopes and undulating plains	July - September	Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat may occur in project area, recorded 3 km south	DBCA
<i>Tribulus adelacanthus</i>	-	P3	Prostrate shrub. Flowers yellow(?)	Gravelly soils, downslope from Banded Ironstone outcrop	Limited data. August	Murchison	Unlikely to occur - suitable habitat may be present in project area, but recorded 10 km north	DBCA
<i>Triglochin protuberans</i>	-	P3	Semi aquatic annual herb 0.15 m high. Flowers green	Clay, mud. Claypans, margins of pools and wetlands	August - October	Avon Wheatbelt, Geraldton Sandplains, Murchison, Yalgoo	Unlikely to occur - suitable habitat unlikely present in project area	DBCA
<i>Verticordia chrysostachys</i> var. <i>pallida</i>	-	P3	Erect to spreading shrub 2 m high. Flowers pale yellow	Sand. Sandplains and dunes	September - January	Avon Wheatbelt, Geraldton Sandplains	Likely to occur - recorded 600 m south of project area	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Verticordia densiflora</i> var. <i>roseostella</i>	-	P3	Erect shrub 0.8 m high. Flowers pale pink and white	Sand. Undulating plains	September - December	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - suitable habitat may be present in project area, but recorded 6.5 km north	DBCA
<i>Verticordia fragrans</i>	-	P3	Openly branched shrub 2 - 3 m high. Flowers pale pink/white	Sand, clay loam. Undulating plains, depressions	September - November	Geraldton Sandplains	Unlikely to occur - suitable habitat may be present in project area, but recorded 10 km south	DBCA
<i>Acacia speckii</i>	-	P4	Shrub to small tree 3 - 5 m high. Flowers yellow	Sand, loam or clay. Plains, slopes, beneath rock outcrops	February - March	Murchison, Yalgoo	Likely to occur - recorded 1 km north of project area	DBCA, Naturemap
<i>Banksia benthamiana</i>	-	P4	Shrub 2 - 4 m high. Flowers yellow/orange	Sandy loam, clay loam, sand and gravel. Ridges, plains and slopes	November - January	Avon Wheatbelt, Yalgoo	Likely to occur - recorded 100 m north of project area	DBCA, Naturemap
<i>Dodonaea amplisemina</i>	-	P4	Multi stemmed shrub 1 m high.	Sand, sandy clay. Rocky hills, gravelly slopes, BIF outcrops	October	Avon Wheatbelt, Murchison, Yalgoo	May occur - suitable habitat may occur in project area, recorded 3 km south	DBCA, Naturemap
<i>Eucalyptus ebbanoensis</i> subsp. <i>photina</i>	-	P4	Mallee 4 - 6 m high with smooth grey over greenish-cream bark. Adult leaves glossy green. Flowers white/cream	Sandy clay, sand. Lateritic breakaways, sandplains	September - March	Avon Wheatbelt, Geraldton Sandplains	Unlikely to occur - small areas of suitable habitat may occur in project area but recorded 6 - 7 km from project area	DBCA
<i>Goodenia neogoodenia</i>	-	P4	Prostrate annual herb. Flowers minute yellow	Sand, sandy clay. Edges of wetlands, creeklines, claypans	August - September	Geraldton Sandplains, Murchison, Yalgoo	Likely to occur - previous record within the project area	DBCA, Naturemap
<i>Grevillea inconspicua</i>	-	P4	Intricately branched, spreading shrub 2 m high. Flowers white/pale pink	Loam, gravel. Drainage lines, rocky outcrops, creeklines	June - September	Murchison	May occur - suitable habitat may occur in project area, recorded 6 km south	DBCA
<i>Hemigenia exilis</i>	-	P4	Erect, multi stemmed shrub 1 m high. Flowers purple	Sand, sandy loam. Drainage lines, laterite and BIF outcrops, slopes	April - December	Murchison	Likely to occur - suitable habitat present in project area	DBCA, Naturemap

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Flowering Period	Relevant IBRA Bioregion	Likelihood of Occurrence	Source of Record
<i>Jacksonia velutina</i>	-	P4	Erect, leafless broom-like shrub 1.5 m high. Flowers yellow with red	Sand. Undulating plains, sand dunes, limestone outcrops and road verges	September - October	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat may occur in project area, recorded 2 km north	DBCA, Naturemap
<i>Lechenaultia longiloba</i>	-	P4	Straggly, prostrate shrub 0.3 m high. Flowers red/yellow	Sand, sometimes with lateritic gravel. Undulating plains	July - October	Geraldton Sandplains	Unlikely to occur - suitable habitat may be present in project area, but records >40 years old	DBCA
<i>Verticordia capillaris</i>	-	P4	Corymbose shrub 1.5 m high. Flowers white/cream	Sand, sandy loam, sandy clay. Sandplains, hills, gentle slopes	September - November	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat may occur in project area, recorded 3.5 km south	DBCA, Naturemap
<i>Verticordia penicillaris</i>	-	P4	Low spreading shrub 0.3 m high. Flowers cream/yellow	Clay loam, sandy clay loam. Ridges, hills, creeklines, granite outcrops	August - November	Avon Wheatbelt, Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat may occur in project area, recorded north and south of project area	DBCA, Naturemap
<i>Verticordia polytricha</i>	-	P4	Shrub 1.5 m high. Flowers white in dense heads	Sand. Sandplains, sandstone outcrops, road verge	September - November	Geraldton Sandplains, Yalgoo	May occur - small areas of suitable habitat may occur in project area, recorded 5 km south	DBCA, Naturemap

5.1.2 Threatened and Priority Ecological Communities

A review of the DBCA Threatened and Priority Ecological Communities (TEC and PEC) database for ecological communities characterised by flora and vegetation values identified the presence of one Commonwealth listed Critically Endangered Threatened Ecological Community and one State listed Priority 3 Ecological Community within the project area (**Figure 9**). These ecological communities are:

- ***Eucalypt Woodlands of the Western Australian Wheatbelt - Critically Endangered (EPBC Act), Priority 3 (DBCA) (Eucalypt woodlands TEC)***

The Eucalypt Woodlands TEC and PEC is found on the flatter landscapes and lower rises of the wheatbelt and consists of a complex mosaic of about 30 Eucalypt species that typically have a single trunk (DoEE 2016).

- ***Yalgoo vegetation complexes (Banded Ironstone Formation) – Priority 3 (DBCA) (Yalgoo BIF PEC)***

The Yalgoo vegetation complexes PEC is comprised of five major groups or flora community types (Markey and Dillon 2011) and typically comprises of Acacia shrublands on Banded Ironstone Formations.

5.2 FIELD ASSESSMENT

5.2.1 Flora

A total of 501 flora species, from 197 genera and 58 families was recorded during the survey in the project area. The dominant families were found to be Fabaceae (Pea Family – 65 taxa), Chenopodiaceae (Chenopod Family - 52 taxa) and Myrtaceae (Myrtle Family – 40 taxa). The total includes 471 (94%) native species and 30 (6%) introduced (weed) species. The full list of vascular flora recorded within each vegetation unit is presented in **Appendix C** and individual quadrat data is presented in **Appendix D**.

Recorded flora species includes those recorded from sampled quadrats, opportunistically whilst moving around the project area and those recorded during targeted searches and opportunistic sampling for Threatened and Priority flora.

5.2.2 Conservation Significant Flora

A total of six Threatened or Priority flora were recorded during the field assessment. This comprised of one species listed as Threatened flora (*Eucalyptus beardiana*) under the BC Act and under the EPBC Act, four Priority 3 flora and one Priority 4 and are summarised in **Table 7**. The targeted search traverses are presented in **Figure 7**. Spring is considered optimal timing to conduct a targeted significant flora survey, as this is considered peak flowering period for the region.

Table 7 - Threatened and Priority Flora Recorded in the Project Area

Species	EPBC Act Conservation Status	WA Conservation Status	Total Number of Individuals Recorded	Recorded Quadrat (or from Targeted Searches)	Vegetation Unit	Species Present within the Project Area
<i>Eucalyptus beardiana</i>	Vulnerable	Endangered	55	Targeted, FW03R	EbW	Yes
<i>Dicrasyllis linearifolia</i>		Priority 3	183	Targeted	CcLOW	Yes
<i>Gnephosis cassiniana</i>		Priority 3	1	11	TspSS	Yes
<i>Petrophile ?pauciflora</i> [#]		Priority 3	5	Targeted	AbMpCS	Yes
<i>Ptilotus beardii</i>		Priority 3	1	68	MpCS	Yes
<i>Acacia speckii</i>		Priority 4	1	27B	AgTS	No
TOTAL			246			

[#] assumes tentative identification is correct to species level

[^] includes *Sida* ?sp. dark green fruits (S. van Leeuwen 2260)

Five of the recorded flora were found to be undescribed (phrase name) species in accordance with records of the Western Australian Herbarium (DBCA 2020f). These species are summarised in **Table 8**.

Table 8 – Recorded Locations of Undescribed Species

Species	Minimum Number of Individuals Recorded	Recorded Quadrat	Vegetation Unit	Location
<i>Baeckea</i> sp. Dudawa (M.E. Trudgen MET 5369)	1	10	McS	371835mE 6847082mN (GDA 94 Zone 50)
<i>Microcorys</i> sp. Mt Gibson (S. Patrick 2098)	1	W13	EkEhW	395056mE 6850896mN (GDA 94 Zone 50)
	1	W14	EkEhW	397396mE 6851397mN (GDA 94 Zone 50)
	1	W16	CcLOW	403189mE 6853085mN (GDA 94 Zone 50)
<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260) [^]	1	S10	AcEspS	599566mE 6888134mN (GDA 94 Zone 50)
	1	20	EkEhW	411957mE 6854896mN (GDA 94 Zone 50)
	1	37	AspTS	472930mE 6864240mN (GDA 94 Zone 50)
	1	45	AspTS	502869mE 6863647mN (GDA94 Zone 50)
	1	W14	EkEhW	397396mE 6851397mN (GDA 94 Zone 50)
<i>Sida</i> sp. golden calyces glabrous (H.N. Foote 32)	1	CEN11R	AcTOS	602093mE 6885074mN (GDA 94 Zone 50)
<i>Tecticornia</i> sp. Dennys Crossing (K.A. Shepherd & J. English KS552)	1	2	TspSS	333495mE 6838496mN (GDA 94 Zone 50)
Total	11			

Of the recorded flora, four endemic species are considered to be exhibiting an extension beyond their currently documented range of occurrence, in accordance with records of the Western Australian Herbarium (DBCA 2020f). These species are summarised in **Table 9**.

Table 9 – Recorded Locations of Undescribed Species

Species	Minimum Number of Individuals Recorded	Recorded Quadrat	Vegetation Unit	Location
<i>Acacia rigens</i>	1	81e	AcTOS	742282mE 6871774mN (GDA 94 Zone 50)
	1	89	AcTOS	791057mE 6868445mN (GDA 94 Zone 50)
	1	99	AcTOS	265300mE 6870585mN (GDA 94 Zone 51)
	1	E03	AcTOS	236344mE 6874076mN (GDA 94 Zone 51)
<i>Eleocharis acuta</i>	1	CEN13R	HspTS	648491mE 6875842mN (GDA 94 Zone 50)
<i>Eremophila platycalyx</i> subsp. Woolgorong	1	E07	AtHpS	648491mE 6875842mN (GDA 94 Zone 50)
<i>Juncus subsecundus</i>	1	E01	EcW	272255mE 6872174mN (GDA 94 Zone 51)

5.2.3 Introduced Flora

Occurrences of Declared Pest plants and Weeds of National Significance (WoNS) were targeted within native vegetation remnants, but not within pasture and other cleared areas, where their abundance may be significant. Two of the recorded introduced (weed) species (**Echium plantagineum* and **Rumex hypogaeus*) are listed as Declared Pest plants under the BAM Act (DPIRD 2020) within the project area, as summarised in **Table 10**. None of the recorded weeds are listed as WoNS (DAWE 2020a).

Table 10 – Locations of Recorded Declared Pest Plants

Species	Common Name	Vegetation Unit	Location	Abundance
<i>*Echium plantagineum</i>	Paterson's Curse	SsTS	351226mE 6844342mN (GDA 94 Zone 50)	1
<i>*Rumex hypogaeus</i> (formerly <i>*Emex australis</i>)	Doublegee	TSP	332169mE 6837462mN (GDA 94 Zone 50)	10
		EsBsW	338445mE 6839423mN (GDA 94 Zone 50)	50
		AspTS	482963mE 6863648mN (GDA 94 Zone 50)	1
		HspTS	648491mE 6875842mN (GDA 94 Zone 50)	1
		AcEspS	601133mE 6885677mN (GDA 94 Zone 50)	50
		Outside project area	472871mE 6864146mN (GDA 94 Zone 50)	50

5.2.4 Vegetation

The vegetation of the project area was defined from a total of 137 sample sites, consisting of 128 quadrats and nine relevés, sampled as part of the spring survey. Floristic analysis of the quadrat data via multivariate cluster analysis of species presence/absence using PATN™ software was carried out, in order to group quadrats of similar species composition. The results of this analysis (**Figure 11**) concluded that the project area supports 34 intact vegetation units (32 within the project area and two additional units outside) and one pasture unit, which have been spatially mapped across the project area (**Figure 12** series).

Broadly, the vegetation units of the project area comprise of *Eucalyptus*, *Banksia*, *Callitris* or *Hakea* woodlands and *Acacia*, *Eremophila*, *Melaleuca* and *Chenopod* dominated shrublands. The vegetation units defined within the project area are summarised in **Table 11**.

Table 11 - Summary of Recorded Vegetation Units

Vegetation Unit Code	Vegetation Description	Representative Quadrats/Relevés	Area (ha)	% of Project Area	Survey Completeness Comment
BsCaW <i>Banksia</i> Woodland	<i>Banksia sceptrum</i> and <i>Callitris arenaria</i> Low Open Woodland over <i>Beaufortia aestiva</i> Sparse Shrubland over <i>Austrostipa elegantissima</i> Low Sparse Grassland.	FW04R	0.68	0.005	Limited distribution. Vegetation unit exists as small, degraded, isolated remnant surrounded by cleared pasture and paddocks.
CcLOW <i>Callitris</i> Woodland	<i>Callitris columellaris</i> , <i>Melaleuca fulgens</i> and <i>Acacia ramulosa</i> var. <i>linophylla</i> Tall Shrubland over <i>Acacia colletioides</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> and <i>Aluta aspera</i> subsp. <i>hesperia</i> Sparse Shrubland over <i>Goodenia capillosa</i> , <i>Waitzia acuminata</i> var. <i>acuminata</i> and <i>Calocephalus multiflorus</i> Low Sparse Forbland.	18, S16^, W16	104.76	0.84	Sufficient number of quadrats sampled
EbW <i>Eucalyptus</i> Woodland	<i>Eucalyptus beardiana</i> Low Woodland over <i>Pimelea microcephala</i> subsp. <i>microcephala</i> Isolated Shrubs over <i>Solanum hesperium</i> Low Sparse Forbland.	FW03R	2.21	0.018	Limited distribution. Vegetation unit exists as small, degraded, isolated remnant surrounded by cleared pasture and paddocks.
EcW <i>Eucalyptus</i> Woodland	<i>Eucalyptus camaldulensis</i> Woodland over <i>Acacia burkittii</i> , <i>Senna artemisioides</i> subsp. <i>artemisioides</i> Tall Sparse Shrubland over <i>Themeda triandra</i> and <i>Eragrostis tenellula</i> Low Sparse Grassland.	97, 100, 101, 102, E01	5.16	0.042	Sufficient number of quadrats sampled
EkAcS <i>Eucalyptus</i> Woodland	<i>Eucalyptus kingsmillii</i> Mallee Woodland over <i>Acacia ?fuscanaura</i> and <i>Acacia caesaneura</i> Tall Open Shrubland over <i>Ptilotus drummondii</i> and <i>Ptilotus obovatus</i> Low Sparse Chenopod Shrubland.	CEN12	60.44	0.49	Limited vegetation distribution
EkDiW <i>Eucalyptus</i> Woodland	<i>Eucalyptus kochii</i> subsp. <i>borealis</i> Low Woodland over <i>Dodonaea inaequifolia</i> , <i>Eremophila clarkei</i> and <i>Acacia andrewsii</i> Sparse Shrubland.	8^	0	0	Not applicable; vegetation unit sampled outside project area
EkEhW <i>Eucalyptus</i> Woodland	<i>Eucalyptus kochii</i> subsp. <i>borealis</i> , <i>Eucalyptus kochii</i> subsp. <i>plenissima</i> and <i>Eucalyptus horistes</i> Low Open Woodland over <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia fuscanaura</i> , <i>Acacia aulacophylla</i> and <i>Acacia tetragonophylla</i> Tall Sparse Shrubland over <i>Ptilotus obovatus</i> and <i>Rhagodia drummondii</i> Low Sparse Shrubland.	20, 22, TEC01^, TEC02^, W13^, W14^, W15	31.17	0.25	Sufficient number of quadrats sampled

Vegetation Unit Code	Vegetation Description	Representative Quadrats/Relevés	Area (ha)	% of Project Area	Survey Completeness Comment
EkTbHG <i>Eucalyptus</i> Woodland	<i>Eucalyptus kingsmillii</i> Low Woodland over <i>Acacia caesaneura</i> , <i>Acacia incurvaneura</i> and <i>Acacia effusifolia</i> Tall Open Shrubland over <i>Triodia basedowii</i> Low Hummock Grassland.	75b, 81, 82, 82B [^]	195.05	1.57	Sufficient number of quadrats sampled
EIW <i>Eucalyptus</i> Woodland	<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> Low Woodland over <i>Melaleuca eleuterostachya</i> Tall Sparse Shrubland over <i>Atriplex semilunaris</i> and <i>Chenopodium gaudichaudianum</i> Low Sparse Chenopod Shrubland.	7	2.24	0.0018	Limited vegetation distribution
EsBsW <i>Eucalyptus</i> Woodland	<i>Eucalyptus</i> sp., and <i>Banksia</i> sp. Low Open Woodland over <i>Acacia</i> sp. Sparse Shrubland over introduced weeds and grasses.	FW02R	0.66	0.005	Limited distribution. Vegetation unit exists as small degraded isolated remnant surrounded by cleared pasture and paddocks.
EsMnS <i>Eucalyptus</i> Woodland	<i>Eucalyptus subangusta</i> Low Open Forest over <i>Melaleuca nematophylla</i> , <i>Dodonaea inaequifolia</i> and <i>Philotheca brucei</i> subsp. <i>brucei</i> Tall Open Shrubland over <i>Waitzia acuminata</i> var. <i>acuminata</i> Low Sparse Forbland.	S23	1.67	0.013	Limited vegetation distribution
HspTS <i>Hakea</i> Woodland	<i>Pittosporum angustifolium</i> isolated trees over <i>Hakea preissii</i> and/or <i>Hakea recurva</i> Tall Shrubland over <i>Acacia victoriae</i> and <i>Acacia tetragonophylla</i> Sparse Shrubland over <i>Eriachne flaccida</i> Low Sparse Shrubland.	S01, S02 [^] , CEN13R [^]	42.62	0.34	Sufficient number of quadrats sampled
MgCS <i>Hakea</i> Woodland	<i>Hakea preissii</i> isolated Trees over <i>Maireana glomerifolia</i> and <i>Frankenia setosa</i> Low Sparse Chenopod Shrubland.	105, 106 [^]	3.29	0.027	Limited vegetation distribution
AtTS <i>Acacia</i> Shrubland	<i>Acacia tysonii</i> , <i>Acacia ligulata</i> and <i>Acacia aulacophylla</i> Tall Shrubland over <i>Atriplex ?bunburyana</i> and <i>Ptilotus obovatus</i> Sparse Shrubland over <i>Frankenia ?cinerea</i> and <i>Roepera eremaea</i> Low Sparse Shrubland.	28, 29, 30, 31, 35	674.41	5.44	Sufficient number of quadrats sampled
AbTOS <i>Acacia</i> Shrubland	<i>Acacia burkittii</i> Tall Open Shrubland.	56, 69, 69a	102.99	0.83	Sufficient number of quadrats sampled
AgTS <i>Acacia</i> Shrubland	<i>Acacia grasbyi</i> , <i>Acacia aulacophylla</i> and <i>Acacia speckii</i> Tall Sparse Shrubland over <i>Micromyrtus prochytes</i> and <i>Cephalopterum drummondii</i> Low Sparse Shrubland.	25B [^] , 27B [^]	0	0	Not applicable; vegetation unit sampled outside project area

Vegetation Unit Code	Vegetation Description	Representative Quadrats/Relevés	Area (ha)	% of Project Area	Survey Completeness Comment
AnTOS <i>Acacia</i> Shrubland	<i>Acacia neurophylla</i> subsp. <i>erugata</i> , <i>Acacia</i> sp. and <i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i> Tall Open Shrubland over <i>Trachymene cyanopetala</i> and <i>Chenopodium gaudichaudianum</i> Low Sparse Shrubland.	9	5.74	0.046	Limited vegetation distribution
AspTS <i>Acacia</i> Shrubland	<i>Acacia caesaneura</i> , <i>Acacia tetragonophylla</i> and <i>Acacia aptaneura</i> Tall Shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Aluta aspera</i> subsp. <i>hesperia</i> , <i>Eremophila fraseri</i> subsp. <i>fraseri</i> Sparse Shrubland over <i>Ptilotus obovatus</i> and <i>Maireana triptera</i> Low Sparse Shrubland.	23, 36, 37 [^] , 38, 39, 41, 42, 44, 45, CEN02R	1,237.69	9.98	Sufficient number of quadrats sampled
AcTOS <i>Acacia</i> / <i>Eremophila</i> Shrubland	<i>Acacia caesaneura</i> , <i>Acacia tetragonophylla</i> , <i>Acacia craspedocarpa</i> , <i>Acacia incurvaneura</i> Tall Shrubland over <i>Eremophila forrestii</i> , <i>Eremophila latrobei</i> and <i>Aluta aspera</i> subsp. <i>hesperia</i> Low Sparse Shrubland over <i>Eragrostis eriopoda</i> Low Open Grassland.	40, 57, 58 [^] , 61, 73, 81e [^] , 88 [^] , 89, 90, 91, 94, 95, 98, 99, 103, 104, 108, 71b, 76c, 91e, CEN11R [^] , E02, E03, E04 [^] , E05 [^] , E06 [^] , E08, E09, E10	5,324.16	42.92	Sufficient number of quadrats sampled
AmTS <i>Acacia</i> / <i>Eremophila</i> Shrubland	<i>Acacia mulganeura</i> , <i>Acacia caesaneura</i> and <i>Acacia ramulosa</i> var. <i>ramulosa</i> Tall Shrubland over <i>Eremophila forrestii</i> Sparse Shrubland.	S03 [^] , S04	71.65	0.58	Limited vegetation distribution
ArEIS <i>Acacia</i> / <i>Eremophila</i> Shrubland	<i>Acacia ramulosa</i> var. <i>linophylla</i> Tall Shrubland over <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Hemigenia divaricata</i> and <i>Philothea brucei</i> subsp. <i>brucei</i> Sparse Shrubland over <i>Borya sphaerocephala</i> and <i>Waitzia acuminata</i> var. <i>acuminata</i> Low Sparse Forbland.	S17, S18	85.09	0.69	Additional quadrat sampling may be appropriate
AvS <i>Acacia</i> / <i>Eremophila</i> Shrubland	<i>Acacia victoriae</i> , <i>Acacia</i> ? <i>inaequilatera</i> and <i>Eremophila</i> ? <i>longiflora</i> Tall Shrubland <i>Ptilotus aevoides</i> and <i>Ptilotus obovatus</i> Sparse Shrubland.	55, 70 [^]	26.44	0.21	Limited vegetation distribution
AcEspS <i>Acacia</i> / <i>Eremophila</i> Shrubland	<i>Acacia caesaneura</i> , <i>Acacia incurvaneura</i> , <i>Acacia mulganeura</i> Tall Open Shrubland over <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila compacta</i> subsp. <i>compacta</i> Low Sparse Shrubland.	43, 46, 47 [^] , 51, 60, 62 [^] , 63, CEN03, CEN04, CEN06, CEN07, CEN09, E11, S10 [^]	1,524.05	12.29	Sufficient number of quadrats sampled

Vegetation Unit Code	Vegetation Description	Representative Quadrats/Relevés	Area (ha)	% of Project Area	Survey Completeness Comment
AtHpS <i>Acacia / Hakea</i> Shrubland	<i>Acacia tetragonophylla</i> , <i>Acacia incurvaneura</i> and <i>Hakea preissii</i> Tall Open Shrubland over <i>Eremophila clarkeii</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> Sparse Shrubland over <i>Ptilotus obovatus</i> , <i>Maireana trichoptera</i> and <i>Maireana georgei</i> Low Chenopod Shrubland.	74 [^] , 107, 109, 77B, E07 [^] , W12 [^]	182.99	1.48	Sufficient number of quadrats sampled
AcMIS <i>Acacia / Melaleuca</i> Shrubland	<i>Acacia caesaneura</i> , <i>Acacia acuminata</i> and <i>Melaleuca leiocarpa</i> Tall Shrubland over <i>Philotheca brucei</i> Sparse Shrubland over <i>Waitzia acuminata</i> var. <i>acuminata</i> Low Sparse Forbland.	S13, S14 [^] , S15	201.25	1.62	Sufficient number of quadrats sampled
AbMpCS Chenopod Shrubland	<i>Atriplex ?bunburyana</i> , <i>Maireana pyramidata</i> and <i>Cratystylis subspinescens</i> Low Open Chenopod Shrubland.	48 [^] , 49 [^] , 50 [^] , 53, 54 [^] , 64, 65 [^] , 66	506.81	4.09	Sufficient number of quadrats sampled
MpCS Chenopod Shrubland	<i>Hakea preissii</i> or <i>Acacia ?fuscaeneura</i> isolated Trees over <i>Maireana pyramidata</i> , <i>Maireana triptera</i> and <i>Frankenia setosa</i> Low Sparse Chenopod Shrubland.	68, CEN01R [^] , CEN08R, CEN10 [^]	27.95	0.23	Sufficient number of quadrats sampled
McS <i>Melaleuca / Acacia</i> Shrubland	<i>Eucalyptus ?oleosa</i> or <i>Eucalyptus comitae-vallis</i> Low isolated Trees over <i>Melaleuca concreta</i> , <i>Melaleuca stereophloia</i> and <i>Acacia acuminata</i> Tall Shrubland over <i>Waitzia acuminata</i> var. <i>acuminata</i> Low Sparse Forbland..	10, S21	14.49	0.12	Additional quadrat sampling may be appropriate
MaTS <i>Melaleuca</i> Shrubland	<i>Melaleuca atroviridis</i> , <i>Melaleuca acutifolia</i> and <i>Melaleuca eleuterostachya</i> Tall Shrubland over <i>Acacia latior</i> , <i>Acacia acuminata</i> and <i>Acacia tetragonophylla</i> Sparse Shrubland.	21, 32, 33, 34	285.31	2.30	Sufficient number of quadrats sampled
MsFIS <i>Melaleuca</i> Shrubland	<i>Melaleuca stereophloia</i> Tall Shrubland over <i>Frankenia laxiflora</i> Low Open Shrubland.	CEN05R	26.43	0.21	Limited vegetation distribution
TspSS Samphire Shrubland	<i>Tecticornia</i> spp. Low Open Samphire Shrubland.	2, 11, 52, S19	58.28	0.47	Sufficient number of quadrats sampled
SsTS <i>Stylobasium</i> Shrubland	<i>Stylobasium spathulatum</i> Tall Sparse Shrubland over <i>Melaleuca filifolia</i> Sparse Shrubland over <i>Seringia hermannifolia</i> , <i>Podotheca gnaphalioides</i> and <i>Schoenia cassiniana</i> Low Open Forbland.	5	0.84	0.007	Limited vegetation distribution
TSP Pasture	Isolated Trees and/or shrubs in pasture.	01R, 03R, 06R, FW01R	105.73	0.85	Not applicable; degraded areas

Vegetation Unit Code	Vegetation Description	Representative Quadrats/Relevés	Area (ha)	% of Project Area	Survey Completeness Comment
	Cleared		1,440.93	11.62	Not applicable
	Unmapped		50.39	0.41	
		Total	12,403.57	100	

^ Regional quadrat (outside Pipeline Licence Area)

5.2.5 Vegetation Condition

The vegetation condition of the project area was found to range from 'Completely Degraded' (CD) to 'Excellent' (Ex), with most areas (37.80%) found to be in 'Very Good' (VG) condition. The majority of the project area supports vegetation in 'Good' (G) or better condition. Some areas of poorer quality vegetation occur adjacent to or near areas of disturbance. The spatial extent of the varying vegetation condition across the project area is presented in **Figure 13** and the areas of each condition category are presented in **Table 12**.

Table 12 - Areas of Varying Vegetation Condition

Vegetation Condition Rating	Total Area (ha)	Proportion of Total Project Area (%)
Excellent (Ex)	2,143.35	17.28
Very Good - Excellent (VG-Ex)	2,032.12	16.38
Very Good (VG)	4,688.27	37.80
Good - Very Good (G-VG)	844.40	6.81
Good (G)	1,014.50	8.18
Degraded - Good (D-G)	49.50	0.40
Degraded (D)	36.17	0.29
Completely Degraded- Degraded (CD-D)	53.61	0.43
Completely Degraded (CD)	1,491.26	12.02
Unmapped	50.39	0.41
Total	12,403.57	100

5.2.6 Threatened and Priority Ecological Communities

The DBCA Threatened and Priority Ecological Communities database search identified the presence of the *Eucalypt Woodlands of the Western Australian Wheatbelt*, listed as a Commonwealth Critically Endangered TEC and State listed Priority 3 Ecological Community. One additional State-listed Priority 3 Ecological Community (*Yalgoo vegetation complexes (Banded Ironstone Formation)*) was also identified from database searches to potentially occur within the project area.

The Critically Endangered Eucalypt Woodlands of the Western Australian Wheatbelt (Eucalypt woodlands TEC) has been delineated by DBCA to occur at four locations within the project area (**Figure 9**). The extent of this TEC, as verified by FVC within the project area (31.19 ha, 0.252% of the project area), is presented in **Figure 14**. The approximate extent (1,330.05 ha) of the TEC in the region surrounding the project area has been mapped based on a combination of ground-truthing and analysis of aerial imagery surrounding confirmed occurrences within the project area, as presented in **Figure 15**.

Three quadrats were established in vegetation within the bounds of the DBCA mapped Yalgoo vegetation complexes (Banded Ironstone Formation (BIF)) (Yalgoo BIF PEC). Two of these quadrats, sampled within the project area, did not record suitable substrate or landforms to be considered representative of the PEC, whilst the third, sampled outside the project area was considered representative of the PEC (**Figure 15**). Based on this assessment, it was determined that the PEC is unlikely to occur within the project area.

6 DISCUSSION

6.1 FLORA

6.1.1 Floral Composition

A total of 501 flora species, from 197 genera and 58 families was recorded during the field assessment survey. The dominant families were found to be Fabaceae (Pea family - 65), Chenopodiaceae (Chenopod family - 52 taxa) and Myrtaceae (Myrtle family – 40 taxa). The total includes 471 (94%) native species and 30 (6%) introduced (weed) species. The floral species diversity across the broad landscape, spanning four bioregions is considered low to moderate, and the result of large-scale clearing in the west and localised effects of drought in the east.

Recorded flora species includes those documented from sampled quadrats, opportunistically whilst moving around the project area and those recorded during targeted searches for Threatened and Priority flora.

Of the recorded flora, five species are considered to be exhibiting an extension beyond their currently documented range, in accordance with records of the Western Australian Herbarium (DBCA 2020f).

Two of the recorded introduced (weed) species (**Echium plantagineum* and **Rumex hypogaeus*) are listed as a Declared Pest plants under the BAM Act (DPIRD 2020a) within the project area. Paterson's Curse (**Echium plantagineum*) is one of the most conspicuous weeds of pastures, roadsides and disturbed land in Western Australia (DPIRD 2020b). Doublegee (**Rumex hypogaeus*, formerly **Emex australis*) is a significant weed of agriculture in temperate Australia and can contaminate grain, leading to rejection of grain deliveries (DPIRD 2020c).

Under the BAM Act, landholders are obliged to carry out specific control measures to prevent the spread of pest weeds (Declared Pests). Any disturbance from the proposed development should ensure it does not result in degradation of the surrounding environment as a result of further proliferation of Paterson's Curse Creeper or other weed species. None of the recorded weeds are listed as WoNS (DAWE 2020a).

Seventy-nine flora specimens collected were unable to be identified with certainty to species level, due to inadequate or sterile material for identification purposes. Despite the lack of identification to species level, it is considered highly unlikely that any of these species are Threatened or Priority flora and therefore does not materially influence the key observations and conclusions of this report regarding significant flora and vegetation.

6.1.2 Threatened and Priority Flora

The desktop review identified the potential for 106 Threatened and Priority flora species to occur within the project area. Of the 106 species, 16 are Threatened species listed under the EPBC Act and BC Act, 25 are Priority 1, nine are Priority 2, 44 are Priority 3 and 12 are Priority 4. Twenty-eight were considered 'likely' to occur in the project area consisting of two Threatened species, 14 Priority 1 species, eight Priority 3 species and four Priority 4 species. Thirty-two were considered as 'possibly' (may) occurring in the project area consisting of one Threatened species, two Priority 1 species, three Priority 2 species, twenty Priority 3 species and seven Priority 4 species. The remaining 46 species were considered 'unlikely' to occur in the project area.

The following six Threatened and Priority flora were recorded during the field assessment:

- *Eucalyptus beardiana* (Vulnerable; EPBC Act, Endangered; BC Act)
- *Dicrastylis linearifolia* (Priority 3)
- *Gnephosis cassiniana* (Priority 3)
- *Petrophile ?pauciflora* (Priority 3)
- *Ptilotus beardii* (Priority 3)
- *Acacia speckii* (Priority 4).

Eucalyptus beardiana (Beard's Mallee) is a mallee up to 5 m tall, with smooth pinkish-grey to cream bark. Beard's Mallee is endemic to Western Australia and is known from 23 locations in the Northampton, Shark Bay and Mullewa areas (DAWE 2020d). One known population of *Eucalyptus beardiana* occurs within the project area, approximately 4 km north-west of Mullewa (**Figure 10**). It is in this location that individuals were recorded in relatively high numbers during the field assessment, with a total of 55 plants recorded. This species was recorded within vegetation unit EbW - *Eucalyptus* Woodland.

Dicrastylis linearifolia (Priority 3) is known from 34 FloraBase records and is distributed from Shark Bay to the Yalgoo area (DBCA 2020f). It was recorded in the field assessment from one population approximately 30 km east of Pindar and in the location of a previously known population, revealed through the DBCA database search results (**Figure 10**). This species was recorded within vegetation unit CcLOW - *Callitris* Woodland.

Gnephosis cassiniana (Priority 3) is an erect annual herb distributed between Northampton and Mullewa (DBCA 2020f). This species was recorded at one location within vegetation unit TspSS - Tecticornia Low Sparse Samphire Shrubland (**Figure 10**).

Five individuals of possible the Priority 3 species, *Petrophile ?pauciflora*, were recorded during targeted search traverses associated with the project area. The species was recorded within vegetation unit AbMpCS - *Atriplex ?bunburyana*, *Maireana pyramidata* and *Cratystylis subspinescens* Low Open Chenopod Shrubland.

Ptilotus beardii (Priority 3) is a compact, perennial shrub known to occur the Shires of Cue and Murchison. This species was recorded from one location within the project area, approximately 25 km south of Paynesville (DBCA 2020f). This species was recorded within vegetation unit MpCS - *Chenopod* Shrubland.

A single individual *Acacia speckii* (Priority 4) was recorded near the project area, approximately 26 km west of Yalgoo. *Acacia speckii* is known from 37 FloraBase records and is distributed from Meekatharra to Yalgoo (DBCA 2020f). This species was recorded within vegetation unit AgTS - *Acacia* Shrubland.

The timing of the survey (spring) was considered optimal for the identification of most flowering flora or annual and ephemeral species and therefore, it is considered that a high proportion of species relevant to the project area were recorded.

6.1.3 Flora of Conservation Interest

In addition to the aforementioned Threatened and Priority flora species, five undescribed species and four endemic species exhibiting an extension beyond their current documented range were also recorded (**Table 8 and 9**).

Baeckea sp. Dudawa (M.E. Trudgen MET 5369) is known from 119 FloraBase records and was recorded from one location within the project area within a *Melaleuca concreta*, *Melaleuca stereophloia* and *Acacia acuminata* Tall Shrubland.

Known from 33 FloraBase records, *Microcorys* sp. Mt Gibson (S. Patrick 2098) broadly occurs within a *Eucalyptus kochii* and *Eucalyptus horistes* Low Open Woodland and *Callitris columellaris* Low Open Woodland at three locations within the project area.

Sida sp. dark green fruits (S. van Leeuwen 2260) was recorded from five locations within the project area, broadly within *Eucalyptus* woodlands and *Acacia* Shrublands. *Acacia* Shrublands also support the additional undescribed *Sida* sp. golden calyces glabrous (H.N. Foote 32). *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J. English KS552) is widely distributed throughout the State and occurs within Samphire Shrublands of the project area.

The range extending species, *Acacia rigens* and *Eremophila platycalyx* subsp. Woolgorong predominantly occur within *Acacia* Shrubland, whilst the sedge species *Eleocharis acuta* occurs within the *Hakea recurva* Shrubland and *Juncus subsecundus* occurs within drainage lines supporting *Eucalyptus camaldulensis* Woodlands.

Whilst these species are not specifically afforded protection under legislation, and are of less concern than conservation significant (Threatened and Priority) flora, they are of interest and may be important in the context of impact assessments.

6.2 VEGETATION

6.2.1 Vegetation Units

The vegetation of the project area was defined from a total of 137 study sites (128 quadrats and nine relevés), sampled as part of the spring survey. Floristic analysis was conducted for all sampled quadrats, in order to determine floristic communities across the project area, utilising PATN™ software and presence/absence of species. Interrogation of the resulting dendrogram clusters defined 32 intact vegetation units within the project area and two additional units outside (EkDiW and AgTS). Each cluster was verified by field botanists by considering tangible site characteristics such as dominant flora species, total species composition and vegetation structure (community type; e.g. woodland, shrubland). In a number of cases, this verification overruled the results of the PATN™ analysis.

Analysis by botanists of species composition, community structure and landscape position allocated these quadrats to another defined comparable vegetation units as was the case with Q75b, which grouped with AcTOS (*Acacia caesaneura*, *Acacia tetragonophylla*, *Acacia crapedocarpa*, *Acacia incurvaneura* Tall Shrubland over *Eremophila forrestii*, *Eremophila latrobei* and *Aluta aspera* subsp. *hesperia* Low Sparse Shrubland over *Eragrostis eriopoda* Low Open Grassland) through PATN™ analysis, however was determined to be more comparable to EkTbHS - *Eucalyptus kingsmillii* Low Woodland over *Acacia caesaneura*, *Acacia incurvaneura* and *Acacia effusifolia* Tall Open Shrubland over *Triodia basedowii* Low Hummock Grassland.

Broadly, the vegetation units of the project area comprise of *Eucalyptus*, *Banksia*, *Callitris* or *Hakea* woodlands and *Acacia*, *Eremophila*, *Melaleuca* and *Chenopod* dominated shrublands. *Acacia* dominated Shrublands (AnTOS, AspTS, AcTOS, AmTS, ArEIS, AvS, AcEspS, AtHpS, AcMIs, AtTS, AbTOS) comprise of 9,436.45 ha or 76.08% of the project area. The most widespread *Acacia* shrubland units are AcTOS (42.92%), AcEspS (12.29%), and AspTS (9.98%), with all other remaining *Acacia* shrublands comprising of less than 6% of the vegetation units within the project area (**Table 11**). Mostly limited to drainage lines, *Eucalyptus* Woodlands (EbW, EcW, EkAcS, EkEhW, EkTbHG, EIW, EsBsW, EsMnS) comprise only 298.60 ha or 2.41% of the project area.

6.2.2 Threatened and Priority Ecological Communities

The DBCA Threatened and Priority Ecological Communities database search identified the presence of the *Eucalypt Woodlands of the Western Australian Wheatbelt*, listed as a Commonwealth Critically Endangered TEC and a State listed Priority 3 Ecological Community. One State-listed Priority 3 Ecological Community (*Yalgoo vegetation complexes (Banded Ironstone Formation)*) within the project area.

The existence and extent of the TEC and PEC within the project area was verified by ground truthing and extrapolation of aerial imagery. Vegetation quadrats were established by FVC at various locations within and adjacent to the DBCA defined TEC and PEC boundaries, in order to verify the presence or absence of each community within the project area and therefore, the Pipeline Licence Area. Each quadrat was assessed for species composition and percentage foliage cover to determine comparability to the TEC and for dominant species composition and the substrate or landform to determine comparability to the PEC.

6.2.2.1 Eucalypt Woodland TEC

The Critically Endangered Eucalypt woodlands TEC has been delineated by DBCA to occur at three locations within the proximity of the project area (**Figure 15**). The approximate extent of the TEC in some of the region surrounding the project area has been mapped at a finer scale than as available from DBCA data, based on a combination of ground-truthing and analysis of aerial imagery (**Figure 15**). Therefore, a high degree of confidence of the local extent and boundaries in this area is provided based on targeted ground-truthing.

The FVC defined vegetation unit EkEhW, comprising of 31.17 ha or 0.25% of the project area, was inferred to be representative of the Eucalyptus woodlands TEC. The condition of the local extent of the Eucalypt woodlands TEC within the project area ranges from 'Very Good - Excellent' (1 ha) to 'Excellent' (30.17 ha).

6.2.2.2 Yalgoo BIF PEC

Three quadrats (36, 37, 38) were established in vegetation within the bounds of the DBCA mapped Yalgoo vegetation complexes (Banded Ironstone Formation (BIF)) (Yalgoo BIF PEC). Two of these quadrats (36, 38) did not record suitable substrate or landforms to be considered representative of the PEC, whilst the third (37), sampled outside the project area was considered representative of the PEC. Quadrat 37 was considered to potentially be representative of the PEC due to the presence of BIF. Based on this assessment, it was determined that the PEC is unlikely to occur within the project area or within the Pipeline Licence Area, due to the lack of suitable BIF substrate. Floristic analysis indicated that Q37, showed affinity of other Acacia dominated quadrats, not determined to be representative of the PEC.

Due to the broad extent of the PEC as mapped by DBCA, and the mosaic vegetation present within this area, as visible in aerial imagery, the mapped extent of this community is likely to be coarse. For the purposes of the mapping presented in this report, the extent of the PEC within the vicinity of the project area has been restricted to the localised area that was verified by ground-truthing and extrapolated using aerial imagery for areas of similar appearance.

6.2.3 Vegetation Condition

The vegetation condition of the project area was found to range from 'Completely Degraded' (CD) to 'Excellent' (Ex), with most areas found to be in 'Very Good' (VG) condition (37.80%). Areas of 'Degraded' to 'Completely Degraded' account for 12.75% of the project area while 'Excellent' vegetation condition comprises 17.28%. The vast proportion of the project area to the west has been subject to a high degree of disturbance with large portions comprising of cleared agricultural properties and with degraded isolated remnants within cleared

paddocks. Some areas of lower quality vegetation occur adjacent to, or near areas of disturbance, such as adjacent to roads or historical mineral exploration areas in the eastern portion, however the majority is considered to be 'Good' or better. The quality of vegetation to the east is likely to be attributed to the isolated location of the project area, removed from townsites and other disturbances. However, in this area, there is also localised impacts from isolated mines, historic mineral exploration, pastoral activity (grazing, weed invasion and soil erosion from cattle) and some evidence of the effects of long-term drought. There are, however, minimal impacts from clearing and the region is relatively isolated, with limited tracks or large-scale clearing disturbances.

6.2.4 State and National Significance

The National significance of the vegetation units was assessed based on:

- presence of EPBC-listed Threatened flora
- presence of EPBC-listed TECs.

The State significance of the vegetation units was assessed based on:

- presence of State listed Threatened flora
- presence of State listed TECs.

6.2.4.1 Presence of Threatened Flora

One species listed as Threatened flora (*Eucalyptus beardiana*) under the EPBC Act and the BC Act was recorded in vegetation unit EbW at the western portion of the project area (**Figure 10**). This vegetation unit accounts for <0.02% (2.21 ha) of the project area.

6.2.4.2 Presence of TECs

The DBCA database search identified the presence of one Commonwealth and State listed TEC (*Eucalypt Woodlands of the Western Australian Wheatbelt*) as traversing the project area approximately 40 km east of Mullewa.

Statistical analysis of quadrat data and ground truthing confirmed FVC defined vegetation unit EkEhW to be representative of the Commonwealth TEC. The FVC defined vegetation unit EkEhW was defined at four locations within the project area and accounts for 0.25% (31.17 ha) of the project area.

In conclusion, two of the recorded vegetation units (EbW and EkEhW) are considered to be of State and National significance due to these aspects.

6.2.5 Regional Significance

The regional significance of the vegetation units was assessed based on:

- presence of Threatened flora
- extents restricted to specific and limited landforms
- regionally uncommon or restricted plant community types
- extent remaining in comparison to pre-European extent.

6.2.5.1 Presence of Threatened Flora

One Threatened flora species (*Eucalyptus beardiana*) was recorded within the project area (**Table 7** and **Figure 10**) and therefore, the unit that supports this species, EbW, is considered to be regionally significant. This vegetation unit accounts for <0.018% (2.21 ha) of the project area.

6.2.5.2 Extents Restricted to Specific and Limited Landforms

Excluding cleared areas (and unmapped areas), the project area predominantly supports two broad landforms, which collectively represent 87.98% (10,912.29 ha):

- uplands and plains supporting woodlands and shrublands
- salt lakes and associated fringing shrublands.

In a local context, both abovementioned landforms are widely distributed in the region, with salt lakes and associated fringes occurring intermittently within the vicinity of the project area, and woodlands and shrublands dominating much of the Wheatbelt, Yalgoo and Murchison regions. Therefore, vegetation units mapped in association with both landforms are not considered to be regionally significant due to this factor.

Other landforms supported by the project area that are less and widespread and may be restricted in their regional extent are:

- rivers and creeklines (supporting vegetation unit EcW)
- breakaways (supporting vegetation unit ActOS).

It follows, that since the abovementioned landforms are restricted in their extent, the vegetation units supported by them may be of regional significance. However, whilst vegetation unit ActOS is associated with the regionally restricted breakaway landform, this vegetation unit was also mapped as occurring on the uplands and plains, which are not restricted and therefore, this vegetation unit is not considered to be regionally significant due to this factor. ActOS is mapped as occupying 42.92% (5,324.16 ha) of the project area.

In conclusion, vegetation unit EcW is considered to be of regional significance due to having an extent restricted to specific and limited landforms, and this unit comprises 0.042% (5.16 ha) of the project area.

6.2.5.3 Regionally Uncommon or Restricted Plant Community Types

Within each IBRA Region, some regionally defined vegetation associations comprise a very small proportion of the vegetation associations within that region. However, none of the defined and mapped vegetation units are representative of any vegetation associations that are significantly limited within the respective IBRA region, and therefore none are of regional significance due to this factor.

6.2.5.4 Extent Remaining in Comparison to Pre-European Extent

Native vegetation significance can be determined based on a range of aspects such as isolation, vegetation that supports conservation significant flora or fauna or representing an unusual landform type, as discussed above. However, the most important aspect in the consideration of regional community significance is the representation of the vegetation unit in the region. Vegetation units are considered significant if they are poorly represented.

In order to gain a wider context for assessing the regional representation and remaining extent of the vegetation units of the current study, units were also aligned with the broad, regional vegetation associations described in Shepherd *et al.* (2002) within each IBRA Region. The results of this analysis are presented in **Table 13**. The EPA's current objective to protect flora and vegetation so that biological diversity and ecological integrity are maintained (EPA 2016b) was identified in EPA Guidance Statement 33, as achievable by ensuring that ecological communities are maintained above certain threshold levels. These levels are considered to be 30% of the original extent in unconstrained areas and 10% in constrained areas, such as urban zones. This

philosophy is also in accordance with the principles of Bush Forever (Government of Western Australia 2000). In the absence of quantified thresholds in the current guidance (EPA 2016b), these philosophies are still considered useful in determining vegetation significance in relation to extent remaining.

The project area is considered to be an unconstrained area and as such, the minimum retention target of 30% of the original Pre-European vegetation extent applies. Numerous regional vegetation associations occurring in the project area, within the Geraldton Sandplains and Avon Wheatbelt are currently represented by less than 30% of their pre-European extent and are therefore considered to be regionally significant due to a limited remaining extent within a particular IBRA Region. Within the Geraldton Sandplains, these Vegetation Associations are 142, 353, 404, and 687, and within the Avon Wheatbelt, Vegetation Associations 142, 353, 380, 676 and 687 are all represented by less the 30% of their original extent. Of the aforementioned vegetation associations, only Vegetation Association 142 within the Geraldton Sandplains IBRA Region and Vegetation Association 676 within the Avon Wheatbelt IBRA Region occur within the project area. Therefore, these vegetation associations (142; Geraldton Sandplains and 380 and 676; Avon Wheatbelt) and the project's vegetation units they correspond to (EIW, TspSS) (**Table 13**) may be considered to be regionally significant (due to exhibiting a limited extent in comparison to their pre-European extent).

All current extents for the remaining vegetation associations are greater than 30% of their pre-European extents and therefore, are not considered to be of regional significance due to this aspect.

Table 13 - Regional and Local Extent of Vegetation Associations within the Project Area

IBRA Region	Shepherd <i>et.al.</i> (2002) Veg. Association No.	Description	Corresponding Vegetation Unit/s	Pre-European Extent (ha)	% of IBRA Region	Current Extent (ha)	% Pre-European Extent Remaining	Extent within the Project Area (ha)	% of Project Area
Geraldton Sandplain IBRA Region	142	Medium woodland; York gum & salmon gum	Unmapped areas	8,761.03	0.2788	933.45	10.65	8.84	0.071
	353	Shrublands; mallee & acacia scrub with scattered York gum	No corresponding vegetation unit	96,823.77	3.0814	7,546.36	7.79	136.22	1.10
	372	Mosaic: Shrublands; scrub-heath on deep sandy flats / Shrublands; thicket, acacia-casuarina alliance	EsBsW	82,083.78	2.6123	31,680.07	38.59	458.29	3.69
	380	Shrublands; scrub-heath on sandplain	BsCaW, EbW, SsTS	507,696.88	16.1576	319,288.64	62.89	163.94	1.32
Avon Wheatbelt IBRA Region	380	Shrublands; scrub-heath on sandplain	No corresponding vegetation unit	23,170.14	0.24	3,444.86	14.87	3.22	0.026
	419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket	AspTS, ArEIS	10,517.64	0.1105	6,370.07	60.57	71.88	0.58
	420	Shrublands; bowgada & jam scrub	McS, AspTS, ArEIS	44,968.05	0.4725	17,161.76	38.16	130.34	1.05
	676	Succulent steppe; samphire	TspSS	124,573.10	1.3089	30,418.61	24.42	328.95	2.65
	686	Medium woodland; York gum & red mallee	EkEhW	8,800.29	0.0925	4,156.84	47.24	48.62	0.39
	687	Shrublands; bowgada and jam scrub with scattered <i>Allocasuarina huegeliana</i> and York gum	EIW	37,458.98	0.3936	10,242.84	27.34	257.01	2.07
	1413	Shrublands; acacia, casuarina & melaleuca thicket	EsMnS, AnTOS	546,675.55	5.7441	174,102.84	31.85	136.75	1.10
Yalgoo IBRA Region	18	Low woodland; mulga (<i>Acacia aneura</i>)	MpCS, AbTOS, AspTS, HspTS	101,331.17	1.99173746	101,232.93	99.9	446.12	3.60
	202	Shrublands; mulga and <i>Acacia quadrimarginea</i> scrub	AtTS	45,096.14	0.8864	45,011.91	99.81	0.34	0.003

IBRA Region	Shepherd <i>et.al.</i> (2002) Veg. Association No.	Description	Corresponding Vegetation Unit/s	Pre-European Extent (ha)	% of IBRA Region	Current Extent (ha)	% Pre-European Extent Remaining	Extent within the Project Area (ha)	% of Project Area
	243	Shrublands; bowgada & minnieritchie scrub	AcTOS, AspTS	40,588.09	0.7978	40,581.74	99.98	43.60	0.35
Yalgoo IBRA Region (cont.)	326	Low woodland over scrub; mulga over bowgada & minnieritchie scrub	AbTOS, AcEspS, AspTS,	539,810.76	10.6104	539,784.14	100	821.63	6.62
	361	Shrublands; bowgada & minnieritchie scrub with scattered mulga	AcTOS, AtTS, AspTS	76,479.74	1.5033	76,453.22	99.97	291.82	2.35
	364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	MaTS, AcMIS, ArEIS, EkEhW, CcLOW	509,047.32	10.0057	504,231.90	99.05	67.57	0.54
	404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	AtTS	151,772.33	2.9832	143,906.80	94.82	21.40	0.17
	415	Succulent steppe with open scrub; scattered mulga and other wattles over saltbush & bluebush	AbMpCS, HspTS, AcEspS, TspSS	31,462.20	0.6184	31,462.20	100	592.90	4.78
	419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket	AcMIS, MaTS, AspTS, AtTS, ArEIS, CcLOW	302,707.72	5.9499	289,825.56	95.74	420.44	3.39
	420	Shrublands; bowgada & jam scrub	AtTS, AspTS, AcTOS, HspTS, MaTS	621,396.05	12.2140	620,265.57	99.82	179.07	1.44
	683	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & snakewood over samphire	AcTOS, AspTS, AtTS, MaTS	50,075.10	0.9843	49,732.32	99.32	542.22	4.37
	686	Medium woodland; York gum & red mallee	EkEhW	4,334.78	0.0852	4,280.12	98.74	1.53	0.012
Murchison IBRA Region	18	Low woodland; mulga (<i>Acacia aneura</i>)	AbMpCs, AbTOS, AcTOS, MpCS, HspTS, AcEspS, EcW, AtHpS, MgCS, AspTS, EkTbHG	12,403,172.30	44.1071	12,363,252.47	99.68	5,972.88	48.15

IBRA Region	Shepherd <i>et.al.</i> (2002) Veg. Association No.	Description	Corresponding Vegetation Unit/s	Pre-European Extent (ha)	% of IBRA Region	Current Extent (ha)	% Pre-European Extent Remaining	Extent within the Project Area (ha)	% of Project Area
	39	Shrublands; mulga scrub	AcTOS, AcEspS, MpCS	1,148,400.30	4.0838	1,138,064.63	99.1	94.14	0.76
Murchison IBRA Region (cont.)	107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex	AcTOS, EkTbHG	2,792,383.45	9.9300	2,790,992.03	99.95	116.89	0.94
	188	Shrublands; mulga and <i>Acacia sclerosperma</i> scrub	AbTOS, AcTOS	11,922.20	0.0424	11,864.15	99.51	57.73	0.47
	202	Shrublands; mulga and <i>Acacia quadrimarginea</i> scrub	AcTOS	339,742.69	1.2082	339,641.41	99.97	22.55	0.18
	339	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, <i>Triodia scariosa</i>	EkAcS, AcTOS, AmTS, AcEspS	27,109.86	0.0964	27,108.54	100	155.83	1.26
	389	Succulent steppe with open low woodland; mulga over saltbush	AcTOS	493,977.54	1.7566	492,089.49	99.62	185.28	1.49
	415	Succulent steppe with open scrub; scattered mulga and other wattles over saltbush & bluebush	AbMpCS, AvS, AbTOS, AcTOS, AcEspS, MsFIS	74,514.56	0.2650	74,514.56	100	538.26	4.34
	420	Shrublands; bowgada & jam scrub	AcEspS, AspTS	191,449.75	0.6808	191,445.88	100	56.98	0.46

6.2.6 Local Significance

An assessment of local significance was conducted for each vegetation unit based on four criteria. Vegetation may be considered locally significant based on one or more of the following:

- presence of Priority or undescribed flora
- presence of flora exhibiting range extensions
- unusually high structural and/or species diversity
- restricted, small or isolated distribution and/or area.

6.2.6.1 Presence of Priority or Undescribed Flora

Five Priority flora species were recorded within the project area (**Table 7**) and therefore, the units that support these species; AgTS (recorded outside of the project area), AbMpCs, CcLOW, MpCS and TspSS are considered to be locally significant. These vegetation units account for 697.81 ha (5.63%) of the project area.

Five undescribed flora species were recorded within the project area and therefore, the units that support these species; AcEspS, AcTOS, AspTS, CcLOW, EkEhW, McS and TspSS are considered to be locally significant. These vegetation units comprise 8,294.60 ha (66.87%) of the project area.

6.2.6.2 Presence of Flora Exhibiting Range Extensions

Of the recorded flora, four are considered to be exhibiting an extension beyond their currently documented range of occurrence, in accordance with records of the Western Australian Herbarium (DBCA 2020f). These species and the vegetation units there were recorded within are:

- *Acacia rigens* (recorded within vegetation unit AcTOS)
- *Eleocharis acuta* (recorded within vegetation unit HspTS)
- *Eremophila platycalyx* subsp. Woolgorong (recorded within vegetation unit AtHpS)
- *Juncus subsecundus* (recorded within vegetation unit EcW).

In conclusion, vegetation units HspTS, AtHpS, EcW and AcTOS are considered to be of local significance due to supporting range-extending flora. Collectively, these vegetation units account for 5,554.93 ha (44.78%) of the project area.

6.2.6.3 Unusually High Structural and/or Species Diversity

Due to the size of the project area and the vast length, spanning numerous IBRA regions, a relatively large number of species was recorded. However, generally, the floral species diversity is considered to be low to moderate for such a large areas. None of the recorded vegetation units are considered to support high structural and/or species diversity and are therefore not considered to be locally significant due to this factor.

6.2.6.4 Restricted, Small or Isolated Distribution and/or Area

Three of the recorded vegetation units, BsCaW, EsBsW and SsTS were mapped to occupy less than 0.01% of the project area and are therefore considered to be of local significance due to being restricted and limited in their distribution (**Table 8**). A further four vegetation units; EbW, EIW, EsMnS and MgCS are also considered to be of some significance on a local scale due to restricted distribution, mapped to occupy less than 0.03% of the project area.

All of the aforementioned vegetation units, excluding MgCS, occur in the western portion of the project area as isolated patches of remnant vegetation amongst cleared paddocks, largely devoid of remnant native vegetation. Due to the largely cleared and disturbed nature of the area, and adjacent land uses, such vegetation units are likely to be limited in their local and regional distribution and unlikely to be represented in sizable areas beyond the areas mapped within the project area. Large proportions of adjacent land have been cleared for agriculture and

much of the remaining remnant vegetation is degraded or modified, occurring within road reserves, surrounding waterways or outcrops and similar isolated locations.

Vegetation unit MgCS occurs as a small, isolated pocket (3.29 ha, 0.027%) in the far eastern section of the project area, approximately 25 km west of the Thunderbox Gold Mine. Interrogation of aerial imagery and regional quadrat data indicates that MgCS is likely to occur south beyond the bounds of the project area.

6.2.7 Summary of Vegetation Significance

The significant vegetation units of the project area, along with the aspects determining their significance, are summarised in **Table 14**. The level of significance for each vegetation unit is broadly summarised in **Table 15**.

Table 14 - Summary of Vegetation Unit Significance

Scale	Significance Aspect	Vegetation Units
National Significance	Presence of EPBC-listed Threatened flora	EbW
	Presence of EPBC-listed TECs	EkEhW
State Significance	Presence of State-listed Threatened flora	EbW
	Presence of State-listed TECs	EkEhW
Regional Significance	Presence of Threatened Flora	EbW
	Restricted to specific and limited landforms	EcW
	Regionally uncommon/restricted representation	Nil
	Poorly retained compared to pre-European extent	EIW, TspSS
Local Significance	Presence of Priority flora	AbMpCs, AgTS [^] , CcLOW, MpCS, TspSS
	Presence of undescribed flora	AcEspS, AcTOS, AspTS, CcLOW, EkEhW, McS, TspSS
	Presence of range-extending flora	AcTOS, AtHpS, EcW, HspTS
	Unusually high structural or species diversity	Nil
	Restricted, small or isolated local distribution	BsCaW, EsBsW, SsTS (and somewhat) EbW, EIW, EsMnS, MgCS

[^] Vegetation Unit occurs outside of the project area

Table 15 - Summary of Broad Significance

Vegetation Unit	Overall Significance	Area (ha)	% of the Project Area
AbMpCs	Local significance	506.81	4.09
AcEspS	Local significance	1,524.05	12.29
AcTOS	Local significance	5,324.16	42.92
AgTS^	Local significance	0	0
AspTS	Local significance	1,237.69	9.98
AtHpS	Local significance	182.99	1.48
BsCaW	Local significance	0.68	0.005
CcLOW	Local significance	104.76	0.84
EbW	Local significance (somewhat) Regional significance State significance National significance	2.21	0.018
EcW	Local significance Regional significance	5.16	0.042
EkEhW	Local significance State significance National significance	31.17	0.25
EIW	Local significance (somewhat) Regional significance	2.24	0.018
EsBsW	Local significance	0.66	0.005
EsMnS	Local significance (somewhat)	1.67	0.013
HspTS	Local significance	42.62	0.34
McS	Local significance	14.49	0.12
MgCS	Local significance (somewhat)	3.29	0.027
MpCS	Local significance	27.95	0.23
SsTS	Local significance	0.84	0.007
TspSS	Local significance Regional significance	58.28	0.47
Total		9,071.72	73.15

^ Vegetation unit occurs outside of the project area

7 CONCLUSIONS

The key findings and conclusions arising from the flora and vegetation assessment within the project area are as follows:

- One Threatened flora (*Eucalyptus beardiana*) listed under the EPBC and BC Acts was recorded. A total of 55 individuals were recorded in a single population within the western portion of the project area.
- Five Priority flora, *Dicrastylis linearifolia* (Priority 3), *Gnephosis cassiniana* (Priority 3), *Petrophile ?pauciflora* (Priority 3), *Ptilotus beardii* (Priority 3) and *Acacia speckii* (Priority 4) were recorded.
- Five additional flora species of conservation interest, due to being undescribed taxa, were recorded during the field assessments.
- Five flora species were recorded that are considered to be exhibiting an extension beyond their currently documented range, in accordance with their current known extent.
- Of the 501 recorded flora species, 30 are introduced (weeds), with two of these, **Echium plantagineum* and **Rumex hypogaeus*, listed as Declared Pest plants under the BAM Act. None of the recorded weeds are listed as WoNS. Under the BAM Act, landholders are obliged to carry out specific control measures to prevent the spread of pest weeds (Declared Pests). Any disturbance to such areas should ensure no further degradation of the surrounding environment as a result of further proliferation of these weed species.
- Thirty-two intact vegetation units were described and mapped within the project area, with one additional pasture unit also described and mapped. An additional two units were mapped but only occur outside of the project area.
- One vegetation unit (EkEhW) occurring within the project area is considered representative of the Commonwealth-listed Threatened Ecological Community (TEC) and State-listed PEC *Eucalypt Woodlands of the Western Australian Wheatbelt*. The TEC/PEC was mapped as intersecting 31.16 ha of the project area. The condition of the local extent of the Eucalypt woodlands TEC/PEC within the project area ranges from 'Very Good - Excellent' to 'Excellent'.
- One PEC, *Yalgoo vegetation complexes (Banded Ironstone Formation)*, was determined to occur adjacent to the project area, and is unlikely to occur within the project area due to the lack of Banded Ironstone Formation within the defined project area.
- Several of the recorded vegetation units within the project area have been determined to be of significance, as follows:
 - Vegetation units considered to be of State and National significance:
 - EbW due to the presence of a State and Commonwealth listed Threatened flora species (representative of 0.018% of the project area)
 - EkEhW due to being representative of a State and Commonwealth listed TEC (representative of 0.252% of the project area).
 - Vegetation units considered to be of regional significance:
 - EbW due to the presence of Threatened flora (representative of 0.018% of the project area)
 - EcW due to being restricted to specific and limited landforms (representative of 0.042% of the project area)
 - EIW and TspSS due to having limited extent remaining in comparison to their pre-European extent (representative of 0.018% of the project area, and 0.470%, respectively).
 - A number of vegetation units were also considered to be of local significance due to supporting Priority flora (four units), undescribed species (seven units), range-extending species (four units), and having limited representation within the local (project) area (six units).

- The timing of the survey (September/October) was considered optimal for the identification of most flowering flora or annual and ephemeral species for the majority of the project area. However, due to the below average rainfall experienced in the region, particularly in the Murchison IBRA region, the abundance of some annual and ephemeral species was found to be low and some species were not able to be identified to species level due to being sterile. Although some of the collections could not be identified to species level, none are considered likely to represent Threatened or Priority flora, with the exception of *Petrophile ?pauciflora* (P3).
- In order to fully meet the EPA guidance requirements to sample at least three quadrats per vegetation unit, one additional quadrat would require sampling in vegetation units ArEIS and McS at discrete locations to provide a full complement of quadrats. Analysis of survey completeness indicates additional vegetation units, where less than three quadrats have been sampled, however many of these vegetation units have limited distribution or are highly degraded, and therefore, sampling of further quadrats within or in close proximity to the project area may not be possible.
- While the vegetation within the eastern portion of the project area has been well characterised, further targeted follow up survey may be warranted given the inherently dry conditions evident during the survey. Further assessment following rainfall would be required to complement the existing results and allow a more representative suite of species (i.e. annual species) in the portion of the project area within the Murchison region to be documented.

8 LIST OF PARTICIPANTS

The personnel who contributed to the project are summarised in **Table 14**.

Table 16 - Project Team

Name	Qualification	Years of Relevant Experience	Role
Kellie Bauer–Simpson Principal Ecologist	B.Sc. Biological Science	21	Project manager, study scoping, field survey, vegetation mapping, reporting, authorisation review
Mike Braimbridge Principal Ecologist	B.Sc. (Hons.) Botany and Environmental Science	24	Field survey, vegetation mapping
Lisa Chappell Senior Botanist/ Environmental Scientist	B.Env.Sc. (Hons) Environmental Science	16	Vegetation mapping, floristic analysis, reporting
Matthew Macdonald Principal Ecologist	Ph.D Botany B.Sc. (Hons) Biological Science	11	Field survey, vegetation mapping
Catherine Krens Senior Ecologist	B.Sc. Botany/Plant Biology	13	Field survey, vegetation mapping
Adrian Barrett Botanist/Ecologist	B.Sc. (Hons.) Biology; Conservation and Wildlife Biology	9	Study scoping, field survey, vegetation mapping, reporting
Dan Roberts Botanist/Ecologist	B.Sc. Environmental Science; Marine Science	8	Field survey, vegetation mapping, reporting
Peter Smith Ecologist	Assoc. Dip. Agriculture	28	Field survey, vegetation mapping
Sam Hall Graduate Botanist	B.Sc. (Hons.) Botany	3	Field survey
Kristen Bleby Senior Ecologist	B.Sc. (Hons) Natural Resource Management	9	Report technical review
Udani Sirisena Botanist/Taxonomist	Ph.D. Botany B.Sc. Botany and Chemistry	10	Flora identifications
Shibi Chandran Biologist/Taxonomist	B.Sc. Zoology M.Sc. Fisheries and Aquaculture	9	Flora identifications
Margaret Collins Botanist/Taxonomist	Ph.D. Botany M.Sc. Biotechnology and Molecular Biology B.Sc. (Hons.) Organic Chemistry and Microbiology	26	Flora identifications
Will Bauer–Simpson Technician/Advisor	Cert. IV (Health and Safety)	9	Field safety and logistics planning, GIS mapping, spatial analysis/data management
Megan Meadowcroft Administration		3	Data entry, report compilation

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