



GOLDEN GROVE PROJECT

J00527 - S0002039

Native Vegetation Clearing Permit Supporting Information

**September 2022**

**Tenement Holder:**

**Golden Grove Operations Pty Ltd**

Applicable Leases:

M59/195

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# 1 Permit Application Details

## 1.1 Background

Golden Grove Operations Pty Ltd (The Proponent) operates the Golden Grove Project (The Project), which comprises two existing underground mines, Scuddles and Gossan Hill, a processing plant, supporting infrastructure and several decommissioned open pits. The Project is located within the Shire of Yalgoo in the Mid-west region of Western Australia (Figure 1.1).

The Proponent mines a volcanic-hosted massive sulphide deposit to produce concentrate products of Copper, Gold, Lead, Silver and Zinc. The Project is expected to deliver approximately 1.7 million tonnes per annum of Copper, Gold, Lead, Silver and Zinc collectively for export over an estimated ten (10) years.

Mineral exploration in the Golden Grove Project Area (the Project Area) commenced in 1971 with the realisation of the potential for base metal sulfide deposits from outcrops of coarse pyroclastic rocks and gossan fragments. The Project has predominately been an underground operation with two (2) separate underground portals, Scuddles and Gossan Hill, of which mining commenced in 1990 and 1998, respectively.

Mining recommenced at the Gossan Hill Open Pit in late 2011, with processing of Copper (II) Oxide (CuO) ore in beginning in 2012. The Gossan Hill open pit was initially mined via conventional open-pit, drill and blast, and shovel and truck methods. Ores (including ore with high precision metal concentrate) were systematically stockpiled on the Run-of-Mine (ROM) pad prior to being loaded and transported via road-train to the Port of Geraldton for exportation to smelters in Asia and Europe for refining.

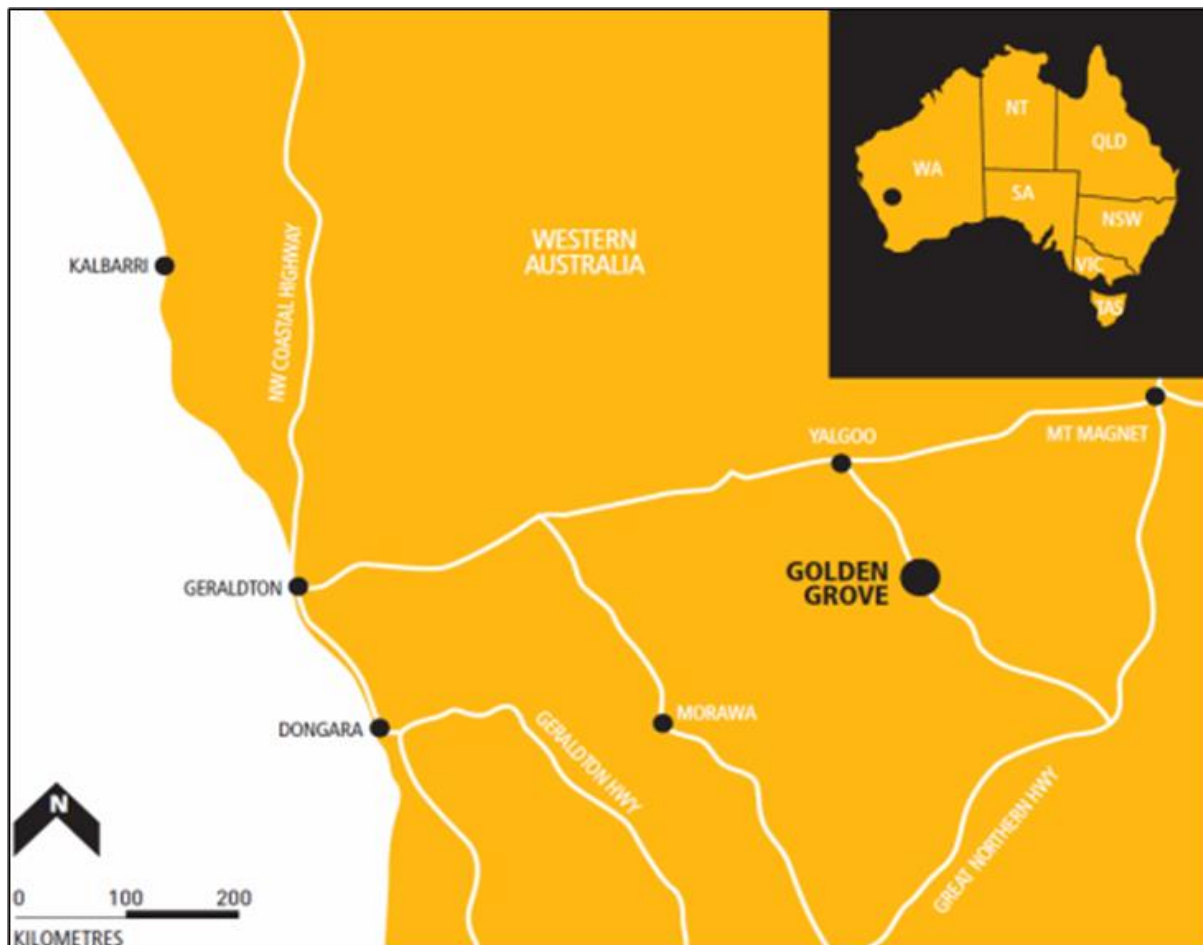


Figure 1.1 Project Location

## 1.2 Proposal Details

The Proponent has recently submitted a Mining Proposal Application (Registration ID 112160) for the extension of the Gossan Hill Run of Mine (ROM) Pad, to allow for greater storage of waste generated from the Gossan Hill underground mine, improved management of potentially acid forming (PAF) waste and greater ore stockpiling capacity. This requires the clearing of 10.82 ha of native vegetation within a 19.44ha footprint (Figure 1.2).





Figure 1.2 ROM Pad Extension Footprint

### 1.3 Alternatives Considered / Actions to Minimise Clearing and Impacts

The ROM Pad extension includes the construction of a PAF Encapsulation Facility. PAF waste is anticipated to be generated by the underground operations at Golden Grove and as such PAF encapsulation is the determining factor in the overall footprint of the ROM Pad. Several construction alternatives were identified, and the advantages and disadvantages associated with each method analysed (O’Kane, 2012). Three primary encapsulation construction alternatives were proposed, these are summarised below.

#### Method 1

Alternating layers of end-tipped PAF and NAF material: PAF material will be end-tipped into the facility, creating a sloping surface, then track compacted using available machines once the full facility width has been filled.

- Advantages: PAF material will be progressively encapsulated to a defined final construction state, thereby reducing the exposure of PAF material to the atmosphere.
- Disadvantages: This method would require a significantly larger ROM pad footprint to encapsulate the anticipated volumes of PAF waste. Logistically this method would require haul trucks to continuously traverse layers of PAF material prior to end tipping the next layer of waste material.

#### Method 2

Horizontal layering of PAF and NAF material: PAF and NAF waste material shall be placed in the facility in alternating, horizontal, PAF and NAF layers. This process will be repeated until completion.

- Advantages: method significantly reduces the surface area of PAF exposed to the atmosphere and the potential for the generation and leaching of acidic water particularly during heavy rainfall events.
- Disadvantages: large volumes of NAF would be required to ensure adequate material available for layering. PAF material may be required to be temporarily stockpiled and require ‘double handling’ increasing operational costs as well as increasing the potential for AMD release into the environment. As with method 1 this method would require a significantly larger ROM pad footprint to encapsulate the anticipated volumes of PAF waste.

#### Method 3

Full PAF deposition prior to NAF capping: The facility would be filled completely with PAF waste material without any internal segregation. A final unit of NAF material will then be used to encapsulate the waste.

- Advantage: This waste deposition method significantly increases the available volume for storage of PAF material as opposed to Method 1 and Method 2, thus reducing the clearing required. It also prevents haul trucks changing materials on a regular basis and removes the requirement to store PAF waste in stockpiles prior to placement.
- Disadvantages: This method involves exposing large surface areas of PAF material to the environment. There is a risk that large quantities of leachate may be generated particularly during large rainfall events.

Given the volume of PAF waste anticipated and the volume of available NAF as well as available space for the extension of the ROM Pad Method 3 has been selected as the preferred option.

## 2 Site Description

### 2.1 Soils and Geology

#### 2.1.1 Land systems

Tenement M59/195 consists of one distinct land system; Land System 1, as defined by Landloch (2006). The proposed Gossan Hill ROM Pad expansion will be located within Land System 1 soils which comprise predominantly of massive red sandy loam soils with only small areas of clay loam soils. Soil depth varies from very shallow (<0.25m) to deep (>1.0m) with the shallower soils generally being found on the crests and slopes of hills and the deeper soils found on the pediments and plains. Hard pans or abundant ironstone may also be found in some areas (Landloch, 2006).

Landloch (2006) identified seven soil types within Land System 1. The proposed Gossan Hill ROM pad expansion is located within soil type D which is described as well drained, deep, sandy soils with soft surfaces with pH of 5-6 at 5cm and 4-5 in the deeper profiles.

#### 2.1.2 Geology

The underlying geology of the Gossan Hill ROM pad expansion area consists mainly of Granodiorite intrusives with a possibility of smaller dolerite dikes crosscutting. As the ROM pad extends south, the underlying geology will change to volcanic sedimentary rocks with more crosscutting dolerites (John Martyn and Associates, 2001).

### 2.2 Hydrology

#### 2.2.1 Surface Hydrology

There are no permanent surface water features in close proximity to the Proposal, due to the low rainfall, high evaporation, and moderately well-draining soils present. Surface water flow patterns follow the topographic gradient, away from ridgelines and into valleys and plains. Drainage is dominated by sheet flow, which concentrates into several unnamed ephemeral watercourses scattered throughout the landscape. These watercourses are dry throughout the year, and only flow after extreme rainfall events.

There are no known surface water dependent receptors near the Proposal. No permanent watercourses, lakes or wetlands are present. The nearest wetlands and water bodies include Lake Wownaminy (27 km north), Lake Monger (67 km south-west), Lake Moore (94 km south-east) and Lake Barlee (190 km southeast).

The Proposal Area is not subject to any water reserves, declared or proposed water supply catchments or groundwater protection areas. The nearest Public Drinking Water Source Area is a Priority 1 Protection Area located 49 km north-west.

The Gossan Hill ROM Pad and underground mine make up the northern most boundary of the Gossan Hill Catchment, which drains an area of 1,575ha in a general northwest direction. The main drainage line in the Gossan Hill Catchment is a valley that trends southwest of the village the catchment is bounded by the sealed access road to the mine village in the north and the BIF ridgeline system that lies to the west. During extreme storm events, surface flows trend northward past Gossan Hill and then to the Southwest towards the village. Using the Average Recurrence Interval (ARI) which incorporates intensity of the rainfall against the area of the catchment and the coefficient of runoff (based on soil, vegetation and rainfall factors) predicted peak flow rates can vary from 4.64m<sup>3</sup>/s after a 5-year ARI storm to 21.61m<sup>3</sup>/s during a 100 year ARI storm (URS, 2010).



### 2.2.2 Groundwater

#### Groundwater Levels

The nearest groundwater users to the Golden Grove Project are Muralgarra Pastoral Station (north) (owned by the Proponent), Thundelarra Pastoral Station (east) and the Golden Dragon Project (west), both of which are owned and operated by Minjar Gold Pty Ltd (Minjar). None of these stations are operating. Warriedar and Thundelarra stations are now being managed by the DBCA, while Muralgarra Station is managed by the Proponent.

Golden Grove is underlain by Archaean rocks that form the eastern limb of a narrow north-northwest trending syncline confined by granite to the east and west. The Archaean rocks of the region are deeply weathered, up to 135 mbgl and mantled with extremely weathered saprolitic clay (very low hydraulic conductivity) that overlies thin saprock (partially weathered, low to moderate hydraulic conductivity) and fresh bedrock (low hydraulic conductivity) (URS 2012). Groundwater occurs in permeable zones in the weathered bedrock and in the fractures underlying fresh bedrock (URS, 2007).

Groundwater levels at a regional scale vary in-sync with the topography because it occurs in the fractured and weathered bedrock and flows by gravity from elevated areas to low-lying areas. Prior to dewatering in the Golden Grove area, groundwater from the Scuddles and Gossan Hill areas flowed towards the break in Gnows Nest Range alongside Phillips Hill and towards Minjar Well. Outside this local catchment, groundwater flowed north of Scuddles to Cattle Creek, east of Gossan Hill towards Thundelarra and west of Gnows Nest Range to low-lying areas.

Dewatering over the past 30 years has induced two drawdown cones around each underground mine. The extent of dewatering impacts and changes with time are assessed each year in annual groundwater summaries and aquifer reviews (AECOM, 2016; AECOM, 2019b). In the 2021 aquifer review the centre of the cone of depression lying southwest of the ROM pad had reached a drawdown depth of 90 metres.

Historical groundwater levels show a steady rate of decline resulting from mine dewatering at Scuddles and Gossan Hill. These trends are expected to continue until the bedrock aquifer becomes fully dewatered, at which time, the groundwater levels will stabilise (i.e. the time-trends will flatten). The combination of dewatering and seepage mounding has yielded groundwater levels that are between about 6 mbgl and 40 mbgl below the interpolated baseline levels.

#### Groundwater Quality

Groundwater quality is representative of the sodium chloride type that is typical of groundwater in the region (URS, 2012). Salinity generally increases along the pathway that groundwater flows. Salt slowly accumulates from rainfall recharge and weathering bedrock. In shallow water table settings, salt also accumulates due to evaporation in clay and salt pans and evapotranspiration where vegetation relies on groundwater in low rainfall environments.

Groundwater in the Golden Grove region is generally fresh to brackish, depending on proximity to recharge areas. The groundwater is near-neutral pH and at depth, the groundwater becomes increasingly saline as evidenced by historical inflows into Gossan Hill (AECOM, 2019b).

## 2.3 Flora and Vegetation

### 2.3.1 Surveys

Flora and vegetation at Golden Grove have been surveyed at various stages during mine development. A total of approximately eight (8) vegetation and flora surveys have been conducted since mining commenced in 1990. These surveys have been undertaken across several years and in different seasons, including the main annual flowering season (September to November).

The most recent vegetation and flora data for the proposed clearing area is provided by a baseline vegetation and flora survey conducted by Woodman in 2013. This survey assessed an approximately 3,000 ha survey area that encompassed Scuddles and Gossan Hill.

### 2.3.2 Pre-European Vegetation

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia at a scale of 1:250 000 in the south-west and at a scale of 1:1 000 000 in less developed areas. Beard's vegetation maps attempted to depict the native vegetation as it was presumed to be at the time of settlement and is known as the pre-European vegetation type and extent. Beard's vegetation maps have since been digitised by Shepherd, Beeston & Hopkins (2002) and updated by DPIRD (2019). Vegetation unit extents are updated every two years by DBCA (2019).

The Proposal overlies one (1) pre-European Vegetation Unit (Beard 1974), Yalgoo 420. Approximately 99.81% of Yalgoo 420 remains intact and is well above the recommended target of retaining 30% of vegetation at a local level (Table 2.1).

Table 2.1: Vegetation System Associations and Representation in WA

Vegetation Unit	Description		
Yalgoo 420	Shrublands, bowgada and jam scrub		
District	Pre-European Extent (ha)	Current Extent (ha)	Current Extent (%)
Statewide	859,632.11	830216.12	96.58
IBRA biographic region (Yalgoo)	621,396.05	620,265.57	99.82
IBRA biogeographic subregion (Tallering)	615,816.17	614,685.69	99.82
Shire of Yalgoo	549,363.07	548,343.13	99.81

### 2.3.3 Vegetation Communities

No conservation-significant ecological communities have been observed in proximity to the Proposal.

#### 2.3.3.1 Scuddles and Gossan Hill

A total of four (4) baseline surveys were conducted by Mattiske Consulting Pty Ltd (Mattiske) (1996 and 2004) and Woodman Environmental (Woodman) (2007 and 2013) in the Scuddles and Gossan Hill areas. The most recent vegetation data for the Scuddles and Gossan Hill areas is provided by the baseline vegetation and flora survey conducted by Woodman in 2013. During this survey Woodman (2013) assessed a broad (approximately 3,000 ha) survey area that encompassed Scuddles and Gossan Hill.

Vegetation communities mapped in proximity to the Proposal are described in the sections below and shown in Figure 2.1. Woodman (2013) reviewed the results of previous surveys in the area and reconciled historic data with the results of additional survey work conducted at the time. Results showed that approximately 300 flora taxa had been recorded in the area. This species diversity is consistent with other surveys conducted in the region (Woodman, 2013).

Woodman (2013) described vegetation in the vicinity of the Proposal as tall, closed to sparse shrubland with mixed Acacia species (Figure 2.1). Vegetation is described as comprising seven (7) vegetation types that were attributed to two (2) distinct vegetation groups that comprise:

- Vegetation Group 1: on lower to upper slopes and hill crests of large hills associated with ranges; low hills on undulating plains; and outwash areas at the base of hills; and
- Vegetation Group 2: on flats, undulating plains, and on low undulating hills not associated with larger ranges.

These vegetation groups are not considered to have regional conservation significance and are likely to be widespread throughout the region. Table 2.2 summarises the vegetation type over the proposed clearing area.

Table 2.2 Vegetation Communities of the Proposal Area

Code	Description	Presence of Significant Flora Taxa	Local Conservation Significance	Regional Conservation Significance	Total mapped in the study area (ha) (Woodman, 2013)	Approved Mining Activities (ha)	Proposed Areas (ha)	Total(ha)
<b>Golden Grove (Woodman 2013)</b>								
VT 11	Tall closed to sparse shrubland of mixed Acacia species dominated by <i>Acacia effusifolia</i> , <i>Acacia ramulosa</i> var. <i>ramulosa</i> and <i>Acacia sibina</i> over low isolated clumps of tussock grasses of <i>Monachather paradoxus</i> on yellow to red-brown loams on plains and slopes.	<i>Acacia speckii</i> (P4) <i>Grevillea globosa</i> (P3) (VT contains preferred habitat) <i>Micromyrtus trudgenii</i> (P3)	VT 11 comprises >10 % of the Study Area; VT 11 occurring on landforms and soil types that are locally common Conservation significant flora taxa present in VT 11 (P3 and P4)	<b>VT 11 not of Regional Conservation Significance</b> VT 11 likely to be widespread within the region according to known soil types, substrate and topographical positions, and previous surveys by consultants	636.28	20.53	10.82	31.21 (4.9% of study area)

#### 2.3.4 Vegetation Condition

Vegetation condition ranges from 'Completely Degraded' to 'Excellent' condition. Historic disturbances contributing the vegetation condition include clearing for exploration, mining activities, existing access tracks and roads, and grazing by goats (Woodman, 2013). The vegetation over the proposed ROM extension is mapped as good condition (Figure 2.2).



Figure 2.1 Vegetation Community Mapping





Figure 2.2 Vegetation Condition Mapping

### 2.3.5 Conservation-significant Flora

#### 2.3.5.1 Local Area

Historic vegetation and flora surveys have mapped populations of conservation significant flora species in the local area (Figure 2.3).

A total of eight (8) conservation significant flora have been recorded in the vicinity of Scuddles and Gossan Hill (Woodman, 2013):

- *Stylidium scintillans* (Threatened)
- *Drummondita fulva* (Priority 3)
- *Micromyrtus trudgenii* (Priority 3)
- *Polianthion collinum* (Priority 3)
- *Grevillea globosa* (Priority 3)
- *Persoonia pentasticha* (Priority 3)
- *Calotis* sp. Perrinvale Station (R.J. Cranfield 7096) (Priority 3)
- *Acacia speckii* (Priority 4)
- *Calytrix uncinata* (formerly (Priority 3) recorded by Woodman (2013) but now de-listed and no longer a Priority flora species).

All of these species are well represented in the region. Most are Priority flora species listed by the DBCA. Only one (1) 'Threatened' flora species has been recorded in the region, *Stylidium scintillans* (Vulnerable, BC Act). The occurrence of *Stylidium scintillans* at Golden Grove has been surveyed in detail during targeted census surveys conducted by Yilgarn Consulting (2011) and Maia (2022) and is well understood.

Sandalwood (*Santalum spicatum*) was also recorded in the Golden Grove area by Woodman (2013). Sandalwood is not listed as a conservation significant species, but permissions to take the species are controlled under special requirements included in the BC Act (formerly the *Sandalwood Act 1929*).

The significance of local conservation significant flora populations to the overall conservation of each taxon as described by Woodman (2013) is provided in Table 2.3.

Table 2.3 Significance of Local Conservation Significant Flora Populations to the Overall Conservation of each Taxon.

Taxon	Conservation Code	Approximate number of regional populations	Approximate Known Range of Taxon (km)	Significance of Populations to the Overall Conservation Significance of Taxon
<i>Stylidium scintillans</i>	T	29	25 km E-W; 45 km N – S (outlier also 70 km west of main range)	High
<i>Calytrix uncinata</i>	P3	42	520 km E-W; 310km N – S	Low
<i>Drummondita fulva</i>	P3	18	50 km E-W; 50 km N – S	Moderate
<i>Grevillea globosa</i>	P3	19	160 km E-W; 120km N – S	Low-Moderate
<i>Micromyrtus trudgenii</i>	P3	36	40 km E-W; 95 km N – S	Low-Moderate
<i>Persoonia pentasticha</i>	P3	40	220 km E-W; 160km N – S	Low-Moderate
<i>Polianthion collinum</i>	P3	12	20 km E-W; 45 km N – S	Moderate
<i>Acacia speckii</i>	P4	30	380 km E-W; 210km N – S	Low-Moderate

#### 2.3.5.2 Proposed Clearing Area

No threatened flora species have been recorded in the ROM pad expansion footprint.

The Priority 3 species, *Grevillea globosa* is located within the Gossan Hill ROM pad expansion footprint (Figure 2.3 and 2.4). Western Australian Herbarium records indicate *Grevillea globosa* is known from multiple collections across two IBRA bioregions (Avon Wheatbelt and Yalgoo) and from four local government areas (Greater Geraldton, Murchison, Perenjori and Yalgoo). Preferred habitat is described as red loam and yellow sand.

A survey of the Golden Grove tenements (Firth, 2006) showed a strong correlation between *Grevillea globosa* plants and disturbance areas due to the plant's colonising behaviour. As a part of the previous Gossan Hill ROM Pad expansion (REGID 18883) Julie Firth was commissioned to undertake an assessment of the impact of the proposed ROM expansion on the overall *Grevillea globosa* population (Firth, 2006). This assessment found the total number of plants across the Golden Grove tenements was between 12,000 and 15,000 individuals across 13 populations. It was determined that the clearing associated with REGID 18883 (12.33 ha) would have a negligible impact on the species (Firth, 2006). Whilst the clearing associated with this proposal (10.82ha) will have a cumulative local impact on this species, impacts are not expected to be significant. As shown in Figure 2.4, there are multiple occurrences of *Grevillea globosa* at Golden Grove that occur outside the mine footprint.

The Proposed clearing footprint will impact 10.82ha of Vegetation Type 11 (

Table 2.2). This represents 1.7% of the total mapped extent of this vegetation type in the study area (Woodman, 2013). Previously approved disturbance of 20.53ha of this vegetation type, will bring the cumulative impact of this proposal to 31.21ha (4.9% of study area). Vegetation Type 11 is not of regional significance and occurs on soil types that are locally common (Woodman, 2013).



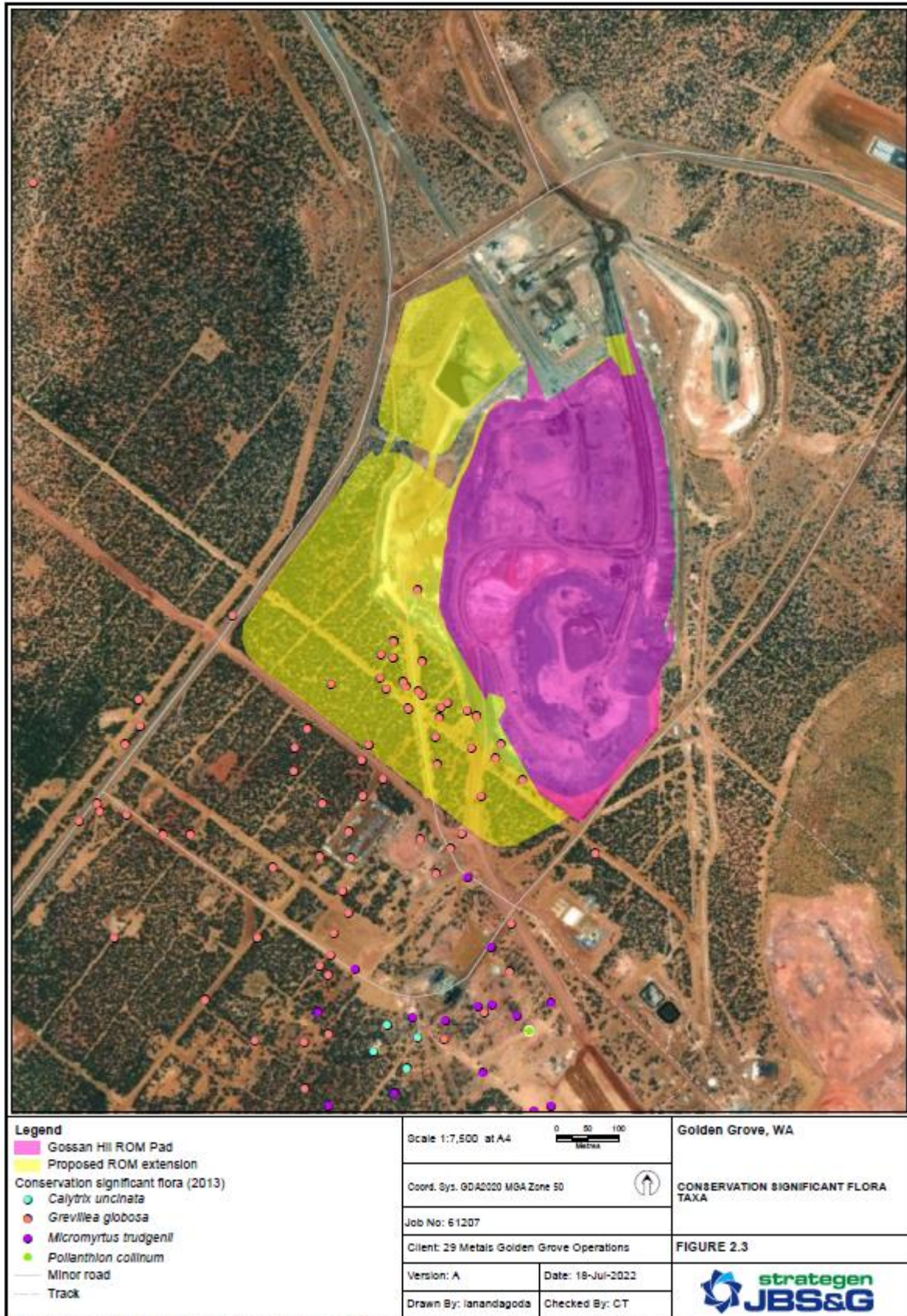


Figure 2.3 Conservation Significant Flora



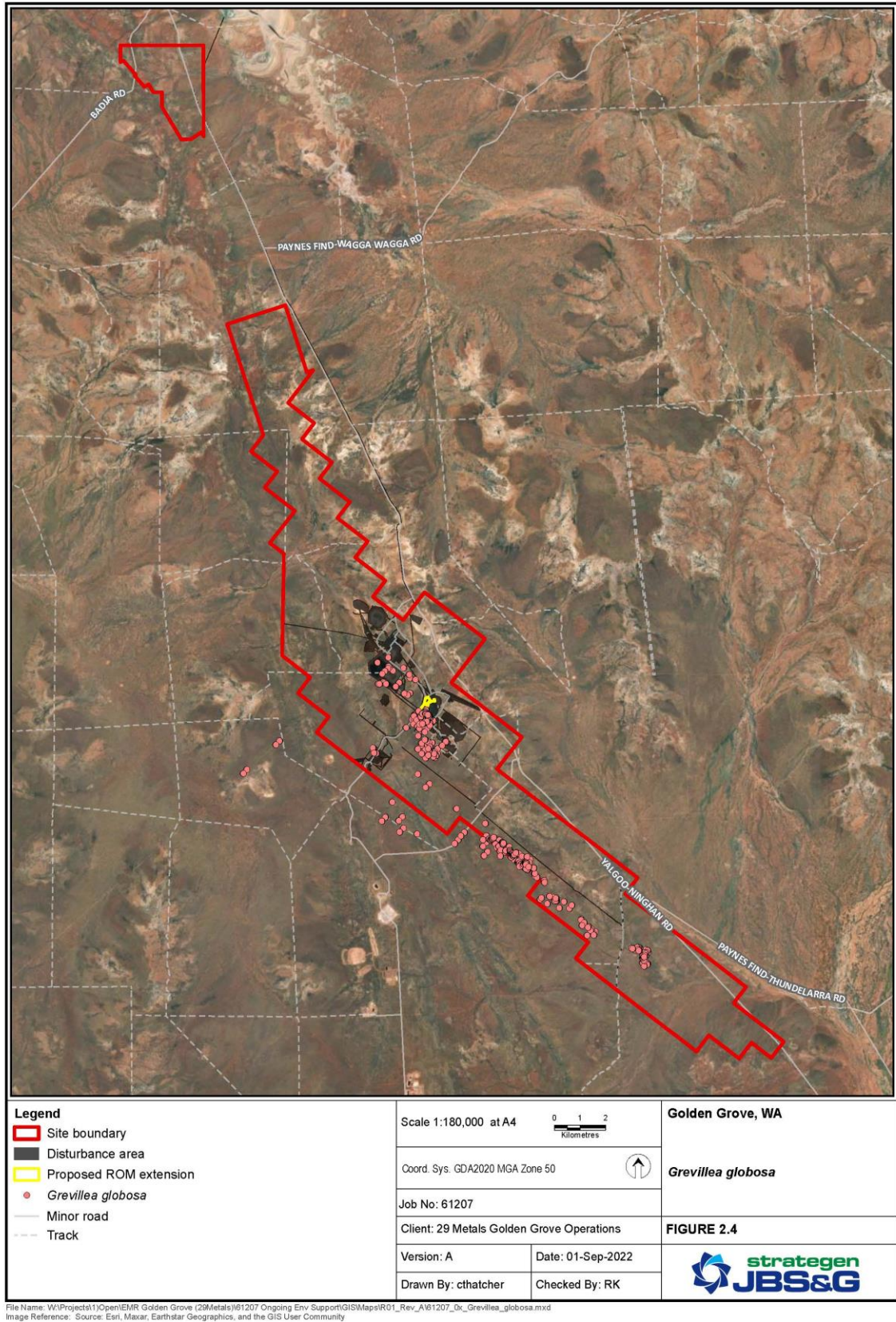


Figure 2.4 *Grevillea globosa* at Golden Grove

## 2.4 Conservation Areas and Environmentally Sensitive Areas

The Proposal is not located within any DBCA Legislated Lands or gazetted Environmentally Sensitive Areas (ESA's). The nearest DBCA Legislated Land is an unnamed timber reserve located approximately 60 km southwest of the Proposal; however, a DBCA Land of Interest overlies Gossan Valley (LR 3074/691). This represents a future conservation reserve that the DBCA intends to establish as part of the 'Plan for Our Parks.' The proposed conservation area, known as the Badimia Conservation Reserve, overlies the Warriedar pastoral lease held by the DBCA.

## 2.5 Terrestrial Fauna

### 2.5.1 Surveys

As with the characterisation of flora and vegetation, many local-scale terrestrial fauna surveys have been conducted across the project area over the period 1997 to 2010. Surveys of the Golden Grove mining tenements, project area and surrounds undertaken by Bamford in 2007 and ENV Australia in 2008 are the equivalent to Level 1 Surveys as outlined in the EPA's Guidance Statement 56 (2004b). Comprehensive surveying of terrestrial fauna has also been undertaken throughout the Yalgoo/Murchison/Midwest bioregions in general.

### 2.5.2 Fauna Habitats

The fourteen (14) vegetation communities identified by Woodman (2007) in proximity to the Proposal comprise of two (2) broad fauna habitat types:

- Open mulga (*Acacia aneura* complex) woodland with scattered herbs over a gravely clay with quartz patches. Soils have more clay on the flats and are stonier on the slopes; and
- Rocky hill with shrubland of *Acacia* species to 2 metres on minimal surface soil.

A Level 1 assessment for fauna was conducted by Phoenix Environmental Services (Phoenix) in 2020. The desktop review identified records of 246 vertebrate taxa within the desktop search extent as summarised in Table 2.3. below.

Table 2.4: Summary of Terrestrial Fauna Desktop Search Results

Class	Introduced Species	Native Species	Total
Amphibians	0	7	7
Birds	2	165	167
Mammals	6	14	20
Reptiles	0	51	51
Spiders	0	1	1
<b>Total</b>	<b>8</b>	<b>238</b>	<b>246</b>

Species of concern (conservation-significant) have been outlined in Table 2.4 below.

Table 2.5: Conservation-significant Fauna Known to Occur in the Vicinity of the Project

Species Name	Common Name	Conservation Status	
		State (BC Act)	C'th (EPBC Act)
Birds			
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR	CR
<i>Falco peregrinus</i>	Peregrine falcon	-	OS
<i>Ixobrychus dubius</i>	Australian Little Bittern	-	P4
<i>Leipoa ocellata</i>	Malleefowl	VU	VU
<i>Oxyura australis</i>	Blue-billed Duck	-	P4
<i>Pezoporus flaviventris</i>	Western Ground Parrot	CR	CR
<i>Rostratula australis</i>	Australian Painted Snipe	EN	EN
<i>Tyto novaehollandiae</i> subsp.	Masked owl (southwest)	-	P3

Species Name	Common Name	Conservation Status	
		State (BC Act)	C'th (EPBC Act)
<i>Tyton. novaehollandiae</i>	Masked owl (northern)	VU	P1
<b>Mammals</b>			
<i>Dasyurus geoffroii</i>	Chuditch	EN	VU
<i>Notamacropus irma</i>	Western Brush Wallaby	-	VU
<b>Reptiles</b>			
<i>Cyclodomorphus branchalis</i>	Gilled slender blue-tongue	-	VU
<i>Egernia stokesii badia</i>	Western spiny-tailed skink	EN	VU

There are currently active and inactive Malleefowl (*Leipoa ocellata*) mounds within the Project Area that are managed in accordance with the internal Malleefowl Management Plan. There are no known mounds within the proposed ROM Pad extension footprint (Figure 2.5).



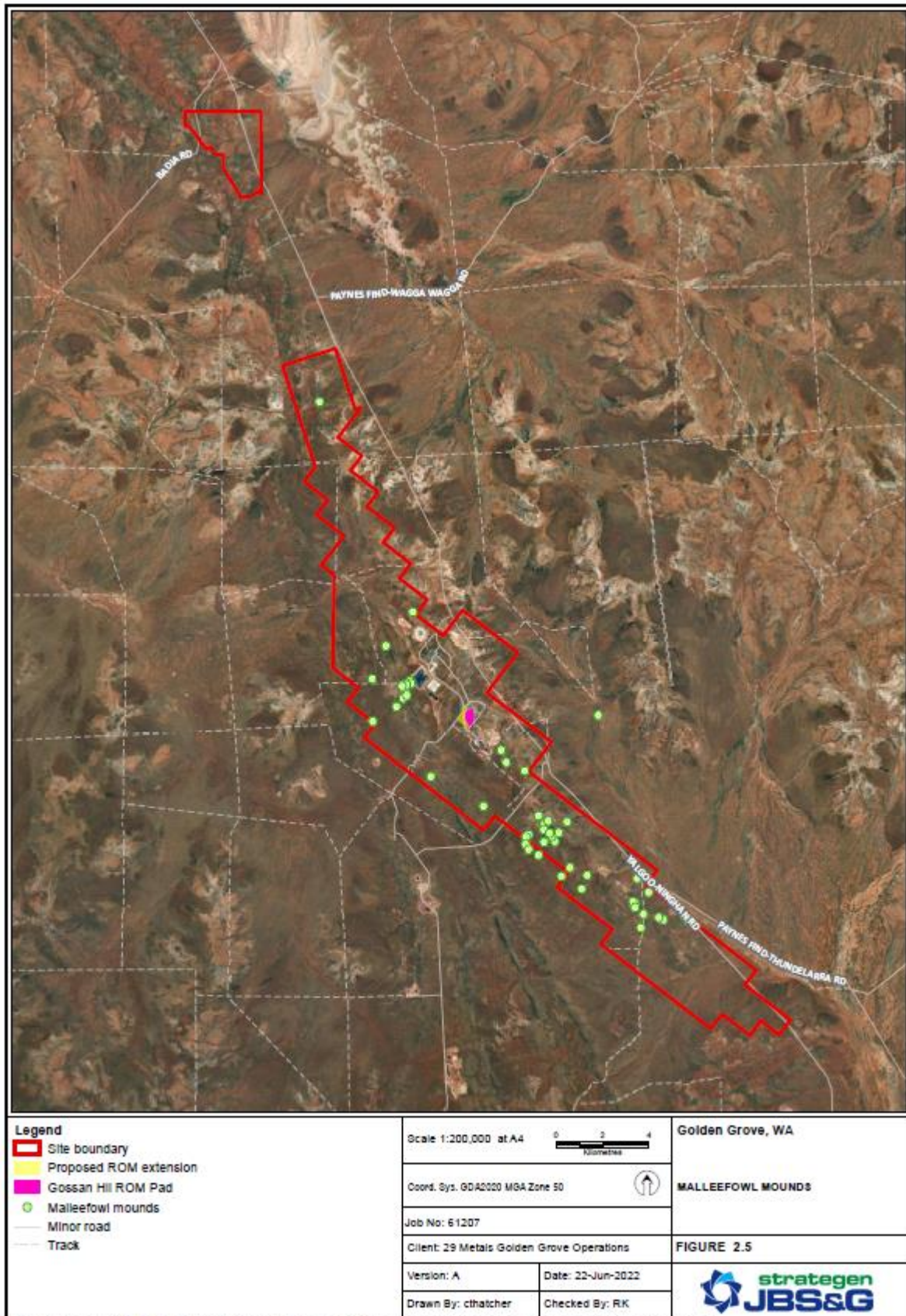


Figure 2.5 Malleefowl Mounds at Golden Grove

### 2.5.3 Short-range Endemic Invertebrates

Short-range Endemic (SRE) Invertebrates are often undescribed species with an unknown, generally restrictive distribution, and are typically confined to mesic refuges associated with hills.

Phoenix undertook a desktop assessment for SRE invertebrate fauna that is likely to occur within the Proposal area. The desktop review identified records of 62 potential SRE taxa. The assemblage is dominated by trap-door spiders (38 taxa), Millipedes (10 taxa) and Urodacidae scorpions (7 taxa). Phoenix also concluded that the majority of the records are from SRE surveys of Banded Iron Stone Formation's related to mining tenements.

In a survey conducted by Bamford Consulting Ecologists (Bamford) in 2007, it was concluded that the SRE invertebrates are likely to be endemic to hill areas rather than a single landform, and therefore, are unlikely to be found within the project area. Based on available survey information, the Proposal is unlikely to impact any SRE invertebrates of significance.

### 2.5.4 Subterranean Fauna

AECOM conducted a subterranean fauna desktop study in 2019. The following conclusions were made in the report (AECOM, 2019a):

- Four stygofauna communities, all listed as Priority 1 Ecological Communities, are known to occur in the local region. These calcretes were listed due to the presence of stygobiontic dytiscid diving beetles and other stygofauna species that occur in virtually every calcrete in the Yilgarn. The calcrete PECs also have a high likelihood of containing troglofauna species, however, TSF1 is located on the boundary and slightly into the PEC buffer; and
- A previous survey of the Golden Grove Project Area (Biota, 2010) recorded no presence of troglofauna and a low likelihood for stygofauna due to a lack of suitable habitat, poor water quality and the highly heterogeneous nature of the aquifer within the nearby Gossan Hill open cut area.

A study conducted by URS (2010) also concluded that it is highly unlikely that any stygofauna will be present in the remaining bedrock aquifer given the geological nature of the area and the impacts from existing and historical dewatering practices from mining operations. Aquifers remaining in the area occur in host rocks contain sulphide which results in groundwater with very low dissolved oxygen concentrations, making the environment unsatisfactory for stygofauna (URS, 2010). It is relatively unlikely that stygobitic fauna would have occurred under these conditions originally, and the extent of historical dewatering would have already reduced any local populations if they did occur.

## 2.6 Aboriginal Heritage

The Proposal is located in an area that is under claim by two indigenous native title claimant groups, the Badimia People (WCD2015/001, determined on 25/05/2015 as having no Native Title claim) and the Yamatji Nation (WC2019/008, determined on 12/07/2019 as having native title existing in parts of the determination area). These claims intersect the Golden Grove tenements with the Badimia claim overlaying the southern tenements and the Yamatji claim overlaying the northern leases.

A desktop search of Aboriginal Heritage Places was conducted in September 2021 by using a search area of 1 km from the boundary of the tenements associated with the Golden Grove Project. The search identified a total of twelve (12) Aboriginal Heritage Places within 1 km of Golden Grove. Of these, eleven (11) are found within or in close proximity to Golden Grove tenements, including M59/195 (DPLH, 2021a).

Historical Aboriginal heritage surveys inclusive of M59/195 included (DPLH, 2021b):

- A report of an archaeological survey of a proposed Haul Road and Mine Development Project at Golden Grove, near Yalgoo, WA (Western Heritage Research Pty Ltd);

- A Report of an Ethnographic Survey of Oxiana Ltd's Proposed Drilling Project, TSF Site Selection and the Proposed Open Pit Waste Rock Dump Site at Golden Grove with Badimia, West Badimia and Widi Binyardi Representatives (Yamatji Communications 2008);
- A site identification Heritage Survey Report of the Proposed Tailing Storage Facility at Gossan Hill, Western Australia;
- An Archaeological and Ethnographic Site Identification Heritage Assessment of Mount Gibson Irons's Shine Project Haul Road Upgrade Conducted by the Badimia Traditional Owners: May 2014. (TBD);
- Archaeological and Ethnographic Site Identification Heritage Assessment of MGI's Shine Project Haul Road Upgrade Conducted by the Widi Traditional Owners : May 2014. (TBD);
- Archaeological and ethnographic work area clearance of Golden Grove Operations's Bassendean and Thundelarra Project Area with the Badimia Traditional Owners and prepared for Golden Grove;
- Preliminary advice of an Aboriginal archaeological survey of the proposed Gossan Hill deposit and associated access road, Minjar Project, Western Australia;
- Report of archaeological and ethnographic survey of the Winddine Project, south of Yalgoo, Western Australia: 1990;
- Report on a site identification survey and a Section 18 consultation under the *Aboriginal Heritage Act 1972* of the proposed Gossan Pit Mine Site at Gossan Hill, Western Australia; and
- Report on an archaeological survey for Aboriginal sites Gossan Hill Project.

Table 2.6: Aboriginal Heritage Places in Proximity to the Proposal

Place ID	Name	Status	Type
20734	Minjar Hills (GGP/04) (GGW/05)	Stored Data/Not a Site	<ul style="list-style-type: none"> <li>• Mythological; and</li> <li>• Natural Feature</li> </ul>
20739	Gossan Hill (GGW/04)	Stored Data/Not a Site	<ul style="list-style-type: none"> <li>• Natural Feature</li> </ul>
5857	WALJUMARUNG, YALGOO.	Registered Site	<ul style="list-style-type: none"> <li>• Man-Made Structure; and</li> <li>• Other: Food Resource</li> </ul>
5856	WALJUMARUNG, YALGOO.	Registered Site	<ul style="list-style-type: none"> <li>• Man-Made Structure; and</li> <li>• Other: Food Resource</li> </ul>
26427	OZ Minerals Stone Source	Lodged	<ul style="list-style-type: none"> <li>• Quarry</li> </ul>
26426	OZ Minerals Gnamma Hole	Lodged	<ul style="list-style-type: none"> <li>• Artefacts/Scatter; and</li> <li>• Water Source</li> </ul>
26451	OZ Minerals Isolated Finds	Lodged	<ul style="list-style-type: none"> <li>• Other: 53 Isolated artefacts</li> </ul>
27411	Warriedar Station	Lodged	<ul style="list-style-type: none"> <li>• Artefacts/Scatter;</li> <li>• Ceremonial;</li> <li>• Grinding Patches / Grooves;</li> <li>• Historical;</li> <li>• Rock Shelter;</li> <li>• Arch Deposit;</li> <li>• Camp;</li> <li>• Natural Feature; and</li> <li>• Ochre</li> </ul>
26428	OZ Minerals Artefact Scatter	Lodged	<ul style="list-style-type: none"> <li>• Artefacts/Scatter</li> </ul>
33032	MJGAS12-01	Registered Site	<ul style="list-style-type: none"> <li>• Artefacts/Scatter</li> </ul>
20740	Gossan Hill Rockhole (GGW/03)	Stored Data/Not a Site	<ul style="list-style-type: none"> <li>• Natural Feature;</li> <li>• Water Source; and</li> <li>• Other: Rockhole</li> </ul>

No approval to disturb Aboriginal Heritage sites under Section 18 of the *Aboriginal Heritage Act 1972* will be required by the Proposal.

## 2.7 European Heritage

The Proposal is within an area that has been subject to mining since the late 19<sup>th</sup> century. As such there are a number of old mining sites, prospects and associated infrastructure near the Proposal, and within the Muralgarra Pastoral Lease. There are no non-indigenous heritage places identified within the vicinity of the Proposal.

### 3 Assessment Against Clearing Principles

#### 3.1 Biodiversity

Clearing Principle	Description	Variance
A	Native vegetation should not be cleared if it comprises a high level of biological diversity	Not at Variance

The project area is located in the Yalgoo IBRA Bioregion and Talling Subregion. The Yalgoo Bioregion is 5,087,577 ha and is a transitional region between the Mediterranean climate of southwest Australia and the deserts of central Australia.

The Talling subregion vegetation is characterised by woodlands, dominated by species of *Eucalyptus*, *Acacia*, and *Callitris*. Plant communities include *Callitris*–*Eucalyptus salubris* woodlands, mulga (*Acacia aneura*) woodlands, and bowgada (*Acacia ramulosa*) open woodlands and scrub. The predominant land use is livestock pasturing on natural vegetation. Approximately 4% of the Talling subregion is in protected areas (Douglass et al, 2019).

The Talling Subregion is known as having low floristic diversity and mapping undertaken by Woodman (2013) concluded that there were no vegetation units considered to be of local significance. Floristically, the local proposal area is not considered to contain any significant species or groups of species not recorded elsewhere in the region. Clearing under this proposal is likely to have a minimal impact on the overall biodiversity of the Yalgoo IBRA Bioregion and the local area which the project area is located.

The application area was subject to a flora and vegetation assessment undertaken in 2013 (Woodman, 2013). The vegetation consists of tall closed to sparse shrubland of mixed *Acacia* species dominated by *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa* and *Acacia sibina* over low isolated clumps of tussock grasses of *Monachather paradoxus* on yellow to red-brown loams on plains and slopes. It is not a Threatened or Priority Ecological Community.

A small population of the priority 3 species, *Grevillea globosa* will be impacted by the proposed clearing (Figure 2.3) however the taxa has been recorded within the site boundary at between 12,000 and 15,000 individuals across 13 populations and in the greater IBRA bioregions of Yalgoo and Avon Wheatbelt.

Assessments undertaken of cumulative impacts on *Grevillea globosa* from Gossan Hill projects including this proposal have found that impacts are not expected to be significant (Firth, 2006) (Appendix A). The proposed clearing footprint will impact 10.82 ha of Vegetation Type 1 (Table 2.2) which represents 1.7% of the total mapped extent of this vegetation type in the study area (Woodman, 2013). Previously approved disturbance of 20.53ha of this vegetation type, will bring the cumulative impact of this proposal to 31.21ha (4.9% of study area). Vegetation Type 11 is not of regional significance and occurs on soil types that are locally common (Woodman, 2013).

The vegetation condition over the proposed area of clearing is affected by historic disturbances including clearing for exploration, mining activities, existing access tracks and roads, and grazing by goats (Woodman, 2013). This is a small area within in a large subregion of vegetation in good to excellent condition and the project location has been mapped as being of good condition (Figure 2.3).

Clearing under this proposal is likely to have a minimal impact on the overall biodiversity of the Yalgoo IBRA Bioregion and the local area within which the project area is located due to the size of the impact of the proposed clearing to native vegetation (10.82 ha) and the low level of biological diversity.

This proposal is therefore not considered to be at variance to this principle.



### 3.2 Fauna Habitat

Clearing Principle	Description	Variance
<b>B</b>	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna	Not at Variance

The vegetation to be cleared is habitat that is widespread in the local area and region. The vegetation condition at the clearing site provides varying value as fauna habitat having been affected by historic disturbances including clearing for exploration, mining activities, existing access tracks and roads, and grazing by goats (Woodman, 2013). The existing disturbances and proximity of the proposed clearing area to the existing ROM suggest the area is unlikely to provide significant breeding or foraging habitat for conservation significant species such as Malleefowl.

The proposed clearing area is not considered to represent significant habitat critical for fauna species listed in Table 2.5, however management methods will be utilised to minimise the direct impact of clearing activities on fauna:

1. Demarcation of area permitted for clearing
2. Check of area for Mallee Fowl nests prior to clearing activities
3. Move through area to be cleared with a loud sound immediately prior to civil equipment entry

The nature and scale of vegetation to be cleared does not comprise significant habitat for local or regional fauna species. No species are at risk of becoming vulnerable or at increased vulnerability due to the loss of the proposed habitat.

This proposal is therefore not considered to be at variance to this principle.

### 3.3 Threatened Flora

Clearing Principle	Description	Variance
<b>C</b>	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of threatened flora	Not likely to be at Variance

No Threatened Flora have been recorded in the proposed clearing area. Woodman (2013) reports that the preferred habitat for *Stylidium scintillans* is decaying granite outcropping, breakaway and granitic flats and brown, rocky-stoney gritty clay loam. These habitat types do not occur in the proposed ROM expansion area.

The proposed clearing is considered unlikely to impact on native vegetation that is necessary for the continued existence of threatened flora.

The proposed clearing is not likely to be at variance to this principle.

### 3.4 Threatened Ecological Community

Clearing Principle	Description	Variance
<b>D</b>	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community	Not at Variance

No Threatened Ecological Communities have been recorded in the vicinity of the proposed project area.

The proposed clearing is therefore not considered to be at variance to this principle.

### 3.5 Remnant Vegetation

Clearing Principle	Description	Variance
<b>E</b>	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared	Not at Variance

The proposed clearing area lies within Vegetation Association Yalgoo 420. Of which there is 99.82% remaining within the IBRA region and subregion. This vegetation association has a current extent well above the 30% National ecological retention target.

The proposed clearing area has been mapped as vegetation type VT 11 “Tall closed to sparse shrubland of mixed Acacia species dominated by *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa* and *Acacia sibina* over low isolated clumps of tussock grasses of *Monachather paradoxus* on yellow to red-brown loams on plains and slopes.” (Figure 2.2). The vegetation type is not considered to have regional conservation significance and is widespread throughout the region.

The proposed clearing area represents a relatively small area of native vegetation surrounded by an extensive region of uncleared vegetation. The project area does not represent an area that is significant as a remnant of native vegetation in an area that has been extensively cleared.

The proposed clearing is therefore not considered to be at variance to this principle.

### 3.6 Watercourse

Clearing Principle	Description	Variance
F	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	Not at Variance

The area is not associated with a watercourse or wetland (nearest is 27km).

The proposed clearing is therefore not considered to be at variance to this principle.

### 3.7 Land Degradation

Clearing Principle	Description	Variance
G	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation	Not at Variance

The proposal is a small extension to an ROM pad in an area that has been heavily modified for an industrial mine. The area to be cleared has been degraded by historic disturbances including clearing for exploration, mining activities, existing access tracks and roads, and grazing by goats (Woodman, 2013).

The proposed clearing is not expected to increase wind, water or soil erosion, salinity, nutrient export, acidification, waterlogging or flooding that could affect the present or future use of the land.

The proposed clearing is therefore not considered to be at variance to this principle.

### 3.8 Conservation Area

Clearing Principle	Description	Variance
H	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area	Not at Variance

While 22% of the Yalgoo IBRA bioregion is protected in Reserves, the proposed area to be cleared is 60 km from the nearest reserve and is located on Mining Tenement M59/195. It is not located near an Environmentally Sensitive Area (ESA), bush forever or red book area. The proposal will not have an impact on the environmental values of any conservation area.

The proposed clearing is therefore not considered to be at variance to this principle.

### 3.9 Water Quality

Clearing Principle	Description	Variance
I	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	Not at Variance

No watercourses or wetlands are located in the proposed clearing area. The proposed clearing will not:

- lead to adverse environmental impacts through sedimentation of water bodies
- contribute to increased nutrient levels in the catchment
- have the potential for low pH waters and/or acid sulphate soils to form
- contribute to increased salinity in catchments already affected by or likely to be affected by salinity
- lead to changes in water regimes of, or result in breaches of environmental water provisions for, groundwater-dependent ecosystems (GDEs) on or off site and subsequent degradation of the biological communities associated with these systems

The operation of the ROM pad will be in accordance with operating manuals and will include the following management measures to protect water quality:

- Vehicles and equipment to be used only within approved project footprint
- The ROM pad is lined
- The Golden Grove Hydrocarbon Management Procedure will be in place
- ROM Pad design includes perimeter and underground drainage which leads to the Coffey Dam. Potentially contaminated water is then pumped to Evaporation Pond C for treatment (evaporation).
- Dewatering is in place at Golden Grove Mine
- Development of Mining Proposal including risk assessment, the development of management strategies with a clear implementation strategy
- All personnel will be instructed on the operation and maintenance of applicable equipment to prevent accidental leak or spill of fuel, oil or chemical
- Personnel will be made aware of spill prevention and clean-up requirements
- Hydrocarbon contaminated waste will be disposed of in designated bins and removed from site by a licenced contractor
- A drip tray and spill kit are in place for all refuelling activities
- All vehicles and equipment are serviced in accordance with their schedule
- All crew will undertake an induction which includes details of environmental sensitivities, spill prevention and clean-up and individual responsibilities
- Control of surface water run-on and run-off

These measures will be implemented under a Mining Proposal under the *Mining Act 1978* and regulated by the Department of Mines, Industry Regulation and Safety. These management measures are consistent with the measures implemented for similar mining proposals in the area.

The proposed clearing is therefore not considered to be at variance to this principle.

### 3.10 Flooding

Clearing Principle	Description	Variance
J	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding	Not at Variance

There are no watercourses or drainage lines in the vicinity of the Project Area. The activity would not result in any changes to flooding of the area. The small area of clearing and associated project footprint will be managed to prevent uncontrolled loss of water to the surrounding environment through surface flows as per the existing



ROM pad. Engineered hydrological processes (underground drainage to coffer dam and evaporation pond) will be in place.

The proposed clearing is therefore not considered to be at variance to this principle.

## 4 Environmental Approvals and Management

### 4.1 Environmental Approvals and Management

The key approval identified as being required and/or potentially required to support the proposed clearing include the following:

- Native Vegetation Clearing permit (NVCP) under s 51E of the EP Act; and
- Mining Proposal under Section 82A of the *Mining Act 1978*.

Based on the known environmental values of the site and the proposed clearing area, a referral under the *Environment Protection and Biodiversity Conservation Act 1999* or Part IV of the *Environmental Protection Act 1986* is not anticipated to be required.

The assessment against the 10 clearing principles (Section 3) concluded that the proposed clearing, whilst resulting in minor local reduction to Priority 3 flora species *Grevillea globosa*, will not result in a significant impact to any flora or fauna species, or TECs particularly with consideration of the proposed mitigation and management measures outlined below.

### 4.2 Environmental Mitigation and Management

The location of the proposed clearing has been selected with consideration as of historic disturbance or the proposal area including the continuation of an existing cleared ROM pad. Considering the proposed clearing is in the vicinity of existing industrial cleared land managed in the surrounding environment, incidental impacts are not expected. Impacts to retained vegetation and fauna will be avoided via the following management measures:

- Clearly demarcate the area of vegetation required to be cleared
- Check area for Mallee Fowl nests prior to clearing activities
- Move through area to be cleared with a loud sound immediately prior to civil equipment entry
- Ensure suitably qualified wildlife spotter/handler is on call during clearing works
- Clearing in accordance with the Golden Grove Land Clearing and Rehabilitation Procedure, including inspection to identify Priority plants.
- Topsoil stripping to be avoided in windy conditions
- Topsoil stockpiles will not exceed 2m in vertical height and will not be compacted during stockpiling activities
- Dust suppression during clearing and operational activities
- Disturbed areas to be rehabilitated progressively as available

## 5 Conclusions

The proposed clearing will result in the removal of 10.82 ha of native vegetation. An assessment against the ten clearing principles listed in Schedule 5 of the EP Act has indicated that the proposed clearing is not at variance with any of the principles and can therefore occur under a Native Vegetation Clearing Permit.

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## Appendix A Impact Assessment of *Grevillea globosa*



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## **Impact Assessment of “*Grevillea globosa*”**

### **1. Objective**

The objective of this report is to assess the impact of proceeding with the ROM Pad Expansion area on the overall “*Grevillea globosa*” population and outlay a number of suggestions that could be utilised to minimise this impact.

### **2. Scope**

This report has been prepared with reference to the known populations of ‘*Grevillea globosa*’, their life cycles and habits. It considers the aspects of regeneration of populations in relation to the ROM Pad Expansion area should it proceed. It does not consider any legislative requirements, mine constraints or priorities.

### **3. Background**

“*Grevillea globosa*” was first noted on the Normandy Golden Grove lease, in October 1996 by Mattiske Consulting in a vegetation survey. It was originally classed as a priority 1 species. Since this time Mattiske Consulting, Golden Grove’s staff and the author have undergone extensive surveys of the local areas, which have resulted in at least 13 populations being mapped on Golden Grove’s mining leases.

After the surveys in 1997 the estimated “*Grevillea globosa*” plant population was estimated 4000 - 6,000 (Mattiske Consulting Oct 1997). *Grevillea globosa*’s priority status has subsequently been reduced to priority 3.

Nursery propagation trials were set up at the Dryland Permaculture Research Farm and Nursery in January 1997. The trials established only the seeds that had their seed coat removed germinated. Previously trials of several other *Grevillea* species at the Permaculture Nursery, which also germinated with similar pre-treatments, have since show excellent germination results using smoked water. It is believed that “*Grevillea globosa*” may show a similar response but still remains to be trialled.

## 4. Key findings

During September 2006, the author undertook two site visits to Oxiana Golden Grove's mine site in the attendance of Rob Will, Environmental Services Co-ordinator and John Morris, Environmental technician, Oxiana Golden Grove.

### 4.1 MAPPING AND PLANT COUNTS -See Appendix 1 and 2

Total numbers of known plants are now estimated at 12,700 – 14,700 plants. These were distributed over 13 populations ranging between 13 and 3570+ estimated plants each.

All populations identified by the author and Mattiske Consulting lay within the area bounded by Oxiana Golden Grove and Gindalbie mining leases.

The proposed ROM Pad Expansion area is located within the Airfield Road. This area contains a population estimated at 2000-3000 plants (Mattiske Consulting Oct 1997). Hence the Expansion area contains an estimated 10-15% of the known total.

Environmental Services Co-ordinator, Rob Will (pers. com.) believes that there are at least as many populations again unmapped on adjoining pastoral stations. These are likely to increase the numbers estimates 30-50%.

### 4.2 PLANT HEALTH AND HABITS

In September 2006, the following observations were made:

**Photo:** Mapping  
"*Grevillea globosa*".



#### 4.2.1 Soil Type & Orientation

Populations were found in belts mainly on west facing slopes at elevations of approx. 350m above sea level on terracotta/yellow coloured sands.

#### 4.2.2 Natural Regeneration & Disturbance

New seedlings of "*Grevillea globosa*" were frequently noted naturally regenerating around areas where mining activity had caused disturbance such as drill pad sites, gridlines and road edges located around and within existing populations. They appeared in good health and were often the only new seedlings apparent. Young healthy plants less than five years old, up to 1m in height were also sighted in the same areas. "*Acacia coolgardenensis*" and "*Grevillea globosa*" seem to be the main coloniser species in these areas.





**Photo:** "*Grevillea globosa*" seedlings regenerating along gridlines

It was noted that only a few young seedlings were seen throughout the Mattiske survey (Mattiske Consulting Oct 1997) and that they mainly occurred on disturbed areas. The numbers of young "*Grevillea globosa*" seedlings and plants seen were a lot higher than noted 10 years ago.



**Photo:** Typical "*Grevillea globosa*" regenerating on a Drill Pad Site

Several plants appearing dead from the top were found reshooting from their base after rain. This is a typical drought adaptation of desert plants witnessed after extremely dry seasons. (See Photo right.)



**Photo:** The edge effect showing 1m high plants growing along Gindalbie road swale made 4 years ago.



*Grevillea globosa* plants growing closest to the existing ROM Pad clearing were examined. The Mattiske report (Mattiske Consulting Oct 1997) 6.1.2 mentioned that potential leaching of acidic run-off during construction might affect this population. None of these plants displayed any obvious visible signs of stress and appeared in good health taking advantage of the edge effect. The only flowering *Grevillea globosa* was noted on this edge.

#### 4.2.3 Rehabilitation

*Grevillea globosa* shrubs thickly colonised the Tailings Dam TSF1 batters where the seed was brought in with the topsoil. Topsoil was spread 9 years prior, in 1997 and a quick visual estimate was made of 500-1000 plants. Plants located were on all sides of the dam indicating they were soil borne, rather than blown in from the Settlement Dam population.

These plants were all less than 9 years old, showing the effectiveness of topsoil rehabilitation with seed of this species. Many of these plants looked in better health here than in their natural habitat. The subsoil on the Tailings Dam batters was clay differing from the sandy soil where *Grevillea globosa* is usually found. The batter slope would allow this to free drain, which may be the reason while *Grevillea globosa* was growing so well.



**Photo:** Plants growing 'out of their soil type' colonising the batters of the Tailings Dam TSF1.

#### 4.2.4 Plant Stress & Deaths

Two stands of mature shrubs off the Airfield Road population had died, possibly 50-100 plants. It is estimated an average of 2-5% of the plants within all the populations noted had died. Only a few dead plants were sighted in the October 1997 survey (Mattiske Oct 1997). There were no signs of any significant mining impacts around the dead plants. They

appeared to have reached maturity then died. This may have been from the effects of the earlier drought\* or the end of their natural life cycle.



**Photo:** Stands of mature dead "*Grevillea globosa*"

Plants on the southern side of the Tailing Dam bank TSF 1 appeared stressed and had experienced some leaf drop. Plant stress is usually associated with climatic conditions, soil and/or overgrazing. The predominant southerly winds suggest this is the result of excessive dust from the dam surface as plants on the lower edges and other banks looked in good condition and no signs of grazing were noticed.

Rabbit warrens were noticed around some areas around the Airfield Road population although only a few young seedlings showed signs of light grazing.

#### **4.2.5 Aging Populations**

An estimate of up to 10% of the '*Grevillea globosa*' sighted in the 13 populations sited during the September 2006 visit had dropped their lower leaves, this was different from October 1997 when most plants were fully leaved at this time of the year.

In general, there seemed to be a greater number of older plants in the populations than sighted 10 years ago. Plants observed during September 2006 were generally larger, appearing fully mature, exhibiting an open stressed appearance compared to the smaller fuller canopy of younger plants. It is a typical pattern of pioneer plants to have germination spikes after disturbance and a period of good rainfall and then die at a similar age. "*Grevillea globosa*" populations appeared to be replicating this pattern.

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\* Annual average rainfall at Golden Grove's mine site for the years 2002-2005 was reduced by 40% compared to the 1998 – 2001.

## 5. Discussion

The Rom Pad Expansion area was examined and 235 plants were counted. They were scattered throughout 1/3 of the area on the NW edge of the Airfield Road population, which consists of an estimated 2000-3000 plants.

Should the Rom Pad Expansion area proceed then 10-15% of the localised population would need to be removed which corresponds to 1.7-2% of the overall mapped plants.

An overview of the overall population's health showed them to be aging and beginning to die out due to recent years of drought and a short life cycle. Almost all the new seedlings and young "*Grevillea globosa*" plants seen were on recently disturbed areas mainly due to mining impacts.

Results of germination trials indicated that seed is likely to respond to smoke treatment. Topsoil sprayed with smoked water in areas where new plant establishment is required may yield positive results. This technique could also be employed to rejuvenate dying populations.

Often in plant ecosystems, fragmentation of a population can affect their ability to regenerate. It is proposed that the edge of this population is removed rather than a large section being cleared through the centre.

The Rom Pad Expansion area to be cleared offers an opportunity to have the topsoil from beneath the "*Grevillea globosa*'s population removed and relocated for re-establishment or rejuvenation of the new or existing populations. Mining rehabilitation on Tailings Dam batters has established a new population of '*Grevillea globosa*' with relative ease due to its colonising behaviour.

Five-year disturbance rotations such as creation of water catchment swales, contour rips or lightly graded contour tracks within dying populations would be a way to rejuvenate them. Grading or scarifying the soil surface containing seeds in areas where dead plants exist would trigger seed germination. Care would need to be taken not to excessively damage living "*Grevillea globosa*" plants in the process.

## 6. Suggested Next Steps

On the assumption that the ROM Pad Extension area is to proceed there are a number of alternatives available to Oxiana Golden Grove that will limit the impact on the "*Grevillea globosa*" species.

1. Another population could be replicated using the topsoil stored seed of the removed plants by either of the following means:
  - Relocating topsoil immediately to new areas either on sandy or free draining soils requiring rehabilitation.
  - Storing topsoil for future rehabilitation areas and projects requiring "*Grevillea globosa*" until suitable sites become available for re-establishment.
2. The existing local population could be rejuvenated and numbers recovered by the following methods:
  - Developing a disturbance programme where small swales are graded or pushed up around dead plants and the soil surface is scarified either by light grading or shallow contour ripples to trigger new seedlings to germinate.
  - Confirming 'smoked water' triggers seed germination via nursery germination or field trials. Field trials could involve spraying of smoked water on the soil around existing bushes including dead ones. On-going spray programmes if successful could be developed.
3. Propagate seedlings and plant in areas that can be reticulated. Seed collection of "*Grevillea globosa*" is usually difficult, as the seed ripens sporadically over several weeks and needs to be hand picked when ripe. If left too late it drops its seed and collection is missed. Being close to a path or road will allow seed collectors to be aware of the seed and its stage of maturity, hence providing the opportunity to collect fresh viable seed for future propagation.

.....  
Julie Firth

Date: 22<sup>nd</sup> Sept 2006

Revegetation Consultant  
Dryland Permaculture Nursery and Research Farm  
T/as Yilgarn Traders

## 7. **References**

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060106 OXGG-EKS-SS-2006 Rolling Weather Data.xls

## **Appendix 1. – Mapping and Plant Count Details:**

Plants were sited at the following locations and GPS readings were plotted onto the Map – Appendix 2. Only living plants were counted. Counting techniques are described below:

*Q.V.* = Quick visual estimation

*I.C.* = Individual count

*D.E.* = Numbers estimated by averaging densities

<b>POPULATION SITE</b>	<b>EXTENT OF POPULATION MAPPING</b>	<b>Estimated Numbers</b>
Airfield Road	GPS perimeter (Mattiske 1997)	2000-3000 <i>D.E.</i>
Proposed ROM Pad expansion area (within the Airfield road population)	GPS centre of plant thickets within the population which was scattered over approx 30% of the area.	235 <i>I.C.</i>
Airfield Road South	GPS centre of population.	22 <i>I.C.</i>
Badjar Station near Minjar Well	Two populations perimeters tagged. See (Mattiske 1997) The larger population perimeter GPS.	2000 350 <i>I.C.</i>
Badjar/ Warriedar Boundary fence line areas	GPS perimeter of the NW side of the fence line. Not fully defined as it extended SSW of the fence line.	3570+ <i>D.E.</i>
Eastern slope facing west Gossan Hill	GPS centre of population.	13 <i>I.C.</i>
Gindalbie Road – East side	GPS readings where population is cut by Gindalbie road. Mapping incomplete, plants extended east.	50+ <i>I.C.</i>
Gindalbie Road – West side	GPS readings where population is cut by Gindalbie road. Mapping incomplete, extended west.	250+ <i>Q.V.</i>
Tailings Dam TSF1	Not mapped, just sighted.	500-1000 <i>Q.V.</i>
West of Gossan Hill	GPS perimeter of population.	1190 <i>D.E.</i>

In 1997 Mattiske Consulting also mapped the following areas without the involvement of the author.

<b>SITE</b>	<b>EXTENT OF POPULATION MAPPING</b>	<b>Estimated Numbers</b>
Settling Dam	GPS population perimeter	1000-1500
Gossan Hill	GPS population perimeter	1500
Village	GPS population perimeter	29

(Mattiske Consulting Oct 1997).



Rob Will from Oxiana Golden Grove (pers. com.) commented that he had also located the following populations of which haven't been accurately counted.

<b>SITE</b>	<b>EXTENT OF POPULATION MAPPING</b>	<b>Estimated Numbers</b>
Three spings Powerline 1 -Badjar Station	Unmapped	3000-4000
Near mine site and old tip -Oxiana Golden Grove	Three small populations unmapped	Not counted
-Warriedar Station	Fifteen small populations unmapped	150+ each





### **Appendix 3: - Work History:**

Yilgarn Traders have provided the following relevant services to Golden Grove and others over the last 10 years:

#### **Previous Services & Activities**

- |         |   |
|---------|---|
| 1995/97 | • <b>Rehabilitation Project</b> , consultant - Golden Grove for Murchison Zinc mining company in the Goldfields. Western Australia. |
| 1995    | • <b>Field Manual</b> for Rehabilitation in the Arid Shrub Lands  |
| 1995    | • <b>Rehabilitation Course</b> -7 day arid land at Golden Grove Mine.   |
| 1996/06 | • <b>Accredited Permaculture &amp; Horticulture Training</b>  |
| 1997    | • <b>Propagation Research</b> – Germination of <i>Prostanthera magnifica</i> & <i>Grevillea globosa</i>                             |
| 1997    | • <b>Flora Mapping</b> -report of <i>Prostanthera magnifica</i>   |
| 1997    | • <b>Seed collection</b> -On-Site collection, cleaning batching and storage at Golden Grove   |
| 1998    | • <b>Field Assistance</b> to Eleanor Bennett in Vegetation survey of Golden Grove and mapping of <i>Grevillea globosa</i> .         |
| 2000/03 | • <b>Site landscaping</b> and tree planting at Golden Grove   |
| 2002    | • <b>Propagation Research</b> - "Honey as a rooting hormone" project. Telford Polytechnic Apiculture Certificate course.            |

#### **On going Support Services**

- |         |   |
|---------|---|
| 1991/06 | • <b>The Permaculture Nursery.</b> - Geraldton, local provenance seedling specialists.- annual seedling suppliers for revegetation at Golden Grove.               |
| 2000/06 | • <b>Geraldton Regional Herbarium</b> - set up the data and specimen collection of local native plants and run community workshops - Julie Firth acting Chairman. |
| 2003/06 | • <b>Native Plant Propagation Trials</b> - Contact: Kingsley Dixon, Kings Park Botanical Gardens, Jenna Brooker Environmental Consultant.                         |
| 1997/06 | • <b>Plant Mapping</b>  |
| 1997/06 | • <b>Seed, Plant Material and Herbarium Specimen Collection</b>   |
| 1995/06 | • <b>Rehabilitation Courses</b>   |



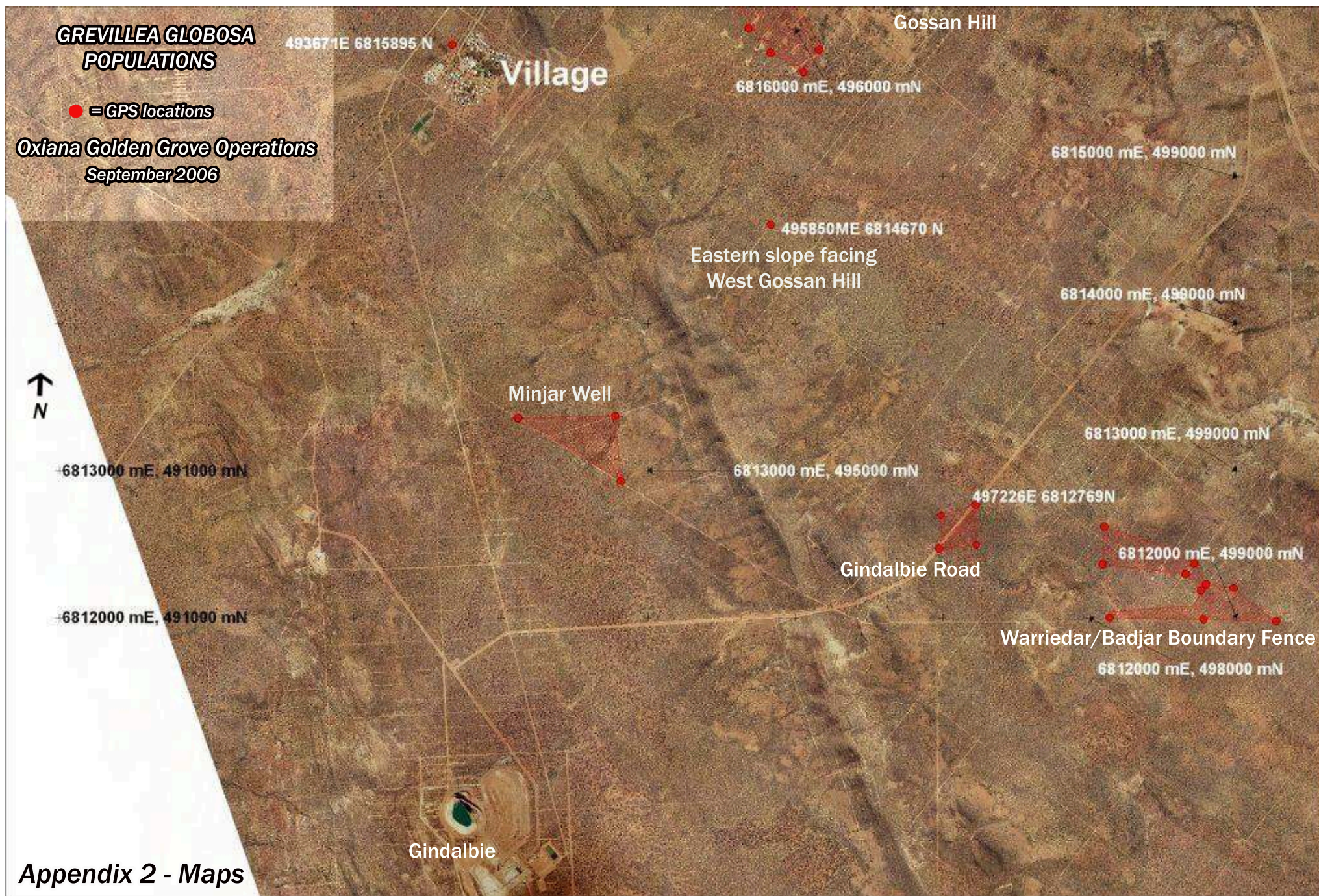
# GREVILLEA GLOBOSA POPULATIONS

● = GPS locations

**Oxiana Golden Grove Operations**  
September 2006









## Appendix B Golden Grove Open Pit Expansion Project Baseline Flora and Vegetation Assessment

**MINERALS AND METALS GROUP LIMITED**

**GOLDEN GROVE OPEN PIT EXPANSION PROJECT**

**BASELINE FLORA AND VEGETATION  
ASSESSMENT**



*August 2013*



**woodmanenvironmentalconsulting**

**A.C.N. 088 055 903**



**DOCUMENT REVISION HISTORY**

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B	Incorporate client comments	KK	CG	10/5/2013	Ben Ryan	13/05/2013
0	Final report	KK			Ben Ryan	15/05/2013
1	Amended CS flora locations	KK	CG	11/6/2013	Natassja Raymond	26/5/2013
2	Final including comments from Coffey	KK	CG	6/8/2013	Natassja Raymond	20/8/2013
3	Final data check	KK	CG	22/8/2013		

Report Number: MMG12-35-01

**DISCLAIMER**

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## EXECUTIVE SUMMARY

MMG owns and operates the Golden Grove mine, which is located approximately 450 km north east of Perth, within the Shire of Yalgoo in Western Australia. The mine currently consists of two underground operations (Scuddles and Gossan Hill) as well as a processing plant, three tailing storage facilities (one active) and associated infrastructure. A new copper oxide open pit mine (Golden Grove Open Pit Project) commenced in January 2012. MMG intends to undertake a new development project at the Golden Grove mine. The Golden Grove Open Pit Expansion Project (the Project) involves the expansion of the existing open pit to mine a combined gold, silver, copper and zinc resource.

MMG commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a Level 2 flora and vegetation survey, as defined by EPA Guidance Statement No. 51 (EPA 2004) to support an impact assessment under the Environmental Protection Act 1986.

This report presents the results of baseline flora and vegetation studies conducted over the Study Area during surveys conducted in October 2012, as well as appropriate historical data relating to conservation significant flora taxa. The Study Area occupies an area of 2,951 ha in size.

The aim of this survey was to describe the flora and vegetation values of the Study Area. The overall objectives of the survey were to:

- Compile an inventory of vascular plant taxa present within the Study Area;
- Record and map locations of conservation significant taxa including Threatened (Declared Rare Flora as defined under the *Wildlife Conservation Act 1950* or the *Environment Protection Biodiversity Conservation Act 1999*) (T-DRF) taxa, Priority Flora taxa (as defined and listed by the Department of Environment and Conservation (DEC)) and other taxa of conservation value such as range extensions, potentially new species to science and taxa of scientific interest that are present within the Study Area;
- Define and map Vegetation Types (VTs) present within the Study Area;
- Define and map vegetation condition within the Study Area; and
- Discuss the local and regional conservation significance of the flora and vegetation of the Study Area.

The tasks undertaken to meet these objectives were:

- Establish floristic quadrats throughout all discernible plant communities within the Study Area;
- Undertake statistical analysis to define VTs within the Study Area;
- Map the distribution of VTs within the Study Area using a combination of aerial photography interpretation and field observation;
- Record locations of conservation significant flora taxa within the Study Area; and
- Prepare a baseline flora and vegetation report and maps, detailing the results of the current survey and incorporating previously collected data on vegetation and conservation significant flora populations.

A total of 114 discrete vascular flora taxa and 2 putative hybrids were recorded within the Study Area in 2012. These taxa represent 26 families and 53 genera. Three conservation significant (Priority) flora taxa were recorded during these surveys, all being of Priority 3 status. No T (DRF) taxa were recorded during surveys in 2012. Targeted surveys for the Threatened flora *Stylidium scintillans* (T) which is known from within the Study Area were not conducted during 2012 as local



populations of this species did not emerge due to the below average rainfall recorded in 2012. A total of eight conservation significant flora taxa (including the Threatened *Stylidium scintillans*) are known to occur within the Study Area, as well as the other specially protected taxon *Santalum spicatum* (Sandalwood). The significance of the local populations of these taxa in terms of their regional conservation were ranked mainly 'Low-Moderate' to 'Moderate' due to the relatively large number of known populations and known ranges. The significance of the local population of *Stylidium scintillans* (T – DRF) was ranked 'High' due to its threatened status. Additional survey following favourable rainfall conditions would provide clear evidence of whether this threatened taxon occurs within any areas of proposed disturbance.

No introduced taxa were recorded during Woodman Environmental surveys in October 2012. A total of 14 introduced flora taxa have been previously recorded within or in close proximity to the Study Area, none of which are listed as Declared Plants within the Shire of Yalgoo.

Statistical analysis of taxon presence/absence data was performed on 175 quadrats, using 182 perennial vascular taxa. This analysis consisted of the inclusion of regional data collected by the DEC to assist in providing regional context. Dissection of the resultant floristic classification of the 175 quadrats defined 13 VTs, which comprise two super-groups. The split between the two super-groups is based primarily on topographical location within the Study Area and the landforms and associated soils, with distinct differences in species composition between the super-groups. Of the 13 VTs defined, seven VTs occur within the study area, these being VTs 3, 4, 9, 10, 11, 12 and 13.

Super-group 1 is comprised of VTs 1 through to 5, of which VT 3 and 4 occur within the Study Area. This group generally consists of vegetation on lower slopes to hill crests, low hills on undulating plains and outwash areas at the base of hills. Super-group 2 is comprised of VTs 6 through to 13, of which VTs 9, 10, 11, 12 and 13 occur within the Study Area. This group generally consisted of vegetation on flats and undulating plains, and slopes on low undulating hills.

The diversity of VTs in the Study Area is considered to be Moderate, with a variety of topographical features, landforms and soil types within the Study Area accounting for this diversity. Many VTs within each super-group are floristically dissimilar, with different overstorey and understory types which are reflective of the particular topographical and landform units. None of the VTs recorded in the Study Area represent any known Threatened Ecological Communities (TECs) as defined under the *Environment Protection Biodiversity Conservation Act 1999* or as defined by the DEC, however VT 4 (from within the Study Area) grouped with quadrats in the regional dataset which described the Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) as described in Markey and Dillon (2008). In addition to this, VT 10 was mapped in very close association with VT 4, can therefore be potentially considered a vegetation complex within Priority Ecological Community (PEC) 13 (as described in Markey and Dillon 2008).

The condition of the majority of vegetation in the Study Area was ranked 'Very Good', with 53.8 % of the Study Area being mapped as this ranking. Vegetation ranked as 'Good' often displayed obvious signs of impact as a result of grazing and trampling from feral goat populations. Vegetation ranked as Poor displayed evidence of disturbance from either mining activities due to their close proximity to current activities and or, more directly, from historic discharge of excess mine water.

# 1. INTRODUCTION

## 1.1 Project and Study Description

Minerals and Metals Group (MMG) Golden Grove Pty Ltd is a subsidiary of MMG Limited which is wholly owned by the Minmetals Resources Limited group of companies. MMG owns and operates the Golden Grove mine, which is located approximately 450 km north east of Perth, within the Shire of Yalgoo in Western Australia. The mine currently consists of two underground operations (Scuddles and Gossan Hill), as well as a processing plant, three tailing storage facilities (one active) and associated infrastructure. A new copper oxide open pit mine (Golden Grove Open Pit Project) also commenced in January 2012. MMG intends to undertake a new development project at the Golden Grove mine. The Golden Grove Open Pit Expansion Project (the Project) involves the expansion of the existing open pit to mine a combined gold, silver, copper and zinc resource.

MMG commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a Level 2 flora and vegetation survey, as defined by EPA Guidance Statement No. 51 (EPA 2004) to support an impact assessment under the *Environmental Protection Act 1986* (EP Act). This level of survey was determined to be appropriate based on a review of Table 2 of Guidance Statement No. 51 (EPA 2004), where the Bioregion Group (Yalgoo Bioregion) is defined as Group 2 and the scale and nature of the impact is considered to have “high” and “moderate” characteristics.

Gossan Hill is located on the privately-owned Badja Station. The Study Area selected for the vegetation and flora survey includes Gossan Hill and surrounding lands covered by lease areas held by MMG. The Study Area itself has an area of 2951.87 ha. The location of the Study Area is presented in Figure 1.

This report provides the combined results and analysis of a field survey of the flora and vegetation of the Study Area conducted in 2012 with flora and vegetation data collected by Woodman Environmental in 2006 and regional flora data collected by the Department of Environment and Conservation in 2005. In addition, the report presents a compilation of previously collected data on the populations of conservation significant flora known from the site. An assessment of impacts of the Project to flora and vegetation is not included as part of this report, but will be addressed in a separate Impact Assessment report.

## 1.2 Aims and Objectives

The aim of this study was to describe the flora and vegetation values of the Study Area. The overall objectives of the survey were to:

- Compile an inventory of vascular plant taxa present within the Study Area;
- Map locations of conservation significant taxa including Threatened (Declared Rare Flora as defined under the *Wildlife Conservation Act 1950* or the *Environment Protection Biodiversity Conservation Act 1999*) (T-DRF) taxa, Priority Flora taxa (as defined and listed by the Department of Environment and Conservation (DEC)) and other taxa of conservation value such as range extensions, potentially new species to science and taxa of scientific interest that are present within the Study Area;
- Define and map Vegetation Types (VTs) present within the Study Area;
- Define and map vegetation condition within the Study Area; and

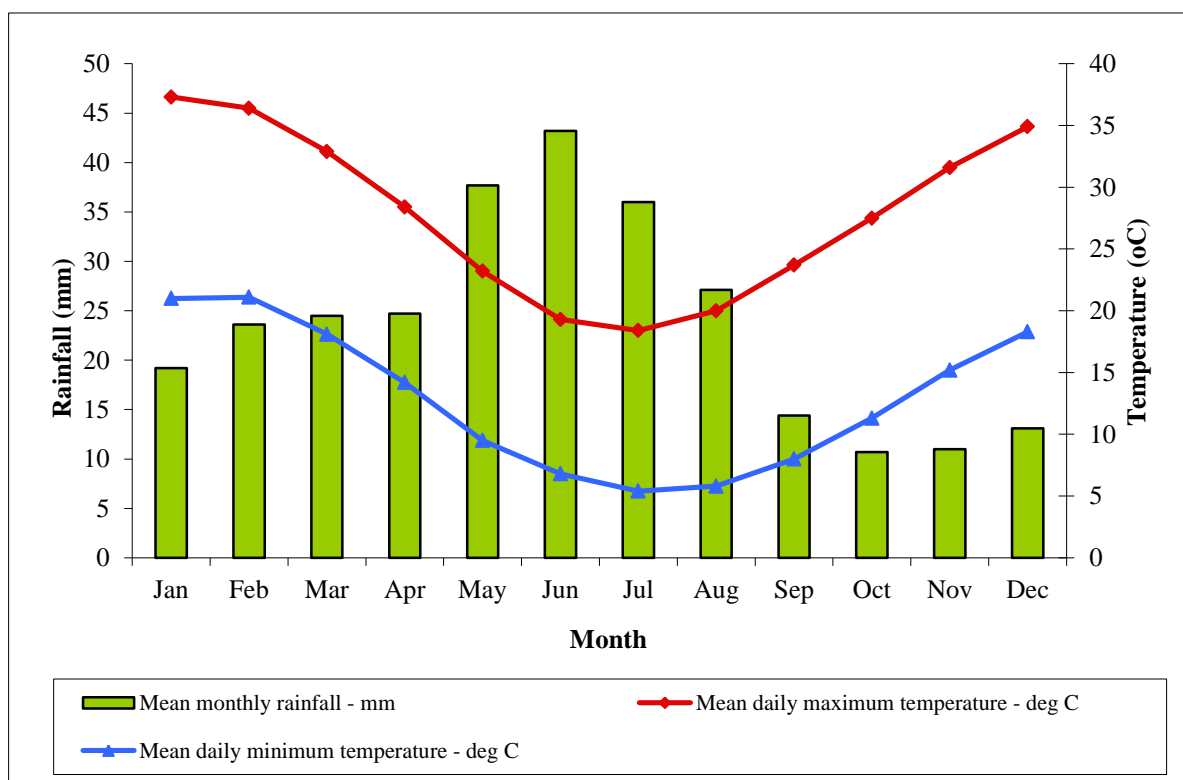
- Discuss the local and regional conservation significance of the flora and vegetation of the Study Area.

## 2. BACKGROUND

### 2.1 Climate

The Study Area lies within the semi - desert, Mediterranean bioclimatic region as described by Beard (1976; 1990), with mild, wet winters and hot, dry summers. Golden Grove has a semi-arid climate with an annual rainfall of approximately 280 mm, however droughts are common, and in high rainfall years the site can experience rainfall in excess of 400 mm. The majority of rainfall occurs between May and August (Figure 2), although heavy rainfall associated with remnants of tropical cyclones off the north - west coast is often experienced in summer months.

Correspondingly, the maximum temperatures are experienced during the summer months, with the minimum temperatures experienced during the winter months (Figure 2).



**Figure 2: Mean Monthly Rainfall (mm) and Mean Daily Maximum and Minimum Temperature (°C) for Paynes Find (Bureau of Meteorology 2013) (temperature data date range 1975 – 2013; rainfall data date range 1919 – 2013)**

### 2.2 Geology, Soils and Landforms

The Study Area is located across six Land Systems as mapped by Payne *et al.* (1998). Gossan Hill itself is located on the Watson land system, with the Kalli land system occurring downslope of Gossan Hill and the Gumbreak, Tallering, Tealtoo and Violet land system occurring beyond these. Table 1 presents the geology, geomorphology and soils of these land systems. Gossan Hill is named after a 'gossan' which is an 'intensely oxidised, weathered or decomposed rock, usually the upper and exposed part of an ore deposit or mineral vein' (Guilbert and Park 1986).

**Table 1: Soils, Geology and Geomorphology of Land Systems of the Gossan Hill Gold Pit Study Area (from Payne *et al.* 1998)**

Land System	Extent in Survey Area (Payne <i>et al.</i> 1998)	Extent in Golden Grove Open Pit Study Area	Geology and Geomorphology	Representative Landforms	Soils
Gumbreak	382,000 ha (0.4 %)	521.99 ha (17.68 %)	Archaean granite and gneiss with Quaternary colluvium and alluvium. Erosional and depositional surfaces; low breakaways with footslopes on pallid zone material upslope of plains with grit and stone mantles and plains of alluvium receiving unchannelled flow.	Breakaways (10 %)  Lower footslopes (15 %) Gritty-surfaced plains (10 %)  Stony saline plains (30 %)  Alluvial plains (30 %)  Drainage lines (5 %)	Stony soils on crests, shallow duplex with a stony mantle on granite on upper footslopes Shallow duplex on granite Shallow coarse red clayey sands on granite Shallow duplex with a stony mantle, on granite Shallow duplex on granite or hardpan Shallow duplex on granite
Kalli	495,400 ha (5.2 %)	644.04 ha (21.82 %)	Quaternary aeolian sand derived from gneiss and granite; local tertiary laterite. Depositional surfaces; residual plateau surfaces with level to gently undulating sand plains high in the landscape, with occasional low linear dunes and exposed duricrust; infrequent drainage features, mostly diffuse and internal but with some broad alluvial tracts with vegetation groves; overall relief to about 20 m.	Sand dunes (<1 %) Sandplains (60 %) Gravelly sandplains (10 %)  Loamy plains (22 %)  Stripped surfaces (3 %)  Alluvial tracts (5 %)	Deep red sands Deep red clayey sands Shallow red clayey sands over ferruginous gravels Sandy red earths and deep red clayey sands Shallow coarse clayey sands over laterite or deeply weathered granite Shallow and deep red earths

Land System	Extent in Survey Area (Payne <i>et al.</i> 1998)	Extent in Golden Grove Open Pit Study Area	Geology and Geomorphology	Representative Landforms	Soils
Tallering	329,000 ha (0.3 %)	406.78 ha (13.78 %)	Archaean banded ironstone formation, dolerite, schist and sedimentary rocks, Cainozoic laterite and colluvium. Erosional surfaces; linear ridges up to 8 km long and low hills and rises with gently inclined footslopes, minor gravelly plains and narrow drainage floors with channels. Relief up to 200m but commonly much less	Ridges and Hills (20 %) Stripped Surfaces (2 %) Hillslopes (58 %)  Stony plains / gravelly plains (10 %)  Narrow drainage tracts (10 %)	Shallow stony red earths Stony soils Shallow red earths and stony red earths Shallow stony red earths and red clayey sands with ferruginous gravel Deep red clayey sands
Tealtoo	693,000 ha (0.7 %)	393.04 ha (13.31 %)	Quaternary sands, Cainozoic alluvial and colluvial deposits and Tertiary ferruginated profiles. Depositional surfaces; level plains and sandy tracts with gravelly mantles and alluvial plains receiving more concentrated flow	Stony plains (10 %)  Gravelly plains / loamy plains (60 %)  Gravelly hardpan plains (20 %)  Gravelly sand sheets (8 %)  Alluvial plains (2 %)	Shallow red earths on ironstone gravel or parent rock Deep red earths on ironstone gravel or hardpan at variable depth Shallow hardpan loams or red earths on hardpan Shallow red clayey sands with ferruginous gravel on hardpan or gravel Deep red earths



Land System	Extent in Survey Area (Payne <i>et al.</i> 1998)	Extent in Golden Grove Open Pit Study Area	Geology and Geomorphology	Representative Landforms	Soils
Violet	882,000 ha (0.9 %)	468.5 ha (15.87 %)	Archaean greenstone and basalt, Tertiary ferruginous duricrust and Quaternary sand, colluvium, eluvium and minor cemented alluvium. Erosional surfaces; level to gently inclined plateaux as gravelly sandplains above gently undulating rises of laterite material and weathered greenstones; level to gently undulating plains with mantles of abundant ironstone and quartz pebbles and cobbles and level to gently inclined lower plains subject to sheet flow and with mantles of fine ironstone pebbles; sparse, sluggish, occasionally channelled drainage floors; relief mostly < 10 m	Low rises (15 %) Gravelly sandy plains (20 %)  Stony plains / saline stony plains (35 %) Stony or gravelly hardpan plains (20 %)  Narrow drainage tracts (10 %)	Shallow red earths and stony soils on gravel Shallow red clayey sands with ferruginous gravel or shallow hardpan loams Shallow red earths on greenstone Stony soils or shallow red earths over ferruginous gravel or hardpan Deep red earths
Watson	155,000 ha (0.2%)	517.53 ha (17.53 %)	Archaean fine grained sedimentary rocks, schist and some felsic volcanics, Quaternary colluvium and lateritic gravel. Erosional surfaces; hills and stony upper slopes, gently undulating rises and gently inclined lower colluvial slopes grading downslope to almost level, gravelly plains; narrow drainage tracts; relief occasionally to 140 m but usually much less	Hill crests (20 %)  Hillslopes (40 %)  Low rises (15 %)  Gravelly plains / stony plains (20 %)  Drainage floors (5 %)	Rock outcrop and stony mantle, pockets of shallow stony soils; Very shallow red earths on parent rock or gravel; Very shallow coarse red clayey sands on granite; Shallow hardpan loams or red earths over hardpan or gravel; Juvenile soils of variable depth or shallow red earths

## 2.3 Regional Vegetation

The Study Area is located within the Yalgoo Region of the Interim Biogeographic Regionalisation for Australia (IBRA) (Environment Australia 2006). This region is described as an interzone between the South - western and Murchison Bioregions, characterised by low to open woodlands of Eucalyptus, Acacia and Callitris on red sandy plains of the Western Yilgarn Craton and southern Carnarvon Basin. The region is characterised by Mulga (*Acacia aneura*), Callitris, *Eucalyptus salubris*, and Bowgada (*Acacia ramulosa*) Open Woodlands and Scrubs on earth to sandy - earth plains in the western Yilgarn Craton.

The Study Area is located within the Yalgoo Subregion of the Austin Botanical District of the Eremaean Botanical Province (Beard 1990), in which the vegetation is generally Eremaean in character, however mulga distribution and density decreases in a south - westerly direction, and is replaced by other Acacia species. This subregion equates to the Yalgoo Bioregion as described by Thackway and Creswell (1995) and forms a transition between the Eremaean Province and the biodiverse South - west Botanical Province (Beard 1990).

Beard (1976) mapped the vegetation of the Austin Botanical District at a scale of 1:1 000 000 where communities were defined by physiognomy and dominant taxa. The Austin Botanical District is dominated by Low Mulga Woodlands on the plains, and reduced to Acacia Scrub on hills (Beard 1976). The hill vegetation is composed of shrublands dominated by *Acacia aneura*, *Acacia quadrimarginea*, *Acacia ramulosa* and *Acacia grasbyi* over a midstratum of Senna and Eremophila shrubs, with little difference being noted between communities on granitoids and metamorphic sedimentary rocks at this scale (Beard 1976).

Shepherd *et al.* (2002) mapped and described vegetation system associations related to physiognomy, expanding on mapping undertaken by Beard (1976). Vegetation associations were described at a scale of 1:250,000. The Study Area contains two vegetation system associations which are summarised in Table 2. Both vegetation system associations are currently at close levels to their pre-European extents, however little is reserved in lands of IUCN Category 1 – 4 rankings.

**Table 2: Vegetation Associations within the Study Area (Shepherd *et al.* 2002; Government of Western Australia 2011)**

Vegetation Association	Description	Current Extent (ha)	Percentage of Pre-European Extent Remaining	Percentage of Current Extent Reserved in IUCN 1 - 4	Percentage of Current Extent Reserved in DEC-Managed Lands
Yalgoo_202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub	45001.10	99.81	0.0	40.17
Yalgoo_420	Shrublands; bowgada & jam scrub	102441.00	100.00	0.0	4.86

The Study Area is located on six land systems as mapped by Payne *et al.* (1998), these being the Gumbreak, Kalli, Talling, Tealtoo, Violet and Watson Land Systems. The hillcrests are dominated by moderately dense, tall Shrublands of *Acacia ramulosa* and other *Acacia* species, whereas the hillslopes are dominated by moderately dense tall Shrublands of *Acacia ramulosa* with *Eremophila* spp. and *Thryptomene* spp. low shrubs (Payne *et al.* 1998). Table 3 presents a description of the types of vegetation found in each of these land systems.

**Table 3: Description of Vegetation occurring within the Land Systems of the Study Area (Payne *et. al.* (1998))**

Land System	Vegetation Description
Gumbreak	<ul style="list-style-type: none"> <li>• Low heath shrublands on plateaux; scattered halophytic low shrublands on upper footslopes;</li> <li>• Halophytic low shrublands, common species including <i>Atriplex vesicaria</i>, <i>Maireana</i> spp. and <i>Frankenia</i> spp.; occasionally scattered eucalypt woodlands with <i>Atriplex</i> spp. understoreys;</li> <li>• Mixed shrublands, often with <i>Acacia quadrimarginea</i>;</li> <li>• <i>Maireana</i> spp. low shrublands;</li> <li>• Halophytic low shrubland commonly with <i>Maireana pyramidata</i> dominant and occasionally with eucalypt overstorey;</li> <li>• <i>Acacia aneura</i> tall shrublands with mixed halophytic and non-halophytic low shrubs</li> </ul>
Kalli	<ul style="list-style-type: none"> <li>• <i>Acacia</i> shrublands; tall shrublands of <i>Acacia ramulosa</i> and <i>A. coolgardiensis</i> with wanderrie grasses; occasional mallees and <i>Callitris glaucophylla</i>;</li> <li>• Mixed height shrublands of <i>Acacia</i> spp., myrtaceous low shrubs and <i>Amphipogon caricinus</i>;</li> <li>• Tall Shrublands of <i>Acacia aneura</i> and <i>A. ramulosa</i> with scattered wanderrie grasses;</li> <li>• <i>Acacias</i>, <i>Eremophilas</i>, and <i>Thryptomene decussata</i> and other myrtaceous shrubs;</li> <li>• Tall shrublands or woodland of <i>A. aneura</i> and <i>A. ramulosa</i> in groves; <i>Acacia</i> tall shrublands</li> </ul>
Tallering	<ul style="list-style-type: none"> <li>• Tall shrublands of <i>Acacia ramulosa</i> and other <i>Acacias</i> with undershrubs such as <i>Thryptomene</i> and <i>Philotheca</i> spp.;</li> <li>• Very scattered mixed height shrublands with <i>Acacia ramulosa</i> and well developed non-halophytic understoreys;</li> <li>• Tall shrublands of <i>Acacia ramulosa</i> and other <i>Acacias</i> with understorey of</li> <li>• <i>Eremophila</i> spp., <i>Ptilotus obovatus</i>, <i>Thryptomene</i> and <i>Philotheca</i> spp.</li> <li>• Tall shrublands of <i>Acacia ramulosa</i> and other <i>Acacias</i> with <i>Eremophila forrestii</i> and <i>Ptilotus obovatus</i></li> </ul>
Tealtoo	<ul style="list-style-type: none"> <li>• <i>Acacia</i> tall shrublands;</li> <li>• <i>Acacia</i> tall shrublands with <i>Acacia aneura</i> and <i>A. ramulosa</i> or Eucalypt mallee overstorey or <i>Allocasuarina eriochlamys</i> subsp. <i>eriochlamys</i> – <i>Acacia coolgardiensis</i> tall shrublands with low and mid myrtaceous shrubs;</li> <li>• <i>Acacia</i> tall shrublands including <i>A. aneura</i>, <i>A. ramulosa</i>, <i>A. linophylla</i> and <i>A. acuminata</i> subsp. <i>burkittii</i>;</li> <li>• <i>Acacia</i> tall shrublands with mallee Eucalypts, understory species include <i>Prostanthera</i>, <i>Phebalium</i> and <i>Mirbelia</i>;</li> <li>• <i>Acacia</i> tall shrublands with <i>Eucalyptus loxophleba</i> overstorey and <i>Atriplex bunburyana</i> understorey or <i>Acacia</i> tall shrublands</li> </ul>
Violet	<ul style="list-style-type: none"> <li>• <i>Acacia aneura</i> tall shrublands;</li> <li>• Tall Shrublands of <i>Acacia aneura</i> and <i>A. ramulosa</i> with sparse wanderrie grasses;</li> <li>• <i>Acacia aneura</i> tall shrublands or <i>Ptilotus</i> spp. low shrublands, also scattered <i>Acacia</i> tall shrublands with halophytic low shrubs;</li> <li>• <i>Acacia aneura</i> and <i>A. ramulosa</i> tall shrublands, occasional <i>A. aneura</i> shrublands in groves;</li> <li>• <i>Acacia aneura</i> tall shrublands or woodlands with very sparse understoreys</li> </ul>
Watson	<ul style="list-style-type: none"> <li>• Tall shrublands of <i>Acacia ramulosa</i> and other <i>Acacias</i>;</li> <li>• Tall shrublands of <i>A. ramulosa</i> with <i>Eremophila</i> and <i>Thryptomene</i> spp. low shrubs;</li> <li>• Tall shrublands of <i>A. ramulosa</i></li> </ul>

The Department of Environment and Conservation (DEC) initiated a regional study of the vegetation of the Banded Ironstone Formations (BIF) of the Yilgarn Craton. The objective of the study was to describe the floristic associations of the ranges in order to provide a regional context within which proposed impacts from mining projects could be placed in a regional conservation context.

The ranges of the Central Tallering Land System (as mapped and described by Payne *et. al.* 1998) were studied as a part of this project, including the BIF and metasedimentary ranges from Karara Station to the Gnows Nest Range, including Minjar (Markey and Dillon 2008). The surveys were conducted from September to October 2005 within this area. The study was originally intended to

include both Gossan Hill and the southern Gnows Nest Range (A. Markey *pers. comm.*), however due to time and access difficulties no studies were conducted at Gossan Hill.

Subsequent survey of the Yalgoo area (north of the Central Talling area), including the Gnows Nest Range north of Golden Grove by Markey and Dillon during 2007 (Markey and Dillon *in prep.*) found clear differences in the floristic community types recorded for the lower and more eroded Gnows Nest Range than for the Central Talling ranges, with notable species such as *Micromyrtus trudgenii* and *Drummondita fulva* missing from the Gnows Nest Range. The Gnows Nest Range also lacked the *Eucalyptus* and *Callitris* Woodlands of the flats areas in the Central Talling Study Area, which are also significant features of the Golden Grove site. Given this, although the Study Area is located on a different land system to that targeted by Markey and Dillon (2008), similarities in the vegetation, presence of ironstone and relief between Gossan Hill and areas targeted for survey by Markey and Dillon within the Central Talling Land System make it appropriate for comparisons to be made between the two areas. However, it is important to note that Gossan Hill is not composed of BIF.

The 2005 Central Talling survey involved the establishment of 103, 20m x 20m quadrats on the crests, slopes and peneplains of the central portion of the Talling Land System (Markey and Dillon 2008). Quadrat data was analysed statistically using three separate statistical packages to determine floristic community types. A total of 414 taxa were recorded from this survey, which included the ironstone hills, ridges and uplands within the region bounded by Mt Karara, Pinyalling Hill and Minjar Hill.

The statistical analysis grouped the taxa into eight floristic community types (FCT) and subtypes, of which one was recorded at Minjar (closest in proximity to the Study Area), this was:

FCT 3: Sparse shrublands on crests and slopes, located on Badja station and the crest of Windanning Ridge (Mungada Ridge); indicator species including *Stylidium longibracteatum*, *Micromyrtus trudgenii* and *Calytrix uncinata*, as well as *Astroloma serratifolium*, *Eremophila glutinosa* and *Melaleuca hamata* amongst others.

FCT 3 (as described in Markey and Dillon 2008) is a component of the Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) at Minjar and in the Gnows Nest Range (Markey and Dillon *in prep.*). This is a Priority 1 ranked PEC (Appendix A).

## 2.4 Regional Flora

A search of the WAHerb specimen database for records of flora specimens (including conservation significant taxa) collected within the Study Area and surrounds was performed using the online tool NatureMap (DEC 2013b). The limits of this search area were:

116°55' 05" E, 116°59' 42" E, 28°48' 06" S, 28°43' 13" S

A total of 67 flora taxa were returned from this search, including five Priority flora taxa and one Threatened (DRF) taxon:

- *Stylidium scintillans* (T – DRF)
- *Calytrix uncinata* (P3)
- *Grevillea globosa* (P3)
- *Micromyrtus trudgenii* (P3)

- *Polianthion collinum* (P3)
- *Acacia speckii* (P4)

A total of two introduced flora taxa were also returned from this search:

- *Cuscuta epithymum* (Lesser dodder)
- *Hypochaeris glabra* (Smooth Cats ear)

Appendix B presents the conservation codes for Western Australian flora.

A search of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Protected Matters Search Tool (PMST), with regard to environmental matters of national significance as listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), was performed for the Study Area (DSEWPC 2013). The results of this search did not return any threatened flora taxa (under the EPBC Act) known to, likely to or have habitat known or likely to occur in the Study Area.

The results of the PMST search indicated that one significant invasive flora taxon, or habitat for this taxon, is likely to occur within the Study Area: *Cenchrus ciliaris* (Buffel Grass). *C. ciliaris* is not listed as a Declared Plant under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) in Western Australia (Department of Agriculture and Food 2013) but is considered by the States and Territories to pose a particularly significant threat to biodiversity, as it is well known to be particularly invasive under certain conditions (Hussey *et. al.* 2007; DSEWPC 2013).

In Western Australia, *Cenchrus ciliaris* is listed under the then - Department of Conservation and Land Management's (CALM) (now DEC) Environmental Weed Strategy for Western Australia (CALM 1999). The environmental impact on biodiversity of this species was ranked as 'High', in relation to rankings of three criteria (invasiveness, distribution and environmental impact). Appendix C provides descriptions of each rating in the Environmental Weed Strategy for Western Australia.

## 2.5 Local Flora and Vegetation

Various surveys by different consultants have been undertaken within and surrounding the Study Area, and each survey has added to the knowledge of the vegetation and flora in the area. These surveys have included both mapping of vegetation units and surveys for conservation significant and other flora taxa. These studies are listed below:

- Mattiske Consulting Pty Ltd (1996)
- Mattiske Consulting Pty Ltd (1997)
- Mattiske Consulting Pty Ltd (2004)
- Outback Ecology (2004)
- Dryland Permaculture Nursery and Research Farm (2006)
- Woodman Environmental Consulting Pty Ltd (2007a)
- Woodman Environmental Consulting Pty Ltd (2007b)
- ENV Australia (2008)
- Markey and Dillon (2008)
- Woodman Environmental Consulting Pty Ltd (2008)
- Yilgarn Traders (2008)
- Woodman Environmental Consulting Pty Ltd (2009)

- Yilgarn Traders (2009)
- Yilgarn Traders (2010)
- Yilgarn Traders (2011)

### 2.5.1 Local Vegetation

Historical vegetation type mapping within the Golden Grove lease area has been confined to structural vegetation mapping. Some limited plot establishment and statistical analysis of floristic data has been undertaken, however vegetation type mapping to a standard expected under a Level 2 flora and vegetation assessment (see Section 1) has not been conducted. The results of the previous local vegetation mapping surveys are summarised below.

Mattiske Consulting (1996) conducted a flora and vegetation survey of the Golden Grove minesite area in 1996. This included mapping of plant community boundaries using aerial photography, ground - truthing boundaries and conducting detailed site assessments. A total of 200 plant taxa, from 115 genera and 45 families were recorded within the area surveyed (Mattiske Consulting 1996). Ten species of introduced taxa and two Priority flora were recorded, these priority flora being *Grevillea globosa* (P3) and *Prostanthera magnifica* (P4). *Prostanthera magnifica* is no longer listed as conservation significant.

Fourteen plant communities, grouped into *Eucalyptus* Woodlands, *Acacia* Woodlands, Shrublands and Heaths, were described and mapped over the survey area by Mattiske Consulting (1996).

The plant communities described and mapped by Mattiske Consulting (1996) are presented in Appendix D:

Nine permanent quadrats were established by Woodman Environmental over Gossan Hill and two adjoining gossans in August 2006 (Woodman Environmental 2007a). A total of 53 plant taxa were recorded from within these quadrats, 31 of which occurred within the three quadrats established on Gossan Hill. Three priority flora species were recorded during this survey: *Calytrix uncinata* (P3), *Micromyrtus trudgenii* (P3) and *Polianthion collinum* (P3). *Drummondita* affin. *microphylla* (R. Cranfield 8586A), which was identified as a species of interest by Markey and Dillon (2008), was recorded within two quadrats on Gossan Hill, and on both of the other gossans on which quadrats were established. This has since been named as *Drummondita fulva* and been given a conservation ranking of P3.

Floristic data from the nine quadrats that were established were analysed in conjunction with the Central Tallering Dataset (Markey and Dillon 2008). All nine quadrats established by Woodman Environmental grouped into Markey and Dillon FCT 3.

Yilgarn Traders conducted vegetation association mapping studies within the Gossan Hill area during May, June and July 2008 (Yilgarn Traders 2008). A total of 86 plant taxa were collected which is a relatively low number for the area, possibly reflecting the timing of the survey. Five current priority species were recorded during this survey, *Calytrix uncinata* (P3), *Drummondita fulva* (P3), *Grevillea globosa* (P3), *Micromyrtus trudgenii* (P3) and *Polianthion collinum* (P3). A total of 16 vegetation associations were defined and mapped within the survey area, relating to the topography and landform upon which they were located. These vegetation associations are presented in Appendix D.

Forty nine quadrats were established by Yilgarn Traders within the MMG Golden Grove Mining Leases in 2011 (Yilgarn Traders 2011). A total of 242 taxa including six introduced taxa belonging



to 52 families were recorded during this survey. Eight taxa recorded were listed as conservation significant: *Stylidium scintillans* (T), *Calotis* sp. Perrinvale Station (R.J. Cranfield 7096) (P3), *Calytrix uncinata* (P3), *Drummondita fulva* (P3), *Grevillea globosa* (P3), *Gunniopsis propinqua* (P3), *Gunniopsis rubra* (P3) and *Micromyrtus trudgenii* (P3).

A site / species matrix was used to group quadrats and transects on the basis of like suites of the dominant and indicator species, species frequency, structural height and cover (Yilgarn Traders 2011). A total of 16 plant communities were subsequently described by Yilgarn Traders, as presented in Appendix D.

## 2.5.2 Local Conservation Significant Flora Taxa

In total, eleven conservation significant flora taxa are known to occur within or in close proximity to the Study Area (Table 4). This list has been compiled from historical flora surveys undertaken within and in the immediate vicinity of the Study Area, including those listed in Section 2.4 and 2.5.

**Table 4: Conservation Significant Flora Taxa Recorded Within or in Close Proximity to the Study Area**

Taxon	Cons. Status	Description (DEC 2013a)	Source
<i>Stylidium scintillans</i>	T – DRF Extant	Cormaceous ephemeral herb 3 to 9 cm high. Fl. white with red-pink throat markings, Aug to Sept. Decaying granite outcropping, breakaway and granitic flats. Brown, rocky-stoney gritty clay loam	Woodman Environmental Consulting (2009) Yilgarn Traders (2011) DEC (2013b)
<i>Calotis</i> sp. Perrinvale Station (R.J. Cranfield 7096)	P3	Prostrate annual herb, Fls August to September. Pink and white clay, skeletal orange brown sandy clay loam soils, Slopes of BIF outcropping and granite outcropping,	Yilgarn Traders (2011)
<i>Calytrix uncinata</i>	P3	Shrub, 0.3-1 m high. Fl. white, Aug to Nov. White or red sand, sandy clay. Granite or sandstone breakaways, rocky rises	Mattiske Consulting(2004) Woodman Environmental Consulting (2007a) Woodman Environmental Consulting (2007b) Yilgarn Traders (2008) Yilgarn Traders (2010) Yilgarn Traders (2011) DEC (2012b)
<i>Drummondita fulva</i>	P3	Erect, branching shrub, 0.5-1.5 m high. Skeletal, shallow, acidic soils of orange-red or red-brown sandy loams and clayey silts. Footslopes, lower to upper slopes and hillcrests.	Markey and Dillon (2008) Woodman Environmental Consulting (2007a) Woodman Environmental Consulting (2007b) Woodman Environmental Consulting (2008a) Yilgarn Traders (2008) Yilgarn Traders (2011)
<i>Grevillea globosa</i>	P3	Spreading, non-lignotuberous shrub, 1-3 m high. Fl. cream & white & green/red-brown, Jan or Jun or Nov. Red loam, yellow sand	Mattiske Consulting (1996) Mattiske Consulting (2004) Mattiske Consulting (1997) Dryland Permaculture (2006) Yilgarn Traders (2008) Yilgarn Traders (2010) Yilgarn Traders (2011) DEC (2013b)

Taxon	Cons. Status	Description (DEC 2013a)	Source
<i>Gunniopsis propinqua</i>	P3	Prostrate annual or perennial, herb, 0.03-0.1 m high. Fl. white/pink, Aug to Sep. Stony sandy loam. Lateritic outcrops, winter-wet sites	Yilgarn Traders (2011)
<i>Gunniopsis rubra</i>	P3	Prostrate annual, herb, 0.01-0.03 m high. Fl. green, Sep. Sandy loam.	Yilgarn Traders (2011)
<i>Micromyrtus trudgenii</i>	P3	Erect, open shrub, 1-2 m high. Red-brown loamy clay, yellow-brown soils, gravel, siltstone, quartz, basalt, banded ironstone, dolerite. Tops and slopes of hills and ridges	Mattiske Consulting (1996) (recorded as <i>Micromyrtus racemosa</i> var. <i>racemosa</i> , now thought to be <i>Micromyrtus trudgenii</i> ) Mattiske Consulting (2004) Woodman Environmental Consulting (2007a) Woodmen Environmental (2007b) Yilgarn Traders (2008) Yilgarn Traders (2010) Yilgarn Traders (2011) DEC (2013b)
<i>Persoonia pentasticha</i>	P3	Erect, spreading shrub, 0.4-1.8 m high. Fl. yellow, Aug to Nov. Sand, loam. Base of granite outcrops.	Mattiske Consulting (1996) (not Priority at the time of survey, no location data available)
<i>Polianthion collinum</i>	P3	Rounded shrub, to 1.25 m high. Fl. white-cream, May to Jul. Red clay loam between blocks of banded ironstone. Low hills and slopes	Mattiske Consulting (2004) Woodman Environmental Consulting (2007a) Outback Ecology (2004) Yilgarn Traders (2008) DEC (2013b)
<i>Acacia speckii</i>	P4	Bushy, rounded shrub or tree, 1.5-3 m high. Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	Yilgarn Traders (2009) DEC (2013b)

### 2.5.3 Local Introduced Flora Taxa

A total of thirteen introduced flora taxa are known to occur within the Study Area, with another taxon also known from locations nearby (Table 5). This list has been compiled from flora surveys undertaken within and in the immediate vicinity of the Study Area and DEC database information.

**Table 5: Introduced Flora Recorded Within or in Close Proximity to the Study Area**

Taxon	Description (DEC 2013a; Hussey <i>et al.</i> 2007)	Environmental Weeds Rating (CALM 1999)	Source
<i>Cirsium vulgare</i> (Spear Thistle)	Spiny biennial, herb, 0.05-1.5(-3) m high with purple-red flowers and flowers from January to December; a widespread weed of disturbed bushland and roadsides and farmland and occurs from Geraldton to Esperance and is most common near the south coast	Moderate	Mattiske Consulting (1996)
<i>Cuscuta epithymum</i> (Lesser Dodder)	Parasitic, twining annual herb or climber with white flowers from August to December; located on sandy soils over limestone or granite	Moderate	DEC (2013b) (Note: known from locations in close proximity to the Study Area only)
<i>Cuscuta planiflora</i> (Small Seeded Dodder)	Parasitic, twining annual with white flowers and flowers from September to October and is a parasitic plant on ephemerals; a widespread weed and occurs from Shark Bay to the eastern goldfields	To Be Advised	Yilgarn Traders (2011)

Taxon	Description (DEC 2013a; Hussey <i>et al.</i> 2007)	Environmental Weeds Rating (CALM 1999)	Source
<i>Emex australis</i> (Doublegee)	Prostrate annual, herb with green flowers and flowers from January to December; a widespread agricultural and wasteland weed throughout the south-west (Hussey <i>et al.</i> 2007).	Low	Mattiske Consulting (1996)
<i>Hypochaeris glabra</i> (Smooth Catsear)	Rosetted annual or perennial, herb, which grows to 0.08-0.5 m high, with smooth leaves and yellow flower heads up to 1.5 cm across during spring and early summer; a widespread weed throughout the south-west and is a common weed of lawns	Moderate	Mattiske Consulting (1996) DEC (2013b)
<i>Lolium rigidum</i> (Wimmera ryegrass)	Erect or spreading annual, grass-like or herb, and grows up to one metre in height. Flowers are green-yellow and flowers from September to November; a common widespread weed from Shark bay to Esperance and is a major cause of hayfever	Moderate	Mattiske Consulting (1996)
<i>Mesembryanthemum nodiflorum</i> (Slender iceplant)	Prostrate or erect, succulent annual, herb, to 0.2 m high with white flowers and flowers from September to November; a very widespread weed of saline soils and of granite rocks in arid areas, salt lake margins and off shore islands from Carnarvon to Eucla	Not listed	Yilgarn Traders (2011)
<i>Pentameris airoides</i> (False Hairgrass)	Annual to 15cm tall which flowers in spring. It is a common and widespread weed of granite rocks, woodlands, shrublands and disturbed sites from Carnarvon to Kalgoorlie and Balladonia	Moderate	Yilgarn Traders (2011); Mattiske Consulting (1996)
<i>Parentucellia latifolia</i> (Common Bartsia)	Erect annual, herb, to 0.4 m high with red-purple/white flowers and flowers from August to December; widespread through wetlands, woodlands and granite rocks throughout the south-west	Moderate	Yilgarn Traders (2011)
<i>Raphanus raphanistrum</i> (Wild Radish)	Erect Annual, herb, to 1 m high with yellow-white/pink flowers and flowers from April to May or July to November; a very common agricultural, horticultural and roadside weed from Geraldton southwards	Mild	Mattiske Consulting (1996)
<i>Sisymbrium orientale</i> (Indian Hedge Mustard)	Erect annual or biennial, herb, to 1 m high with yellow flowers and flowers from March to November; a widespread weed of the wheatbelt and is found in grazed woodlands on the Swan Coastal plain and is spreading along roadsides and disturbed areas in the arid zone	Moderate	Mattiske Consulting (1996)
<i>Sonchus oleraceus</i> (Common Sowthistle)	Erect annual, herb, to 1.5 m high with yellow flowers and flowers from January to December; it is a widespread on roadsides, gardens, market gardens and wastelands in all parts of the state, but most common on the south-west	Moderate	Yilgarn Traders (2011); Mattiske Consulting (1996)
<i>Spergula pentandra</i> (Five Anther Spurry)	Spreading annual, herb, to 0.3 m high with white flowers and flowers from May to October; it is found through the Murchison, Yalgoo area and northern wheatbelt	To Be Advised	Yilgarn Traders (2011)
<i>Vulpia myuros</i> var. <i>megalura</i>	Tufted annual, grass-like or herb, to 0.7 m high; it has green flowers and flowers from July to November; a very widespread weed of cereal crops, pastures, revegetation area and many other vegetation types throughout southern Western Australia, from Shark bay to Esperance	Moderate	Mattiske Consulting (1996)

None of these introduced taxa are listed as Declared Pests (within the Shire of Yalgoo) under the BAM Act (Department of Agriculture & Food 2012), nor are they listed as Weeds of National Significance (Australian Weeds Committee 2012).

### 3. METHODS

#### 3.1 Personnel and Licensing

Table 6 lists the personnel involved in both fieldwork and plant identifications for the field survey conducted in 2012. All senior personnel have had previous field experience in the Midwest, with personnel involved in plant identifications having extensive taxonomic experience with the flora of the Midwest. All plant material was collected by personnel holding current DEC Flora Collecting Permits / Permit to Take T-DRF (pursuant to *Wildlife Conservation Act 1950* Section 23C and Section 23F) as listed in Table 5.

**Table 6: Personnel and Licensing Information**

Personnel	Role	Flora Collecting Permit / Permit to take T-DRF
Bethea Loudon	Senior Botanist	SL009953 / 150-1112
Sharnya Thomson	Botanist / Plant Identification	SL 010159
Samantha Gray	Botanist	N/A
Peter Malajczuk	Botanist	N/A
Frank Obbens	Plant Identifications	N/A

N/A = not applicable

#### 3.2 Initial Aerial Photography Interpretation

Initial interpretation of structural vegetation boundaries was conducted with the use of orthorectified aerial photography at a scale of 1:15,000, supplied to Woodman Environmental by MMG. Preliminary vegetation type (VT) boundaries were transcribed onto the aerial photography, to allow for ground-truthing of these boundaries to be conducted in the field. Preliminary quadrat locations were also allocated based on these VT boundaries. Aerial photography utilised during the mapping was taken in 2010, prior to clearing as part of the Golden Grove Open Pit Project. Impact assessment as part of that project utilised plant community mapping undertaken in 1996 (Mattiske Consulting 1996); mapping as part of this project

##### 3.2.1 Detailed Field Survey

A total of 63 flora survey quadrats were established within the Study Area during one field trip totalling 5 days (10 team days) from the 22<sup>nd</sup> to 26<sup>th</sup> October 2012. Quadrat locations are shown on Figures 4.1 – 4.3 and presented in Appendix G.

The Study Area was accessed by vehicle where possible, using available tracks and public roads, and also traversed on foot.

##### 3.2.2 Quadrat Establishment

Quadrats were established and assessed in accordance with the methods contained in DEC (2009). All quadrats measured 20 m by 20 m. This quadrat size corresponds to that used during the DEC's Central Tallering Survey (Markey and Dillon 2008), and is the standard size recommended for use in Midwest flora and vegetation surveys. Quadrats were established in all vegetation types (VTs) identified from interpretation of aerial photography with additional quadrats allocated to potentially different VTs identified during the field studies. The number of quadrats within each identified VT was determined based on the size of the area covered by the VT, and the potential species richness

of each plant community. The survey attempted to establish at least 3 quadrats in each separate VT with quadrats established across the range of larger VTs to more fully sample variation within these units.

All quadrats established were non-permanent, and were demarcated during the survey by the use of measuring tapes to define the boundary of each quadrat. The quadrats were orientated north-south-east-west, with the bearings of each side recorded for any quadrats that could not be established in this fashion. All vascular taxa that were visually identifiable within each quadrat were recorded, and collected as necessary. The following information was recorded at each quadrat:

- Personnel
- Unique quadrat number
- Date of survey
- GPS coordinates (GDA94), and location at quadrat where coordinates were recorded
- Quadrat photograph
- Topography (including landform type and aspect)
- Soil colour and type (including the presence of any rock outcropping and surface stones)
- Vegetation condition (using the scale adapted from Keighery (1994), and displayed in Appendix E)
- Approximate time since fire
- Presence of disturbance (if any)
- Percentage foliage cover (for each species)
- Height (m) (for each species, excluding climbers/aerial shrubs)

Additional flora taxa were also recorded opportunistically via a search around the general vicinity of each quadrat, during traverses on foot between quadrats and while driving along tracks.

### 3.3 Plant Collection and Identification

Specimens of any unknown taxa, or taxa unable to be completely identified in the field, were collected and pressed for later identification at the WAHerb. Identifications were undertaken by experienced taxonomists Sharnya Thomson and Frank Obbens, with experts in particular families or genera consulted for any specimens considered to be of taxonomic interest. Species nomenclature follows *FloraBase* (DEC 2013b) with all names checked against the current DEC Max database to ensure their validity. The conservation status of each species was checked against *FloraBase* (DEC 2013b), which provides the most up-to-date information regarding the conservation status of flora taxa in Western Australia.

Priority Flora taxa and any other specimens of interest (for example range extensions, unusual characteristics) will be vouchered at the WAHerb at the conclusion of the Project. Threatened and Priority Flora Report Forms (TPFRF) will be submitted to the DEC for all populations of Priority Flora taxa at the conclusion of the project.

### 3.4 Statistical Analysis

Quadrat data only was statistically analysed to aid in the determination of VTs, using methods similar to those used by Markey & Dillon (2008). A total of 175 quadrats were included in the analysis. These quadrats were compiled from the following surveys:

- 103 quadrats from Markey & Dillon (2008);
- 9 quadrats from Woodman Environmental Consulting (2007a); and



- 63 quadrats from the 2012 Woodman Environmental Consulting survey.

Classification and ordination analyses were conducted on a data matrix compiled from the quadrat data, with introduced taxa, putative hybrids, opportunistic recordings (i.e. those taxa recorded outside of the quadrat), ephemeral (short-lived) taxa and singletons (taxa recorded only once in the quadrat dataset) excluded from the analysis. Various taxa were grouped together within the data matrix for the analysis where taxonomy was unclear or where different infra - taxa were identified within the dataset and not correlated to plant community, landform or soil type. Some taxa were omitted from the analysis as they could not be positively identified due to inadequate material (Appendix I).

Pattern analysis was conducted using PATN (V3.03) (Belbin 1989). The Bray - Curtis coefficient was used to generate an association matrix for both the classification and ordination analyses. This association matrix consisted of pairwise coefficients of similarities between quadrats based on floristic data. Agglomerative, hierarchical clustering, using flexible UPGMA ( $\beta=-0.1$ ) was used to generate a species and quadrat classification (Sneath and Sokal 1973). A two-way table of the species and quadrat matrix was produced, with the matrix sorted into groups generated from the species and quadrat classification. Indicator species analysis (INDVAL) was conducted using PC-Ord (McCune and Mefford 1999) using the method of Dufrene and Legendre (1997). The INDVAL measures were used to determine the indicator species for each VT and a Monte Carlo permutation test was used to test for the significance of the indicator species.

### 3.5 Vegetation Mapping and Description

The species and quadrat classification (Dendrogram) generated from the statistical analysis of quadrat data produced groupings of quadrats which were interpreted and used as the basis for identification of floristic units (VTs). Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the Study Area. These polygon boundaries were then digitised using Geographic Information System (GIS) software, and are displayed on Figures 3.1 – 3.3.

VT descriptions (though floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units preferred by the DEC. This model follows nationally - agreed guidelines to describe and represent VTs, so that comparable and consistent data is produced nation-wide. For the purposes of this report, it is considered that a VT is equivalent to a NVIS sub-association as described in ESCAVI (2003). Common taxa within each stratum were defined as taxa that occurred in 30 % or greater of quadrats established within a particular VT; this may not include all taxa in the VT description, as the description is based on dominance within each stratum, as well as the frequency that a taxon was recorded within each VT.

### 3.6 Vegetation Condition Mapping

Vegetation condition was recorded at all quadrats, and also opportunistically within the Study Area where significant areas of disturbance to vegetation were noted (e.g. weed infestations, areas of heavy grazing or livestock movement or other sources of disturbance). Vegetation condition was described using the Northern Province Vegetation Condition Scale adapted from Keighery (1994). This scale is presented in Appendix E. Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation mapping polygon boundaries and are presented on Figures 4.1 – 4.3.

### 3.7 Conservation Significant and Introduced Flora

Specific targeted searches for conservation significant flora and introduced flora were not undertaken during the 2012 flora and vegetation survey, as numerous comprehensive surveys for conservation significant flora taxa have historically been undertaken within the Study Area. However both conservation significant and introduced taxa encountered were recorded while conducting quadrat surveys, including while traversing between quadrats.

If populations of conservation significant taxa were identified during the survey, a representative collection of material was made, and the abundance and spatial distribution (using GPS coordinates) of individuals within each population was recorded. Any occurrences of introduced flora were also recorded.

Targeted surveys for the Threatened flora taxon *Stylidium scintillans* were not conducted during the 2012 survey as the plant did not emerge within the Study Area in 2012 due to the below average rainfall recorded.

### 3.8 Significance of Conservation Significant Flora Populations and Vegetation

In this report, a local population of a flora taxon is defined as one occurring within the Study Area, with the local distribution of a flora taxon or VT defined as the known distribution within the Study Area. The regional distribution refers to the total distribution of the taxon or VT in Western Australia, in particular the Midwest Region. Locations of plants are considered separate populations if there is a distance of more than approximately 500 m between locations, or otherwise separated by terrain with no suitable habitat for the taxon.

The significance of a local population of a conservation significant flora taxon to the regional conservation significance of the taxon depends upon the extent of the regional distribution of the taxon, the number of known populations of the taxon, and the location of local populations within the regional distribution of the taxon. The significance of the local population/s of conservation significant flora taxa within the Study Area to the regional conservation significance of the taxon has been determined using Table 7.

**Table 7: Significance of Local Populations to the Overall Conservation Significance of Taxon**

Ranking	Description
High	<ul style="list-style-type: none"> <li>Known range of taxon either entirely located within the Study Area, or within the Study Area and to a radius of &lt;5 km of the Study Area; and/or</li> <li>Taxon known from &lt;10 discrete populations, including within the Study Area; and/or</li> <li>Study Area on boundary of known regional distribution; and/or</li> <li>Taxon listed as T-DRF in Western Australia, and/or federally listed as Threatened</li> </ul>
Moderate	<ul style="list-style-type: none"> <li>Known range of taxon extends &lt;50 km; and/or</li> <li>Taxon known from &gt;10 but &lt;20 discrete populations; and/or</li> <li>Study Area may be on boundary of known regional distribution</li> </ul>
Low	<ul style="list-style-type: none"> <li>Known range of taxa extends &gt;50 km; and/or</li> <li>Taxon known from 20 or more discrete populations; and/or</li> <li>Study Area not on boundary of known regional distribution</li> </ul>

The local significance of VTs can be measured by the extent of the VT within the Study Area, and the type and extent of landforms they are associated with. They may also be significant in containing a particularly significant flora taxon or taxa that may be uncommon or restricted (e.g. Threatened (T-DRF) and restricted Priority flora, disjunct occurrence of a particular taxon). Table 8 presents local conservation significance rankings of VTs in the Study Area, based on these criteria, with '1' indicating the lowest conservation significance ranking, and '4' the highest.

**Table 8: Descriptions of Local Conservation Significance Rankings of Vegetation Types in the Study Area**

Local Conservation Significance Ranking	Description
1	<ul style="list-style-type: none"> <li>VT comprises &gt;10 % of the Study Area; and</li> <li>Landform/soil type where VT occurs is locally common and widespread</li> </ul>
2	<ul style="list-style-type: none"> <li>VT comprises &lt;10 % of the Study Area; and</li> <li>Landform/soil type where VT occurs is locally common and widespread</li> </ul>
3	<ul style="list-style-type: none"> <li>VT comprises &lt;10 % of the Study Area; and</li> <li>Landform/soil type where VT occurs is locally uncommon and/or restricted; or</li> <li>VT comprises preferred habitat for taxa of Priority Ranking 1 or 2, or other potentially undescribed taxa</li> </ul>
4	<ul style="list-style-type: none"> <li>VT comprises &lt; 1 % of the Study Area; and</li> <li>Landform/soil type where VT occurs is locally uncommon and/or restricted; or</li> <li>VT comprises critical habitat for taxa listed as T (DRF)</li> </ul>

The following criteria were used to determine regional significance of VTs of the Study Area:

- The VT forms part of a listed TEC or PEC (either at Commonwealth or State level).
- The VT forms part of a larger vegetation unit that has been identified through regional surveys (for example those conducted by the DEC) as being rare or restricted on a regional scale.
- The VT forms part of a vegetation unit of which <30 % of its pre-european extent is extant at time of survey.

### 3.9 Limitations of Survey

Table 9 presents the limitations of the flora and vegetation survey of the Study Area in accordance EPA Guidance Statement No. 51 (EPA 2004).

**Table 9: Limitations of the Flora and Vegetation Survey of the Study Area**

Limitation	Comment
Level of survey.	Level 2 Detailed Survey: A detailed survey was conducted in October towards the end of the usual peak flowering season in the Midwest. Previous surveys within the Study Area (data used in the statistical analysis) have been conducted within the peak flowering period in different years. Replicated quadrats were established in each plant community/ vegetation type identified over the Study Area.

Limitation	Comment
Competency / experience of the consultant(s) carrying out the survey.	Senior personnel (Bethea Loudon and Sharnya Thomson) have experience in conducting similar assessments in the Midwest, with mentoring given to less experienced botanists during the survey.
Scope (floral groups that were sampled; some sampling methods not able to be employed because of constraints?)	All vascular groups that were present during the detailed survey were sampled; good foot and vehicle access to most of the Study Area allowed for appropriate sampling techniques (quadrat establishment, foot transects) to be employed.
Proportion of flora identified, recorded and / or collected.	High proportion of perennial vascular taxa was recorded based on intensity and method of survey within the Study Area; low proportion of ephemeral vascular taxa were recorded based on the timing of survey. All vascular taxa recorded had at least one reference specimen collected, with specimens identified at the WAHerb.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Sources include government databases (DEC, EPBC) and numerous unpublished reports within or in the vicinity of the Study Area. Good contextual information was available including previous local experience of Woodman Environmental.
The proportion of the task achieved and further work which might be needed.	Level 2 survey complete, intensity considered to be adequate. Further work to detail location of conservation significant flora may be required, in particular for <i>Stylidium scintillans</i> (T-DRF) during favourable flowering conditions.
Timing / weather / season / cycle.	Detailed field survey conducted in October 2012 towards the end of the usual peak flowering period, species of both ephemeral and perennial taxa were not flowering at the time of the survey. Below average rainfall was recorded for the flowering period and immediately prior.
Disturbances (e.g. fire, flood, accidental human intervention etc.), which affected results of survey.	Previous fire history in parts of the Study Area influenced patterns discernible from aerial photography and also existing structure and composition of the vegetation in some areas; this had a minor effect on the survey results in regard to vegetation polygon boundaries.
Intensity of survey.	Survey intensity was adequate to identify floristic and structural groupings of terrestrial flora as required by a Level 2 survey.
Completeness and mapping reliability.	Survey of Study Area considered complete. Mapping reliability good as high resolution aerial photography was used, 63 quadrats were established, and foot and vehicle transecting was employed.
Resources and experience of personnel.	Adequate resources including experienced senior field personnel and taxonomists with appropriate expertise in Midwest.
Remoteness and / or access problems.	Access to the Study Area was considered adequate given the availability of local tracks, drill lines and public roads.

## 4. RESULTS

### 4.1 Flora of the Study Area

A total of 114 discrete vascular flora taxa and two putative hybrids were recorded within the Study Area during October 2012. These taxa represent 26 families and 53 genera. A full list of taxa is presented in Appendix F, with raw quadrat data and environmental parameters presented in Appendix G.

#### 4.1.1 Conservation Significant Flora Taxa in the Study Area

Three Conservation Significant flora taxa were recorded from within the Study Area during surveys conducted by Woodman Environmental in October 2012 (Table 10). *Santalum spicatum* (Sandalwood) was also recorded during the survey in 2012. Sandalwood is a protected species, under the *Sandalwood Act 1929*, with clearing of this species prohibited without a permit under legislation in Western Australia. One plant was recorded at quadrat GG09 within VT 10 (Appendix G, Figure 3.1). Appendix H presents the location details of each of these records collected in 2012.

**Table 10: Summary of Conservation Significant Taxa Recorded within the Study Area during surveys in 2012**

Taxon	Ranking	Number of Locations Recorded	Total Number of Plants recorded	Vegetation Types in which Present
<i>Calytrix uncinata</i>	P3	3	42	4
<i>Micromyrtus trudgenii</i>	P3	1	1	4
<i>Persoonia pentasticha</i>	P3	1	1	9
<i>Santalum spicatum</i>	Other	1	1	10

In total, eight conservation significant flora taxa and one other significant flora taxon are known from within the Study Area. Table 11 presents these taxa, and details regarding the locations of these taxa within the Study Area. Locations that appear on areas which have been mapped as 'Cleared Land' have been removed. Locations of each of these taxa are presented in Figures 4.1 – 4.3.

**Table 11: Number of Locations and Vegetation Types in which Conservation Significant Flora Taxa are known from within the Study Area**

Taxon	Ranking	Number of Locations in Study Area	VTs
<i>Stylidium scintillans</i>	T (DRF)	2	9 (2 locs)
<i>Calytrix uncinata</i>	P3	103	4 (27 locs); 4d (2 locs); 9 (24 locs); 9d (40 locs); 11 (8 locs); 11d (2 locs)
<i>Drummondita fulva</i>	P3	29	4 (16 locs); 9d (10 locs); 11d (3 locs)
<i>Grevillea globosa</i>	P3	83	4d (1 loc); 9 (3 locs); 11 (72 locs); 11d (7 locs);
<i>Micromyrtus trudgenii</i>	P3	86	4 (14 locs); 4d (8 locs); 9d (41 locs); 11 (14 locs); 11d (9 locs);

Taxon	Ranking	Number of Locations in Study Area	VTs
<i>Persoonia pentasticha</i>	P3	1	9 (1 loc)
<i>Polianthion collinum</i>	P3	56	4 (20 locs); 4d (15 locs); 9 (1 locs); 9d (5 locs); 11 (1 loc); 11d (14 loc)
<i>Acacia speckii</i>	P4	39	3 (9 locations); 9 (25 locations); 11 (5 locations)
<i>Santalum spicatum</i>	other	12	9 (11 locs); 10 (1 loc)

#### 4.1.2 Range Extensions and Distribution Gaps

The collection of *Persoonia pentasticha* (P3) is a range extension for this taxon; it has previously been recorded at Gossan Hill (Matiske Consulting 1996), however no location data was given and no specimen to confirm this was lodged at the WAHerb. There were no other collections made during surveys in October 2012 that constituted or correlated to range extensions, filled locality holes or represented taxa with few vouchered collections at the WA Herbarium. This is due to the high number of flora surveys that have historically been undertaken at Gossan Hill and the surrounds.

#### 4.1.3 Introduced Taxa

No introduced taxa were recorded during surveys undertaken in October 2012. A total of **thirteen** introduced flora taxa have been historically recorded within the Study Area, as listed in Table 5 (excluding *Cuscuta epithymum* which is known from areas in close proximity to the Study Area, as recorded from DEC database information). Locations of each of these flora taxa are however not available. None of these introduced taxa are listed as Declared Pests (within the Shire of Yalgoo) under the BAM Act (Department of Agriculture & Food 2012), nor are they listed as Weeds of National Significance (Australian Weeds Committee 2012).

#### 4.1.4 Significance of Conservation Significant Flora Populations

Table 12 presents the significance of local conservation significant flora populations to the overall conservation of each taxon, as determined from Table 7. The significance of the local populations of *Stylidium scintillans* (T – DRF) was ranked ‘High’ due to its Threatened status. The significance of the local populations of *Drummondita fulva* and *Polianthium collinum* (both P3) were ranked as Moderate due to a combination of relatively low numbers of regional populations, a known range generally less than 20 km and the location of the Study Area being on the edge of their respective ranges. The significance of the local populations of *Micromyrtus trudgenii* and *Persoonia pentasticha* (both P3) were ranked Low-Moderate, due to a combination of the larger number of known regional populations and range, and the proximity of the populations in the Study Area to the edge of their ranges. Likewise *Grevillea globosa* (P3) was also ranked Low-Moderate; although it has a large known range and the location of the populations in the Study Area are not in proximity to the edge of its range, it has less than 20 known populations. The significance of the local populations of *Calytrix uncinata* (P3) and *Acacia speckii* (P4) were ranked Low, due to relatively large numbers of regional populations and large ranges.



**Table 12: Significance of Local Conservation Significant Flora Populations to the Overall Conservation of Each Taxon**

<b>Taxon</b>	<b>Conservation Code</b>	<b>Number of Populations in the Study Area</b>	<b>Approximate Number of Regional Populations^</b>	<b>Approximate Known Range of Taxon (km) (DEC 2013b)</b>	<b>Location of Study Area in relation to Known Range</b>	<b>Significance of Populations to the Overall Conservation Significance of Taxon</b>
<i>Stylidium scintillans</i>	T	1	29	25 km E-W; 45 km N – S (outlier also 70 km west of main range)	Study Area at northern-most end of known range	High
<i>Calytrix uncinata</i>	P3	6	42	520 km E-W; 310 km N – S	Study Area close to but not on edge of western-most end of known range	Low
<i>Drummondita fulva</i>	P3	1	18	50 km E-W; 50 km N – S	Study Area at northern-most end of known range	Moderate
<i>Grevillea globosa</i>	P3	5	19	160 km E-W; 120 km N – S	Study Area not on the edge of the known range	Low-Moderate
<i>Micromyrtus trudgenii</i>	P3	3	36	40 km E-W; 95 km N – S	Study Area at northern-most end of known range	Low-Moderate
<i>Persoonia pentasticha</i>	P3	1	40	220 km E-W; 160 km N – S	Study Area extends the known range to the north-east	Low-Moderate
<i>Polianthion collinum</i>	P3	3	12	20 km E-W; 45 km N – S	Study Area at northern-most end of known range	Moderate
<i>Acacia speckii</i>	P4	3	30	380 km E-W; 210 km N – S	Study Area at southern-most end of known range	Low-Moderate

Note: ^ Approximate Regional populations determined from DEC 2013b. Regional population information may include populations from within the Study Area.

## 4.2 Vegetation of the Study Area

The total area of the Study Area is 2951.90 ha, of which 2456.8 ha (83.2 %) comprises intact native vegetation.

### 4.2.1 Vegetation Type Mapping

Initial dissection of the resultant floristic classification of the 175 quadrats resulted in two super-groups, further split into 14 floristic groups. The differentiation in species composition between the two super-groups is based primarily on differences in topographical location and landform within the Study Area.

During the examination of the results of the floristic classification, it was discovered that one quadrat (GG25) had grouped into its own group despite having similar topographical and soil characters as the majority of quadrats from adjacent groups on the dendrogram. Inspection of the quadrat data determined that this quadrat was species-poor in comparison to the majority of other quadrats assessed, possibly as a result of the area not receiving a burn in many years. This quadrat was subsequently manually allocated to a group that better reflected its topography, soil type and dominant vegetation composition (Appendix J).

As a result of this analysis, a total of 13 floristic groupings (mapped as Vegetation Types, or VTs) were defined. Of these, seven VTs occur and have been mapped within the Study Area (VTs 3, 4, 9, 10, 11, 12 and 13). The remainder of VTs were composed of quadrats from the regional dataset and therefore are not discussed further in this report.

Appendix K presents a list of vascular plant taxa recorded in each VT. Appendix L presents the summary dendrogram of relationships between each quadrat. Appendix M presents the two-way table of the species and quadrats matrix. Appendix N presents significant indicator species for each VT. Figures 4.1 – 4.3 present the VT mapping across the Study Area.

#### 4.2.1.1 Super-group 1

Super-group 1 is comprised of VTs 1 through to 5 (VTs 1, 2 and 5 do not occur in the Study Area) (Appendix L). This group generally consists of vegetation on lower to upper slopes and hill crests of large hills associated with ranges; low hills on undulating plains; and outwash areas at the base of hills. The taxon richness of VTs within Super-group 1 was somewhat variable, ranging from 11.0 to 51.9 taxa per quadrat. Within Super-group 1, VT 5 had the highest taxon richness per quadrat ( $51.9 \pm 9.5$ ) while VT 3 had the lowest taxon richness per quadrat ( $11.0 \pm 3.4$ ). VT 3 also recorded the lowest number of taxa (a total of 22) in Super-group 1, while VT 5 recorded the most taxa (a total of 109). On average species richness was generally higher in Super-group 1 than that of Super-group 2.

A description of VT 3 and 4 is as follows:

**VT 3:** Tall open to sparse shrubland of mixed *Acacia* species dominated by *Acacia grasbyi*, *Acacia umbraculiformis* and *Acacia tetragonophylla* over mid open to sparse shrubland of *Thryptomene costata* over isolated clumps of shrubs of *Ptilotus obovatus* and *Eremophila punicea* over low isolated clumps of forbs of *Borya sphaerocephala* on red-brown to yellow sandy to clay loams often associated with decomposing granite or granite outcropping on plains and upperslopes

**VT 4:** Tall shrubland of mixed *Acacia* species dominated by *Acacia aulacophylla* and *Acacia ramulosa* var. *ramulosa* over mid open shrubland sparse shrubland of mixed species dominated by *Eremophila glutinosa*, *Eremophila latrobei* subsp. *latrobei*, *Mirbelia* sp. *bursarioides* (T.R. lally760), *Philotheca brucei* subsp. *brucei* and *Philotheca sericea* on red-brown sandy clay or loams on lowerslopes to crests with ironstone or granite outcropping

**VT 4d:** Disturbed areas of VT 4

Detailed descriptions of VTs 3, 4 and 4d are presented in Appendix O.

#### 4.2.1.2 Super-group 2

Super-group 2 is composed of VTs 6 through to 13; VTs 9 - 13 occur within the Study Area. This group generally consists of vegetation on flats, undulating plains, and on low undulating hills not associated with larger ranges. The taxon richness of VTs within Super-group 2 was highly variable, ranging from 4.0 to 52.7 taxa per quadrat. Within Super-group 2, VT 6 had the highest taxon richness per quadrat ( $52.7 \pm 8.4$ ) while VT 13 had the lowest taxon richness per quadrat ( $4.0 \pm 0.0$ ). VT 13 also recorded the lowest number of taxa (a total of 4) in Super-group 2, while VT 6 also recorded the most taxa (a total of 105). VT 6 recorded the highest taxon richness per quadrat and total number of taxa out of all 13 VTs.

VTs 9 through to 13 are described below.

**VT 9:** Tall closed to sparse shrubland of mixed *Acacia* species dominated by *Acacia ramulosa* var. *ramulosa* with *Acacia burkittii* and *Acacia tetragonophylla* over low isolated clumps of shrubs of mixed species dominated by *Ptilotus obovatus* on yellow, red and red-brown loams predominantly on plains and occasionally on mid to upperslopes of low hills

**VT 9d:** Disturbed areas of VT 9

**VT 10:** Tall open shrubland of mixed species including *Acacia caesaneura*, *Acacia incurvaneura*, *Acacia latior*, *Acacia sibina*, *Acacia umbraculiformis* and *Grevillea obliquistigma* subsp. *obliquistigma* over mid open shrubland of *Aluta aspera* subsp. *hesperia* over low isolated clumps of shrubs of *Solanum cleistogamum* and tussock grasses of *Monochather paradoxus* on red-brown sandy clay on hill slopes

**VT 11:** Tall closed to sparse shrubland of mixed *Acacia* species dominated by *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa* and *Acacia sibina* over low isolated clumps of tussock grasses of *Monochather paradoxus* on yellow to and red-brown loams on plains and slopes

**VT 11d:** Disturbed areas of VT 11

**VT 12:** Low sparse isolated shrubs to shrubland of chenopods of mixed species including *Rhagodia drummondii*, *Sclerolaena diacantha* and *Atriplex codonocarpa* occasionally with low open forest of *Eucalyptus loxophleba* subsp. *supralaevis* or low open samphire shrubland of *Tecticornia disarticulata* on red-brown sandy to clay loams on plains

**VT 13:** Low open samphire shrubland of *Tecticornia disarticulata* over low sparse isolated chenopod shrubs of *Atriplex ?bunburyana* on yellow or white sandy loam on breakaway outwash areas

Detailed descriptions of VTs 9 - 13 are presented in Appendix O.

#### 4.2.2 Other Areas Mapped

Areas where no vegetation occurred due to human disturbance were mapped as ‘Cleared Land’, e.g. the Yalgoo-Ninghan Road and mining infrastructure such as roads, tracks and tailings dams. The total area of Cleared Land which was mapped was 495.1 ha (16.8 % of the Study Area). Numerous small tracks and gridlines throughout the Study Area were not mapped as Cleared Land due to their complexity.

#### 4.2.3 Vegetation Condition Mapping

The total area mapped of each condition ranking and the relative percentage of Study Area attributed to each ranking is presented in Table 13. The majority of the Study Area was mapped as being in Very Good condition. Areas mapped as in Good condition, was attributed to feral goat activity. Disturbed vegetation ranked as Poor was attributed to either mining activities (impact due to close proximity to current activities) or from historic discharge of excess mine water (Figures 5.1 – 5.3).

**Table 13: Vegetation Condition Mapped within the Study Area**

Condition Ranking	Total Area in ha	Percentage of Study Area
E	405.9	13.7
E/VG	198.0	6.7
VG	1588.3	53.8
VG/G	54.2	1.8
G	94.1	3.1
P	117.1	4.0
C	494.4	16.7

In some cases quadrat information relating to vegetation condition rankings varied within a vegetation polygon; definitive vegetation condition boundaries could not be determined and were therefore combined.

#### 4.2.4 Significance of Vegetation

Table 14 presents the local significance of each VT (as defined in Table 8). The majority of VTs (4) were ranked ‘3’, with one each ranked ‘4’ and ‘1’. VT 13 was ranked ‘4’ due to the high level of restriction of appropriate landform and soil type for this VT in the Study Area. VT 11 was ranked ‘1’ due to the relatively large extent mapped within the Study Area, and the location on landforms which are common in the Study Area.

VT 9 was the most widespread VT mapped within the Study Area (approximately 39 % of the Study Area). It provides habitat for the Threatened flora taxon *Stylidium scintillans*, however this taxon occurs primarily within isolated pockets of micro habitat within VT 9, and therefore this VT does not provide critical habitat for this taxon. As a result VT 9 was allocated a conservation significance ranking of 3 and not 4.

The regional significance of the VTs has also been described in Table 14. No listed TECs are known to occur in the Study Area. VT 4 is considered to form part of a listed PEC, with VT 10 also considered part of this PEC due to its co-occurrence with VT 4.

On a regional scale, the vegetation units of the Study Area (vegetation system associations Yalgoo\_202 and Yalgoo\_420) are not restricted, with current extant areas of each being > 30 % of the pre-european mapped extents (Table 2).

For the most part, the landforms and soil types upon which the VTs mapped within the Study Area occur on are not regionally restricted. However, VTs 3, 4, 10, 12 and 13 do occur on landforms and soil types which are considered to be uncommon to regionally restricted (decomposing granite, ironstone or granite outcropping, saline areas and breakaway outwash). However, they are not recognized by state or commonwealth legislation as being conservation significant.



Table 14: Local and Regional Conservation Significance of Vegetation Types within Study Area

Vegetation Type	Extent in Study Area (ha) (% of Study Area)	Presence of Significant Flora Taxa	Local Conservation Significance Comments	Local Conservation Significance Ranking of VT	Regional Conservation Significance
3	149.1 ha (5.05%)	<i>Acacia speckii</i> (P4) (VT forms part of local preferred habitat)	VT comprises <10 % of the Study Area VT occurs on landforms that are locally uncommon CS flora taxa present (P4 ranking), but are not restricted to this VT (forms part of preferred habitat for <i>Acacia speckii</i> (P4))	3	<b>VT 3 not of Regional Conservation Significance</b> Although dominant species of VT 3 are widespread or are relatively widespread in the region, this particular habitat type with granite outcropping is not regionally common
4	300.09 ha (10.17%)	<i>Calytrix uncinata</i> (P3) <i>Drummondita fulva</i> (P3) (VT is local preferred habitat) <i>Micromyrtus trudgenii</i> (P3) <i>Polianthion collinum</i> (P3) (VT is local preferred habitat)	VT comprises >10 % of the Study Area VT occurs on landforms that are locally uncommon CS flora taxa present (P3 ranking), but are not restricted to this VT The VT is represented within the regional quadrat dataset (Markey and Dillon 2008) outside of the Survey area	3	<b>VT 4 of Regional Conservation Significance</b> VT 3 regional distribution indicated by Markey and Dillon (2008) (quadrat locations only); Potential to be Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) (as described in Markey and Dillon 2008) Soil, substrate and topographical positions all restricted in region; Significant flora species of restricted and moderately restricted distribution
4d	10.01 ha (0.34%)	<i>Micromyrtus trudgenii</i> (P3) <i>Polianthion collinum</i> (P3)	Although disturbed, VT 4d should be considered the same local conservation significance as VT 4 (as above)	3	<b>VT 4d of Regional Conservation Significance</b> Should be considered the same regional significance as VT 4; Potential to be Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) (as described in Markey and Dillon 2008)
9	1143.05 ha (38.72%)	<i>Stylidium scintillans</i> (T) <i>Calytrix uncinata</i> (P3) (VT is local preferred habitat) <i>Grevillea globosa</i> (P3) <i>Persoonia pentasticha</i> (P3) <i>Polianthion collinum</i> (P3) <i>Acacia speckii</i> (P4) (VT forms part of local preferred habitat) <i>Santalum spicatum</i> (other)	VT comprises >10 % of the Study Area VT occurs on locally common landforms and soil types Habitat for Threatened flora taxon (although taxon not widespread through VT), and other various Priority flora species (P3 and P4)	3	<b>VT 9 not of Regional Conservation Significance</b> VT 9 likely to be widespread within the region according to known soil types, substrate and topographical positions.

Vegetation Type	Extent in Study Area (ha) (% of Study Area)	Presence of Significant Flora Taxa	Local Conservation Significance Comments	Local Conservation Significance Ranking of VT	Regional Conservation Significance
9d	64.32 ha (2.18%)	<i>Calytrix uncinata</i> (P3), <i>Drummondita fulva</i> (P3), <i>Micromyrtus trudgenii</i> (P3) (areas contain preferred habitat) <i>Polianthion collinum</i> (P3)	Although disturbed, VT 9d should be considered the same local conservation significance as VT 9 (as above)	3	<b>VT 9d not of Regional Conservation Significance</b> Should be considered the same regional significance as VT 9
10	42.99 ha (1.46%)	<i>Santalum spicatum</i> (other)	VT comprises <10 % of the Study Area VT occurs on landforms that are locally uncommon No conservation significant flora species known to occur.	3	<b>VT 10 of Regional Conservation Significance</b> VT 10 co-occurs within VT 4 and could be potentially considered a vegetation complex within Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) (as described in Markey and Dillon 2008) due to its occurrence within and adjacent to VT 4
11	636.28 ha (21.56%)	<i>Acacia speckii</i> (P4) <i>Grevillea globosa</i> (P3) (VT contains preferred habitat) <i>Micromyrtus trudgenii</i> (P3)	VT 11 comprises >10 % of the Study Area VT 11 occurring on landforms and soil types that are locally common Conservation significant flora taxa present in VT 11 (P3 and P4)	1	<b>VT 11 not of Regional Conservation Significance</b> VT 11 likely to be widespread within the region according to known soil types, substrate and topographical positions, and previous surveys by consultants
11d	43.33 ha (1.47%)	<i>Calytrix uncinata</i> (P3) <i>Grevillea globosa</i> (P3) <i>Micromyrtus trudgenii</i> (P3)	Although disturbed, VT 11 should be considered the same local conservation significance as VT 11 (as above)	1	<b>VT 11d not of Regional Conservation Significance</b> Should be considered the same regional significance as VT 11
12	49.23 ha (1.67)%	-	VT 12 comprises <10 % of the Study Area VT 12 occurs on landforms and soil types that are locally restricted No conservation significant flora taxa known to occur	3	<b>VT 12 not of Regional Conservation Significance</b> Regional distribution of VT 12 not common but also not restricted (samphire shrublands) Similar VT mapped within the Karara-Mungada project survey area (Woodman Environmental 2008)
13	18.41 ha (0.62%)	-	VT 13 comprises <1 % of the Study Area VT 13 occurs on landforms and soil types that are locally uncommon and restricted Conservation significant flora taxa not known to occur in VT	4	<b>VT 13 not of Regional Conservation Significance</b> Regional distribution of VT 13 may be restricted in region (breakaway outwash); Similar VT mapped within the Karara-Mungada project survey area (Woodman Environmental 2008)

## 5 DISCUSSION AND CONCLUSIONS

### 5.1 Flora of the Study Area

A total of 114 discrete vascular flora taxa and 2 putative hybrids were recorded within the Study Area during surveys in 2012, representing 26 families and 53 genera. The species richness recorded in 2012 was lower than that recorded during previous surveys in the vicinity of the Gossan Hill Gold Pit Project, as a result of the survey being conducted towards the end of the usual flowering period for this region (October). It is therefore possible that some ephemeral and geophytic taxa potentially present were not recorded, hence the lower richness. In addition, lower than average rainfall experienced by the area leading up to the survey meant that a greater number of species were not available to be sampled.

As listed in Section 2.5, numerous flora surveys had previously been undertaken in the area. These surveys have been undertaken across several years and in different seasons, including the main annual flowering time (early spring). A tally of the taxa recorded during these surveys (allowing for changes in nomenclature, etc, and including the current survey) has resulted in approximately 300 flora taxa being recorded within the Survey Area (an area of approximately 3000 ha) over all previous surveys. In comparison, a total of 514 plant taxa were recorded across the Karara-Mungada project survey area (Woodman Environmental 2008), across an area of 14 500 ha (approximately five times larger than the Study Area). Markey and Dillon (2008) recorded 414 taxa during their survey of the Central Talling area, and 243 taxa were recorded during the survey of the Yalgoo area (including Gnows Nest Range) (Markey and Dillon 2008 *in prep.*). Therefore the species diversity of the Study Area compares favourably with that recorded during recent regional surveys; despite the high level of historical clearing undertaken in the Study Area (just over 18 % of the Study Area has been cleared).

A total of eight conservation significant flora taxa are known from the Survey Area, including three which were recorded during the 2012 survey. This is a relatively high number of taxa, the majority of which are associated with banded ironstone and other similar rocky habitats. The local populations of most of these conservation significant taxa were ranked as 'Low-Moderate' or 'Moderate' with regard to their significance to the overall conservation of the taxa. The significance of the local populations of *Drummondita fulva* and *Polianthion collinum* (both P3) were ranked Moderate due to their more restricted regional distributions, with the local population of *Stylidium scintillans* being ranked High significance due to its threatened status. Additional survey following favourable rainfall conditions would provide clear evidence of whether this threatened taxon occurs within any areas of proposed disturbance.

### 5.2 Vegetation of the Study Area

Of the 13 VTs defined as a result of the statistical analysis, seven VTs occur within the Study Area (VTs 3, 4, 9, 10, 11, 12 and 13). These VTs group into two separate super-groups, which were mapped on separate landforms: Super-group 1 was mapped on lower to upper slopes and hill crests of large hills associated with ranges; low hills on undulating plains; and outwash areas at the base of hills, with super-group 2 mapped on flats, undulating plains, and on low undulating hills not associated with larger ranges.

The diversity of VTs in the Study Area is considered to be Moderate, with a variety of topographical features, landforms and soil types within the Study Area accounting for this diversity. Many VTs within each super-group are floristically dissimilar, with different overstorey and

understory types which are reflective of the particular topographical and landform units. In addition some of this diversity within the VTs may reflect the numerous taxonomic updates that have been carried out in recent years, in particular with the *Acacia* species group.

Of the seven VTs recorded within the Study Area, only three were considered locally common (>10 % Study Area). However, the VT with the largest area was ranked a local conservation significance of '3' due to its suitability as habitat for the Threatened flora taxon *Stylidium scintillans*. The only VT to be ranked '4' was VT 13, due to the extremely small area it occupies coupled with the scarcity of suitable landform and soil type in the local area.

None of the VTs recorded in the Study Area represent any known TECs, however it is considered that the PEC 13: Minjar/Gnows Nest vegetation complexes (banded ironstone formation) is located within the Study Area. This area (VT 4) was mapped occurring on Gossan Hill, an area to the east of Gossan Hill and a larger area within the low hill system to the north and northwest of the Golden Grove camp. This VT was usually mapped on hill slopes that were moderately to very steeply inclined, with significant granite or ironstone outcropping. Gossan Hill is geographically disjunct from, and therefore not considered part of, the Minjar or Gnows Nest Range areas, and the geology of the hill is not strictly banded ironstone. However, Gossan Hill is located in close proximity to Minjar, and the vegetation present in the quadrats established on Gossan Hill is equivalent to Central Talling VT 3. It is therefore considered that the vegetation type on Gossan Hill and the other areas mapped as VT 4 constitute an occurrence of MidWest PEC 13 (Minjar/Gnows Nest vegetation complexes (banded ironstone formation), and are therefore of High regional conservation significance.

In addition VT 10 co-occurs within VT 4 and could be potentially considered a vegetation complex within Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) (as described in Markey and Dillon 2008) due to its occurrence within and adjacent to VT 4.

The main disturbances to vegetation recorded during the survey were due to both human impact (clearing) and grazing by feral goats. The condition of the majority of vegetation in the Study Area was ranked 'Very Good' (53.8 % of the Study Area); with vegetation ranked as 'Good' often displaying obvious signs of impact as a result of grazing and trampling from feral goat populations. Disturbed vegetation which was ranked as 'Poor' was attributed to either mining activities or from historic discharge of excess mine water.

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## Appendix A: Definitions, Categories and Criteria for Threatened and Priority Ecological Communities (DEC 2010)

### DEFINITIONS, CATEGORIES AND CRITERIA FOR THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

#### 1. GENERAL DEFINITIONS

##### **Ecological Community**

A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A **threatened ecological community** (TEC) is one which is found to fit into one of the following categories; “presumed totally destroyed”, “critically endangered”, “endangered” or “vulnerable”.

Possible threatened ecological communities that do not meet survey criteria are added to DEC’s Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

An **assemblage** is a defined group of biological entities.

**Habitat** is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (eg. substrate and topography), and the biotic factors.

**Occurrence:** a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

**Adequately Surveyed** is defined as follows:

“An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts.”

**Community structure** is defined as follows:

“The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage” (eg. *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, eg. dominance by feeders on detritus as distinct from feeders on live plants).

**Definitions of Modification and Destruction** of an ecological community:

**Modification:** “changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention.”

**Destruction:** “modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention.”

**Note:** Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be bought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising underground watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels.

Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

**Threatening processes** are defined as follows:

“Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community.”

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced microorganisms; direct human exploitation and disturbance of ecological communities.

**Restoration** is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.



**Rehabilitation** is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

## **2. DEFINITIONS AND CRITERIA FOR PRESUMED TOTALLY DESTROYED, CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE ECOLOGICAL COMMUNITIES**

### **Presumed Totally Destroyed (PD)**

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies ( A or B):

A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or

B) All occurrences recorded within the last 50 years have since been destroyed

### **Critically Endangered (CR)**

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii):

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known

threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

### **Endangered (EN)**

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

### **Vulnerable (VU)**

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

### 3. DEFINITIONS AND CRITERIA FOR PRIORITY ECOLOGICAL COMMUNITIES

#### PRIORITY ECOLOGICAL COMMUNITY LIST

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

##### **Priority One:** Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

##### **Priority Two:** Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

##### **Priority Three:** Poorly known ecological communities

- (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or;
- (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
- (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

**Priority Four:** Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

- (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
- (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (c) Ecological communities that have been removed from the list of threatened communities during the past five years.

**Priority Five:** Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

## **Appendix B: Conservation Codes for Western Australian Flora (DEC 2013c)**

Under the *Wildlife Conservation Act* (1950), the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

### **T: Threatened Flora (Declared Rare Flora – Extant)**

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act 1950).

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List Criteria:

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild
- EN: Endangered – considered to be facing a very high risk of extinction in the wild
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild

### **X: Presumed Extinct Flora (Declared Rare Flora – Extinct)**

Taxa that have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950).

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

### **1: Priority One – Poorly-known Taxa**

Taxa that are known from one or a few collections or sight records (generally less than 5), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.



**2: Priority Two – Poorly-known Taxa**

Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

**3: Priority Three – Poorly-known Taxa**

Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

**4: Priority Four – Rare, Near Threatened and other taxa in need of monitoring**

1. **Rare.** Taxa 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 taxa are usually represented on conservation lands

2. **Near Threatened.** Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

3. Taxa that have been removed from the list of threatened species during the past 5 years for reasons other than taxonomy.

**5: Priority 5 – Conservation Dependent Taxa**

Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within 5 years.

**Appendix C: Environmental Weed Strategy - Criteria for the Assessment and Rating of Weeds in Terms of their Environmental Impact on Biodiversity (Department of Conservation and Land Management 1999)**

**ENVIRONMENTAL WEEDS RATING**

- **Invasiveness**- ability to invade bushland in good to excellent condition or ability to invade waterways (Score as yes or no).
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world (Score as yes or no).
- **Environmental Impacts** – ability to change the structure, composition and function of ecosystems; in particular an ability to form a monoculture in a vegetation community (Score as yes or no).

**The Rating System used in the Environmental Weed Strategy for Western Australia**

<b>High</b>	A weed species would have to score yes for all three criteria. Rating a weed species as high would indicate prioritising this weed for control and/or research.
<b>Moderate</b>	A weed species would have to score yes for two of the above criteria. Rating a weed species as moderate would indicate that control or research effort should be directed to it if funds are available; however it should be monitored (possibly a reasonably high level of monitoring).
<b>Mild</b>	A weed species scoring one of the criteria. A mild rating would indicate monitoring of the weed and control where appropriate.
<b>Low</b>	A weed species would score none of the criteria. A low ranking would mean that this species would require a low level of monitoring.

## Appendix D: Descriptions of Plant Communities Historically mapped within the Survey Area and Surrounds

### Plant Communities mapped by Mattiske (1996)

#### Eucalyptus Woodlands

EW1: Open Woodland of *Eucalyptus loxophleba* subsp. *supralaevis* over mixed shrubs dominated by *Scaevola spinescens*, *Rhagodia spinescens*, *Maireana* spp., *Ptilotus exaltatus* and *Ptilotus obovatus*

EW2: Open Woodland of *Eucalyptus kochii*, *Eucalyptus leptopoda* and *Callitris columellaris* over *Eremophila pantonii*, *Acacia ramulosa* subsp. *ramulosa* and *Acacia burkittii* with an understorey of annual species dominated by *Cephalopterum drummondii*

#### Acacia Woodlands

AW3: Open Low Woodland or Tall Shrubland of mixed *Acacia* species over scattered shrubs and dense annual species dominated by mixed *Asteraceae* species and *Austrostipa trichophylla*

AW4: Open Low Woodland or Tall Shrubland of mixed *Acacia* species over scattered shrubs and dense annual species dominated by *Monachather paradoxus* and *Waitzia acuminata*

AW5: Open Low Woodland of *Acacia ramulosa* subsp. *ramulosa* or occasionally *Acacia aneura* var. *aneura* and *Acacia craspedocarpa* with an understorey dominated by shrubs of *Eremophila forrestii* and *Eremophila margarethae* with *Ptilotus obovatus* and annuals *Velleia rosea* and *Podolepis lessonii*

AW6: Open Low Woodland of *Acacia ramulosa*, *Acacia burkittii* and *Acacia tetragonophylla* over chenopods and annuals

AW7: Open Low Woodland of *Acacia burkittii* and *Acacia ramulosa* subsp. *ramulosa* with scattered *Acacia tetragonophylla* and *Santalum spicatum* over *Eremophila pantonii*, *Monachather paradoxus*, other annual grasses and *Asteraceae* species

#### Shrublands

S8: Open Tall Shrubland of *Acacia burkittii* and *Eremophila oppositifolia* with scattered *Acacia* species and *Frankenia fecunda*

S9: Very Open Low Shrubland of *Homalocalyx thryptomenoides*, *Euomyrtus patrickiae*, *Stylidium induratum*, mixed annual grasses and *Asteraceae* species over emergent *Acacia* species

S10: Open Low Shrubland of *Mirbelia rhagodioides*, *Thryptomene costata* and *Baeckea* sp. with emergent *Acacia grasbyi* and mixed *Acacia* species

S11: Open Low Shrubland of *Mirbelia rhagodioides*, *Thryptomene costata*, *Aluta aspera* subsp. *hesperia*, *Baeckea* sp. and *Hemigenia benthamii* over scattered annual species

S12: Very Open Low Shrubland of *Acacia aneura* var. *aneura*, *Acacia ramulosa* var. *ramulosa* and *Acacia aulacophylla* over *Dodonaea petiolaris*, *Ptilotus obovatus*, *Olearia stuartii*, *Philotheca brucei*, *Philotheca sericea* and *Mirbelia rhagodioides*

### Heaths

H13: Open Heath of *Ptilotus obovatus*, *Gunniopsis quadrifida* and *Frankenia setosa* with emergent *Acacia aulacophylla* over annuals dominated by *Erymophyllum ramosum* subsp. *ramosum* and *Podolepis capillaris*

H14: Dense Heath of *Ptilotus obovatus* with emergent *Acacia* species

### **Vegetation Associations mapped by Yilgarn Traders (2008)**

D2m - Drainage line 2 (mid-dense): Mid-dense *Acacia* shrublands < 5m incl. *Acacia aneura*, *Acacia craspedocarpa*, *Acacia effusifolia* over *Eremophila forrestii* var. *forrestii* and dense annuals dominated by *Haloragis odontocarpa*

D4 - Drainage 4: Very open to mid-dense mixed shrublands < 2m incl. *Acacia tetragonaphylla*, *Acacia* ? *rigens* and *Acacia burkittii* with *Scaevola spinescens* and *Senna* sp. Austin and sparse chenopod annuals.

OS – Outcrop slope: Open mixed shrublands with emergent *Acacia* < 2.5m incl. *Acacia burkittii* and *Acacia aulacophylla* through patches of < 1m shrublands incl. *Philotheca brucei*, *Ptilotus obovatus* and *Polianthion collinum*. Sparse annuals

OS2 – Outcrop slope 2: Open to mid-dense *Acacia* shrublands < 3m incl. *Acacia aneura*, *Acacia exocarpoides*, and *Acacia quadrimarginea* around rocky patches of low mixed shrublands < 1m incl. *Micromyrtus trudgenii*, *Calytrix uncinata* and *Eremophila glutinosa*.

P1 – Plains 1: Mid-dense to open *Acacia* shrublands < 3.5m of *Acacia effusifolia* and *Acacia ramulosa* over *Grevillea globosa* and dense annuals mainly *Haloragis odontocarpa*. Includes open scrub heath patches < 1m incl. *Euryomyrtus patrickiae*, *Aluta aspera* ssp. *hesperia* and *Hemigenia* sp. Cue.

P5m - Plains 5 (mid-dense): Mid-dense *Acacia* woodlands < 6m incl. *Acacia aneura* and *Acacia craspedocarpa* with *Grevillea obliquistigma* and *Bursaria occidentalis* over *Scaevola spinescens* < 2m with sparse annuals.

P6 – Plains 6: Open to mid-dense mixed shrublands mainly *Aluta aspera* ssp. *hesperia* and *Eremophila forrestii* var. *forrestii* < 1.5m surrounded by *Acacia aneura*, *Grevillea obliquistigma* and *Persoonia manotricha* < 3m. Dense annuals dominated by *Haloragis odontocarpa*.

P7 – Plains 7: Open woodlands <5m incl. *Callitris columellaris* with *Acacia effusifolia*, *Scaveola spinescens* and *Microcorys* sp. Mt Gibson over *Monachather paradoxa* grass and annuals *Haloragis odontocarpa*.

P8o – Plains 8 (open): Scattered *Acacia* species <3.5m incl. *Acacia grasbyi* and *Acacia craspedocarpa* with open mixed shrublands <1.5m incl. *Eremophila forrestii* var. *forrestii* and *Mirbelia bursarioides*. Sparse annuals.

P8v - Plains 8 (very open): Open to very open mixed shrublands <1m incl. *Eremophila latrobei* and *Borya nitida* with scattered *Acacia* species <3m including *Acacia grasbyi* and *Acacia quadrimarginea*. Very sparse annuals.

P9 - Plains 9: Open mixed shrublands < 2.0m incl. *Philotheca brucei*, *Scaevola spinescens*, *Thryptomene costata* with emergent *Acacia* species <3.0m incl. *Acacia ramulosa* var. *linophylla* and *Acacia aneura*. Sparse annuals.

P10 - Plains 10: Open *Acacia* shrublands <3m incl. *Acacia aneura*, *Acacia ramulosa*, *Acacia tetragonophylla* with understorey incl. *Eremophila forrestii* var. *forrestii* and *Eremophila georgei* < 1.5 m. Mid-dense annuals mainly *Velleia rosea* and *Goodenia* species.

R4 - Ridge 4: Open to mid-dense *Acacia* shrublands < 4m incl. *Acacia aneura*, *Acacia quadrimarginea* with mixed understorey incl. *Scaveola spinescens* and *Eremophila forrestii* var. *forrestii* <2.5m. Sparse annuals.

UP1 – Upper Plains 1 (with Aluta patches): Open to mid-dense *Acacia* shrublands < 4m incl. *Acacia tetragonophylla* and *Acacia exocarpoides* with taller 6m *Acacia aneura* over *Eremophila forrestii* var. *forrestii* and patches of *Aluta aspera* ssp. *hesperia* <1.5m. Sparse annuals.

UP3– Upper Plains 3: Open low heath < 500mm of *Aluta aspera* ssp. *hesperia*, *Thryptomene decussata* with emergent shrubs < 2.5m incl. *Persoonia manotricha* and *Grevillea obliquistigma*

UP4 - Upper Plains 4: Open to mid-dense *Acacia* shrublands <3m incl. *Acacia ramulosa* and *Acacia effusifolia* with scattered patches of *Aluta aspera* ssp. *hesperia* and *Stachystemon intricatus* < 1.5m. Mid-dense annuals mainly *Haloragis odontocarpa*.

### **Plant Communities mapped by Yilgarn Traders (2011)**

#### Flats and Depressions

- 1: Claypan: *Eremophila oppositifolia* / *Acacia tetragonophylla*
- 2: Flats: *Acacia burkittii* / *Eremophila oppositifolia*
- 3: Flats: *Eucalyptus loxophleba* subsp. *supralaevis* / *Senna charlesiana*
- 4: Flats: *Eremophila pantonii* / *Ptilotus obovatus*

5: Flats: *Acacia ramulosa* / *Acacia tetragonophylla*

Plains

6: Plains: *Acacia effusifolia* / *Grevillea globosa*

7: Plains: *Allocasuarina acutivalvis* / *Philotheca deserti*

8: Plains: *Aluta aspera* subsp. *hesperia* / *Acacia assimilis* subsp. *assimilis*

Ridges and Rises

9: Rise crest: *Aluta aspera* subsp. *hesperia* / *Eremophila glutinosa*

10: Ridge crest and slope: *Acacia umbraculiformis* / *Thryptomene costata*

11: Ridge crest and slope: *Acacia caesaneura* / *Eremophila forrestii* subsp. *forrestii*

12: Ridge crest and slope: *Acacia aulacophylla* / *Mirbelia bursarioides*

Hill slopes

13: Hill slope: *Acacia grasbyi* / *Ptilotus drummondii*

14: Hill slope: *Acacia caesaneura* / *Eremophila georgei*

15: Hill slope: *Acacia caesaneura* / *Dodonaea petiolaris*

16: Outcrop: *Eremophila glutinosa* / *Philotheca sericea*



## Appendix E: Vegetation Condition Scale for the Eremaean and Northern Botanical Provinces (adapted from Keighery 1994)

Condition Ranking	Description
E (Excellent)	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
VG (Very Good)	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
G (Good)	More obvious signs of damage caused by human activities since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
P (Poor)	Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
VP (Very Poor)	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
D (Completely Degraded)	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising of weed or crop species with isolated native trees or shrubs.

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**Appendix F: Vascular Plant Taxa Recorded in the Gossan Hill Gold Pit Project Study Area 2012**

<b>Aizoaceae</b>	<i>?Sarcosoma praecox</i>
<b>Amaranthaceae</b>	<i>Ptilotus divaricatus</i> <i>Ptilotus drummondii</i> <i>Ptilotus obovatus</i> <i>Ptilotus schwartzii</i>
<b>Apocynaceae</b>	<i>Rhynchospora linearis</i>
<b>Asteraceae</b>	<i>Eryngium ramosum</i> subsp. <i>ramosum</i> <i>Hyalosperma glutinosum</i> <i>Minuria cunninghamii</i> <i>Olearia pimeleoides</i> <i>Podolepis capillaris</i> <i>Pogonolepis muelleriana</i> <i>Waitzia acuminata</i> var. <i>acuminata</i>
<b>Boryaceae</b>	<i>Borya sphaerocephala</i>
<b>Chenopodiaceae</b>	<i>Atriplex ?amnicola</i> <i>Atriplex ?bunburyana</i> <i>Atriplex codonocarpa</i> <i>?Enchylaena lanata</i> <i>Enchylaena tomentosa</i> <i>Maireana amoena</i> <i>Maireana carnosae</i> <i>Maireana georgei</i> <i>Maireana glomerifolia</i> <i>Maireana ?planifolia</i> <i>Maireana thesioides</i> <i>Maireana tomentosa</i> subsp. <i>tomentosa</i> <i>Maireana triptera</i> <i>Rhagodia drummondii</i> <i>Sclerolaena densiflora</i> <i>Sclerolaena diacantha</i> <i>Sclerolaena eriacantha</i> <i>Sclerolaena fusiformis</i> <i>Sclerolaena gardneri</i> <i>Sclerolaena microcarpa</i> <i>Tecticornia disarticulata</i>
<b>Cupressaceae</b>	<i>Callitris columellaris</i>

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<b>Euphorbiaceae</b>	<i>Stachystemon intricatus</i>
<b>Fabaceae</b>	<i>Acacia aneura</i> hybrid <i>Acacia anthochaera</i> <i>Acacia aulacophylla</i> <i>Acacia burkittii</i> <i>Acacia caesaneura</i> ms <i>Acacia craspedocarpa</i> <i>Acacia effusifolia</i> <i>Acacia exocarpoides</i> <i>Acacia grasbyi</i> <i>Acacia incurvaneura</i> ms <i>Acacia incurvaneura</i> hybrid <i>Acacia kalgoorliensis</i> <i>Acacia latior</i> <i>Acacia masliniana</i> <i>Acacia ramulosa</i> var. <i>linophylla</i> <i>Acacia ramulosa</i> var. <i>ramulosa</i> <i>Acacia sibina</i> <i>Acacia tetragonophylla</i> <i>Acacia umbraculiformis</i> <i>Mirbelia bursarioides</i> ms <i>Senna artemisioides</i> subsp. <i>filifolia</i> <i>Senna charlesiana</i> <i>Senna</i> sp. Austin (A. Strid 20210)
<b>Frankeniaceae</b>	<i>Frankenia setosa</i>
<b>Goodeniaceae</b>	<i>Scaevola spinescens</i>
<b>Hemerocallidaceae</b>	<i>Dianella revoluta</i>
<b>Lamiaceae</b>	<i>Microcorys</i> sp. Mt Gibson (S. Patrick 2098) <i>Prostanthera patens</i>
<b>Loranthaceae</b>	<i>Amyema gibberula</i> var. <i>gibberula</i> <i>Amyema gibberula</i> var. <i>tatei</i>
<b>Malvaceae</b>	<i>Brachychiton gregorii</i> <i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32)
<b>Myrtaceae</b>	<i>Aluta aspera</i> subsp. <i>hesperia</i> <i>Calytrix uncinata</i> (P3) <i>Eucalyptus kochii</i> subsp. <i>plenissima</i> <i>Eucalyptus loxophleba</i> subsp. <i>supralaevius</i> <i>Melaleuca hamata</i>

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<b>Myrtaceae</b> (cont.)	<i>Melaleuca leiocarpa</i> <i>Micromyrtus trudgenii</i> (P3) <i>Thryptomene costata</i> <i>Thryptomene decussata</i>
<b>Pittosporaceae</b>	<i>Bursaria occidentalis</i> <i>Cheiranthra simplicifolia</i>
<b>Poaceae</b>	<i>Aristida contorta</i> <i>Austrostipa elegantissima</i> <i>Austrostipa scabra</i> <i>Enneapogon caerulescens</i> <i>Eragrostis dielsii</i> <i>Monachather paradoxus</i>
<b>Proteaceae</b>	<i>Grevillea nematophylla</i> subsp. <i>supraplana</i> <i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i> <i>Grevillea pityophylla</i> <i>Hakea recurva</i> subsp. <i>arida</i> <i>Hakea recurva</i> subsp. <i>recurva</i> <i>Persoonia pentasticha</i> (P3)
<b>Rhamnaceae</b>	<i>Cryptandra imbricata</i>
<b>Rubiaceae</b>	<i>Psydrax suaveolens</i>
<b>Rutaceae</b>	<i>Philotheca brucei</i> subsp. <i>brucei</i> <i>Philotheca deserti</i> subsp. <i>deserti</i> <i>Philotheca sericea</i> <i>Philotheca tomentella</i>
<b>Santalaceae</b>	<i>Santalum acuminatum</i> <i>Santalum spicatum</i>
<b>Sapindaceae</b>	<i>Dodonaea inaequifolia</i> <i>Dodonaea ?petiolaris</i>
<b>Scrophulariaceae</b>	<i>Eremophila clarkei</i> <i>Eremophila eriocalyx</i> <i>Eremophila forrestii</i> subsp. <i>forrestii</i> <i>Eremophila georgei</i> <i>Eremophila glutinosa</i> <i>Eremophila granitica</i> <i>Eremophila latrobei</i> subsp. <i>latrobei</i> <i>Eremophila oldfieldii</i> subsp. <i>oldfieldii</i> <i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>

**Scrophylariaceae** (cont.)    *Eremophila pantonii*  
                                      *Eremophila punicea*

**Solanaceae**                    *Solanum cleistogamum*  
                                      *Solanum lasiophyllum*  
                                      *Solanum nummularium*

Total Taxa: 114 taxa and 2 putative hybrids

**Appendix G:                Raw Data Recorded within Quadrats in the Gossan Hill Cold Pit  
Project Study Area**



Site Name: GG-01  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 494902E 6822785N  
 Landform Type: Plain  
 Slope Class: Gently Inclined (3 degrees)  
 Aspect: NE  
 Soil Type: Sandy Loam  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 Vegetation Condition: VG - Very Good  
 Fire: > 3 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Tecticornia disarticulata*  
 Lower Stratum 1: *Maireana amoena*, *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Atriplex ?amnicola</i>	0.7	0.25
<i>Atriplex codonocarpa</i>	0.1	0.1
<i>Enneapogon caeruleus</i>	0.1	0.1
<i>Maireana amoena</i>	0.3	1
<i>Ptilotus obovatus</i>	0.5	0.5
<i>Rhagodia drummondii</i>	0.8	0.9
<i>?Sarcocolla praecox</i>	0.1	0.2
<i>Sclerolaena diacantha</i>	0.3	0.25
<i>Tecticornia disarticulata</i>	0.6	12.5

### **PHOTOS**



Site Name: GG-02  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 494869E 6822448N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Aspect: W  
 Soil Type: Sandy clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 Vegetation Condition: VG - Very Good  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*  
 Mid Stratum 1: *Scaevola spinescens*  
 Lower Stratum 1: *Maireana* sp., *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	3.5	3
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	20
<i>Acacia tetragonophylla</i>	2.4	1
<i>Aristida contorta</i>	0.1	0.1
<i>Austrostipa ?scabra</i>	0.3	0.1
<i>Eremophila eriocalyx</i>	1.9	0.2
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.3	0.1
<i>Eremophila georgei</i>	0.8	0.2
<i>Eremophila granitica</i>	0.9	0.2
<i>Maireana carnosa</i>		0.2
<i>Maireana</i> sp.	0.7	0.2
<i>Maireana tomentosa</i>	0.1	0.1
<i>Monachather paradoxus</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.5	0.5
<i>Rhagodia drummondii</i>	1.7	0.2
<i>Scaevola spinescens</i>	1.4	3

<i>Sclerolaena gardneri</i>	0.2	0.1
<i>Senna</i> sp. Austin (A. Strid 20210)	1.2	0.1
<i>Solanum lasiophyllum</i>	0.7	0.1

**PHOTOS**

Site Name: GG-03  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 494383E 6821870N  
 Landform Type: Mid Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Soil Type: Sandy Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 200-600mm  
 CF Types: Granite  
 Vegetation Condition: VG - Very Good  
 Fire: > 3 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia ramulosa* var. *ramulosa*  
 Upper Stratum 2: *Acacia burkittii*, *Acacia tetragonophylla*  
 Mid Stratum 1: *Eremophila glutinosa*  
 Mid Stratum 2: *Philotheca brucei* subsp. *brucei*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	2.1	9
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	35
<i>Acacia tetragonophylla</i>	2	1
<i>Aristida contorta</i>	0.1	0.2
? <i>Enchylaena lanata</i>	0.01	0.1
<i>Eremophila glutinosa</i>	1	1.5
<i>Eremophila granitica</i>	0.5	0.25
<i>Mirbelia bursarioides</i> ms	0.3	0.25
<i>Philotheca brucei</i> subsp. <i>brucei</i>	0.3	0.3
<i>Rhagodia drummondii</i>	0.8	0.25
<i>Senna</i> sp. Austin (A. Strid 20210)	1	0.4

### **PHOTOS**







Site Name: GG-04  
Site Type: QUADRAT  
Dimensions: 20m x 20m  
Survey Date: 23/10/2012  
GPS Location: WGS84 (Zone 50) 495436E 6821713N  
Landform Type: Plain  
Slope Class: Level (0 degrees)  
Soil Type: Sandy Loam  
Soil Colour: Yellow  
Rock Outcrop: No bedrock exposed  
CF Abundance: 0%  
Vegetation Condition: G - Good

**DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*

**SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia exocarpoides</i>	1.5	0.25
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	40
<i>Acacia tetragonophylla</i>	2	1
<i>Maireana</i> sp.	0.6	0.2
<i>Monachather paradoxus</i>	0.2	0.1
<i>Ptilotus obovatus</i>	0.5	0.25
<i>Rhagodia drummondii</i>	0.3	0.1
<i>Scaevola spinescens</i>	1.5	0.6

**PHOTOS**



Site Name: GG-05  
Site Type: QUADRAT  
Dimensions: 20m x 20m  
Survey Date: 23/10/2012  
GPS Location: WGS84 (Zone 50) 495420E 6821144N  
Landform Type: man made open depression (other)  
Slope Class: Level (0 degrees)  
Soil Type: Sandy Loam  
Soil Colour: Yellow  
Rock Outcrop: No bedrock exposed  
CF Abundance: 0%  
Vegetation Condition: VG - Very Good  
Disturbance: rubbish (other)

**DOMINANT TAXA IN VEGETATION STRATA**

Lower Stratum 1: *Tecticornia disarticulata*

**SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Atriplex ?bunburyana</i>	0.2	0.5
<i>Eragrostis dielsii</i>	0.01	0.4
<i>Pogonolepis muelleriana</i>	0.01	0.4
<i>Tecticornia disarticulata</i>	0.5	20

**PHOTOS**



Site Name: GG-06  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 495778E 6821007N  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 20-60mm  
 CF Types: Quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats, proximity to tip (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia masliniana*  
 Mid Stratum 2: *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*  
 Lower Stratum 1: *Tecticornia disarticulata*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	5	3
<i>Acacia masliniana</i>	4.5	12.5
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	5
<i>Acacia tetragonophylla</i>	0.2	0.1
<i>Atriplex ?bunburyana</i>	0.1	0.2
<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	3	0.2
<i>Erymophyllum ramosum</i> subsp. <i>ramosum</i>	0.01	0.1
<i>Ptilotus obovatus</i>	0.4	0.2
<i>Rhagodia drummondii</i>	0.6	0.1
<i>Scaevola spinescens</i>	1	0.1
<i>Sclerolaena densiflora</i>	0.1	0.1
<i>Solanum lasiophyllum</i>	0.6	0.5
<i>Tecticornia disarticulata</i>	0.6	8

### **PHOTOS**







Site Name: GG-07  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 495311E 6820436N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: Sandy Loam / Clay Loam (other)  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 60-200mm  
 CF Types: Granite  
 Vegetation Condition: VG - Very Good  
 Fire: > 3 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia grasbyi*, *Acacia ramulosa* var. *ramulosa*  
 Lower Stratum 1: *Acacia burkittii*  
 Lower Stratum 2: *Eremophila granitica*, *Eremophila punicea*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	2.5	2
<i>Acacia grasbyi</i>	4	4
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	4
<i>Acacia tetragonophylla</i>	0.6	0.2
<i>Acacia umbraculiformis</i>	3	1.5
<i>Aristida contorta</i>	0.1	0.1
<i>Eremophila granitica</i>	0.5	2
<i>Eremophila punicea</i>	0.6	3
<i>Hakea recurva</i> subsp. <i>arida</i>	1.2	1
<i>Philotheca brucei</i> subsp. <i>brucei</i>	0.7	1

### **PHOTOS**



Site Name: GG-08  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 495711E 6820392N  
 Landform Type: Upper Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 20-60mm  
 CF Types: Quartz / Granite (other)  
 Vegetation Condition: VG - Very Good

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*  
 Lower Stratum 1: *Eremophila granitica*, *Eremophila latrobei* subsp. *latrobei*, *Solanum lasiophyllum*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	4	9
<i>Acacia caesaneura</i> ms	3.5	0.4
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	25
<i>Acacia tetragonophylla</i>	4	0.2
<i>Atriplex ?bunburyana</i>	0.2	0.1
<i>Eremophila granitica</i>	0.4	0.25
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.3	0.2
<i>Scaevola spinescens</i>	1	0.2
<i>Solanum lasiophyllum</i>	0.5	0.2

### **PHOTOS**



Site Name: GG-09  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 493334E 6820399N  
 Landform Type: Simple Slope  
 Slope Class: Moderately Inclined (10 degrees)  
 Aspect: SE  
 Soil Type: Sandy clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

#### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia caesaneura* ms, *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 1: *Eremophila forrestii* subsp. *forrestii*  
 Lower Stratum 1: *Monachather paradoxus*

#### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	5	3.5
<i>Acacia craspedocarpa</i>	3.5	
<i>Acacia exocarpoides</i>	1.5	
<i>Acacia incurvaneura</i> ms	4.2	4
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	10
<i>Acacia umbraculiformis</i>	1.6	0.2
<i>Brachychiton gregorii</i>	2.5	
<i>Dianella revoluta</i>	0.9	0.1
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.4	2
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.2	
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	4	2
<i>Hakea recurva</i> subsp. <i>recurva</i>	2.8	1
<i>Monachather paradoxus</i>	0.4	0.1
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.7	
<i>Rhyncharrhena linearis</i>		0.1
<i>Santalum spicatum</i>	2	



<i>Solanum cleistogamum</i>	0.2	0.1
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## **PHOTOS**





Site Name: GG-10  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 493252E 6819975N  
 Landform Type: Simple Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm  
 CF Types: Granite, Quartz & Ironstone (other)  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia umbraculiformis*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia tetragonophylla</i>	1.3	0.1
<i>Acacia umbraculiformis</i>	3	1.5
<i>Aristida contorta</i>	0.1	0.5
<i>Borya sphaerocephala</i>	0.1	0.5
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.5	0.1
<i>Grevillea pityophylla</i>	0.5	0.1
<i>Mirbelia bursarioides</i> ms	1.3	0.1
<i>Ptilotus obovatus</i>	1	0.2
<i>Thryptomene costata</i>	1.6	10

### **PHOTOS**



Site Name: GG-11  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 492803E 6818800N  
 Landform Type: Mid Slope  
 Slope Class: Steep (23 degrees)  
 Aspect: W  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Pink / Brown (other)  
 Rock Outcrop: Granite, 20-50% bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia aulacophylla*, *Acacia grasbyi*

Mid Stratum 1: *Dodonaea inaequifolia*, *Eremophila glutinosa*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aulacophylla</i>	3.5	6
<i>Acacia caesaneura</i> ms	1.2	0.1
<i>Acacia grasbyi</i>	2.5	1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	5
<i>Acacia umbraculiformis</i>	4	2
<i>Aristida contorta</i>	0.1	0.1
<i>Borya sphaerocephala</i>	0.1	0.1
<i>Calytrix uncinata</i> (3)	1	0.3
<i>Dodonaea inaequifolia</i>	1.2	0.5
<i>Eremophila clarkei</i>	1	0.1
<i>Eremophila glutinosa</i>	1.3	6
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.3	1
<i>Grevillea pityophylla</i>	0.3	0.1
<i>Mirbelia bursarioides</i> ms	1.5	0.2
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.4	1
<i>Thryptomene costata</i>	1.4	0.5

## **PHOTOS**



Site Name: GG-12  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 23/10/2012  
 GPS Location: WGS84 (Zone 50) 492351E 6818400N  
 Landform Type: Simple Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Aspect: SW  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm, 6-20mm  
 CF Types: Granite, Ironstone  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa*  
 Lower Stratum 1: *Minuria cunninghamii*  
 Lower Stratum 2: *Monachather paradoxus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia effusifolia</i>	6	13
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	5	6
<i>Acacia sibina</i>	2.3	0.5
<i>Austrostipa elegantissima</i>	0.7	0.2
<i>Austrostipa ?scabra</i>	0.4	0.1
<i>Cryptandra imbricata</i>	1.2	0.2
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.5	
<i>Eremophila granitica</i>	1.2	0.1
<i>Minuria cunninghamii</i>	1	2
<i>Monachather paradoxus</i>	0.4	2

### **PHOTOS**







Site Name: GG-13  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 493110E 6818342N  
 Landform Type: Upper Slope  
 Slope Class: Steep (23 degrees)  
 Aspect: WSW  
 Soil Type: Clayey sand (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: Laterite, 2-10% bedrock exposed  
 CF Abundance: >90%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm  
 CF Types: Laterite  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia caesaneura* ms, *Acacia umbraculiformis*, *Grevillea obliquistigma* subsp. *obliquistigma*  
 Mid Stratum 1: *Aluta aspera* subsp. *hesperia*, *Philotheca sericea*, *Thryptomene costata*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aulacophylla</i>	3	
<i>Acacia caesaneura</i> ms	4	5
<i>Acacia craspedocarpa</i>	3	
<i>Acacia effusifolia</i>	3	
<i>Acacia incurvaneura</i> ms	3.5	
<i>Acacia umbraculiformis</i>	3.5	1
<i>Aluta aspera</i> subsp. <i>hesperia</i>	1.1	10
<i>Aristida contorta</i>	0.1	0.1
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	3	1
<i>Monachather paradoxus</i>	0.2	0.1
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.2	
<i>Philotheca sericea</i>	1.4	5
<i>Solanum cleistogamum</i>	0.1	0.1

<i>Thryptomene costata</i>	1.6	8
<i>Thryptomene decussata</i>	2.3	

**PHOTOS**

Site Name: GG-14  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 493339E 6817515N  
 Landform Type: Simple Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Aspect: SW  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm  
 CF Types: Quartz / Granite (other)  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

#### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia aneura hybrid*, *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa*, *Acacia sibina*  
 Mid Stratum 1: *Eremophila clarkei*, *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *brucei*  
 Lower Stratum 1: *Monachather paradoxus*

#### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aneura hybrid</i>	4.5	0.2
<i>Acacia effusifolia</i>	4	35
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	30
<i>Acacia sibina</i>	4	5
<i>Eremophila clarkei</i>	1.4	0.3
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.1	0.2
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.2	0.7
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	3	2
<i>Monachather paradoxus</i>	0.5	0.5
<i>Philotheca brucei</i> subsp. <i>brucei</i>	0.7	0.2
<i>Solanum cleistogamum</i>	0.2	0.1

**PHOTOS**



Site Name: GG-15  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 493924E 6817448N  
 Landform Type: Upper slope of ridge (other)  
 Slope Class: Very Steep (37 degrees)  
 Aspect: WSW  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: Granite, 20-50% bedrock exposed  
 CF Abundance: 50-90%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm  
 CF Types: Quartz / Granite (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: goat tracks (other)  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia incurvaneura* ms, *Acacia ramulosa* var. *ramulosa*,  
*Thryptomene decussata*

Mid Stratum 1: *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *brucei*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia exocarpoides</i>	1.6	0.5
<i>Acacia incurvaneura</i> ms	4.5	7
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	7
<i>Dodonaea ?petiolaris</i>	0.3	0.1
<i>Eremophila clarkei</i>	0.7	0.1
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.5	4
<i>Hakea recurva</i> subsp. <i>recurva</i>	2	1
<i>Mirbelia bursarioides</i> ms	1.5	0.4
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.9	4
<i>Solanum cleistogamum</i>	0.1	0.1
<i>Thryptomene decussata</i>	3	7

### **PHOTOS**







Site Name: GG-16  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 493976E 6817511N  
 Landform Type: Upper slope of ridge (other)  
 Slope Class: Very Steep (37 degrees)  
 Aspect: ENE  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: Ironstone, >50% bedrock exposed  
 CF Abundance: 50-90%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm  
 CF Types: Ironstone  
 Vegetation Condition: VG - Very Good  
 Disturbance: goat pads, minor grazing (other)  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia incurvaneura* ms, *Acacia ramulosa* var. *ramulosa*,  
*Thryptomene decussata*

Lower Stratum 1: *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aulacophylla</i>	3	0.1
<i>Acacia incurvaneura</i> ms	4	4
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	2
<i>Aristida contorta</i>	0.2	0.1
<i>Dodonaea ?petiolaris</i>	0.3	0.1
<i>Eremophila clarkei</i>	0.6	0.1
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.8	0.1
<i>Mirbelia bursarioides</i> ms	1.6	0.1
<i>Philotheca sericea</i>	0.8	0.2
<i>Ptilotus obovatus</i>	0.8	40
<i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32)	0.2	0.1
<i>Solanum cleistogamum</i>	0.2	0.1
<i>Solanum lasiophyllum</i>	0.6	0.1

<i>Thryptomene decussata</i>	3	20
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**PHOTOS**

Site Name: GG-17  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 495445E 6818180N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Aspect: NW  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Lower Stratum 1: *Monachather paradoxus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia effusifolia</i>	3.5	30
<i>Acacia exocarpoides</i>	2	0.7
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	2.5	1
<i>Acacia sibina</i>	1.8	0.3
<i>Acacia tetragonophylla</i>	1	0.2
<i>Dianella revoluta</i>	0.8	0.1
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	2	0.5
<i>Monachather paradoxus</i>	0.5	2

### **PHOTOS**



Site Name: GG-18  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 494546E 6817283N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm, 6-20mm  
 CF Types: Ironstone  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats present (other)  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia ramulosa* var. *ramulosa*, *Bursaria occidentalis*  
 Lower Stratum 1: *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	3.5	0.5
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	20
<i>Acacia tetragonophylla</i>	0.7	0.1
<i>Austrostipa elegantissima</i>	0.3	0.1
<i>Austrostipa ?scabra</i>	0.3	0.2
<i>Bursaria occidentalis</i>	5	4
<i>Cryptandra imbricata</i>	1.4	0.4
<i>Enchylaena tomentosa</i>	0.1	0.1
<i>Maireana tomentosa</i>	0.1	0.1
<i>Minuria cunninghamii</i>	0.4	0.1
<i>Monachather paradoxus</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.6	1
<i>Rhagodia drummondii</i>	0.3	0.4
<i>Solanum nummularium</i>	0.4	0.2

### **PHOTOS**







Site Name: GG-19  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 493732E 6816913N  
 Landform Type: Simple Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Aspect: SW  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm, 6-20mm  
 CF Types: Granite, Ironstone  
 Vegetation Condition: E - Excellent  
 Disturbance: None  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia incurvaneura* ms, *Acacia latior*, *Acacia sibina*

Mid Stratum 1: *Aluta aspera* subsp. *hesperia*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aulacophylla</i>	1.4	0.2
<i>Acacia incurvaneura</i> ms	3.5	2
<i>Acacia latior</i>	2.2	4
<i>Acacia sibina</i>	2	3
<i>Aluta aspera</i> subsp. <i>hesperia</i>	1.2	10
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.9	0.1
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	2.4	1.5
<i>Monachather paradoxus</i>	0.3	0.1

### **PHOTOS**



Site Name: GG-20  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 494405E 6816184N  
 Landform Type: Ridge  
 Slope Class: Very Steep (37 degrees)  
 Aspect: S  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: Ironstone, >50% bedrock exposed  
 CF Abundance: >90%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm  
 CF Types: Ironstone / Quartz (other)  
 Vegetation Condition: VG - Very Good  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia aulacophylla*, *Acacia craspedocarpa*, *Acacia incurvaneura* ms, *Grevillea obliquistigma* subsp. *obliquistigma*  
 Mid Stratum 1: *Eremophila latrobei* subsp. *latrobei*, *Thryptomene decussata*  
 Lower Stratum 1: *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aulacophylla</i>	4	4
<i>Acacia burkittii</i>	3.5	1.5
<i>Acacia craspedocarpa</i>	4.5	1.5
<i>Acacia exocarpoides</i>	1.3	1
<i>Acacia incurvaneura</i> ms	4.5	5
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	2
<i>Acacia tetragonophylla</i>	3.5	0.5
<i>Austrostipa elegantissima</i>	0.2	0.1
<i>Dodonaea ?petiolaris</i>	0.3	0.1
<i>Eremophila clarkei</i>	0.4	0.1
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.5	2
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	3.5	3
<i>Hakea recurva</i> subsp. <i>recurva</i>	1.7	0.2

<i>Mirbelia bursarioides</i> ms	1.4	0.4
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.3	0.2
<i>Philotheca sericea</i>	1.1	0.1
<i>Ptilotus obovatus</i>	0.8	3
<i>Santalum acuminatum</i>	3.8	0.6
<i>Solanum lasiophyllum</i>	0.5	0.2
<i>Thryptomene decussata</i>	3.5	2

## **PHOTOS**



Site Name: GG-21  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 494598E 6815980N  
 Landform Type: Simple Slope  
 Slope Class: Very Gently Inclined (1 degree)  
 Aspect: S  
 Soil Type: Sandy Clay (other)  
 Soil Colour: Red / Brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm  
 CF Types: Granite, Ironstone  
 Vegetation Condition: VG - Very Good  
 Disturbance: disturbed / scalped area with regrowth 50 m to west (other)  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	3	
<i>Acacia caesaneura</i> ms	4.5	
<i>Acacia effusifolia</i>	2.2	1
<i>Acacia exocarpoides</i>	1.6	
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	10
<i>Acacia sibina</i>	1.5	0.5
<i>Acacia tetragonophylla</i>	3	0.5
<i>Solanum lasiophyllum</i>	0.6	

### **PHOTOS**





Site Name: GG-22  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 495583E 6816057N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Aspect: SW  
 Soil Type: Clayey sand (other)  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

#### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia effusifolia*  
 Lower Stratum 1: *Monachather paradoxus*

#### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia effusifolia</i>	4.5	40
<i>Dianella revoluta</i>	0.9	0.1
<i>Monachather paradoxus</i>	0.5	10
<i>Philotheca deserti</i> subsp. <i>deserti</i>	1.3	0.2
<i>Philotheca tomentella</i>	1	0.1

#### **PHOTOS**



Site Name: GG-23  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 22/10/2012  
 GPS Location: WGS84 (Zone 50) 493656E 6815184N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy clay (other)  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Fire: > 5 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Grevillea nematophylla* subsp. *supraplana*  
 Mid Stratum 1: *Acacia effusifolia*, *Acacia sibina*  
 Lower Stratum 1: *Monachather paradoxus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia effusifolia</i>	3.5	21
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	1.8	1
<i>Acacia sibina</i>	2.4	5
<i>Austrostipa elegantissima</i>	0.4	0.1
<i>Cheiranthra simplicifolia</i>		0.1
<i>Cryptandra imbricata</i>	1.5	0.2
<i>Grevillea nematophylla</i> subsp. <i>supraplana</i>	5.5	2
<i>Monachather paradoxus</i>	0.5	2
<i>Ptilotus drummondii</i>	0.4	0.1
<i>Rhagodia drummondii</i>	0.5	0.1

### **PHOTOS**



Site Name: GG-24  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 22/10/2012  
 GPS Location: WGS84 (Zone 50) 493388E 6814858N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)  
 Fire: > 4 years

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 1: *Acacia tetragonophylla*, *Hakea recurva* subsp. *arida*  
 Lower Stratum 1: *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	1.5	0.2
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	40
<i>Acacia tetragonophylla</i>	3	3
<i>Amyema gibberula</i> var. <i>tatei</i>		0.1
<i>Dianella revoluta</i>	0.5	0.1
? <i>Enchylaena lanata</i>	0.3	0.1
<i>Hakea recurva</i> subsp. <i>arida</i>	2.2	4
<i>Monachather paradoxus</i>	0.3	0.25
<i>Ptilotus divaricatus</i>	0.4	0.1
<i>Ptilotus obovatus</i>	1.2	0.6

### **PHOTOS**







Site Name: GG-25  
Site Type: QUADRAT  
Dimensions: 20m x 20m  
Survey Date: 24/10/2012  
GPS Location: WGS84 (Zone 50) 495740E 6819297N  
Landform Type: Flat  
Slope Class: Level (0 degrees)  
Soil Type: Clay Loam  
Rock Outcrop: No bedrock exposed  
CF Abundance: <2%  
CF Sizes: 2-6mm, 6-20mm  
CF Types: Quartz / Granite (other)  
Vegetation Condition: VG - Very Good  
Disturbance: Goats, proximity to road (other)

**DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*

**SPECIES LIST**

Taxon Name	Avg. Height	% Cover Alive
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	65
<i>Dodonaea inaequifolia</i>	1	0.2
<i>Eremophila granitica</i>	0.6	0.2
<i>Senna charlesiana</i>	1.5	0.2
<i>Solanum lasiophyllum</i>	0.5	0.2

**PHOTOS**



Site Name: GG-26  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 497060E 6818927N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Clay Loam  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm  
 CF Types: Quartz / Granite (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats, proximity to road (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Eucalyptus loxophleba* subsp. *supralaevis*  
 Lower Stratum 1: *Maireana tomentosa* subsp. *tomentosa*, *Maireana triptera*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Eremophila oldfieldii</i> subsp. <i>oldfieldii</i>	4	2
<i>Erymophyllum ramosum</i> subsp. <i>ramosum</i>	0.01	0.1
<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>	7	40
<i>Maireana tomentosa</i> subsp. <i>tomentosa</i>	0.1	1
<i>Maireana triptera</i>	0.5	3
<i>Ptilotus obovatus</i>	0.4	0.4
<i>Rhagodia drummondii</i>	0.7	1
<i>Sclerolaena diacantha</i>	0.1	0.1

### **PHOTOS**



Site Name: GG-27  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 497410E 6818382N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Clay Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 0%  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Lower Stratum 1: *Frankenia setosa*, *Maireana georgei*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Atriplex codonocarpa</i>	0.01	0.1
<i>Erymophyllum ramosum</i> subsp. <i>ramosum</i>	0.01	0.1
<i>Frankenia setosa</i>	0.3	7
<i>Maireana georgei</i>	0.3	1
<i>Maireana ?georgei</i>	0.5	0.1
<i>Rhagodia drummondii</i>	0.8	0.1
<i>Sclerolaena gardneri</i>	0.2	0.1

### **PHOTOS**







Site Name: GG-28  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 496610E 6817778N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: Clay Loam  
 Rock Outcrop: Granite, >2% bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm  
 CF Types: Granite  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats, proximity to pit (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia umbraculiformis*  
 Mid Stratum 2: *Acacia caesaneura* ms, *Acacia ramulosa* var. *linophylla*, *Acacia ramulosa* var. *ramulosa*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	5	6
<i>Acacia grasbyi</i>	5	0.9
<i>Acacia ramulosa</i> var. <i>linophylla</i>	4	7
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	8
<i>Acacia tetragonophylla</i>	3	2
<i>Acacia umbraculiformis</i>	4.5	6
<i>Aristida contorta</i>	0.1	0.1
<i>Borya sphaerocephala</i>	0.1	0.1
<i>Eremophila punicea</i>	0.5	0.2
<i>Grevillea pityophylla</i>	1.5	1
<i>Hakea recurva</i> subsp. <i>arida</i>	2.5	6
<i>Mirbelia bursarioides</i> ms	2	1.5
<i>Ptilotus obovatus</i>	0.6	1
<i>Ptilotus schwartzii</i>	0.2	0.1
<i>Solanum lasiophyllum</i>	0.7	0.3
<i>Thryptomene costata</i>	1	0.75

**PHOTOS**



Site Name: GG-29  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 498050E 6817015N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: Sandy Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm, 6-20mm  
 CF Types: Quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: None

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 2: *Acacia burkittii*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	3	20
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	50
<i>Acacia tetragonophylla</i>	3	5
<i>Austrostipa scabra</i>	0.4	0.1
<i>Eremophila georgei</i>	0.5	0.1
<i>Monachather paradoxus</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.4	0.1
<i>Scaevola spinescens</i>	0.5	0.2

### **PHOTOS**



Site Name: GG-30  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 498120E 6816551N  
 Landform Type: Top of Hillock / Upper Slope (other)  
 Slope Class: Gently Inclined (3 degrees)  
 Soil Type: Sandy Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm  
 CF Types: Granite  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia grasbyi*, *Acacia umbraculiformis*  
 Lower Stratum 1: *Ptilotus schwartzii*, *Thryptomene costata*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia grasbyi</i>	3	0.75
<i>Acacia umbraculiformis</i>	4	4
<i>Aristida contorta</i>	0.1	0.1
<i>Borya sphaerocephala</i>	0.1	0.25
<i>Eremophila punicea</i>	0.4	0.2
<i>Pogonolepis muelleriana</i>	0.1	0.1
<i>Ptilotus obovatus</i>	0.4	0.1
<i>Ptilotus schwartzii</i>	0.3	0.4
<i>Thryptomene costata</i>	1.2	8

### **PHOTOS**







Site Name: GG-31  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 496230E 6815650N  
 Landform Type: Flat / Plain (other)  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 0%  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Callitris columellaris*  
 Mid Stratum 2: *Acacia ramulosa* var. *ramulosa*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	30
<i>Callitris columellaris</i>	12	35
<i>Cryptandra imbricata</i>	1.5	0.75
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	2	2
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.8	0.4
<i>Microcorys</i> sp. Mt Gibson (S. Patrick 2098)	1.1	1
<i>Monachather paradoxus</i>	0.4	0.8
<i>Olearia pimeleoides</i>	1	0.2
<i>Rhagodia drummondii</i>	0.7	0.5
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	1.5	0.25
<i>Senna charlesiana</i>	1.2	0.3

### **PHOTOS**



Site Name: GG-32  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 498025E 6814965N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 6-20mm  
 CF Types: Ironstone  
 Vegetation Condition: VG - Very Good

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*

Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*, *Eremophila pantonii*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	5	20
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	12.5
<i>Acacia tetragonophylla</i>	4	0.25
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.5	0.2
<i>Eremophila pantonii</i>	3	5
<i>Hakea recurva</i> subsp. <i>recurva</i>	0.3	0.1
<i>Ptilotus obovatus</i>	0.5	0.5
<i>Santalum acuminatum</i>	3	1
<i>Scaevola spinescens</i>	2	0.3
<i>Sclerolaena eriacantha</i>	0.1	0.1
<i>Sclerolaena fusiformis</i>	0.01	0.1
<i>Sclerolaena gardneri</i>	0.1	0.1
<i>Sclerolaena microcarpa</i>	0.1	0.4
<i>Solanum nummularium</i>	0.3	0.1

### **PHOTOS**



Site Name: GG-33  
Site Type: QUADRAT  
Dimensions: 20m x 20m  
Survey Date: 24/10/2012  
GPS Location: WGS84 (Zone 50) 498204E 6814827N  
Landform Type: Flat  
Slope Class: Level (0 degrees)  
Soil Type: Sandy Loam  
Soil Colour: red-brown (other)  
Rock Outcrop: No bedrock exposed  
CF Abundance: 0%  
Vegetation Condition: VG - Very Good

**DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia sibina*  
Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*  
Lower Stratum 1: *Monachather paradoxus*

**SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	6
<i>Acacia sibina</i>	5	40
<i>Monachather paradoxus</i>	0.5	5
<i>Waitzia acuminata</i> var. <i>acuminata</i>	0.1	0.1

**PHOTOS**







Site Name: GG-34  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 498540E 6814681N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Loam  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 50-90%  
 CF Sizes: 20-60mm  
 CF Types: Granite, Ironstone, quartz (other)  
 Vegetation Condition: VG - Very Good

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*  
 Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	4	15
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	9
<i>Acacia tetragonophylla</i>	3	0.4
<i>Aristida contorta</i>	0.1	0.1
<i>Hyalosperma glutinosum</i>	0.1	0.1
<i>Ptilotus obovatus</i>	0.3	0.3
<i>Senna charlesiana</i>	1.5	0.2
<i>Thryptomene costata</i>	1.3	0.25

### **PHOTOS**



Site Name: GG-35  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 24/10/2012  
 GPS Location: WGS84 (Zone 50) 498740E 6814670N  
 Landform Type: Ridgetop (other)  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: Sandy Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 Vegetation Condition: VG - Very Good

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia grasbyi*, *Acacia umbraculiformis*  
 Lower Stratum 1: *Thryptomene costata*  
 Lower Stratum 2: *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	2.5	2
<i>Acacia grasbyi</i>	4	5
<i>Acacia tetragonophylla</i>	3	1
<i>Acacia umbraculiformis</i>	3	2
<i>Aristida contorta</i>	0.01	0.1
<i>Borya sphaerocephala</i>	0.1	0.1
<i>Eremophila punicea</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.5	3
<i>Senna charlesiana</i>	0.8	0.1
<i>Solanum nummularium</i>	0.5	0.1
<i>Thryptomene costata</i>	1	7

### **PHOTOS**



Site Name: GG-36  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 26/10/2012  
 GPS Location: WGS84 (Zone 50) 497192E 6817937N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: sandy clay (other)  
 Soil Colour: pinkish grey (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm  
 CF Types: Granite, quartz (other)  
 Vegetation Condition: VG - Very Good  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia kalgoorliensis*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*

Mid Stratum 1: *Dodonaea inaequifolia*, *Eremophila georgei*, *Rhagodia drummondii*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	3.5	6
<i>Acacia incurvaneura</i> ms	6	0.4
<i>Acacia kalgoorliensis</i>	3	15
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	15
<i>Acacia tetragonophylla</i>	3.5	3
<i>Dodonaea inaequifolia</i>	1.8	3
<i>Eremophila georgei</i>	1.7	2
<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	3	1
<i>Maireana georgei</i>	0.4	
<i>Maireana glomerifolia</i>	0.3	
<i>Maireana triptera</i>	0.1	0.2
<i>Ptilotus obovatus</i>	0.6	0.4
<i>Rhagodia drummondii</i>	1.3	3
<i>Scaevola spinescens</i>	1.5	1
<i>Senna</i> sp. Austin (A. Strid 20210)	1.5	1



**PHOTOS**





Site Name: GG-37  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 498595E 6816815N  
 Landform Type: Upper Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Soil Type: Clay Loam  
 Soil Colour: Yellow  
 Rock Outcrop: Granite, >2% bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 60-200mm  
 CF Types: Granite  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia grasbyi*, *Acacia umbraculiformis*  
 Mid Stratum 1: *Thryptomene costata*  
 Mid Stratum 2: *Philotheca sericea*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia grasbyi</i>	4.5	7
<i>Acacia umbraculiformis</i>	3.5	6
<i>Aristida contorta</i>	0.1	0.1
<i>Borya sphaerocephala</i>	0.1	1
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.5	0.3
<i>Philotheca sericea</i>	1	8
<i>Thryptomene costata</i>	1.2	20

### **PHOTOS**



Site Name: GG-38  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 498657E 6816321N  
 Landform Type: Flat  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia grasbyi*  
 Mid Stratum 1: *Acacia aulacophylla*, *Acacia ramulosa* var. *ramulosa*  
 Lower Stratum 1: *Eremophila glutinosa*, *Eremophila latrobei* subsp. *latrobei*,  
*Philotheca brucei* subsp. *brucei*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aulacophylla</i>	4	15
<i>Acacia grasbyi</i>	6	9
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	25
<i>Acacia tetragonophylla</i>	3	3
<i>Aristida contorta</i>	0.1	0.1
<i>Eremophila clarkei</i>	0.5	0.75
<i>Eremophila glutinosa</i>	1	2
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.5	4
<i>Hakea recurva</i> subsp. <i>recurva</i>	3	1
<i>Mirbelia bursarioides</i> ms	1.7	3
<i>Philotheca brucei</i> subsp. <i>brucei</i>	2	5
<i>Psyrax suaveolens</i>	4	0.4

### **PHOTOS**



Site Name: GG-39  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 498009E 6815928N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Yellow  
 CF Abundance: 2-10%  
 CF Sizes: 6-20mm  
 CF Types: Laterite, Ironstone, quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats, proxy to track (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*, *Grevillea obliquistigma* subsp. *obliquistigma*

Mid Stratum 1: *Eremophila forrestii* subsp. *forrestii*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	5.5	7
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	5	10
<i>Acacia tetragonophylla</i>	4	3
<i>Brachychiton gregorii</i>	5	2
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	2	5
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	4.5	5
<i>Hakea recurva</i> subsp. <i>recurva</i>	3	2
<i>Monachather paradoxus</i>	0.5	0.3
<i>Solanum lasiophyllum</i>	0.1	0.1

### **PHOTOS**





Site Name: GG-40  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 497406E 6815715N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia sibina*  
 Mid Stratum 1: *Acacia caesaneura* ms, *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 2: *Acacia tetragonophylla*, *Hakea recurva* subsp. *recurva*, *Scaevola spinescens*  
 Lower Stratum 1: *Monachather paradoxus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	5	20
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	10
<i>Acacia sibina</i>	5	30
<i>Acacia tetragonophylla</i>	0.5	12.5
<i>Dianella revoluta</i>	1.5	0.25
<i>Hakea recurva</i> subsp. <i>recurva</i>	4.5	8
<i>Monachather paradoxus</i>	0.5	2
<i>Ptilotus obovatus</i>	0.6	1.5
<i>Scaevola spinescens</i>	3.5	6
<i>Senna charlesiana</i>	1.2	0.8

### **PHOTOS**



Site Name: GG-41  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 497654E 6815526N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Clay Loam  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 20-60mm  
 CF Types: Granite, quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 1: *Acacia burkittii*, *Acacia tetragonophylla*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	3.5	3
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	17
<i>Acacia tetragonophylla</i>	3	5
<i>Aristida contorta</i>	0.1	0.1
<i>Eremophila eriocalyx</i>	2.2	0.4
<i>Eremophila granitica</i>	0.5	1
<i>Ptilotus obovatus</i>	0.5	0.4
<i>Ptilotus schwartzii</i>	0.2	0.1

### **PHOTOS**



Site Name: GG-42  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 496900E 6815411N  
 Landform Type: Flat  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 0%  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia effusifolia*, *Acacia sibina*  
 Mid Stratum 1: *Philotheca deserti* subsp. *deserti*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	3	8
<i>Acacia effusifolia</i>	2.5	20
<i>Acacia sibina</i>	2.5	32
<i>Monachather paradoxus</i>	0.5	0.8
<i>Philotheca deserti</i> subsp. <i>deserti</i>	1	9

### **PHOTOS**







Site Name: GG-43  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 497256E 6815073N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Rock Outcrop: No bedrock exposed  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia caesaneura* ms  
 Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*, *Melaleuca leiocarpa*  
 Lower Stratum 1: *Monachather paradoxus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	6	5
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	30
<i>Acacia sibina</i>	3.5	6
<i>Dianella revoluta</i>	0.7	0.2
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.5	0.3
<i>Hakea recurva</i> subsp. <i>recurva</i>	3	2
<i>Melaleuca leiocarpa</i>	3	15
<i>Monachather paradoxus</i>	0.6	2

### **PHOTOS**



Site Name: GG-44  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: GDA94 (Zone 50) 497090E 6814851N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Red  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*  
 Mid Stratum 1: *Acacia anthochaera*, *Acacia caesaneura* ms

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia anthochaera</i>	7.5	9
<i>Acacia burkittii</i>	5	20
<i>Acacia caesaneura</i> ms	5.5	8
<i>Acacia incurvaneura</i> ms	4	0.8
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	3
<i>Acacia tetragonophylla</i>	3	2
<i>Maireana thesioides</i>	0.4	0.5
<i>Minuria cunninghamii</i>	0.3	0.2
<i>Rhagodia drummondii</i>	1.5	0.4
<i>Sclerolaena fusiformis</i>	0.2	0.5
<i>Sclerolaena microcarpa</i>	0.2	1
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	1.2	0.4

### **PHOTOS**



Site Name: GG-44a  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 497020E 6814895N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Red  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Eucalyptus ?kochii* subsp. *plenissima*  
 Mid Stratum 1: *Acacia anthochaera*, *Acacia ramulosa* var. *ramulosa*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia anthochaera</i>	6	6
<i>Acacia caesaneura</i> ms	3	0.75
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	7
<i>Acacia tetragonophylla</i>	2	0.75
<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	4.5	1
<i>Eremophila pantonii</i>	1.5	0.25
<i>Eucalyptus ?kochii</i> subsp. <i>plenissima</i>	7	10
<i>Maireana thesioides</i>	0.5	0.2
<i>Minuria cunninghamii</i>	0.7	0.25
<i>Monachather paradoxus</i>	0.5	0.4
<i>Ptilotus obovatus</i>	0.6	0.2
<i>Rhagodia drummondii</i>	0.4	0.2
<i>Sclerolaena fusiformis</i>	0.2	0.2
<i>Sclerolaena microcarpa</i>	0.2	0.1
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	2.5	0.25

### **PHOTOS**







Site Name: GG-45  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 496394E 6817557N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Yellow  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm  
 CF Types: Laterite  
 Vegetation Condition: G - Good  
 Disturbance: Goats, proxy to stockpile and track (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*  
 Lower Stratum 1: *Eremophila forrestii* subsp. *forrestii*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	45
<i>Dianella revoluta</i>	1	0.2
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.5	7
<i>Stachystemon intricatus</i>	0.8	1.5

### **PHOTOS**



Site Name: GG-47  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 496147E 6820242N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: Clay Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 20-60mm, 60-200mm  
 CF Types: quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*  
 Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	6	24
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	25
<i>Acacia tetragonophylla</i>	5	4
<i>Dianella revoluta</i>	1	0.25
<i>Podolepis capillaris</i>	0.1	0.1
<i>Ptilotus obovatus</i>	0.5	2
<i>Rhagodia drummondii</i>	0.8	1.2
<i>Scaevola spinescens</i>	2	3
<i>Senna</i> sp. Austin (A. Strid 20210)	2.5	1.5
<i>Solanum lasiophyllum</i>	1.5	1.5
<i>Solanum nummularium</i>	0.3	0.8

### **PHOTOS**



Site Name: GG-48  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 26/10/2012  
 GPS Location: WGS84 (Zone 50) 495114E 6820730N  
 Landform Type: Upper Slope  
 Slope Class: Gently Inclined (3 degrees)  
 Soil Type: Sandy Loam  
 Rock Outcrop: Granite, >2% bedrock exposed  
 CF Abundance: 10-20%  
 CF Sizes: 20-60mm, 60-200mm  
 CF Types: Granite, quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

#### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*  
 Mid Stratum 1: *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 2: *Acacia tetragonophylla*

#### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	5	17
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	25
<i>Acacia tetragonophylla</i>	3.5	10
<i>Eremophila granitica</i>	0.6	0.2
<i>Eremophila punicea</i>	0.75	1
<i>Mirbelia bursarioides</i> ms	2	0.75
<i>Ptilotus obovatus</i>	0.5	1
<i>Scaevola spinescens</i>	1.5	0.8
<i>Solanum lasiophyllum</i>	0.1	0.1

#### **PHOTOS**





Site Name: GG-49  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 26/10/2012  
 GPS Location: WGS84 (Zone 50) 494651E 6820803N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: Clay Loam  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 50-90%  
 CF Sizes: 20-60mm  
 CF Types: Granite, Ironstone, quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Mining, goats, proxy to road (other)

#### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 2: *Acacia exocarpoides*, *Acacia tetragonophylla*, *Grevillea obliquistigma* subsp. *obliquistigma*  
 Lower Stratum 1: *Philotheca brucei* subsp. *brucei*, *Ptilotus obovatus*

#### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	4.5	15
<i>Acacia exocarpoides</i>	2.5	6
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	10
<i>Acacia tetragonophylla</i>	4	5
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	5	5
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.5	0.2
<i>Ptilotus obovatus</i>	0.6	1.5

#### **PHOTOS**



Site Name: GG-50  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 26/10/2012  
 GPS Location: WGS84 (Zone 50) 495108E 6822148N  
 Landform Type: Flat  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Red  
 Rock Outcrop: Granite, >2% bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 20-60mm  
 CF Types: Granite, quartz (other)  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Acacia tetragonophylla*, *Eremophila oppositifolia* subsp. *angustifolia*,  
*Senna* sp. Austin (A. Strid 20210)  
 Mid Stratum 2: *Acacia burkittii*  
 Lower Stratum 1: *Atriplex* sp., *Maireana georgei*, *Ptilotus obovatus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	3.5	1.5
<i>Acacia tetragonophylla</i>	3	3
<i>Atriplex</i> sp.	1.5	1.5
<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	2.5	2
<i>Maireana georgei</i>	0.4	6
<i>Ptilotus obovatus</i>	0.5	1
<i>Rhagodia drummondii</i>	0.5	0.25
<i>Senna</i> sp. Austin (A. Strid 20210)	2.5	7

### **PHOTOS**



Site Name: GG-51  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 26/10/2012  
 GPS Location: WGS84 (Zone 50) 493565E 6818218N  
 Landform Type: Ridge  
 Slope Class: Moderately Inclined (10 degrees)  
 Aspect: ENE  
 Soil Type: Sandy Loam  
 Soil Colour: brown (other)  
 Rock Outcrop: Ironstone, 2-10% bedrock exposed  
 CF Abundance: >90%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm  
 CF Types: Ironstone  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia incurvaneura* ms, *Acacia ramulosa* var. *ramulosa*  
 Mid Stratum 1: *Eremophila latrobei* subsp. *latrobei*, *Philotheca sericea*, *Thryptomene decussata*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aulacophylla</i>	3	1
<i>Acacia exocarpoides</i>	2	1.5
<i>Acacia incurvaneura</i> ms	8	5
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	5
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.9	2
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	4	0.5
<i>Mirbelia bursarioides</i> ms	1.4	0.2
<i>Monachather paradoxus</i>	0.2	0.1
<i>Philotheca sericea</i>	1.2	2
<i>Solanum lasiophyllum</i>	0.5	0.1
<i>Thryptomene decussata</i>	2	2

### **PHOTOS**







Site Name: GG-53  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 494150E 6821907N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: sandy clay (other)  
 Soil Colour: red-brown (other)  
 Rock Outcrop: Granite, 2-10% bedrock exposed  
 CF Abundance: >90%  
 CF Sizes: 6-20mm, 20-60mm, 60-200mm  
 CF Types: Granite, quartz (other)  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia grasbyi*, *Acacia ramulosa* var. *ramulosa*, *Acacia umbraculiformis*, *Hakea recurva* subsp. *arida*  
 Lower Stratum 1: *Eremophila punicea*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia grasbyi</i>	2	1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	2	0.5
<i>Acacia tetragonophylla</i>		2
<i>Acacia umbraculiformis</i>	2.4	0.5
<i>Aristida contorta</i>	0.1	0.1
<i>Austrostipa elegantissima</i>	0.6	0.1
<i>Borya sphaerocephala</i>	0.1	0.2
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.4	0.2
<i>Eremophila punicea</i>	0.5	4
<i>Hakea recurva</i> subsp. <i>arida</i>	2.1	1
<i>Mirbelia bursarioides</i> ms	1.3	0.1
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.2	0.2
<i>Ptilotus obovatus</i>	0.3	0.1
<i>Ptilotus schwartzii</i>	0.1	0.1

### **PHOTOS**



Site Name: GG-54  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 493495E 6819448N  
 Landform Type: Simple Slope  
 Slope Class: Moderately Inclined (10 degrees)  
 Soil Type: sandy clay (other)  
 Soil Colour: red-brown (other)  
 Rock Outcrop: Granite, 2-10% bedrock exposed  
 CF Abundance: >90%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm  
 CF Types: Granite, Laterite, quartz (other)  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia incurvaneura* ms, *Acacia ramulosa* var. *ramulosa*, *Acacia umbraculiformis*  
 Mid Stratum 1: *Philotheca sericea*, *Thryptomene decussata*  
 Lower Stratum 1: *Eremophila latrobei* subsp. *latrobei*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia incurvaneura</i> ms	4	2
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	2
<i>Acacia umbraculiformis</i>	3.5	2
<i>Aristida contorta</i>	0.1	0.2
<i>Borya sphaerocephala</i>	0.1	0.2
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.7	0.4
<i>Mirbelia bursarioides</i> ms	1.5	0.2
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.4	0.2
<i>Philotheca sericea</i>	1.2	3
<i>Ptilotus obovatus</i>	0.5	0.1
<i>Thryptomene decussata</i>	1.9	10

### **PHOTOS**



Site Name: GG-55  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 493798E 6818340N  
 Landform Type: Simple Slope  
 Slope Class: Moderately Inclined (10 degrees)  
 Soil Type: sandy clay (other)  
 Soil Colour: red-brown (other)  
 Rock Outcrop: Granite, 10-20% bedrock exposed  
 CF Abundance: >90%  
 CF Sizes: 2-6mm, 6-20mm, 20-60mm, 60-200mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Disturbance: Goat droppings  
 Fire: >5

#### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia aneura hybrid*, *Acacia aulacophylla*, *Acacia ramulosa* var. *ramulosa*, *Acacia umbraculiformis*  
 Mid Stratum 1: *Eremophila glutinosa*, *Eremophila latrobei* subsp. *latrobei*, *Mirbelia bursarioides* ms, *Philotheca brucei* subsp. *brucei*, *Prostanthera patens*  
 Lower Stratum 1: *Calytrix uncinata*

#### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aneura hybrid</i>	5	7
<i>Acacia aulacophylla</i>	3	2
<i>Acacia exocarpoides</i>	0.8	0.1
<i>Acacia grasbyi</i>	1.2	0.1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	2
<i>Acacia umbraculiformis</i>	3.5	1
<i>Aristida contorta</i>	0.1	0.1
<i>Borya sphaerocephala</i>	0.1	0.1
<i>Calytrix uncinata</i> (3)	0.7	0.5
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	0.9	0.2
<i>Eremophila glutinosa</i>	1.2	1
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	1.3	0.2

<i>Hakea recurva</i> subsp. <i>recurva</i>	0.3	0.1
<i>Mirbelia bursarioides</i> ms	1.4	1
<i>Philotheca brucei</i> subsp. <i>brucei</i>	1.6	3
<i>Philotheca sericea</i>	1.5	0.5
<i>Prostanthera patens</i>	0.3	0.4
<i>Ptilotus schwartzii</i>	0.2	0.1
<i>Thryptomene costata</i>	1.5	0.3
<i>Thryptomene decussata</i>	2	0.3

## **PHOTOS**





Site Name: GG-56  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 494294E 6818479N  
 Landform Type: Sheetflow (other)  
 Slope Class: Gently Inclined (3 degrees)  
 Soil Type: sandy clay (other)  
 Soil Colour: red-brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 20-50%  
 CF Sizes: 2-6mm, 6-20mm  
 CF Types: Granite, coffee rock (other)  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia effusifolia*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia craspedocarpa</i>	5	
<i>Acacia effusifolia</i>	3	40
<i>Acacia incurvaneura</i> ms	4	
<i>Acacia sibina</i>	1.8	0.3
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.2	0.2
<i>Monachather paradoxus</i>	0.3	0.1

### **PHOTOS**



Site Name: GG-57  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 495125E 6818000N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: sandy clay (other)  
 Soil Colour: red-brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm, 6-20mm  
 CF Types: Granite, Ironstone, quartz (other)  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*  
 Lower Stratum 1: *Eremophila granitica*, *Eremophila punicea*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia burkittii</i>	2.2	5
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	10
<i>Acacia tetragonophylla</i>	3	1
<i>Austrostipa elegantissima</i>	0.7	0.1
<i>Eremophila granitica</i>	0.8	1
<i>Eremophila punicea</i>	0.9	3
<i>Maireana carnosa</i>	0.1	0.1
<i>Maireana ?planifolia</i>	0.3	0.1
<i>Monachather paradoxus</i>	0.3	0.1
<i>Senna charlesiana</i>	1.4	0.1

### **PHOTOS**



Site Name: GG-58  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 493622E 6816654N  
 Landform Type: Plain  
 Slope Class: Very Gently Inclined (1 degree)  
 Soil Type: sandy clay (other)  
 Soil Colour: red-brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm, 6-20mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia effusifolia*, *Acacia sibina*, *Grevillea obliquistigma* subsp. *obliquistigma*  
 Lower Stratum 1: *Monachather paradoxus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia effusifolia</i>	4	12
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	0.5
<i>Acacia sibina</i>	3	2
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>	3	3
<i>Melaleuca leiocarpa</i>	3	0.4
<i>Monachather paradoxus</i>	0.5	2
<i>Solanum cleistogamum</i>	0.1	0.1

### **PHOTOS**





Site Name: GG-59  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 493345E 6816364N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: sandy clay (other)  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Callitris columellaris*, *Eucalyptus kochii* subsp. *plenissima*  
 Mid Stratum 1: *Acacia effusifolia*, *Acacia incurvaneura* hybrid, *Acacia ramulosa* var. *ramulosa*, *Bursaria occidentalis*  
 Lower Stratum 1: *Microcorys* sp. Mt Gibson (S. Patrick 2098), *Rhagodia drummondii*, *Senna artemisioides* subsp. *filifolia*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia effusifolia</i>	4.5	8
<i>Acacia exocarpoides</i>	1.5	0.2
<i>Acacia incurvaneura</i> hybrid	5.5	1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	2
<i>Austrostipa</i> ? <i>scabra</i>	0.2	0.1
<i>Bursaria occidentalis</i>	3.5	2
<i>Callitris columellaris</i>	18	2
<i>Cryptandra imbricata</i>	1.1	0.2
? <i>Enchylaena lanata</i>	0.2	0.2
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>	9	9
<i>Maireana</i> ? <i>planifolia</i>	0.7	0.1
<i>Maireana thesioides</i>	1.9	0.1
<i>Microcorys</i> sp. Mt Gibson (S. Patrick 2098)	1.5	5
<i>Monachather paradoxus</i>	0.5	1

<i>Olearia pimeleoides</i>	0.8	0.1
<i>Ptilotus obovatus</i>	0.3	0.2
<i>Rhagodia drummondii</i>	1.1	1
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	1.5	0.5

## **PHOTOS**



Site Name: GG-60  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 495295E 6816070N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: sandy clay (other)  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm  
 CF Types: Granite, Ironstone  
 Vegetation Condition: E - Excellent  
 Disturbance: Goats present  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*

Lower Stratum 1: *Eremophila granitica*, *Minuria cunninghamii*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia aneura hybrid</i>	6	
<i>Acacia burkittii</i>	5	8
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3	10
<i>Acacia tetragonophylla</i>	3	7
<i>Austrostipa ?scabra</i>	0.3	0.1
<i>Dianella revoluta</i>	0.8	0.1
<i>?Enchylaena lanata</i>	0.2	0.1
<i>Eremophila eriocalyx</i>	1.3	
<i>Eremophila granitica</i>	0.6	0.2
<i>Maireana carnosa</i>	0.1	0.1
<i>Minuria cunninghamii</i>	0.6	0.2
<i>Ptilotus drummondii</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.3	0.1
<i>Scaevola spinescens</i>	1.6	0.4
<i>Solanum cleistogamum</i>	0.2	0.1

**PHOTOS**



Site Name: GG-61  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 493227E 6815442N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: sandy clay (other)  
 Soil Colour: red-brown (other)  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 2-6mm  
 CF Types: Granite  
 Vegetation Condition: E - Excellent  
 Fire: >5

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Eucalyptus kochii* subsp. *plenissima*  
 Mid Stratum 1: *Acacia craspedocarpa*, *Acacia effusifolia*  
 Lower Stratum 1: *Minuria cunninghamii*, *Rhagodia drummondii*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia craspedocarpa</i>	5	2.5
<i>Acacia effusifolia</i>	2.5	0.5
<i>Acacia incurvaneura</i> ms	4	
<i>Acacia sibina</i>	3.5	0.6
<i>Austrostipa elegantissima</i>	0.5	0.1
<i>Callitris columellaris</i>	4	
<i>Cryptandra imbricata</i>	1.4	0.1
? <i>Enchylaena lanata</i>	0.4	0.1
<i>Eremophila georgei</i>	1.2	0.1
<i>Eremophila granitica</i>	1.1	0.1
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>	7	25
<i>Hakea recurva</i> subsp. <i>recurva</i>	2.5	0.2
<i>Melaleuca leiocarpa</i>	1.9	0.5
<i>Minuria cunninghamii</i>	0.7	3
<i>Monachather paradoxus</i>	0.3	0.1
<i>Psydrax suaveolens</i>	3	



<i>Ptilotus obovatus</i>	0.6	0.2
<i>Rhagodia drummondii</i>	1	0.6

**PHOTOS**



Site Name: GG-63  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 492896E 6815238N  
 Landform Type: Plain  
 Slope Class: Level (0 degrees)  
 Soil Type: sandy clay (other)  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: 2-10%  
 CF Sizes: 2-6mm  
 CF Types: Ironstone  
 Vegetation Condition: E - Excellent  
 Fire: >5

#### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Eucalyptus kochii* subsp. *plenissima*, *Grevillea nematophylla* subsp. *supraplana*  
 Mid Stratum 1: *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*  
 Lower Stratum 1: *Maireana georgei*, *Ptilotus obovatus*, *Rhagodia drummondii*

#### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	5.5	
<i>Acacia effusifolia</i>	3	3
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	3.5	6
<i>Acacia tetragonophylla</i>	3.5	2
<i>Amyema gibberula</i> var. <i>gibberula</i>		0.1
<i>Austrostipa</i> ? <i>scabra</i>	0.2	0.1
<i>Dianella revoluta</i>	0.5	0.1
? <i>Enchylaena lanata</i>	0.3	0.1
<i>Enchylaena tomentosa</i>	0.4	0.1
<i>Eremophila eriocalyx</i>	1.5	0.1
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>	8	10
<i>Grevillea nematophylla</i> subsp. <i>supraplana</i>	8	5
<i>Hakea recurva</i> subsp. <i>recurva</i>	1.8	0.3
<i>Maireana carnosa</i>	0.1	0.1

<i>Maireana georgei</i>	1	1
<i>Maireana thesioides</i>	0.6	
<i>Melaleuca hamata</i>	2.5	
<i>Melaleuca leiocarpa</i>	3	
<i>Minuria cunninghamii</i>	0.4	0.1
<i>Olearia pimeleoides</i>	1.3	
<i>Ptilotus obovatus</i>	0.8	2
<i>Ptilotus schwartzii</i>	0.3	0.1
<i>Rhagodia drummondii</i>	1	1.5
<i>Santalum acuminatum</i>	4	
<i>Scaevola spinescens</i>	0.8	0.1
<i>Sclerolaena fusiformis</i>	0.2	0.1
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	1.5	0.3
<i>Solanum lasiophyllum</i>	0.4	0.1
<i>Solanum nummularium</i>	0.3	0.1

## **PHOTOS**



Site Name: GG-64  
 Site Type: QUADRAT  
 Dimensions: 20m x 20m  
 Survey Date: 25/10/2012  
 GPS Location: WGS84 (Zone 50) 497393E 6816259N  
 Landform Type: Flat  
 Slope Class: Level (0 degrees)  
 Soil Type: Sandy Loam  
 Soil Colour: Red  
 Rock Outcrop: No bedrock exposed  
 CF Abundance: <2%  
 CF Sizes: 6-20mm  
 CF Types: Ironstone  
 Vegetation Condition: VG - Very Good  
 Disturbance: Goats (other)

### **DOMINANT TAXA IN VEGETATION STRATA**

Upper Stratum 1: *Bursaria occidentalis*  
 Mid Stratum 1: *Acacia caesaneura* ms, *Acacia exocarpoides*, *Acacia ramulosa* var. *ramulosa*  
 Lower Stratum 1: *Monachather paradoxus*

### **SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia caesaneura</i> ms	4	17
<i>Acacia exocarpoides</i>	3	6
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4.5	7
<i>Acacia tetragonophylla</i>	4	1
<i>Bursaria occidentalis</i>	5.5	5
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1.8	8
<i>Monachather paradoxus</i>	0.4	2
<i>Scaevola spinescens</i>	2	1.5

### **PHOTOS**



Site Name: GG-65  
Site Type: QUADRAT  
Dimensions: 20m x 20m  
Survey Date: 25/10/2012  
GPS Location: WGS84 (Zone 50) 495900E 6820800N  
Landform Type: Plain  
Slope Class: Level (0 degrees)  
Soil Type: Sandy Loam  
Soil Colour: white (other)  
Rock Outcrop: No bedrock exposed  
CF Abundance: 0%  
Vegetation Condition: VG - Very Good  
Disturbance: Goats (other)  
Fire: >5

**DOMINANT TAXA IN VEGETATION STRATA**

Mid Stratum 1: *Tecticornia disarticulata*

Mid Stratum 2: *Acacia masliniana*

**SPECIES LIST**

<b>Taxon Name</b>	<b>Avg. Height</b>	<b>% Cover Alive</b>
<i>Acacia masliniana</i>	4	4
<i>Atriplex ?bunburyana</i>	0.2	5
<i>Solanum lasiophyllum</i>	0.2	0.1
<i>Tecticornia disarticulata</i>	0.5	10

**PHOTOS**







## Appendix H: GPS Locations of All Conservation Significant Flora and Recorded During the 2012 Survey of the Gossan Hill Gold Pit Project Study Area

Note: All GPS co-ordinates in GDA94 Zone 50

<b>Taxon</b>	<b>Status</b>	<b>GPS E</b>	<b>GPS N</b>	<b>Record Location</b>	<b>Abundance</b>
<i>Calytrix uncinata</i>	P3	492803	6818800	GG-11	6
<i>Calytrix uncinata</i>	P3	493798	6818340	GG-55	16
<i>Calytrix uncinata</i>	P3	493848	6818347	Opportunistic	20
<i>Micromyrtus trudgenii</i>	P3	494462	6816206	Opportunistic	1
<i>Persoonia pentasticha</i>	P3	493000	6815100	Opportunistic	1
<i>Santalum spicatum</i>		493455	6820580	Opportunistic	1

## Appendix I: Vascular Plant Taxa Amalgamated and Omitted During Statistical Analysis

Taxon	Amalgamation / Deletion
<i>Acacia cf.aneura</i> var. <i>aneura</i>	Amalgamated
<i>Acacia aneura</i> var. <i>?intermedia</i>	
<i>Acacia cf.aneura</i> var. <i>major</i>	
<i>Acacia cf.aneura</i> var. <i>tenuis</i>	
<i>Amphipogon caricinus</i>	Amalgamated
<i>Amphipogon caricinus</i> var. <i>caricinus</i>	
<i>Atriplex ?bunburyana</i>	Amalgamated
<i>Atriplex bunburyana</i>	
<i>Austrostipa scabra</i>	Amalgamated
<i>Austrostipa ?scabra</i>	
<i>Dianella revoluta</i>	Amalgamated
<i>Dianella revoluta</i> var. <i>divaricata</i>	
<i>Dodonaea petiolaris</i>	Amalgamated
<i>Dodonaea ?petiolaris</i>	
<i>Dodonaea ?petiolaris</i>	
<i>Dodonaea viscosa</i> subsp. <i>mucronata</i>	Amalgamated
<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	
<i>Enchylaena tomentosa</i>	Amalgamated
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	
<i>Eremophila clarkei</i>	Amalgamated
<i>Eremophila ?clarkei</i>	
<i>Eremophila oldfieldii</i>	Amalgamated
<i>Eremophila oldfieldii</i> subsp. <i>oldfieldii</i>	
<i>Eucalyptus kochii</i> subsp. <i>amaryssia</i>	Amalgamated
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>	
<i>Eucalyptus ?kochii</i> subsp. <i>plenissima</i>	
<i>Eucalyptus leptopoda</i> subsp. <i>arctata</i>	Amalgamated
<i>Eucalyptus leptopoda</i> subsp. <i>elevata</i>	
<i>Hakea recurva</i>	Amalgamated
<i>Hakea recurva</i> subsp. <i>arida</i>	
<i>Hakea recurva</i> subsp. <i>recurva</i>	
<i>Maireana georgei</i>	Amalgamated
<i>Maireana ?georgei</i>	
<i>Maireana ?planifolia</i>	Amalgamated
<i>Maireana planifolia</i>	
<i>Maireana tomentosa</i>	Amalgamated
<i>Maireana tomentosa</i> subsp. <i>tomentosa</i>	

Taxon	Amalgamation / Deletion
<i>Mirbelia</i> sp. Bursarioides	Amalgamated
<i>Mirbelia</i> ?sp. Bursarioides	
<i>Ptilotus obovatus</i>	Amalgamated
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	
<i>Acacia aneura</i> hybrid	Deleted - hybrid
<i>Acacia incurvaneura</i> hybrid	Deleted - hybrid
<i>Acacia</i> cf. <i>kalgoorliensis</i> (A. Markey & S. Dillon 3478)	Deleted – not definitive identification
<i>Amyema gibberula</i> var. <i>gibberula</i>	Deleted – parasitic
<i>Amyema gibberula</i> var. <i>tatei</i>	Deleted - parasitic
<i>Amyema preissii</i>	Deleted - parasitic
<i>Atriplex</i> sp.	Deleted – insufficient material for identification
<i>Austrostipa</i> sp.	Deleted – insufficient material for identification
<i>Cheilanthes</i> cf. <i>lasiophylla</i> X <i>sieberi</i> (A. Markey & S. Dillon 3048)	Deleted - hybrid
<i>Cheilanthes</i> sp.	Deleted – insufficient material for identification
? <i>Enchylaena lanata</i>	Deleted – insufficient material for identification
<i>Lysiana casuarina</i>	Deleted - parasitic
<i>Maireana planifolia</i> x <i>villosa</i> (A. Markey & S. Dillon 3479)	Deleted - hybrid
<i>Maireana planifolia</i> x <i>villosa</i> (A. Markey & S. Dillon 3482)	Deleted - hybrid
<i>Maireana</i> sp.	Deleted – insufficient material for identification
<i>Prostanthera</i> aff. <i>campbellii</i> (A. Markey & S. Dillon 3386)	Deleted - not definitive identification
? <i>Sarcozona praecox</i>	Deleted – insufficient material for identification
<i>Sida</i> sp.	Deleted – insufficient material for identification
<i>Thysanotus</i> sp. climbing	Deleted – insufficient material for identification
<i>Velleia</i> sp. (A. Markey & S. Dillon 3463)	Deleted – insufficient material for identification
<i>Velleia</i> sp. <i>cynopotamica</i> / <i>rosea</i> complex	Deleted - not definitive identification

**Appendix J:    Quadrats Moved Within Analysis Output**

<b>Quadrat</b>	<b>Vegetation Type Moved From/To</b>	<b>Reasoning</b>
GG25	10* to 9	Quadrat GG25 was originally grouped alone due to exceptionally low species richness. Dominant species present in GG25 matched those representing VT9.

\*Original VT, prior to GG25 moving and subsequent VT changes

## Appendix K: Vascular Plant Taxa Recorded within Each Vegetation Type within the Gossan Hill Gold Pit Project Study Area

Taxon	Vegetation Type						
	3	4	9	10	11	12	13
<i>Abutilon cryptopetalum</i>		X					
<i>Acacia cf.aneura</i> var. <i>major</i>		X					
<i>Acacia cf.aneura</i> var. <i>aneura</i>		X					
<i>Acacia aneura</i> var. <i>?intermedia</i>		X					
<i>Acacia aneura</i> hybrid		X	X		X		
<i>Acacia anthochaera</i>			X				
<i>Acacia assimilis</i> subsp. <i>assimilis</i>				X			
<i>Acacia aulacophylla</i>		X		X			
<i>Acacia burkittii</i>	X	X	X		X		
<i>Acacia caesaneura</i> ms	X	X	X	X	X		
<i>Acacia craspedocarpa</i>		X		X	X		
<i>Acacia effusifolia</i>			X	X	X		
<i>Acacia exocarpoides</i>		X	X	X	X		
<i>Acacia grasbyi</i>	X	X	X				
<i>Acacia incurvaneura</i> ms		X	X	X	X		
<i>Acacia incurvaneura</i> hybrid					X		
<i>Acacia kalgoorliensis</i>			X				
<i>Acacia latior</i>				X			
<i>Acacia longispinea</i>				X			
<i>Acacia masliniana</i>			X				X
<i>Acacia ramulosa</i> var. <i>linophylla</i>	X						
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	X	X	X	X	X		
<i>Acacia sibina</i>			X	X	X		
<i>Acacia tetragonophylla</i>	X	X	X		X		
<i>Acacia umbraculiformis</i>	X	X	X	X			
<i>Allocasuarina acutivalvis</i>		X					
<i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i>		X					
<i>Aluta aspera</i> subsp. <i>hesperia</i>		X		X			
<i>Alyxia buxifolia</i>		X					
<i>Amyema gibberula</i> var. <i>tatei</i>			X				
<i>Amyema gibberula</i> var. <i>gibberula</i>			X				
<i>Aristida contorta</i>	X	X	X	X			
<i>Arthropodium dyeri</i>		X					
<i>Astroloma serratifolium</i>		X					
<i>Atriplex ?amnicola</i>						X	
<i>Atriplex ?bunburyana</i>			X				X
<i>Atriplex codonocarpa</i>						X	
<i>Atriplex</i> sp.			X				

Taxon	Vegetation Type						
	3	4	9	10	11	12	13
<i>Austrostipa elegantissima</i>	X	X	X		X		
<i>Austrostipa scabra</i>		X	X				
<i>Austrostipa ?scabra</i>			X		X		
<i>Austrostipa</i> sp.		X					
<i>Austrostipa trichophylla</i>		X					
<i>Bellida graminea</i>		X		X			
<i>Borya sphaerocephala</i>	X	X					
<i>Brachychiton gregorii</i>			X	X			
<i>Brachyscome cheilocarpa</i>		X		X			
<i>Brachyscome ciliocarpa</i>		X					
<i>Brachyscome perpusilla</i>		X					
<i>Bursaria occidentalis</i>			X		X		
<i>Calandrinia calyptrata</i>		X					
<i>Calandrinia eremaea</i>		X					
<i>Calandrinia</i> sp. Blackberry (D.M. Porter 171)		X					
<i>Callitris columellaris</i>					X		
<i>Calocephalus multiflorus</i>		X		X			
<i>Calotis hispidula</i>		X					
<i>Calotis multicaulis</i>		X					
<i>Calycopeplus paucifolius</i>		X		X			
<i>Calytrix uncinata</i>		X					
<i>Ceratogyne obionoides</i>				X			
<i>Cheilanthes adiantoides</i>		X		X			
<i>Cheilanthes brownii</i>		X					
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>		X					
<i>Cheilanthes</i> sp.		X					
<i>Cheiranthra simplicifolia</i>		X			X		
* <i>Cleretum papulosum</i> subsp. <i>papulosum</i>		X					
<i>Crassula closiana</i>		X					
<i>Crassula colorata</i> var. <i>acuminata</i>		X					
<i>Crassula tetramera</i>		X					
<i>Cryptandra imbricata</i>			X		X		
* <i>Cuscuta epithymum</i>		X		X			
<i>Daucus glochidiatus</i>		X					
<i>Dianella revoluta</i> var. <i>divaricata</i>				X			
<i>Dianella revoluta</i>		X	X	X	X		
<i>Dodonaea inaequifolia</i>		X	X				
<i>Dodonaea petiolaris</i>		X					
<i>Dodonaea ?petiolaris</i>		X					
<i>Dodonaea ?petiolaris</i>		X					
<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>		X					
<i>Drummondita fulva</i>		X					



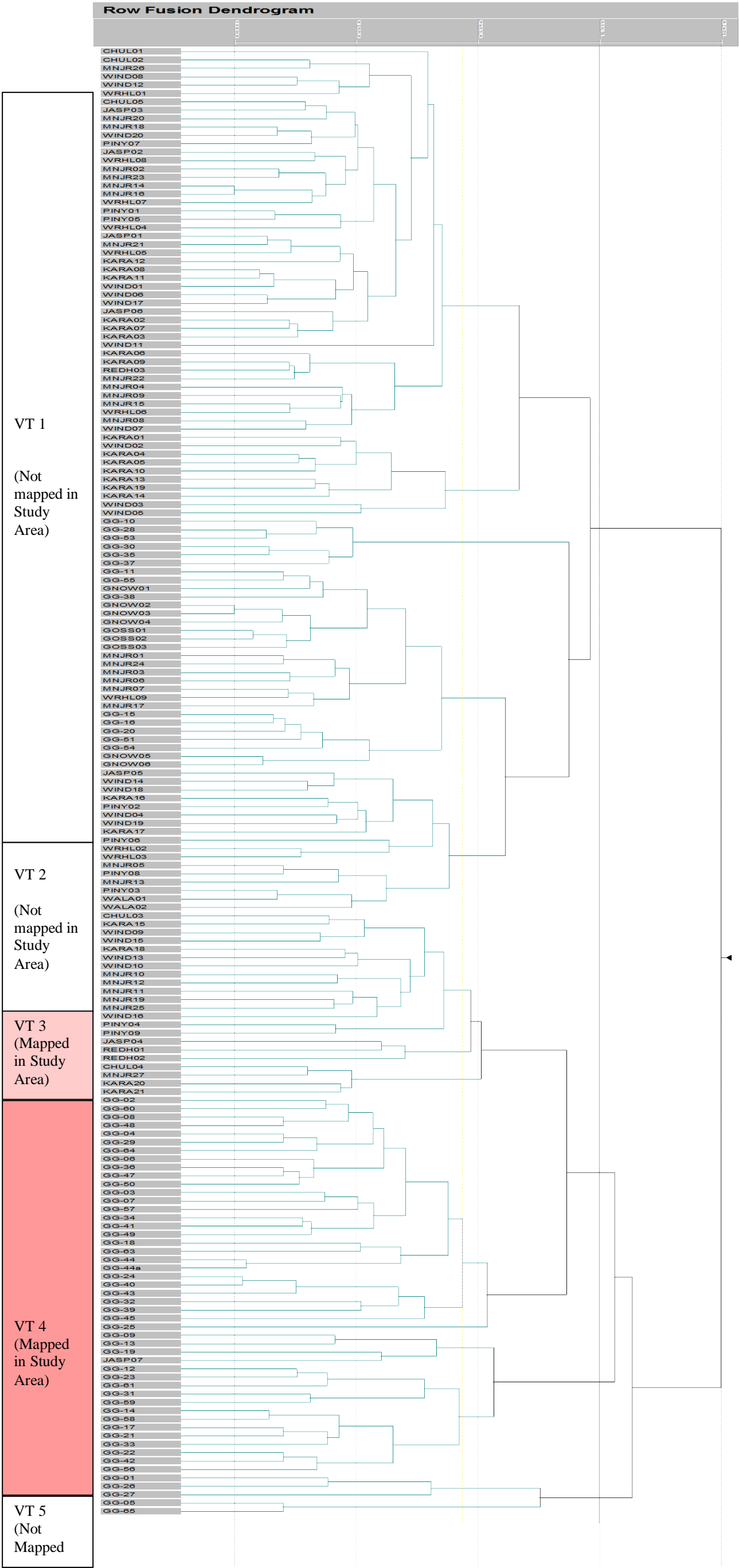
Taxon	Vegetation Type						
	3	4	9	10	11	12	13
<i>Dysphania melanocarpa</i>		X					
<i>Dysphania saxatilis</i>		X					
<i>?Enchylaena lanata</i>			X		X		
<i>Enchylaena tomentosa</i>			X				
<i>Enneapogon caeruleus</i>						X	
<i>Eragrostis dielsii</i>							X
<i>Eremophila ?clarkei</i>		X					
<i>Eremophila clarkei</i>		X			X		
<i>Eremophila eriocalyx</i>			X				
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>		X	X	X	X		
<i>Eremophila georgei</i>		X	X		X		
<i>Eremophila glutinosa</i>		X	X				
<i>Eremophila granitica</i>			X		X		
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	X	X	X	X	X		
<i>Eremophila oldfieldii</i> subsp. <i>oldfieldii</i>						X	
<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>			X				
<i>Eremophila pantonii</i>			X				
<i>Eremophila punicea</i>	X		X				
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>		X					
<i>Erodium cygnorum</i>		X					
<i>Erymophyllum ramosum</i> subsp. <i>ramosum</i>			X			X	
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>			X		X		
<i>Eucalyptus ?kochii</i> subsp. <i>plenissima</i>			X				
<i>Eucalyptus leptopoda</i> subsp. <i>elevata</i>				X			
<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>						X	
<i>Euphorbia boophthona</i>		X					
<i>Frankenia setosa</i>						X	
<i>Gilberta tenuifolia</i>		X		X			
<i>Gonocarpus nodulosus</i>		X		X			
<i>Goodenia berardiana</i>		X					
<i>Goodenia occidentalis</i>		X		X			
<i>Grevillea extorris</i>		X					
<i>Grevillea nematophylla</i> subsp. <i>supraplana</i>			X		X		
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>		X	X	X	X		
<i>Grevillea pityophylla</i>	X	X					
<i>Gunniopsis rubra</i>		X					
<i>Hakea preissii</i>		X					
<i>Hakea recurva</i>		X					
<i>Hakea recurva</i> subsp. <i>arida</i>	X	X	X				
<i>Hakea recurva</i> subsp. <i>recurva</i>		X	X	X	X		

Taxon	Vegetation Type						
	3	4	9	10	11	12	13
<i>Haloragis odontocarpa</i> f. <i>pterocarpa</i>				X			
<i>Hibbertia arcuata</i>		X					
<i>Hibbertia stenophylla</i>				X			
<i>Hyalosperma glutinosum</i>			X				
<i>Lachnagrostis plebeia</i>		X					
<i>Lawrencella rosea</i>		X					
<i>Lemooria burkittii</i>		X					
<i>Lepidium oxytrichum</i>		X					
<i>Leucopogon</i> sp. Clyde Hill (M.A. Burgman 1207)		X		X			
<i>Lobelia heterophylla</i>		X					
<i>Lobelia winfridae</i>		X					
* <i>Lysimachia arvensis</i>		X					
<i>Maireana amoena</i>						X	
<i>Maireana carnosae</i>			X				
<i>Maireana georgei</i>			X			X	
<i>Maireana ?georgei</i>						X	
<i>Maireana glomerifolia</i>			X				
<i>Maireana planifolia</i>		X					
<i>Maireana ?planifolia</i>			X		X		
<i>Maireana</i> sp.			X				
<i>Maireana thesioides</i>			X		X		
<i>Maireana tomentosa</i>			X				
<i>Maireana tomentosa</i> subsp. <i>tomentosa</i>						X	
<i>Maireana triptera</i>			X			X	
<i>Melaleuca hamata</i>		X	X				
<i>Melaleuca leiocarpa</i>			X		X		
<i>Melaleuca nematophylla</i>		X					
<i>Microcorys</i> sp. Mt Gibson (S. Patrick 2098)					X		
<i>Micromyrtus trudgenii</i>		X					
<i>Minuria cunninghamii</i>			X		X		
<i>Mirbelia bursarioides</i> ms	X	X	X				
<i>Mirbelia ?bursarioides</i> ms		X					
<i>Monachather paradoxus</i>		X	X	X	X		
<i>Myriocephalus guerinae</i>				X			
<i>Nicotiana rosulata</i> subsp. <i>rosulata</i>		X					
<i>Olearia humilis</i>		X					
<i>Olearia pimeleoides</i>			X		X		
* <i>Pentameris airoides</i>		X					
<i>Persoonia manotricha</i>		X					
<i>Philotheca brucei</i> subsp. <i>brucei</i>	X	X	X	X	X		
<i>Philotheca deserti</i> subsp. <i>deserti</i>					X		

Taxon	Vegetation Type						
	3	4	9	10	11	12	13
<i>Philotheca sericea</i>	X	X		X			
<i>Philotheca tomentella</i>					X		
<i>Plantago debilis</i>		X					
<i>Podolepis canescens</i>				X			
<i>Podolepis capillaris</i>		X	X				
<i>Podolepis lessonii</i>		X					
<i>Podotheca gnaphalioides</i>		X					
<i>Pogonolepis muelleriana</i>	X						X
<i>Polianthion collinum</i>		X					
<i>Poranthera microphylla</i>				X			
<i>Prostanthera patens</i>		X					
<i>Psammomoya implexa</i>				X			
<i>Psydrax suaveolens</i>		X			X		
<i>Ptilotus divaricatus</i>			X				
<i>Ptilotus drummondii</i>			X		X		
<i>Ptilotus drummondii</i> var. <i>drummondii</i>		X					
<i>Ptilotus gaudichaudii</i> var. <i>parviflorus</i>		X					
<i>Ptilotus gaudichaudii</i> subsp. <i>gaudichaudii</i>		X					
<i>Ptilotus obovatus</i>	X	X	X		X	X	
<i>Ptilotus obovatus</i> var. <i>obovatus</i>		X					
<i>Ptilotus schwartzii</i>	X	X	X				
<i>Rhagodia drummondii</i>			X		X	X	
<i>Rhodanthe battii</i>		X					
<i>Rhodanthe citrina</i>		X					
<i>Rhodanthe laevis</i>		X					
<i>Rhodanthe maryonii</i>		X					
<i>Rhyncharrhena linearis</i>				X			
<i>Rytidosperma caespitosum</i>		X					
<i>Rytidosperma setaceum</i>		X					
<i>Santalum acuminatum</i>		X	X				
<i>Santalum spicatum</i>		X		X			
? <i>Sarcozona praecox</i>						X	
<i>Scaevola spinescens</i>		X	X				
<i>Schoenia cassiniana</i>		X					
<i>Schoenus nanus</i>		X					
<i>Sclerolaena densiflora</i>		X	X				
<i>Sclerolaena diacantha</i>						X	
<i>Sclerolaena eriacantha</i>			X				
<i>Sclerolaena fusiformis</i>			X				
<i>Sclerolaena gardneri</i>			X			X	
<i>Sclerolaena microcarpa</i>			X				
<i>Senna artemisioides</i> subsp. <i>filifolia</i>			X		X		

Taxon	Vegetation Type						
	3	4	9	10	11	12	13
<i>Senna charlesiana</i>	X	X	X		X		
<i>Senna</i> sp. Austin (A. Strid 20210)			X				
<i>Sida</i> sp.		X					
<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)		X					
<i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32)		X					
<i>Solanum cleistogamum</i>		X	X	X	X		
<i>Solanum lasiophyllum</i>	X	X	X		X		X
<i>Solanum nummularium</i>	X	X	X				
<i>Stachystemon intricatus</i>			X				
<i>Stylidium longibracteatum</i>		X					
<i>Synaptantha tillaeacea</i> var. <i>tillaeacea</i>		X					
<i>Tecticornia disarticulata</i>			X			X	X
<i>Tetragonia moorei</i>		X					
<i>Thryptomene costata</i>	X	X	X	X			
<i>Thryptomene decussata</i>		X		X			
<i>Thysanotus</i> sp. climbing		X					
<i>Trachymene cyanopetala</i>				X			
<i>Trachymene ornata</i>		X		X			
<i>Velleia hispida</i>		X		X			
<i>Velleia</i> sp. <i>cynopotamica/rosea</i> complex		X					
<i>Wahlenbergia preissii</i>		X					
<i>Wahlenbergia tumidifructa</i>		X					
<i>Waitzia acuminata</i> var. <i>acuminata</i>		X			X		
<i>Wurmbea densiflora</i>		X					
<i>Xerolirion divaricata</i>		X					

Appendix L: Summary Dendrogram of Relationships Between Quadrats







(Print as A1)

[illegible]

## Appendix N: Significant Indicator Taxa of the Vegetation Types Located Within the Gossan Hill Gold Pit Project Study Area

Note: Shading denotes highest indicator values per taxon.

Indicator values (%) are shown only for taxa which were significant at  $P < 0.05$  (\* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ )

		Vegetation Type						
Taxon		3	4	9	10	11	12	13
ACAGRA	<i>Acacia grasbyi</i> **	54	1	0	0	0	0	0
ACAUMB	<i>Acacia umbraculiformis</i> ***	38	3	0	9	0	0	0
BORSPH	<i>Borya sphaerocephala</i> ***	86	1	0	0	0	0	0
EREPUN	<i>Eremophila punicea</i> **	57	0	1	0	0	0	0
GREPIT	<i>Grevillea pityophylla</i> *	30	0	0	0	0	0	0
PTISCH	<i>Ptilotus schwartzii</i> *	32	6	1	0	0	0	0
THRCOS	<i>Thryptomene costata</i> *	38	11	0	3	0	0	0
ACAAUL	<i>Acacia aulacophylla</i> ***	0	40	0	3	0	0	0
CALUNC	<i>Calytrix uncinata</i> *	0	36	0	0	0	0	0
EREGLU	<i>Eremophila glutinosa</i> *	0	39	0	0	0	0	0
ERELATLA	<i>Eremophila latrobei</i> subsp. <i>latrobei</i> ***	3	24	0	1	1	0	0
MIRBUR	<i>Mirbelia bursarioides</i> ms, <i>Mirbelia ?bursarioides</i> ms***	9	34	0	0	0	0	0
PHIBRUBR	<i>Philotheca brucei</i> subsp. <i>brucei</i> ***	3	22	0	0	0	0	0
STYLON	<i>Stylidium longibracteatum</i> **	0	45	0	0	0	0	0
ACABUR	<i>Acacia burkittii</i> *	2	0	32	0	0	0	0
ACARAMRA	<i>Acacia ramulosa</i> var. <i>ramulosa</i> ***	2	14	17	1	9	0	0
ACAINC	<i>Acacia incurvaneura</i> ms*	0	6	1	32	0	0	0
GREOBLOB	<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i> ***	0	3	0	35	2	0	0
MONPAR	<i>Monachather paradoxus</i> **	0	1	3	19	16	0	0
ACAEFF	<i>Acacia effusifolia</i> **	0	0	0	0	49	0	0
ATRCOD	<i>Atriplex codonocarpa</i> ***	0	0	0	0	0	67	0

		Vegetation Type						
Taxon		3	4	9	10	11	12	13
MAITRI1	<i>Maireana triptera</i> *	0	0	0	0	0	33	0
RHADRU	<i>Rhagodia drummondii</i> *	0	0	4	0	3	28	0
ACAMAS	<i>Acacia masliniana</i> **	0	0	0	0	0	0	47
ATRBUN	<i>Atriplex bunburyana</i> , <i>Atriplex ?bunburyana</i> ***	0	0	0	0	0	0	60
TECDIS	<i>Tecticornia disarticulata</i> ***	0	0	0	0	0	8	73

## **Appendix O: Detailed Description of Vegetation Types**

**VT 3:** Tall open to sparse shrubland of mixed *Acacia* species dominated by *Acacia grasbyi*, *Acacia umbraculiformis* and *Acacia tetragonophylla* over mid open to sparse shrubland of *Thryptomene costata* over isolated clumps of shrubs of *Ptilotus obovatus* and *Eremophila punicea* over low isolated clumps of forbs of *Borya sphaerocephala* on red-brown to yellow sandy to clay loams often associated with decomposing granite or granite outcropping on plains and upperslopes

**Total Area:** 149.1 ha

**Percentage of Study Area:** 5.05 %

**Sampling:** 6 quadrats within Study Area

**Common taxa recorded within each stratum:**

Stratum	Descriptor	Taxa
Mid Stratum 1	Tall Open Shrubland to Tall Sparse Shrubland (Shrubs >2 m)	<i>Acacia umbraculiformis</i> <i>Acacia grasbyi</i> <i>Acacia tetragonophylla</i> <i>Acacia ramulosa</i> var. <i>ramulosa</i> <i>Grevillea ptyophylla</i> <i>Hakea recurva</i> subsp. <i>arida</i>
Lower Stratum 1	Mid Open Shrubland to Mid Sparse Shrubland (Shrubs 1 - 2 m), Mid Isolated Clumps of Shrubs (Shrubs 1 - 2 m), Low Isolated Clumps of Shrubs (Shrubs <1 m), Low Isolated Clumps of Forbs (<0.5 m)	<i>Aristida contorta</i> <i>Borya sphaerocephala</i> <i>Ptilotus obovatus</i> <i>Thryptomene costata</i> <i>Eremophila punicea</i> <i>Mirbelia</i> sp. <i>Bursarioides</i> (T.R. Lally 760) <i>Ptilotus schwartzii</i> <i>Eremophila latrobei</i> subsp. <i>latrobei</i> <i>Philotheca brucei</i> subsp. <i>brucei</i>

**Indicator Taxa:** *Acacia grasbyi*, *Acacia umbraculiformis*, *Borya sphaerocephala*, *Eremophila punicea*, *Grevillea ptyophylla*, *Ptilotus schwartzii* and *Thryptomene costata*

**Landform Types:** Simple Slopes, Upper Slopes and Plains

**Soil Types:** Red / brown sandy clay or yellow clay loam or sandy loam

VT 3 was mapped in small areas adjacent to and south of the waste management facility, south of the airstrip, south west of the tailings dam and south west section of the study area and a small section at the southeast end of the proposed haul road (Figures 3.1 – 3.3). It was mapped on upperslopes with granite which were slightly rocky or outwash/plain areas with granite and quartz course fragments.

A total of 22 vascular plant taxa from the statistical analysis were recorded in quadrats grouped in VT 3. Species richness per quadrat within VT 3 was  $11.0 \pm 3.4$ . No Conservation significant taxa were recorded in this VT during WEC surveys in 2012 however, the conservation significant flora taxa *Acacia speckii* (P4) has previously been recorded in areas mapped as VT 3. No introduced taxa were recorded in VT 3, either in quadrats or opportunistically while traversing the landscape in 2012. All vascular plant taxa recorded within VT 3 is presented in Appendix K.

The condition of the vegetation of quadrats established in VT 3 ranged from Excellent to Very Good (Appendix E).



**Plate 1: VT 3 (Quadrat GG37) (Photo: Woodman Environmental)**



**VT 4:** Tall shrubland of mixed *Acacia* species dominated by *Acacia aulacophylla* and *Acacia ramulosa* var. *ramulosa* over mid open shrubland sparse shrubland of mixed species dominated by *Eremophila glutinosa*, *Eremophila latrobei* subsp. *latrobei*, *Mirbelia* sp. *bursarioides* (T.R. Lally 760), *Philotheca brucei* subsp. *brucei* and *Philotheca sericea* on red-brown sandy clay or loams on lower slopes to crests with ironstone or granite outcropping

**Total Area:** 300.09 ha

**Percentage of Study Area:** 10.17 %

**Sampling:** 11 quadrats within Study Area (13 quadrats outside Study Area)

**Common taxa recorded within each stratum:**

Stratum	Descriptor	Taxa
Mid Stratum 1	Tall Shrubland to Tall Sparse Shrubland (Shrubs >2 m)	<i>Acacia aulacophylla</i> <i>Acacia exocarpoides</i> * <i>Acacia ramulosa</i> var. <i>ramulosa</i> <i>Hakea recurva</i> subsp. <i>recurva</i>
Lower Stratum 1	Mid Open shrubland to Mid Sparse Shrubland (Shrubs 1 – 2 m)	<i>Aristida contorta</i> <i>Calytrix uncinata</i> (P3) <i>Cheiranthra simplicifolia</i> * <i>Drummondita fulva</i> (P3) <i>Eremophila glutinosa</i> * <i>Eremophila latrobei</i> subsp. <i>latrobei</i> <i>Micromyrtus trudgenii</i> (P3) <i>Mirbelia</i> sp. <i>Bursarioides</i> (T.R. Lally 760) <i>Philotheca brucei</i> subsp. <i>brucei</i> <i>Philotheca sericea</i> <i>Stylidium longibracteatum</i> * <i>Thryptomene costata</i> <i>Thryptomene decussata</i>

\*Not located within Study Area

**Indicator Taxa:** *Acacia aulacophylla*, *Calytrix uncinata*, *Eremophila glutinosa*, *Eremophila latrobei* subsp. *latrobei*, *Mirbelia* sp. *Bursarioides* (T.R. Lally 760), *Philotheca brucei* subsp. *brucei* and *Stylidium longibracteatum*

**Landform Types:** Simple slopes, lower slopes, midslopes, Ridges and crests

**Soil Types:** Red / brown sandy clay, brown sandy loam or light brown silty clay with some granite, ironstone and/or quartz surface pebbles

VT 4 was mapped occurring on Gossan Hill, an area to the east of Gossan Hill and a larger area within the low hill system to the north and northwest of the Golden Grove camp. This VT was usually on hill slopes that were moderately to very steeply inclined, with significant granite or ironstone outcropping (Figures 3.1 – 3.3). This VT grouped with quadrats which described the Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) (as described in Markey and Dillon 2008) (Appendix L).

A total of 74 vascular plant taxa from the statistical analysis were recorded in quadrats grouped were recorded in quadrats grouped in VT 4. Species richness per quadrat within VT 4 was  $24.8 \pm 13.7$ . The conservation significant flora *Calytrix uncinata* (P3) and *Micromyrtus trudgenii* (P3) were recorded within this VT during WEC surveys in 2012 with the additional conservation significant species *Drummondita fulva* (P3) and *Polianthion collinum* (P3) having been previously recorded in areas mapped as VT 4. No introduced taxa were recorded in VT 4. All vascular plant taxa recorded within VT 4 is presented in Appendix K.

The condition of the vegetation in the majority of the quadrats established in VT 4 was ranked as either Excellent or Very Good (Appendix E).



Plate 2: VT 4 (Quadrat GG15) (Photo: Woodman Environmental)

#### **VT 4d: Disturbed Vegetation Type VT 4**

**Total Area:** 5.87 ha

**Percentage of Study Area:** 0.2 %

This disturbed vegetation type was mapped in one area west and adjacent to Gossan Hill, with the disturbance to the vegetation being related to mining activities. The vegetation condition for these areas was ranked as Poor.

The conservation significant flora *Calytrix uncinata* (P3), *Micromyrtus trudgenii* (P3) and *Polianthion collinum* (P3) has previously been recorded in areas mapped as VT 4d.

**VT 9:** Tall closed to sparse shrubland of mixed *Acacia* species dominated by *Acacia ramulosa* var. *ramulosa* with *Acacia burkittii* and *Acacia tetragonophylla* over low isolated clumps of shrubs of mixed species dominated by *Ptilotus obovatus* on yellow, red and red-brown loams predominantly on plains and occasionally on mid to upperslopes of low hills

**Total Area:** 1109.33 ha

**Percentage of Study Area:** 37.58 %

**Sampling:** 28 quadrats within Study Area

**Common taxa recorded within each stratum:**

Stratum	Descriptor	Taxa
Mid Stratum 1	Tall Closed Shrubland to Tall Sparse Shrubland (Shrubs >2 m)	<i>Acacia burkittii</i> <i>Acacia ramulosa</i> var. <i>ramulosa</i> <i>Acacia tetragonophylla</i>
Lower Stratum 1	Low Isolated Clumps of Shrubs (Shrubs <1 m),	<i>Eremophila granitica</i> <i>Monachather paradoxus</i> <i>Ptilotus obovatus</i> <i>Rhagodia drummondii</i> <i>Scaevola spinescens</i>

**Indicator Taxa:** *Acacia burkittii* and *Acacia ramulosa* var. *ramulosa*

**Landform Types:** Primarily on Plains and occasionally on midslopes and upperslopes

**Soil Types:** Red-brown or red sandy clay, red, yellow or brown sandy loam, yellow caly loam with granite, quartz or ironstone pebbles

VT 9 was mapped over a reasonably large area of the undulating plains through the eastern and northern parts of the Study Area (Figures 3.1 – 3.3). It was also mapped over a majority of the haul road which extends from the Study Area to the south east.

A total of 64 vascular plant taxa from the statistical analysis were recorded in quadrats grouped in VT 9. Species richness per quadrat within VT 9 was  $10.6 \pm 4.6$ . The conservation significant taxa *Persoonia pentasticha* (P3) was recorded within this VT during WEC surveys in 2012 with the additional conservation significant species *Acacia speckii* (P4), *Calytrix uncinata* (P3), *Grevillea globosa* (P3), *Polianthion collinum* (P3) and *Stylidium scintillans* (T) being previously recorded in areas mapped as VT 9. No introduced taxa were recorded in VT 9. All vascular plant taxa recorded within VT 9 is presented in Appendix K.

Sandalwood (*Santalum spicatum*) is a protected species, with clearing of this species prohibited without a permit under legislation in Western Australia and has been previously recorded in areas mapped at VT 9 southeast of Gossan Hill and along the haul road in the southeast of the Study Area.

The condition of the vegetation in most of the quadrats established within VT 9 were ranked as Very Good with two sites GG45 and GG04 ranked as Good from the disturbance caused by goat activity (Appendix E). Three sites GG60, GG 57 and GG63 were ranked as Excellent with no signs of disturbance.



Plate 3: VT 9 (Quadrat GG06) (Photo: Woodman Environmental)

**VT 9d: Disturbed Vegetation Type VT 9**

**Total Area:** 54.49 ha

**Percentage of Study Area:** 1.85 %

This disturbed vegetation type was mapped in a number of small areas through the central part of the study area including to the north of Gossan Hill, and areas north of the tailings dams and adjacent to the processing area, with the disturbance to the vegetation being related to mining activities. The vegetation condition for these areas was ranked as Poor.

The conservation significant flora *Calytrix uncinata* (P3), *Drummondita fulva* (P3), *Micromyrtus trudgenii* (P3) and *Polianthion collinum* (P3) has previously been recorded in areas mapped as VT 9d.



**VT 10:** Tall open shrubland of mixed species including *Acacia caesaneura*, *Acacia incurvaneura*, *Acacia latior*, *Acacia sibina*, *Acacia umbraculiformis* and *Grevillea obliquistigma* subsp. *obliquistigma* over mid open shrubland of *Aluta aspera* subsp. *hesperia* over low isolated clumps of shrubs of *Solanum cleistogamum* and tussock grasses of *Monochather paradoxus* on red-brown sandy clay on hill slopes

**Total Area:** 42.99 ha

**Percentage of Study Area:** 1.46 %

**Sampling:** 3 quadrats within Study Area (1 quadrat outside Study Area)

**Common taxa recorded within each stratum:**

Stratum	Descriptor	Taxa
Mid Stratum 1	Tall Open shrubland (Shrubs >2 m)	<i>Acacia aulacophylla</i> <i>Acacia caesaneura</i> ms <i>Acacia craspedocarpa</i> <i>Acacia incurvaneura</i> ms <i>Acacia latior</i> <i>Acacia sibina</i> <i>Acacia umbraculiformis</i> <i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>
Lower Stratum 1	Low Isolated Clumps of Shrubs (Shrubs <1 m), Low Isolated Clumps of Tussock (Grasses <0.5 m)	<i>Aluta aspera</i> subsp. <i>hesperia</i> <i>Eremophila latrobei</i> subsp. <i>latrobei</i> <i>Monachather paradoxus</i> <i>Philotheca brucei</i> subsp. <i>brucei</i> <i>Solanum cleistogamum</i>

**Indicator Taxa:** *Acacia incurvaneura* ms, *Grevillea obliquistigma* subsp. *obliquistigma* and *Monachather paradoxus*

**Landform Types:** Simple slopes and upperslopes

**Soil Types:** Red-brown sandy clay or clayey sand, with granite, ironstone and laterite surface pebbles and occasional laterite outcropping

Within the Study Area VT 10 was mapped in small areas within and adjacent to the low hill system to the west of the study area north of the camp and west of the tailings dams (Figure 3.1 – 3.2). It was mainly mapped on simple slopes but did occur higher within the landscape.

This VT grouped with 1 DEC quadrat (JASP 07) from the Central Tallering survey (Markey and Dillon 2008) which had previously aligned with DEC VT 1a and this has possibly occurred due to the presence of the indicator species for this VT. VT 10 co-occurs within VT 4 and could be potentially considered a vegetation complex within Priority Ecological Community (PEC) 13: Minjar / Gnows Nest vegetation complexes (banded ironstone formation) (as described in Markey and Dillon 2008) due to its occurrence within and adjacent to VT 4

A total of 25 vascular plant taxa from the statistical analysis were recorded in quadrats grouped in VT 10. Species richness per quadrat within VT 10 was  $17.0 \pm 8.3$ . No conservation significant or introduced flora taxa were recorded in VT 10. All vascular plant taxa recorded in VT 10 is presented in Appendix K.

Sandalwood (*Santalum spicatum*) is a protected species, with clearing of this species prohibited without a permit under legislation in Western Australia where 1 plant was recorded at quadrat GG09, which is northwest of the tailings dam during WEC surveys in 2012

The condition of the vegetation in all quadrats established in VT 10 was ranked as Excellent (Appendix E).



**Plate 4: VT 10 (Quadrat GG19) (Photo: Woodman Environmental)**



**VT 11:** Tall closed to sparse shrubland of mixed *Acacia* species dominated by *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa* and *Acacia sibina* over low isolated clumps of tussock grasses of *Monochather paradoxus* on yellow to and red-brown loams on plains and slopes

**Total Area:** 636.55 ha

**Percentage of Study Area:** 21.56 %

**Sampling:** 13 quadrats within Study Area

**Common taxa recorded within each stratum:**

Stratum	Descriptor	Taxa
Mid Stratum 1	Tall Closed Shrubland to Tall Sparse Shrubland (Shrubs >2 m)	<i>Acacia effusifolia</i> <i>Acacia ramulosa</i> var. <i>ramulosa</i> <i>Acacia sibina</i>
Lower Stratum 1	Mid Isolated Clumps of Shrubs (Shrubs <2 m), Low Isolated Clumps of Tussock Grasses (Shrubs <0.5 m),	<i>Cryptandra imbricata</i> <i>Eremophila forrestii</i> subsp. <i>forrestii</i> <i>Monachather paradoxus</i> <i>Rhagodia drummondii</i>

**Indicator Taxa:** *Acacia effusifolia*

**Landform Types:** Plains, flats and simple slopes

**Soil Types:** Red-brown or Red sandy clay, sandy loam or clayey sand, with predominantly granitic surface pebbles

Within the Study Area VT 11 was mapped in large areas through the southern central part of the Study Area (Figures 3.1 – 3.3) and was mainly mapped on plains and simple slopes. It was also mapped through the central area of the haul road which extends out from the south east of the Study Area.

A total of 38 vascular plant taxa from the statistical analysis were recorded in quadrats grouped in VT 11. Species richness per quadrat within VT 11 was  $9.0 \pm 4.0$ . No Conservation significant taxa were recorded in this VT during WEC surveys in 2012 however the conservation significant flora taxa *Acacia speckii* (P4), *Calytrix uncinata* (P3), *Grevillea globosa* (P3), *Micromyrtus trudgenii* (P3) and *Polianthion collinum* (P3) have previously been recorded in areas mapped as VT 11. No introduced taxa were recorded in VT 11, either in quadrats or opportunistically while traversing the landscape in 2012. All vascular plant taxa recorded within VT 11 are presented in Appendix K.

The condition of the vegetation in almost all quadrats established in VT 11 was ranked as Excellent except for four quadrats (GG21, GG31, GG33 and GG42) which were ranked as Very Good (Appendix E).



Plate 5: VT 11 (Quadrat GG58) (Photo: Woodman Environmental)

**VT 11d: Disturbed Vegetation Type VT 11**

**Total Area:** 42.94 ha

**Percentage of Study Area:** 1.45 %

This disturbed vegetation type was mapped in a number of small areas through the central part of the study area including to the south and west of Gossan Hill, and areas south of the tailings dams, with the disturbance to the vegetation being related to mining activities and historic discharge of excess mine water. The vegetation condition for these areas was ranked as Poor.

The conservation significant flora *Calytrix uncinata* (P3), *Drummondita fulva* (P3), *Grevillea globosa* (P3) and *Micromyrtus trudgenii* (P3) have previously been recorded in areas mapped as VT 11d.

**VT 12:** Low sparse isolated shrubs to shrubland of chenopods of mixed species including *Rhagodia drummondii*, *Sclerolaena diacantha* and *Atriplex codonocarpa* occasionally with low open forest of *Eucalyptus loxophleba* subsp. *supralaevis* or low open samphire shrubland of *Tecticornia disarticulata* on red-brown sandy to clay loams on plains

**Total Area:** 49.23 ha

**Percentage of Study Area:** 1.67 %

**Sampling:** 3 quadrats within Study Area

**Common taxa recorded within each stratum:**

Stratum	Descriptor	Taxa
Upper Stratum 1	Low Open Forest (Trees <10 m)	<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>
Lower Stratum 1	Low Sparse Chenopod Shrubland (Shrubs <1 m)	<i>Atriplex codonocarpa</i> <i>Enneapogon caeruleus</i> <i>Eremophila oldfieldii</i> subsp. <i>oldfieldii</i> <i>Erymophyllum ramosum</i> subsp. <i>ramosum</i> <i>Frankenia setosa</i> <i>Maireana amoena</i> <i>Maireana georgei</i> <i>Maireana tomentosa</i> subsp. <i>tomentosa</i> <i>Maireana triptera</i> <i>Ptilotus obovatus</i> <i>Rhagodia drummondii</i> <i>Sclerolaena diacantha</i> <i>Sclerolaena gardneri</i> <i>Tecticornia disarticulata</i>

**Indicator Taxa:** *Atriplex codonocarpa*, *Maireana triptera* and *Rhagodia drummondii*

**Landform Types:** Plains

**Soil Types:** Red clay loam or yellow sandy loam, with some granite and quartz surface pebbles

Within the Study Area VT 12 was mapped in three small areas to the north and east within the Study Area (Figures 3.1, 3.3). It was mapped on flat areas plains with saline influences due to the presence of numerous chenopod species.

A total of 11 vascular plant taxa from the statistical analysis were recorded in quadrats grouped in VT 12. Species richness per quadrat within VT 12 was  $7.3 \pm 1.1$ . No conservation significant or introduced flora taxa were recorded in VT 12. All vascular plant taxa recorded with VT 12 is presented in Appendix K.

The condition of the vegetation in all quadrats established in VT 12 was ranked as Very Good (Appendix E).



**Plate 6: VT 12 (Quadrat GG27) (Photo: Woodman Environmental)**

**VT 13:** Low open samphire shrubland of *Tecticornia disarticulata* over low sparse isolated chenopod shrubs of *Atriplex ?bunburyana* on yellow or white sandy loam on breakaway outwash areas

**Total Area:** 18.41 ha

**Percentage of Study Area:** 0.62 %

**Sampling:** 2 quadrats within Study Area

**Common taxa recorded within each stratum:**

Stratum	Descriptor	Taxa
Mid Stratum 1	Tall Isolated clumps of Shrubs (Shrubs > 2 m)	<i>Acacia masliniana</i>
Lower Stratum 1	Low Open Samphire Shrubland (Shrubs <1 m), Low Sparse Isolated Chenopod Shrubs (Shrubs <1 m)	<i>Atriplex ?bunburyana</i> <i>Eragrostis dielsii</i> <i>Pogonolepis muelleriana</i> <i>Solanum lasiophyllum</i> <i>Tecticornia disarticulata</i>

**Indicator Taxa:** *Acacia masliniana*, *Atriplex ?bunburyana* and *Tecticornia disarticulata*

**Landform Types:** Breakaway outwash

**Soil Types:** yellow or white sandy loam

Within the Study Area VT 13 was mapped in a few small areas to the south of the waste management facility and adjacent to the Yalgoo – Ninghan Road to the northeast of the Study Area (Figures 3.1). It was mapped primarily on breakaway outwash areas on plains.

A total of 4 vascular plant taxa from the statistical analysis were recorded in quadrats grouped in VT 13. Species richness per quadrat within VT 13 was  $4.0 \pm 0.0$ . No conservation significant or introduced flora taxa were recorded in VT 13. All vascular plant taxa recorded with VT 13 is presented in Appendix K.

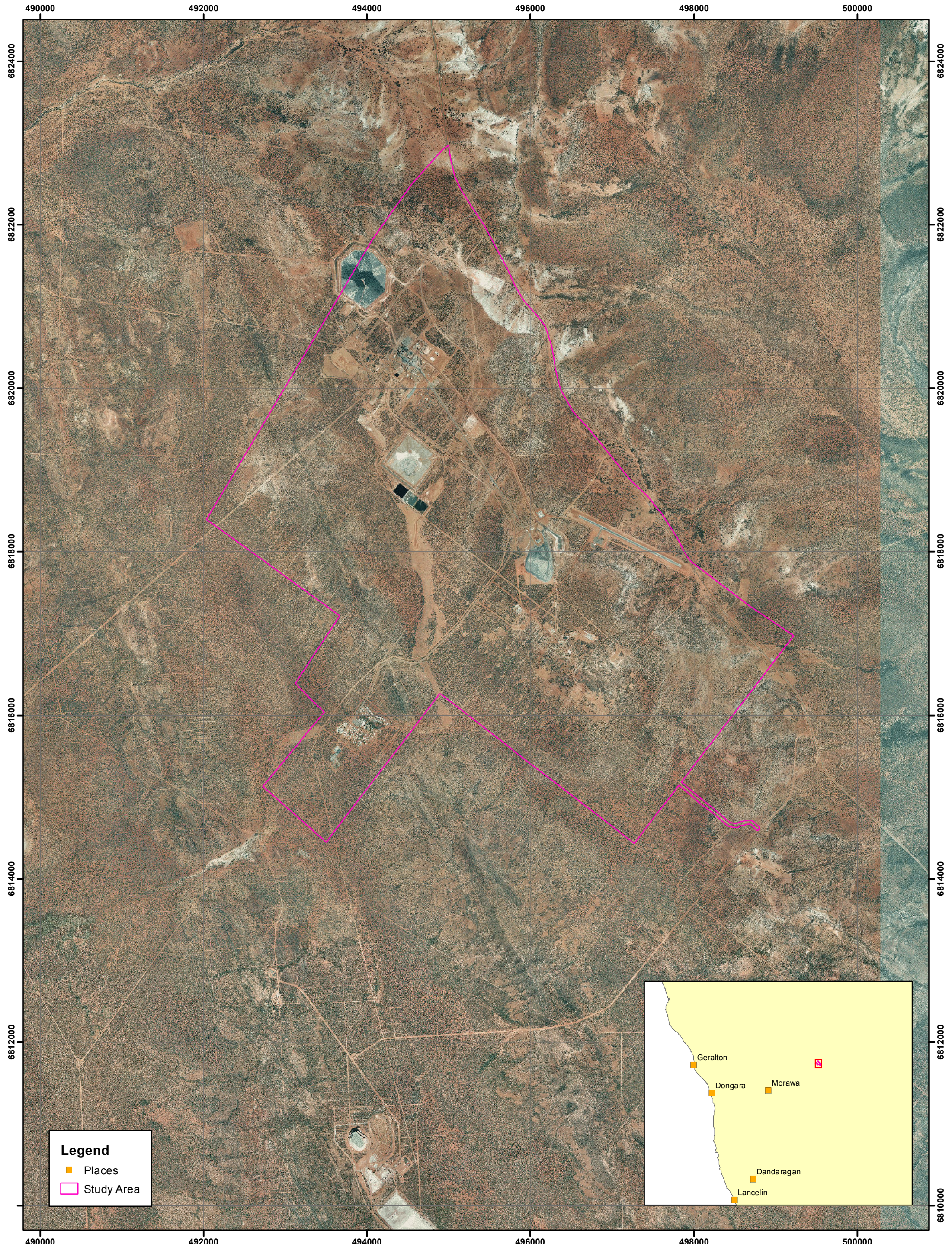
The condition of the vegetation in all quadrats established in VT 12 was ranked as Very Good (Appendix E).



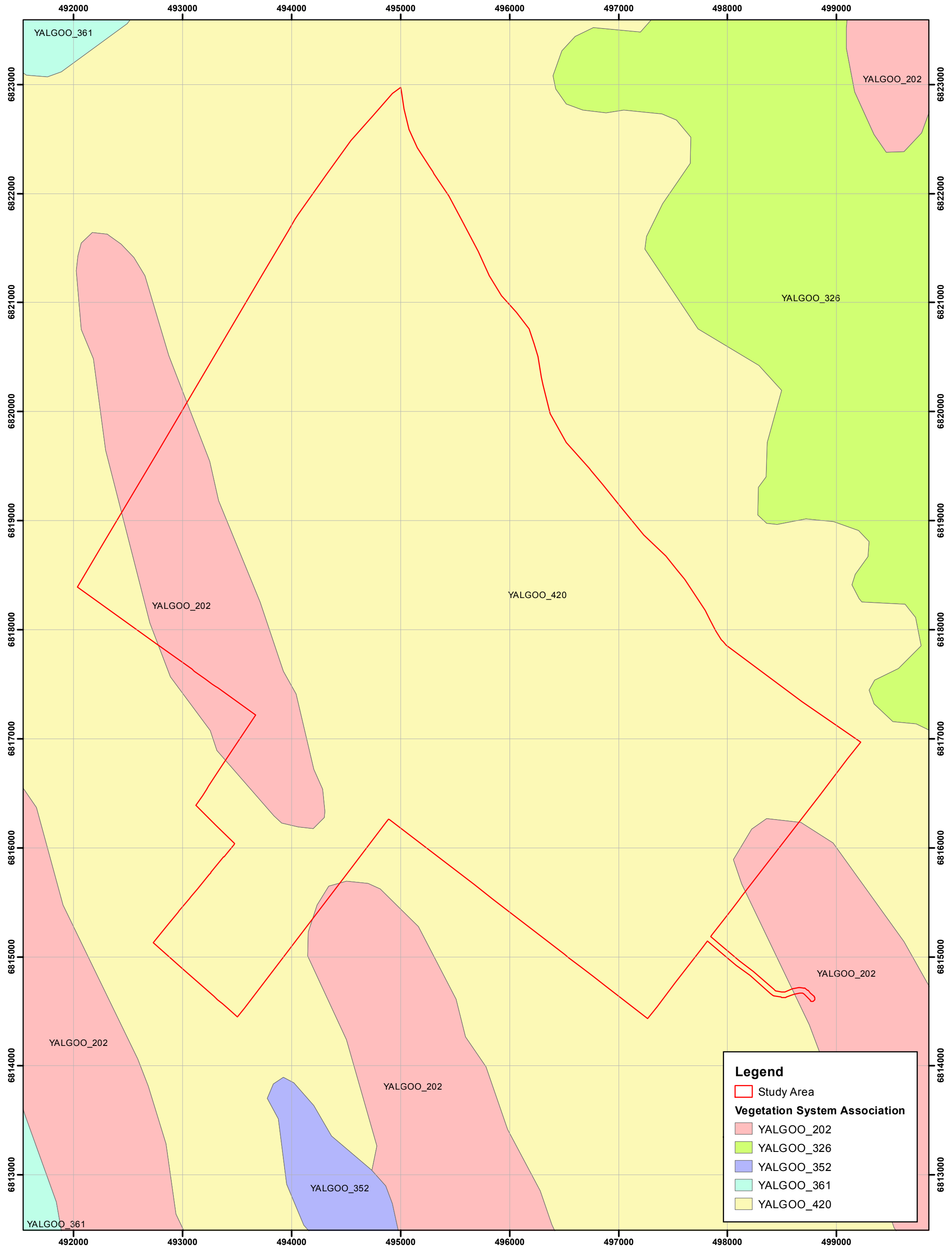


**Plate 7: VT 13 (Quadrat GG65) (Photo: Woodman Environmental)**









Legend

- Quadrats (Woodman Environmental Consulting 2012)
- Quadrats (Woodman Environmental Consulting 2007a)
- Polianthion\_collinum\_2007

Vegetation Types

- 3 Tall open to sparse shrubland of mixed *Acacia* species dominated by *Acacia grasbyi*, *Acacia umbraculiformis* and *Acacia tetragonophylla* over mid open to sparse shrubland of *Thryptomene costata* over isolated clumps of shrubs of *Ptilotus obovatus* and *Eremophila punicea* over low isolated clumps of forbs of *Borya sphaerocephala* on red-brown to yellow sandy to clay loams often associated with decomposing granite or granite outcropping on plains and upperslopes
- 4 Tall shrubland of mixed *Acacia* species dominated by *Acacia aulacophylla* and *Acacia ramulosa* var. *ramulosa* over mid open shrubland sparse shrubland of mixed species dominated by *Eremophila glutinosa*, *Eremophila latrobei* subsp. *latrobei*, *Mirbelia* sp. Bursarioides (T.R. lally760), *Philotheca brucei* subsp. *brucei* and *Philotheca sericea* on red-brown sandy clay or loams on lowerslopes to crests with ironstone or granite outcropping
- 4d Disturbed areas of Vegetation Type 4.
- 9 Tall closed to sparse shrubland of mixed *Acacia* species dominated by *Acacia ramulosa* var. *ramulosa* with *Acacia burkittii* and *Acacia tetragonophylla* over low isolated clumps of shrubs of mixed species dominated by *Ptilotus obovatus* on yellow, red and red-brown loams predominantly on plains and occasionally on mid to upperslopes of low hills
- 9d Disturbed areas of Vegetation Type 9.
- 10 Tall open shrubland of mixed species including *Acacia caesaneura*, *Acacia incurvaneura*, *Acacia latior*, *Acacia sibina*, *Acacia umbraculiformis* and *Grevillea obliquistigma* subsp. *obliquistigma* over mid open shrubland of *Aluta aspera* subsp. *hesperia* over low isolated clumps of shrubs of *Solanum cleistogamum* and tussock grasses of *Monochather paradoxus* on red-brown sandy clay on hill slopes
- 11 Tall closed to sparse shrubland of mixed *Acacia* species dominated by *Acacia effusifolia*, *Acacia ramulosa* var. *ramulosa* and *Acacia sibina* over low isolated clumps of tussock grasses of *Monochather paradoxus* on yellow to and red-brown loams on plains and slopes
- 11d Disturbed areas of Vegetation Type 11.
- 12 Low sparse isolated shrubs to shrubland of chenopods of mixed species including *Rhagodia drummondii*, *Sclerolaena diacantha* and *Atriplex codonocarpa* occasionally with low open forest of *Eucalyptus loxophleba* subsp. *supralaevis* or low open samphire shrubland of *Tecticornia disarticulata* on red-brown sandy to clay loams on plains
- 13 Low open samphire shrubland of *Tecticornia disarticulata* over low sparse isolated chenopod shrubs of *Atriplex ?bunburyana* on yellow or white sandy loam on breakaway outwash areas

Other Mapped Areas

- C Cleared Land.

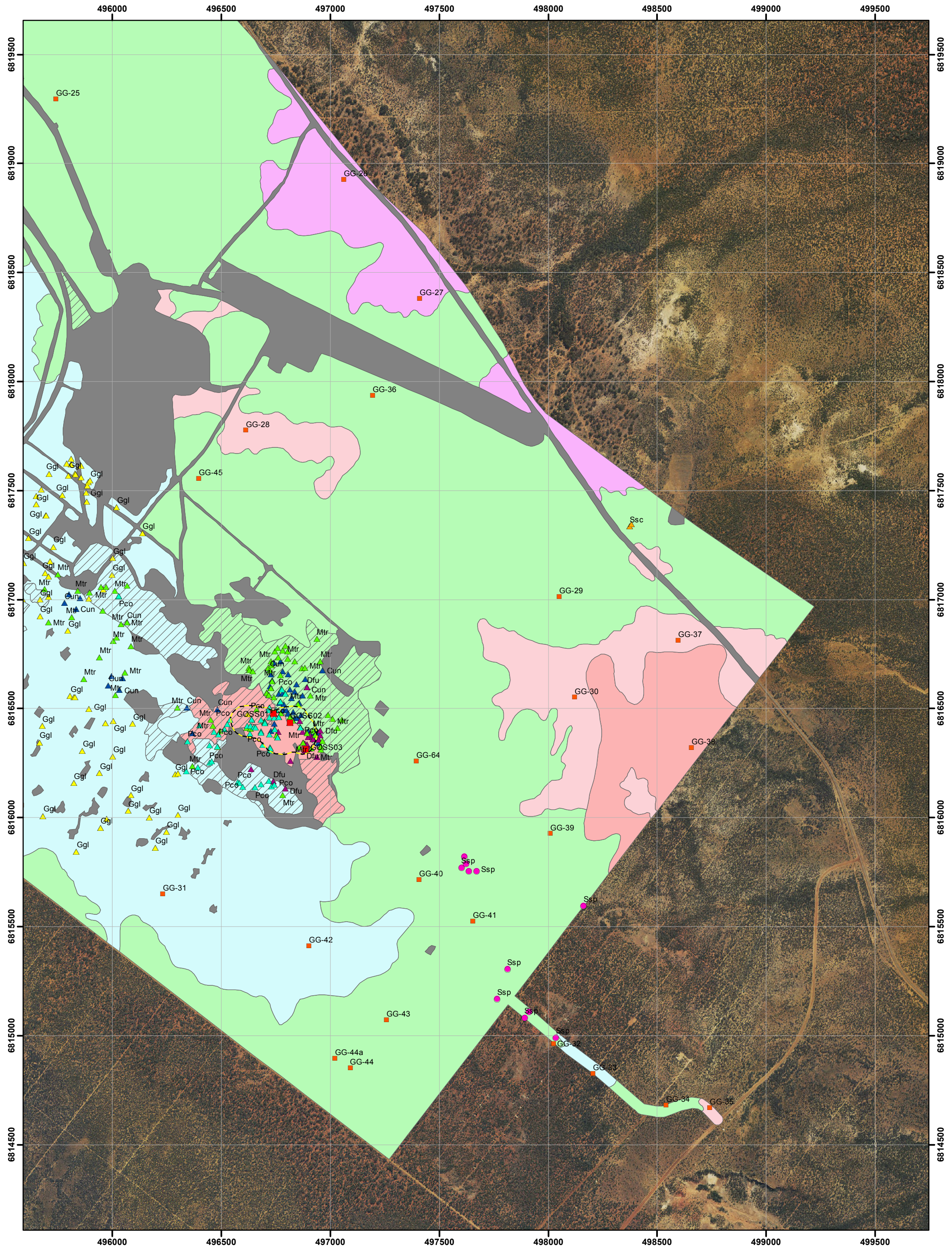
Conservation Significant Flora

- Ssc *Stylidium scintillans* (T)
- Cun *Calytrix uncinata* (3)
- Dfu *Drummondita fulva* (3)
- Ggl *Grevillea globosa* (3)
- Mtr *Micromyrtus trudgenii* (3)
- Pco *Polianthion collinum* (3)
- Ppe *Persoonia pentasticha* (3)
- Aspk *Acacia speckii* (4)

Other Flora of Interest

- Ssp *Santalum spicatum*







Legend

Quadrats (Woodman Environmental Consulting 2012)

Quadrats (Woodman Environmental Consulting 2007a)

Vegetation Condition Rating

E

Excellent: Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement

E/VG

Mosaic of condition ratings Excellent and Very Good

VG

Very Good: Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks

VG/G

Mosaic of condition ratings Very Good and Good

G

Good: More obvious signs of damage caused by human activities since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds

P

Poor :Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds

C

Cleared Land







