



Karara Mining Limited

Targeted Flora and Vegetation Assessment – Hinge Haul Road

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KARARA

MINING LTD

Outback Ecology Services
1/71 Troy Terrace
Jolimont WA 6014
Ph: +61 (08) 9388 8799
Fax: +61 (08) 9388 8633
admin@outbackecology.com

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Karara Mining Limited	Digital copy (pdf)	Parveen Bauer

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Executive Summary

Outback Ecology was commissioned to conduct a flora and vegetation survey of a proposed haul road footprint, which forms a component of the Karara Mining Limited (KML) mining Project, located approximately 215 km east of Geraldton and 320 km north northeast of Perth. The haul road Study area is approximately 13 kilometres (km) long and 100 metres (m) wide (Study area). Several surveys have previously been completed in the region for KML, including mapping of Floristic Community Types (FCTs) and targeted surveys for conservation significant flora. In this study, Outback Ecology was commissioned by KML to undertake targeted flora surveys within the Study area and to ground truth FCT boundaries and descriptions, many of which are extrapolated from the broader regional data. A summary of the results of the November 2012 Targeted Flora and Vegetation Assessment is as follows:

- no Threatened Flora or *EPBC Act* listed species were recorded within the Study area;
- three Priority Flora species were recorded during the 2012 survey reported here, *Drummondita fulva* (P3), *Grevillea globosa* (P3) and *Micromyrtus trudgenii* (P3);
- an estimated 310 individuals of *Drummondita fulva* were recorded within FCTs 2, 7, 12 and 13 within the Study area;
- eight individuals of *Grevillea globosa* were recorded in the central section of the proposed haul road;
- a single individual of *Micromyrtus trudgenii* was recorded within FCT 7. There are expected to be additional individuals of this species outside of the surveyed corridor (Study area) associated with exposed granite outcropping and Banded Ironstone Formation within the immediate vicinity;
- no Threatened Ecological Communities or *EPBC Act* listed communities were recorded for the Study area; and
- the vegetation condition recorded in the Study area ranged from Very Good to Excellent.

The Study area is located within the buffer zone of the Priority 1 Ecological Community Mid West 2: Mt Karara/Mungada Ridge (Blue Hills) Banded Ironstone Formation. Areas mapped as Floristic Community Types 1 and 2 (BIF) in the Study area are likely to represent the outer extent and continuation of this PEC due to the close proximity to the main BIF range. Further examination of PEC quadrat data from the Department of Environment and Conservation and Woodman Environmental Consulting Pty Ltd would be required to confirm this. Woodman Environmental Consulting Pty Ltd previously identified FCTs 1, 2, 3, 4, 5, 6, 10 and 12 which can occur on BIF or upper slopes and crests high in the landscape and/or on restricted landforms within the region, with the potential to occur within the Blue Hills Priority Ecological Community (Midwest 2). The extent of the mapping of FCT 1 and 2 was amended by Outback for the Study area, these two vegetation types were the only areas to contain upper slopes with BIF, likely to be representative of Blue Hills PEC in the Study area. There was 6.15ha of potential PEC mapped within the Study area. This represents 1% of the known mapping of FCT 1 and 2 in the region.

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1. INTRODUCTION

1.1. Project Background and Location

Karara Mining Limited (KML) intends to construct a proposed haul road as part of the Hinge Iron Ore Project. Outback Ecology was commissioned by KML to conduct a targeted flora survey and verification of Floristic Community Type (FCT) mapping conducted by Woodman Environmental Consulting Pty Ltd (Woodman) (2012) within a 13 km long and 100 metre wide proposed haul road corridor (Study area) (**Figure 1** and **Figure 2**).

1.2. Report Scope and Objectives

The specific objectives of the flora and vegetation assessment were to:

- complete a desktop assessment to review the status of conservation significant flora species and vegetation communities, including a review of Threatened and Priority Ecological Communities (TECs/PECs) and other Environmentally Sensitive Areas within and adjacent to the Survey areas;
- survey, map and describe the vegetation communities and their condition in each Survey area, and reconcile these with the descriptions of floristic community types (FCTs) (Woodman, 2012) that have previously been mapped as part of a larger regional survey;
- record locations of conservation significant flora and introduced flora encountered in the field, describe the population size, condition and habitat;
- waypoint the locations of all conservation significant (Threatened and Priority Flora) species in the field so that they can be easily re-located by exploration staff when selecting final tracks and drill pad locations; and
- identify the number of individuals of conservation significance within each FCT, to enhance the level of knowledge of these species at a local scale.

The objectives and methods adopted for the flora and vegetation surveys were aligned with the:

- EPA Position Statement No. 3, *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002); and
- EPA Guidance No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004).

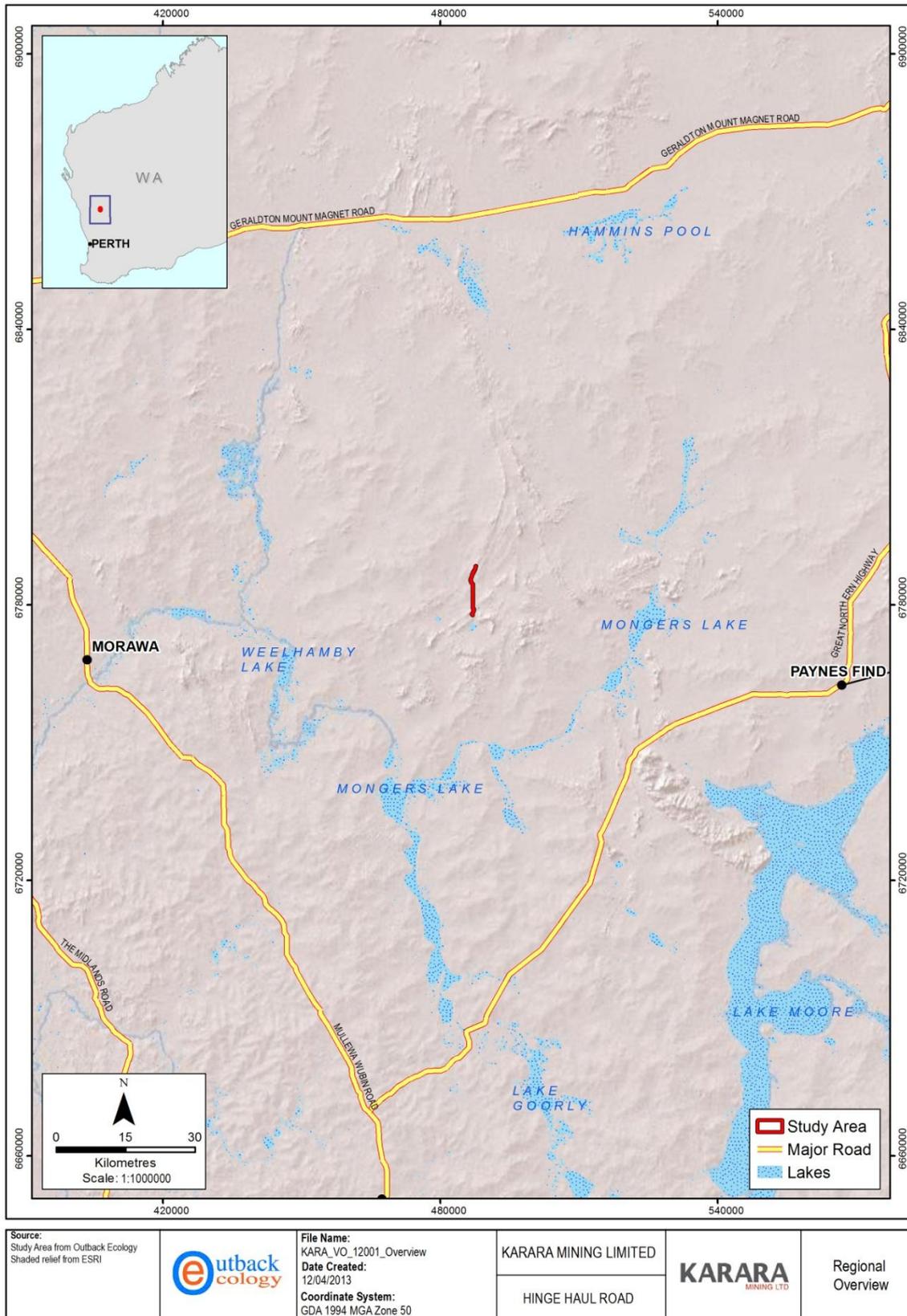


Figure 1: General location of the Hinge Haul Road Study area



Figure 2: The Hinge Haul Road Study area

2. EXISTING ENVIRONMENT

2.1. Biogeographic Region

In 2012, the Department of Sustainability, Environment, Water Populations and Communities (DSEWPaC) (2012) described a system of 89 ‘biogeographic regions’ (bioregions) and 419 subregions covering the whole of Australia which are defined on the basis of climate, geology, landforms, vegetation and fauna. The Study areas are located within the Yalgoo (Yal) bioregion which is recognised as an interzone between the South-west Botanical Province and the Murchison, “characterised by low woodlands to open woodland of *Eucalyptus*, *Acacia* and *Callitris* on red sandy plains of the Western Yilgarn Craton and southern Carnarvon Basin” (Desmond and Chant 2001). The Yalgoo bioregion comprises 4,254,289 ha and two subregions; the Edel subregion to the north and in which the majority of conservation estate in the region is located and the Talling subregion in which the Study area lies. (Figure 4).

2.2. Climate

The Yalgoo region experiences an arid to semi-arid, warm Mediterranean climate. Long term weather data recorded at Paynes Find (approximately 75 km to the southeast of the Study areas) shows that rainfall is received throughout the year, with the greatest amounts received between May and July (Figure 3). Paynes Find has a mean average rainfall of approximately 284 mm and an average of 53 rain days per annum (BOM 2012). The highest average monthly temperatures for Paynes Find are recorded from November to March with the hottest month being January (mean daily maximum temperature greater than 37 °C). The coolest month is July when the mean daily maximum temperature is 18°C (BOM 2012). Rainfall for the region is considered unreliable and received either in summer or winter months (Beard 1976).

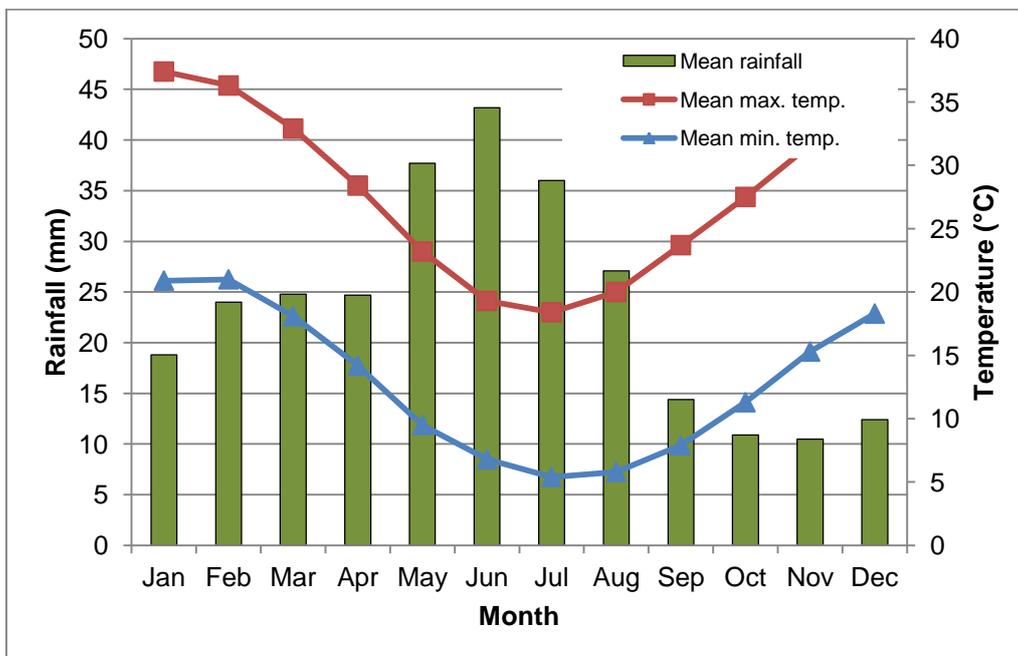


Figure 3: Climate data recorded at Paynes Find

Source data: BOM (2012): Temperature 1975 – 2012, Rainfall 1919 – 2012



Figure 4: Biogeographic Subregions of the Study area

2.3. Land Use

The dominant land use in the Yalgoo bioregion is pastoral (77%), conservation (10%), Unallocated Crown land (UCL) and Crown reserves (9%) and mining leases (Desmond and Chant 2001) (**Figure 5**).

2.4. Beard Vegetation Mapping

Beard (1976) mapped the Yalgoo bioregion as part of the Murchison region at a scale of 1:000,000. Beard noted that the Yalgoo bioregion represented a transition between the Eremaean and South-west Botanical Provinces. Three vegetation associations intersect with the Study area, (**Figure 6, Table 1**), however these associations are relatively broad and do not reflect the more localised vegetation communities recorded by Woodman (2012) and this study.

Table 1: Beard Vegetation Associations within the Study areas

Code	Beard Vegetation Association Description	Hectares	Percentage of Study area	Percentage of Total Regional Area
358	Shrublands; bowgada & <i>Acacia quadrimarginea</i> on stony ridges	9.67	8.56	0.02
363	Shrublands; bowgada scrub with scattered cypress pine	13.91	12.32	0.01
420	Shrublands; bowgada & jam scrub	89.30	79.12	0.01

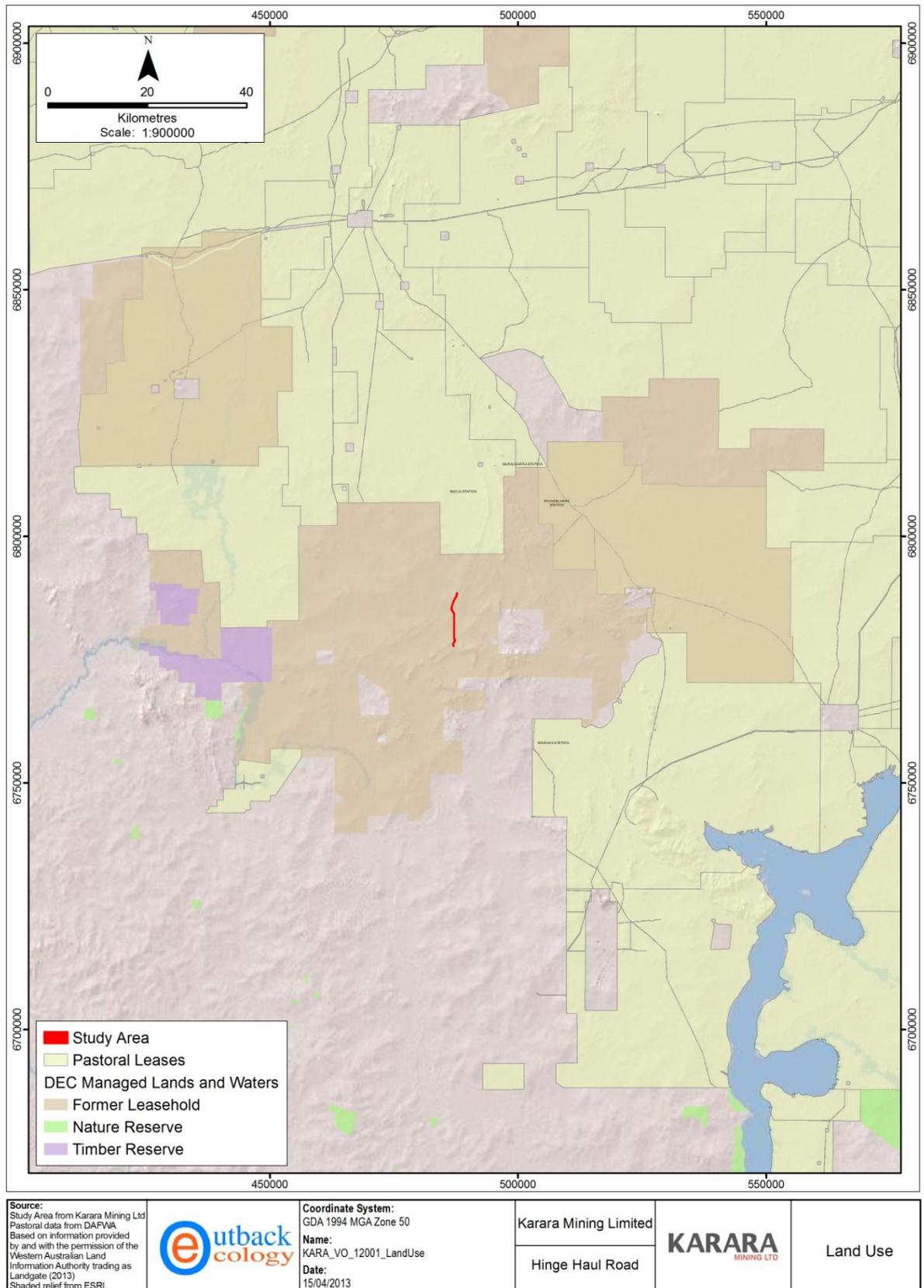


Figure 5: Regional Land Use

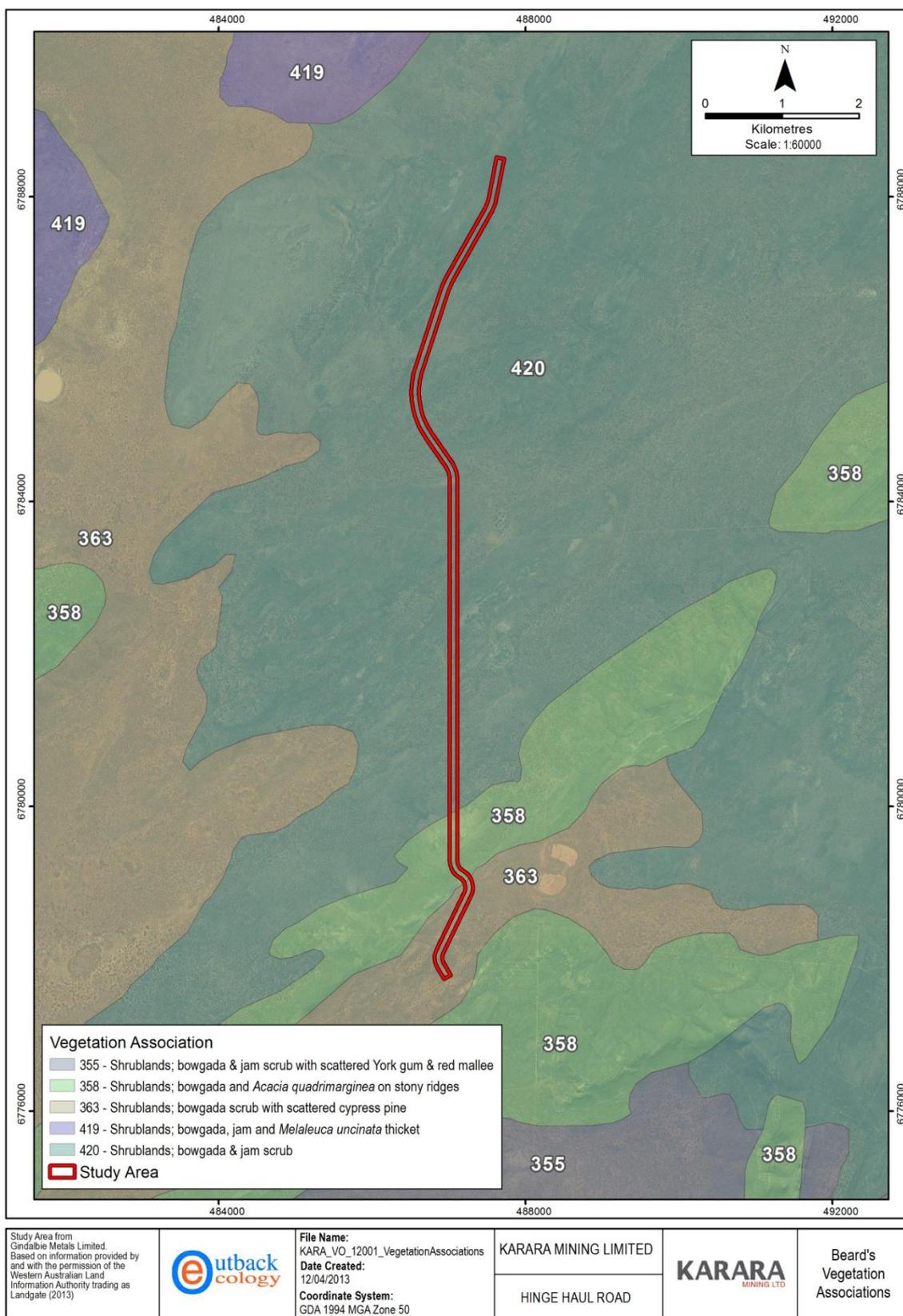


Figure 6: Beard Vegetation Associations within the Hinge Haul Road Study area and surrounds

2.5. Land Systems

Land systems are defined using landform, soil, vegetation, geological and geomorphology data. An assessment of land systems provides an indication of the occurrence and distribution of vegetation types. Three land systems across the Study areas are described (**Table 2**) and illustrated (**Figure 7**). Conservation significant flora and ecological communities may sometimes be associated with particular land systems and thus some understanding of them may assist in identifying potential habitat for these species and vegetation associations.

Table 2: Land Systems in the Hinge Haul Road Study area

Land System	Area (ha)	Percentage of Study area	Percentage of Total Land System Area
Tallering System: Prominent ridges and hills of banded ironstone, dolerite and sedimentary rocks supporting bowgada and other acacia shrublands.	30.05	26.62	0.09
Tealtoo System: Level to gently undulating loamy plains with fine ironstone gravel mantles supporting dense acacia shrublands.	54.98	48.71	0.08
Yowie System: Sandy plains supporting tall shrublands of mulga and bowgada with patchy wanderrie grasses.	27.85	24.67	0.002

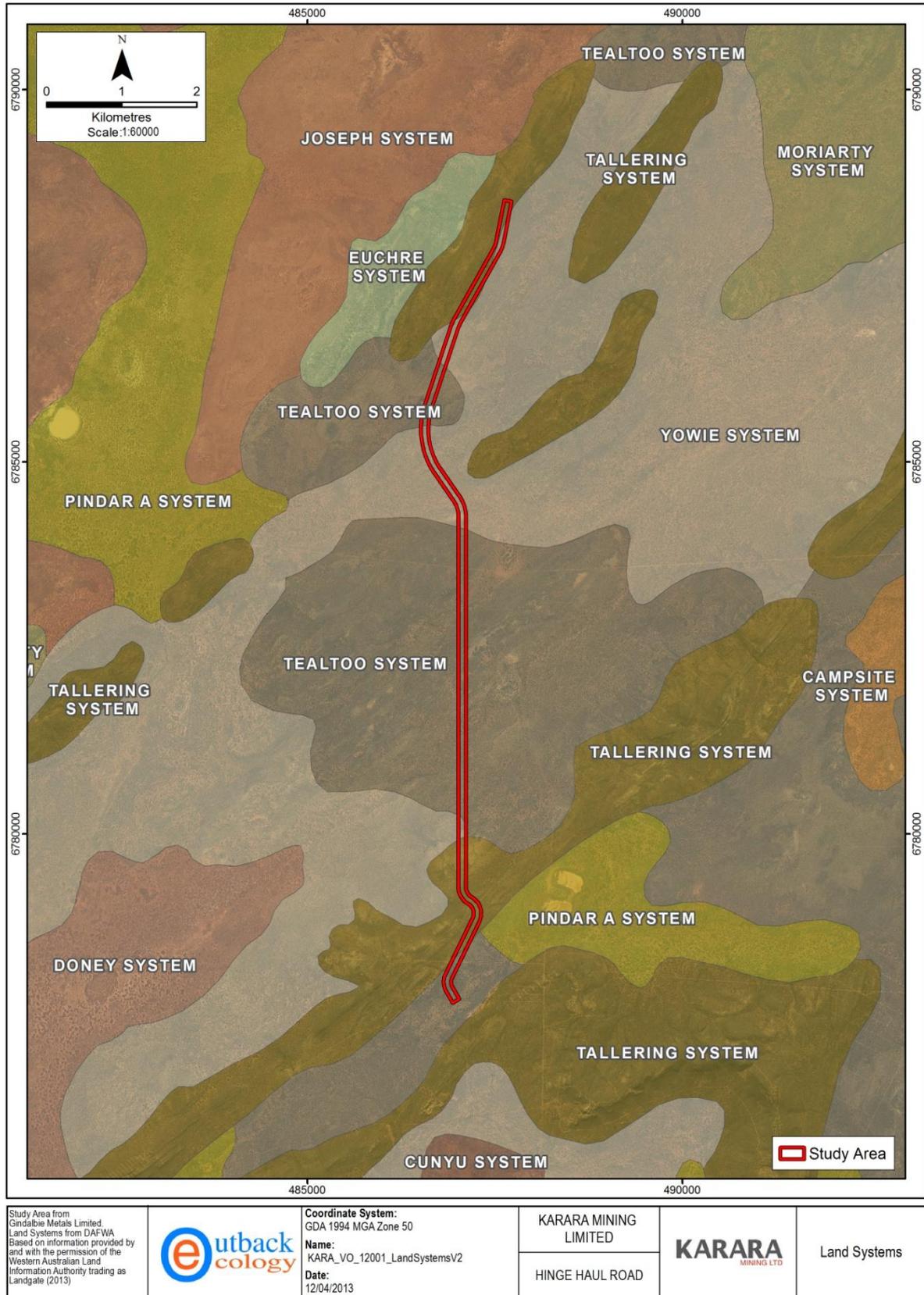


Figure 7: Land Systems of the Hinge Haul Road Study area

2.6. Conservation Significant Ecological Communities

Banded Ironstone formation (BIF) has been found to support numerous conservation significant species and vegetation assemblages due to its unique geology, soils and relative isolation (DEC 2007). Several flora surveys have been conducted by the Department of Environment and Conservation (DEC) in the BIF ranges of the Mid-West. Gibson *et al.* (1997) found high plant endemism and emphasised the uniqueness of BIF plant communities. A survey of the Mt Karara/Mungada Ridge/ Blue Hills areas by Markey and Dillon (2008) described eight vegetation community types that were endemic to these ranges and restricted in their distributions within the ranges.

The Study area is located within the buffer zone of the Mid West 2: Mt Karara/Mungada Ridge (Blue Hills) Priority 1 Ecological Communities (PECs) a Banded Ironstone Formation, defined in Appendix A and shown in relation to the Study area (Figure 8). The Mt Karara/Mungada Ridge (Blue Hills) is considered “*intact and protectable; high priority for conservation*” in a recommendation of the EPA Bulletin 1256 to protect 15 to 60% of the total number of BIF ranges (DEC 2007). The Blue Hills area is at the interface of the South West Botanical Province and the arid Eremaean Province, recognized for its high diversity and endemism with many undescribed and conservation significant species and communities.

2.7. Vegetation Mapping by Woodman

The Karara – Mungada project area was extensively surveyed by Woodman between 2008 and 2011. Twenty-one floristic community types, analogous to the *National Vegetation Information System* (National Heritage Trust (2003) were described of which five were rated as of moderate to high conservation significance and three rated as high (Woodman 2012). The DEC (2007) considered that further subdivision of these FCTs may be possible with more intensive survey. Woodman (2012) indicated that FCTs 3, 4, 5, 8, 14, 16, 19b, 19d, 21a, 21b, 21c and 30 represented less than 1% of the total regional area and thus were considered potentially of conservation significance.

Woodman (2012) identified FCTs 1, 2, 3, 4, 5, 6, 10 and 12 which occur on BIF or upperslopes and crests high in the landscape and/or on restricted landforms within the region, with the potential to occur within the Blue Hills Priority Ecological Community (Midwest 2). Three of the 17 FCTs previously mapped in the Study area by Woodman (2012) are possible BIF and upperslope FCTs (2, 10 and 12). The proportion of the Study area and the regional mapped area of Woodman that each FCT defined for the Study area represents is presented in the Table below (**Table 3**).

Table 3: Woodman FCTs within the vicinity of the Study area

Woodman FCT Description	Hectares	Percentage of Study area	Hectares in Region (Woodman)
FCT 1: Tall shrubland to tall open shrubland of mixed <i>Acacia</i> species, including <i>Acacia aneura</i> , <i>A. assimilis</i> subsp. <i>assimilis</i> , <i>A. ramulosa</i> var. <i>ramulosa</i> and occasional <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> over mid sparse shrubland of mixed species including <i>Eremophila clarkei</i> , <i>E. latrobei</i> subsp. <i>latrobei</i> , <i>Mirbelia bursarioides</i> ms, <i>Philotheca brucei</i> subsp. <i>brucei</i> and <i>Philotheca sericea</i> over low isolated clumps of shrubs of <i>Xanthosia bungei</i> on red-brown silty clay loams on lower slopes to crests with ironstone (BIF) or granite outcropping.	Nil	Nil	73
FCT 2: Tall shrubland to tall open shrubland of mixed <i>Acacia</i> species, including <i>Acacia ramulosa</i> var. <i>ramulosa</i> , <i>A. exocarpoides</i> , <i>A. aneura</i> and <i>A. tetragonophylla</i> over mid open shrubland to mid sparse shrubland of mixed species including <i>Eremophila clarkei</i> , <i>E. latrobei</i> subsp. <i>latrobei</i> , <i>Hibbertia arcuata</i> , <i>Philotheca brucei</i> subsp. <i>brucei</i> and <i>Philotheca sericea</i> on red-brown silty loams or clay loams on flats to upper slopes with ironstone (BIF).	6.35	5.63	781
FCT6: Tall shrubland to tall open shrubland of mixed <i>Acacia</i> species including <i>Acacia latior</i> , <i>A. sibina</i> , <i>A. assimilis</i> subsp. <i>assimilis</i> with low isolated clumps of trees of <i>Eucalyptus</i> spp. over mid open shrubland to mid sparse shrubland of mixed species including <i>Aluta aspera</i> subsp. <i>hesperia</i> over low isolated clumps of ferns of <i>Cheilanthes adiantoides</i> over low isolated clumps of grasses of <i>Monachather paradoxus</i> on red-brown or orange sandy clay loam or clay loam with ironstone gravel on flats to upper slopes.	Nil	Nil	90
FCT 7: Tall closed shrubland to tall open shrubland of mixed <i>Acacia</i> species including <i>Acacia latior</i> and <i>A. sibina</i> with low isolated clumps of trees of mixed <i>Eucalyptus</i> spp. over low sparse shrubland of mixed species including <i>Dianella revoluta</i> over low isolated clumps of grasses of <i>Monachather paradoxus</i> and <i>Amphipogon caricinus</i> subsp. <i>caricinus</i> on red-brown silty clay loam with ironstone gravel on flats to lowerslopes	18.68	16.55	2671

Woodman FCT Description	Hectares	Percentage of Study area	Hectares in Region (Woodman)
FCT 9: Low open woodland of <i>Eucalyptus kochii</i> subsp. <i>plenissima</i> over a tall closed shrubland to tall open shrubland of mixed species including <i>Acacia latior</i> and <i>A. sibina</i> , <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> and <i>Melaleuca leiocarpa</i> on red or red-brown sandy loam or clay loam on flats to upper slopes.	20.90	18.52	1923
FCT10: Tall closed shrubland to tall open shrubland of mixed <i>Acacia</i> species dominated by <i>Acacia assimilis</i> subsp. <i>assimilis</i> over mid open shrubland to mid sparse shrubland of mixed species including <i>Aluta aspera</i> subsp. <i>hesperia</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> and <i>Philothea sericea</i> on red or red-brown silty clay loam or clay loam with ironstone gravel on flats to crests (primarily midslopes)	0.78	0.69	867
FCT 12: Tall shrubland of mixed <i>Acacia</i> species including <i>Acacia ramulosa</i> var. <i>ramulosa</i> , <i>A. sibina</i> and <i>A. effusifolia</i> over mid open shrubland to mid sparse shrubland of mixed species including <i>Aluta aspera</i> subsp. <i>hesperia</i> , <i>Philothea brucei</i> subsp. <i>brucei</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>E. clarkei</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> over low isolated clumps of ferns of <i>Cheilanthes sieberi</i> over low isolated clumps of grasses of <i>Monachather paradoxus</i> on red, brown or red-brown silty clay loam or silty loam.	5.29	4.68	114
FCT13: Tall shrubland of mixed species including <i>Acacia sibina</i> , <i>A. latior</i> , <i>A. ramulosa</i> var. <i>ramulosa</i> and <i>Melaleuca leiocarpa</i> with low isolated clumps of trees of mixed <i>Eucalyptus</i> spp. over low isolated clumps of grasses of <i>Monachather paradoxus</i> on red or red-brown silty clay loam or clay loam on flats to midslopes.	16.80	14.89	634
FCT18: Tall shrubland to tall sparse shrubland of mixed species dominated by <i>Acacia ramulosa</i> var. <i>ramulosa</i> over mid sparse shrubland of mixed species including <i>Philothea deserti</i> subsp. <i>deserti</i> and <i>Hibbertia arcuata</i> on red clay loam or sandy loam on flats.	Nil	Nil	244

Woodman FCT Description	Hectares	Percentage of Study area	Hectares in Region (Woodman)
<p>FCT 19a: Low woodland to low open woodland of <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> over tall open shrubland of mixed species including <i>Acacia tetragonophylla</i> over mid sparse shrubland of mixed species including <i>Senna artemisioides</i> subsp. <i>filifolia</i> and <i>Rhagodia drummondii</i> over low sparse chenopod shrubland of mixed species including <i>Enchylaena tomentosa</i> var. <i>tomentosa</i>, <i>Sclerolaena diacantha</i>, <i>S. fusiformis</i> and <i>Maireana carnosae</i> over low isolated clumps of grasses of <i>Austrostipa elegantissima</i> on red to red-brown clay loam or silty clay with ironstone gravel on drainage lines, flats to midslopes.</p>	24.90	22.06	5698
<p>FCT21b: Tall shrubland of <i>Melaleuca eleuterostachya</i> and <i>Acacia ?caesaneura</i> surrounding disturbed clay pan.</p>	Nil	Nil	4
<p>FCT23: Tall shrubland to tall open shrubland of <i>Acacia</i> species including <i>Acacia ramulosa</i> var. <i>ramulosa</i>, <i>A. tetragonophylla</i>, <i>A. burkittii</i> over low sparse shrubland of mixed species including <i>Solanum lasiophyllum</i> and <i>Ptilotus obovatus</i> over low isolated clumps of grasses of <i>Austrostipa elegantissima</i> and <i>Monachather paradoxus</i> on red or red-brown clay loam or silty clay loam on flats.</p>	Nil	Nil	49
<p>FCT24: Tall shrubland to tall open shrubland of <i>Acacia</i> species dominated by <i>Acacia ramulosa</i> var. <i>ramulosa</i> over low sparse shrubland of mixed species including <i>Ptilotus obovatus</i> over low isolated clumps of grasses of <i>Monachather paradoxus</i> on red clayey sand on flats.</p>	Nil	Nil	85
<p>FCT26: Tall shrubland to tall open shrubland of mixed species including <i>Acacia ramulosa</i> var. <i>ramulosa</i>, <i>A. tetragonophylla</i>, <i>A. assimilis</i> subsp. <i>assimilis</i> and <i>Hakea recurva</i> subsp. <i>recurva</i> with low isolated clumps of trees of <i>Eucalyptus</i> spp. over low sparse shrubland of <i>Senna artemisioides</i> subsp. <i>filifolia</i> and <i>Rhagodia drummondii</i> over low isolated clumps of grasses of <i>Austrostipa elegantissima</i> on red or red-brown clay loam or sandy clay loam on flats to midslopes.</p>	5.70	5.05	3.62

Woodman FCT Description	Hectares	Percentage of Study area	Hectares in Region (Woodman)
FCT27: Tall shrubland to tall open shrubland of <i>Acacia</i> species including <i>Acacia acuminata</i> , <i>A. tetragonophylla</i> , and <i>A. obtecta</i> with low isolated clumps of trees of <i>Callitris columellaris</i> and/or <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> over low sparse shrubland of <i>Rhagodia drummondii</i> and <i>Ptilotus obovatus</i> over low isolated clumps of grasses of <i>Austrostipa elegantissima</i> and <i>Monachather paradoxus</i> on red or red-brown clay loam or sandy clay loam on flats	6.62	5.87	1914
FCT32: Tall shrubland to tall open shrubland of <i>Acacia</i> species including <i>Acacia umbraculiformis</i> , <i>A. tetragonophylla</i> , <i>A. ramulosa</i> var. <i>ramulosa</i> and <i>A. kochii</i> over mid sparse shrubland of species including <i>Solanum lasiophyllum</i> , <i>Dodonaea inaequifolia</i> and <i>Thryptomene costata</i> over low isolated clumps of ferns of <i>Cheilanthes sieberi</i> over low sparse forbland of <i>Borya sphaerocephala</i> on red-brown clay loam on slopes with granite or ironstone outcropping.	6.86	6.08	75
FCT 33: Low sparse forbland of mixed species on red-brown clay pan with ironstone gravel.	Nil	Nil	13.40

2.8. Threatened (T) and Priority Flora

The desktop assessment utilised several sources of information to determine which Threatened Flora (T) and Priority Flora may occur within the vicinity of the Study area. A search radius of 2.5 km by 20km is presented in **Figure 5** and **6** from the following datasets*:

- Naturemap;
- the Threatened and Priority Flora Database (TPFL);
- the WA Herbarium database (WAHerb);
- the Threatened and Priority Flora Species List; and
- previously recorded significant species (Woodman)

*as provided by KML

Seventeen species of conservation significance were identified as previously being recorded within the vicinity of the Study area from the database searches (**Table 4**, **Figure 8** and **Figure 9**). The preferred, known habitat of these species was assessed to provide an indication of the likelihood of them occurring in the Study area. The definitions of the status of these conservation significant species are provided in **Appendix B**.

Table 4: Conservation Significant Flora species identified within the vicinity of the Study area.

Status	Conservation Significant Taxa	Habit, flowering time and habitat	Likelihood in Survey Area
T	<i>Acacia woodmaniorum</i>	Intricately branched, prickly, hard shrub, to 2 m high. Skeletal red silt, red-brown soil, banded ironstone, laterite. Slopes, sides of hills, crests of ridges, ranges, disturbed overburden of mine sites.	Possible
T	<i>Stylidium scintillans</i>	Erect annual herb to 4 cm, red and white flowers. Recorded on decaying granite plateau on top of breakaways.	Possible
P2	<i>Acacia karina</i>	Straggling, woody shrub, to 1.5 m high, phyllodes terete with appressed hairs between nerves. Red-brown silty clay loam with ironstone pebbles, banded ironstone, shalestone. Rocky slopes.	Possible
P2	<i>Calandrinia kalanniensis</i>	Semi-erect to erect tuberous, perennial, herb, to 0.09 m high. Fl. pink-white, Nov to Dec or Jan. Shallow brown clay, often gritty, derived from eroded granite. Rock outcrops, herbfields.	Possible
P3	<i>Dicrastylis linearifolia</i>	Much-branched shrub, 1-3 m high, inflorescence with scale-like indumentum; upper surface of leaves hairy; stamens usually 5. Fl. white, Nov to Dec. Red sand. Sandplain.	Possible
P3	<i>Drummondita fulva</i>	Erect branching shrub 0.5 to 1.5 m, growing on skeletal, shallow acidic soils of orange-red or red-brown sandy loams and clayey silts. Foothills, lower to upper slopes and hillcrests.	Likely
P1	<i>Gunnopsis divisa</i>	Annual, herb, 0.05-0.1 m high. Fl. white, Aug. Loam, quartz. Roadsides.	Possible
P3	<i>Gunnopsis rubra</i>	Prostrate annual, herb, 0.01-0.03 m high. Fl. green, Sep. Sandy loam.	Possible
P3	<i>Grevillea globosa</i>	Spreading shrub 1-3 m with cream and white and green/red-brown flowering in January, June or November. Stony plains, flats and slopes.	Possible
P1	<i>Lepidosperma</i> sp. Blue Hills	No information available	Possible
P3	<i>Micromyrtus acuta</i>	Erect shrub, 0.8-2 m high. Grey-tan silty fine to coarse sand, laterite, granite. Rock outcrops.	Possible
P3	<i>Micromyrtus trudgenii</i>	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	Likely
P3	<i>Persoonia pentasticha</i>	Erect spreading shrub from 0.4 to 1.8 m tall with yellow flowers between August and November. Sand, loam at the base of granite outcrops.	Possible
P1	<i>Prostanthera</i> sp. Karara	No information available	Possible
P3	<i>Psammomoya implexa</i>	Large, spreading, much-branched shrub, to 1 m high. Fl. white, Aug to Oct. Stony rises.	Possible
P1	<i>Rhodanthe collina</i>	Erect bushy annual 0.1 – 0.25 m with white and yellow flowers between August and October. Growing in loam on rocky hills.	Possible
P3	<i>Spartothamnella</i> sp. Helena and Aurora range	No information available	Possible

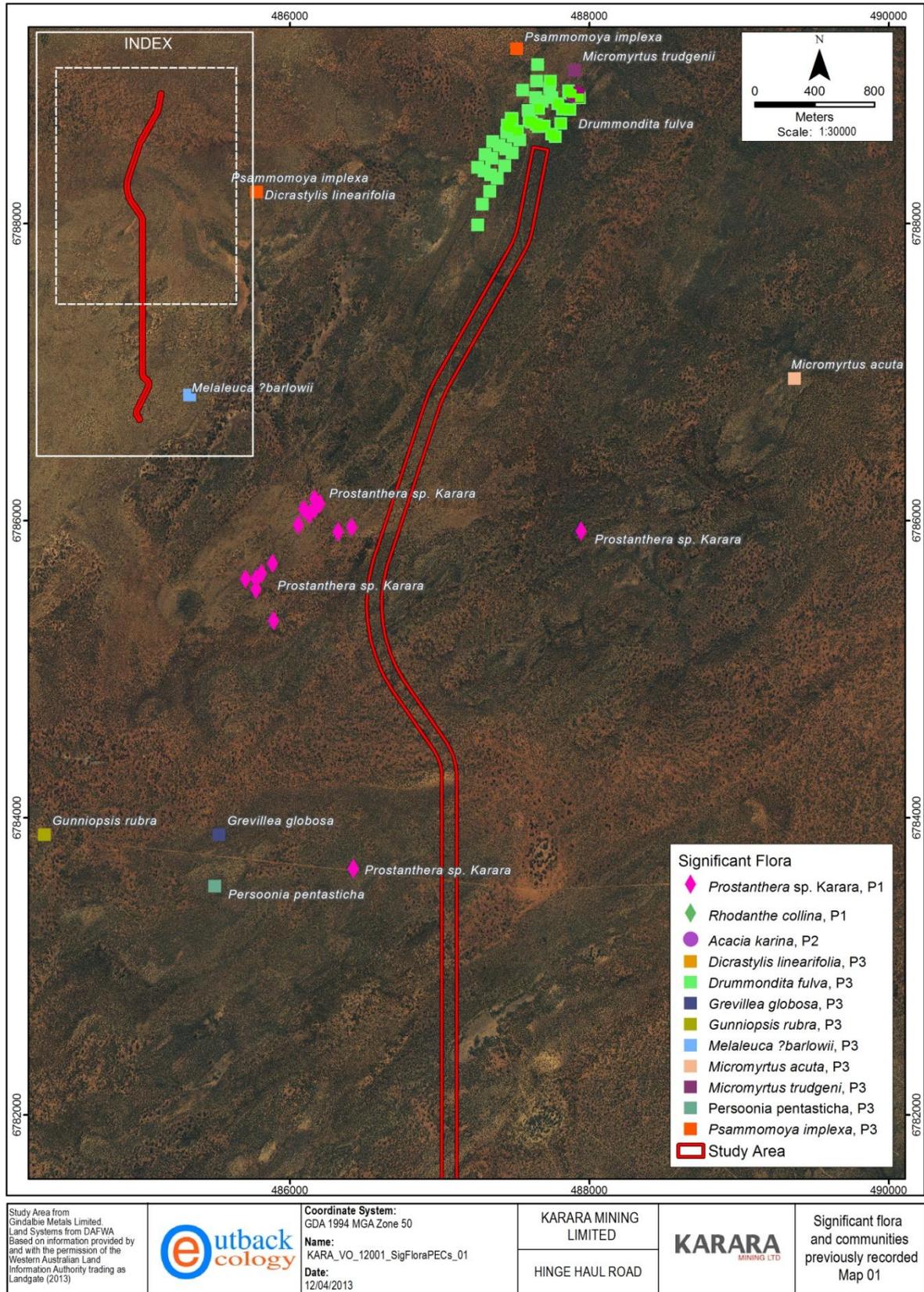


Figure 8: Priority Flora and Communities within the vicinity of the Hinge Haul Road Study area (northern end)

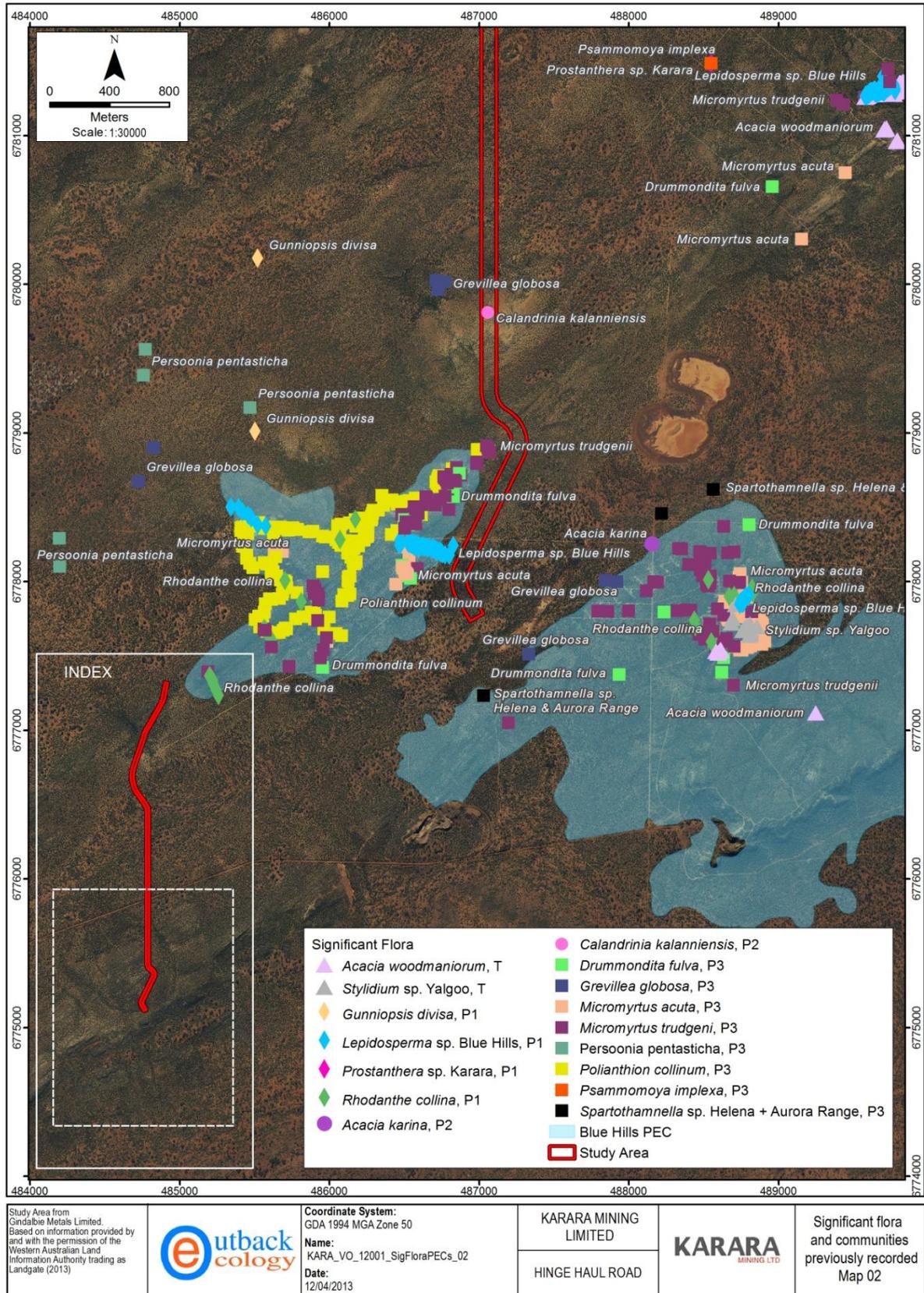


Figure 9: Priority Flora and Communities within the vicinity of the Hinge Haul Road Study area (southern end)

3. METHODS

3.1. Desktop Review

The desktop review analysed relevant information on the Study area. This included landform information in addition to flora species and vegetation communities.

3.1.1. Database Searches

The following databases and public information sources were searched and reviewed for conservation significant flora.

Federal databases:

- Protected Matters Database Search Tool for Threatened Species and Threatened Ecological Communities (TECs) (DSEWPaC 2012) listed under the *EPBC Act, 1999*.

Western Australia State databases:

- DEC Threatened and Priority Ecological communities (TEC and PECs) database for listings of communities known to occur within the Study area (DEC 2012a);
- DEC Threatened Flora database for Threatened (Declared) Rare and Priority Flora (DEC 2012b);
- Western Australian Herbarium specimen database for Priority Flora species (WAHERB 2012c); and
- NatureMap database for all flora species records occurring within the Study area (DEC 2012d).

3.1.2. Review of Existing Reports

A review of literature was undertaken on any previous flora survey work conducted over the Study area and surrounds:

- Woodman Environmental Consulting (2012). KML Regional Flora and Vegetation Survey of the Karara to Minjar Block. Unpublished report for KML;
- Woodman Environmental Consulting (2010). Exploration Drilling Programme: Onga Prospect Flora and Vegetation Impact Assessment. Unpublished report for Karara Mining Limited;
- Woodman Environmental Consulting (2008). Exploration Drilling Programme: Brak Prospect Flora and Vegetation Impact Assessment. Unpublished report for Karara Management Services; and
- Desmond, A. and Chant, A. (2001) Yalgoo (Yal) in: *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Kensington, WA

3.2. Field Survey

3.2.1. Survey Timing and Weather

Two Botanists from Outback Ecology conducted the survey on 20th to the 22nd of November. The mean rainfall recorded at the Paynes Find BOM station for 1919 to 2012 is 283 mm (BOM 2012). In 2012 a good season with 299mm of rainfall was recorded, however there was below average rainfall in July, August and Oct and therefore due to the late season survey (November) many annuals were drying off or had senesced (**Figure 10**).

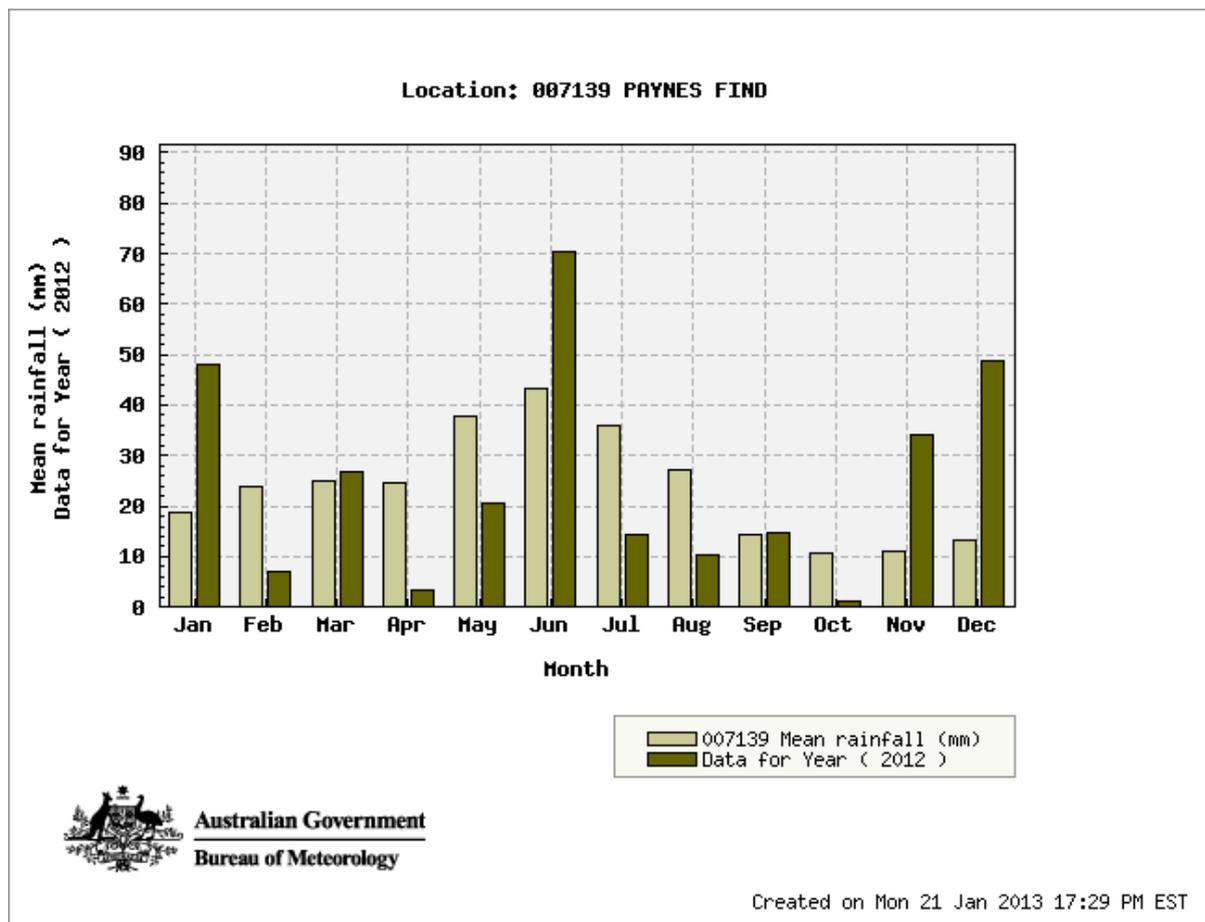


Figure 10: Mean monthly rainfall and monthly rainfall recorded at Paynes Find in 2012 (Rainfall 1919-2012)

3.2.2. Survey Design and Rationale

Prior to the field survey, relevant supporting information was reviewed, which included database searches (**Section 3.2**), previous vegetation surveys/mapping in the general area, topography, and land system mapping.

3.2.3. Survey for Flora of Conservation Significance

Survey personnel familiarized themselves with the target conservation significant species and information describing their preferred habitats prior to the field survey. Photographs and descriptions of the conservation significant species were collated with aerial photographs of known populations for use in the field. Any species recorded in the field that was unknown to the observer, was treated as if a conservation significant species and collected for verification in the WA Herbarium utilizing the reference herbarium, taxonomic keys and where necessary specialist determination. Similarly any dominant species in the vegetation communities that was not known by the botanists was also collected for verification. When a species of conservation significance was noted, an estimate of the number of individuals within a 10 metre radius was made. Each waypoint recorded in the field represented one or more conservation significant species or species that required confirmation.

3.2.4. Identification Of Flora Specimens

Voucher specimens of all conservation significant species, undescribed taxa, and suspected range extensions, or where there were known gaps of knowledge, were collected for lodgment with the Western Australian Herbarium.

3.2.5. Vegetation Mapping and Condition

Prior to the survey, survey personnel familiarized themselves with the dominant species characterizing the Floristic Community Types described by Woodman (2008, 2010, and 2012) in the Survey Area that had been previously mapped. The previous vegetation mapping was checked using relevés (unbound vegetation transects), recording the following information for each:

- GPS location (recorded in GDA94 UTM);
- a photograph of the vegetation association;
- landform description, including aspect and slope;
- soil texture and colour;
- structure of, and dominant species in, each vegetation stratum;
- size, type and nature of any rocks, stones or gravel;
- vegetation condition and descriptions of any observed disturbances; and
- estimated time since last fire.

Vegetation was described using structural classes of Specht (1970) modified by Aplin (1979) (**Appendix C**) and compared to the Floristic Community Types to firstly ascertain whether they were one of those previously described and if not they were described as vegetation associations.

Vegetation condition of the survey sites was also assessed using the Keighery (1994) comparison scale (**Appendix D**).

3.2.6. Survey and Flora Identification Personnel

Field survey, collection of specimens and identification tasks were conducted by two botanists from Outback Ecology. The two botanists held current collecting licences as required under S23C and 23F of the *Wildlife Conservation Act 1950* (WA):

- Vanessa Yeomans - SL010063; and
- Alex Sleep - SL009973.

3.2.7. Constraints and Limitations

The EPA (2004) lists a number of possible limitations and constraints that can impinge on the adequacy of vegetation and flora surveys. The possible limitations and constraints are listed in (**Table 5**) and are assessed with respect to the Study area survey undertaken in November 2012.

A number of factors can influence the design and intensity of a vegetation and flora survey. All vegetation and flora surveys are limited to some degree by time and seasonal factors, and ideally a number of surveys would be undertaken over a number of years and appropriately timed with the flowering seasons. Nevertheless, all the factors identified by the EPA (2004) were considered in the design of this survey, and none were determined to be a significant constraint.

Table 5: Summary of potential vegetation and flora survey constraints

Aspect	Constraints	Comment regarding the flora and vegetation surveys
Competency/experience of consultants	No	Members of the survey team were flora specialists employed by Outback Ecology, and have many years experience undertaking flora surveys of this kind.
Scope	No	The scope was clearly defined and realistically achievable.
Proportion of flora identified	No	Numerous specimens were collected for identification in Perth. The survey area is particularly rich in <i>Acacia</i> and myrtaceous species, many of which are difficult to identify in the field. Unidentified specimens were compared to known conservation significant species to ensure conservation significant species were identified.
Information sources (e.g. historic or recent)	No	A number of local and a widespread regional study have been carried out in the area. Available data was reviewed prior to commencement of the survey.
Proportion of task achieved, and further work which might be needed	No	It is noted that the vegetation floristic communities (FCTs) described by Woodman (2012) were complex and in many cases did not correlate with what was found in the Study areas. The vegetation in the Study areas can change rapidly and is not as strongly related to topography as in

Aspect	Constraints	Comment regarding the flora and vegetation surveys
		other regions of Western Australia.
Timing / weather / season / cycle	Possible	The timing of the field survey is a late season survey and many of the ephemeral grasses and daisies etc could not be readily identified. Optimal habitat for species such as <i>Gunniopsis</i> and <i>Calandrinia</i> (Priority species) was identified - claypans of FCT 26 and 32. However due to the senescence of the herb layer the presence of additional species cannot be ruled out.
Disturbances	No	Limited disturbance was noted in the area and most of the vegetation was considered to be in Very Good to Excellent Condition.
Intensity	No	Sweeps for conservation significant flora were spaced up to 50 metres apart. Areas in which preferred habitat or actual priority species were located were searched more intensely.
Completeness	No	The majority of each Study area was systematically covered on foot. Due to the random sampling methodology necessitated by flora and vegetation surveys, as with any conducted field visit additional survey and sampling at different times would reveal additional flora specimens and variation in floristic communities.
Resources	No	WA Herbarium specimens, taxonomic guides, DEC database searches and the Florabase database were all used to prepare for the survey and used for the confirmation of any species where their identification was uncertain. Resources were adequate to carry out the survey satisfactorily.
Remoteness / access problems	No	All areas of the Study area were covered as scoped and access was not considered a limitation.
Availability of contextual information	No	Information was available from Woodman (2012), the Interim Biogeographic Regionalisation for Australia (IBRA) Yalgoo Bioregion, from FloraBase, DEC and BoM.

4. SURVEY RESULTS

4.1. Significant Species of the Study Area Field Assessment

A total of 69 taxa from 20 families and 34 genera were recorded across the Study area during the November 2012 field assessment. A species list for the Study area is presented in **Appendix E** and species list per FCT in **Appendix F**.

No Threatened (T) Flora species were recorded in the Study area during the field survey.

Two populations in excess of 310 individuals of Priority 3 Flora species *Drummondita fulva* were recorded in the Study area with the largest population at the northern end of the proposed haul road. This species occurs in FCTs 2, 7, 12 and 13 (**Figure 11**) (**Plate 1**).

Eight individuals of *Grevillea globosa* were recorded in the central section of the proposed haul road within FCTs 7 and 19a of the Study area (**Figure 11**) (**Plate 2**).

One individual of Priority 3 Flora species *Micromyrtus trudgenii* was recorded within the Study area in FCT 7 and it is likely to be an outlying individual from FCT 1 a Banded Ironstone Formation to the west of the Study area. There is expected to be further occurrence of this species to the west of the Study area following the ridgeline. This species is known to be strongly associated with massive BIF outcropping (**Figure 11**).

Habitat for annual species of conservation significance within claypans such as *Calandrinia* and *Gunniopsis* was recorded within FCT 26 and 32 (AS2 and AS10). Due to the late seasonal survey in November 2012 additional species including possible species of conservation significance may be recorded during optimal survey timing.

The coordinates of all of the Priority Flora recorded in the Study area are shown in **Appendix H**.

No introduced flora species were found in the Study area.



Plate 1 Priority 3 Flora species *Drummondita fulva* (Outback Ecology 2012)



Plate 2 Priority 3 Flora species *Grevillea globosa* (Outback Ecology 2012)



Plate 3 Priority 3 Flora species *Micromyrtus trudgenii* (Outback Ecology 2012)

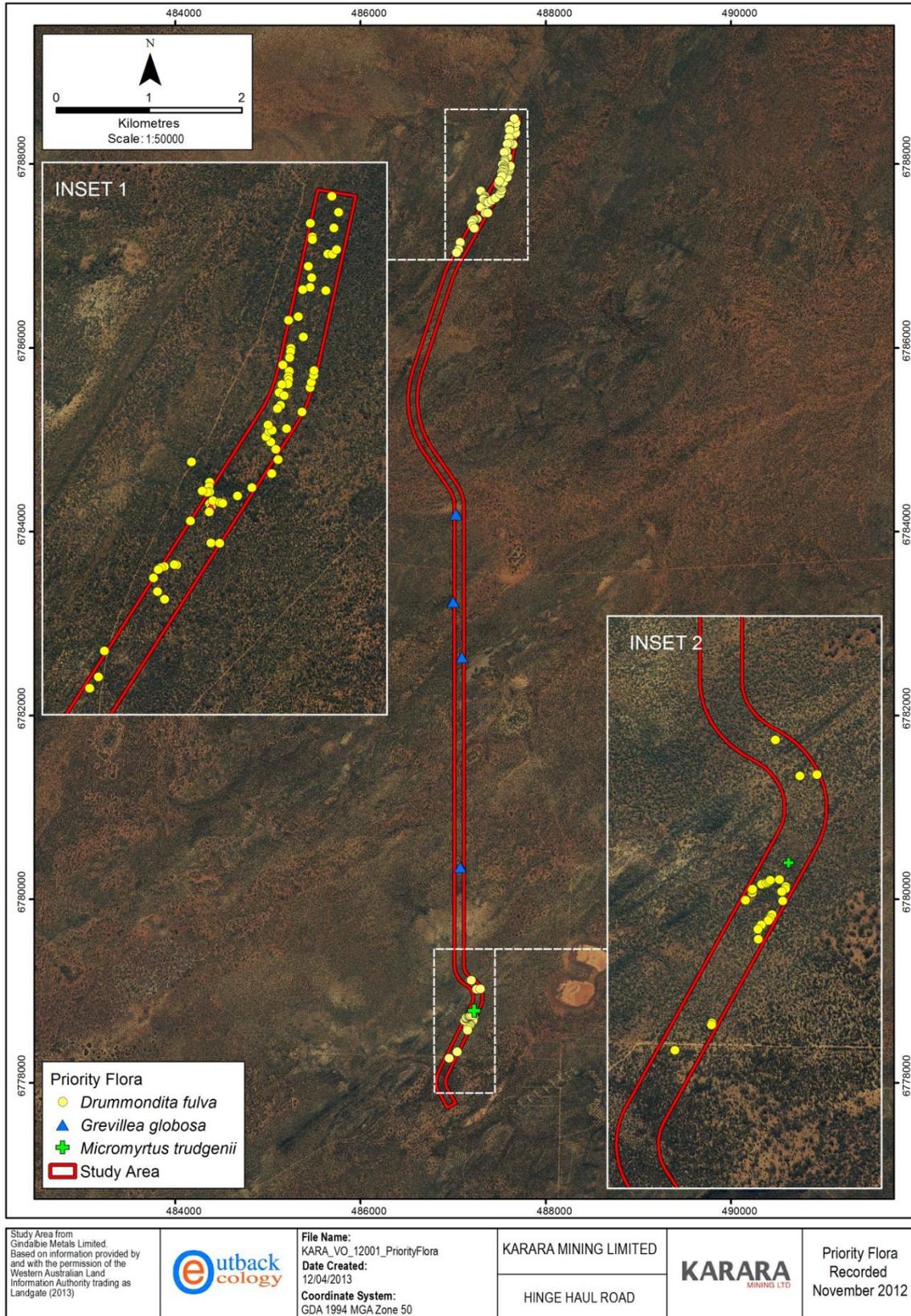


Figure 11: Priority Flora recorded in the Hinge Haul Road Study area

4.2. Vegetation

4.2.1. Desktop Assessment

Seventeen Vegetation Associations; Floristic Community Types (FCTs) were previously mapped in the vicinity of the Study area by Woodman (2012). The previous Floristic Community Types were extrapolated from this data and quadrat data across a much wider regional survey area. The 11 FCTs extrapolated to occur within the Study area and the hectare coverage following adjustments by Outback Ecology is as follows (**Table 6**):

Table 6: Woodman FCTs within the Study area (Outback Ecology 2012)

Woodman FCT Description	Hectares	Percentage of Study area	Percentage of Regional Area
FCT 1: Tall shrubland to tall open shrubland of mixed <i>Acacia</i> species, including <i>Acacia aneura</i> , <i>A. assimilis</i> subsp. <i>assimilis</i> , <i>A. ramulosa</i> var. <i>ramulosa</i> and occasional <i>Allocasuarina acutivalvis</i> subsp. <i>pinsepiana</i> over mid sparse shrubland of mixed species including <i>Eremophila clarkei</i> , <i>E. latrobei</i> subsp. <i>latrobei</i> , <i>Mirbelia bursarioides</i> ms, <i>Philothea brucei</i> subsp. <i>brucei</i> and <i>Philothea sericea</i> over low isolated clumps of shrubs of <i>Xanthosia bungei</i> on red-brown silty clay loams on lower slopes to crests with ironstone (BIF) or granite outcropping.	0.20	0.18	0.28
FCT 2: Tall shrubland to tall open shrubland of mixed <i>Acacia</i> species, including <i>Acacia ramulosa</i> var. <i>ramulosa</i> , <i>A. exocarpoides</i> , <i>A. aneura</i> and <i>A. tetragonophylla</i> over mid open shrubland to mid sparse shrubland of mixed species including <i>Eremophila clarkei</i> , <i>E. latrobei</i> subsp. <i>latrobei</i> , <i>Hibbertia arcuata</i> , <i>Philothea brucei</i> subsp. <i>brucei</i> and <i>Philothea sericea</i> on red-brown silty loams or clay loams on flats to upper slopes with ironstone (BIF).	5.95	5.27	0.76
FCT 7: Tall closed shrubland to tall open shrubland of mixed <i>Acacia</i> species including <i>Acacia latior</i> and <i>A. sibina</i> with low isolated clumps of trees of mixed <i>Eucalyptus</i> spp. over low sparse shrubland of mixed species including <i>Dianella revoluta</i> over low isolated clumps of grasses of <i>Monachather paradoxus</i> and <i>Amphipogon caricinus</i> subsp. <i>caricinus</i> on red-brown silty clay loam with ironstone gravel on flats to lower slopes	18.04	15.98	0.68

Woodman FCT Description	Hectares	Percentage of Study area	Percentage of Regional Area
<p>FCT 9: Low open woodland of <i>Eucalyptus kochii</i> subsp. <i>plenissima</i> over a tall closed shrubland to tall open shrubland of mixed species including <i>Acacia latior</i> and <i>A. sibina</i>, <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> and <i>Melaleuca leiocarpa</i> on red or red-brown sandy loam or clay loam on flats to upper slopes.</p>	37.63	33.34	1.96
<p>FCT10: Tall closed shrubland to tall open shrubland of mixed <i>Acacia</i> species dominated by <i>Acacia assimilis</i> subsp. <i>assimilis</i> over mid open shrubland to mid sparse shrubland of mixed species including <i>Aluta aspera</i> subsp. <i>hesperia</i>, <i>Eremophila latrobei</i> subsp. <i>latrobei</i> and <i>Philotheca sericea</i> on red or red-brown silty clay loam or clay loam with ironstone gravel on flats to crests (primarily midslopes)</p>	0.78	0.69	0.09
<p>FCT 12: Tall shrubland of mixed <i>Acacia</i> species including <i>Acacia ramulosa</i> var. <i>ramulosa</i>, <i>A. sibina</i> and <i>A. effusifolia</i> over mid open shrubland to mid sparse shrubland of mixed species including <i>Aluta aspera</i> subsp. <i>hesperia</i>, <i>Philotheca brucei</i> subsp. <i>brucei</i>, <i>Eremophila latrobei</i> subsp. <i>latrobei</i>, <i>E. clarkei</i>, <i>Eremophila forrestii</i> subsp. <i>forrestii</i> over low isolated clumps of ferns of <i>Cheilanthes sieberi</i> over low isolated clumps of grasses of <i>Monachather paradoxus</i> on red, brown or red-brown silty clay loam or silty loam.</p>	5.82	5.16	5.1
<p>FCT13: Tall shrubland of mixed species including <i>Acacia sibina</i>, <i>A. latior</i>, <i>A. ramulosa</i> var. <i>ramulosa</i> and <i>Melaleuca leiocarpa</i> with low isolated clumps of trees of mixed <i>Eucalyptus</i> spp. over low isolated clumps of grasses of <i>Monachather paradoxus</i> on red or red-brown silty clay loam or clay loam on flats to midslopes</p>	18.50	16.39	2.92

Woodman FCT Description	Hectares	Percentage of Study area	Percentage of Regional Area
<p>FCT 19a: Low woodland to low open woodland of <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> over tall open shrubland of mixed species including <i>Acacia tetragonophylla</i> over mid sparse shrubland of mixed species including <i>Senna artemisioides</i> subsp. <i>filifolia</i> and <i>Rhagodia drummondii</i> over low sparse chenopod shrubland of mixed species including <i>Enchylaena tomentosa</i> var. <i>tomentosa</i>, <i>Sclerolaena diacantha</i>, <i>S. fusiformis</i> and <i>Maireana carnososa</i> over low isolated clumps of grasses of <i>Austrostipa elegantissima</i> on red to red-brown clay loam or silty clay with ironstone gravel on drainage lines, flats to midslopes</p>	8.82	7.81	0.15
<p>FCT26: Tall shrubland to tall open shrubland of mixed species including <i>Acacia ramulosa</i> var. <i>ramulosa</i>, <i>A. tetragonophylla</i>, <i>A. assimilis</i> subsp. <i>assimilis</i> and <i>Hakea recurva</i> subsp. <i>recurva</i> with low isolated clumps of trees of <i>Eucalyptus</i> spp. over low sparse shrubland of <i>Senna artemisioides</i> subsp. <i>filifolia</i> and <i>Rhagodia drummondii</i> over low isolated clumps of grasses of <i>Austrostipa elegantissima</i> on red or red-brown clay loam or sandy clay loam on flats to midslopes.</p>	4.09	3.62	0.37
<p>FCT27: Tall shrubland to tall open shrubland of <i>Acacia</i> species including <i>Acacia acuminata</i>, <i>A. tetragonophylla</i>, and <i>A. oblecta</i> with low isolated clumps of trees of <i>Callitris columellaris</i> and/or <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> over low sparse shrubland of <i>Rhagodia drummondii</i> and <i>Ptilotus obovatus</i> over low isolated clumps of grasses of <i>Austrostipa elegantissima</i> and <i>Monachather paradoxus</i> on red or red-brown clay loam or sandy clay loam on flats</p>	5.92	5.24	0.31
<p>FCT32: Tall shrubland to tall open shrubland of <i>Acacia</i> species including <i>Acacia umbraculiformis</i>, <i>A. tetragonophylla</i>, <i>A. ramulosa</i> var. <i>ramulosa</i> and <i>A. kochii</i> over mid sparse shrubland of species including <i>Solanum lasiophyllum</i>, <i>Dodonaea inaequifolia</i> and <i>Thryptomene costata</i> over low isolated clumps of ferns of <i>Cheilanthes sieberi</i> over low sparse forbland of <i>Borya sphaerocephala</i> on red-brown clay loam on slopes with granite or ironstone outcropping.</p>	7.14	6.32	9.49

4.2.2. Study area Floristic Community Types recorded during the 2012 Field Assessment

The vegetation mapping adjustments and 27 relevés in eleven Floristic Community Types across the Study area is shown in **Figure 10a to 10c** and in **Appendix F** and **Appendix G**. Alterations to boundaries and vegetation composition may be attributed to several factors, including the timing of the surveys in relation to the age of the vegetation following fire, the influence of fire scars on aerial photograph interpretation and the proportion of the actual survey area covered prior to mapping (Extrapolation of vegetation types from aerial photography).

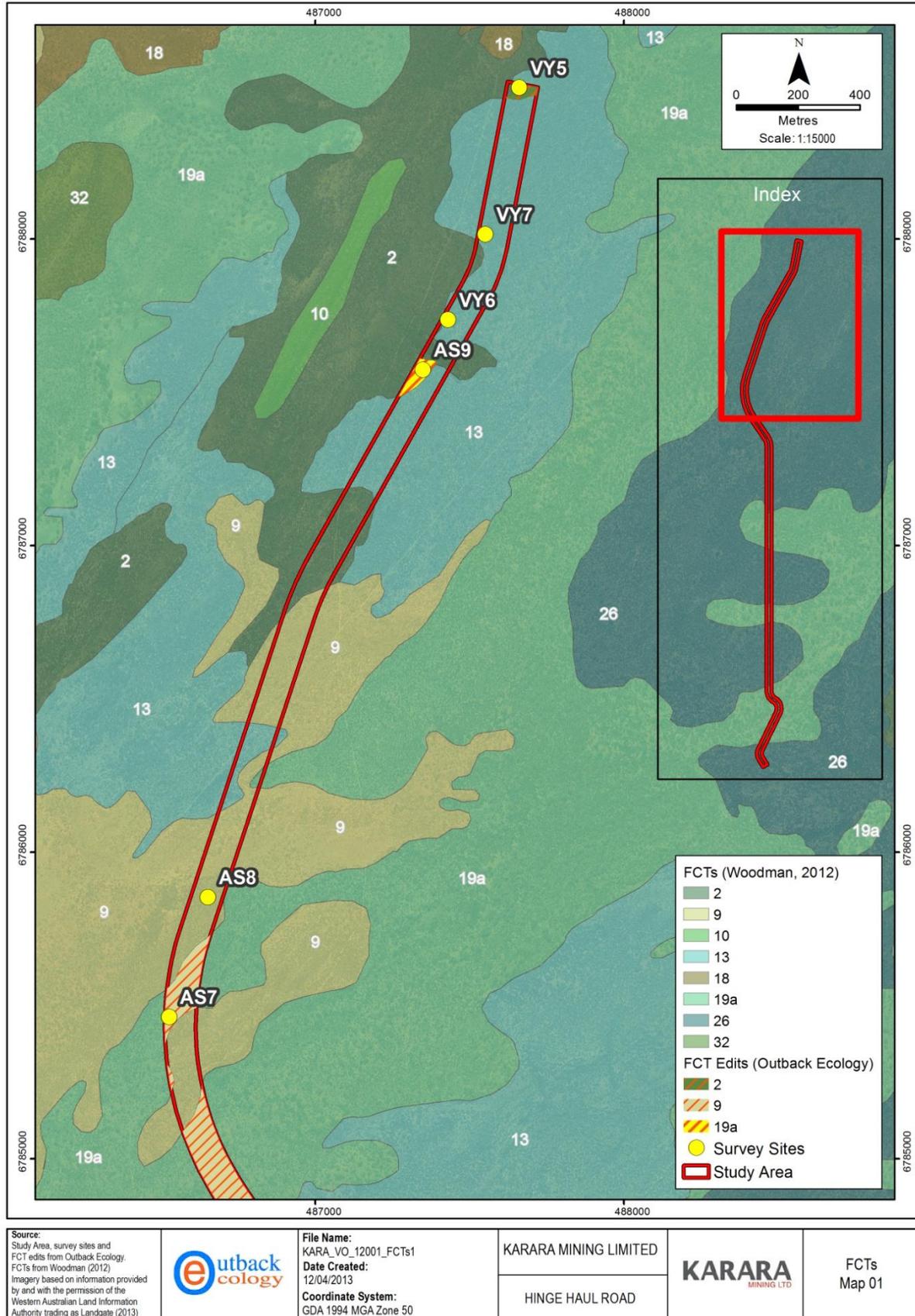


Figure 12a: Floristic Community Types recorded in the northern Hinge Haul Road Study area

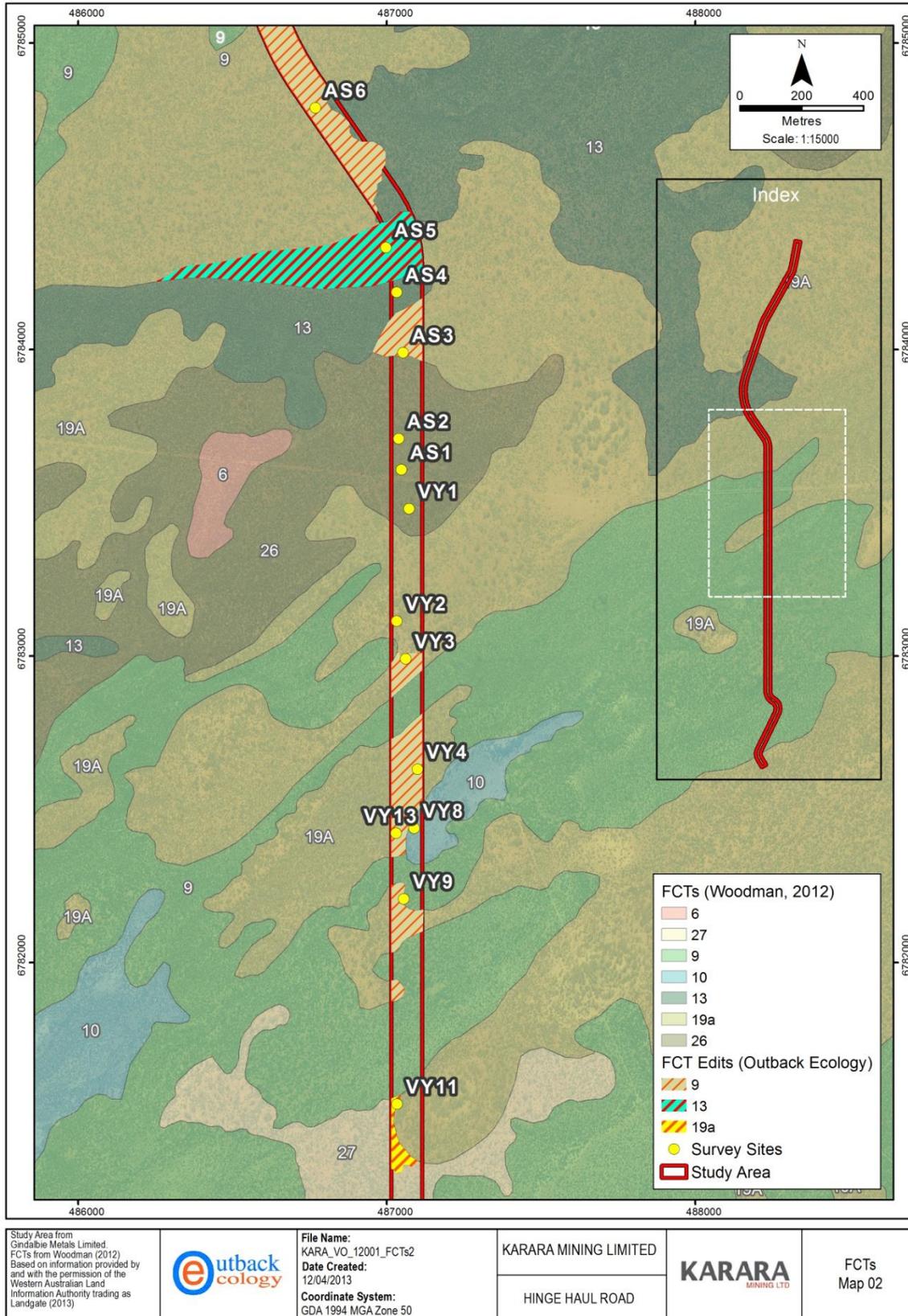


Figure 13: Floristic Community Types recorded in the central Hinge Haul Road Study area

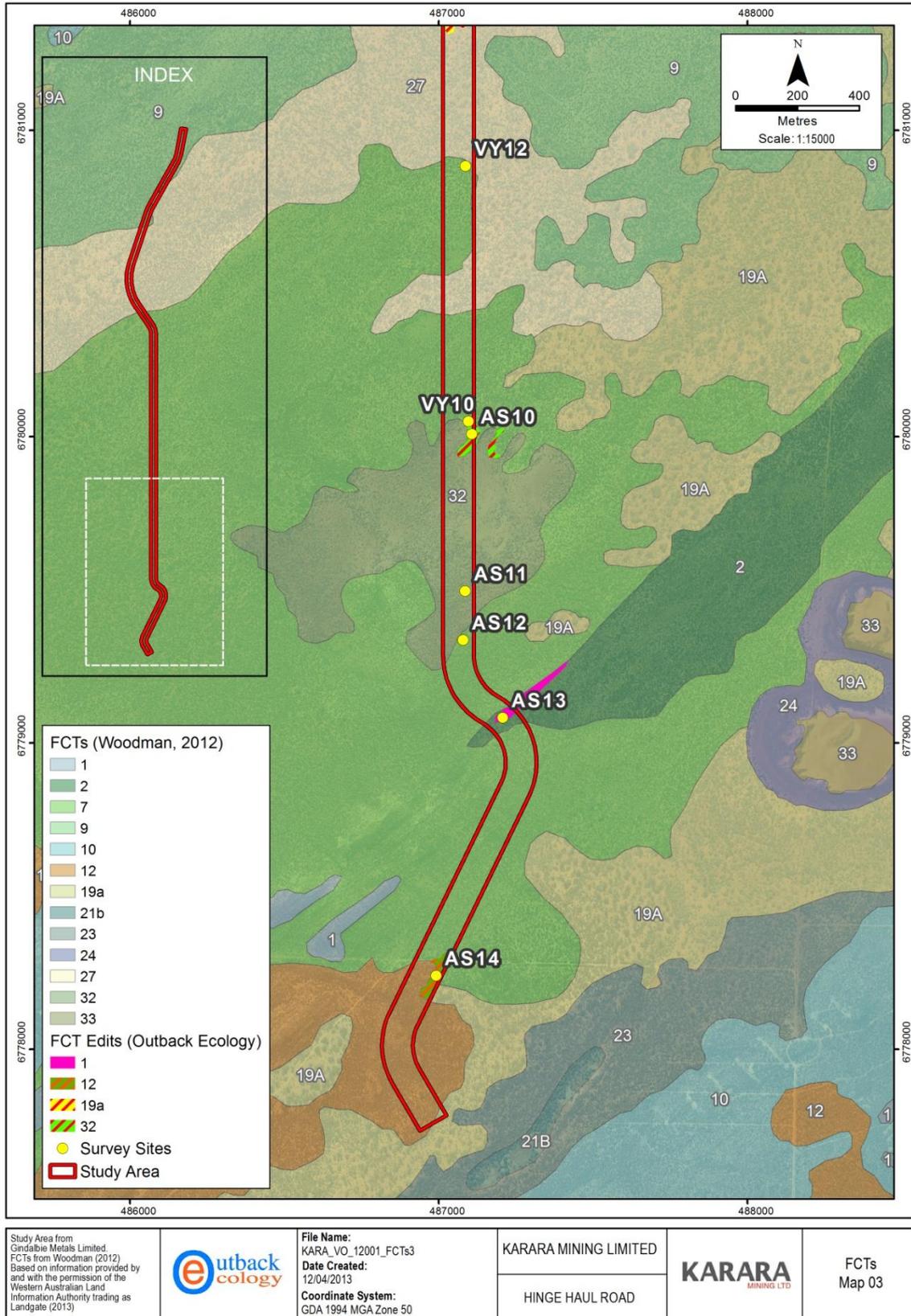


Figure 10c: Floristic Community Types recorded in the southern Hinge Haul Road Study area

4.3. Threatened Ecological Communities

No TECs as defined under the *EPBC Act 1999* or as listed under the *Wildlife Conservation Act 1950* (WA) endorsed by the Environment Minister (DEC 2012) were listed as occurring within or adjacent to the Study area, on the DEC (2012) and DEWHA (2012) databases.

None of the eleven vegetation communities described during the field survey were analogous to any known TEC.

4.4. Priority Ecological Communities

The Study area is located within the buffer zone of the Priority 1 Ecological Community Mid West 2: Mt Karara/Mungada Ridge (Blue Hills) Banded Ironstone Formation. Areas mapped as Floristic Community Types 1 and 2 (BIF) in the Study area are likely to represent the outer extent and continuation of this PEC due to the close proximity to the main BIF range. Further examination of the DEC and Woodman (2012) PEC quadrata data would be required to confirm this. Woodman identified FCTs 1, 2, 3, 4, 5, 6, 10 and 12 which occur on BIF or upper slopes and crests high in the landscape and/or on restricted landforms within the region, with the potential to occur within the Blue Hills Priority Ecological Community (Midwest 2). The extent of the mapping of FCT 1 and 2 was amended by Outback for the Study area, these two vegetation types were the only areas to contain upper slopes with BIF, likely to be representative of Blue Hills PEC in the Study area. There was 6.15ha of potential PEC mapped within the Study area. This represents 1% of the known mapping of FCT 1 and 2 in the region (Woodman 2012).

4.5. Vegetation Condition

Vegetation condition was assessed using the Vegetation Condition Scale of Keighery (1994) provided in **Appendix D**. The condition of vegetation ranged from Very Good to Excellent with the majority (24 of the 27 relevés) recorded as in Excellent Condition. Minor disturbance from vehicular access was recorded, particularly in the southern area in closest proximity to existing mining operations. No weed species were recorded within the Study area. The entire area is subject to pastoral activities; however no evidence of this was noted during the flora and vegetation survey.

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APPENDIX A
Definitions of Priority Ecological Communities (PECs)

Definitions for Priority Ecological Communities (PEC)

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List 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 that are known from very few occurrences with a very restricted distribution (generally =5 occurrences or a total area of = 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. 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 occurrences with a restricted distribution (generally =10 occurrences or a total area of =200ha). At least some occurrences are not believed to be under immediate 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 with 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 may 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:

- i. **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.
 - (ii) **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.
 - (iii) **Ecological communities that have been removed from the list of threatened communities during the past five years.**

These communities require regular monitoring.

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
Definitions Of Threatened and Priority Flora

DEC (2012)

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 of the Wildlife Conservation (Rare Flora) Notice 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 which 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 of the Wildlife Conservation (Rare Flora) Notice 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 five), 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 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 five years for reasons other than taxonomy.

5: Priority Five: 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 five years.

APPENDIX C

Classification of Vegetation Structural Classes

Vegetation Structural Classes – Specht (1970) as modified by Aplin (1979).

Stratum	Canopy Cover (%)				
	70-100%	30-70%	10-30%	2-10%	<2%
Trees >30m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees <10m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs >2m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs <1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses Sedges, Herbs	Closed tussock grassland/bunch grassland /sedgeland /herbland	Tussock grassland/ bunch grassland/ sedgeland/ herbland	Open tussock grassland / bunch grassland/ sedgeland / herbland	Very open tussock grassland / bunch grassland / sedgeland / herbland	Scattered tussock grasses / bunch grasses / sedges / herbs

APPENDIX D

Vegetation Condition Scale

Vegetation Condition Scale (Keighery, 1994)

Code	Description
Pristine	Pristine or nearly so. No obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX E

Study area Species List

FAMILY	Species
AMARANTHACEAE	<i>Ptilotus obovatus</i>
	<i>Ptilotus schwartzii</i>
ASPARAGACEAE	<i>Lomandra effusa</i>
ASTERACEAE	Asteraceae sp.
	<i>Lawrencella davenportii</i>
	<i>Olearia dampieri</i>
	<i>Rhodanthe citrina</i>
BORYACEAE	<i>Borya sphaerocephala</i>
CASUARINACEAE	<i>Allocasuarina acutivalvis</i>
CHENOPODIACEAE	<i>Atriplex</i> sp.
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>
	<i>Maireana georgei</i>
	<i>Rhagodia</i> sp.
CUPRESSACEAE	<i>Callitris columellaris</i>
DILLENACEAE	<i>Hibbertia arcuata</i>
FABACEAE	<i>Acacia acuaria</i>
	<i>Acacia aneura</i>
	<i>Acacia anthochaera</i>
	<i>Acacia assimilis</i> subsp. <i>assimilis</i>
	<i>Acacia burkittii</i>
	<i>Acacia ? caesaneura</i> (narrow phyllode variant)
	<i>Acacia erinacea</i>
	<i>Acacia exocarpoides</i>
	<i>Acacia masliniana</i>
	<i>Acacia ramulosa</i> var. <i>linophylla</i>
	<i>Acacia ramulosa</i> var. <i>ramulosa</i>

FAMILY	Species
FABACEAE	<i>Acacia roycei</i>
	<i>Acacia sibina</i>
	<i>Acacia tetragonophylla</i>
	<i>Acacia umbraculiformis</i>
	<i>Senna artemisioides</i> subsp. <i>filifolia</i>
	<i>Senna</i> sp.
FRANKENIACEAE	<i>Frankenia setosa</i>
GOODENIACEAE	<i>Scaevola spinescens</i>
HEMEROCALLIDACEAE	<i>Dianella revoluta</i>
MYRTACEAE	<i>Aluta aspera</i> subsp. <i>hesperia</i>
	<i>Eucalyptus ewartiana</i>
	<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>
	<i>Eucalyptus leptopoda</i> subsp. <i>arctata</i>
	<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>
	<i>Euryomyrtus patrickiae</i>
	<i>Melaleuca atroviridis</i>
	<i>Melaleuca leiocarpa</i>
	<i>Melaleuca nematophylla</i>
	<i>Micromyrtus trudgenii</i> (P3)
	<i>Micromyrtus</i> sp.
	<i>Thryptomene costata</i>
	<i>Thryptomene decussata</i>
POACEAE	Poaceae sp.
PROTEACEAE	<i>Grevillea globosa</i> (P3)
	<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>
	<i>Hakea invaginata</i>

FAMILY	Species
PROTEACEAE	<i>Hakea recurva</i> subsp. <i>recurva</i>
RHAMNACEAE	<i>Cryptandra</i> sp.
RUTACEAE	<i>Drummondita fulva</i> (P3)
	<i>Philotheca brucei</i>
	<i>Philotheca deserti</i> subsp. <i>deserti</i>
	<i>Philotheca sericea</i>
	<i>Philotheca tomentella</i>
SANTALACEAE	<i>Exocarpos aphyllus</i>
	<i>Santalum acuminatum</i>
	<i>Santalum spicatum</i>
SCROPHULARIACEAE	<i>Eremophila clarkei</i>
	<i>Eremophila forrestii</i>
	<i>Eremophila georgei</i>
	<i>Eremophila granitica</i>
	<i>Eremophila latrobei</i>
	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>
	<i>Eremophila</i> sp.
SOLANACEAE	<i>Solanum lasiophyllum</i>

APPENDIX F

Species by Site

	FCT 1	FCT2	FCT 7	FCT 9	FCT 10	FCT 12	FCT 13	FCT 19a	FCT 26	FCT 32
	AS13	VY5	AS12 VY10 VY12	AS3 AS6 As7 AS8 VY3 VY4 VY9	VY8	AS14	AS4 AS5 VY6 VY7	AS9 VY11 VY13 VY2	AS1 AS2 VY1	AS10 AS11
Species										
<i>Acacia acuaria</i>			+							
<i>Acacia aneura</i>	+		+	+		+	+	+	+	
<i>Acacia anthochaera</i>								+		
<i>Acacia assimilis</i> subsp. <i>assimilis</i>				+			+	+	+	
<i>Acacia burkittii</i>	+		+	+	+	+	+	+	+	+
<i>Acacia ? caesaneura</i>				+		+	+	+		
<i>Acacia erinacea</i>					+				+	
<i>Acacia exocarpoides</i>	+		+				+	+		
<i>Acacia masliniana</i>								+		
<i>Acacia ramulosa</i> var. <i>linophylla</i>				+	+					
<i>Acacia ramulosa</i> var. <i>ramulosa</i>		+	+	+	+	+	+	+	+	
<i>Acacia roycei</i>	+		+					+	+	
<i>Acacia sibina</i>		+	+				+	+	+	
<i>Acacia tetragonophylla</i>			+	+		+			+	+
<i>Acacia umbraculiformis</i>			+							+
<i>Allocasuarina acutivalvis</i>				+			+	+		
<i>Aluta aspera</i> subsp. <i>hesperia</i>		+	+					+		+
Asteraceae sp.									+	
<i>Atriplex</i> sp.									+	
<i>Borya sphaerocephala</i>										+
<i>Callitris columellaris</i>		+		+				+	+	
<i>Cryptandra</i> sp.									+	
<i>Dianella revoluta</i>			+							
<i>Drummondita fulva</i>	+	+		+			+	+		
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>				+						
<i>Eremophila clarkei</i>			+						+	

	FCT 1 AS13	FCT2 VY5	FCT 7 AS12 VY10 VY12	FCT 9 AS3 AS6 As7 AS8 VY3 VY4 VY9	FCT 10 VY8	FCT 12 AS14	FCT 13 AS4 AS5 VY6 VY7	FCT 19a AS9 VY11 VY13 VY2	FCT 26 AS1 AS2 VY1	FCT 32 AS10 AS11
Species										
<i>Eremophila granitica</i>										+
<i>Eremophila latrobei</i>	+		+	+				+	+	+
<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>					+					
<i>Eremophila</i> sp.		+								
<i>Eucalyptus ewartiana</i>			+	+				+		
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>			+	+		+	+	+		
<i>Eucalyptus leptopoda</i> subsp. <i>arctata</i>			+	+			+	+		
<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>								+	+	
<i>Euryomyrtus patrickiae</i>				+						
<i>Exocarpos aphyllus</i>								+		
<i>Frankenia setosa</i>									+	
<i>Grevillea globosa</i>								+	+	
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>							+			+
<i>Hakea invaginata</i>		+					+			
<i>Hakea recurva</i> subsp. <i>recurva</i>			+	+			+		+	
<i>Hibbertia arcuata</i>			+	+				+	+	
<i>Lawrencella davenportii</i>									+	
<i>Lomandra effusa</i>				+			+			
<i>Maireana georgei</i>				+	+					
<i>Melaleuca atroviridis</i>			+					+		
<i>Melaleuca leiocarpa</i>				+			+	+	+	
<i>Melaleuca nematophylla</i>	+	+		+			+	+		
<i>Micromyrtus</i> sp.			+	+						
<i>Micromyrtus trudgenii</i>			+							
<i>Olearia dampieri</i>									+	
<i>Philotheca brucei</i>			+				+	+	+	
<i>Philotheca deserti</i> subsp. <i>deserti</i>			+	+			+	+	+	

Species

Poaceae sp.

Ptilotus obovatus

Ptilotus schwartzii

Rhagodia sp.

Rhodanthe citrina

Santalum acuminatum

Santalum spicatum

Scaevola spinescens

Senna artemisioides subsp. *filifolia*

Senna sp.

Solanum lasiophyllum

Thryptomene costata

Thryptomene decussata

FCT 1	FCT2	FCT 7	FCT 9 AS3 AS6 As7 AS8 VY3 VY4 VY9	FCT 10	FCT 12	FCT 13	FCT 19a AS9 VY11 VY13 VY2	FCT 26	FCT 32
AS13	VY5	AS12 VY10 VY12		VY8	AS14	AS4 AS5 VY6 VY7		AS1 AS2 VY1	AS10 AS11
								+	
			+				+	+	+
			+					+	+
								+	
		+	+						
		+			+		+		
			+					+	
			+						+
			+				+		+

APPENDIX G

Relevé Site Data and Photographic Record

Karara Hinge Haul Road: Site: AS1 FCT: 26

Described by: Alex Sleep **Date:** 21/11/2012 **Type:** Relevé

Location: MGA **Zone:** 50 6783609 degrees S, 487048 degrees E

Soil: Orange Clay Loam with ironstone gravel mantle

Vegetation: Tall Shrubland of *Acacia assimilis* subsp. *assimilis* with *Acacia ramulosa* var. *ramulosa* and *Acacia tetragonophylla* over Scattered Shrubs of *Eremophila georgei* and *Ptilotus obovatus*

Vegetation Condition: Excellent

Species List:

<i>Acacia aneura</i>
<i>Acacia assimilis</i> subsp. <i>assimilis</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Acacia tetragonophylla</i>
<i>Eremophila clarkei</i>
<i>Hakea recurva</i> subsp. <i>recurva</i>
<i>Hibbertia arcuata</i>
<i>Philotheca brucei</i>
<i>Ptilotus obovatus</i>
<i>Ptilotus schwartzii</i>



Karara Hinge Haul Road: Site: AS10 FCT: 32**Described by:** Alex Sleep **Date:** 22/11/2012 **Type:** Relevé**Location:** MGA **Zone:** 50 6780008 degrees S, 487108 degrees E**Soil:** Orange Clay**Vegetation:** Tall Open Shrubland of mixed *Acacia* species, including *Acacia burkittii*, *Acacia quadrimarginea* and *Acacia tetragonophylla* with *Grevillea obliquistigma* subsp. *obliquistigma* over an Open Shrubland of *Eremophila forrestii* and *Thryptomene costata* over a Low Open Herbland of *Borya sphaerocephala***Vegetation Condition:** Excellent**Species List:**

<i>Acacia burkittii</i>	<i>Eremophila latrobei</i>
<i>Acacia quadrimarginea</i>	<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>
<i>Acacia tetragonophylla</i>	<i>Ptilotus obovatus</i>
<i>Aluta aspera</i> subsp. <i>hesperia</i>	<i>Ptilotus schwartzii</i>
<i>Borya sphaerocephala</i>	<i>Thryptomene costata</i>
<i>Eremophila forrestii</i>	<i>Thryptomene decussata</i>
<i>Eremophila granitica</i>	



Karara Hinge Haul Road: Site: AS11 FCT: 32

Described by: Alex Sleep **Date:** 22/11/2012 **Type:**

Location: Latitude: -29.1129259765 Longitude: 116.8672710378

Soil: Orange Brown Clay Loam with ironstone mantle and ironstone outcropping

Vegetation: Tall Open Shrubland of *Acacia quadrimarginea*, *Acacia tetragonophylla* and *Grevillea obliquistigma* subsp. *obliquistigma* over an Open Shrubland of *Thryptomene costata*, *Philotheca sericea* and *Eremophila granitica*

Vegetation Condition: Excellent

Species List:

<i>Acacia quadrimarginea</i>
<i>Acacia tetragonophylla</i>
<i>Eremophila granitica</i>
<i>Eremophila latrobei</i>
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>
<i>Philotheca sericea</i>
<i>Thryptomene costata</i>



Karara Hinge Haul Road: Site: AS12 FCT: 7**Described by:** Alex Sleep **Date:** 22/01/2012 **Type:** Relevé**Location:** MGA Zone: 50 6779336 degrees S, 487080 degrees E**Soil:** Red Orange Clay Loam**Vegetation:** Tall Shrubland of Mixed *Acacia* spp. dominated by *Acacia tetragonophylla*, *Acacia aneura*, *Acacia burkittii* over a Low Open Shrubland of *Hibbertia arctata* and *Eremophila* spp.**Vegetation Condition:** Excellent**Species List:**

<i>Acacia aneura</i>	<i>Eremophila latrobei</i>
<i>Acacia burkittii</i>	<i>Hakea recurva</i> subsp. <i>recurva</i>
<i>Acacia exocarpoides</i>	<i>Hibbertia arcuata</i>
<i>Acacia quadrimarginea</i>	<i>Philotheca brucei</i>
<i>Acacia roycei</i>	<i>Philotheca sericea</i>
<i>Acacia tetragonophylla</i>	<i>Santalum spicatum</i>
<i>Dianella revoluta</i>	<i>Scaevola spinescens</i>
<i>Eremophila clarkei</i>	



Karara Hinge Haul Road: Site: AS13 FCT: 1**Described by:** Alex Sleep **Date:** 22/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6779082 degrees S, 487209 degrees E**Soil:** Orange Clay Loam on Banded Ironstone Formation**Vegetation:** Tall Open Shrubland of *Acacia ? aneura*, *Acacia roycei*, *Acacia exocarpoides* and *Melaleuca nematophylla* over Low Open Shrubland of *Eremophila* spp. with *Philotheca sericea* on a Banded Ironstone ridge.**Vegetation Condition:** Excellent**Species List:**

<i>Acacia aneura</i>
<i>Acacia burkittii</i>
<i>Acacia exocarpoides</i>
<i>Acacia roycei</i>
<i>Drummondita fulva</i>
<i>Eremophila latrobei</i>
<i>Melaleuca nematophylla</i>
<i>Philotheca sericea</i>



Karara Hinge Haul Road: Site: AS14 FCT: 12**Described by:** Alex Sleep **Date:** 22/11/2012 **Type:** Relevé**Location:** MGA **Zone:** 50 6778240 degrees S, 486992 degrees E**Soil:** Orange Clay Loam Flats**Vegetation:** Low Open Woodland of *Eucalyptus kochii* subsp. *plenissima* over a mixed Shrubland of *Acacia ?aneura*, *Acacia caesaneura* (narrow phyllode variant), *Acacia ramulosa* var. *ramulosa* and *Acacia burkittii* over Scattered *Scaevola spinescens***Vegetation Condition:** Excellent**Species List:**

<i>Acacia aneura</i>
<i>Acacia burkittii</i>
<i>Acacia caesaneura</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Acacia tetragonophylla</i>
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>
<i>Scaevola spinescens</i>



Karara Hinge Haul Road: Site: AS2 FCT: 26

Described by: Alex Sleep **Date:** 21/11/2012 **Type:**

Location: MGA **Zone:** 50 6783710 degrees S, 487038 degrees E

Soil: Orange Clay Loam with ironstone gravel mantle

Vegetation: Scattered *Acacia assimilis* var. *assimilis* over Low Open Shrubland of *Acacia erinacea* over *Atriplex* sp. and *Frankenia setosa* over Open Herbland of ephemeral daisies and grasses (senescent)

Vegetation Condition: Excellent

Species List:

<i>Acacia assimilis</i> var. <i>assimilis</i>
<i>Acacia erinacea</i>
<i>Asteraceae</i> sp.
<i>Atriplex</i> sp.
<i>Frankenia setosa</i>
<i>Poaceae</i> sp.
<i>Senna</i> sp.



Karara Hinge Haul Road: Site: AS3 FCT: 9**Described by:** Alex Sleep **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6783991 degrees S, 487053 degrees E**Soil:** Orange Clayey Loam with a Fine Gravel Mantle**Vegetation:** Low Open Woodland of *Eucalyptus kochii* subsp. *plenissima* over a Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa* and *Acacia assimilis* subsp. *assimilis* over a Very Open Shrubland of *Senna artemisioides* subsp. *filifolia*, *Rhagodia drummondii*, *Maireana georgei* and *Eremophila latrobei***Vegetation Condition:** Excellent**Species List:***Acacia assimilis* subsp. *assimilis**Acacia ramulosa* var. *ramulosa**Enchylaena tomentosa* var. *tomentosa**Eremophila latrobei**Eucalyptus kochii* subsp. *plenissima**Maireana georgei**Senna artemisioides* subsp. *filifolia*

Karara Hinge Haul Road: Site: AS4 FCT: 13

Described by: Alex Sleep **Date:** 21/11/2012 **Type:** Relevé

Location: MGA Zone: 50 6784125 degrees S, 487027 degrees E

Soil: Orange Clay Loam

Vegetation: Tall Shrubland of *Acacia sibina* and *Melaleuca leiocarpa* with *Grevillea obliquistigma* subsp. *obliquistigma* over Shrubland of *Acacia aneura* and *Acacia sibina* (Fire regrowth)

Vegetation Condition: Very Good to Excellent - Fire Regrowth

Species List:

<i>Acacia aneura</i>
<i>Acacia sibina</i>
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>
<i>Melaleuca leiocarpa</i>



Karara Hinge Haul Road: Site: AS5 FCT: 13**Described by:** Alex Sleep **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6784333 degrees S, 486997 degrees E**Soil:** Orange Silty Clay with fine gravel mantle and sheet flow drainage scars**Vegetation:** Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa*, *Melaleuca leiocarpa* and *Melaleuca nematophylla* over Open Sedgeland of *Lomandra effusa***Vegetation Condition:** Excellent**Species List:**

<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Hakea recurva</i> subsp. <i>recurva</i>
<i>Lomandra effusa</i>
<i>Melaleuca leiocarpa</i>
<i>Melaleuca nematophylla</i>



Karara Hinge Haul Road: Site: AS6 FCT: 9**Described by:** Alex Sleep **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6784789 degrees S, 486769 degrees E**Soil:** Orange Clay with fine gravel mantle**Vegetation:** Low Open Woodland of *Eucalyptus kochii* subsp. *plenissima* (with *Callitris columellaris*) over a Tall Open Shrubland of Mixed *Acacia* species, including *Acacia ramulosa* var. *ramulosa*, *Acacia sibina* and *Acacia ?caesaneura***Vegetation Condition:** Excellent**Species List:**

<i>Acacia caesaneura</i>

<i>Acacia ramulosa</i> var. <i>ramulosa</i>

<i>Acacia sibina</i>

<i>Callitris columellaris</i>

<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>

<i>Senna artemisioides</i> subsp. <i>filifolia</i>
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Karara Hinge Haul Road: Site: AS7 FCT: 9**Described by:** Alex Sleep **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6785463 degrees S, 486527 degrees E**Soil:** Orange Clay with fine gravel mantle**Vegetation:** Low Open Woodland of *Eucalyptus kochii* subsp. *plenissima* over Tall Open Shrubland of *Acacia sibina*, *Acacia assimilis* subsp. *assimilis* and *Melaleuca nematophylla* over a Low Open Shrubland of *Acacia aneura* and *Thryptomene decussata***Vegetation Condition:** Excellent**Species List:***Acacia aneura**Acacia assimilis* subsp. *assimilis**Acacia sibina**Eucalyptus kochii* subsp. *plenissima**Melaleuca nematophylla**Philotheca deserti* subsp. *deserti**Thryptomene decussata*

Karara Hinge Haul Road: Site: AS8 FCT: 9**Described by:** Alex Sleep **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6785854 degrees S, 486652 degrees E**Soil:** Red Orange Silty Clay with fine gravel mantle on surface**Vegetation:** Scattered Mallees of *Eucalyptus kochii* subsp. *plenissima* and *Eucalyptus leptopoda* subsp. *arctata* over a Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa* with occasional *Melaleuca leiocarpa* over Shrubland of *Drummondita fulva*, *Philotheca sericea* and *Euryomyrtus ?patrickiae***Vegetation Condition:** Excellent**Species List:**

<i>Acacia aneura</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Drummondita fulva</i>
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>
<i>Eucalyptus leptopoda</i>
<i>Euryomyrtus patrickiae</i>
<i>Melaleuca leiocarpa</i>
<i>Philotheca sericea</i>



Karara Hinge Haul Road: Site: AS9 FCT: 19a**Described by:** Alex Sleep **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6787574 degrees S, 487349 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Scatted *Eucalyptus loxophleba* subsp. *supralaervis* and *Callitris columellaris* over Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa*, *Melaleuca leiocarpa*, *Acacia assimilis* over a mixed Low Shrubland of *Eremophila latrobei*, *Hibbertia arcuata* and *Philotheca brucei***Vegetation Condition:** Excellent**Species List:**

<i>Acacia aneura</i>	<i>Eucalyptus leptopoda</i> subsp. <i>arctata</i>
<i>Acacia assimilis</i>	<i>Eucalyptus loxophleba</i> subsp. <i>supralaervis</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	<i>Hibbertia arcuata</i>
<i>Aluta aspera</i> subsp. <i>hesperia</i>	<i>Melaleuca leiocarpa</i>
<i>Callitris columellaris</i>	<i>Melaleuca nematophylla</i>
<i>Drummondita fulva</i>	<i>Philotheca brucei</i>
<i>Eremophila forrestii</i>	<i>Philotheca sericea</i>
<i>Eremophila georgei</i>	<i>Scaevola spinescens</i>
<i>Eremophila latrobei</i>	<i>Thryptomene decussata</i>



Karara Hinge Haul Road: Site: VY1 FCT: 26**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** Hinge Haul Road **MGA Zone:** 50 6783482 degrees S, 487073 degrees E**Soil:** Orange Loam with an Ironstone Mantle**Vegetation:** Scattered *Eucalyptus loxophleba* subsp. *supralaevis* over a mixed Tall Open Shrubland of *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*, *Acacia tetragonophylla*, *Acacia ?sibina* and *Hakea recurva* over Low Open Shrubland of *Ptilotus obovatus*, *Solanum lasiophyllum* over an Open Herbland of *Lawrencella davenportii* and *Rhodanthe citrina***Vegetation Condition:** Very Good to Excellent**Species List:**

<i>Acacia burkittii</i>	<i>Hakea recurva</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	<i>Lawrencella davenportii</i>
<i>Acacia roycei</i>	<i>Melaleuca leiocarpa</i>
<i>Acacia sibina</i>	<i>Olearia dampieri</i>
<i>Acacia tetragonophylla</i>	<i>Philothea deserti</i> subsp. <i>deserti</i>
<i>Callitris columellaris</i>	<i>Philothea tomentella</i>
<i>Cryptandra</i> sp.	<i>Ptilotus obovatus</i>
<i>Eremophila georgei</i>	<i>Rhagodia</i> sp.
<i>Eremophila latrobei</i>	<i>Rhodanthe citrina</i>
<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>	<i>Solanum lasiophyllum</i>
<i>Grevillea globosa</i>	



Karara Hinge Haul Road: Site: VY10 FCT: 32**Described by:** Vanessa Yeomans **Date:** 22/11/2012 **Type:** Relevé**Location:** **MGA Zone:** 50 6780050 degrees S, 487097 degrees E**Soil:** Orange Loam with an Ironstone Mantle**Vegetation:** Scattered *Eucalyptus ewartiana* with Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa*, *Acacia sibina*, *Acacia tetragonophylla* and *Acacia burkittii* over Low Open Shrubland of *Philotheca deserti* subsp. *deserti***Vegetation Condition:** Excellent**Species List:***Acacia burkittii**Acacia ramulosa* var. *ramulosa**Acacia sibina**Acacia tetragonophylla**Eucalyptus ewartiana**Hakea recurva**Philotheca deserti* subsp. *deserti*

Karara Hinge Haul Road: Site: VY11 FCT: 19a**Described by:** Vanessa Yeomans **Date:** 22/11/2012 **Type:** Relevé**Location:** **MGA Zone:** 50 6781539 degrees S, 487033 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Woodland of *Eucalyptus loxophleba* subsp. *supralaervis* with *Melaleuca atroviridis* and *Exocarpos aphyllus* and *Callitris columellaris* over Tall Open Shrubland of *Acacia burkittii*, *Acacia sibina* and *Acacia ramulosa* var. *ramulosa*.**Vegetation Condition:** Excellent**Species List:**

<i>Acacia bur</i>
<i>Acacia exocarpoides</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Acacia sibina</i>
<i>Callitris columellaris</i>
<i>Eucalyptus loxophleba</i> subsp. <i>supralaervis</i>
<i>Exocarpos aphyllus</i>
<i>Melaleuca atroviridis</i>
<i>Santalum acuminatum</i>



Karara Hinge Haul Road: Site: VY12 FCT: 7**Described by:** Vanessa Yeomans **Date:** 22/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6780883 degrees S, 487088 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Open Woodland of *Eucalyptus kochii* subsp. *plenissima* and *Eucalyptus leptopoda* over Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa* and *Acacia sibina* with *Melaleuca atroviridis* and *Acacia acuaria* over Open Shrubland of *Philotheca deserti* subsp. *deserti* and *Aluta aspera* subsp. *hesperia***Vegetation Condition:** Excellent**Species List:**

<i>Acacia acuaria</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Acacia sibina</i>
<i>Aluta aspera</i> subsp. <i>hesperia</i>
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>
<i>Eucalyptus leptopoda</i>
<i>Melaleuca atroviridis</i>
<i>Micromyrtus</i> sp. Mt Gibson
<i>Philotheca deserti</i> subsp. <i>deserti</i>



Karara Hinge Haul Road: Site: VY13 FCT: 9**Described by:** Vanessa Yeomans **Date:** 22/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6782422 degrees S, 487030 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Low Open Woodland of *Eucalyptus ewartiana* and *Eucalyptus kochii* subsp. *plenissima* over Tall Open Shrubland of *Allocasuarina acutivalvis* and *Melaleuca atroviridis*, *Acacia ramulosa* var. *ramulosa*, *Acacia masliniana* and *Acacia caesaneura* over *Philotheca deserti* subsp. *deserti***Vegetation Condition:** Excellent**Species List:***Acacia masliniana**Acacia ramulosa* var. *ramulosa**Allocasuarina acutivalvis**Eucalyptus ewartiana**Eucalyptus kochii* subsp. *plenissima**Melaleuca atroviridis**Philotheca deserti* subsp. *deserti*

Karara Hinge Haul Road: Site: VY2 FCT: 19a**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** Hinge Haul Road **MGA Zone:** 50 6783115 degrees S, 487032 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Scattered Tall Shrubs of *Callitris columellaris* and *Acacia ?caesaneura* with Tall Open Shrubs of *Acacia anthochaera* and *Acacia ?sibina* over Low Open Shrubland of *Ptilotus obovatus***Vegetation Condition:** Excellent**Species List:**

<i>Acacia ? caesaneura</i> (narrow phyllode variant)
<i>Acacia anthochaera</i>
<i>Acacia roycei</i>
<i>Acacia sibina</i>
<i>Callitris columellaris</i>
<i>Exocarpos aphyllus</i>
<i>Grevillea globosa</i>
<i>Ptilotus obovatus</i>



Karara Hinge Haul Road: Site: VY3 FCT: 9**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6782992 degrees S, 487061 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Low Open Woodland of *Eucalyptus ewartiana* with Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa* and *Acacia sibina* over *Lomandra effusa***Vegetation Condition:** Excellent**Species List:**

<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Acacia sibina</i>
<i>Eucalyptus ewartiana</i>
<i>Lomandra effusa</i>



Karara Hinge Haul Road: Site: VY4 FCT: 9**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6782631 degrees S, 487099 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Open Woodland of *Eucalyptus kochii* subsp. *plenissima* with *Eucalyptus ewartiana* over Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa*, *Acacia sibina* and *Callitris columellaris* Over Open Shrubland of *Hibbertia arcuata* and *Micromyrtus* sp. Mt Gibson**Vegetation Condition:** Excellent**Species List:**

<i>Acacia ramulosa</i> var. <i>ramulosa</i>	<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>
<i>Acacia sibina</i>	<i>Hibbertia arcuata</i>
<i>Acacia tetragonophylla</i>	<i>Micromyrtus</i> sp. Mt Gibson
<i>Callitris columellaris</i>	<i>Philotheca tomentella</i>
<i>Eremophila georgei</i>	<i>Ptilotus obovatus</i>
<i>Eucalyptus ewartiana</i>	<i>Solanum lasiophyllum</i>



Karara Hinge Haul Road: Site: VY5 FCT: 2**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** **MGA Zone:** 50 6788494 degrees S, 487660 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Rock Type:** On Lower Slopes of Sandstone Banded Ironstone Formation**Vegetation:** Scattered *Callitris columellaris* with *Melaleuca nematophylla*, *Acacia sibina* and *Acacia ramulosa* var. *ramulosa* over *Eremophila* spp. with Shrubland of *Philotheca sericea* and *Aluta aspera* subsp. *hesperia*.**Vegetation Condition:** Excellent**Species List:**

<i>Acacia ramulosa</i> var. <i>ramulosa</i>	<i>Eremophila</i> sp.
<i>Acacia sibina</i>	<i>Hakea invaginata</i>
<i>Aluta aspera</i> subsp. <i>hesperia</i>	<i>Melaleuca nematophylla</i>
<i>Callitris columellaris</i>	<i>Philotheca sericea</i>
<i>Drummondita fulva</i>	



Karara Hinge Haul Road: Site: VY6 FCT: 13**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** **MGA Zone:** 50 6787737 degrees S, 487430 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Tall Scrub of *Melaleuca leiocarpa* and *Acacia ramulosa* var. *ramulosa* over Scattered *Drummondita fulva* and *Philotheca sericea***Vegetation Condition:** Excellent**Species List:**

<i>Acacia ramulosa</i> var. <i>ramulosa</i>

<i>Drummondita fulva</i>

<i>Melaleuca leiocarpa</i>

<i>Philotheca sericea</i>



Karara Hinge Haul Road: Site: VY7 FCT: 13**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** Latitude: -29.0360319894 Longitude: 116.8721460365**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Scattered *Eucalyptus kochii* subsp. *plenissima* and *Eucalyptus leptopoda* subsp. *arctata* with Tall Open Shrubland of *Acacia caesaneura*, *Acacia assimilis*, *Grevillea obliquistigma* subsp. *obliquistigma*, *Allocasuarina acutivalvis* and *Hakea invaginata* over Open Shrubland of *Acacia exocarpoides* and *Philotheca brucei***Vegetation Condition:** Excellent**Species List:**

<i>Acacia assimilis</i>
<i>Acacia caesaneura</i>
<i>Acacia exocarpoides</i>
<i>Allocasuarina acutivalvis</i>
<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>
<i>Eucalyptus leptopoda</i> subsp. <i>arctata</i>
<i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i>
<i>Hakea invaginata</i>
<i>Philotheca brucei</i>



Karara Hinge Haul Road: Site: VY8 FCT: 10**Described by:** Vanessa Yeomans **Date:** 21/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6782439 degrees S, 487088 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Tall Open Shrubland of *Acacia burkittii*, *Acacia ramulosa* var. *ramulosa*, *Acacia ramulosa* var. *linophylla*, and *Eremophila oppositifolia* subsp. *angustifolia* over Open Shrubland of *Acacia erinacea*, *Eremophila georgei* and *Maireana georgei*.**Vegetation Condition:** Very Good to Excellent**Species List:**

<i>Acacia burkittii</i>
<i>Acacia erinacea</i>
<i>Acacia ramulosa</i> var. <i>linophylla</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>
<i>Eremophila georgei</i>
<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>
<i>Maireana georgei</i>



Karara Hinge Haul Road: Site: VY9 FCT: 9**Described by:** Vanessa Yeomans **Date:** 22/11/2012 **Type:** Relevé**Location:** MGA Zone: 50 6782209 degrees S, 487055 degrees E**Soil:** Red Orange Clay loam with and an ironstone mantle**Vegetation:** Scattered *Eucalyptus kochii* subsp. *plenissima* and over Tall Open Shrubland of *Acacia ramulosa* var. *ramulosa*, *Acacia ramulosa* var. *linophylla*, *Acacia burkittii*, *Acacia sibina*, *Allocasuarina acutivalvis* over Low Open Shrubland of *Ptilotus obovatus* and *Ptilotus schwartzii***Vegetation Condition:** Excellent**Species List**

<i>Acacia burkittii</i>	<i>Callitris columellaris</i>
<i>Acacia ramulosa</i> var. <i>linophylla</i>	<i>Eucalyptus kochii</i> subsp. <i>plenissima</i>
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	<i>Hakea recurva</i>
<i>Acacia sibina</i>	<i>Ptilotus obovatus</i>
<i>Acacia tetragonophylla</i>	<i>Ptilotus schwartzii</i>
<i>Allocasuarina acutivalvis</i>	<i>Santalum spicatum</i>



APPENDIX H

Significant Flora Records

Species	Number of individuals	Easting	Northing
<i>Drummondita fulva</i>	2	487298	6787707
<i>Drummondita fulva</i>	1	487346	6787583
<i>Drummondita fulva</i>	1	487350	6787575
<i>Drummondita fulva</i>	3	487344	6787559
<i>Drummondita fulva</i>	1	487296	6787532
<i>Drummondita fulva</i>	1	487261	6787402
<i>Drummondita fulva</i>	1	487255	6787402
<i>Drummondita fulva</i>	2	487229	6787397
<i>Drummondita fulva</i>	5	487220	6787394
<i>Drummondita fulva</i>	3	487213	6787388
<i>Drummondita fulva</i>	5	487201	6787363
<i>Drummondita fulva</i>	4	487211	6787323
<i>Drummondita fulva</i>	5	487229	6787300
<i>Drummondita fulva</i>	4	487075	6787146
<i>Drummondita fulva</i>	5	487059	6787070
<i>Drummondita fulva</i>	5	487036	6787036
<i>Drummondita fulva</i>	1	487349	6787467
<i>Drummondita fulva</i>	1	487372	6787466
<i>Drummondita fulva</i>	2	487195	6779121
<i>Drummondita fulva</i>	1	487253	6779021
<i>Drummondita fulva</i>	5	487294	6779026
<i>Drummondita fulva</i>	3	487220	6778718
<i>Drummondita fulva</i>	2	487219	6778712
<i>Drummondita fulva</i>	2	487211	6778705
<i>Drummondita fulva</i>	4	487213	6778679
<i>Drummondita fulva</i>	1	487188	6778642
<i>Drummondita fulva</i>	3	487182	6778631
<i>Drummondita fulva</i>	2	487179	6778626
<i>Drummondita fulva</i>	1	487162	6778613
<i>Drummondita fulva</i>	1	487154	6778601
<i>Drummondita fulva</i>	1	487154	6778574
<i>Drummondita fulva</i>	1	487044	6778345
<i>Drummondita fulva</i>	1	487043	6778339
<i>Drummondita fulva</i>	1	486956	6778270
<i>Drummondita fulva</i>	7	487124	6778681
<i>Drummondita fulva</i>	1	487140	6778702
<i>Drummondita fulva</i>	1	487139	6778710
<i>Drummondita fulva</i>	1	487140	6778711
<i>Drummondita fulva</i>	1	487162	6778725
<i>Drummondita fulva</i>	1	487175	6778729
<i>Drummondita fulva</i>	1	487180	6778732
<i>Drummondita fulva</i>	1	487180	6778733
<i>Drummondita fulva</i>	1	487183	6778736

Species	Number of individuals	Easting	Northing
<i>Drummondita fulva</i>	1	487205	6778738
<i>Drummondita fulva</i>	5	487345	6787647
<i>Drummondita fulva</i>	5	487344	6787633
<i>Drummondita fulva</i>	5	487345	6787618
<i>Drummondita fulva</i>	5	487339	6787617
<i>Drummondita fulva</i>	5	487327	6787620
<i>Drummondita fulva</i>	5	487354	6787592
<i>Drummondita fulva</i>	5	487372	6787587
<i>Drummondita fulva</i>	5	487379	6787584
<i>Drummondita fulva</i>	5	487418	6787606
<i>Drummondita fulva</i>	5	487455	6787631
<i>Drummondita fulva</i>	5	487506	6787673
<i>Drummondita fulva</i>	5	487523	6787714
<i>Drummondita fulva</i>	5	487516	6787745
<i>Drummondita fulva</i>	5	487503	6787766
<i>Drummondita fulva</i>	5	487491	6787783
<i>Drummondita fulva</i>	5	487499	6787798
<i>Drummondita fulva</i>	5	487507	6787801
<i>Drummondita fulva</i>	5	487544	6787806
<i>Drummondita fulva</i>	5	487584	6787855
<i>Drummondita fulva</i>	5	487604	6787927
<i>Drummondita fulva</i>	5	487608	6787943
<i>Drummondita fulva</i>	5	487614	6787964
<i>Drummondita fulva</i>	5	487615	6787977
<i>Drummondita fulva</i>	5	487587	6788077
<i>Drummondita fulva</i>	5	487609	6788254
<i>Drummondita fulva</i>	5	487650	6788323
<i>Drummondita fulva</i>	5	487663	6788323
<i>Drummondita fulva</i>	5	487673	6788336
<i>Drummondita fulva</i>	5	487666	6788400
<i>Drummondita fulva</i>	5	487677	6788447
<i>Drummondita fulva</i>	5	487660	6788494
<i>Drummondita fulva</i>	5	487605	6788414
<i>Drummondita fulva</i>	5	487610	6788374
<i>Drummondita fulva</i>	5	487610	6788366
<i>Drummondita fulva</i>	5	487600	6788287
<i>Drummondita fulva</i>	2	487645	6788215
<i>Drummondita fulva</i>	2	487604	6788224
<i>Drummondita fulva</i>	2	487585	6788218
<i>Drummondita fulva</i>	2	487574	6788138
<i>Drummondita fulva</i>	2	487549	6788126
<i>Drummondita fulva</i>	2	487555	6788043
<i>Drummondita fulva</i>	2	487554	6788034

Species	Number of individuals	Easting	Northing
<i>Drummondita fulva</i>	2	487551	6788016
<i>Drummondita fulva</i>	2	487535	6787994
<i>Drummondita fulva</i>	2	487551	6787975
<i>Drummondita fulva</i>	2	487548	6787959
<i>Drummondita fulva</i>	2	487549	6787950
<i>Drummondita fulva</i>	2	487547	6787938
<i>Drummondita fulva</i>	2	487532	6787936
<i>Drummondita fulva</i>	2	487524	6787912
<i>Drummondita fulva</i>	2	487538	6787903
<i>Drummondita fulva</i>	2	487528	6787875
<i>Drummondita fulva</i>	2	487520	6787865
<i>Drummondita fulva</i>	2	487496	6787817
<i>Grevillea globosa</i>	1	487032	6784187
<i>Grevillea globosa</i>	1	487349	6787574
<i>Grevillea globosa</i>	2	487083	6780356
<i>Grevillea globosa</i>	1	487078	6780347
<i>Grevillea globosa</i>	1	486997	6783237
<i>Grevillea globosa</i>	1	487003	6783235
<i>Grevillea globosa</i>	1	487099	6782631
<i>Micromyrtus trudgenii</i>	1	487227	6778785