2.6.5 Conservation significant ecological communities

A search of the EPBC Act PMST database (DotE 2013d) did not identify any federally listed Threatened Ecological Community (TECs) within the Study Area. A search of the DPaW TEC and Priority Ecological Community (PEC) databases identified six PEC Calcrete Groundwater Assemblages (CGA) mapped within the Study Area, with three intersecting the Survey Area. These PECs are listed in Table 9 and mapped in Figure 3. In addition the desktop assessment of CGAs by Subterranean Ecology (2014) determined that numerous additional calcretes occur within the study Area which are also likely to harbour CGAs that would quality for listing as Priority 1 PECs. These have not been listed as PECs because they have not been sampled for stygofauna. CGAs are the ecological community or assemblage of subterranean invertebrates (typically stygofauna) that inhabit groundwater in calcrete.

The Subterranean Ecology report is provided in Appendix E.

No field surveys for the CGA PEC have been conducted. No additional TECs or PECs were recorded during the field survey.

Table 9 Priority ecological communities within the vicinity of the Survey Area

Community name	Description	Location relative to the Survey Area	
Killara Calcrete	Killara calcrete groundwater assemblage types on Murchison palaeodrainage on Killara Station	Priority 1	Killara station, intersecting the Survey Area between SLK 720-734
Millbillillie Bubble Well Calcrete	Millbillillie Bubble Well groundwater calcrete assemblage type on Carey palaeodrainage on Millbillillie Station	Priority 1	Bubble Creek area on Millbillillie station intersecting the Survey Area between SLK 625-644
Paroo Calcrete	Paroo calcrete groundwater assemblage type on Carey palaeodrainage on Paroo Station	Priority 1	Paroo station, intersecting the Survey Area between SLK 655-665
Wiluna BF Calcrete	Wiluna BF calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station	Priority 1	Six kilometres east of Wiluna
Uramurdah Calcrete	Uramurdah Lake calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station	Priority 1	Seven kilometres south-east of Wiluna
Lake Violet Calcrete	Lake Violet south and Lake Violet calcrete groundwater assemblage types on Carey palaeodrainage on Millbillillie Station	Priority 1	Six kilometres south of the Wiluna

670,000 715,000 760,000 805,000

7,080,000

KARALUNDI
Buttah Rd
Mooloogool Rd
Munarra Rd
Great Northern Hwy
Diamond Well-Doolgunna Rd
Paroo Rd
Wilrna North Rd
Goldfields Hwy
MEEKATHARRA
WILUNA
Murchison Downs Rd
Meekatharra-Sandstone Rd
Hillview-Murchison Downs Rd
Nannine-Polelle Rd
Young Downs Rd
Sandstone-Wiluna Rd
Meekatharra-Yeelirrie Rd
Yeelirrie Rd

7,035,000

670,000 715,000 760,000 805,000

1: 450,000 (at A3)

0 5 10 15 20 25

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

- Localities

Threatened and Priority Species (DPaW databases)

- (T) Threatened Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa
- Priority 5 - Conservation Dependent Taxa
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

PEC Areas (DPaW 2013)

- Priority 1

Main Roads Western Australia
EIA and EMP for
Goldfields Highway Project

Job Number	61-30097
Revision	0
Date	16 Sep 2014

Priority Ecological Communities and previously recorded conservation significant flora

Figure 7

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Data source: DAFWA: Threatened and Priority Species, PEC Areas, 2013; Landgate: Roads - 20140611; GA: Localities 2007; GHD: Study Area, Impact Area - 20140617. Created by: ES

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2.6.6 Riparian vegetation

Two vegetation associations considered to support riparian vegetation were recorded in the Survey Area. These include *Eucalyptus* woodland (VA15) and *Acacia aptaneura* low woodland (VA02) which cover 251.2 ha and 83 ha respectively. Both vegetation associations were restricted to ephemeral drainage lines and adjacent floodplains, and supported riparian taxa.

Eucalyptus woodland was restricted to two small patches near SLK 660 and two parts in the Bubble Creek area. This association comprised *Eucalyptus camaldulensis* in the upper stratum over mid to low shrub layers and sparse ground layers. *Eucalyptus camaldulensis* is associated with riparian systems (Honczar & Thompson 2006) and obtains water from groundwater, rainfall and river flooding events, the latter enabling the species to survive in semi-arid regions. It is reported that *E. camaldulensis* trees that are exposed to prolonged drought-like conditions will respond by shedding leaf canopy, death of limbs, and curtailment of growth and replacement of the primary crown with epicormic growth (Batini 2008). Water stress of *E. camaldulensis* trees was evident near SLK 660 with a number of trees having dead limbs, reduced leaf canopies and limited new growth.

Acacia aptaneura low woodland was restricted to a number of clearly defined channels occurring near Meekatharra, SLK 733, SLK 736-738 and SLK 616.5. This association comprised *Acacia aptaneura* with ± *Hakea lorea* in the upper stratum over tall, mid and low shrub layers and sparse ground layers. *Hakea lorea* is considered a riparian species by Loomes (2010).

The vegetation condition of *Eucalyptus* woodland (VA15) and *Acacia aptaneura* low woodland (VA02) was rated as *Very Good* (3).

2.6.7 Other significant vegetation

The field survey identified vegetation that may be considered as significant due to reasons defined by the EPA (2004a) such as unusual species and a role as a refuge (described further in Appendix A). These vegetation types were restricted to very specific landforms and supported the majority of the priority species recorded in the field survey. The 'other significant vegetation' recorded during the field survey has been mapped at Figure 8 and detailed in Table 10.

Table 10 Vegetation associations mapped within the Survey Area classified as 'other significant vegetation'

Vegetation association	Reason for consideration as 'other significant vegetation'
VA05: Mixed low woodland on banded ironstone and chert hills	Scarcity; unusual combination of species
VA09: *Acacia burkittii* tall shrubland on quartz and ironstone hills	Scarcity; unusual combination of species
VA12: *Eremophila* low shrubland on low rocky hills	Scarcity
VA15: *Eucalyptus camaldulensis* woodland over mixed shrubland in ephemeral drainage lines and adjacent floodplains	Role as a refuge, supports large population of priority species *Stackhousia clementii* (Priority 3)
VA20: Mixed low shrubland on calcareous breakaways	Only occurs in isolated occurrences in the Survey Area and supported priority species including *Calytrix uncinata* (Priority 3) and *Gunniopsis propinqua* (Priority 3)

Vegetation association	Reason for consideration as 'other significant vegetation'
VA21: Mixed *Acacia* and *Eremophila* low shrubland on granite and quartz outcrops	Scarcity and this outcropping granite and associated vegetation type only occurred in this one restricted area within the Survey Area (total 19 ha) and supported a mixed low shrubland that included a number of species that were not recorded elsewhere, including *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (Priority 3) and *Sauropus ramosissimus* (Priority 3)
VA22: Mixed *Acacia* tall shrubland on banded ironstone hills	Scarcity
VA23: Mixed low shrubland on outcrops	Scarcity
VA24: *Corymbia lenziana* open woodland on sand dunes	Scarcity; novel combination of species; restricted distribution; representative of the range of vegetation (outlier – generally occurs further east)
VA25: *Acacia rhodophloia* tall shrubland on chert hills	Scarcity; supports priority species – *Eremophila congesta* (Priority 1)

2.6.8 Diseases and pathogens

Phytophthora cinnamomi (Dieback) disease is generally restricted to areas of the south west of the State, south of the 26th parallel of latitude, in areas receiving an average annual rainfall of greater than 400 mm. The Survey Area is not considered to be susceptible to the development of the Dieback pathogen, this region only receives on average between 237 to 258 mm per annum.

Puccinia psidii sensu lato (Myrtle rust) is a fungus that causes disease in plants from the Myrtaceae family. There are no confirmed reports of Myrtle rust in Western Australia but DPaW is on the alert for this disease.

No diseases or pathogens of native flora were noted during the field survey.

2.7 Flora

2.7.1 Flora diversity[1]

A search of the *NatureMap* database (DPaW 2007–) identified 707 plant taxa, representing 62 families and 223 genera that have previously been recorded within the Study Area. This total comprised 683 native flora taxa and 24 naturalised (non-native) flora taxa. Dominant families within this search result included Fabaceae, Asteraceae and Scrophulariaceae.

A total of 398 flora taxa (including subspecies and varieties) representing 53 families and 154 genera were recorded in the Survey Area during the GHD field surveys. This total comprised 391 (98 %) native taxa and seven (2 %) introduced taxa.

Dominant families recorded from the Survey Area included:

- Fabaceae 63 taxa
- Poaceae 41 taxa
- Asteraceae 41 taxa
- Scrophulariaceae 39 taxa
- Chenopodiaceae 35 taxa

[1] A number of flora collections are currently pending identification at the Western Australian Herbarium. Flora diversity results are subject to change and will be updated when all flora collections IDs are completed.

Dominant genera recorded from the Survey Area included:

- *Acacia* 40 taxa
- *Eremophila* 39 taxa
- *Ptilotus* 14 taxa
- *Senna* 12 taxa
- *Maireana* 12 taxa

A flora list for the Survey Area is provided in Appendix D.

2.7.2 Conservation significant flora

Desktop searches of the EPBC Act PMST database (DotE 2013d), NatureMap database (DPaW 2007–), DPaW Threatened and Priority Flora database (TPFL) and Western Australian Herbarium database (WAHERB) identified the presence/potential presence of 33 conservation significant flora taxa within the Study Area (Appendix C and Figure 8). A review of data provided by Main Roads identified the presence/potential presence of an additional five conservation significant flora taxa. The desktop searches recorded:

- One EPBC Act/*Wildlife Conservation Act 1950* (WC Act) listed taxon
- Ten Priority 1 taxa
- 22 Priority 3 taxa
- Five Priority 4 taxa

Likelihood of occurrence

A likelihood of occurrence assessment, which takes into account previous records including date of record and proximity to Survey Area, species habitat requirements, recorded flowering times, cryptic nature of each taxon and efficacy of the field survey was completed for all conservation significant flora taxa identified in the desktop assessment (Appendix D).

This assessment concluded that four taxa are known to occur, seven taxa are likely to occur, 25 taxa may possibly occur and two taxa are unlikely to occur in the Survey Area.

Field survey

The GHD field survey did not record any EPBC Act or WC Act-listed flora taxa within the Survey Area, however, nine DPaW Priority-listed flora taxa were recorded. These were:

- *Eremophila congesta* (Priority 1)
- *Calytrix uncinata* (Priority 3)
- *Calytrix verruculosa* (Priority 3)
- *Gunniopsis propinqua* (Priority 3)
- *Homalocalyx echinulatus* (Priority 3)
- *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (Priority 3)
- *Ptilotus luteolus* (Priority 3)
- *Sauropus ramosissimus* (Priority 3)
- *Stackhousia clementii* (Priority 3)

A brief description of each of these taxa is provided below (Source: WA Herbarium, 1998). The conservation significant flora species recorded during the field survey have been mapped at Figure 8.

Eremophila congesta (Priority 1)

Eremophila congesta is a densely branched, upright grey-green shrub, growing to 1.2 m high (WA Herbarium, 1998–). The species has purple-blue flowers in August and September (WA Herbarium, 1998–). *Eremophila congesta* grows in skeletal or red/deep orange brown sandy clay loam soils on lateritic outcrops in greenstone hills and on stony quartzite slopes in mulga woodland (WA Herbarium, 1998–). The species is known only from the Wiluna local government area, including at Mt Alice, where it is the dominant shrub just below the summit (Chinnock, 2007 and WA Herbarium, 1998–).

During the field survey *E. congesta* was recorded in Mixed *Acacia* tall shrubland on rocky footslopes (VA19) and *Acacia rhodophloia* tall shrubland on a chert hill (VA25). It is estimated that 588+ individuals occur within the Survey Area with a further 159+ occurring adjacent to the Survey Area. It is possible that more individuals occur scattered throughout the Survey Area within Mixed *Acacia* tall shrubland on rocky footslopes (VA19).

Plate 2 *Eremophila congesta* in situ

Calytrix uncinata (Priority 3)

Calytrix uncinata is a shrub, growing from 0.3 m to one metre high and 1.5 m wide. The species has white flowers from August to November. *C. uncinata* grows in white or red sand, sandy clay on granite or sandstone breakaways, on Banded Ironstone and rocky rises in mulga shrubland (WA Herbarium, 1998–). The species has previously been recorded within the local government areas of Leonora, Meekatharra, Menzies, Mount Magnet, Sandstone, Wiluna, Yalgoo (WA Herbarium, 1998–).

During the field survey *C. uncinata* was recorded in mixed low shrubland on calcareous breakaways (VA20) near SLK 778. A total of 17 individuals were recorded on and adjacent to calcareous breakaways within the Survey Area.

Plate 3 *Calytrix uncinata* in situ

Calytrix verruculosa (Priority 3)

Calytrix verruculosa is a shrub, growing from 0.3 to one metre high. The species has pink/white flowers in August to October (WA Herbarium 1998–). *C. verruculosa* grows in sandy clay on rocky slopes, valleys and flats in mulga shrubland and scrub. The species has previously been recorded within the local government areas of Cue, Meekatharra and Murchison (WA Herbarium 1998–).

During the field survey *C.verruculosa* was recorded in mixed tall shrubland on stony plains (VA01) near SLK 781. A total of 75 individuals were recorded within the Survey Area. These plants were recorded on shallow soils in decomposed gravel.

Plate 4 *Calytrix verruculosa* in situ

Gunniopsis propinqua (Priority 3)

Gunniopsis propinqua is a prostrate annual or perennial herb to 0.1 m high. This species has white or pink flowers from August to September. It occurs in stony sandy loam, lateritic outcrops and in winter-wet sites (WA Herbarium 1998). This species has been recorded from scattered locations in the IBRA regions of Gascoyne, Murchison, Pilbara and Yalgoo.

This species was recorded in two locations within and adjacent to the vegetation type VA20 ‘Mixed low shrubland on calcareous breakaways’

Plate 5 *Gunniopsis propinqua* in situ

Homalocalyx echinulatus (Priority 3)

Homalocalyx echinulatus is a shrub, growing from 0.45 to one metre high with characteristically toothed leaf margins (Craven 1987 and WA Herbarium 1998–). The species has pink flowers from June to September (WA Herbarium 1998). *H. echinulatus* grows in sandy loam or clay, or laterite, on rocky hills, breakaways and Banded Ironstone (Craven 1987 and WA Herbarium 1998). The species was first collect in July 1931 by CA Gardner west of Meekatharra and has also previously been recorded within the local government areas of Cue, Murchison, Sandstone and Wiluna (WA Herbarium 1998).

Homalocalyx echinulatus was recorded in one location during the field survey upper slope with chert blocks with *Eremophila congesta* (P1).

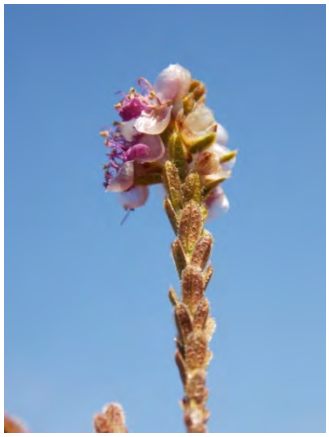

Plate 6 *Homalocalyx echinulatus* in situ

Indigofera sp. Gilesii (M.E. Trudgen 15869) (Priority 3)

Indigofera sp. Gilesii (M.E. Trudgen 15869) is a shrub, growing to 1.6 m high with characteristically spiny stipules. The species has salmon to deep pink or purple/red flowers in May to August.*I.* sp Gilesii (M.E. Trudgen 15869) grows in red/brown skeletal, stony loamy/sandy soils on gorges, gullies, hilltops, creeklines and sandplains in low trees/shrubland and grasslands. The species has previously been recorded within the local government areas of Ashburton, East Pilbara, Halls Creek, Meekatharra and Ngaanyatjarraku (WA Herbarium 1998–).

This species was recorded in one location within the Survey Area on a granite outcrop on the southern side to the existing highway (VA21) at approximately SLK 738.4. As well as an isolated occurrence on the northern side of the highway in this same location This outcropping granite and associated vegetation type only occurred in this one restricted area within the Survey Area (total 19 ha) and supported a mixed low shrubland that included a number of species that were not recorded elsewhere, including *Sauropus ramosissimus* (Priority 3 – discussed below). Twelve *I.* sp Gilesii plants were recorded within this area.

Plate 7 *Indigofera* sp. Gilesii (M.E. Trudgen 15869) in situ

Ptilotus luteolus (Priority 3)

Ptilotus luteolus is an erect compact woody subshrub, growing to 30 cm high and 40 cm across. The species has greenish-yellow flowers in June, August and September (WA Herbarium, 1998–). *P. luteolus* grows in shallow orange/brown clay loams or sandy soils on rocky slopes, screes and ridges in the southern Gascoyne and Murchison IBRA regions (Davis, 2009). The species has previously been recorded within the local government areas of Carnarvon, Meekatharra, Mount Magnet, Upper Gascoyne and Wiluna (WA Herbarium, 1998–).

During the field survey *P. luteolus* was recorded in the material pit at SLK614. A total of two individuals were recorded within the material pit with a third individual recorded outside of the material pit but on the edge of the track to the pit.

Plate 8 *Ptilotus luteolus* in situ

Sauropus ramosissimus (Priority 3)

Sauropus ramosissimus is a slender, much-branched shrub to 0.3 m high. This species occurs within the Gibson Desert and Great Victoria Desert to the east and south of Wiluna. This species has generally been recorded within gravelly ironstone soils, rocky pavements and lateritic pavements (WA Herbarium, 1998–).

This species was recorded in one location within the Survey Area on a granite outcrop on the southern side to the existing highway (VA21) at approximately SLK 738.4. This outcropping granite and associated vegetation type only occurred in this one restricted area within the Survey Area (total 19 ha) and supported a mixed low shrubland that included a number of species that were not recorded elsewhere, including *Indigofera* sp. Gilesii (Priority 3 – discussed above). Six plants were recorded within this area.

Plate 9 *Sauropus ramosissimus* in situ

Stackhousia clementii (Priority 3)

Stackhousia clementii is a dense broom-like perennial herb, growing to 45 cm high and 30 cm wide. The species has green/yellow/brown flowers in April and August. *S. clementii* grows in dark red/brown clay or skeletal soils on sandstone/limestone hills or hills, rocky plains and along creeklines in mulga shrubland and riparian zones. The species has previously been recorded within the local government areas of Ashburton, Carnarvon, Ngaanyatjarraku, Roebourne and Wiluna (WA Herbarium, 1998–).

During the field survey *S. clementii* was recorded in *Eucalyptus* woodland (VA15) vegetation association in the Bubble Creek area. At this location many individuals were recorded on the floodplain with counts averaging 180 individuals per 100 m^2.

Plate 10 *Stackhousia clementii* in situ

2.7.3 Other significant flora

The flora species recorded during the field surveys were assessed to determine whether any were regarded as other 'significant flora' as defined by the EPA (2004a). No new or potentially new species were recorded during the field assessments within the Survey Area; however, one specimen had anomalous or indistinct features and was unable to be sufficiently identified. These taxa were submitted to the Western Australian Herbarium (Accession 5735) for verification and one was subsequently identified as *Wahlenbergia gracilenta* which is a genus that is in need of revision in Western Australia. As such, the identification is tentative. This species is poorly known from the vicinity of the Study Area with the closest records being approximately 150 km west of the Survey Area. The field surveys recorded one species that was considered as a range extension: *Pterocaulon sphacelatum*. This species was recorded once within the Survey Area and its location mapped at Figure 8. The closest record of this species on NatureMap is approximately 150 km to the north of the Survey Area.

650,000 655,000 660,000 665,000

7,060,000

Great Northern Hwy

Goldfields Hwy

Main St
High St
Hill St
Dardo St
Railway St
Campbell Rd
Mecleary St
Meekatharra-Sandstone Rd

793 792 791 790 789 788 787 786 785 784 783 782 781 780 779 778 777 776 775

20

7,055,000

Priority Species (GHD)

- *Eremophila congesta* (Priority 1)
- *Homalocalyx echinulatus* (Priority 3)
- *Ptilotus luteolus* (Priority 3)
- *Stackhousia clementii* (Priority 3)
- *Calytrix verruculosa* (Priority 3)
- *Calytrix uncinata* (Priority 3)
- *Gunniopsis propinqua* (Priority 3)
- *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (Priority 3)
- *Sauropus ramosissimus* (Priority 3)

Other Significant Flora (GHD)

- *Pterocaulon sphacelatum* Range Extension

Other Significant Vegetation (GHD)

- VA05: Mixed low woodland on banded ironstone and chert hills
- VA09: *Acacia burkittii* tall shrubland on quartz and ironstone hills
- VA12: *Eremophila* low shrubland on low rocky hills
- VA15: *Eucalyptus camaldulensis* woodland over mixed shrubland in ephemeral drainage lines and adjacent floodplains
- VA20: Mixed low shrubland on calcareous breakaways
- VA21: Mixed *Acacia* and *Eremophila* low shrubland on granite and quartz outcrops
- VA22: Mixed *Acacia* tall shrubland on banded ironstone hills
- VA23: Mixed low shrubland on outcrops
- VA24: *Corymbia lenziana* open woodland on sand dunes

650,000 655,000 660,000 665,000

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
Date 17 Sep 2014

Conservation significant vegetation and flora

Figure 8

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Data source: GA: Topo 250k Series 3 - 2006; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK Marker - 20131219; GHD: Impact Area, Study Area, Priority Species, Taxon, Other Significant Flora, Other Significant Vegetation - 20140617. Created by: bflorczak

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670,000 675,000 680,000 685,000

7,065,000

7,060,000

753 754 755 756 757 758 759 760 761 762 763 765 766 767 768 769 770 771 772 773 774 20 22

Goldfields Hwy

Priority Species (GHD)

- *Eremophila congesta* (Priority 1)
- *Homalocalyx echinulatus* (Priority 3)
- *Ptilotus luteolus* (Priority 3)
- *Stackhousia clementii* (Priority 3)
- *Calytrix verruculosa* (Priority 3)
- *Calytrix uncinata* (Priority 3)
- *Gunniopsis propinqua* (Priority 3)
- *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (Priority 3)
- *Sauropus ramosissimus* (Priority 3)

Other Significant Flora (GHD)

- *Pterocaulon sphacelatum* Range Extension

Other Significant Vegetation (GHD)

- VA05: Mixed low woodland on banded ironstone and chert hills
- VA09: *Acacia burkittii* tall shrubland on quartz and ironstone hills
- VA12: *Eremophila* low shrubland on low rocky hills
- VA15: *Eucalyptus camaldulensis* woodland over mixed shrubland in ephemeral drainage lines and adjacent floodplains
- VA20: Mixed low shrubland on calcareous breakaways
- VA21: Mixed *Acacia* and *Eremophila* low shrubland on granite and quartz outcrops
- VA22: Mixed *Acacia* tall shrubland on banded ironstone hills
- VA23: Mixed low shrubland on outcrops
- VA24: *Corymbia lenziana* open woodland on sand dunes

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
Date 17 Sep 2014

Conservation significant vegetation and flora

Figure 8

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Data source: GA: Topo 250k Series 3 - 2006; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK Marker - 20131219; GHD: Impact Area, Study Area, Priority Species, Taxon, Other Significant Flora, Other Significant Vegetation - 20140617. Created by: bflorczak

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690,000 695,000 700,000 705,000

7,075,000 7,070,000

Goldfields Hwy

731 732 734 735 736 737 738 739 740 741 742 744 745 746 747 748 749 750 751 752

20 21 23 24

Priority Species (GHD)

- *Eremophila congesta* (Priority 1)
- *Homalocalyx echinulatus* (Priority 3)
- *Ptilotus luteolus* (Priority 3)
- *Stackhousia clementii* (Priority 3)
- *Calytrix verruculosa* (Priority 3)
- *Calytrix uncinata* (Priority 3)
- *Gunniopsis propinqua* (Priority 3)
- *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (Priority 3)
- *Sauropus ramosissimus* (Priority 3)

Other Significant Flora (GHD)

- *Pterocaulon sphacelatum* Range Extension

Other Significant Vegetation (GHD)

- VA05: Mixed low woodland on banded ironstone and chert hills
- VA09: *Acacia burkittii* tall shrubland on quartz and ironstone hills
- VA12: *Eremophila* low shrubland on low rocky hills
- VA15: *Eucalyptus camaldulensis* woodland over mixed shrubland in ephemeral drainage lines and adjacent floodplains
- VA20: Mixed low shrubland on calcareous breakaways
- VA21: Mixed *Acacia* and *Eremophila* low shrubland on granite and quartz outcrops
- VA22: Mixed *Acacia* tall shrubland on banded ironstone hills
- VA23: Mixed low shrubland on outcrops
- VA24: *Corymbia lenziana* open woodland on sand dunes

690,000 695,000 700,000 705,000

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
Date 17 Sep 2014

Conservation significant vegetation and flora

Sheet 3 of 11

Figure 8

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Data source: GA: Topo 250k Series 3 - 2006; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK Marker - 20131219; GHD: Impact Area, Study Area, Priority Species, Taxon, Other Significant Flora, Other Significant Vegetation - 20140617. Created by: bflorczak

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Goldfields Hwy

Priority Species (GHD)

- *Eremophila congesta* (Priority 1)
- *Homalocalyx echinulatus* (Priority 3)
- *Ptilotus luteolus* (Priority 3)
- *Stackhousia clementii* (Priority 3)
- *Calytrix verruculosa* (Priority 3)
- *Calytrix uncinata* (Priority 3)
- *Gunniopsis propinqua* (Priority 3)
- *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (Priority 3)
- *Sauropus ramosissimus* (Priority 3)

Other Significant Flora (GHD)

- *Pterocaulon sphacelatum* Range Extension

Other Significant Vegetation (GHD)

- VA05: Mixed low woodland on banded ironstone and chert hills
- VA09: *Acacia burkittii* tall shrubland on quartz and ironstone hills
- VA12: *Eremophila* low shrubland on low rocky hills
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- VA24: *Corymbia lenziana* open woodland on sand dunes

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
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Conservation significant vegetation and flora

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Figure 8

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Goldfields Hwy

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Priority Species (GHD)

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Kilometres

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Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
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- Impact Area
- Survey Area

Locality Map

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Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

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Figure 8

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Goldfields Hwy

1:50,000 (at A3)

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
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N

LEGEND

- SLK Marker
- Highway
- Minor Road
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- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
Date 17 Sep 2014

Conservation significant vegetation and flora

Sheet 6 of 11

Figure 8

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Paroo Rd

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Priority Species (GHD)

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
Date 17 Sep 2014

Conservation significant vegetation and flora

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Figure 8

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- *Eremophila congesta* (Priority 1)
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Goldfields Hwy

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Kilometres

Map Projection: Transverse Mercator
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Grid: Map Grid of Australia 1994, Zone 50

N

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- Minor Road
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- Survey Area

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Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
Date 17 Sep 2014

Conservation significant vegetation and flora

Sheet 8 of 11

Figure 8

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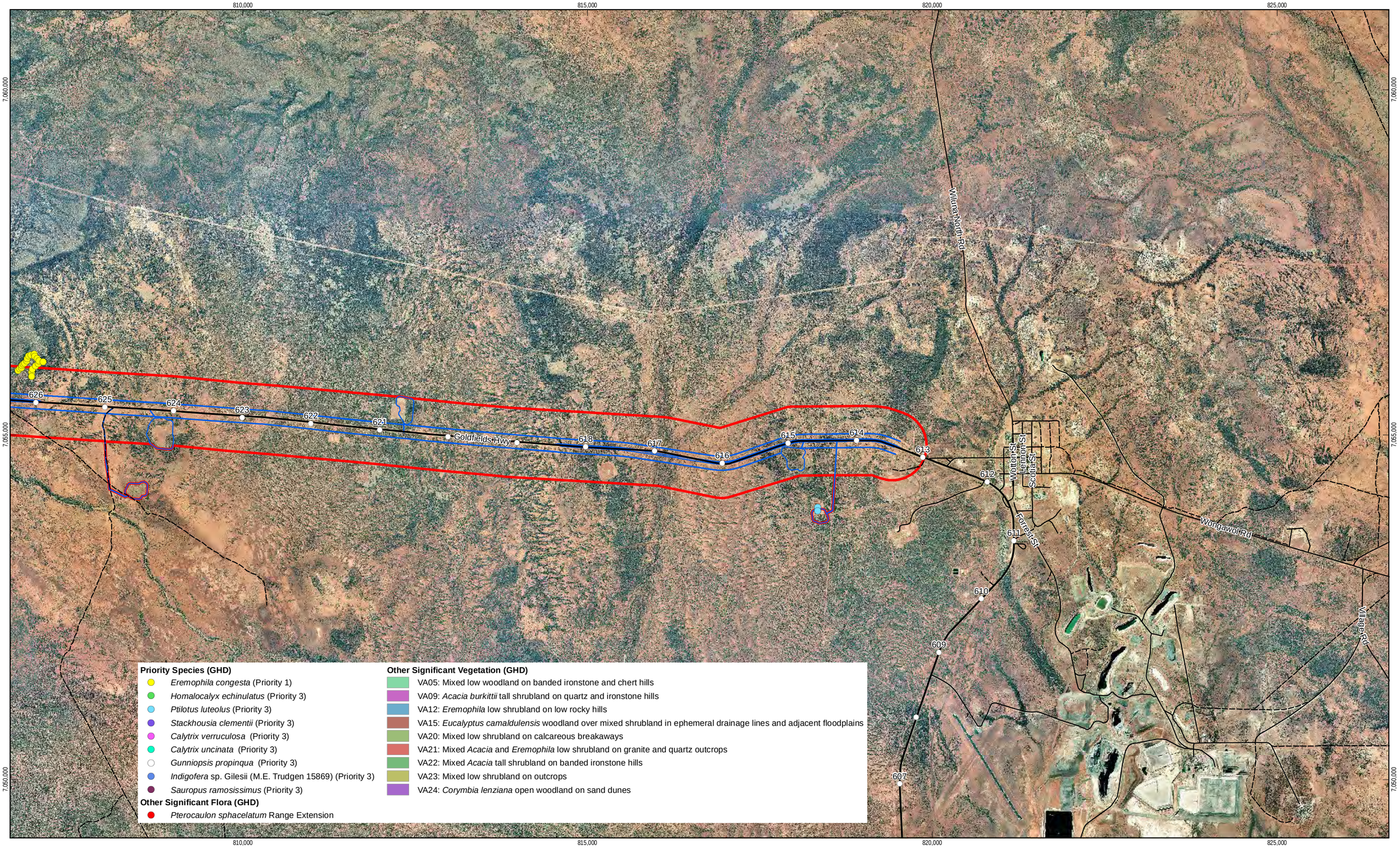

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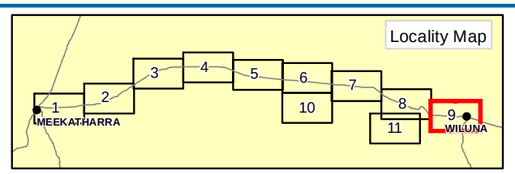

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Conservation significant vegetation and flora

Figure 8

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Priority Species (GHD)

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

GHD mainroads WESTERN AUSTRALIA powered by SLIP ENABLER

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Conservation significant vegetation and flora

Job Number	61-30097
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Sheet 10 of 11

Figure 8

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Conservation significant vegetation and flora

Sheet 11 of 11

Figure 8

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2.7.4 Introduced flora (weeds)

A search of the *NatureMap* database (DPaW 2007–) identified 24 naturalised (non-native) flora taxa within the Study Area. None of these taxa are Declared Pests or Weeds of National Significance (WoNS).

The GHD field survey recorded seven introduced taxa during the field survey, these included:

- **Acetosa vesicaria*
- **Bidens pinnata (*Bipinnate Begger's Tick)
- **Cenchrus ciliaris* (Buffel Grass)
- **Citrullus lanatus* (Pie Melon)
- **Cuscuta planiflora*
- **Lysimachia arvensis*
- **Setaria verticillata*

All introduced taxa were recorded in small densities in isolated occurrences scattered throughout the Survey Area.

2.8 Fauna

2.8.1 Habitat types

Eight broad fauna habitat types were identified in the Survey Area, based on predominant landforms, soil and vegetation structure in the area (Figure 9). The structure and condition of the habitat types varied depending on the level of impact from various disturbances including cattle grazing, fire and past clearing. The habitat types closely correspond to the vegetation associations described in section 2.6.3, but represent a much broader description of the vegetation and landforms, and their value as habitat for fauna species. The habitat types are:

- *Acacia* shrubland over tussock grasses
- *Acacia* shrubland over hummock grasses
- Mixed shrubland
- Tussock grassland
- Chenopod shrubland
- *Eucalyptus*/*Corymbia* woodland (including riparian habitat around Bubble Creek)
- Rocky outcrops, breakaways and Banded Ironstone Formation (BIF) hills
- Sand dune

Plate 11 *Acacia* shrubland over spinifex grassland habitat

Acacia shrublands are the most dominant habitat type within the Survey Area, comprising a variety of different vegetation types including open *Acacia* shrublands with sparse hummocks (Plate 11), denser areas of tall *Acacia* shrubland with little understorey, as well as *Acacia* shrublands over scattered tussock grasses. A large proportion of the *Acacia* shrublands has been previously disturbed by cattle grazing, resulting in large areas with very limited understorey or groundcover vegetation. There are also areas with little evidence of disturbance, which retain some structural diversity. In areas where the shrubland is denser, this vegetation would provide suitable habitat for a variety of fauna species, in particular foraging opportunities, breeding habitat and refugia for birds such as the threatened Malleefowl (*Leipoa ocellata*) at the Wiluna end of the Survey Area. Where the shrubland is more open, and on loamy soils, this would provide suitable habitat for the Priority 1 listed Good-legged Lerista skink (*Lerista eupoda*).

Plate 12 Tussock grassland habitat

In most areas, the understorey of the *Acacia* shrublands consists of tussock grasses and patches that are quite open with scattered low shrubs and bare ground (Plate 12. This vegetation would provide foraging habitat for small to medium birds as well as reptiles such as monitors, skinks and snakes. Less frequent are areas of *Acacia* shrubland with a hummock grassland understorey (Plate 13). These hummocks vary from large, mature, well-spaced clumps, to young, small patches of regrowth, and provide a key habitat feature for a number of fauna species such as small ground-dwelling mammals such as native hopping mice, and the Priority 4 listed Brush-tailed Mulgara (*Dasycercus blythi*) (recorded in this habitat type). Australian Bustard (*Ardeotis australis*) (Priority 4) prints were also recorded in these areas. Mature clumps of hummock grasses also provide valuable refugia for a variety of reptile species such as skinks, dragons and snakes. The areas with patches of mature hummock grasses, mostly with only scattered *Acacia* shrubs, are mapped in Figure 9.

Plate 13 Spinifex hummock grassland habitat

Throughout the Survey Area there are some small patches of tussock grasslands which are dominated by sparse tussocks grasses and some scattered medium to tall shrubs (Plate 14). Throughout the lower lying areas are also some small patches of chenopod shrublands (Plate 15). These shrublands occur on the sandy clay plains, and provide some limited habitat for fauna species such as shelter for small reptiles (skinks and dragons).

Plate 14 Tussock grassland habitat

Plate 15 Chenopod shrubland habitat

On the floodplains and surrounding the ephemeral Bubble Creek, there is also a small area of *Eucalyptus camaldulensis* open woodland (Plate 16). This woodland would provide a variety of habitat resources for fauna species, and generally has a greater structural diversity than the surrounding shrublands. The *Acacia* shrublands that occur on the floodplains surrounding Bubble Creek would also provide good habitat for burrowing species given the looser sandy substrate. There is also one small patch of *Corymbia* woodland on a small dune around SLK 732 on the northern side of the highway. This dune provides suitable habitat for a variety of fauna species, including ground-dwelling mammals and fossorial reptiles.

Plate 16 *Eucalyptus/Corymbia* woodland habitat

Rocky habitat also occurs in isolated areas throughout the Survey Area. This rocky habitat includes rocky outcrops (Plate 17), breakaways (mostly calcareous), a small gorge and BIF hills (including Mt Russell) (Plate 18). These rocky areas provide valuable refuge habitat for fauna species such as the Priority 4 listed Long-tailed Dunnart (*Sminthopsis longicaudata*).

Plate 17 Rocky gorge habitat

Plate 18 Rocky slope habitat

The Survey Area also contains some areas that have been cleared or highly disturbed. These areas provide little to no habitat value and principally comprise of borrow pits, roads, vehicle tracks, cattle yards and other infrastructure.

2.8.2 Habitat value

The habitat present within the Survey Area provides a variety of resources for fauna species. While a large proportion of these habitats has been heavily disturbed as a result of grazing, there are some areas which retain valuable resources for fauna species, including conservation significant fauna. The value of the habitat for fauna species is summarised in Table 11 and should be considered in association witht the vegetation (habitat) condition mapped in Figure 6.

Table 11 Fauna habitat value

Habitat type	Habitat value	Reasoning	Conservation significant fauna habitat
Acacia shrubland over tussock grasses	Medium	Areas with minimal disturbance have good vegetation structure	Malleefowl (where *Acacia* shrubs are more dense) Good-legged Lerista skink Australian Bustard Bush Stone-curlew Grey Falcon Peregrine Falcon
Acacia shrubland over hummock grasses	High	Areas with minimal disturbance have good vegetation structure	Brush-tailed Mulgara Good-legged Lerista skink Australian Bustard Bush Stone-curlew Grey Falcon Peregrine Falcon Striated Grasswren
Mixed shrubland	Moderate	Areas with minimal disturbance have good vegetation structure	Australian Bustard Bush Stone-curlew Grey Falcon Peregrine Falcon
Tussock grassland	Low	Limited vegetation structure	Grey Falcon Peregrine Falcon
Chenopod shrubland	Low	Limited vegetation structure	Grey Falcon Peregrine Falcon
Eucalyptus/ *Corymbia* woodland	High	Good structural diversity and variety of habitat resources	Good-legged Lerista skink Grey Falcon Peregrine Falcon Major Mitchell's Cockatoo (riparian habitat)
Rocky outcrops and breakaways	High	Isolated habitat in the area	Long-tailed Dunnart Grey Falcon Peregrine Falcon
Sand dune	High	Rare habitat in the area	Northern Marsupial Mole (potentially, although unlikely) Grey Falcon Peregrine Falcon

2.8.4 Habitat linkages

Habitat linkages are important to allow animals to move between areas of resource availability. They are important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction. Fragmentation of habitat limits the resources available to species, particularly sedentary species, which means they may be more vulnerable to natural disasters or habitat changes over time. Fragmentation of habitat can lead to edge effects, leading to degradation of the habitat. Where the distance between habitat fragments is small, species may still be able to move between these areas, but may be more exposed to predation pressures in the cleared areas.

Overall, the habitats within the Survey Area are well connected both locally and regionally to other areas of habitat. The majority of the Survey Area has previously been grazed and therefore the habitats have experienced various levels of disturbance resulting in some areas being highly degraded. Patches of habitat with good vegetation structure form a mosaic with highly degraded habitat, which may reduce the ability of some fauna species to move through the landscape at a local scale.

2.8.5 Fauna diversity

A search of the NatureMap database (DPaW, 2007–) identified 224 fauna species as previously recorded within the Study Area, of which 220 species are native and four are pest (introduced) species (Appendix C).

The Spring field survey recorded a total of 102 fauna species, consisting of 63 birds, 19 reptiles, 19 mammals and one amphibian within the Survey Area. Of these, seven are introduced (feral) species. The list of fauna species recorded during the survey is provided in Appendix E.

The fauna species recorded using the camera traps, Elliot traps and bat detector unit (Songmeter SM2 bat +) are listed in Appendix E.

2.8.6 Conservation significant fauna

Desktop searches of the EPBC Act PMST (DotE 2013d) and NatureMap (DPaW 2007-) databases revealed the potential presence of 18 fauna taxa protected under the EPBC Act and/or WC Act or listed by DPaW as priority within the Study Area (Appendix C). In addition to these species, five conservation significant fauna species not identified in the database searches were identified as potentially occurring within the Study Area as they are known to occur in the region. These species include the Bush Stone-curlew, Major Mitchell's Cockatoo, Grey Falcon, Western Spiny-tailed Skink and Brush-tailed Mulgara.

Likelihood of occurrence

A likelihood of occurrence assessment, which takes into account the field survey data, habitats present, known species distribution and previous records, was completed for all conservation significant fauna taxa identified in the desktop assessment and known to occur in the region.

The assessment concluded that five species are known to occur (discussed below), four species are likely to occur, two species could possibly occur and twelve species are unlikely to occur in the Suvey Area. A summary of the conservation significant fauna likelihood of occurrence assessment is shown in Table 12 and the full assessment is provided in Appendix E.

Table 12 Summary of conservation significant fauna - likelihood of occurrence assessment

Species	Common name	Status		Likelihood of occurrence
		State	Federal	
Birds				
Acanthiza iredalei iredalei	Slender-billed Thornbill (western)		V	Unlikely
Amytornis striatus subsp. *striatus*	Striated Grasswren (inland)	P4		Possible
Apus pacificus	Fork-tailed Swift	IA	Mi	Unlikely
Ardea modesta	Great Egret	IA	Mi	Unlikely
Ardeotis australis	Australian Bustard	P4		Present
Burhinus grallarius	Bush Stone-curlew	P4		Present
Cacatua leadbeateri	Major Mitchell's Cockatoo	S		Possible
Charadrius veredus	Oriental Plover	IA	Mi	Unlikely
Falco hypoleucos	Grey Falcon	T		Present
Falco peregrinus macropus	Peregrine Falcon	S		Likely
Leipoa ocellata	Malleefowl	T	V, Mi	Likely
Merops ornatus	Rainbow Bee-eater	IA	Mi	Present
Polytelis alexandrae	Princess Parrot	P4	V	Unlikely
Tyto novaehollandiae subsp. *novaehollandiae*	Masked Owl (southern subsp.)	P3		Unlikely
Mammals				
Dasycercus blythi	Brush-tailed Mulgara	P4		Present
Dasycercus cristicauda	Crest-tailed Mulgara	T	V	Unlikely
Macrotis lagotis	Bilby	T	V	Unlikely
Notoryctes caurinus	Northern Marsupial Mole	T	En	Unlikely
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	T	V	Unlikely
Sminthopsis longicaudata	Long-tailed Dunnart	P4		Likely
Reptiles				
Lerista eupoda	Good-legged Lerista skink	P1		Likely
Liopholis kintorei	Giant Desert Skink	T	V	Unlikely
Egernia stokesii badia	Western Spiny-tailed Skink	T	En	Unlikely

Targeted fauna assessment

Species recorded during field assessment

The field surveys conducted by GHD identified five conservation significant fauna species within the Survey Area, including:

- Grey Falcon (*Falco hypoleucos*) – Threatened under the WC Act
- Australian Bustard (*Ardeotis australis*) – Priority 4 listed by DPaW
- Bush Stone-curlew (*Burhinus grallarius*) – Priority 4 listed by DPaW
- Brush-tailed Mulgara (*Dasycercus blythi*) – Priority 4 listed by DPaW
- Rainbow Bee-eater (*Merops ornatus*) – Schedule 3 under the WC Act and Migratory under the EPBC Act

A brief description of each of these species and their associated habitat types is provided below.

Mulgara

The results of the desktop assessment indicate that the EPBC – listed Vulnerable Crest-tailed Mulgara (*Dasycercus cristicauda*) has been recorded within 50 km of the Survey Area. The closest of these includes three records from one location approximately 10 km south of the Goldfields Highway, and 31 km south-west of Wiluna in 2007 (*NatureMap* and DPaW data). Recent research regarding the taxonomic status and distribution of this species and the Brush-tailed Mulgara (*Dasycercus blythi*) by Woolley *et al*. (2013) has revealed that the Crest-tailed Mulgara has not been recorded in Western Australia since the Canning Stock Route Expedition in 1930-1. Woolley *et al*. (2013) stipulates that this may simply reflect a lack of targeted collecting activity in appropriate habitat, rather than the absence of the species. In addition to this, historic records of Crest-tailed Mulgara are restricted to the Northern Deserts of the Canning Stock Route, and are not known from the vicinity of the Survey Area.

By comparison, there are multiple records of the Brush-tailed Mulgara in close proximity to the Survey Area. Museum specimen records of the Brush-tailed Mulgara exist from the Canning Stock Route in 2002 when five individuals were caught (one a little north of Well 27 and two near Well 29) and in 2008 when one individual was caught (near Well 26) (Woolley *et al*. 2013). These locations are approximately 540 km north-east of the Survey Area and therefore may not be relevant to the current survey, however they do confirm that the species has been vouchered in Western Australia more recently than the Crest-tailed Mulgara. Further to this, there are numerous *NatureMap* records of the Brush-tailed Mulgara within proximity of the Survey Area.

Records of Brush-tailed Mulgara have previously been misidentified as Crest-tailed Mulgara (Woolley *et al*. 2013), and therefore it is likely that the three 2007 records of the species are the DPaW Priority 4-listed Brush-tailed Mulgara. However it is difficult to definitively confirm this, as these records were not verified by the Western Australian Museum. Woolley *et al*. (2013) also indicates that Crest-tailed Mulgara records are typically from sand dune habitats, whereas Brush-tailed Mulgara habitat is typically spinifex grasslands with medium to dense cover (Woolley 2005; Woolley *et al*. 2013). In addition the Brush-tailed Mulgara is closely associated with *Triodia* Sand Plains and swales between low dunes from south-western Queensland across the Simpson, Tanami, and Great Sandy Deserts of southern and central Northern Territory and central Western Australia, including parts of the Pilbara (Pavey *et al*. 2012).

These findings are consistent with the information presented at the recent DPaW Mulgara workshop on the 11th December 2013. The status of both species is currently under review by the DotE, and the Brush-tailed Mulgara is currently under consideration for listing under the EPBC Act (DSEWPaC 2012).

Field assessment – A number of Mulgara active and old burrows, prints and scats were recorded within spinifex grassland habitat in the Survey Area (Plate 19). It is likely that this evidence is of the Brush-tailed Mulgara, based on the literature discussed above and that these records came from spinifex grasslands. These survey records are shown in Figure 9.

Two camera traps were also positioned on active Mulgara burrows within spinifex grasslands (as shown in Plate 19), however no photos of Mulgara were captured during the field survey.

Plate 19 Camera trap set-up targeting active Mulgara burrow and Mulgara prints recorded in the Project Area.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is listed under Schedule 3 of the WC Act (Migratory birds protected under an international agreement) and as Migratory under the EPBC Act. The Rainbow bee-eater occupies open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation throughout Australia. It also inhabits sand dune systems in coastal areas and at inland sites that are in close proximity to water (Morcombe, 2004). The species is a breeding resident in northern Australia, and a summer breeding migrant to southern Australia.

Field assessment – Rainbow Bee-eaters were observed in the Survey Area during the field survey. It is likely that the species is an occasional seasonal migrant to the Survey Area. No breeding of the species was recorded however suitable breeding habitat is present throughout the Survey Area in sandy soils. It should be noted that Rainbow Bee-eaters often take advantage of windrows of soil pushed up by graders and earth moving equipment along tracks, and may potentially use these areas for breeding.

Australian Bustard (*Ardeotis australis*)

The Australian Bustard is listed as Priority 4 by DPaW, and is therefore is classified as 'Rare, Near Threatened and other taxa in need of monitoring'. The Australian Bustard occurs across much of Australia, including across most of Western Australian, except in heavily wooded areas in the south. It occurs mainly in open country, such as grasslands, low heath or lightly wooded grassland (Morcombe, 2004). The Bustard is a nomadic bird which is known to migrate to suitable feeding areas dependent upon conditions.

Field assessment – Australian Bustard tracks were recorded within hummock grassland habitats in the Survey Area during the field survey (Figure 9). It is likely that the Bustard is a nomadic visitor to the Survey Area, and is likely to utilise all of the habitat types for foraging. Given the availability of suitable habitat in the local area and surrounding region, the proposed project is unlikely to have a significant impact on this species.

Bush Stone-curlew (*Burhinus grallarius*)

The Bush Stone-curlew as Priority 4 by DPaW and inhabits dry open woodlands, lightly timbered country, mallee and mulga; anywhere with groundcover of small sparse shrubs, grass or litter of twigs. The species avoids dense forest and closed canopy habitats (Morcombe 2004). In southern Australia, they persist most often where there is a well-structured litter layer and fallen timber debris. In general, habitat occurs in open woodlands with few, if any, shrubs, and short, sparse grasses of less than 15 cm in height, with scattered fallen timber, leaf litter and bare ground present.

Field assessment – One Bush Stone-curlew individual was recorded on camera trap 4, located at the dam on the north side of the highway (near SLK 741) during the field survey (Figure 9).

Grey Falcon (*Falco hypoleucos*)

The Grey Falcon inhabits lightly timbered country, especially stony plains and lightly timbered *Acacia* scrub, and generally uses standing dead trees as lookout posts. This species is considered scarce to rare and is usually found singularly or sometimes in pairs (Morcombe 2004).

Field assessment – One Grey Falcon individual was observed perching on a dead tree within *Acacia* shrubland during the field survey. This species has not previously been recorded within 50 km of the Survey Area, and therefore it is likely to occur only rarely in the region.

Species targeted but not recorded during field assessment

Targeted assessments were conducted during the field survey for the following species and the results are outlined below:

- Greater Bilby (*Macrotis lagotis*) - Threatened under the WC Act, Vulnerable under the EPBC Act
- Long-tailed Dunnart (*Sminthopsis longicaudata*) - Priority 4 listed by DPaW
- Malleefowl (*Leipoa ocellata*) - Threatened under the WC Act, Vulnerable under the EPBC Act
- Northern Marsupial Mole (*Notoryctes caurinus*) - Threatened under the WC Act, Endangered under the EPBC Act
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) - Threatened under the WC Act, Vulnerable under the EPBC Act
- Great Desert Skink (*Liopholis kintorei*) - Threatened under the WC Act, Vulnerable under the EPBC Act
- Western Spiny-tailed Skink (*Egernia stokesii badia*) - Threatened under the WC Act, Endangered under the EPBC Act

Greater Bilby (*Macrotis lagotis*)

The Greater Bilby is listed as Vulnerable under the EPBC Act and is listed under Schedule 1 of the WC Act (Threatened).The Greater Bilby occupies three major vegetation types, including open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas. In the south of its range, the Greater Bilby lives on rises and ridges among sparse grasses. In Western Australia there are disjunct populations in the Gibson Desert, south-western Kimberley, inland areas of the Pilbara and northern Great Sandy Desert (Van Dyke and Strahan 2008).

Field assessment – During the field survey a total of 28 Bilby Search Areas (BSAs) were undertaken throughout the Survey Area in areas of suitable habitat. These BSAs are shown in Figure 9. No evidence of the Greater Bilby was recorded during these BSAs or throughout the field survey. There are historical *NatureMap* records of this species from the Wiluna area, however given the pastoral use of the region, and the degradation caused by cattle grazing it is unlikely that the Greater Bilby occurs within the Survey Area.

Long-tailed Dunnart (*Sminthopsis longicaudata*)

The Long-tailed Dunnart is listed as Priority 4 by DPaW and is known to occur from widely scattered localities in the arid zone where it inhabits rugged and rocky areas. These areas include scree slopes, boulder and stony plateaus, and adjacent stony plains with shrubs over spinifex grasslands (Van Dyck *et al.* 2013).

Field assessment – During the field survey, two quadrats of Elliot traps were set within rocky slope habitat at Mt Russell. No Long-tailed Dunnart individuals or evidence was recorded during the field survey.

Malleefowl (*Leipoa ocellata*)

The Malleefowl is classified as Vulnerable under the EPBC Act and is listed under Schedule 1 of the WC Act (Threatened). In Western Australia, the Malleefowl generally occurs in semi-arid areas, from Carnarvon to the south-west Nullarbor. The species occupies shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine *Callitris* woodlands, *Acacia* shrublands, Broombush (*Melaleuca uncinata*) vegetation or coastal heathlands. They prefer vegetation with a dense understorey of shrubs and their breeding habitat is characterized by light soil and an abundant leaf litter, which is used in the construction of nesting mounds. The nest is a large mound of sand or soil and organic matter (Jones and Goth 2008; Morcombe, 2004).

Field assessment – Active searches within suitable *Acacia* shrubland were undertaken during the field survey, however no evidence (individuals, scratching, diggings, tracks or mounds) of the Malleefowl was recorded. The species has previously been recorded approximately halfway between Meekatharra and Wiluna in 2010. It is likely that the region is sparsely populated with the species as the Survey Area is located at the northern extent of its range. In addition there have also been multiple records (sightings, tracks and mounds) in 2006-7 of Malleefowl, approximately 20 km south of Goldfields Highway, just north of the Sandstone Wiluna Road.

Northern Marsupial Mole (*Notoryctes caurinus*)

The Northern Marsupial Mole is listed as Endangered under the EPBC Act and under Schedule 1 of the WC Act (Threatened). The Northern Marsupial Mole lives underground, primarily in sand dunes and sandy soils along river flats. It occasionally comes to the surface, apparently more frequently after rain (DotE 2013f). Underground signs of marsupial moles are usually found on well-vegetated dunes (where prey may be more abundant) and generally not in swales (flats between dunes). The vegetation in Northern Marsupial Mole habitat is generally *Acacia* spp., small shrubs and Desert Oak (*Allocasuarina decaisneana*) and often (but not always) associated with spinifex (*Triodia* spp.). Sandy river flats are also thought to be potential Northern Marsupial Mole habitat, as they are rich in food resources and may act as dispersal corridors. Underground signs of the species are generally found between 20—100 cm below the dune surface. Records of the Northern Marsupial Mole are predominantly known from the Little Sandy Desert, Great Sandy Desert and Gibson Desert regions of Western Australia (DotE 2013f).

Field assessment – Given the difficultly is surveying for this species, and that there is no proven or accepted survey technique to detect them, the field assessment for the Northern Marsupial Mole was restricted to targeted habitat searches. The only potential habitat for the species within the Survey Area is the small sand dune system located north of the highway (around SLK 732). Visual inspection of this dune habitat was undertaken looking for signs of use, however no evidence was recorded. Due to the isolated nature of this system, it is unlikely that the species occurs within this dune. Sand dune habitat is also rare in the surrounding area, and therefore suitable habitat for this species is limited surrounding the Survey Area.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The Pilbara Leaf-nosed Bat is classified as Vulnerable under the EPBC Act and is listed under Schedule 1 of the WC Act (Threatened). The Pilbara Leaf-nosed Bat is restricted to the Pilbara region and field surveys suggest that it is divided into three discrete subpopulations (eastern Pilbara mines and granite, Hamersley Range, Upper Gascoyne). The Pilbara Leaf-nosed Bat is restricted to caves and mine adits (horizontal shafts) with stable, warm and humid microclimates because of its poor ability to thermoregulate and retain water. The roost is usually over pools of water in deeper mines, or deep within the mine or cave structure in an area that maintains elevated temperature and humidity. Thus, the roosting site is often at depth in mines; in small crevices within caves, usually those ascending between sedimentary rock layers; and with associated groundwater seeps.

Field assessment – A Songmeter SM2 bat + bat detector unit was deployed at six locations across the Survey Area (as shown in Figure 9), for one night each. The Pilbara Leaf-nosed Bat was not recorded using this detector, nor was any suitable habitat for the species identified within the Survey Area. The Pilbara Leaf-nosed Bat has not been recorded in the Mid-West region, and the closest record of the species is located 250 km north of the Survey Area in 1999.

Great Desert Skink (*Liopholis kintorei*)

The Great Desert Skink is classified as Vulnerable under the EPBC Act and is listed under Schedule 1 of the WC Act (Threatened). The Great Desert Skink generally occurs on red sandplains and sand ridges, and in Western Australia it is typically found at sites dominated by *Triodia basedowii* and *Triodia schinzii* with some *Eremophila leucophylla* shrubs. This species appears to prefer a mosaic landscape of different aged vegetation and inhabit sites that have been burnt in the previous three to fifteen years.

Field assessment – There was no suitable habitat for the Great Desert Skink identified during the field survey within the Survey Area and no evidence of the species was recorded. The nearest record of the species is located 100 km south-east of Wiluna from 1964.

Western Spiny-tailed Skink (*Egernia stokesii badia*)

The Western Spiny-tailed Skink is listed as Endangered under the EPBC Act and under Schedule 1 of the WC Act (Threatened). The Western Spiny-tailed Skink occurs in open eucalypt woodlands and Acacia-dominated shrublands in semi-arid to arid areas of south-western Western Australia. The 'black form' populations of this species occur in granite outcrops and lateritic breakaways in the Cue-Yalgoo-Mt Magnet region. Individuals of the 'black form' live on granite outcrops and ironstone breakaways and shelters in horizontal crevices and under boulders (DotE 2013f).

Field assessment – There is very limited suitable habitat for the Western Spiny-tailed Skink within the Survey Area, and no evidence of this species was recorded during active searches of rocky habitats.

2.8.7 Introduced fauna

Seven introduced species were recorded during the field assessment, including European Rabbits (*Oryctolagus cuniculus*), domestic cattle (*Bos taurus*), feral cats (*Felis catus*), feral dogs (*Canis lupus*), goats (*Capra hircus*), camels (*Camelus dromedarius*) and the House Mouse (*Mus musculus*).

Evidence of feral cats was recorded throughout the Survey Area during the field survey and one cat was recorded on one of the motion sensor camera traps (Camera 6). Feral dogs are also known to occur in the region, and together with feral cats, both of these predatory species are likely to have a significant impact on the native fauna occurring within the area.

Domestic cattle were also present, with evidence of this species throughout the majority of the Survey Area. Domestic cattle disturbance represents one of the major disturbances to the Survey Area, particularly in areas where they congregate such as well-marked cattle tracks and around water sources.

650,000 655,000 660,000 665,000

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Fauna Legend

Conservation Significant Fauna (GHD)

- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Conservation Significant Fauna (DPaW)

(Type, Conservation Code)

- MAMMAL, 4

Survey Locations

- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type

- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
- Chenopod shrubland
- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

Great Northern Hwy
Main St
High St
Hill St
Daniel St
Railway St
Campbell Rd
Mecleary St
Meekatharra-Sandstone Rd
Murchison Downs Rd
Goldfields Hwy
Camera 1
793 792 791 790 789 788 787 786 785 784 783 782 781 780 779 778 777 776 775

1:50,000 (at A3)

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 1 of 11

Figure 9

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Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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670,000 675,000 680,000 685,000

7,065,000

7,060,000

Fauna Legend

Conservation Significant Fauna (GHD)

- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Survey Locations

- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type

- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
- Chenopod shrubland
- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

753 754 755 756 757 758 759 760 761 762 763 765 766 767 768 769 770 771 772 773 774

Goldfields Hwy

Camera 2

1:50,000 (at A3)

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 2 of 11

Figure 9

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Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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Fauna Legend

Conservation Significant Fauna (GHD)
- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Survey Locations
- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type
- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
- Chenopod shrubland
- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

Camera 9
Camera 8
Camera 6
Camera 7
Camera 5
Camera 4
Camera 3
731
732
734
735
736
737
738
739
740
741
742
744
745
746
747
748
749
750
751
752
Goldfields Hwy

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND
- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 3 of 11

Figure 9

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239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

710,000 715,000 720,000 725,000

7,080,000

7,075,000

7,070,000

Fauna Legend

Conservation Significant Fauna (GHD)
- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Survey Locations
- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type
- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
- Chenopod shrubland
- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

Camera 10

730 729 728 727 726 725 724 723 722 721 720 719 718 717 716 715 714 713 712 711

Goldfields Hwy

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND
- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number 61-30097
Revision 0
Date 17 Sep 2014

Sheet 4 of 11

Fauna habitat, conservation significant fauna locations and survey locations

Figure 9

G:\61\30097\GIS\Maps\MXD\6130097_G009_Fig9_Rev0.mxd

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

239 Adelaide Terrace Perth WA 6004 Australia **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

730,000 735,000 740,000 745,000

7,075,000 7,070,000

Elliot 1
Camera 12
Elliot 4
Elliot 3
Camera 15
Goldfields Hwy
Camera 13
Camera 14
Elliot 2
Camera 16
Diamond

710 709 708 Camera 11 706 705 704 703 Goldfields Hwy 701 700 699 697 696 695 694 693 692 691

Elliot 1
Elliot 3
Camera 15
Elliot 4
Camera 12
Camera 14
Camera 13
Elliot 2
Camera 16

Fauna Legend

Conservation Significant Fauna (GHD)
- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Conservation Significant Fauna (DPaW)
(Type, Conservation Code)
- BIRD, T

Survey Locations
- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type
- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
- Chenopod shrubland
- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND
- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
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Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 5 of 11

Figure 9

G:\61\30097\GIS\Maps\MXD\6130097_G009_Fig9_Rev0.mxd

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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750,000 755,000 760,000 765,000

7,075,000

7,070,000

7,065,000

Fauna Legend

Conservation Significant Fauna (GHD)

- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Conservation Significant Fauna (DPaW)

(Type, Conservation Code)

- BIRD, S

Survey Locations

- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type

- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
- Chenopod shrubland
- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

690 689 688 687 686 685 684 683 682 681 Goldfields Hwy 679 678 677 676 675 674 673 672 671

Camera 17

Camera 18

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 6 of 11

Figure 9

G:\61\30097\GIS\Maps\MXD\6130097_G009_Fig9_Rev0.mxd

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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770,000 775,000 780,000 785,000

7,070,000

7,065,000

Paroo Rd

Goldfields Hwy

Elliot 6
Camera 20
Elliot 5

670 669 Camera 19 668 667 666 665 664 663 662 661 659 658 657 656 655 654 Elliot 6 653 Camera 20 652 651 650

Elliot 5

Fauna Legend

Conservation Significant Fauna (GHD)
- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Survey Locations
- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type
- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
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- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND
- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 7 of 11

Figure 9

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Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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790,000 795,000 800,000 805,000

7,065,000 7,060,000 7,055,000

Fauna Legend

Conservation Significant Fauna (GHD)
- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Survey Locations
- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type
- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
- Chenopod shrubland
- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

649 648 647 646 Camera 21 645 644 643 642 641 640 639 638 637 636 Camera 22 635 Goldfields Hwy 633 632 631 630 629 628 627 Camera 23 Camera 24

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND
- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 2 3 4 5 6 7 8 9 10 11 MEEKATHARRA WILUNA

GHD mainroads WESTERN AUSTRALIA powered by SLIP ENABLER

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 8 of 11

Figure 9

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239 Adelaide Terrace Perth WA 6004 Australia **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

Fauna Legend

Conservation Significant Fauna (GHD)
- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Conservation Significant Fauna (DPaW)
(Type, Conservation Code)
- BIRD, 4
- BIRD, IA
- MAMMAL, 4
- MAMMAL, T

Survey Locations
- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type
- Acacia shrubland over hummock grasses
- Acacia shrubland over tussock grasses
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- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

810,000 815,000 820,000 825,000

7,060,000 7,055,000 7,050,000

Goldfields Hwy

Wiluna North Rd

Wongawol Rd

Village Rd

Forrest St

Wotton St

Lennon St

Scoria St

626 625 624 623 622 621 618 617 616 615 614 613 612 611 610 609 607

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND
- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

Locality Map

1 MEEKATHARRA 2 3 4 5 6 7 8 9 WILUNA 10 11

GHD mainroads WESTERN AUSTRALIA powered by SLIP ENABLER

Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 9 of 11

Figure 9

G:\61\30097\GIS\Maps\MXD\6130097_G009_Fig9_Rev0.mxd

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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750,000 755,000 760,000 765,000

7,060,000

7,055,000

Fauna Legend

Conservation Significant Fauna (GHD)
- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
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Fauna Habitat Type
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- Cleared/Highly disturbed
- Eucalyptus/Corymbia woodland
- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

750,000 755,000 760,000 765,000

1:50,000 (at A3)

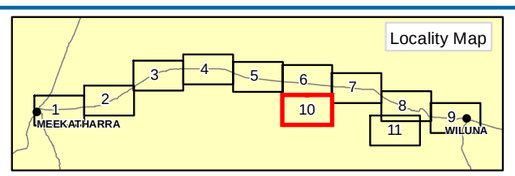
0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND
- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area



Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 10 of 11

Figure 9

G:\61\30097\GIS\Maps\MXD\6130097_G009_Fig9_Rev0.mxd

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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785,000 790,000 795,000 800,000

7,055,000

7,050,000

7,045,000

Fauna Legend

Conservation Significant Fauna (GHD)

- Active Mulgara burrow
- Mulgara prints
- Mulgara scat
- Old Mulgara burrow
- Australian Bustard prints
- Old Malleefowl mound

Conservation Significant Fauna (DPaW)
(Type, Conservation Code)

- MAMMAL, T

Survey Locations

- Bat Detection Sites
- Elliot Trap Lines
- Camera Trap Locations
- Elliot Trap Lines
- Bilby Search Areas

Fauna Habitat Type

- Acacia shrubland over hummock grasses
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- Mixed shrubland
- Previously cleared/regrowth
- Rocky outcrops, breakaways and BIF hills
- Tussock grassland

785,000 790,000 795,000 800,000

1:50,000 (at A3)

0 0.5 1 1.5 2 2.5

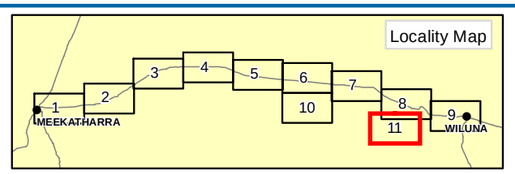
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

- SLK Marker
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area



Main Roads Western Australia
Goldfields Highway Wiluna to Meekatharra
EIA & EMP

Job Number	61-30097
Revision	0
Date	17 Sep 2014

Fauna habitat, conservation significant fauna locations and survey locations

Sheet 11 of 11

Figure 9

G:\61\30097\GIS\Maps\MXD\6130097_G009_Fig9_Rev0.mxd

Data source: GA: Mainlands, Roads, Localities - 2007; Landgate: Roads - 20140611, Mooloogool 2006 Mosaic - 20131121, Gabanintha 2006 Mosaic - 20131121, Mount Bartle 2006 Mosaic - 20131121, Yaganoo 2006 Mosaic - 20131121; MRWA: SLK - 20131219; DPaW: Conservation Significant Fauna; GHD: Camera Trap Locations - 20140618, Additional Conservation Significant Fauna - 20140612, Study Area, Impact Area - 20140617. Created by: bflorczak

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2.9 Land vesting and existing use

2.9.1 Pastoral lease

The Survey Area traverses a number of different land tenures including leasehold for pastoralism, leasehold for conservation and road reserve. The Survey Area intersects six pastoral leases, including Millbillillie, Lake Way, Paroo, Mooloogool, Killara and Sherwood. The dominant landuse on these leases is livestock (cattle) grazing of native pastures.

In a number of areas the existing road is not within the road reserve, this is assumed to be related to errors in mapping accuracy in the past.

2.9.2 Conservation areas

The Survey Area does not intersect any conservation reserves. However, Mooloogool pastoral station, which was relinquished to DPaW and destocked in the early 2000's is a proposed conservation area. Mooloogool Station holds no reservation status at this time.

2.10 Environmentally Sensitive Areas

A search of the Department of Environment and Regulation (DER) (was DEC) Native Vegetation Viewer (DEC 2013c) did not identify any ESAs within the Survey Area.

The Native Vegetation Map Viewer (DEC 2013c) indicates that the Survey Area intersects three areas that are listed as Schedule 1 areas. Under Schedule 1 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* low impact mineral and petroleum activities may be exempt from requiring a clearing permit in certain areas. The Schedule 1 areas identified in the Native Vegetation Map Viewer area areas where the regulations do not apply. Two of these areas are located within Meekatharra and Wiluna and one occurs in the central part of the Survey Area (part of Lot 143, Shire of Meekatharra).

670,000 715,000 760,000 805,000

7,080,000

7,035,000

KARALUNDI
Buttah Rd
Mooloogool Rd
Munarra Rd
Great Northern Hwy
Diamond Well-Doolgunna Rd
Paroo Rd
Wiluna North Rd
Goldfields Hwy
MEEKATHARRA
WILUNA
Murchison Downs Rd
Meekatharra-Sandstone Rd
Hillview-Murchison Downs Rd
Nannine-Polelle Rd
Young Downs Rd
Sandstone-Wiluna Rd
Yeelirrie Rd
Meekatharra-Yeelirrie Rd

1: 450,000 (at A3)

0 5 10 15 20 25

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

LEGEND

- Localities
- Highway
- Minor Road
- Track
- Impact Area
- Survey Area

DPaW Managed Land & Waters (DPaW 2014)

- Former Leasehold

European Heritage (State Heritage Office 2013)

- Permanent Heritage Site

Main Roads Western Australia
EIA and EMP for
Goldfields Highway Project

Job Number	61-30097
Revision	0
Date	16 Sep 2014

Landuse and Heritage

Figure 10

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Data source: GA: Localities; SHO: European Heritage 2013; DPaW: Managed Land & Waters, 2014; Landgate: Virtual Mosaic, Roads - 20140611; GHD: Study Area, Impact Area - 20140617. Created by: ES

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2.11 Contamination

A search of the DER Contaminated Sites database (DPaW 2013a) indicated that no recorded contaminated sites or potentially contaminated sites occur within the Survey Area.

There are two contaminated sites located in the Meekatharra town site and one in the Wiluna town site; however these sites occur outside the Survey Area. The land use of the Survey Area has predominantly been low intensity grazing, therefore the likelihood of contamination for this land use is low.

2.12 Visual Amenity

There is limited topographic relief in the Survey Area which predominantly consists of low undulating plains and low rocky hills and outcrops. The existing amenity of the Study Area comprises of pastoral lands and landscape features such as low outcrops. There are limited residences within the Survey Area that would be affected by the visual amenity of the road. However, residences occur within 300 to 400 m of the road within the town of Meekatharra and at the homestead of Mt Russell Waters, which was recorded during the field survey at SLK 661. The visual amenity of the Survey Area would be likely appreciated by road users, which includes tourist traffic.

2.13 Air quality and dust

There is no publicly available air quality monitoring data for the Study Area. No air quality monitoring has been carried out as part of this assessment. There is likely to be minimal pollution (other than dust) due to the regional nature (dominated by pastoral use) and low traffic volumes.

Dust is likely to be measureable in the area, which is typical of regional areas.

2.14 Noise and vibration

Noise monitoring has not been undertaken and therefore there is no quantitative information available with respect to the existing noise environment. The regional aspect of the Study Area and low traffic volumes suggest that noise and vibration in the area would be minimal.

2.15 Heritage (non-indigenous)

2.15.1 World heritage

A search of the EPBC Act PSMT database (DotE 2013d) did not identify any World Heritage Properties within the Survey Area.

2.15.2 National heritage

The National Heritage List is a list of natural, historic and Indigenous places that are of outstanding national heritage value to the Australian nation. No national heritage-listed places were identified within the Survey Area.

2.15.3 Commonwealth heritage

The Commonwealth Heritage List is a list of natural, indigenous and historic heritage places owned or controlled by the Australian Government. No Commonwealth heritage-listed places were identified within the Survey Area.

2.15.4 European heritage

A search of the Australian Heritage (DotE 2013e) and the InHerit (GoWA 2013a) databases did not identify any heritage sites within the Survey Area.

There are five heritage sites in close proximity to the Survey Area (Table 13).

Table 13 Heritage sites in close proximity to the Survey Area

Site name	Place ID/no.	Database	Location	Distance from Survey Area
Canning Stock Route (former)	Place ID 18153	Australian Heritage - Indicative Place	Eight kilometre wide strip of land running from Wiluna 1,867 km north-east to Billiluna Station near Lake Gregory, 169 km south-east of Halls Creek	One kilometre north east of the eastern end of the Survey Area
Old Courthouse	Place ID 10829	Australian Heritage - Registered Place	Darlot Street, Meekatharra	350 m south of the Survey Area
Wiluna District Hospital Group	Place no 3635	InHerit - State Registered Place	Scotia Street, Wiluna	1.7 km east of the eastern end of the Survey Area
Mine Manager's House	Place no. 5507	InHerit - State Registered Place	2 km south east of Wiluna	3.7 km south east of the eastern end of the Survey Area
Masonic Lodge	Place no. 1530	InHerit - State Registered Place	Corner of Darlot and Savage Streets Meekatharra	360 m south of the Survey Area
Presbyterian Church	Place no. 1529	InHerit - State Registered Place	Darlot Street, Meekatharra	350 m south of the Survey Area