Appendix A

Low Impact Environmental Screening Checklist

Form No. 6707/001/01

Checklist - Low Impact Screening Checklist

The Low Impact Screening Checklist is part of the environmental assessment and approval process, refer to in Figure 2 in the Main Roads environmental guideline Environment Assessment and Approvals. It should be noted that the checklist does not address Aboriginal heritage issues. Please refer to Main Roads guideline *Aboriginal Heritage* for the heritage assessment process.

All projects are to be screened to identify those that are Low Impact.

Projects that have "No" to **all** items are classed as Low Impact and should be implemented using standard contract clauses in the Tender Document Process.
Projects that have "Yes" to **any** item will require further environmental assessment and will be implemented using an Environmental Management Plan.
Tick "Yes" or "No" for every item.

Project Name Atlas Mt Dove DSO Project – Great Northern Highway Intersection Improvement Works .....

ITEM NO.	ITEM	Y	N
1	New road or road reserve to be created or expansion of existing road reserve.	X	
2	Works require clearing of native vegetation outside the maintenance zone.	X	
3	Works require clearing of native vegetation that is older than 10 years old within the maintenance zone.	X	
4	Works to occur outside normal working hours.		X
5	Passes over, adjoins or drains directly into a wetland or sensitive watercourse.		X
6	Local natural drainage regime / hydrology will be changed.		X
7	Dewatering, or a new water bore required.		X
8	Known potential source of hazardous materials within or adjoining project area. e.g. Acid Sulphate Soils, existing petrol station, industrial site or waste disposal site (landfill)		X
9	Buildings will require demolition.		X

Completed By:

Signature _____ *Date* 29-10-12

Name Brendan Bow *Title* Enviro Approvals Manager

To be reviewed by a Main Roads Environment Officer

Signature _____ *Date* 29/10/12

Name Fiona van Ryneveld *Title* Envirn Officer (MRWA)

Comments:

Appendix B

Flora and Vegetation Assessment (Woodman 2011)

ATLAS IRON LIMITED

MOUNT DOVE DIRECT SHIPPING ORE PROJECT

FLORA AND VEGETATION STUDIES

JULY 2011

woodmanenvironmentalconsulting

A.C.N. 088 055 903

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0	Final Report	DC/CG	DC	11/02/2011	Clinton Van Den Bergh	18/02/2011
1	Final Report with additional change	DC/CG	DC	18/02/2011		
2	Final Report with revised impact assessment	DC/CG	KK	18/07/2011		

Reference: Atlas10-19-01

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EXECUTIVE SUMMARY

Atlas Iron Limited (Atlas) has proposed the Mount Dove Direct Shipping Ore (DSO) Project („the Project"). The Project includes the development of a 2.5 million-tonne iron ore resource, and associated infrastructure, located approximately 68 km south of Port Hedland, approximately 13.5 km west of the Great Northern Highway. As part of the Environmental Impact Assessment (EIA) process for the Project, Atlas commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a flora and vegetation survey and impact assessment of the Mount Dove Study Area („study area"). This flora and vegetation survey is a Level 2 survey as defined by the Environmental Protection Authority"s (EPA) Guidance Statement No. 51 (EPA 2004). A Level 2 survey consists of a background research/desktop study and reconnaissance survey, followed by either a detailed/ comprehensive survey of the study area, and is considered to be the appropriate level of survey for the Project.

Fieldwork for the detailed survey was conducted by experienced botanists from the 14th to 23rd of June 2010. The Study area was traversed by vehicle and on foot using all available tracks and roads, with a total of 49 non-permanent quadrats measuring 50 m x 50 m established within the study area. These quadrats were established in all vegetation types identified following interpretation of aerial photography, with particular focus on areas of proposed impact, including pits, waste dumps and the proposed camp. Additional flora taxa were also recorded opportunistically via a search around the general vicinity of each quadrat, and during traverses on foot between quadrats. Survey for conservation-significant flora and introduced flora was also undertaken. Targeted searches for conservation-significant flora were undertaken within areas of proposed disturbance footprints, with the areas traversed on foot via a series of transects. Significant flora searching was also conducted while undertaking survey of quadrats, including while traversing between quadrats. Survey for introduced flora was also conducted while undertaking targeted conservation-significant flora searches.

A total of 90 discreet vascular flora taxa and 1 known hybrid, from 24 families and 52 genera, were recorded from within the study area. The most well-represented families were Fabaceae (23 discreet taxa and 2 putative hybrids), Poaceae (13 discreet taxa) and Malvaceae (9 discreet taxa). No DRF taxa were recorded within the study area, however one Priority flora taxon, *Heliotropium muticum* (P1), was recorded. Two introduced (weed) taxa were recorded within the study area: *Aerva javanica* (kapok) and *Cenchrus ciliaris* (buffel grass).

Five Floristic Community Types (FCTs) were defined in the study area, which comprise 2 super-groups. One FCT was divided further in 2 sub-types, however one sub-type did not occur in the study area. The split between the two super-groups based primarily on topographical location, and hence associated soil types, within the study area, with distinct differences in species composition between the super-groups. Super-group 1 is comprised of FCTs 1, 2 and 3, and was mapped on flat plains and lower slopes, generally with sandy loam soils and little or no surface stones. Super-group 2 is comprised of FCTs 4 and 5, with 5 being divided into 2 subtypes. It was generally mapped on rocky or stony areas, including hill slopes and crests. No FCTs within the study area are equivalent to any listed Threatened Ecological Communities or Priority Ecological Communities. Several FCTs were ranked as being of local conservation significance because of their limited extent in the study area, with FCT 5a considered to be the most

significant FCT. The condition of the majority of vegetation was ranked „Excellent‟ or „Very Good‟ over the vast majority of the study area. The vegetation on the upper slopes and summit of Mount Dove were ranked as „Good‟, because the invasive weed *Aerva javanica* (Kapok) has established as a dominant component of the shrub layer in this vegetation.

The Priority flora taxon *Heliotropium muticum* (P1) will not be directly impacted by the Project. It is considered that this taxon may be indirectly impacted through loss of potential habitat and soil-stored seed, as areas of FCT 2 in the vicinity of known locations will be cleared; however any potential impacts are not considered significant. Known locations of the introduced taxa recorded in the study area, *Aerva javanica* and *Cenchrus ciliaris,* will be impacted by the Project. This may result in the spread of these taxa within the study area through the removal and transportation of topsoil.

A total of 219 ha of vegetation is proposed to be impacted by the Project. The level of impact to FCTs 1, 2, 3 and 4 is considered to be Low, however, there will be a high impact to FCT 5a, with 66.7 % of the extent of this subtype to be impacted. FCT 5a is considered to be equivalent to FCT 16 as described in Atlas‟ Turner River Hub (TRH) Project study area, located just to the east of the study area. TRH FCT 16 is not considered to be of regional conservation significance, and therefore it is considered that FCT 5a is not of regional conservation significance. All other FCTs and subtypes mapped in the study area are also represented in the TRH study area, and are not considered to be of regional conservation significance.

The following recommendations are given:

- The flora and vegetation impact assessment should be updated if the final project infrastructure layout significantly differs from the Project layout displayed on Figure 2.
- Clearing should be minimised as much as practicable (especially in FCT 5a).
- A weed hygiene plan and monitoring programme should be developed and implemented for construction and on-going operations, with actions to include control of weed populations prior to and following ground disturbance, monitoring of disturbed areas, and machinery hygiene.
- Limit dust-creating activities during periods of high wind velocity/duration.
- Prompt rehabilitation of mining areas once mining has ceased, including all pit areas, waste rock dumps and other cleared areas.
- A comprehensive rehabilitation management plan (including a monitoring programme) should be developed and approved by the DEC for the project, including factors such as appropriate management, care of and re-spreading of stockpiled topsoil and vegetation, development of keystone species and appropriate seeding and seeding rates of these, and final landform planning.

1. INTRODUCTION

1.1 Description of Project and Study Area

Atlas Iron Limited (Atlas) currently mine iron ore at their Pardoo (east of Port Hedland) and Wodgina (south of Port Hedland) operations in the Pilbara region of Western Australia, and have several other prospective iron ore prospects to the south and south-east of Port Hedland, including Abydos, Mount Webber and Mount Dove. As part of the development of these prospects into mining operations, Atlas has proposed the Mount Dove Direct Shipping Ore (DSO) Project („the Project"). The Project includes the development of a 2.5 million-tonne iron ore resource, and associated infrastructure, located approximately 68 km south of Port Hedland, approximately 13.5 km west of the Great Northern Highway. The Project is located on Indee pastoral station, on exploration tenement E47/891.

As part of the Environmental Impact Assessment (EIA) process for the Project, Atlas commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a flora and vegetation survey and impact assessment of the Mount Dove Study Area („study area"). This flora and vegetation survey is a Level 2 survey as defined by the Environmental Protection Authority"s (EPA) Guidance Statement No. 51 (EPA 2004). A Level 2 survey consists of a background research/desktop study and reconnaissance survey, followed by either a detailed/ comprehensive survey of the study area, and is considered to be the appropriate level of survey for the Project. The level of survey required has been determined from Table 2 of Guidance Statement No. 51 (EPA 2004), where the Bioregion Group is defined as Group 2, and the nature of the impact is considered to be high. The purpose of the background research/desktop study is to review known information relevant to the study area through all sources of literature available (EPA 2004). The results of the background research/desktop study are presented in Section 2 of this report, with the results of the detailed/comprehensive survey of the study area presented in Section 4.

1.2 Aims

The aim of this survey was to ascertain flora and vegetation values that may be impacted by the Project. This included surveying for Declared Rare Flora (DRF) and Priority Flora taxa that may be present in areas that are proposed to be disturbed by mining activities, as well as undertaking statistical analysis to determine Floristic Community Types (FCTs) present within the study area. The information collected during the survey will assist Atlas in their decision-making with regard to minimising the potential impacts of mining and related activities to the flora and vegetation values of the study area.

The tasks required to meet this aim were:

- Review all existing literature relating to flora, vegetation and other environmental factors relevant to the study area, including relevant State and Federal databases;
- Establish a series of 50 m x 50 m quadrats throughout all discernable plant communities within the study area;
- Undertake statistical analysis to define FCTs within the study area;
- Map the distribution of FCTs within the study area;

- Search for significant flora taxa, including DRF, Priority Flora and introduced taxa that may be present within the study area;
- Provide a report and map detailing FCTs, conservation-significant flora, introduced flora and vegetation condition within the study area;
- Provide an assessment of the impacts of the Project on FCTs and any conservation-significant flora taxa; and
- Identify management measures to minimise the impact of the Project on the flora and vegetation of the study area.

2. BACKGROUND

2.1 Climate

The study area is located within the Pilbara region in the Arid Zone of Western Australia, and is classified as desert because of low, erratic rainfall (Beard 1990). The Pilbara region experiences an arid tropical climate with predominantly summer rainfall (Beard 1990), and is strongly influenced by summer cyclones. The prevalence of such cyclonic events results in the Pilbara receiving slightly higher average annual rainfall (250-300 mm) than the remainder of the Arid Zone.

Figure 1 displays average monthly maximum and minimum temperatures, and average monthly rainfall, recorded for Port Hedland Airport, the nearest meteorological station to the study area (Bureau of Meteorology 2010a; data averaged over 1942 – 2010).

The average daily maximum temperatures at Port Hedland Airport peak in March (36.8°C), however the average temperature is above 36°C for the period November – March (Bureau of Meteorology 2010a). The lowest average minimum temperature is experienced in July. The average annual rainfall for this station is 311.4 mm (Bureau of Meteorology 2010a). Average monthly rainfall peaks in summer, particularly February – March, with rainfall strongly influence by tropical cyclones, which generally form between December to April.

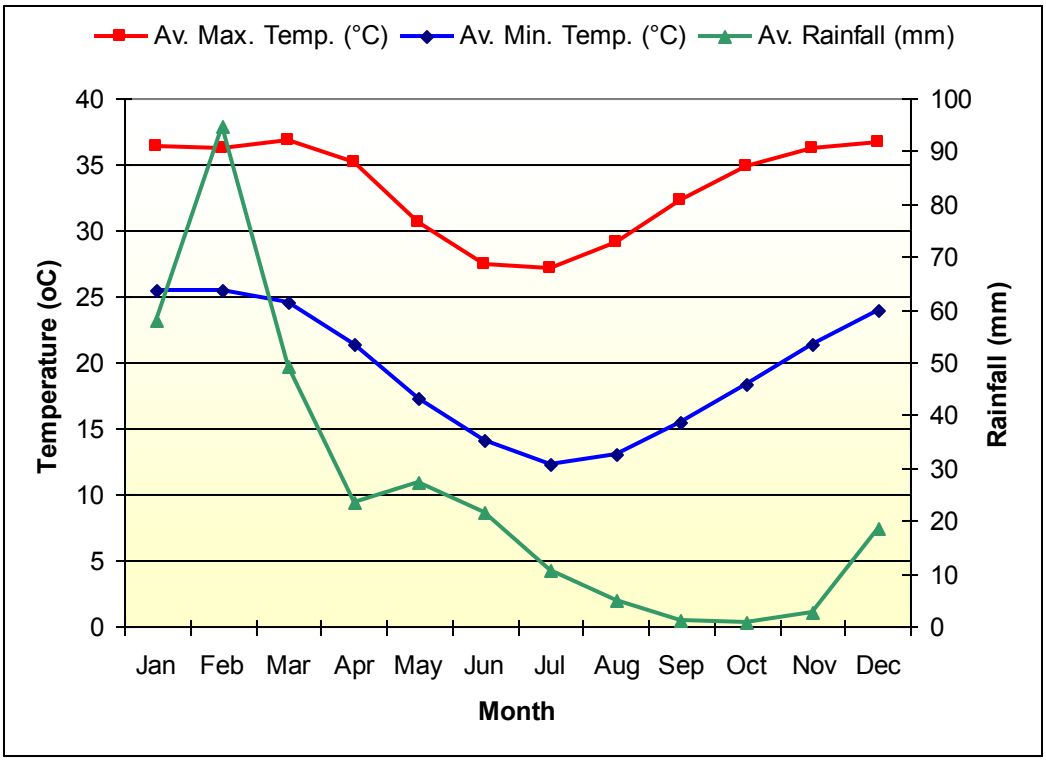

Figure 1: Average maximum and minimum temperatures (° Celsius) and average rainfall (mm) for Port Hedland Airport (Bureau of Meteorology 2010a)

2.2 Soils and Landforms

The study area is located in the Pilbara region (Fortescue Botanical District), which is formed of a basement of Archaean rocks, overlain by massive deposits of Proterozoic sediments and volcanics (Beard 1990). This region is generally mountainous, rising to 1250 m, with hard alkaline red soils on plains and pediments, and shallow and skeletal soils on ranges. The study area traverses one physiographic region: the Abydos Plain (Beard 1975).

The Abydos Plain is alluvial in origin near the coast, however further inland is of Archaean granite origin. It consists of a variety of features including alluvial plains, pediplains, low stony hills and dissected pediments, low granite outcrops and tors, and basic dykes. The main soils are hard alkaline red soils, some areas with coarse textured A horizons to 45 cm thick, while other areas have shallow stony A horizons. Patches of calcrete also occur. On the eastern part of the plain near the De Grey River, the soils are chiefly neutral and acidic red earths. The alluvial plains along the coast generally consist of red earthy sands with extensive areas of red earths, and hard red soils along creek lines (Beard 1975).

Churchward and McArthur (1980) undertook a study of the soil pattern in relation to physiography and geology in the Pilbara region, within two areas: the Strelley catchment (east Pilbara, immediately west of the Shaw River) and the Gorge catchment (west Pilbara). The Strelley catchment is relevant to the study area. In the upland sections, the Strelley catchment

consists of shales, cherts, banded jaspillites, sandstones and basalts, whereas in the downstream section it is composed of granite outcropping or granite at shallow depth, overlain by alluvium.

The uplands of the Strelley catchment were described as extensively and deeply incised and mantled by shallow stony red clay soil, with laterite residuals occurring on the dissected uplands, and as isolated residuals from the plain. The piedmont zone has sediments less than 2 m thick; gravelly and stoney red clays are the most common profiles, with some gravely cracking clays (Churchward and McArthur 1980). The alluvial terrain of this catchment is restricted to narrow zones, eventually widening out to an extensive plain. The pediplains consist of a gently undulating surface, with low local relief, underlain by granite. The most extensive units were described as relatively uniform areas of red earths on gentle convex divides. Eroded margins of pediplains occur extensively, with granite outcrops, quartz and dolerite dykes and pockets of calcrete common. Sandy loam sediments are found on shallow drainage lines, and are laterally continuous with terraces of the main streams (Churchward and McArthur 1980).

2.3 Regional Vegetation and Flora

2.3.1 Regional Vegetation

The study area is located within the north-eastern section of the Pilbara IBRA Region (Interim Biogeographic Regionalisation for Australia) (Government of Australia 2005), specifically within the Pilbara 1 (PIL1) – Chichester subregion.

The Chichester subregion is comprised of undulating Archaean granite and basalt plains, with significant areas of basaltic ranges (Kendrick and McKenzie 2001). Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. The subregion is also extensively used for pastoralism (Kendrick and McKenzie 2001).

The Pilbara IBRA Region is equivalent to the Fortescue Botanical District as defined by Beard (1975), who mapped the vegetation of the Pilbara at a broad scale of 1:1,000,000. The Fortescue Botanical District extends northwards from the *Acacia*-dominated scrub in the south, and is determined by a major biogeographic boundary, the *Acacia-Triodia* line, to the north of which Spinifex vegetation is the characteristic landscape element.

As previously mentioned, the study area is within the Abydos Plain physiographic region, within the Fortescue Botanical District (Beard 1975). The Abydos Plain is characterized by 4 broad associations: Shrub steppe, Dwarf-shrub steppe, Grass plains and the Coastal Complex. Of these, the former three associations are relevant to the study area. Shrub steppe is the main community of the granite plain, which is dominated by the *Acacia pyrifolia-Triodia pungens* association, with hummock grasses dotted widely-spaced shrubs. The plain is broken by stony rises and hills with small ranges, with *Triodia pungens* usually replaced by *T. wiseana*, *T. longiceps* or *T. angusta*, with scattered shrubs. Larger ranges tend to possess little else but *Triodia*, with only a few scattered shrubs. Major creeks and rivers are wooded with *Eucalyptus camaldulensis* and *Melaleuca leucadendron* (considered synonymous with *M. argentea*). Dwarf-shrub steppe occurs on the seaward margin of the granite plain between the Sherlock and Strelley Rivers, with extensive sandplains dominated by dwarf-shrub steppe, where the general cover is

Triodia pungens interspersed with numerous very low shrubs of *Acacia translucens* (considered synonymous with *A. stellaticeps*). Grass plains occur where finer-grained alluvium has been deposited. These are often dominated by a single or a few grass taxa, and the grass community is closed, unlike the open hummock grasslands occurring with shrub steppe and dwarf-shrub steppe.

Shepherd *et al.* (2002) mapped and described vegetation associations related to physiognomy, expanding on mapping undertaken by Beard (1975). Vegetation associations were described at a scale of 1:250,000. The study area is comprised of a single vegetation system association, Abydos Plain 93, as summarised in Table 1. Table 1 also presents the current extent of vegetation association Abydos Plain 93 in relation to pre-European extent, and the extent in Department of Environment and Conservation-managed (DEC) lands, including conservation reserves (DEC 2007a). The current extent of Abydos Plain 93 currently remains at the pre-European extent, however none is formally reserved, with 5.2% currently in DEC managed lands (former leasehold) (Table 1).

Table 1: Extent of Vegetation Association Abydos Plain 93 Within the Study Area (Shepherd *et al.* 2002; DEC 2007a)

Vegetation System Association	Description	Current Extent (ha)	Percentage of Pre-European Extent Remaining	Percentage of Current Extent Reserved in DEC-Managed Lands
Abydos Plain 93	Hummock grasslands, shrub steppe; kanji over soft spinifex	3,044,249	100.0	5.2

In 2004, the Department of Agriculture described vegetation site types within the Pilbara IBRA region considering general ecological information, vegetation physiognomy and composition, patterns of variation, conservation status, gradational association and land system representation (Van Vreeswyk *et al.* 2004). The study area is located within 3 land systems, of which the Uaroo land system dominates (Table 2).

Table 2: Land Systems Located Within the Study Area (Van Vreeswyk *et al.* 2004)

Land System	Mapped Extent (ha)	Description of Land System
Mallina	255,700	Sandy surfaced alluvial plains supporting soft spinifex (and occasionally hard spinifex) grasslands.
Ruth	34,600	Hills and ridges of volcanic and other rocks supporting hard spinifex (occasionally soft spinifex) grasslands.
Uaroo	768,100	Broad sandy plains supporting shrubby hard and soft spinifex grasslands.

The DEC Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC) database was interrogated for information regarding any occurrences of TECs or PECs within or in the immediate vicinity of the study area (DEC 2010a). There are no known occurrences of TECs or PECs within a 50 km radius of the study area. Only two TECs are known from the Pilbara (TEC 46 – Themeda Grasslands and TEC 78 – Ethel Gorge Aquifer

Stygobiont Community), and both are associated with the Hamersley Range area, located over 100 km the south of the study area (DEC 2010e). It is therefore considered highly unlikely that either of these TECs will occur within the study area. Appendix A presents definitions of categories and criteria for TECs and PECs (DEC 2007b).

A search of the Department of Sustainability, Environment, Water, Population and Communities (DoSEWPC) database, with regard to environmental matters of national significance as listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), was performed for the study area (DoSEWPC 2010). The results of this search indicate that no federally-listed threatened ecological communities are known from the study area.

The DEC has undertaken a biodiversity survey of the Pilbara IBRA biogeographic region, with fieldwork conducted over the years 2002-2007 (McKenzie *et al.* 2009). The project sampled various organisms and included 422 terrestrial sites, 98 sites on water bodies and 508 boreholes which were spread across the region. Of the 422 terrestrial sites there were 304 terrestrial biodiversity sample sites (sampling vertebrates, invertebrates and perennial and annual vascular plants), with an additional 118 sites being added subsequently to focus on sampling flora only. One of these sites to focus on sampling flora only was located in relatively close proximity to the study area, on the Great Northern Hwy. The results of the flora and vegetation component of this study are currently being analysed and interpreted, with no results available at this stage.

2.3.2 Regional Flora

The relevant DEC databases, including the Western Australian Herbarium (WAHerb) specimen database, and DEFL database, were interrogated for information regarding conservation significant taxa known from within or in the immediate vicinity of the study area (DEC 2010b). The „Declared Rare and Priority Flora list" was also interrogated, which provides information on taxa known to occur in the general region of the study area. The search area also included the Atlas Turner River Hub Survey Area, which consists of a corridor and associated mining prospects stretching approximately 150 km south-southwest from Port Hedland, and therefore records returned may be up to 100 km from the study area. A total of 16 conservation-significant taxa were returned. A list of these taxa is presented in Appendix B. Appendix C presents definitions of conservation status codes (Smith 2010).

The locations of *Eremophila forrestii* subsp. *viridis* and *Goodenia nuda* returned from this search do not match the locality details as listed on *FloraBase* (DEC 2010c), and are therefore considered to be erroneous records. These taxa are therefore not expected to occur within the study area.

Acacia glaucocaesia and *Tephrosia andrewii* were returned from the database search of the „Declared Rare and Priority Flora list" (regional listing), and have no locations in the immediate vicinity of the study area. *A. glaucocaesia* is known from within 50 km of the study area and therefore may occur in the study area, however the nearest known location of *T. andrewii* is more than 300 km from the study area, and it is therefore unlikely that this taxon will occur in the study area.

No DRF taxa are known to occur in the vicinity of the study area. Only two DRF taxa occur in the Pilbara region: *Lepidium catapycnon* and *Thryptomene wittweri*. *Lepidium catapycnon* occurs on skeletal soils on hillsides, with the nearest location to the study area being

approximately 155 km to the south of the study area. *Thryptomene wittweri* prefers skeletal red stony soils on breakaways and stony creek beds, the nearest known record being approximately 230 km to the south of the study area.

During the search of the Department of Sustainability, Environment, Water, Population and Communities (DoSEWPC) database, it was indicated that no federally-listed (EPBC Act) threatened taxa are known from the study area. However, the search indicated that four significant invasive taxa (or habitat for such taxa) potentially occur within the study area: *Cenchrus ciliaris*, *Parkinsonia aculeata, Prosopis* spp. and *Salvinia molesta*.

P. aculeata, *Prosopis* spp. and *S. molesta* are classified as P1 Declared Plants for the whole of Western Australia under the *Agriculture and Related Resources Protection Act 1976* (Department of Agriculture and Food 2010), meaning movement of plants or their seeds within the state, including on contaminated machinery and produce, is prohibited. These taxa are also P2 Declared Plants for the Town of Port Hedland and East Pilbara municipal districts, where the study area is located. P2 means all plants must be treated to destroy and prevent propagation each year until no plants remain, and that the infested area must be managed in such a way that prevents the spread of seed or plant parts in or on livestock, fodder, grain, vehicles and/or machinery (Department of Agriculture and Food 2010).

P. aculeata, *Prosopis* spp. and *Salvinia molesta* are also listed as Weeds of National Significance (Thorp & Lynch 2000), and are under national management for the purpose of restricting their spread, and eradicating them from parts of Australia.

C. ciliaris is not listed as a Declared Plant in Western Australia (Department of Agriculture and Food 2010) but is considered by the States and Territories to pose a particularly significant threat to biodiversity, as it is well known to be particularly invasive under certain conditions (Hussey *et al.* 1997; DEWHA 2010).

In Western Australia, these four taxa are listed under the then Department of Conservation and Land Management's (CALM) Environmental Weed Strategy for Western Australia (CALM 1999), with *C. ciliaris* and *S. molesta* ranked „High", *P. aculeata* „Moderate" and *Prosopis* spp. „Mild" or „Low" (depending on the individual taxon). This Strategy assesses and ranks environmental weeds in terms of their environmental impact on biodiversity. Each weed taxon was ranked according to three criteria; invasiveness, distribution and environmental impact, and is assigned a score of „High", „Moderate", „Mild" or „Low". Appendix D provides the description of each rating in the Environmental Weed Strategy for Western Australia.

A search of the W.A. Herbarium specimen database for records of introduced taxa recorded within the study area and surrounds was performed using the online tool *NatureMap* (DEC 2010d). A total of 32 introduced taxa were returned, as presented in Appendix E. Of these, the Weed of National Significance and Declared Plant *Parkinsonia aculeata*, and the highly invasive *Cenchrus ciliaris* were returned. Additionally, the Declared Plant *Jatropha gossypiifolia* was also returned. This taxon is classified as P1 for the whole of Western Australia, and is listed as P4 for the Port Hedland and East Pilbara municipal districts, where the study area is located. P4 means that infestations must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery (Department of Agriculture and Food 2010).

2.4 Local Flora and Vegetation

2.4.1 Local Vegetation

Mattiske Consulting Pty Ltd (2000) undertook a flora and vegetation survey and vertebrate fauna desktop review of the Wodgina mining lease, and an associated water pipeline to the former Lynas gold mine, located approximately 20 km south of the study area. A total of 19 plant communities were mapped over the area surveyed, over a wide range of environments including rugged hillslopes near the mine, and extended flats over which the water pipeline route traversed. Hummock Grasslands *of Triodia wiseana*, *Triodia brizoides*, *Triodia angusta* and *Triodia pungens* were the most common communities mapped.

Woodman Environmental (2001) undertook a flora and vegetation survey of a natural gas pipeline route linking the Wodgina minesite to the PEPL (Pilbara Energy Pipeline), a distance of approximately 80 km. This survey area intersects the study area. A total of 19 plant communities were mapped as occurring in the survey area, consisting of Open Woodlands, Shrublands and Hummock Grasslands. The terrain was predominantly flat open plain, with steep rocky hills present in the south of the survey area, and intersected several minor ephemeral drainage lines. Only one of the plant communities mapped was recorded as being locally restricted (S7), and none were recorded as being listed as threatened (Woodman Environmental 2001).

Biota Enviromental Sciences (Biota) and Trudgen (2002) undertook a flora and vegetation survey of the Hope Downs Iron Ore rail and port facility project in 2001, for Hope Downs Management Services. The Biota and Trudgen (2002) survey consisted of a corridor stretching approximately 325 km from Weeli Wolli Creek north of Newman, to Port Hedland. The corridor passes the study area approximately 10 km to the east. Terrestrial vegetation and flora was assessed in 286 permanent 50 m x 50 m quadrats, which were distributed along the rail corridor survey area. A total of 131 vegetation types were mapped over the entire survey area. Vegetation associations were mapped within individual phytogeographic units, with the Abydos Plain unit relevant to the study area. In this unit, 6 main groupings of vegetation types were described: Littoral Vegetation (Shrub Dominated), Sandy Plain Vegetation (Spinifex Dominated), Sandy Plain Vegetation (Shrub Dominated), Stony Plain and Hill Vegetation (Shrub Dominated), Drainage Vegetation (Tree/Shrub Dominated) and Outcrop/Ridge Vegetation. Within these, 71 vegetation associations were recognized.

Biota (2004) undertook a baseline botanical survey of the Fortescue Metals Group port facility at Port Hedland and a connecting railway to the location of the proposed Mindy Mindy iron ore mining operation, located 345km south south-east of Port Headland. The Biota (2004) survey area was located east of the Great Northern Hwy, the closest point to the study area of which was approximately 10km east of the Great Northern Hwy. The survey was undertaken in March and April 2004, with 97 permanent 50 m x 50 m quadrats established. Of the 122 terrestrial vegetation types described by Biota (2004) over the FMG proposed railway survey area, 57 terrestrial vegetation types were mapped by Biota (2004) as occurring within the Abydos Plain region of the survey area. These were further grouped into separate landform types: Littoral

Areas, Sandy Areas, Stony Plains and Hills, Major Creeklines, Minor Creeklines and Floodplains, and Rocky Outcrops.

Outback Ecology Services (2008) undertook a flora and vegetation survey of the Talison Minerals Wodgina Operations Project located approximately 120 km south of Port Hedland, and approximately 30 km south of the study area. The areas surveyed were the Tailings Storage Facility (TSF3) at Wodgina Operations and the Mount Fransico project area, located 20 km south west of this. The survey was undertaken in May 2008 and involved collecting flora and vegetation data by traversing the TSF3 area and part of the Mount Fransico project area. No quadrats were established during this study. A total of four vegetation associations across the Mt Francisco project area and 11 vegetation associations in the TSF3 area were described. The majority of the vegetation surveyed was *Triodia wiseana* hummock grasslands in association with a range of herb and shrub taxa. The vegetation associations were widespread and were considered unlikely to be locally or regionally significant. No TECs were identified during the survey.

Woodman Environmental (2009) undertook a flora and vegetation survey of the Atlas Abydos Direct Shipping Ore (DSO) Project study area, during May and July 2008. This study area is located approximately 20 km south-east of the study area. A total of 77 permanent 50 m x 50 m quadrats were established, concentrating on areas proposed to be impacted by mining and related activities. A total of 13 FCTs with a further three mosaics were described, with the majority of these FCTs consisted of hummock grasslands dominated by *Triodia* taxa, with occasional shrublands and open woodlands. No TECS or PECS were identified in this project area and although the reservation status of each of these vegetation associations is poor, none of the vegetation associations were recognized as restricted. No regional conservation significance rankings could be applied to the FCTs in this study, due to the lack of regional dataset.

Outback Ecology Services (2009) undertook a flora and vegetation survey of the Atlas Iron Wodgina Direct Shipping Ore (DSO) Project located approximately 100 km south of Port Hedland, and 7 km west of the Great Northern Highway. The project is situated approximately 20 km south of the study area. The survey was undertaken in mid-May and mid-July 2009, with 41 50 m x 50 m quadrats established. A total of 12 vegetation communities from eight broad floristic formations were mapped and described by Outback Ecology Services (2009). The broad floristic formations included several communities with *Acacia* woodland/shrubland over mixed *Triodia* hummock grassland, one community with *Grevillea* low open woodland over *Acacia* shrubland over *Triodia* hummock grassland, two communities consisting of *Triodia* hummock grasslands and a *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia* shrubland over *Triodia* hummock grassland. None of these were listed as TECs or PECs.

Woodman Environmental have undertaken a flora and vegetation survey of the Turner River Hub (TRH) Project study area on behalf of Atlas (report in prep.). A total of 646 50 m x 50 m quadrats were established as part of this survey, with data from a total of 831 quadrats statistically analysed. The statistical analysis included data collected by Woodman Environmental during similar projects in the local area to the TRH Project study area, including quadrats established within the Mt Dove study area. A total of 22 FCTs have been mapped and described within the TRH Project study area.

2.4.2 Local Flora

The survey of the Wodgina mining lease by Mattiske Consulting Pty Ltd (2000) recorded a total of 214 plant taxa, from 112 genera and 46 families. The most well-represented families were Poaceae, Papilionaceae and Mimosaceae. No DRF taxa were located during the survey, however two current (as of July 2010) Priority flora taxa were located. These Priority Flora taxa were:

- *Acacia aphanoclada* (P1)
- *Euphorbia inappendiculata* (P3)

A total of 166 plant taxa, from 116 genera and 36 families were recorded by Woodman Environmental (2001) during the survey of the natural gas pipeline route linking the Wodgina minesite to the PEPL. The most well-represented families were Poaceae, Mimosaceae, Papilionaceae, Amaranthaceae and Malvaceae. Two introduced taxa were recorded during the survey: *Aerva javanica* and *Cenchrus ciliaris*. No DRF taxa were recorded on the route, however two current (as of July 2010) Priority Flora taxa were recorded. These were:

- *Euphorbia clementii* (P2)
- *Phyllanthus aridus* (P3)

A total of 763 vascular flora taxa, belonging to 236 genera within 72 families, were recorded along the proposed Hope Downs Iron Ore rail corridor by Biota Environmental and Trudgen (2002). The most well represented families were Poaceae, Papilionaceae, Malvaceae and Mimosaceae. The introduced taxa *Cenchrus setiger, Cucumis melo* subsp. *agrestis, Echinochloa colona*, *Eragrostis minor*, *Euphorbia hirta, Opuntia stricta*, *Sigesbeckia orientalis, Sonchus oleraceus* and *Tridax procumbens* were all recorded in areas in close proximity to the study area. No DRF flora taxa were located during this survey, however 14 current (as of July 2010) Priority flora taxa were recorded. Of these, six Priority flora taxa are located within or in close proximity to the study area. These are listed below:

- *Bulbostylis burbidgeae* (P4)
- *Euphorbia clementii* (P2)
- *Gymnanthera cunninghamii* (P3)
- *Indigofera ixocarpa* (P2)
- *Phyllanthus aridus* (P3)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3)

Biota (2004) recorded a total of 762 vascular flora taxa, from 218 genera within to 69 families, during the survey of the proposed port facility and railway location for FMG. The most well represented families included Poaceae, Papilionaceae, Malvaceae and Mimosaceae. No DRF taxa were recorded during the study. A total of 11 introduced taxa were recorded during the survey, of which *Citrullus colocynthus*, *Datura leichhardtii*, *Malvastrum americanum, Solanum nigrum* and *Stylosanthes hamata* were recorded in areas in close proximity to the study area. There were a number of flora taxa of conservation significance (including Priority flora taxa) recorded along the rail corridor, however only two of these occur within or in close proximity to the study area. These are:

- *Bulbostylis burbidgeae* (P4)
- *Gymnanthera cunninghamii* (P3)

During a Level 1 flora and vegetation survey of proposed drill sites at the Mt Francisco project area, and the TSCF3 area of the Talison Minerals Wodgina Operations Project, Outback Ecology Services (2008) recorded a total of 111 vascular plant taxa, from 69 genera within 36 families, were recorded across both the TSF3 and Mount Fransico study areas. The most dominant families from the survey were Poaceae, Amaranthaceae, Papilionaceae, Malvaceae and Asteraceae. Three introduced taxa were recorded: *Aerva javanica*, *Cenchrus ciliaris* and *Passiflora foetida* subsp. *hispida*. No DRF or Priority flora taxa were located during this survey.

During the Abydos DSO flora and vegetation survey, Woodman Environmental (2009) recorded a total of 278 discrete vascular flora taxa from 118 genera and 47 families were recorded. Five introduced taxa were recorded during this survey: *Aerva javanica*, *Cenchrus ciliaris*, *Citrullus* spp., *Malvastrum americanum* and *Portulaca oleracea*. No DRF taxa were located during this survey, however, two current Priority flora taxa (as of July 2010) and four potentially undescribed taxa were recorded (as listed below).

- *Heliotropium muticum* (P1)
- *Euphorbia clementii* (P2)
- *Abutilon* sp. Nov (now *Abutilon* aff. *hannii*) (potentially undescribed)
- *Pityrodia* sp. Nov (now *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) (recently listed as P1)
- *Eriachne* affin. *festucacea* (potentially undescribed)
- *Senna* affin. *pilocarina* (potentially undescribed)

Pityrodia sp. Nov has recently been given the phrase name *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4), and has been listed as Priority 1.

The survey by Outback Ecology Services (2009) of the Atlas Iron Wodgina Direct Shipping Ore (DSO) Project resulted in a total of 122 vascular plant taxa, from 67 genera within 38 families, being recorded, with Poaceae, Papilionaceae, Mimosaceae and Malvaceae the most dominant families. No DRF taxa were located during this study. The priority flora taxon *Terminalia supranitifolia* (P3) was recorded during the survey; this was a significant range extension for this taxon. The introduced taxon *Aerva javanica* (Kapok bush) was also recorded.

A total of 403 discrete vascular flora taxa, three known hybrids and four putative hybrids have been recorded within the TRH Project study area (report in prep.). This total is inclusive of data collected specifically in the TRH Project study area during 2010, and from quadrats established in the study area during the survey of the Abydos DSO Project study area (Woodman Environmental 2009). A total of 15 conservation significant flora taxa were recorded within the TRH Project study area (as listed below), as well as seven introduced taxa (report in prep.).

- *Abutilon* aff. *hanii* (potentially undescribed)
- *Abutilon pritzelianum* ms (P1)
- *Amaranthus* sp. (potentially undescribed)
- *Bulbostylis burbidgeae* (P4)

- *Eragrostis crateriformis* (P3)
- *Eriachne* aff. *festucacea* (potentially undescribed)
- *Euphorbia clementii* (P2)
- *Gomphrena leptophylla* (P3)
- *Goodenia nuda* (P4)
- *Gymanthera cunninghamii* (P3)
- *Heliotropium muticum* (P1)
- *Indigofera ixocarpa* (P2)
- *Ptilotus mollis* (P4)
- *Tephrosia bidwillii* (P3)
- *Terminalia supranitifolia* (P3)

A summary of the conservation significant flora taxa that are either known within or in the vicinity of the study area is presented in Table 3. This data has been compiled from data presented in Appendix B, and from historical local flora surveys as detailed above. A total of 31 conservation significant flora taxa may occur within the study area.

Table 3: Conservation Significant Flora Taxa Known to Occur Within or in the Vicinity of the Study Area

Note: Yellow shading denotes taxa whose locality details do not match the actual location recorded in the DEC"s Threatened Flora databases.
„**Nearest known population'** are those recorded on NatureMap (DEC 2010d), which may not reflect data reported within the baseline studies referenced.

Taxon	Status	Description	Known Locations
Abutilon pritzelianum	P1	Erect shrub to 2.5 m high, flowers yellow/orange, August. Sand dunes and sand plains	Turner River crossing on Great Northern Highway **Nearest known population:** approximately 35 km to north-west of Mt Dove
Abutilon sp. nov (*Abutilon* aff. *hannii*)	-	Low shrub to 0.3m high, flowers yellow, May. Creeklines	Abydos DSO study area
Acacia aphanoclada	P1	Slender, wispy shrub to 5 m high, flowers yellow, August-October. Rocky hills	Wodgina minesite/water pipeline **Nearest known population**: approximately 190 km to south-east of Mt Dove
Acacia glaucocaesia	P3	Dense shrub or tree to 6 m, flowers yellow, July-September. Floodplains	No locations in immediate vicinity of study area, known from near the Shaw River and Whim Creek **Nearest known population**: approximately 45 km to the west north-west of Mt Dove
Acacia leeuweniana	P1	Tree to 14 m high with minni ritchi bark, flowers yellow, May. Granite outcrops	Obstinate Creek and Woodstock Station **Nearest known population**: approximately 60 km to the south-east and south-west

Taxon	Status	Description	Known Locations
Acacia levata	P3	Spreading shrub to 3 m high, flowers yellow, May. Granite outcrops and hill slopes	Woodstock Station **Nearest known population**: approximately 50 km to the south-east of Mt Dove
Amaranthus sp.	-	-	Turner River Hub Project study area
Bulbostylis burbidgeae	P4	Tufted, erect to spreading annual sedge to 0.25 m high, flowers brown, March/June-August. Outcrops, cliff bases	Abydos/Woodstock Reserve and Lalla Rookh Homestead, FMG Rail Corridor; Hope Downs Railway Corridor **Nearest known population**: approximately 20 km to the west of Mt Dove
Eragrostis crateriformis	P3	Annual grass to 0.4 m	**Nearest known population:** Approximately 100 km to the north-east of Mt Dove
Eremophila forrestii subsp. *viridis*	P3	Shrub to 1 m high, flowers pink/cream, August. Slopes and ridges	Coondewanna Hill, Hamersley Ranges **Nearest known population**: approximately 750 km to the east south-east of Mt Dove
Eriachne aff. *festucacea*	-	Perennial grass to 0.8 m high, flowers green and purple, May. Rocky river channel.	Abydos DSO study area
Euphorbia clementii	P2	Erect herb to 0.6m high, flowers green/white, May-June. Stony ground	Wodgina LNG pipeline, Abydos DSO study area **Nearest known population**: approximately 30 km to the south-east of Mt Dove
Euphorbia inappendiculata	P3	Spreading, procumbent herb to 0.4m. Flowers pink, August. Rocky plains	Wodgina minesite/water pipeline **Nearest known population**: approximately 110 km to the east north-east of Mt Dove
Gomphrena leptophylla	P3	Spreading annual herb to 0.15 m	South of Karratha, Yandeyarra Station, Moolyella Tin Fields (Marble Bar), Christmas Creek Station and between Nerrima Creek and Tutu Bore (Kimberley Region) **Nearest known population**: approximately 50 km to the south south-east of Mt Dove
Gomphrena pusilla	P2	Annual herb to 0.2 m high, flowers white/pink, March-June. Beach foredunes on limestone	Port Hedland townsite and Finucane Island **Nearest known population**: approximately 70 km to the north north-east of Mt Dove.
Goodenia nuda	P4	Erect herb to 0.5 m high, flowers yellow, April-August. Flood plains, drainage lines	FMG Cloudbreak Mine **Nearest known population**: approximately 30 km to the south-east of Mt Dove

Taxon	Status	Description	Known Locations
Gymnanthera cunninghamii	P3	Erect shrub to 2m high, flowers cream/yellow/ green, January-December. Variety of soils	Port Hedland townsite and Boodarie Station, Woodstock Station, FMG Rail Corridor; Hope Downs Railway Corridor **Nearest known population**: approximately 50 km to the south-east of Mt Dove
Heliotropium muticum	P1	Ascending to spreading perennial herb to 0.3m high, flowers white, May – August. Rocky plains	Pippingarra Station; Abydos DSO study area **Nearest known population**: approximately 30 km to the south-east of Mt Dove
Indigofera ixocarpa	P2	Shrub to 1 m high, flowers pink, May. Massive ironstone.	Hope Downs Railway Corridor **Nearest known population**: approximately 180 km to south of Mt Dove
Nicotiana umbratica	P3	Erect annual or short-lived perennial herb to 0.7 m high, flowers white, April – June. Granite outcrops and cliffs	Abydos Station and Woodstock Station **Nearest known population**: approximately 30 km to the south-east of Mt Dove
Phyllanthus aridus	P3	Erect, much branched shrub to 0.25m high, flowers cream/green, May-June. Variety of soils.	Hope Downs Railway Corridor **Nearest known population**: approximately 130 km west south-west of Mt Dove
Pityrodia sp. nov (*Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4))	P1	Erect, woolly shrub to 1.2 m. Rocky creekline	Abydos DSO study area **Nearest known population**: approximately 80 to south-east of Mt Dove
Polymeria distigma	P3	Prostrate trailing herb, flowers pink, July. Sandy areas, plains	Mundabullangana Station **Nearest known population**: approximately 140 km to the north of Mt Dove
Ptilotus mollis	P3	Shrub to 0.5 m	**Nearest known population:** approximately 120 km to the east north-east of Mt Dove
Ptilotus appendiculatus var. *minor*	P1	Prostrate or ascending perennial herb to 0.2 m high, flowers white, September. Floodplain	Boodarie Station **Nearest known population**: approximately 60 km north of Mt Dove
Senna aff. *pilocarina*	-	Erect shrub to 1 m, flowers yellow, July. Rocky outcrop on an upperslope, shaley rocky ground.	Abydos DSO study area
Tephrosia andrewii	P1	Ascending shrub to 0.8 m high, flowers orange, September-October. Sand plains	No locations in vicinity of study area, nearest location near Sandfire Roadhouse **Nearest known population**: approximately 400 km to east north-east (near Sandfire Roadhouse)
Tephrosia bidwillii	P3	Erect shrub to 0.9 m	**Nearest known population**: approximately 50 km east south-east of Mt Dove

Taxon	Status	Description	Known Locations
Tephrosia rosea var. *venulosa*	P1	Erect shrub to 1.7 m high, flowers red/purple, August-September. Sand dunes, creek lines	Finucane Island **Nearest known population**: approximately 40 km north north-east of Mt Dove
Terminalia supranitifolia	P3	Spreading, tangled shrub or tree to 3 m high, flowers green/yellow, May-July. Rock outcrops,cliffs	Wodgina DSO study area **Nearest known population:** approximately 160 km to west of Mt Dove
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Perennial tussock grass to 1.8 m high, flowers brown, August. Plains	Hope Downs Railway Corridor

A summary of the introduced taxa either known within or in the vicinity of the study area are listed in Table 4. This is a combination of results presented in Appendix E and from historical local flora surveys as detailed above.

Table 4: Weed Taxa Known to Occur Within or in the Vicinity of the Study Area

Taxon	Common Name	Comments
Aerva javanica	Kapok Bush	Rated as „High" for priority for control and research (CALM 1999)
Andropogon gayanus	-	-
Argemone ochroleuca subsp. *ochroleuca*	Mexican Poppy	Rated as „Mild" for priority for control and research (CALM 1999)
Bidens bipinnata	Beggartick	-
Cenchrus ciliaris	Buffel Grass	Federally recognized as being highly invasive and pose a significant threat to biodiversity; Rated as „High" for priority for control and research (CALM 1999)
Cenchrus setiger	Birdwood Grass	Rated as „High" for priority for control and research (CALM 1999)
Chloris barbata	Purpletop Chloris	Rated as „Low" for priority for control and research (CALM 1999)
Chloris virgata	Feathertop Rhodes Grass	Rated as „Low" for priority for control and research (CALM 1999)
Citrullus colocynthis	-	Rated as „Low" for priority for control and research (CALM 1999)
Coccinia grandis	-	-
Cucumis melo subsp. *agrestis*	Ulcardo Melon	-
Datura leichhardtii	Native Thornapple	Declared Plant (not listed under any Priority category for Port Hedland and East Pilbara municipal districts including study area); Rated as „Moderate" for priority for control and research (CALM 1999)
Desmodium scorpiurus	-	-
Digitaria ciliaris	Summer Grass	Rated as „Low" for priority for control and research (CALM 1999)
Echinochloa colona	Awnless Barnyard Grass	Rated as „Mild" for priority for control and research (CALM 1999)
Eragrostis minor	Smaller Stinkgrass	Rated as „Low" for priority for control and research (CALM 1999)

Taxon	Common Name	Comments
Euphorbia hirta	Asthma Plant	Rated as „Moderate" for priority for control and research (CALM 1999)
Euphorbia tirucalli	-	Rated as „Low" for priority for control and research (CALM 1999)
Flaveria trinervia	Speedy Weed	-
Gomphrena celosioides	Gomphrena weed	Rated as „Low" for priority for control and research (CALM 1999)
Gossypium hirsutum	Upland Cotton	Rated as „Low" for priority for control and research (CALM 1999)
Indigofera oblongifolia	-	Rated as „Moderate" for priority for control and research (CALM 1999)
Indigofera sessiliflora	-	-
Jatropha gossypiifolia	Bellyache Bush	Declared Plant (P1 for whole of state, P4 for Port Hedland and East Pilbara municipal districts including study area) Rated as „Moderate" for priority for control and research (CALM 1999)
Lamarckia aurea	Goldentop	Rated as „Moderate" for priority for control and research (CALM 1999)-
Leptochloa fusca subsp. *uninervia*	-	-
Leucaena leucocephala	Leucaena	Rated as „Moderate" for priority for control and research (CALM 1999)-
Malvastrum americanum	Spiked Malvastrum	Rated as „Moderate" for priority for control and research (CALM 1999)
Opuntia stricta	Prickly Pear	Declared Plant (P1 for whole of state, P4 for Port Hedland and East Pilbara municipal districts including study area)
Parkinsonia aculeata	Parkinsonia	Weed of National Significance; Declared Plant (P1 for whole of state, P2 for Port Hedland and East Pilbara municipal districts including study area) Rated as „Moderate" for priority for control and research (CALM 1999)
Paspalum fasciculatum	-	Rated as „Low" for priority for control and research (CALM 1999)
Pennisetum setaceum	Fountain Grass	Rated as „Mild" for priority for control and research (CALM 1999)
Portulaca oleracea	Purslane	-
Prosopis spp.	Mesquite	Weeds of National Significance; Declared Plants (P1 for whole of state, P2 for Port Hedland and East Pilbara municipal districts including study area); *P. pallida* and *P. glandulosa* rated as „Mild" and „Low" respectively for priority for control and research (CALM 1999)
Pupalia lappacea	-	Rated as „Mild" for priority for control and research (CALM 1999)
Salvinia molesta	Salvinia	Weed of National Significance; Declared Plant (P1 for whole of state, P2 for Port Hedland and East Pilbara municipal districts including study area); Rated as „High" for priority for control and research (CALM 1999)
Senna occidentalis	-	Rated as „Moderate" for priority for control and research (CALM 1999)
Setaria sphacelata	South African Pigeon Grass	Rated as „Mild" for priority for control and research (CALM 1999)
Setaria verticillata	Whorled Pigeon grass	Rated as „Low" for priority for control and research (CALM 1999)

Taxon	Common Name	Comments
Sigesbeckia orientalis	Indian Weed	Rated as „Moderate" for priority for control and research (CALM 1999)
Solanum nigrum	Black Berry Nightshade	Rated as „Moderate" for priority for control and research (CALM 1999)
Sonchus oleraceus	Common Sowthistle	Rated as „Moderate" for priority for control and research (CALM 1999)
Stylosanthes guianensis	Stylo	Rated as „Mild" for priority for control and research (CALM 1999)
Stylosanthes hamata	Verano Stylo	Rated as „Mild" for priority for control and research (CALM 1999)
Trianthema portulacastrum	Giant Pigweed	Rated as „Moderate" for priority for control and research (CALM 1999)
Tribulus terrestris	Caltrop	-
Tridax procumbens	Tridax	Rated as „Moderate" for priority for control and research (CALM 1999)
Vachellia farnesiana	Mimosa Bush	Rated as „High" for priority for control and research (CALM 1999)

3. METHODS

3.1 Aerial Photography Interpretation

Initial interpretation of vegetation boundaries was conducted with the use of orthorectified aerial photography at a scale of 1:10 000, supplied to Woodman Environmental by Atlas. Preliminary vegetation type boundaries were transcribed onto the aerial photography, to allow for ground-truthing of these boundaries to be conducted in the field. Preliminary quadrat locations were also allocated based on these vegetation type boundaries. A minimum of three quadrats were allocated to each discernable vegetation type where possible; such replication is required for meaningful results to be produced following statistical analysis of quadrat data, and to provide local context for FCT distribution.

3.2 Plant Collecting Licenses

All plant material was collected under the following licences:

Personnel	Flora Collecting Permit	DRF Collecting Permit
David Coultas	SL00 8954	114-0910
Greg Woodman	SL00 8953	110-0910
Kylie Greenacre	SL00 8949	113-0910
Alison Saligari	SL00 8955	-

3.3 Field Survey

3.3.1 Reconnaissance Survey

An initial reconnaissance visit to the study area was conducted by experienced botanists Greg Woodman and David Coultas on the 31st March 2010. This visit served to identify access within the study area and preliminary vegetation boundaries, with opportunistic recordings of conservation-significant flora taxa and introduced (weed) taxa also made. Alterations to preliminary vegetation boundaries were also undertaken if applicable, depending on vegetation types encountered.

3.3.2 Detailed Survey

Fieldwork for the detailed survey was conducted by experienced botanists from the 14th to 23rd of June 2010, which corresponds to the end of the usual peak flowering season in the Pilbara region. The study area was traversed by vehicle and on foot using all available tracks and roads, with a total of 49 non-permanent quadrats measuring 50 m x 50 m established within the study area. These quadrats were established in all vegetation types identified following interpretation of aerial photography and reconnaissance survey, with particular focus on areas of proposed impact, including pits, waste dumps and the proposed camp. The number of quadrats within each identified vegetation type was determined based on the size of the area covered by the plant community and potential species richness of each plant community. Multiple quadrats were established in all identified vegetation types.

It was identified early in the field survey programme that the vegetation type present on the slopes and summit of Mount Dove itself was likely to be limited in extent within the study area, because no other landforms of this type occur within the study area. It was therefore considered desirable to establish additional quadrats on similar nearby landforms, to determine whether this vegetation type occurs elsewhere within the general region. This quadrat data would therefore be included with data from the study area for statistical analysis. An additional 4 quadrats were established on the slopes and summit of similar hills located approximately 10 km to the west of Mount Dove.

All quadrats established were non-permanent, with measuring tapes extended to define the boundary of the quadrat. The quadrats were orientated north-south-east-west where possible, with the bearings of each side recorded for any quadrats that could not be established in this fashion. All vascular taxa that were visually identifiable within each quadrat were recorded, and collected as necessary. At least one reference specimen for each identifiable taxon was collected. The following information was recorded at each quadrat:

- Personnel
- Unique Quadrat Number
- Date of survey
- GPS coordinates (GDA94), and location of where coordinates were recorded
- Quadrat Photograph
- Topography (including landform type and aspect)
- Soil colour and type (including the presence of outcropping and surface stones)
- Vegetation condition (adapted from Keighery 1994; Appendix F)
- Approximate time since fire
- Presence of disturbance (if any)
- Percentage foliage cover (for each taxon); and
- Height (m) (for each taxon, excluding climbers/aerial shrubs)

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

Survey for conservation-significant flora and introduced flora was also undertaken. Targeted searches for conservation-significant flora were undertaken within areas of proposed disturbance footprints, with the areas traversed on foot via a series of transects. If populations of conservation-significant taxa were identified, a representative collection of material was made, and the abundance and spatial distribution (using GPS coordinates) of individuals within each population was recorded. Significant flora searching was also conducted while undertaking survey of quadrats, including while traversing between quadrats. Any populations identified were treated as for populations identified during targeted searches.

Survey for introduced flora was also conducted while undertaking targeted conservation-significant flora searches, and during survey of quadrats, including while traversing between quadrats. Any populations identified were treated as for populations of conservation-significant flora.

The Project layout presented in this report differs from that provided for the purposes of field survey, as such not all areas of the current Project layout have been searched for conservation-significant and introduced flora.

3.4 Plant Collections and Identifications

Specimens of any unknown taxa were collected and pressed for later identification at the Western Australian Herbarium (WAHerb). Identifications were undertaken by experienced Pilbara botanist Sharnya Thomson, with experts in particular families or genera consulted for any specimens considered to be of taxonomic interest. Taxon nomenclature follows *Florabase* (DEC 2010d) with all names checked against the current DEC Max database to ensure their validity. The conservation status of each taxon was checked on *Florabase*, which provides the most up-to-date information regarding the conservation status of flora taxa in Western Australia.

Specimens of interest (DRF and Priority Flora taxa, range extensions of taxa and potential new taxa) will be vouchered at the WAHerb at the conclusion of the Project. Rare Flora Report Forms (RFRF) will be submitted to the DEC for all locations of DRF and Priority Flora taxa.

3.5 Statistical Analysis and Floristic Community Types

Quadrat data only was statistically analysed to aid in the determination of FCTs, using methods similar to those used by Markey & Dillon (2008). Classification and ordination analyses were conducted on a data matrix compiled from the quadrat data, with introduced taxa and opportunistic recordings (i.e. those taxa recorded outside of the quadrat) excluded from the anlaysis. Ephemeral taxa and singletons (taxa recorded only once in the quadrat dataset) were included in the analysis. Various taxa were grouped together within the data matrix for the analysis where taxonomy was unclear or where different infra-taxa were identified within the dataset and not correlated to plant community, landform or soil type. Some taxa were omitted from the analysis as they could not be positively identified because of inadequate material. A list of grouped and omitted taxa is presented in Appendix G.

Pattern analysis was conducted using PATN (V3.03) (Belbin 1989). The Bray-Curtis coefficient was used to generate an association matrix for both the classification and ordination analyses. This association matrix consisted of pairwise coefficients of similarities between quadrats based on floristic data. Agglomerative, hierarchical clustering, using flexible UPGMA (ß=-0.1) was used to generate a taxa and quadrat classification (Sneath and Sokal 1973). A two-way table of the taxa and quadrat matrix was produced, with the matrix sorted into groups generated from the taxa and quadrat classification. The taxa and quadrat classification was used in conjunction with aerial photography interpretation and notes taken during the survey to develop FCT mapping polygon boundaries over the study area.

Indicator species analysis (INDVAL) was conducted using PC-Ord (McCune and Mefford 1999) using the method of Dufrene and Legendre (1997). The INDVAL measures were used to determine the indicator species for each FCT and a Monte Carlo permutation test was used to test for the significance of the indicator species.

FCT descriptions have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003). This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. For the purposes of this report, it is considered that a FCT is equivalent to a NVIS sub-association as described in ESCAVI (2003).

3.6 Assessment of Impacts to Flora and Vegetation

The assessment of impacts of the Project on flora and vegetation within the study area was conducted using the Project layout provided to Woodman Environmental by Atlas on 4th January 2011 (Figure 2). These areas were overlayed on all known locations of conservation-significant flora within the study area, and FCT mapping of the study area (Figure 2). Note that these areas include a disturbance buffer to allow for adjustments in final locations of Project infrastructure.

Calculations using GIS software were undertaken to determine the number of known conservation-significant flora locations to be impacted (if any), and area of each FCT to be impacted.

3.6.1 Significance of Impact on Flora Taxa

The local distribution of a flora taxon is defined as the known distribution within the study area. The regional distribution refers to the known regional distribution of throughout Western Australia, in particular in the Pilbara Region.

Impacts to the local distribution of conservation-significant taxa for the purposes of this assessment have been defined as being „Low", „Moderate" or „High", depending upon the number of known locations or individuals that are proposed to be impacted:

- Low Impact: 25% or less of individuals are proposed to be impacted;
- Moderate Impact: between 25% and 50% of known individuals are proposed to be impacted;
- High Impact: greater than 50% of known individuals are proposed to be impacted.

The significance of impact on the regional distribution of conservation-significant flora taxa depends upon the known range of the taxon throughout the region, in conjunction with previously known records of the taxon either within or in close proximity to the study area.

The significance of impact on the regional distribution of conservation-significant flora taxa depends upon the significance of the local populations to the regional distribution of the taxon, and the level of impact to the taxon at the local level. The significance of the local population/s of the taxon to the regional distribution of the taxon has been determined by Table 5. The overall significance of impact on the regional distribution is then determined using Table 6.

Table 5: Significance of Local Populations to the Overall/Regional Conservation of Taxon

Ranking	Description
High	• Known range of taxon either entirely located within the study area, or within the study area and to a radius of <5km of the study area; and/or • Taxon known from <10 discrete populations, including within the study area; and/or • study area on boundary of known regional distribution
Moderate	• Known range of taxon extends <50km; and/or • Taxon known from >10 discrete populations; and/or • study area may be on boundary of known regional distribution
Low	• Known range of taxa extends >50km; and/or • Taxon known from >20 discrete populations; and/or • study area not on boundary of known regional distribution

Table 6: Matrix of Regional Significance of Impact on Conservation-Significant Taxa

		Local Impact		
		Low	**Moderate**	**High**
Significance of Local Populations to the Overall/Regional Conservation of Taxa	**Low**	Low	Low	Low
	Moderate	Low	Moderate	Moderate-High
	High	Low	Moderate-High	High

3.6.2 Significance of Impact on Vegetation

The local distribution of FCTs refers to the area of each FCT mapped within the study area. No regional information regarding the distribution of FCTs is available for the Pilbara Region; although a regional survey of the Pilbara Region is currently being undertaken by the DEC, no reports detailing FCTs on a regional scale are yet available.

Impacts to the local distribution of FCTs for the purposes of this assessment have also been defined as being of „Low", „Moderate" or „High", depending upon the proportion of the mapped area of each FCT that is proposed to be impacted:

- Low Impact: 25% or less of mapped area is proposed to be impacted;
- Moderate Impact: between 25% and 50% of mapped area is proposed to be impacted;
- High Impact: greater than 50% of mapped area is proposed to be impacted.

The local significance of FCTs can be measured by the extent of the FCT within the local area; the type of landforms they are associated with (and their extent in the local area); and the presence of significant flora taxa that are known from each FCT. For the purposes of this assessment, FCTs with an extent less than 10% of the total study area (5,224 ha or less) are defined as being restricted in the local area, and thus are locally significant. FCTs that contain conservation-significant flora taxa are also considered locally significant. Table 7 presents conservation significance rankings of FCTs in the study area, based on these criteria. A local

conservation significance ranking of „1" is of the least local conservation significance; a local conservation significance ranking of „4" is of the highest local conservation significance.

Table 7: Descriptions of Local Conservation Significance Rankings of Floristic Community Types in the Study Area

Local Conservation Significance Ranking	Description
1	• FCT is widespread through the study area (>10% of mapped area); • No conservation-significant flora known from the FCT
2	• FCT is widespread through the study area (>10% of mapped area); and • Conservation-significant flora known from the FCT
3	• FCT is restricted within the study area (<10% of the mapped area); and • No conservation-significant flora known from the FCT
4	• FCT is restricted within the study area (<10% of mapped area); and • Conservation-significant flora known from the FCT

3.7 Limitations of Survey

Table 8 presents the limitations of the flora and vegetation assessment in accordance with EPA Guidance Statement No. 51 (EPA 2004).

Table 8: Limitations of the Flora and Vegetation Study of the Study Area

Limitation	Impact	Comment
Level of survey.	No	Level 2 Detailed Survey: A reconnaissance survey, which including opportunistic recordings of flora taxa (particularly potentially conservation-significant flora and introduced flora) was undertaken in March, at the beginning of the usual peak flowering season in the Pilbara. A detailed survey was undertaken in June, at the end of the usual peak flowering season in the Pilbara, with replicated quadrats established in each plant community identified over the study area.
Competency/experience of the consultant(s) carrying out the survey.	No	Senior botanists have had experience in conducting similar assessments, including in the Pilbara, with mentoring given to less experienced botanists throughout the survey.
Scope (floral groups that were sampled; some sampling methods not able to be employed because of constraints?)	No	All vascular groups that were present during the reconnaissance and detailed survey were sampled; good foot and vehicle access to most of the study area allowed for appropriate sampling techniques (quadrat establishment, foot transects) to be employed. A portion of the proposed access corridor was difficult to access, with limited sampling in this area.

Limitation	Impact	Comment
Proportion of flora identified, recorded and/or collected.	No	High proportion of perennial vascular taxa recorded based on intensity and method of survey and relative uniformity of vegetation within the study area; moderate proportion of ephemeral vascular taxa recorded based on intensity and method of survey, relative uniformity of vegetation and low rainfall totals prior to survey; all vascular taxa recorded were collected and identified at the W.A. Herbarium
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	No	Sources include databases (DEC, EPBC) and numerous unpublished reports in similar nearby areas. Good contextual information was available including previous local experience of Woodman Environmental.
The proportion of the task achieved and further work which might be needed.	No	Level 2 survey complete, intensity considered to be adequate.
Timing/weather/season/cycle.	No	Reconnaissance survey conducted in March, corresponding with the usual start of the maximum flowering period for the Pilbara. Detailed field survey conducted in June, corresponding with the end of the maximum flowering period for the Pilbara. Flowering season generally considered to be poor, with below-average rainfall over the usual „wet" summer months (December – February)
Disturbances (e.g. fire, flood, accidental human intervention etc.), which affected results of survey.	Yes	Previous fire history of the study area influenced patterns discernible from aerial photography and also existing structure and composition of the vegetation, which affected the survey.
Intensity of survey.	No	Survey intensity adequate to identify floristic and structural groupings of terrestrial flora as required by a Level 2 survey, with replication of quadrats through plant community types and foot searching.
Completeness and mapping reliability.	No	Survey of study area considered complete. Mapping reliability good as high resolution aerial photography was used, 49 quadrats were established, and foot and vehicle transecting was employed, however fire history affected vegetation patterns discernable on aerial photography. Not all areas of proposed disturbance in study area surveyed, however survey considered adequate because of uniformity of vegetation.
Resources and experience of personnel.	No	Adequate resources including experienced field personnel and taxonomists with appropriate expertise in Pilbara flora were utilised.
Remoteness and/or access problems.	Yes - partial	Access to the study area was considered adequate, however limited sampling was undertaken in the central section of the study area (where the proposed access track heading south-west from the Great Northern Highway is located) due to lack of tracks..

4. RESULTS

4.1 Flora of the Study Area

4.1.1 Census of Vascular Flora

A total of 90 discreet vascular flora taxa and 1 known hybrid, from 24 families and 52 genera, were recorded from within the study area. The most well-represented families were Fabaceae (23 discreet taxa and 2 putative hybrids), Poaceae (13 discreet taxa) and Malvaceae (9 discreet taxa). Average species richness per quadrat was 11.4 (±4.0); the greatest number of taxa recorded in a single quadrat was 22, with 3 taxa the lowest number. Appendix H presents a list of all vascular plant taxa recorded in the study area. This list also includes taxa recorded within the four additional quadrats established outside the study area, however no taxa additional to those recorded within the study area were recorded within these quadrats. Appendix I presents a list of attributes for each quadrat, including locality, topography and soil information, and quadrat observation data. Appendix J and Figure 3 present quadrat locations and locations of conservation significant and introduced flora.

4.1.2 Conservation Significant Flora

No DRF taxa were recorded within the study area, however one Priority flora taxon, *Heliotropium muticum* (P1), was recorded. *H. muticum* is a relatively spindly, spreading, perennial herb growing to a height of 0.3 m (DEC 2010c) (Plate 1). This taxon has a relatively restricted distribution in Western Australia, and is known from only seven records within the Pilbara Region, all in the vicinity of the Port Hedland – Whim Creek area (DEC 2010d), with a range of approximately 120 km. However, this taxon was recorded from a total of 56 locations in the nearby Atlas Turner River Hub Survey Area during 2010 (Woodman Environmental report in prep.), and was also recorded at Abydos (Woodman Environmental 2009). It appears to prefer sandy or loamy plains, occasionally with granite outcropping. It also appears to be a short-lived taxon, with recent surveys in the vicinity of the study area recording this taxon almost exclusively in areas that had been recently (<5 years previous) burnt (Woodman Environmental in prep.).

This taxon was recorded within two quadrats in the study area, with further targeted searching resulting in 11 point locations being recorded (Figure 3). A total of 40 individuals were recorded. All locations were on red sandy loam on flats within FCT 2 (see section 4.2), with the vegetation noted as being burnt approximately three years previously. This population has a Moderate conservation significance in terms of its regional distribution (Table 5). Appendix C provides definitions of conservation status codes in Western Australia (Smith 2010). Appendix J presents GPS locations of all *H. muticum* individuals recorded within the study area.

Plate 1: ***Heliotropium muticum*** **(P1)**

4.1.3 Introduced Flora

Two introduced (weed) taxa were recorded within the study area: *Aerva javanica* and *Cenchrus ciliaris*. Appendix J presents GPS locations of introduced taxa recorded during the survey.

Aerva javanica (Kapok Bush) is a multi-stemmed, perennial herb to 1.6 m high which prefers sandy soils and is commonly found along drainage lines, sand dunes and floodplains (DEC 2010c) (Plate 2). It has a relatively wide distribution throughout Western Australia and is widespread throughout the Pilbara region (DEC 2010d). It was recorded on the summit and slopes of Mount Dove within two quadrats on skeletal red-brown sandy loam within FCT 5a (see Section 4.2). Further targeted searching to map the distribution of this taxon on Mount Dove resulted in 34 point locations being recorded (Figures 3 & 4), with an estimated total of over 3300 individuals recorded.

Cenchrus ciliaris (Buffel Grass) is a tufted, perennial grass growing to 1.5 m high (Plate 3). It grows on a variety of soil types and is commonly found along road verges, creeklines and river edges (DEC 2010c). This taxon has a wide distribution in pastoral regions where it has been planted as a pastoral grass (Hussey *et. al.* 1997). *C. ciliaris* is widespread throughout Western Australia and has become a naturalised taxon (DEC 2010c). It was recorded on the summit and slopes of Mount Dove within two quadrats on skeletal red-brown sandy loam within FCT 5a (see section 4.2), where only isolated plants were noted (Figures 3 & 4). In addition, this taxon was recorded at three locations outside the study area on nearby hills in FCT 5b (see Section 4.2).

Neither *A. javanica* or *C. ciliaris* are listed as Declared Plants under the *Agriculture and Related Resources Act 1976*) (Department of Agriculture and Food 2010), however *C. ciliaris* is considered by the States and Territories to pose a particularly significant threat to biodiversity, as it is well known to be particularly invasive under certain conditions (Hussey *et al.* 1997; DEWHA 2010).

Plate 2: *Aerva javanica* (Kapok)

Plate 3: *Cenchrus ciliaris* (Buffel Grass)

4.2 Vegetation of the Study Area

4.2.1 Floristic Community Types

Statistical analysis of taxon presence/absence data was performed using 82 vascular taxa. Several taxa were amalgamated because of identification issues resulting from poor available material in the field; these are listed in Appendix G. Dissection of the resultant floristic classification of the 53 quadrats (including four established outside the study area) defined five FCTs, which comprise two super-groups. One FCT was divided further in two sub-types. The split between the two super-groups based primarily on topographical location, and hence associated soil types, within the study area, with distinct differences in species composition between the super-groups.

During examination of the results of the floristic classification, it was discovered that one quadrat had grouped into super-group 1 despite its topographical position on the mid-slope of Mount Dove on rocky soils, which contrasts with the position of all other quadrats in super-group 1 (flat plains and lower slopes). The vegetation in this quadrat had been recently burnt, and difficulty in identifying several dominant taxa occurred because of immaturity of individuals. It is suspected that misidentification has occurred; however, as this issue could not be properly resolved without re-scoring of quadrats at a more favourable time, this quadrat was manually assigned to FCT 4 within supergroup 2 based on topography and soil type.

Appendix K presents a list of vascular plant taxa recorded in each FCT (quadrat data only). Appendix L presents the summary dendrogram of relationships between each quadrat, while Appendix M presents a summary matrix of taxon presence within quadrats. Appendix N presents significant indicator species for each FCT.

Supergroup 1

Super-group 1 is comprised of FCTs 1, 2 and 3, and was mapped on flat plains and lower slopes, generally with sandy loam soils and little or no surface stones. The structure of the vegetation frequently consisted of an open to sparse shrubland over hummock grassland, however occasionally areas of only hummock grassland occurred. The species richness of FCTs within Supergroup 1 ranged from 6.6 ± 1.9 species per quadrat (FCT 1) to 13.7 ± 2.7 species per quadrat (FCT 2) (inclusive of introduced taxa).

The FCTs in super-group 1 are floristically similar, with FCTs 2 and 3 the most closely related, and characterised by higher species richness than FCT 1, particularly from taxon group 2 (Appendix M). FCT 1 appears to occur on slightly wetter floodplains and lower slopes, including in the vicinity of the Turner River, which flows just to the east of the study area, and is was generally dominated by a single spinifex (*Triodia*) taxon (*T. epactia*), which usually prefers wetter sites. FCTs 2 and 3 occur slightly higher in the landscape on dry plains, with FCT 3 only mapped on an outwash area from Mount Dove itself. These FCTs contain a mixture of spinifex species (*T. epactia* and *T. lanigera*). Structurally, FCTs 1 and 2 were very similar, however FCT 2 often possessed emergent low trees. FCT 3 differed structurally from 1 and 2, as it was represented by a hummock grassland only.

FCT 1: Mid Open to Sparse Shrubland of mixed *Acacia* species including *A. inaequilatera*, *A. colei* var. *colei* and *A. ancistrocarpa* over Low Open Shrubland dominated by *Acacia stellaticeps* over Low Hummock Grassland dominated by *Triodia epactia* and/or *T. lanigera* on red sandy loams on lower slopes, flats and plains.

Total Area: 1 431 ha

Percentage of Study Area: 27.4 %

Sampling: 11 Quadrats (MD01, MD02, MD03, MD04, MD05, MD06, MD09, MD10, MD12, MD13, MD20)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Mid Stratum 1	Mid Open to Sparse Shrubland (Shrubs 1-2 m)	*Acacia inaequilatera*, *A. colei* var. *colei; A. ancistrocarpa*
Mid Stratum 2	Low Open Shrubland (Shrubs <1 m)	*Acacia stellaticeps*, *Pluchea tetranthera*, *Sida* sp. Pilbara (A.A. Mitchell PRP 1543)
Lower Stratum	Low Hummock Grassland (Hummock Grasses <0.5 m)	*Triodia epactia*, *Triodia lanigera*

Indicator Taxa: *Acacia stellaticeps*

Landform Types: Plains, Lower Slopes, Minor Basin, Flats

Soil Types: Red sandy loams

FCT 1 was mapped in the north-eastern section of the study area, and also through the central section, on flat plains and lower slopes (Figure 3). The taller shrub layer (mid stratum 1) varied in composition, with *Acacia* taxa generally comprising this layer, however this layer was absent altogether at several quadrats. The lower shrub layer (mid stratum 2) was consistently dominated by *Acacia stellaticeps*. The hummock grass layer (lower stratum) of most quadrats was dominated by *Triodia epactia*, however several were dominated by *Triodia lanigera,* with the two taxa co-dominating at one site (Plate 4).

A total of 23 vascular plant taxa were recorded in quadrats grouped in FCT 1 (Appendix K). No introduced or conservation-significant flora taxa were recorded in this FCT. Species richness per quadrat within FCT 1 was 6.6 ± 1.9. FCT 1 was not dominated by taxa from any particular taxon group (Appendix M). The sole indicator taxon for FCT 1 was *Acacia stellaticeps* (Appendix N), a common and widespread species throughout the Pilbara which generally prefers red sandy soils on plains.

Plate 4: Photograph of FCT 1 (Quadrat MD09)

FCT 2: Low Isolated Trees of *Corymbia zygophylla* or *Corymbia hamersleyana* over Mid Sparse Shrubland of mixed *Acacia* species including *A. ancistrocarpa*, *A. inaequilatera*, *A. sericophylla* and *A. acradenia* over Low Sparse Shrubland of mixed species including *Acacia stellaticeps*, *Pluchea tetranthera*, *Corchorus elachocarpus* and *Sida arenicola* over Low Hummock Grassland dominated by *Triodia lanigera* and/or *Triodia schinzii* on red sandy loams on lower slopes, flats and plains.

Total Area: 3 271 ha

Percentage of Study Area: 62.6 %

Sampling: 23 Quadrats (MD07, MD08, MD11, MD14, MD15, MD16, MD17, MD18, MD19, MD25, MD27, MD28, MD32, MD33, MD35, MD38, MD39, MD40, MD41, MD42, MD47, MD48, MD49)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Upper Stratum 1	Low Isolated Trees	*Corymbia zygophylla, C. hamersleyana*
Mid Stratum 1	Mid Sparse Shrubland (Shrubs 1-2 m)	*Acacia ancistrocarpa, A. inaequilatera*, *A. sericophylla; A. acradenia*
Mid Stratum 2	Low Sparse Shrubland (Shrubs <1 m)	*Acacia stellaticeps*, *Pluchea tetranthera*, *Corchorus elachocarpus, Sida arenicola, Indigofera monophylla, Bonamia rosea, Senna glutinosa* subsp. *glutinosa*
Lower Stratum	Low Hummock Grassland (Hummock Grasses <0.5 m)	*Triodia lanigera, Triodia schinzii*

Indicator Taxa: *Acacia ancistrocarpa, Bonamia linearis*

Landform Types: Plains, Lower Slopes, Flats

Soil Types: Red sandy loams

FCT 2 was mapped over much of the study area, including on the plains and lower slopes surrounding Mount Dove (Figure 3). A tree layer (upper stratum 1) was often present, and always consisted of one of either *Corymbia zygophylla* or *C. hamersleyana*. The taller shrub layer (mid stratum 1) varied in composition between quadrats; *Acacia* taxa generally comprised this layer, with *A. ancistrocarpa* being most commonly recorded. The lower shrub layer (mid stratum 2) was not dominated by any particular taxon and was the most species-diverse layer, however several taxa, including *Acacia stellaticeps*, *Pluchea tetranthera*, *Corchorus elachocarpus* and *Sida arenicola* were consistently present. The hummock grass layer (lower stratum) of most quadrats was dominated by *Triodia lanigera*, however several were co-dominated or dominated by *T. schinzii,* with one unusual quadrat dominated by *T. epactia* (Plate 5).

A total of 54 vascular plant taxa were recorded in quadrats grouped in FCT 2 (Appendix K). No introduced taxa were recorded, however the conservation-significant flora taxon *Heliotropium muticum* (P1) was recorded only in this FCT. Species richness per quadrat within FCT 2 was 13.7 ± 2.7. FCT 2 was dominated by taxa from taxon group 2, with taxon group 7 also well represented (Appendix M). Indicator taxa for FCT 2 were *Acacia ancistrocarpa* and *Bonamia linearis* (Appendix N), both of which are common taxa in the Pilbara on sandy soils on plains.

Plate 5: Photograph of FCT 2 (Quadrat MD16)

FCT 3: Low Sparse Shrubland of mixed species including *Pluchea tetranthera*, *P. ferdinandi-muelleri* and *Acacia* stellaticeps over Low Hummock Grassland of *Triodia lanigera* and *Triodia schinzii* on red sandy loams on lower slopes, flats and plains.

Total Area: 126 ha

Percentage of Study Area: 2.4 %

Sampling: 2 Quadrats (MD36, MD37)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Mid Stratum	Low Sparse Shrubland (Shrubs <1 m)	*Pluchea tetranthera*, *P. ferdinandi-muelleri, Acacia stellaticeps*, *Gossipium australe, Solanum phlomoides,*
Lower Stratum	Low Hummock Grassland (Hummock Grasses <0.5 m)	*Triodia lanigera, Triodia schinzii*

Indicator Taxa: *Gossypium australe, Melaleuca glomerata, Pluchea ferdinandi-muelleri, Pluchea tetranthera, Solanum phlomoides, Triodia lanigera, Triodia schinzii*

Landform Types: Plains, Lower Slopes, Flats

Soil Types: Red sandy loams

FCT 3 was mapped only on an outwash flat to the west of Mount Dove (Figure 3). Only two quadrats grouped into this FCT; floristically it appears to be closely related to FCT 2, however may be influenced to a greater extent by nearby Mount Dove. Because of the low level of sampling in this FCT, the structure of this FCT cannot be described with certainty, however both quadrats consisted of a low shrub layer of mixed taxa (mid stratum) over a hummock grass layer (lower stratum) dominated by *Triodia lanigera* and *T. schinzii* (Plate 6).

A total of 20 vascular plant taxa were recorded in quadrats grouped in FCT 3 (Appendix K). No introduced taxa or conservation-significant flora taxa were recorded in this FCT. Species richness per quadrat within FCT 3 was 10.5 ± 2.1. FCT 3 was dominated by taxa from taxon group 2 and 4, with taxon group 7 also well represented (Appendix M). Indicator taxa for FCT 3 (Appendix N) are all common taxa on sandy plains in the Pilbara.

Plate 6: Photograph of FCT 3 (Quadrat MD37)

Supergroup 2: Sparse Shrublands and Grasslands on mid – upperslopes and crests. The native species richness of FCTs within Supergroup 2 ranged from Low to Moderate (11+-1.8 species per quadrat to 21+-5.7species per quadrat).

Super-group 2 is comprised of FCTs 4 and 5, with FCT 5 being divided into two subtypes. It was generally mapped on rocky or stony areas, including hill slopes and crests. The structure of the vegetation frequently consisted of a mid sparse shrubland over low sparse shrubland over hummock grassland. The species richness of FCTs within Supergroup 2 ranged from 10.4 ± 2.6 species per quadrat (FCT 4) to 19.5 ± 3.5 species per quadrat (FCT 5a).

Topographical position appears to separate the FCTs in super-group 2, with FCT 4 being mapped on low rocky hills and outcrops, as well as the gentle footslopes of Mount Dove. FCT 5 was restricted to the steep upper slopes of Mount Dove and several hills to the west of the study area, and was characterised by taxa from taxon group 1, which contains a number of taxa found only on cliffs and outcrops (Appendix M). FCT 5 was split into subtypes 5a and 5b, with 5a being mapped only on Mount Dove, and 5b only recorded on hills to the west of the study area. FCT 5a was dominated by a different spinifex (*Triodia*) taxa to 5b, with 5b also possessing a mid sparse shrubland layer of *Acacia* taxa, which was not present in 5a.

FCT 4: Mid Sparse Shrubland of mixed species including *Acacia inaequilatera*, *Grevillea wickhamii*, *A. ancistrocarpa* and *A. acradenia* over Low Sparse Shrubland of mixed species including *Corchorus elachocarpus*, *Indigofera monophylla* and *Goodenia stobbsiana* over Low Hummock Grassland of *Triodia epactia*, *Triodia wiseana* or *Triodia lanigera* on shallow stony red-brown sandy loams on slopes and crests of low rises and hills.

Total Area: 375 ha

Percentage of Study Area: 7.2 %

Sampling: 11 Quadrats (MD21, MD22, MD23, MD24, MD26, MD29, MD30, MD31, MD34, MD43, MD46)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Mid Stratum 1	Mid Sparse Shrubland (Shrubs 1-2 m)	*Acacia inaequilatera*, *Grevillea wickhamii*, *A. ancistrocarpa, A. acradenia, Hakea lorea* subsp. *lorea*
Mid Stratum 2	Low Sparse Shrubland (Shrubs <1 m)	*Corchorus elachocarpus*, *Indigofera monophylla*, *Goodenia stobbsiana, Senna notabilis, S. glutinosa* subsp. *x luerssenii*
Lower Stratum	Low Hummock Grassland (Hummock Grasses <0.5 m)	*Triodia epactia, T. wiseana. T. lanigera*

Indicator Taxa: *Heliotropium tenuifolium*

Landform Types: Lower Slopes, Low Hills and Rises, Rocky Plains

Soil Types: Red or red-brown sandy loams with ironstone, quartz and granite stones and outcropping

FCT 4 was mapped on the footslopes of Mount Dove, over a low hill and associated slopes in the central part of the study area, and on several small areas of rocky outcrop or plain (Figure 3). The taller shrub layer (mid stratum 1) consistently possess *Acacia inaequilatera*, however this taxon was usually co-dominant with *Grevillea wickhamii* and other *Acacia* taxa, with *A. ancistrocarpa* being most commonly recorded. The lower shrub layer (mid stratum 2) was not dominated by any particular taxon and was the most species-diverse layer. The hummock grass layer (lower stratum) of most quadrats was dominated by *Triodia epactia*, however several were dominated by *T. wiseana* and/or *Triodia lanigera* (Plate 7).

A total of 45 vascular plant taxa were recorded in quadrats grouped in FCT 4 (Appendix K). No conservation-significant or introduced taxa were recorded in this FCT. Species richness per quadrat within FCT 4 was 10.4 ± 2.6. FCT 4 was dominated by taxa from taxon group 7 (Appendix M). The sole indicator taxon for FCT 1 was *Heliotropium tenuifolium* (Appendix N), a common and widespread taxon throughout the Pilbara which occurs in a variety of habitats (DEC 2010d).

Plate 7: Photograph of FCT 4 (Quadrat MD46)

FCT 5a: Low Sparse Shrubland of mixed species including *Ptilotus obovatus*, *Aerva javanica* and *Capparis spinosa* var. *nummularia* over Low Hummock Grassland of *Triodia epactia* and *Eriachne mucronata* on skeletal red sandy loams over massive ironstone outcropping on mid and upper slopes and crests of hills

Total Area: 21 ha

Percentage of Study Area: 0.4 %

Sampling: 2 Quadrats (MD44, MD45)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Mid Stratum	Low Sparse Shrubland (Shrubs <1 m)	*Ptilotus obovatus*, *Aerva javanica*, *Capparis spinosa* var. *nummularia, Abutilon lepidum, Senna venusta, Solanum phlomoides, Senna glutinosa* subsp. *glutinosa*
Lower Stratum	Low Hummock Grassland (Hummock Grasses <0.5 m)	*Triodia epactia, Eriachne mucronata, Enneapogon lindleyanus, Cymbopogon ambiguus*

Indicator Taxa: *Abutilon lepidum, Capparis spinosa* var. *nummularia*, *Cucumis maderaspatensis, Cymbopogon ambiguus, Enneapogon lindleyanus, Eriachne mucronata, Senna glutinosa* subsp. *glutinosa, Senna venusta*, *Solanum phlomoides*

Landform Types: Upper Slopes, Crests

Soil Types: Skeletal Red sandy loam over massive ironstone

FCT 5a was mapped on the steep upper slopes and crest of Mount Dove only (Figure 3). The shrub layer (mid stratum) consisted of mixed species, including a number of taxa generally restricted to rocky cliffs. The hummock grass layer (lower stratum) was dominated by *Triodia epactia*, however in one quadrat *Eriachne mucronata* was co-dominant (Plate 8).

A total of 28 vascular plant taxa were recorded in quadrats grouped in FCT 5a (Appendix K). No conservation-significant flora taxa were recorded in this subtype, however the introduced taxa *Aerva javanica* and *Cenchrus ciliaris* were recorded, with *Aerva javanica* recorded widely on Mount Dove (Figure 3), and forming a significant component of the shrub layer. Species richness per quadrat within FCT 5a was 19.5 ± 3.5. FCT 5a was dominated by taxa from taxon group 1 (Appendix M). Indicator taxa for FCT 5a (Appendix K) are all common taxa on rocky areas in the Pilbara.

Plate 8: Photograph of FCT 5a (Quadrat MD45)

FCT 5b: Mid Sparse shrubland of *Acacia arida* and *A. inaequilatera* over Low Isolated Shrubs of *Ptilotus obovatus* over Low Hummock and Tussock Grassland of *Triodia wiseana* and *Cenchrus ciliaris* on skeletal red-brown sandy loams over massive ironstone outcropping on mid-upperslopes and crests.

Sampling: 4 Quadrats (MD50, MD51, MD52, 53)

Common taxa recorded within each stratum:

Stratum	Descriptor	Taxa
Mid Stratum 1	Mid Sparse Shrubland (Shrubs 1-2m)	*Acacia arida*, *A. inaequilatera*, *Hakea lorea, Grevillea pyramidalis* subsp. *leucadendron*
Mid Stratum 2	Low Isolated Shrubs (Shrubs <1 m)	*Ptilotus obovatus*, *Senna glutinosa* subsp. *glutinosa, Abutilon lepidum*
Lower Stratum	Low Hummock Grassland (Hummock Grasses <0.5 m)	*Triodia wiseana, Cenchrus ciliaris, Eriachne mucronata, Enneapogon lindleyanus, Cymbopogon ambiguus*

Indicator Taxa: *Acacia arida, Grevillea pyramidalis* subsp. *leucadendron, Triodia wiseana*

Landform Types: Upper Slopes, Crests

Soil Types: Skeletal Red sandy loam over massive ironstone

FCT 5b was recorded on the steep upper slopes and crest of several hills to the west of the study area, however no mapping of the extent of this subtype was undertaken. In contrast to FCT 5a, a mid-height shrub layer (mid stratum) was present in all quadrats, and was co-dominated by *Acacia arida* and *A. inaequilatera*. No such defined low shrub layer existed as for FCT 5a, however isolated low shrubs occurred as a secondary mid stratum, of which *Ptilotus obovatus* was most common. The hummock and tussock grass layer (lower stratum) was dominated by *Triodia wiseana*, as opposed to *T. epactia* in FCT 5a, however *Cenchrus ciliaris* also formed a large component of this layer in most quadrats (Plate 9).

A total of 20 vascular plant taxa were recorded in quadrats grouped in FCT 5b (Appendix K). No conservation-significant flora taxa were recorded in this FCT, however the introduced taxon *Cenchrus ciliaris* was recorded, and formed a significant component of the hummock grass layer. Species richness per quadrat within FCT 5b was 11.0 ± 1.8. FCT 5b was dominated by taxa from sub-sections of taxon groups 1 and 7 (Appendix M). Indicator taxa for FCT 5b (Appendix K) are all common taxa on rocky areas in the Pilbara.

Plate 9: Photograph of FCT 5b (Quadrat MD51)

4.2.2 Local and Regional Significance of Vegetation

No DEC-listed (State level) TECs or PECs are known from within the study area. Two TECs are currently known from the Pilbara Bioregion: TEC 46 (Themeda grasslands), which is known from Hamersley Station, and TEC 78 (Ethel Gorge aquifer stygbiont community). Both of these TECs are located in excess of 200 km to the south south-west of the study area. No FCTs within the study area are equivalent to any listed TECs or PECs (DEC 2010e, 2010f).

No federally-listed (EPBC Act) threatened ecological communities are known from the study area. No FCTs within the study area are equivalent to any listed TECs as listed under the EPBC Act (DoSEWPC 2010).

The local conservation significance ranking (as described in Table 7) of each FCT has been determined in relation to both the extent of the FCT within the study area, and the location of significant flora taxa within the FCT (Table 9). FCTs which composed supergroup 1 were generally widespread within the study area, with 90 % of the study area covered by FCTs 1 and 2. FCTs of supergroup 2 were generally more restricted, as they were located on rocky, hilly areas.

FCT 5a is considered to be the most locally significant FCT, as this subtype was only mapped on the summit and slopes of Mount Dove (0.4 % of the study area). However, FCT 5 was recorded on several hills to the west of the study area, albeit as a separate subtype (FCT 5b). As FCT 5b was not mapped in the study area, it is not considered with regard to local or regional significance.

Table 9: Local Conservation Significance of Floristic Community Types

FCT	Extent in study area (ha) (percentage of study area)	Presence of Significant Flora Taxa	Local Conservation Significance Ranking of FCT	Comments
1	1 431 (27.4 %)	-	1	Not locally significant
2	3 271 (62.6 %)	*Heliotropium muticum* (P1)	2	Locally significant – the FCT contains conservation-significant flora
3	126 (2.4 %)	-	3	Locally significant - the extent of the FCT mapped is < 10 % of the total study area
4	375 (7.2 %)	-	3	Locally significant - the extent of the FCT mapped is < 10 % of the total study area
5a	21 (0.4 %)	-	3	Locally significant - the extent of the FCT mapped is < 10 % of the total study area

In a broad context, the study area is located within a vegetation association (Abydos Plain 93) that is well represented within Western Australia, and has 100 % of its pre-European extent currently remaining (DEC 2007a). Although the current reservation status of this vegetation association is poor, it is not restricted in distribution (Table 1). There is currently no regional

dataset available to determine the regional extent of FCTs within the Pilbara Region, therefore there is no information to directly determine the range of each of the FCTs described above throughout the region.

The Mt Dove quadrat data analysed during this assessment has also been used in the TRH Project analysis (Woodman Environmental report in prep.). The TRH Project study area is extensive, extending from Port Hedland in the north to Mt Webber in the south, a distance of approximately 200 km, and located to the east of the Mt Dove study area. Although no GIS analysis to determine the extent of each FCT within the TRH Project study area has been finalised, the results of this analysis can be used to determine if these equivalent FCTs are present outside of the Mt Dove study area.

The 11 quadrats which grouped during the Mt Dove analysis into FCT 1 were variously split between TRH FCTs 1, 4, 11 and 13 (Woodman Environmental report in prep.). None of these TRH FCTs are thought to be restricted, and all occur on landforms which are well represented in the region.

The majority of the 23 quadrats which grouped to form Mt Dove FCT 2 also grouped together during the TRH analysis within TRH FCT 11 (Woodman Environmental report in prep.). TRH FCT 11 was mapped in a large area over a small range in the northern part of the TRH Project study area, and in a few small areas in the central and southern parts of the study area, on plains. Although the extent of TRH FCT 11 has not yet been determined, this FCT (and therefore equivalent Mt Dove FCT 2) is present outside of the Mt Dove study area.

The two quadrats which grouped to form Mt Dove FCT 3 also grouped together during the TRH analysis within TRH FCT 9. TRH FCT 9 was mapped widely but infrequently over much of the TRH Project study area, on undulating plains and on hill slopes and crests (Woodman Environmental report in prep.). Although the extent of TRH FCT 9 has not yet been determined, this FCT (and therefore equivalent Mt Dove FCT 3) is present outside of the Mt Dove study area.

The 11 quadrats which grouped to form Mt Dove FCT 4 were split across TRH FCTs 11, 13 and 15 during the TRH analysis (Woodman Environmental report in prep.). Each of these FCTs were composed of quadrats located both within and outside of the TRH Project study area, with FCTs 11 and 13 mapped in large areas in the northern part of the TRH Project study area on plains and flats, and FCT 15 being mapped widely across the central and southern parts of the TRH Project study area on various hills and rocky, undulating plains (Woodman Environmental report in prep.). Although the extent of TRH FCTs 11, 13 and 15 have not yet been determined, these FCTs (and therefore equivalent Mt Dove FCT 3) is present outside of the Mt Dove study area.

The two quadrats which grouped to form Mt Dove FCT 5a (MD44 and MD45) grouped together with a further 16 quadrats to form FCT 16 during the TRH analysis. TRH FCT 16 was mapped on crests, ridges, cliffs, gorges and granite outcrops, on both massive ironstone and granite. The extent of FCT 16 throughout the TRH Project study area has not as yet been calculated, and therefore the regional extent is unknown, Mt Dove MCT 5a does occur outside of the Mt Dove study area.

The four quadrats which grouped as FCT 5b as part of the Mt Dove assessment (MD50 – 53) did not group into TRH FCT 16, however grouped into TRH FCT 18 (Woodman Environmental report in prep.). It is therefore considered that the vegetation of the hills adjacent to Mt Dove where these quadrats were established is not the same as that on Mt Dove itself.

4.2.3 Vegetation Condition

The condition of the majority of vegetation was ranked „Excellent" or „Very Good" over the vast majority of the study area. However, for the purposes of vegetation condition mapping, all areas ranked as „Excellent" or „Very Good" were mapped as „Very Good", as individual areas allocated different rankings frequently could not be accurately discerned from each other using aerial photography and FCT mapping boundaries (Figure 4). Quadrats were ranked as „Very Good" because of minor grazing and trampling impacts to vegetation; no introduced taxa were recorded in any areas mapped as „Very Good".

The vegetation on the upper slopes and summit of Mount Dove, which is equivalent to the area mapped as FCT 5a (Figure 3), was ranked as „Good". The invasive weed *Aerva javanica* (Kapok) has established as a dominant component of the shrub layer in this vegetation, and the invasive *Cenchrus ciliaris* (Buffel Grass) was also recorded in this vegetation. Additionally, significant disturbance has occurred in this vegetation as a result of exploration drilling. Appendix F provides vegetation condition scale rankings for each quadrat, while Appendix L presents the vegetation condition scale used during the survey (adapted from Keighery 1994).

5 ASSESSMENT OF IMPACTS TO FLORA AND VEGETATION

5.1 Impact on Flora

The Priority flora taxon *Heliotropium muticum* (P1) was recorded within the study area, however as no known locations will be impacted by the Project, both the local and regional significance of the impact to this taxon cannot be directly ranked (Section 3.6.1; Table 6). It is considered that this taxon may be indirectly impacted through loss of potential habitat and soil-stored seed, as areas of FCT 2 in the vicinity of known locations will be cleared; however any potential impacts are not considered significant.

This is a short-lived taxon, most likely a fire responder, and may senesce during periods when the vegetation is not burnt regularly.

Known locations of the introduced taxa recorded in the study area, *Aerva javanica* (a total of 25 locations) and *Cenchrus ciliaris* (1 location), will be impacted by the Project. This may result in the spread of these taxa within the study area through the removal and transportation of topsoil, which will require management (see Section 6).

5.2 Impact on Vegetation

A total of 219 ha of vegetation is proposed to be impacted by the Project. Table 10 presents the impact on each FCT mapped within the study area. FCTs 3, 4, and 5a are considered to be of higher conservation significance (ranking „3"); although FCT 2 is ranked at „2" it is still considered locally significant, due to the presence of the P1 taxon *Heliotropium muticum*. FCT 1

is considered to be low local significance (ranking „1") (Table 7; 9). FCT 5b does not occur in the study area, and therefore no impacts will occur to this subtype.

The level of impact to FCTs 1, 2, 3 and 4 is considered to be Low, with the impacts to all FCTs being less than 25 % of the total mapped area of each FCT (Section 3.6.2). However, there will be a High impact to FCT 5a, with 66.7 % of the extent of this subtype within the study area to be impacted.

The level of impact to FCTs cannot be considered in a regional context, as no regional Pilbara vegetation dataset is currently available. However, Mt Dove FCT 5a can be considered part of TRH FCT 16 (Woodman Environmental report in prep.), which is known to occur outside of the Mt Dove study area. The extent of this FCT throughout the TRH Project study area is spatially relatively small (379 ha, 0.6 % of TRH Project study area), however the FCT is geographically widespread throughout the TRH Project study area.

Table 10: Impacts of the Project on Floristic Community Types

FCT	Local Conservation Significance	Total area mapped (ha)	Area Proposed to be impacted by the Project (ha)	Percentage of FCT to be Impacted	Level of Proposed Impact (Section 3.6.2)
1	1	1431	30	2.1	Low Impact
2	2	3271	99	3.0	Low Impact
3	3	126	1	0.8	Low Impact
4	3	375	75	20.0	Low Impact
5a	4	21	14	66.7	High Impact
Total		**5,224**	**219**	**4.2**	**Low Impact**

5.3 Assessment of Clearing Principles under *Environmental Protection Act 1986*

Clearing of native vegetation for the project will require a clearing permit to be granted under section 51C of the *Environmental Protection Act 1986* (EP Act). In making the assessment of the clearing permit application, the significance of the clearing of vegetation in terms of the following clearing principles is required.

Principle (a) – Native vegetation should not be cleared if it comprises a high level of biological diversity.

The flora of the study area does not contain a high level of diversity, with a total of 90 discreet vascular flora taxa and 1 known hybrid, from 24 families and 52 genera recorded from within the study area during the surveys in 2010. The number of taxa recorded during this study was lower than that recorded by Mattiske at Wodgina (Mattiske 2000), by Outback Ecology at the Mt Francisco and TSCF3 areas at Wodgina (Outback Ecology 2008) and at the Atlas DSO project at Wodgina by Outback Ecology (2009). In addition, the species richness per quadrat (50 m x 50 m) ranged from 6.6 ± 1.9 to 19.5 ± 3.5 species per quadrat, which is not high.

The number of FCTs described and mapped during this study was also not high in relation to the number of plant communities mapped in nearby areas as outlined in the studies above.

The Pilbara bioregion is not known for a high level of biological diversity, in terms of flora and vegetation, in comparison to other regional areas of Western Australia, for example the Northern Sandplains region in the vicinity of Eneabba and Dongara.

Principle (b) – Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

This clearing principle is required to be addressed by a fauna specialist.

Principle (c) – Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora

No flora listed as Declared Rare Flora (under the *Wildlife Conservation Act 1950*) (WC Act), as threatened flora (under the EPBC Act), or listed as Priority Flora (Smith 2010; DEC 2010d), will be directly impacted by the Project. *Heliotropium muticum*, listed as a Priority 1 flora taxon, was recorded within the study area, however this taxon will not be impacted by the current layout.

Principle (d) – Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community

No Threatened Ecological Communities (TECs) as listed by the DEC (DEC 2010e), or listed under the EPBC Act, are known within or in close proximity to the study area, and therefore no TECs will be impacted by the Project. No Priority Ecological Communities (PECs) as listed by DEC (2010f) are known from or in the vicinity of the study area.

Principle (e) – Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared

The vegetation of the study area has not been historically extensively cleared. The study area is located within the PIL 3 (Chichester) Subregion, of which 100 % of the pre-european extent is extant (DEC 2007a).

Principle (f) – Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland

There are no defined watercourses or wetlands occurring within the study area. The nearest defined watercourse is the Turner River, occurring immediately to the east of the Great Northern Highway, which is located at the eastern extent of the study area. Minor run-off lines occur on the slopes of Mt Dove, where water sheds from the feature during rainfall events, however these are ephemeral and the vegetation of these areas is not different from the surrounding features.

Principle (g) – Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation

As clearing will occur on the slopes of Mt Dove, land degradation may occur if appropriate rehabilitation techniques are not followed.

Principle (h) – Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area

The study area is located within the central portion of Indee Station, which is a privately leased and operated pastoral station. The closest nature reserve to the study area is located approximately 50 km to the south-west of Mt Dove (Mungaroona Range Nature Reserve), and the Millstream-Chichester National Park is located approximately 110 km to the west south-west.

Principle (j) – Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

It is unlikely that clearing would cause or exacerbate the incidence of flooding in the area.

6 DISCUSSION

6.1 Flora of the Study Area

A total of 90 discrete vascular plant taxa were recorded within the study area in 2010, including two introduced taxa. This compares with 122 vascular plant taxa recorded during survey for the nearby Wodgina DSO Project (Outback Ecology 2009). The survey results indicate the study area is relatively species-poor; this is likely to be a function of the limited variety of topographical features and soil types, with the vast majority of the study area consisting of broad floodplains with some minor rocky hills. In particular, no major drainage features (e.g. rivers, gorges), which generally contain high vascular plant diversity, are present in the study area. However, the relatively poor „wet" season prior to survey in 2010 may also have influenced the number of taxa recorded in the study area; it is possible that some ephemeral taxa likely to occur in the study area were not recorded because of lack of rainfall. Port Hedland, the nearest meteorological station to the study area, received only 36 mm of rainfall over the period November 2009-April 2010 (Bureau of Meteorology 2010b), compared to a long-term average of approximately 240 mm over this period (Bureau of Meteorology 2010a).

One conservation-significant flora taxon, *Heliotropium muticum* (P1), was recorded within the study area. This taxon will not be directly impacted by the Project; it may be indirectly impacted through clearing of potential habitat and loss of soil-stored seed, however any potential indirect impacts are not considered to be significant. *Heliotropium muticum* is currently ranked as Priority 1, with available information indicating it has a restricted distribution and is known from relatively few populations, none of which occur in secure conservation tenure (DEC 2010d). However, this taxon has been recorded at numerous locations within the nearby TRH Project study area, where it has proved to be a relatively common taxon (Woodman Environmental report in prep.), and it is considered that this taxon could potentially be downgraded to a lower Priority category, or be removed from the Priority flora list; this will be investigated in the near future.

Two introduced (weed) taxa, *Aerva javanica* (Kapok) and *Cenchrus ciliaris* (Buffel Grass), were recorded within the study area, exclusively on Mount Dove itself. Locations of both taxa will be impacted by the Project, specifically for the proposed pit, waste dump and borrow pits. Both taxa are highly invasive, and while they have the ability to spread into undisturbed native vegetation, are particularly adept at colonising recently disturbed areas. It is therefore important that a weed hygiene management programme be developed prior to ground disturbance. It is recommended that weed control, in the form of spraying of appropriate herbicides to destroy individual plants, be undertaken on Mount Dove itself prior to ground disturbance, to minimise the risk of weeds spreading to disturbed areas. This may also serve to reduce the level of weed propagules in topsoil to be removed from the pit and waste dump areas. Removed topsoil from areas with known infestations should be stockpiled separately from topsoil stripped from uninfested areas, with weed control to be undertaken on the stockpiles if necessary. Inspection and cleaning of all machinery and vehicles prior to entering the study area should be undertaken, to prevent the introduction of weed propagules. Inspection and cleaning of machinery and vehicles prior to leaving areas known to have infestations of weeds within the study area should also be undertaken. It is also recommended that a weed monitoring programme be developed, to ensure that any new infestations, particularly around disturbance areas such as roads, are identified and can be controlled or eradicated.

As mentioned in Section 3.3, the Project footprint presented in this report is different to the conceptual plan that was originally provided for field survey, and therefore not all areas of proposed disturbance were searched for conservation-significant and introduced flora. However, based on quadrat and traverse data for the study area, and the uniformity of habit types, it is considered unlikely that populations of conservation-significant and introduced flora will occur elsewhere in the study area, including areas of proposed disturbance.

6.2 Vegetation of the Study Area

Five FCTs were mapped in the study area, from two super-groups. One FCT was divided further in two sub-types. The two super-groups were based primarily on topographical location, and hence associated soil types, within the study area, with super-group 1 generally mapped on sandy and loamy plains, and super-group 2 on rocky areas, including hills and rises. The diversity of FCTs in the study area is considered to be poor, primarily because of limited variety of topographical features. The FCTs within each super-group are floristically similar, a further indication of the relative uniformity of the study area in terms of topographical and soil characteristics.

The condition of the majority of vegetation was ranked „Excellent“ or „Very Good“ over the vast majority of the study area. Minor grazing and trampling impacts to vegetation from cattle were noted, however because of the lack of major drainage features, it is unlikely that cattle heavily use the study area. This is likely to account for the limited distribution of introduced taxa in the study area. The vegetation on the upper slopes and summit of Mount Dove, which is equivalent to the area mapped as FCT 5a (Figure 3), was ranked as „Good“. The invasive weed *Aerva javanica* (Kapok) has established as a dominant component of the shrub layer in this vegetation, and the invasive *Cenchrus ciliaris* (Buffel Grass) was also recorded. Management of weed taxa is discussed above in Section 6.1.

Of the FCTs mapped within the study area, FCTs 3, 4 and 5a are considered to be of relatively high local conservation significance, because of their limited extent in the study area (less than 10 % of the total study area). Although there is no regional vegetation dataset to determine the extent of such FCTs within the Pilbara, results of the floristic analysis undertaken as part of the TRH Project (Woodman Environmental report in prep.), indicate that each of these FCTs is represented outside of the study area, and the TRH FCTs within which the Mount Dove quadrats were grouped into, were not considered to be of regional conservation significance.

In addition, the landforms on which FCT 1, 2, 3 and 4 occur are relatively common throughout the region. Although the landforms that FCT 5a (and 5b) occur on are considered to be regionally uncommon, they are not considered to be regionally rare or restricted. It is therefore considered that none of the FCTs mapped in the study area (as well as FCT 5b) are of regional conservation significance.

All FCTs mapped in the study area will be directly impacted by clearing for infrastructure for the Project. With the exception of FCT 5a, the level of impact to all FCTs is considered to be Low, with less than 25 % of the total mapped area of each FCT to be impacted. The local impact to FCT 5a is considered to be High, with 66.7 % of this FCT to be cleared. As this FCT is of high local conservation significance (ranking of „3"), it is important that clearing in this FCT is minimised as much as practicable. However, as mentioned above, this FCT is not considered to be of regional conservation significance, and although regional impacts cannot be quantified because of the absent of a regional floristic dataset, they are not expected to be significant.

There is also the potential for indirect impacts to this FCT and other FCTs to occur, with changed hydrological regimes (drainage shadow and ponding), introduction of waste products (including hydrocarbons), increased dust deposition and increased fire among the potential indirect impacts. It is therefore important that appropriate management actions be implemented during construction of the Project, to minimise the risk of these indirect impacts occurring.

Methods undertaken during initial clearing of vegetation and topsoil will be crucial to the overall success of rehabilitation of vegetation in disturbed areas. Topsoil and cleared vegetation should be retained where practicable, each stored separately with the stockpiles protected against direct or indirect impacts during construction and mining. Topsoil is scarce on Mount Dove itself and it is acknowledged that topsoil stockpiling in many areas will not be possible. Correct re-spreading of both the topsoil and cleared vegetation will be vital to achieve the best results during rehabilitation. This may have to be supplemented with seeding of appropriate native taxa. The dominant genus (in terms of total foliage cover) is *Triodia*, which traditionally is difficult to re-introduce into rehabilitation. Appropriate techniques to reintroduce *Triodia* to areas of rehabilitation will need to be implemented. Keystone species should also be identified as part of a comprehensive rehabilitation plan. Keystone species are those which are most common, provide the most cover, and are representative of each stratum within a particular. They may also be species that are required to provide for fauna habitat and/or food sources.

7 RECOMMENDATIONS

The following recommendations are given:

- The flora and vegetation impact assessment should be updated if the final project infrastructure layout significantly differs from the Project layout displayed on Figure 2.
- Clearing should be minimised as much as practicable (especially in FCT 5a).
- A weed hygiene plan and monitoring programme should be developed and implemented for construction and on-going operations, with actions to include control of weed populations prior to and following ground disturbance, monitoring of disturbed areas, and machinery hygiene.
- Limit dust-creating activities during periods of high wind velocity/duration.
- Prompt rehabilitation of mining areas once mining has ceased, including all pit areas, waste rock dumps and other cleared areas.
- A comprehensive rehabilitation management plan (including a monitoring programme) should be developed and approved by the DEC for the project, including factors such as appropriate management, care of and re-spreading of stockpiled topsoil and vegetation, development of keystone species and appropriate seeding and seeding rates of these, and final landform planning.

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Appendix C

Vertebrate Fauna Assessment (Outback Ecology 2011)

Atlas Iron Limited

Mt Dove DSO Project

Vertebrate Fauna Assessment

August 2011

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Vertebrate Fauna Assessment

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Final Report V2	Outback Ecology	Coffey Environments		29 June 2011
Final Report V3	Outback Ecology	Coffey Environments		13 July 2011
Final Report V4	Outback Ecology	Coffey Environments		09 August 2011

Executive Summary

Atlas Iron Limited (Atlas) commissioned Outback Ecology to undertake a terrestrial vertebrate fauna assessment of the Mt Dove Direct Shipping Iron Ore (DSO) Project (the Project), located approximately 68 km due south of Port Hedland, in the Pilbara region of Western Australia (WA).

The overall objectives of this assessment were to:

- Develop an inventory of terrestrial vertebrate fauna species identified or likely to occur within the Mt Dove study area and surrounds and characterise the habitats present; and
- Assess the potential impacts of the Project on the terrestrial fauna assemblages and habitat in the area.

This report documents the results of two detailed fauna surveys conducted over the Mt Dove study area (herein referred to as the study area) in 2010; an autumn survey from 19-30 May and a spring survey from 3-12 September. For regional context, this report also presents a summary of terrestrial vertebrate fauna species recorded from relevant fauna surveys conducted in the wider surrounds from 1991 to 2010. Further, this report also includes unpublished data from a baseline Northern Quoll survey conducted during May 2011, which will be reported on separately.

Four broad fauna habitats were identified within the Mt Dove study area: Acacia, Spinifex on Sandplain; Acacia Shrubland on Footslopes, Rocky Ridge and Stony Rise. Systematic, targeted and opportunistic sampling was undertaken in each of these habitat types. Systematic sampling methods included the use of pitfall, Elliott, funnel and cage trapping, hand searching, spotlighting and avifauna census.

A total of 92 vertebrate fauna species were recorded within the detailed autumn and spring 2010 surveys of the Mt Dove study area; comprising 23 mammals (17 of which were native), 40 species of birds and 29 reptile species. Based on findings of database searches and a comprehensive literature review, the vertebrate fauna assemblage recorded was as expected and found to be comparable with findings of similar sized surveys conducted within the surrounding region.

With the exception of the Rocky Ridge habitat, the fauna habitats identified within the study area are widely represented outside the study area and throughout the Chichester sub bioregion. The Rocky Ridge habitat associated with Mt Dove encompasses a total area of 22 ha and represents a naturally occurring isolated habitat island within the landscape, with the the nearest fauna habitat possessing similar characteristics (ironstone outcropping, caves, crevices and boulders) occurring 12 km to the south. This habitat type yielded the greatest diversity (four) and abundance of conservation significant fauna species recorded from the autumn and spring 2010 surveys.

Five conservation significant fauna species have been recorded within the Mt Dove study area, comprising:

- The Northern Quoll (*Dasyurus hallucatus*) which is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and Schedule 1 of the Western Australian *Wildlife Conservation Act, 1950* (WC Act);

- The Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) which is listed as Vulnerable under the EPBC Act and Schedule 1 of the WC Act;
- Two Priority 4 species listed under the Western Australian Department of Environment and Conservation (DEC) Priority Species List, the Ghost Bat (*Macroderma gigas*) and Australian Bustard (*Ardeotis australis*); and
- The Rainbow Bee-eater (*Merops ornatus*) which is listed as Migratory under the EPBC Act.

The desktop study of the study area, which involved a comprehensive database search and literature review, indicates that an additional fifteen conservation significant fauna species may occur within the study area. These species include:

- Three species listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act, Mulgara (*Dasycercus cristicauda/blythi*), Bilby (*Macrotis lagotis*) and Pilbara Olive Python (*Liasis olivaceus barroni*);
- Two species listed as Schedule 4 under the WC Act, the Peregrine Falcon (*Falco peregrinus*) and Woma Python (*Aspidites ramsayi*);
- One Priority 1 species listed under the DEC Priority Species List, *Ramphotyphlops ganei*;
- Two Priority 2 species listed under the DEC Priority Species List, *Ctenotus nigrilineata* and *Ctenotus uber johnstonei*;
- One Priority 3 species, Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*); and
- Six Priority 4 species, Lakeland Downs Mouse (*Leggadina lakedownensis*), Long-tailed Dunnart (*Sminthopsis longicaudata*), Western Pebble-mound Mouse (*Pseudomys chapmani*), Bush Stone-curlew (*Burhinus grallarius*), Grey Falcon (*Falco hypoleucos*) and Star Finch (*Neochmia ruficauda subclarescens*).

The Project will impact vertebrate faunal assemblages on a local scale through direct loss of fauna during land clearing, loss of habitat and indirect impacts. The development of the Project will directly impact 64% of the significant Rocky Ridge habitat occurring on Mt Dove. Four conservation significant fauna species were recorded from this habitat including the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*); Ghost Bat (*Macroderma gigas*); Rainbow Bee-eater (*Merops ornatus*) and the Northern Quoll (*Dasyurus hallucatus*), of which nine individuals were recorded during 2010. This habitat is uncommon in the landscape and consequently, with the exception of the Rainbow Bee-eater, the development of the Project is likely to have an impact on these conservation significant species at a localised scale (i.e. within the surrounding 10 km).

Subsequent to the implementation of the management actions and strategies recommended within this assessment, the impacts of the Project on conservation significant species at a regional scale are likely to range from negligible (no perceived affect on species) to moderate (permanent species decline expected – no perceived threat to regional conservation status of species).

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1. INTRODUCTION

1.1 Project Background and Location

Atlas Iron Limited (Atlas) commissioned Outback Ecology to undertake a terrestrial vertebrate fauna assessment of the Mt Dove Direct Shipping Iron Ore (DSO) Project (the Project). The Project is located approximately 68 km due south of Port Hedland and is linked by road to Port Hedland via the Great Northern Highway (GNH). The Project is situated 13.5 km to the west of the GNH in the Pilbara region of Western Australia (WA) (**Figure 1**). In relation to land tenure, the Project is located on the Mt Dove exploration licence (E47/891) and lies entirely within the Indee Pastoral Lease (3114/1197). Tenements are currently being sought for: the access road from the GNH to the Project area (miscellaneous licence application L47/228); access road, borrow pits, laydown areas and access road / GNH intersection (miscellaneous licence application L45/248); borrow pits east of the Project area (miscellaneous licence application L45/248); and the Project area, camp and supporting infrastructure (mining lease application M47/1449).

The Project will be developed by open pit, with minimal pre-stripping required to expose ore stocks. Current inventories estimate an iron ore resource of about 2.5 million tonnes (Mt). It is anticipated that the Project will be completely depleted of ore within 12 months of mining commencement, however it is expected that processing and haulage will continue for an estimated further 12 months after cessation of mining.

The run-of-mine (ROM) ore (uncrushed) will be stored within the dedicated stockpiles waiting crushing and screening by a mobile crushing and screening plant. The plant will move between stockpile locations as each stockpile location is depleted. It is anticipated that the Project will haul the final product by road train to the newly constructed Utah Point Port Facility located in Port Hedland, Western Australia.

The onsite support facilities include: administration offices; workshops; fuelling facilities; water bores; diesel generators; communication infrastructure; and sewage facilities. A small accommodation camp will also be installed locally to service the Project‘s workforce.

The study area consisted of an approximate 5,224 hectare (ha) parcel of land, which contains Mt Dove itself and extends to the northwest to the Great Northern Highway. An overview of the study area and a conceptual Project layout is presented in **Figure 2**.

The proposed total area of disturbance required for the development of the Project over the planned two year life span is approximately 219 ha.

Upon depletion of the ore body, Atlas will undertake a programme of mine closure and rehabilitation to satisfy lease and bond conditions.

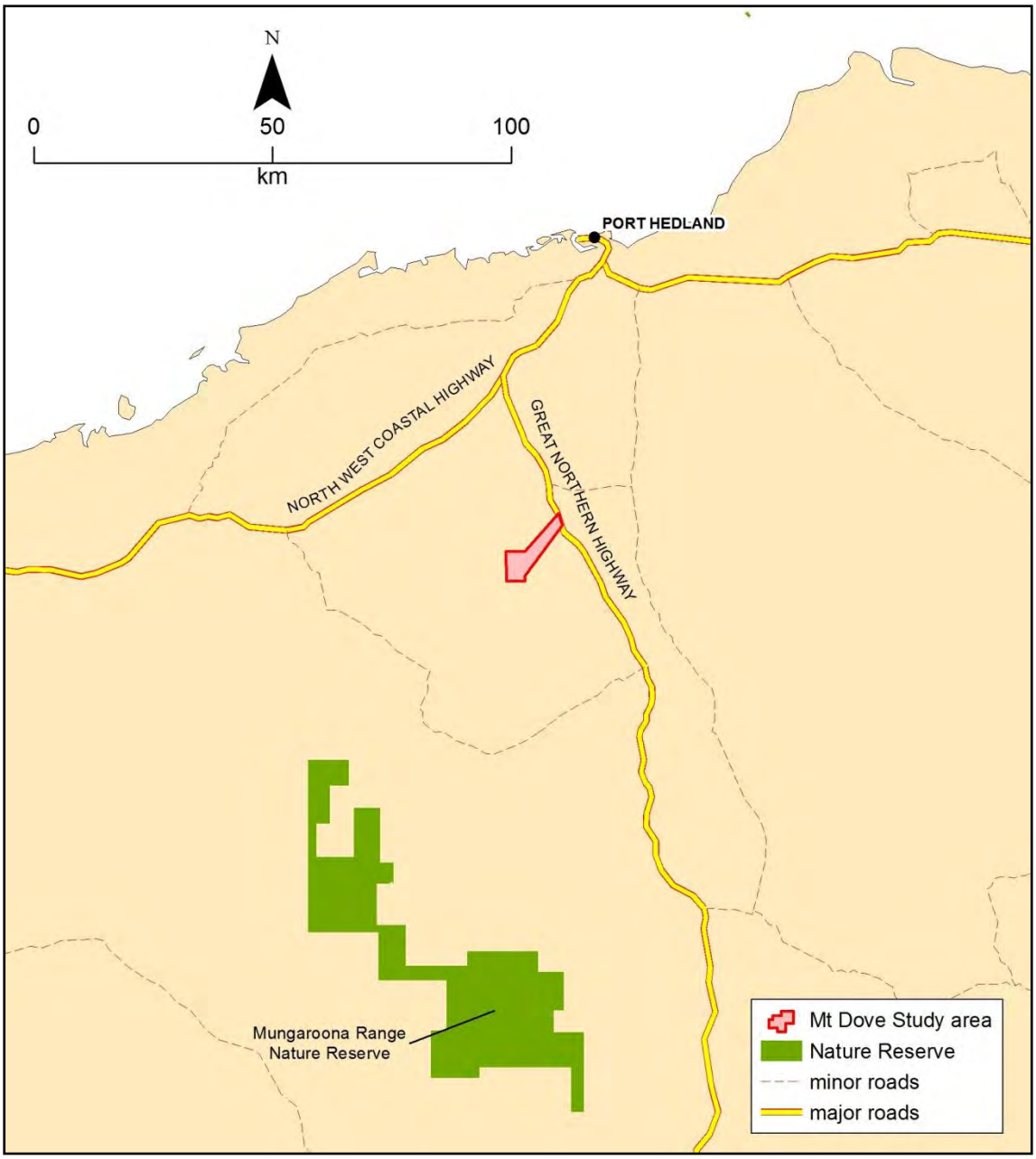

Figure 1: Regional location of the Mt Dove study area

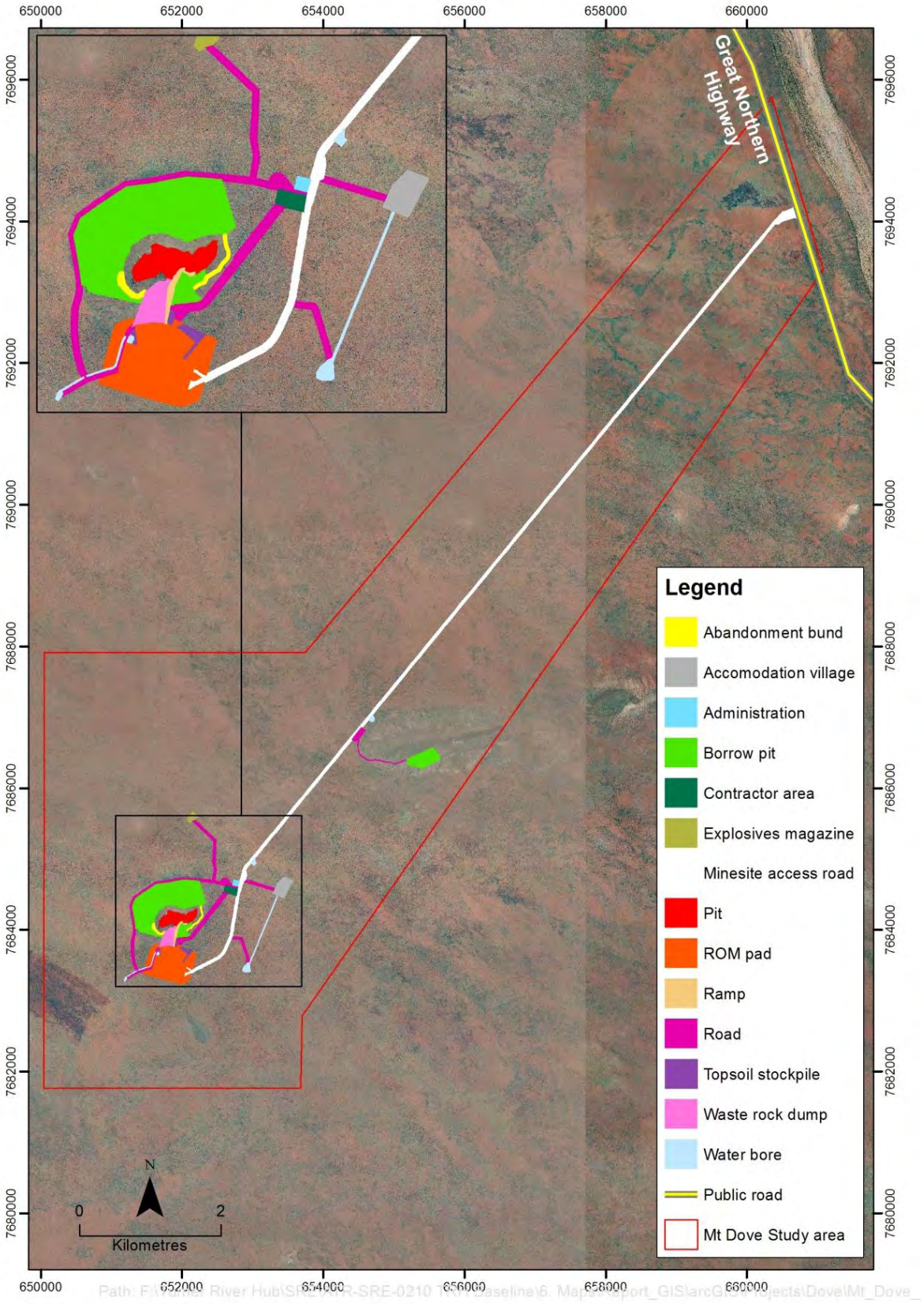

Figure 2: Mt Dove DSO Project study area and conceptual Project layout

1.2 Report Scope and Objectives

This report documents the results of two detailed terrestrial vertebrate fauna surveys conducted over the Mt Dove study area in 2010: an autumn survey from 19-30 May and a spring survey from 3-12 September. Further, this report includes unpublished data from a baseline Northern Quoll survey conducted during May 2011, which will be reported on separately (Outback Ecology in prep). For regional context, this report also presents a summary of terrestrial vertebrate fauna species recorded from relevant fauna surveys conducted in the wider surrounds from 1991 to 2010.

The 2010 fauna surveys were designed and conducted in accordance with:

- WA Environmental Protection Authority's (EPA's) Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (Environmental Protection Authority 2003);
- WA EPA Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (Environmental Protection Authority 2004); and
- WA EPA and Department of Environment and Conservation (DEC) Technical Guide – *Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (Environmental Protection Authority and Department of Environment and Conservation 2010).

The specific objectives of this assessment were to:

- Develop an inventory of terrestrial vertebrate fauna species identified or likely to occur within the study area and surrounds;
- Assess the occurrence and likely distribution of vertebrate fauna of conservation significance within the study area;
- Identify, describe and map vertebrate fauna habitat and any significant habitat within the study area;
- Assess survey findings in the regional context by comparing with available data from other localities within the Pilbara bioregion; and
- Assess the potential impacts of the Project on the terrestrial vertebrate fauna assemblages and their habitats.

The fauna assessment involved:

- A desktop study entailing:
    - A comprehensive review of database searches and internet search tools;
    - A review of previous fauna studies conducted in the surrounding areas to provide regional context to this assessment;
- A reconnaissance survey conducted from the 23-24 March 2010 to assess habitat, and select and establish systematic trapping sites;
- A multi-seasonal detailed vertebrate fauna survey (autumn and spring 2010); and
- An assessment of potential impacts of the Project to vertebrate fauna and their habitats.

2. EXISTING ENVIRONMENT

2.1 Biogeographic Region

The Interim Biogeographical Regionalisation for Australia (IBRA) classification system (Thackway and Cresswell 1995), describes a refined system of 85 ‗biogeographic regions' (bioregions) covering the whole of Australia. The results were a collaboration between all state conservation agencies with coordination by the Commonwealth Department of the Environment, Water, Heritage and the Arts (now the Department of Sustainability, Environment, Water, Population and Communities [DSEWPC]). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The Mt Dove study area occurs within the Pilbara bioregion. The Pilbara bioregion has a semi-desert tropical climate, with active drainage in the Fortescue, De Grey and Ashburton river systems (McKenzie *et al.* 2003). The Pilbara has a high level of fauna biodiversity and species endemism. However, a combination of invasive weeds, altered fire regimes, feral predators and grazing by introduced herbivores is causing ecosystem degradation and consequently a loss of vegetation and of native species, in particular mammals within the critical weight range of 35 - 5,500 g (McKenzie *et al.* 2003). These mammal species of intermediate body mass (e.g. bettongs, potoroos, wallabies) have suffered severe declines compared with mammals of smaller or larger body size (e.g. rodents, kangaroos) (Burbidge and McKenzie 1989), particularly in low rainfall areas (Johnson and Isaac 2009).

The Pilbara bioregion is further classified into four sub regions; the Chichester, Roebourne, Fortescue Plains, and Hamersley using the Interim IBRA classification system (McKenzie *et al.* 2003). The Mt Dove study area falls within the Chichester sub-bioregion (**Figure 3**).

The Chichester sub-bioregion contains undulating Archaean granite and basalt plains with significant areas of basalt ranges (Kendrick and McKenzie 2001). The basalt plains host a shrub steppe characterised by *Acacia inaequilatera* over *Triodia* spp. hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on the ranges (Kendrick and McKenzie 2001). This sub bioregion lies predominantly inland from the coast.

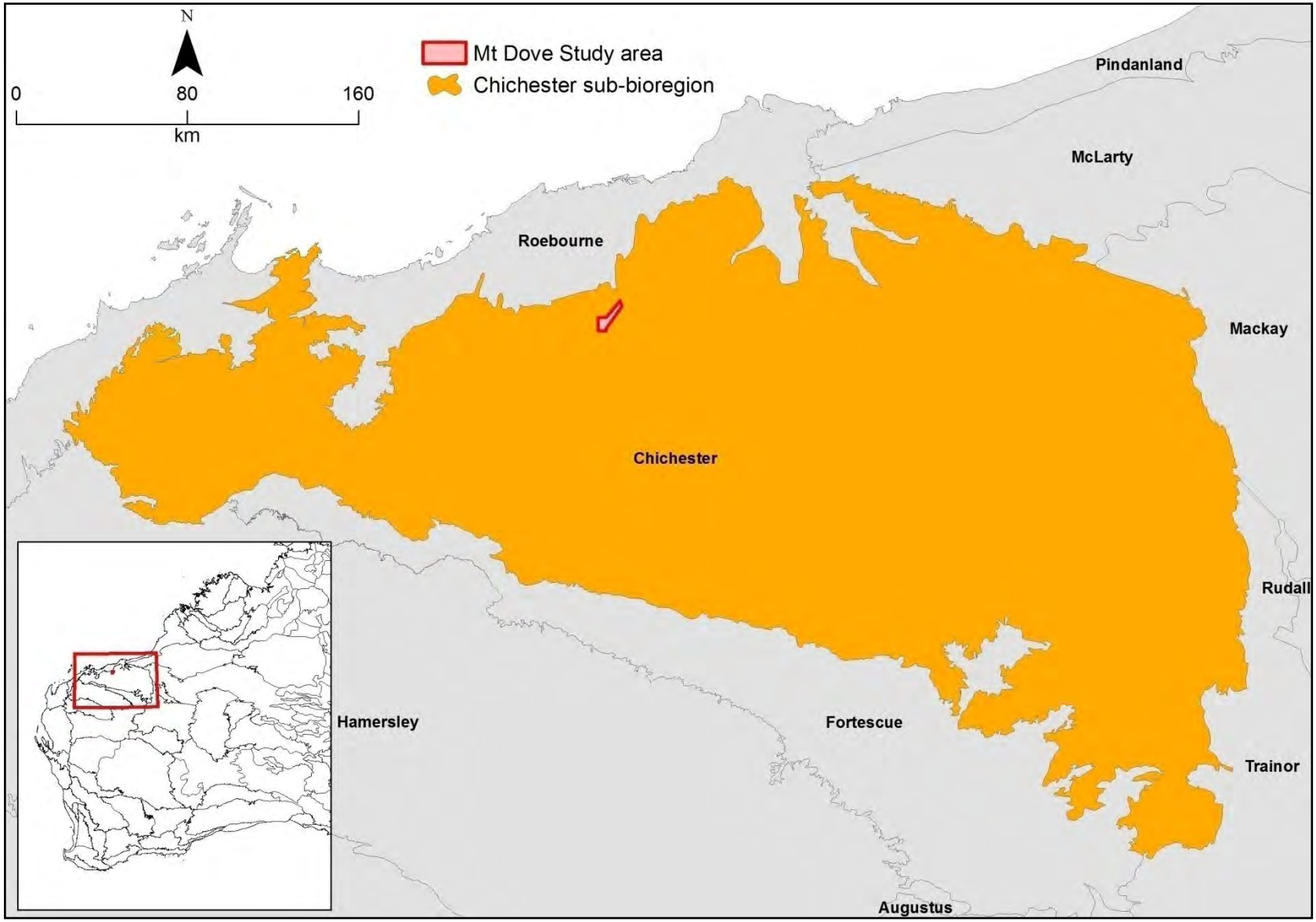

Figure 3: The location of the Mt Dove study area with respect to IBRA sub-bioregions

2.2 Climate

The study area is located within the northern section of the Pilbara bioregion, which experiences a semi-arid to arid-tropical climate that is characterised by hot summers and relatively warm, dry winters (Bureau of Meteorology 2010). Tropical cyclones can occur between the months of January to April, bringing sporadic drenching rainfall events (How *et al.* 1991).

The nearest Bureau of Meteorology (BOM) weather station to the Project is located at Indee Station, approximately 10 km to the north east of the study area and 22 km to the north east of Mt Dove itself. Although not recognised as a formal BOM weather station, rainfall data from the Indee weather station has been included in this section as it is likely to provide a better indicative account of long term rainfall over the study area. To supplement the Indee Station rainfall data, temperature records were collated from Port Hedland airport weather station, approximately 68 km to the north of the Project. Historical data collated from these stations are used within this report to provide contextual climate data for the study area.

Summer occurs from November to February when mean daily maximum temperatures for Port Hedland can reach 36°C (**Figure 4**). Winter occurs from June to August with mean daily maximum temperatures reaching 26°C. Rainfall within the study can be highly unpredictable, both temporally and spatially, and substantial fluctuations can occur from year to year (How *et al.* 1991) (**Figure 4**). Such variability is illustrated in **Figure 5**, where monthly rainfall recorded from the Indee weather station for the most recent years possessing a complete data set (2005 to 2008) are shown.

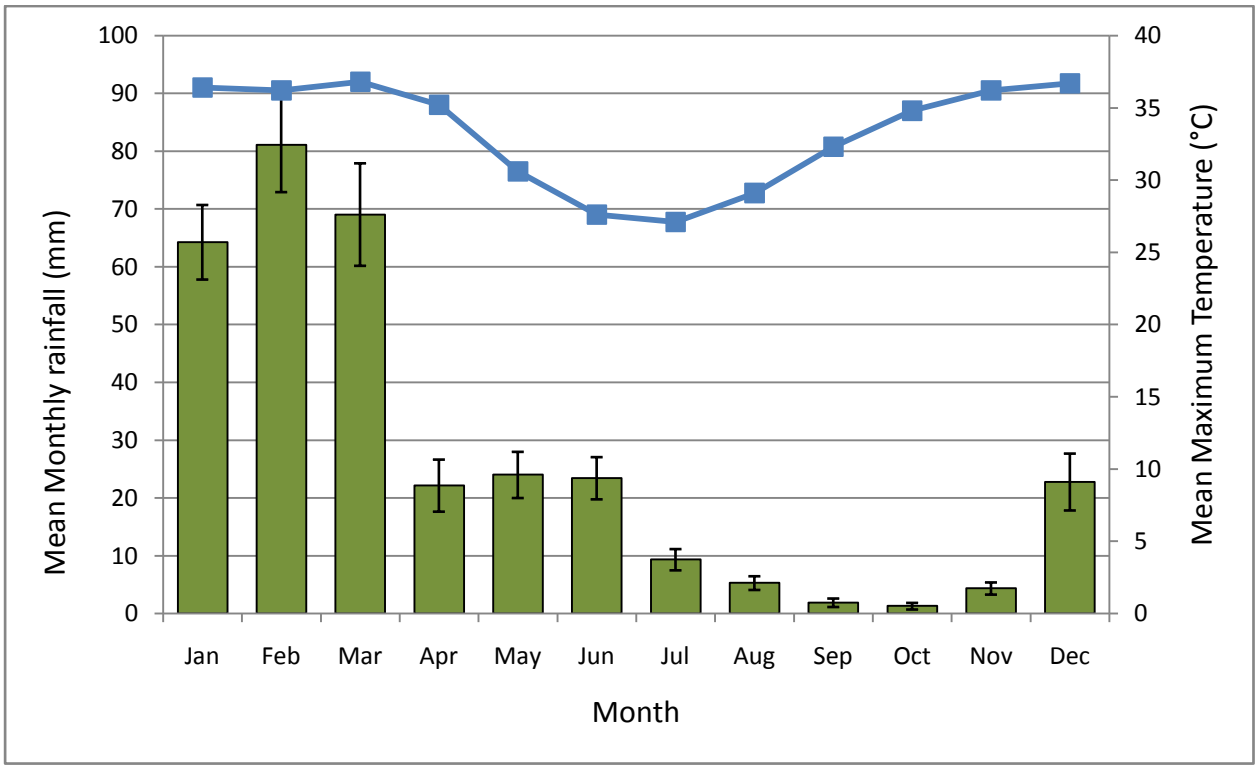

Figure 4: Mean monthly rainfall for Indee Station (1909 – 2010) and mean maximum temperature for Port Hedland Airport (1942 – 2010) (BOM, 2010)

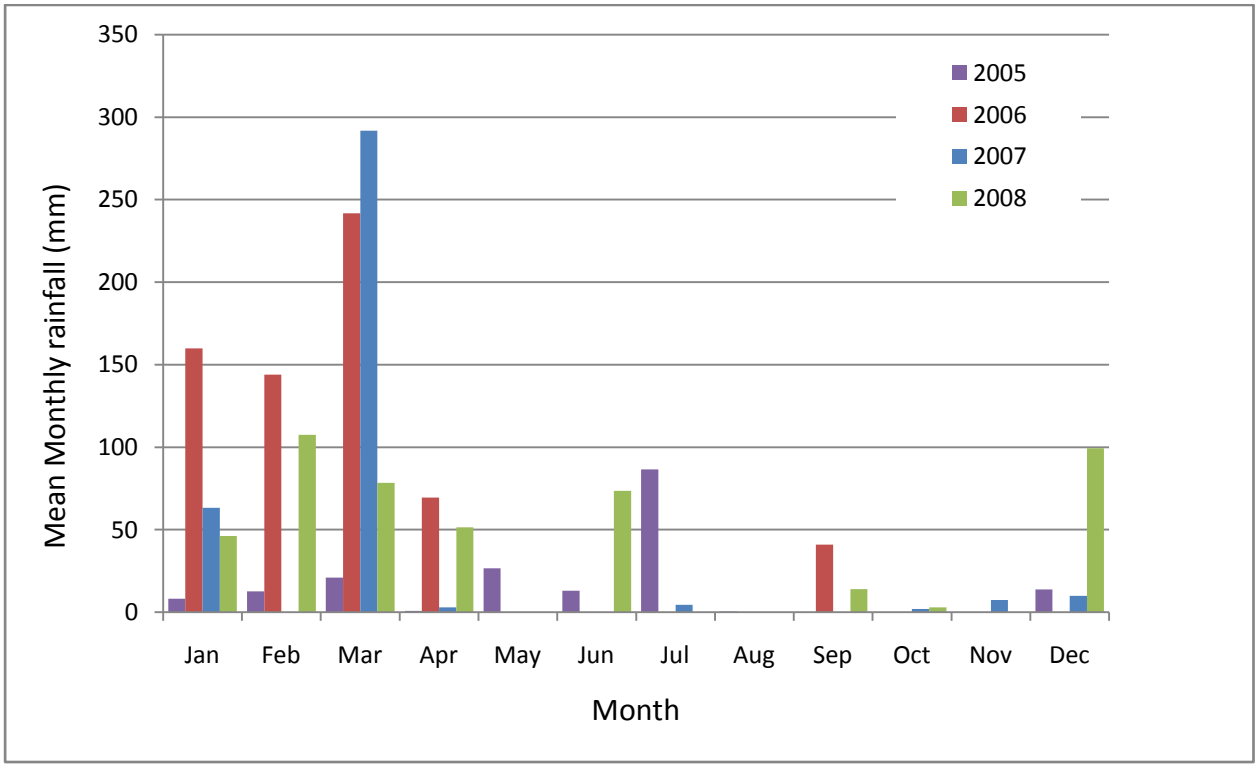

Figure 5: Monthly rainfall for Indee Station for 2005-2008 (most recent years with complete records, BOM, 2010)

2.3 Land Systems of the study area

A regional survey was undertaken in the Pilbara region between 1995 and 1999 by the Department of Agriculture (now the Department of Agriculture and Food) and the Department of Land Administration (now Landgate) to develop a comprehensive description of the biophysical resources and assess the vegetation composition and soil condition within the region. This information was used by Van Vreeswyk et al. (2004) to classify and map the land systems of the Pilbara region according to similarities in landform, soil, vegetation, geology and geomorphology. An assessment of land systems provides a broad-scale indication of the occurrence and distribution of fauna habitats present within and surrounding the Mt Dove study area.

The Mt Dove study area contains three land systems: Mallina, Ruth and Uaroo. The characteristics and extent of these land systems are summarised in **Table 1** and are mapped in **Figure 6**. Of these three land systems, the Ruth land system is likely to be of particular significance to conservation significant fauna occurring within the study area. This land system, which consists of hills and ridges of volcanic and other rocks supporting hard Spinifex, is likely to support Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), Ghost Bat (*Macroderma gigas*) and Rothschild's Rock-wallaby (*Petrogale rothschildi*), with Western Pebble-mound Mouse (*Pseudomys chapmani*) likely to be present on stony slopes.

Occurrences of the Ruth land system are isolated within the study area and surrounds. Mt Dove occurs within this land system. Although it is scattered throughout the study area and surrounds, not all of the occurrences of the Ruth land system are equivalent. Mt Dove is approximately 750 m in length, 250 m in width and stands approximately 70 m above the surrounding plains with no similar features within a 12 km radius. Additionally, it is unique in that it possesses ironstone outcropping and caves that are not present within the other occurrences of Ruth land system within the study area and surrounds, thereby highlighting the broad scale at which land systems are mapped. Finer scale mapping of specific fauna habitats is presented in Section 4.1.

Table 1: Land systems and their occurrence within the Mt Dove study area

Land system	Brief Description	Area within study area (ha)	Proportion of study area (%)	Extent within Chichester sub-bioregion (ha)
Mallina	Sandy surfaced alluvial plains supporting soft Spinifex (and occasionally hard Spinifex) grasslands.	871	16.7	196 266
Ruth	Hills and ridges of volcanic and other rocks supporting hard Spinifex (occasionally soft Spinifex) grasslands)	274	5.2	137 145
Uaroo	Broad sandy plains supporting shrubby hard and soft Spinifex grasslands.	4 079	78.1	488 731
	Total	**5 224**	**100**	**822 142**

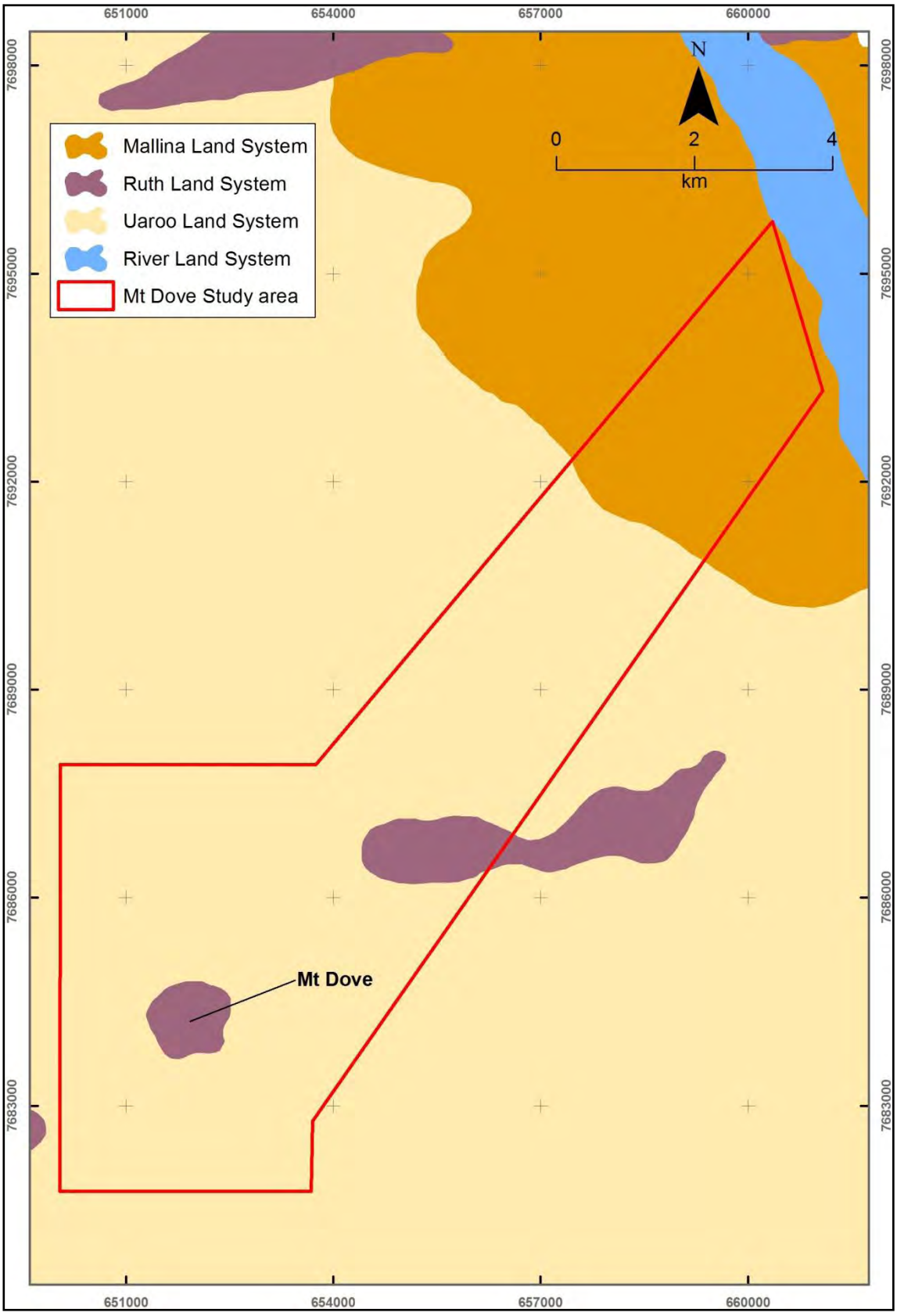

Figure 6: Land systems occurring within the Mt Dove study area

2.4 Land Use

Land tenure in the Pilbara consists primarily of pastoral leases, with other crown reserves such as Aboriginal reserves and leasehold reserves also forming a large proportion. National parks and reserves and unallocated crown land are the other major land use categories present in the region. The first mining exploration in the Pilbara commenced in the early 1800s and currently this area provides the majority of Western Australia's petroleum, gas and iron ore exports, while gold mining is also an important industry (Australian Natural Resources Atlas 2007).

In the Chichester subregion, the dominant land uses are pastoralism (i.e. grazing of native pasture by cattle), Aboriginal lands and reserves, unallocated crown land (UCL) and crown reserves, conservation, and mining (Kendrick and McKenzie 2001). The Chichester subregion has 6.56% of its land surface reserved under some form of conservation. The subregion contains Millstream-Chichester National Park, Mungaroona Range Nature Reserve and Meentheena ex-pastoral lease (Kendrick and McKenzie 2001).

Mungaroona Range Nature Reserve is the only substantial portion of the conservation estate that exists near the Mt Dove study area (**Figure 7**). Knowledge of the fauna of this nature reserve is limited (Department of Environment and Conservation 2007). It is proposed that all of the Mungaroona Range Nature Reserve will be gazetted as ‗wilderness' under the *Conservation and Land Management Act 1984*. The Department of Environment and Conservation (DEC) considers the Mungaroona Range Nature Reserve warrants gazettal as a wilderness area based on the following criteria:

- The reserve more than exceeds the minimum size criterion of 20 000 hectares;
- There is currently no vehicle access into the reserve, no built infrastructure and visitation to the reserve is exceptionally low; and
- Given the reserve's considerable remoteness and lack of impacts from modern technological society, much of the area's biodiversity and natural systems are likely to be intact (DEC, 2007).

In relation to land tenure, the Project is located on the Mt Dove exploration licence (E47/891) and lies entirely within the Indee Pastoral Lease (3114/1197). Land use across the study area includes exploration activities and cattle grazing (**Figure 7**).

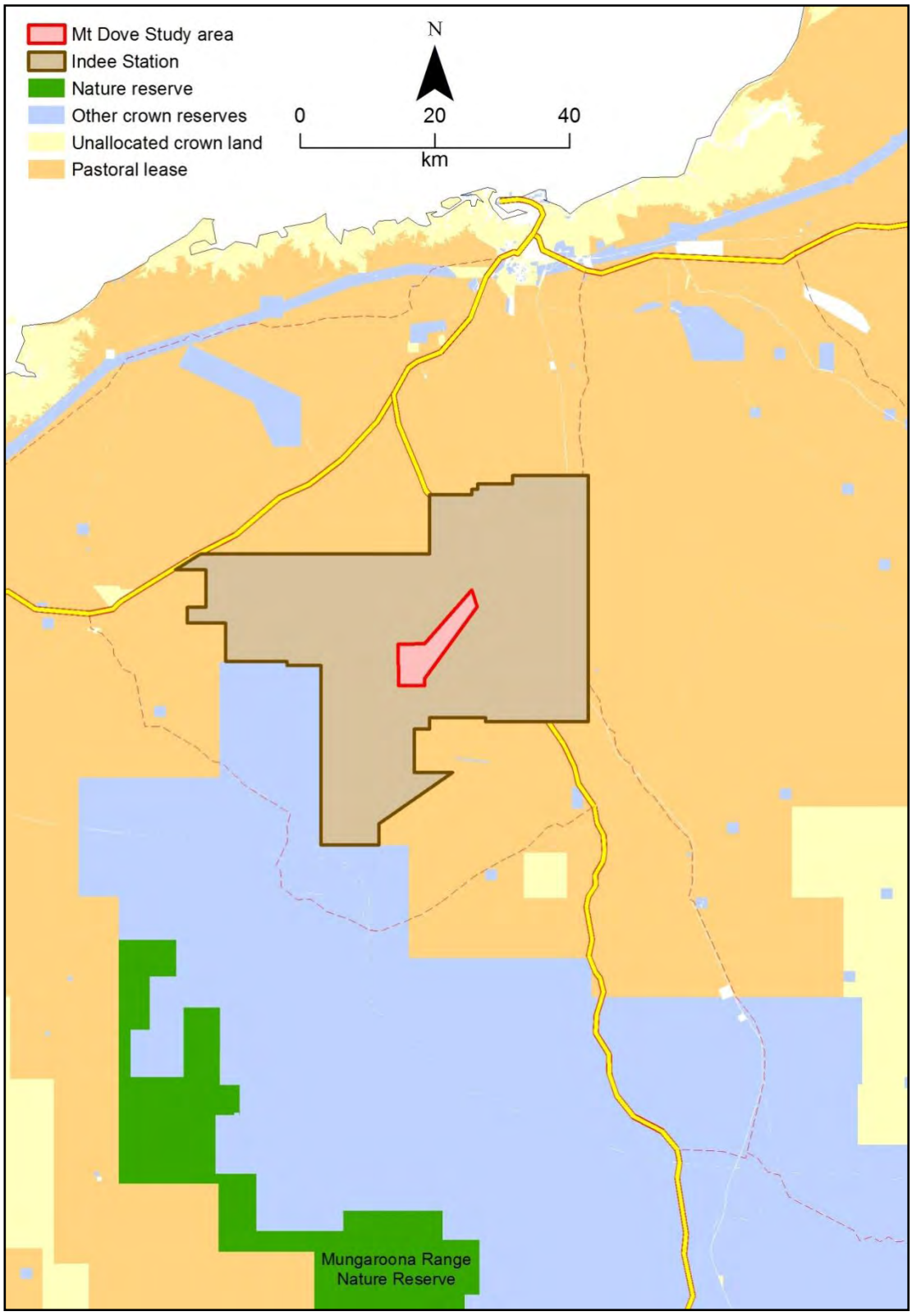

Figure 7: Land use surrounding the Mt Dove study area

3. SURVEY ASSESSMENT AND METHODOLOGY

The methods used to assess the potential impacts on terrestrial vertebrate fauna during this assessment include database searches (Section 3.1), a literature review (Section 3.2) and field surveys (Section 3.3).

3.1 Database Searches

Database searches were undertaken prior to the field surveys to develop a list of potential mammal, bird, reptile and amphibian species occurring in the study area. The search area consisted of a 50 km buffer around the study area. Database searches of these areas were made using the following databases and internet tools:

- The WA DEC's NatureMap database (Department of Environment and Conservation 2010a);
- DEC's Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) Lists (Department of Environment and Conservation 2010b);
- DEC's Threatened and Priority Fauna Database (Department of Environment and Conservation 2010c);
- The Birds Australia New Atlas 1998 – 2010 database (Birds Australia 2010);
- The Australian Museum database (Australian Museum 2010);
- The Environmental Reporting Tool (Department of Sustainability Environment Water Population and Communities 2010a) and Protected Matters Search Tool (Department of Sustainability Environment Water Population and Communities 2010b).

Presence of fauna species recorded in regional summary documents was also considered in this report. Documents included:

- A Biodiversity Audit of Western Australian's 53 Biogeographical Subregions (Kendrick and McKenzie 2001, Kendrick and Stanley 2001);
- The Australian Natural Resources Atlas (Australian Natural Resources Atlas 2007) of the National Land and Water Resources Audit;
- Birds of the Pilbara Region, Western Australia (Storr 1984); and
- Environmental Associations of small ground-dwelling mammals in the Pilbara region, Western Australia (Gibson and McKenzie 2009).

3.2 Literature Review

A literature review was undertaken to provide a list of mammals, birds, reptiles, amphibians and fish species that have been previously recorded within the vicinity of the study area and wider surrounds for regional context. The following two sections distinguish between those surveys that were conducted within close proximity of the study area (~ 15 km) (Section 3.2.1) and those that were conducted in the wider surrounds (Section 3.2.2). These surveys are described below and the location of each study area (where

available) is shown in **Figure 8**. A list of vertebrate fauna species recorded in each survey is presented in **Attachment A**.

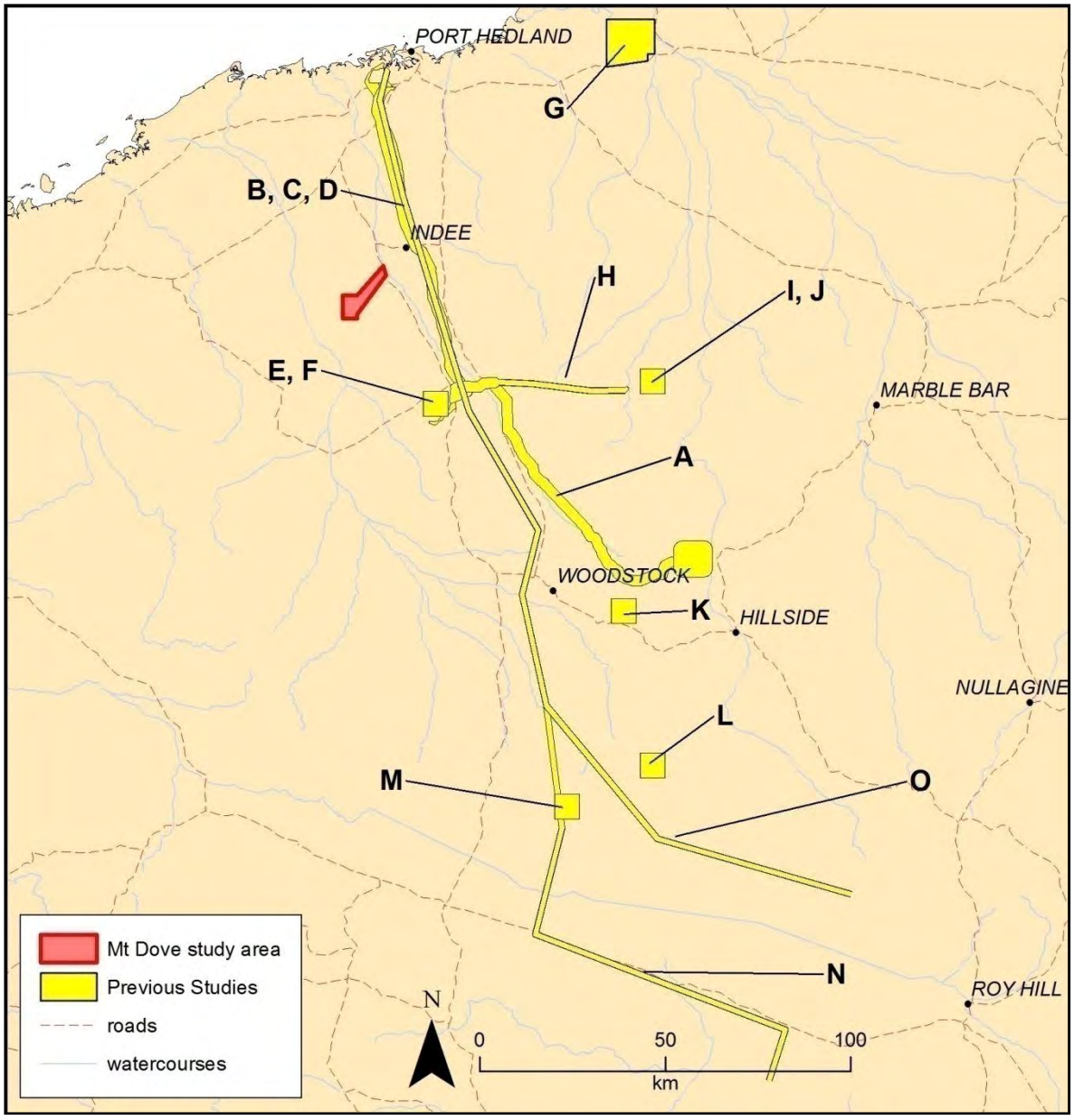

Figure 8: Location of previous fauna surveys within the surrounding region

Table 2: Key to map of location of previous fauna surveys within the surrounding region

Map Label	Reference
A	Outback Ecology (2010b). Turner River Hub Terrestrial Vertebrate Fauna Assessment, Prepared for Atlas Iron Limited (in preparation).
B (nth) N (sth)	Biota (2002b). Proposed Hope Downs Rail Corridor From Weeli Wolli Siding to Port Hedland: Vertebrate Fauna Survey.
C	Biota (2002a). An Assessment of the Distribution of the Mulgara and Bilby Along and Adjacent to the Proposed Hope Downs to Port Hedland Rail Corridor.
D (nth) O (sth)	Biota (2004). Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor.
E	Mattiske Consulting Pty Ltd. (2000). Flora, Vegetation and Vertebrate Fauna of the Proposed Expansion at Wodgina, Prepared for Sons of Gwalia Ltd.
F	Outback Ecology Services (2009). Wodgina DSO Stage 1 Project: Terrestrial Vertebrate Fauna Assessment, Prepared for Atlas Iron Limited.
G	Bamford Consulting Ecologists (2007). Fauna Assessment of the Pardoo Direct Shipping Ore Project Atlas Iron Limited, Prepared for Enesar Consulting Pty Ltd.
H	Bamford Consulting Ecologists. (2009). Fauna Assessment of the Abydos DSO Project, Prepared for Atlas Iron Limited.
I	Bamford Consulting Ecologists (2001). Panorama Project Area: Baseline Fauna Study as Part of the Sulphur Springs Feasibility Study, Prepared for Astron Environmental.
J	Biota (2007). Panorama Project: Mine Site and Haul Road Corridor Targeted Fauna Survey, Prepared for CBH Resources.
K	How, R. A., Dell, J. and Cooper, N. K. (1991). Ecological Survey of Abydos-Woodstock Reserve, Western Australia: Vertebrate Fauna. Records of the Western Australian Museum Supplement 37: 78-125.
L	Ninox Wildlife Consulting (2009a). A Fauna Survey of the Proposed Hope Downs 4 Mining Area Near Newman, Western Australia. Prepared for Mattiske Consulting Pty Ltd on behalf of Pilbara Iron Company (Services) Pty Ltd.
L	Ninox Wildlife Consulting (2009b). A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor: Option 1 Near Newman, Western Australia. Prepared for Mattiske Consulting Pty Ltd on behalf of Pilbara Iron Company (Services) Pty Ltd.
L	Ninox Wildlife Consulting (2009c). A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Option 6 Infrastructure Corridor Near Newman, Western Australia. Prepared for Mattiske Consulting Pty Ltd on behalf of Pilbara Iron Company (Services) Pty Ltd.
M	ecologia (2008). RGP 5 Level 2 Fauna Survey: Chichester Deviation. A report commissioned by BHP Billiton Iron Ore Pty Ltd.

3.2.1 Fauna Surveys near the study area

Several terrestrial vertebrate fauna surveys have been conducted previously near the study area. A brief synopsis of a select set of relevant surveys is presented in chronological order below with data from these surveys summarised in **Attachment A**.

Outback Ecology (2010) Turner River Hub Terrestrial Vertebrate Fauna Assessment. Prepared for Atlas Iron Ltd (in prep)

This fauna survey encompassed the Turner River Hub Project, which extends from Port Hedland to Mount Webber, east of Marble Bar (**Figure 8**). The field surveys for this assessment were conducted during April/May 2010 and September/October 2010. This study area passes approximately 15 km east of the Mt Dove study area. The fauna assessment incorporated a variety of sampling techniques including pitfall traps, Elliott traps, funnel traps, and cage traps, systematic hand searching, targeted searching, AnaBat echolocation recording, motion sensor camera trapping and avifauna census.

Fourteen major habitats were identified during this assessment comprising Spinifex Sandplain, Spinifex Stony Plain, Stony Rise, Rocky Foothills, Rocky Ridges and Gorges, Acacia, Spinifex on Sandplain, Low Acacia Heath with Spinifex, Riverine, Hard Spinifex on Calcrete, Granite Uplands, Granite Outcrop, Drainage Line, Channel Iron Deposit and Mangrove Forest.

A total of 228 vertebrate fauna species were recorded, comprising 32 mammals, 105 birds, 80 reptiles, seven amphibians and four fish.

Twelve conservation significant vertebrate fauna species were recorded from this survey, comprising:

- One species listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and Schedule 1 under the WA *Wildlife Conservation Act, 1950* (WC Act), the Northern Quoll (*Dasyurus hallucatus*);
- Two species listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act, the Pilbara Olive Python (*Liasis olivaceous barroni*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*);
- One species listed as Priority 1 Fauna on the DEC Priority Species List, *Ramphotyphlops ganei* (a blind snake*)*;
- One species listed as Priority Three Fauna on the DEC Priority Species List, Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*);
- Five species listed as Priority 4 on the DEC Priority Species List, Brush-tailed Mulgara (*Dasycercus blythi*), Ghost Bat (*Macroderma gigas*); Western Pebble-mound Mouse (*Pseudomys chapmani*); Australian Bustard (*Ardeotis australis*); and Bush Stone-curlew (*Burhinus grallarius*); and
- Two species listed as Migratory under the EPBC Act; Rainbow Bee Eater (*Merops ornatus*) and Whimbrel (*Numenius phaeopus*).

Biota (2002b) Proposed Hope Downs Rail Corridor From Weeli Wolli Siding to Port Hedland - Vertebrate Fauna Survey

This fauna survey was conducted on the Hope Downs Rail Corridor from Port Hedland to Weeli Wolli siding in April and June 2001. The study area assessed for this proposed rail corridor passes approximately 15 km east of the Mt Dove study area. The fauna assessment incorporated a variety of

sampling techniques including pitfall traps, Elliott traps, funnel traps, and cage traps, systematic hand searching, targeted searching, AnaBat echolocation recording, harp trapping for bats and avifauna census.

Six habitats were identified during this assessment comprising of sand dune, Fortescue basin flats, cracking clay, major drainage lines, granite rock piles, and mangrove and mudflats.

A total of 243 vertebrate fauna species were recorded, comprising 39 mammals, 125 birds, 73 reptiles and six amphibians.

Twelve conservation significant vertebrate fauna species were recorded from this survey, comprising:

- Two species listed as Endangered under the EPBC Act and Schedule 1 under the WC Act, the Northern Quoll (*Dasyurus hallucatus*) and Mulgara (*Dasycercus cristicauda*) (burrows, diggings and tracks only);
- One species listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act, the Bilby (*Macrotis lagotis* – burrows only);
- Two species listed as Schedule 4 under the WC Act, the Peregrine Falcon (*Falco peregrinus*) and Woma (*Aspidites ramsayi*); and
- Seven species listed as Priority 4 on the DEC Priority Species List, the Ghost Bat (*Macroderma gigas*); Lakeland Downs Mouse (*Leggadina lakedownensis*); Western Pebble-mound Mouse (*Pseudomys chapmani*); Australian Bustard (*Ardeotis australis*); Bush Stone-curlew (*Burhinus grallarius*); Eastern Curlew (*Numenius madagascariensis*); and Pin-striped Finesnout Ctenotus (*Ctenotus nigrilineatus*).

Biota (2002a) An Assessment of the Distribution of the Mulgara (Dasycercus cristicauda) and Bilby (Macrotis lagotis) along and adjacent to the Proposed Hope Downs to Port Hedland Rail Corridor

This Level 1 targeted fauna assessment surveyed areas where evidence of Bilby and Mulgara had been recorded during a previous survey of the proposed rail corridor study area. Thirty separate locations comprising of over 200 individual data points corresponding to Mulgara activity were recorded. Field investigations confirmed that the primary habitat for the Mulgara in the study area comprised sandy or sandy clay plains dominated by *Triodia*. Two additional Bilby diggings were recorded from the same locality as previously recorded in Spinifex hummock grassland.

Biota (2004) Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor

This study area assessed during this fauna survey encompassed the FMG Stage A Rail Corridor. The survey was undertaken between March and April 2004. The FMG rail corridor passes approximately 10 km east of the Mt Dove study area. This fauna assessment incorporated a variety of sampling techniques including pitfall traps, Elliott traps, funnel traps, cage traps, hand searching and avifauna census.

Thirteen vegetation types occurred within the study area, comprising Littoral Vegetation – shrub dominated; Sandy Plain Vegetation – Spinifex dominated; Sandy Plain Vegetation – Tree/shrub dominated; Stony Plain and Hill Vegetation – Spinifex dominated; Drainage and Sandy Plain Vegetation – Tree/shrub dominated; Minor Creeklines, Drainage Areas and Floodplains; Granite Outcrop Vegetation; Granite Ridge Vegetation; Quartz Ridge Vegetation; Dolerite Dyke Vegetation; Cracking Clay Vegetation; Vegetation of Clayey/Sandy Plains; and Sand Dune Vegetation.

A total of 176 vertebrate species were recorded, comprising 25 mammals, 84 birds, 58 reptiles, six amphibians and three fish.

Six conservation significant vertebrate fauna species were recorded from this survey, comprising:

- Mulgara (*Dasycercus cristicauda*) (EPBC Act – Endangered; WC Act – Schedule 1);
- Peregrine Falcon (*Falco peregrinus*) (WC Act - Schedule 4); and
- Four species listed as Priority 4 under the DEC Priority List: Lakeland Downs Mouse (*Leggadina lakedownensis*); Australian Bustard (*Ardeotis australis*); Bush Stone-curlew (*Burhinus grallarius*); and Grey Falcon (*Falco hypoleucos*).

3.2.2 Fauna Surveys in the region

The following surveys have been conducted in the region surrounding the Mt Dove study area.

Bamford Consulting Ecologists (2007) Pardoo Direct Shipping Ore Project Fauna Assessment

Bamford Consulting conducted this fauna survey in April 2007. The study area assessed during this survey is located 80 km north-east of the Mt Dove study area. This fauna assessment consisted of a literature review and an extended site inspection with the key objectives of documenting the vertebrate fauna and habitats present within the study area, assessing their conservation significance, and identifying potential impacts from the proposed operations.

Five fauna habitat types occurred within the study area including Spinifex plains, major watercourses, ephemeral drainage lines, rocky hills and gorges and gullies.

A total of 89 vertebrate species were recorded, comprising of 12 mammals, 51 birds, 21 reptiles, four amphibians and one fish.

Five conservation significance fauna species were recorded in the study area;

- Northern Quoll (*Dasyurus hallucatus*) (EPBC Act - Endangered; WC Act – Schedule 1);
- Mulgara (*Dasycercus cristicauda*) burrows (EPBC Act – Endangered; WC Act – Schedule 1);
- Pilbara Olive Python (*Liasis olivaceus barroni)* (EPBC Act – Vulnerable; WC Act – Schedule 1);
- Peregrine Falcon (*Falco peregrinus)* (WC Act - Schedule 4); and

- Western Pebble-mound Mouse (*Pseudomys chapmani*) (DEC - Priority 4).

Mattiske Consulting (2000) Flora, Vegetation and Vertebrate Fauna of the Proposed Expansion at Wodgina

This Level 1 fauna assessment reviewed the terrestrial fauna potentially occurring at the Wodgina Tantalum Project, located 35 km south-east of Mt Dove. The purpose of this assessment was to identify the potential impacts of the proposed expansion of the Wodgina Tantalum Mine on local fauna assemblages and habitat. The emphasis of this report was on the flora and vegetation of the area and only provided a cursory discussion of potential fauna.

Five key fauna habitats were described including Eucalyptus woodlands, Acacia shrublands, hummock grasslands, adits and caves, and water bodies.

Four conservation significant fauna species were identified as possibly occurring in the area, comprising the Peregrine Falcon (*Falco peregrinus*), Grey Falcon (*Falco hypoleucos*), Woma (*Aspidites ramsayi*) and Pilbara Olive Python (*Liasis olivaceus barroni*).

Outback Ecology Services (2009) Wodgina DSO Project: Terrestrial Vertebrate Fauna Assessment

A detailed Level 2 survey was conducted over the Wodgina DSO Project study area in April 2009. This study area was located approximately 35 km to the south-east of Mt Dove. This survey incorporated a variety of sampling techniques including pitfall traps, Elliott traps, funnel traps, and cage traps, systematic hand searching, targeted searching, spotlighting, AnaBat echolocation recording and avifauna census.

A total of 90 species were recorded, comprising 18 mammals, 45 birds, 25 reptiles and two amphibians.

Six conservation significant fauna species were recorded within this study area, comprising:

- Northern Quoll (*Dasyurus hallucatus*) (EPBC Act - Endangered; WC Act – Schedule 1);
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (EPBC Act - Vulnerable; WC Act – Schedule 1);
- Three species listed as Priority 4 under the DEC Priority List: Western Pebble-mound Mouse (*Pseudomys chapmani*); Ghost Bat (*Macroderma gigas*); and Long-tailed Dunnart (*Sminthopsis longicaudata*); and
- Rainbow Bee-eater (*Merops ornatus*) (EPBC Act – Migratory).

Fourteen Ghost Bat roost locations were recorded within the Wodgina DSO Stage 1 Project study area of which, four were considered significant roost sites supporting large numbers of Ghost Bats. The four significant roost sites all occurred outside of the Wodgina DSO Stage 1 Project disturbance area.

Bamford Consulting Ecologists (2009) Fauna Assessment of the Abydos DSO Project

This fauna assessment involved two detailed field surveys of the Abydos DSO Project study area in October 2008 and April 2009. Abydos is located approximately 70 km east south-east of Mt Dove. The surveys incorporated a variety of sampling techniques including pitfall trapping, Elliott traps, funnel traps, cage traps, systematic hand searching, targeted searching, spotlighting, AnaBat echolocation recording and avifauna census.

The study area comprised thirteen fauna habitats including ironstone ridges, sandstone ridges, major gorges, cliff faces, major drainage lines, permanent water holes and springs, caves, stony lower slopes and undulating stony plains, Spinifex plains on sand/loam soil, low rounded hills, minor gorges and gullies, and cracking clay drainage.

A total of 125 vertebrate fauna species were recorded, comprising 17 mammals, 72 birds, 30 reptiles, four amphibians and two fish species.

A total of eight significant vertebrate species were recorded from Abydos, comprising:

- Northern Quoll (*Dasyurus hallucatus*) (EPBC Act - Endangered; WC Act – Schedule 1);
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (EPBC Act - Vulnerable; WC Act – Schedule 1);
- Pilbara Olive Python (*Liasis olivaceus barroni)* (EPBC Act – Vulnerable; WC Act – Schedule 1);
- Four species listed as Priority 4 under the DEC Priority List: Bush Stone-curlew (*Burhinus grallarius*), Western Pebble-mound Mouse (*Pseudomys chapmani*), Ghost Bat (*Macroderma gigas*) and Australian Bustard (*Ardeotis australis*); and
- Rainbow Bee-eater (*Merops ornatus*) (EPBC Act – Migratory).

A highly significant maternity roost of Ghost Bats was recorded during these surveys as well as six additional roosts, two containing regionally high number of bats.

Bamford Consulting Ecologists (2001) Panorama Project Area: Baseline Fauna Study as Part of the Sulphur Springs Feasibility Study

The Panorama study area is located approximately 80 km to the east of Mt Dove. This comprehensive fauna assessment was conducted over two periods: June and September 2001. Survey methods included: systematic trapping for amphibians, reptiles and mammals; census for birds; spotlighting for nocturnal reptiles, birds and mammals; mist-netting, harp trapping and ultra-sonic detecting for bats; and active searches.

The Panorama study area was considered a locally significant example of a Pilbara landscape possessing rocky hills, small gorges and undulating plains. Rocky hills, gorges and cliff-lines were identified as important habitat for mammals, reptiles and birds, including Ghost Bats (*Macroderma gigas*) and Peregrine

Falcons (*Falco peregrinus*). Although limited in extent, watercourses and riparian vegetation were also considered highly significant fauna habitats.

A total of 137 species were recorded during the surveys, comprising 22 mammals, 80 birds, 29 reptiles, two amphibians and four fish species.

Conservation significant fauna recorded during the survey included:

- Northern Quoll (*Dasyurus hallucatus*) (EPBC Act - Endangered; WC Act – Schedule 1);
- Mulgara (*Dasycercus cristicauda*) burrows (EPBC Act – Endangered; WC Act – Schedule 1);
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (EPBC Act - Vulnerable; WC Act – Schedule 1);
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) (DEC - Priority 3);
- Four species listed as Priority 4 under the DEC Priority List: Western Pebble-mound Mouse (*Pseudomys chapmani*), Ghost Bat (*Macroderma gigas*), Australian Bustard (*Ardeotis australis*), and Bush Stone-curlew (*Burhinus grallarius*).

Biota (2007) Panorama Project: Mine Site and Haul Road Corridor Targeted Fauna Survey

A Level 2 survey was conducted to assess the haul road associated with the Panorama project. The survey incorporated a variety of sampling techniques including pitfall trapping, Elliott traps, harp traps, avifauna census and opportunistic recording.

The study area encompassed two habitat types: a narrowly incised valley supporting mid-dense to dense riparian vegetation and small to medium sized pools of water; and low stony hills, vegetated with *Triodia* hummock grasslands.

The survey recorded a total of 73 vertebrate fauna species, comprising 12 mammals, 41 birds, 18 reptiles and two amphibians.

Conservation significant fauna recorded during the survey included:

- Northern Quoll (*Dasyurus hallucatus*) (EPBC Act - Endangered; WC Act – Schedule 1);
- Mulgara (*Dasycercus cristicauda*) burrows (EPBC Act – Endangered; WC Act – Schedule 1);
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (EPBC Act - Vulnerable; WC Act – Schedule 1);
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) (DEC - Priority 3); and
- Four species listed as Priority 4 under the DEC Priority List: Western Pebble-mound Mouse (*Pseudomys chapmani*), Ghost Bat (*Macroderma gigas*), Australian Bustard (*Ardeotis australis*), and Bush Stone-curlew (*Burhinus grallarius).*

How et al. (1991) Ecological Survey of Abydos-Woodstock Reserve, Western Australia

This publication represented the first major survey of the region and was conducted by the Western Australian Museum (WAM). The survey sought to determine the richness and diversity of vertebrate fauna and identify unique fauna communities of conservation value within the Abydos-Woodstock Reserve, located approximately 100 km to the south-east of the Mt Dove study area.

Sampling of vertebrate fauna was conducted over nine sessions during a two and a half year period. Sampling techniques included pitfall and Elliott traps, mist nets, active searches and avifauna censuses. A total of 179 vertebrate fauna species were recorded, comprising 14 mammals, 92 birds, 68 reptiles and five amphibian species. Fauna abundance remained reasonably consistent across different habitats and seasons, although species composition varied significantly. Further, species richness was seen to decrease substantially after fire, particularly for mammals.

The Abydos-Woodstock Reserve was found to be depauperate in avifauna, due largely to the lack of free-standing water and mulga plains, which are known to support a greater diversity in the southern Pilbara. Rocky slope, ridge, plateau and rockpile habitats were deemed of particular importance to mammal and reptile assemblages.

Conservation significant fauna recorded during the survey included:

- Northern Quoll (*Dasyurus hallucatus*) (EPBC Act - Endangered; WC Act – Schedule 1);
- Mulgara (*Dasycercus cristicauda*) burrows (EPBC Act – Endangered; WC Act – Schedule 1);
- Pilbara Olive Python (*Liasis olivaceus barroni)* (EPBC Act – Vulnerable; WC Act – Schedule 1);
- Common Slender Blue-tongue (*Cyclodomorphus branchialis*) (WC Act -Schedule 1);
- *Ctenotus nigrilineatus* (DEC - Priority 1);
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) (DEC - Priority 3); and
- Four species listed as Priority 4 under the DEC Priority List: Western Pebble-mound Mouse (*Pseudomys chapmani*), Ghost Bat (*Macroderma gigas*), Bush Stone-curlew (*Burhinus grallarius*), and Australian Bustard (*Ardeotis australis*); and
- Three migratory species listed under the EPBC Act, Common Greenshank (*Tringa nebularia*), Fork-tailed Swift (*Apus pacificus*), and Rainbow Bee-Eater (*Merops ornatus*).

Ninox Wildlife Consulting (2009a) A Fauna Survey of the Proposed Hope Downs 4 Mining Area Near Newman, Western Australia

The study area for this survey is located 140 km south-east of Mt Dove. Two detailed surveys were conducted as part of this assessment, in May and September 2008. The surveys incorporated a variety of sampling techniques including: pitfall, Elliott, funnel and cage traps; harp trap and AnaBat echolocation recordings for bats; targeted searching; and avifauna census.

Four broad habitat types were identified from vegetation associations comprising Spinifex with Eucalypts, Ridges and Ranges (two categories), and Mulga Groves.

A total of 71 vertebrate fauna species were recorded during the May survey, comprising six mammals, 19 reptiles and 46 birds. A total of 84 fauna species were recorded in the September 2008 survey, comprising seven mammals, 22 reptiles and 55 birds.

Three species of conservation significance were recorded during the 2008 surveys, comprising:

- Western Pebble-mound Mouse (*Pseudomys chapmani*) (DEC- Priority 4);
- Australian Bustard (*Ardeotis australis*) (DEC - Priority 4); and
- Rainbow Bee-eater (Merops ornatus) (EPBC Act - Migratory).

Ninox Wildlife Consulting (2009b) A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor: Option 1 Near Newman, Western Australia

The Hope Downs Infrastructure Corridor: Option 1 study area was located approximately 140 km south-east of Mt Dove. A detailed survey was undertaken over this study area in May 2008. Fauna sampling techniques included pitfall traps, Elliott traps, AnaBat echolocation recording for bats, opportunistic records and avifauna census.

The four major plant communities defined in this survey included grassland with emergent mulga on cracking clays, low open mulga woodland on sandy loam and plains, Triodia hummock grassland on gravely soils, and open Eucalypt woodland on major creeklines.

A total of 71 species were recorded during this survey comprising 11 mammal, 37 bird and 23 reptile species.

Two species of conservation significance were recorded:

- Western Pebble-mound Mouse (*Pseudomys chapmani*) (DEC - Priority 4); and
- Australian Bustard (*Ardeotis australis*) (DEC - Priority 4).

Ninox Wildlife Consulting (2009c) A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Option 6 Infrastructure Corridor Near Newman, Western Australia

The study area assessed for the proposed Hope Downs 4 Option 6 infrastructure corridor is located 140 km south-east of Mt Dove. Two detailed surveys were conducted as part of this assessment, a spring survey in September 2008 and an autumn survey in April 2009. The surveys incorporated a variety of sampling techniques including: pitfall, Elliott, funnel and cage traps; AnaBat echolocation recordings for bats; targeted searching; and avifauna census.

Three significant fauna habitats were identified within the study area including riverine woodlands, spinifex grasslands and mulga woodlands.

A total of nine species of bat and 10 non-volant mammal species were recorded from the September 2008 and April 2009 surveys. Thirty-two species of reptile were recorded during this September 2008 survey and 41 species in April 2009. One amphibian species was recorded in September 2008 and no frogs were recorded April 2009. A total of 62 avifauna species were recorded over both seasons; 47 were recorded in September 2008 and 44 in April 2009.

Two fauna species of conservation significance were recorded in the study area, the Australian Bustard (*Ardeotis australis*) (DEC – Priority 4) and the Western Pebble-mound Mouse (*Pseudomys chapmani*) (DEC – Priority 4). No conservation significant reptile or amphibian species were recorded during these surveys.

ecologia (2008) RGP 5 Level 2 Fauna Survey: Chichester Deviation

The study area assessed for the Chichester Deviation of the BHP Billiton rail corridor is located 140 km south south-east of Mt Dove. Fauna sampling techniques implemented during the survey included: pitfall traps, Elliott traps, funnel traps, and cage traps; systematic hand searching; targeted searching; spotlighting; AnaBat echolocation recording for bats; and avifauna census.

Six broad fauna habitats were identified during this survey comprising, Mulga woodland over spinifex hummocks; Open woodland over dense grass hummocks; Rocky hill slope regenerating after fire; Open woodland over dense understorey on rocky ground; Rocky hill side with dense spinifex hummocks; and burnt mulga woodland, open canopy with regenerating spinifex.

Three conservation significant fauna species were recorded during this survey, comprising:

- Ghost Bat (*Macroderma gigas*) (DEC -Priority 4);
- Lakeland Downs Mouse (*Leggadina lakedownensis*) (DEC -Priority 4); and
- Western Pebble-mouse (*Pseudomys chapmani*) (DEC -Priority 4).

3.3 Fauna Survey Methodology

A reconnaissance survey and two detailed vertebrate fauna surveys were conducted for this assessment. The reconnaissance survey was conducted from the 23 – 24 March 2010, with the primary purpose of ground truthing fauna habitat types and survey site selections prior to the trapping surveys. This section details the methodology used during the detailed fauna surveys conducted in autumn and spring 2010.

3.3.1 Survey Timing and Weather

The detailed autumn survey was conducted from the 19 - 30 May 2010. Maximum temperatures recorded from the Port Hedland Airport meteorological station (closest official weather station) during this survey ranged between 28.1 ºC and 31.0 ºC, with minima between 13.0 ºC and 23.8 ºC (BOM, 2010; **Table 3**). The mean maximum and minimum temperatures recorded during the survey period were 29.7 ºC and 17.6 ºC, respectively (BOM, 2010). The total rainfall received during the survey period was 19.2 mm (BOM, 2010; **Table 3**), with all of this rain falling on the first day of the survey.

The detailed spring survey was conducted from the 3 - 12 September 2010. Maximum temperatures recorded during this survey ranged between 27.6 ºC and 31.3 ºC, with minima between 9.7 ºC and 22.0 ºC (BOM, 2010; **Table 3**). The mean maximum and minimum temperatures recorded during the survey period were 28.7 ºC and 16.7 ºC, respectively (BOM, 2010). The total rainfall received during the survey period was 4 mm (BOM, 2010; **Table 3**).

Weather conditions experienced during both the autumn and spring 2010 survey periods were considered appropriate to conduct the fauna survey. However, rainfall recorded during the six months prior to May was less than the long-term average (**Figure 9**), potentially resulting in a reduction in fauna activity recorded during that survey. Conversely, rainfall recorded in the six months prior to the spring survey (September 2010) was comparable to the long term average (**Figure 10**), with a peak two months prior to the survey.

Table 3: Daily weather observations for the autumn and spring 2010 survey periods

Date	Temperature Min (°C)	Temperature Max (°C)	Relative Humidity (9am, %)	Rainfall (mm)
2010 Autumn Survey				
19/05/2010	23.8	30.2	88	19.2
20/05/2010	19.6	31	54	0
21/05/2010	18.8	29.9	56	0
22/05/2010	20	29.9	60	0
23/05/2010	22.4	30.3	52	0
24/05/2010	16.9	29.6	33	0
25/05/2010	15	28.8	25	0
26/05/2010	13	29.9	22	0
27/05/2010	16.1	30	30	0
28/05/2010	14.9	28.6	31	0
29/05/2010	16	28.1	31	0
30/05/2010	14.5	29.9	24	0
2010 Spring Survey				
3/09/2010	13.3	28.1	35	0
4/09/2010	13.3	27.7	22	0
5/09/2010	12.8	29.1	19	0
6/05/2010	9.7	28.9	13	0
7/05/2010	17.6	27.6	19	0
8/05/2010	16.3	29.7	34	0
9/05/2010	21.9	31.3	46	0
10/05/2010	20.3	28.9	38	0.4
11/05/2010	22	27.7	39	0
12/05/2010	19.9	28	76	3.4

Data source: Port Hedland Airport (BOM, 2010)

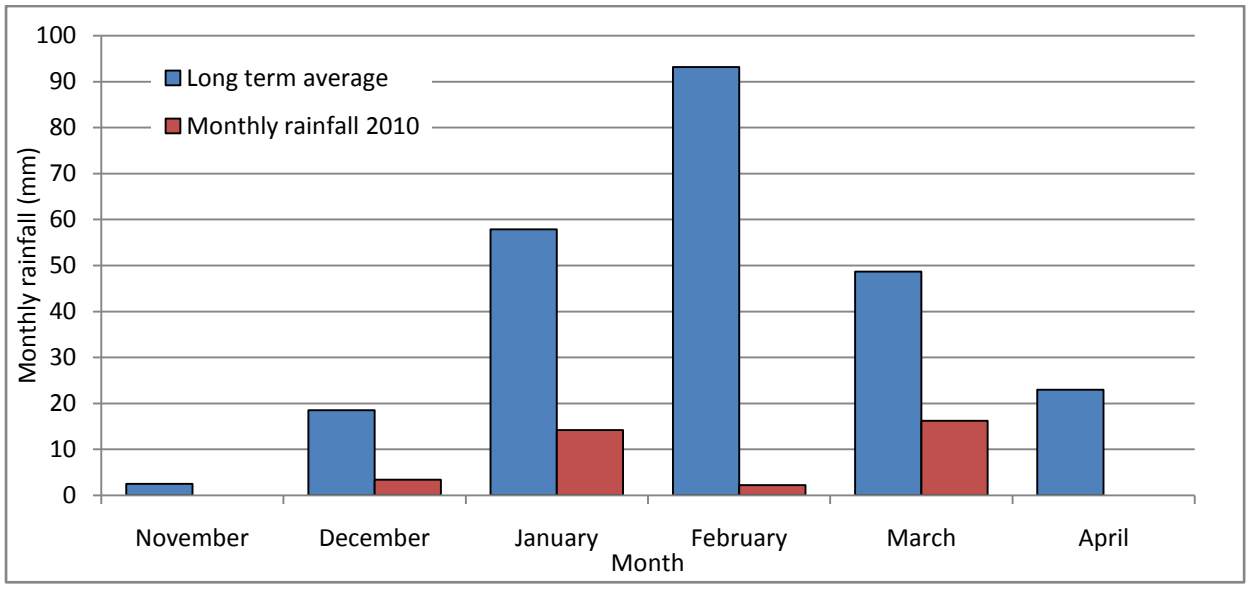

Figure 9: Rainfall occurring at Port Hedland Airport during the six months prior to May 2010 vs. the long term climate average

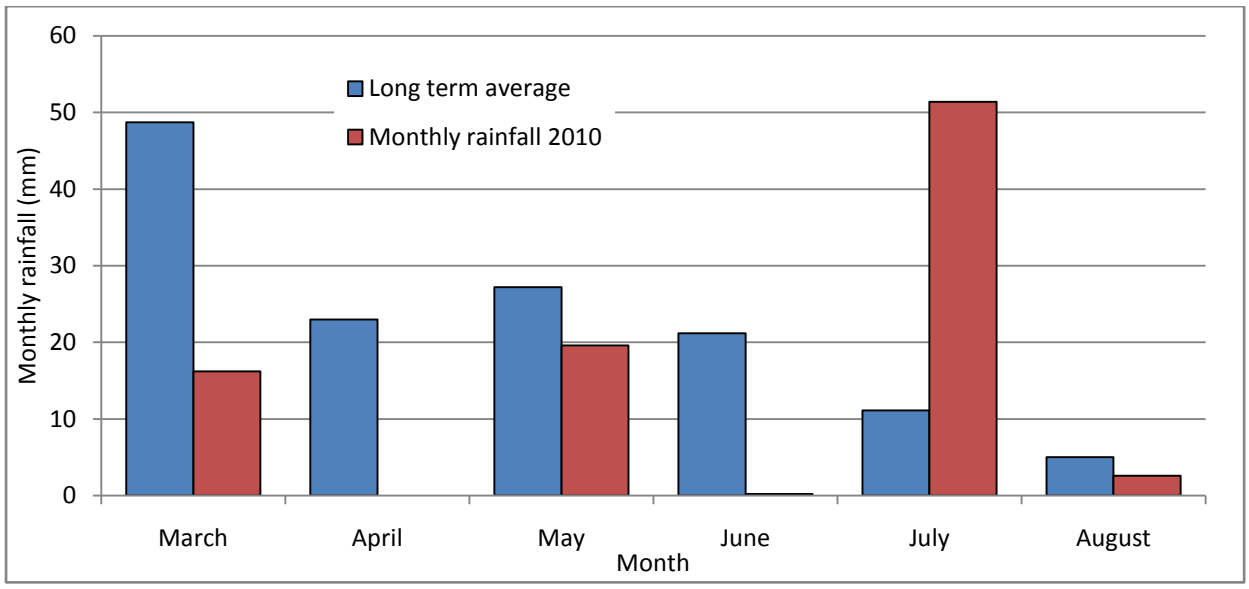

Figure 10: Rainfall occurring at Port Hedland Airport during the six months prior to September 2010 vs. the long term climate average

3.3.2 Site Selection, Locations and Habitat Descriptions

Prior to the autumn survey, broad habitat types present within the study area were identified during the literature review and from analysis of aerial imagery and topographical mapping. During the March 2010 reconnaissance survey, broad habitat types present within the study area were confirmed and the locations of trapping and targeted fauna survey sites were selected.

Systematic trapping sites were primarily selected on the basis of:

- Being characteristic of the major or significant fauna habitats present in the study area; and
- Encompassing the geographic spread of the study area.

Definitions of fauna habitat used in this survey are consistent with classifications used elsewhere in biodiversity assessments (Section 3.2). It should be noted that fauna habitats were mapped at a broad scale; therefore microhabitats are not likely to be evenly distributed within them and habitat boundaries are likely to be accurate only to within 50-100m. It was not feasible to survey the wide range of specialised microhabitats present in the region; however, site selection based upon broad fauna habitats characteristic of the study area, or those of particular relevance to conservation significant fauna, provides a useful framework within which to discuss species occurrence.

Three systematic survey sites were surveyed during the autumn and spring 2010 surveys. The major fauna habitats and details of the systematic trapping sites are presented in **Table 4**. The location of these survey sites within the study area is shown in **Figure 11**.

A representative area (20m x 20m) was selected at each site to conduct a vertebrate fauna habitat assessment. Each representative area was assessed for percentage of bare ground, live and dead vegetation, leaf litter, logs and water cover. Sites were given a rating of excellent, very good, good, moderate, degraded or completely degraded based on the overall condition of the habitat for fauna. Existing disturbance at each site was characterised and the potential for the habitat to support species of conservation significance was assessed.

Table 4: Fauna habitats and survey sites within the Mt Dove study area

Fauna Habitat	Site	Plate	Vegetation Association and Substrate	Coordinates (GDA 1994, MGA z50)
Acacia Shrubland on Footslopes	MD-F-1	1	*Acacia ancistrocarpa, A. inaequilatera, A. sericophylla* and *A. acradenia* and sparse *Corymbia hamersleyana* and *C. zygophylla over Triodia lanigera* and *T. schinzii* on red sandy loams on lower slopes.	651382E 7683706S
Rocky Ridge	MD-F-2	2	Mid sparse shrubland of *Acacia arida* and *A. inaequilatera* over Low Isolated Shrubs of *Ptilotus obovatus* over Low Hummock and Tussock Grassland of *Triodia wiseana* and *Cenchrus ciliaris* on skeletal red-brown sandy loams over massive ironstone outcropping on mid-upper slopes and crests. Isolated *Ficus brachypoda* present. Caves and boulders present also.	651869E 7684133S
Acacia, Spinifex on Sandplain	MD-F-3	3	*Acacia ancistrocarpa, A. inaequilatera, A. sericophylla* and *A. acradenia* and sparse *Corymbia hamersleyana* and *C. zygophylla over Triodia lanigera* and *T. schinzii* on red sandy loams on flats and plains.	655430E 7688723S
Stony Rise	No site established	4	*Scattered Corymbia hamersleyana, Grevillea wickhamii, Acacia inaequilatera* and *Triodia spp.* over a red/brown substrate consisting of lateritic quartz and gravel.	N/A

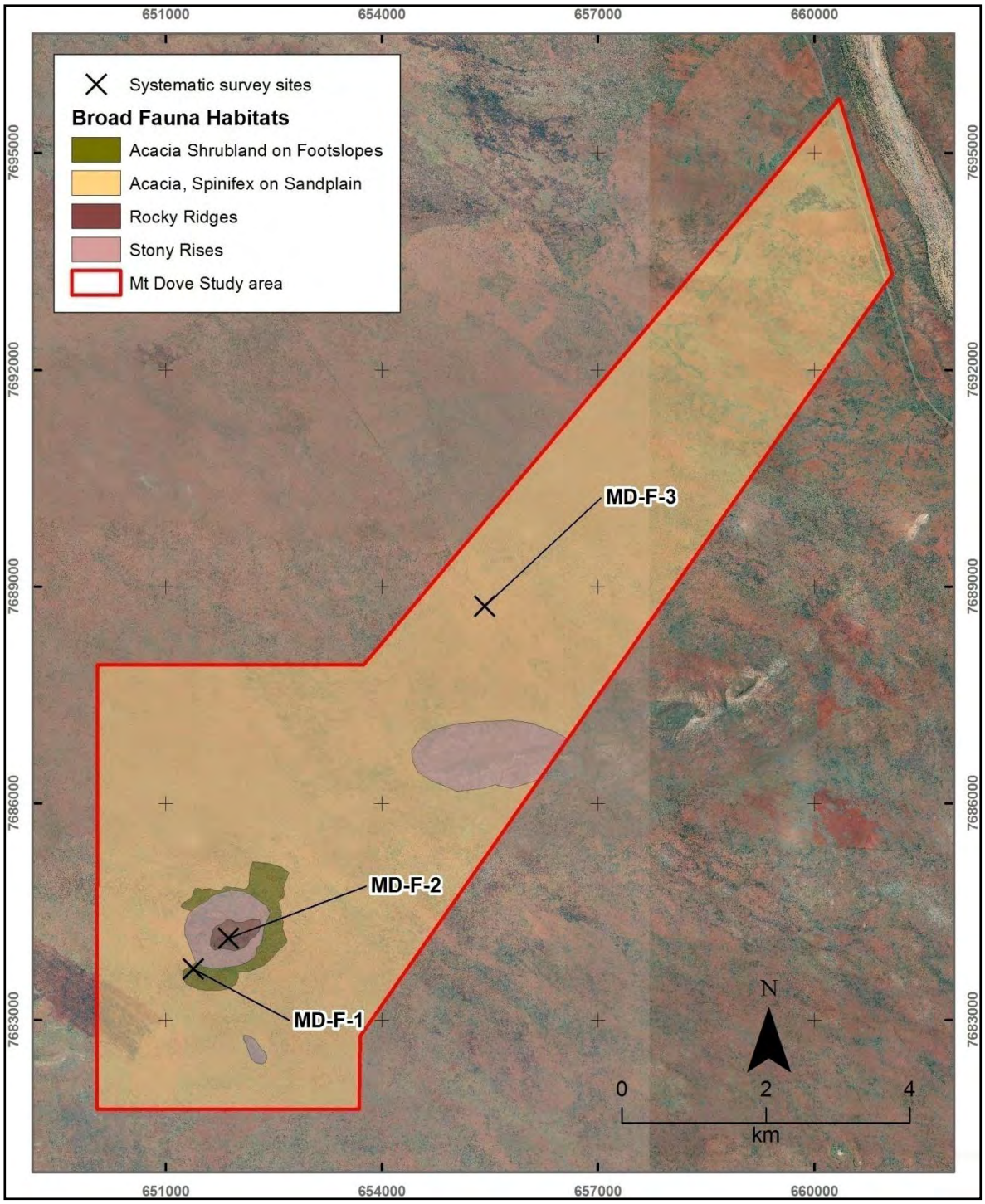

Figure 11: Location of systematic survey sites within the Mt Dove study area

Plate 1: Acacia Shrubland on Footslopes habitat at systematic trapping site MD-F-1

Plate 2: Rocky Ridge habitat at systematic trapping site MD-F-2

Plate 3: Acacia, Spinifex on Sandplain habitat at systematic trapping site MD-F-3

Plate 4: Stony Rise habitat (no trapping site established)

3.3.3 Systematic Sampling

Systematic sampling was conducted over a fixed time period in defined broad fauna habitats. Systematic sampling methods included trapping, systematic hand searching, fixed-time bird census and night spotlight searches. These survey techniques are described below.

Trapping Grids

Trapping grids were aimed at catching terrestrial mammals, reptiles and amphibians. Trapping grids were surveyed at a total of three sites during the detailed autumn and spring 2010 surveys. Each trapping grid consisted of two drift fences set into the substrate, which were 40 cm high and 50 m in length. Traps were left open over night and checked early each morning.

Two types of pitfall traps were installed along the drift fences: five standard 20 L PVC buckets and five PVC pipe traps 15 cm in diameter and 40 cm deep. Pitfall traps were set flush with the surface of the ground with the drift fence running across the middle. Ten funnel traps measuring 75 cm x 18 cm x 18 cm were placed along each drift fence, with one side pressed firmly against the fence. Ten baited Elliott box traps and two Sheffield cage traps were positioned in two lines on either side of the trap lines.

Traps were opened for a period of seven nights over both seasons of surveying. Setting each grid resulted in 52 traps being open each night, resulting in a total combined trapping effort of 2,184 trap nights over both surveys (1,092 trap nights for each survey). A summary of trapping effort for each survey period is presented in **Table 5**.

To protect animals from heat stress, Elliott, cage and funnel traps were placed in shade where practicable and covered with shade covers. Shelter (e.g. egg cartons, glare shield insulation) was placed in the bottom of pit traps to provide refuge for captured animals.

Table 5: Composition of trapping grids and trapping effort for the 2010 detailed autumn and spring surveys

Fauna Habitat	Site	Survey Period	Trap Opening	Trap Closing	Number of traps set per grid per night					No. of Nights	Total Trap Nights
					Pits	Funnels	Elliotts	Cages	Total per night		
Acacia Shrubland on Footslopes	MD-F-1	Autumn 2010	21/5/2010	27/5/2010	10	20	20	2	52	7	364
		Spring 2010	5/09/2010	11/09/2010	10	20	20	2	52	7	364
Rocky Ridge	MD-F-2	Autumn 2010	21/5/2010	27/5/2010	10	20	20	2	52	7	364
		Spring 2010	5/09/2010	11/09/2010	10	20	20	2	52	7	364
Acacia, Spinifex on Sandplain	MD-F-3	Autumn 2010	21/5/2010	27/5/2010	10	20	20	2	52	7	364
		Spring 2010	6/09/2010	12/09/2010	10	20	20	2	52	7	364
Total trap nights during autumn 2010 survey											**1,092**
Total trap nights during spring 2010 survey											**1,092**
Total Trap Nights											**2,184**

Northern Quolls – Marking and Measurements

To identify recaptured individual Northern Quolls (*Dasyurus hallucatus*), animals were tattooed through the inside of the ear (left for males and right for females) with a single or double unique digit, using standard ‗baby animal' tattoo clamps and tattoo ink. Alcohol swabs were used to sterilise the ear prior to tattoo application and all tattoo numbers were disinfected between applications to reduce risk of infection and disease spreading between individuals. The following parameters were measured and recorded for each individual:

- Sex;
- Age (juvenile or adult);
- Notes on reproductive condition e.g. females with distended pouch or extended teats, males with prominent testes;
- Weight (grams);
- Tail diameter (millimetres); and
- Pes (Left hind foot) length.

The above parameters provide valuable information as to the overall condition and health of the Northern Quoll population allowing comparison between monitoring years. For example, Northern Quolls store fat in their tails so an increase in tail diameter generally indicates an increase in condition of the Northern Quoll. Notes on reproductive condition can provide an indication as to the breeding cycle of the population and determine if females are pregnant, lactating or weaning their young. The age of a Northern Quoll can be determined through a combination of factors such as weight, pes (hind foot length) and incisor condition (Oakwood, 2000).

Systematic Hand Searching

Systematic searching for cryptic vertebrate species was conducted at all sites during the autumn and spring 2010 surveys. Techniques included identification of active animals, investigating caves and crevices, overturning logs and stones, searching beneath the bark of dead trees, investigating burrows and recording tracks, diggings, scats and any other signs. Time spent systematic searching all study sites totalled 10.5 hours for both surveys (4.5 hours with 1.5 hours per site during the autumn 2010 survey; and six hours with two hours per site during the spring 2010 survey).

Avifauna Census

Birds were recorded by means of several 20 minute duration bird surveys within a 500 m radius of each systematic search site, and limited to the habitat type within the vicinity of the trapping grid. All bird species seen and heard were recorded. Seven systematic bird surveys were carried out at each sampling site during both autumn and spring 2010. Each census was carried out as soon after dawn as was practicable, with each site being surveyed within two hours of dawn at least four times. Time spent on sampling avifauna over both surveys totalled 14 hours.

Spotlighting

Spotlighting surveys were conducted on foot using head torches at all three sites where it was possible to safely traverse terrain in darkness. Additional spotlighting effort was invested in driving along roads and tracks within the study area. Night searches were aimed at finding nocturnally active species such as Bush Stone-curlew (*Burhinus grallarius*), Rock Wallabies (*Petrogale rothschildi),* owls (e.g. Southern Boobook Owl *Ninox novaeseelandiae*), nightjars (e.g. Spotted Nightjar *Eurostopodus argus*), frogs and geckos.

Time spent spotlighting over both surveys totalled 7.5 person hours. **Figure 12** displays the locations of spotlight surveys during autumn and spring 2010.

3.3.4 Opportunistic Sampling

To supplement systematic sampling, the presence of all vertebrate species was recorded wherever and whenever possible within the study area, during both survey periods.

Opportunistic or non-systematic sampling involved recording all sightings of vertebrate fauna species while working and travelling within the study area during the day and night. These included species sighted:

- Before or after the fixed-time active searches or bird censuses;
- During reconnaissance visits to the study area;
- During trap line establishment; and
- While travelling to and from survey sites.

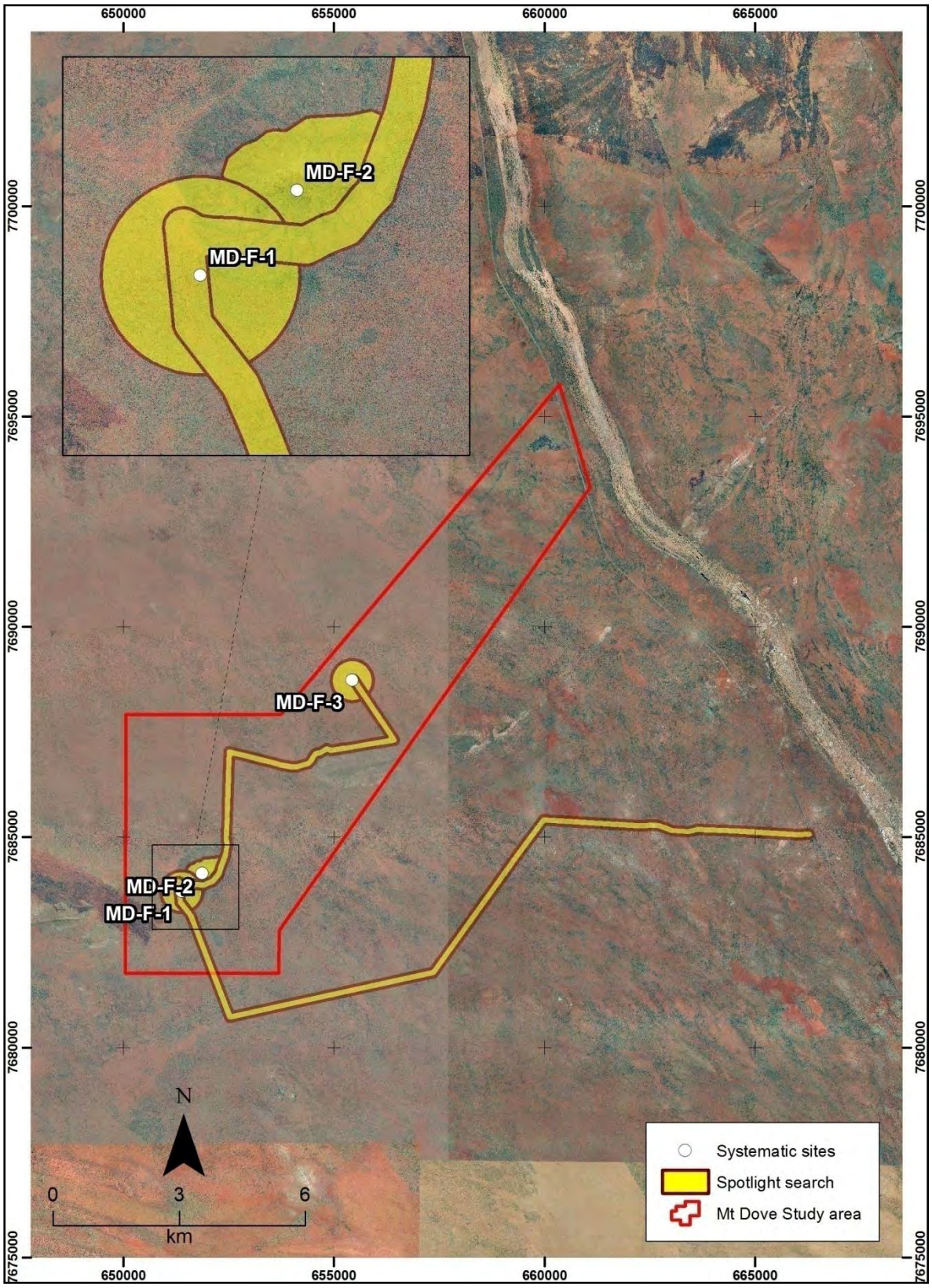

Figure 12: Spotlight survey locations within the Mt Dove study area

3.3.5 Targeted Survey Methods

Habitats with the potential to support fauna species of conservation significance (those listed under the EPBC Act, the WC Act or as Priority by the DEC), were identified during the desktop study and initial reconnaissance visits to the study area. The systematic and opportunistic methods utilised during the autumn and spring 2010 surveys were appropriate to detect these species as outlined in **Table 6**. In addition to these methods, targeted searches for conservation significant species were undertaken at targeted search sites in suitable habitats as follows:

- Rocky Ridge habitat on Mt Dove: Targeted searches in caves, crevices and rocky habitat for evidence of Northern Quolls (*Dasyurus hallucatus*) and Rothschild's Rock-wallaby (*Petrogale rothschildi*) including tracks, scats and polished runways were conducted during the autumn and spring surveys. Motion sensor cameras were also set within cave habitat on Mt Dove to detect the above species;
- Cave and crevice habitat on Mt Dove: Searches were made for suitable caves and crevices for the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*). Evidence of occupation (e.g. scats, odour) was noted and appropriate caves were marked for further AnaBat sampling;
- Stony Rise habitat on Mt Dove and surrounds: Searches were made for the characteristic mounds of the Western Pebble-mound Mouse (*Pseudomys chapmani*);
- Acacia, Spinifex on Sandplain habitat: Targeted searches were undertaken for spoil heaps and other evidence of Mulgara (*Dasycercus cristicauda*) (e.g. burrows).

Time spent conducting targeted searches totalled 4.5 hours during the autumn 2010 survey and 8.3 hours during the spring 2010 survey. A total of 12.8 hours were spent targeted searching over the two surveys. Locations of targeted searches are shown in **Figure 13**.

Table 6: Methods used to target conservation significant species

Scientific Name	Common Name	Conservation Status[1]			Survey Method						
		EPBC Act[1]	WC Act[2]	Priority List[3]	Trapping	Systematic Searching	Bird Census	Spotlighting	Targeted Searching	AnaBat	Motion Cameras
Mammals											
Dasycercus blythi	Mulgara			P4	•	•		•	•		
Dasycercus cristicauda	Mulgara	VU	S1		•	•		•	•		
Dasyurus hallucatus	Northern Quoll	EN	S1		•	•		•	•		•
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby (mainland)			P3		•		•			•
Leggadina lakedownensis	Lakeland Downs Mouse			P4	•	•		•			
Macroderma gigas	Ghost Bat			P4		•		•	•	•	•
Macrotis lagotis	Greater Bilby	VU	S1			•		•			
Pseudomys chapmani	Western Pebble-mound Mouse			P4	•	•		•	•		
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1			•		•	•	•	
Reptiles											
Aspidites ramsayi	Woma		S4			•		•			
Ctenotus nigrilineatus	Pin-striped Finesnout Ctenotus			P1	•	•		•			
Ctenotus uber johnstonei	-			P2	•	•		•			
Liasis olivaceus barroni	Olive Python	VU	S1			•		•	•		•
Ramphotyphlops ganei	-			P1	•	•		•			
Birds											
Ardeotis australis	Australian Bustard			P4		•	•	•			
Burhinus grallarius	Bush Stone-curlew			P4		•	•	•			
Falco hypoleucos	Grey Falcon			P4			•				
Falco peregrinus	Peregrine Falcon		S4				•				
Merops ornatus	Rainbow Bee-eater	M					•				

[1]Threatened species status under the Commonwealth EPBC Act: VU = Vulnerable, EN = Endangered, M = Migratory

[2]Threatened species status under the WC Act: S1 = Schedule S1, S4 = Schedule 4.

[3]DEC Priority Species List = Priority 1, P2, P3, P4

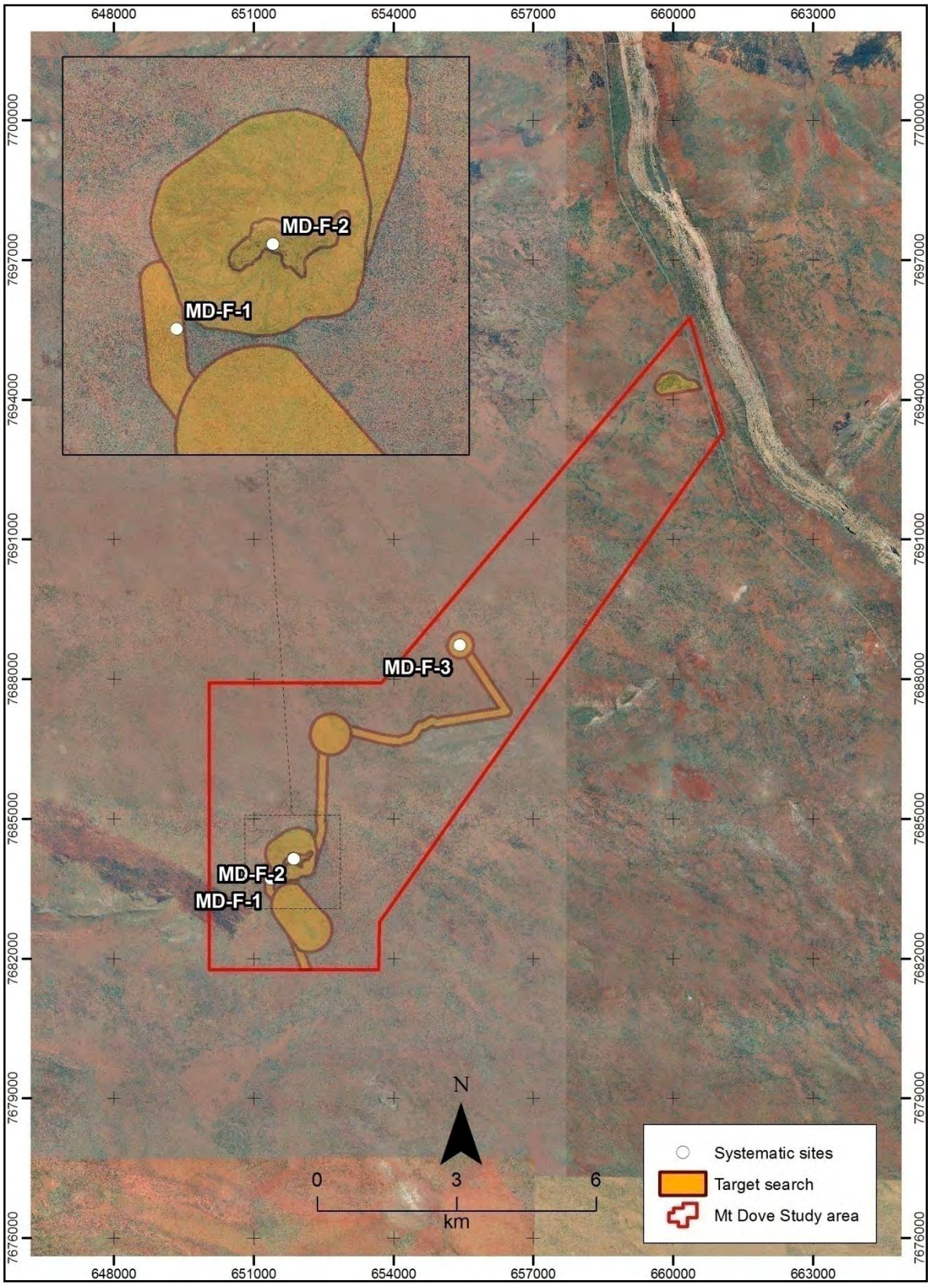

Figure 13: Target search locations within the Mt Dove study area

3.3.6 Targeted bat surveys

Several survey techniques were utilised in order to detect conservation significant bat species, the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*). These included cave assessments, use of AnaBat echolocation detectors, shotgun microphone recordings and remote camera photography. These are discussed in further detail below.

Cave Assessments

Caves situated on Mt Dove were assessed for their suitability as roosts for the Ghost Bat and Pilbara Leaf-nosed Bat. Descriptions of the following attributes were documented for each cave:

- Presence of scat material;
- Cave dimensions**;**
- GPS location;
- Photograph;
- Notes on structural condition (eg rock falls, cracking etc); and
- Presence of bats.

AnaBat Detectors

AnaBat SD1 electronic detectors (Titley Electronics, Ballina, NSW) were placed at caves with attributes most likely to be suitable for Ghost Bat and Pilbara Leaf-nosed Bat activity (**Table 7**). The AnaBat unit records ultrasonic echolocation bat calls directly onto removable storage devices (e.g. compact flash cards) for later analysis. AnaBat locations were chosen within or around caves or rocky ridges, as bats are known to shelter in these habitats; or around water bodies where bats drink or forage after emerging from shelter at dusk. One AnaBat unit was set up at four separate locations at Mt Dove during the autumn 2010 survey. During the spring 2010 survey, three AnaBat units were set up to record continuously for four consecutive nights at cave locations where Pilbara Leaf-nosed Bat activity was recorded during the autumn 2010 survey (**Table 7**). Timing of echolocation recordings of Pilbara Leaf-nosed Bats were then analysed to gain a better understanding as to whether Pilbara Leaf-nosed Bats were using any caves on Mt Dove as roosting sites or alternatively if they were using the caves intermittently during foraging activity.

Shotgun Microphone Recordings

Human-audible (non-ultrasonic) social calls of the Ghost Bat were recorded with a Røde NTG-2 shotgun microphone connected to a Roland Edirol R-09HR digital recorder (sampling rate 44.1 kHz, 16 bit). This recording unit was placed at cave entrance identified as a potential Ghost Bat roosting site or feeding cave (**Table 7**).

Remote Camera Photography

Two types of remote cameras (Reconyx PC900 series and Bushnell Trophy Cam XLT Viewer) were used to take time and date stamped still images of bats emerging from caves. Remote cameras were left at

cave entrances overnight providing the opportunity to capture early morning recordings of Ghost Bats as they enter the caves.

Details of the AnaBat recording locations within the study area are provided in **Table 7** and shown in **Figure 14**. Recorded calls were analysed by Specialised Zoological (2010) to identify bat species utilising the study area. Specialist reports summarising these analyses for the autumn and spring 2010 surveys are provided in **Attachment E** and **Attachment F**, respectively.

Table 7: AnaBat recording site details

AnaBat Site Reference	Plate No.	Habitat Description	Recording Date		Site Location (WGS 84, MGA z50)
			Autumn Survey	Spring Survey	
MD-AN-1	**5**	Stock watering dam approximately 3.3 km south of Mt Dove. Site provides foraging habitat for both the Pilbara Leaf-nosed Bat and the Ghost Bat.	Overnight 22/05/2010	Overnight 08/09/2010	652525 E 7680687 N
MD-AN-2	**-**	Large cave on northern face of Mt Dove; with dimensions 5m wide by 3m high and approximately 10m deep. Small bat scats present on the floor of cave.	Overnight 24/05/2010	4 consecutive nights: 06/09/2010 to 09/09/2010	651776 E 7684227 N
MD-AN-3	**6**	Rocky Ridge habitat	Overnight 26/05/2010	-	651828 E 7684035 N
MD-AN-4	**7**	Cave in Rocky Ridge habitat	Overnight 27/05/2010	4 consecutive nights: 04/09/2010 to 07/09/2010	651932 E 7684070 N
MD-AN-5	**8**	Collapsed boulders located near the top of Mt Dove which have formed a small cave 60cm wide by 1m high and approximately 3m deep.	-	4 consecutive nights: 06/09/2010 to 09/09/2010	651811 E 7684146 N
MD-GB-1	**9**	Cave with oval shaped entrance approximately 1m wide, with a cave height of 1m and 4m deep.	-	Overnight 06/09/2010	651877 E 7684112 N

Plate 5: AnaBat site MD-AN-1

Plate 6: AnaBat site MD-AN-2

Plate 7: AnaBat site MD-AN-3

Plate 8: AnaBat site MD-AN-4

Plate 9: AnaBat site MD-AN-5

Plate 10: Ghost Bat microphone recording site (MD-GB-1)

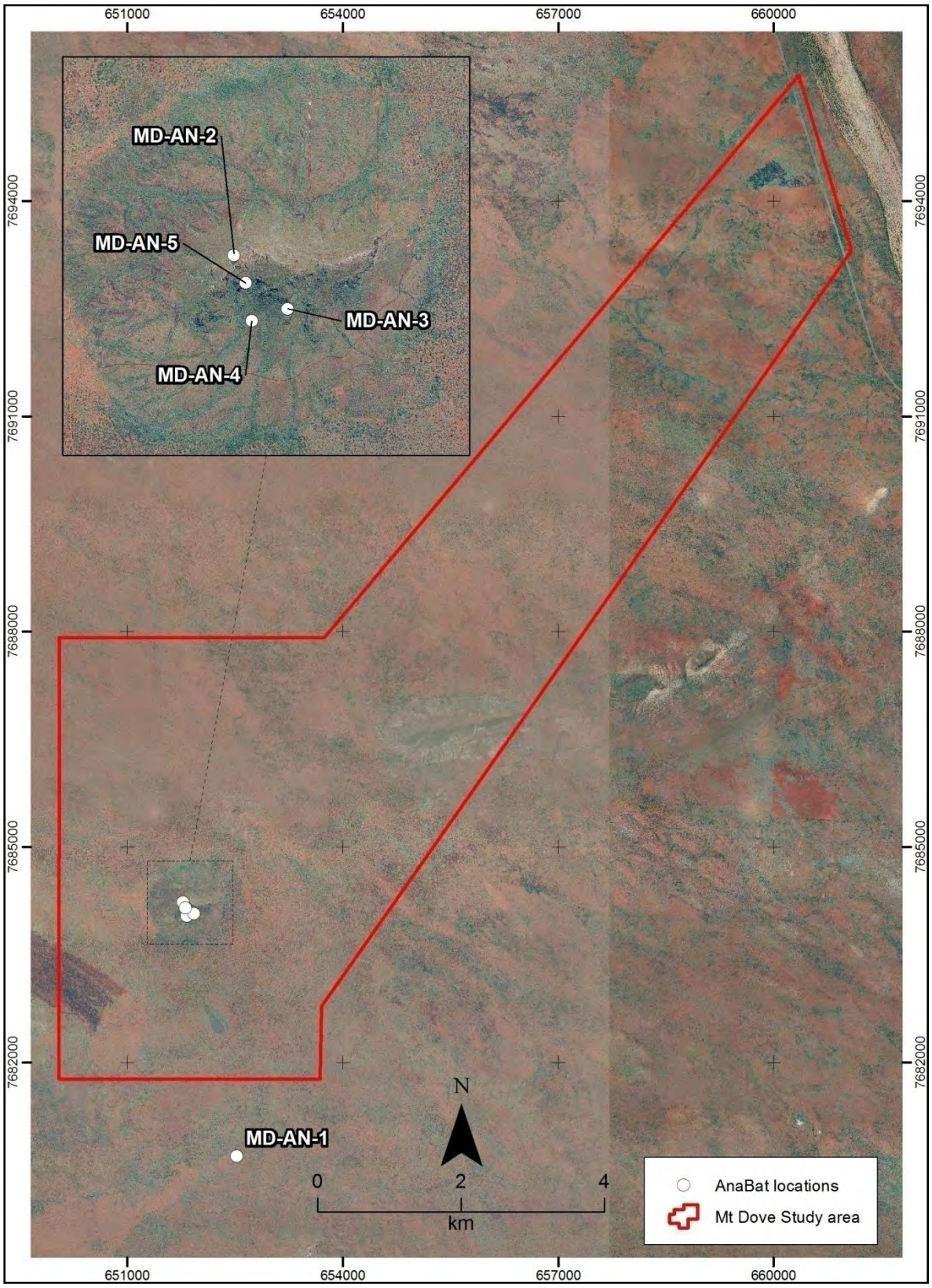

Figure 14: AnaBat site locations within the Mt Dove study area

3.3.7 Targeted SRE Wet Pitfall Trapping

As part of a separate, short-range endemic (SRE) terrestrial invertebrate survey, Outback Ecology established invertebrate wet pitfall sites at Mt Dove (Outback Ecology 2010a). A total of five survey sites were established within or adjacent to the study area, and were left open for six weeks from the 24th of March through to the 4th of May 2010.

At each site, five wet pitfall traps were dug into the ground, consisting of four litre plastic containers (20 cm x 20 cm) with 75 cm drift fences set on each side. Traps were generally spaced at 5 to 10 m intervals where possible. Each trap was filled with approximately one litre of preserving agent (100% propylene glycol) and a cover was suspended approximately 4 cm above the trap to reduce vertebrate by-catch and to limit rain entering the trap. Further details of the SRE sampling methodology and survey design are outlined within the *Mt Dove DSO Project: Terrestrial Short-range Endemic Invertebrate Fauna Assessment 2010* (Outback Ecology 2010a).

Although the traps were designed to collect invertebrate specimens, a small number of vertebrate by-catch specimens were also collected. These specimens have been included as part of the overall Mt Dove vertebrate fauna dataset with a list of the species recorded presented in **Attachment A**.

3.3.8 Baseline Northern Quoll Monitoring Survey 2011

As part of a separate, targeted Northern Quoll monitoring survey, Outback Ecology established six systematic trapping sites at Mt Dove and surrounds (Outback Ecology in prep). Two sites were established in Rocky Ridge habitat on Mt Dove itself, one site in Acacia Shrubland on Footslopes habitat on the south-east of Mt Dove and one site in Stony Rise habitat 1.5 km to the south of Mt Dove. In addition, two regional sites were established in Rocky Ridge habitat 12 km to the south of Mt Dove (**Figure 15**).

At each site, 20 traps consisting of either large Elliott traps (15 x 15 x 45cm) or cage traps were placed at intervals of up to 50m within equivalent habitat. In Rocky Ridge habitat, traps were specifically placed within optimum habitat (i.e. at the base of outcropping ironstone and adjacent to the entrance of caves (**Figure 15**). Traps were baited each afternoon and checked the following morning for a period of seven nights (or four nights if two or more quolls were captured twice at the same site). All traps were closed during daylight hours. All Northern Quolls captured were processed as per the methodology described in **Section 3.3.3**, with the exception that passive implant transponders (PIT tags) were used to individually mark animals in place of tattooing. These Northern Quoll data have been included as part of the Mt Dove vertebrate fauna impact assessment.

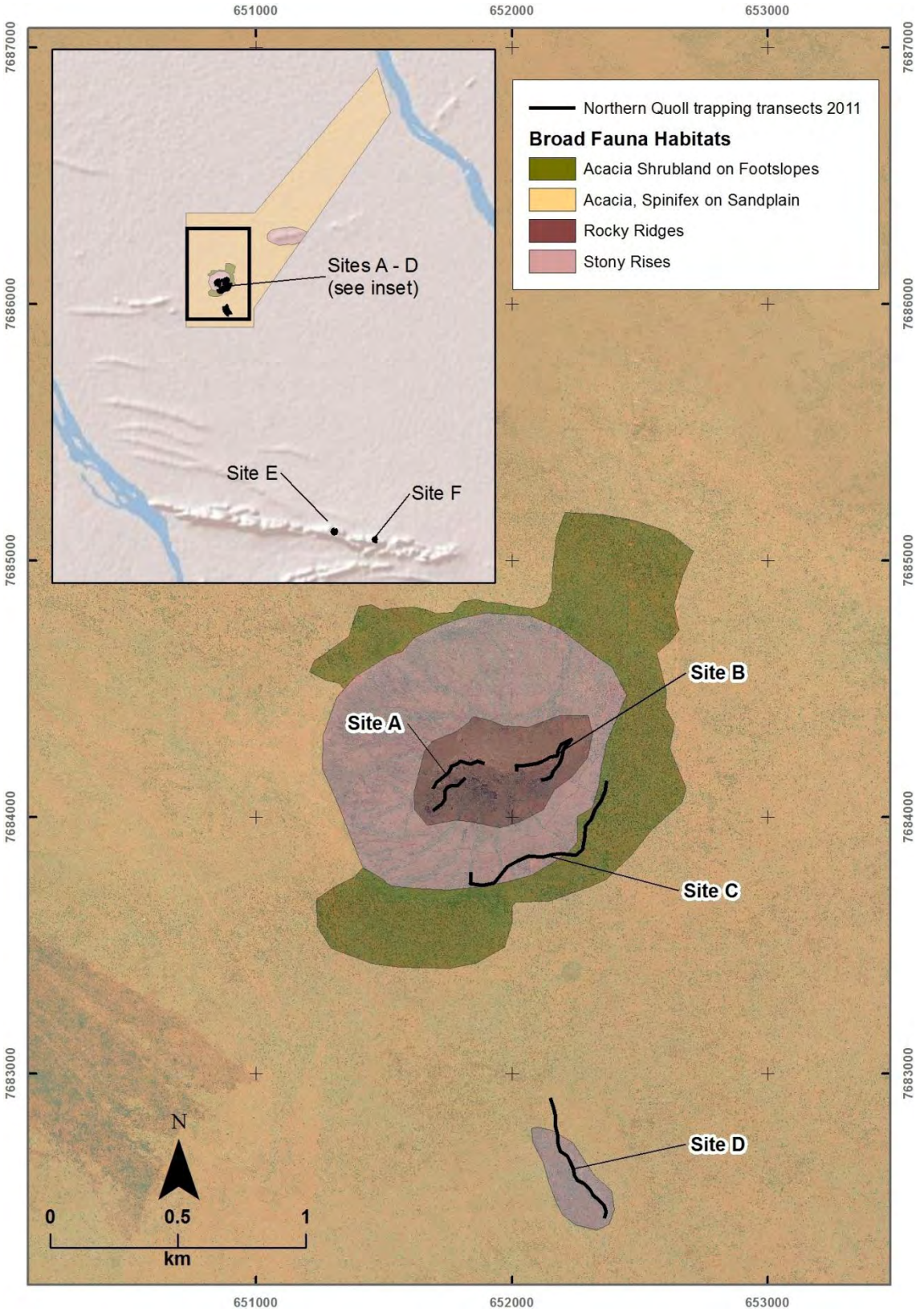

Figure 15: Northern Quoll monitoring sites within the Mt Dove study area

3.4 Taxonomy and Nomenclature

Nomenclature and taxonomy of all vertebrate fauna species follows that of the Western Australian Museum (WAM) provided in the *Checklist of the Vertebrates of Western Australia* for amphibians, reptiles and mammals (Western Australian Museum 2009), and for the *Bird's Australia Checklist of Australian Birds*, based on Christidis and Boles (2008). Relevant texts from which information on general patterns of distribution were obtained included:

Recent published taxonomic revisions have also been included. Relevant texts from which more recent taxonomic updates and information on general patterns of distribution were obtained included:

Mammals (non-volant) -	Van Dyck and Strahan (2008) and Menkhorst and Knight (2004);
Bats -	Churchill (2008);
Birds -	Johnstone and Storr (1998, 2004), Pizzey and Knight (2007) and Morcombe (2003);
Reptiles -	Storr *et al.* (1999, 2002), Cogger (2000) and Wilson and Swan (2008); and
Amphibians -	Cogger (2000).

4. RESULTS AND DISCUSSION

4.1 Vertebrate Fauna Habitats

The Mt Dove study area measures 5,224 ha in area and over 17 km in length, and is relatively homogenous in terms of fauna habitat. A total of four broad fauna habitats were identified on the basis of location, landform, substrate, vegetation community and the vertebrate fauna habitat which they offer. These habitats are:

- Acacia Shrubland on Footslopes;
- Acacia, Spinifex on Sandplain;
- Rocky Ridge; and
- Stony Rise.

With the exception of the Rocky Ridges and Acacia Shrubland on Footslopes, habitats occurring within the study area are considered to be widespread and typical of the Pilbara bioregion and the immediate surrounds. Rocky Ridge habitat is isolated and of limited extent in the local area, and represents significant fauna habitat. The nearest equivalent habitat is located approximately 12 km to the south. Acacia Shrubland on Footslopes is also of limited extent in the local area; however, this habitat represents a transition between Stony Rise and Acacia, Spinifex on Sandplain habitat and is of lesser importance to conservation significant species.

The key characteristics of each of the broad fauna habitats identified within the study area are summarised in **Table 8**. Mapping of broad fauna habitats is presented in **Figure 16**.

A brief description of each habitat identified, with a focus on the complexity and the quality that each provides for the local fauna assemblages and specific suitability for conservation significant species, is provided below.

Table 8: Habitat assessment summary

Fauna Habitat	Site	Vegetation Association and Substrate	Habitat Assessment	Overall Condition of Fauna Habitat (Keighery 1994)	Disturbance	Area within study area: Ha (%)
Acacia Shrubland on Footslopes	MD-F-1	*Acacia ancistrocarpa, A. inaequilatera, A. sericophylla* and *A. acradenia* and sparse *Corymbia hamersleyana* and *C. zygophylla over Triodia lanigera* and *T. schinzii* on red sandy loams on lower slopes.	20% bare ground, 75% live vegetation, 2% leaf litter, 2% dead wood. Evidence of recent fires	Good	Cattle, Fire, Weeds	81 (1.6%)
Rocky Ridge	MD-F-2	Mid Sparse Shrubland of *Acacia arida* and *A. inaequilatera* over Low Isolated Shrubs of *Ptilotus obovatus* over Low Hummock and Tussock Grassland of *Triodia wiseana* and *Cenchrus ciliaris* on skeletal red-brown sandy loams over massive ironstone outcropping on mid-upper slopes and crests. Isolated *Ficus brachypoda* present. Caves and boulders present.	30% bare ground, 70% live vegetation, < 1% leaf litter, no dead wood. Evidence of recent fires	Degraded	Localised mining exploration activity, Fire, Weeds	22 (0.4%)
Acacia, Spinifex on Sandplain	MD-F-3	*Acacia ancistrocarpa, A. inaequilatera, A. sericophylla* and *A. acradenia* and sparse *Corymbia hamersleyana* and *C. zygophylla over Triodia lanigera* and *T. schinzii* on red sandy loams on flats and plains.	10% bare ground, 85% live vegetation, 3% leaf litter, 2% dead wood. Evidence of recent fires	Good	Cattle, Fire	4879 (93.4%)
Stony Rise	-	*Scattered Corymbia hamersleyana, Grevillea wickhamii, Acacia inaequilatera and Triodia spp.* over a red/brown substrate consisting of lateritic quartz and gravel.	30% bare ground, 70% live vegetation, no leaf litter, dead wood. Evidence of recent fires	Degraded	Localised mining exploration activity, Fire	241 (4.6%)

Acacia Shrubland on Footslopes

Acacia Shrubland on Footslopes occurs within 1.6% of the study area. This habitat is restricted to the lower slopes of Mt Dove where water and alluvium collect, supporting a higher density of *Acacia* shrubs than the surrounding sandplains (**Figure 16)**. Based on interpretation of satellite imagery and aerial photography, this habitat also appears to occur at the base of stony rises three kilometres to the west of the study area and at the base of a prominent ridge some eight kilometres to the south of the study area.

One systematic survey site was established within this habitat type (MD-F-1), on the southern side of Mt Dove (**Figure 11**; **Plate 1**). Much of this habitat type within the study area had been burnt recently (< five years), reducing its potential to support faunal assemblages. This habitat type is vulnerable to disturbance by fire, however may also require fires periodically to maintain stands of *Acacia* species.

Owing to the greater density of Acacia shrubs, this habitat type may support a greater diversity of bird and reptile species than the surrounding sandplains. This is supported by the findings of the autumn and spring 2010 surveys. Four conservation significant species were recorded within this habitat type: Northern Quoll (*Dasyurus hallucatus*), Australian Bustard (*Ardeotis australis*), Western Pebble-mound Mouse (*Pseudomys chapmani* – inactive mounds only) and Rainbow Bee-eater (*Merops ornatus*).

One Northern Quoll was captured during systematic trapping in this habitat, although this individual was also trapped in Rocky Ridge habitat, which represents core habitat for the species. It is unlikely that the Northern Quoll is wholly reliant on Acacia Shrubland on Footslopes habitat for its survival; it is more likely that individuals are merely foraging within it.

Rocky Ridge

Less than 0.5% of the study area consists of this habitat type, which occurs exclusively on the upper slopes of Mt Dove (**Figure 16**), which protrude some 70 metres above the surrounding plains. Rocky Ridge habitat is uncommon within the broader landscape area as it is comprised specifically of hills featuring outcropping ironstone, fallen boulders, caves, overhangs and crevices. Although there are some low stony rises located within three kilometres of Mt Dove, none of these possess the structural complexity of Rocky Ridge habitat and are therefore not likely to be of comparable value to fauna.

This habitat type is considered as important for fauna assemblages in general, owing to the presence of a cooler microclimate and shelter, which is largely absent from the surrounding landscape (Bamford Consulting Ecologists 2008, How *et al.* 1991). Rocky Ridge habitat supports a number of species of conservation significance within the Pilbara bioregion. Ridge habitats provide important breeding habitat and nursery dens for the Northern Quoll (*Dasyurus hallucatus*) (Van Dyck and Strahan, 2008). Deep, humid caves provide roost habitats for conservation significant bat species such as the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*). Rocky ridges also provide shelter for rocky habitat specific species such as the Rothschild‘s Rock-wallaby (*Petrogale rothschildi*).

Four conservation significant species were recorded within this habitat during the autumn and spring 2010 surveys. Northern Quolls were present with seven individuals recorded during systematic trapping in autumn 2010. Four of these individuals were recaptured in spring 2010 along with two new individuals. Seven individuals were also captured within this habitat as part of the Northern Quoll monitoring program conducted in May 2011, with three of these being recaptures from 2010. Ghost Bats and Pilbara Leaf-nosed Bats were also detected within this habitat type. These species are making use of the various caves and smaller crevices and pipes that occur in the rocky faces of Mt Dove. These features, which represent optimum habitat for these species, are concentrated around the peak of Mt Dove as opposed to the periphery of this habitat. The Rainbow Bee-eater was also recorded in Rocky Ridge habitat during bird surveys in autumn and spring 2010, although it is unlikely that this species is reliant on this habitat alone.

Acacia, Spinifex on Sandplain

Acacia, Spinifex on Sandplain comprises the vast majority (93%) of the Mt Dove study area (**Figure 16)**. This habitat consists of several Acacia shrub species including *Acacia ancistrocarpa, A. inaequilatera, A. sericophylla and A. acradenia* (Woodman Environmental Consulting, pers. comm. 2010). These shrubs are likely to provide food resources to avifauna species.

The value of Acacia, Spinifex on Sandplain in supporting fauna assemblages is often closely related to their fire history, with areas retaining a mosaic of fire ages often providing the best habitat (Parr and Andersen 2006, Southgate *et al.* 2007, Woinarski 1999). The reasoning is that newly burnt habitat may be used for foraging, where as long unburnt areas may be used for shelter and breeding. It is common for large swathes of this habitat type to be burnt on a frequent basis (Burrows *et al.* 2006) as part of pastoral operations in order to promote new palatable growth and prevent regrowth of non-palatable Acacia species (Van Vreeswyk *et al.* 2004, Wright and Clarke 2007). Much of this habitat type within the study area was recently burnt (< 5 years) and has been grazed by cattle.

One systematic trapping site (MD-F-3) was established within this habitat type (**Figure 11**, **Plate 3**). This site yielded two conservation significant species; the Australian Bustard (*Ardeotis australis*) and Rainbow Bee-eater (*Merops ornatus*). It is likely that other conservation significant fauna would be present within this habitat, including the Bush Stone-curlew (*Burhinus grallarius*); and potentially the Mulgara (*Dasycercus blythi*) provided that fire regimes allowed for the establishment of large, unburnt hummocks of Spinifex, which are considered important habitat elements for this species (Menkhorst and Knight 2004).

Stony Rise

Stony Rise habitat comprises approximately 5% of the Mt Dove study area, occurring as a band surrounding Mt Dove itself, and also as an isolated band of low hills towards the centre of the study area (**Figure 16**). A minor occurrence of Stony Rise habitat also occurs 1.5 km to the south of Mt Dove. Stony Rise habitat forms part of the Ruth land system, which is not typically utilised for pastoralism in the Pilbara bioregion, resulting in much of this habitat being left undisturbed from cattle grazing (Van Vreeswyk *et al.*

2004). Stony Rises also represent a transition between Spinifex Stony Plains and the more rugged Rocky Ridges.

Stony Rise habitat is frequently burnt and offers little in the way of shelter, microclimate or resources. Consequently, it is of less significance than other habitats present at Mt Dove, such as Rocky Ridges or Acacia Shrublands on Footslopes.

One male Northern Quoll was captured within a small occurrence of Stony Rise habitat 1.5 km south of Mt Dove during the Northern Quoll monitoring program conducted in May 2011. This individual had been trapped three times within Rocky Ridge habitat on Mt Dove during the same survey and so it is likely that its presence within Stony Rise habitat was transitory.

The only evidence of a conservation significant species recorded within this habitat during the 2010 surveys was of the Western Pebble-mound Mouse (*Pseudomys chapmani*), which was detected via its characteristic mounds, although these were inactive at the time of survey.

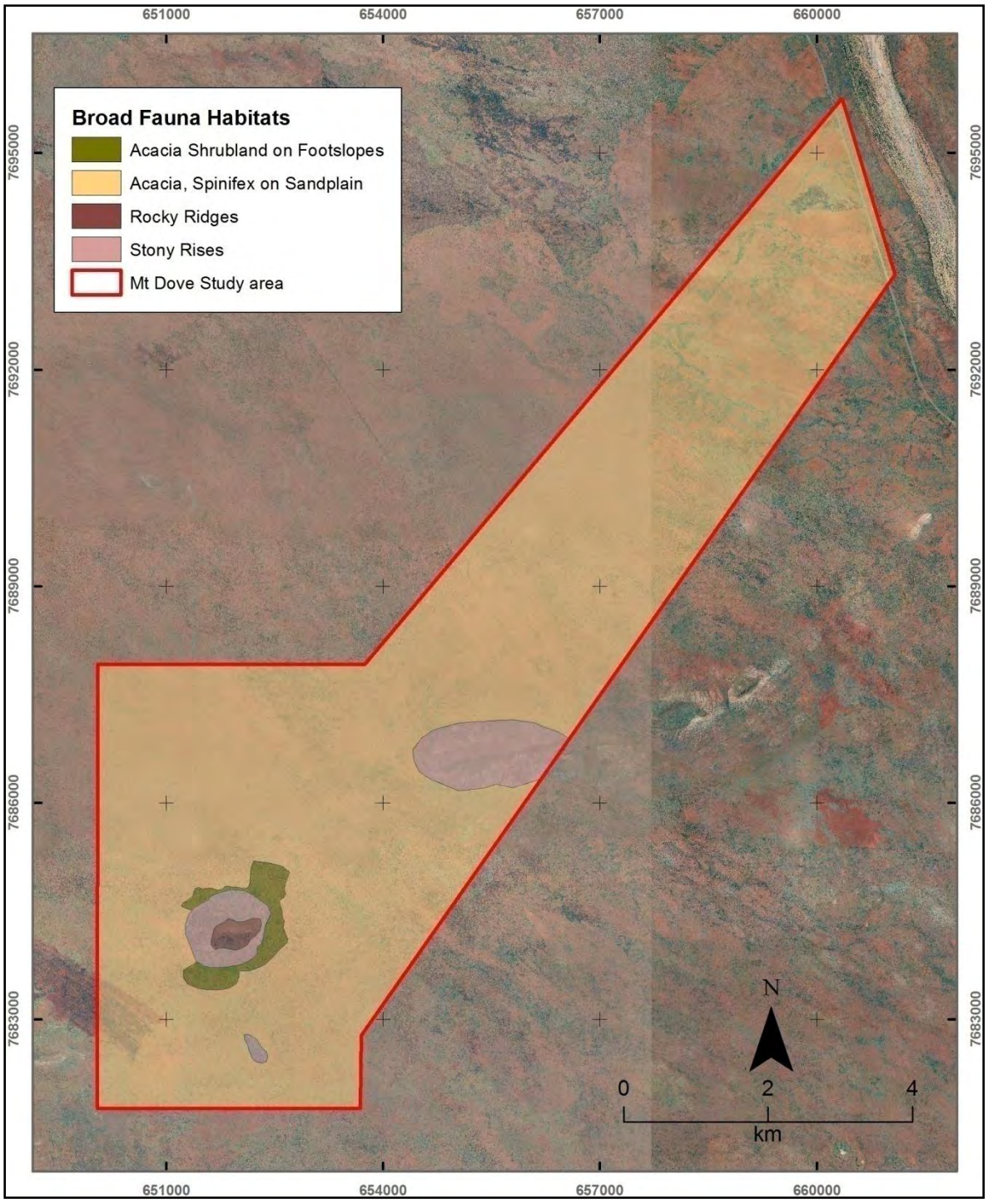

Figure 16: Habitat mapping for the Mt Dove study area

4.2 Vertebrate Fauna Species

A summary of vertebrate fauna species recorded from the Mt Dove study area during the autumn and spring 2010 surveys is shown in Table 9 together with a summary of species recorded from surveys conducted within the surrounds and wider region and from database searches. A summary of fauna abundance for the Mt Dove study area during autumn and spring 2010 is provided in **Table 10**. A detailed

summary of the faunal assemblages recorded from each of these surveys and database searches is provided in **Table 12** with a complete inventory of species recorded from each survey and database search presented in **Attachment A**.

The review of database searches and previous surveys determined that a total of 365 vertebrate species occur within the surrounding region, comprising 49 mammal species, 115 reptiles, 192 bird species and nine amphibians. Of these species, 297 have been recorded in surveys within the surrounding area; namely, surveys of the Turner River Hub Project (Outback Ecology 2010b), the northern sections of the FMG Rail corridor (Biota 2004) and proposed Hope Downs rail corridor (Biota 2002b). The 297 species comprised 40 mammals, 152 birds, 94 reptiles, seven amphibians and four fish. It should be noted that these surveys encompassed a wider rage of habitat types than those present within Mt Dove study area; hence, lower species diversity was expected from the Mt Dove study area.

Vertebrate fauna surveys of similar scale to this Mt Dove fauna survey (i.e. comparable numbers of survey sites, habitat types, study area size) yielded lower species diversity than the large projects mentioned above. For example, Outback Ecology (2009) recorded 92 species during the detailed fauna survey of the Wodgina DSO Project study area (30 km south of Mt Dove), comprising 19 mammals, 46 birds, 25 reptiles and two amphibians. Similarly, a fauna survey of the Panorama mine site and haul road corridor (Biota 2007), 80 km to the east of Mt Dove, recorded a total of 73 species in two different habitats (valleys with riparian vegetation and low stony hills). The species recorded comprised 12 mammals, 41 birds, 18 reptiles and two amphibians.

Outback Ecology recorded a total of 92 vertebrate fauna species during the autumn and spring 2010 surveys, comprising 23 mammals (17 native), 40 birds and 29 reptile species. No amphibians were recorded (**Attachment A**).

Of the three habitats for which systematic trapping grids were established, Acacia Shrubland on Footslopes (Site MD-F-1) yielded the highest relative fauna abundance (i.e. the sum of animal captures and observations across all taxa) (**Table 10**). Within this habitat, 410 observations were made, compared with 284 and 240, in Acacia Spinifex on Sandplain (Site MD-F-3) and Rocky Ridge habitats (Site MD-F-2), respectively. This habitat may support greater fauna abundance as it receives water runoff from the Rocky Ridges, supporting a higher density of shrubs, which offer structural diversity and a source of food for avifauna.

Table 9: Summary of vertebrate fauna species richness recorded within the study area and surrounds during 2010 surveys

Fauna	Mt Dove 2010 Surveys	Previous studies	Database searches
Native Mammals	17	41	24
Birds	40	167	155
Reptiles	29	115	69
Amphibians	-	8	9
Introduced Fauna	6	9	4
Total Native Fauna	86	331	257
Total Fauna	92	340	261

Table 10: Summary of relative abundance of vertebrate fauna species recorded within the Mt Dove study area during 2010 surveys

Vertebrate Fauna	Sampling Method					
	Systematic survey sites			SRE Wet Pitfall Survey	Targeted searches	Opportunistic
	MD-F-1 (Acacia Shrubland on Footslopes)	MD-F-2 (Rocky Ridge)	MD-F-3 (Acacia, Spinifex on Sandplain)			
Mammals	9	53	22	0	4	28
Birds	328	163	175	0	8	190
Reptiles	73	24	87	12	15	32
Amphibians	0	0	0	1	0	0
Total	**410**	**240**	**284**	**13**	**27**	**250**

Table 11: Detailed summary of vertebrate fauna species richness recorded within the study area and surrounds during 2010 surveys

Fauna	Mt Dove Survey Outback Ecology (2010)	Previous studies												Database searches				
		Local surveys				Surveys in region												
		Biota (2004) FMG Nth	Biota (2004) FMG Sth *	Biota (2002) HD Nth	Biota (2002) HD Sth*	Bamford (2007)	Outback Ecology (2009)	Bamford (2009)	Bamford (2001)	Biota (2006)	WAM (1991)	Ninox (2009)	ecologia (2008)	DEC (2010)	Nature Map (2010)	Birds Australia (2010)	Aust Museum (2010)	DSEWPC (2010)
Native Mammals	17	18	19	27	26	9	19	13	20	10	21	20	20	6	20	-	1	4
Birds	40	92	92	116	76	51	46	72	82	41	92	78	94	2	37	152	-	8
Reptiles	29	55	56	48	68	21	25	30	28	18	67	54	57	1	61	-	22	1
Amphibians	-	6	6	6	6	4	2	4	2	2	5	1	1	-	8	-	3	-
Introduced Fauna	6	5	5	4	6	3	2	4	4	2	5	1	5	-	1	-		3
Total Native Fauna	86	171	173	197	176	85	89	119	132	71	185	153	172	9	126	152	26	13
Total Fauna	92	176	178	201	182	88	91	123	136	73	190	154	177	9	127	152	26	16

Key

Local surveys

Biota (2004) FMG Nth*	Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor: Northern study area
Biota (2004) FMG Sth	Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor: Southern study area
Biota (2002) HD Nth*	Fauna Assessment of the Proposed Hope Downs Rail Corridor From Weeli Wolli Siding to Port Hedland: Northern study area)
Biota (2002) HD Sth	Fauna Assessment of the Proposed Hope Downs Rail Corridor From Weeli Wolli Siding to Port Hedland: Southern study area

* Data for FMG Stage A (Biota, 2004) and Hope Downs (Biota, 2002) rail corridor fauna assessments was split into two study areas to allow for direct comparisons with Mt Dove; with the northern sections of these study areas encompassing fauna habitats which are closer aligned with that encountered at Mt Dove. The southern study areas encompass many habitats not present in or near Mt Dove and are not directly relevant.

Surveys in surrounding region

Bamford (2007)	Fauna Assessment of the Pardoo Direct Shipping Ore Project
Outback Ecology (2009)	Fauna Assessment of the Wodgina DSO Project
Bamford (2009)	Fauna Assessment of the Abydos DSO Project
Bamford (2001)	Fauna Assessment of the Panorama Project (as Part of the Sulphur Springs Feasibility)

Biota (2006)	Fauna Assessment of the Panorama Project Mine Site and Haul Road Corridor
WAM (1991)	Western Australian Museum Ecological Survey of Abydos-Woodstock Reserve
Ninox (2009)	Vertebrate Fauna Survey of the Proposed Hope Downs 4 Mining Area and Infrastructure Corridor: Option 1, 6
Ecologia (2008)	Fauna Assessment of the RGP 5 Chichester Rail Deviation

Database Searches

DEC (2010)	Department of Environment and Conservation's Threatened and Priority Fauna Database Search (July 2010)
NatureMap (2010)	Department of Environment and Conservation's NatureMap Database Search (July 2010)
Birds Australia	Birds Australia Atlas Database Search (July 2010)
Aust. Museum (2010)	Australian Museum Database Search (July 2010)
DSEWPC (2010)	Department of Sustainability, Environment, Water, Population and Communities database search (July 2010)

Table 12 shows the native fauna species richness recorded during the autumn and spring 2010 fauna surveys according to broad habitat types. The following can be noted:

- The number of mammal species recorded was comparable for all habitats where systematic sites were established;
- Bird species richness was greatest in Acacia Shrubland on Footslopes habitat, followed by Acacia, Spinifex on Sandplain and Rocky Ridge habitat, which had comparable bird species richness;
- The number of reptile species recorded was greatest in Acacia Shrubland on Footslopes habitat, followed by Acacia, Spinifex on Sandplain. Rocky Ridge habitat yielded substantially fewer reptile species.

Table 12: Native terrestrial fauna species richness recorded within broad habitat types during the autumn and spring 2010 surveys

Habitat type	Native mammals	Birds	Reptiles	Amphibians	Total Species Richness
Acacia Shrubland on Footslopes	3	26	19	-	48
Acacia, Spinifex on Sandplain	4	21	13	-	38
Rocky Ridges	4	19	5	-	28

NB – table excludes AnaBat and opportunistic data

4.2.1 Mammals

Based on the findings of database searches and previous surveys, a total of 49 mammal species have the potential to occur in the region surrounding the Mt Dove study area (**Attachment A**).

Of these species, 40 have been recorded in surveys within the surrounding area; namely, surveys of the Turner River Hub Project (Outback Ecology 2010b), the northern sections of the FMG Rail corridor (Biota 2004) and proposed Hope Downs rail corridor (Biota 2002b). It should be noted that these surveys encompassed a wider rage of habitat types than those present within Mt Dove study area; hence, lower species diversity was expected from the Mt Dove study area.

Fauna surveys of similar scale to the Mt Dove fauna survey (i.e. comparable numbers of sites, habitat types) yielded lower mammal species diversity than the autumn and spring 2010 surveys. For example, Outback Ecology (2009) recorded 19 mammal species during a detailed survey of the Wodgina DSO Project study area, located 30 km south of Mt Dove; Biota (2007) recorded 12 mammal species from two habitats (valleys with riparian vegetation and low stony hills) during the fauna survey of the Panorama mine site and haul road corridor, 80 km to the east of Mt Dove; and Bamford (2007) recorded nine mammal species during the fauna assessment of the Pardoo DSO Project, 80 km to the north-east of Mt Dove (**Table 11**).

A total of 23 mammal species (17 native) were recorded during the Mt Dove autumn and spring 2010 surveys (**Attachment B**).

The autumn 2010 trapping survey yielded 36 mammal captures from three different species within the study area: the Northern Quoll (*Dasyurus hallucatus*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), and Planigale (*Planigale sp.*) (**Attachment A** and **Attachment B**). Of the 36 captures, twenty-five of these were Northern Quolls, consisting of seven individuals.

The spring 2010 trapping survey yielded 25 mammal captures from five different species within the study area: the Northern Quoll (*Dasyurus hallucatus*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Stripe-faced Dunnart (*Sminthopsis macroura*), Echidna (*Tachyglossus aculeatus*) and Kaluta (*Dasykaluta rosamondae*) (**Table 13**, **Attachment A** and **Attachment B**). Of the 25 captures, 19 were Northern Quolls, consisting of six individuals.

The most abundant mammals recorded throughout this survey were the Northern Quoll (*Dasyurus hallucatus*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*) and Western Pebble-mound Mouse (*Pseudomys chapmani* – inactive mounds only). Northern Quolls were captured 44 times during the surveys, consisting of at least nine individuals, with two quolls escaping from traps, thereby avoiding identification. A single individual was also detected during spotlighting. Thirteen captures of Sandy Inland Mouse were recorded during systematic trapping and a single sighting of one individual was recorded during spotlighting, all at MD-F-3 in Acacia, Spinifex Sandplain. Seven mounds of the Western Pebble-mound Mouse were recorded within the study area on stony scree slopes, although no individuals were sighted or trapped during the survey. It must therefore be noted that the number of mounds recorded on this survey is not a reliable indicator of abundance, as the majority of the mounds were inactive and may represent signs of a population that has declined substantially in recent times.

Eight (possibly nine) species of bats were identified during the autumn and spring surveys at Mt Dove, namely: Gould‘s wattled bat (*Chalinolobus* gouldii), Yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*), Little broad-nosed bat (*Scotorepens greyii*), Common sheath-tailed bat (*Taphozous georgianus*), Finlayson‘s cave bat (*Vespadelus finlaysoni*), Northern free-tailed bat (*Chaerephon jobensis*) or the Yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*), and two conservation significant species; Ghost bat (*Macroderma gigas)* and Pilbara leaf-nosed bat (*Rhinonicteris aurantia).* Some call types of the Yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*) can be confused with those of the Northern free-tailed bat (*Chaerephon jobensis)*, so call sequences have been attributed to either of these species in order to be conservative (Specialised Zoological 2010).

Detailed supplementary reports summarising the number and location of bat species recorded from the Mt Dove study area during the autumn and spring 2010 surveys have been prepared by an independent Bat

Specialist (Kyle Armstrong of Specialised Zoological) and are presented in **Attachment E** and **Attachment F.**

In total, three conservation significant mammals were recorded during this survey including the Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*). These three species have previously been recorded in other regional surveys (**Attachment A**).

Table 13: Number of mammals captured within different fauna habitats

Habitat	No. of Species Recorded	Relative Mammal Abundance*
Acacia Shrubland on Footslopes	1	2
Acacia, Spinifex on Sandplain	3	15
Rocky Ridges	3	44

** Sum of all captures from systematic trapping sites, does not take account of number of individuals*
NB – table includes trapping data only (i.e. excludes AnaBat, search and opportunistic data)

4.2.2 Birds

Based on the findings of database searches and previous surveys, a total of 192 bird species have the potential to occur in the region surrounding the Mt Dove study area (**Attachment A**).

Of these species, 152 have been recorded in surveys within the surrounding area; namely, surveys of the Turner River Hub Project (Outback Ecology 2010b), the northern sections of the FMG Rail corridor (Biota 2004) and the proposed Hope Downs rail corridor (Biota 2002b). It should be noted that these surveys encompassed a wider rage of habitat types than those present within Mt Dove study area; hence, lower species diversity was expected from the Mt Dove study area.

Fauna surveys of similar scale to the Mt Dove survey (i.e. comparable numbers of sites, habitat types) yielded lower species diversity than the larger surveys mentioned above. For example, Outback Ecology (2009) recorded 46 bird species from the Wodgina DSO Project study area located 30 km south of Mt Dove. Similarly, a targeted survey of the Panorama mine site and haul road corridor (Biota 2007), 80 km to the east of Mt Dove, recorded a total of 41 bird species in two different habitats (valleys with riparian vegetation and low stony hills) (**Table 11**).

A total of 40 bird species were recorded during the autumn and spring 2010 surveys of the Mt Dove study area. (**Attachment A**, **Attachment B**). The autumn 2010 survey yielded 36 bird species and the spring 2010 survey yielded 25 species. Twenty-one species were observed during both surveys, with a further 15 species recorded during autumn only and four recorded during spring only. A total of 666 bird records from 35 different species were collected during site specific surveys in autumn and spring 2010 with a further five species sighted opportunistically (**Attachment B**).

The diversity and number of bird species found in each habitat are shown in **Table 14**. Higher numbers of birds were recorded within Acacia Shrubland on Footslopes habitat, most probably due to the presence of trees and shrubs utilised for foraging and nesting. This habitat type also represents a transition between the Rocky Ridge and Acacia, Spinifex on Sandplain habitats. Rocky Ridge habitat supported a lower diversity of bird species, perhaps due to its limited extent and paucity of vegetation present.

Overall bird abundance and diversity was lower in spring 2010 compared with autumn 2010 due to cool, windy conditions experienced on several days during the spring survey.

Table 14: Diversity and number of birds recorded in each habitat type

Habitat	No. of Species Recorded		Relative Bird Abundance*	
	Autumn 2010	Spring 2010	Autumn 2010	Spring 2010
Acacia Shrubland on Footslopes	21	16	164	164
Acacia, Spinifex on Sandplain	21	12	110	65
Rocky ridge	14	13	100	63

** Sum of all individuals recorded during 7 x 20 minute bird censuses, 1 x 90 minute hand search, 1 x 90 minute spotlight survey; excludes opportunistic and target search data*

Of the 31 species recorded during the daytime avifauna censuses, five species represented singletons (i.e. only a single individual was recorded for that species). Conversely, there were four species for which over 50 records were collected: Crested Pigeon (*Ocyphaps lophotes* – 125 records), Singing Honeyeater (*Lichenostomus virescens* – 112 records), Zebra Finch (*Taeniopygia guttata* - 90 records) and Black-faced Woodswallow (*Artamus cinereus* - 52 records) (**Attachment B**). Both the Crested Pigeon and Zebra Finch are granivores that are known to exist in high numbers throughout the Pilbara, particularly after periods of substantial rainfall (How et al., 1991). The Singing Honeyeater is one of Western Australia‘s most widespread and common bird species, particularly in the semi-arid to arid areas of the state (Barrett *et al.* 2003).

4.2.3 Reptiles

Based on the findings of database searches and previous surveys, a total of 115 reptile species have the potential to occur in the region surrounding the Mt Dove study area (**Attachment A**).

Of these species, 94 have been recorded in surveys within the surrounding area; namely, surveys of the Turner River Hub Project (Outback Ecology 2010b), the northern sections of the FMG Rail corridor (Biota 2004) and proposed Hope Downs rail corridor (Biota 2002b). It should be noted that these surveys encompassed a wider rage of habitat types than those present within Mt Dove study area; hence, lower reptile species diversity was expected from the Mt Dove study area.

Previous fauna surveys in the wider region, of similar scale to the Mt Dove survey (i.e. comparable numbers of sites, habitat types), yielded a lower reptile species diversity than this survey. For example, Outback Ecology (2009) recorded 25 reptile species from the Wodgina DSO Project study area located 30 km south of Mt Dove; Biota (2007) recorded 18 reptile species from two habitats (valleys with riparian vegetation and low stony hills) during the fauna survey of the Panorama mine site and haul road corridor, 80 km to the east of Mt Dove; and Bamford (2007) recorded 21 reptile species during the fauna assessment of the Pardoo DSO Project, 80 km to the north-east of Mt Dove (**Table** 11**)**.

A total of 29 reptile species were recorded during the autumn and spring 2010 surveys (**Attachment B**). The autumn 2010 survey yielded 21 reptile species and the spring 2010 survey yielded 25 species. Seventeen species were observed during both surveys, with a further four species recorded during autumn only and eight recorded during spring only (**Attachment B**).

The diversity and number of reptile species found in each habitat are shown in **Table 15**. Species diversity and abundance was highest in Acacia Spinifex on Sandplain and Acacia Shrubland on Footslopes habitat, with Rocky Ridge habitat showing considerably lower abundance. Spinifex Sandplain habitat is known for its high reptile diversity and abundance; however, assemblages are also known to be profoundly affected by inappropriate fire regimes (How *et al.* 1991).

Overall reptile abundance was lower in spring 2010 compared with autumn 2010 due to cool, windy conditions experienced on several days during the spring survey (**Table 3**). Despite this, reptile diversity was higher during the spring 2010 survey.

Of the 25 reptile species recorded during systematic trapping, eleven species represented singletons (i.e. only a single individual was recorded for that species); highlighting the degree to which fauna assemblages may fluctuate from season to season. Conversely, there were four species for which over ten records were collected: *Ctenotus pantherinus* (39 captures), *Lerista bipes* (34 records), *Ctenotus saxatilis* (17 records) and *Ctenophorus isolepis* (12 records) (**Attachment B**).

Table 15: Diversity and number of reptiles recorded in each habitat type

Habitat	No. of Species Recorded		Relative Reptile Abundance*	
	Autumn 2010	Spring 2010	Autumn 2010	Spring 2010
Acacia Shrubland on Footslopes	12	16	47	26
Acacia, Spinifex on Sandplain	10	9	60	28
Rocky Ridge	4	4	13	11

** Sum of all captures from systematic trapping sites, active searches and spotlight surveys; excludes opportunistic and target data.*

4.2.4 Amphibians

Based on the data from the review of database searches and previous surveys in the region, a total of nine amphibian species have the potential to utilise the Mt Dove study area. Six of these species have been recorded in surveys in the vicinity of the study area (Biota 2002b, 2004), while a further three have been recorded in the surrounding wider region (**Attachment A**).

In semi-arid areas such as the study area, it is typical for frogs to avoid exposure to drying conditions by sheltering in rock crevices, burrows or other well-insulated positions, thereby rendering them non-trappable. However, they are also known to emerge in great numbers during rainfall events, allowing them to be identified by trapping or via their calls. As no significant rainfall fell during the survey periods, no amphibians were recorded during the autumn or spring 2010 surveys; however, one individual *Cyclorana maini* was recorded from an invertebrate fauna wet pitfall trap located in Rocky Ridge habitat on the southern slope of Mt Dove (Outback Ecology 2010a). This species is not of conservation significance.

4.2.5 Introduced Fauna Species

Six introduced fauna species were recorded during the autumn and spring 2010 surveys: the Cat (*Felis catus*), Dingo or Dog (*Canis lupus dingo/familiaris*), Camel (*Camelus dromedarius*), Donkey (*Equus asinus*), European Cattle (*Bos taurus*) and Fox (*Vulpes vulpes*) (**Table 16**; **Attachment A**). All of these species with the exception of the cat are listed as ‗Declared Animals' under the WA *Agriculture and Related Resources Protection Act 1976*. The Act calls for reductions in numbers of the camel, dog (*Canis lupus familiaris*) donkey and fox. The remaining species (excluding European Cattle) are excluded from declaration as specific management programmes exist that outline the area and conditions under which controls may be applied.

Table 16: Introduced species recorded in each habitat type

Broad Fauna Habitat	European Cattle	Camel	Dog/ Dingo	Donkey	Fox	Feral Cat
Acacia Shrubland on Footslopes	X	X	X	-	-	X
Acacia, Spinifex on Sandplain	X	X	X	X	-	X
Rocky Ridge	X	-	X	X	X	X

NB – includes systematic trapping, active searches and targeted searches

Eight introduced species could potentially occur within and surrounding the study area, as indicated by database and literature searches (**Attachment A**). The two species not recorded in the current study, but identified from other studies or databases are the House Mouse (*Mus musculus*) and Rabbit (*Oryctolagus cuniculus*). The House Mouse was recorded in a range of previous surveys and database searches, however, the Rabbit only appeared in the survey of the BHP Railway Chichester Deviation report (ecologia 2008) and also the Environmental Reporting Tool database search (Department of Environment Water Heritage and the Arts 2010) (**Attachment A**). The Rabbit is only infrequently observed in the Chichester bioregion, as shallow soils (e.g. rocky ridge habitat) are unsuitable for burrow systems and *Triodia* spp are unsuitable for forage (e.g. Acacia Shrubland on Footslopes, Acacia, Spinifex on Sandplain habitats) (King 1990).

4.3 Conservation Significant Fauna Species

This section provides a summary of the occurrence of conservation significant vertebrate fauna species recorded or likely to occur within the study area.

A total of six species of conservation significance were recorded during the autumn and spring 2010 surveys. These species and a description of their records are provided in **Table 17** below. The locations of conservation significant species recorded within and in close proximity to the study area are shown in **Figure 17** and **Figure 18** and detailed in **Attachment D**.

Table 17: Conservation significant species recorded in the Mt Dove study area during 2010 surveys

Scientific Name	Common Name	Conservation Status			Notes
		EPBC Act[1]	WC Act[2]	DEC Priority[3]	
Dasyurus hallucatus	Northern Quoll	EN	S1		Nine individuals captured, one sighting.
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	S1		AnaBat recording from caves and water source (dam)
Macroderma gigas	Ghost Bat			P4	AnaBat recording, high confidence
Ardeotis australis	Australian Bustard			P4	Three individuals sighted, tracks observed
Merops ornatus	Rainbow Bee-eater	M			Widespread and common throughout the study area.

[1]Threatened species status under the Commonwealth EPBC Act: VU = Vulnerable, EN = Endangered, M = Migratory
[2]Threatened species status under the WC Act: S1 = Schedule S1, S4 = Schedule 4.
[3]DEC Priority Species List = Priority 1 (P1), P2, P3, P4
NB – Seven inactive Western Pebble-Mouse (*Pseudomys chapmani*) mounds also recorded during 2010 surveys

The conservation significance of terrestrial vertebrate fauna potentially occurring, within the study area is described in the following sections, including:

- Threatened fauna species listed under the EPBC Act and specially protected fauna listed under the WC Act (Section 4.3.1).
- Priority fauna recognised by DEC (Section 4.3.2).
- Species not listed under any Acts, but considered of conservation significance due to patterns of distribution (for instance bioregional endemics) (Section 4.3.3).
- Migratory species listed under the EPBC Act and international agreements which include the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), Republic of Korea Australia Migratory Bird Agreement (ROKAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals) (Section 4.3.4).

In the following sections, the likelihood of conservation significant fauna occurring within the Mt Dove study area has been ranked using the following definitions:

Confirmed - presence in study area recorded unambiguously during the last ten years (i.e. recent surveys of study area or via database searches)

Very Likely – study area lies within the species' known distribution and contains suitable habitat(s), plus the species generally occurs in suitable habitat and has been recorded nearby in the last 20 years.

Likely – study area lies within the species' known distribution and the species has been recorded nearby in the last 20 years; however, either:

a) contains habitat that is marginally suitable, or only a small area of suitable habitat;
b) the species is generally rare and patchily distributed in suitable habitat.

Possible - Outside chance of occurrence based on:

a) study area is just outside the known distribution; however, contains suitable and sufficient habitat (species may be common, rare, or patchy); or
b) study area lies within the known distribution but species is very rare and/or patchily distributed; or
c) study area lies on the edge or within the known distribution and has suitable habitat, but the species has not been recorded in the area for over 20 years.

Unlikely – study area lies outside the species known distribution, does not contain suitable habitat and the species has not been recorded in the area for over 20 years.

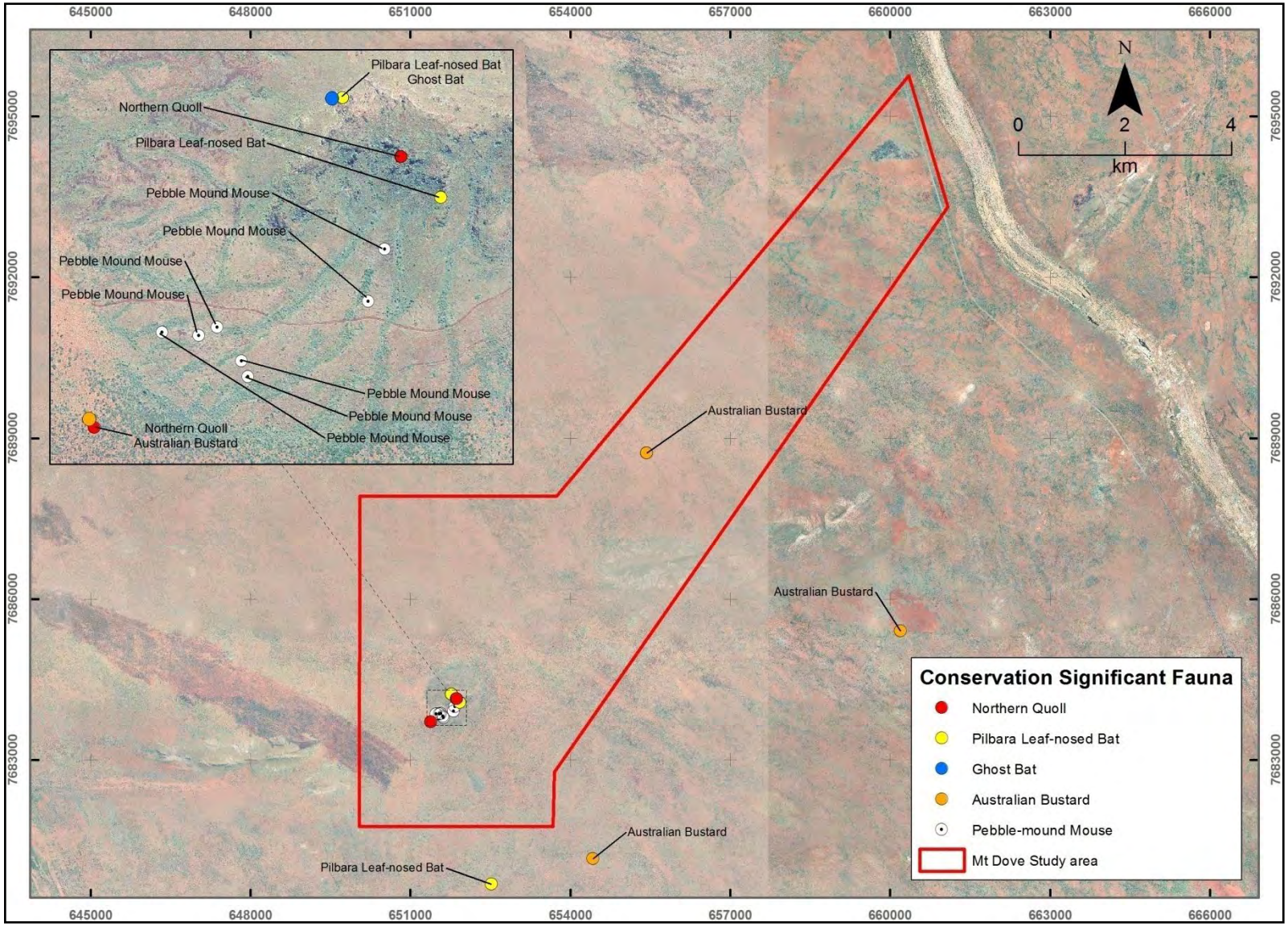

Figure 17: Location of conservation significant fauna recorded during the 2010 surveys of the Mt Dove study area

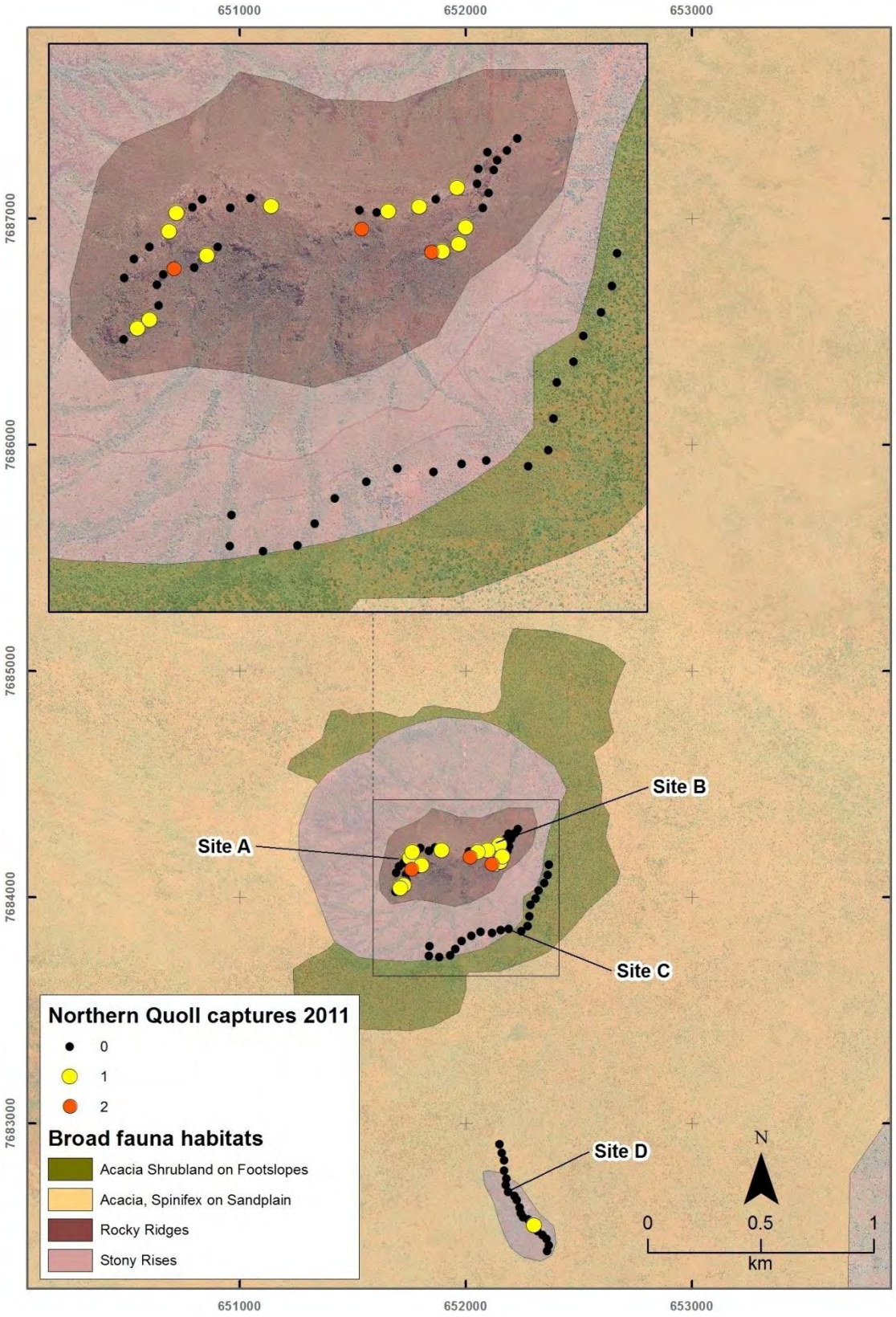

Figure 18: Location of Northern Quoll captures within the Mt Dove study area during the 2011 monitoring survey

4.3.1 Threatened Fauna Species

Legislation has been developed at a Commonwealth and State level to protect fauna species that have been formally recognised as rare, threatened with extinction or as having high conservation value. At the national level, fauna are protected under the EPBC Act. Within WA, fauna can be listed under various Schedules within the WC Act. Definitions of conservation significance are presented in **Attachment C**.

Nine threatened species were identified via searches of previous surveys, databases and regional summary documents, however, only seven species could be reasonably expected to occur within the Mt Dove study area (**Table 18**). These seven species are examined below. The remaining two species are unlikely to occur as their known range occurs well outside the Mt Dove study area. Potential impacts and management implications for threatened fauna with respect to the proposed Mt Dove Project are discussed in further detail in **Table 25**.

Table 18: Threatened fauna species recorded or potentially occurring in the Mt Dove study area

Common Name (*Scientific Name*)	Likelihood	Conservation Status		No of previous surveys recorded within surrounding region	No. of database searches recorded
		EPBC Act[1]	WC Act[2, 3]		
Mammals					
Northern Quoll (*Dasyurus hallucatus)*	Confirmed	EN	S1	7	3
Mulgara (*Dasycercus cristicauda/blythi*)	Likely	EN / -	S1 / P4	5	2
Bilby (*Macrotis lagotis*)	Possible	VU	S1	1	1
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	Confirmed	VU	S1	3	1
Birds					
Princess Parrot (*Polytelis alexandrae*)	Unlikely	VU	P4	0	1
Peregrine Falcon (*Falco peregrinus*)	Likely	-	S4	5	1
Major Mitchell's Cockatoo (*Cacatua leadbeateri*)	Unlikely	-	S4	0	1
Reptiles					
Pilbara Olive Python (*Liasis olivaceus barroni*)	Possible	VU	S1	3	1
Woma Python (*Aspidites ramsayi*)	Likely	-	S4	1	2

[1]Threatened species status under the Commonwealth EPBC Act: VU = Vulnerable, EN = Endangered, M = Migratory

[2]Threatened species status under the WC Act: S1 = Schedule S1, S4 = Schedule 4.

[3]DEC Priority Species List = Priority 1, P2, P3, P4

- **Northern Quoll (*Dasyurus hallucatus*)**

The Northern Quoll is listed as Endangered under the EPBC Act and listed as Schedule 1 under the WC Act. Little is known of the Northern Quoll's biology and ecology in the Pilbara. Knowledge gaps include home range, reproductive cycle, population ecology, diet, critical habitat requirements and the response of populations to fire.

The Pilbara is considered to be the last 'stronghold' for Northern Quolls as the species has experienced a precipitous decline in much of its former range in northern Queensland and the Northern Territory (Fitzsimons *et al.* 2010). This decline has been directly associated with the spread of the Cane Toad (*Bufo marinus*).

The Northern Quoll is both arboreal and terrestrial, inhabiting ironstone ridges, scree slopes of sandstone or ironstone and granite boulders and outcrops. It also inhabits drainage lines and riverine habitats where it utilises tree hollows as den sites (Van Dyck and Strahan 2008). Rocky escarpments with rock crevices and caves support higher densities of Northern Quolls than habitats such as *Eucalyptus* woodlands and human settlements (Van Dyck and Strahan 2008). Ironstone ridges, crevices and caves are present within the Mt Dove area, and occur towards the central portion of the area mapped as Rocky Ridge habitat (**Figure 16**). The closest drainage line habitat (i.e. the Yule River) is located 12 km to the west of Mt Dove.

The Northern Quoll is the largest mammal species in the world known to undergo male die-off after mating (Van Dyck and Strahan 2008). The species' abundance is highly cyclical and annual reproduction is highly synchronised. The abundance of Northern Quolls in the Pilbara is lowest after the mating season, which occurs in the winter months, as a significant proportion of males have died off and young have not yet begun to forage independently (Oakwood 2000). Therefore the population density is expected to be highest in the summer months, prior to the mating season and when juveniles have begun foraging independently.

The majority of home range data for the Northern Quoll has been acquired from studies in the Kimberley and Northern Territory (Oakwood 2002). Schmitt *et al.* (1989) reported far smaller home ranges in rugged habitat in the Kimberley; i.e. 2.3 ha for females and 1.8 ha for males, whereas King (1989) recorded a minimum activity area of 75 to 443 ha for females and 5 to 1109 ha for males in the Western Pilbara. In the same study, King found that Northern Quolls moved up to 3.5 km over seven days in an area of mainly ironstone hills sparsely covered with spinifex (*Triodia* spp.) and scattered trees (*Eucalyptus* and *Acacia* spp.). During the Northern Quoll monitoring survey in May 2011, a male was found to have travelled 1.5 km over two nights from Rocky Ridge habitat to Stony Rise habitat to the south, further demonstrating the species' ability to move considerable distances.

Review of the literature indicates that ten of 12 surveys conducted within 150 km of the study area recorded the presence of Northern Quolls, primarily in rocky ridges, gorges, granite outcrops and

watercourses (**Attachment A**). Additionally, database records show that the Northern Quoll has been recorded from Wodgina, the FMG and Hope Downs rail corridors, and Marble Bar (Department of Environment and Conservation 2010c). The closest known populations of Northern Quolls outside the study area are known from rocky ridges 12 km south of Mt Dove (Outback Ecology in prep), Indee Station 22 km to the east of the study area (Colin Brierley, pers comm. May 2010) and Wodgina 35 km southeast of the study area (Outback Ecology 2009, 2010c). With the exception of the Wodgina population, numbers of individuals captured from surrounding populations during previous surveys have been lower. However it is recognised there are a range of factors that may influence the number of Northern Quolls recorded during these surveys including:

- Season – Northern Quolls exhibit naturally high fluctuations in numbers across different seasons;
- Timing of survey – Northern Quolls populations are higher in the summer months; and
- Habitat quality and existing disturbance of the study area being assessed.

Trapping effort for Northern Quolls during the autumn and spring 2010 surveys totalled 924 trap nights (i.e. 20 Elliott traps and two Sheffield cage traps set at each of the three systematic survey sites over 14 trapping nights); however, it should be noted that only one site was located within suitable Northern Quoll denning habitat (site MD-F-2; **Figure 11**). A total of nine individuals were recorded, comprising seven females and two males. Seven individuals were recorded during the autumn 2010 survey, with four of these individuals recaptured in spring 2010 along with a further two unmarked individuals (i.e. not captured in autumn). The vast majority of these captures were recorded within Rocky Ridge habitat with two captures recorded within Acacia Shrubland on Footslopes habitat, some 600 m to the south west. More specifically, most captures were associated with traps placed near caves, crevices and outcropping ironstone, which are used by Northern Quolls for denning. These features occur primarily around the peak of Mt Dove.

Trapping effort for Northern Quolls at Mt Dove during the Northern Quoll monitoring program conducted in May 2011 totalled 433 trap nights (i.e. four nights of trapping for two sites in Rocky Ridge habitat and seven nights of trapping in Stony Rise and Acacia Shrubland on Footslopes habitat). A total of seven individuals were recorded (19 captures, trap success of 4.4%), comprising five females and two males. Three of these females had been captured during the 2010 baseline survey. All but one capture of these individuals was in Rocky Ridge habitat with a single capture of an adult male recorded within Stony Rise habitat, some 1.5km to the south of Mt Dove (**Figure 18**).

The only comparable study within reasonable proximity to the current study area was that conducted at Wodgina, 35 km to the south-east of Mt Dove (Outback Ecology 2010c). This study involved a targeted Northern Quoll baseline survey, which was undertaken at Atlas' Wodgina DSO Project, during February 2009 to set the platform for an ongoing monitoring program. The study area contained 1,577 ha of Northern Quoll habitat including drainage lines, rocky ridges and outcrops and gullies. This survey consisted of eight monitoring sites with a total trapping effort of 1,120 trap nights, with seven of these sites

located within suitable Northern Quoll habitat. A total of 18 individuals were recorded and a population estimate of 20 individuals was calculated from this baseline population survey (Outback Ecology 2010c).

With consideration to the Wodgina Northern Quoll baseline survey, it is suggested that Northern Quolls occur in a relatively high density at Mt Dove. Consequently, Mt Dove is likely to be an important refuge for the Northern Quoll, although it is unknown whether Mt Dove is an important ecological link between surrounding populations or is in itself an isolated, genetically distinct population. The genetics, dispersal and recruitment patterns of Northern Quolls in the Pilbara region are unknown. Riverine, drainage line and rocky outcrops may provide fauna corridors in which the species' can disperse; however, the habitat surrounding Mt Dove is open, low lying and sparsely vegetated. Therefore, the level of interaction occurring with surrounding Northern Quoll populations is likely to be limited, although this is currently unknown. The nearest potential denning habitat is situated 12 km to the south of the study area which is and comprises a ridge system which extends 17km in an east-west orientation. The western edge of this ridge system abuts the Yule River. The southern face of this ridge contains outcropping ironstone, caves, gullies and scree slopes. The northern face also contains outcropping ironstone, caves and scree however lacks the sheltered microclimate created by southern facing slopes.

- **Mulgara (*Dasycercus cristicauda, D. blythi*)**

Until recently the Brush-tailed Mulgara (*Dasycercus blythi*) was considered the same species as the Crest-tailed Mulgara *(Dasycercus cristicauda*) (Van Dyck and Strahan, 2008). The Crest-tailed Mulgara is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act; the Brush-tailed Mulgara is listed as Priority 4 by the DEC. The current distribution of each of these species is uncertain and can only be ascertained once correct identification of museum specimens has been undertaken (Van Dyck and Strahan, 2008). However, current estimates show that Mt Dove study area falls within the range of the Brush-tailed Mulgara with the Crest-tailed Mulgara being limited to central Australia (Van Dyck and Strahan, 2008). Recent consultation with the WA Museum (Ric How, pers comm. Oct 2010) indicates that the vast majority of Mulgara specimens captured in Western Australia, after taxonomic revision of the species, are of the Brush-tailed Mulgara *(Dasycercus blythi*) as opposed to the Crest-tailed Mulgara (*Dasycercus cristicauda*).

Both species of Mulgara prefer mature spinifex grasslands on sandy soils, constructing burrows on the flats between sand dunes (Van Dyck and Strahan, 2008). Introduced grazers namely cattle and rabbits, altered fire regimes and predation by cats and foxes have contributed to the population decline of this species (Van Dyck and Strahan, 2008; Maxwell *et al*. 1996).

Mulgara have been recorded near the Mt Dove study area at Kangan, Wallareenya and Boodarie (Department of Environment and Conservation 2010c); as well as in fauna surveys of the FMG and proposed Hope Downs rail corridors, Panorama Project, Pardoo DSO Project and Abydos-Woodstock Reserve (**Attachment A**). The closest recording to the Mt Dove study area occurs at Kangan,

approximately 20 km to the south. Mulgara were not recorded within the Mt Dove study area, although it is considered likely to occur in sandy habitat such as Acacia, Spinifex on Sandplain, particularly where mature, long-unburnt hummocks of Spinifex exist.

- **Bilby (*Macrotis lagotis*)**

The Bilby is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. The Bilby was formerly associated with a variety of inland habitats including desert sandplains and dune fields with hummock grasslands and massive red earths and *Acacia* shrubland (Maxwell *et al.* 1996). Bilbies dig large burrows in the sandy substrates that can reach up to three metres long and 1.8 metres deep (Van Dyck and Strahan 2008). Bilbies are not reliant on surface water and receive most of their water requirements from food sources. Their diet consists of insects, larvae, seeds, bulbs, fruit and fungi (Van Dyck and Strahan 2008). The Bilby has undergone a widespread population decline as a result of altered fire regimes, predation by the European Red Fox (*Vulpes vulp*es) and feral cats and grazing pressure from introduced herbivores and livestock. Many of these introduced species (i.e. Cat, Fox, Cattle, Camel, Donkey) were recorded within the study area.

Bilby diggings have been recorded near the study area at Kangan in 2001 (approximately 20 km south), from Marble Bar in 2006 (Department of Environment and Conservation 2010c) and from the southern portion of the proposed Hope Downs rail corridor (Biota 2002b). It is possible that the species could occur within the Mt Dove study area where sandy habitat supporting mature hummock grasslands exists (i.e. within Acacia, Spinifex on Sandplain habitat).

- **Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia)***

The Pilbara Leaf-nosed Bat is classified as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. This species is subject to several threatening processes including flooding and human impacts such as mining (Department of Sustainability Environment Water Population and Communities 2010c). In the Kimberley, mating has been documented as occurring in July for Orange Leaf-nosed Bat populations, followed by a prolonged gestation of 150 days with females giving birth in December (Churchill 2008). Young were weaned and independent by late February. This is assumed to be similar in the Pilbara populations and Armstrong (2001) has previously captured pregnant females in December and weaned and independent young have been observed in March (Department of Sustainability, Environment, Water, Pollution and Arts 2010).

In the Pilbara, this species has been observed foraging in numerous habitats including *Triodia* hummock grasslands (Armstrong 2001, Churchill 1988), small watercourses near granite koppies and around pools in riverine or gorge habitats (Armstrong 2001). At present, the diet of Pilbara Leaf-nosed Bat (*R. aurantia*) has not been studied in any detail, however it is assumed to be similar to the Orange Leaf-nosed Bat (*R. aurantius*). *R. aurantius* shows a pattern of selective foraging for moths (*Lepidoptera)* and beetles (*Coleoptera*) depending on their seasonal abundance (Churchill 1994).

The Pilbara Leaf-nosed Bat requires warm, very humid roost sites in caves and mines as they enable the species to persist in arid climates by limiting water loss and energy expenditure (Van Dyck and Strahan 2008). Due to this species reliance on humid, moist environments for its survival, it is the scarcity of caves that possess the required microclimate of between 28 - 32^{o}C and between 85 - 100% humidity that is thought to limit their distribution (Armstrong, 2000; Churchill, 1991). The home range of the Pilbara Leaf nosed Bat has not been studied; however, it is unlikely to travel long distances from its roost sites to forage in the dry season (Armstrong, 2001). Environmental conditions are more favourable in the wet season as the weather is more humid and fluctuates less. Further, there is an increased abundance of prey and water sources available (Churchill, 1991).

A total of 14 caves with the potential to support Pilbara Leaf-nosed Bats on Mt Dove were assessed during the autumn and spring 2010 surveys. AnaBat recording units were established within or near caves considered to most likely represent suitable roost habitat for this species (**Figure 14**). No sightings of Pilbara Leaf-nosed Bats were made during the day time assessments of these caves. Positive AnaBat echolation recordings of the Pilbara Leaf-nosed Bat were recorded from two of these caves (cave sites MD-AN-2 and MD-AN-4) within the Rocky Ridge habitat on Mt Dove (**Figure 19**); and from the stock water dam (site MD-AN-1) outside of the study area, approximately 3.3 km to the south of Mt Dove (**Figure 19**). These records are discussed below.

Cave site MD-AN-2 represented a large cave feature located on the northern face of Mt Dove, which lies within the proposed Project disturbance area (**Figure 19**). Calls of the Pilbara Leaf-nosed Bat were recorded from this cave during both the autumn and spring 2010 surveys. Call sequences recorded during both seasons occurred in the middle of the night. This pattern is suggestive of an occasional visit by one or more individuals to this cave whilst foraging at night (Specialised Zoological 2010; **Attachment F**). This species typically visits caves at night, possibly for resting, and may or may not roost in the structure during the day. The conservation significant Ghost Bat (*Macroderma gigas*) was also recorded from this cave site during both seasons (**Figure 19**); further suggesting this cave is an important site for both species on Mt Dove. The significance of this cave is discussed further with the occurrence of Ghost Bat in Section 4.3.2.

Cave site MD-AN-4 is a small cave on the southern face of Mt Dove, which occurs within the Project disturbance area (**Figure 19**; **Plate 7**). Only one Pilbara Leaf-nosed Bat call sequence was recorded at this site during the autumn survey. This activity was considered to be low and is indicative of a short visit from an individual whilst foraging (**Attachment E**). The Pilbara Leaf-nosed Bat and Ghost Bat were not recorded at location MD-AN-4 from a continuous AnaBat recording conducted over four nights during the spring survey. These findings suggest that the cave site MD-AN-4 is unlikely to be a significant roosting location for Pilbara Leaf-nosed Bats and is more likely to be a cave that is visited occasionally whilst the species is foraging at night.

Pilbara Leaf-nosed Bat activity was recorded during the autumn survey at the stock water dam (site MD-AN-1), approximately 3.3km to the south of Mt Dove (**Figure 19**; **Plate 5**). Permanent water sources are thought to be important for this species and this constructed dam is likely to encourage the presence of foraging Pilbara Leaf-nosed Bats around Mt Dove as permanent water sources are scarce within the region. Call sequences at the dam site MD-AN-1 occurred between 21:00 hours and 01:30 hours which is indicative of foraging behaviour for this species (**Attachment E**). An AnaBat was set up at this location again in spring however it did not record any positive call sequences for the Pilbara Leaf-nosed Bat.

Detailed summaries of AnaBat echolocation results conducted by Kyle Armstrong of Specialised Zoological are provided in **Attachment E** and **F**. DEC records and previous surveys indicate that the Pilbara Leaf-nosed Bat has been recently recorded from other regional sites including Wodgina located 35 km to the south south-east of Mt Dove (Outback Ecology, 2009); and Abydos, located 75km to the south-east of Mt Dove (Bamford Consulting Ecologists, 2009) (**Attachment A**).

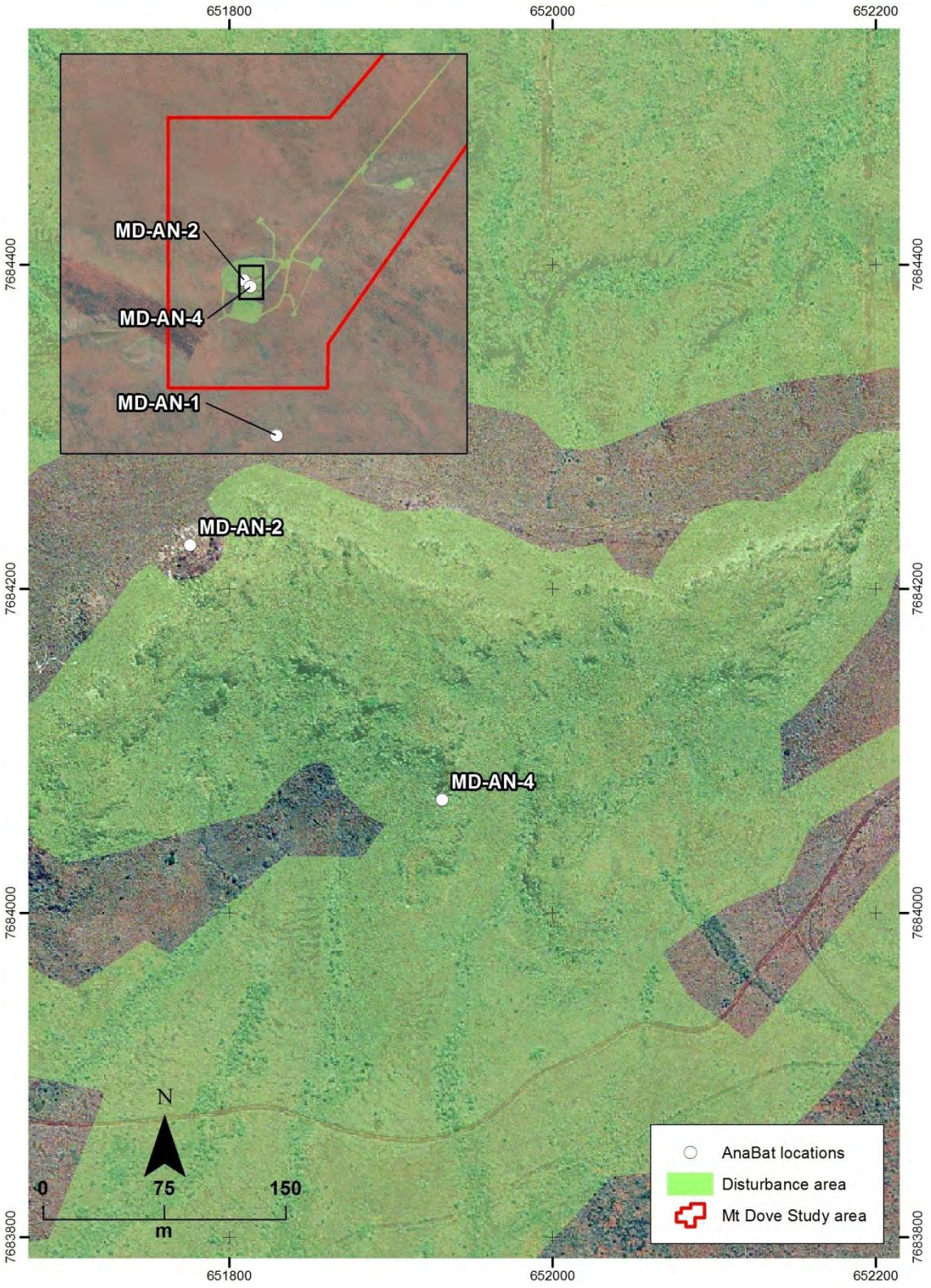

Figure 19: Locations of caves on Mt Dove from which conservation significant bat species have been recorded

- **Peregrine Falcon (*Falco peregrinus*)**

The Peregrine Falcon is listed as Schedule 4 under the WC Act. It is a nomadic species that utilises a wide range of habitats across Australia, including rocky escarpments and gorges, cliffs, tree lined watercourses, open woodland and *Acacia* shrublands (Pizzey and Knight 2007). This species has a home range of approximately 20 – 30 km^2. The Peregrine Falcon utilises cliffs and tree hollows for breeding.

The Peregrine Falcon was not recorded within the Mt Dove study area, however has been recorded from a range of projects in the surrounding region, including surveys of the Hope Downs and FMG railway corridor projects (Biota 2002b, 2004) and the WA Museum survey of the Abydos-Woodstock Reserve (How *et al.* 1991). The species is found in most habitats but prefers inland cliffs and open woodlands near water for nesting (Pizzey and Knight 2007). Consequently, the species may favour Rocky Ridge habitat as it may provide more secure nesting sites than the other habitats within the study area. It is likely that this species would utilise the study area intermittently; however, it is unlikely to be dependent on the habitat within it given its mobility and the availability of suitable habitat within the region.

- **Pilbara Olive Python (*Liasis olivaceus barroni*)**

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. This species inhabits rocky escarpments, deep gullies and gorges within the Pilbara region and is often recorded near water holes and riverine habitats (Wilson and Swan 2008). Tracking of individuals using radiotelemetry has found that the Pilbara Olive Python occupies a distinct home range; however males travel long distances during their breeding season from June to July to locate females (Department of Sustainability Environment Water Population and Communities 2010c).

The Pilbara Olive Python was not recorded within the Mt Dove study area during the autumn and spring 2010 surveys. The species has been recorded from Rocky Ridge habitat at Abydos, approximately 70 km east south-east of Mt Dove (Bamford Consulting Ecologists, 2009); Pardoo, 90km north-east of Mt Dove) (Bamford Consulting Ecologists 2007) and anecdotal records from Wodgina, 30 km to the south of Mt Dove (Outback Ecology 2009). Given that Rocky Ridge habitat on Mt Dove is limited in extent and the species is generally rare and patchily distributed in suitable habitat, it is possible that the Pilbara Olive Python could occur within the study area.

- **Woma or Ramsay's Python (*Aspidites ramsayi*)**

The Woma Python is listed under Schedule 4 of the WC Act. This species occurs in arid zones of Western Australia in woodland habitats, heathland and shrubland habitats often containing spinifex. The south-west Wheatbelt population appears to be threatened as opposed to the northern populations (Storr *et al.* 2002).

This species was not recorded within the study area during the autumn or spring 2010 surveys. The Woma has been recorded during the survey of the southern section of the Hope Downs railway corridor

(Biota 2002b), on Indee Station (22 km to the east) and Pipingarra (approximately 50 km to the north east). Consequently, it is likely that the Woma could occur within the study area.

The following two species have been recorded from database searches, however are considered unlikely to occur within the Mt Dove study area.

- **Princess Parrot (*Polytelis alexandrae*)**

The Princess Parrot is listed as Vulnerable under the EPBC Act and as a Priority 4 species by the DEC. The Princess Parrot is found primarily in the central and western arid zone of Australia and large-scale movements and sporadic appearances outside the western deserts make it difficult to determine whether there has been any change in distribution or numbers. The Princess Parrot is an inhabitant of lightly wooded country of desert areas to the east of the study area; from the Great Sandy Desert, through the Gibson Desert and into the Great Victoria Desert (Johnstone, 1998). The study area lies outside the core range of this species and suitable habitat is not present. Subsequently, the species is unlikely to occur.

- **Major Mitchell's Cockatoo (*Cacatua leadbeateri*)**

The Major Mitchell's Cockatoo is listed as Schedule 4 under the WC Act. This species occupies sparsely timbered grasslands, paddocks with trees, mulga, open scrublands, open mallee country and tree lined watercourses. The Major Mitchell's Cockatoo is a sedentary, uncommon species with a patchy distribution, although it may be locally common in some areas. The species is considered unlikely to occur within the study area as it lies outside its core range and no suitable habitat is present.

4.3.2 Priority Fauna Species

The DEC recognises species not listed under the WC Act but for which there is some concern, and has produced a supplementary list of 'Priority' fauna. Definitions of Priority fauna are listed in **Attachment C**.

Fourteen Priority species were identified via searches of previous surveys, databases and regional summary documents, however, only eight species could be reasonably expected to occur within the Mt Dove study area (**Table 19**). Potential impacts and management implications for Priority fauna with respect to the proposed Mt Dove Project are discussed in further detail in **Table 25**.

Table 19: Priority fauna species recorded or potentially occurring in the Mt Dove study area

Common Name (*Scientific Name*)	Likelihood	DEC Priority Listing[1]	No of previous surveys recorded within the surrounding region	No. of database searches recorded
Mammals				
Mangrove Freetail-bat (*Mormopterus cobourgiana*)	Unlikely	P1	1	0
Spectacled Hare-Wallaby (*Lagorchestes conspicillatus leichardti*)	Likely	P3	2	2
Ghost Bat (*Macroderma gigas*)	Confirmed	P4	6	3
Lakeland Downs Mouse (*Leggadina lakedownensis*)	Likely	P4	3	0
Western Pebble-mound Mouse (*Pseudomys chapmani*)	Very likely	P4	7	2
Long-tailed Dunnart (*Sminthopsis longicaudata*)	Possible	P4	1	-
Birds				
Australian Bustard (*Ardeotis australis*)	Confirmed	P4	7	3
Bush Stone-curlew (*Burhinus grallarius*)	Very Likely	P4	6	3
Eastern Curlew (*Numenius madagascariensis*)	Unlikely	P4	1	0
Flock Bronzewing (*Phaps histrionica*)	Unlikely	P4	0	1
Grey Falcon (*Falco hypoleucos*)	Likely	P4	2	1
Star Finch (*Neochmia ruficauda subclarescens*)	Likely	P4	2	1
Reptiles				
Ramphotyphlops ganei	Possible	P1	1	0
Pin-striped Finesnout Ctenotus (*Ctenotus nigrilineatus*)	Unknown	P2	1	0
Spotted Ctenotus (*Ctenotus uber johnstonei*)	Unknown	P2	1	0

[1]DEC Priority Species List = Priority 1, P2, P3, P4

- **Spectacled Hare-Wallaby (*Lagorchestes conspicillatus leichardti*)**

The Spectacled Hare-Wallaby is listed as Priority 3 by the DEC. This species inhabits *Triodia* hummock grasslands and *Acacia* shrublands and has declined dramatically within the Pilbara region, possibly due to fox predation and inappropriate fire regimes, which have prevented the development of large tussock grasslands required for adequate shelter (Van Dyck and Strahan 2008).

The Spectacled Hare-Wallaby was not recorded within the Mt Dove study area during the autumn and spring 2010 surveys. This species has been recorded some 40 km to the south east at Pilgangoora in 1994 (Department of Environment and Conservation 2010c) and evidence for this species was recorded during a survey of the Panorama project, approximately 80 km to the east (Bamford Consulting Ecologists 2001). This species was not recorded in the Mt Dove study area; however, the species was recently recorded by Outback Ecology (2010b) in Spinifex over sandplain habitat 70 km to the south-east of Mt Dove.

Suitable mature stands of Spinifex for this species exist within Acacia, Spinifex on Sandplain habitat and subsequently the species is considered likely to occur within the study area.

- **Ghost Bat (*Macroderma gigas*)**

The Ghost Bat is listed as Priority 4 by the DEC. The Ghost Bat is Australia's only carnivorous bat and is known to feed on a variety of vertebrate species including large insects, frogs, lizards, small mammals and other bats (Van Dyck and Strahan, 2008). Ghost bats occupy a variety of habitats from the arid Pilbara to the rainforests of Northern Queensland (Van Dyck and Strahan 2008). Ghost Bats roost in undisturbed caves usually with several entrances, in deep fissures or abandoned mine shafts (Menkhort and Knight 2004).

Ghost Bats mate between July and August with females bearing a single young around September. Mothers form nursery colonies and genetic testing has shown that the entire species is centralised upon regional maternity sites, of which approximately ten are known to exist (Van Dyck and Strahan, 2008). In the Pilbara, a number of natural formations are used by the Ghost Bat intermittently as short-term transient roosts and for feeding activity by an individual or small numbers of individuals, whilst others are used by maternity colonies (Armstrong and Anstee 2000).

The structure of a roost site is largely indicative of its use. The transient day roosts or feeding sites of Ghost Bats are often shallow overhangs and crevices with microclimates similar to ambient conditions, whereas roosts for breeding activity have a relative humidity of above 80% (Armstrong and Anstee 2000). Domed ceilings which create humid microclimates are often present in, but not exclusive to maternity caves. Deep, humid and complex mine shafts and deep humid caves with several chambers and dome ceilings are associated with permanent Ghost Bat occupancy and maternity roosts (Hall *et al.* 1997).

Ghost Bats have large and well developed eyes and ears and quietly scan an area before swooping on prey (Van Dyck and Strahan 2008). Unlike other microbats, Ghost Bats do not use the echolocation call continuously during flight, and consequently, AnaBat echolocation recording may not always detect their presence. Further, the echolocation calls of the Ghost Bat can be difficult to distinguish from other ultrasonic signals, including some higher harmonic components from the Common Sheath-tailed Bat

(*Taphozous georgianus*), in the confines of a cave. As such, ascribing echolocation recordings to the Ghost Bat during surveys of the study area was done conservatively. To supplement AnaBat echolation sampling, shotgun microphones were also used in this survey to detect the non-ultrasonic social calls of this species. Detailed summaries of AnaBat echolocation results conducted by Kyle Armstrong of Specialised Zoological are provided in **Attachment E** and **F**.

The entire Rocky Ridge system on Mt Dove was traversed on foot during the autumn 2010 survey. A total of 14 caves with the potential to support Ghost Bats were identified and assessed during both the autumn and spring 2010 surveys. No sightings of Ghost Bats were made during the day time assessments of these caves. AnaBat recording units and a shotgun microphone were established in the cave structures considered to most likely represent potential roost habitat for this species.

Positive AnaBat echolation recordings for Ghost Bats were recorded from cave site MD-AN-2 during both the autumn and spring 2010 surveys (**Figure 17**). Cave site MD-AN-2 represented a large cave feature (5m wide by 3m high and approximately 10m deep) located on the northern face of Mt Dove, which lies within the proposed disturbance area (**Figure 19**). Calls from this cave were recorded from one night during the autumn survey and four consecutive nights during the spring survey. The majority of calls recorded occurred predominantly after midnight suggesting visitation to this cave at night and not roosting during the day. However, two calls were recorded during soon after sunset which may be indicative of daytime roosting in the cave. Additionally, records of social calls produced by at least two individuals calling to each other within this cave in the middle of the night were recorded over a considerable time period during the autumn survey.

Based on the findings of the autumn and spring bat surveys, it appears cave site MD-AN-02 is used regularly (over consecutive nights) and in more than one season (autumn and spring) by both the Pilbara Leaf-nosed Bat and Ghost Bat. Most echolocation calls and social calls were recorded in the middle of the night, which indicates the site was used as a night refuge; however evidence of this site being used as a daytime roost was not identified during the visual assessments of the cave.

While Pilbara Leaf-nosed Bats and Ghost Bats are found throughout the region, it is possible that their movements amongst roosts that provide appropriate microclimates throughout the year are aided by ‗transitory roosts' that may be useful as stop-over points in intervening areas (**Attachment F**). Regardless of whether cave site MD-AN-02 is used as a daytime roost by either species, the data collected to date suggest the site is important as it is used regularly by both species, and might also be important for aiding regional movements, especially given the lack of other significant Rocky Ridge habitat within the surrounding landscape.

The nearest potential Ghost Bat roost habitat for Ghost Bats may occur in the ridge system located 12 km to the south of the Mt Dove study area. Roost sites have also been identified in the wider surrounds during

the fauna assessment of the Wodgina DSO study area, located 35 km to the south-east of the Mt Dove study area (Outback Ecology, 2009). During this assessment, a total of 30 Ghost Bat roost locations were identified in the Wodgina DSO study area and surrounds. Two of these sites were considered to be regionally significant and were found to contain large aggregations of between 40 – 70 bats (Outback Ecology, 2009). These caves are located approximately 35 km south south-east and 55 km south-east of the Mt Dove study area. A highly significant maternity roost of Ghost Bats and six additional roosts, two containing regionally high number of bats, was recorded by Bamford (2009) during a fauna assessment of the Abydos Project, 75 km to the south-east of the Mt Dove study area.

- **Lakeland Downs Mouse (*Leggadina lakedownensis*)**

The Lakeland Downs Mouse is classified as Priority 4 by the DEC and utilises a variety of different habitats including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical *Eucalyptus* woodlands and stony ranges. Most of these habitats are seasonally inundated on red or white sandy-clay soils (Van Dyck and Strahan 2008). Previous records of the Lakeland Downs Mouse was recorded during both the proposed Hope Downs and FMG railway corridor surveys (Biota 2002b, 2004). Records also occur from Chichester and Marble Bar in 2001 (Department of Environment and Conservation 2010c).

This species was not recorded in the autumn or spring 2010 surveys, however is considered likely to occur as suitable habitat for this species (i.e. Acacia, Spinifex on Sandplain) does occur within the study area.

- **Western Pebble-mound Mouse (*Pseudomys chapmani*)**

The Western Pebble-mound Mouse is listed as Priority 4 species by the DEC. This mouse constructs mounds out of small pebbles that can cover 0.5 to 9.0 m² (Van Dyck and Strahan 2008). Breeding for this species can occur throughout the year. Females may produce several litter per year of up to four young (Van Dyck and Strahan 2008).

Suitable habitat for the species is patchy but populations are widespread throughout the ranges of the central and southern Pilbara (Van Dyck and Strahan 2008). Furthermore, evidence of the mouse has been has been frequently recorded within the region surrounding Mt Dove (Bamford Consulting Ecologists 2001, 2007, 2008, Biota 2004, How and Cooper 2002, How *et al.* 1991).

Seven inactive mounds were recorded within Stony Rise habitat during the autumn and spring 2010 surveys (**Attachment E**). It should be noted that the prevalence of mounds within the study area and surrounds is not a reliable indicator of abundance or even presence as mounds are often used by successive generations (Van Dyck and Strahan 2008) and persist in the landscape for many years. All of the mounds recorded during the autumn and spring 2010 surveys were inactive and may represent signs of a population that has declined substantially in recent times. Despite this, the Western Pebble-mound Mouse is considered very likely to occur within the study area.

- **Long-tailed Dunnart (*Sminthopsis longicaudata*)**

The Long-tailed Dunnart is classified as Priority 4 by the DEC. This species lives in arid rocky areas and has been recorded from flat topped hills, plateaus and scree slopes. In the winter, the Long-tailed Dunnart feeds entirely on arthropods and may enter hibernation (Van Dyck and Strahan 2008). Although suitable rocky habitat for this species occurs within the Mt Dove study area and wider region, the species is only represented by a single record in this area; namely, from Wodgina, which is located 30 km to the south (Outback Ecology Services 2009). This species was not recorded within the study area; however, it is possible that this species occurs within the Mt Dove study area.

- **Grey Falcon (*Falco hypoleucos)***

The Grey Falcon is listed as Priority 4 species by the DEC. This species mainly occurs around inland drainage systems where the annual rainfall is less than approximately 500mm (Garnett and Crowley 2000). The Grey Falcon inhabits lightly wooded areas especially stony plains and *Acacia* scrublands (Morcombe 2003). This species can be rare, resident or nomadic to most of the semi-arid interior of Western Australia.

The Grey Falcon was not recorded in the autumn or spring 2010 surveys, however suitable habitat for this species (i.e. semi-arid grasslands such as Acacia, Spinifex on Sandplain) occurs within and surrounding the Mt Dove study area. Further, this species was recorded during fauna surveys of the FMG railway corridor (Biota, 2004) and the BHP RGP5 Chichester railway deviation (ecologia, 2008). Subsequently, it is considered likely to occur within the study area, at least intermittently.

- **Australian Bustard (*Ardeotis australis)***

The Australian Bustard is listed as a Priority 4 species by DEC. The Australian Bustard has a wide distribution across Australia, inhabiting open dry Mulga woodlands, arid scrublands and Spinifex tussock grasslands (Johnstone and Storr 1998, Morcombe 2003).

The species is primarily insectivorous and its abundance may vary considerably depending on the availability of this food source (e.g. grasshoppers) (Johnstone and Storr 1998). The Australian Bustard is a ground-nesting bird, laying its eggs on bare ground, with breeding season falling within March to September in the Pilbara (Johnstone and Storr 1998).

The Australian Bustard was recorded at several sites within and adjacent to the study area (**Figure 17**) during both the autumn and spring surveys. Further, the DEC Priority and Threatened Fauna Database shows that this species has previously been recorded near Kangan, Marble Bar and Boodarie and Port Hedland with the most recent recording being from 2008 (Department of Environment and Conservation 2010c). It has also been recorded from a number of previous surveys nearby and in the wider region (**Attachment A**).

- **Bush Stone-curlew *(Burhinus grallarius*)**

The Bush Stone-curlew is classified as Priority 4 by the DEC and is found in open woodland and forest particularly near water courses or swampy areas and is rarely seen near or on the beach (Geering *et al.* 2007). Surveys during 2010, including call playback and spotlighting, were unsuccessful in locating the Bush Stone-curlew within the study area. However, the Bush Stone-curlew has been frequently recorded in the surrounding area (**Attachment A**) and considered very likely to occur in the study area within Acacia, Spinifex on Sandplain habitat.

- **Star Finch (western) (*Neochmia ruficauda subclarescens*)**

The western race of the Star Finch is classified as Priority 4 by the DEC. This species occurs in lush, green woodland vegetation along temporary or permanent water courses, the margins of swamps or in green crops (Morcombe 2003). The Star Finch can be seen in pairs or in small flocks of up to 20 birds feeding on seed heads in low vegetation or on the ground (Morcombe 2003). This species is susceptible to changes that impact on riparian ecosystems (Bamford Consulting Ecologists 2008).

The Star Finch has been recorded from the Indee Homestead during May 2010 (Outback Ecology, unpublished data), from the WA Museum survey of the Abydos-Woodstock Reserve (How *et al.* 1991) and from the fauna survey of the BHP RGP5 Chichester railway deviation (ecologia 2008) (**Attachment A**). The Star Finch has not previously been recorded within the Mt Dove study area; however, this species could intermittently occur in woodland vegetation and temporary water pools, especially after significant rainfall events.

- **Unnamed Blind Snake *(Ramphotypholops ganei*)**

Ramphotyphlops ganei is listed as Priority 1 and is endemic to the Pilbara region. There is a lack of data pertaining to this species‘ habitat requirements as few specimens have been recorded (Department of Environment and Conservation 2010c). *Ramphotypholops ganei* is thought to be associated with moist gorge and gully habitats.

Ramphotyphlops ganei has been recorded from the Turner River Hub, approximately 105 km to the south-east of the study area (**Attachment A**). Suitable habitat for this species within the study area is present (i.e. Rocky Ridge habitat) although it was not recorded during the autumn or spring 2010 surveys. Therefore it may possibly occur in the study area but any estimate of likelihood of occurrence is putative, owing to the paucity of data for the species.

- **Pin-striped Finesnout *Ctenotus* (*Ctenotus nigrilineatus*)**

Ctenotus nigrilineatus is classified as Priority 2 by the DEC. The species is known from *Triodia pungens* hummock grassland at the base of granite outcrops near Woodstock in the hilly interior of the Pilbara

(Wilson and Swan 2008). Previous records of *C. nigrilineatus* exist for Marble Bar in 1990 and the Abydos Plain in 2001 (Department of Environment and Conservation 2010c, How *et al.* 1991).

Suitable habitat for this species within the study area is limited (i.e. occurrences of granite) and it was not recorded during the autumn or spring 2010 surveys. Therefore it may possibly occur in the study area but any estimate of likelihood of occurrence is putative, owing to the paucity of data for the species.

- **Spotted *Ctenotus* (*Ctenotus uber johnstonei*)**

Ctenotus uber johnstonei is classified as Priority 2 by the DEC and is known from hard reddish soils from interior Western Australia (Wilson and Swan 2008). Previous records of *C. uber johnstonei* are scant although it has been recorded from both the northern and southern portions of the FMG rail corridor (Biota 2004). The species may possibly occur in the study area but any estimate of likelihood of occurrence is putative, owing to the scarcity of data for the species.

Species recorded from previous surveys within the region and / or recorded form database searches that are considered unlikely to occur within the Mt Dove study area are briefly discussed below.

- **Mangrove Freetail Bat (*Mormopterus cobourgiana*)**

This species occurs in Western Australian coastal areas from the Exmouth Gulf to Broome and is restricted to mangrove forests and other dense vegetation associated with coastal waterways (Churchill, 2008). As there is no suitable habitat present within the study area, this species is unlikely to occur.

- **Eastern Curlew (*Numenius phaeopus*)**

The Eastern Curlew is a migratory species that breeds in damp bogs and marshes in Siberia and Mongolia. The majority of the species migrates south to Australia with a major stronghold in southeast Queensland (Geering *et al.* 2007). Within Western Australia, Roebuck Bay and Eighty Mile Beach are considered sites of international importance to the species (Bamford *et al.* 2008). Although the study area is within the range of the species, there is no suitable habitat present and so the species is unlikely to occur.

- **Flock Bronzewing (*Phaps histrionica*)**

This species is patchy and nomadic across its range, which extends from central NSW and Queensland across to the north-western coast of Western Australia (Pizzey, 2007). Its preferred habitat is treeless grassy plains, saltbush, Spinifex and mulga. Although habitat within the Mt Dove study area may be suitable, there are very few records existing for the species within the surrounding region. A record for the species exists some 22 km to the east of Mt Dove; however, this record is dates back to 1957 (Department of Environment and Conservation, 2010). It is unlikely this species occurs in the study area.

4.3.3 Locally and Regionally Significant Fauna Species

Other species of conservational significance include endemics, those with restricted or fragmented ranges, or those that are at the extremes limits of their known distribution.

Fourteen locally significant fauna that are endemic to the Pilbara and species with restricted ranges could potentially occur within the Mt Dove study area, of which two were recorded during this survey. **Table 20** details the number of previous surveys and database searches that recorded locally significant species potentially occurring within the Mt Dove study area. A brief discussion on these species is included below (i.e. those species recorded in one or more previous surveys).

Table 20: Pilbara endemic and restricted species previously recorded or potentially occurring in the study area

Common Name	Scientific Name	Likelihood	No of previous surveys recorded	No. of database searches recorded
Mammals				
Rothschild's Rock-wallaby	*Petrogale rothschildi*	Very likely	6	-
Western Pebble-mound Mouse	*Pseudomys chapmani*	Very likely	8	2
Reptiles				
Pilbara Death Adder	*Acanthophis wellsi*	Likely	5	-
Rufous Whipsnake	*Demansia rufescens*	Likely	5	1
Pilbara Olive Python	*Liasis olivaceus barroni*	Possible	4	1
Yellow-spotted Pilbara Gecko	*Diplodactylus savagei*	Likely	6	1
Pilbara Crevice-skink	*Egernia pilbarensis*	Likely	1	-
	Delma elegans	Possible	3	-
-	*Lucasium wombeyi*	Likely	5	-
-	*Ctenotus rubicundus*	Likely	6	1
Pilbara Rock Monitor	*Varanus pilbarensis*	Likely	3	-
Pilbara Mulga Monitor	*Varanus bushi*	Possible	4	-
	Ramphotyphlops ganei	Possible	1	-
	Ramphotyphlops pilbarensis	Confirmed	1	-
Amphibians				
Glandular Toadlet	*Uperoleia glandulosa*	Unlikely	2	1

* PE= Pilbara Endemic and RR= Restricted Range.

- **Rothschild's Rock-wallaby (*Petrogale rothschildi*)**

The Rothschild's Rock-wallaby is confined to the Pilbara and Ashburton regions of Western Australia where it occurs on a range of specific rocky habitats such as ranges and sometimes even on iron ore

overburden piles and railway cuttings. This species shelters in caves and crevices in the rocks during the heat of the day to conserve energy and reduce water loss (Short and Parsons 2008, Van Dyck and Strahan 2008). The Pilbara Olive Python (*Liasis olivaceus barroni*) is a native predator of the Rothschild's Rock-wallaby. This species is not listed as threatened; however, mainland populations of the Rothschild's Rock-wallaby have declined and have been attributed to predation by the European Red Fox (Van Dyck and Strahan 2008). The Rothschild's Rock-wallaby may be present intermittently within the Mt Dove study area although no evidence of its presence (e.g. distinctive scats) was recorded during the autumn and spring 2010 surveys. Further, the Rocky Ridge habitat is not likely to be extensive enough to support a permanent population of the species.

- **Western Pebble-mound Mouse (*Pseudomys chapmani*)**

This priority species is discussed in further detail in Section 4.3.2.

- **Pilbara Death Adder (*Acanthophis wellsi*)**

The Pilbara Death Adder is widespread across the Pilbara and occurs amongst Spinifex on stony soils and in rocky habitats (Wilson and Swan 2008). This species was not recorded during this survey and is often sedentary and cryptic amongst rocky habitat. Four surveys in the surrounding region have recorded this species and it is likely that this species occurs at Mt Dove as suitable habitat for this species (e.g. Acacia, Spinifex on Sandplain) occurs throughout the study area (**Attachment A)**.

- **Rufous Whipsnake (*Demansia rufescens*)**

The Rufous Whipsnake occurs within arid regions of the Pilbara often occurring on stony hills and plains with Spinifex and open woodlands (Wilson and Swan 2008). This species was not recorded in the study area during the autumn or spring 2010 surveys.

- **Yellow-spotted Pilbara Gecko (*Diplodactylus savagei*)**

This species is widespread across stony spinifex grasslands within the Pilbara region and is not considered to be threatened. Yellow-spotted Pilbara Gecko has been recorded from seven surveys conducted in the surrounding region; however, it was not recorded in the study area during the autumn or spring 2010 surveys (**Attachment A**).

- ***Lucasium wombeyi***

This species occurs in heavy soils of the Pilbara region. Records of this species are relatively common with six previous surveys recording *Lucasium wombeyi* in the surrounding region (**Attachment A**). This species was not recorded in the study area during the autumn or spring 2010 surveys.

- **Pilbara Crevice-skink (*Egernia pilbarensis)***

Egernia pilbarensis occurs in rocky ranges and outcrops of the Pilbara region (Wilson and Swan 2008). Suitable rocky ridge and gorge habitat for this skink is well represented within the Pilbara; however records of this species seem to be scarce as only one individual has been recorded in a study from the surrounding region (Outback Ecology, 2010b). This may be due to inaccessibility of preferred rocky habitat resulting in a scarcity of records of the species. *Egernia pilbarensis* was not recorded within the Mt Dove study area.

- ***Delma elegans***

This species occurs in rocky areas of the Hamersley ranges and is common throughout adjacent lowlands and outcrops of the arid Pilbara (Wilson and Swann 2008). This species has been recorded from three previous surveys conducted in the wider region; however, it was not recorded during the autumn or spring 2010 surveys at Mt Dove (**Attachment A**).

- **Ruddy Ctenotus (*Ctenotus rubicundus*)**

Ctenotus rubicundus occurs in rock hills and escarpments vegetated with Spinifex in the interior of the Pilbara (Wilson and Swan 2008). This species is widespread across rocky areas in the Pilbara and has been recorded from seven surveys in the surrounding region (**Attachment A**). The Ruddy Ctenotus was not recorded during the autumn or spring 2010 surveys within the study area.

- ***Varanus pilbarensis***

Varanus pilbarensis inhabits rocky cliff, ridge, gorge and outcrop areas within the Pilbara sheltering in narrow rock crevices (Wilson and Swan 2008). There is an abundance of suitable habitat for this species in the surrounding region and three previous surveys in the study area surrounds have recorded this species (**Attachment A**). *Varanus pilbarensis* was not recorded during within the study area during the autumn or spring 2010 surveys.

- **Pilbara Mulga Monitor *(Varanus bushi*)**

Varanus bushi is restricted to the Pilbara region and is closely associated with Mulga woodland where it lives in trees. It is relatively common in the study area surrounds and has been recorded from four previous surveys in the surrounding region (**Attachment A**). This species has not been recorded in the study area, most likely due to a lack of suitable habitat.

- ***Ramphotyphlops ganei***

This priority species is discussed in further detail in Section 4.3.2.

- **Pilbara Blind Snake (*Ramphotyphlops pilbarensis*)**

The Pilbara Blind Snake has been recorded from arid areas within the catchments of the Yule and De Grey River from areas of shrublands over Spinifex (Wilson and Swann 2008). This species was recorded in the study area during the 2010 surveys (**Attachment B**).

- **Glandular Toadlet (*Uperoleia glandulosa*)**

The Glandular Toadlet occurs in the northern Pilbara from the Strelley River south to Woodstock, occurring in creeks and low lying areas that are subject to seasonal flooding (Tyler, 2009). This species has been recorded from two previous surveys in the study area surrounds (**Attachment A**). The Glandular Toadlet was not recorded in the study area, most likely attributable to a lack of suitable habitat.

4.3.4 Migratory Bird Species

Migratory species are listed under the EPBC Act and international agreements including the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), Republic of Korea Australia Migratory Bird Agreement (ROKAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals).

The database searches and literature review identified 21 migratory species that have the potential to occur in the wider area. One of these species, the Rainbow Bee-eater (*Merops ornatus*), was recorded as widespread and common across the Mt Dove study area during the current survey.

Table 21 shows the number of previous surveys and database searches that identified each of the migratory bird species as potentially occurring within the Mt Dove study area. A brief discussion on those species considered as potentially occurring within the Mt Dove study area is included below (i.e. possible, likely, very likely or confirmed as defined above). Those species that are unlikely to occur within the region are excluded from further consideration.

Broadly speaking, the occurrence of migratory waterbirds in arid Australia is known to be highly sporadic and many species are only likely to be present in favourable seasons when water is plentiful (Halse *et al.* 1998, Kingsford and Norman 2002, Kingsford *et al.* 2010). As no major water bodies occur within the study area, the occurrence of most migratory waterbirds would be occasional only.

Table 21: Migratory bird species potentially occurring in the Mt Dove study area

Scientific Name	Common Name	Likelihood	EPBC Act[1]	WC Act[2,3]	No of previous surveys	No. of database searches
Haliaeetus leucogaster	White-bellied Sea-Eagle	Unlikely	M	S3	-	2
Acrocephalus australis	Australian Reed-Warbler	Unlikely	M	S3	3	1
Apus pacificus	Fork-tailed Swift	Likely	M	S3	3	2
Ardea ibis	Cattle Egret	Possible	M	S3	-	2
Charadrius veredus	Oriental Plover	Possible	M	S3	-	2
Glareola maldivarum	Oriental Pratincole	Unlikely	M	S3	-	2
Hirundo rustica	Barn Swallow	Unlikely	M	S3	-	2
Chlidonias leucopterus	White-winged Black Tern	Unlikely	M	S3	-	1
Hydroprogne caspia	Caspian Tern	Unlikely	M	S3	1	1
Merops ornatus	Rainbow Bee-eater	Confirmed	M	S3	8	3
Actitis hypoleucos	Common Sandpiper	Unlikely	M	S3	1	1
Calidris acuminata	Sharp-tailed Sandpiper	Possible	M	S3	-	1
Calidris ruficollis	Red-necked Stint	Unlikely	M	S3	-	1
Calidris subminuta	Long-toed Stint	Unlikely	M	S3	-	1
Numenius madagascariensis	Eastern Curlew	Unlikely	M	S3, P4	1	-
Numenius phaeopus	Whimbrel	Unlikely	M	S3	1	-
Tringa brevipes	Grey-tailed Tattler	Unlikely	M	S3	1	-
Tringa glareola	Wood Sandpiper	Unlikely	M	S3	1	1
Tringa nebularia	Common Greenshank	Unlikely	M	S3	1	1
Tringa stagnatilis	Marsh Sandpiper	Unlikely	M	S3	-	1
Plegadis falcinellus	Glossy Ibis	Unlikely	M	S3	-	1

[1]M = Migratory status under the Commonwealth EPBC Act
[2] S3 = Schedule 3—Migratory birds protected under an international agreement, WC Act
[3]DEC Priority Species List = Priority 1, P2, P3, P4

- **Fork-tailed Swift (*Apus pacificus)***

The Fork-tailed Swift is a nomadic species that may be seen before and after storm fronts or tropical cyclonic events that are associated with an increase in insect activity which the species feeds on (Johnstone and Storr 2004). The Fork-tailed Swift was recorded during surveys of the FMG rail corridor, to the east of the study area (Biota 2004), as well as several studies further to the south (Biota 2005, ecologia 2008, How *et al.* 1991).

This species may fly over the study area without specifically utilising the habitats present.

- **Cattle Egret (*Ardea ibis)***

This species is associated with inland rivers and lakes that contain surface water. The Cattle Egret is highly mobile and can be found throughout most of the western fringes of the State in coastal areas and towards the semi-arid interior (Johnstone and Storr 1998).

Although this species has not been recorded during previous studies of the region, it may occur at Mt Dove intermittently in Acacia, Spinifex on Sandplain habitat, when standing water is present after rainfall.

- **Oriental Plover (*Charadrius veredus)***

The Oriental Plover breeds in northern China and Mongolia and the bulk of the population spends the non-breeding period in northern Australia (Bamford *et al.* 2008). All important sites in the non-breeding period are in northern Australia (Bamford *et al.* 2008). This species favours dry grasslands, particularly shorter grassland areas or recently burnt areas, rarely feeding in wet habitats but may occupy mudflats or beaches to roost when warm conditions prevail (Geering *et al.* 2007).

Although this species has not been recorded during previous studies of the region, it may occur within the study area intermittently, when standing water is present after rainfall.

- ***Merops ornatus*** **Rainbow Bee-eater**

The Rainbow Bee-eater occupies numerous habitats including open woodlands, sandpits, riverbanks, road cuttings, beaches, cliffs, mangroves and rain forests (Pizzey and Knight 2007). The Rainbow Bee-eater can occur as a resident, breeding visitor, passage migrant or winter visitor (Pizzey and Knight 2007).

This species is insectivorous, with bees and flies representing the bulk of its diet. The Rainbow Bee-eater nests in burrows dug at a slight angle in flat ground and sandy banks (Johnstone and Storr 1998). It is also known to nest in sandy embankments and cuttings and often perches on man-made structures such as power lines and fences (Johnstone and Storr 1998). As a consequence, it is commonly seen in areas occupied by humans such as mining camps and urban areas.

The Rainbow Bee-eater was widespread and common across the Mt Dove study area during the autumn and spring 2010 surveys.

- **Sharp-tailed Sandpiper (*Calidris acuminata)***

The Sharp-tailed Sandpiper breeds in north-east Siberia and migrates south to New Guinea and Australia. Over 90% of the population occurs in Australia during the non-breeding period and many occur on ephemeral wetlands across inland Australia (Bamford *et al*. 2008). The distribution of Sharp-tailed Sandpipers in Australia changes markedly from year to year based on the availability of this habitat (Bamford *et al.* 2008).

This species was identified via a search of the Birds Australia Atlas database (Birds Australia 2010) but has not been recorded from any previous surveys. The species may possibly occur within the Mt Dove study area intermittently as it is known to be widespread across well-watered parts of the Pilbara around August-September (Johnstone and Storr 1998), although the species is unlikely to remain within the study

area for any length of time as all habitat is marginal. The Sharp-tailed Sandpiper is most likely to occur within the study area following significant rainfall events, although it is not possible to predict the abundance of the species during these periods.

4.4 Sampling Adequacy

Species accumulation curves give an indication of the sampling adequacy of trapping for a survey. When a curve approaches an asymptote it suggests that sampling effort has been sufficient to adequately collect the species comprising the faunal assemblage at the location(s) sampled. The value at which the curve asymptotes also represents an approximate measure of the total species complement at that location. It must be noted that the use of species accumulation curves assumes that the survey methods and timing are capable of recording all species present at a site, whereas this is not likely to be the case.

Species accumulation curves for this assessment were calculated using systematic trapping data for herpetofauna and mammals, and timed census surveys for bird species. During autumn 2010 survey, the curve tended to asymptote after around three days for mammals and five days for birds, with a less pronounced asymptote evident for reptiles/amphibians after five days (**Figure 20**). These data suggest that survey effort was sufficient to sample the bulk of the fauna present within the Mt Dove study area during autumn.

During the spring 2010 survey, the curve tended to asymptote after around five days for mammals and six days for birds, with a substantial increase in reptile numbers recorded on the last day of trapping (**Figure 21**). This rise is likely to be attributable to a change in minimum temperature and humidity during the last trapping days (11 and 12 of September) compared with the remainder of the survey (**Table 3**). A mean minimum temperature of 16 ºC and relative humidity (9am) of 27% was experienced in the seven days prior to the 11 of September whereas for the two days after, the mean minimum temperature and relative humidity were 21 ºC and 57%, respectively.

When combined with the autumn data (**Figure 22**), these species accumulation curves suggest that survey effort was sufficient to attain a comprehensive sample of the fauna present within the Mt Dove study area.

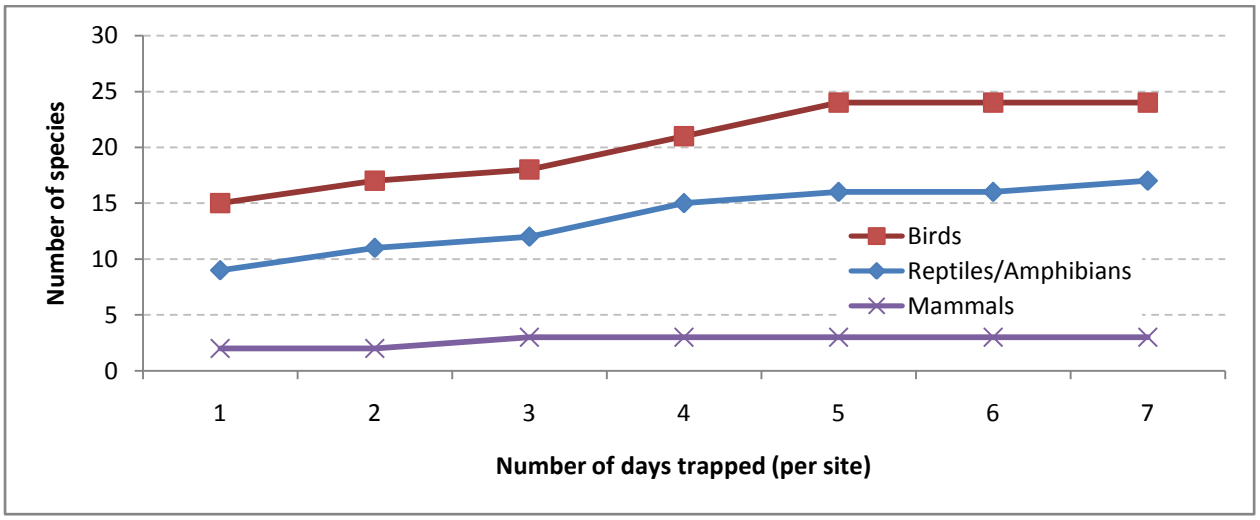

Figure 20: Species accumulation curve for the Mt Dove study area during autumn 2010

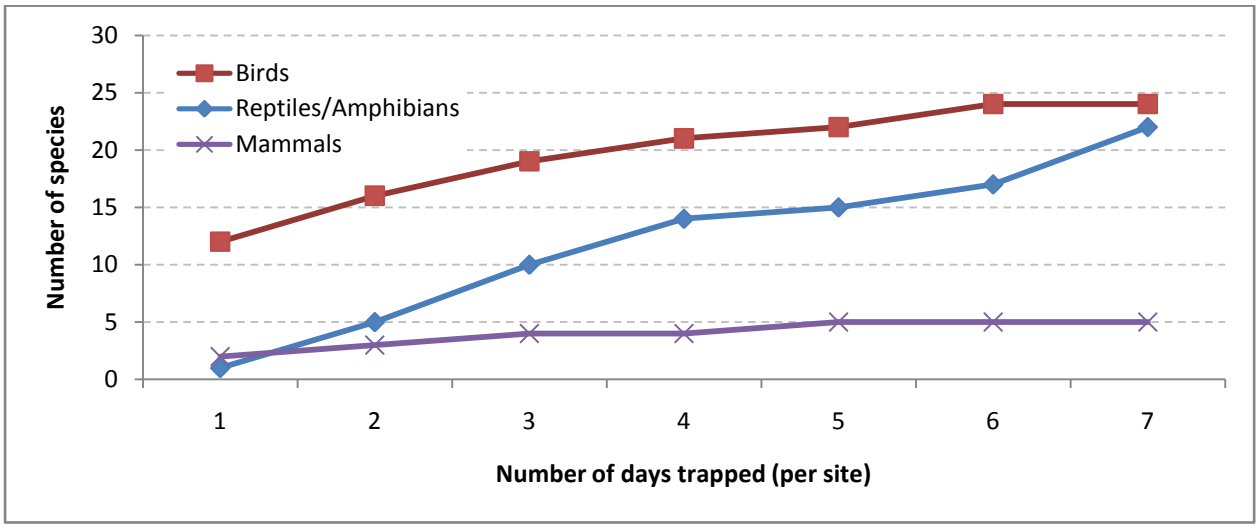

Figure 21: Species accumulation curve for the Mt Dove study area during spring 2010

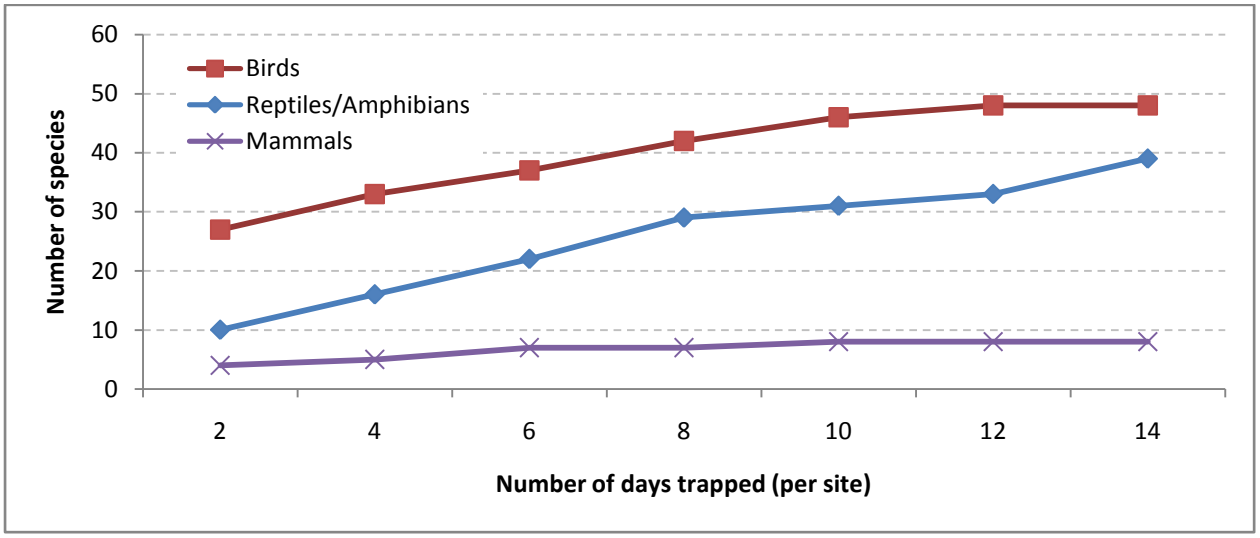

Figure 22: Combined species accumulation curve for the Mt Dove study area during 2010

4.5 Limitations and Constraints

The EPA (2004) lists a number of possible limitations and constraints that can impinge on the adequacy of fauna surveys. These are replicated in **Table 22** below with an assessment relating to the current survey. A number of factors can influence the design and intensity of a fauna survey. All fauna surveys are limited to some degree by time and seasonal factors, and ideally a number of surveys would be undertaken over a number of years and within a number of different seasons. Nevertheless, all the factors identified by the EPA (2004) were considered.

Table 22: Summary of Potential Fauna Survey Constraints

Aspect	Constraint Yes/No?	Comment Regarding Current Survey
Competency/experience of consultants	No	Survey team members were fauna specialists employed by Outback Ecology, or zoological sub-consultants. All team members have had extensive experience undertaking fauna surveys of this nature in Western Australia.
Scope	No	All terrestrial vertebrate fauna groups were surveyed using a wide range of standardised and well-established techniques. All previous survey work over the study area and surrounds was reviewed. Bat survey work was analysed by Specialised Zoological.
Proportion of fauna identified	No	Further survey effort not likely to considerably increase the number of species recorded (See **Figures 20**-**22**). A total of 92 vertebrate fauna species were recorded during the surveys, comprising 23 mammals (17 native), 40 birds and 29 reptile species. Furthermore, the number of species recorded is comparable to other studies of similar scale that have been undertaken within the surrounding region (Biota 2007; Bamford Consulting Ecologists 2007, 2009; Outback Ecology 2009).
Information sources (e.g. historic or recent)	No	The survey area is located in a relatively well surveyed region due predominantly to regional surveys and those undertaken for mining operations.
Proportion of task achieved, and further work which might be needed	No	The conservation value for fauna in the study area has been demonstrated by this fauna assessment. All planned survey works were conducted according to plan.
Timing / weather / season / cycle	No	Timing, weather, and seasonality of survey were appropriate for vertebrate fauna. This report details the results of a multi-season survey (autumn and spring 2010). Additional survey effort is unlikely to significantly improve the number of species recorded within the study area.
Disturbances	Yes	The Rocky Ridge habitat present on Mt Dove had been recently disturbed by exploration activities (e.g. construction of ramps, drill pads) prior to the commencement of this survey. Evidence of cattle grazing and fire disturbance was present throughout the study area, however were typical of that occurring within the surrounding region.
Intensity	No	The study area was sampled over two seasons (autumn and spring 2010) giving a total of 2,184 trap-nights and a total of 44.8 person hours spent undertaking bird census, active hand searching, targeted searching and spotlighting searching, which is considered adequate intensity.
Completeness	No	Survey was complete. All major habitats and landforms were covered

Aspect	Constraint Yes/No?	Comment Regarding Current Survey
		and the study area was adequately covered geographically. A comprehensive fauna assessment entailing systematic trapping, habitat assessment, hand searching, targeted searching, spotlighting, bird census and AnaBat surveying, was successfully executed in this area.
Resources	No	Resources were adequate to carry out the survey satisfactorily. Survey participants were competent in identification of species present. A total of 49 person days were required to complete the field component of this survey.
Remoteness / access problems	No	Access was very good throughout the study area and adequate survey coverage was achieved.
Availability of contextual information	No	Information is available for the Chichester sub-bioregion from a variety of data sources including DEC's Threatened and Priority Fauna Database, NatureMap, Birds Australia Atlas, Australian Museum Database, National Land and Water Resources Audit and regional fauna surveys.

5. POTENTIAL IMPACTS

The primary objectives of this section are to describe the relevant threatening processes associated with the proposed Project (Section 5.1), and to examine the likely impact of these threatening processes on fauna habitat (Section 5.2) and fauna assemblages (Section 5.3) and vertebrate fauna species of conservation significance (Section 5.4).

5.1 Threatening Processes

Threatening processes relevant to the Pilbara bioregion have been identified by the Australian Natural Resources Audit (Australian Natural Resources Atlas 2009) and include feral predators, inappropriate fire regimes, grazing by introduced herbivores, and invasive weeds.

Threatening processes specifically associated with the Project are categorised as either direct or indirect impacts:

Direct impacts of the Project include:

- Habitat removal/modification; and
- Collision with vehicles.

Indirect impacts of the Project include

- Noise and vibration;
- Light;
- Dust;
- Introduced flora; and
- Introduced fauna.

These are discussed in detail below.

5.1.1 Habitat Removal/Modification

The development of the Mt Dove Project will result in the removal of at least 219 ha of habitat via land clearance. Land clearance will result in a reduction in size and quality of isolated habitats (e.g. Rocky Ridge habitat), increased edge effects and habitat fragmentation.

All four habitats identified within the study area will be impacted by land clearance and the construction of infrastructure including the open pit, waste dumps, ROM stockpiles, access roads, transmission lines and pipelines (**Section 1.1**; **Figure 2**). The broad fauna habitats defined in this report are widely represented throughout the Pilbara region (ANRA, 2007), with the exception of Rocky Ridges. This fauna habitat is relatively uncommon within the broader landscape as it is comprised specifically of those hills featuring outcropping ironstone, fallen boulders, caves, overhangs and crevices, which are known to be important for

fauna and support a number of species of conservation significance. Taxa that are confined to this habitat will be those most impacted by the Project.

Land clearing is a necessary part of the Project development, and represents the most direct impact on habitats and fauna assemblages present within the study area. Often, clearing of vegetation can be conducted in a manner that minimises impact by progressively clearing over time to allow animals to disperse to other suitable areas, and also by retaining corridors or linkages so that individuals can move between remaining habitat patches. Of the four habitats to be impacted by the Project, Rocky Ridges will be subject to the greatest direct impact from clearing activities (Section 5.2). Rocky Ridge habitat at Mt Dove represents an isolated habitat island within the landscape and so progressive clearing of vegetation is not likely to benefit populations that reside on Mt Dove itself as there is no equivalent habitat nearby for animals to disperse to. Although mobile fauna may be able to avoid direct impact from operations, the degree of subsequent impact is dependent on the availability of suitable habitat elsewhere in the vicinity.

Land clearance is likely to result in the direct loss of individuals. Species at greatest risk are those which inhabit cave habitats within the Mt Dove Rocky Ridges, arboreal habitats (e.g. hollow roosting bats), subterranean habitats (e.g. some snakes) or have low mobility (e.g. small reptiles). Nesting birds and their young may also be directly impacted, although this potential impact will be reduced by considering the timing of clearance activities.

5.1.2 Collision with Vehicles

Vehicle collisions may potentially have a sizeable impact on some fauna assemblages as although incidents typically only involve individuals, the cumulative effect they may have on small or isolated populations such as those present on Mt Dove may be considerable. The proposed pit access ramp and haul road dissects the current Rocky Ridge habitat on the southern face of Mt Dove. Species that typically forage at night within this habitat (e.g. Northern Quoll) may be at risk when traversing the pit access ramp and haul route to access adjacent Rocky Ridge habitat. However, collisions with vehicles can be directly addressed by reducing the speed at which vehicles travel and also by erecting fences or barriers in strategic areas where fauna are known to cross major transport routes.

Any incidents that result in the injury or death of conservation significant species should be reported to the DEC and specimens should be retained (i.e. stored in a freezer) for further examination by DEC or the Western Australian Museum.

5.1.3 Noise and Vibration

The development of the Project is likely to generate constant noise and vibration due to blasting general operation of heavy mining machinery, crushing and screening processes, diesel generators and people. The affects of noise on wildlife have been well studied, although responses vary depending on the species

and on the age and sex of the individual animal (For comprehensive summaries see (Larkin *et al.* 1996); and (Radle 2007)).

General responses to noise across a wide variety of animal species range from interruptions in feeding and resting behaviour to complete abandonment of an area. Noise may lead to reduced population densities in small mammals; nest failure and decreased population densities in birds (Slabbekoorn and Ripmeester 2008); abandoning of roost sites and a reduced hunting efficiency in bats due to disturbance of their echolocation system. Constant levels of noise also interfere with species communication and is known as acoustic interference (Parris and Schneider 2009). Species that may be especially at risk of disturbed communication are those that use calls to communicate over larger distances such as the conservation significant Bush Stone-curlew (*Burhinus grallarius*) which is likely to occur within the study area.

The Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*) are sensitive to human disturbance and may abandon roosting caves that are too close to mechanical and human noise generated from mine sites. Little is known about the effects of vibration on these species; however, it is possible that high levels of vibration may disturb roosting bats.

5.1.4 Light

The Project is likely to result in an increase in exposure of fauna to artificial light. Artificial light from mining activities may have detrimental effects on resident bird, mammal and reptile species, as it may interfere with biological and behavioural activities that are governed by the length of day or photoperiod, including reproduction, dormancy, foraging and migration (Bradshaw and Holzapfel 2007, Le Corre *et al.* 2002). Bird *et al*. (2004) found that nocturnal mice exposed to artificial light exploited fewer food patches compared to mice exposed to areas of less light, while nocturnal frogs exposed to artificial light have been known to suspend normal feeding and reproductive behaviour (Harder 2002).

Light pollution has also been shown to interfere with timing of songbird choruses, potentially leading to reduction in breeding success or survival (Miller 2006). Excessive light is likely to have an adverse effect on the natural foraging behaviour of bats in particular the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), which is attracted to artificial light sources. To reduce the impact of artificial light on faunal communities particularly during night-time hours, lights should be designed to illuminate designated areas such as pathways and roads, rather than poorly designed lights that illuminate the night sky. Further, care should be taken to ensure that transport and haul routes are designed to avoid inadvertent illumination of important habitat features such as caves and overhangs.

5.1.5 Dust Emissions

The development and operation of the Mt Dove Project will create dust emissions due to mining and general traffic activities. Dust emissions may affect surrounding vegetation as high levels of dust have been associated with a reduction in plant growth resulting in the degradation of the overall ecosystem and

the increased risk of disease in plants (Woodman Environmental Consulting, pers. comm. 2010). Altering the structure of vegetation communities reduces the quality of fauna habitats and is likely to impact on faunal assemblages within the area due to a reduction in food resources availability and shelter. Adequate dust suppression measures should be implemented to reduce the effects of dust on vegetation and hence fauna habitats and assemblages.

5.1.6 Introduced Flora

Environmental weeds may be brought in by mobile mining equipment. Weed invasion is widely recognised as having a negative impact on fauna species as it can fundamentally alter the composition and structure of native vegetation communities (Cowie and Werner 1993, Gordon 1998). Invasion by non-native species typically results in declines in native plant species richness, but the response of fauna may be more complicated with individual invasions potentially resulting in increase, decrease or no-change scenarios for different assemblages (Grice 2006). For example, both Smyth *et al.* (2009) and Binks *et al.* (2005) found that even at low densities, Buffel Grass (*Cenchrus ciliaris*) affected the composition of ground vegetation, birds and ant fauna, leading to declines in some species. Buffel grass (*Cenchrus ciliaris*), kapok bush (*Aerva javanica*) and several other weed species have been found within Rocky Ridge habitat on Mt Dove (Woodman Environmental Consulting, pers. comm.); it is therefore important to implement management strategies to reduce the occurrence and spread of weeds during mining operations.

5.1.7 Introduced Fauna

Introduced fauna (both herbivorous and predatory) cause fundamental changes to ecosystems, and have lead to the decline and extinction of many species in Australia (Abbott 2002, Burbidge and McKenzie 1989, Ford *et al.* 2001, Short and Smith 1994). Additionally, predation of native fauna by the fox and feral cat is listed as key threatening process under the EPBC Act.

Six introduced fauna species have been recorded in the Mt Dove study area including the Cat (*Felis catus*), Dingo or Dog (*Canis lupus dingo/familiaris*), Camel (*Camelus dromedarius*), Donkey (*Equus asinus*), European Cattle (*Bos taurus*), and Fox (*Vulpes vulpes*). While European Cattle are domesticated within the study area, other herbivorous species are considered to be feral animals. Together, these introduced herbivores have been responsible for the widespread degradation of much of semi-arid Australia due to overgrazing (Morton 1990).

Development of the Project may provide additional resources or habitat (e.g. via an accommodation village, rubbish tips, food disposal areas) that may attract and support a greater abundance of feral animals in the area, which in turn may adversely impact on populations of native fauna. Of particular concern would be an increase in the local population of feral cats which are not only a predator of the Northern Quoll (*Dasyurus hallucatus*), but also directly compete for food resources and habitat requirements with this species.

It is suggested that monitoring and control of feral animals be conducted, in participation with surrounding land managers. Management measures to prevent the increase of feral species numbers and control the attraction of any new feral species include proper hygiene practices, appropriate disposal of wastes and control programs.

5.2 Impacts on Fauna Habitats

Vertebrate fauna habitat loss as a direct result of land clearing and excavation for the development of the Project is considered the primary impact on terrestrial vertebrate fauna. Further, loss of habitat is listed as a key threatening process under the EPBC Act, although it is recognised as a necessary component of developing a resources Project. It is likely that sedentary fauna currently residing within areas to be cleared would be lost and more mobile fauna would be displaced.

A total of 219 ha of vertebrate habitat will be removed for the development of the Project (**Table 23; Figure 23**). The greatest area of habitat to be cleared will be from Acacia, Spinifex on Sandplain (109.9 ha), although this represents a low proportion of habitat present within the study area (2.3%). Furthermore, this habitat is common and occurs widely within the region. It should also be noted that the majority of Acacia, Spinifex on Sandplain habitat within the study area was somewhat degraded due to cattle grazing and frequent fire. The conservation significant Australian Bustard (*Ardeotis australis*) was recorded from this habitat during the autumn and spring 2010 surveys (**Figure 17**).

Table 23: Extent of impact on each broad fauna habitat occurring within the Mt Dove study area

Broad Fauna Habitat	Total extent within study area (ha)	Extent within project disturbance area (ha)	Extent of Habitat within study area to be impacted (%)
Rocky Ridge	22.3	14.3	64
Acacia Shrubland on Footslopes	81.4	23.9	29.4
Stony Rise	240.7	71.1	29.5
Acacia, Spinifex on Sandplain	4878.7	109.9	2.3

Development of the Project will result in removal of 29.5% of Stony Rise habitat (71.1 ha); however, this habitat constitutes 4.6% of the Mt Dove study area and it is well represented within the wider region. Stony Rise habitat supports the Priority 4 Western Pebble-mound Mouse (*Pseudomys chapmani*), of which seven inactive mounds were recorded during the autumn and spring 2010 surveys. No other conservation significant species were recorded in this habitat.

Acacia Shrubland on Footslopes is an uncommon habitat within the study area and surrounding landscape; however, it is not of particular importance as there does not appear to be any fauna that rely solely on its

presence. The removal of 23.9 ha of Acacia Shrubland on Footslopes habitat (29.4 %) is not likely to be significant from a regional perspective.

Of particular importance is the Rocky Ridge habitat on Mt Dove as it consists of a 22 ha isolated island of habitat, with optimum habitat features such as caves, crevices and outcropping ironstone primarily occurring within the centre of this habitat. The nearest equivalent habitat occurs 12 km to the south. The construction and establishment of infrastructure including a pit, waste dump, borrow pits and haul roads will directly impact 64 % of Rocky Ridge habitat within the study area and will result in the removal of the vast majority of the specific habitat features described above. Given that Rocky Ridge habitat on Mt Dove is small and naturally isolated, the degree of impact is likely to result in the loss of populations of species residing within it, including conservation significant species such as the Northern Quoll (*Dasyurus hallucatus*).

5.3 Impacts on Terrestrial Vertebrate Faunal Assemblages

Land clearance is likely to result in the direct loss of individuals during initial clearance activities. Faunal assemblages most likely to be impacted by the Project are those dependent on specific habitats or those with restricted ranges. Consequently, the impacts detailed above are likely to significantly affect fauna assemblages dependent on Rocky Ridge habitat. Although Rocky Ridge habitat recorded the lowest species diversity (28), it possessed the greatest number of conservation significant fauna species, including Northern Quolls (*Dasyurus hallucatus*), Pilbara Leaf-nosed Bats (*Rhinonicteris aurantia*) and Ghost Bats (*Macroderma gigas*).

Impacts to fauna assemblages may be reduced by considering the timing of land clearing activities and other developmental proposed works.

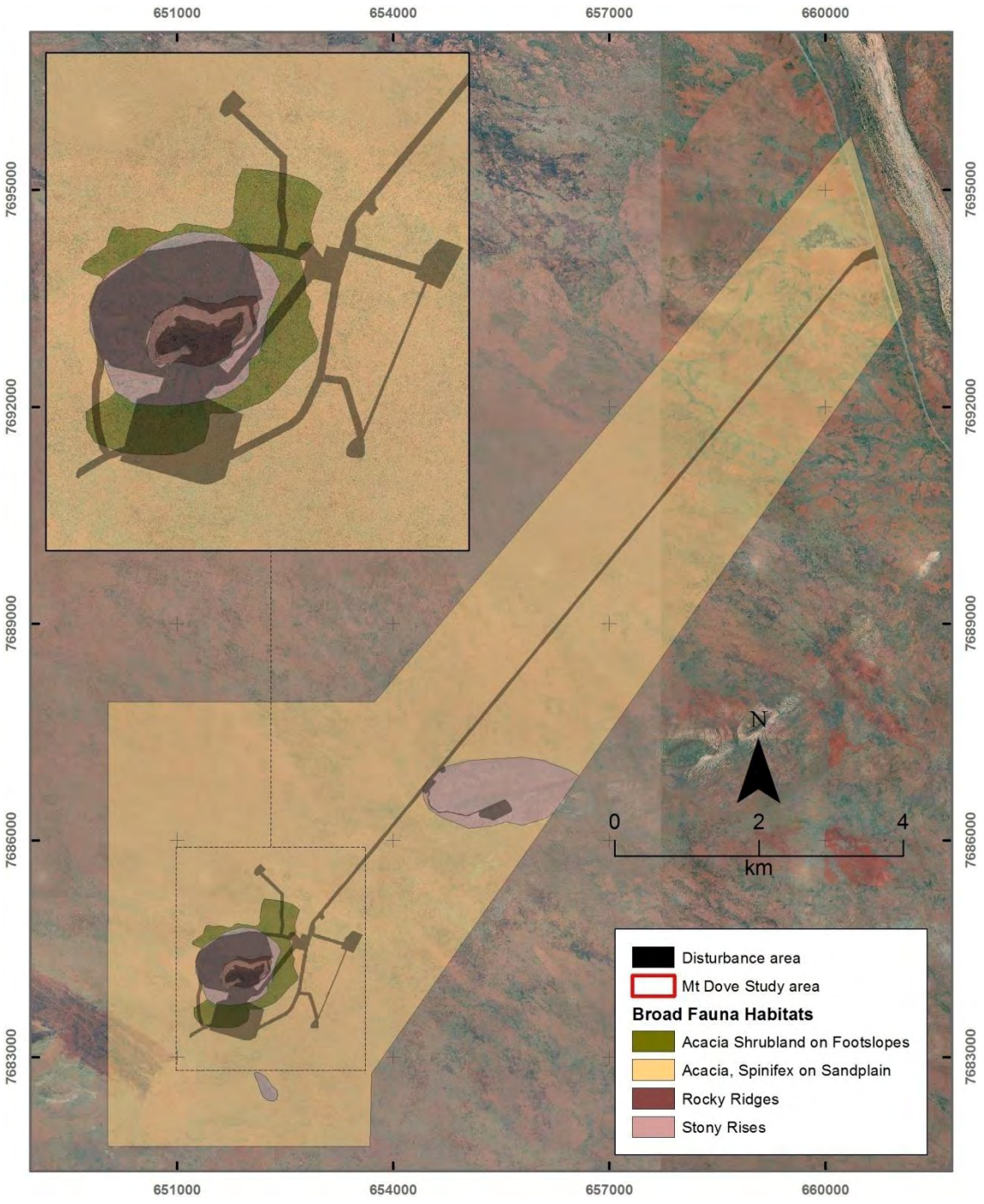

Figure 23: Proposed disturbance area within the Mt Dove study area

5.4 Impacts on Fauna Species of Conservation Significance

The likely impact of the Project on conservation significant species from a local and a regional perspective were ranked using the categories outlined in **Table 24** and detailed in **Table 25**. Impacts were ranked based on the assumption that no management actions or strategies were to be conducted. The fauna assessed in this section are known to occur or have the potential to occur in the Mt Dove study area. Species have been assessed in order of conservation significance and level of impact (highest to lowest).

Recommended actions and strategies to manage the impacts of the Project on conservation significant fauna are provided in **Table 25**. The ranking of impact for conservation significant fauna is likely to be reduced should the recommended actions and strategies be implemented.

Table 24: Assessment criteria for impacts on conservation significant species

Impact	Description	
	Localised scale	**Regional Scale**
Negligible	No perceived affect on population	No perceived affect on species
Minimal	No population decline expected	No species decline expected
Low	Short-term population decline expected within Project area (recovery expected after life of the Project)	Short-term species decline expected within the region (recovery expected after life of the Project)
Moderate	Permanent population decline expected – no perceived threat to population persistence	Permanent species decline expected – no perceived threat to regional conservation status of species
High	Permanent population decline expected – persistence of local population threatened	Permanent species decline expected – resulting in a change in conservation status of species
Extreme	Local population extinction likely	Regional extinction likely

Table 25: Impacts on conservation significant species and suggested management actions

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
Northern Quoll (*Dasyurus hallucatus*)	EN	S1	-	EXTREME • 14.3 ha of Rocky Ridge habitat will be directly removed during the development of the Project. This represents 64% of Rocky Ridge habitat that occurs within the study area and immediate surrounds (10 km radius). • The quality of habitat that remains subsequent to the removal of Rocky Ridge habitat is unlikely to be suitable for supporting Northern Quolls as it is unlikely to contain the caves, crevices and outcropping ironstone used by the species for denning. The extent of this habitat may be insufficient to support a viable population. • Suitable denning habitat that could potentially be used by Northern Quolls to supplement that removed from Rocky Ridge habitat on Mt Dove is limited in the surrounding landscape. The nearest Rocky Ridge habitat similar in quality and complexity as that occurring	MODERATE • The Northern Quoll occurs in fragmented, isolated populations predominantly occurring within Rocky Ridge habitat within the Pilbara. • The Project development will result in a small decline (< 1%) of potential Northern Quoll habitat within the region. • The Project development is likely to result in a small decline in the regional population of Northern Quolls. • It is unknown whether Mt Dove represents an ecological link between surrounding populations or is an isolated, genetically distinct population. Recolonisation of Mt Dove post mining will be limited due to lack of suitable habitat remaining and its isolated nature. A reduction in regional genetic diversity through localised population loss is expected.	• Locate and utilise suitable material (e.g. oversize waste rock) to create artificial Northern Quoll denning habitat (i.e. rock piles) outside of the Project impact footprint at Mt Dove. Should the quantity of waste material from Mt Dove be insufficient or the dimensions unsuitable (boulders of insufficient size to form cavities and crevices when piled up), source additional waste rock from Wodgina DSO Project (35 km south of Mt Dove). • Immediately prior to clearing (pre-stripping) of Rocky Ridge habitat at Mt Dove, conduct exclusion trapping to minimise the likelihood of direct mortality of quolls. Release quolls at artificial habitat adjacent to Mt Dove. • Monitor the Mt Dove Northern Quoll population using techniques consistent with SEWPAC and DEC requirements and guidelines (e.g. radio-telemetry upon commencement of pre-stripping of Rocky Ridge habitat, annual trapping survey during life of project) to further the scientific understanding of species

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				on Mt Dove is located 12km to the south. Quolls are known to occur within this habitat (Outback Ecology in prep). • Increased potential for road kill of any remaining individuals, particularly if mining activities occur at night. • Potential elevation in numbers of introduced predators (Feral Cat, Dog) as a result of the Project may represent a threat to the Northern Quoll. • Extinction of local population is likely to occur due to combination of initial land disturbance and impacts from ongoing mining activities.	• Potential Northern Quoll habitat identified within the region is not continuous and is dissected by extensive spinifex plains and undulating hills, limiting species dispersal. • The Northern Quoll population at Mt Dove, although limited in area, is of similar or greater size to those found in other previous detailed Level 2 surveys of larger study areas conducted within the wider surrounds and region including the FMG Rail Corridor (Biota, 2004), Hope Downs Proposed Rail Corridor (Biota 2002), and Wodgina DSO Project (Outback Ecology, 2009).	response to disturbance. • Design Project to avoid rocky ridge habitat and caves as far as practical during mine planning. • Prepare and Implement a Significant Species Management Plan that contains specific management and monitoring plans for the Northern Quoll. • Implement feral animal control and monitor feral predators. • Educate mine site personnel and contractors with respect to the conservation status of the Northern Quoll. • Implement measures to reduce road kill. • The Northern Quoll is listed under the Commonwealth EPBC Act. The Mt Dove Project is likely to impact on > 10 ha of Northern Quoll habitat and therefore the findings of this report are required to be referred to the DSEWPC
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	S1	-	HIGH • Pilbara Leaf-nosed Bat activity was recorded via AnaBat echolocation records	LOW • The Project development may result in an immediate small decline in the	• Minimise destruction of Rocky Ridge habitat where practicable, particularly that containing caves.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				from two caves within Rocky Ridge habitat at Mt Dove and at a water source (stock dam) on the southern boundary of the study area. Both caves (MD-AN-2, MD-AN-4) are located within the Project disturbance area (**Figure 23**). Atlas has committed to establishing a 20m buffer around cave site MD-AN-02 to preserve its physical structure and allow for recolonisation subsequent to mining. • Results of this survey suggest cave site MD-AN-2 is an important site for this species as it was found to be used regularly and in more than one season (autumn and spring). • 14.3 ha of Rocky Ridge habitat will be removed via establishment of the pit, haul roads and waste dumps. This represents 64% of Rocky Ridge habitat that occurs within the study area and immediate surrounds and contains the vast majority of optimum habitat (i.e. caves and crevices) that are present on Mt Dove. • Rocky Ridge represents foraging habitat and potential roost habitat for this	regional population of the Pilbara Leaf-nosed Bat. • The 14.3 ha of potential Pilbara Leaf-nosed Bat habitat to be removed as a result of the Project development does not represent a significant portion of this species regional habitat. However, disturbance to Rocky Ridge habitat surrounding cave site MD-AN-2 may potentially constrain the regional movements of this species throughout the landscape as the species desiccates easily and is reliant on humid roost sites and transient roost locations for foraging. This cave may represent a ‗transitory' roost site for this species, functioning as a stop-over point between surrounding areas, and disturbance may discourage the species from making use of this cave. • The majority of optimal roosting habitat for the Pilbara Leaf-nosed Bat in the region is located in gorges with water pools and tall *Melaleuca* or *Eucalyptus* forests (e.g. Ridges located 12 km to the south of the study	• Establish a ‗no-disturbance' buffer around cave site MD-AN-2, which is located adjacent to the disturbance area, to preserve the physical structure of this cave. • Minimise secondary impacts at cave site MD-AN-2. Impacts may include vibration, noise, light and damage to the cave. • Prepare and implement a Significant Species Management Plan that contains specific management and monitoring programs for the Pilbara Leaf-nosed Bat. • Investigate the potential for construction of artificial roost sites to provide additional habitat post-mining as per the —Australian Handbook for the Conservation of Bats in Mines and Artificial Cave-Bat Habitats" (Thompson, 2002). • The PLNB is listed under the Commonwealth EPBC Act. The Mt Dove Project is likely to impact on > 10 ha of PLNB habitat and therefore the findings of this report are required to be referred to the DSEWPC.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				species (most likely night or ‗transitory' roost sites; daytime roost sites were not confirmed in this survey via visual assessments and echolocation recordings of prominent caves). • Remaining habitat (i.e. MD-AN-02 and immediate surrounds) may be suitable for supporting Pilbara Leaf-nosed Bats although the extent of remaining habitat may be insufficient to support a viable population. • Permanent decline in local population may occur (via direct mortality or emigration) due to combination of initial clearing disturbance and impacts from ongoing mining activities.	area).	
Crest-tailed Mulgara (*Dasycercus cristicauda*) **Brush-tailed Mulgara (*Dasycercus blythi*)**	VU -	S1 -	- P4	LOW • Not recorded within study area. Targeted searches were undertaken; however evidence of this species was not identified. • Suitable habitat for this species does occur in the study area; however it is of marginal quality as it does not contain the ‗pure' unburnt stands of old growth Spinifex that are preferred	MINIMAL • DEC threatened and Priority fauna database records indicate that the Mulgara has been recorded from Kangan, Wallareenya, Boodarie (DEC, 2010); and from various fauna surveys for mining Projects in the surrounding region including the FMG Rail Corridor (Biota, 2004), Hope Downs Proposed	• Minimise destruction of old growth spinifex habitat which occurs in patches within the Acacia, Spinifex on Sandplain habitat. • Reduce the scale, frequency and intensity of fires within spinifex habitat and implement fire management where possible. • Avoid disturbance to areas where Mulgara burrows are likely to occur (i.e. old growth

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				by Mulgara (i.e. much of the study area was recently burnt, which is not conducive to supporting this species.	Rail Corridor (Biota 2002), Panorama Project (Bamford, 2001; Biota, 2007) and Pardoo DSO Project (Bamford, 2007).	spinifex habitat within the Acacia, Spinifex on Sandplain habitat). • Implement feral animal control and monitor feral predators. • Educate mine site personnel and contractors with respect to the conservation status of the Mulgara. • If sighted, report sightings of this species to the DEC.
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	S1	-	LOW • Species not recorded during the autumn and spring 2010 surveys, although could possibly occur within the study area. • 14.3 ha (64 %) of Rocky Ridge habitat will be removed via establishment of pits, haul roads, waste dumps. This represents potential habitat for the species, although not optimal as species prefers deep gullies and gorges preferentially located near water sources. • Increased potential for road kill.	MINIMAL • Localised habitat loss will occur, although extent of loss is negligible for the species. • Species is widespread although patchily distributed across the Pilbara (i.e. populations are fragmented.	• Educate mine site personnel and contractors with respect to the conservation status of the Olive Python. • Reduce accidental deaths and road kills by implementing speed limits and educating mine site personnel. Any road deaths should be reported to the DEC. • Relocate Pythons to undisturbed areas when observed in active mining areas.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
Greater Bilby (*Macrotis lagotis*)	VU	S1	-	MINIMAL • Not recorded within study area. Targeted searches were undertaken; however evidence of this species was not identified. • Suitable habitat for this species does occur in the study area (i.e. Acacia, spinifex on sandplain); however it is of marginal quality due to frequent burning, degradation by cattle grazing, and presence of introduced predators. • The Mt Dove project will impact on a small proportion (2.3 %) of the suitable habitat available within the study area.	MINIMAL • DEC threatened and Priority fauna database records indicate that the Bilby was recorded from Kangan in 2001 (DEC, 2010); and from a fauna survey for the southern portion of the Hope Downs Proposed Rail Corridor (Biota 2002). • The Mt Dove project will impact on a negligible proportion of the suitable habitat available within the region.	• Minimise destruction of old growth spinifex habitat which occurs in patches within the Acacia, Spinifex on Sandplain habitat. • Reduce the scale, frequency and intensity of fires within spinifex habitat and implement fire management where possible. • Avoid disturbance to areas where Bilby burrows are likely to occur (i.e. old growth spinifex habitat within the Acacia, Spinifex on Sandplain habitat). • Implement feral animal control and monitor feral predators. • Educate mine site personnel and contractors with respect to the conservation status of the Bilby. • If sighted, report sightings of this species or its burrows to the DEC.
Peregrine Falcon (*Falco peregrinus*)	-	S4	-	MINIMAL • Species not recorded during the autumn and spring 2010 surveys, although could use habitat within the study area intermittently. • This species occupies a wide	MINIMAL • The loss of breeding habitat for this species as a result of the Project is considered to be minimal as the study area comprises of a small portion of the species‘ range.	• Minimise destruction of ironstone ridge habitat and mature *Corymbia* trees with hollows wherever possible. • If sighted, report to the DEC.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				range over a variety of habitats and is unlikely to be reliant on habitat within the designated impact area. • Loss of a limited amount of nesting habitat may potentially occur.	• Habitat for this species is widely represented throughout the Pilbara region	
Woma Python (*Aspidites ramsayi*)	-	S4	-	MINIMAL • The Woma may occur on sandy soils within the Mt Dove study area. • There will be some localised habitat loss for this species, with some direct mortality possible. • The species is vulnerable to road kill.	NEGLIGIBLE • The Project is unlikely to significantly impact the conservation status of this species as it is the southern population that is considered to be rare. • The species is widespread, especially to the north and east. • The Project is unlikely to alter the conservation status of this species	• Educate mine site personnel and contractors with respect to the conservation status of the Woma Python. • Reduce accidental deaths and road kills by implementing speed limits and educating mine site personnel. Any road deaths should be reported to the DEC. • Relocate Woma Pythons to undisturbed areas when observed in active mining areas.
Ramphotyphlops ganei	-	-	P1	NEGLIGIBLE • Not recorded during autumn or spring 2010 surveys. • Distribution of species is poorly known, occurrence within the study area unlikely to be different to that in the surrounding region.	NEGLIGIBLE • No regional impact on this species is expected.	• None
Spectacled Hare-Wallaby (*Lagorchestes conspicillatus*	-	-	P3	LOW • Not recorded within study	MINIMAL • The Project is unlikely to	• Minimise destruction of old growth spinifex habitat which occurs in patches within the Acacia, Spinifex on Sandplain

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
leichardti)				area. Targeted searches were undertaken; however evidence of this species was not identified. • Suitable habitat for this species does occur in the study area; however it is of marginal quality as it does not contain stands of large, old growth Spinifex that are preferred by the species (i.e. much of the study area was recently burnt, which is not conducive to supporting this species.	impact the regional population of this species. • DEC threatened and Priority fauna database records indicate that the species has been recorded from 40 km to the south east at Pilgangoora in 1994 (Department of Environment and Conservation 2010c). Evidence for this species was recorded during a survey of the Panorama Project, approximately 80 km to the east (Bamford Consulting Ecologists, 2001) and a survey of the Turner River Hub Project, approximately 70 km south-east of Mt Dove.	habitat. • Implement fire management where possible; i.e. reduce the scale, frequency and intensity of fires within spinifex habitat. • Educate mine site personnel and contractors with respect to the conservation status of the Spectacled Hare-wallaby. • If sighted, report to DEC.
Ghost Bat (*Macroderma gigas*)	-	-	P4	HIGH • Ghost Bat activity was recorded during both the autumn and spring 2010 surveys via AnaBat echolocation records from cave site MD-AN-2 within Rocky Ridge habitat on the northern side of Mt Dove. This cave site is located adjacent to the Project disturbance area (**Figure 23**). Atlas has committed to establishing a 20m buffer around cave site MD-AN-02 to preserve its physical structure	LOW • The Mt Dove Project may result in the short-term decline of the species in the surrounding region as loss of individuals could potentially occur during clearing activities and the operation of the mine. • The 14.3 ha of potential Ghost Bat habitat to be removed as a result of the Project development does not represent a significant portion this species regional	• Minimise destruction of Rocky Ridge habitat where practicable, particularly that containing caves. • Establish a ‗no-disturbance' buffer around cave site MD-AN-2, which is located adjacent to the disturbance area, to preserve the physical structure of this cave. • Minimise secondary impacts at cave site MD-AN-2. Impacts may include vibration, noise, light and damage to the cave.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				and allow for recolonisation subsequent to mining. • Results of this survey suggest cave site MD-AN-2 is an important site for this species as it was found to be used regularly and in more than one season (autumn and spring). • 14.3 ha of Rocky Ridge habitat will be removed via establishment of the pit, haul roads and waste dumps. This represents 64% of Rocky Ridge habitat that occurs within the study area and immediate surrounds and contains the vast majority of optimum habitat (i.e. caves) that are present on Mt Dove. • Rocky Ridge represents foraging habitat and potential roost habitat for this species (most likely night or ‗transitory' roost sites; daytime roost sites were not confirmed in this survey via visual assessments and echolocation recordings of prominent caves). • Remaining habitat (i.e. MD-AN-02 and immediate surrounds) may be suitable for supporting Ghost Bats although the extent of	habitat. However, disturbance to Rocky Ridge habitat surrounding cave site MD-AN-2 may potentially constrain the regional movements of this species throughout the landscape. This cave may represent a ‗transitory' roost site for this species, functioning as a stop-over point between surrounding areas, and disturbance may discourage the species from making use of this cave. • Potential habitat for significant Ghost Bat roosts may potentially occur 12km to the south of Mt Dove. • Two significant roost locations with large aggregations of Ghost Bats (40-70 individuals) have been recorded approximately 35 km to the south south-east of Mt Dove and 55 km to the south east near Pincunah. These large aggregations are thought to be indicative of breeding colonies. Ghost Bat populations are heavily reliant on these maternity caves. The Mt Dove Project will not impact on these caves. • One significant Ghost Bat	• Investigate the potential for construction of artificial roost sites to provide additional habitat post-mining as per the —Australian Handbook for the Conservation of Bats in Mines and Artificial Cave-Bat Habitats" (Thompson, 2002) • Prepare and implement a Significant Species Management Plan that contains specific management and monitoring programs for Ghost Bats.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				remaining habitat may be insufficient to support a viable population. • Permanent decline in local population may occur (via direct mortality or emigration) due to combination of initial clearing disturbance and impacts from ongoing mining activities.	maternity roost and an additional six roost sites have been located at Abydos, 75 km to the south-east of the Mt Dove study area (Bamford 2009). The Project will not impact upon these caves.	
Lakeland Downs Mouse (*Leggadina lakedownensis*)	-	-	P4	MINIMAL • Not recorded during autumn and spring 2010 surveys. • This species is associated with grasslands on clay soils that may be subject to seasonal waterlogging. Therefore, habitat at Mt Dove is probably marginal.	MINIMAL • Project is unlikely to have an impact on the regional population of this species. • Suitable habitat for this species is widespread across the Pilbara. • Previous records occur from Chichester and Marble Bar in 2001 (Department of Environment and Conservation 2010c) and both the Hope Downs and FMG railway corridor surveys (Biota 2002b, 2004).	• Implement fire management where possible; i.e. reduce the scale, frequency and intensity of fires within spinifex habitat. • Implement feral animal control and monitor feral predators. • If sighted, report to the DEC.
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	-	P4	MINIMAL • Six inactive Western Pebble-mouse mounds were recorded within the proposed impact area.	MINIMAL • The Project is unlikely to impact the regional population of this species as there is significant habitat	• Avoid clearing Western Pebble Mound-mouse mounds. • Record location and status (i.e. active or inactive) of mounds.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				• Suitable habitat for this species occurs in the immediate vicinity of the Project disturbance area and wider surrounds.	available both in the Mt Dove study area and the wider surrounds.	
Long-tailed Dunnart (*Sminthopsis longicaudata*)	**-**	-	P4	LOW • Not recorded during autumn and spring 2010 surveys. • The preferred habitat of this species (Rocky Ridge) is limited in extent and will be significantly impacted by the Project.	MINIMAL • The Project is unlikely to impact the regional population of this species. • Suitable habitat occurs within the surrounding region. • Regionally, the species is only represented by a single record, from Wodgina, 30 km to the south.	• Minimise destruction of Rocky Ridge habitat where possible. • Implement feral animal control and monitor feral predators. • If sighted, report to the DEC.
Australian Bustard (*Ardeotis australis)*	-	-	P4	LOW • This species was recorded at several sites within Acacia, Spinifex on Sandplain habitat within the Mt Dove study area and adjacent surrounds during the autumn and spring 2010 surveys. • Potential habitat loss is minimal. • Increased likelihood of introduced predators and road kill.	MINIMAL • Regional habitat loss to this species is minimal.	• Educate mine site personnel and contractors with respect to the conservation status of the Australian Bustard. • Reduce accidental deaths and road kill.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
Bush Stone-curlew (*Burhinus grallarius*)	-	-	P4	LOW • Not recorded during autumn or spring 2010 surveys. • Potential habitat loss is minimal. • Increased likelihood of introduced predators and road kill.	MINIMAL • Regional habitat loss to this species is minimal.	• Reduce speed limits of nocturnal road traffic. • Educate mine site personnel and contractors to reduce likelihood of road kill.
Star Finch (western) (*Neochmia ruficauda subclarescens*)	-	-	P4	MINIMAL • Not recorded during autumn and spring 2010 surveys. • Potential habitat loss is minimal as this species tends to occur where permanent water is available.	NEGLIGIBLE • No overall impact on the species is expected.	• None
Grey Falcon (*Falco hypoleucos)*	-	-	P4	NEGLIGIBLE • Not recorded during autumn or spring 2010 surveys. • Wide-ranging species that is not likely to be reliant on habitat within the Project impact area.	NEGLIGIBLE • Overall habitat disturbance for this species is considered to be minimal.	• None
Ctenotus nigrilineatus	-	-	P2	NEGLIGIBLE • Not recorded during autumn or spring 2010 surveys. • Distribution of species is	NEGLIGIBLE • No regional impact on this species is expected.	• None

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				poorly known, occurrence within the study area unlikely to be different to that in the surrounding region.		
Ctenotus uber johnstonei	-	-	P2	NEGLIGIBLE • Not recorded during autumn or spring 2010 surveys. • Distribution of species is poorly known, occurrence within the study area unlikely to be different to that in the surrounding region.	NEGLIGIBLE • No regional impact on this species is expected.	• None
Fork-tailed Swift (*Apus pacificus*)	M	-	-	NEGLIGIBLE • Not recorded during autumn or spring 2010 surveys. • The Fork-tailed Swift is almost entirely aerial, and therefore not likely to be reliant on habitat within the Mt Dove study area	NEGLIGIBLE • No overall impact on this species is expected. • The Fork-tailed Swift is almost entirely aerial, and therefore not likely to be reliant on habitat within the Mt Dove study area.	• None
Rainbow Bee-eater (*Merops ornatus*)	M	-	-	NEGLIGIBLE • No change to impact status as a result of the Project • Widespread species that occupies a variety of habitats.	NEGLIGIBLE • Widespread species that occupies a variety of habitats	• None
Migratory water birds (discussed in Section 4.3.4)	M	-	-	NEGLIGIBLE • Migratory water birds may utilise water pools and plains	NEGLIGIBLE • Small area of disturbance with respect to available	• Avoid the creation of permanent artificial water sources where possible to prevent attracting waterbirds to the study area.

Species	Conservation Significance			Impact on Species (Localised Scale)	Impact on Species (Regional Scale)	Suggested Management Actions
	EPBC Act [1]	WC Act[2]	DEC Priority[3]			
				within the study area intermittently, particularly after heavy rainfall. • These species would not be expected to utilise habitat within the study area for a significant period of time and would more than likely fly overhead to utilise other permanent water sources nearby.	regional habitat for migratory water bird species.	• Where creation of artificial water sources is necessary, minimize surface exposure of water.
Rothschild's Rock-wallaby (Petrogale rothschildi)	-	-		LOW • This species is not listed, however is considered a Pilbara endemic and declines have been observed for mainland populations. • Rocky Ridge habitat is a preferred habitat type for the species, although the extent at Mt Dove may be insufficient to support a viable population. • The species may be capable of dispersing to nearby habitat (e.g. ridge habitat 12 km south, granite outcrops 20 km to the east).	NEGLIGIBLE • The Project is unlikely to impact the regional population of this species. • The species has been recorded from previous surveys including the FMG and Hope Downs Rail Corridors (2004, 2002).	• Minimise destruction of Rocky Ridge habitat where possible. • Implement feral animal control and monitor feral predators. • Implement measures to reduce road kill.

[1]Threatened species status under the Commonwealth EPBC Act: VU = Vulnerable, EN = Endangered, M = Migratory

[2]Threatened species status under the WC Act: S1 = Schedule S1, S4 = Schedule 4.

[3]DEC Priority Species List = Priority 1, P2, P3, P4

6. CONCLUSION

A total of 92 vertebrate fauna species were recorded within the detailed autumn and spring 2010 surveys of the Mt Dove study area; comprising 23 mammals (17 of which were native), 40 species of birds and 29 reptile species. Based on findings of database searches and a comprehensive literature review, the vertebrate fauna assemblage recorded was as expected and found to be broadly comparable with findings of similar sized surveys conducted within the region.

Four broad fauna habitats were identified within the Mt Dove study area: Acacia, Spinifex on Sandplain; Acacia Shrubland on Footslopes, Rocky Ridge and Stony Rise. Systematic, targeted and opportunistic sampling was undertaken in each of these habitat types. Systematic sampling methods included the use of pitfall, Elliott, funnel and cage trapping, hand searching, spotlighting and avifauna census.

With the exception of the Rocky Ridge habitat on Mt Dove, the fauna habitats identified within the study area are widely represented outside the study area and throughout the Chichester sub bioregion. The Rocky Ridge habitat associated with Mt Dove encompasses a total area of 22 ha and represents a naturally occurring isolated habitat island within the landscape, with the the nearest fauna habitat possessing similar characteristics (ironstone outcropping, caves, crevices and boulders) occurring 12 km to the south. This habitat type yielded the greatest diversity (four) and abundance of conservation significant fauna species recorded from the autumn and spring 2010 surveys.

Five conservation significant fauna species were recorded within the Mt Dove study area, comprising:

- The Northern Quoll (*Dasyurus hallucatus*) which is listed as Endangered under the EPBC Act and Schedule 1 of the WC Act;
- The Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) which is listed as Vulnerable under the EPBC Act and Schedule 1 of the WC Act;
- Two Priority 4 species listed under the DEC Priority Species List, the Ghost Bat (*Macroderma gigas*) and Australian Bustard (*Ardeotis australis*); and
- One Migratory species listed under the EPBC Act, the Rainbow Bee-eater (*Merops ornatus*).

The Project will impact vertebrate faunal assemblages on a local scale through direct loss of fauna during land clearing, loss of habitat and indirect impacts. The development of the Project will directly impact 64% of the significant Rocky Ridge habitat occurring on Mt Dove. Four conservation significant fauna species were recorded from this habitat including the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*); Ghost Bat (*Macroderma gigas*); Rainbow Bee-eater (*Merops ornatus*) and the Northern Quoll (*Dasyurus hallucatus*), of which nine individuals were recorded during 2010. This habitat is uncommon in the landscape and consequently, with the exception of the Rainbow Bee-eater, the development of the Project is likely to have an impact on these conservation significant species at a localised scale (i.e. within the surrounding 10 km).

Subsequent to the implementation of the management actions and strategies recommended within this assessment, the impacts of the Project on conservation significant species at a regional scale are likely to range from negligible (no perceived affect on species) to moderate (permanent species decline expected – no perceived threat to regional conservation status of species).

7. STUDY TEAM

Miss Sonja Creese	B Sc Hons (Conservation Biology)	Senior Zoologist
Mr David Steane	B. Animal Sc (Hons)	Senior Zoologist
Mr Eddy Cannella	B Sc (Zoology); Masters Environmental Science	Senior Zoologist
Mr Dane Trembath	Bachelor of Science (Environmental Science)	Senior Zoologist
Dr Blair Parsons	B Sc Hons (Biological/ Env. Science) PhD Zoology (UWA)	Senior Zoologist

All AnaBat data was analysed by bat specialist Kyle Armstrong from Specialized Zoological.

The autumn and spring 2010 surveys were conducted under the following Licence issued by DEC:

Licence to Take Fauna for Scientific Purposes (Regulation 17) – Licence No: SF007349

Date of issue: 18/03/2010

Valid from: 22/03/2010

Date of expiry: 21/03/2011

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Attachment A

Vertebrate Fauna Species Recorded Within the Mt Dove Study Area and/or Surrounds

Legend

Abbreviations/Symbols

*	Introduced Species
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*: EX Extinct, E Endangered, VU Vulnerable M Migratory
WC Act	State Wildlife Conservation Act 1950 and Department of Environment and Conservation's Threatened and Priority Fauna Rankings: S1 Schedule 1 Rare or likely to become extinct, S4 In need of special protection, P1 Priority 1 Fauna, P2, P3, P4, P5

Previous Surveys in surrounding area

A	Turner River Hub Terrestrial Fauna Assessment (Outback Ecology 2010)
B	Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor (Biota 2004, Northern study area)
C	Proposed Hope Downs Rail Corridor From Weeli Wolli Siding to Port Hedland (Biota 2002, Northern study area)

Previous Surveys in surrounding region

D	Wodgina DSO Project: Terrestrial Vertebrate Fauna Assessment (Outback Ecology 2009)
E	Fauna Assessment of the Abydos DSO Project (Bamford 2009)
F	Panorama Project Area: Baseline Fauna Study as Part of the Sulphur Springs Feasibility Study (Bamford 2001)
G	Panorama Project: Mine Site and Haul Road Corridor Targeted Fauna Survey (Biota 2007)
H	Fauna Assessment of the Pardoo Direct Shipping Ore Project Atlas Iron Limited (Bamford 2007)
I	Ecological Survey of Abydos-Woodstock Reserve, Western Australia: Vertebrate Fauna (How *et al.* 1991)
J	A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Mining Area and Infrastructure Corridor: Option 1, 6 (Ninox 2009a,b,c)
K	RGP 5 Level 2 Fauna Survey: Chichester Deviation (ecologia 2008)
L	Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor (Biota 2004, Southern study area)
M	Proposed Hope Downs Rail Corridor From Weeli Wolli Siding to Port Hedland (Biota 2002, Southern study area)

Database Searches

N	Department of Environment and Conservation's Threatened and Priority Fauna Database Search (July 2010)
O	Department of Environment and Conservation's NatureMap (July 2010)
P	Birds Australia Atlas Database Search (July 2010)
Q	Australian Museum Database Search (July 2010)
R	Department of Sustainability, Environment, Water, Population and Communities database search (July 2010)

Attachment A

Vertebrate Fauna Species Recorded Within the Mt Dove study area and /or Surrounds

Scientific Name	Common Name	Conservation Status		This study			Surveys in surrounding area			Surveys in surrounding region										Database searches				
		EPBC Act	WC Act	Autumn 2010	Spring 2010	SRE Trapping	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Mammals																								
BOVIDAE																								
*Bos taurus**	European Cattle			X			X			X	X		X		X		X		X					
CAMELIDAE																								
*Camelus dromedarius**	Dromedary			X			X	X			X	X			X			X						
CANIDAE																								
*Canis lupus(dingo/familiaris)**	Dingo/Common Dog			X	X		X	X	X		X	X		X		X	X	X	X					
*Vulpes vulpes**	Fox			X										X					X					X
DASYURIDAE																								
Dasycercus blythi	Brush-tailed Mulgara		P4																	X				
Dasycercus cristicauda	Crest-tailed Mulgara	EN	S1				X	X	X			X		X	X			X	X	X				X
Dasykaluta rosamondae	Kaluta				X		X	X	X			X			X	X	X	X	X		X			
Dasyurus hallucatus	Northern Quoll	EN	S1	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X			X
Ningaui ridei	Wongai Ningaui							X										X						
Ningaui timealeyi	Pilbara Ningaui						X	X	X			X	X		X	X	X	X	X		X			
Planigale sp.	Planigale species			X			X	X	X	X		X					X	X	X		X			
Planigale maculata	Common Planigale														X	X								
Pseudantechinus macdonnellensis	Fat-tailed False Antechinus								X										X					
Pseudantechinus roryi	Tan False Antechinus										X	X			X						X			
Pseudantechinus woolleyae	Woolley's Pseudantechinus						X			X				X	X	X					X			
Sminthopsis longicaudata	Long-tailed Dunnart		P4							X														
Sminthopsis macroura	Stripe-faced Dunnart				X		X	X	X				X		X		X	X	X		X			
Sminthopsis ooldea	Ooldea Dunnart															X								
Sminthopsis youngsoni	Lesser hairy-footed Dunnart							X	X						X			X	X		X			
EMBALLONURIDAE																								
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat			X	X		X			X						X	X							
Taphozous georgianus	Common Sheathtail-bat			X	X		X		X	X	X	X		X	X	X	X		X		X			
EQUIDAE																								
*Equus asinus**	Donkey			X			X	X	X						X			X	X					
*Equus caballus**	Horse						X																	
FELIDAE																								
*Felis catus**	Cat			X	X		X	X	X	X	X	X		X	X		X	X	X					X
HIPPOSIDERIDAE																								
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	S1	X	X		X			X	X	X	X											X
LEPORIDAE																								
*Oryctolagus cuniculus**	Rabbit																X							X
MACROPODIDAE																								
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby (mainland)		P3				X					X			X					X	X			
Macropus robustus	Common Wallaroo			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X			
Macropus rufus	Red Kangaroo			X			X		X							X			X		X			
Petrogale rothschildi	Rothschild's Rock-wallaby						X	X	X	X	X	X			X			X	X					
MEGADERMATIDAE																								
Macroderma gigas	Ghost Bat		P4	X	X		X		X	X	X	X			X		X			X	X		X	
MOLOSSIDAE																								
Austronomus australis	White-striped Freetail-bat								X	X	X	X				X			X					
Chaerephon jobensis	Northern Freetail-bat						X		X	X						X	X		X					

Scientific Name	Common Name	Conservation Status		This study			Surveys in surrounding area			Surveys in surrounding region										Database searches				
		EPBC Act	WC Act	Autumn 2010	Spring 2010	SRE Trapping	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Mormopterus beccarii	Beccari's Freetail-bat																X							
Mormopterus cobourgiana	Mangrove Freetail-bat		P1						X															
MURIDAE																								
Leggadina lakedownensis	Lakeland Downs Mouse		P4					X	X								X	X	X					
*Mus musculus**	House Mouse						X	X	X			X	X		X		X	X	X		X			
Notomys alexis	Spinifex Hopping-mouse			X			X		X					X			X		X		X			
Pseudomys chapmani	Western Pebble-mound Mouse		P4	X	X		X			X	X	X	X	X	X	X	X		X	X	X			
Pseudomys delicatulus	Delicate Mouse						X	X	X			X			X	X		X	X		X			
Pseudomys desertor	Desert Mouse							X	X			X	X	X		X	X	X	X		X			
Pseudomys hermannsburgensis	Sandy Inland Mouse			X	X		X	X	X			X	X		X	X	X	X	X		X			
Zyzomys argurus	Common Rock-rat						X	X	X	X	X	X	X		X	X	X	X	X		X			
TACHYGLOSSIDAE																								
Tachyglossus aculeatus	Short-beaked Echidna			X	X		X	X	X		X	X		X	X			X	X					
THYLACOMYIDAE																								
Macrotis lagotis	Greater Bilby	VU	S1																X					X
VESPERTILIONIDAE																								
Chalinolobus gouldii	Gould's Wattled Bat			X	X		X	X	X	X						X	X	X	X					
Chalinolobus morio	Chocolate Wattled Bat															X								
Nyctophilus arnhemensis	Arnhem Long-eared Bat								X															
Nyctophilus geoffroyi	Lesser Long-eared Bat																X							
Scotorepens greyii	Little Broad-nosed Bat			X	X		X	X	X	X	X		X		X	X	X	X	X					
Vespadelus finlaysoni	Inland Cave Bat			X	X		X		X	X	X	X			X	X	X	X	X		X			
Birds																								
ACANTHIZIDAE																								
Acanthiza apicalis	Inland Thornbill															X	X		X					
Acanthiza robustirostris	Slaty-backed Thornbill							X									X	X	X					
Acanthiza uropygialis	Chestnut-rumped Thornbill							X								X	X	X	X					
Gerygone fusca	Western Gerygone											X			X	X	X		X					
Gerygone levigaster	Mangrove Gerygone						X																	
Gerygone tenebrosa	Dusky Gerygone						X		X															
Pyrrholaemus brunneus	Redthroat															X								
Smicrornis brevirostris	Weebill						X	X	X			X			X	X	X	X	X					
ACCIPITRIDAE																								
Accipiter cirrocephalus	Collared Sparrowhawk							X				X			X			X				X		
Accipiter fasciatus	Brown Goshawk						X	X	X	X	X	X	X	X	X		X	X	X			X		
Aquila audax	Wedge-tailed Eagle			X			X	X	X		X	X	X	X	X	X	X	X	X			X		
Circus approximans	Swamp Harrier						X	X										X				X		
Circus assimilis	Spotted Harrier						X	X	X		X	X		X	X		X	X				X		
Elanus axillaris	Black-shouldered Kite							X	X			X		X	X		X	X	X			X		
Haliaeetus leucogaster	White-bellied Sea-Eagle	M																				X		X
Haliastur indus	Brahminy Kite						X		X													X		
Haliastur sphenurus	Whistling Kite			X	X		X	X	X		X	X		X		X	X	X	X			X		
Hamirostra melanosternon	Black-breasted Buzzard							X	X		X					X		X						
Hieraaetus morphnoides	Little Eagle						X	X	X			X		X	X	X	X	X				X		
Lophoictinia isura	Square-tailed Kite							X								X	X	X				X		
Milvus migrans	Black Kite							X	X	X	X			X	X			X	X			X		
Pandion cristatus	Eastern Osprey																					X		
ACROCEPHALIDAE																								
Acrocephalus australis	Australian Reed-Warbler	M							X								X		X			X		
AEGOTHELIDAE																								

Scientific Name	Common Name	Conservation Status		This study			Surveys in surrounding area			Surveys in surrounding region										Database searches				
		EPBC Act	WC Act	Autumn 2010	Spring 2010	SRE Trapping	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Aegotheles cristatus	Australian Owlet-nightjar						X	X	X	X	X	X		X	X	X	X	X				X		
ALAUDIDAE																								
Mirafra javanica	Horsfield's Bushlark						X	X	X					X			X	X	X			X		
ANATIDAE																								
Anas gracilis	Grey Teal						X		X		X				X							X		
Anas rhynchotis	Australasian Shoveler																					X		
Anas superciliosa	Pacific Black Duck						X	X	X		X	X			X		X	X	X			X		
Aythya australis	Hardhead																					X		
Chenonetta jubata	Australian Wood Duck								X													X		
Cygnus atratus	Black Swan						X															X		
Dendrocygna eytoni	Plumed Whistling-Duck										X											X		
Malacorhynchus membranaceus	Pink-eared Duck																					X		
ANHINGIDAE																								
Anhinga novaehollandiae	Australasian Darter							X	X			X			X			X				X		
APODIDAE																								
Apus pacificus	Fork-tailed Swift	M						X							X		X	X				X		X
ARDEIDAE																								
Ardea ibis	Cattle Egret	M																				X		X
Ardea intermedia	Intermediate Egret																					X		
Ardea modesta	Eastern Great Egret						X		X			X		X								X		X
Ardea pacifica	White-necked Heron						X		X		X	X		X	X	X	X					X		
Butorides striata	Striated Heron								X															
Egretta garzetta	Little Egret								X													X		
Egretta novaehollandiae	White-faced Heron						X	X			X	X	X		X		X	X	X			X		
Nycticorax caledonicus	Nankeen Night Heron								X			X	X		X							X		
ARTAMIDAE																								
Artamus cinereus	Black-faced Woodswallow			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Artamus leucorynchus	White-breasted Woodswallow						X															X		
Artamus minor	Little Woodswallow						X		X	X	X	X	X	X	X	X	X		X		X	X		
Artamus personatus	Masked Woodswallow							X			X		X		X	X		X	X			X		
Artamus superciliosus	White-browed Woodswallow								X															
Cracticus nigrogularis	Pied Butcherbird			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Cracticus tibicen	Australian Magpie						X	X	X		X	X	X		X	X	X	X	X			X		
Cracticus torquatus	Grey Butcherbird			X				X	X							X	X	X	X					
BURHINIDAE																								
Burhinus grallarius	Bush Stone-curlew		P4				X	X	X		X	X			X		X	X		X	X	X		
CACATUIDAE																								
Cacatua sanguinea	Little Corella			X			X	X	X	X	X	X			X	X	X	X	X			X		
Eolophus roseicapillus	Galah			X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Nymphicus hollandicus	Cockatiel						X	X	X	X	X	X	X	X	X		X	X	X		X	X		
CAMPEPHAGIDAE																								
Coracina maxima	Ground Cuckoo-shrike															X	X							
Coracina novaehollandiae	Black-faced Cuckoo-shrike			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Lalage sueurii	White-winged Triller						X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
CASUARIIDAE																								
Dromaius novaehollandiae	Emu			X			X	X	X						X		X	X	X			X		
CHARADRIIDAE																								
Charadrius ruficapillus	Red-capped Plover								X													X		
Charadrius veredus	Oriental Plover	M																				X		X
Elseyornis melanops	Black-fronted Dotterel						X	X	X	X	X	X		X	X		X	X	X			X		

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Erythrogonys cinctus	Red-kneed Dotterel																					X		
Vanellus miles	Masked Lapwing																					X		
Vanellus tricolor	Banded Lapwing						X															X		
CICONIIDAE																								
Ephippiorhynchus asiaticus	Black-necked Stork						X	X	X	X	X	X						X				X		
CLIMACTERIDAE																								
Climacteris melanura	Black-tailed Treecreeper						X							X								X		
COLUMBIDAE																								
Geopelia cuneata	Diamond Dove						X	X	X	X	X	X	X	X	X	X	X	X	X			X		
Geopelia humeralis	Bar-shouldered Dove						X		X													X		
Geopelia striata	Peaceful Dove						X		X		X	X		X	X		X					X		
Geophaps plumifera	Spinifex Pigeon			X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Ocyphaps lophotes	Crested Pigeon			X	X		X	X	X		X	X	X		X	X	X	X	X			X		
Phaps chalcoptera	Common Bronzewing			X	X		X		X		X	X	X		X	X	X		X			X		
Phaps histrionica	Flock Bronzewing		P4																		X			
CORVIDAE																								
Corvus bennetti	Little Crow						X		X						X	X	X					X		
Corvus orru	Torresian Crow			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
CUCULIDAE																								
Cacomantis pallidus	Pallid Cuckoo						X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Centropus phasianinus	Pheasant Coucal								X		X	X	X				X				X	X		
Chalcites basalis	Horsfield's Bronze-Cuckoo				X		X	X	X		X	X	X	X		X	X	X	X			X		
Chalcites osculans	Black-eared Cuckoo						X		X						X				X					
ESTRILDIDAE																								
Emblema pictum	Painted Finch			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Neochmia ruficauda subclarescens	Star Finch (western)		P4												X		X					X		
Taeniopygia guttata	Zebra Finch			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
EUROSTOPODIDAE																								
Eurostopodus argus	Spotted Nightjar			X			X	X	X	X	X	X		X	X	X	X	X				X		
FALCONIDAE																								
Falco berigora	Brown Falcon			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Falco cenchroides	Nankeen Kestrel			X	X		X	X	X	X	X	X		X	X	X	X	X	X			X		
Falco hypoleucos	Grey Falcon		P4					X									X	X				X		
Falco longipennis	Australian Hobby							X	X	X				X	X	X		X			X	X		
Falco peregrinus	Peregrine Falcon		S4					X	X					X	X	X		X	X			X		
Falco subniger	Black Falcon									X											X	X		
GLAREOLIDAE																								
Glareola maldivarum	Oriental Pratincole	M																				X		X
Stiltia isabella	Australian Pratincole														X							X		
HAEMATOPODIDAE																								
Haematopus longirostris	Australian Pied Oystercatcher								X															
HALCYONIDAE																								
Dacelo leachii	Blue-winged Kookaburra						X	X	X		X	X	X	X	X	X	X	X				X		
Todiramphus chloris	Collared Kingfisher						X																	
Todiramphus pyrrhopygius	Red-backed Kingfisher			X			X	X	X		X	X	X	X	X	X	X	X	X			X		
Todiramphus sanctus	Sacred Kingfisher						X	X	X	X	X	X		X	X	X	X	X	X		X	X		
HIRUNDINIDAE																								
Cheramoeca leucosterna	White-backed Swallow																					X		
Hirundo neoxena	Welcome Swallow						X										X					X		
Hirundo rustica	Barn Swallow	M																				X		X

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Petrochelidon ariel	Fairy Martin						X	X	X	X	X				X		X	X	X			X		
Petrochelidon nigricans	Tree Martin						X	X	X	X		X		X	X	X	X	X	X			X		
LARIDAE																								
Chlidonias hybrida	Whiskered Tern																					X		
Chlidonias leucopterus	White-winged Black Tern	M																				X		
Chroicocephalus novaehollandiae	Silver Gull								X													X		
Gelochelidon nilotica	Gull-billed Tern								X													X		
Hydroprogne caspia	Caspian Tern	M							X													X		
Thalasseus bergii	Crested Tern								X															
MALURIDAE																								
Amytornis striatus	Striated Grasswren						X	X		X	X	X			X	X		X			X			
Malurus lamberti	Variegated Fairy-wren				X		X	X	X	X	X	X	X		X	X	X	X	X		X	X		
Malurus leucopterus	White-winged Fairy-wren			X	X		X	X	X		X			X	X	X	X	X	X		X	X		
Malurus melanocephalus	Red-backed Fairy-wren																					X		
Malurus splendens	Splendid Fairy-wren															X								
Stipiturus ruficeps	Rufous-crowned Emu-wren								X			X			X	X			X					
MEGALURIDAE																								
Cincloramphus cruralis	Brown Songlark			X			X	X	X			X			X			X						
Cincloramphus mathewsi	Rufous Songlark							X	X			X		X			X	X	X			X		
Eremiornis carteri	Spinifexbird			X	X		X	X	X	X	X	X			X	X	X	X	X		X	X		
MELIPHAGIDAE																								
Acanthagenys rufogularis	Spiny-cheeked Honeyeater						X	X	X						X	X	X	X	X					
Certhionyx variegatus	Pied Honeyeater						X	X		X		X			X			X			X	X		
Conopophila whitei	Grey Honeyeater						X			X							X							
Epthianura tricolor	Crimson Chat			X				X	X			X			X		X	X				X		
Lichenostomus keartlandi	Grey-headed Honeyeater						X	X	X	X	X	X	X		X	X	X	X	X		X	X		
Lichenostomus leucotis	White-eared Honeyeater						X																	
Lichenostomus ornatus	Yellow-plumed Honeyeater						X																	
Lichenostomus penicillatus	White-plumed Honeyeater			X			X	X	X		X	X	X	X	X	X	X	X	X			X		
Lichenostomus plumulus	Grey-fronted Honeyeater			X			X			X		X				X					X			
Lichenostomus virescens	Singing Honeyeater			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Lichmera indistincta	Brown Honeyeater						X	X	X	X	X	X	X		X	X	X	X	X		X	X		
Manorina flavigula	Yellow-throated Miner			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Melithreptus gularis	Black-chinned Honeyeater						X	X			X	X	X			X	X	X				X		
Purnella albifrons	White-fronted Honeyeater						X								X									
Sugomel niger	Black Honeyeater							X	X	X								X	X					
MEROPIDAE																								
Merops ornatus	Rainbow Bee-eater	M		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X
MONARCHIDAE																								
Grallina cyanoleuca	Magpie-lark			X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
MOTACILLIDAE																								
Anthus novaeseelandiae	Australasian Pipit			X	X		X	X	X		X			X	X	X	X	X				X		
NECTARINIIDAE																								
Dicaeum hirundinaceum	Mistletoebird							X	X		X	X			X	X		X	X			X		
NEOSITTIDAE																								
Daphoenositta chrysoptera	Varied Sittella							X										X						
OTIDIDAE																								
Ardeotis australis	Australian Bustard		P4	X	X		X	X	X		X	X			X	X	X	X	X	X	X	X		
PACHYCEPHALIDAE																								
Colluricincla harmonica	Grey Shrike-thrush						X	X		X	X	X	X		X	X	X	X	X		X	X		

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Oreoica gutturalis	Crested Bellbird			X	X		X	X	X		X	X			X	X	X	X	X			X		
Pachycephala lanioides	White-breasted Whistler						X																	
Pachycephala melanura	Mangrove Golden Whistler								X															
Pachycephala rufiventris	Rufous Whistler			X	X		X	X	X			X				X	X	X	X			X		
PARDALOTIDAE																								
Pardalotus rubricatus	Red-browed Pardalote						X	X	X		X	X	X	X	X		X	X	X			X		
Pardalotus striatus	Striated Pardalote						X	X		X	X	X				X	X	X			X	X		
PELECANIDAE																								
Pelecanus conspicillatus	Australian Pelican								X			X			X				X			X		
PETROICIDAE																								
Melanodryas cucullata	Hooded Robin							X								X	X	X	X			X		
Peneonanthe pulverulenta	Mangrove Robin						X		X															
Petroica goodenovii	Red-capped Robin							X	X						X	X	X	X	X					
PHALACROCORACIDAE																								
Microcarbo melanoleucos	Little Pied Cormorant						X		X			X										X		
Phalacrocorax carbo	Great Cormorant																					X		
Phalacrocorax sulcirostris	Little Black Cormorant								X			X			X				X			X		
Phalacrocorax varius	Pied Cormorant						X		X													X		
PHASIANIDAE																								
Coturnix pectoralis	Stubble Quail							X							X			X						
Coturnix ypsilophora	Brown Quail				X		X				X	X		X			X					X		
PODARGIDAE																								
Podargus strigoides	Tawny Frogmouth						X	X	X		X	X	X		X		X	X				X		
PODICIPEDIDAE																								
Podiceps cristatus	Great Crested Grebe																					X		
Poliocephalus poliocephalus	Hoary-headed Grebe																					X		
Tachybaptus novaehollandiae	Australasian Grebe								X						X		X					X		
POMATOSTOMIDAE																								
Pomatostomus superciliosus	White-browed Babbler						X	X								X	X	X	X					
Pomatostomus temporalis	Grey-crowned Babbler						X		X		X			X		X	X		X			X		
PSITTACIDAE																								
Barnardius zonarius	Australian Ringneck				X		X	X	X		X	X			X	X	X	X	X			X		
Melopsittacus undulatus	Budgerigar						X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Psephotus varius	Mulga Parrot								X															
PSOPHODIDAE																								
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush							X										X						
PTILONORHYNCHIDAE																								
Ptilonorhynchus guttatus	Western Bowerbird			X			X		X	X	X	X	X			X	X		X			X		
Ptilonorhynchus maculatus	Spotted Bowerbird														X									
RALLIDAE																								
Fulica atra	Eurasian Coot																					X		
Gallinula tenebrosa	Dusky Moorhen						X																	
Gallirallus philippensis	Buff-banded Rail																					X		
Porzana tabuensis	Spotless Crake																X							
Tribonyx ventralis	Black-tailed Native-hen																					X		
RECURVIROSTRIDAE																								
Himantopus himantopus	Black-winged Stilt							X	X									X				X		
Recurvirostra novaehollandiae	Red-necked Avocet																					X		
RHIPIDURIDAE																								
Rhipidura albiscapa	Grey Fantail															X			X			X		

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Rhipidura leucophrys	Willie Wagtail			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Rhipidura phasiana	Mangrove Grey Fantail						X		X															
SCOLOPACIDAE																								
Actitis hypoleucos	Common Sandpiper	M							X													X		
Calidris acuminata	Sharp-tailed Sandpiper	M																				X		
Calidris ruficollis	Red-necked Stint	M																				X		
Calidris subminuta	Long-toed Stint	M																				X		
Numenius madagascariensis	Eastern Curlew	M	P4						X															
Numenius phaeopus	Whimbrel	M					X		X															
Tringa brevipes	Grey-tailed Tattler	M							X															
Tringa glareola	Wood Sandpiper	M															X					X		
Tringa nebularia	Common Greenshank	M													X							X		
Tringa stagnatilis	Marsh Sandpiper	M																				X		
STRIGIDAE																								
Ninox connivens	Barking Owl										X				X	X						X		
Ninox novaeseelandiae	Southern Boobook Owl			X			X	X	X		X	X			X	X	X	X				X		
THRESKIORNITHIDAE																								
Platalea flavipes	Yellow-billed Spoonbill																					X		
Platalea regia	Royal Spoonbill																					X		
Plegadis falcinellus	Glossy Ibis	M																				X		
Threskiornis molucca	Australian White Ibis								X													X		
Threskiornis spinicollis	Straw-necked Ibis						X		X			X			X							X		
TIMALIIDAE																								
Zosterops lateralis	Silvereye						X																	
Zosterops luteus	Yellow White-eye						X		X													X		
TURNICIDAE																								
Turnix velox	Little Button-quail						X	X	X	X	X	X		X	X	X	X	X	X		X	X		
TYTONIDAE																								
Tyto javanica	Eastern Barn Owl						X								X		X					X		
Reptiles																								
AGAMIDAE																								
Amphibolurus longirostris	Long-nosed Dragon						X	X	X	X	X	X		X	X	X	X	X	X		X		X	
Caimanops amphiboluroides	Mulga Dragon							X								X	X	X	X					
Ctenophorus caudicinctus	Ring-tailed Dragon			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	
Ctenophorus isolepis	Central Military Dragon			X	X		X	X	X		X			X	X		X	X	X		X		X	
Ctenophorus nuchalis	Central Netted Dragon				X				X						X		X		X				X	
Ctenophorus reticulatus	Western Netted Dragon															X	X		X					
Diporiphora valens	Pilbara Two-line Dragon								X										X		X			
Diporiphora winneckei	Canegrass Dragon			X	X		X								X									
Pogona minor minor	Dwarf Bearded Dragon			X	X		X		X						X	X	X		X		X			
Pogona minor mitchelli																					X			
Tympanocryptis cephalus	Pebble Dragon							X										X						
Tympanocryptis intima	Gibber Earless Dragon																						X	
CHELIDAE																								
Chelodina steindachneri	Flat-shelled Turtle							X							X			X						
ELAPIDAE																								
Acanthophis pyrrhus	Desert Death Adder													X	X									
Acanthophis wellsi	Pilbara Death Adder						X				X					X	X		X					
Brachyurophis approximans	North-western Shovel-nosed Snake						X	X							X		X	X						
Demansia psammophis	Yellow-faced Whip Snake						X	X	X					X	X	X	X	X	X		X			

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Demansia reticulata	Desert Whipsnake																						X	
Demansia rufescens	Rufous Whipsnake						X	X		X		X					X	X			X			
Furina ornata	Orange-naped Snake				X		X	X		X					X			X	X		X			
Parasuta monachus	Monk Snake															X								
Pseudechis australis	King Brown Snake						X	X	X						X	X	X	X	X					
Pseudonaja modesta	Ringed Brown Snake				X		X			X	X				X		X				X			
Pseudonaja nuchalis	Western Brown Snake						X		X					X	X		X		X		X			
Simoselaps anomalus	Desert Banded Snake						X		X										X		X			
Suta fasciata	Rosen's Snake							X								X		X	X					
Suta punctata	Little Spotted Snake							X	X					X	X			X	X		X			
Vermicella snelli							X						X			X			X					
GEKKONIDAE																								
Crenadactylus ocellatus	Clawless Gecko											X												
Diplodactylus conspicillatus	Fat-tailed Diplodactylus			X	X		X	X	X					X	X			X	X		X			
Diplodactylus pulcher	Fine-faced Gecko															X								
Diplodactylus savagei	Yellow-spotted Pilbara Gecko						X			X	X	X	X			X	X				X			
Gehyra australis	Northern Dtella																						X	
Gehyra pilbara	Pilbara Dtella			X			X					X			X									
Gehyra punctata	Spotted Dtella						X		X		X	X		X	X	X	X		X		X		X	
Gehyra purpurascens	Purplish Dtella			X			X																	
Gehyra variegata	Tree Dtella			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	
Heteronotia binoei	Bynoe's Gecko					X	X	X	X	X	X	X		X	X	X	X	X	X		X		X	
Heteronotia planiceps	Bynoe's Prickly Gecko									X											X			
Heteronotia spelea	Desert Cave Gecko						X			X							X		X		X			
Lucasium stenodactylum	Crowned Gecko				X		X	X	X	X	X		X		X	X	X	X	X		X		X	
Lucasium wombeyi	Pilbara Ground Gecko						X	X			X		X				X	X						
Nephrurus levis	Three-lined Knob-tail						X	X							X			X			X			
Nephrurus wheeleri	Banded Knob-tail															X	X		X					
Oedura marmorata	Marbled Velvet Gecko			X			X				X				X		X		X					
Rhynchoedura ornata	Beaked Gecko			X	X		X								X	X	X		X		X		X	
Strophurus ciliaris	Spiny-tailed Gecko								X										X		X			
Strophurus elderi	Jewelled Gecko						X	X	X			X	X		X		X	X	X		X			
Strophurus jeanae	Southern Phasmid Gecko							X							X			X			X			
Strophurus wellingtonae	Western Shield Spiny-tailed Gecko							X								X	X	X	X					
PYGOPODIDAE																								
Delma butleri	Unbanded Delma						X			X											X			
Delma elegans	Pilbara Delma						X					X					X							
Delma haroldi	Neck-barred Delma															X			X		X			
Delma nasuta	Sharp-snouted Delma						X	X	X	X	X	X				X	X	X	X		X			
Delma pax	Peace Delma						X	X	X	X		X	X		X	X	X	X	X		X			
Delma tincta	Excitable Delma						X	X	X					X	X	X	X	X	X		X			
Lialis burtonis	Burton's Snake-lizard			X	X		X	X	X			X		X	X	X	X	X	X		X			
Pygopus nigriceps	Hooded Scaly-foot						X		X							X	X		X		X			
PYTHONIDAE																								
Antaresia perthensis	Pygmy Python						X	X	X			X		X	X			X	X		X			
Antaresia stimsoni	Stimson's Python						X	X	X	X	X			X	X		X	X	X		X			
Aspidites melanocephalus	Black-headed Python						X	X			X				X	X	X	X	X					
Aspidites ramsayi	Woma		S4																X	X	X			
Liasis olivaceus barroni	Olive Python (Pilbara)	VU	S1				X				X			X	X									X
SCINCIDAE																								

Scientific Name	Common Name	Conservation Status		This study			Surveys in surrounding area			Surveys in surrounding region										Database searches				
		EPBC Act	WC Act	Autumn 2010	Spring 2010	SRE Trapping	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Carlia munda	Shaded-litter Rainbow-skink				X	X	X	X	X	X	X	X	X		X	X	X	X	X		X			
Carlia triacantha	Desert Rainbow-skink			X	X			X	X	X						X		X	X		X			
Cryptoblepharus buchananii																X								
Cryptoblepharus plagiocephalus	Callose-palmed Shinning-skink											X			X		X		X					
Cryptoblepharus ustulatus							X				X					X								
Ctenotus ariadnae	Ariadna's Ctenotus							X										X						
Ctenotus duricola				X	X		X	X	X				X		X	X	X	X	X		X			
Ctenotus fallens	West-coast Laterite Ctenotus																						X	
Ctenotus grandis	Grand Ctenotus			X	X		X	X	X						X		X	X	X		X			
Ctenotus helenae	Clay-soil Ctenotus			X			X	X	X						X	X	X	X	X		X		X	
Ctenotus nigrilineatus	Pin-striped Finesnout Ctenotus		P1												X									
Ctenotus pantherinus	Leopard Ctenotus			X	X		X	X	X		X			X	X	X	X	X	X		X		X	
Ctenotus robustus	Robust Ctenotus																		X					
Ctenotus rubicundus	Ruddy Ctenotus						X	X		X	X	X					X	X			X			
Ctenotus rufescens	Rufous Finesnout Ctenotus																				X			
Ctenotus rutilans	Rusty-shouldered Ctenotus															X								
Ctenotus saxatilis	Stony-soil Ctenotus			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	
Ctenotus schomburgkii	Barred Wedgesnout Ctenotus						X	X							X	X		X						
Ctenotus serventyi	North-western Sandy-loam Ctenotus						X								X			X					X	
Ctenotus uber	Spotted Ctenotus															X	X		X					
Ctenotus uber johnstonei			P2					X										X						
Cyclodomorphus melanops	Spinifex Slender Blue-tongue						X	X	X	X		X	X		X	X	X	X	X		X			
Egernia depressa	Pygmy Spiny-tailed Skink						X		X					X	X				X		X			
Egernia formosa	Goldfields Crevice-skink						X				X	X	X		X									
Egernia pilbarensis	Pilbara Crevice-skink						X																	
Eremiascincus fasciolatus	Narrow-banded Sand-swimmer						X																X	
Eremiascincus richardsonii	Broad-banded Sand-swimmer						X		X						X				X		X			
Lerista bipes	North-western Sandslider			X	X		X	X	X						X			X	X		X		X	
Lerista clara							X																	
Lerista desertorum	Central Deserts Robust Slider						X																	
Lerista jacksoni							X														X			
Lerista muelleri	Wood Mulch-slider							X	X	X	X	X	X		X	X	X	X	X		X			
Lerista neander	Pilbara Robust Slider															X								
Lerista zietzi																X								
Liopholis striata	Nocturnal Desert-skink			X	X		X								X									
Menetia greyii	Common Dwarf Skink						X	X	X						X	X	X	X	X		X			
Menetia surda	Western Dwarf Skink											X				X								
Morethia ruficauda	Lined Firetail Skink				X	X	X	X	X	X	X	X	X		X	X	X	X	X		X			
Notoscincus ornatus	Ornate Soil-crevice Skink						X	X				X	X		X			X			X		X	
Proablepharus reginae	Western Soil-crevice Skink						X	X	X			X			X		X	X	X		X			
Tiliqua multifasciata	Centralian Blue-tongue						X	X	X						X	X	X	X	X					
TYPHLOPIDAE																								
Ramphotyphlops ammodytes					X		X	X	X		X						X	X	X		X			
Ramphotyphlops diversus	Northern Blind Snake														X									
Ramphotyphlops ganei			P1				X																	
Ramphotyphlops grypus	Long-beaked Blind Snake						X	X	X	X					X	X	X	X	X		X			
Ramphotyphlops hamatus	Pale-headed Blind Snake														X	X								
Ramphotyphlops pilbarensis					X		X																	
Ramphotyphlops waitii	Beaked Blind Snake															X								
VARANIDAE																								

Scientific Name	Common Name	Conservation Status		This study			Surveys in surrounding area			Surveys in surrounding region										Database searches				
		EPBC Act	WC Act	Autumn 2010	Spring 2010	SRE Trapping	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Varanus acanthurus	Ridge-tailed Monitor						X	X	X	X	X	X		X	X	X	X	X	X		X		X	
Varanus brevicauda	Short-tailed Pygmy Monitor						X	X	X						X	X		X	X		X			
Varanus bushi	Pilbara Mulga Monitor						X									X	X		X					
Varanus caudolineatus	Stripe-tailed Monitor						X								X		X							
Varanus eremius	Pygmy Desert Monitor			X	X		X	X	X				X		X		X	X	X		X			
Varanus giganteus	Perentie						X		X	X	X	X			X				X					
Varanus gouldii	Gould's Goanna			X	X		X	X	X		X				X			X	X		X		X	
Varanus panoptes	Yellow-spotted Monitor						X	X			X				X	X	X	X	X					
Varanus pilbarensis	Pilbara Rock Monitor						X							X	X									
Varanus tristis	Black-headed Monitor						X				X		X		X	X	X		X					
Amphibians																								
HYLIDAE																								
Cyclorana australis	Giant Frog						X	X	X					X				X	X		X			
Cyclorana maini	Main's Frog					X	X	X	X	X				X	X	X		X	X		X			
Litoria rubella	Desert Tree Frog						X	X	X	X	X	X	X	X	X		X	X	X		X		X	
LIMNODYNASTIDAE																								
Neobatrachus aquilonius	Northern Burrowing Frog																				X			
Neobatrachus sudelli	Sudell's Frog																						X	
Neobatrachus sutor	Shoemaker Frog						X																	
Notaden nichollsi	Desert Spadefoot Toad						X	X	X					X				X	X		X		X	
Platyplectrum spenceri	Spencer's Burrowing Frog						X	X	X		X				X			X	X		X			
MYOBATRACHIDAE																								
Uperoleia glandulosa	Glandular Toadlet										X				X						X			
Uperoleia russelli	Russell's Toadlet						X	X	X		X	X	X		X			X	X		X			
Fish																								
CLUPEIDAE																								
Nematalosa erebi	Bony Bream											X												
DIODONTIDAE																								
Allomycterus pilatus	Australian Burrfish						X																	
MELANOTAENIIDAE																								
Melanotaenia australis	Western Rainbowfish						X				X	X											X	
Melanotaenia splendida	Eastern Rainbowfish																						X	
PLOTOSIDAE																								
Neosilurus hyrtlii	Hyrtl's Catfish						X					X												
TERAPONTIDAE																								
Amniataba percoides	Barred Grunter											X		X									X	
Leiopotherapon unicolor	Spangled Perch						X				X	X												
			Total	**78**	**66**	**5**	**228**	**176**	**201**	**92**	**125**	**141**	**73**	**89**	**190**	**153**	**177**	**178**	**182**	**9**	**127**	**152**	**29**	**16**

Attachment B

Abundance of Vertebrate Species Recorded During the Autumn and Spring 2010 Surveys

NB: For abundance, tracks, scats, AnaBat records, mounds, nests and other indirect signs were treated as a 1. Table excludes all database and literature searches.

Within this table, abundance is a relative measure based on captures or observations rather than number of individuals (i.e. may include multiple captures/observations of individuals).

Abundance of Mammal Species Recorded During the Autumn and Spring 2010 Surveys

Scientific Name	Common Name	Conservation status		Systematic sites			SRE Wet Pitfall	Target searches	ANABAT	Opportunistic
		EPBC Act	WC Act	MD-F-1	MD-F-2	MD-F-3				
Mammals										
BOVIDAE										
*Bos taurus**	European Cattle			1	1	1				
CAMELIDAE										
*Camelus dromedarius**	Dromedary			1		1				
CANIDAE										
*Canis lupus**	Dingo			1	1	1				1
*Vulpes vulpes**	Fox				1					
DASYURIDAE										
Dasykaluta rosamondae	Kaluta					1				
Dasyurus hallucatus	Northern Quoll	EN	S1	2	43					
Planigale ingrami	Long-tailed Planigale				1					
Sminthopsis macroura	Stripe-faced Dunnart					1				
EMBALLONURIDAE										
Taphozous georgianus	Common Sheathtail-bat								X	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat								X	
EQUIDAE										
*Equus asinus**	Donkey				1	1				1
FELIDAE										
*Felis catus**	Cat			1	1	1				1
HIPPOSIDERIDAE										
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	S1						X	
MACROPODIDAE										
Macropus rufus	Red Kangaroo			2				2		6
Macropus robustus	Common Wallaroo				2			1		10
MEGADERMATIDAE										
Macroderma gigas	Ghost Bat		P4						X	
MURIDAE										

Scientific Name	Common Name	Conservation status		Systematic sites			SRE Wet Pitfall	Target searches	ANABAT	Opportunistic
		EPBC Act	WC Act	MD-F-1	MD-F-2	MD-F-3				
Pseudomys hermannsburgensis	Sandy Inland Mouse					14				
Pseudomys chapmani[#]	Western Pebble-mound Mouse		P4	1						6
Notomys alexis	Spinifex Hopping-mouse					1				
TACHYGLOSSIDAE										
Tachyglossus aculeatus	Short-beaked Echidna				2			1		3
VESPERTILIONIDAE										
Scotorepens greyii	Little Broad-nosed Bat								X	
Vespadelus finlaysoni	Inland Cave Bat								X	
Chalinolobus gouldii	Gould's Wattled Bat								X	
Total				**9**	**53**	**22**	**0**	**4**	**N/A**	**28**

[#] Inactive mounds only

Abundance of Bird Species Recorded During the Autumn and Spring 2010 Surveys

Scientific Name	Common Name	Conservation status		Systematic sites			Target searches	Opportunistic
		EPBC Act	WC Act	MD-F-1	MD-F-2	MD-F-3		
ACCIPITRIDAE								
Aquila audax	Wedge-tailed Eagle							1
Haliastur sphenurus	Whistling Kite					2		1
ARTAMIDAE								
Artamus cinereus	Black-faced Woodswallow			26	11	21		12
Cracticus nigrogularis	Pied Butcherbird			4	5			1
Cracticus torquatus	Grey Butcherbird					1		
CACATUIDAE								
Cacatua sanguinea	Little Corella			8	27			28
Eolophus roseicapillus	Galah							4
CAMPEPHAGIDAE								
Coracina novaehollandiae	Black-faced Cuckoo-shrike			3	3	3		
CASUARIIDAE								
Dromaius novaehollandiae	Emu			1		1		
COLUMBIDAE								
Geophaps plumifera	Spinifex Pigeon			3			4	8
Ocyphaps lophotes	Crested Pigeon			45	13	67		51
Phaps chalcoptera	Common Bronzewing			2				1
CORVIDAE								
Corvus orru	Torresian Crow			5	3	2		1
CUCULIDAE								
Chalcites basalis	Horsfield's Bronze-Cuckoo				1			1
ESTRILDIDAE								
Emblema pictum	Painted Finch				2			7
Taeniopygia guttata	Zebra Finch			87	11			4
EUROSTOPODIDAE								
Eurostopodus argus	Spotted Nightjar						4	
FALCONIDAE								

Scientific Name	Common Name	Conservation status		Systematic sites			Target searches	Opportunistic
		EPBC Act	WC Act	MD-F-1	MD-F-2	MD-F-3		
Falco berigora	Brown Falcon			2	1	2		5
Falco cenchroides	Nankeen Kestrel			1	7	4		8
HALCYONIDAE								
Todiramphus pyrrhopygius	Red-backed Kingfisher			1				
MALURIDAE								
Malurus lamberti	Variegated Fairy-wren			11				
Malurus leucopterus	White-winged Fairy-wren			31		18		
MEGALURIDAE								
Eremiornis carteri	Spinifexbird					2		
Cincloramphus cruralis	Brown Songlark							1
MELIPHAGIDAE								
Epthianura tricolor	Crimson Chat			13				
Lichenostomus penicillatus	White-plumed Honeyeater			1		2		4
Lichenostomus plumulus	Grey-fronted Honeyeater			1		2		2
Lichenostomus virescens	Singing Honeyeater			48	39	31		15
Manorina flavigula	Yellow-throated Miner			4	15	2		14
MEROPIDAE								
Merops ornatus	Rainbow Bee-eater	M		21	16	4		6
MONARCHIDAE								
Grallina cyanoleuca	Magpie-lark							2
MOTACILLIDAE								
Anthus novaeseelandiae	Australasian Pipit				1			2
OTIDIDAE								
Ardeotis australis	Australian Bustard		P4	1		2		3
PACHYCEPHALIDAE								
Oreoica gutturalis	Crested Bellbird			3		2		
Pachycephala rufiventris	Rufous Whistler			2		1		2
PHASIANIDAE								
Coturnix ypsilophora	Brown Quail							1
PSITTACIDAE								
Barnardius zonarius	Australian Ringneck			2				

Scientific Name	Common Name	Conservation status		Systematic sites			Target searches	Opportunistic
		EPBC Act	WC Act	MD-F-1	MD-F-2	MD-F-3		
PTILONORHYNCHIDAE								
Ptilonorhynchus guttatus	Western Bowerbird				1			1
RHIPIDURIDAE								
Rhipidura leucophrys	Willie Wagtail			2	3	5		2
STRIGIDAE								
Ninox novaeseelandiae	Southern Boobook Owl				4	1		2
	Total			**328**	**163**	**175**	**8**	**190**

Abundance of Reptile and Amphibian Species Recorded During the Autumn and Spring 2010 Surveys

Scientific Name	Common Name	Conservation status		Systematic sites			SRE Wet Pitfall	Target searches	Opportunistic
		EPBC Act	WC Act	MD-F-1	MD-F-2	MD-F-3			
AGAMIDAE									
Diporiphora winneckei	Canegrass Dragon			1		2			
Ctenophorus isolepis	Central Military Dragon			13		22			10
Ctenophorus caudicinctus	Ring-tailed Dragon				2			2	2
Pogona minor minor	Dwarf Bearded Dragon					1			1
Ctenophorus nuchalis	Central Netted Dragon			1					
ELAPIDAE									
Furina ornata	Orange-naped Snake			1					
Pseudonaja modesta	Ringed Brown Snake					1			1
GEKKONIDAE									
Lucasium stenodactylum	Crowned Gecko			1					
Gehyra purpurascens	Purplish Dtella			1					
Gehyra variegata	Tree Dtella			4		1			
Oedura marmorata	Marbled Velvet Gecko				1				
Rhynchoedura ornata	Beaked Gecko			2					
Diplodactylus conspicillatus	Fat-tailed Diplodactylus			5		4		2	
Gehyra pilbara	Pilbara Dtella					1			
Heteronotia binoei	Bynoe's Gecko						2		
PYGOPODIDAE									
Lialis burtonis	Burton's Snake-lizard			1				1	
SCINCIDAE									
Carlia triacantha	Desert Rainbow-skink				3				2
Liopholis striata	Nocturnal Desert-skink			1				2	
Ctenotus pantherinus	Leopard Ctenotus			10		30		2	
Ctenotus helenae	Clay-soil Ctenotus					1		5	
Ctenotus saxatilis	Stony-soil Ctenotus				17		7	1	6
Ctenotus grandis	Grand Ctenotus			4		1			2
Ctenotus duricola				2		1			1

Scientific Name	Common Name	Conservation status		Systematic sites			SRE Wet Pitfall	Target searches	Opportunistic
		EPBC Act	WC Act	MD-F-1	MD-F-2	MD-F-3			
Lerista bipes	North-western Sandslider			20		14			5
Morethia ruficauda	Lined Firetail Skink				1		2		1
Carlia munda	Shaded-litter Rainbow-skink						1		1
TYPHLOPIDAE									
Ramphotyphlops pilbarensis				1					
Ramphotyphlops ammodytes				1					
VARANIDAE									
Varanus eremius	Pygmy Desert Monitor			2		8			
Varanus gouldii	Gould's Goanna			2					
Amphibians									
HYLIDAE									
Cyclorana maini	Main's Frog						1		
	Total			**73**	**24**	**87**	**13**	**15**	**32**

Attachment C

Definitions of Conservation Significance Status

Status	Conservation Code	Description
Categories used in EPBC Act		
Endangered	E	A taxon is Endangered when the best available evidence indicates that it is considered to be facing a very high risk of extinction in the wild.
Vulnerable	V	A taxon is Vulnerable when the best available evidence indicates that it is considered to be facing a high risk of extinction in the wild.
Migratory	M	Species migrate to, over and within Australia and its external territories.
Schedules of the Western Australian Wildlife Conservation Act 1950		
Schedule 1	S1	Fauna that is rare or likely to become extinct.
Schedule 2	S2	Fauna that is presumed to be extinct.
Schedule 3	S3	Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds.
Schedule 4	S4	Fauna that is in need of special protection, otherwise than for the reasons mentioned above
Priority Fauna Codes used by the Western Australian DEC		
Priority 1 Taxa with few, poorly known populations on threatened lands.	P1	Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2 Taxa with few, poorly known populations on conservation lands.	P2	Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3 Taxa with several, poorly known populations, some on conservation lands	P3	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4 Taxa in need of monitoring	P4	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5 Taxa in need of monitoring	P5	Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Attachment D

Conservation Significant Species Recorded During the Autumn and Spring 2010 Surveys

Conservation Significant Species Recorded During the Autumn and Spring 2010 Surveys

Scientific Name	Common Name	EPBC Act[1]	WC Act[2]	DEC Priority[3]	Eastings	Northings	Notes
Mammals							
Dasyurus hallucatus	Northern Quoll	EN	S1		651869	7684134	7 individuals captured, 1 sighting
					651382	7683707	2 individuals captured
Rhinonicteris aurantius (Pilbara form)	Pilbara Leaf-nosed Bat	VU	S1		651932	7684070	AnaBat recording from Mt Dove cave (MD-AN-04)
					651776	7684227	AnaBat recordings from Mt Dove cave (MD-AN-02)
					652525	7680687	AnaBat recording at water source (dam)
Macroderma gigas	Ghost Bat			P4	651776	7684227	AnaBat recordings, high confidence
Pseudomys chapmani	Western Pebble-mound Mouse			P4	651817	7683906	Inactive mound
					651626	7683787	Inactive mound
					651843	7683988	Inactive mound
					651577	7683865	Inactive mound
					651616	7683812	Inactive mound
					651548	7623852	Inactive mound
					651490	7683857	Inactive mound
Birds							
Ardeotis australis	Australian Bustard			P4	655431	7688724	Tracks
					651382	7683707	Tracks
					654424	7681160	Sighted

Scientific Name	Common Name	EPBC Act[1]	WC Act[2]	DEC Priority[3]	Eastings	Northings	Notes
					660194	7685402	Sighted
Merops ornatus	Rainbow Bea-eater	M			655431	7688724	Heard/sighted
					651382	7683707	Heard/sighted
					651869	7684134	Heard/sighted
					652525	7680687	Heard/sighted
					651869	7684134	Heard/sighted

[1]Threatened species status under the Commonwealth EPBC Act: VU = Vulnerable, EN = Endangered, M = Migratory

[2]Threatened species status under the WC Act: S1 = Schedule S1, S4 = Schedule 4.
[3]DEC Priority Species List = Priority 1, P2, P3, P4

Attachment E

Autumn 2010 Specialised Zoological Bat Identification Report – Autumn 2010

Specialised Zoological

Bat call identification from the Atlas Iron Mt Dove project area, WA

Type:	Bat Call Analysis
Prepared for:	Outback Ecology
Date:	13 July 2010
Job No.:	SZ153B
Prepared by:	Specialised Zoological Kyle Armstrong and Yuki Konishi ABN 92 265 437 422 0404 423 264 kyle.armstrong@graduate.uwa.edu.au kyle.n.armstrong@gmail.com

SUMMARY OF RESULTS

Bat identifications from Anabat echolocation call recordings are provided from the Atlas Iron Mt Dove project area, in the Pilbara region of Western Australia. At least seven species were identified as being present, with the possibility of an additional one species (Table 1).

Some call types of the yellow-bellied sheath-tailed bat *Saccolaimus flaviventris* can be confused with those of the northern free-tailed bat *Chaerephon jobensis*. In some cases, call sequences could be identified to species, but in others it was not possible.

Details supporting the identifications are provided, as recommended by the Australasian Bat Society (ABS 2006). A summary of pulse parameters is provided in Table 2, and representative Anabat call sequences are illustrated in Figure 1. Further data is available should verification be required.

ANALYSIS METHODS

Signals as recorded with Anabat SD1 units were downloaded and examined in AnalookW 3.7w software. Three call variables were measured on good quality search phase pulses in representative call sequences: pulse duration (milliseconds), maximum frequency (kHz) and characteristic frequency (kHz). Species were identified based on information in McKenzie and Muir (2000), Armstrong and Coles (2007), McKenzie and Bullen (2009) and K.N. Armstrong unpublished data. Nomenclature follows Armstrong and Reardon (2006).

SPECIES OF CONSERVATION SIGNIFICANCE

Two bat species of conservation significance were recorded at several sites: Pilbara leaf-nosed bat *Rhinonicteris aurantia* and ghost bat *Macroderma gigas*. The detection of *M. gigas* was based on the recognition of both social calls and ultrasonic echolocation calls from the Anabat recordings (Figure 1). Unambiguous echolocation calls of *R. aurantia* were recorded at 3 sites in the project area (Tables 1 and 3).

The likelihood of a daytime roost of *R. aurantia* being present within a cave site can be estimated (but not confirmed) from the amount of their activity recorded throughout the night. The number of call sequences was tallied in 30-minute intervals, and cave sites were separated from those where bat detectors were placed in the open (Table 3). There were relatively few calls at all sites, and no obvious difference in activity between the two cave sites and the site with a pool of water. Observations of relatively high activity around pools has been made in the Pilbara numerous times previously, often greater than at cave entrances (K.N. Armstrong, unpubl. obs.). Caves with records of activity at the entrance may need to be examined further to determine if they serve as day roosts of *R. aurantia*, if it is likely that these sites will be impacted. This would need to be undertaken using a non-invasive method (e.g. as detailed by DEWHA 2010a, b).

REFERENCES

ABS (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. *The Australasian Bat Society Newsletter* 27: 6–9. [ISSN 1448-5877]

Armstrong, K. and Reardon, T. (2006). Standardising common names of bats in Australia. *The Australasian Bat Society Newsletter* 26: 37–42.

Armstrong, K.N. and Coles, R.B. (2007). Echolocation call frequency differences between geographic isolates of *Rhinonicteris aurantia* (Chiroptera: Hipposideridae): implications of nasal chamber size. *Journal of Mammalogy* 88: 94–104.

DEWHA (2010a). *Rhinonicteris aurantia* (Pilbara form). In: Species Profile and Threats Database, Department of the Environment, Water, Heritage and the Arts, Canberra. URL: http://www.environment.gov.au/sprat

DEWHA (2010b). Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Water, Heritage and the Arts, Canberra.

McKenzie, N.L. and Muir, W.P. (2000). Bats of the southern Carnarvon Basin, Western Australia. *Records of the Western Australian Museum* Supplement 61: 465–477.

McKenzie, N.L. and Bullen, R.D. (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. *Records of the Western Australian Museum* Supplement 78: 123–155.

TABLE 1. Species identifications from Mt Dove stationary sites, with the degree of confidence indicated by a code. See Table 2 for full species names.

		C. gouldii	*C. jobensis/S.flaviventris*	*M. gigas*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Date	**Site**								
Serial 1514									
22/05/2010	MD-AN-01	H	NC	–	H	–	H	–	–
24/05/2010	MD-AN-02	H	–	H	H	H	–	H	H
26/05/2010	MD-AN-04	-	-	-	-	-	-	H	H
27/05/2010	MD-AN-05	-	-	-	H	H	-	H	H

Definition of confidence level codes:

H High. Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or submission of a specimen/tissue to a museum.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the Summary section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

TABLE 2. Summary of variables from representative call sequences.

Species	s,p[1]	Duration (msec)2	Max Frequency (kHz)2	Char frequency (kHz)2
Gould's wattled bat *Chalinolobus gouldii*	6,72	7.6 ± 1.0 5.4 – 10.3	38.5 ± 4.0 34.3 – 51.0	30.3 ± 1.0 28.9 – 32.7
Northern free-tailed bat *Chaerephon jobensis /* Yellow-bellied sheath-tailed bat *Saccolaimus flaviventris*	3,22	11.3 ± 2.2 7.5 – 14.6	27.6 ± 4.4 20.4 – 34.3	19.6 ± 1.4 16.8 – 22.2
Ghost bat *Macroderma gigas*	1,7	3.3 ± 0.8 2.2 – 4.5	44.1 ± 4.2 40.4 – 51.6	36.9 ± 1.9 32.8 – 38.7
Pilbara leaf-nosed bat *Rhinonicteris aurantia*	4,17	—	—	120.0 ± 1.8 115.1 – 120.9
Yellow-bellied sheath-tailed bat *Saccolaimus flaviventris*	2,4	9.2 ± 4.2 6.2 – 15.2	16.6 ± 2.2 14.9 – 19.9	15.5 ± 1.0 14.6 – 16.8
Little broad-nosed bat *Scotorepens greyii*	4,21	6.3 ± 0.8 4.3 – 7.6	43.7 ± 2.3 39.4 – 48.2	34.7 ± 0.8 33.2 – 36.5
Common sheath-tailed bat *Taphozous georgianus*	2,7	12.5 ± 0.9 11.0 – 13.5	25.8 ± 0.7 24.7 – 26.9	23.9 ± 0.1 23.8 – 24.1
Finlayson's cave bat *Vespadelus finlaysoni*	1,25	4.8 ± 1.3 3.0 – 7.1	70.1 ± 8.0 58.4 – 85.1	55.6 ± 0.7 54.4 – 56.7

[1]s,p: number of sequences measured, combined total number of pulses measured;

[2]Mean ± SD; range.

TABLE 3. Number of sequences of *R. aurantia* recorded in 30-minute intervals at stationary Anabat sites. Cave sites in bold; pools in italics.

Serial, Date	1514, 22/5/2010	1514, 24/5/2010	1514, 27/5/2010
Site	MD-AN-01	MD-AN-02	MD-AN-04
Interval			
17:30–18:00			
18:00–18:30			
18:30–19:00			
19:00–19:30			**1**
19:30–20:00			
20:00–20:30			
20:30–21:00			
21:00–21:30	*1*	**1**	
21:30–22:00	*1*	**1**	
22:00–22:30	*1*		
22:30–23:00			
23:00–23:30		**9**	
23:30–0:00	*4*	**1**	
0:00–0:30	*1*		
0:30–1:00			
1:00–1:30	*1*	**3**	
1:30–2:00			
2:00–2:30			
2:30–3:00			
3:00–3:30			
3:30–4:00			
4:00–4:30			
4:30–5:00			
5:00–5:30			
5:30–6:00			
6:00–6:30			
6:30–7:00			

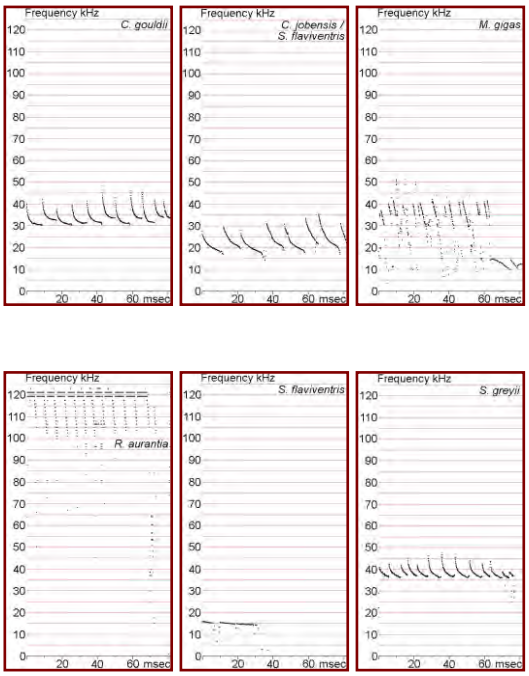

FIGURE 1A. Representative call sequences of the species identified (time is compressed between pulses).

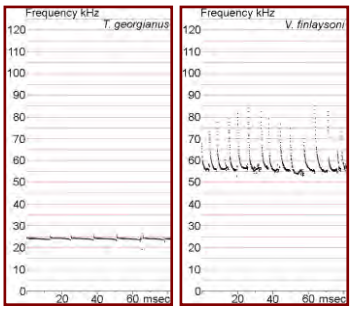

FIGURE 1B. Representative call sequences of the species identified (time is compressed between pulses).

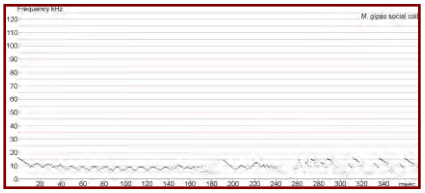

FIGURE 1C. Representative social calls of the ghost bat *M. gigas* (time is compressed between calls).

Attachment F

Specialised Zoological Bat Identification Report – Spring 2010

Specialised Zoological

Bat call identification

from Mt Dove, WA

Type:	Bat Call Analysis
Prepared for:	Outback Ecology
Date:	4 November 2010
Job No.:	SZ174
Prepared by:	Specialised Zoological Kyle Armstrong and Yuki Konishi ABN 92 265 437 422 0404 423 264 kyle.armstrong@graduate.uwa.edu.au kyle.n.armstrong@gmail.com

SZ174: *Bat call identification from Mt Dove, WA*

SZ174 Document revision history

Date	Type
6 October 2010	Standard report submitted to Outback Ecology
4 November 2010	Final version with additional comments submitted to Outback Ecology

SZ174: *Bat call identification from Mt Dove, WA*

SUMMARY

Bat identifications from Anabat echolocation call recordings are provided from Mt Dove, in the Pilbara region of Western Australia. This represents the second echolocation survey at the site, with a previous effort made in May 2010 (Specialised Zoological 2010). Seven species were identified as being present, with two of these being species of conservation significance – ghost bat *Macroderma gigas* and Pilbara leaf-nosed bat *Rhinonicteris aurantia* (Table 1).

The identification of both species of conservation significance was made from unambiguous echolocation calls. Non-ultrasonic social calls of the *M. gigas* were also recognised from AnaBat recordings, but an unambiguous confirmation of presence was made only from short duration (≤ 2 ms), multi-harmonic echolocation calls at the same sites. The social calls were used to provide less critical information, such as the times that the species was present at sites.

Details supporting the identifications are provided, as recommended by the Australasian Bat Society (ABS 2006). A summary of pulse parameters derived from the AnaBat analysis is provided in Table 2, and representative call sequences are illustrated in Figure 1. Further data is available should verification be required.

METHODS

Signals as recorded with AnaBat SD1 units were downloaded and examined in AnalookW 3.7w software. The frequency division ratio was set to a factor of 8. Three call variables were measured on good quality search phase echolocation pulses in representative call sequences: pulse duration (milliseconds), maximum frequency (kHz) and characteristic frequency (kHz) (minimum frequency of the higher harmonic for the ghost bat *M. gigas*). Species were identified based on information in McKenzie and Muir (2000), McKenzie and Bullen (2009), Armstrong and Coles (2007) and K.N. Armstrong unpublished data. Nomenclature follows Armstrong and Reardon (2006). To double-check that all signals of the Pilbara leaf-nosed bat *R. aurantia* had been noted, a continuous representation of the AnaBat recordings in ZCA and MAP files was examined. No additional calls were present. Note a likely equipment problem for the results from AnaBat unit 3186.

COMMENTS ON THE IMPORTANCE OF THE SITES FOR BATS OF CONSERVATION SIGNIFICANCE

The number of call sequences recorded of *R. aurantia* was relatively low on both of the nights that it was detected – two and three sequences, respectively (Table 3). The recordings were also from the middle of the night. The pattern is suggestive of an occasional visit by one or more individuals while they are out foraging at night. A similar pattern was recorded in May 2010 at the same site (named MD-AN-02 in Specialised Zoological 2010; named as DSAN04 in this report), though with a greater number of call sequences recorded. This species typically visits caves at night, possibly for resting, and may or may not roost in the structure during the day. In such cases, and given the importance of the roost site for this species (Armstrong 2001), confirmation of roosting during the day can be undertaken using an entrance barricade at dusk, and determining which side the species originates from (as detailed in DEWHA 2010a,b).

The ghost bat *M. gigas* was recorded on four consecutive nights at site DSAN04. The number of calls recorded was not large, and concentrated mainly after midnight, which suggests visitation during the night and not roosting during the day. However, there were two echolocation calls recorded soon after sunset (calls at 19:44 and 19:46) on 8/9/2010, which might be indicative of daytime roosting in the cave.

A previous echolocation survey at Mt Dove using AnaBat equipment detected the presence of both *M. gigas* and *R. aurantia* at the same site on 24/5/2010 (MD-AN-02 in Specialised Zoological 2010; DSAN04 in this report). This indicates that both species use the site in more than one season (i.e. species were present in both May 2010 and September 2010). Given the consistent presence of *M. gigas* at DSAN04 between 6/9/2010 and 9/9/2010, the raw data was re-examined from the previous survey on 24/5/2010 (Specialised Zoological 2010) for comparison. On the May survey, echolocation calls were first heard at 20:21, and many social calls were heard throughout the period 21:23 to 03:40. These were likely to have been produced by at least two individuals calling to each other inside the cave. It suggests that the cave is an important site for the species, given the length of time spent inside the cave, and the observation of presence in a later survey in September 2010.

In summary, it appears that site DSAN04 (= MD-AN-02) is used regularly (over consecutive nights) and in more than one season (at least May, September) by both species of conservation significance. Most echolocation and social calls were recorded in the middle of the night, which indicates that the site was used as a night refuge, but daytime roosting has not been investigated with a method other than acoustic recordings. While *M. gigas* and *R. aurantia* are found throughout the region (Armstrong and Anstee 2000; Armstrong 2001;

McKenzie and Bullen 2009), it is possible that their movements amongst roosts that provide appropriate microclimates throughout the year are aided by 'transitory roosts' that may be useful as stop-over points in intervening areas. Regardless of whether site DSAN04 is used as a daytime roost by either species, the data collected to date suggest the site is important because it is used regularly by both species, and might also be important for aiding regional movements, especially given the lack of other significant outcrop within several kilometres of this formation.

References

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Armstrong, K. and Reardon, T. (2006). Standardising common names of bats in Australia. *The Australasian Bat Society Newsletter* 26: 37–42.

Armstrong, K.N. and Coles, R.B. (2007). Echolocation call frequency differences between geographic isolates of *Rhinonicteris aurantia* (Chiroptera: Hipposideridae): implications of nasal chamber size. *Journal of Mammalogy* 88: 94–104.

DEWHA (2010a). *Rhinonicteris aurantia* (Pilbara form). In: Species Profile and Threats Database, Department of the Environment, Water, Heritage and the Arts, Canberra. URL: http://www.environment.gov.au/sprat

DEWHA (2010b). Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Water, Heritage and the Arts, Canberra.

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McKenzie, N.L. and Bullen, R.D. (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. *Records of the Western Australian Museum* Supplement 78: 123–155.

Specialised Zoological (2010). Bat call identification from the Atlas Iron Mt Dove project area, WA. Unpublished report (SZ153B) by Specialised Zoological for Outback Ecology Pty Ltd, 13 July 2010.

SZ174: *Bat call identification from Mt Dove, WA*

TABLE 1. Species identifications, with the degree of confidence indicated by a code. Date correlates with site; see Table 3 for full species names.

Date	Site	*C. gouldii*	*M. gigas*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Serial 3006								
6/09/2010	DSAN04	—	H	H	H	—	H	H
7/09/2010	DSAN04	—	H	H	H	—	H	H
8/09/2010	DSAN04	—	H	—	H	—	H	H
9/09/2010	DSAN04	—	H	—	H	—	H	H
Serial 3060								
4/09/2010	DSAN07	—	—	—	—	—	H	—
5/09/2010	DSAN07	H	—	—	—	—	—	H
6/09/2010	DSAN07	—	—	—	—	—	—	H
7/09/2010	DSAN07	—	—	—	H	—	H	H
Serial 3230								
8/09/2010	DSAN02	H	—	—	H	H	H	H
Serial 5695								
6/09/2010	EC01	—	—	—	—	—	H	H
7/09/2010	EC01	—	—	—	H	—	—	H
8/09/2010	EC01	H	—	—	H	H	H	H
9/09/2010	EC01	—	—	—	—	—	—	—

Definition of confidence level codes:

H High. Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or submission of a specimen/tissue to a museum.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the Summary section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

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TABLE 2. Summary of variables from representative echolocation call sequences.

Species	s,p[1]	Duration (msec)[2]	Max Frequency (kHz)[2]	Char frequency (kHz)[2,3]
Gould's wattled bat *Chalinolobus gouldii*	3,21	7.7 ± 1.1 4.5 – 9.4	42.1 ± 4.9 34.6 – 53.3	32.7 ± 1.7 29.9 – 35.4
Ghost bat *Macroderma gigas*	2,25	0.6 ± 0.2 0.3 – 1.0	54.5 ± 3.6 48.8 – 65	46.7 ± 1.4 44.0 – 49.7
Pilbara leaf-nosed bat *Rhinonicteris aurantia*	2,3	4.1 ± 0.4 3.8 – 4.6	—	123.7 ± 1.1 123.1 – 125.0
Yellow-bellied sheath-tailed bat *Saccolaimus flaviventris*	2,4	20.2 ± 4.0 14.3 – 23.1	16.4 ± 1.7 15.4 – 18.9	15.4 ± 0.8 14.9 – 16.6
Little broad-nosed bat *Scotorepens greyii*	1,11	6.7 ± 0.7 5.7 – 8.4	66.5 ± 5.3 59.3 – 74.1	37.7 ± 0.4 37.2 – 38.8
Common sheath-tailed bat *Taphozous georgianus*	1,3	13.0 ± 0.7 12.3 – 13.7	25.5 ± 1.1 24.4 – 26.5	23.6 ± 0.3 23.4 – 24.0
Finlayson's cave bat *Vespadelus finlaysoni*	1,8	6.4 ± 1.4 4.7 – 9.2	55.7 ± 2.0 53.3 – 58.8	52.9 ± 0.5 52.0 – 53.3

[1] s,p: number of sequences measured, combined total number of pulses measured;

[2] Mean ± SD; range.

[3] Minimum frequency of the higher harmonic is given for *M. gigas*.

SZ174: *Bat call identification from Mt Dove, WA*

TABLE 3. Number of sequences of *R. aurantia* and *M. gigas* recorded in 30-minute intervals at stationary AnaBat sites. (E: echolocation call sequence; S: social call sequence – not illustrated).

Serial, Date	3006, 6/92010	3006, 7/92010	3006, 6/92010	3006, 7/92010	3006, 8/92010	3006, 9/92010
Site	DSAN04	DSAN04	DSAN04	DSAN04	DSAN04	DSAN04
	R. aurantia		*M. gigas*			
Interval						
17:30–18:00						
18:00–18:30						
18:30–19:00						
19:00–19:30						
19:30–20:00					2E	
20:00–20:30						
20:30–21:00						
21:00–21:30			1E			
21:30–22:00						
22:00–22:30	1					
22:30–23:00						
23:00–23:30	1					
23:30–0:00						
0:00–0:30				1E		
0:30–1:00		1				
1:00–1:30			2S	13S		1S
1:30–2:00						
2:00–2:30				3S 1E		
2:30–3:00		1	1S			
3:00–3:30						
3:30–4:00		1				
4:00–4:30				1E		
4:30–5:00						
5:00–5:30						
5:30–6:00						
6:00–6:30						
6:30–7:00						

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SZ174: *Bat call identification from Mt Dove, WA*

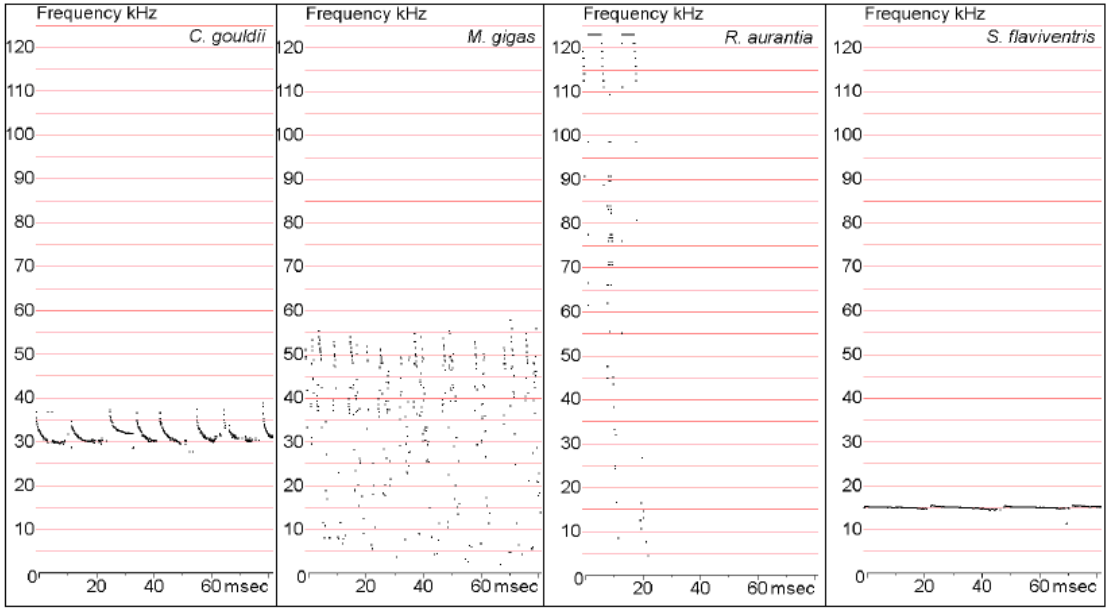


FIGURE 1A. Representative call sequences of the species identified (time is compressed between pulses).

SZ174: *Bat call identification from Mt Dove, WA*

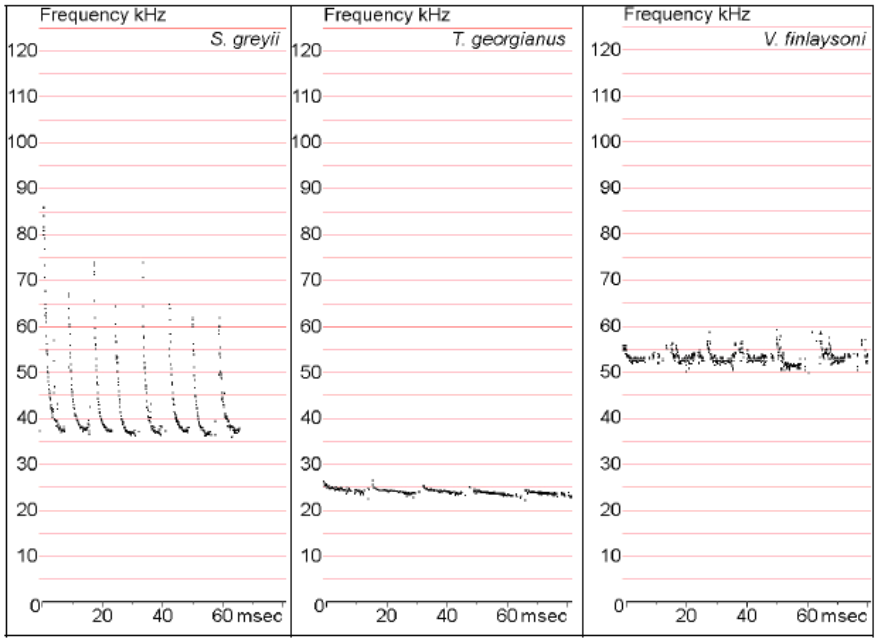
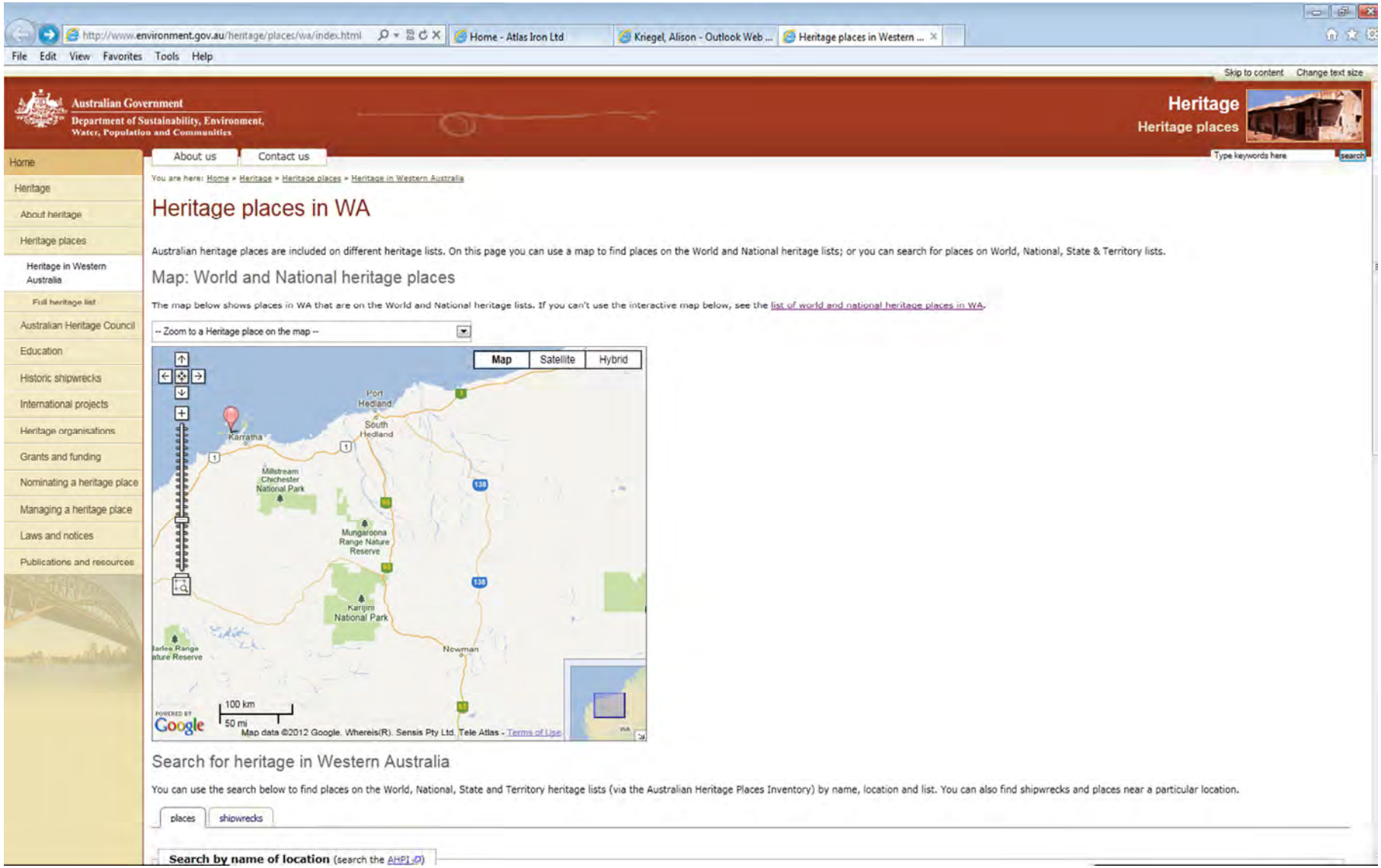


FIGURE 1B. Representative call sequences of the species identified (time is compressed between pulses).

Appendix D

Australian Heritage Places Inventory and Heritage Council of Western Australia Searches



Australian Heritage Places Inventory (http://www.environment.gov.au/heritage/places/wa/index.html) accessed on Friday, 26 October, 2012.

RAAF Base Pearce

AUTHOR Heritage Council **PLACE NUMBER** 16879

LOCATION

Great Northern Highway Bullsbrook

LOCATION DETAILS

LOCAL GOVERNMENT	Swan	**REGION**	Metropolitan
CONSTRUCTION DATE	0 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT CATEGORY	GRADING/MANAGEMENT DESCRIPTION
Art Deco Significant Bldg Survey	Adopted	17 Jun 2004	Recommend RHP	
RHP - To be assessed	YES	27 Jul 2012		

State Heritage Office library entries

ISBN NUMBER	TITLE	MEDIUM	YEAR OF PUBLICATION
	RAAF base Pearce: Australia's pilot training base.	Electronic	2002

Creation Date 17 Jun 2004 **Last Update** 10 Oct 2012 **Viewing Status** Approved

Disclaimer

Millendon Coach House

AUTHOR Heritage Council **PLACE NUMBER** 23618

LOCATION

813 Great Northern Highway Herne Hill

LOCATION DETAILS

LOCAL GOVERNMENT	Swan	**REGION**	Metropolitan
CONSTRUCTION DATE	1915 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT CATEGORY	GRADING/MANAGEMENT DESCRIPTION
Municipal Inventory	Adopted	25 Jun 1997	Considerable Significance	Conservation of the place is highly desirable. Any alterations or extensions should be sympathetic to the heritage values of the place.

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Original	Transport\Communications	Road: Coach House

Construction Materials

TYPE	GENERAL	SPECIFIC
Roof	METAL	Corrugated Iron
Wall	METAL	Corrugated Iron

Creation Date 9 Sep 2002 **Last Update** 25 Jun 2012 **Viewing Status** Draft

Disclaimer

AUTHOR City of Swan

CONSTRUCTION DATE 1915 to 0 DEMOLITION YEAR N/A

Parent Place or Precinct

14361 Millendon House

Statement of Significance

Relates to the settlement of the Swan Valley.

Physical Description

Corrugated iron structure with steeply pitched roof currently used as a garage. Three pairs of double doors with diagonal tongued and grooved boarding. Loft room constructed 1995. Located adjacent to homestead.

History

An outbuilding associated with a homestead constructed c.1900.

Integrity/Authenticity

Fair

Condition

Good

Last Update 30 Sep 2011 **Viewing Status** Approved

Disclaimer

St Michael's Roman Catholic Church

AUTHOR Heritage Council **PLACE NUMBER** 24408

LOCATION

770 Great Northern Highway Herne Hill

LOCATION DETAILS

LOCAL GOVERNMENT	Swan	**REGION**	Metropolitan
CONSTRUCTION DATE	0 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT	
			CATEGORY	DESCRIPTION
Municipal Inventory	Adopted	31 Mar 1998	Some Significance	Photographically record prior to major development or demolition. Recognise and interpret the site if possible.

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Original	RELIGIOUS	Church, Cathedral or Chapel
Present	RELIGIOUS	Church, Cathedral or Chapel

Construction Materials

TYPE	GENERAL	SPECIFIC
Roof	METAL	Corrugated Iron
Roof	BRICK	Common Brick

Historic Themes

GENERAL	SPECIFIC
SOCIAL & CIVIC ACTIVITIES	Religion

Creation Date 25 Jun 2012 **Last Update** 24 Sep 2012 **Viewing Status** Draft

Disclaimer

AUTHOR City of Swan

CONSTRUCTION DATE 1935 to 0 **DEMOLITION YEAR** N/A

Statement of Significance

Has social significance for those people who have celebrated or worshipped at the church.

Physical Description

Brick and iron church building with buttressed walls and porch. Small weatherboard section at the back under skillion roof.

History

For more details see Ena Willemsen, "St Michael's in the Vally: a history of St Michael's Catholic Church in the Swan Valley, Herne Hill".

Integrity/Authenticity

Integrity: High Degree

Condition

Good

References

REF ID NO	REF NAME	REF SOURCE	REF DATE
	E Willemsen, "St Michael's in the Vally: a history of St Michael's Catholic Church in the Swan Valley, Herne Hill".		

Last Update 24 Sep 2012 **Viewing Status** Approved

Disclaimer

Wubin Wheatbin (fmr)

AUTHOR Heritage Council **PLACE NUMBER** 00666

LOCATION

Great Northern Highway Wubin

LOCATION DETAILS

OTHER NAME(S)

Wubin Wheatbin Museum, CBH Wheatbin

LOCAL GOVERNMENT	Dalwallinu	**REGION**	Wheatbelt
CONSTRUCTION DATE	1939 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
Town Planning Scheme	YES	24 Nov 2000	
State Register	Interim	13 Apr 2012	

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT CATEGORY	GRADING/MANAGEMENT DESCRIPTION
Municipal Inventory	Adopted	24 Feb 1998	High level of protection - TPS	
Classified by the National Trust	Classified	08 Mar 1988	NA	
Register of the National Estate	Indicative Place	22 Jun 2012	NA	
Register of the National Estate	Nominated	09 Aug 1988	NA	
Municipal Inventory	Adopted	24 Feb 1998	Category 2	May be nominated to the National Trust of Australia (WA) for National Trust Classification. A National Trust classification has no legal significance and does not infringe on the rights of ownership of a property in any way. National Trust Classification is a mark of recognition of the cultural heritage value of a property, and relies on moral persuasion for protection.

Condition

This is an 'H' type bin built in 1939. These çwere designed for CBH by engineer Robert Sticht. ç It has 11 curved bays of corrugated iron on each ç side supported by vertical timber posts with çinternal tie rods. The roof is of corrugated çiron sheeting supported by timber columns in a çgrid pattern. The iron sheeting on the side of çthe roof apex facing the railway line could be çreadily removed to permit inloading and çoutloading of grain. Original floors were of çflat iron sheeting over sleepers. These were çlater removed and replaced by terolas laid over çcompacted gravel. A portable CBH elevator was çused for inloading the grain and also served for çoutloading, coupled with a Clarke shovel. A door ç in a side bay at the northern end of the bin çwas used when outloading. There were sheet çmetal shutes for use in conjunction with the çelevator.

Associations

NAME	ASSOCIATION TYPE	DATE FROM	DATE TO
Robert Sticht	Architect	22/06/2012	22/06/2012
Coperative Bulk Handling	Builder	22/06/2012	22/06/2012
Shire of Dalwallinu	Previous Owner	22/06/2012	5/06/2002
Mr Hugh Barnes	Builder	22/06/2012	22/06/2012

Place Type

Other Structure

Uses

EPOCH	GENERAL	SPECIFIC
Original	FARMING\PASTORAL	Silo or Grain Shed
Present	EDUCATIONAL	Museum

Construction Materials

TYPE	GENERAL	SPECIFIC
Roof	METAL	Corrugated Iron
Wall	TIMBER	Other Timber
Wall	BRICK	Other Brick

Historic Themes

GENERAL	SPECIFIC
OCCUPATIONS	Grazing, pastoralism & dairying

Creation Date 30 May 1989 **Last Update** 22 Jun 2012 **Viewing Status** Approved

Disclaimer

This information is provided voluntarily as a public service. The information provided is made available in good faith and is derived from sources believed to be reliable and accurate. However, the information is provided solely on the basis that readers will be responsible for making their own assessment of the matters discussed herein and are advised to verify all relevant representations, statements and information.

AUTHOR **Shire of Dalwallinu**

CONSTRUCTION DATE 1939 to 0 **DEMOLITION YEAR** N/A

Statement of Significance

The Wheatbin Museum is classified by the National Trust as the only 1933/1936 'H' type design remaining in the Northern Wheatbell. It was also the first permanent roofed storage facility for grain in the Wheatbelt. Its rounded corrugated iron construction is no longer used by CBH for grain storage. The Wheatbin is a unique feature in Wubin's townscape on the Great Northern Hwy.

Physical Description

Corrugated iron, timber and brick building set in Railway Reserve. The Bin is visible from the Great Northern Highway.

Integrity/Authenticity

Integrity: Intact or redeemable Alterations/additions: Brick entrance added 1997

Condition

Good

Associations

NAME	ASSOCIATION TYPE	DATE FROM	DATE TO
Robert Sticht	(none)	1939	-
Mr Hugh Barnes	(none)	-	-
Cooperative Bulk Handling (CBH)	(none)	-	-

References

REF ID NO	REF NAME	REF SOURCE	REF DATE
	National Trust of Australia (WA) ;"Assessment Documentation".	National Trust of Australia (WA)	

OWNER	CATEGORY
Shire of Dalwallinu	Local Gov't

Last Update 21 May 2012 **Viewing Status** Approved

Disclaimer

Halls Creek Police Station

AUTHOR Heritage Council **PLACE NUMBER** 17364

LOCATION

Great Northern Highway Halls Creek

LOCATION DETAILS

LOCAL GOVERNMENT	Halls Creek	**REGION**	Kimberley
CONSTRUCTION DATE	1997 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT CATEGORY	GRADING/MANAGEMENT DESCRIPTION
(no listings)				

Condition

Good

Associations

NAME	ASSOCIATION TYPE	DATE FROM	DATE TO
WA Police	Previous Owner	23/10/2012	23/10/2012

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Other	GOVERNMENTAL	Police Station or Quarters

Historic Themes

GENERAL	SPECIFIC
SOCIAL & CIVIC ACTIVITIES	Law & order

Creation Date 15 Mar 2006 **Last Update** 23 Oct 2012 **Viewing Status** Approved

Disclaimer

Wallal Downs Station Group

AUTHOR Heritage Council **PLACE NUMBER** 00305

LOCATION

56 Great Northern Highway Eighty Mile Beach

LOCATION DETAILS

Located off Gt.Nthn Hwy, 260km S/W of Broome and 220km E/N/E of P/Hedland

LOCAL GOVERNMENT	Broome	**REGION**	Kimberley
CONSTRUCTION DATE	1900 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
Town Planning Scheme	YES	21 Dec 1999	
State Register	Interim	19 May 1992	Register only

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT	
			CATEGORY	DESCRIPTION
Register of the National Estate	Nominated	15 Oct 1984	NA	
Register of the National Estate	Indicative Place	06 Jun 2012	NA	
Classified by the National Trust	Classified	05 Jun 1984		
Municipal Inventory	Adopted	30 Jun 1996	Category 1	A place of exceptional cultural heritage significance to the Shire of Broome and the state of Western Australia, ie. either in the Heritage Council's Register of Heritage Places, or worthy of consideration for entry into the Register.

Associations

NAME	ASSOCIATION TYPE	DATE FROM	DATE TO
Soldier Settler Scheme	Other Association	6/06/2012	6/06/2012
Wade, F.J. & B. J.	Previous Owner	6/06/2012	6/06/2012
	Architect	6/06/2012	6/06/2012
Dept Land Administration DOLA	Previous Owner	6/06/2012	6/06/2012

State Heritage Office library entries

ISBN NUMBER	TITLE	MEDIUM	YEAR OF PUBLICATION
	Historic buildings of the Kimberley region of W.A.	Book	1988

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Present	FARMING\PASTORAL	Homestead
Present	FARMING\PASTORAL	Servants or Shearers Quarters

EPOCH	GENERAL	SPECIFIC
Present	FARMING\PASTORAL	Homestead
Original	FARMING\PASTORAL	Homestead
Original	FARMING\PASTORAL	Servants or Shearers Quarters
Present	FARMING\PASTORAL	Servants or Shearers Quarters

Construction Materials

TYPE	GENERAL	SPECIFIC
Other	STONE	Other Stone
Other	METAL	Corrugated Iron
Other	STONE	Limestone

Historic Themes

GENERAL	SPECIFIC
OCCUPATIONS	Grazing, pastoralism & dairying

Creation Date 30 May 1989 **Last Update** 6 Jun 2012 **Viewing Status** Approved

Disclaimer

AUTHOR **Shire of Broome**

CONSTRUCTION DATE 0 to 0 **DEMOLITION YEAR** N/A

Statement of Significance

Wallal Downs Station is historically significant as the first pastoral lease taken up on the Eighty Mile Beach, and as a World War One Soldier settlement in the region. The use of local limestone and coral rock construction materials and is significant. Wallal Downs Station informs of the history of pastoral activities in the region.

Physical Description

The Register entry comprises the house, stone tanks, stone wall, and the former shearers' kitchen. The stone section of the house dates from c. 1922, as do the shearers' kitchen/dining room and two of the tanks. Roof structures were often replaced following cyclone damage.

History

Wallal Downs Station was the first land taken up on the 80-mile beach, with a lease issued about 1900 to Piper and Galbraith. They were joined in partnership by Charles Somerset of Pardoo, who bought them out in 1910. In the 1920s, a syndicate of ten returned soldiers acquired the property under the Soldier Settlement Scheme. The active partners in the group were the two Lacey brothers and Reg King who were responsible for the early stone buildings, including the stone section of the residence, the shearers' kitchen-dining room and two of the tanks. In 1973, following the death of Reg King, the remaining members of the syndicate sold the property.

Associations

NAME	ASSOCIATION TYPE	DATE FROM	DATE TO
Soldier Settlement Scheme	(none)	1920	-
Reg King & Lacey Brothers	(none)	-	-
FJ & BJ Wade	(none)	-	2008
Department of Land Administration	(none)	-	2007

References

REF ID NO	REF NAME	REF SOURCE	REF DATE

REF ID NO	REF NAME	REF SOURCE	REF DATE
	Shire of Broome's Municipal Inventory.		1996
	Heritage Council:" Assessment Documentation place 305"		

OWNER	CATEGORY
Dep't for Planning & Infrastructure	State Gov't
Lallaw Pastoral Pty Ltd.	Other Private

Last Update 13 Dec 2011 **Viewing Status** Approved

Disclaimer

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millendon coach house

AUTHOR Heritage Council **PLACE NUMBER** 23626

LOCATION

795 Great Northern Highway Herne Hill

LOCATION DETAILS

LOCAL GOVERNMENT	Swan	**REGION**	Metropolitan
CONSTRUCTION DATE	0 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT	
			CATEGORY	DESCRIPTION
Municipal Inventory	Adopted	25 Jun 1997	Considerable Significance	Conservation of the place is highly desirable. Any alterations or extensions should be sympathetic to the heritage values of the place.

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Present	Transport\Communications	Road: Other
Original	Transport\Communications	Road: Coach House

Construction Materials

TYPE	GENERAL	SPECIFIC
Roof	METAL	Corrugated Iron
Wall	METAL	Corrugated Iron

Creation Date 14 Sep 2011 **Last Update** 30 May 2012 **Viewing Status** Draft

Disclaimer

AUTHOR City of Swan

CONSTRUCTION DATE 1915 to 0 DEMOLITION YEAR N/A

Parent Place or Precinct

14361 Millendon House

Statement of Significance

Relates to the settlement of the Swan Valley.

Physical Description

Corrugated iron structure with steeply pitched roof currently used as a garage. Three pairs of double doors with diagonal tongued and grooved boarding. Loft room constructed 1995. Located adjacent to homestead.

History

An outbuilding associated with a homestead constructed c.1900.

Integrity/Authenticity

Fair

Condition

Good

Last Update 19 Sep 2011 **Viewing Status** Approved

Disclaimer

Herne Hill Playgroup

AUTHOR Heritage Council **PLACE NUMBER** 23620

LOCATION

770 Great Northern Highway Herne Hill

LOCATION DETAILS

OTHER NAME(S)

St Michael's school

LOCAL GOVERNMENT	Swan	**REGION**	Metropolitan
CONSTRUCTION DATE	0 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT CATEGORY	GRADING/MANAGEMENT DESCRIPTION
Municipal Inventory	Adopted	31 Mar 1998	Considerable Significance	Conservation of the place is highly desirable. Any alterations or extensions should be sympathetic to the heritage values of the place.

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Original	EDUCATIONAL	Primary School

Construction Materials

TYPE	GENERAL	SPECIFIC
Wall	TIMBER	Weatherboard
Roof	METAL	Corrugated Iron

Creation Date 9 Sep 2011 **Last Update** 13 Sep 2011 **Viewing Status** Draft

Disclaimer

AUTHOR City of Swan

CONSTRUCTION DATE 1935 to 0 DEMOLITION YEAR N/A

Statement of Significance

Significant to the history of the settlement of the Swan Valley and the provision of education in the area.

Physical Description

Timber framed school building with weatherboard and fibro cladding and corrugated iron roof. Front verandah with traditional stove chimney. Rear extension under skillion roof. 12-pane double hung sash windows.

History

Associated with St Michaels in the Valley, a Roman Catholic church.

Integrity/Authenticity

High

Condition

Fair

OWNER	CATEGORY
Roman Catholic Archbishop	Church Property

Last Update 13 Sep 2011 **Viewing Status** Approved

Disclaimer

House

AUTHOR Heritage Council **PLACE NUMBER** 23613

LOCATION

9 Great Northern Highway Midland

LOCATION DETAILS

LOCAL GOVERNMENT	Swan	**REGION**	Metropolitan
CONSTRUCTION DATE	0 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT CATEGORY	GRADING/MANAGEMENT DESCRIPTION
Municipal Inventory	Adopted	15 Dec 2010	Considerable Significance	Conservation of the place is highly desirable. Any alterations or extensions should be sympathetic to the heritage values of the place.

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Original	COMMERCIAL	Other
Present	COMMERCIAL	Other

Creation Date 6 Sep 2011 **Last Update** 13 Sep 2011 **Viewing Status** Draft

Disclaimer

AUTHOR City of Swan

CONSTRUCTION DATE	1900 to 0	**DEMOLITION YEAR**	N/A

Statement of Significance

Associated with the growth of commerce in Midland in the early 20th century.

Physical Description

Single-storey building with a simple parapet wall and central pediment.

History

Constructed at the turn of the 20th century, the building was one of the commercial premises erected in response to the increased population resulting from the expansion of industry in the area.

Integrity/Authenticity

High

Condition

Good

Last Update 9 Sep 2011 **Viewing Status** Approved

Disclaimer

shop

AUTHOR **Heritage Council** **PLACE NUMBER** **23628**

LOCATION

9 Great Northern Highway Midland

LOCATION DETAILS

LOCAL GOVERNMENT	Swan	**REGION**	Metropolitan
CONSTRUCTION DATE	0 to 0	**DEMOLITION YEAR**	N/A

Statutory Heritage Listings

TYPE	STATUS	DATE	DOCUMENTS
(no listings)			

Other Heritage Listings and Surveys

TYPE	STATUS	DATE	GRADING/MANAGEMENT	
			CATEGORY	DESCRIPTION
Municipal Inventory	Adopted	15 Dec 2010	Considerable Significance	Conservation of the place is highly desirable. Any alterations or extensions should be sympathetic to the heritage values of the place.

Place Type

Individual Building or Group

Uses

EPOCH	GENERAL	SPECIFIC
Present	COMMERCIAL	Other
Original	COMMERCIAL	Other

Creation Date 13 Sep 2011 **Last Update** 21 Sep 2011 **Viewing Status** Draft

Disclaimer

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AUTHOR **City of Swan**

CONSTRUCTION DATE	1900 to 0	**DEMOLITION YEAR**	N/A

Statement of Significance

Associated with the growth of commerce in Midland in the early 20th century.

Physical Description

Single-storey building with a simple parapet wall and central pediment.

History

Constructed at the turn of the 20th century, the building was one of the commercial premises erected in response to the increased population resulting from the expansion of industry in the area.

Integrity/Authenticity

High

Condition

Good

Last Update 19 Sep 2011 **Viewing Status** Approved

Disclaimer

Appendix E

Department of Indigenous Affairs Database Search

Search Criteria

6 sites in mining tenement 'E 4503392'.

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L - Lodged		ACMC Decision Made
Information lodged, awaiting assessment	→	R - Registered Site I - Insufficient information S - Stored Data

Spatial Accuracy

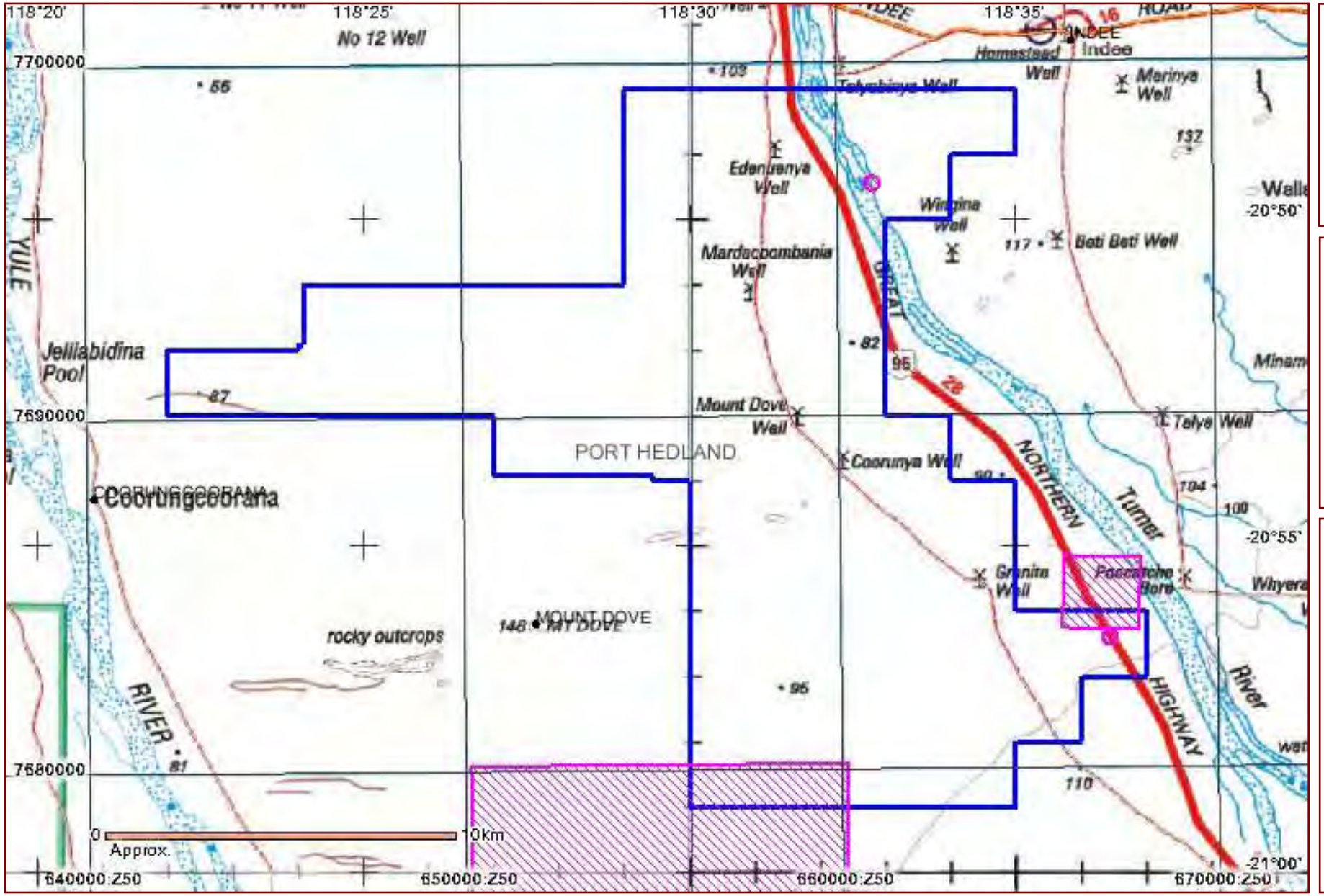
Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

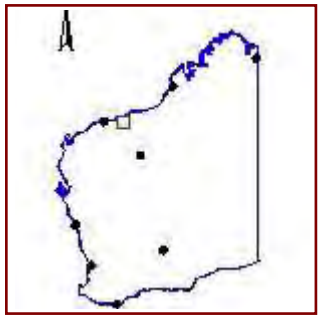
Sites Shown on Maps

Site boundaries may not appear on maps at low zoom levels

List of 4 Registered Aboriginal Sites with Map

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
8442	R	O	N	Port Hedland-White Sprgs 03	Artefacts / Scatter			660940mE 7696555mN Zone 50 [Reliable]	P04235
8444	R	C	N	Port Hedland-White Sprgs 05	Grinding patches / grooves			Not available for closed sites	P04237
8445	R	O	N	Port Hedland-White Sprgs 06	Artefacts / Scatter, Grinding patches / grooves			667140mE 7683655mN Zone 50 [Reliable]	P04238
11385	R	O	N	Wamerina Ridge	Engraving			655141mE 7675156mN Zone 50 [Unreliable]	P00788





Legend

Selected Heritage Sites

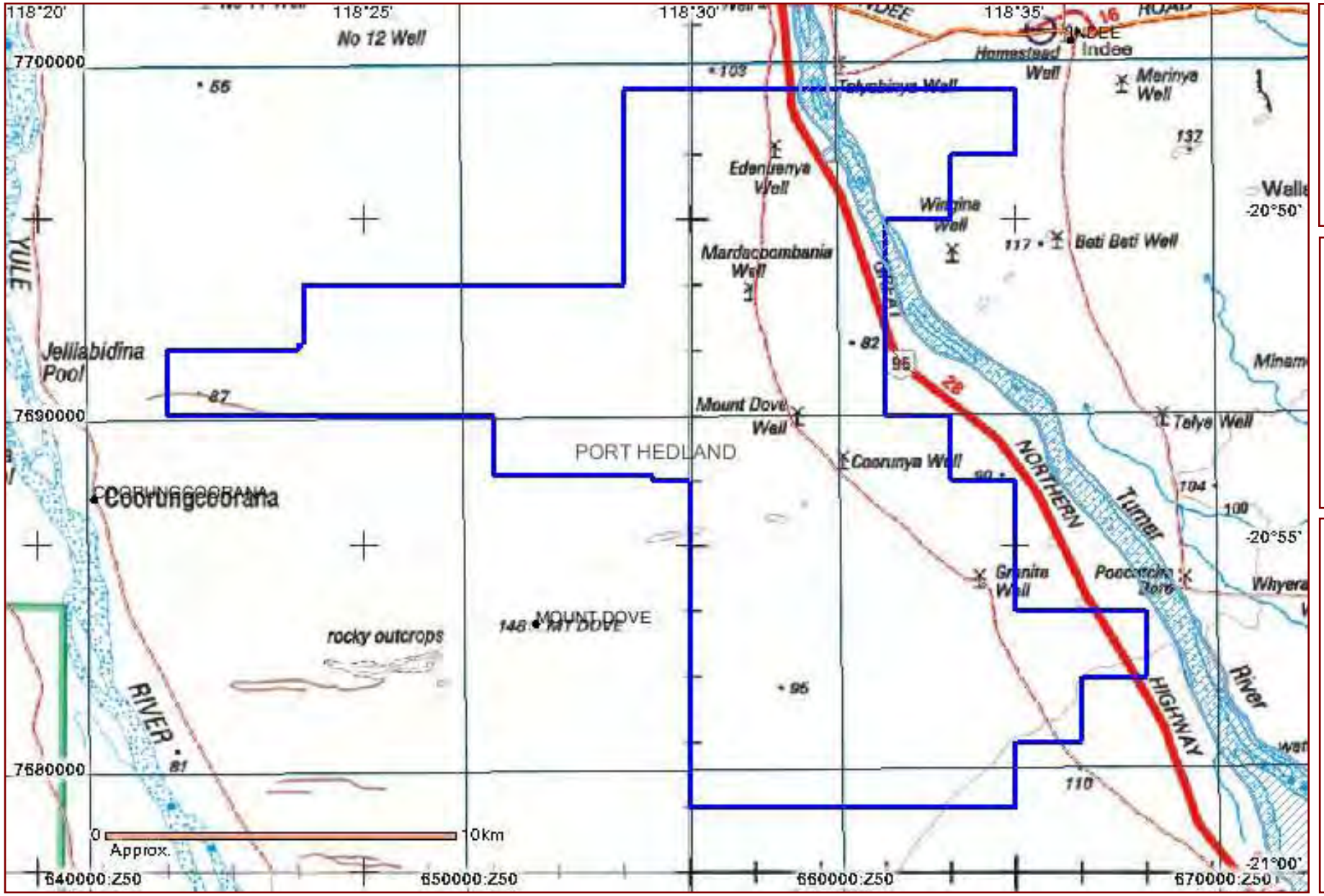
- Registered Sites
- Town
- Map Area
- Search Area

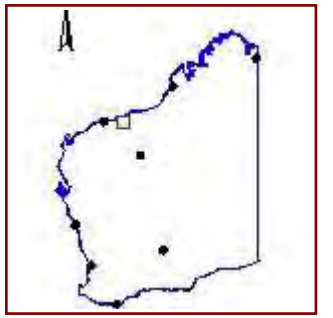
List of 2 Other Heritage Places with Map

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
6653	S	O	N	Turner River (Tjirrlil).		Named Place		674856mE 7683044mN Zone 50 [Reliable]	P06291
8441	S	O	N	Port Hedland-White Sprgs 02	Artefacts / Scatter			659840mE 7697355mN Zone 50 [Reliable]	P04234

Aboriginal Heritage Inquiry System

Aboriginal Sites Database





Legend

Selected Heritage Sites

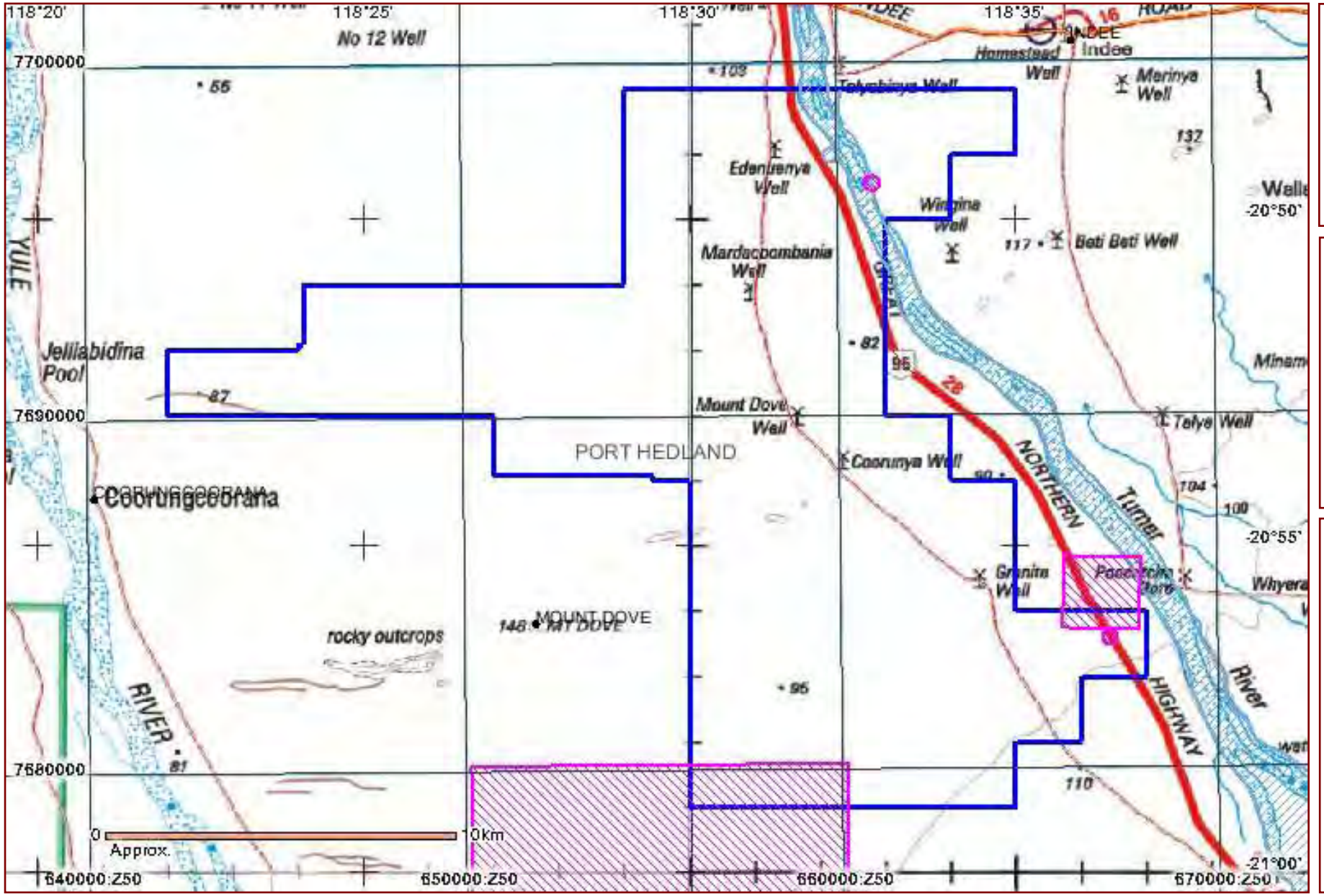
Other Heritage Places

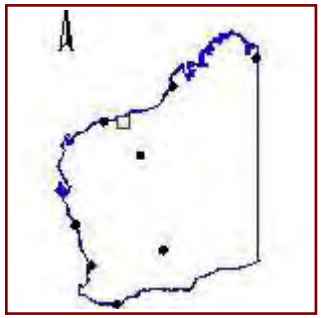
Town

Map Area

Search Area

Map Showing Registered Aboriginal Sites and Other Heritage Places





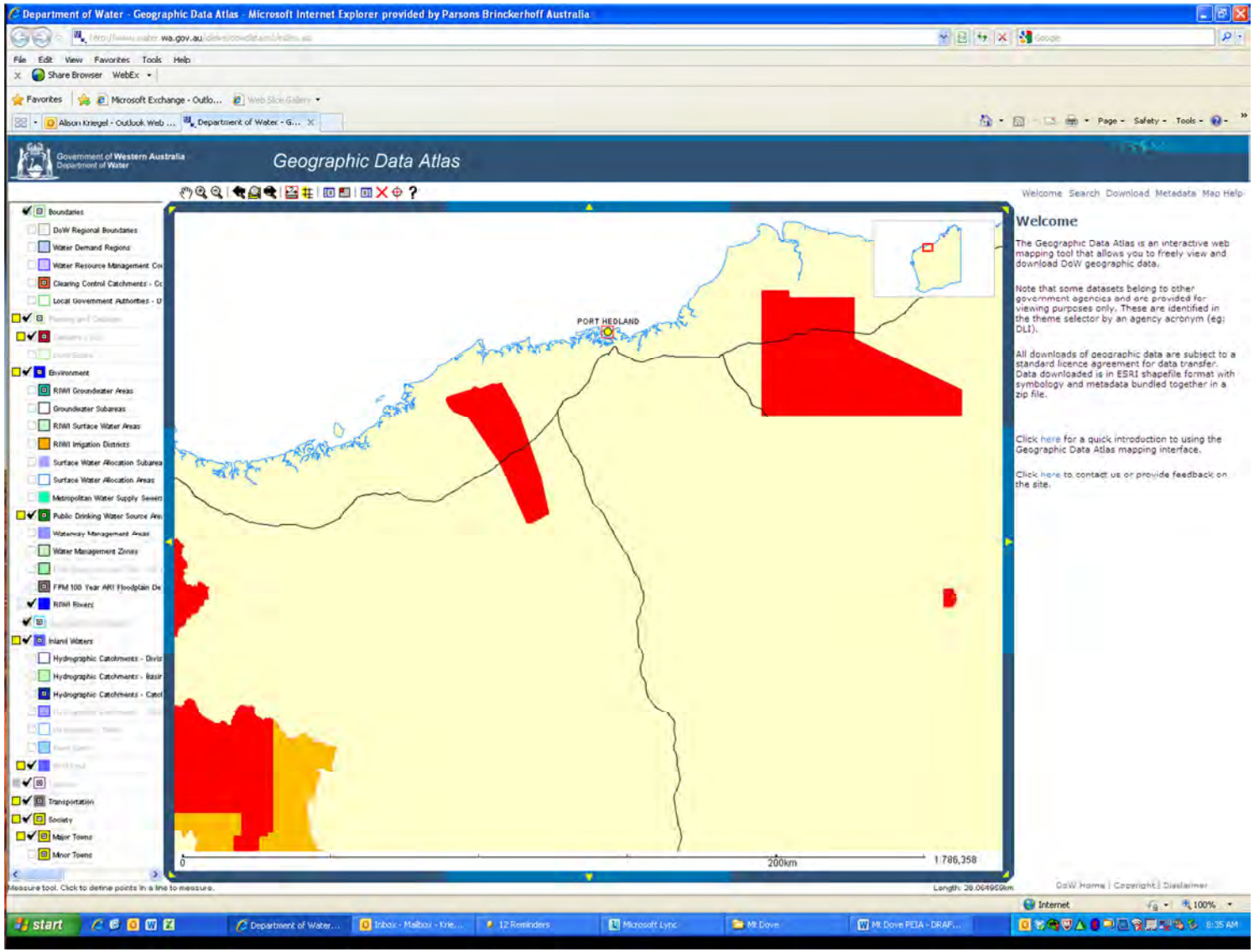
Legend

Selected Heritage Sites

- Registered Sites
- Other Heritage Places
- Town
- Map Area
- Search Area

Appendix F

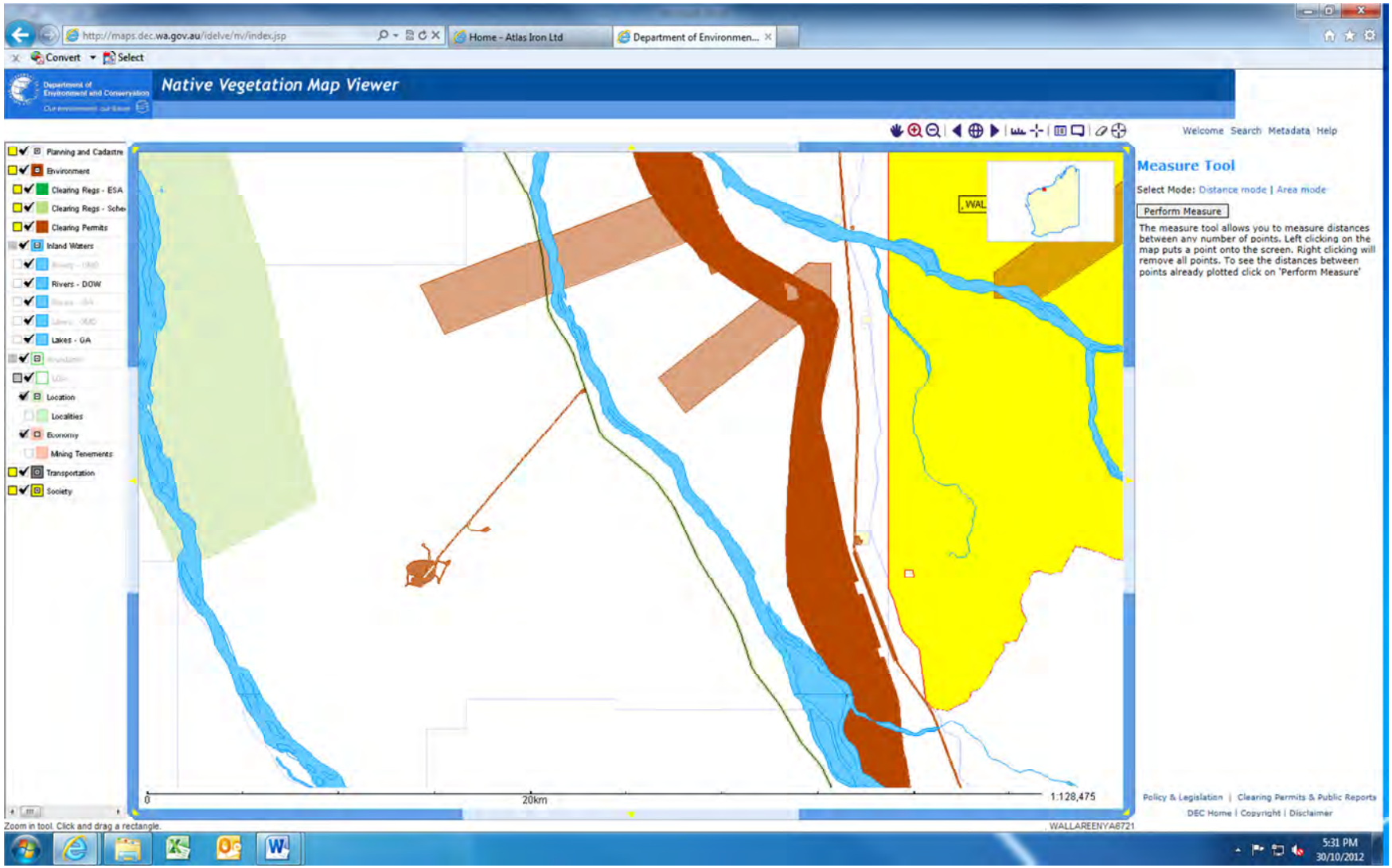
DoW Geographic Data Atlas Database Search



Department of Water's database search (http://www.water.wa.gov.au/idelve/dowdataext/index.jsp) accessed on 29 October 2012.

Appendix G

DEC Native Vegetation Map Viewer Database Search



DEC's online mapping tool, *http://maps.dec.wa.gov.au/idelve/nv/index.jsp* accessed on 30 October 2012.

Appendix H

DSEWPC Database Search

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 30/10/12 16:07:49

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 0.5Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	4
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	8
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	None
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	4
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Mammals		
Dasycercus cristicauda Mulgara [328]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area

Extra Information

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Coordinates

-20.778023 118.421356,-20.775643 118.603384,-21.002882 118.626584,-20.891047 118.481437,-20.778023 118.421356

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix I

Department of Agriculture & Food Advice on Declared Weeds

AGRICULTURE AND RELATED RESOURCES PROTECTION ACT, 1976

Agriculture Protection Board
South Perth, 29 October 2012

PURSUANT to Section 37 of the *Agriculture and Related Resources Protection Act, 1976*, the Agriculture Protection Board hereby lists the classes of plants that are for the time being the subject of a declaration made under Section 35 of that Act, together with the matters specified pursuant to Subsection (2) of that Section in relation to each class:

Declared Plants

Acacias (*Acacia spp., all species not native to Australia (except Acacia farnesiana*)
P1, P2; for the whole of the State . All species not native to Australia (except Acacia farnesiana)

African rue (*Peganum harmala*)
P1, P2; for the whole of the State

African thistle (*Berkheya rigida*)
P1, P3; for the whole of the State

Alligator weed (*Alternanthera philoxeroides*)
P1, P2; for the whole of the State

Aquarium Plants (*all types*)
P1; for the whole of the State

Arrowhead (*Sagittaria montevidensis*)
P1, P3; for the whole of the State

Artichoke thistle, cardoon (*Cynara cardunculus*)
P1, P3; for the whole of the State

Arum lily (*Zantedeschia aethiopica*)
P1, P4; for the whole of the State

Athel pine (*Tamarix aphylla*)
P1; for the whole of the State

Bathurst burr (*Xanthium spinosum*)
P1; for the whole of the State
P3; For the municipal districts of Coolgardie (S), Kalgoorlie/Boulder (C).
P2; For the municipal districts of Albany (C), Armadale (C), Ashburton (S), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broome (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Carnarvon (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cranbrook (S), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Derby-West Kimberley (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth

(S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Halls Creek (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Plantagenet (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Wyndham-East Kimberley (S), Yalgoo (S), Yilgarn (S), York (S).

Bellyache bush (*Jatropha gossypiifolia*)

P2; For the municipal districts of Albany (C), Armadale (C), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cranbrook (S), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), Esperance (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Plantagenet (S), Quairading (S), Ravensthorpe (S), Rockingham (C), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Yalgoo (S), Yilgarn (S), York (S).

P1; for the whole of the State

P4; For the municipal districts of Ashburton (S), Broome (S), Carnarvon (S), Derby-West Kimberley (S), East Pilbara (S), Exmouth (S), Halls Creek (S), Port Hedland (T), Roebourne (S), Wyndham-East Kimberley (S).

Blackberry (*Rubus laudatus, and R. fruticosus agg.- including R. anglocandicans, R. rugosus, R. ulmifolius*)

P1; for the whole of the State

P2; For the municipal districts of Boddington (S).

P4; For the municipal districts of Albany (C), Augusta-Margaret River (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Bunbury (C), Busselton (S), Capel (S), Collie (S), Cranbrook (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Harvey (S), Mandurah (C), Manjimup (S), Murray (S), Nannup (S), Plantagenet (S), Serpentine-Jarrahdale (S), Waroona (S).

Boneseed, bitou bush (*Chrysanthemoides monilifera*)

P1, P2; for the whole of the State

Bridal creeper (*Asparagus asparagoides*)

P1; for the whole of the State

Broomrape; branched broomrape (*Orobanche ramosa; Orobanche spp. except O.minor*)

P1, P2; for the whole of the State

Cabomba (*Cabomba caroliniana*)

P1, P2; for the whole of the State

Calotropis (*Calotropis procera*)

P1; For the municipal districts of East Pilbara (S), Exmouth (S), Port Hedland (T).

P3; For the municipal districts of Ashburton (S), East Pilbara (S), Port Hedland (T), Roebourne (S).

Camelthorn (*Alhagi maurorum*)

P1, P3; for the whole of the State

Canadian pond weed (*Elodea canadensis*)

P1, P3; for the whole of the State

Candle bush (*Senna alata*)

P1, P3; for the whole of the State

Cape Tulip, one leaf; two leaf Cape tulip (*Moraea flaccida, Moraea miniata*)

P4; For the municipal districts of Albany (C), Augusta-Margaret River (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broomehill (S), Bunbury (C), Busselton (S), Capel (S), Collie (S), Corrigin (S), Cuballing (S), Dardanup (S), Donnybrook-Balingup (S), Dumbleyung (S), Esperance (S), Gnowangerup (S), Harvey (S), Jerramungup (S), Katanning (S), Kojonup (S), Mandurah (C), Manjimup (S), Murray (S), Nannup (S), Narrogin (S), Pingelly (S), Plantagenet (S), Ravensthorpe (S), Serpentine-Jarrahdale (S), Tambellup (S), Wagin (S), Wandering (S), Waroona (S), West Arthur (S), Wickepin (S), Williams (S), Woodanilling (S), Yilgarn (S). and that area of the Cranbrook Shire bordered by Albany Highway, Weir Road, Boyup-Cranbrook Road, Shamrock and Yeriminup Roads and Frankland-Cranbrook Road

P3; For the municipal districts of Cranbrook (S), Denmark (S), Kent (S). except that area bordered by Albany Highway, Weir Road, Boyup-

Cranbrook Road, Shamrock and Yeriminup Roads and Frankland-Cranbrook Road.

P1; for the whole of the State

Chilean needle grass (*Nassella neesiana*)

P1; for the whole of the State

Chinee apple (*Ziziphus mauritiana*)

P1, P5; For the municipal districts of Broome (S), Derby-West Kimberley (S), Halls Creek (S), Wyndham-East Kimberley (S).

P1; For the municipal districts of Albany (C), Armadale (C), Ashburton (S), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Carnarvon (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cranbrook (S), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Plantagenet (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Yalgoo (S), Yilgarn (S), York (S).

Cleavers (*Galium aparine*)

P1, P2; for the whole of the State

Creeping knapweed (*Rhaponticum repens*)

P1, P2; for the whole of the State

Devil's claw, small fruit Devi's claw, and purpleflower Devi's claw (*Martynia annua) and (Proboscidea louisianica*)

P1, P2; for the whole of the State

Field bindweed (*Convolvulus arvensis*)

P3; For the municipal districts of Esperance (S).

P1; for the whole of the State

Floating water chestnut (*Trapa spp*)
P1, P2; for the whole of the State

Gamba grass (*Andropogon gayanus*)
P1, P2; for the whole of the State

Golden dodder (*Cuscuta campestris*)
P1, P2; For the municipal districts of Armadale (C), Ashburton (S), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broome (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Carnarvon (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Derby-West Kimberley (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Halls Creek (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Wyndham-East Kimberley (S), Yalgoo (S), Yilgarn (S), York (S).
P1, P4; For the municipal districts of Albany (C), Cranbrook (S), Denmark (S), Plantagenet (S).

Gorse (*Ulex europaeus*)
P1; for the whole of the State
P2; For the municipal districts of Armadale (C), Ashburton (S), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broome (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Carnarvon (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Derby-West Kimberley (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells

(C), Greenough (S), Halls Creek (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Wyndham-East Kimberley (S), Yalgoo (S), Yilgarn (S), York (S).

P3; For the municipal districts of Albany (C), Cranbrook (S), Denmark (S), Plantagenet (S).

Harrisia cactus (*Harrisia martinii*)

P1, P3; for the whole of the State

Hoary cress (*Lepidium draba*)

P1, P2; for the whole of the State

Horehound (*Marrubium vulgare*)

P1, P2; For the municipal districts of Albany (C), Ashburton (S), Broome (S), Broomehill (S), Carnarvon (S), Cranbrook (S), Cue (S), Denmark (S), Derby-West Kimberley (S), Dumbleyung (S), East Pilbara (S), Exmouth (S), Gnowangerup (S), Halls Creek (S), Katanning (S), Laverton (S), Leonora (S), Meekatharra (S), Menzies (S), Mount Magnet (S), Murchison (S), Ngaanyatjarraku (S), Port Hedland (T), Roebourne (S), Sandstone (S), Shark Bay (S), Tambellup (S), Upper Gascoyne (S), Wagin (S), West Arthur (S), Wiluna (S), Woodanilling (S), Wyndham-East Kimberley (S), Yalgoo (S).

P1, P3; For the municipal districts of Plantagenet (S).

P1, P4; For the municipal districts of Coolgardie (S), Dundas (S), Esperance (S), Jerramungup (S), Kalgoorlie/Boulder (C), Kent (S), Kojonup (S), Ravensthorpe (S).

Horsetails, common horsetail and all other plants within the genus Equisetum ((*Equisetum arvense), (Equisetum spp)*)

P1, P3; for the whole of the State

Hydrocotyl (*Hydrocotyle ranunculoides*)

P1, P3; for the whole of the State

Hymenachne (*Hymenachne amplexicaulis*)

P1, P2; for the whole of the State

Ivy gourd (*Coccinia grandis*)

P1, P3; for the whole of the State

Jointed goatgrass (*Aegilops cylindrica*)
P1, P2; for the whole of the State

Kochia (*Bassia scoparia*)
P1, P2; for the whole of the State

Lagarosiphon (*Lagarosiphon spp.*)
P1, P2; for the whole of the State

Lantana (*Lantana camara*)
P1; for the whole of the State

Leafy elodea (*Egeria densa*)
P1, P3; for the whole of the State

Mesquite (*Prosopis spp. and hybrids*)
P4; for the area on Mardie Station bordered by the coast, the boundary between Mardie and Karratha stations, the North West Coastal Hwy, Peter's Creek and the boundary between Yarraloola & Mardie stations
P2; for the whole of the State except the area on Mardie Station bordered by the coast, the boundary between Mardie & Karratha stations, the North West Coastal Hwy, Peter's Creek and the boundary between Yarraloola & Mardi stations
P1; for the whole of the State

Miconia (*Miconia spp*)
P1, P2; for the whole of the State

Mimosa (*Mimosa pigra*)
P1, P2; for the whole of the State

Mimosa; Common sensitive plant (*Mimosa pudica*)
P1, P3; for the whole of the State

Mimosa; Giant sensitive plant (*Mimosa invisa*)
P1, P2; for the whole of the State

Mintweed (*Salvia reflexa*)
P1, P3; for the whole of the State

Needle burr, spiny amaranth (*Amaranthus spinosus*)
P1, P2; for the whole of the State

Nodding thistle (*Carduus nutans*)
P1, P2; for the whole of the State

Noogoora burr (*Xanthium strumarium (formerly X. occidentale)*)
P1; for the whole of the State
P2; For the municipal districts of Albany (C), Armadale (C), Ashburton (S),

Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Carnarvon (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cranbrook (S), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Plantagenet (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Yalgoo (S), Yilgarn (S), York (S).

P4; For the municipal districts of Broome (S), Derby-West Kimberley (S), Halls Creek (S), Wyndham-East Kimberley (S).

Parkinsonia (*Parkinsonia aculeata*)

P1; for the whole of the State

P2; For the municipal districts of Ashburton (S), Carnarvon (S), Coolgardie (S), Cue (S), Dundas (S), East Pilbara (S), Exmouth (S), Kalgoorlie/Boulder (C), Laverton (S), Leonora (S), Meekatharra (S), Menzies (S), Mount Magnet (S), Murchison (S), Ngaanyatjarraku (S), Port Hedland (T), Roebourne (S), Sandstone (S), Shark Bay (S), Upper Gascoyne (S), Wiluna (S), Yalgoo (S).

P4; For the municipal districts of Broome (S), Derby-West Kimberley (S), Halls Creek (S), Wyndham-East Kimberley (S).

Parrot's feather (*Myriophyllum aquaticum*)

P1, P3; for the whole of the State

Parthenium weed (*Parthenium hysterophorus*)

P1, P2; for the whole of the State

Paterson's curse (*Echium plantagineum*)

P1; for the whole of the State

P3; For the municipal districts of Augusta-Margaret River (S), Broomehill (S), Bunbury (C), Busselton (S), Capel (S), Chittering (S), Collie (S), Cranbrook (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Esperance (S), Gingin (S), Harvey (S),

Kent (S), Kojonup (S), Mandurah (C), Moora (S), Murray (S), Ravensthorpe (S), Serpentine-Jarrahdale (S), Tambellup (S), Victoria Plains (S), Wagin (S), Waroona (S), West Arthur (S), Wongan-Ballidu (S), Woodanilling (S).

P4; For the municipal districts of Albany (C), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Bruce Rock (S), Corrigin (S), Cuballing (S), Dumbleyung (S), Gnowangerup (S), Jerramungup (S), Katanning (S), Kondinin (S), Kulin (S), Lake Grace (S), Manjimup (S), Merredin (S), Mukinbudin (S), Nannup (S), Narembeen (S), Narrogin (S), Nungarin (S), Pingelly (S), Plantagenet (S), Wandering (S), Westonia (S), Wickepin (S), Williams (S), Yilgarn (S). and those portions of the municipal districts of Carnamah and Coorow west of the M idlands Road

Penny cress (*Thlaspi arvense*)

P1, P2; for the whole of the State

Perennial thistle or Canada thistle (*Cirsium arvense*)

P1, P3; for the whole of the State

Physic nut (*Jatropha curcas*)

P1; for the whole of the State

P2; For the municipal districts of Albany (C), Armadale (C), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cranbrook (S), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), Esperance (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Plantagenet (S), Quairading (S), Ravensthorpe (S), Rockingham (C), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Yalgoo (S), Yilgarn (S), York (S).

P4; For the municipal districts of Ashburton (S), Broome (S), Carnarvon (S), Derby-West Kimberley (S), East Pilbara (S), Exmouth (S), Halls Creek (S), Port Hedland (T), Roebourne (S), Wyndham-East Kimberley (S).

Pond apple (*Anona glabra*)

P1, P2; for the whole of the State

Praxelis (*Praxelis clematidea*)
P1, P2; for the whole of the State

Prickly pear (*Opuntia elata, O. engelmannii, O. ficus-indica, O. monocantha, O. stricta*)
P1; For the municipal districts of Ashburton (S), Broome (S), Carnarvon (S), Derby-West Kimberley (S), East Pilbara (S), Exmouth (S), Halls Creek (S), Murchison (S), Port Hedland (T), Roebourne (S), Shark Bay (S), Upper Gascoyne (S), Wyndham-East Kimberley (S).
P4; For the municipal districts of Carnarvon (S), Exmouth (S), Murchison (S), Shark Bay (S), Upper Gascoyne (S).
P2; For the municipal districts of Ashburton (S), Broome (S), Derby-West Kimberley (S), East Pilbara (S), Halls Creek (S), Port Hedland (T), Roebourne (S), Wyndham-East Kimberley (S).

Ragwort (*Senecio jacobaea*)
P1, P2; for the whole of the State

Rubber vine (*Cryptostegia madagascariensis*)
P1, P3; for the whole of the State

Rubber vine (*Cryptostegia grandiflora*)
P1, P2; for the whole of the State

Saffron thistle (*Carthamus lanatus*)
P3; For the municipal districts of Albany (C), Augusta-Margaret River (S), Broomehill (S), Bunbury (C), Busselton (S), Capel (S), Carnamah (S), Collie (S), Coorow (S), Cranbrook (S), Cunderdin (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Gnowangerup (S), Harvey (S), Katanning (S), Kellerberrin (S), Kojonup (S), Koorda (S), Mandurah (C), Mount Marshall (S), Murray (S), Plantagenet (S), Serpentine-Jarrahdale (S), Tambellup (S), Tammin (S), Trayning (S), Wagin (S), Waroona (S), West Arthur (S), Woodanilling (S), Wyalkatchem (S).
P1; for the whole of the State
P4; For the municipal districts of Ashburton (S), Beverley (S), Boddington (S), Brookton (S), Broome (S), Bruce Rock (S), Carnarvon (S), Chittering (S), Coolgardie (S), Corrigin (S), Cuballing (S), Cue (S), Dalwallinu (S), Dandaragan (S), Derby-West Kimberley (S), Dundas (S), East Pilbara (S), Esperance (S), Exmouth (S), Gingin (S), Goomalling (S), Halls Creek (S), Jerramungup (S), Kalgoorlie/Boulder (C), Kent (S), Kondinin (S), Kulin (S), Lake Grace (S), Laverton (S), Leonora (S), Meekatharra (S), Menzies (S), Merredin (S), Moora (S), Mount Magnet (S), Mukinbudin (S), Murchison (S), Narembeen (S), Narrogin (S), Ngaanyatjarraku (S), Northam (S), Northam (T), Nungarin (S), Pingelly (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Roebourne (S), Sandstone (S), Shark Bay (S), Toodyay (S), Upper Gascoyne (S), Victoria Plains (S), Wandering (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Wyndham-East Kimberley (S), Yalgoo (S), Yilgarn (S), York (S).

Sagittaria (*Sagittaria platyphylla*)
P1, P3; for the whole of the State

Salvinia (*Salvinia molesta*)
P1, P2; for the whole of the State

Senegal tea (*Gymnocoronis spilanthoides*)
P1, P3; for the whole of the State

Serrated tussock (*Nasella trichotoma*)
P1, P2; for the whole of the State

Shield pennywort (*Hydrocotyle verticillata*)
P1, P2; for the whole of the State

Siam weed (*Chromolaena odorata*)
P1, P2; for the whole of the State

Sicklepod (*Senna tora - see also Senna obtusifolia*)
P1, P2; for the whole of the State

Sicklepod, javabean (*Senna obtusifolia*)
P1, P3; for the whole of the State

Skeleton weed (*Chondrilla juncea*)
P1, P2; For the municipal districts of Albany (C), Armadale (C), Ashburton (S), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broome (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Carnarvon (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cranbrook (S), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Derby-West Kimberley (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Halls Creek (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Plantagenet (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Wyndham-East Kimberley (S), Yalgoo (S), York (S).

P1, P3; For the municipal districts of Narembeen (S), Yilgarn (S).

South African Cape rush (*Elegia tectorum*)
P1, P2; for the whole of the State

St. John's wort (*Hypericum perforatum*)
P1, P2; For the municipal districts of Albany (C), Armadale (C), Ashburton (S), Bassendean (T), Bayswater (C), Belmont (C), Broome (S), Broomehill (S), Cambridge (T), Canning (C), Carnamah (S), Carnarvon (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Coolgardie (S), Coorow (S), Cottesloe (T), Cranbrook (S), Cue (S), Dalwallinu (S), Dandaragan (S), Denmark (S), Derby-West Kimberley (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Gosnells (C), Greenough (S), Halls Creek (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kent (S), Kojonup (S), Kondinin (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Meekatharra (S), Melville (C), Menzies (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mullewa (S), Mundaring (S), Murchison (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northampton (S), Peppermint Grove (S), Perenjori (S), Perth (C), Plantagenet (S), Port Hedland (T), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Three Springs (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wanneroo (S), West Arthur (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyndham-East Kimberley (S), Yalgoo (S).

Thatching reed (*Thamnochortus insignis*)
P1, P2; for the whole of the State

Three-horned bedstraw (*Galium tricornutum*)
P1, P2; for the whole of the State

Tutsan (*Hypericum androsaemum*)
P1, P2; for the whole of the State

Tutsan, flair (*Hypericum x inodorum*)
P4; for lands approved for cultivation by the Chief Officer.
P2; for the whole of the State , except lands approved for cultivation by the Chief Officer.

Variegated thistle (*Silybum marianum*)
P1; for the whole of the State
P2; For the municipal districts of Armadale (C), Ashburton (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Brookton (S), Broome (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Cambridge (T), Canning (C), Carnamah (S), Carnarvon (S), Chittering (S), Claremont (T), Cockburn (C), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Derby-West Kimberley (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), East Pilbara (S), Esperance (S), Exmouth (S), Fremantle (C), Gingin (S), Gnowangerup (S), Goomalling

(S), Gosnells (C), Halls Creek (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mundaring (S), Murchison (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Port Hedland (T), Quairading (S), Ravensthorpe (S), Rockingham (C), Roebourne (S), Sandstone (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Wyndham-East Kimberley (S), Yalgoo (S), Yilgarn (S), York (S).

P3; For the municipal districts of Augusta-Margaret River (S), Boyup Brook (S), Busselton (S), Capel (S), Chapman Valley (S), Collie (S), Cranbrook (S), Geraldton (C), Greenough (S), Harvey (S), Irwin (S), Mandurah (C), Mullewa (S), Murray (S), Nannup (S), Northampton (S), Serpentine-Jarrahdale (S), Waroona (S).

P4; For the municipal districts of Albany (C), Bridgetown-Greenbushes (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Manjimup (S), Plantagenet (S).

Water hyacinth (*Eichhornia crassipes*)

P1, P3; for the whole of the State

Water lettuce (*Pistia stratiotes*)

P1, P3; for the whole of the State

Willows (*Salix spp, except weeping willow (S.babylonica), pussy willow (S.x calodendron) and sterile pussy willow (S.x reichardtii)*)

P1; for the whole of the State

Witchweed (*Striga spp - all non-indigenous Striga species*)

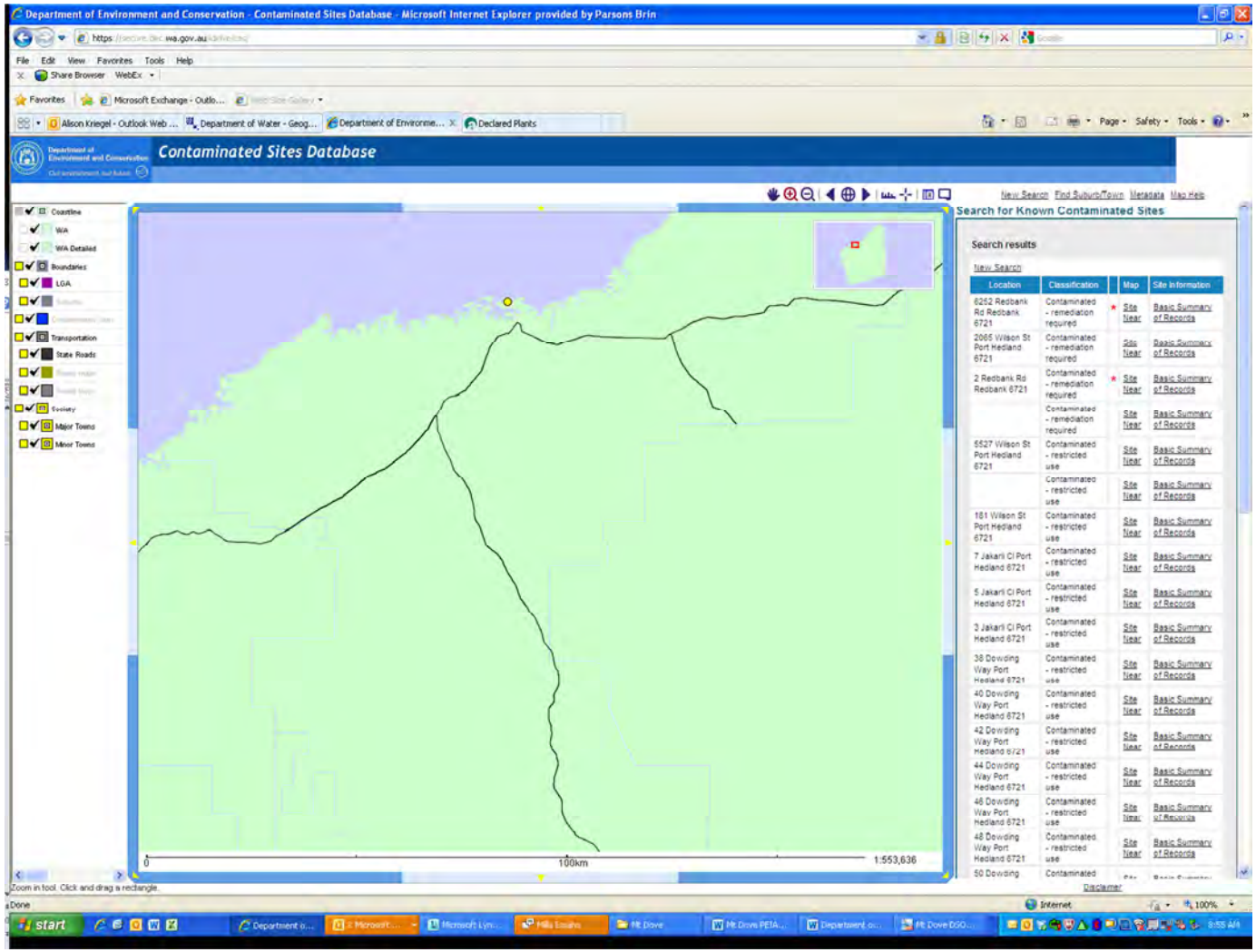
P1, P2; for the whole of the State

Yellow burr weed (*Amsinckia spp.*)

P1, P2; for the whole of the State

Appendix J

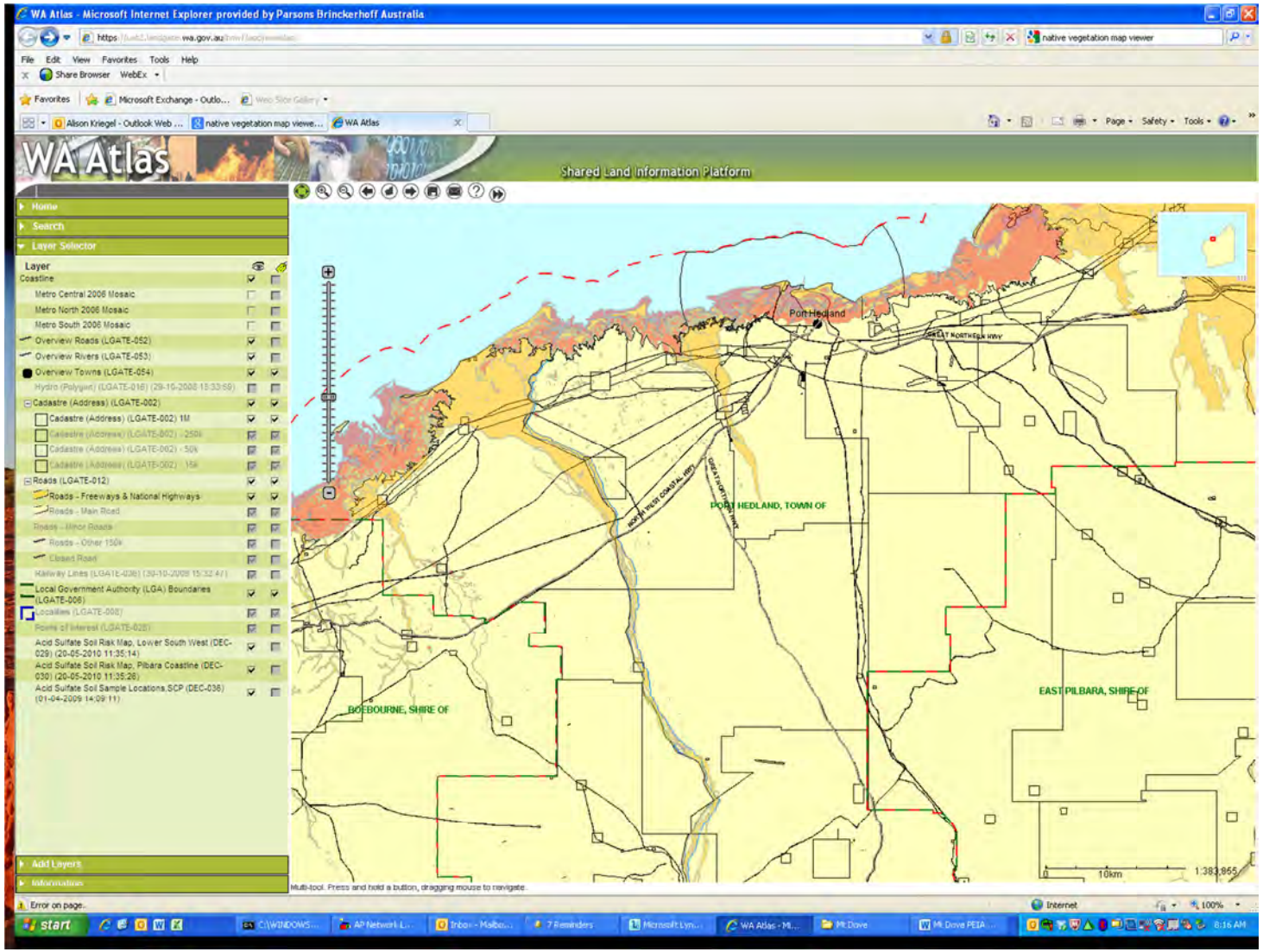
DEC Contaminated Sites Database Search



DEC Contaminated Sites Database (https://secure.dec.wa.gov.au/idelve/css/) accessed on 29 October 2012, search for LGA Town of Port Hedland and Great Northern Highway with no contaminated sites in the Project area.

Appendix K

Acid Sulfate Soils Mapping



DEC's acid sulfate soils maps were reviewed on the Shared Land Information Platform (SLIP - https://uat2.landgate.wa.gov.au/bmvf/app/waatlas/) on 30 October 2012.

Appendix L

Site Photos

Site photos

Mt Dove, view looking north

View looking south

View looking east to Great Northern Highway

View looking west to mine

Appendix M

Environmental Management Plan

ENVIRONMENTAL MANAGEMENT PLAN

MT DOVE GREAT NORTHERN HIGHWAY INTERSECTION WORKS

Introduction

This Environmental Management Plan (EMP) has been developed for the project area following the completion of the Preliminary Environmental Impact Assessment (PEIA) report. The aim of this EMP is to minimise the environmental impacts associated with the proposed works as well as to identify areas of responsibilities required for the implementation of management strategies.

This EMP addresses specific issues that were identified during the PEIA. The project management measures identified within this EMP are in addition to the standard environmental management contract specifications used for Category 2 projects. Main Roads' standard environmental contract specifications (Specifications 203, 204, 301, 302 and 304) are to be adhered to where appropriate.

The areas that require special management will be addressed in terms of:

- the timing of the various management actions;
- the topic (e.g. vegetation);
- the objectives for each area;
- the actions that are necessary to minimise the impact;
- the responsible party for implementing the action; and
- whether the action arose from external advice or is a Main Roads requirement.

Communication Plan

Environmental issues specific to the project will be communicated as follows:

Method	Frequency	Participants	Reference	Record
Project Site				
Email and/or written communication	As required	Pastoralists, E45/3392 tenement holders	-	Email/written communication
Induction	Prior to Work	All personnel and subcontractors	EMP and Contractor Environmental Policy	Induction Meeting
Toolbox Meetings	Weekly	Project Personnel	Contractor Safety Plan	Minutes of Meeting
Authority Consultation				
Department of Environment and Conservation	As required	Main Roads' Project Manager and Contractor Project Manager	-	Minutes of meeting

External Communication and Complaints

A complaints register shall be maintained by the contractor. All complaints received shall be forwarded to the Main Roads' Project Manager for action. Serious complaints shall be investigated within 24 hours of the complaint being received.

Monitoring

After project completion and project handover, the Asset manager should develop a monitoring program to monitor for those aspects that have been identified as requiring monitoring.

Contingency Measures

Due to the scale and nature of the project, no contingency measures are identified as the inherent environmental risks are small.

Auditing

Due to the scale and nature of the project, there is no requirement for auditing the implementation of the EMP as the environmental risks are small.

ENVIRONMENTAL MANAGEMENT PLAN					
Timing	**Topic**	**Objective**	**Action**	**Responsible Party**	**Advice**
All phases of Construction	Vegetation Clearing - Record-keeping	All projects should maintain the required records relating to clearing native vegetation under the purpose permit.	Clearing: • a copy of the PEIA & EMP (Minor projects) for small projects; • a map showing the location where the clearing occurred, recorded in an ESRI Shapefile*;* • the size of the area cleared (in hectares); and • the dates on which the clearing was done.	Project Manager	DEC
			Revegetation and rehabilitation of areas: • a map showing the location of any area revegetated and rehabilitated recorded in an ESRI Shapefile; • a description of the revegetation and rehabilitation activities undertaken; and • the size of the area revegetated and rehabilitated (in hectares).	Project Manager	DEC
All phases of Construction	Vegetation Clearing - Record-keeping	All projects should maintain the required records relating to clearing native vegetation under the purpose permit.	Control of weeds and other pathogens: • a copy of any management plan prepared; and • for any pathogen, the appropriate steps taken.	Project Manager	Main Roads
Pre-Construction	Vegetation Clearing	Ensure that the overall objectives of the alignment and construction works are compatible with maintaining and, where possible, enhancing the biological integrity of the surrounding environment and minimising vegetation loss and degradation. Ensure the retention of as many habitat trees, shrubs and vegetated corridors for fauna as possible, particularly where associated with riparian zones.	Selection of designs/locations that minimise adverse impacts on the biological environment.	Project Manager	Main Roads
			Any stockpiled vegetation from clearing works shall not be burnt. This vegetation shall be used during any rehabilitation works and either mulched or respread.	Contractor	Main Roads
Pre - Construction	Vegetation Clearing - CPS 818/6 management requirements	Compliance with management conditions of purpose permit – weed control.	• Maintain vehicle hygiene to minimise spread of pathogens • Site will be inspected for signs of weed infestation.	Contractor/Project Manager	DEC
Pre-Construction	Surface Drainage	Maintain the hydrological regime that exists prior to the construction of the proposal.	Stormwater drainage shall be treated and disposed of in accordance with DEC requirements.	Project Manager	DEC

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Pre-Construction	Ground disturbance	All projects will obtain appropriate approvals prior to disturbing ground.	Obtain an Atlas Ground Disturbance Permit. Permit ensures all applicable approvals are obtained prior to ground disturbance including: • environmental approvals • heritage clearance • land access • permit to dig	Project Manager	Atlas
Construction	Noise, Vibration and Dust	Ensure that the construction of the proposal does not become a nuisance to the public.	Appropriate traffic management measures should be planned and implemented prior to the construction of works.	Contractor	Main Roads
			Any complaints regarding dust will be attended to as soon as possible.	Contractor/Project Manager	Main Roads
			Where it is found that trucks leaving the site are carrying excessive material onto sealed surfaces, these areas will be swept to reduce dust generation and maintain traffic safety.	Contractor	Main Roads
Construction	Pollution and Litter	Ensure that the construction of the proposal is managed to a standard that minimises any adverse impacts on the environment.	The designated servicing area will be bunded to contain any spills or leaks and shall not be located in an area adjacent to any drainage areas or watercourses or will drain into a temporary sump.	Contractor	Main Roads
			Temporary storage of bitumen, asphalt, concrete or aggregate should only occur at designated depots or controlled hardstands. Precoating of aggregate will only occur in approved areas.	Contractor	Main Roads
			Emergency cleanup procedures shall be implemented in the case of any spillage. These will include control of spilled material and removal of contaminated soil to an approved site. The contractor shall ensure appropriate equipment is available at all times and shall notify the Superintendent's Representative of a spill.	Contractor	Main Roads
			All waste oil will be collected for recycling and any empty fuel/oil containers, used filters and waste hydraulic parts to be collected and stored in an allocated area then removed to an approved site.	Contractor	Main Roads
			The project areas, including hardstand areas, will be kept in a tidy manner at all times.	Contractor	Main Roads
Construction	Fire	Ensure that the fire risk associated with the construction of the proposal is minimised.	No fires shall be lit within the project area.	Contractor	Main Roads
			Machinery will be fitted with approved spark arresting mufflers.	Contractor	Main Roads
			A fire extinguisher will be on site at all times.	Contractor	Main Roads
Construction	Fauna	Avoid unnecessary impacts to fauna and damage to fauna habitat.	Fauna are not to be fed or intentionally harmed.	Contractor	Main Roads
			No pets or firearms permitted on site.	Contractor	Main Roads
			The WILDCARE Helpline is to be contacted, 9474 9055, in the event of sick, injured or orphaned native wildlife on the site.	Contractor	Main Roads
Construction	Site Management	Ensure that the site is managed to ensure that construction of the proposal will have minimal impact upon the surrounding environment.	Site office and materials storage areas will be located on previously disturbed/ designated area, where possible.	Contractor	Main Roads

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Timing	**Topic**	**Objective**	**Action**	**Responsible Party**	**Advice**
Construction	Rehabilitation	Rehabilitate the project area to meet project commitments.	All waste materials from the development are to be completely removed from the site upon completion of the project. Final clean-up shall be to the satisfaction of the Project Manager and the Site Superintendent.	Contractor	Main Roads
Construction	Revegetation	Meet project commitments for revegetating.	• All waste materials from the works are to be completely removed from the site upon completion of the project. • Vegetation stockpiled separately for use in rehabilitation, if required. • All rubbish removed from site (including hydrocarbon spills).	Contractor	Main Roads
Construction	General land clearing management	Minimise vegetation clearance	• Minimise the area of vegetation clearance and land disturbance as much as practicable. • Areas designated for clearing will be clearly delineated on the ground, along with the designated areas for cleared vegetation and topsoil stockpiling.	Project Manager	Atlas
Construction	Terrestrial fauna	Minimise impact on fauna	• Off-road driving will be minimised. • All fauna mortalities and injuries will be reported to the Environmental Advisor – Mt Dove Operations within 24 hours. • Where required, fauna will be handled and transported in accordance with the procedures outlined in the DEC guidelines for the transport and temporary holding of wildlife.	Project Manager	Atlas
Post - Construction	Monitoring	Meet project revegetation commitments.	Monitor effectiveness of revegetation works and weed control.	Contractor/ Project Manager	Main Roads