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PROPOSED YEELIRRIE DEVELOPMENT
SHORT-RANGE ENDEMIC INVERTEBRATE BASELINE SURVEY

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PROPOSED YEELIRRIE DEVELOPMENT

SHORT-RANGE ENDEMIC INVERTEBRATE BASELINE SURVEY

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ACRONYMS

ACE	Abundance-based Coverage Estimator
ANOVA	Analysis of Variance
ANOSIM	Analysis of Similarities
DEC	Department of Environment and Conservation
EPA	Environmental Protection Authority
EPBC	*Environment Protection and Biodiversity Conservation Act* 1999
SAC	Species Accumulation Curve
SRE	Short-Range Endemic
WAM	Western Australian Museum
WC Act	*Wildlife Conservation Act 1950*

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EXECUTIVE SUMMARY

BHP Billiton Yeelirrie Development Company Pty Ltd is proposing to develop the Yeelirrie Uranium Project (the Project). The Project is located in the Shire of Wiluna, approximately 60 km west of Mount Keith in the Midwest of Western Australia and aims to mine uranium mineralised ore over an anticipated mine life of over 30 years, producing up to 5000 tonnes per annum (tpa) of uranium peroxide ($UO_4.2H_2O$), more commonly referred to as uranium oxide concentrate (UOC).

ecologia Environment (*ecologia*) was commissioned by URS Australia Pty Ltd (URS) on behalf of BHP Billiton to conduct a literature review providing an overview of the short-range endemism in the East Murchison bioregion of Western Australia, and to conduct a survey for short-range endemic invertebrates within the project area. Short Range Endemic (SRE) species are recognised from mostly flightless arthropod groups such as arachnids (i.e. trap-door spiders, scorpions, and pseudoscorpions), myriapods (i.e. specific millipedes and centipedes) and snails.

The survey was undertaken in three parts. Part One consisted of a five phase survey from July 2009 to October 2010. Phases 1 to 3 sampled within the project footprint from July 2009 to January 2010, phase 4 sampled outside the project footprint but within the project area and phase 5 sampled the prospective wellfields (ie the project area outside of the Ministerial Temporary Reserve). Part Two consisted of a single phase survey sampling Yeelirrie Playa, Playa A and Playa B undertaken in February 2010 and Part Three was a targeted survey for the trap-door spider *Idiosoma* sp.

The main conclusions of this survey were:

- The survey methods of the SRE survey were consistent with the EPA Guidance Statement 20 to sample for SRE fauna. Species accumulation curves were used to assess survey adequacy and these indicate that the survey was sufficient;
- A total of 42 species were collected during the baseline SRE survey (Part One), of which three species were confirmed SREs (*Idiosoma* sp., *Pseudolaureola* sp., and Platyarthridae/Barthytropidae) and 13 were considered potential SREs (*Aganippe* sp., *Aname* 'MYG170', *Aname* 'MYG212', Barychelidae, Cheridiidae, *Cubaris* sp. 1, *Cubaris* sp. 2, Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG172', *Kwonkan* 'MYG210', *Kwonkan* 'MYG211' and *Urodacus* 'yeelirrie');
- Hardpan Mulga habitat was the most diverse in SRE species followed by Calcrete Outwash, Calcrete and Mixed Shrubs over Spinifex Sandplain habitats, however the Calcrete habitat showed the highest specimen abundance followed by Hardpan Mulga, Calcrete Outwash and Mixed Shrubs over Spinifex Sandplain habitats;
- Three species showed a preference for habitat type including *Aname* 'MYG170' (Calcrete), Platyarthridae/Bathytropidae (Calcrete Outwash) and *Urodacus* 'yeelirrie' (Hardpan Mulga) despite being collected in three habitat types each. No other species showed statistically significant habitat preference because of the low number of specimens collected;
- A survey of the Yeelirrie Playa and two other playas within the project area (Part Two) found 21 terrestrial invertebrate species including one confirmed SRE (*Pseudotetracha helmsi*) and one potential SRE (*Kwonkan* 'MYG172') that was also collected during the baseline survey;
- A targeted survey for *Idiosoma* sp. was undertaken and found that the species occurring at Yeelirrie prefers sandplain habitats although it exists in low numbers. This species was located in the project area, while no specimens were found to be located within the project footprint;

- Nine of the 16 SRE species have only been collected from within the project footprint including *Aname* 'MYG170', Barychelidae, Cheridiidae, *Cubaris* sp. 1, Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG172', *Pseudolaureola* sp. and Platyarthridae/Barthytropidae (species collected within the potential wellfields are considered outside the project footprint);
- A habitat analysis showed no statistically significant difference between SRE species diversity and habitat type inside and outside the project footprint. SRE species distribution depends on micro-habitats ('island' habitats) rather than broadscale habitat types; and
- All of the habitat types extend beyond the proposed project footprint indicating a potential for all species to be found outside the project footprint.

1 INTRODUCTION

1.1 PROJECT OVERVIEW

BHP Billiton Yeelirrie Development Company Pty Ltd proposes to develop an open pit mine and associated processing facilities at Yeelirrie in the Northern Goldfields region of Western Australia (the Project). The Project is located approximately 500 km north of Kalgoorlie, 60 km west of Mount Keith, 70 km south-west of Wiluna and 110 km north-west of Leinster (Figure 1.1). The Project would produce approximately 5,000 tonnes per annum (tpa) of uranium peroxide ($UO_4.2H_2O$), more commonly referred to as uranium oxide concentrate (UOC), through the development and operation of an open pit mine and on-site metallurgical plant. The open pit mine would be about 9 km long, up to 1.5 km wide and about 10 m deep. Up to 8 million tonnes (Mt) of overburden and ore would be mined per annum. Ore would be stockpiled and subsequently treated in the proposed metallurgical plant. The mined material would be stockpiled adjacent to the open pit prior to it being processed within the metallurgical plant, or backfilled into the pit, if it is not economic to process.

ecologia Environment (*ecologia*) was commissioned by URS Australia Pty Ltd (URS) on behalf of BHP Billiton to conduct a literature review providing an overview of the short-range endemism in the East Murchison bioregion of Western Australia, and to conduct a survey for short-range endemic (SRE) invertebrates in the project area. SRE species are recognised from mostly flightless arthropod groups such as arachnids (i.e. trap-door spiders, scorpions, pseudoscorpions), myriapods (i.e. specific millipedes and centipedes) and snails. This report documents the findings of the literature review and field survey.

1.2 LEGISLATIVE FRAMEWORK

Federal and State legislation applicable to the conservation of native fauna include, but are not limited to, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Wildlife Conservation Act 1950* (WC Act) and the *Environmental Protection Act 1986* (EP Act). Section 4a of the EP Act requires that developments take into account the following principles applicable to native fauna:

- The Precautionary Principle

Where there are threats of serious or irreversible damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

- The Principles of Intergenerational Equity

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

- The Principle of the Conservation of Biological Diversity and Ecological Integrity

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

This document was constructed with a view to satisfy the requirements of EPA Guidance Statement *No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). In relation to SRE fauna, the guidance statement states that:

> *"Comprehensive systematic reviews of different faunal groups often reveal the presence of short-range endemic* species *(Harvey 2002). Among the terrestrial fauna there are numerous*

regions that possess short-range endemics. Mountainous terrains and freshwater habitats often harbour short-range endemics, but the widespread aridification and forest contraction that have occurred since the Miocene has resulted in the fragmentation of populations and the evolution of many new species. Particular attention should be given to these types of species in environmental impact assessment because habitat loss and degradation will further decrease their prospects for long-term survival."

Harvey (2002) considered that although there were occasional SREs among the vertebrates and insects, there were much higher numbers among the molluscs, earthworms, some spider groups (especially the mygalomorphae), millipedes and some groups of crustaceans. SREs generally possessed similar ecological and life history characteristics, especially poor powers of dispersal, confinement to discontinuous habitats, slow growth, and low fecundity.

Some better known SRE species have been listed as threatened or endangered under State or Commonwealth legislation in the *WC Act* and/or *EPBC Act*, but the majority have not. Often the lack of knowledge about these species precludes their consideration for listing as threatened or endangered. Listing under legislation should therefore not be the only conservation consideration in environmental impact assessment.

This document also satisfies the requirements of Guidance Statement No. 20: *Sampling of Short-range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (EPA 2009b).

1.3 SURVEY OBJECTIVES

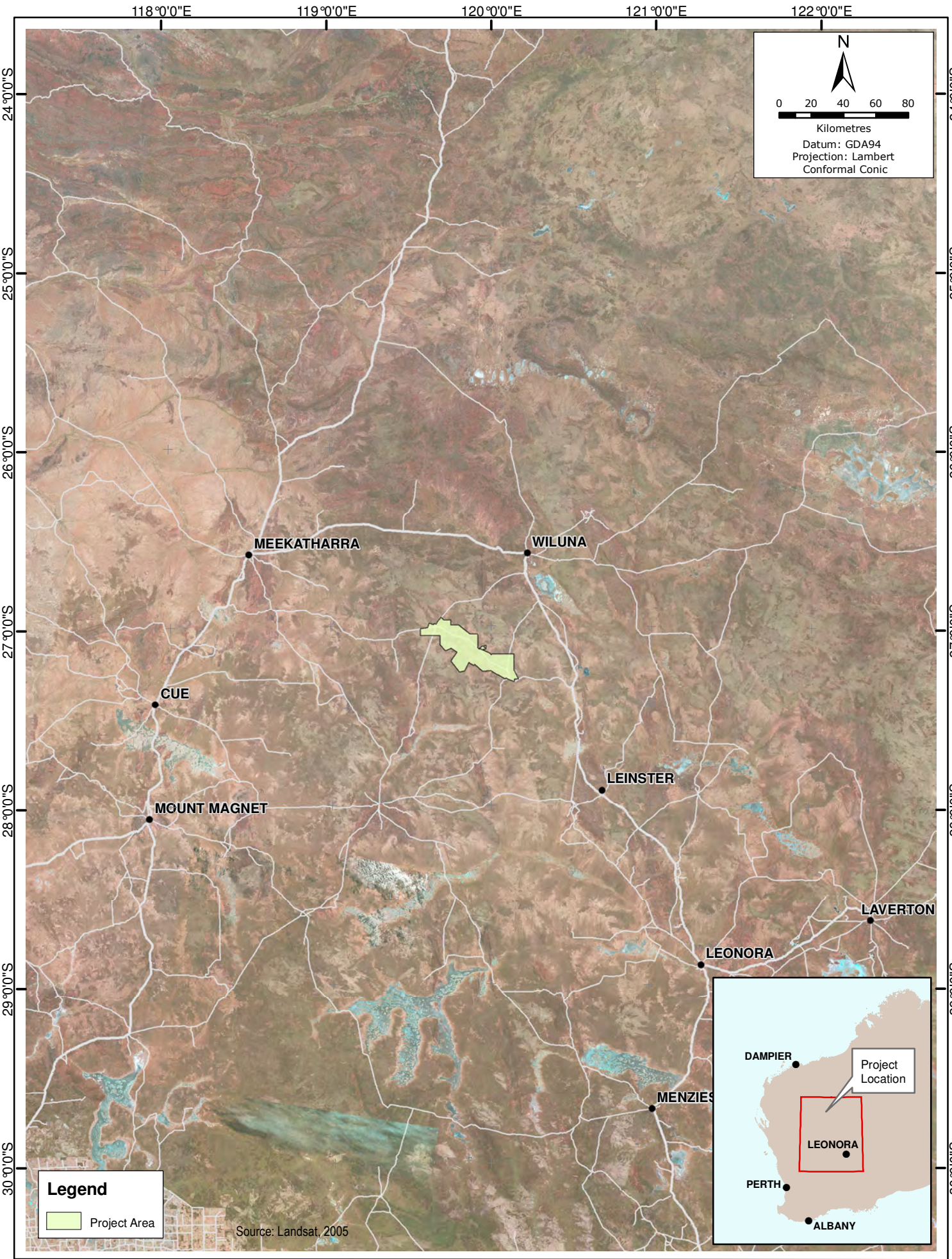
The Environmental Protection Authority's (EPA) objectives with regards to fauna management are to:

- maintain the abundance, species diversity and geographical distribution of terrestrial invertebrate fauna; and
- protect Specially Protected (Threatened) fauna, consistent with the provisions of the WC Act.

Hence, the primary objective of this study was to provide sufficient information for the EPA to assess the impact of the Project on the invertebrate fauna of the area, thereby informing assessment against these objectives.

Specifically, the objectives were to undertake a survey that satisfies the requirements documented in EPA's Guidance Statement 20, thus providing:

- a review of background information (including literature and database searches);
- an inventory of SRE fauna species occurring in the project area, incorporating recent published and unpublished records;
- an inventory of species of biological and conservation significance recorded or likely to occur within the project area and surrounds; and
- an assessment of aerial photographs (Google Earth™) for likely habitats that could support SREs. Ground habitat assessment was subsequently carried out in the field within the project area and nearby vicinity to determine suitability for supporting SRE species; a review of regional and biogeographical significance, including the conservation status of species recorded in the project area.



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1.4 SHORT-RANGE ENDEMIC FAUNA: A REVIEW

The decline in biodiversity of terrestrial communities has already been observed both nationally and state-wide (CALM 2004). There is also an increasing shift in environmental protection from species based conservation to biodiversity based conservation (Chessman 1995; Burbidge *et al.* 2000; McKenzie *et al.* 2000) and one of the important considerations involved in this is the presence of endemic species.

Endemism refers to the restriction of species to a particular area, whether it is at the continental, national or local level (Allen *et al.* 2002). This review focuses on SREs, outlines the major paths to short-range endemism, the current knowledge of short-range endemism in Australia and the conservation significance of such species. It is important to note that the individual taxa and broader groups discussed are not an exhaustive list of all SREs. This is due to the fact that SREs are dominated by invertebrate species, which are historically understudied and in many cases lack formal descriptions. An extensive, reliable taxonomic evaluation of these species has begun only relatively recently and thus the availability of literature relevant to SREs is relatively scarce.

1.4.1 Processes Promoting Short-Range Endemism

Short-range endemism is influenced by numerous processes or factors which result in the isolation of a species. These processes or factors include the limited ability and opportunity to disperse, life history, physiology, habitat requirements, habitat availability, biotic and abiotic interactions, and historical conditions, and they influence not only the distribution of a taxon, but also the tendency for differentiation and speciation (Ponder and Colgan 2002).

Isolated populations of plants and animals tend to differentiate both morphologically and genetically as they are influenced by different selective pressures over time. Additionally, a combination of novel mutations and genetic drift promote the accumulation of genetic differences between isolated populations. Conversely, the maintenance of genetic similarity is promoted by a lack of isolation through migration between the populations, repeated mutation and balancing selection (Wright 1943). The level of differentiation and speciation between populations is determined by the relative magnitude of these factors, with the extent of migration generally being the strongest determinant. Migration is hindered by the poor dispersal ability of the taxon as well as geographical barriers to impede dispersal. Thus, in summary, those taxa that exhibit short-range endemism are generally characterised by poor dispersal, low growth rates, low fecundity and reliance on habitat types that are discontinuous (Harvey 2002).

The historical connections between habitats are also important in determining species distributions and often explain patterns that are otherwise inexplicable by current conditions. Many SREs are considered to be relictual taxa (remnants of species that have become extinct elsewhere) and are confined to certain habitats, and in some cases, single geographic areas (Main 1996). Relictual taxa include extremely old species that can be traced back to the Gondwanan periods (180-65 million years ago) and have a very restrictive biology (Harvey 2002).

In Western Australia, relictual taxa generally occur in fragmented populations, from lineages reaching back to historically wetter periods. For example, during the Miocene period (from 25 million to 13 million years ago), the aridification of Australia resulted in the contraction of many areas of moist habitat and the fragmentation of populations of fauna occurring in these areas (Hill 1994). With the onset of progressively dryer and more seasonal climatic conditions since this time, suitable habitats have become increasingly fragmented. Relictual species now generally persist in habitats characterised by permanent moisture and shade, maintained by high rainfall and/or prevalence of fog. This may be induced by topography or coastal proximity, or areas associated with freshwater

courses (e.g. swamps or swampy headwater of river systems), caves, or microhabitats associated with southern slopes of hills and ranges, rocky outcrops, deep litter beds, or various combinations of these features (Main 1996; Main 1999). As a result, these habitats support only small, spatially isolated populations, which are further restricted by their low dispersal powers typical of all SRE species.

1.4.2 Taxonomic Groups Likely to Support Short-Range Endemism

1.4.2.1 Arachnids (Phylum: Arthropoda, Sub Class: Arachnida)

Four orders of arachnids can exhibit short-range endemism: Pseudoscorpiones (false scorpions), Scorpiones (true scorpions), Schizomida (short-tailed whip spiders) and Araneae (i.e. Infraorder: Mygalomorphae or trap-door spiders). Many mygalomorph trap-door spider species are vulnerable to disturbance and exhibit short range endemism due to their limited ability to disperse. These spiders also have extreme longevity and the long-term persistence of females in a single burrow (Raven 1982). Mygalomorph spiders are largely considered 'old world' spiders and, as such, are generally adapted to past climatic regimes making them vulnerable to desiccation in arid environments. They use a variety of behavioral techniques to avoid desiccation, the most obvious of which is their burrow, which may reach up to 70 cm in depth (Main 1982). Mygalomorph groups are thus capable of surviving on the periphery of the great central desert region and minor habitats within the general arid regions of the continent. Mygalomorph spiders tend to be the most diverse SRE group found in the Murchison region with two protected species (*Aganippe castellum* and *Idiosoma nigrum*) known from the region (Government Gazette 2010) as well as many other genera including *Cethegus*, *Eucyrtpos*, *Kwonkan*, *Missulena*, *Teyl*, *Synothele*, *Gaius* and *Aname* (*ecologia* 2007, 2008; Framenau 2009).

Another member of the arachnid class, the Schizomida, is comprised entirely of SREs, with most recorded from single localities (Harvey 2002). Forty-six schizomid species have been described in northern Australia. Most are known to occur in the entrances to and inside caves, while the remainder occur in nearby habitats (Harvey 2002). None are known to occur in the Murchison bioregion of Western Australia.

Scorpions and pseudoscorpions also exhibit high degrees of endemism (Koch 1981; Harvey 1996). Scorpions are popularly thought of as desert animals although they can be found in most of Australia's climatic zones. Several genera of scorpions are known from the Murchison region including *Lychas*, *Isometroides* and *Urodacus* (Framenau 2009).

1.4.2.2 Millipedes and Centipedes (Phylum Arthropoda, Class Myriapoda)

Despite millipedes being highly abundant in soil and leaf litter, and highly diverse at the order level, they are inadequately studied and relatively little is known of their biogeography (Harvey 2002). Millipedes from the genus *Antichiropus* are known from several locations within the Midwest region. With the exception of *A. variabilis*, which inhabits the jarrah forests of south-western Western Australia, all recorded species of the genus are known to be SREs, and many are known from areas of only a few hundred square kilometres (Harvey *et al.* 2000; Harvey 2002).

Centipedes are not listed by Harvey (2002) as SRE species; however they have been shown to be endemic to small areas on the east coast (Edgecombe *et al.* 2002). Examination of the distributions of species featured in the CSIRO centipede webpage also reveals disjunct and isolated occurrences of many species. A number of genera have Pangaean and Gondwanan affinities (Edgecombe *et al.* 2002). In general, these animals have a relatively cryptic biology, preferring moist habitats in deep

litter accumulations, under rocks and in rotting logs, and they have relatively poor dispersal abilities (Lewis 1981). This suggests that they are potential candidates for designation as SREs.

1.4.2.3 Molluscs (Phylum: Mollusca)

Numerous species of freshwater and terrestrial molluscs belonging to many genera have been identified in Australia, with most being SREs (Harvey 2002). Restricted ranges of the terrestrial molluscs of the drier northern and Western Australia were noted for a vast number of species (Solem 1997). Among these were seven endemic species of *Rhagada* from the Dampier Archipelago, five of which were found to occur sympatrically on one island. However, in a recent genetic study conducted on *Rhagada* (Johnson *et al.* 2004), allozyme analysis revealed little variation between taxa. Such a finding could indicate that there is merely high morphological diversity within one or a few species. It is also possible however, that there are a number of highly endemic species and that morphological diversity has taken place rapidly with little genetic change (Johnson *et al.* 2004). One protected species of snail (*Bothriembryon peroberus*) is known from the Murchison region (Government Gazette 2010) and another potential SRE genus (*Pleuroxia*) has been collected this region (*ecologia* 2008).

1.4.2.4 Worms (Phylum: Annelida & Onychophora)

The taxonomic status of the earthworm family, Megascolecidae, in Western Australia was revised by Jamieson in 1971. As a result of this study, it was concluded that most of the earthworm genera are made up almost entirely of short-range endemics (Harvey 2002). This is also the case with the velvet worms (Onychophorans). Due to several taxonomic revisions that have been conducted (see references within Harvey, 2002), the number of onychophoran species has expanded since 1985 from six to over 70 species, and a number of species still remain undescribed (Harvey 2002). Very few of these species exceed ranges of 200 km^2 and some are restricted to single localities and have high genetic differentiation, indicating very little mobility and dependence on their permanently moist habitats (Harvey 2002). No SRE worm species have been collected from the Murchison region.

1.4.3 Current Knowledge of the Short-range Endemic Species in the Yeelirrie Area

SREs are common among the invertebrates. Many species are confined to topographically or geographically restricted areas and specialised microhabitats because of their small size and often specialised behaviour, typical for relict species. These microhabitats provide areas of short-range endemism and are vulnerable to artificial disturbances imposed by agriculture and other rural and urban disruptions to the landscape, for instance roads and other human constructions (Main 1996).

Groups or organisms which display short-range endemism include (but are not limited to) molluscs (e.g. Camaenid land snails), onychophorans (velvet worms), millipedes, some arachnids (scorpions, pseudoscorpions and schizomids) and some crustaceans (isopods) (Harvey 2002). The current state of knowledge on short-range endemism of invertebrates across Australia is relatively poor and the same is true for the Yeelirrie area. The paucity of targeted collections makes assessing the likely occurrence and the distribution of SRE fauna very difficult by means of database and or literature review. Consequently the information presented in this report, based on detailed field surveys, constitute a noteworthy addition to our knowledge of SREs in the Yeelirrie area.

2 METHODS

The methodology used was based on the principles outlined in EPA Guidance Statement 20: *Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (EPA 2009a). The methodology developed for the survey is compliant with these requirements and in accordance with the guidance received from the DEC throughout the survey period.

2.1 WAM DATABASE SEARCH

Ideally, a database search for SRE species would be undertaken of the project area and surrounding local area. However, as knowledge of invertebrate diversity throughout the Murchison Region is very limited, a regional approach was taken. Taxa (Orders) known to contain SREs were searched within the Malacology and Terrestrial Invertebrate electronic databases of the Western Australian Museum (WAM 2009). A search was undertaken between the coordinates of 26° 30’ S to 27° 30’ S, and 119° 00’ E to 121° 00’ E. The list of species obtained represents possible SRE invertebrate species with the potential to be present in the area.

2.2 SRE STATUS

The likelihood of the invertebrate species to be considered a SRE or not a SRE was determined by expert taxonomists (Volker Framenau and Mark Harvey, Department of Terrestrial Invertebrates, WAM; Shirley Slack-Smith and Corey Whisson, Department of Malacology; Erich Volschenk, private consultant; Simon Judd, private consultant) based on the current knowledge of the distribution and biology of each species, as follows:

- No – Not considered a SRE
- Yes - Current knowledge confirms that this species is a SRE
- Likely – Current knowledge suggests this species is probably a SRE. However, further research is required to confirm status.
- Potential – Current knowledge of this species or group is very limited however, there is the potential for this species to represent a SRE. Further research is required to confirm status.

2.3 CONSERVATION SIGNIFICANT FAUNA

Fauna species that have been formally recognised as rare, threatened, or as having high conservation value are protected under Commonwealth and State legislation. A DEC NatureMap database search was undertaken in order to determine if any species listed by the EPBC Act or the WC Act have potential to occur in the project area.

2.4 FIELD SURVEY METHODS

The survey was undertaken in three parts over an 18-month period. Part One consisted of a five phase SRE survey using foraging and wet-pitfall trapping techniques both inside and outside the project area (Figure 2.1) and within the prospective wellfields. Part Two was a single phase survey targeting aquatic invertebrates at two playas within the project footprint (Figure 2.2) and the Yeelirrie Playa and Part Three was a targeted survey for the trap-door spider *Idiosoma* sp. across various vegetation communities project area (Figure 2.4). The specific methods (as described in this

section) were employed to facilitate a comprehensive survey of groups known to include SRE taxa including Mygalomorph spiders, scorpions, pseudoscorpions, millipedes, isopods, land snails and aquatic invertebrates.

2.4.1 Part One (Baseline Survey)

2.4.1.1 Site Selection, Survey Timing and Intensity

A total of 72 sites within the project area were selected during the Part One survey and are shown in Figure 2.1. The site locations and descriptions are provided in Appendices 1A, 2A, 2B, 2C and 2D and the survey timing, survey intensity and methodology used is provided in Table 2.1.

Survey site locations were selected primarily based on those habitats likely to support SRE invertebrates in areas inside and outside of the project area. Aerial photographs (Google Earth™) and habitat mapping (Bamford 2011) were studied to determine the habitats in which the SREs were likely to occur within the project area. Micro-habitats likely to maintain higher moisture levels and 'island' habitats were targeted. The site locations were further refined following on-site examination. A brief descricption of each of the habitats suveryed is provided in Table 2.2.

Table 2.1 – Survey Timing, Intensity and Methods used During Part One

Phase	Location	Intensity	Timing	Methods Used
Phase 1	Inside project footprint and 5 km surrounds	20 Sites F1 – F29	3 – 10 June 2009	Foraging
Phase 2	Inside project footprint	20 Sites T1 – T20	26 October – 10 December 2009	Wet-pitfall trapping
Phase 3	Inside project footprint (same sites as Phase 2)	20 Sites T1 – T20	10 December 2009 – 27 January 2010	Wet-pitfall trapping
Phase 4	Outside project footprint; inside project area	12 Sites O1 – O20	12 April – 13 May 2010	Wet-pitfall trapping Foraging
Phase 5	Inside project area (prospective wellfields)	20 Sites A1 – A20	8 October – 12 November 2010	Wet-pitfall trapping Foraging

Table 2.2 – Habitats Sampled During the Survey

SRE Habitat	Habitat Description	Vegetation Types Present (Western Botanical 2011)
Calcrete	Low calcrete rises with Eucalypt open woodland (variable) over a sparse shrubland.	CAbS CAbS + CEgW CCpW CEgW
Calcrete Outwash	Clayey-loam and clay flats, subject to occasional inundation with some open claypans. Vegetation includes Acacia open shrubland, sometimes with thickets of *Melaleuca xerophila*, and chenopod shrub-heaths	CErG + CAbS + CEgW CMxS
Hardpan Mulga	Mulga woodland with poorly-developed understorey on hard loam soils	HPMS HPMS + PLAPoS PLAET PLAPoS PLMpS
Mixed Shrubs over Spinifex Sandplains	Sandplains supporting Spinifex, scattered shrubs and open Acacia/Eucalypt woodland	SAGS SAMU SAWS

2.4.1.2 Survey Adequacy

There are three general methods of estimating species richness from sample data: extrapolating species-accumulation curves (SAC), fitting parametric models of relative abundance, and using non-parametric estimators (Bunge and Fitzpatrick 1993; Colwell and Coddington 1994; Gaston 1996). In this report, the level of survey adequacy was estimated using species accumulation curves (SACs) as computed by Mao Tao. A SAC is a plot of the accumulated number of species found with respect to the number of units of effort. The curve, as a function of effort, monotonically increases and typically approaches an asymptote, which is the total number of species. In addition, a Michaelis-Menten enzyme kinetic curve was calculated and used as a stopping rules technique. To eliminate features caused by random or periodic temporal variation, the sample order was randomised 50 times. All estimators applied to the data set were performed using EstimateS (version 8, Colwell 2009).

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760000 770000 780000 790000 210000 220000 230000 240000

7010000 7000000 6990000 6980000 6970000

MGA ZONE 50 MGA ZONE 51

N

0 2.5 5 7.5 10

Kilometres

Datum: GDA94
Projection: MGA
Grid: MGA Grid Zone 50 and 51

A03 A01 A02 O10 O06 O05 O04 O07 O11 A06 A17 O08 O09 A05 O02 O03 O01 A18 A07 O12 A04 A20 F23 F02 F12 F01 A19 F14 F03 A08 A14 A09 A10 A15 A16 F04 A11 A12 A13 Albion Downs

Inset

MEEKATHARRA YEELIRRIE ROAD

F15 T13 T05 T19 T18 T20 T14 F09 F10 F25 T07 T06 F07 T15 T04 F06 F24 T03 T09 T17 T02 T08 T01 T16 F29 F05 F11 F30 T11 F08 T12 T10 F13

Source: Landsat, 2005

Legend

- Project Area
- Pit Outline
- Study Area
- Indicative Project Footprint
- Homestead

Survey Phase

- Phase 1 (Foraging)
- Phase 2 and 3 (Pitfall Trapping)
- Phase 4 (Foraging and Pitfall Trapping)
- Phase 5 (Foraging and Pitfall Trapping)

BHP Billiton Yeelirrie Development Company Pty Ltd

ecologia ENVIRONMENT

Project: **Proposed Yeelirrie Development**

Title: Location of Survey Sites in Part One - SRE Baseline Survey

Drawn: DL/AK/CJT	Approved: JN	Date: 21/01/2011	Figure: 2.1	Rev. F
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2.4.1.3 Survey Methods

Wet-Pitfall Trapping

As most excavated trapdoor spiders tend to be females or juveniles, which cannot be identified, wet-pitfall trapping is useful for collecting male trap-door spiders as they tend to roam more than the females who remain sedentary in the burrows. Wet-pitfall traps are also useful for collecting other invertebrate groups such as isopods, centipedes and scorpions.

During phases 2 – 5 of Part One, wet-pitfall traps were deployed at each site. Wet pitfall traps (Plate 2.1) consisting of a PVC tube (25cm long) and containing 30% Ethylene Glycol and 5% Formaldehyde were dug into the ground so that the surface was flush with the ground level. A receptacle (containing 700 ml of pitfall trapping solution) and funnel (fitting flush to the inside of the pitfall trap) were deployed into each tube and a cover was fitted 3 cm above the tube with steel fittings to exclude medium sized vertebrates and rain, and to deter attention of larger vertebrates. The traps were left open for approximately four weeks before being removed and transported for sorting in *ecologia's* Perth laboratory.

Plate 2.1 – Wet-Pitfall Traps

Foraging

Opportunistic foraging involved physically searching through microhabitats for SREs. This involved a number of techniques including searching the underside of rocks and logs for SRE invertebrate groups and searching the ground for spider and scorpion burrows. All specimens collected were placed in 100% ethanol.

When active and fresh trapdoor spider burrows were found, an attempt was made to excavate the spider from the burrow. The surface was cleared of debris and a hole was dug on one side of the burrow. Long forceps were used to gently remove one side of the burrow to prevent the soil collapsing on top of the spider. Plate 2.2 shows an example of a spider burrow and the excavation.

Burrow Pitfall Trapping

In order to collect burrowing scorpions, dry pitfall traps were deployed at the entrance of active burrows. The traps consisted of plastic cups with a diameter of 8 cm and were checked each morning. Suitable specimens were collected and juvenile specimens were returned to their burrow.

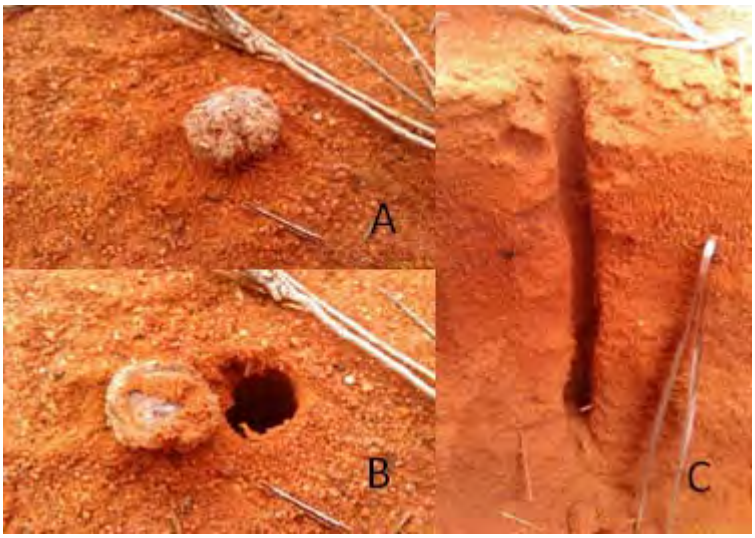

Plate 2.2 – Excavated Spider Burrow A. Closed Burrow, B. The Same Burrow with the Lid Open, C. The Same Burrow Excavated

Leaf-litter/Soil Collection

Leaf-litter sifting occurred at all of the sites during Phase 1 of the survey. A total of six samples were collected per site (three by each team member). Locations of the deepest leaf-litter were selected at each site and the litter and underlying soil was sifted through graduated geology sieves. Each sieve was examined and invertebrates from potential SRE groups were collected and placed in 100 % ethanol.

During Phases 4 and 5, a different method of leaf-litter sorting occurred. At each site, three quadrats (3 m^2) of leaf litter were collected and placed into a leaf-litter reducer separately (Plate 2.3). The contents from each collection was placed into a paper bag inside a zip-lock bag and kept separate. Samples were then transported back to Perth in a cool, dark container. Samples were then placed on the Tullgren Funnels (Plate 2.3) to extract any specimens.

Extraction Methods

Tullgren funnels were used to extract any animals from the collected leaf litter samples (Plate 2.3). The general principle of Tullgren funnels is that a sample of leaf litter is suspended above a vessel containing ethanol. Animals inhabiting the sample are forced downwards by the progressive drying of the sample and ultimately fall into the collecting vessel containing ethanol. Typically, drying is enhanced by placing an incandescent lamp or heat source above the sample.

After the leaf litter samples were processed on the Tullgren funnels, each sample was then examined for dead snail shells, or any other dead animals not collected during the Tullgren funnel extraction. Each sample was emptied into a tray and examined using a fluorescent light magnifier. Any dead animals were collected and immediately placed into ethanol.

Plate 2.3 – Examples of the Leaf Litter Reducer and Tullgren Funnels

2.4.1.4 Laboratory Sorting and Specimen Identification

All samples, whether from foraging or pitfall traps were then sorted under a stereomicroscope into potential SRE groups and sent to the relevant taxonomic expert for further identification. A list of taxonomic specialists used for identification and the relevanct experience of field staff is shown in Table 2.3.

Table 2.3 – Experinece and Qualifications of Taxonomic Experts and Field Staff Involved During the Survey

	Institution	Relevant Experience
Corey Whisson	Western Australian Museum	Taxonomic expert in molluscs
Dr Erich Volschenk	Private consultant	Taxonomic expert in scorpions
Dr Mark Harvey	Western Australian Museum	Taxonomic expert in pseudoscorpions and myriapods
Shirley Slack-Smith	Western Australian Museum	Taxonomic expert in molluscs
Simon Judd	Private consultant	Taxonomic expert in isopods
Volker Framenau	Western Australian Museum	Taxonomic expert in mygalomorph spiders
Dr Lazaro Roque-Albelo	*ecologia*	>20 years experience with terrestrial invertebrates >100 hours *Idiosoma* targeted surveys
Catherine Hall (BSc, Hons)	*ecologia*	>3 years experience with SRE invertebrates >100 hours *Idiosoma* targeted surveys
Nicki Thompson (BSc, Hons)	*ecologia*	>5 years experience with terrestrial and marine invertebrates
Nicholas Dight (BSc)	*ecologia*	>3 years experience with SRE invertebrates
Sean White (BSc)	*ecologia*	>7 years experience with terrestrial invertebrates >100 hours *Idiosoma* targeted surveys

2.4.1.5 Habitat Correlation

Habitat Correlation of SRE Community

Habitat type has been established in the literature as playing an important role in SRE invertebrate diversity. Variability of habitats has been strongly linked with invertebrate species richness and diversity. The expectation of this study was to find a relationship between species richness and habitat type, with higher species richness in moister habitats and less in drier habitats.

Statistical analyses were carried out on the data collected from the 72 sites sampled during Part One of the survey. The primary aim of the statistical analysis was to determine whether the SRE invertebrates of the project area differ in terms of richness (number of taxa present) and diversity (relative abundance of taxa).

Differences between habitat types and species richness were tested with a one-way ANOVAs. Prior to run the ANOVA a test of normality (Anderson –Darling) and Homogeneity (Barlett's and Levene) were performed in order test if the data set complains with the ANOVA assumptions.

To analyse differences in species diversity between habitats, Raup-Crick similarity index was calculated for each pairwise site comparison followed by a non-metric multidimensional scaling (MDS) of similarity matrix. Stress values below 0.20 were considered to indicate a good fit of the scaling to the matrix. The dimensions that reduced the majority of the "raw stress" were chosen for the final scaling. In addition, to test wheter the differences in species diversity between habitat types and areas (outside/inside project footprint) were significant, analyses of similarity (ANOSIM) (Clarke 1993) comparisons were made using the two-way ANOSIM function in the PAST software package (Hammer *et al.* 2001). This would help determine whether habitat suitability for SRE communities was the same both inside. ANOSIM was calculated using the Bray-Curtis Similarity Index with 10000 permutations. Bray Curtis is a widely used and well-tested index for incidence data. The analysis was run without the inclusion of rare species, to avoid potential bias. "Rare" species were defined as those species found in only one sample, based on visual inspection of a histogram of species abundances.

Individual SRE Species and Habitat Dependance

A non-parametric ANOVA (Kruskall-Wallis test) was carried out on each individual species data set to detect differences in abundance between the four habitat types. One way ANOVA were not calculated because the assumptions for the parametric statistic were not fulfilled.

2.4.2 Part Two (Playa Survey)

2.4.2.1 Site Selection, Survey Timing and Intensity

Part Two of the survey involved sampling two playas (Playa A and Playa B) that are within the project area and the Yeelirrie Playa located approximately 30 km south east, and down stream of the proposed project. Ten sites at Yeelirrie Playa and five sites each at Playa A and Playa B were sampled for SRE invertebrates and are shown in Figure 2.2. Details and photos of each of the sites are provided in Appendices 1B and 3. Part two of the survey was undertaken in January to February 2010 (Table 2.4).

Table 2.4 – Survey Timing, Intensity and Methods used During Part Two

Location	Intensity	Timing	Methods Used
Playa A Inside project area	5 Sites PA1 – PA5	28 – 30 January 2010	Dry-pitfall trapping Sediment Collection

Location	Intensity	Timing	Methods Used
Playa B Inside project area	5 Sites PB1 – PB5	28 – 31 January 2010	Dry-pitfall trapping Night Foraging Sediment Collection
Yeelirrie Playa Outside project area	10 Sites YP1 – YP10	30 January – 3 February 2010	Dry-pitfall trapping Sediment Collection

2.4.2.2 Survey Methods

Dry Pitfall Trapping

Dry pitfall traps measuring 16 by 16 cm were used at every site. The traps were deployed in the same arrangement as the wet-pitfall traps used in Part One. To ensure animals did not die in the traps, the sites were deployed, checked and collected on different days.

Each pitfall trap was left out for two nights and was checked each morning for specimens. However, traps at Playa B were left out for three nights as rain on the first night flooded the traps causing them to be ineffective.

All potential SRE invertebrates were collected each morning and any other captured specimens were released.

Night Foraging

As most of the targeted terrestrial species are nocturnal, night foraging was undertaken at Playa B on one night during the field trip. Working approximately 10 m apart, the field team searched for invertebrates using hand-held and head torches. Any areas of vegetation within or around the edge of the playa were searched for any potential SRE specimens.

No further night foraging was undertaken due to wet weather conditions.

Specimens collected from all three methods were immediately placed in vials and preserved with absolute ethanol. Each specimen was labelled with the date, coordinates, trap number and the names of the collectors. The vials were then transported back to *ecologia*'s Perth laboratory for further sorting.

Sediment Collection

Yeelirrie Playa, Playa A and Playa B were dry when sampled, therefore in order to determine the array of aquatic species that may dwell in the lakes when inundated, sediment samples were collected for a simulated aquatic environment assessment at the *ecologia* laboratory.

Sediment was collected from a total of seven sites spread across Yeelirrie Playa, Playa A and Playa B. Sediment was collected from sites YP1, YP4, YP6, YP7 and YP10 from Yeelirrie Playa and one location each from Playa A and Playa B (Figure 2.3).

At Playa A and Playa B, one sample was collected from the deepest point of the clay pan (evident from a salt crust on the surface), the second sample from the edge of the clay pan and the third sample in between the first two where there was evidence of changes in the clay surface caused by previous water levels when the pan was flooded (Figure 2.3). As Yeelirrie Playa is much larger than Playa A and Playa B, samples were collected from the deepest point near the site; the highest point near the site where water would have collected (usually near vegetation); and a point in between the first two where there was evidence of changes in the clay surface caused by changing water levels (Figure 2.3).

At each point where a sample was collected, a 20 x 20 cm square was marked on the ground. Using a small, flat trowel, the top 3 cm of soil was collected from the square and placed in a brown paper bag. This bag was labelled and then placed in a plastic zip-lock bag. The sample was then placed in a secure eski and transported back to *ecologia*'s Perth laboratory for further processing. Care was taken to prevent the samples from becoming damp in order to stop any resting eggs or cysts from hatching.

At *ecologia*'s laboratory, each sediment sample was placed in an individual glass aquarium measuring 14 x 14 x 22 cm, with the sediment surface that faced upwards in the field also facing upwards in the tank (Plate 2.4). These tanks were filled up to 10 cm above the sediment level with distilled water and placed under full-spectrum lights. The lights were on a timer so they provided the samples with 18 hours of light in a 24-hour period. The samples were left for two weeks to allow any resting eggs or cysts to hatch and the animals to mature for identification. Care was taken at all times to ensure that dust and sediment from each sample did not contaminate any other samples.

There were no visible organisms after the two-week period, so measurements were taken of the water quality of each of the samples in order to determine whether any physio-chemical parameters were influencing the results. Measurements were taken using a 90 FL multi-parameter meter and the parameters measured included temperature, conductivity, dissolved oxygen, pH, total dissolved solids, percentage of dissolved oxygen and the oxygen reduction potential. The conductivity of the sample (a measure of salinity) was measured twice as it was thought that this factor may have the most influence over the presence of any organisms.

Due to the lack of visible organisms in the aquariums, the samples were sorted under an Olympus compound microscope. From each aquarium three water samples were collected, one from the top, middle and bottom of the water column just above the sediment. These samples were collected using a plastic pipette, mounted on a glass slide and examined under the microscope. This was repeated three times for each aquarium.

The sediment was then dried for one week and re-hydrated. The samples were left for three weeks before being processed using the same methods as previously described.

760000 770000 780000 790000 210000 220000 230000 240000

7010000 7000000 6990000 6980000 6970000

MGA ZONE 50
MGA ZONE 51

Yeelirrie Playa

YP8
YP6
YP10
YP7
YP4
YP3
YP5
YP9
YP2
YP1

Yeelirrie

Albion Downs

Playa A

PA4
PA5
PA3
PA1
PA2

Playa B

PB5
PB4
PB1
PB2
PB3

N

0 2.5 5 7.5 10

Kilometres

Datum: GDA94
Projection: MGA
Grid: MGA Grid Zone 50 and 51

Source:
Landsat, 2005 (Main Map)
SPOT, 2009 (Insets)

Legend

- Project Area
- Pit Outline
- Study Area
- Indicative Project Footprint
- Survey Site
- Homestead
- Non-perennial Lake

BHP Billiton Yeelirrie Development Company Pty Ltd

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Project: **Proposed Yeelirrie Development**

Title: Location of Survey Sites in Part Two - Playa Survey

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Job No.: 42907132	File No.: 42907132-SUS-215_RD.mxd	

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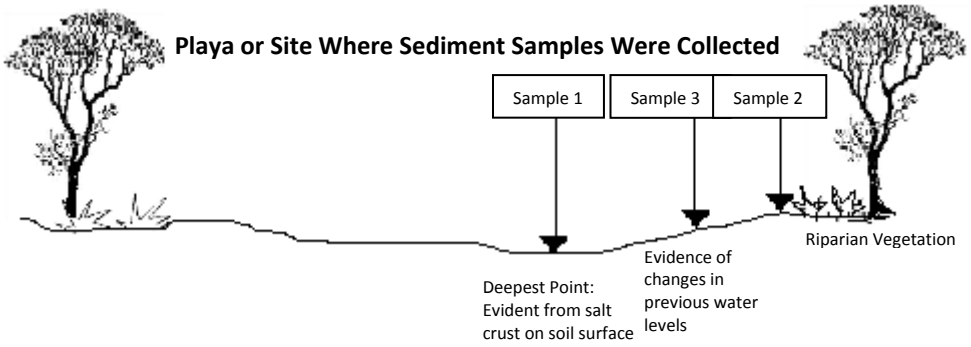

Figure 2.3 – Diagram Showing Position of Sediment Collection Samples

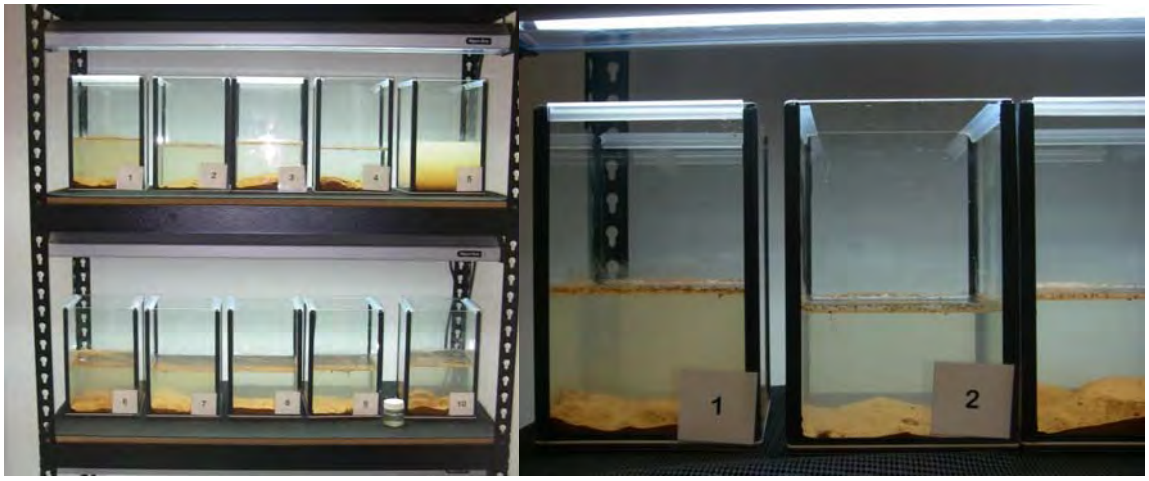

Plate 2.4 – Aquarium Set-up for Processing Sediment Samples

2.4.3 Part Three (*Idiosoma* sp. Targeted Survey)

Part Three consisted of a targeted survey for the trap-door spider species *Idiosoma* sp. Forty-five quadrats were selected from nine vegetation types and are shown in Figure 2.4 and described in Appendices 1C and 4. The nine vegetation types targeted were based on the vegetation types where SRE species had been collected during previous sampling. Ten quadrats in each vegetation type were selected based on the vegetation mapping conducted by Western Botanical (2011). Five quadrats from each vegetation type were then randomly selected using a random number generator. This *Idiosoma* sp. survey occurred during September 2010.

All fieldwork was conducted by invertebrate zoologists with previous experience of *Idiosoma* sp. This was extremely important given that *Idiosoma* species are a cryptic species group and the burrows are inconspicuous (Plate 2.5). All individuals involved in the survey spent sufficient time (5-10 hrs) developing a "search image" of the spider burrows before commencing field work. Locating burrows involved slowly walking through the quadrats while examining the ground for evidence of spider burrows (burrow characteristics include trapdoor lids and radial twig lining). Each quadrat measured 100 m by 100 m and was foraged individually by field staff along parallel transects, 10 m apart.

When active *Idiosoma* sp. burrow/s were detected, the tree under which the burrow/s was located was marked with flagging tape and the GPS coordinate of the tree recorded. As multiple burrows may be found underneath a single tree, each *Idiosoma* sp. waypoint may be representative of more that one individual spider.

One specimen was collected for formal identification and inclusion in an *Idiosoma* genus genetic study to be undertaken by the WAM of spiders.

The following data was collected on each transect within each quadrat when *Idiosoma* sp. burrows were found:

- GPS coordinates of a burrow / burrow cluster
- Number of burrows
- Measurement of the trap door (lid) diameter
- Measurement of the burrow lumen (atrium) diameter
- Soil type (1. fine sand, 2. coarse sand, 3. rocks/pebbles, 4. clay, 5. other)
- Aspect (1. hilltop, 2. slope, 3. foot, 4. plane)
- Estimate of the percentage of leaf litter cover
- Samples of vegetation under which burrows were found
- Photographs of burrows and overall habitats

Plate 2.5 – *Idiosoma* sp. Burrow

760000 770000 780000 790000 210000 220000 230000 240000

7010000 7000000 6990000 6980000 6970000

SANDSTONE WILUNA ROAD

MEEKATHARRA YEELIRRIE ROAD

ALTONA YEELIRRIE ROAD

MGA ZONE 50
MGA ZONE 51

Yeelirrie

Albion Downs

I41 I36 I32 I33 I31 I40 I27 I28 I43 I34 I42 I44 I25 I21 I24 I45 I39 I23 I08 I26 I09 I07 I37 I10 I38 I22 I02 I06 I03 I35 I04 I29 I30 I05 I01 I11 I12 I15 I13 I14 I18 I17 I19 I16 I20

N

0 2.5 5 7.5 10

Kilometres

Datum: GDA94
Projection: MGA
Grid: MGA Grid Zone 50 and 51

Source: Landsat, 2005

Legend

- Project Area
- Study Area
- Pit Outline
- Indicative Project Footprint
- Homestead
- *Idiosoma* sp. Survey Quadrat

BHP Billiton Yeelirrie Development Company Pty Ltd	Project: **Proposed Yeelirrie Development**		Title: Location of Sites in Part Three - Targeted *Idiosoma* sp. Survey
ecologia ENVIRONMENT	Drawn: AK/CJT	Approved: JN	Date: 21/01/2011
	Job No.: 42907132	File No.: 42907132-SUS-214_RD.mxd	Figure: 2.4
			Rev. D
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3 RESULTS

3.1 WAM DATABASE SEARCH RESULTS

The Malacology and Terrestrial Invertebrate electronic databases of the WAM identified a total 74 species in the database search of the area surrounding the project area (Section 2.1). Forty six species within these records potentially represent SRE species. The results from database searches are presented in Appendix 5.

Mygalomorph spiders were the most diverse group found in the database search representing five families, 10 genera and 41 species of which only two species are not considered to represent SREs.

Scorpions were the second most diverse group with 17 species from three genera and two families. Of these, only the 11 species of the family Urodacidae were considered to represent potential SREs however, the status of four of the species of the family Buthidae is unknown.

Six species of pseudoscorpion were found in the database search from four genera and three families. Two of the species (*Beierolpium* 'sp. 8/2' and *Beierolpium* 'sp. 8/3') were considered potential SREs and similar species were found during Part One of the survey. It is unknown whether the species from the database search and those collected during the survey are the same, until further research is conducted on this genus (pers. comm. V. Framenau 2010). It is unknown whether the two species of *Tyrannochthonius* represent SREs however some species of this genus are known to be widespread (pers. comm. M. Harvey 2010).

None of the four snail species from the family Pupillidae or the nine Scolopendrid centipedes were considered SREs.

3.2 CONSERVATION SIGNIFICANT FAUNA

The results of the DEC Naturemap search are provided in Appendix 6. A total of 18 species are listed by the *EPBC Act*, *WC Act* or DEC priority list to occur in the Midwest and Goldfields areas including three arachnid, four crustacean, ten insect and one mollusc species.

None of these species were found during the surveys completed for this report.

3.3 SURVEY ADEQUACY

3.3.1 Species Accumulation Curves/ Number of Samples

Species Accumulation Curve (SAC) through 50 randomisations of the sample sequence of the complete data set gave a smooth curve with little change in slope beyond approximately 24 samples (Figure 3.1). New species were accumulated at mean rates of 0.66 species per sample during the first ten samples, 0.44 species between the samples 10 to 24 where the curve brake point is; 0.23 species per sample between 24 and 62 samples, 0.14 species per sample between 62 and 114 samples and 0.11 species per sample during the final 10 samples. Michaelis-Menten estimator, used as stopping rule, that the survey was 67 % sufficient at the 24th sample. Furthermnore, 92 % sufficiency was approximated at the 124th sample for the entire dataset. These results confirm the confidence of the survey efficiency.

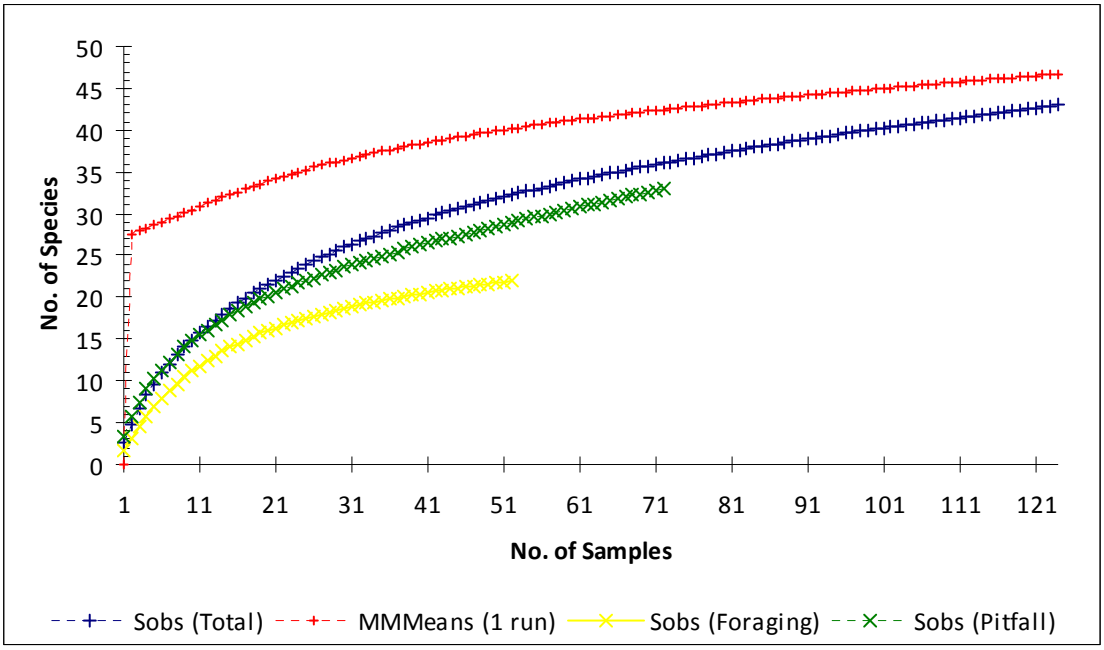

Figure 3.1 – SAC of the SRE Fauna Data Using the Observed Number of Species (Sobs Mao Tau) for foraging, pitfall and combined methods and Michaelis-Menten Enzyme Kinetic Curve as a Stopping Rule

As typical in SRE surveys, many species were recorded in low abundance, being represented only by singletons and doubletons (Figure 3.2). Rarity makes it difficult to determine their distribution across the area. The only potential SRE species represented by a singleton were the spiders Barychelidae, *Kwonkan* 'MYG 171', *Kwonkan* 'MYG 172' and *Idiosoma* sp., the isopods *Cubaris* sp. 1 and *Pseudolaureola* sp. and the pseudoscorpion Cheriidae. Approximately 46 % of the species are confirmed as having distribution spanning two or more sites.

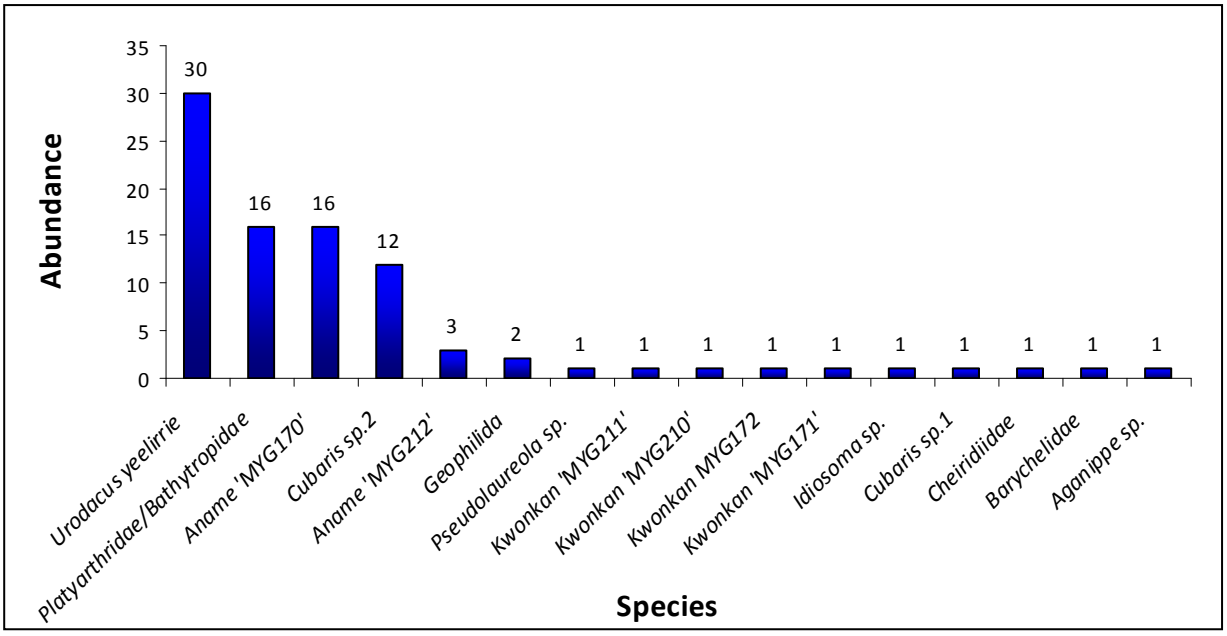

Figure 3.2 – Abundance Histogram of SRE Groups in pitfall samples

3.3.2 Collection Method Efficiency

The efficiency of the methods employed during the survey (pitfall traps and foraging) differs significantly in species richness ($p \leq 0.005$) and abundance ($p \leq 0.005$). Pitfall traps producing the highest species richness and abundance.

Incidence is the presence of at least one individual of a species in a sample. Species collected more frequently by a particular method than by other methods would provide another indication that the method is more reliable. Spiders, scorpions and isopods were collected more frequently by wet-pitfall trapping than by foraging; however foraging was more effective in the collection of snails and pseudoscorpions.

3.4 PART ONE SURVEY RESULTS (BASELINE SURVEY)

A total of 1679 invertebrate specimens were collected during Part One of the survey. These individuals represented 6 orders, 16 families, 26 genera, and at least 42 species of invertebrates. A summary of the survey results from Part One are presented in Appendices 7A to 7E and the distribution of the species is shown in Figure 3.3.

Three confirmed and 13 potential SRE species were recorded during the survey including Mygalomorph spiders, scorpions, pseudoscorpions and isopods (Table 3.1). Five of these species (*Aganippe* sp., *Kwonkan* 'MYG210', *Kwonkan* 'MYG211', *Cubaris* sp. 2 and *Idiosoma* sp.) have been collected outside the project footprint.

Table 3.1 – SRE and Potential SRE Species Collected During Part One

Taxa	Species	Sites Collected	Habitat Types	Collected Outside the Project Footprint (Y/N)
Mygalomorph Spiders	*Aganippe* sp.	A10	Hardpan Mulga	Yes (Wellfield Survey)
	Aname 'MYG170'	T04, T05, T06, T07, T13, T14, T15	Calcrete Calcrete Outwash Hardpan Mulga	No
	Aname 'MYG212'	F08, F09, A08	Calcrete Outwash	Yes (Wellfield Survey)
	Barychelidae	T17	Calcrete Outwash	No
	Idiosoma sp.	O04	Mixed Shrubs over Spinifex Sandplain	Yes
	Kwonkan 'MYG171'	T11	Hardpan Mulga	No
	Kwonkan 'MYG172'	T01	Calcrete	No
	Kwonkan 'MYG210'	A10	Hardpan Mulga	Yes (Wellfield Survey)
	Kwonkan 'MYG211'	A11	Hardpan Mulga	Yes (Wellfield Survey)
Scorpion	*Urodacus* 'yeelirrie'	F04, F29, T08, T17, O03, O05, O06, A05, A14, A19	Calcrete Calcrete Outwash Hardpan Mulga	Yes
Pseudoscorpion	Cheiridiidae	T18	Calcrete Outwash	No
Isopods	*Cubaris* sp. 1	T07	Calcrete	No
	Cubaris sp. 2	O04, O07, O12, A07	Hardpan Mulga Mixed Shrubs over Spinifex Sandplain	Yes
	Platyarthridae/Bathytropidae	F11, T01, T02, T03, T07, T14, T20	Calcrete Calcrete Outwash Hardpan Mulga	No
	Pseudolaureola sp.	T04	Calcrete Outwash	No
Chilopod	Geophilida	F25, T11	Hardpan Mulga	No

760000 770000 780000 790000 210000 220000 230000 240000

7010000 7000000 6990000 6980000 6970000

MGA ZONE 50 MGA ZONE 51

Urodacus 'yeelirrie'
Cubaris sp. 2
Idiosoma sp.
Cubaris sp. 2
Urodacus 'yeelirrie'
Urodacus 'yeelirrie'
Urodacus 'yeelirrie'
Cubaris sp. 2
Cubaris sp. 2
Urodacus 'yeelirrie'
Aname 'MYG212'
Aganippe sp.
Kwonkan 'MYG210'
Urodacus 'yeelirrie'
Kwonkan 'MYG211'
Yeelirrie Homestead
Albion Downs
Inset

MEEKATHARRA-YEELIRRIE ROAD

Aname 'MYG 170'
Aname 'MYG 170'
Cheiridiidae
Geophilida
Pseudolaureola sp.
Aname 'MYG 170'
Aname 'MYG212'
Platyarthridae
Aname 'MYG 170'
Aname 'MYG 170'
Aname 'MYG 170'
Cubaris sp. 1
Platyarthridae
Platyarthridae
Platyarthridae
Platyarthridae
Urodacus 'yeelirrie'
Urodacus 'Yeelirrie'
Barychelidae
Urodacus 'yeelirrie'
Kwonkan 'MYG 172'
Platyarthridae
Platyarthridae
Kwonkan 'MYG 171'
Geophilida
Aname 'MYG212'
Inset

N

0 2.5 5 7.5 10

Kilometres

Datum: GDA94
Projection: MGA
Grid: MGA Grid Zone 50 and 51

Source: Landsat, 2005

Legend

- Project Area
- Pit Outline
- Indicative Project Footprint

Species

- *Aganippe* sp.
- *Aname* 'MYG 170'
- *Aname* 'MYG212'
- Barychelidae
- Cheiridiidae
- *Cubaris* sp. 1
- *Cubaris* sp. 2
- Geophilida
- *Idiosoma* sp.
- *Kwonkan* 'MYG 171'
- *Kwonkan* 'MYG 172'
- *Kwonkan* 'MYG210'
- *Kwonkan* 'MYG211'
- Platyarthridae
- *Pseudolaureola* sp.
- *Urodacus* 'yeelirrie'

Fauna Habitat derived from Western Botanical (Bamford, 2011)

- Bare
- Calcrete
- Calcrete Outwash
- Chenopod shrubland over sandplain
- Disturbed Area
- Granite Outcrops and Breakaways
- Hardpan Mulga
- Mixed Shrubs over Spinifex sandplains

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Project: **Proposed Yeelirrie Development**

Title: Location of SRE and Potential SRE Specimens Collected During Part One

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3.4.1 Arachnida (Mygalomorphae)

A total of 35 specimens of Mygalomorph spiders have been collected from the survey. These individuals represent four families, six genera and 10 species. Nine species from these surveys are either confirmed SREs or potential SREs (Harvey and Framenau 2009; Framenau and Harvey 2010b, c, d, e). As identified in Table 3.1, four of these specimens including *Aname* 'MYG170', Barychelidae, *Kwonkan* 'MYG171' and *Kwonkan* 'MYG172' were found only within the project footprint.

Family Barychelidae

Synothele* or *Aurecocrypta

A single juvenile specimen presumably belonging to the genera *Synothele* or *Aurecocrypta* was collected at site T17, within Calcrete Outwash habitat, within the project footprint.

Members of the family Barychelidae appear to have very restricted distribution (Raven 1994) however, mature male specimens are required for accurate species identification and assessment of the distribution and conservation status of this species. Due to this species' restricted distribution, this juvenile specimen is assumed to be a SRE (Framenau and Harvey 2010c).

Family Dipluridae

***Cethegus* sp.**

Two female *Cethegus* specimens were excavated from sites F01 and F08. They are known as curtain-web spiders due to the shape of their webs, which consist of numerous strands of silk hanging across the entrance of their burrows (Framenau and Harvey 2010d).

The genus *Cethegus* is represented in Western Australia by one named species, *C. fugax*, and several unnamed species. Although further identification is not possible because the specimens are female, based on the distribution of other species of this genus it is unlikely that they represent a SRE species (Framenau and Harvey 2010d).

Family Idiopidae

***Aganippe* sp.**

One female specimen from the genus *Aganippe* was collected during the survey from site A10 within the Hardpan Mulga habitat. This genus is widespread in Australia and most abundant in woodland and semi-arid regions and build burrows with a true trapdoor and often a collar of twig-lines (Framenau and Harvey 2010e). As the specimen collected was female, it is not able to be identified and it is unknown whether this represents a known species. It is possible that this species represents a SRE (Framenau and Harvey 2010e).

***Idiosoma* sp.**

One specimen of *Idiosoma* sp. was excavated at site O04, located approximately 20 km north west of the project footprint. The specimen was found to be associated with Mixed Shrubs over Spinifex Sandplains. It was originally thought that the specimen collected may represent *Idiosoma nigrum*, a listed Schedule 1 species under the 1950 *Wildlife Conservation Act* (Framenau and Harvey 2010d) as such a targeted survey for *Idiosoma* sp. was undertaken, these results are discussed in Section 3.7. It was later determined that the species did not represent *I nigrum* but a closely related species which is not listed. Despite these findings, *Idiosoma* sp. is considered a SRE species (pers. comm. V. Framenau).

Family Nemesiidae

***Aname* 'MYG170'**

The genus *Aname* currently includes 33 named species in Australia and is well represented by four named and numerous unnamed species from many different regions in Western Australia. Sixteen specimens of *Aname* 'MYG170' were collected at sites T04, T05, T06, T07, T13, T14 and T15, all of which are located within the project footprint. The specimens were found in a variety of habitats including Calcrete, Calcrete Outwash and Hardpan Mulga.

The species collected during the survey is not represented in the reference collection of WAM and potentially represents a SRE species (Framenau and Harvey 2010c).

***Aname* 'MYG212'**

Two individuals from sites F08 and F09 were collected by excavating the spider burrows during Phase 1 but could not be identified as they were females. However, during Phase 5 a single male specimen was collected from site A08 and confirmed to represent the same species (Framenau and Harvey 2010e). *Aname* 'MYG212' is a new species in the WAM collection and is morphologically similar to *A. mainae* but very different from other *A.* 'MYG170' also collected in the project area (Framenau and Harvey 2010e). This species is considered a potential SRE species (Framenau and Harvey 2010e).

This species was found in the habitat types Calcrete Outwash and Mixed Shrubs over Spinifex Sandplains.

***Aname* sp.**

Two specimens of *Aname* were collected at sites A12 and A15. These specimens were female or juvenile and could not be identified to species level and it is unknown whether they represent *Aname* species previously collected in the survey (Framenau and Harvey 2010e).

***Kwonkan* 'MYG171'**

The genus *Kwonkan* is restricted to Western Australia and currently includes six named species. All of these are currently known for their type specimen only. One specimen of *Kwonkan* 'MYG171' was collected at site T11 Hardpan Mulga habitat, located on the southern edge of the project footprint. It is possible that the species is a SRE (Framenau and Harvey 2010c).

***Kwonkan* 'MYG172'**

One individual of the species *Kwonkan* 'MYG172' was recorded at site T01 in Calcrete habitat within the project footprint. This species was not previously part of the WAM reference collection and may represent a SRE (Framenau and Harvey 2010c).

***Kwonkan* 'MYG210'**

One specimen of *Kwonkan* 'MYG210' was collected at site A10, located on the edge of the project area in Hardpan Mulga habitat. This species is much smaller than *K.* 'MYG171' and *K.* 'MYG172' and is morphologically unusual in that tarsal spines are restricted to one leg (Framenau and Harvey 2010e). This species was not previously part of the WAM collection and is considered a potential SRE species (Framenau and Harvey 2010e).

***Kwonkan* 'MYG211'**

One specimen of *Kwonkan* 'MYG211' was collected at site A11, located outside the project area, approximately 2.5 km north of the Yeelirrie Playa within Hardpan Mulga Habitat. This species is

similar to *K.* 'MYG210' in that it is a small species with tarsal spines on one leg (Framenau and Harvey 2010e). This species was not previously part of the WAM collection and is considered a potential SRE species (Framenau and Harvey 2010e)

Nemesiidae sp.

Five specimens from the family Nemesiidae were collected outside the project footprint at sites O04, O06, O08 and O10. These spiders could not be identified further as all collected specimens were juveniles, therefore it is not known if they represent any of the *Aname* or *Kwonkan* species previously collected (Framenau and Harvey 2010d).

3.4.2 Arachnida (Scorpiones)

A total of 103 scorpion specimens were collected during the survey. These specimens included eight species and three genera from the two families Buthidae and Urodacidae. Only one species (*Urodacus* 'yeelirrie') is considered a potential SRE.

Family Buthidae

***Isometroides* sp.**

A total of eight specimens from the genus *Isometroides* were collected during the survey from sites T05, T08, T09, T10, T12, T15 and T17.

The family Buthidae is the most diverse and wide spread of all scorpion families. In Western Australia, Buthidae is represented by the genera *Isomerus, Isometroides* and *Lychas*. Most Australian Buthid species appear to have wide distributions however, a few taxa have confirmed SRE distributions (Volschenk 2010b).

The taxonomy of the genus *Isometroides* is poorly known with only two currently recognised species, however most morpho-species appear to have wide distributions so the specimens collected are unlikely to be a SRE (Volschenk 2010b).

***Lychas* 'adonis'**

Ten specimens of *Lychas* 'adonis' were collected at sites O10, A04 and A20. This species has a wide distribution across arid Australia and numerous arid habitats from sparse Mallee forests to Spinifex covered dunes and sand plains. This species has been recorded from Victoria, South Australia and Western Australia and is therefore not considered to be a SRE (Volschenk 2010a, c).

***Lychas* 'annulatus'**

Eleven specimens of *Lychas* 'annulatus' were collected from sites O04, O07, O10, A02, A04, A08, A12 and A17. This species has wide distribution across arid Australia, having been recorded from Victoria, South Australia and Western Australia. This species is not considered to be a SRE (Volschenk 2010a, c).

Lychas jonesae

Specimens of *Lychas jonesae* were collected at sites T09, T10, T11, T12 and O08. This species has a wide distribution across arid Australia and has been collected from Victoria, South Australia and other areas in Western Australia (Volschenk 2010b). This species does not represent a SRE (Volschenk 2010a, c) species.

***Lychas* 'multipunctatus'**

One specimen of *Lychas* 'multipunctatus' was recorded from site A17. This species has been recorded widely throughout the Pilbara region and is not currently considered to represent a SRE species (Volschenk 2010c).

Family Urodacidae

***Urodacus* 'gibson 3'**

A total of 20 specimens of *Urodacus* 'gibson3' were collected during the survey from sites T08, T11, T12, T15, T17 and A18.

The family Urodacidae is endemic to Australia where it is represented by the genera *Urodacus* and *Aops*. *Urodacus* is very widespread and most diverse in Western Australia and is only absent from Tasmania. Currently 22 species of *Urodacus* are described, however many species remain undescribed.

This species is undescribed but has been collected several locations including the Laverton area and around Mt Gibson (Volschenk 2010b). This species is not considered to be a SRE (Volschenk 2010b, c).

Urodacus yaschenkoi

Six specimens of *Urodacus yaschenkoi* were collected using burrow pitfall traps from sites F04, F29 and O11. This species has a wide distribution across arid Australia and has been recorded from Victoria, South Australia and Western Australia (Volschenk 2010b). This species is therefore not considered to be a SRE (Volschenk 2010b).

***Urodacus* 'yeelirrie'**

Thirty specimens of *Urodacus* 'yeelirrie' were collected during the survey from sites F04, F29, T08, T17, O03, O05, O06, A05, A14 and A19 This species was found in a wide variety of habitat types and both inside and outside the project footprint including Calcrete, Calcrete Outwash and Hardpan Mulga.This species is undescribed, has only been collected from Yeelirrie and Lake Way and is considered a potential SRE species (Volschenk 2010b).

3.4.3 Arachnida (Pseudoscorpiones)

Pseudoscorpions from six families were collected during the survey representing at least 13 species. One of the species (Cheiridiidae sp.) may represent a SRE species, but the group is not well studied in Australia making it difficult to determine its conservation status (Framenau and Harvey 2010d, c).

Family Atemnidae

***Oratemnus* sp.**

Twenty seven specimens from the genus *Oratemnus* were collected during the survey from sites F03, F04, F11, F30, T10, T11, T12 and T17.

Atemnids are frequently found under the bark of trees in Western Australia, but the systematics of the group, particularly of the genus *Oratemnus*, is uncertain and the taxonomy of individual species is unclear. However, based upon current evidence, it seems that most species will eventually be found to be widely distributed and are unlikely to be classified as SREs (Harvey and Framenau 2009).

Family Cheiridiidae

One specimen from the family Cheridiidae was collected at site T18 in Calcrete Outwash Habitat. Pseudoscorpions from this family are usually restricted to tropical regions although some species are found in temperate zones (Framenau and Harvey 2010c). The specimen from Yeelirrie most likely represents a new species and because of its small size it is difficult to ascertain whether it is the same species as other cheiridiids collected elsewhere in Western Australia (Framenau and Harvey 2010c). This species, currently located only within the project footprint and could be considered a SRE (Framenau and Harvey 2010c).

Family Chernetidae

The family Chernetidae is very diverse with 37 described species from Australia and 652 described species worldwide (Harvey and Framenau 2009).

Specimens from this family were collected from sites F07, F08, F12, F13, F14, T02, T14 and T18 and may represent up to four species. The species collected are not considered to be SREs as species from this family tend to have wide distributions (Harvey and Framenau 2009; Framenau and Harvey 2010c).

***Nesidochernes* sp.**

A single specimen of *Nesidochernes* sp. was collected from outside the project footprint at site O04. This specimen belongs to a species that is very widely distributed in southern Australia, which may be conspecific with *N. australicus*, originally described from New South Wales (Framenau and Harvey 2010d). This species is not considered to be a SRE (Framenau and Harvey 2010d).

Family Garypinidae

***Amblyolpium* sp.**

Pseudoscorpions from the genus *Amblyolpium* are found throughout the world, however there are currently no described species in Australia. Specimens from this genus were collected from four sites during phase 1 (F12, F14, F24 and F29). They appear to be very similar to specimens collected in south-western Australia and therefore are not considered to be SREs specimens (Harvey and Framenau 2009).

Family Geogarypidae

***Geogarypus* sp.**

A single specimen of *Geogarypus* sp. was collected during the survey from site A20. Although it is not certain which species of *Geogarypus* was found, it appears that all Australian species of this family have widespread distributions and are therefore not considered to be SRE specimens (Framenau and Harvey 2010e).

Family Olpiidae

***Austrohorus* sp.**

Specimens from the genus *Austrohorus* were collected at sites F04, F06, F10, F13, T02, T07, T11, T12, T17, O02, O07, A01, A02, A03, A05, A07, A08 and A10 both inside and outside the project footprint. They appear to be very similar to samples collected elsewhere in Western Australia, including the Pilbara region (Framenau and Harvey 2010c). Initially it was unknown if this species represented a SRE however, based upon current evidence, it seems that most species will eventually be found to be widely distributed and are unlikely to be SRE species (pers. comm. V. Framenau May 2010).

***Beierolpium* 'sp. 8/2'**

Specimens from the genus *Beierolpium* were collected both inside and outside the project footprint from sites F01, F02, F03, F05, F07, F08, F10, F15, F25, F29, O02, O03, O04, O05, O06, O07, O08, O10, O11 and O12. Initially it was unknown if this species represented a SRE however, based upon current evidence, it seems that most species will eventually be found to be widely distributed and are unlikely to be considered SRE fauna (pers. comm. V. Framenau May 2010).

***Beierolpium* 'sp. 8/3'**

Specimens from the genus *Beierolpium* were collected both inside and outside the project footprint from sites T01, T02, T05, T06, T07, T09, T14, T16, T17, T20, O03, A02, A03, A04, 05, A08, A09, A10, A11, A12, A14, A15, A16, A17, A19, A20. These specimens are different from *B.* 'sp. 8/2' because of pedipalp setation (Framenau and Harvey 2010c). Initially it was unknown if this species represented a SRE however, based upon current evidence, it seems that most species will eventually be found to be widely distributed and are unlikely to to be considered SRE fauna (Framenau and Harvey 2010e).

***Indolpium* sp.**

Two hundred and seventy one specimens from the genus *Indolpium* were collected at sites T02, T05, T06, T08, T10, T11, T12, T13, T15, T16, T17, T19, T20, A07, A08, A11, A13, A14, A18 and A19. These were the most abundant pseudoscorpions collected, with site T12 (immediately south of the project footprint) recording 143 individuals. These specimens are very similar to specimens collected elsewhere in Western Australia suggesting that this species does not represent SRE fauna (Framenau and Harvey 2010c).

3.4.4 Crustacea (Malacostraca: Isopoda)

Six species of isopod were collected during the survey. The specimens comprise two families, Armadillidae and Platyarthridae/Bathytropidae. Four of these species (Platyarthridae/Bathytropidae sp., *Cubaris* sp.1, *Cubaris* sp.2 and *Pseudolaureola* sp.) may represent SRE fauna (Judd 2010a, b). Two of these species, specifically *Cubaris* sp.1 and *Pseudolaureola* sp. were found only within the project footprint.

Family Armadillidae

***Buddelundia* sp.**

A total of 340 specimens from the genus *Buddelundia* were collected from sites F11, F24, F25, T01, T02, T03, T04, Y05, T06, T07, T09, T10, T11, T12, T13, T14, T15, T16, T17, T20, O08, A02, A12, A17, and A20. This species was the most abundantly collected during the surveys.

Initially it was thought that this species may represent a SRE however, the specimens collected during phase 2 were adults and able to be identified to an undescribed but common and widespread species (Judd 2010a). These specimens do not represent SRE fauna (Judd 2010a).

***Cubaris* sp. 1**

One specimen from the genus *Cubaris* was collected from site T07. This site is located within the project footprint and in the Calcrete Habitat. Very few species have been described from the family Armadillidae and it is likely that the specimen collected represents a new genus (Judd 2010a). Similar isopods have been collected from Western Australia but are never common or widespread. This species is considered a potential SRE (Judd 2010a).

***Cubaris* sp. 2**

Specimens of *Cubaris* sp. 2 were collected from sites O04, O07, O12 and A07 in two habitat communities including Hardpan Mulga and Mixed Shrubs over Spinifex Sandplains. These specimens differ enough in shape from the *Cubaris* sp. 1, collected previously, to be considered a different species. Similar isopods have been collected from Western Australia but are never common or widespread and therefore this species is considered a potential SRE (Judd 2010b).

***Pseudolaureola* sp. nov.**

One specimen of the genus *Pseudolaureola* was collected from site T04 in the Calcrete Outwash Habitat. The specimen is thought to be a new undescribed species.

The species is considered relic taxa of the Gondwanic rainforest and the whole genus comprise of SRE species, therefore it is highly likely that this species is also a SRE (Judd 2010a).

***Sperillo* sp.**

An undescribed species of the genus *Spherillo* was the second most abundant species recorded within the project area with a total of 302 specimens collected. *Sperillo* specimens were collected from sites F04, F08, F14, F23, F25, T01, T02, T03, T04, T05, T06, T07, T08, T09, T10, T12, T13, T14, T15, T16, T18, T20, O01, O07, O09, O11, O12, A06, A08, A09, A13, A15 and A18. These specimens belong to an undescribed species but are commonly found in Western Australia including just north of Perth (Judd 2010a). This species is not considered to be a SRE (Judd 2010a).

Family Platyarthridae/Bathytropidae

Gen. nov. sp. nov.

Sixteen specimens were collected at sites F11, T01, T02, T03, T07, T14 and T20. These locations occur within the project footprint and were found within the Calcrete, Calcrete Outwash and Hardpan Mulga habitats. It is likely that the specimens represent a new genus and a new species from the family Platyarthridae/Bathytropidae. These families are poorly known in Australia and Western Australia with only one described species from each family (Judd 2009). These specimens are considered to be an ancient Gondwanic group and all of the previous examples of this morphology have been considered a SRE. Likewise, this species is considered to be a SRE (Judd 2009).

3.4.5 Mollusca (Snails)

All of the specimens collected during the survey are considered to be indigenous to Western Australia and belong to the terrestrial snail family Pupillidae and to the genera *Pupoides* and *Gastrocopta* (Whisson and Slack-Smith 2009). The family Pupillidae is found almost worldwide although, in Western Australia the pupillid fauna has been poorly collected with the exception of coastal and inland corridors of main roads (Whisson and Slack-Smith 2009). From the current knowledge, the identification experts have no reason to believe that any of the specimens should be considered to be SRE fauna (Whisson and Slack-Smith 2009).

Family Pupillidae

Gastrocopter bannertonensis

A total of 39 specimens that closely resemble the species *Gastrocopta bannertonensis* were collected during the survey from sites F04, F13, F24, F30 and A20. This species has a wide geographical distribution in southern Australia with records from the southern regions of Western Australia, South Australia and New South Wales. There is also a record of this species from Alice Springs in the Northern Territory (Whisson and Slack-Smith 2009). This species is therefore not considered to be SRE fauna (Whisson and Slack-Smith 2009).

Pupoides* sp. cf. *P. adelaidae

Several specimens collected from sites F05, F07, F12, F14, F15, F23 F24, F25, T04 and T07 most closely resemble the species *Pupoides adelaidae*. *Pupoides adelaidae* has a wide geographical distribution that extends from New South Wales and north-western Victoria, across southern South Australia into the wheatbelt areas of Western Australia (Whisson and Slack-Smith 2009). This species is not considered to be SRE fauna (Whisson and Slack-Smith 2009).

Pupoides* sp. cf. *P. myoporinae

Several specimens collected during the survey from sites F07, F08, F12, F14, F15, F23, F24, F25, F29, T01 and T20 most closely resemble the species *Pupoides myoporinae* (Whisson and Slack-Smith 2009). This species also has a wide geographical distribution across most of southern Australia, with scattered populations extending westwards from Yalata in South Australia to Hines Hill in Western Australia. These specimens represent a significant range extension of *P. myoporinae* inland and do not represent a SRE species (Whisson and Slack-Smith 2009).

3.4.6 Myriapoda (Chilopoda)

Order Geophilida

Two specimens of Geophilid centipedes were collected during the survey from sites F25 and T11, within the Hardpan Mulga habitat. Both sample sites are located within the project footprint; however these vegetation communities also occur outside the project footprint. Geophilid centipedes are very difficult to identify as their taxonomy is poorly known in Western Australia (Framenau and Harvey 2010c). Furthermore, the conservation status of the specimens from Yeelirrie is unknown but it is possible that they represent a SRE species (Framenau and Harvey 2010c).

3.5 HABITAT CORRELATION

3.5.1 Habitat Correlation SRE Assemblage

Five different habitats occur within the project area and four of these were sampled for SRE species during Part One. The results of this survey indicate that the Hardpan Mulga supports the most diverse range of SRE species (9) followed by the Calcrete Outwash (7), Calcrete (5) and Mixed Shrubs over Spinifex Sanplains (3) (Figure 3.4). However, the Calcrete was the most abundant in SREs with 27 specimens collected in this habitat followed by the Hardpan Mulga (26), Calcrete Outwash (20) and finally Mixed Shrubs over Spinifex Sanplains (14) (Figure 3.4). All of these habitat types extend outside the project footprint.

Five species: *Aganippe* sp., Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG210' and *Kwonkan* 'MYG211' were unique to the Hardpan-Mulga habitat. Two species: *Cubaris* sp. 1 and *Kwonkan*

'MYG172' were exclusively found on the Calcrete habitat. Three species: Barychelidae, Cheiridiidae and *Pseudolaureola* sp. were unique of the Calcrete Outwash. One species: *Idiosoma* sp. was unique of the Mixed Shrubs over Spinifex Sandplains. However, according to the ANOVA test on the utilisation-availability data, there was no statistically significant difference between habitats types and species richness (F= 2.32, P=0.083, DF 3) and abundance (F= 2.03, P> 0.118, DF 3). All four of the sampled habitats are well distributed outside of the project footprint.

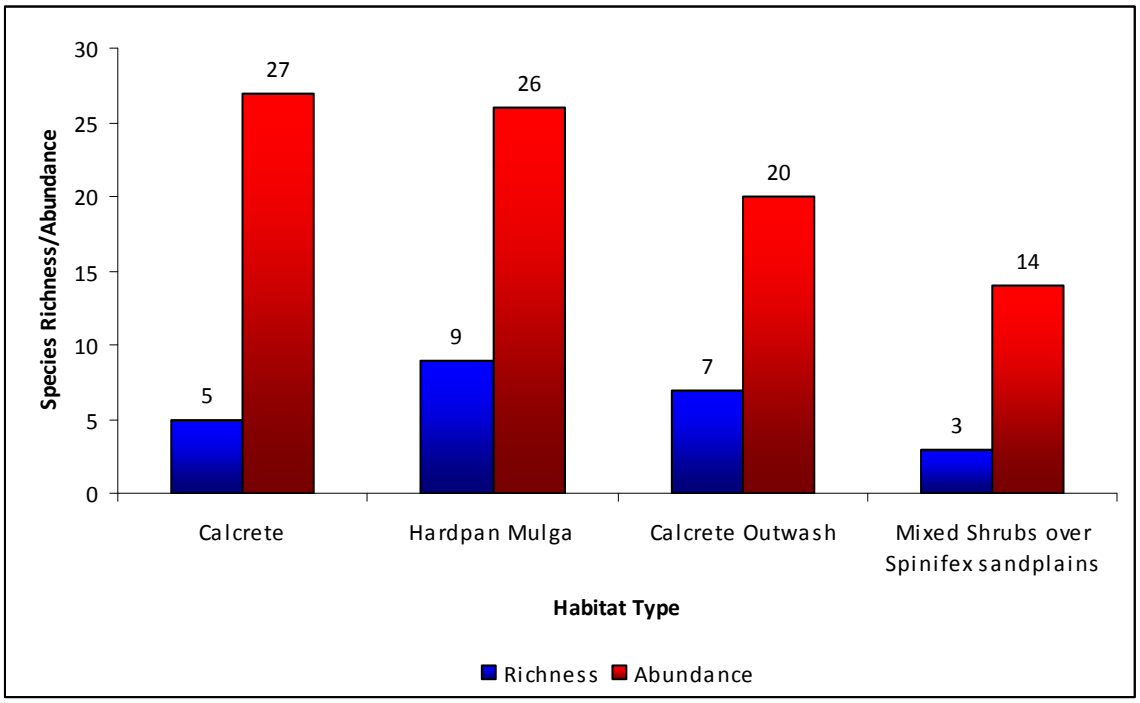

Figure 3.4 – Number SRE Species (blue) and Specimens (red) Sampled in the Four Habitat Types.

A multivariate two-way ANOSIM test did not show statistical differences among the four habitat types (R= 0.0057; P= 0.409) or between the areas (inside-outside footprint area) (R= 0.076; P= 0.86). Visual inspection of the ordination diagram (Figure 3.5) showed six clusters within each are different sites representing different habitat types in and out the project footprint area. The superposition of samples in the plot was due to severeal samples with only one SRE group and very similar density.

It can be reasonably inferred that the SRE assemblage identified in this study is not associated with specific area or habitat i.e. each habitat type supports the same species diversity but not necessarily the same species.

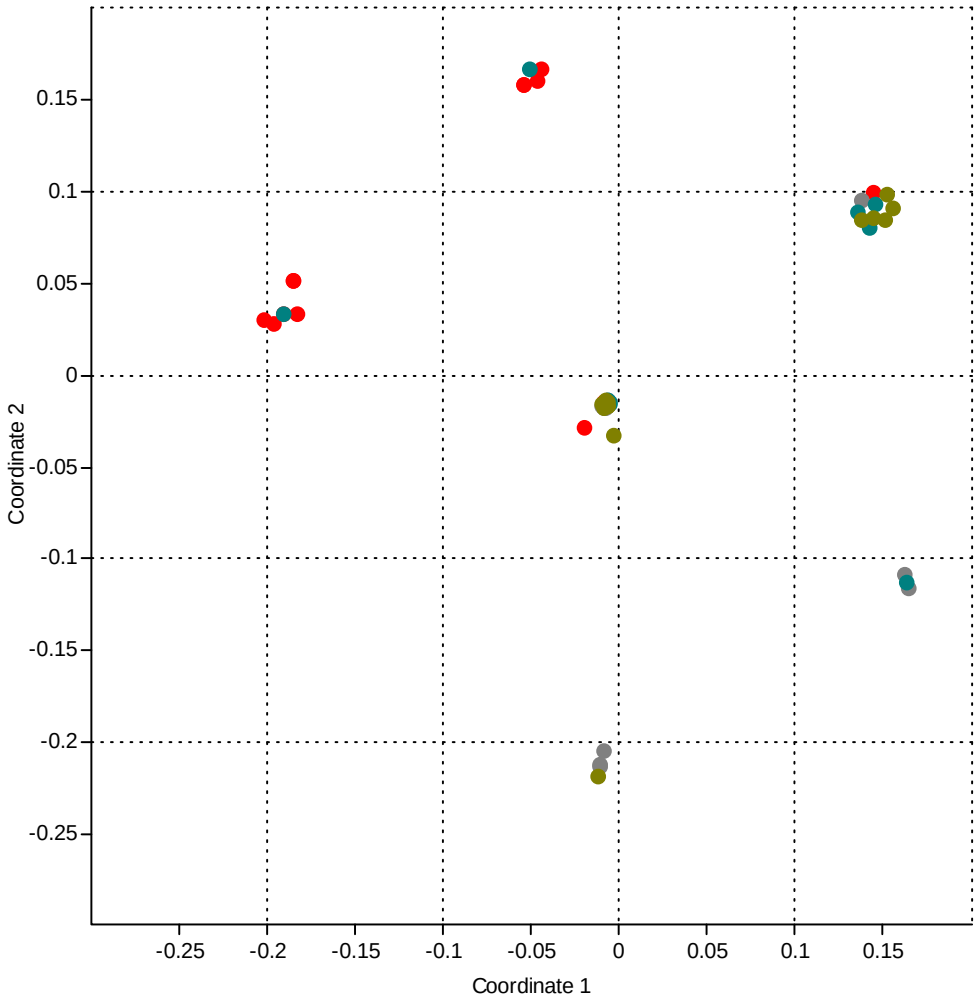

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Figure 3.5 – Ordination Diagram Non-metric multidimensional scaling of SRE Assamblage(Raup-Crick distance measure) differentiating calcrete (red), mixed shrubs over Spinifex sandplains (grey), harplain Mulga (olive) and calcrete outwash (green).. Each symbol represents a single collection sample. Rare species (singletons) were removed prior to analysis.

3.5.2 Habitat Dependance of SRE Species Abundance

The Kruskall-Wallis test on habitat dependence of SRE species abundance is shown in Table 3.2. The results indicate that three species (*Aname* 'MYG170', Platyarthridae/Bathytropidae and *Urodacus* 'yeelirrie') are depandant on the habitat for species abundance. These species have been collected from three habitat types however the population demonstrates a preference for a particular community by being more abundant (*Aname* 'MYG170' – Calcrete, Platyarthridae/Bathytropidae – Calcrete Outwash, *Urodacus* 'yeelirrie' – Hardpan Mulga).

The other 13 species recorded not significant results. All of these species were collected in low numbers and therefore the results do not necessarily indicate that species abundance is not dependant on habitat type i.e. if a single specimen is collected this does not indicate that it is only found in that particular habitat but indicates that the species is very cryptic.

Table 3.2 – Habitat Dependance of SRE Species Abundance

Species	Test Value[1]	Test Significance[2]	Comments[3]
Aganippe sp.	3.24	N.S.	Low number of specimens collected
Aname 'MYG 170'	12.39	$p \leq 0.05$	Species abundance is dependant on habitat type
Aname 'MYG212'	3.46	N.S.	Low number of specimens collected
Barychelidae	5	N.S.	Low number of specimens collected
Cheiridiidae	5	N.S.	Low number of specimens collected
Cubaris sp. 1	2.43	N.S.	Low number of specimens collected
Cubaris sp. 2	4.7	N.S.	Low number of specimens collected
Geophilida	1.86	N.S.	Low number of specimens collected
Idiosoma sp.	2.27	N.S.	Low number of specimens collected
Kwonkan 'MYG171'	3.24	N.S.	Low number of specimens collected
Kwonkan 'MYG172'	2.43	N.S.	Low number of specimens collected
Kwonkan 'MYG210'	3.24	N.S.	Low number of specimens collected
Kwonkan 'MYG211'	3.24	N.S.	Low number of specimens collected
Platyarthridae/Bathytropidae	12.14	$p \leq 0.05$	Species abundance is dependant on habitat type
Pseudolaureola sp.	5	N.S.	Low number of specimens collected
Urodacus 'yeelirrie'	7.53	$p \leq 0.05$	Species abundance is dependant on habitat type

[1]Value of the Kruskall-Wallis test

[2]n.s. = statistically not significant differences; $p \leq 0.05$ = statistically significant differences (suggesting that species abundance is dependant on habitat type)

[3]If low numbers of specimens were collected, an n.s. result does not necessarily mean that the species abundance is not associated with habitat type but may be caused by species rarity.

3.6 PART TWO SURVEY RESULTS (PLAYA SURVEY)

A total of 108 terrestrial invertebrate specimens representing eight orders, 21 families, 21 genera and 21 species were collected during Part Two of the survey at the Yeelirrie Playa and two other clay pans (Appendix 8). Although there was relative high diversity, only one confirmed SRE species (tiger beetle, *Pseudotetracha helmsi*) and one potential SRE species (trap-door spider, *Kwonkan* 'MYG172') were collected during the survey (Figure 3.7). *Pseudotetracha helmsi* was collected from three sites at Yeelirrie Playa and *Kwonkan* 'MYG172' was collected from Playa B and during the Part One survey.

3.6.1 Arachnida (Araneomorphae)

Spiders from the infra-order araneomorphae were the most commonly collected specimens during the survey with 11 species from nine families collected.

Family Clubionidae (Sac Spiders)

Two specimens from the family Clubionidae were collected during the survey from sites PA1 and PB3. These spiders are nocturnal hunters that usually dwell under foliage and bark in sac-like retreats during the day (Framenau and Harvey 2010a). In Australia, the family includes three genera with four described species from Western Australia, although many undescribed species are known to occur (Framenau and Harvey 2010a). The specimens collected were juveniles and could not be identified however, as most Clubionid species appear to be widely distributed, these specimens are unlikely to represent SRE fauna (Framenau and Harvey 2010a).

Family Desidae

Desidae are a very diverse family of spiders and are commonly encountered in Australia (Framenau and Harvey 2010a). This was the most common spider family collected with nine specimens from this family collected at four sites (PA1, PA3, PB3 and PB4). The taxonomy of Desidae is poorly resolved and most of the specimens collected were immature and unable to be identified further. However, they are unlikely to be SREs based on the wide dispersal capabilities of most species within this family (Framenau and Harvey 2010a).

Family Gnaphosidae (Ground Spiders)

One specimen from the family Gnaphosidae was collected from site YP9. The family Gnaphosidae is very diverse though taxonomically poorly known (Framenau and Harvey 2010a). This family is not considered to be a target taxa for SRE surveys and therefore the specimen collected is unlikely to be a SRE (Framenau and Harvey 2010a).

Family Lycosidae (Wolf Spiders)

Spiders from the family Lycosidae were the second most common group collected during the survey. Six juvenile specimens that could not be further identified were collected at sites YP7, PA4, PA5 and PB1. Two specimens from the '*gibsoni*-group' were also collected from sites YP5 and YP8. Wolf spiders are ground dwellers with a variety of prey-capture techniques including sheet-webs, active hunting and burrows (Framenau and Harvey 2010a). These spiders generally disperse well via ballooning, however some species are habitat specialists with narrow distributions including single salt lakes (Framenau and Harvey 2010a).

Many species of wolf spiders remain undescribed and although the specimens collected could not be identified further, they do represent exclusive salt lake dwelling species and are therefore not considered SREs (Framenau and Harvey 2010a).

Family Miturgidae (Prowling Spiders)

One specimen from the family Miturgidae was collected during the survey at PA2. These spiders are ground hunting spiders that are morphologically similar to wolf spiders (Framenau and Harvey 2010a). Whilst some Miturgid species appear to have limited distribution, many are widespread and therefore the specimen from the survey is not considered to be a SRE species (Framenau and Harvey 2010a).

Family Prodidomidae (Long-spinneret Ground Spiders)

Two specimens from the family Prodidomidae were collected during the survey from site YP2 and PB1. The specimen from Playa B was a mature female of the species *Wesmaldra Wiluna* and is only the second record of this species in addition to the type material collected from Wiluna (Framenau and Harvey 2010a). Whilst this species is rare, it does not appear to be a SRE (Framenau and Harvey 2010a).

Family Sparassidae (Huntsman Spiders)

One specimen from the family Sparassidae was collected during night foraging at Playa B. Many species remain undescribed, however many species of this family appear to be widespread and are therefore not considered to represent a SRE species (Framenau and Harvey 2010a).

Family Thomisidae (Crab or Flower Spiders)

***Stephanopis* sp.**

At site YP3, one specimen from the genus *Stephanopis* was collected. Spiders from the family Thomisidae are diverse and often live on flowers and wait to catch prey (Framenau and Harvey

2010a). The genus *Stephanopis* is one of the largest thomisid genera in Australia with around 30 described species (Framenau and Harvey 2010a). Taking into account the wide distribution of other species in this genus, it is considered unlikely that this specimen represents a SRE species (Framenau and Harvey 2010a).

Family Zodariidae (Ant-eating Spiders)

***Euasteron* sp.**

Zodariidae are free-living ground dwellers that usually prey on ants (Framenau and Harvey 2010a). One specimen from the genus *Euasteron* was collected from site YP10. Members of this genus generally have a wide distribution and therefore the specimen collected is not considered to be a SRE species (Framenau and Harvey 2010a).

3.6.2 Arachnida (Mygalomorphae)

Mygalomorph spiders belong to one of the focal groups in SRE surveys as many mygalomorph species have low dispersal capabilities. Two mygalomorph spider species were collected during the Part Two survey.

Family Dipluridae

***Cethegus* sp. (Curtain-web Spiders)**

One specimen from the genus *Cethegus* was collected during the survey from site YP10. This genus is represented in Western Australia by one named species, *C. fugax,* and several unnamed species (Framenau and Harvey 2010a). The status and distribution of these species are not well understood, however it is considered unlikely that the specimen collected represents a SRE species (Framenau and Harvey 2010a).

Family Nemesiidae

***Kwonkan* 'MYG172'**

One specimen of *Kwonkan* 'MYG172' was collected from site PB4 during the survey. The genus *Kwonkan* is restricted to Western Australia and currently includes one species, *K. eboracum*, that is listed as Schedule 1 under the *WC Act* (Framenau and Harvey 2010a). The specimen collected during the survey has previously been found in Part One of the survey within the project area at site T01. This specimen potentially represents a SRE species (Framenau and Harvey 2010a).

The habitat at Playa B is a clay pan with large areas of exposed clay and is subject to flooding after rain. There is no leaf-litter cover on the ground so animals rely on the surrounding vegetation for food and shelter. The surrounding vegetation at Playa B consists of a mosaic comprising hardpan Mulga shrubland and Acacia *Ptilotus obovatus* shrubland.

3.6.3 Arachnida (Scorpiones)

Family Buthidae

***Lychas* 'annulatus'**

One specimen of *Lychas '*annulatus' was collected from night foraging at Playa B. This species is often associated with sparse Mallee forests on sand and has been collected from Victoria, South Australia and Western Australia (Volschenk 2010b). Additionally, the species was collected during the Part One

survey. This species is known to have a very wide distribution and is therefore not considered a SRE (Volschenk 2010b).

3.6.4 Arachnida (Pseudoscorpiones)

Family Olpiidae

***Indiolpium* sp.**

One specimen from the genus *Indolpium* was collected at site YP8. This was the only pseudoscorpion recorded during the Part Two survey. This specimen is very similar to specimens collected elsewhere in Western Australia suggesting that this species does not represent a SRE (Framenau and Harvey 2010a).

3.6.5 Crustacea (Malacostraca: Isopoda)

Family Armadillidae

***Buddelundia* sp.**

One species of isopod from the genus *Buddelundia* was collected during the survey from sites YP1 and YP9. This species is undescribed but common and is considered widespread, therefore the *Buddelundia* specimen does not represent a SRE (pers comm. S. Judd, April 2010).

3.6.6 Myriapoda (Chilopoda)

Family Scolopendridae

Scolopendra laeta

One centipede specimen, *Scolpendra laeta*, was collected from site YP8. This species is widely distributed through mainland Australia and is therefore not considered to be a SRE (Framenau and Harvey 2010a).

3.6.7 Insecta (Coleoptera)

Two species of beetles were collected from the Part Two survey. One of these species was not identified and was collected from sites YP6, PA1, PA2, PA3 and PB4. This species exhibits wide dispersal capabilities and therefore is not considered to be a SRE.

Family Carabidae; Sub-family Cicindelinae

Pseudotetracha helmsi

The second species of beetle collected was a species of tiger beetle (*Pseudotetracha helmsi*) collected at sites YP4, YP6 and YP7. Tiger beetles are predatory and are known to have restricted distributions. specifically to ephemeral salt lakes (pers comm. F. Cassola, Feb 2010). This species was previously known only from a few salt lakes located in the Murchison Bioregion and is considered a SRE.

Yeelirrie Playa is a salt playa that is subject to periods of flooding after rainfall. The vegetation at sites YP4, YP6 and YP7 comprise of low scrub that is resistant to flooding events and the high salinity levels in the soil. Semi-aquatic plants also occur at site YP7. During dry periods, the clay surface is dry and exposed with large areas of salt crust on the surface.

3.6.8 Sediment Samples

No specimens were collected during this part of the survey. No visible organisms were seen at any stage in the aquariums.

3.6.9 Water Quality

The water parameters measured from the sediment samples are listed in Appendix 9. The most relevant parameter is the SpC (conductivity) which is a measure of the salinity of the samples. The measurements of salinity remained consistent between each sample for both sampling events.

Playa A and Playa B had much fresher water than the Yeelirrie Playa with conductivity relatively consistent between samples and results less than 0.3 mS/cm. The highest level of salinity was recorded at YP4 which recorded 29.1 mS/cm at the deepest point. In each case, the deepest sample point recorded the highest conductivity at each site with the exception of YP10 where the middle sample recorded the highest conductivity.

760000 770000 780000 790000 210000 220000 230000 240000

7010000 7000000 6990000 6980000 6970000

MGA ZONE 50
MGA ZONE 51

Yeelirrie Playa

Yeelirrie

Albion Downs

Playa B

N

0 2.5 5 7.5 10

Kilometres

Datum: GDA94
Projection: MGA
Grid: MGA Grid Zone 50 and 51

Source:
Landsat, 2005 (Main Map)
SPOT, 2009 (Insets)

Legend

- Project Area
- Pit Outline
- Study Area
- Indicative Project Footprint
- Homestead
- Non-perennial Lake

Location of SRE and Potential SRE Species

- *Kwonkan* 'MYG172'
- *Pseudoetracha helmsi*

BHP Billiton Yeelirrie Development Company Pty Ltd	Project: **Proposed Yeelirrie Development**		Title: Location of SRE and Potential SRE Specimens Collected During Part Two
ecologia ENVIRONMENT	Drawn: AK/CJT	Approved: JN	Date: 21/01/2011
	Job No.: 42907132	File No.: 42907132-SUS-235_RB.mxd	Figure: 3.7
			Rev. B
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3.7 PART THREE SURVEY RESULTS

Initial results from the Part One survey indicated that a specimen from sample site O04 was the Schedule 1 species listed under the WC Act*, Idiosoma nigram*. This preliminary finding instigated a targeted *Idiosoma* sp. survey to ascertain habitat association and abundance. Specimens collected were later confirmed to be a different species of *Idiosoma,* classified a SRE but not listed under the *WC Act*.

A total of 11 *Idiosoma* sp. burrows were found from four sites (I38, I40 and I41) during the targeted survey (Appendix 10; Figure 3.8). In addition, four burrows were found opportunistically during Part One of the survey (Appendix 10; Figure 3.8).

All recorded burrows were found in sand plain habitats dominated by Mulga. The burrow at site O04 was located on the sandplain in the SAWS which is dominated by Spinifex and Wattles.

All recorded burrows are located outside the project footprint.

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760000 770000 780000 790000 210000 220000 230000 240000

7010000 7000000 6990000 6980000 6970000

SANDSTONE WILUNA ROAD

MEEKATHARRA YEELIRRIE ROAD

MGA ZONE 50
MGA ZONE 51

Inset 1

Inset 2

Inset 3

Inset 4

ND001

NT002

NT001

Yeelirrie

Albion Downs

N

0 2.5 5 7.5 10

Kilometres

Datum: GDA94
Projection: MGA
Grid: MGA Grid Zone 50 and 51

Inset 1

MEEKATHARRA YEELIRRIE ROAD

CH001 LRA002 O04 SW002

Inset 2

SW003 LRA003

Inset 3

SW001 LRA001

Source:
Landsat, 2005 (Main Map)
SPOT, 2009 (Insets)

Legend

- Pit Outline
- Project Area
- Study Area
- Indicative Project Footprint
- Homestead
- *Idiosoma* sp. Burrows
  - Survey
  - Opportunistic

BHP Billiton Yeelirrie Development Company Pty Ltd	Project: **Proposed Yeelirrie Development**		Title: Location of *Idiosoma* sp. Burrows
ecologia ENVIRONMENT	Drawn: AK/CJT	Approved: JN	Date: 21/01/2011
	Job No.: 42907132	File No.: 42907132-SUS-236_RB.mxd	Figure: 3.8
			Rev. B A3

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4 DISCUSSION

The WAM database search showed that the project area had a high potential to contain species from SRE groups including trap-door spiders, scorpions, pseudoscorpions, isopods, snails and centipedes. Specimens from all these groups were collected, although none of the species observed from the WAM database search were recorded in Part One, Two or Three surveys.

A total of 18 conservation significant species had the potential to be found at Yeelirrie however none of these were found during the survey. Three species of trap-door spider were listed with the potential to occur in the area; however these species were not collected. Trap-door spiders of the same genera (*Aganippe, Idiosoma* and *Kwonkan*) were collected indicating that if the listed species were present, they would have almost certainly been collected during the survey. This is also supported by the test of survey adequacy (Section 3.3).

Other listed species included four aquatic crustaceans. None of these were found during the Part Two survey for aquatic invertebrates.

The survey was carried out in accordance with EPA Guidance Statement 20 (EPA 2009a) and a test of survey adequacy showed that the Part One survey was sufficient, collecting approximately 92 % of the expected SRE invertebrate species.

Tests on the efficiency of different sampling methods showed that wet-pitfall traps were best at collecting trap-door spiders, scorpions and isopods and that foraging techniques were better to collect snails and pseudoscorpions. The use of both of these methods during the survey indicates that species from all SRE groups were likely to be collected at each site.

The 17 confirmed and potential SRE species found during the survey are exhibited in Table 4.1. These included four confirmed SREs (*Idiosoma* sp., *Pseudolaureola* sp., Platyarthridae/Barthytropidae and *Pseudotetracha helmsi*) and 13 potential SREs (*Aganippe* sp., *Aname* 'MYG170', *Aname* 'MYG212', Barychelidae, Cheridiidae, *Cubaris* sp. 1, *Cubaris* sp. 2, Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG172', *Kwonkan* 'MYG210', *Kwonkan* 'MYG211' and *Urodacus* 'yeelirrie'). Just under half (46 %) are known from at least two locations, however nine of these species are known only from within the project footprint. These include four mygolorph spiders: *Aname* 'MYG170', Barychelidae, *Kwonkan* 'MYG171' and *Kwonkan* 'MYG172'; one pseudoscorpion of the family Cheiridiidae; three isopods: *Cubaris* sp. 1, Platyarthridae/Bathytropidae and *Pseudolaureola* sp; and one centipede of the order Geophilida.

Four habitat types inside and outside the project footprint were sampled for SRE species. This includes Calcrete, Calcrete Outwash, Hardpan Mulga and Mixed Shrubs over Spinifex Sandplains. No significant differences between habitat types or between SRE assemblages inside and outside the project footprint were found. This is likely to be caused by the presence of suitable micro-habitats for SRE assemblages across all four habitat types and these equally support SRE species diversity inside and outside the project footprint. All habitats are well represented and connected within the project area and potentially extend beyond. Similar distribution patterns have been recorded by (Volschenk *et al.* 2010). Many invertebrate species have patchy distribution, responding to different environmental factors such as high temperatures, soil type and humidity (Ponder and Colgan 2002). These patchy habitats are known as 'island' habitats and are independent of the broadscale habitat type.

On a species level three species (*Aname* 'MYG170', Platyarthirdae/Bathytropidae and *Urodacus* 'yeelirrie') are dependant on habitat type for species abundance indicating a preference for a particular habitat type even though they can exist within several habitats. It is unknown whether the

other species are dependant on habitat type as low numbers of the species were collected, which does not allow for accurate analysis.

No species were collected during the sediment sampling even though the water quality results suggested that organisms could dwell in the areas after rainfall. As *ecologia* has successfully grown and raised aquatic invertebrates from sediment in the past, it was thought that other factors may affect the dispersal of aquatic invertebrates in the Yeelirrie Playa. Some aquatic invertebrates may be present in the Yeelirrie Playa but they did not occur in the sites where sediment was collected.

The mygalomorph spider *Idiosoma* sp. was collected outside the project footprint during the Part One survey at site O04. Despite an extensive targeted search, the species was not found within the project footprint. This species was confirmed to not be the listed Schedule 1 Shield-Backed Trap Door spider *I. nigrum* however, it still represents a SRE species. Part Three of the survey found that the species was widespread outside the project footprint in sandplain habitats although it exists in very low numbers. The habitat where specimens were found is considered atypical of this genus which is usually found on the mid-slopes of hills in dense *Acacia* leaf-litter in areas dominated by clay and rock (*ecologia* 2007, 2009, 2010b, a). This could explain the low numbers of burrows found in the project area in comparison to other areas in Western Australia as the species may indicate a habitat preference for mid-slopes associated with clay and rock, but not restricted to a particular habitat type.

Table 4.1 – Summary of SRE and Potential SRE Species Collected at Yeelirrie

Taxa	Species	Collected Outside Impact Area (Y/N)	Habitat Type
Mygalomorph Spiders	*Aganippe* sp.	Yes (Wellfield Survey)	Hardpan Mulga
	Aname 'MYG170'	No	Caclrete Calcrete Outwash Hardpan Mulga
	Aname 'MYG212'	Yes (Wellfield Survey)	Calcrete Outwash Mixed Shrubs over Spinifex Sandplains
	Barychelidae	No	Calcrete Outwash
	Idiosoma sp.	Yes	Mixed Shrubs over Spinifex Sandplains
	Kwonkan 'MYG171'	No	Hardpan Mulga
	Kwonkan 'MYG172'	No	Caclrete Playa B
	Kwonkan 'MYG210'	Yes (Wellfield Survey)	Hardpan Mulga
	Kwonkan 'MYG211'	Yes (Wellfield Survey)	Hardpan Mulga
Scorpion	*Urodacus* 'yeelirrie'	Yes	Caclrete Calcrete Outwash Hardpan Mulga
Pseudoscorpion	Cheiridiidae	No	Calcrete Outwash
Isopods	*Cubaris* sp. 1	No	Caclrete
	Cubaris sp. 2	Yes	Hardpan Mulga Mixed Shrubs over Spinifex Sandplains
	Platyarthridae/Bathytropidae	No	Caclrete Calcrete Outwash Hardpan Mulga
	Pseudolaureola sp.	No	Calcrete Outwash
Centipede	Geophilida	No	Hardpan Mulga
Insect	*Pseudotetracha helmsi*	Yes	Yeelirrie Playa

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5 SURVEY LIMITATIONS

Table 5.1 – Limitations fo the SRE Survey for the Proposed Yeelirrie Development

Aspect	Limitation (Y/N)	Comment
Survey Adequacy	No	Test of survey adequacy estimated survey sufficiency as 92% which is adequate
Method Efficiency	No	Survey methods utilised were efficient at collecting a broad range of SRE groups
Seasonality	Possible	Survey phase occurred year-round. This resulted in a high species diversity being collected
		Some species may not have been collected inside/outside the project area because of the seasons in which the survey was conducted in different areas.
Field Personel Expererience	No	All field personnel had a minimum of three years experience working with terrestrial invertebrates.
		All staff involved with the targeted *Idiosoma* survey had over 100 hours previous experience of targeted searching for *Idiosoma*.
Species Identification Resolution	Yes	Poor taxonomic knowledge (e.g. Geophilida and Cheridiidae) Specimens could not be identified to species level due to poor taxonomic knowledge of these groups, however are considered potneital SREs because of biology or knowledge of closely related species.
		New species but unknown distribution (e.g. *Aname*, *Kwonkan* and *Cubaris* species) The specimens were identified as a new species but distribution and SRE status is unknown. Considered potential SREs because of biology and closely related species.
		Specimens could not be identified to species level due to gender or immaturity (e.g. Barychelidae, Nemesiidae and *Aganippe* sp.) Unknown if they represent new or known species however, are considered potential SREs as similar species have limited distribution

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6 CONCLUSIONS

The main conclusions of this survey were:

- The survey methods of the SRE survey were consistent with the EPA Guidance Statement 20 to sample for SRE fauna. Species accumulation curves were used to assess survey adequacy and these indicate that the survey was sufficient;
- A total of 42 species were collected during the baseline SRE survey (Part One), of which three species were confirmed SREs (*Idiosoma* sp., *Pseudolaureola* sp., and Platyarthridae/Barthytropidae) and 13 were considered potential SREs (*Aganippe* sp., *Aname* 'MYG170', *Aname* 'MYG212', Barychelidae, Cheridiidae, *Cubaris* sp. 1, *Cubaris* sp. 2, Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG172', *Kwonkan* 'MYG210', *Kwonkan* 'MYG211' and *Urodacus* 'yeelirrie');
- Hardpan Mulga habitat was the most diverse in SRE species followed by Calcrete Outwash, Calcrete and Mixed Shrubs over Spinifex Sandplain habitats, however the Calcrete habitat showed the highest specimen abundance followed by Hardpan Mulga, Calcrete Outwash and Mixed Shrubs over Spinifex Sandplain habitats;
- Three species showed a preference for habitat type including *Aname* 'MYG170' (Calcrete), Platyarthridae/Bathytropidae (Calcrete Outwash) and *Urodacus* 'yeelirrie' (Hardpan Mulga) despite being collected in three habitat types each. No other species showed statistically significant habitat preference because of the low number of specimens collected;
- A survey of the Yeelirrie Playa and two other playas within the project area (Part Two) found 21 terrestrial invertebrate species including one confirmed SRE (*Pseudotetracha helmsi*) and one potential SRE (*Kwonkan* 'MYG172') that was also collected during the baseline survey;
- A targeted survey for *Idiosoma* sp. was undertaken and found that the species occurring at Yeelirrie prefers sandplain habitats although it exists in low numbers. This species was located in the project area, while no specimens were found to be located within the project footprint;
- Nine of the 17 SRE species have only been collected from within the project footprint including *Aname* 'MYG170', Barychelidae, Cheridiidae, *Cubaris* sp. 1, Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG172', *Pseudolaureola* sp. and Platyarthridae/Barthytropidae (species collected within the potential wellfields are considered outside the project footprint);
- A habitat analysis showed no statistically significant difference between SRE species diversity and habitat type inside and outside the project footprint. SRE species distribution depends on micro-habitats ('island' habitats) rather than broadscale habitat types; and
- All of the habitat types extend beyond the proposed project footprint indicating a potential for all species to be found outside the project footprint.

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7 STUDY TEAM

The BHPB Yeelirrie Uranium Project SRE Baseline Survey described in this document was planned, coordinated, and executed by:

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APPENDIX 1 SRE SURVEY SITE GPS CO-ORDINATES

Appendix 1A Part One Site GPS Co-ordinates UTM (GDA 94)

Site Name	GPS Co-ordinates		
	Zone	Easting	Northing
Phase 1			
F01	50	791436	6993838
F02	50	789603	6994760
F03	50	789536	6993194
F04	51	211556	6982071
F05	50	789143	6989757
F06	50	788893	6990729
F07	50	788469	6990913
F08	50	791376	6988582
F09	50	788166	6991727
F10	50	792951	6991998
F11	50	789879	6989267
F12	50	782788	6994588
F13	50	793032	6988316
F14	50	784667	6993072
F15	50	785938	6992156
F23	50	782820	6995568
F24	50	785924	6990676
F25	50	785661	6991700
F29	50	787622	6990802
F30	50	789830	6988820
Phases 2 and 3			
T01	50	787630	6990797
T02	50	787265	6990705
T03	50	787072	6991223
T04	50	786348	6991338
T05	50	785984	6992014
T06	50	785924	6991442
T07	50	788205	6990944
T08	50	788300	6990714
T09	50	788349	6990867
T10	50	792720	6988385
T11	50	790240	6988733
T12	50	789832	6988819
T13	50	785924	6992138
T14	50	787626	6991521
T15	50	786006	6991159
T16	50	787332	6990713
T17	50	787756	6990644
T18	50	786670	6991628
T19	50	786569	6991542

Site Name	GPS Co-ordinates		
	Zone	Easting	Northing
T20	50	787101	6991490
Phase 4			
O01	50	778621	6998159
O02	50	773788	6999507
O03	50	777985	6998237
O04	50	769376	7006800
O05	50	766991	7007169
O06	50	766980	7007913
O07	50	774501	7005207
O08	50	773866	7001582
O09	50	773828	7001283
O10	50	762734	7008852
O11	50	775164	7004639
O12	50	775629	6996538
Phase 5			
A01	50	770391	7012163
A02	50	768216	7010872
A03	50	764980	7012286
A04	50	775957	6996132
A05	50	782830	7001512
A06	50	786232	7004907
A07	50	793778	6996810
A08	51	208239	6992569
A09	51	215615	6989662
A10	51	216710	6989648
A11	51	223790	6978546
A12	51	229661	6977737
A13	51	225168	6974074
A14	50	774391	6991254
A15	50	773731	6989030
A16	50	780173	6983204
A17	50	766450	7001656
A18	50	767126	6997902
A19	50	776873	6994315
A20	50	781614	6995849

Appendix 1B Part Two Site GPS Co-ordinates UTM (GDA 94)

Site Name	GPS Co-ordinates		
	Zone	Easting	Northing
Yeelirrie Playa			
YP1	51	221051	6973273
YP2	51	221743	6973612
YP3	51	222539	6975080
YP4	51	223407	6975321
YP5	51	224489	6974510
YP6	51	224835	6976047
YP7	51	225769	6975531
YP8	51	227714	6976493
YP9	51	221217	6973655
YP10	51	221383	6975415
Playa A			
PA1	50	782499	6996501
PA2	50	782407	6996465
PA3	50	782351	6996548
PA4	50	782454	6996658
PA5	50	782535	6996594
Playa B			
PB1	50	787100	6991956
PB2	50	787139	6991882
PB3	50	787274	6991905
PB4	50	787280	6992027
PB5	50	787211	6992062

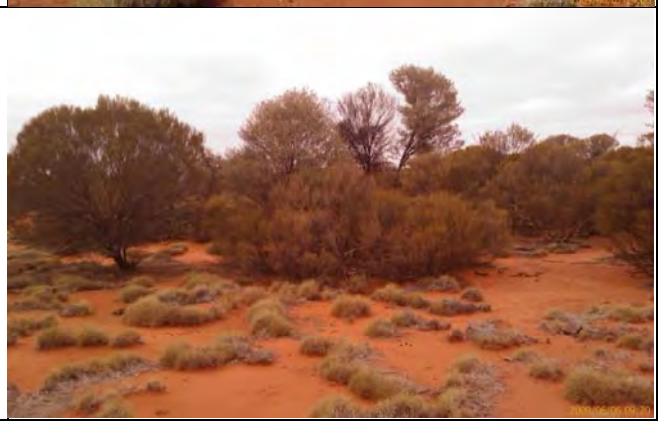
Appendix 1C Part Three Site GPS Co-ordinates UTM (GDA 94)

Site Name	GPS Co-ordinates		
	Zone	Easting	Northing
I01	50	784731	6992456
I02	50	783507	6994255
I03	50	783728	6994231
I04	50	783790	6994043
I05	50	784556	6992850
I06	50	782800	6994356
I07	50	782368	6995456
I08	50	782831	6995017
I09	50	782946	6994881
I10	50	783413	6994562
I11	50	786235	6991958
I12	50	786218	6991807
I13	50	786121	6991452
I14	50	786691	6991298
I15	50	786908	6991293
I16	50	793095	6987541
I17	50	788012	6990660
I18	50	788480	6990584
I19	50	790838	6988842
I20	50	794378	6987019
I21	50	780297	6999179
I22	50	780916	6994977
I23	50	782525	6996222
I24	50	782167	6999047
I25	50	781172	6999021
I26	50	781598	6995834
I27	50	777114	7001672
I28	50	777362	7001426
I29	50	783337	6993632
I30	50	783562	6993710
I31	50	779338	7002482
I32	50	768606	7003985
I33	50	769309	7003070
I34	50	780183	7001365
I35	50	779903	6994152
I36	50	777340	7004324
I37	50	786074	6995453
I38	50	786523	6995136
I39	50	782961	6997217
I40	50	774276	7001714
I41	50	769375	7006800

Site Name	GPS Co-ordinates		
	Zone	Easting	Northing
I42	50	778893	7000130
I43	50	777074	7001449
I44	50	778404	6999667
I45	50	780692	6998182

APPENDIX 2 PART ONE SURVEY SITE DESCRIPTIONS

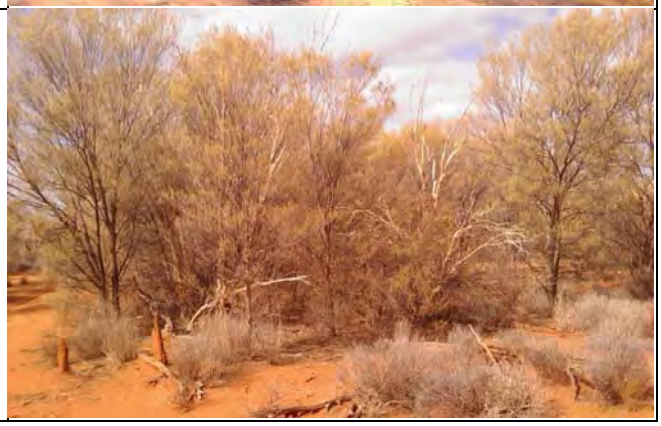
Appendix 2A Phase 1 Site Descriptions

Vegetation and Habitat Description	Site Photo
Site F01 Coordinates: 50 791436E 6993838S Habitat: Plain with Mallee and Spinifex Leaf-litter: < 1 cm depth, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMA	
Site F02 Coordinates: 50 789603E 6994760S Habitat: Plain with Mallee and Spinifex Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMA	
Site F03 Coordinates: 50 789536E 6993194S Habitat: Plain with Mallee and Spinifex Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMA	
Site F04 Coordinates: 51 211556E 6982071S Habitat: Plain with Acacia and Spinifex Leaf-litter: < 1 cm depth, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMA	

Vegetation and Habitat Description	Site Photo
Site F05 Coordinates: 50 789143E 6989757S Habitat: Plain with *Melaleuca xerophila* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Brown sandy-clay with loose gravel and exposed calcrete Vegetation Community: CMxS	
Site F06 Coordinates: 50 788893E 6990729S Habitat: Plain with Acacia Leaf-litter: < 1 cm depth, concentrated under trees and shrubs Soil Type: Red-orange sandy loam Vegetation Community: SAMA	
Site F07 Coordinates: 50 788469E 6990913S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Red-orange sandy loam with gravel and exposed calcrete Vegetation Community: CEgW	
Site F08 Coordinates: 50 791376E 6988582S Habitat: Plain with *Melaleuca xerophila* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Brown loam Vegetation Community: CMxS	

Vegetation and Habitat Description	Site Photo
Site F09 Coordinates: 50 788166E 6991727S Habitat: Plain with Mulga and Spinifex Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMU	
Site F10 Coordinates: 50 792951E 6991998S Habitat: Plain with Mulga and Spinifex Leaf-litter: < 1 cm depth, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMA	
Site F11 Coordinates: 50 789879E 6989267S Habitat: Plain with Mulga Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Grey-brown loam with exposed calcrete and quartz Vegetation Community: CMxS	
Site F12 Coordinates: 50 782788E 6994588S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 – 5 cm deep, widespread distribution Soil Type: Brown loam with exposed calcrete Vegetation Community: CEgW	

Vegetation and Habitat Description	Site Photo
Site F13 Coordinates: 50 793032E 6988316S Habitat: Plain with *Eremophila* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Loam Vegetation Community: PLAET	
Site F14 Coordinates: 50 784667E 6993072S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Brown loam with loose gravel and exposed calcrete Vegetation Community: CAbS, CEgW	
Site F15 Coordinates: 50 785938E 6992156S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Brown loam with loose gravel and exposed calcrete Vegetation Community: CAbS, CEgW	
Site F23 Coordinates: 50 782820E 6995568S Habitat: Plain with *Acacia burkitii* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Red-brown loam with loose gravel and exposed calcrete Vegetation Community: CAbS	

Vegetation and Habitat Description	Site Photo
Site F24 Coordinates: 50 785924E 6990676S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 – 5 cm deep, widespread distribution Soil Type: Brown sandy loam with loose gravel and exposed calcrete Vegetation Community: CEgW	
Site F25 Coordinates: 50 785661E 6991700S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 – 5 cm deep, widespread distribution Soil Type: Brown sandy loam with loose gravel and exposed calcrete Vegetation Community: CEgW	
Site F29 Coordinates: 50 787622E 6990802S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Red-brown sandy loam with loose gravel and exposed calcrete Vegetation Community: CEgW	
Site F30 Coordinates: 50 789830E 6988820S Habitat: Plain with Mulga Leaf-litter: 1 – 5 cm deep, concentrated under trees and shrubs Soil Type: Red-brown loam Vegetation Community: PLAET	

Appendix 2B Phase 2 and 3 Site Descriptions

Vegetation and Habitat Description	Site Photo
Site T01 Coordinates: 50 787630E 6990797S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 5 - 10 cm deep, widespread distribution Soil Type: Yellow-brown sandy loam Vegetation Community: CEgW	
Site T02 Coordinates: 50 787265E 6990705S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 5 - 10 cm deep, widespread distribution Soil Type: Yellow-brown sandy loam Vegetation Community: CEgW	
Site T03 Coordinates: 50 787072E 6991223S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 5 - 10 cm deep, widespread distribution Soil Type: Yellow-brown sandy loam with exposed calcrete Vegetation Community: CEgW	
Site T04 Coordinates: 50 786348E 6991338S Habitat: Plain with *Eucalyptus gypsophila* and *Atriplex sp.* shrubs Leaf-litter: 5 - 10 cm deep, widespread distribution Soil Type: Yellow-brown sandy loam with exposed calcrete and quartz Vegetation Community: CErG, CAbS, CEgW	

Vegetation and Habitat Description	Site Photo
Site T05 Coordinates: 50 785984E 6992014S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 1 - 5 cm deep, widespread distribution Soil Type: Yellow-brown sandy loam Vegetation Community: CAbS, CEgW	
Site T06 Coordinates: 50 785924E 6991442S Habitat: Plain with *Eucalyptus gypsophila* and *Tecticornia indica* shrub Leaf-litter: 1 - 5 cm deep, widespread distribution Soil Type: Yellow-brown sandy loam with fine and coarse gravel. Areas of exposed calcrete Vegetation Community: CEgW	
Site T07 Coordinates: 50 788205E 6990944S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 5 - 10 cm deep, widespread distribution Soil Type: Brown sandy loam with fine and coarse gravel. Areas of exposed basalt Vegetation Community: CEgW	
Site T08 Coordinates: 50 788300E 6990714S Habitat: Plain with *Melaleuca* sp. Leaf-litter: <1 cm deep, concentrated under trees and shrubs Soil Type: Red-orange sandy clay Vegetation Community: CMxS	

Vegetation and Habitat Description	Site Photo
Site T09 Coordinates: 50 788349E 6990867S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 5 - 10 cm deep, widespread distribution Soil Type: Brown sandy loam Vegetation Community: CEgW	
Site T10 Coordinates: 50 792720E 6988385S Habitat: Plain with *Acacia tetragonophylla*, *Tecticornia* sp., *Santalum lanceolatum*, *Eremophila longifolia*, and *Senna artemisioides* Leaf-litter: 1 - 5 cm deep, concentrated under trees and shrubs Soil Type: Red-brown clay Vegetation Community: PLAET	
Site T11 Coordinates: 50 790240E 6988733S Habitat: Plain with *Acacia tetragonophylla*, *Tecticornia* sp., *Santalum lanceolatum*, *Eremophila longifolia*, and *Senna artemisioides* Leaf-litter: 1 - 5 cm deep, concentrated under trees and shrubs Soil Type: Yellow-brown sandy loam with fine gravel Vegetation Community: PLAET	
Site T12 Coordinates: 50 789832E 6988819S Habitat: Plain with *Acacia aneura* var. *conifera* Leaf-litter: 1 - 5 cm deep, concentrated under trees and shrubs Soil Type: Red-brown loam with fine gravel Vegetation Community: PLAET	

Vegetation and Habitat Description	Site Photo
Site T13 Coordinates: 50 785924E 6992138S Habitat: Plain with *Eucalyptus gypsophila* Leaf-litter: 5 - 10 cm deep, widespread distribution Soil Type: Grey sandy loam with fine gravel Vegetation Community: CAbS, CEgW	
Site T14 Coordinates: 50 786670E 6991628S Habitat: Plain with *Eucalyptus gypsophila* and *Acacia* sp. Leaf-litter: 1 - 5 cm deep, concentrated under trees and shrubs Soil Type: Brown sandy loam with fine and coarse gravel. Exposed calcrete Vegetation Community: CErG, CAbS, CEgW	
Site T15 Coordinates: 50 786569E 6991542S Habitat: Plain with *Acacia burkittii* and *Eremophila* sp. Leaf-litter: <1 cm deep, concentrated under trees and shrubs Soil Type: Brown sandy loam with fine and coarse gravel. Exposed calcrete and quartz Vegetation Community: CErG, CAbS, CEgW	
Site T16 Coordinates: 50 787101E 6991490S Habitat: Plain with *Acacia burkittii* Leaf-litter: <1 cm deep, concentrated under trees and shrubs Soil Type: Brown sandy loam with fine and coarse gravel. Exposed calcrete Vegetation Community: CAbS	

Vegetation and Habitat Description	Site Photo
Site T17 Coordinates: 50 787626E 6991521S Habitat: Plain with *Grevillea* sp. and *Ptilotus obvatus* shrubland Leaf-litter: 1 - 5 cm deep, concentrated under trees and shrubs Soil Type: Red-brown sand Vegetation Community: PLAPoS	
Site T18 Coordinates: 50 787756E 6990644S Habitat: Plain with *Melaleuca* sp. Leaf-litter: <1 cm deep, widespread distribution Soil Type: Brown, powdery loam with soil cracking and coarse gravel. Exposed calcrete Vegetation Community: CMxS	
Site T19 Coordinates: 50 786006E 6991159S Habitat: Plain with *Acacia aneura* var. *argentea*, *Acacia aneura* var. *conifera* and *Acacia aneura* var. *intermedia* Leaf-litter: <1 cm deep, concentrate under trees and shrubs Soil Type: Red-brown sandy loam with coarse gravel. Exposed calcrete Vegetation Community: PLAPoS	
Site T20 Coordinates: 50 787332E 6990713S Habitat: Plain with *Melaleuca* sp. Leaf-litter: 1 - 5 cm deep, widespread distribution Soil Type: Brown sand Vegetation Community: CMxS	

Appendix 2C Phase 4 Site Descriptions

Vegetation and Habitat Description	Site Photo
Site O01 Coordinates: 50 778621E 6998159S Habitat: Plain with *Melaleuca interioris*, *Melaleuca sheatheana*, *Acacia ayersiana*, *Acacia burkitii*, *Acacia ramulosa* var *linophylla* and *Bertya dimerostigma* Leaf-litter: <1 cm, concentrated under trees and shrubs Soil Type: Red-orange sand with exposed calcrete gravel	
Site O02 Coordinates: 50 773788E 6999507S Habitat: Plain with *Eucalyptus eremicola* and *Acacia aneura* var *argentea* Leaf-litter: 1 – 5 cm, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMA	
Site O03 Coordinates: 50 777985E 6998237S Habitat: Plain with *Melaleuca sheatheana*, *Melaleuca interioris*, *Acacia ayersiana* and *Acacia burkittii* Leaf-litter: <1 cm, concentrated under trees and shrubs Soil Type: Red-brown sand with exposed calcrete gravel Vegetation Community: HPMS	
Site O04 Coordinates: 50 769376E 7006800S Habitat: Undulating plain with *Acacia burkitii*, *Acacia ligulata*, *Acacia tetragonophylla*, *Hakea lorea*, *Eremophila glabra* subsp. *tomentose* and *Senna artemisioides* Leaf-litter: 1-5cm, concentrated under trees and shrubs Soil Type: Red-orange sand with small amounts of exposed calcrete gravel Vegetation Community: SAWS	

Vegetation and Habitat Description	Site Photo
Site O05 Coordinates: 50 766991E 7007169S Habitat: Plain with *Acacia aneura* var *microcarpa*, *Melaleuca interioris* and *Acacia aneura* var *tenuis* Leaf-litter: 1 – 5 cm, concentrated under trees and shrubs Soil Type: Red-orange clay with slight surface cracking Vegetation Community: HPMS	
Site O06 Coordinates: 50 766980E 7007913S Habitat: Plain with *Acacia aneura* var *tenuis*, *Ptilotus obovatus*, *Eremophila longifolia* and *Senna artemisioides* Leaf-litter: 5 - 10 cm, concentrated under trees and shrubs Soil Type: Red-orange clay with slight surface cracking Vegetation Community: PLAET	
Site O07 Coordinates: 50 774501E 7005207S Habitat: Plain with *Eucalyptus gongylocarpa*, *Acacia ligulata*, *Senna artemisioides* and *Halgania cyanea* Leaf-litter: 5 - 10 cm, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAGS	
Site O08 Coordinates: 50 773866E 7001582S Habitat: Plain with *Eucalyptus trivalva*, *Scaveola spineceus* and *Acacia anerura* var *argentea* Leaf-litter: 1 - 5 cm, concentrated under trees and shrubs Soil Type: Red-orange clay with <5 % calcrete gravel Vegetation Community: SAMA	

Vegetation and Habitat Description	Site Photo
Site O09 Coordinates: 50 773828E 7001283S Habitat: Undulating plain with *Acacia burkitii*, *Acacia aneura* var *aneura*, *Ptilotus obovatus* and *Senna artemisioides* Leaf-litter: 1 - 5 cm, concentrated under trees and shrubs Soil Type: Red-orange sand with exposed calcrete gravel Vegetation Community: CCpW	
Site O10 Coordinates: 50 762734E 7008852S Habitat: Undulating plain with *Callitris preissii*, *Hakea francsiana* and *Bertya dimerostigma* Leaf-litter: 1 - 5 cm, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SDSH	
Site O11 Coordinates: 50 775164E 7004639S Habitat: Plain with *Eucalyptus trivalva*, *Acacia lingulata* and *Halgania cyanea* Leaf-litter: 5 - 10 cm, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAMA	
Site O12 Coordinates: 50 775629E 6996538S Habitat: Plain with *Eucalyptus gongylocarpa*, *Acacia ligulata* and *Acacia aneura* var *aneura* Leaf-litter: 1 - 5 cm, concentrated under trees and shrubs Soil Type: Red-orange sand Vegetation Community: SAGS	

Appendix 2D Phase 5 Site Descriptions

Vegetation and Habitat Description	Site Photo
Site A01 Coordinates: 50 770391E 70121632S Aspect: Plain with *Acacia sclerosperma* Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	
Site A02 Coordinates: 50 768216E 67010872S Aspect: Plain with *Eucalyptus* sp. Leaf-litter: Negligible Soil Type: Sand	
Site A03 Coordinates: 50 764980E 7012286S Aspect: Plain with *Acacia aneura* and under-storey of *Spinifex* sp. Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	

Vegetation and Habitat Description	Site Photo
Site A04 Coordinates: 50 775957E 6996132S Aspect: Plain *Eucalyptus gongylocarpa* and *Acacia sclerosperma* Leaf-litter: Widespread Soil Type: Sand	
Site A05 Coordinates: 50 782830E 7001512S Aspect: Plain with *Acacia aneura* and *Eremophilla feliossima* Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	
Site A06 Coordinates: 50 786232E 7004907S Aspect: Plain with *Acacia tetragonophylla* and *Eucalyptus kingsmillii* Leaf-litter: Sparse Soil Type: Sand with a surface crust and slight cracking. Widespread calcrete and quartz stones (5 – 30% cover)	

Vegetation and Habitat Description	Site Photo
Site A07 Coordinates: 50 793778E 699810S Aspect: Plain with *Acacia aneura* Leaf-litter: Negligible Soil Type: Sand with a surface crust and slight cracking. Widespread calcrete and quartz stones (5 – 30% cover)	
Site A08 Coordinates: 51 208239E 6992569S Aspect: Plain with Mulga and isolated patches of *Eucalyptus kingsmillii* and *Spinifex* under-storey Leaf-litter: Sparse Soil Type: Sand	
Site A09 Coordinates: 51 215615E 6980662S Aspect: Plain with *Acacia anuera* and *Spinifex* under-storey Leaf-litter: Sparse Soil Type: Sand	

Vegetation and Habitat Description	Site Photo
Site A10 Coordinates: 51 216710E 6989648S Aspect: Plain with *Acacia ramulosa* and *Acacia aneura* Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	
Site A11 Coordinates: 51 223790E 6978546S Aspect: Plain with *Acacia aneura* and *Eremophila feliossima* under-storey Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	
Site A12 Coordinates: 51 229661E 6977737S Aspect: Plain with *Acacia aneura* and *Spinifex* under-storey Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	

Vegetation and Habitat Description	Site Photo
Site A13 Coordinates: 51 225168E 6974074S Aspect: Plain with *Acacia ramulosa* and *Acacia tetragonophylla* with *Eremophila forestii* under-storey Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	
Site A14 Coordinates: 50 774391E 6991254S Aspect: Plain with *Acacia ramulosa*, *Acacia aneura* and *Eucalyptus kingsmillii* Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	
Site A15 Coordinates: 50 773731E 698030S Aspect: Plain with *Acacia ramulosa* and *Eucalyptus kingsmillii* with *Spinifex* under-storey Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	

Vegetation and Habitat Description	Site Photo
Site A16 Coordinates: 50 780173E 698204S Aspect: Plain with *Eucalyptus gongylocarpa*, *Acacia sclerosperma* and *Acacia ramulosa* Leaf-litter: Concentrated under trees and shrubs Soil Type: Sand	
Site A17 Coordinates: 50 766450E 7001656S Aspect: Plain with *Acacia aneura*, *Eucalyptus trivalva* and under-storey of *Spinifex* and *Philotheca coateana* Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay loam	
Site A18 Coordinates: 50 767126E 6997902S Aspect: Plain with *Acacia aneura* Leaf-litter: Widespread Soil Type: Sandy clay	

Vegetation and Habitat Description	Site Photo
Site A19 Coordinates: 50 776873E 6994315S Aspect: Plain with *Acacia aneura* and *Acacia ramulosa* Leaf-litter: Sparse Soil Type: Sand	
Site A20 Coordinates: 50 781614E 6995849S Aspect: Plain with *Eucalyptus trivalva*, *Acacia tetragonophylla* and *Acacia linophyla* with grass and herb under-storey Leaf-litter: Concentrated under trees and shrubs Soil Type: Sandy clay with deep cracking	

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APPENDIX 3 PART TWO SITE PHOTOS

Appendix 3A Yeelirrie Playa Site Photos

YP1 Coordinates (GDA94): Zone 51 221051E 6973273S	
YP2 Coordinates (GDA94): Zone 51 221743E 6973612S	
YP3 Coordinates (GDA94): Zone 51 222539E 6975080S	
YP4 Coordinates (GDA94): Zone 51 223407E 6975321S	

YP5 Coordinates (GDA94): Zone 51 224489E 6974510S	
YP6 Coordinates (GDA94): Zone 51 224835E 6976047S	
YP7 Coordinates (GDA94): Zone 51 225769E 6975531S	
YP8 Coordinates (GDA94): Zone 51 227714E 6976493S	

YP9 Coordinates (GDA94): Zone 51 221217E 6973655S	
YP10 Coordinates (GDA94): Zone 51 221383E 6975415S	

Appendix 3B Playa A and Playa B Site Photos

PA1 Coordinates (GDA94): Zone 50 782499E 6996501S	
PA2 Coordinates (GDA94): Zone 50 782407E 6996465S	
PA3 Coordinates (GDA94): Zone 50 782351E 6996548S	
PA4 Coordinates (GDA94): Zone 50 782454E 6996658S	

PA5 Coordinates (GDA94): Zone 50 782535E 6996594S	
PB1 Coordinates (GDA94): Zone 50 787100E 6991956S	
PB2 Coordinates (GDA94): Zone 50 787139E 6991882S	
PB3 Coordinates (GDA94): Zone 50 787274E 6991905S	

PB4 Coordinates (GDA94): Zone 50 787280E 6992027S	
PB5 Coordinates (GDA94): Zone 50 787211E 6992062S	

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APPENDIX 4 PART THREE SITE DESCRIPTIONS

Vegetation and Habitat Description	Site Photo
Site I01 Coordinates: 50 784731E 6992456S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CAbS, CEgW	
Site I02 Coordinates: 50 783507E 6994255S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CCpW	
Site I03 Coordinates: 50 783728E 6994231S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CCpW	

Vegetation and Habitat Description	Site Photo
Site I04 Coordinates: 50 783790E 6994043S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CCpW	
Site I05 Coordinates: 50 784556E 6992850S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay Vegetation Community: CAbS, CEgW	
Site I06 Coordinates: 50 782800E 6994356S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand and clay with some calcrete stones Vegetation Community: CEgW	

Vegetation and Habitat Description	Site Photo
Site I07 Coordinates: 50 782368E 6995456S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CCpW	
Site I08 Coordinates: 50 782831E 6995017S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CCpW	
Site I09 Coordinates: 50 782946E 6994881S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed Vegetation Community: CCpW	

Vegetation and Habitat Description	Site Photo
Site I10 Coordinates: 50 783413E 6994562S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CCpW	
Site I11 Coordinates: 50 786235E 6991958S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CErG, CAbS, CEgW	
Site I12 Coordinates: 50 786218E 6991807S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CErG, CAbS, CEgW	

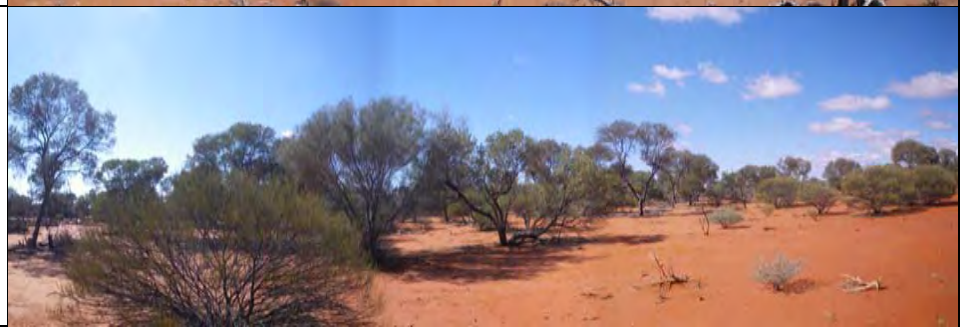
Vegetation and Habitat Description	Site Photo
Site I13 Coordinates: 50 786121E 6991452S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CErG, CAbS, CEgW	
Site I14 Coordinates: 50 786691E 6991298S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CErG, CAbS, CEgW	
Site I15 Coordinates: 50 786908E 6991293S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CErG, CAbS, CEgW	

Vegetation and Habitat Description	Site Photo
Site I16 Coordinates: 50 793095E 6987541S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with fine sand Vegetation Community: CMxS	
Site I17 Coordinates: 50 788012E 6990660S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay Vegetation Community: CMxS	
Site I18 Coordinates: 50 788480E 6990584S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with fine sand Vegetation Community: CMxS	

Vegetation and Habitat Description	Site Photo
Site I19 Coordinates: 50 790838E 6988842S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay Vegetation Community: CMxS	
Site I20 Coordinates: 50 794378E 6987019S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay Vegetation Community: CMxS	
Site I21 Coordinates: 50 780297E 6999179S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with coarse sand Vegetation Community: PLAET	

Vegetation and Habitat Description	Site Photo
Site I22 Coordinates: 50 780916E 6994977S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: PLAET	
Site I23 Coordinates: 50 782525E 6996222S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with fine sand Vegetation Community: PLAET	
Site I24 Coordinates: 50 782167E 6999047S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay Vegetation Community: PLAET	

Vegetation and Habitat Description	Site Photo
Site I25 Coordinates: 50 781172E 6999021S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with coarse sand Vegetation Community: PLAET	
Site I26 Coordinates: 50 781598E 6995834S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: PLAPoS	
Site I27 Coordinates: 50 777114E 7001672S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with fine sand Vegetation Community: PLAPoS	

Vegetation and Habitat Description	Site Photo
Site I28 Coordinates: 50 777362E 7001426S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay Vegetation Community: PLAPoS	
Site I29 Coordinates: 50 783337E 6993632S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with coarse sand Vegetation Community: PLAPoS	
Site I30 Coordinates: 50 783562E 6993710S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with coarse sand Vegetation Community: PLAPoS	

Vegetation and Habitat Description	Site Photo
Site I31 Coordinates: 50 779338E 7002482S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: SAMA	
Site I32 Coordinates: 50 768606E 7003985S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: SAMA	
Site I33 Coordinates: 50 769309E 7003070S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: SAMA	

Vegetation and Habitat Description	Site Photo
Site I34 Coordinates: 50 780183E 7001365S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: SAMA	
Site I35 Coordinates: 50 779908E 6994152S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: SAMA	
Site I36 Coordinates: 50 777340E 7004324S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with fine sand Vegetation Community: SAMU	

Vegetation and Habitat Description	Site Photo
Site I37 Coordinates: 50 786074E 6995453S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: SAMU	
Site I38 Coordinates: 50 786523E 6995136S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand Vegetation Community: SAMU	
Site I39 Coordinates: 50 782961E 6997217S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with fine sand Vegetation Community: SAMU	

Vegetation and Habitat Description	Site Photo
Site I40 Coordinates: 50 774276E 7001714S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand with exposed calcrete Vegetation Community: SAMU	
Site I41 Coordinates: 50 769375E 7006800S Aspect: Slight slope with exposed calcrete Leaf-litter: Concentrated under trees and shrubs Soil Type: Fine sand with exposed calcrete Vegetation Community: SAWS	
Site I42 Coordinates: 50 778893E 7000130S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CAbS	

Vegetation and Habitat Description	Site Photo
Site I43 Coordinates: 50 777074E 7001449S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CAbS	
Site I44 Coordinates: 50 778404E 6999667S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CAbS	
Site I45 Coordinates: 50 780692E 6998182S Aspect: Plain Leaf-litter: Concentrated under trees and shrubs Soil Type: Clay with exposed calcrete Vegetation Community: CAbS	

APPENDIX 5 WAM DATABASE SEARCH

WAM Database Search Results

Class (Order)	Family	Genus	Species	SRE Status
Arachnida (Araneae)				
	Actinopididae	*Missulena*	*insignis*	Potential
			occatoria	Potential
			'MYG046'	Potential
			sp.	Potential
	Barychelidae	*Mandjelia*	sp.	Potential
		Synothele	*meadhunteri*	Potential
	Dipluridae	*Cethegus*	'Diplurid species A (Biota)'	Potential
			sp.	Potential
	Idiopidae	*Aganippe*	'sp. female'	Potential
			'species B (Biota)'	Potential
			'sp. Honeymoon Well'	Potential
			sp.	Potential
			'sp. nov'	Potential
		Eucyrtops	'MYG029'	Potential
			'sp. Honeymoon Well 2'	Potential
		Gaius	sp.	Potential
			'sp. female'	Potential
			'sp. juv'	Potential
			'species? (Biota)'	Potential
			villosus	No
	Nemesiidae	*Aname*	'MT Keith sp. 1'	Potential
			'MT Keith sp. 2'	Potential
			'sp. 2'	Potential
			sp.	Potential
			'sp. Honeymoon Well'	Potential
			'sp. nov'	Potential
			'species A (Biota)'	Potential
			'species B (Biota)'	Potential
			'Wanjarri sp.1'	Potential
			'Wanjarri sp.2'	Potential
			mainae	No
		Kwonkan	'sp. juv'	Potential
			'sp. Honeymoon Well'	Potential
			moriartii	No
		Teyl	'sp. Honeymoon Well'	Potential
			sp.	Potential
Arachnida (Scorpiones)				
	Buthidae	*Isometroides*	sp.	Unknown
			vescus	No
		Lychas	'adonis'	Unknown
Arachnida (Scorpiones) continued				

Class (Order)	Family	Genus	Species	SRE Status
	Buthidae	*Lychas*	*annulatus*	Unknown
			'harveyi'	No
			sp.	Unknown
	Urodacidae	*Urodacus*	*armatus*	Potential
			hoplurus	Potential
			'lakeway1'	Potential
			'lakeway2'	Potential
			'Laverton sp. 3'	Potential
			'Laverton sp. 4'	Potential
			'Laverton sp. 5'	Potential
			simils	Potential
			sp.	Potential
			'species A (Biota)'	Potential
			'species B (Biota)'	Potential
Arachnida (Pseudoscorpiones)				
	Cthoniidae	*Tyrannochthonius*	'sp. indet (juv)'	Unknown
			'sp. nov. Millbillillie'	Unknown
	Olpiidae	*Beierolpium*	'sp. 8/2'	Potential
			'sp. 8/3'	Potential
		Indolpium	sp.	No
	Oonopidae	*Grymeus*	sp.	No
Gastropoda				
	Pupillidae	*Gastrocopta*	*mussoni*	No
			cf. *bannertonensis*	No
		Pupoides	cf. *adelaidae*	No
			cf. *myoporinae*	No
Chilopoda (Scolopendromorpha)				
	Scolopendridae	*Arthrorhabdus*	*paucispinus*	No
		Cormocephalus	*aurantiipes*	No
			turneri	No
		Ethmostigmus	*curtipes*	No
			rubripes	No
			pachysoma	No
		Rhysida	sp.	Unknown
		Scolpendra	*laeta*	No
			morsitans	No
	Scutigeridae	*Pilbarascutigera?*	sp.	No
		Theuropoda	sp.	No

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APPENDIX 6 CONSERVATION SIGNIFICANT FAUNA

Conservation Significant Fauna from the Midwest and Goldfields Regions

Taxa	Species	EPBC Act	WC Act	DEC
Arachnids	*Aganippe castellum*	EN	S1	
	Idiosoma nigrum	VU	S1	
	Kwonkan Moriartii			P2
Crustaceans	*Branchinella apophysata*			P1
	Branchinella denticulata			P1
	Branchinella simplex			P1
	Branchinella wellardi			P1
Insects	*Austromerope poultoni*			P2
	Austrosaga spinifer			P3
	Hemisaga vepreculae			P3
	Hylaeus globuliferus			P3
	Jalmenus aridus			P1
	Phasmodes jeeba			P2
	Psacadonotus seriatus			P1
	Neopasiphe simplicolor	EN		
	Ogyris subterrestris petrina		S1	
	Throscodectes xederoides			P3
Molluscs	*Bothriembryon perobesus*			P1

APPENDIX 7 PART ONE COLLECTED SPECIMENS

Appendix 7A Specimens Collected During Part One, Phase 1 (June 2009)

					Site Name																			
Class (Order)	**Family**	**Genus**	**Species**	**SRE**	**F01**	**F02**	**F03**	**F04**	**F05**	**F06**	**F07**	**F08**	**F09**	**F10**	**F11**	**F12**	**F13**	**F14**	**F15**	**F23**	**F24**	**F25**	**F29**	**F30**
Arachnida (Aranae)																								
	Dipluridae	*Cethegus*	sp.	No	1							1												
	Nemesiidae	*Aname*	MYG212'	Potential								1	1											
Arachnida (Scorpiones)																								
	Urodacidae	*Urodacus*	*yaschenkoi*	No				1															1	
		Urodacus	yeelirrie'	Potential				3															3	
Arachnida (Pseudoscorpiones)																								
	Atemnidae	*Oratemnus*	sp.	No			2	1							4									6
	Chernetidae	unknown	sp.1	No							2	1				3	32							
		unknown	sp.2	No														12						
	Garypinidae	*Amblyolpium*	sp.	No												2		3			2		3	
	Olpiidae	*Austrohorus*	sp.	No				1		12				1			1							
		Beierolpium	sp 8/2'	No	1	1	2		4		7	1		2					2			1	1	
Malacostraca (Isopoda)																								
	Armadillidae	*Buddelundia*	sp.	No											2						2	1		
		Spherillo	sp.	No				1				2						2		1		1		
	Platyarthridae/Bathytropidae	Gen. nov	sp. nov	Yes											5									
Gastropoda																								
	Pupillidae	*Gastrocopta*	*bannertonensis*	No				21									12				1			4
		Pupoides	cf. *adelaidae*	No					8		1					8		1	5	113	2	18		
		Pupoides	cf. *myoporinae*	No							27	4				1		2	14	16	31	5	4	
Chilopoda (Geophilida)																								
	Unknown			Potential																		1		

Appendix 7B Specimens Collected During Part One, Phase 2 (October – December 2009)

					Site Name																			
Class (Order)	**Family**	**Genus**	**Species**	**SRE**	**T01**	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**
Arachnida (Aranae)																								
	Barychelidae*	unknown		Potential																	1			
	Nemesiidae	*Kwonkan* *	MYG171'*	Potential											1									
Arachnida (Scorpiones)																								
	Buthidae	*Isometroides**	sp.	No								1				1			1		1			
		*Lychas**	*jonesae**	No									1	1	1	2								
	Urodacidae	*Urodacus**	gibson3'*	No											1	1								
		Urodacus	yeelirrie'	Potential								4									4			
Arachnida (Pseudoscorpiones)																								
	Atemnidae	*Oratemnus*	sp.	No												3					1			
	Cheiridiidae*	unknown		Potential																		1		
	Chernetidae	unknown	small'*	No		1																6		
		unknown	big'*	No														1						
	Olpiidae	*Austrohorus*	sp.	No		1														1				
		Beierolpium	sp. 8/3'*	No	11	3			1	2	5		4											
		Beierolpium	sp.	No					5	2			5											
		*Indiolpium**	sp.	No	1										3	4								
Malacostraca (Isopoda)																								
	Armadillidae	*Buddelundia*	sp.	No	23	5	8	2	2	2	2		26	10	2	3	57	12	3	8	1			
		*Cubaris**	sp. 1	Potential							1													
		*Pseudolaureola**	sp.	Yes				1																
		Spherillo	sp.	No	1	6	8	5	8	1	10	3	7	1			6	10	5	5	2	58		5
	Platyarthridae/Bathytropidae	Gen. nov	sp. nov	Yes	1	2	1				3							1						3
Gastropoda																								
	Pupillidae	*Pupoides*	cf. *adelaidae*	No				1			1													

* Indicates species that were not previosuly collected

Appendix 7C Specimens Collected During Part One, Phase 3 (December 2009 – January 2010)

					Site Name																			
Class (Order)	**Family**	**Genus**	**Species**	**SRE**	**T01**	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**
Arachnida (Aranae)																								
	Nemesiidae	*Aname**	MYG170'*	Potential				3	3	3	1						4	1	1					
		*Kwonkan**	MYG172'*	Potential	1																			
Arachnida (Scorpiones)																								
	Buthidae	*Isometroides*	sp.	No					1				1	1		1								
		Lychas	*jonesae*	No									1		7	3								
	Urodacidae	*Urodacus*	gibson3'	No								2			6	7			1		1			
Arachnida (Pseudoscorpiones)																								
	Atemnidae	*Oratemnus*	sp.	No										1	1	5					3			
	Olpiidae	*Austrohorus*	sp.	No							10				3	2					1			
		Beierolpium	sp. 8/3'	No	16	18			12	1	29		12					1		2	7			13
		Beierolpium	sp.	No													2		1					
		Indiolpium	sp.	No		2			1	1		4		1	73	143	1		7	7	4		2	1
Malacostraca (Isopoda)																								
	Armadillidae	*Buddelundia*	sp.	No	12	11	7		10	3	4		23	7	5	1	15	3		43	1			1
		Spherillo	sp.	No	1	3	2		1	1	3	2		2	1		1	1			1	8		
Gastropoda																								
	Pupillidae	*Pupoides*	cf. *myoporinae*	No	1																			1
Chilopoda (Geophilida)																								
	Unknown			Potential											1									

* Indicates species that were not previosuly collected

Appendix 7D Specimens Collected During Part One, Phase 4 (April – May 2010)

					Site Name											
Class (Order)	**Family**	**Genus**	**Species**	**SRE**	**O01**	**O02**	**O03**	**O04**	**O05**	**O06**	**O07**	**O08**	**O09**	**O10**	**O11**	**O12**
Arachnida (Aranae)																
	Idiopidae	*Idiosoma**	*nigrum* group*	Yes				1								
	Nemesiidae	Unknown						1		1		2		1		
Arachnida (Scorpiones)																
	Buthidae	*Lychas*	adonis'*	No										1		
		Lychas	annulatus'*	No				1			2			1		
		Lychas	*jonesae*	No								1				
	Urodacidae	*Urodacus*	*yaschenkoi*	No											4	
		Urodacus	yeelirrie'	Potential			1		3	7						
Arachnida (Pseudoscorpiones)																
	Chernetidae	*Nesidiochernes*	sp.	No				1								
	Olpiidae	*Austrohorus*	sp.	No		1					1					
		Beierolpium	sp. 8/2'	No		7	3	16	4	1	10	1		7	7	1
		Beierolpium	sp. 8/3'	No			1									
Malacostraca (Isopoda)																
	Armadillidae	*Buddelundia*	sp.	No								1				
		Cubaris	sp. 2*	Potential				3			7					1
		Spherillo	sp.	No	3						6		3		2	1

* Indicates species that were not previosuly collected

Appendix 7E Specimens Collected During Part One, Phase 5 (October – November 2010)

					Site Name																			
Class (Order)	**Family**	**Genus**	**Species**	**SRE**	**A01**	**A02**	**A03**	**A04**	**A05**	**A06**	**A07**	**A08**	**A09**	**A10**	**A11**	**A12**	**A13**	**A14**	**A15**	**A16**	**A17**	**A18**	**A19**	**A20**
Arachnida (Aranae)																								
	Idiopidae	*Aganippe**	sp.	Potential										1										
	Nemesiidae	*Aname*	MYG212'	Potential								1												
		Aname	unknown													1			1					
		Kwonkan	MYG210'*	Potential										1										
		Kwonkan	MYG211'*	Potential											1									
Arachnida (Scorpiones)																								
	Buthidae	*Lychas*	adonis'	No				8																1
		Lychas	annulatus'	No		2		1				1				1					2			
		Lychas	multipunctatus'*	No																	1			
	Urodacidae	*Urodacus*	gibson 3'	No																		1		
		Urodacus	yeelirrie'	Potential					1									1					3	
Arachnida (Pseudoscorpiones)																								
	Geogarypidae*	*Geogarypus**	sp.	No																				1
	Olpiidae	*Austrohorus*	sp.	No	1	2	3		1		1	1		1										
		Beierolpium	sp 8/3'	No		2	5	3	5			1	1	2	5	1		2	12	7	2	2	6	44
		Indolpium	sp.	No							1	4			3		3	1				3	1	
Malacostraca (Isopoda)																								
	Armadillidae	*Buddelundia*	sp.	No		1										2					1			18
		Cubrais	sp. 2	Potential							1													
		Spherillo	sp.	No						1		2	2				1		5			1		
Gastropoda																								
	Pupillidae	*Gastrocopta*	*bannertonensis*	No																				1

* Indicates species that were not previosuly collected

APPENDIX 8 PART TWO COLLECTED SPECIMENS

Specimens Collected During Part Two

					Site Name																			
Class (Order)	**Family**	**Genus**	**Species**	**SRE**	**YP1**	**YP2**	**YP3**	**YP4**	**YP5**	**YP6**	**YP7**	**YP8**	**YP9**	**YP10**	**PA1**	**PA2**	**PA3**	**PA4**	**PA5**	**PB1**	**PB2**	**PB3**	**PB4**	**PB5**
Arachnida (Aranae)																								
Araneomorphae	Clubionidae			No											1							1		
	Desidae			No											5		1					1	2	
	Gnaphosidae			No									1											
	Lycosidae	*gibsoni* -group'		No					1			1												
	Lycosidae			No							2							1	1	2*				
	Miturgidae			No												1								
	Prodidomidae	*Wesmaldra*	*wiluna*	No															1					
	Prodidomidae			No		1																		
	Sparassidae			No																1*				
	Thomisidae	*Stephanopis*	sp.	No			1																	
	Zodariidae	*Euasteron*	sp.	No										1										
Mygalomorphae	Dipluridae	*Cethegus*	sp.	No										1										
	Nemesiidae	*Kwonkan*	MYG172'	Potential																			1	
Arachnida (Scorpiones)																								
	Buthidae	*Lychas*	annulatus	No																1*				
Arachnida (Pseudoscorpiones)																								
	Olpiidae	*Indiolpium*	sp.	No								1												
Malacostraca (Isopoda)																								
	Armadillidae	*Buddelundia*	sp.	No	4								11											
Chilopoda																								
	Scolopendridae	*Scolopendra*	*laeta*	No								1												
Insecta (Coleoptera)																								
	Unknown			No						1					4	1	3						1	
	Carabidae (Cicindelinae)	*Pseudotetracha*	*helmsi*	Yes				12		14	21													
Insecta (Orthoptera)																								
	Gryllidae			No												1						3	1	
Insecta (Thysanura)																								
	Unknown			No											1							1		

*Indicate species collected by night foraging

APPENDIX 9 PART TWO WATER QUALITY RESULTS

Water Quality Results from Sediment Samples

Site	Position	Temperature (°C)	1. SpC (mS/cm)	2. SpC (mS/cm)	DO (mg/L)	pH	TDS (g/L)	DO%	ORP (mV)
YP1	**Deep**	24.16	0.375	0.375	3.81	7.78	0.2	31.3	134
YP1	**Middle**	25.21	3.32	3.31	4.38	7.9	2.1	18.6	141
YP1	**Edge**	25.67	0.318	0.313	5.17	6.88	0.2	51.5	160
YP4	**Deep**	25.7	29.1	29.1	3.69	7.1	18.7	38.1	173
YP4	**Middle**	25.14	0.363	0.372	4.6	7.65	0.2	46.2	144
YP4	**Edge**	25.6	6.81	6.79	5.12	7.27	4.3	55.4	161
YP6	**Deep**	25.1	10.5	10.5	5.16	7.5	6.8	59.5	165
YP6	**Middle**	25.5	1.91	1.9	5.23	7.87	1.2	55.4	146
YP6	**Edge**	25.3	0.908	0.908	5.75	7.55	0.5	61.1	156
YP7	**Deep**	25.2	15.1	15.1	6.14	7.11	9.7	58.7	169
YP7	**Middle**	25.6	10.49	10.53	5.4	7.2	6.7	56.5	163
YP7	**Edge**	25.56	3.96	3.94	4.73	7.67	2.5	38.7	155
YP10	**Deep**	25.1	5.02	6.77	6.23	7.14	2.3	62	167
YP10	**Middle**	25.8	20.2	20.2	5.04	6.76	13	51.9	184
YP10	**Edge**	25.5	5.89	5.85	5.45	6.24	3.8	56.7	200
PA	**Deep**	24.1	0.105	0.105	6.83	7.71	0.1	58.6	151
PA	**Edge**	23.9	0.159	0.125	6.25	7.72	0.1	51.6	157
PA	**Middle**	24.2	0.141	0.138	5.26	7.79	0.1	48.1	150
PB	**Deep**	25.4	0.122	0.125	6.19	8.24	0.1	67.5	126
PB	**Middle**	24.1	0.171	0.171	6.5	7.86	0.1	55.8	135
PB	**Edge**	23.9	0.195	0.187	5.42	7.76	0.1	52.7	132

APPENDIX 10 *IDIOSOMA* SP. DATA

Location of *Idiosoma* sp. Burrows

Site	Burrow Name	Number of Burrows	Habitat Type	Zone	Easting	Northing
Part One						
Phase 4 Site O04	O04	1	SAWS	50	769376	7006800
Phase 5 Opportunistic	ND001	1	Unknown	50	771915	6990099
Phase 5 Opportunistic	NT001	1	Unknown	51	216812	698790
Phase 5 Opportunistic	NT002	1	Unknown	51	216812	698801
Part Three						
Opportunistic	LRA001	4	SAMU	50	786334	6995048
I38	SW001	1	SAMU	50	786704	6995260
I40	SW003	1	SAMU	50	774496	7001878
I40	LRA003	1	SAMU	50	774525	7001801
I41	CH001	1	SAMU	50	769423	7006815
I41	SW002	2	SAMU	50	769417	7006827
I41	LRA002	1	SAMU	50	769575	7006998

Idiosoma sp. Habitat and Burrow Data from Part Three

Burrow Name	Burrow No.	Lid Diameter (mm)	Atrium Diameter (mm)	Soil Type	Aspect	Rock Presence (Y/N)	Log Presence (Y/N)	Leaf-litter Cover (%)
LRA001	1	21.3	16.8	Fine sand	Plain	No	No	5
LRA001	2	16.5	10.6	Fine sand	Plain	No	No	5
LRA001	3	10.6	6.3	Fine sand	Plain	No	No	5
LRA001	4	9	4.9	Fine sand	Plain	No	No	5
SW001	1	19	10.4	Fine sand	Plain	No	No	10
SW003	1	29.4	18.6	Fine sand	Plain	No	No	50
LRA003	1	23	19.9	Fine sand	Plain	No	No	87
CH001	1	8.7	6.9	Fine sand	Slight slope	Calcrete	No	50
SW002	1	20.2	14.4	Fine sand	Slight slope	No	No	40
SW002	2	18.9	16.5	Fine sand	Slight slope	No	No	40
LRA002	1	19.1	15.5	Fine sand	Plain	No	No	90