Weld Range Iron Ore Project

Spider Management Plan (*Idiosoma and Cethegus*)

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December 2011

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<th>ORIGINATOR</th>
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<td>A</td>
<td>Issued as Final</td>
<td>Ian Findlay</td>
<td>Mike Wood</td>
<td>Wayne Ennor</td>
<td>20 Dec 2011</td>
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</tbody>
</table>
# TABLE OF CONTENTS

1.0 **INTRODUCTION** 1

1.1 Project Background 2

2.0 **LEGISLATIVE REQUIREMENTS** 7

3.0 **AIMS, OBJECTIVES AND SCOPE** 8

4.0 **EXISTING ENVIRONMENT** 9

4.1 Regional Information 9

4.2 Heritage Status 9

4.3 Climate 10

4.4 Topography and Landforms 11

4.5 Vegetation and Flora 12

4.6 Weeds 13

4.7 Terrestrial Fauna 14

4.8 Fauna of Conservation Significance 14

5.0 **SPECIES INFORMATION** 16

5.1 Curtain-Web Spider (*Cethegus* sp. MUR) 16

5.2 Shield-Backed Trapdoor Spider (*Idiosoma nigrum*) 19

6.0 **IMPACTS TO SPIDER SPECIES** 22

6.1 Stock and goat grazing 22

6.2 Habitat alteration 22

6.3 Vegetation clearing 23

6.4 Fire 23

6.5 Dust 23

7.0 **SPIDER MANAGEMENT MEASURES** 24

7.1 Establish a Mygalomorph Conservation Team 24

7.2 Designate Conservation Areas for Sub-species and Genetically Distinct Populations 24

7.3 De-stock and Remove Goats from Weld Range 24

7.4 Implementation of a Fire Prevention Plan 24

8.0 **ENVIRONMENTAL MONITORING AND MANAGEMENT** 26

8.1 Performance Assessment 27
9.0 REVIEW AND REVISION

10.0 TIME FRAME

11.0 REFERENCES

TABLES

Table 2.1 Summary of the Curtain-web spider Species 3
Table 2.2 Summary of the Shield-Backed Trapdoor Spider Species 4
Table 9.1 Summary of conservation actions 29

FIGURES

Figure 1.1 Location Map 1
Figure 4.1 Western Murchison Subregions and Surrounds. MUR1 – Eastern Murchison, MUR2 Western Murchison (Based on IBRA Version 6.1 Thackway and Cresswell 1995) 9
Figure 4.2 Summary of Climatic Data for Meekatharra Airport (BOM, 2009) 11
Figure 4.3 Vegetation Structures within the Mining Tenement 13
Figure 5.1 Cethegus sp. MUR Adult Female (A) and Nest (B) 17
Figure 5.2 The Shield-Back Spider Idiosoma nigrum. Adult Female (A), Spider Plugging The Burrow Lumen With Its Sclerotised Abdomen (B), Trap Door With Twig-Lining - 5 Cent Coin In The Left Top Corner Is Shown For Scale (C) 19
Figure 9.1 Distribution of Cethegus sp. MUR at Weld Range 30
Figure 9.2 Distribution of Idiosoma nigrum at Weld Range 31
## TERMS AND ABBREVIATIONS GLOSSARY

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>ANZECC</td>
<td>Australian and New Zealand Environment and Conservation Council</td>
</tr>
<tr>
<td>bgl</td>
<td>below ground level</td>
</tr>
<tr>
<td>BIF</td>
<td>banded iron formation</td>
</tr>
<tr>
<td>DEC</td>
<td>Department of Environment and Conservation</td>
</tr>
<tr>
<td>DMP</td>
<td>Department of Mines and Petroleum</td>
</tr>
<tr>
<td>DoW</td>
<td>Department of Water</td>
</tr>
<tr>
<td>DRET</td>
<td>Department of Resources Energy and Tourism (Commonwealth)</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Authority</td>
</tr>
<tr>
<td>GDE</td>
<td>Groundwater Dependant Ecosystems</td>
</tr>
<tr>
<td>GLpa</td>
<td>Gigalitre per annum</td>
</tr>
<tr>
<td>ha</td>
<td>hectare</td>
</tr>
<tr>
<td>IBRA</td>
<td>Interim Biogeographic Regionalisation of Australia</td>
</tr>
<tr>
<td>mRL</td>
<td>meters Reduced Level (relative to the Australian Height Datum)</td>
</tr>
<tr>
<td>OEPA</td>
<td>Office of the Environmental Protection Authority</td>
</tr>
<tr>
<td>SMC</td>
<td>Sinosteel Midwest Corporation Limited</td>
</tr>
<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>TSF</td>
<td>Tailings Storage Facility</td>
</tr>
<tr>
<td>uS/cm</td>
<td>microSiemens per centimetre</td>
</tr>
<tr>
<td>SRK</td>
<td>SRK Consulting (Australasia) Pty Ltd</td>
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1.0 INTRODUCTION

Western Australia's economy is heavily dependent on mineral resource projects and its future growth and development rely on the continued viability of resource development projects. The Weld Range Iron Ore Project will provide financial and social benefits for the area through employment, infrastructure and flow-on effects to the non-mining sector.

![Figure 1.1 Location Map](image)

Sinosteel Midwest Corporation Ltd (SMC) is an incorporated entity set up to conduct mineral exploration, engineering, environmental and economic studies into the feasibility to mine Weld Range 60km NW of Cue.

The Weld Range Iron Ore Project (the Project) is a direct shipping iron ore project with high grade outcrops over a 60 km strike length. SMC is targeting to export 15 million tonnes per annum (Mtpa) of iron ore over a 15 year period, however, this Management Plan covers the first 11 years of planned
operations. To implement this project, major infrastructure will be designed, installed and constructed immediately, with production scheduled for 2014, and decommissioning in 2024.

There are a number of significant environmental impacts expected as a result of this Project, as described in Section 7 of the Public Environmental Review (PER) document. As a result, Environmental Management Plans for the significant factors have been developed as a primary method of controlling, managing and monitoring these known and expected environmental impacts. The management plans are elements of the Project’s Environmental Management System (EMS) that will be used to achieve the environmental objectives, targets and commitments of the Project and the application of mitigation measures described in the PER.

It is a primary objective that all environmental impacts during operation of the Project are avoided or minimised as far as reasonably practicable; consistent with the principles of environmental protection. Environmental impacts will also be evident during construction of the Project infrastructure and the objectives and management practices within these plans will also apply to these construction activities.

Full management plans have been developed for impacts that represent the more significant aspects of the Project, including:

- Fire Management Plan
- Rare Flora Management Plan
- Surface Water Management Plan
- Ground Water Management Plan
- Spider Management Plan
- Dust Management Plan
- Acid Mine Drainage Management Plan

Compliance with commitments outlines in this document will be internally audited by SMC and subject to external audits by the relevant regulatory agencies, including the Department of Environment and Conservation (DEC) and the Department of Mines and Petroleum (DMP).

This Spider Management Plan (the Plan) and subsequent Actions Plans will be developed and implemented in consultation with the Department of Environment and Conservation (DEC) and any other relevant bodies.

1.1 Project Background

Mining will occur at two main deposits, namely Beebyn and Madoonga, with estimated impacts on Weld Range of approximately 10%. The project is anticipated to have localised impacts to the environment, including two species of spiders, the Shield-backed Trapdoor Spider (Idiosoma nigrum) and the Curtain-web Spider (Cethegus sp. MUR; in previous reports ‘Cethegus fugax species complex’).
SMC commissioned *ecologia* develop a management plan for *Idiosoma* and *Cethegus* at Weld Range and provide conservation actions for each species from known threats including stock grazing, habitat alteration, vegetation clearing, fire and dust.

### Table 2.1 Summary of the Curtain-web spider Species

<table>
<thead>
<tr>
<th>Curtain-web spider</th>
<th><em>Cethegus</em> sp. MUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>Dipluridae</td>
</tr>
<tr>
<td>Location</td>
<td>Weld Range</td>
</tr>
<tr>
<td>Distribution</td>
<td>Isolated ranges in the Western Murchison subregion</td>
</tr>
<tr>
<td>Current status of taxon</td>
<td>none listed but reported as SRE (<em>ecologia</em> 2009a)</td>
</tr>
<tr>
<td>Description</td>
<td>Spiders are a light, dusty brown colour and the usual dark brown patches on pale lung-book covers noted by Raven (1984) of <em>C. fugax</em> are absent. The Weld Range specimens also appear to have more “larger” teeth on the pro-margin of the cheliceral furrow than <em>C. fugax</em>. The nest consists of a copious mass of vertical, curtain-like strands of silk with adherent soil particles and there are two or three funnel-like tubes that join into a common tube leading into a shallow burrow at the centre of the nest. Radiating from the main mass of web, there are catching strands which entrap both crawling and flying insects. The nests may be up to thirty centimetres in height and width and they are generally supported against stems of trees or shrubs, tussocks of grass, logs or irregularities in soil such as banks or rocks.</td>
</tr>
<tr>
<td>Habitat</td>
<td>Shaded microhabitats, mostly associated with vegetated areas on southern slopes.</td>
</tr>
<tr>
<td>Conservation plan objective</td>
<td>To maintain or enhance the condition (i.e. prior to commencement of mining) of Weld Range populations for the duration of active mining, and a minimum of three years after active mining ceases.</td>
</tr>
<tr>
<td>Recovery criteria</td>
<td>The population trend shows no change or an increase in population size</td>
</tr>
<tr>
<td>Criteria for success</td>
<td>The number of adult individuals has remained the same or increased over the term of the plan.</td>
</tr>
<tr>
<td>Criteria for failure</td>
<td>The number of adult individuals has decreased by 15% or more over the term of the plan.</td>
</tr>
</tbody>
</table>
| Conservation actions | 1. Establish a mygalomorph conservation team  
2. Designate conservation areas for subspecies *Cethegus* sp. MUR HH in Hampton |
3. Undertake monitoring
4. De-stock Madonga and Beebyn stations
5. Design fire prevention plan
6. Conduct employee / contractor awareness sessions
7. Conduct plan evaluation

Conservation team
The formation of Mygalomorph conservation team is recommended as part of this conservation plan

Conservation plan time frame
This conservation plan will be implemented at least a year prior to the mining commencing in 2013. The plan will be upheld through the estimated 11 years of the mine’s life (till 2024) and a minimum of three years after mining ceases (till 2027)

<table>
<thead>
<tr>
<th>Shield-backed trapdoor spider</th>
<th>Idiosoma nigrum Main 1952</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>Idiopidae</td>
</tr>
<tr>
<td>Location</td>
<td>Weld Range</td>
</tr>
<tr>
<td>Distribution</td>
<td>Avon Wheatbelt, Geraldton Sandplains, Yalgoo and Murchison bioregions</td>
</tr>
<tr>
<td>Current status of taxon</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Description</td>
<td>The most distinguishing characteristic of <em>I. nigrum</em> is the dark brown to black colour of the abdomen and appendages, which sits in contrast to the yellow to grey abdominal underside. The dorsal side of the abdomen is heavily sclerotised and deeply grooved, forming a shield-like structure. The eyes are arranged in three rows with the two anterior rows possessing two eyes and the posterior row possessing four eyes in a transverse line</td>
</tr>
<tr>
<td>Habitat</td>
<td>Boundaries of drainage lines and underneath <em>Acacia</em> vegetation. With the exception of the Weld Range North area, which has north-south orientation, all burrows are found on the southern side of the range.</td>
</tr>
<tr>
<td>Conservation plan objective</td>
<td>To maintain or enhance the condition (i.e. prior to commencement of mining) of Weld Range populations for the duration of active mining, and a minimum of three years after</td>
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</table>

Table 2.2 Summary of the Shield-Backed Trapdoor Spider Species
### Recovery criteria

The population trend shows no change or an increase in population size.

### Criteria for success

The number of adult individuals has remained the same or increased over the term of the plan, and the number of recruits (emergents and juveniles) has represented 66% or more of the entire population.

### Criteria for failure

The number of adult individuals has decreased by 15% or more over the term of the plan and/or the number of recruits (emergents and juveniles) has represented 51% or less of the entire population.

### Conservation actions

1. Establish a mygalomorph conservation team
2. Designate conservation areas for genetically distinct populations in Hampton Hill, Weld Range South and Weld Range North
3. Undertake monitoring
4. De-stock Madonga and Beebyn stations
5. Design fire prevention plan
6. Conduct employee / contractor awareness sessions
7. Conduct plan evaluation

### Conservation team

The formation of Mygalomorph conservation team is recommended as part of this conservation plan.

### Conservation plan time frame

This conservation plan will be implemented at least a year prior to the mining commencing in 2013. The plan will be upheld through the estimated 11 years of the mine’s life (till 2024) and a minimum of three years after mining ceases (till 2027).

*Idiosoma nigrum* and *Cethegus* sp. MUR belong to the suborder Mygalomorphae and are commonly referred to as trapdoor spiders. Trapdoor spiders are primarily terrestrial burrowing spiders that build narrow silk-lined burrows. Some trapdoor spider genera consist solely of short-range endemic species (Harvey 2002) as they have low dispersal ability, a long life cycle and sedentary life style (Main 1987). Mygalomorph spiders can take several years to reach reproductive maturity and females of some species can live for more than 20 years although males die shortly after mating (Main *et al.* 1985). Females lay eggs within their burrow and spiderlings emerge approximately one year after parental mating (Main 1982). After emerging, the spiderlings establish a new burrow and, during this time, are subject to predation that can result in greater than 50% loss of emergents (Main *et al.* 1985). Natural predators include other arthropods such as Scorpions, Centipedes and Pompilid wasps, some of which specialise in preying upon trapdoor spiders, and vertebrates such as lizards and some marsupials which dig spiders out of their burrows (Main 1985).
At Weld Range, there are several threats to *I. nigrum* and *Cethegus* sp. MUR. These include stock grazing, which causes vegetation degradation and therefore reduces habitat suitability and availability, and man-induced habitat alteration and clearing. Due to their confinement to specific, disjunct habitats, combined with barriers to dispersal (i.e. the natural gaps in the range), both species comprise several genetically distinct populations at Weld Range. Physical disturbance to these habitats may result in population extinction and thus a loss of genetic information in these species.
WELD RANGE IRON ORE PROJECT
SPIDER MANAGEMENT PLAN (IDIOSOMA AND CETHEGUS)

2.0 LEGISLATIVE REQUIREMENTS

SMC will, as a minimum, meet all relevant regulatory requirements in managing spiders – during the construction and operation of the Weld Range Project. The key Western Australian legislation to which SMC will have regard in its management of spiders includes:

**WA State Legislation**

- Conservation and Land Management Act 1984
- Environmental Protection Act 1986
- Wildlife Conservation Act 1950
- Environment Protection Act 1986

**Commonwealth Legislation**

*Environmental Protection & Biodiversity Conservation Act 1999 and Regulations 2000*
3.0 AIMS, OBJECTIVES AND SCOPE

This (Spider Management) Plan is prepared under the Weld Range Environmental Plan 2010, the object of which is to minimise and, where possible, eliminate any adverse environmental impacts associated with construction and operation of the Project. Each management plan within the EMP describes the objectives for managing the individual environmental aspect.

The **Aim** of this Plan is to –

- To maintain or enhance the condition (i.e. prior to commencement of mining) of Weld Range populations of *Idiosoma nigrum* and *Cethegus* sp. MUR for the duration of active mining.

The **Objectives** of this Plan are to:

- Protect areas with spider populations from grazing livestock and goats
- Protect areas with viable spider populations from habitat alteration and vegetation clearing
- Prevent accidental man-induced damage to areas with spider populations by promoting awareness on site and within the region (SMC employees, independent contractors)
- Prevent fire damage to areas with spider populations by implementing specific fire-prevention strategies
- Institute a population monitoring scheme and undertake an annual census of all individuals in designated monitoring areas to research the spiders’ ecology and population dynamics

The **Scope** of the Plan includes:

- Establishment of a spider conservation team
- Designation of genetically distinct populations
- On ground monitoring
- De-stocking and goat removal from the Weld Range
- Fire prevention planning
4.0 EXISTING ENVIRONMENT

4.1 Regional Information

The Interim Biogeographic Regionalisation for Australia (IBRA) categorises the Australian continent into regions of similar geology, landform, vegetation, fauna and climate (IBRA, 2000). The Weld Range lies within the Western Murchison sub region of the Murchison Biogeographic Region, which lie within the Eremaean botanical province or the arid zone of Western Australia, as illustrated below in Figure 4.1.

Figure 4.1 Western Murchison Subregions and Surrounds. MUR1 – Eastern Murchison, MUR2 Western Murchison (Based on IBRA Version 6.1 Thackway and Cresswell 1995)

The Western Murchison subregion comprises predominately Mulga (Acacia aneura) low woodlands, with an understorey often rich in ephemerals (usually with hummock grasses). The substrate consists primarily of outcrop and fine textured Quaternary alluvial and eluvial surfaces (extensive hardpan wash plains that dominate and characterise the subregion) mantling granitic and greenstone strata. Where occluded drainage features occur, vegetation is dominated by saltbush shrub lands on calcareous soils and Halosarcia low shrub lands on saline alluvia. The Western Murchison subregion contains the headwaters of the Murchison and Wooramel Rivers, which drain the subregion westwards to the coast.

4.2 Heritage Status

Western Australia has an abundant cultural and natural heritage that enriches our lives and helps shape our individual and collective identities. Aboriginal heritage places include Aboriginal sites and objects within the meaning of the Aboriginal Heritage Act 1972, and historic heritage places. Heritage
places range in size from whole regions or landscapes to features or buildings that have natural and/or cultural heritage significance for the present community as well as for future generations.

There have been a number of ethnographic and archaeological surveys conducted over the proposed mining area and indigenous sites of heritage value identified and these will not be impacted on by mining operations or protection strategies proposed within this SMP

4.3 Climate

Climate and Meteorology

Meteorological data has been recorded at the Bureau of Meteorology (BOM) weather station at Meekatharra airport.

Climate

Weld Range is located in the Midwest Region of WA, approximately 80 km west south west of Meekatharra. The region experiences hot, dry summers and mild winters. A high pressure band or subtropical ridge dominates the weather pattern throughout the year. During the warmer months, a low pressure trough is located to the south, resulting in southerly and south easterly winds. Occasional cold fronts bring little rain to the region whereas tropical cloud bands bring the most rains during the winter months.

Temperature

Mean maximum temperatures range from 38.2°C in January to 19°C in July. Mean minimum temperatures range from 24.3°C in January to 7.4°C in July. Very hot summers and mild winters are representative of the region (Figure 4.2).

Rainfall

The late summer and early winter months (February and June) provide the most rainfall over the year (Figure 4.2). The total annual rainfall in this region is very low (less than 250 mm per annum).

September is the driest month of the year, receiving on average less than 5 mm of rainfall over the entire month.
Relative Humidity

The morning (9 am) mean relative humidity is consistently higher than the afternoon (3 pm) mean. On average, humidity increases to between 41% and 63% in the winter months and decreases to between 16% and 28% in the summer months. This low humidity can increase the potential for higher particulate emissions from mining activities.

Winds

The long term wind recordings at Meekatharra indicate the following:

- for January to March, eastern and south eastern winds are predominant;
- for April to June, the main winds are from the east;
- for July to September, the winds are primarily from the east or south; and
- for October to December, the wind pattern is similar to July to September but the wind speed is generally higher.

The overall wind speed ranges between 2 m/s and 5 m/s. The frequency of wind speeds between 5 m/s and 10 m/s reduces gradually to the point that very few hours have an hourly average wind speed greater than 10 m/s.

4.4 Topography and Landforms

The topography of the area is dominated by the Weld Range - a long band of steep ridges that run southwest to northeast and extend over a distance of more than 60 km. The Project tenements are situated within these ridges. The elevation ranges from approximately 460 Mrl TO 730 Mrl. The slope angles in the area of the Weld Range vary from less than 5% to greater than 90%. Away from the ridges the topography is very flat.
There are some clearly delineated drainage channels within Weld Range itself, however the land to
the north has only a few well defined channels and is characterised by numerous mud flats and sand
pans. There is a significant salt pan in a depression immediately north of the Madoonga tenement.
The available topographic data indicates a minimum elevation of 482.7m AHD (Average Height
Datum) in this salt pan.

4.5 Vegetation and Flora

The vegetation within the mining tenement is dominant Mulga with approximately 70% of the area
ground cover free and the remaining 30% has mixed annual grasses with areas of saltbush and mixed
scrub species to 50cm high.

There are a number of priority flora within the tenement but the impact on plant species cannot be
determined currently until the actual disturbance sites area are surveyed.

Mulga and Mulga communities are an ecologically and culturally important tree species with many
values, including:

- Conservation: Mulga plays an important role in nutrient capture and hydrology, which is a vital
function in arid ecosystems. Mulga provides unique habitat for many flora and fauna species. Mulga
is particularly important habitat for many bird species, provides woody forage for native herbivores and
may be important as refugia from summer heat and from fire for many species.

- Cultural value: Mulga is a very important species for the indigenous people of central Australia as
it provides food, wood for utensils, weapons and shelter in the hot summer months. The biota
associate with Mulga such as honey ants, kangaroos and lerps are also highly valued by indigenous
people (Williams 2001).

- Economic value: Pastoralism is the most common agricultural land-use on Mulga communities
and is an important area for meat and wool production. The stands of Mulga provide stock shade and
rest areas and a palatable, abundant and widespread fodder shrub during periods of drought.

- Intrinsic value: Mulga and Spinifex habitats together characterise a large part of central Australia.
The isolation of most Mulga communities adds to the intrinsic value of these vegetation types.

- Recreation and tourism: Recreational opportunities that mulga woodlands provide include bird
watching, walking, plant identification and appreciation of the natural environment.

The disappearance of mulga usually goes hand in hand with a spread of grasses, thereby leading to
increased termite activity and this may result in greater erosion during dry times. Furthermore,
disappearing Mulga decreases nitrogen levels in the ground, depriving other valuable desert plants of
food. This is due to a symbiotic relationship between acacias and a nitrogen binding bacteria called
Rhizobium. Naturally, Mulgas normally long life plays a strong part in a staple provision of nitrogen.
Figure 4.3 Vegetation Structures within the Mining Tenement

4.6 Weeds

Introduced Flora Species

The Australian Weed Strategy (2007) defines a weed as “a plant which has, or has the potential to have, a detrimental effect on economic, social or conservation values”. Weeds that have proliferated in bushland without direct human intervention or assistance are also referred to as naturalized alien species.

Declared Weeds

Weeds that are, or have the potential to become, a threat to agriculture may be formally declared under the Agriculture and Related Resources Protection Act 1976 (ARRP Act). Declared Plants under this Act are listed with Standard Control Codes that outline the requirements for control. Five Priority groupings exist (P1, P2, P3, P4 or P5), and more than one Priority may be placed on a weed species. Weeds may also be prioritised differently in different agricultural regions. Eighty three Declared Plants are listed as occurring in the Murchison region of Western Australia under the ARRP Act.
A search was conducted of the Department of Agriculture and Food's list of Declared Plants (weeds), under the Agriculture and Related Resources Protection Act 1976, and 83 Declared Plants are listed as occurring in the Murchison Region of Western Australia.

No Declared Plants (weeds) were recorded during the Weld Range survey.

Fire, applied at the appropriate time during the seeding cycle, may be used to assist in the management or control or containment of weed species.

4.7 Terrestrial Fauna

Vertebrate Fauna

A total of 29 native and eight introduced mammal, 156 bird, 88 reptile and five frog species have the potential to occur in the area around the evaporation pond site. However, based on the size and fauna habitats present within the proposed evaporation pond, only a proportion of these species will occur within the evaporation pond area.

Two species of conservation significance have previously been recorded within the proposed evaporation pond site; Long-tailed Dunnart (Sminthopsis longicaudata) and a skink (Lerista eupoda), both of which were recorded within the proposed access track to the evaporation pond. In addition to these, an additional six species have been recorded within the vicinity of the evaporation pond and have the potential to occur within this area: Bush Stone-curlew (Burhinus grallarius), Mallee-fowl (Leipoa ocellata), Peregrine Falcon (Falco peregrinus), Slender-billed Thornbill (Acanthiza iredalei iredalei), Australian Bustard (Ardeotis australis), and Rainbow Bee-eater (Merops ornatus).

Invertebrate Fauna

In 2007, ecologia identified a number of species that are short-range endemics including two mygalomorph spiders (Cethegus ‘fugax complex’ and the Shield-back Spider Idiosoma nigrum – a Schedule 1 species under the Wildlife Conservation Act), one snail species (Pleuroxia sp.) and a millipede (Antichiropus sp. ‘Weld Range’).

A total of 76 ha was surveyed for Idiosoma nigrum and on all occasions Idiosoma nigrum burrows were found within the boundaries of drainage lines and underneath Acacia vegetation. With the exception of the Weld Range North area, which has north-south orientation, all burrows were found on the southern side of the range.

4.8 Fauna of Conservation Significance

During the two Level 2 and Level 1 ecologia fauna surveys, 17 native and six introduced species of mammal, 80 bird species, 44 reptile species and one amphibian species were recorded in the project area (ecologia, 2009e).

Of these, five species of conservation significance were recorded on site:
• Long-tailed Dunnart (Sminthopsis longicaudata) (DEC Priority 3);
• Peregrine Falcon (Falco peregrinus) (WCA Schedule 4);
• Bush Stone-curlew (Burhinus grallarius) (DEC Priority 4);
• Slender-billed Thornbill (Acanthiza iredalei) (EPBC Act Vulnerable); and
• A fossorial skink (Lerista eupoda) (DEC Priority 1).

A further two conservation significant species, the Rainbow Bee-eater and the Australian Bustard, were not recorded but were considered highly likely to utilise the project area on occasion.
5.0 SPECIES INFORMATION

5.1 Curtain-Web Spider (*Cethegus* sp. MUR)

**History and Taxonomic Relationships**

The genus *Cethegus* Thorell (family Dipluridae) is widespread in Australia and it currently includes eleven named species (Raven 1984). Specimens of the genus *Cethegus* collected in the Murchison bioregion were originally identified as *C. fugax*, known from the type locality in Mt Helena near Perth within the Jarrah Forrest bioregion. However, both morphological and genetic analyses confirmed that the *Cethegus* specimens collected within the Murchison bioregion represented a new species. For the purpose of this document, this new species has been called *Cethegus* sp. MUR. Furthermore, an analysis based on molecular taxonomy showed that two genetically distinct sub populations were present at Weld Range, one at Hampton Hill (here named as *Cethegus* sp. MUR HH) and the other at Weld Range South in Madoonga and Beebyn (here named as *Cethegus* sp. MUR WRS) (*ecologia* 2009a).

**Description**

The species at Weld Range (Figure 2.1) differs from *Cethegus fugax* in a number of characteristics (*ecologia* 2009a).

1. The specimens from Weld Range appear to have more “larger” teeth on the pro-margin of the cheliceral furrow than does *C. fugax*.
2. Unlike some northern and inland specimens which are black, the Weld Range specimens are all a light, dusty brown.
Distribution, Habitat and Movements

The genus *Cethegus* is widespread in Australia exclusive of the extreme southwest and southeast regions and Tasmania (Raven 1984). It occurs from tropical rainforests to semiarid areas where it is believed to be relictual from a former wetter era when rainforest predominated in such areas (Main 1997).

At Weld Range, *Cethegus* sp. MUR was found at Hampton Hill and Weld Range South (Madoonga, Wilgie Mia and Beebyn) (Figure 9.1). No specimens were ever found at Weld Range North. The species displays several characteristics typical for relictual species - it is found in shaded microhabitats, mostly associated with vegetated areas on southern slopes. Although several nests were also found on the plain below the range, their density was sparse and their total numbers too low to warrant a viable population, thus it was assumed that a local flood or an unusually strong wind transported the spiders from their source populations on the range down to the plain during their aerially-dispersed emergent stage.

**Biology and Ecology**

The common name, Curtain-web spider, reflects the appearance of the spider’s nest, which includes a copious mass of vertical, curtain-like strands of silk with adherent soil particles that are assumed to function as camouflage and increase the shading of the nest. At the centre of the nest are two or three funnel-like tubes that join into a common tube leading into a shallow burrow. Radiating from the main mass of web, there are catching strands which entrap both crawling and flying insects. The nests may be up to thirty centimetres in height and width and they are generally supported against stems of trees or shrubs, tussocks of grass, logs or irregularities in soil such as banks or rocks (Main 1980).

Mating and reproduction appears to depend on prevailing seasonal conditions in relation to region or location. No data on longevity or time to maturation are currently available, however some field evidence suggests that *Cethegus fugax* in WA central wheatbelt can mature in approximately two
Emergent spiderlings may be aerially dispersed over short distances (i.e. several meters) (Main 1995). Although Cethegus spiderlings are known to use limited aerial dispersal, the pattern of the genetic structure at Weld Range showed that dispersal was very limited and spiders were unable to disperse across the 1 km wide natural gap between Hampton Hill and Madoonga (ecologia 2009a). This presents evidence that aerial dispersal may possibly enable Cethegus to escape disturbance on a very local scale (i.e. < 1km) but it does not function as a long-distance vector. No data exist on survivor rate of new emergents, however observations by ecologia staff in the field suggest that the mortality of new emergents is very high (>50%), with the population size rapidly decreasing over summer and autumn (December – May).

Because of such little knowledge about population structure and its trends, it will be of a key importance to the mygalomorph team to develop methodology that will help to understand the dynamics of this species.

**Genetics of Populations at Weld Range**

A genetic analysis of *Cethegus sp.* MUR was undertaken, comparing the Weld Range specimens and other specimens collected from the Murchison bioregion with *Cethegus fugax* collected at the type locality in the Jarrah Forest bioregion and *Cethegus ischnoteloides* from the Great Victoria Desert (ecologia 2009a). This study showed that there was a very high genetic divergence among specimens from different bioregions (ecologia 2009a). This is most likely a consequence of a long evolutionary history in a geologically stable environment. A crude estimate suggested that the divergence among regions occurred between 24-41 million years ago (ecologia 2009a). Because of such a high divergence, the specimens collected within the Murchison region are considered to be a new species, separate from *C. fugax* and *C. ischnoteloides* (ecologia 2009a).

Furthermore, the genetic divergence among populations within the Murchison region ranged significantly, with populations from isolated ranges displaying a divergence as high as half of the value of those from different regions (ecologia 2009a). These isolated populations were considered distinct sub-species, two of which occur at Weld Range, one at Hampton Hill (*Cethegus sp.* MUR HH) and the other at Weld Range South in Madoonga and Beebyn (*Cethegus sp.* MUR WRS) (ecologia 2009a).

**Conservation Status**

*Cethegus* sp. MUR is not listed under state or federal government legislation, however, the species is considered a potential short-range endemic. Due to the two sub-species being collected at Weld Range (*Cethegus sp.* MUR HH and *Cethegus sp.* MUR WRS), they require separate conservation management (ecologia 2010b).
5.2 Shield-Backed Trapdoor Spider (*Idiosoma nigrum*)

History and Taxonomic Relationships

The shield-backed spider *Idiosoma nigrum* was first described by Barbara York Main in 1952. It is one of three species that belong to the genus *Idiosoma* which is endemic to south-west Western Australia (Main *et al.* 1985). This species is a product of extensive radiation and adaptation to dry habitats in south-western Australia (Main 1999).

Description

The most distinguishing characteristic of *I. nigrum* is the dark brown to black colour of the abdomen and appendages, which sits in contrast to the yellow to grey abdominal underside (Figure 5.2). The dorsal side of the abdomen is heavily sclerotised and deeply grooved, forming a shield-like structure. The eyes are arranged in three rows with the two anterior rows possessing two eyes and the posterior row possessing four eyes in a transverse line (Main 1952).

![Figure 5.2 The Shield-Back Spider Idiosoma nigrum. Adult Female (A), Spider Plugging The Burrow Lumen With Its Sclerotised Abdomen (B), Trap Door With Twig-Lining - 5 Cent Coin In The Left Top Corner Is Shown For Scale (C)](image)

Distribution, Habitat and Movements

Previously to surveys undertaken at Weld Range (*ecologia* 2009b), the known distribution of *I. nigrum* was throughout the central and northern wheatbelt, and across to areas north of the Murchison river where populations are known to be small, fragmented and extremely isolated (Main 2003). The collections at Weld Range by *ecologia* have extended the known geographic boundary of the species distribution by approximately 200 km further north, into more arid areas.

At Weld Range, *Idiosoma* burrows were located in every part of the range (Hampton Hill, Madoonga, Wilgie Mia Aboriginal Reserve, Bieby and Weld Range North) (Figure 9.2). The burrows were found within the boundaries of drainage lines and underneath Acacia vegetation. With the exception of the Weld Range North area, which has north-south orientation, all burrows were found on the southern side of the range. Several populations were also found on the flats several hundred meters south of the range (*ecologia* 2009b).
Biology and Ecology

*Idiosoma nigrum* is one of the most arid-adapted mygalomorph spiders in Australia (Main 1982). This is due to a combination of morphological and behavioural attributes, such as a deep burrow which provides a narrow range of temperature and humidity beneath the surface, ‘twig-lining’ of the burrow rim to increase the prey foraging area Figure 5.2, a sclerotised abdominal cuticle which reduces evaporative water loss and also plugs the burrow to stop the entry of predators, enlarged eyes which increase visual acuity and relatively long legs that facilitate hunting (Main 1982).

The spider is long-lived, with females possibly reaching 20+ years of age. Both males and females reach maturity in a minimum of 5-6 years, by which time males undergo a final moult, reproduce and subsequently die. The females are probably capable of reproducing every second year until the age of about 20 (B.Y. Main, pers. comm.). Emergent spiderlings generally establish their burrows within several centimetres of the matriarch female, forming a family cluster typical for all mygalomorph spiders with no aerial dispersal. Gene flow is facilitated by male-biased dispersal (< 500 m; B. Y. Main, pers. comm.), as males only leave their burrows in search of females, while females spend their entire life in the burrow and its proximity. There is some field evidence from other species that females may be capable of storing sperm (B.Y. Main, pers. comm.), however it is unclear whether only the virgin females mate with emergent males or whether adult females mate repeatedly throughout their life.

Population Structure

As already mentioned in section 2.2.3, *I. nigrum* burrows were found at all sections of Weld Range (Hampton Hill, Madoonga, Beebyn, Wilgie Mia Aboriginal Reserve and Weld Range North), however, there were differences in population size and structure between these sections (*ecologia* 2009b).

The population structure at Weld Range North and Hampton Hill indicated that these populations were growing while the populations at Madoonga and Wilgie Mia were declining. The population structure at Beebyn indicated that this population had been growing until recently but is currently stagnating (*ecologia* 2009b).

Beebyn had the lowest effective population size followed by Hampton Hill and Madoonga. If these decrease further, the populations will be at risk from genetic inbreeding in the long term (*ecologia* 2009b). The populations at Weld Range North and Wilgie Mia had the highest effective population sizes and are not at danger from genetic inbreeding unless the populations decline over the next 15 to 20 years.

Genetics of Populations at Weld Range

The microsatellite genetic study of *I. nigrum* at Weld Range confirmed that geographic features separate the populations into three isolated units (Weld Range North, Weld Range South and Hampton Hill) (*ecologia* 2010a). These populations do not experience gene flow among each other (*ecologia* 2010a). If these populations were to be exposed to major disturbance causing a decline in
population size and subsequent decline in genetic diversity, it is highly unlikely that natural input of either new recruits or genetic diversity will take place to facilitate recovery (ecologia 2010a).

**Conservation Status**

*Idiosoma nigrum* is listed under the Western Australian *Wildlife Conservation Act 1950* as Schedule 1 Fauna (fauna that is rare or likely to become extinct).

For the sustainable future of the species at Weld Range, each unit (Weld Range North, Weld Range South and Hampton Hill) should be managed as a separate entity to preserve genetic diversity of the species on the range (ecologia 2010b).
6.0 IMPACTS TO SPIDER SPECIES

Due to the species confinement to specific, disjunct habitats, the main threatening processes at Weld Range are:

- stock and goat grazing
- habitat alteration
- vegetation clearing
- fire
- dust.

These threats singularly and collectively contribute towards reduced ecological viability of both species and their habitat at Weld Range.

6.1 Stock and goat grazing

Heavy grazing has been shown to alter the composition and structure of spider assemblages through the reduction in understorey vegetation and modifications to the leaf-litter and ground microclimate (Bromham et al. 1999; Harris et al. 2003; Lindsay and Cunningham 2009). Studies of grazing in remnant vegetation have shown that grazing leads to a decrease in the abundance of mygalomorph spider species and that heavy grazing can eliminate mygalomorph spider species from the community altogether (Abernsperg-Traun et al. 1996). This is thought to be due to the sedentary nature of mygalomorph spiders thereby increasing their susceptibility to disturbance through persistent damage or destruction of their burrows (Abernsperg-Traun et al. 1996) as well as a decrease in leaf-litter and soil moisture. Juvenile *I. nigrum* are particularly susceptible to disturbance by heavy grazing as their burrows are shallow and delicate.

6.2 Habitat alteration

The main habitat alterations at Weld Range include fragmentation of previously continuous habitat and changes to surface hydrology. The former restricts gene flow via reduction of movement of individuals and, if long-term, results in population decline. The latter affects the microclimate within burrows, the burrowing ability of spiderlings and the density of surface vegetation cover which is linked to the spiders' foraging success.

Although some mygalomorph spider species have been known to persist in small remnants of vegetation, large areas containing suitable microhabitats are still required for the conservation of the species (Main 1987). This is especially important at Weld Range where genetically dissimilar populations occur in different areas (*ecologia* 2010a). Studies of highly fragmented and disturbed
bushland remnants show that mygalomorph spider populations decline rapidly and may cause the local extinction of some species (Abernsperrg-Traun et al. 1996).

6.3 Vegetation clearing

Vegetation clearing has a capacity to result in direct mortality of spiders, especially juveniles, and contributes to a reduction of suitable habitat and/or its fragmentation, effects of which are discussed above.

6.4 Fire

Fire represents a direct threat to both spider species as it has a capacity to result in direct mortality of spiders, especially juveniles, and contributes to a reduction of suitable habitat by removing vegetation and leaf-litter and/or habitat fragmentation, effects of which are discussed above. In some circumstances, fire has been known to destroy Mulga habitats and associated flora and fauna, resulting in the destruction of suitable habitat for mygalomorph spiders (Williams 2002). Direct impacts of fire of mygalomorph spiders have been observed with the mygalomorph family Barychelidae where spiders living in clay soils and subject to a hot fire were destroyed (Raven 2008).

6.5 Dust

Fine dust can cause reduction of suitable habitat through vegetation degradation and is known to affect vegetation by reducing growth rates and plant vigour, increasing plant pests and diseases and changing community structure (Farmer 1993; MENZ 2001). Vegetation degradation results in changes to invertebrate community structure and leaf-litter distribution and depth thus influencing the spiders’ foraging success. Reduction in leaf-litter distribution and depth also increases the chance of predation and causes the loss of soil moisture making it difficult for juvenile spiders to burrow and increasing susceptibility to hot weather and fire.
7.0 SPIDER MANAGEMENT MEASURES

The aim of conservation actions is to provide operational guidelines for the implementation of on-ground actions. The following list is presented in order of descending priority:

7.1 Establish a Mygalomorph Conservation Team

A mygalomorph conservation team will be established, consisting of SMC representatives, government agencies and experts with knowledge in spider taxonomy, ecology and conservation. This team will focus on conservation of *I. nigrum* and *Cethegus* sp. at Weld Range, participating in decision-making about the monitoring design and undertaking evaluation review of this conservation management plan after five year of its implementation.

Completion date: 2012

Cost: 8 hours of stakeholder liaison for 1 ecologia staff/year + $500 for incidental costs/year

7.2 Designate Conservation Areas for Sub-species and Genetically Distinct Populations

*Idiosoma nigrum*

A minimum of three conservation areas will be designated, one at Hampton Hill, one at Weld Range South and one at Weld Range North. This is to ensure a long-term survival of genetically isolated populations in these sections of the range.

*Cethegus* sp. MUR

A minimum of two conservation areas will be designated, one at Hampton Hill and one at Weld Range South. This is to ensure a long-term survival of the two sub-species, Cethegus sp. MUR HH and Cethegus sp. MUR WRS.

7.3 De-stock and Remove Goats from Weld Range

Measures will be taken to reduce and control livestock and goats at Weld Range in order to reduce direct damage to spider burrows, and slow down the process of vegetation degradation and soil compaction, which affects the spiders’ ability to burrow and forage.

7.4 Implementation of a Fire Prevention Plan

While bush fires provide a number of important ecological functions, accidental fires or inappropriate fire regime may threaten the survival of *I. nigrum* and *Cethegus* sp. at Weld Range. This is mainly due to the fact that both species have already been under pressure from pre-mining activities for some time, and the already fragmented nature of their populations is likely to reduce their ability to recover
and re-colonise the remaining habitat. This is especially valid for fires that occur when spiders are especially vulnerable (i.e. immediately after dispersal of emergent spiderlings), for fires that are too intense, resulting in high mortality of adult spiders, or for fires that are too large, resulting in no unburnt refuge habitat.

General

As knowledge of spiders is limited, both in scientific and public circles, it is necessary to promote awareness on the ecological importance of spiders in general, and especially of *I. nigrum* and *Cethegus* sp. at Weld range.

A series of ‘Show and tell’ sessions and information workshops will be held annually on site, providing employees / contractors with information about the two spider species and the aspects of this management plan.

Posters with information on the two spider species will be displayed on site’s information boards to promote awareness.
8.0 ENVIRONMENTAL MONITORING AND MANAGEMENT

SMC will implement monitoring to check on the effectiveness of its Spider management:

On-ground monitoring will be undertaken annually in winter months after the first rains (June – July) when the burrows of *I. nigrum* are open and easier to locate, and the nests of *Cethegus* sp. MUR are freshly built so little error is introduced into monitoring due to abandoned nests.

*Idiosoma nigrum*

A minimum of 10 subpopulations will be selected for the on-ground monitoring from known populations (Figure 9.1), of which at least one sub-population will be within the conservation designated area and at least two subpopulations will be the control populations away from mining impact. The purpose of the control populations is to provide information on natural fluctuation in populations and the impact of regional and/or global influences (e.g. seasonal changes, climate change) in order to distinguish processes that are not related to the mining impact. Populations will be selected from each of the geographically isolated units (Weld Range North, Weld Range South and Hampton Hill) to ensure genetic diversity across the range is included in the monitoring design.

Individual burrows will be marked and a full census of every individual will be conducted annually in each subpopulation selected for monitoring in order to record the population dynamics.

*Cethegus* sp. MUR

*Cethegus* builds above-ground nests rather than deep burrows, and because they are known to abandon their nests (e.g. when wet) and rebuild them in new locations, individual spiders cannot be tracked by the same census process as *I. nigrum*. Instead, designated areas of known dimensions will be surveyed annually for presence of each sub-species of the spider at Weld Range. A minimum of six areas will be selected from known locations (Figure 9.2), of which three will be selected from Hampton Hill (to monitor subspecies *Cethegus* sp. MUR HH) and three from Weld Range South (to monitor subspecies *Cethegus* sp. MUR WRS). At least one area in each section will be within the designated conservation designated area, and at least one area will be a control area away from the mining impact. Similarly to the control populations of *I. nigrum*, the purpose of the control areas will be to provide information on natural fluctuation in populations and the impact of regional and/or global influences (e.g. seasonal changes, climate change) in order to distinguish processes that are not related to the mining impact.
8.1 Performance Assessment

Criteria for Success

*Idiosoma nigrum*

The population trend shows no change or an increase in population size over the term of the plan. The number of adult individuals has remained the same or increased over the term of the plan, and the number of recruits (emergents and juveniles) has represented 66% or more of the entire population.

*Cethegus sp. MUR*

The population trend shows no change or an increase in population size over the term of the plan. The number of adult individuals has remained the same or increased over the term of the plan.

Criteria for Failure

*Idiosoma nigrum*

The population trend shows a decrease in population size over the term of the plan. The number of adult individuals has decreased by 15% or more over the term of the plan and/or the number of recruits (emergents and juveniles) has represented 51% or less of the entire population.

*Cethegus sp. MUR*

The population trend shows a decrease in population size over the term of the plan. The number of adult individuals has decreased by 15% or more over the term of the plan.
9.0 REVIEW AND REVISION

The plan will be reviewed within five years of its implementation by the Mygalomorph conservation team and any changes to the strategy, objectives and/or conservation actions will be documented accordingly.
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Table 9.1 Summary of Conservation Actions
Distribution of Idiosoma nigrum at Weld Range
10.0 TIME FRAME

This conservation plan will be implemented at least a year prior to the mining commencing in 2013. The plan will be upheld through the estimated 11 years of the life of the mine (till 2024) and a minimum of three years after mining ceases (till 2027).
11.0 REFERENCES


Harvey, M. S. 2002. Short-range endemism among the Australian fauna: some examples from non-marine environments. Invertebrate Systematics. 16:555 - 570.


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