Western Ridge Southern Tenements SRE Invertebrate Fauna Desktop Assessment

Biologic Environmental Survey

BHP Billiton Iron Ore Pty Ltd

November 2016

WESTERN RIDGE SOUTHERN TENEMENTS

SRE INVERTEBRATE FAUNA DESKTOP ASSESSMENT

DOCUMENT STATUS				
Revision No.	Author	Review / Approved for Issue	Approved for Issue to	
			Name	Date
1	Shae Callan	Brad Durrant	Breanne Menezies	30/09/2016
2	Shae Callan	Brad Durrant	Breanne Menezies	21/10/2016
Final	Shae Callan	Brad Durrant	Breanne Menezies	22/11/2016

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1 EXECUTIVE SUMMARY

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) commissioned Biologic Environmental Survey (Biologic) to undertake a short-range endemic (SRE) invertebrate fauna desktop assessment covering the Western Ridge southern tenements E52/3360 and E52/3361. These two tenements are hereafter referred to collectively as the Study Areas, or individually as the Western Study Area (E52/3360) and Eastern Study Area (E52/3361). The Study Areas occur in the eastern Pilbara region of Western Australia, approximately 7 km to 17 km south west of the town of Newman, covering 1745 ha.

A review of available literature and survey reports within a radius of 20 km was undertaken. Four SRE fauna databases were searched to obtain information on species previously recorded and species of conservation significance likely to occur within the Study Area, as well as any Priority or Threatened Ecological Communities (PEC/TEC) of relevance.

Previous surveys recorded eight Confirmed SRE taxa and 11 Potential SRE taxa, mainly to the immediate north of the Study Areas at Western Ridge and Orebody 35, plus 20 km north east at Orebody 24/ Eastern Ridge. No previous records of SRE taxa were recorded within the Study Areas themselves. No records of SRE taxa were found from the fauna database searches in addition to the previous survey records. No PECs or TECs occur within the Study Areas, and the nearest of the communities (within 50 km) are not relevant to terrestrial SRE fauna.

Preliminary SRE habitat assessments were conducted at eight sites within the Study Areas during a reconnaissance visit on 14 October 2016. Sites were chosen to reflect the major habitat types present, as observed from accessible vantage points and tracks driven within in the Study Areas. The site visit identified four broad habitat zones reflecting landform features, drainage features and vegetation types relevant to SRE fauna:

1. Drainage areas (SRE suitability moderate/ low, due mainly to the presence of moderately dense stands of Mulga);
2. Low ridges and outcrops (SRE suitability moderate/ low due to highly exposed small rocky outcrops);
3. Low undulating hills (SRE suitability low due to a lack of leaf litter, woody debris or rocky microhabitats);
4. Stony plains (SRE suitability low due to very sparse vegetation and a lack of suitable landforms).

Overall, the assessment found that the Study Areas comprise mainly low, flat, open landforms and sparse vegetation types, which generally lack the complexity, shelter, and isolation factors associated with highly suitable SRE habitats. Although previous surveys to

the north have detected a range of Confirmed and Potential SRE fauna (mainly from more mountainous habitats), only a few of these types of taxa, would be considered likely to occur within the Study Areas. This could potentially include mygalomorph spiders and *Urodacus* scorpions, which tend to form burrows in deep clay-loam soils of Drainage areas with Mulga vegetation, and isopods and *Lychas* scorpions, which may occur within the leaf litter of the of Drainage areas or under rocks in the Low ridges and outcrops zone. Nevertheless, the habitats within the Study Areas are not expected to be rich in terrestrial SRE fauna species, and owing to the mainly open, low habitat types, it is unlikely that any highly restricted species would occur.

2 INTRODUCTION

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) commissioned Biologic Environmental Survey (Biologic) to undertake a short-range endemic (SRE) invertebrate fauna desktop assessment covering the Western Ridge southern tenements E52/3360 and E52/3361. These two tenements are hereafter referred to collectively as the Study Areas, or individually as the Western Study Area (E52/3360) and Eastern Study Area (E52/3361). The Study Areas occur in the eastern Pilbara region of Western Australia, approximately 7 km to 17 km south west of the town of Newman (Figure 2.1). The Study Areas collectively cover approximately 1745 ha (Figure 2.2) and are located south west of Orebodies 35, 29, 30 and Mt Whaleback.

The SRE fauna desktop assessment will be used to inform future baseline surveys and identify the potential occurrence of SRE species and associated environmental values in the Study Areas.

This report provides a contemporary review and assessment of:

1. all SRE fauna records within the Study Areas and surrounds, based on consolidated data from all available surveys and SRE fauna databases within 20 km of the Study Areas;
2. the conservation values and SRE statuses of all species present, based on WA Museum categories;
3. the extent and suitability of important habitats for SRE fauna throughout the Study Areas and immediate surrounds; and
4. preliminary SRE habitat mapping throughout the Study Areas, based on available aerial imagery, topography, drainage, and vegetation information.

2.1 Short-Range Endemic Fauna

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale, the latter being commonly referred to as short-range endemism (Allen *et al.* 2002, Harvey 2002). Short-range endemism is influenced by several factors including life history, physiology, habitat requirements, dispersal capabilities, biotic and abiotic interactions and historical conditions which, not only influence the distribution of a species, but also the tendency for differentiation and speciation (Ponder and Colgan 2002).

In recent years a number of taxonomic groups of invertebrates have been highlighted as comprising a high proportion of species likely to be regarded as short-range endemics (SREs) (*i.e.* Harvey 2002; freshwater snails: Ponder and Colgan 2002; land snails: Johnson *et al.* 2004; mygalomorph spiders: Main *et al.* 2000). This identification of restricted taxonomic groups has led to SRE invertebrate fauna becoming an important component of

the environmental impact assessment process, as it has provided a focal point for survey work aimed at protecting species of conservation value.

Harvey (2002) proposed a range criterion for terrestrial SRE species at less than 10,000 km^2 (or 100 km x 100 km), which has been adopted by regulatory authorities in Western Australia (EPA 2009). SRE invertebrate species often share similar biological, behavioural and life history characteristics that influence their restricted distributions and limit their wider dispersal (Harvey 2002).

2.2 Legislation and Guidance

An increasingly large number of terrestrial invertebrates exhibit short-range endemism in Western Australia; however, very few SRE species and communities are listed within federal and state legislation, largely due to incomplete taxonomic and/or ecological knowledge. During EIA, the EPA's primary objectives for SRE fauna are to:

"ensure the protection of key habitats for SRE species; maintain the distribution, abundance, and productivity of populations of SRE taxa; and ensure that the conservation status of SRE taxa is not adversely changed as a result of development proposals" (EPA 2009).

Field surveys and EIAs for SRE invertebrates are conducted using the following guidelines:

- EPA (2009) Guidance Statement 20 Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia;
- EPA (2004) Guidance Statement 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia; and
- EPA (2002) Position Statement 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection.

Protection for listed (conservation significant) species and/ or Threatened or Priority Ecological Communities is provided under State and Federal legislation, including:

- *Environmental Protection Act 1986* (EP Act 1986) (WA);
- *Wildlife Conservation Act 1950* (WC Act 1950) (WA); and
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) (Commonwealth).

400000 450000 500000 550000 600000 650000 700000 750000 800000 850000 900000 950000

7750000 7700000 7650000 7600000 7550000 7500000 7450000 7400000

Pindanland
McLarty
Nimingarra
PORT HEDLAND
Roebourne
Yarrie
Mackay
KARRATHA
MARBLE BAR
Chichester
Rudall
Hamersley
TOM PRICE
Marillana
Yandi (Marillana Creek)
Fortescue
Trainor
Mining Area C
Jinidi
Hope Downs
Mudlark
South Parmelia
South Flank
Ashburton
PARABURDOO
Cathedral Gorge
OB 24
OB 23
OB 31
OB 32
OB 18
OB 25
Western Ridge
Jimblebar (Wheelarra Hill)
Augustus

Legend

- Pilbara Towns
- Pilbara Rail
- Great Northern Hwy
- Study Area

IBRA subregion

- Ashburton
- Augustus
- Chichester
- Fortescue
- Hamersley
- Mackay
- McLarty
- Pindanland
- Roebourne
- Rudall
- Trainor

Mining & Exploration Locations

- Care & Maintenance
- Exploration
- Operations
- Operations (Third party)

biologic Environmental Survey

N

1:1,600,000

0 12.5 25 50 75 100 km

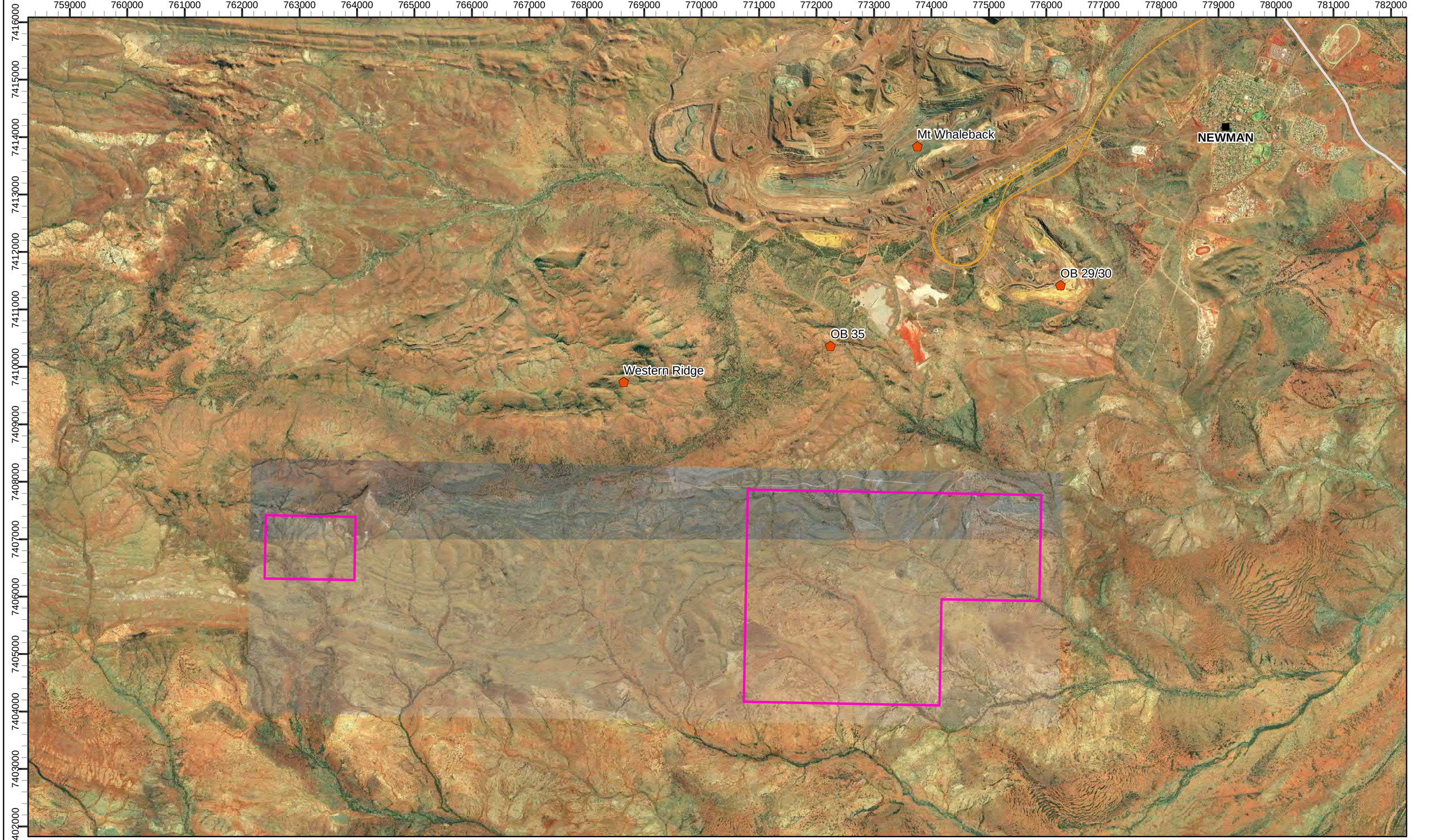
BHP Billiton Iron Ore - Western Ridge Project

Southern Tenements SRE Desktop Assessment

Fig. 2.1: Location and IBRA sub-region

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016



Legend

- Pilbara Towns
- Pilbara Rail
- Great Northern Hwy
- Study Area

Mining & Exploration Locations

- Operations

biologic Environmental Survey

N

1:60,000

0 0.5 1 2 3 4 km

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Southern Tenements SRE Desktop Assessment

Fig. 2.2: Study Areas and nearby mining locations

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016

3 ENVIRONMENT

3.1 Biogeography

As defined by the Interim Biogeographic Regionalisation of Australia (Thackway and Cresswell 1995), the Study Areas are located on the southern boundary of the Hamersley sub-region of the Pilbara bioregion. The Hamersley sub-region is characterised by mountainous areas of Proterozoic sedimentary ranges and plateaux, dissected by gorges. The vegetation of the sub-region is dominated by *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils on the ranges, while between them are swathes of Mulga (formerly *Acacia aneura*) woodland over bunch grasses on fine textured soils (Kendrick 2001). The Pilbara bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly Mulga low woodlands or snappy gum over bunch and hummock grasses (Bastin 2008).

3.2 Climate

The Hamersley sub-region features a semi-desert to tropical climate, with rainfall occurring sporadically within either summer or winter, but mostly during the former season. Summer rainfall is a result of either tropical storms in the north or tropical cyclones that impact upon the coast and move inland. The winter rainfall is generally lighter and is the result of cold fronts moving north easterly across the state (Leighton 2004). The average annual rainfall ranges from about 200 to 350 mm, but there are significant fluctuations between years (Department of Water 2012) with up to 1200 mm falling in some locations in some years (McKenzie *et al.* 2009).

Long-term climatic data is not available for the Study Areas themselves; however, long term climatic data (BoM 2016) is available from the Bureau of Meteorology weather station at Newman Aero (Station 7176), approximately 10 km east of the Eastern Study Area, which provides an indication of climatic conditions experienced at the Study Areas (Figure 3.1).

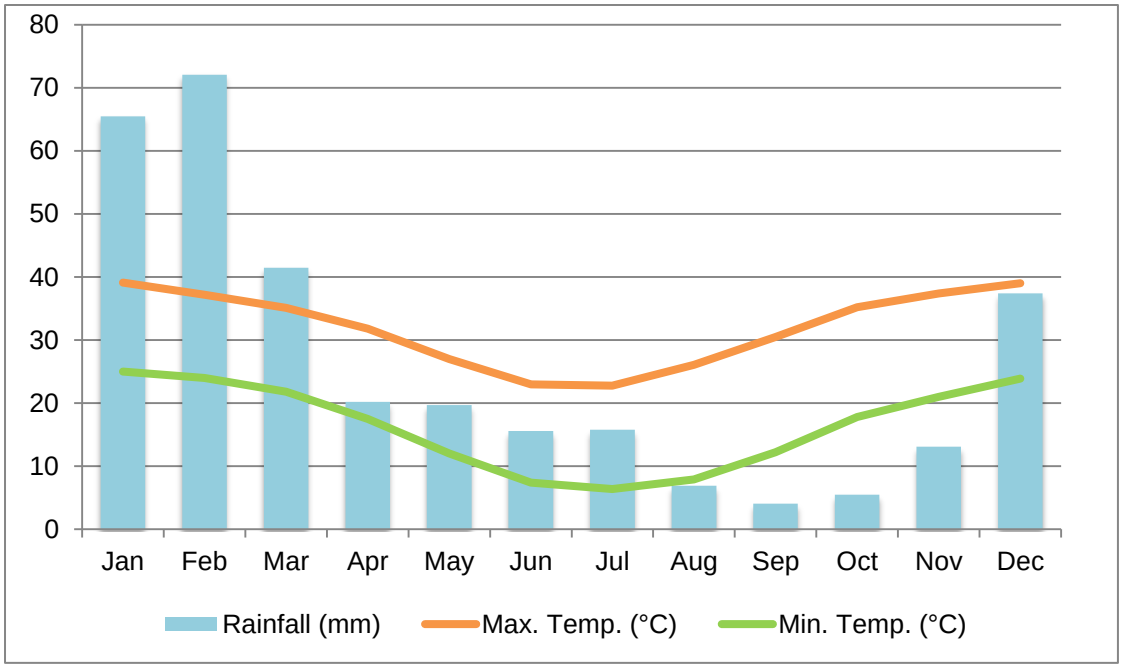


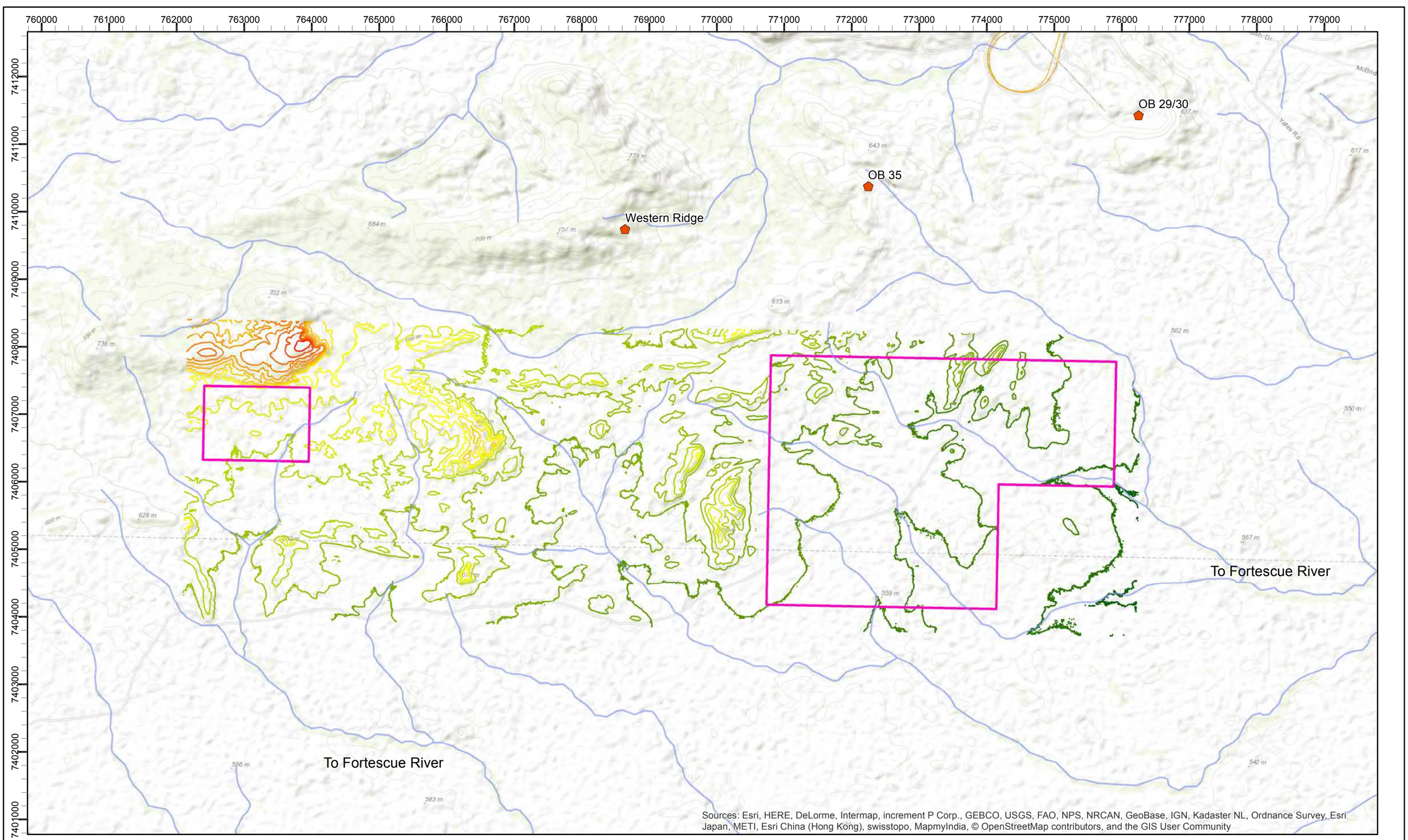
Figure 3.1 Long-term climatic averages of monthly rainfall and diurnal temperature range from Newman Aero (BoM 2016).

3.3 Topography and Drainage

The major hills and ranges of the local area occur immediately to the north of the Study Areas, dominated by Western Ridge (Figure 3.2). The Western Study Area is at the southern foot slope of the south western section of Western Ridge.

The average annual rainfall at Newman Aero is approximately 330 mm, but rainfall occurs mainly as intense tropical summer storms, and annual totals vary greatly. Watercourses flow only after prolonged heavy rain, as short-duration flooding with rapid peaks and slightly less rapid decline. Along major watercourses, including the Fortescue River (Figure 3.2), water can pond and may persist as pools for short periods following major flow events.

The Study Areas are located in the upper Fortescue River catchment, which flows north east in the local area towards Ophthalmia Dam, before continuing north and turning west-north-westerly to discharge into the Indian Ocean. Several minor, unnamed tributaries of the Fortescue River run through the Study Areas in either a southerly or south easterly direction (Figure 3.2).



Legend

- Pilbara Rail
- Study Area
- Pilbara Water Courses

Mining & Exploration Locations

- Operations

Contour (mAHD)

546, 550, 560, 570, 580, 590, 600, 610, 620, 630, 640, 650, 660, 670, 680, 690, 700

biologic Environmental Survey

N

1:50,000

0 0.4 0.8 1.6 2.4 3.2 km

BHP Billiton Iron Ore - Western Ridge Project

Southern Tenements SRE Desktop Assessment

Fig. 3.2: Local topography and drainage

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016

3.4 Land Systems

The Land Systems of the Pilbara region are classified according to similarities in landform, soil, vegetation, geology and geomorphology, following van Vreeswyk *et al.* (2004). Figure 3.3 shows two Land Systems occurring within, and extending beyond the Study Area. Descriptions of each Land System occurring within the Study Areas are provided in Table 3.1.

Table 3.1: Land Systems of the Study Area

Land System (within Study Areas)	Land Type	Description	SRE suitable habitats
Rocklea (793.9 ha)	Hills and ranges with spinifex grassland	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands	Gullies, ridges, and rocky outcrops. All types moderately frequent within this Land System.
Elimunna (951.8 ha)	Stony plains with Acacia shrublands	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands	Vegetation groves (typically Mulga), and minor drainage lines. Both types moderately frequent within this Land System.

Biologic's (2015a) Pilbara-wide assessment of Land Systems for SRE suitability (conducted as part of BHP Billiton Iron Ore's Strategic Environmental Assessment) found that the two Land Systems within the Study Areas varied in overall SRE suitability, and in the types of habitats they offer for SRE fauna. The Rocklea Land System was regarded as moderately suitable overall for SRE fauna, due mainly to the moderately frequent occurrence of sheltered and complex rocky habitat types such as gullies, ridges, and rocky outcrops (Biologic 2015a). Meanwhile, the Elimunna Land System was dominated by more open habitats, and it's moderate to low overall SRE suitability was based on moderately frequent occurrences of vegetation groves and minor drainage lines dominated by Mulga.

760000 761000 762000 763000 764000 765000 766000 767000 768000 769000 770000 771000 772000 773000 774000 775000 776000 777000 778000 779000

7412000 7411000 7410000 7409000 7408000 7407000 7406000 7405000 7404000 7403000 7402000 7401000

EGE

Western Ridge

BGD

NEW

Mine

OB 29/30

OB 35

ROC

SPH

ELI

ROB

PRA

RIV

Legend

- Pilbara Rail
- Study Area

LAND SYSTEMS

- Boolgeeda
- Disturbed Land
- Egerton
- Elimunna
- Newman
- Prairie
- River
- Robe
- Rocklea
- Spearhole

Mining & Exploration Locations

- Operations

biologic Environmental Survey

N

1:50,000

0 0.4 0.8 1.6 2.4 3.2 km

BHP Billiton Iron Ore - Western Ridge Project

Southern Tenements SRE Desktop Assessment

Fig. 3.3: Land Systems of the Study Areas

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016

3.5 Vegetation

The Study Areas are situated in the Hamersley Plateau, which forms part of the Fortescue Botanical District in the Eremaean Botanical Province of Western Australia (Beard 1980). Two vegetation types fall within the Study Areas; 18 (Low woodland; Mulga) and 82 (Hummock grasslands, low tree steppe; Snappy Gum over *Triodia wiseana*), and both vegetation types are known to have a large distribution, particularly within the Pilbara bioregion (Shepherd *et al*. 2001).

Onshore Environmental (2016) considered the Study Area to comprise thirteen (13) vegetation associations (Table 3.2, Figure 3.4).

Table 3.2: Vegetation Associations of the Study Area

Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
Triodia Hummock Grassland	HC TsTwTbr AbAtenSegg ErcnPtoAsp	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and/or *Triodia brizoides* with Open Shrubland of *Acacia bivenosa*, *Acacia tenuissima* and *Senna glutinosa* subsp. *glutinosa* and Low Open Shrubland of *Eremophila canaliculata*, *Ptilotus obovatus* and *Acacia spondylophylla* on hill crests, steep scree slopes and BIF ridges	None
Triodia Closed Hummock Grassland	HC TbrTw Erfr AbAk	Closed Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* with Shrubland of *Eremophila fraseri* and High Open Shrubland of *Acacia bivenosa* and *Acacia kempeana* on high dolerite hills	None
Acacia High Open Shrubland	HS AaAsyAte ErcuSolMag Arc	High Open Shrubland of *Acacia aptaneura* , *Acacia synchronicia* and *Acacia tetragonophylla* over Low Open Shrubland of *Eremophila cuneifolia*, *Solanum lasiophyllum* and *Maireana georgei* over Very Open Bunch Grassland of *Aristida contorta* on stony chert ironstone plains and rises	None
Triodia Hummock Grassland	FS TwTbr AbAi Seao	Hummock Grassland of *Triodia wiseana* ± *Triodia brizoides* with Open Shrubland of *Acacia bivenosa* and *Acacia inaequilatera* and Low Open Shrubland of *Senna artemisioides* subsp. *oligophylla* on dolerite footslopes and undulating low hills	None
Triodia Hummock Grassland	CP TragTw AbAkAsi EsEg	Hummock Grassland of *Triodia angusta* and *Triodia wiseana* with High Shrubland of *Acacia bivenosa*, *Acacia kempeana* and *Acacia sibirica* and Low Open Mallee of *Eucalyptus socialis* subsp. *eucentrica* or *Eucalyptus gamophylla* on calcrete, quartz and dolerite low hills, stony rises and stony plains	None

Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
Acacia Low Open Woodland	SP Aa AteAsy CcArlaErmu	Low Open Woodland of *Acacia aptaneura* over High Open Shrubland of *Acacia tetragonophylla* and *Acacia synchronicia* over Very Open Tussock Grassland of **Cenchrus ciliaris*, *Aristida latifolia* and *Eriachne mucronata* on quartz plains	None
Triodia Open Hummock Grassland	SP Tp AaAp AsyAbAte	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Acacia aptaneura* and *Acacia paraneura* and Open Shrubland of *Acacia synchronicia*, *Acacia bivenosa* and *Acacia tetragonophylla* in red loamy sand on stony plains	None
Acacia Low Open Forest	FP AaAprAay ErffSeao Tp	Low Open Forest (to Low Open Woodland) of *Acacia aptaneura*, *Acacia pruinocarpa*, *Acacia ayersiana* and *Acacia catenulata* subsp. *occidentalis* over Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Senna artemisioides* subsp. *oligophylla* and Open Hummock Grassland of *Triodia pungens* forming groves on hardpan plains	Representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001). This ecosystem is represented by vegetation associations occurring on valley floors or broad plains, which have a reasonably dense Mulga overstorey (i.e. at least 10-30 percent cover).
Astrebla Closed Tussock Grassland	GP AspeAselArla ErlcAte Aa	Closed Tussock Grassland of *Astrebla pectinata*, *Astrebla elymoides* and *Aristida latifolia* with Open Shrubland of *Eremophila lachnocalyx* and *Acacia tetragonophylla* and Scattered Low Trees of *Acacia aptaneura* on cracking gilgai clays	Closely affiliated with West Angelas Cracking-Clays PEC (Priority 1) - Open tussock grasslands of Astrebla pectinata, Astrebla elymoides, Aristida latifolia, in combination with Astrebla squarrosa and low scattered shrubs of Sida fibulifera, on basalt derived cracking-clay loam depressions and flowlines.
Aristida Tussock Grassland	GP ArlaAranErx AaAteAsy SifSeaoSeh	Tussock Grassland of *Aristida latifolia*, *Aristida* cf. *nitidula* and *Eragrostis xerophila* with High Open Shrubland of *Acacia aptaneura*, *Acacia tetragonophylla* and *Acacia synchronicia* and Low Open Shrubland of *Sida fibulifera*, *Senna artemisioides* subsp. *oligophylla* and *Senna hamersleyensis* on gilgai drainage flats and minor drainage lines	None
Triodia Hummock Grassland	MI Tp AbAten	Hummock Grassland of *Triodia pungens* with Open Scrub of *Acacia bivenosa* and *Acacia tenuissima* on minor drainage lines	None

Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
Corymbia Low Woodland	ME ChExAa PelApypAma ErtThtCc	Low Woodland of *Corymbia hamersleyana*, *Eucalyptus xerothermica* and *Acacia aptaneura* over High Open Shrubland of *Petalostylis labicheoides*, *Acacia pyrifolia* subsp. *pyrifolia* and *Acacia maitlandii* over Open Tussock Grassland of *Eriachne tenuiculmis*, *Themeda triandra* and **Cenchrus ciliaris* along medium drainage lines	Representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001).
Acacia Low Open Forest	ME AaAprEx ErffSieErll ThtAriCc	Low Open Forest (to Low Woodland) of *Acacia aptaneura*, *Acacia pruinocarpa* and *Eucalyptus xerothermica* over Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Sida ectogama* and *Eremophila latrobei* subsp. *latrobei* over Open Tussock Grassland of *Themeda triandra*, *Aristida inaequiglumis* and **Cenchrus ciliaris* on stony floodplains and unincised drainage zones	Representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001).

769000 770000 771000 772000 773000 774000 775000 776000

7408000 7407000 7406000 7405000 7404000

Western Study Area

1:20,000

Eastern Study Area

Legend

- Study Area

BROAD_FF, VEG_CODE

- Acacia High Open Shrubland, HS AaAsyAte ErcuSolMag
- Acacia Low Open Forest, FP AaAprAay ErffSeao Tp
- Acacia Low Open Forest, ME AaAprEx ErffSieErll ThtAriCc
- Acacia Low Open Woodland, SP Aa AteAsy
- Aristida Tussock Grassland, GP ArlaAranErx AaAteAsy SifSeaoSeh
- Astrebla Closed Tussock Grassland, GP AspeAselArla ErlcAte
- Corymbia Low Woodland, ME ChExAa PelApypAma ErtThtCc
- Triodia Closed Hummock Grassland, HC TbrTw Erfr AbAk
- Triodia Hummock Grassland, CP TragTw AbAkAsi EsEg
- Triodia Hummock Grassland, FS TwTbr AbAi Seao
- Triodia Hummock Grassland, MI Tp AbAten
- Triodia Open Hummock Grassland & Acacia Low Open Forest, SP Tp AaAp AsyAbAte & FP AaAprAay ErffSeao Tp
- Triodia Open Hummock Grassland, SP Tp AaAp

biologic Environmental Survey

N 1:20,000

0 0.15 0.3 0.6 0.9 1.2 km

BHP Billiton Iron Ore - Western Ridge Project

Southern Tenements SRE Desktop Assessment

Fig. 3.4: Vegetation of the Study Areas

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016

4 METHODOLOGY

4.1 Review of previous studies

A review of all publicly available literature relevant to the Study Area and nearby areas (within a 20 km radius), and additional reports commissioned and held by BHP Billiton Iron Ore, was undertaken in September 2016 (Figure 4.1).

These reports were (in chronological order):

- Orebody 24/25 Upgrade Terrestrial Invertebrate Short-range Endemic Assessment (Outback Ecology 2008);
- Orebody 24/Orebody 25 Short-Range Endemic Study, Case Study Pseudoscorpions (ENV 2008);
- Assessment of Terrestrial Short-range Endemic Invertebrates in the Orebody 35-Western Ridge Area near Newman, Western Australia (AMBS 2011);
- Orebody 35 Short-range Endemic Invertebrate Survey Report (Biologic 2011);
- Orebody 24-25 SRE Invertebrate Survey (Biologic 2014);
- Eastern Ridge Targeted SRE Survey (Biologic 2015b).

4.2 Review of online databases

Four databases were searched to obtain information on species previously recorded (NatureMap and Threatened Fauna Database) or species of conservation significance likely to occur within the Study Area (Protected Matters Database), and any Priority or Threatened Ecological Communities (PEC/TEC) in the area (Table 3.1):

- WA Museum (WAM) Arachnida/ Myriapoda and Mollusca databases – to determine previous potential and confirmed SRE species collected in the local area;
- DPaW's NatureMap database – to determine threatened fauna recorded from the Study Area;
- DPaW's Priority and Threatened Ecological Communities Database – to determine the most up to date Priority and Threatened Ecological Communities recorded from the Study Area; and
- Department of Environment (DoE) Protected Matters Database – to determine matters of national environmental significance likely to occur within the Study Area based on bioclimatic modelling.

760000 765000 770000 775000 780000 785000 790000 795000

7420000 7415000 7410000 7405000

Cathedral Gorge

OB 32

OB 24

OB 25

OB 23

Mt Whaleback

NEWMAN

Newman

Fortescue Golf Club

Newman Dr

Welsh Dr

Fortescue River

OB 29/30

OB 35

Western Ridge

823 m 1046 m 687 m 742 m 718 m 710 m 692 m 778 m 757 m 616 m 566 m 550 m 628 m 606 m 567 m 610 m

Sources: Esri, HERE, DeLorme, Intermap, increment
Japan, METI, Esri China (Hong Kong), swisstopo, Ma

Legend

- Pilbara Towns
- Pilbara Rail
- Great Northern Hwy
- Study Area

Survey Title

- Orebody 24/25 Short-Range Endemic Study (Pseudoscorpions) (ENV 2008)
- Orebody 24/25 Upgrade Terrestrial Invertebrate SRE Assessment (Outback Ecology 2008)
- Assessment of Terrestrial SRE Invertebrates OB35 - Western Ridge (AMBS 2011)
- OB35 Short-range Endemic Invertebrate Survey Report (Biologic 2011)
- Orebody 24/25 SRE invertebrate survey (Biologic 2014)
- Eastern Ridge Targeted Short-Range Endemic Survey (Biologic 2015)

Mining & Exploration Locations

- Care & Maintenance
- Exploration
- Operations

biologic Environmental Survey

N

1:90,000

0 0.75 1.5 3 4.5 6 km

BHP Billiton Iron Ore - Western Ridge Project

Southern Tenements SRE Desktop Assessment

Fig. 4.1: Previous fauna surveys within 10 km of the Study Areas

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016

Table 4.1 Databases used for the review.

Provider	Database	Parameters
WAM	Arachnida/ Myriapoda Mollusca. Accessed 6 September 2016	Bounding box 50 km x 50 km centred on the Study Areas. NW corner -22.978,119.092. SE corner -23.890, 120.101.
DPaW	NatureMap. Accessed 7 September 2016	Circle of radius 40 km centred on the coordinates 23°25'16.54"S, 119°36'35.76"E to identify species recorded within and in the vicinity of the Study Area.
DPaW	Priority and Threatened Ecological Communities Database. Received 12 September 2016	Circle of radius 40 km centred on the coordinates 23°25'16.54"S, 119°36'35.76"E
DoE	Protected Matters Database Search Tool. Accessed 7 September 2016	Circle of radius 40 km centred on the coordinates 23°25'16.54"S, 119°36'35.76"E to identify species recorded within and in the vicinity of the Study Area.

4.2.1 Habitat assessment and mapping

SRE habitats were assessed in accordance with BHP Billiton Iron Ore's Guidance for Short-Range Endemic Invertebrate Surveys in the Pilbara Region (SPR-IEN-EMS-013) (BHP Billiton Iron Ore 2015). Preliminary SRE habitat assessments were conducted at eight sites within the Study Areas during a reconnaissance visit on 14 October 2016. Sites were chosen to reflect the major habitat types present, as observed from accessible vantage points and major tracks driven within in the Study Areas. The habitat assessment was based on three major factors influencing SRE habitat suitability; isolation, protection and habitat complexity, as briefly outlined below and illustrated in Figure 4.2.

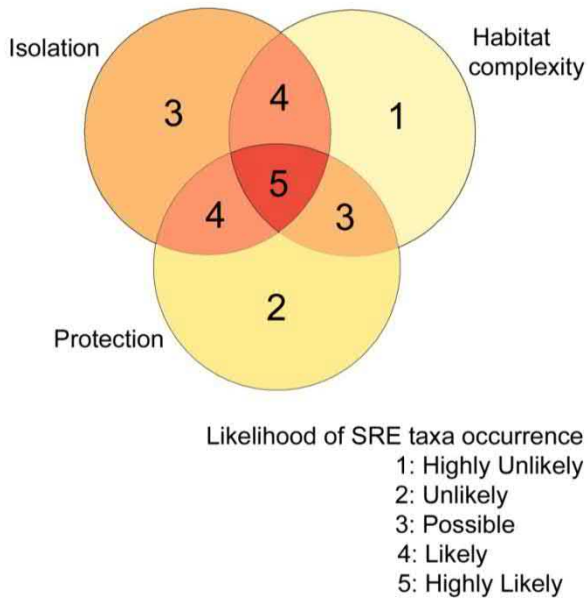


Figure 4.2: Habitat assessment diagram.

Isolation: based on the level of connectivity between sites, which share similar habitat characteristics. Isolation is the most important factor when it comes to the level of risk, as any fauna with limited dispersal characteristics, regardless of the habitat preference, will likely be, at least, an isolated population. Examples include islands and mountaintops; in the Pilbara, peaks like Mount Meharry have been shown to harbour significant SRE species (Durrant 2011).

Protection (Shelter): this primarily covers protection from exposure. With respect to the Pilbara region however, protection from disturbance is also very important for the long term viability of SRE habitats and communities, *i.e.* protection from fire, flood and invasive species.

Protection is provided at two levels; the site level where the structural composition of the site (aspect, slope *etc.*) can provide protection from exposure and disturbance by providing physical barriers (*e.g.* gorges and gullies); and the habitat level where certain microhabitat characteristics, associated with habitat complexity, provide more direct protection, particularly from exposure (*i.e.* leaf litter, rocky substrates, canopy cover and soil depth).

Habitat complexity**:** this factor drives species richness and often abundance at a site, *i.e.* the more complex a site is, the more species and individuals it is likely to contain. This is particularly important, as a number of SRE groups are predators; therefore the richness and abundance of prey species are critical to their survival.

Complexity, with respect to SREs, is based around a number of microhabitat types:

- Leaf litter: both depth, coverage, and structural variation;
- Rocky substrates: loose rocks, cracks and crevices;
- Woody debris: size, abundance and decomposition rate of dead wood;
- Vegetation variation: flora richness and structural variation; and
- Soil: depth, texture, and structural variation.

Likewise, the complexity of the habitat is important to detritivore SRE taxa, such as isopods, millipedes and some snails, which rely upon decaying leaf litter, woody debris and organic matter for survival. Examples in the Pilbara include deep gullies and gorges, where most of the above microhabitat types occur; these therefore tend to be species-rich areas.

The habitats of the Study Area were classified into broad zones that reflect major changes in the important landform features, drainage features and vegetation features which influence SRE likelihood. The information used to classify and map the habitat zones included Land Systems, vegetation mapping (Onshore Environmental 2016), topographical contours,

drainage information, and recent, high resolution aerial photography obtained from BHP Billiton Iron Ore.

4.2.2 SRE Status Categorisation

The SRE status categories used in this report follow the WAM (2013) categorisation for SRE invertebrates (Table 4.2). This system is based upon the 10,000 km^2 range criterion proposed by Harvey (2002), and uses three broad categories to deal with varying levels of taxonomic certainty that may apply to any given taxon (Table 4.2).

Under this system, "Potential SRE" status is the default categorisation for species within the typical SRE taxonomic groups including mygalomorph spiders, selenopid spiders, land snails, pseudoscorpions, scorpions, and isopods, unless sufficient evidence exists to confirm Widespread or Confirmed SRE status.

Potential SRE status is sub-categorised by what is currently known about the species in question; *i.e.* whether there are B) habitat indicators, C) morphology indicators, D) molecular evidence, or E) a weight of general knowledge and experience with the group that suggests a reasonable likelihood that the species could be SRE. In terms of SRE likelihood, the more evidence that exists under sub categories B, C, D, and E, the greater the likelihood that further investigation will confirm that the species is a SRE.

Table 4.2: SRE categorisation used by WAM taxonomists (Appendices 3 and 4).

<table>
<tr><th></th><th>Taxonomic Certainty</th><th>Taxonomic Uncertainty</th></tr>
<tr><td>Distribution <10,000 km^2</td><td>Confirmed SRE
A known distribution of < 10,000 km^2.
The taxonomy is well known.
The group is well represented in collections and/ or via comprehensive sampling.</td><td rowspan="2">Potential SRE
Patchy sampling has resulted in incomplete knowledge of geographic distribution.
Incomplete taxonomic knowledge.
The group is not well represented in collections.
Category applies where there are significant knowledge gaps.
SRE Sub-categories may apply:
A) Data Deficient
B) Habitat Indicators
C) Morphology Indicators
D) Molecular Evidence
E) Research & Expertise</td></tr>
<tr><td>Distribution >10,000 km^2</td><td>Widespread (not SRE)
A known distribution of > 10,000 km^2.
The taxonomy is well known.
The group is well represented in collections and/ or via comprehensive sampling.</td></tr>
</table>

However, the WAM category A) 'data deficient' is different; this category indicates that the current taxonomic data or specimen collection records are insufficient to adequately assess the SRE status of the species in question. The current assessment considers `data deficient`

taxa to be unable to be assessed as potential SRE species at the current time, owing to a lack of taxonomic information or geographical context.

4.3 Limitations

No previous SRE surveys have been conducted within the Study Area boundaries. As such, the desktop assessment of SRE fauna is based upon the results of adjacent surveys and database searches. Several preliminary habitat assessments have been undertaken from a brief site visit, although the habitat mapping was mainly developed from analysis of background information such as vegetation mapping, land systems, topography, drainage, and aerial photography.

5 RESULTS

5.1 Survey Effort

No previous surveys have been conducted within the Study Area, although six surveys have been undertaken within 20 km, mainly to the north and north east. Table 5.1 compares the survey effort of these six surveys.

Table 5.1: Summary of survey effort across previous surveys within 20 km of the Study Area

Survey report	Outback Ecology 2008	ENV 2008	AMBS 2011	Biologic 2011	Biologic 2014	Biologic 2015b
Survey type	2 season baseline	Targeted survey	2 season baseline	1 season baseline	2 season baseline	Targeted survey
Dates	April, June 2008	March 2006	March-May, August 2010	Sept 2011	April-May 2013 Sept 2013	May 2015
No. sites	8 sites	12 sites	30 sites	30 sites	163 sites	24 sites
Areas sampled	OB24, OB25	OB24, OB25	OB35, Western Ridge	OB35	OB24, OB25, Eastern Ridge, OB32	OB25, Eastern Ridge, Homestead
Habitats targeted	S-facing slopes, gullies, ridges, groves	Crests, S-facing slopes, ridges, gullies	Gullies, ridges, S-facing slopes, valley floors, rolling hills	Gorges, gullies, ridges, slopes	Gorges, gullies, ridges, outcrops, drainage lines, groves, plains	S-facing slopes, gullies, gorges
Methods	Dry pits, foraging, leaf litter, soil, nocturnal	Foraging	Wet & dry pits, foraging, soil	Foraging, leaf litter, soil	Foraging, leaf litter, soil, burrow excavation	Burrow excavation

5.2 Literature Review

The surveys considered for this review recorded eight Confirmed SRE and 11 Potential SRE taxa comprising seven mygalomorph spiders, one selenopid spider, one pseudoscorpion, two scorpions, three millipedes, and five isopods (Table 5.2; Figure 5.1). The majority of taxa were recorded as part of the AMBS 2011 and Biologic 2014 surveys, which may reflect the greater survey effort expended as part of these two-season baseline surveys. The SRE statuses of the taxa recorded in Table 5.2 were verified as current following advice from the WAM and other relevant specialist taxonomists.

Table 5.2: Confirmed and Potential SRE taxa recorded from surveys within 20 km of the Study Area.

Taxon	Outback Ecology 2008	ENV 2008	AMBS 2011	Biologic 2012	Biologic 2014	Biologic 2015b	SRE Status
Mygalomorph spiders							
Aname `MYG001 grp (fem.)`			●				Confirmed
Aname `MYG205`			●				Confirmed
Aname `MYG206`			●				Confirmed
Aurecocrypta `MYG315`	●				●		Confirmed
Cethegus `MYG299-DNA`					●		Potential
Conothele sp. `MYG385-DNA`					●	●	Potential
Kwonkan `MYG098`			●				Confirmed
Selenopid spiders							
Karaops `ARA005-DNA`					●		Potential
Pseudoscorpions							
Feaella callani					●		Confirmed
Scorpions							
Urodacus `pilbara12`			●	●			Potential
Lychas 'hairy tail' group			●		●		Potential
Millipedes							
Antichiropus `DIP014`			●				Confirmed
Antichiropus `DIP015`			●				Confirmed
Antichiropus indet.			●				Potential
Isopods							
Buddelundia 16NM					●		Potential
Buddelundia 78					●		Potential
Buddelundia 79					●		Potential
Buddelundia 80					●		Potential
Buddelundiinae OB24					●		Potential
Total	**1**	**0**	**8**	**1**	**11**	**1**	

5.3 Database Searches

5.3.1 WAM SRE Databases

The WAM Arachnida/ Myriapoda database contained no additional SRE records within the local area of the Study Area (20 km), beyond those shown in Table 5.2.

The WAM Mollusca database contained no records of SRE molluscs within the local area (20 km) of the Study Area.

5.3.2 DPaW Nature Map

The DPaW NatureMap database contained no additional SRE invertebrate records within the local area of the Study Area (20 km), beyond those shown in Table 5.2.

5.3.3 EPBC Protected Matters Report

The EPBC Protected Matters database contained no additional SRE invertebrate records within the local area of the Study Area (20 km), beyond those shown in Table 5.2.

760000 765000 770000 775000 780000 785000 790000

7420000 7415000 7410000 7405000

NEWMAN
Newman
Fortescue Golf Club
Newman Dr
Welsh Dr
Fortescue River

Legend

- Pilbara Towns
- Pilbara Rail
- Great Northern Hwy
- Study Area

SRE Status, Morphospecies

- Confirmed SRE, Aname `MYG001 grp (fem.)`
- Confirmed SRE, Aname `MYG205`
- Confirmed SRE, Aname `MYG206`
- Confirmed SRE, Aurecocrypta `MYG315`
- Confirmed SRE, Kwonkan `MYG098`
- Confirmed SRE, Antichiropus `DIP014`
- Confirmed SRE, Antichiropus `DIP015`
- Confirmed SRE, Feaella callani
- Potential SRE, Buddelundia 16NM
- Potential SRE, Buddelundia 78
- Potential SRE, Buddelundia 79
- Potential SRE, Buddelundia 80
- Potential SRE, Buddelundiinae OB24
- Potential SRE, Antichiropus indet.
- Potential SRE, Cethegus `MYG299-DNA`
- Potential SRE, Conothele sp. `MYG385-DNA`
- Potential SRE, Karaops `ARA005-DNA`
- Potential SRE, Lychas sp. hairytail group
- Potential SRE, Urodacus `pilbara12`

biologic Environmental Survey

N

1:90,000

0 0.75 1.5 3 4.5 6 km

BHP Billiton Iron Ore - Western Ridge Project

Southern Tenements SRE Desktop Assessment

Fig. 5.1: SRE Fauna within 20 km of the Study Areas

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016

5.3.4 Priority and Threatened Ecological Communities

No Priority or Threatened Ecological Communities are known within or adjacent to the Study Areas. The nearest Priority and Threatened Ecological Communities to the Study Areas comprise the Ethel Gorge Stygofauna TEC (20 km north east), the Fortescue Sand Dunes PEC (60 km north), Weeli Wolli Spring PEC (60 km north west), and West Angelas Cracking Clay PEC (70 km west north west), although none of these communities are relevant to terrestrial SRE fauna.

5.4 SRE Habitats

Preliminary SRE habitat assessments were conducted at eight sites within the Study Areas during a reconnaissance site visit on 14 October 2016. Sites were chosen to reflect the major habitat types present, as observed from accessible vantage points visited in the Study Areas (Figure 5.2). Table 5.3 provides summary details of the habitats assessed at each site.

The habitat assessment identified four SRE habitat zones throughout the Study Areas that broadly reflect major differences in landform features, drainage features and vegetation features relevant to SRE fauna suitability. The habitat mapping (Figure 5.2) shows the indicative extent of the following four habitat zones (based mainly on vegetation mapping, topography and drainage information):

1. Drainage area zone – incorporating minor and major drainage lines and the adjacent broad floodplain areas running through the Study Area. These areas tend to feature the main stands of tall vegetation (either Mulga and/ or *Eucalyptus*/ *Corymbia* species) that provides shade and leaf litter/ detrital microhabitats. The soils range from sandy loam to clay loam and may be suitable for burrowing fauna such as mygalomorph spiders and *Urodacus* scorpions. Overall SRE suitability moderate/ low, due to the moderate density of vegetation and the presence of disturbances such as grazing and weeds. This habitat zone may act as a potential dispersal habitat for SRE fauna;
2. Low ridges and outcrops zone - a series of low ridges with occasional small rocky outcrops occur in the north of the Eastern Study Area. Some of these may have the potential to host rocky-habitat adapted fauna such as pseudoscorpions, isopods, and selenopid spiders. Overall SRE suitability is moderate/ low due to the high exposure and very small size of the rocky outcrops;
3. Low undulating hills zone – large areas of low undulating hills occur throughout the Study Areas. Neither the vegetation nor the landforms in this zone are considered to be sufficiently sheltered and complex to provide suitable habitat for SRE fauna, therefore SRE suitability is considered low.

4. Stony plain zone – open, mainly flat plains occur throughout both Study Areas, with mainly stony soils nearer the low undulating hills, tending towards stony/ sandy. Soils and clays (with some cracking clays) near the drainage areas. The vegetation in most of these areas is very sparse, and there are no suitable landforms for SRE fauna, therefore SRE suitability is considered low.

Table 5.3: Summary of site habitat assessment characteristics

Site (study Area) Photo	SRE Habitat type, Description	UTM GDA94 z50	Slope; Aspect	Drainage features	Canopy shade (C%); Midstorey shade (M%)	Leaf litter (LL %); Litter depth (LD (cm); Woody debris (WD%); Bare ground (BG%)	Soil characteristics	SRE suitability
1 (Western Study Area)	**Hillslope/ Footslope**							
	Stony low basalt hills, Spinifex grassland	762696 E; 7407322 N	Low; SW	Negligible; No water present	C N/A; M <2	LL= None; WD= None; BG= 31 to 50	Skeletal, Brown silty loam with basalt cobbles	Negligible
2 (Western Study Area)	**Stony Plain**							
	Sandy/ stony valley, Spinifex grassland and Acacia shrubland	762724 E; 7407141 N	N/A (flat)	Sheet Flow; No water present	C N/A; M 11 to 30	LL= <2; LD= <1cm; WD= <2; BG= 71 to 100	Deep (>20cm), Red sandy clay loam with gravel	Low
3 (Western Study Area)	**Drainage Focus**							
	Sandy/ stony minor drainage, sparse mixed Mulga and Eucalyptus	762721 E; 7406995 N	Low; SE	Creek; No water present	C 2 to 10; C 31 to 50	LL= 11 to 30; LD= 1 to 5cm; WD= 2 to 10; BG= 11 to 30	Deep (>20cm), Red sandy clay loam with gravel	Low

Site (study Area) Photo	SRE Habitat type, Description	UTM GDA94 z50	Slope; Aspect	Drainage features	Canopy shade (C%); Midstorey shade (M%)	Leaf litter (LL %); Litter depth (LD (cm); Woody debris (WD%); Bare ground (BG%)	Soil characteristics	SRE suitability
4 (Eastern Study Area)	**Stony Plain**							
	Stony/ sandy plain, sparse Acacia shrubland	771241 E; 7405019 N	N/A (flat)	Sheet Flow; No water present	C 2 to 10; M 11 to 30	LL= <2; LD= <1cm; WD= <2; BG= 71 to 100	Deep (>20cm), Red sandy loam with gravel	Negligible
5 (Eastern Study Area)	**Drainage Line**							
	Silty/ stony minor drainage, sparse Mulga and Eucalyptus	772700 E; 7405683 N	N/A (flat)	Sheet Flow; No water present	C11 to 30; M 11 to 30	LL= 2 to 10; LD= 1 to 5cm; WD= 11 to 30; BG= 31 to 50	Deep (>20cm), Brown sandy clay loam	Mod/ low
6 (Eastern Study Area)	**Outcrop/ Dome**							
	Low BIF outcrop on small hill, Spinifex grassland	773423 E; 7406515 N	Mod; North	Negligible; No water present	C N/A; M 11 to 30	LL= None; WD= 2 to 10; BG= 31 to 50	Skeletal, Red silty loam with BIF boulders	Mod/ low

Site (study Area) Photo	SRE Habitat type, Description	UTM GDA94 z50	Slope; Aspect	Drainage features	Canopy shade (C%); Midstorey shade (M%)	Leaf litter (LL %); Litter depth (LD (cm); Woody debris (WD%); Bare ground (BG%)	Soil characteristics	SRE suitability
7 (Eastern Study Area)	**Drainage Line**							
	Silty/ sandy drainage line, Mulga and Eucalyptus with tussock grass	773594 E; 7406894 N	N/A (flat)	Creek; No water present	C 11 to 30; M 11 to 30	LL= 11 to 30; LD= 1 to 5cm; WD= 2 to 10; BG= 2 to 10	Deep (>20cm), Brown silty clay	Mod/ low
8 (Eastern Study Area)	**Hillslope/ Footslope**							
	Stony BIF hills, Spinifex grassland and patches of Eucalyptus	774018 E; 7407598 N	Mod; South	Negligible; No water present	C <2; M <2	LL= <2; LD= <1cm; WD= <2; BG= 31 to 50	Shallow (0 to 10cm), Grey silty loam with gravel	Low

769000 770000 771000 772000 773000 774000 775000 776000

7408000 7407000 7406000 7405000 7404000

Western Study Area

Eastern Study Area

1 2 3 4 5 6 7 8

1:20,000

Legend

- Study Area

Indicative SRE habitat zone

- Drainage area
- Low ridges and outcrops
- Low undulating hills
- Stony plain

SRE Habitat assessed on-site

- Stony Plain
- Outcrop/ Dome
- Hillslope/ Footslope
- Drainage Line
- Drainage Focus

biologic Environmental Survey

N

1:20,000

0 0.15 0.3 0.6 0.9 1.2 km

BHP Billiton Iron Ore - Western Ridge Project

Southern Tenements SRE Desktop Assessment

Fig. 5.2: Indicative SRE habitat zones and habitat assessment sites

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 25/09/2016

5.5 Suitability of Habitats for SRE fauna

The majority of SRE fauna recorded within the immediate local area of the Study Areas would not be expected to occur within the Study Areas themselves due to the low to moderate/ low suitability of the mostly flat, sparsely vegetated habitats present. Nevertheless, some species with more generalised habitat preferences, or those that prefer more open habitats, may occur.

The fauna occurring immediately to the north at Orebody 35 and Western Ridge included *Antichiropus* millipedes, *Aname* and *Kwonkan* mygalomorph spiders, and scorpions of the genera *Lychas* and *Urodacus* (Figure 5.1). All of these taxa, other than the *Aname* spiders, were recorded primarily or exclusively in habitats that had high SRE potential such as gorges and gullies and south/ southeast facing slopes (AMBS 2011). These types of habitats are associated with mountainous terrains and are not found within the Study Areas. The *Aname* species were all recorded in open floodplains, which were considered to occur well beyond the Orebody 35/ Western Ridge area (AMBS 2011), and may have similarities to the Drainage area zone of the Study Areas. There may also be some potential for the *Lychas* and *Urodacus* species detected at Western Ridge to occur within the Western Study Area owing to the close proximity of the previous records, and the moderate suitability of some of the habitats found within the Study Areas (e.g. Drainage Areas, Low Ridges and Outcrops) for these types of taxa (Figure 5.1).

Further afield, it is considered unlikely that any of the rocky-habitat adapted SRE fauna collected at Orebody 24, Orebody 25, and Eastern Ridge/ Cathedral Gorge would occur within the Study Areas, owing to both distance and the considerably flatter and more open habitats within the Study Areas. The few low rocky outcrops that do occur within the Eastern Study Area may be too small and too isolated to support populations of selenopid spiders, but it is almost certain that selenopid spiders would occur in the more mountainous terrains beyond the Study Areas to the north at Western Ridge.

Nevertheless, there were a number of isopod species (genus *Buddelundia*) that were readily found in more open sandy/ stony plain habitats at Orebody 24/ Homestead (Biologic 2014), and there is anecdotal evidence that an isopod specimen aligning to *Buddelundia* 16NM was detected at Orebody 35 (S. Judd pers. comm. 2013). Owing to their preference for inhabiting moderately open Mulga vegetation along drainage lines, it is also possible that curtain web spiders of the genus *Cethegus* could occur in the Drainage area zone, although it is unknown whether the species *C*. `MYG299-DNA` found at Homestead and Orebody 24 would range as far south as the Study Areas.

6 CONCLUSION

The Study Areas comprise mainly low, flat, open landforms and sparse vegetation types, which generally lack the complexity, shelter and isolation factors associated with highly suitable SRE habitats.

Previous surveys to the north have detected a range of Confirmed and Potential SRE fauna, but only a few of these types of taxa (particularly those with more generalised habitat preferences, or those that prefer more open habitats) are considered likely to occur within the Study Areas.

The habitat zones where SRE fauna would be more likely to be found include the Drainage area zone, and potentially the Low ridges and outcrops zone in the Eastern Study Area. Nevertheless, the habitats within the Study Areas are not expected to be rich in terrestrial SRE fauna species, and it is considered unlikely that any highly restricted species would occur.

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