Marillana Iron Ore Project

Environmental Referral
Supporting Documentation

January 2009

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***ecologia* Environment**
1025 Wellington Street
WEST PERTH WA 6005
Phone: 08 9322 1944
Fax: 08 9322 1599
Email: admin@ecologia.com.au
www.ecologia.com.au

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EXECUTIVE SUMMARY

This referral supporting documentation has been developed for the proposed Marillana Iron Ore Project.

The Marillana Iron Ore Project (the project) is located in the Hamersley Iron province in the Pilbara region of Western Australia, about 100 km from the town of Newman. The project is located within Exploration Licence E47/1408 and is subject to Mining Lease applications M47/1414 and M47/1419. All tenements are held by Brockman Iron Pty Ltd (Brockman) a wholly owned subsidiary of ASX listed company Brockman Resources Limited.

Brockman is currently undertaking a pre-feasibility study into the establishment of a 15 Mtpa mining and beneficiation processing operation at the project. The project proposed by Brockman will consist of open pit mining of iron ore, pit dewatering, ore processing and beneficiation, stock piling, and establishment and maintenance of an accommodation village. The ore will be transported by rail to Port Hedland for export.

Brockman intends to commence construction activities by Q3 2010 with the aim of producing by Q4 2011.

1.0 PROPONENT AND PROPOSAL INFORMATION

The proposal nominated by Brockman for which approval is being sought is the "Marillana Iron Ore Project".

1.1 PROPONENT DETAILS

Marillana Iron Ore Project

Brockman Iron Pty. Ltd.

1.2 KEY CONTACT

Brockman Iron Pty. Ltd.

1/117 Stirling Highway

P.O. Box 141

NEDLANDS WA 6909

Tel: 9389 3000

www.brockman.com.au

ABN: 12 122 652 886

Project Director

Paul Bartlett

paulbartlett@brockman.com.au

Project Manager

Brendan Hynes

Brendanhynes@brockman.com.au

1.3 ENVIRONMENTAL CONSULTANT

ecologia Environment has been engaged by Brockman to facilitate the environmental approval process. This role involves:

- representing the proponents when liaising with government, public stakeholders and contractors;
- providing advice to Brockman on the environmental requirements for the project approvals process;
- undertaking the required environmental impact assessment studies;
- providing specialist technical advice on environmental matters; and
- preparing the environmental documentation required to be submitted to regulatory authorities.

The environmental manager and key contact for this proposal is Garry Connell.

***ecologia* Environment**

1025 Wellington Street

WEST PERTH WA 6005

Phone: 08 9322 1944

Fax: 08 9322 1599

Mobile: 0418904921

Email: Garry.Connell@ecologia.com.au

www.ecologia.com.au

1.4 GOVERNMENT APPROVALS

The project is subject to both federal and state legislation. Legislation applicable to this project is summarised in Table 1.1.

The proposal will be assessed pursuant to Part IV of the *Environmental Protection Act, 1986*.

Table 1.1: Legislation Applicable to the Project.

Legislation	Responsible Government Authority	Aspect
Commonwealth Legislation		
Environmental Protection & Biodiversity Conservation Act 1999	Department of Environment, Water, Heritage and the Arts	Rare flora and fauna, Cetaceans.
Native Title Act 1993	National Native Title Tribunal	Aboriginal rights
Protection of Moveable Cultural Heritage Act 1986	Protection of Moveable Cultural Heritage Act 1986	Protection of moveable cultural artefacts
National Greenhouse and Energy Reporting Act 2007	Department of Climate Change	Climate change
State Government Legislation		
Aboriginal Heritage Act 1972	Department of Indigenous Affairs	Archaeological and ethnographic heritage
Agricultural and Related Resources Protection Act 1976	Department of Agriculture, Western Australia	Weeds and feral pest animals
Bush Fires Act 1954	Bush Fires Board	Wild fire control
Conservation and Land Management Act 1984	Department of Environment and Conservation	Flora and fauna / habitat / weeds / pests / diseases
Contaminated Sites Act 2003	Department of Environment and Conservation	Management of pollution
Country Areas Water Supply Act 1947.	Department of Water	Water resources supply
Dangerous Goods Safety Act 2004	Department of Consumer and Employment Protection	Dangerous goods management
Environmental Protection Act 1986	Department of Environment and Conservation	Environmental impact assessment and management
Explosives and Dangerous Goods Act 1961	Department of Consumer and Employment Protection	Explosives and dangerous goods, transport and management
Health Act 1911	Department of Health	Human health management
Heritage of Western Australia Act 1990	Heritage Council of Western Australia	European heritage management
Local Government Act 1995	Shire of East Pilbara	Development approvals and management

Legislation	Responsible Government Authority	Aspect
Local Government (Miscellaneous Provisions) Act 1960	Shire of East Pilbara	Community issues / resources / facilities
Metropolitan Water Supply, Sewerage and Drainage Act 1909	Department of Health	Management of sewage
Occupational Safety and Health Act 1984	Department of Consumer and Employment Protection	Occupational safety and health
Public Works Act 1902	Department of Housing and Works	Development approvals and management
Soil and Land Conservation Act 1945	Department of Agriculture	Protection of soil resources
Water and Rivers Commission Act 1985	Department of Water	Protection of surface and groundwater
Waterways Conservation Act, 1976	Department of Water	Protection of surface and groundwater
Wildlife Conservation Act 1950	Department of Environment and Conservation	Protection of indigenous wildlife
Rights in Water and Irrigation Act 1914	Department of Water	Access to and use of water resources

Subsequent to this approval, various Works Approvals and Licences (or amendments to Stage I Licences) will be required for construction and operation of prescribed premises under Part V of the *Environmental Protection Act 1986.* These may include:

- ore processing;
- bulk material loading;
- sewage facility; and
- bulk storage of chemicals.

Approvals are also required under the *Rights in Water and Irrigation Act 1914* for activities that include:

- Taking water from any watercourse, wetland or underground water source.
- The commencement or construction of an artesian well or a non-artesian well or for the enlargement, deepening or altering of an existing well.
- Obstruction, destruction or interference with the waters, beds or banks of any watercourse flowing through or over, or wetland situated wholly or partly on, land that has not been granted or demised by the Crown.

These approvals include:

- application for a 11/17/21A Permit to interfere with Bed and Banks;
- application for a 5C Licence to Take Groundwater; and
- an application for a 26D Licence to Construct or Alter Wells.

Any bore field constructed and operated for the project may need to be covered by a Miscellaneous Licence under the *Mining Act 1978* depending on its location.

Other approvals that will be required include:

- application for Licences to Store Explosives (Magazine Licence)/ Notification of Explosives Magazine Relocation; and
- an application for a Licence to Store Dangerous Goods.

1.5 DESCRIPTION OF PROPOSAL

1.5.1 Mine Pits

Mining will commence in pits along the strike length. Waste overburden will be removed to waste dumps to access the Tertiary Haematite Detrital (THD) and Channel Iron Deposits (CID).

Overburden material will be stored in waste stockpiles adjacent to the pit in the initial years of operation, or in mined-out pits later in the life of mine.

Much of the ore body has been found to be unconsolidated. Hence it is anticipated that much of the ore body will be free digging. However, in some cases, the THD and/or CID ores may be semi-cemented by clays or iron oxides. In these cases, drilling and blasting may be employed. An explosives storage facility will be provided on the site if required.

Pit dewatering bores will be provided to dewater the ore body suitable for conventional dry mining using shovels and haul trucks. Water from pit dewatering will be directed in the first instance for re-use in the process plant and for dust suppression It is not anticipated that an external process water supply borefield will be required. Excess water from pit dewatering will be returned to the aquifer via a managed aquifer recharge process (MAR).

Levees and/or diversion drains will be constructed to protect mine pits from inundation.

Flood protection structures will be constructed to protect the mine pits and infrastructure from severe flood events emanating from Weeli Wolli Creek, which runs North West to South East of the tenement (Figure 1.1).

1.5.2 Processing Facilities

Ore will be processed in a wet process beneficiation plant to produce 25 Mtpa of iron ore product. Water used in the beneficiation plant will be sourced from the local aquifer through pit dewatering, supplemented by abstraction bores if required. Bores will be designed to abstract water from the upper fresh water aquifer and to minimise abstraction from below the fresh/saline interface. Waste from the beneficiation plant will be pumped to a tailings storage facility (TSF). In-pit tailings disposal will be employed later in the life of mine once mined-out pits become available. Decant water from tailings storage will be returned to the processing plant for re-use.

1.5.3 Power Generation

A main power plant with a capacity of approximately 10MW will also be installed at the mine facility to cater for the power requirements of the administration, processing, workshop and storage facilities as required.

Power for the accommodation village will be supplied by means of on-site diesel generator sets with a total installed capacity of approximately 1.5MW.

The accommodation village and mining facility will use diesel fuelled generators in parallel. The power supply will be designed such that it has adequate capacity for emergency standby.

Power reticulation requirements to remote locations (such as bore pumps) will be by overhead power distribution lines or from other stand alone generators as required.

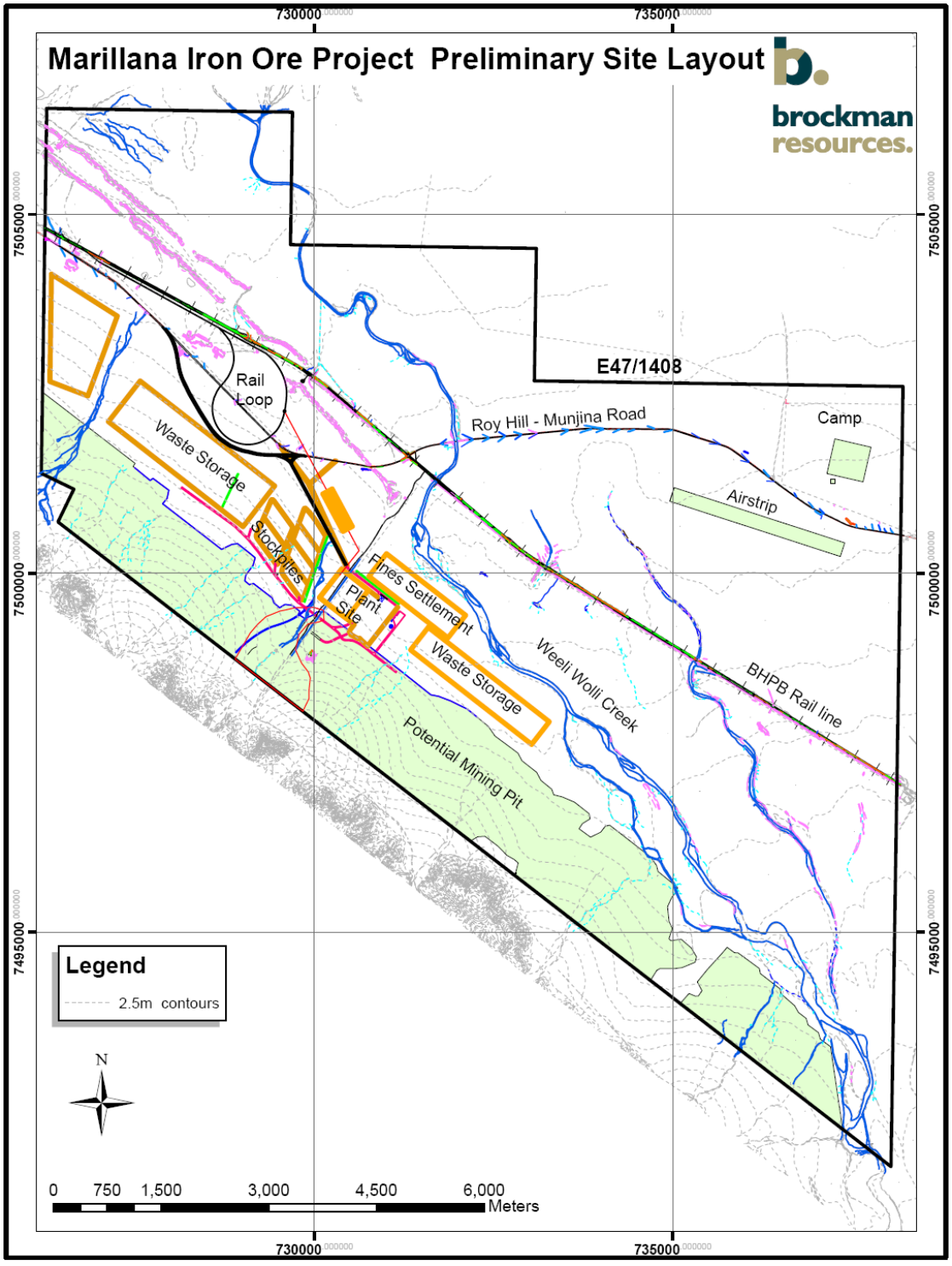

Figure 1.1 Site plan-proposal details

1.5.4 Bulk Fuel Storage

Two bulk fuel facilities will be established for the storage of diesel fuel. The facilities will be constructed with full containment of the diesel storage units as well as fuel transfer points.

The primary facility will be located at the mine operations area for re-fuelling of the mine fleet as well as power generation for the mining, processing and stockpiling facilities.

A second facility will be located adjacent to the accommodation village for supplying power generators.

The fuel storage facility will comprise single skin tanks within a containment bund or a series of double skinned tanks on a compacted gravel base.

Concrete slabs will be provided to contain fuel spillages during transfer of incoming fuel from road trains or refuelling of vehicles.

1.5.5 Accommodation Village

A 500 person accommodation village will be constructed within the tenement boundary and situated away from the mining operations. This facility will include a first aid room, a dry mess, wet mess, recreation facilities, gym, sewage treatment and potable water supply to current Pilbara standards.

Construction personnel building the accommodation village will be housed at the nearby Auski Roadhouse until the village is habitable and ready to be utilised.

1.5.6 Administration Offices and Crib Rooms

Administration offices will be located within close proximity to the pit and process plant. This area will accommodate owner and contractor offices.

During the construction phase, temporary facilities and infrastructure will be required for all construction contractors, Brockman's Engineering Procurement Construction and Management (EPCM) consultant and Brockman's Owners team representatives. Where possible the temporary facilities will be located within the proposed area of disturbance designated for the permanent facilities.

1.5.7 Waste Water treatment

Discharge from ablution buildings will be directed to packaged sewage treatment facilities at the accommodation village & mine site for treatment. Treated discharge from the waste water treatment plants will be disposed via reticulation to spray fields.

1.5.8 Landfill

Waste will be segregated into general (inert) waste and hazardous waste. Initial construction waste will be removed from site to existing facilities in the Newman area. A landfill will subsequently be established on the site to deal with non-hazardous waste. Hazardous waste will be removed from site to suitably licenced facilities.

1.5.9 Potable Water

Potable water will be supplied on site from bores via a suitable treatment system.

Bores will be established for the provision of potable water for the accommodation village and mine facility use. Suitably sized water treatment plants for potable water treatment will be installed at both locations. Processes to be considered for the treating of bore water to

achieve drinking water standards include UV sterilisation, chlorination, water softening, filtration and reverse osmosis (RO). In the event that filtration or RO are required, the backwash will be directed to evaporation ponds.

1.5.10 Process Water

Process water will be sourced from pit dewatering. An above ground process water storage tank will be constructed adjacent to the mine facility for holding water prior to use on site. Process water will be supplied from the process water storage tank to the processing plant, vehicle wash down area and potable water treatment plant at the mine facility. Additional water may be extracted from production bores established within the mining area and in close proximity to the mining and processing operations within the tenement if required.

Water cart stand pipes will be located in close proximity to the bore sites for dust suppression.

1.5.11 Lay Down Areas

Cleared areas will be prepared for construction purposes, including contractor offices, vehicle parking, materials storage and unloading of trucks. Where possible, these areas will be located within the area of disturbance for the permanent facilities. Areas will be rehabilitated when no longer required.

1.5.12 Borrow Pits

Borrow pits will be constructed to provide construction material required for the infrastructure located on the tenement. Where possible, borrow pits will be located in the mine pit area, however this will be subject to the suitability of the overburden material for construction purposes.

Borrow pits outside the pit area will be rehabilitated when no longer required.

1.5.13 Aerodrome Facilities

The operation will be by a fly-in/fly-out working arrangement. An aerodrome will be constructed on the lease to facilitate this.

1.5.14 Site Access Roads

Haul roads will be constructed for heavy mining equipment as required.

An access road will be constructed from the Munjina – Roy Hill road to the accommodation village and aerodrome. An access road from the Munjina-Roy Hill road will be constructed to the mining operation and maintenance facilities.

1.5.15 Workshop Facilities

Workshop facilities to support maintenance of heavy mining equipment (HME) and process plant maintenance will be located close to the mining operations, and will be supplemented by vehicle washing facilities, tyre changing facilities, and other necessary ancillary infrastructure.

1.5.16 Laboratory Facility

An ore sample preparation facility will be established on-site complete with sample jaw crusher, splitter, scale, screens, ovens and pulveriser. A laboratory will be established on

site for preliminary testing of ore material. Potable water, fume hood discharge, power and waste water services will be connected to the facility.

1.5.17 Heavy Vehicle Parking Area

A hardstand area will be established for parking of mining equipment for purposes of shift change, meal breaks and in preparation for maintenance activities.

1.5.18 Train Loading Facility

A loading facility will be constructed consisting of a train loop and product reclaim systems for the loading of iron ore product from the product stockpile onto trains for transport.

1.5.19 Communication Systems

The mine will be provided with communication systems for intra-site and off-site communications. On-site communications will include a radio repeater tower for two way radio, mobile phone and process control functions. Off-site communications will be by fibre optic cables to connect to existing Telstra networks, supplemented by satellite or microwave links to other regional services depending on available capacity.

Fibre optic cables will be trenched in-ground between major facilities such as the accommodation village, mine administration, rail loop and communications tower. Radio telemetry will be utilised for communication remote facilities with smaller communications requirements, such as bore pumps.

1.6 LOCATION INFORMATION

The Marillana mine site is located within the Pilbara region of Western Australia approximately 100 km north west of the township of Newman (Figure 1.2). The tenement covers 95 square kilometres of the Fortescue Valley and borders the Hamersley Range, where extensive areas of supergene iron ore mineralisation are developed within the dissected Brockman Iron Formation which caps the range.

The main access to the project site is via the Great Northern Highway and the unsealed Munjina – Roy Hill Road. Approximately 58 kilometres along the Munjina – Roy Hill road the BHPB rail line into the Yandi mine intersects the road. The northern boundary of the tenement is a further 1 kilometre west of this rail line intersection (Figure 1.3).

Previous developments at the site include the Munjina-Roy Hill road and the Newman-Hedland railway and numerous borrow pits associated with their construction and maintenance.

The Project lies south of the Fortescue Marsh, and is intersected by distributaries of the Weeli Wolli creek delta (Figure 1.1).

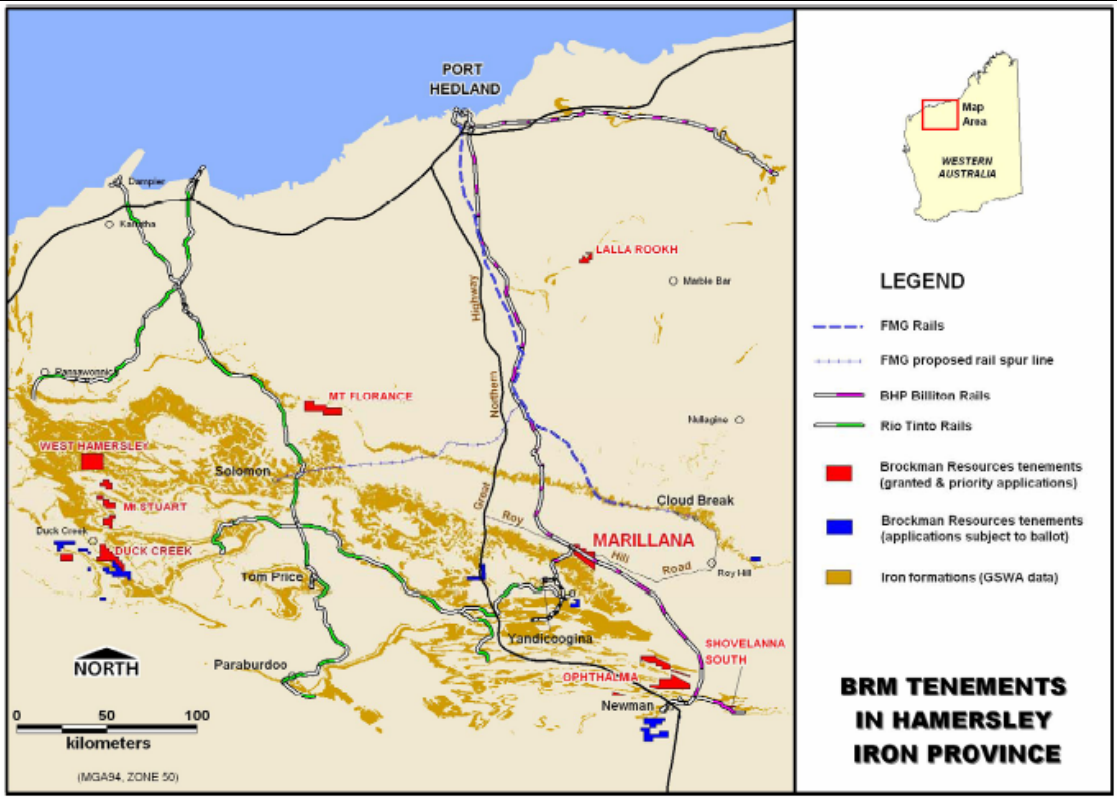

Figure 1.2: Regional Location of Project

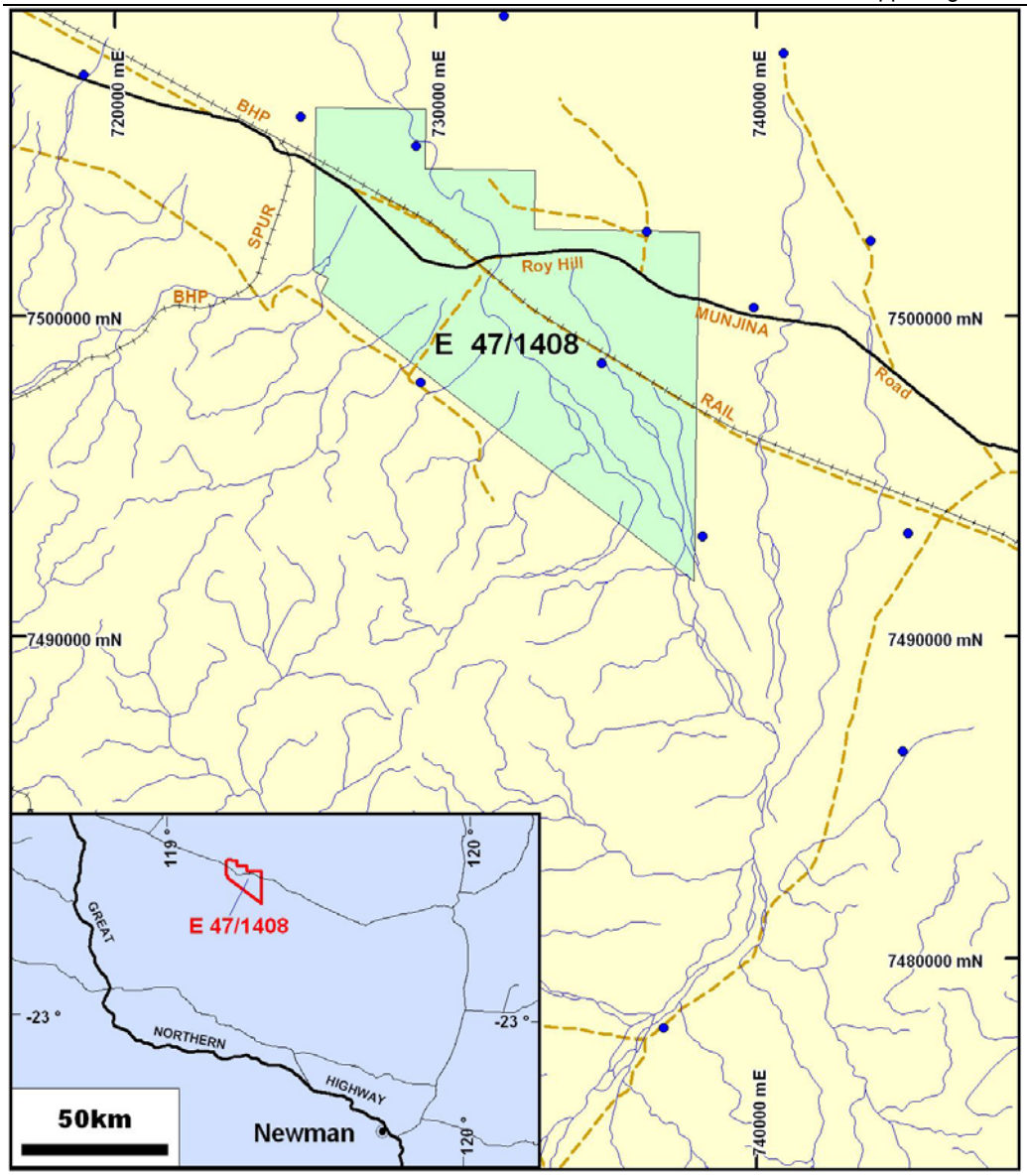

Figure 1.3: Access to Site

The Project is located with in the Hamersley Province on the southern Pilbara Craton of Western Australia. The Hamersley province has been described by MacLeod (1966), Trendall and Blockley (1970) and Trendall (1983). The Province is characterised by a thick succession of low grade metamorphic, late Archaean to early Paleoproterozoic rocks, known as the Mt Bruce supergroup. The Mt Bruce supergroup is composed of volcanic rocks, banded iron formations (BIFs), carbonate and clastic rocks, which unconformably overlay an Archaean granite and greenstone basement. The Mt Bruce supergroup is subdivided into four subgroups; the basal Fortescue group, which is overlain by the Hamersley Group, the Turee Creek Group and the uppermost Wyloo group. The Fortescue Group consists of basalt, felsic volcanics and sandstones and overlies an Archaean granite and greenstone basement. It is interpreted to be formed in a rift environment.

The Hamersley Group is an approximately 2500 metre thick sequence of BIF, shale, dolomite, mafic volcanics and dolerite sills, and is Archaean to Paleoproterozoic in age. A

notable feature of this group is the presence of five major BIF units that are laterally continuous throughout the province with no apparent facies change. Two of these BIF units, the Marra Mamba Iron Formation and the Brockman Iron Formation host all of the major iron ore deposits in the Pilbara, and are the source for most detrital iron deposits. The Hamersley group is regarded as being deposited on a stable marine platform. The lower Hamersley group is interpreted as a passive cratonic margin deposit, while the upper Hamersley group is thought to be part of a back arc platform setting.

The overall exploration tenement for this project covers 95 square km of the Fortescue Valley and borders the Hamersley Range where extensive areas of supergene iron ore mineralisation have developed within the dissected Brockman Iron Formation which caps the range.

The iron ore mineralisation within E47/1408 comprises buried hematite-goethite CID mineralisation (with grades ranging from 55 – 63% Fe), overlain by unconsolidated detrital material with grades ranging from 40 – 60 % Fe. The detrital mineralisation has been derived from erosion and deposition in detrital fans of the iron formation in the adjacent ranges. The overburden comprises loosely compacted detritus with significantly lower iron content than the mineralised material.

1.7 PROJECT JUSTIFICATION

Western Australia's economy is heavily dependent on mineral resource, and its future growth and development rely on the continued viability of resource development projects. The nearby town of Newman has developed as a result of mineral exploitation, and requires ongoing resource projects to provide revenue to the community. The development of the Marillana mine will provide financial and social benefits for the area through employment and flow-on effect to the non-mining sector.

The Marillana Iron Ore Project will have a significant beneficial impact on the Pilbara region, bringing revenue and jobs to the area.

2.0 POTENTIAL ENVIRONMENTAL IMPACTS

2.1 FLORA AND VEGETATION

2.1.1 Regional Vegetation

The Marillana survey area lies in the Pilbara biogeographic region as classified by IBRA, with over approximately 95% of the area in the Fortescue plains sub-region and the remainder in the Hamersley sub-region.

The vegetation of the Fortescue Plains sub-region is described by Kendrick (2001a) as:

- salt marshes fringing the salt lakes;
- *Acacia aneura* (mulga) and tussock grasses on the alluvial plains;
- short grass communities on the alluvial plains; and
- *Eucalyptus camaldulensis* (River Gum) woodlands fringing the drainage lines.

The vegetation of the Hamersley sub-region is described by Kendrick (2001b) as a mountainous area of sedimentary ranges dissected by gorges with:

- *Acacia aneura* (mulga) low woodlands, over tussock grasses on the valley floors; and
- *Eucalyptus leucophloia* (Snappy Gum) over *Triodia brizoides* on skeletal soils of the ranges.

Beard, 1975, classifies the Marillana survey area as falling within the Fortescue Botanical region of the Pilbara. Beard mapped these vegetation communities and they are described as;

- *Acacia aneura* (mulga) in groved patterns with an understorey of *Triodia pungens* (spinifex);
- *Eucalyptus gamophylla* shrub steppe, over *Triodia basedowii* (spinifex) hummock grassland; and,
- *Eucalyptus brevifolia* (Snappy Gum) sparse low trees, over *Triodia wiseana* open hummock grassland.

2.1.2 Minesite Vegetation

The tenement itself is mainly characterised by *Acacia aneura* (mulga) in the majority of the north eastern half, however the Rock Hole Bore pit located within the area classified as *Eucalyptus gamophylla* shrub steppe, over *Triodia basedowii* (spinifex) Hummock grassland (Figure 2.1).

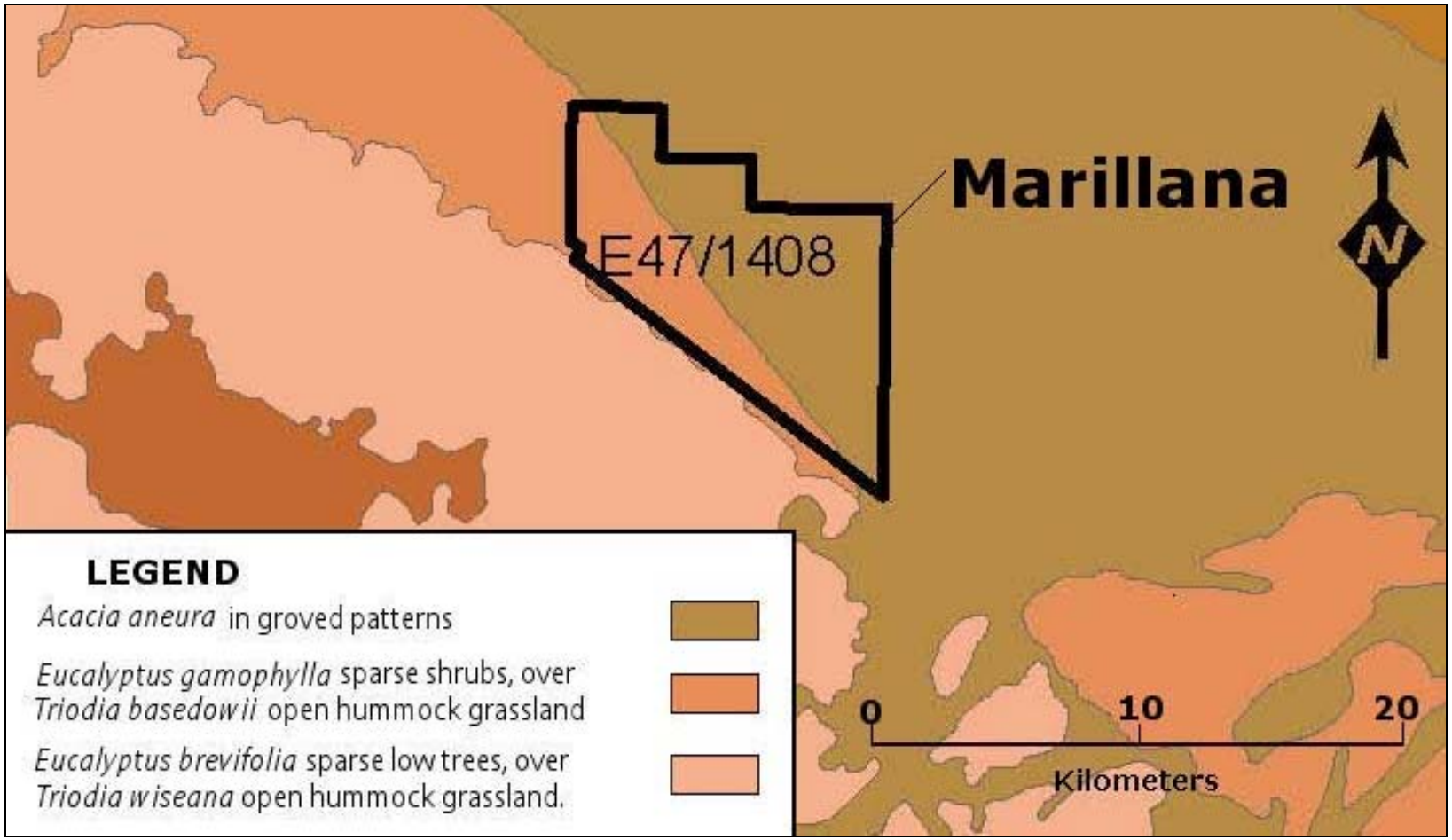

Figure 2.1: Vegetation Types in and Around the Tenement (Beard 1975)

2.1.3 Minesite Flora

Flora species are protected at a national level under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild.

Flora of conservation significance within Western Australia are protected under the Wildlife Conservation Act 1950 (WC Act) and termed Declared Rare Flora (DRF). The current list of DRF is provided in the Western Australian Wildlife Conservation (Rare Flora) Notice 2005. Declared Rare Flora is defined as "taxa which have been adequately searched for and deemed to be either rare, in danger of extinction, or otherwise in need of special protection in the wild".

The Department of Environment and Conservation (DEC) also maintains a list of priority flora taxa, which are considered poorly known, uncommon, or under threat, but for which there is insufficient justification based on known distribution and population sizes for inclusion on the DRF schedule. Priority Flora are assigned to one of four Priority categories (P1, P2, P3 and P4).

Priority flora listed on the Western Australian Herbarium Specimen database and on the Department of the Environment and Water Resources' databases as potentially occurring in the area are summarised in Table 2.1.

Table 2.1: Priority Flora with Potential to Occur at the Marillana Survey Area

Status	Species	Distribution (nearest named location)	Preferred Habitat	Potential to occur	DEC record
Rare	*Lepidium catapycnon* (Brassicaceae)	Wittenoom, Weeli Wolli Creek, Newman.	Skeletal soils on stony hill slopes.	**Unlikely**	Yes
	Thryptomene wittweri (Myrtaceae)	Hamersley Range, Mt Augustus, Carnarvon Range, White Cliffs Stn, NT.	Skeletal red stony soils, breakaways and stony creek beds.	**Possible**	Yes
Priority 1	*Calotis squamigera* (Asteraceae)	Wittenoom, Hamersley Range.	Pebbly loam.	**Unlikely**	Yes
	Eremophila spongiocarpa (Myoporaceae)	Mt Marsh, Chichester Range, Marillana Station, Mulga Downs Station.	Weakly saline alluvial plain on margins of salt lakes.	**Unlikely**	Yes
	Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) (Goodeniaceae)	Outside mining lease, ca 90 km NW of Newman.	Red-brown clayey pan, swamp on major river floodplain.	**Possible**	No
	Ischaemum albovillosum (Poaceae)	Chichester Plateau, near Fortescue River.	Plateaus, cracking clay.	**Unlikely**	No
	Myriocephalus nudus (Asteraceae)	Hamersley Range, Paynes Find, Yannarie River, Juna Downs, Swan River (Drummond).	Along rivers & creeks, granite.	**Unlikely**	Yes
	Rhagodia sp.Hamersley (M. Trudgen 17794) (Chenopodiaceae)	Hamersley Ranges.	Hard clay pans, under mulga.	**Possible**	Yes
	Acacia daweana (Mimosaceae)	Hamersley Range, Karijini N.P.	Stony red loamy soils, low rocky rises, along drainage.	**Possible**	Yes
	Eremophila forrestii subsp. *Pingandy* (M.E. Trudgen 2662) (Myoporaceae)	Karijini NP, Hamersley Range NP, Turee Creek Stn.	Flat terrain, low in landscape, base of broad valley, stony gibber plain above shallow drainage line, red clay-loam.	**Unlikely**	Yes

Status	Species	Distribution (nearest named location)	Preferred Habitat	Potential to occur	DEC record
Priority 2	*Gonocarpus ephemerus* (Haloragaceae)	Trugallenden Pool, Port Hedland.	Sand, along drainage lines, granite.	**Unlikely**	No
	Olearia fluvialis (Asteraceae)	Hamersley Range, Karijini N.P., West Angelas, Newman.	Iron rich alluvium, pebbly sand, stony creeks.	**Possible**	Yes
	Spartothamnella puberula (Lamiaceae)	Mt Bruce, Hamersley Range, West Angelas, NT.	Rocky loam, sandy or skeletal soils, clay, sandplains.	**Possible**	Yes
Priority 3	*Acacia bromilowiana* (Mimosaceae)	Tom Price, Balfour Downs Stn, West Angelas, Hope Downs, Hamersley Ranges, Marillana Stn, Ophthalmia Range.	Red skeletal stony loam, orange-brown pebbles, gravel loam, laterite, banded ironstone, basalt, rocky hills, breakaways, scree slopes, gorges, creek beds.	**Unlikely**	Yes
	Acacia glaucocaesia (Mimosaceae)	Ashburton River, Woodie Woodie, Mardie Station, Karratha, Dampier.	Red loam, sandy loam, clay.	**Possible**	No
	Calotis latiuscula (Asteraceae)	Giles, Warburton, Blackstone Range, Rawlinson Range, Hamersley Range.	Rocky hillsides, floodplains, rocky creeks and river beds.	**Possible**	Yes
	Eremophila youngii subsp. *lepidota* (Myoporaceae)	Roy Hill-Munjini Road, Mulga Downs Station, Newman.	Stony red sandy loam, flats plains, floodplains, sometimes semi-saline, clay flats.	**Possible**	No
	Glycine falcata (Papilionaceae)	Munjina Claypan, Juna Downs Station, Bungle Bungle National Park.	Black clayey sand, along drainage depressions in crabhole plains on river floodplains.	**Unlikely**	No
	Goodenia nuda (Goodeniaceae)	Weeli Wolli Creek, Roy Hill, Wittenoom, Mulga Downs, Marillana Creek, Yandi Eastern Pit 2.	Plain, dry, red sand, bare river sand in dry scoured river bed.	**Confirmed**	No
	Goodenia pascua (Goodeniaceae)	Roebourne, Port Hedland, Onslow.	Red sandy soils. Basaltic plains.	**Unlikely**	No
	Gymnanthera cunninghamii (Asclepidiaceae)	Boodarie Landing, Boodarie Homestead, Woodstock Station, Tom Price.	Brown red sand, major drainage, limestone rise, creekline, river sand.	**Possible**	No

Status	Species	Distribution (nearest named location)	Preferred Habitat	Potential to occur	DEC record
Priority 3	*Hibiscus brachysiphonius* (Malvaceae)	Balgo Mission, Christmas Creek, Wandagee, Karratha, Tom Price, Millstream, Warrawagine, Hamersley Range.	Red loam over basalt, hard setting red clay pan on limestone, gilgai within clayey plain.	**Possible**	Yes
	Indigofera gilesii subsp. *gilesii* (Papilionaceae)	Hamersley Range, Meekatharra, West Angelas.	Pebbly loam amongst boulders & outcrops, hills.	**Unlikely**	Yes
	Polymeria sp. Hamersley (ME Trudgen 11353) (Convolvulaceae)	Hamersley Stn, Wittenoom, Marandoo, Hamersley Ranges.	Red-brown cracking clay.	**Unlikely**	Yes
	Rhynchosia bungarensis (Papilionaceae)	Hamersley Ranges, Chichester Ranges, Yardie Creek, Robe River, Tom Price, Ashburton, East Lewis Island, Burrup, Dampier Archipelago.	Floodplain with deep gorge, creekline within deep gorge, river channels, summit of hill, steep slope, skeletal red stony soil.	**Unlikely**	Yes
	Rostellularia adscendens var. *latifolia* (Acanthaceae)	Hamersley Ranges.	Ironstone soils, near creeks, rocky hills.	**Possible**	Yes
	Tephrosia sp. Cathedral Gorge (F.H. Mollemans 2420) (Papilionaceae)	Newman, Hamersley Range, Fortescue Valley.	Stony hill slope, ridge crest, skeletal loam, gentle drainage depression.	**Unlikely**	Yes
	Triumfetta leptacantha (Tiliaceae)	Marillana BHP BIO Mining Lease, Yandi Iron Ore Mine, Ministers North, Yandicoogina Creek, Packsaddle Range, Munjina (Auski) Roadhouse.	Red clay over boulder, red loam, fluviatile gravel, rocky breakaway, steep rock slopes, skeletal soil.	**Unlikely**	Yes
Priority 4	*Eremophila magnifica* subsp. *magnifica* (Myoporaceae)	Hamersley Ranges, Tom Price, Marandoo, Wittenoom.	Skeletal soils over ironstone, rocky scree.	**Possible**	Yes

2.1.4 *Ecologia* Field Survey

Phase one of the two phase survey was conducted at Marillana from the 4th – 12th of July 2008. This report details the results of this first phase survey.

The survey methods used were developed to meet the Environmental Protection Authority's Guidance Statement 51 (*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia; EPA, 2004*) and Position Statement Number 3 (*Terrestrial Biological Surveys as an element of Biodiversity Protection; EPA, 2002*).

2.1.5 Priority Flora Recorded at Marillana

One Priority Flora taxon, *Goodenia nuda* (Priority Three) was recorded once in low numbers (< 2% cover) during the Marillana survey.

Goodenia nuda is an erect non woody herb growing to 50 cm high. The leaves and stems are a pale green to grey-green colour, sometimes with a frosted look from a powdery coating and are between 4 - 10 cm in length and 0.5 - 1 cm in width. The flowering section can be up to 25 cm long, with the yellow flowers less than 2 cm long, occurring between April and August (Figure 2.2).

Figure 2.2: *Goodenia nuda* specimen

The preferred habitat of *Goodenia nuda* is in dry river beds and at the edge of floodplains on stony hard pans and cracking clays. There are currently 12 records on FloraBase of G. nuda from areas including Newman, Roy Hill and Weeli Wolli Creek (FloraBase, 2008).*Goodenia nuda* was recorded at one location (quadrat 16) on the site (Figure 2.3).

Whilst engineering plans have not been finalised, Brockman will make every effort to avoid impacting vegetation in the vicinity quadrat 16, where *Goodenia nuda* was found. Brockman has sought direction from the DEC on the appropriate steps to be taken, to negate impacts to vegetation in the vicinity and will readily accept guidance on the matter.

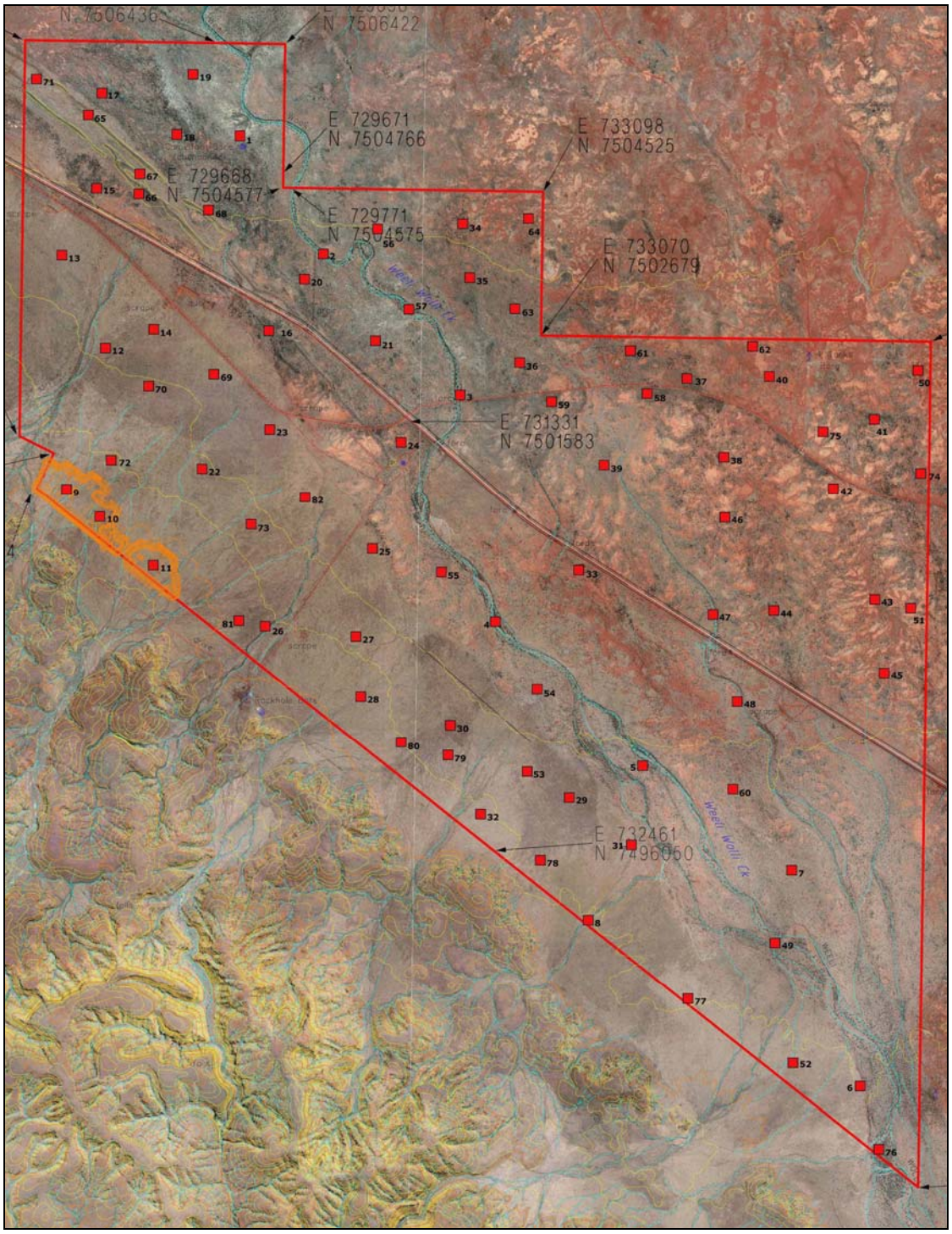

Figure 2.3: Quadrats surveyed at the Marillana survey area

2.2 FAUNA

2.2.1 Vertebrate Fauna

Fauna species (including invertebrate fauna) that have been formally recognised as rare, threatened with extinction, or as having high conservation value are protected by law under Commonwealth and State legislation. At the national level, fauna are protected under the Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act*). Within WA, rare fauna are listed under the Western Australian Wildlife Conservation Act 1950: Wildlife Conservation (Specially Protected Fauna) Notice 2006(2). International Agreements include the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

Schedule 1 of the Commonwealth EPBC Act 1999 contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent.

Rare and endangered fauna are listed as one of four distinct schedules under the WA Wildlife Conservation (Specially Protected Fauna) Notice 2006(2) of the Wildlife Conservation Act 1950. In addition, DEC maintains a Priority Fauna list which includes fauna removed from the Wildlife Conservation Act and other species known from only a few populations or in need of monitoring.

Fauna species previously found or which could be potentially found within the area of the Marillana Iron Ore Project are summarised in Table 2.2.

Table 2.2: Fauna Species of Conservation Significance Recorded or Potentially Occurring Within the Project Area

Species	Common Name	CAMBA / JAMBA	EPBC Act	WCA	CALM Priority	Endemic to Pilbara	Habitat	Previous records	Likelihood of Occurrence
Mammals									
Dasyurus hallucatus	Northern Quoll		EN			N	Occurs in wooded areas, most commonly in rocky and broken country in open Eucalypt forest.	Not recorded during any previous surveys but is listed on WAM Fauna base.	Low
Macroderma gigas	Ghost Bat				P4	N	Occur in a broad range of habitats. Distribution is influenced by availability of roost sites. They roost in shallow sandstone caves along cliff lines, under boulder piles, in deep limestone caves and in abandoned mines (Churchill 1998).	Recorded within West Angelas Pipeline Corridor (*ecologia* 1998).	Low
Pseudomys chapmani	Western Pebble-mound Mouse				P4	Y	Inhabits hummock grassland areas of Triodia, Cassia, Acacia and Ptilotus on skeletal soils containing an abundance of small (~5 g) pebbles (Strahan, 1995)	Recorded in eight of the previous nine surveys undertaken between 1994 & 2005 within a 100 km radius of the project area (Appendix V).	Moderate
Sminthopsis longicaudata	Long-tailed Dunnart				P4	N	Occurs on rocky hills and mesas.	Not recorded during any previous surveys but is listed on WAM Faunabase.	Low
Dasycercus cristicauda	Mulgara		VU			N	Inhabits moderately open spinifex grassland on softer soils & sands	Recorded to the north of the Chichester Range	Low
Rhinonicteris aurantius	Pilbara Leaf Nosed bat		VU			Y	May occur in rocky gorges where suitable habitat occurs	Recorded from the Hamersley Range	Low
Macrotis lagotis	Greater bilby		VU			N	Sandplain and desert inhabitant	Recorded to the north of the Chichester Range and to the west on Cloudbreak	Moderate in suitable habitat

Species	Common Name	CAMBA / JAMBA	EPBC Act	WCA	CALM Priority	Endemic to Pilbara	Habitat	Previous records	Likelihood of Occurrence
Birds									
Pezoporus occidentalis	Night Parrot		EN	S1			Known from dense Spinifex grasslands and chenopod shrublands. Has been recorded recently at Mulga Downs Station in similar habitat to that which occurs in the SW corner of the study area.	Recorded at proposed Cloudbreak Iron Ore mine in 2005 (Davis et al. 2005). Only known record from region.	Low
Neochmia ruficauda	Star Finch	✓	EN		P4		Occurs in grassland and reeds near water.	Recorded at Mining Area C (*ecologia* 2004), Roy Hill (*ecologia* 2006) and Cloudbreak (Davis et al. 2005).	Moderate if suitable habitat present
Falco peregrinus	Peregrine Falcon			S4			Occurs in a wide range of habitats. Nesting occurs on cliffs or abandoned nests of other raptors in tall, wooded forests.	Recorded at Mining Area C (*ecologia* 2004), Roy Hill (*ecologia* 2006) and Cloudbreak (Davis et al. 2005).	Low but may use habitat for foraging
Burhinus grallarius	Bush Stone-curlew				P4		Preferred habitat is grassy woodland, and they are almost absent in rainforest and bare deserts (Frith, 1976).	Recorded at Wheelarra Hill (*ecologia* 2004) and Roy Hill (*ecologia* 2006).	Moderate if suitable habitat present

Species	Common Name	CAMBA / JAMBA	EPBC Act	WCA	CALM Priority	Endemic to Pilbara	Habitat	Previous records	Likelihood of Occurrence
Falco hypoleucos	Grey Falcon				P4		Preferred habitat includes shrubland, grassland and wooded watercourses. It nests in disused stick nests of other birds.	1 record at Nullagine in 1997 and Roy Hill (*ecologia* 2006).	Low but may use habitat for foraging
Ardeotis australis	Australian Bustard				P4		Occurs in open or lightly wooded country.	Recorded at Orebody 18 (*ecologia* 1995b), West Angelas (*ecologia* 1998, Mining Area C (*ecologia* 2004) and Cloudbreak (Davis et al. 2005).	Moderate
Tringa glareola	Wood Sandpiper	✓	M				Freshwater swamps.		Moderate if water present
Tringa nebularia	Common Greenshank	✓	M				Any habitat containing water, from coastal sand and mudflats to freshwater lakes.		Moderate if water present
Apus pacificus	Fork-tailed Swift	✓	M				Aerial, occurring over a variety of habitats.	Recorded at East Ophthalmia Range (*ecologia* 2004)	Sporadic
Merops ornatus	Rainbow Bee-eater		M				Occurs anywhere suitable for hawking insects	Recorded at Mining Area C (*ecologia* 2004a), Orebody 24 (*ecologia* 2004b), East Ophthalmia Range (*ecologia* 2004c), Wheelarra Hill (*ecologia* 2004d) and Cloudbreak (Davis et al. 2005).	Likely

Species	Common Name	CAMBA / JAMBA	EPBC Act	WCA	CALM Priority	Endemic to Pilbara	Habitat	Previous records	Likelihood of Occurrence
Reptiles									
Liasis olivaceus barroni	Pilbara Olive Python		VU	S1			Generally associated with permanent water bodies, such as rivers, large rock holes and swamps.	Has not been recorded in previous surveys available to *ecologia* in the region, but WAM records indicate it occurs in the area.	Low, requires specific habitat
Aspidites ramsayi	Woma			S4			Prefers woodlands and shrublands, nesting in burrows in sandy soil.	Has not been recorded in previous surveys available to *ecologia* in the region, but WAM records indicate it occurs in the area.	Low; potentially occurs if sandy areas are present
Ramphotyphlops ganei					P1		No knowledge on habitat preferences, but has been recorded nearby by *ecologia* (2005c) in similar habitat to that within the study area.	Previously recorded at Mining Area C (*ecologia* 2004c).	Moderate
Lerista macropisthropus remota	Unpatterned Robust Lerista				P2		Favours sandy to loamy soils supporting Acacia shrubland or woodland where it occurs in leaf litter or loose sand at the base of trees or shrubs.	Has not been recorded in previous surveys available to *ecologia* in the region, but WAM records indicate it occurs in the area.	Low

2.2.2 *Ecologia* Field Survey

The field work was conducted by a team of four *ecologia* personnel from 25th April to 7th May 2008. Trapping was undertaken at six sites over ten nights using standard trapping methods. Active searches for mammals, birds, reptiles, and amphibians were performed at the six systematic trapping sites, with an additional nine opportunistic sites surveyed.

Twenty-one species of mammal, 67 species of bird, and 37 species of reptile were recorded within the survey area.

Several species recorded in these surveys were not recorded in a previous *ecologia* survey of the adjacent BHPBIO Marillana lease (*ecologia* 2006). These included four native mammals, 27 bird and 16 reptile species. All new species were within their expected ranges.

Two conservation significant species were recorded during this survey. The Australian Bustard and the Rainbow Bee-eater were both observed at numerous locations within the survey area.

2.2.2.1 Rainbow Bee-eater (*Merops ornatus*) – EPBC Act Migratory

The Rainbow Bee-eater is a strikingly colourful bird that lives almost anywhere suitable for hawking insects - principally bees, flies, dragonflies and grasshoppers. They are scarce to common throughout much of Western Australia, except for the arid interior, preferring lightly wooded, preferably sandy, country near water (Johnstone and Storr 1998). Rainbow Bee-eaters can occur as a resident, breeding visitor, postnuptial nomad, passage migrant or winter visitor.

The Weeli Wolli Creek will not be impacted during the mining project, and the species' abundance throughout the project area suggests that the proposed mining is unlikely to impact the local or regional population.

2.2.2.2 Australian Bustard (*Ardeotis australis*) – DEC Priority 4

Australian Bustards are large ground-dwelling birds that occur throughout Australia, utilising a wide range of open habitats, including open or lightly-wooded grasslands, chenopod flats, plains and heathlands (Johnstone and Storr 1998). The species is unmistakeable in the field, being the only bird of its size and shape, and is usually encountered either singly or in small single-sex groups. Occasionally it occurs in flocks of more than 30 in remote areas (Johnstone and Storr 1998).

Because Australian Bustards are mobile and relatively common in the Pilbara, and habitat suitable for the species is widespread and common in the surrounding areas, the proposed development is not expected to impact the species either locally or regionally.

2.2.3 Short Range Endemics (SRE)

A four phased short-range endemic survey was undertaken by *Ecologia* within E47/1408 over three months, July-October 2008. The primary aim of the survey was to document the presence / absence of short-range endemic invertebrates within the project impact area and determine the risk of the project upon these organisms.

Short-range endemic organisms are characterised by having highly restricted natural distributions of 10,000 km² (100 km x 100 km) or less. Habitats conducive to supporting short-range endemics are typically isolated patches of landscape with abiotic properties

(ambient moisture, sun exposure or temperature profiles) differing from the surrounding land forms. These land forms are frequently remnants of historically wetter periods that became isolated during the last 30 million years as the Australian landscape tended to become much dried. Speciation within these populations is mediated by the quantity of genetic cross over (emigration and immigration of individuals) between populations. Isolation over sufficiently long periods produces species that are restricted to the habitat they have evolved in. Short range endemic species are recognised from mostly flightless arthropod groups such as arachnids (i.e. trap door spiders, scorpions, pseudoscorpions), myriapods (i.e. specific millipedes and centipedes) and snails.

Approximately 50% of the pitfall and foraging samples have been sorted and are currently awaiting identification by the Western Australian Museum (WAM).

The terrestrial habitats surveyed on this tenement appear unlikely to support relictual short-range endemic invertebrates. No significant millipedes or snails have been found at this time. It seems unlikely that the terrestrial habitats present on this tenement would support relictual short-range endemic species; however, a significant portion of the survey material is still to be sorted and identified. A more definite assessment of the survey is not possible at this time.

2.2.4 Stygofauna

Stygofauna are obligate, groundwater dwelling fauna known to be present in a variety of rock types including karst limestones, fissured rock and porous rock (Mamonier et al., 1993). They are typically adapted for the subterranean environment, with features such as lack of pigmentation, elongated appendages, filiform body shape (worm like) and reduced or absent eyes. Many of these fauna have other primitive features which link them to geological periods when vast areas of Australia were covered by tropical forests. They are, therefore, regarded as 'relict' fauna which have survived in aquifers over geological timeframes (Humphreys 1993a; Danielopol and Stanford 1994; Humphreys 2001).

Numerous stygofauna studies have taken place in the Pilbara (Figure 2.4) with over 150 published records of stygofauna existing within the Fortescue Basin (Eberhard et al., 2005). Stygofauna found in the Pilbara region tend to colonise most groundwater environments, whether karst conduit or the benthic and interstitial zones of springs and spring-brooks (Eberhard et al., 2005).

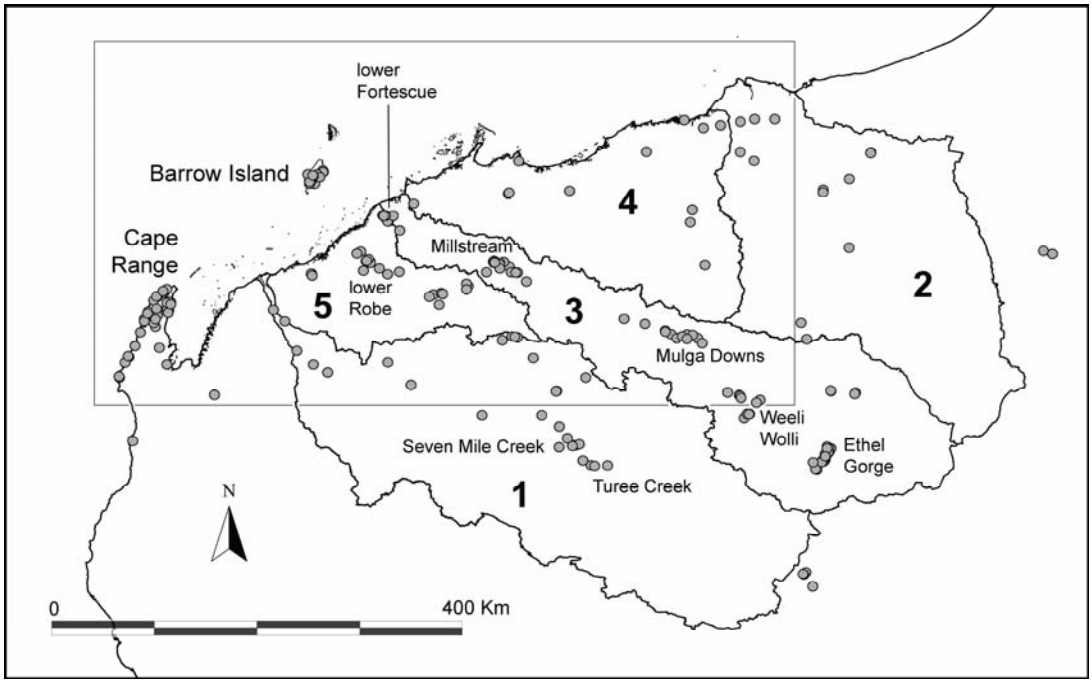

Figure 2.4: Distribution of Published Stygofauna Records of the Pilbara Region and Adjacent Localities including Cape Range and Barrow Island.

Stygofauna are generally recorded in fresher water with an electrical conductivity below 60,000 µs/cm and where relatively neutral pH conditions exist (i.e. approx. pH = 6.5 – 7.5). Considering water conditions recorded within the project area were between 1300 - 1500 µs/cm and with neutral pH (between 7.4 and 7.8) and the prevalence of stygofauna previously identified in surrounding tenements, it is likely that stygofauna will exist within the project impact area.

Surface runoff (SRO) analysis and groundwater modelling undertaken by Aquaterra indicate that should stygofauna be present within the aquifer it is considered unlikely that the stygofauna will be adversely affected by abstractions, (over 5 years with no recharge within this period).this is due to the fact that less than 61% of the saturated thickness of the aquifer is impacted in the immediate vicinity of the PS1PB and 6% of the saturated thickness of the aquifer is impacted in the immediate vicinity of the Potable Bore (Aquaterra 2008).

Ecologia has planned stygofauna surveys scheduled for February 2009.

2.2.5 Troglofauna

Troglofauna are communities of terrestrial subterranean animals that inhabit air chambers in underground caves or small, humid voids. A species is considered truly troglobitic if it displays morphological characters that appear to restrict it to subterranean habitats (Howarth 1983). These include a significant reduction or a complete loss of eyes, pigmentation, wings, and a circadian rhythm (24-hour biological cycle), as well as development of elongated appendages, slender body form and, in some species, a lower metabolism. Troglobitic faunal assemblages are dominated by arthropods such as schizomids, pseudoscorpions, spiders, harvestmen, centipedes, millipedes, diplurans and mites. Many species are relict rainforest litter fauna from previous tropical climate eras

(Humphreys 1993), therefore depending on subterranean habitats that are constantly humid.

True troglobites are incapable of dispersing on the surface and thus are subject to dispersal barriers related to the geological structure of their habitat. Such dispersal limitations result in extremely small, fragmented species ranges and thus high levels of endemism (EPA 2003), which is characteristic of subterranean fauna worldwide (Strayer 1994). Examples include the millipede *Stygiochiropus peculiaris*, which is restricted to a single cave system at Cape Range (Humphreys and Shear 1993). Exceptions exist, however - genetic analyses of some troglobitic mites from Pilbara provide evidence that these microscopic organisms have wide-range distribution, suggesting that they use other means of dispersal, possibly on the surface (Biota 2006).

The presence of troglofauna in Western Australia is still poorly understood and documented (Eberhard 2006). To date, troglofauna have been recorded from karstic limestone systems at Cape Range, Barrow Island and in the Kimberley (Biota 2005; Harvey 1988), from pisolitic mesa formations in the Pilbara (Biota 2006) and in the cave systems of Yanchep (EPA 2005), Margaret River (Eberhard 2006) and across the Nullarbor (Moore 1995).

The survey methods adopted by *ecologia* have been developed in consultation with the Department of Environment and Conservation (DEC) and incorporate the proposed methodology by the Environmental Protection Authority's Guidance Statement No. 54a: *Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia* (EPA 2004). The limited available knowledge with respect to troglobite biology (i.e. species and community distributions, maturity, longevity etc) is such that the temporal and spatial replication attained is developed largely at the discretion of the environmental consultant conducting the survey.

Troglofauna sampling consisted of a two phase survey between June and Mid September:

Table 2.3: Troglofauna Survey Schedule

Phase	Deployed	Recovered	Trapping Duration
Phase One (61 bores)	26th -29th May 2008	14th – 18th July 2008	~ 49 days
Phase Two (61 bores)	14th – 18th July 2008	15th – 18th September 2008	~ 59 days
Rockhole (30 bores)	13th-16th August 2008	14th-16th October 2008	~ 60 days

Significant findings from the trapping period were the discovery of a number of different troglobitic organisms. These are listed in the Table 2.4.

Table 2.4: Troglobites Found at Marillana

Troglobite	Individuals	Drill Holes
Order Schizomida (schizomids)	2	MRC219, MRC212
Order Pseudoscorpiones (pseudoscorpions)	1	MRC175
Order Hemiptera (bugs)	1	MRC112
Order Isopoda (slaters)	1	MRC367
Order Polyxenida (pincushion millipedes)	2	MRC247, MRC084
Order Coleoptera (beetles)	Several	MRC247, MRC213
Order Collembola (springtails)	Several	MRC170
Class Acari (mites)	1	MRC277

The locations of the Troglofauna can be found in Figure 2.5.

2.2.5.1 Order Schizomida (schizomids)

Schizomids are small arachnids that superficially resemble spiders (Harvey 1992). They are found in moist environments in tropical and subtropical regions of the world. Their reliance on high humidity environments and their absence in the terrestrial short range endemic survey indicate that this is not an accidental species from the surface.

2.2.5.2 Order Pseudoscorpiones (pseudoscorpions)

Pseudoscorpions are predatory arachnids that capture and subdue their invertebrate prey using pincer-like anterior appendages (Brusca and Brusca 2003). Numerous troglobitic psedoscorpion species are known (Harvey 1991).

2.2.5.3 Order Hemiptera (Bugs)

A specimen representing an undescribed species in the subfamily Emesinae (Family Reduvidae). Emesines are long and slender bugs with extremely long and thin legs and possess mantis-like raptorial front legs (Gross and Malipatil 2000). They occur worldwide and all known species are predatory, using their raptorial front legs to capture and secure prey items (Gross and Malipatil 2000). Emesines are known from cave habitats; however, taxonomic knowledge of the Western Australian species is fairly poor. Approximately 44 named species are known from Australia (Gross and Malipatil 2000)

2.2.5.4 Order Isopoda (Slaters)

An unidentified oniscoid slater was detected. Terrestrial isopods are a diverse order of the subphylum Crustacea with more than 4000 species known (Brusca and Brusca 2003). Isopods are known from nearly all environment types, including subterranean habitats

(Brusca and Brusca 2003). The suborder Oniscoidea contains all terrestrial species, members of which are generally omnivorous or herbivorous (Brusca and Brusca 2003).

2.2.5.5 Order Polyxenida (pincushion millipedes)

Polyxenids are very small, caterpillar-like millipedes, usually less than 5mm in length. They possess numerous setae over the dorsal surfaces; giving them a bristly or pincushion-like appearance. Polyxenids are herbivorous or omnivorous and may occur in very large numbers (aggregations) at certain times of the year (Volschenk pers. obs.).

2.2.5.6 Order Coleoptera (beetles)

Several specimens of an unknown beetle species were detected. The specimens possess very reduced eye spots and lack pigmentation, leading to the conclusion that they are likely to be troglobitic. The specific identity of this species is currently being determined.

2.2.5.7 Order Collembola (springtails)

Several specimens of springtail were detected during this survey and their identifications are still being determined. Two morphospecies appear to be present: one completely blind and white species and one possessing eyes and pigmentation, which is probably a troglobite. The specific identity of this species is currently unknown and its status as a troglobite is also unknown.

2.2.5.8 Class Acari (mites)

One specimen of an unknown mite species was recovered. The specific identity of this species and its status as a troglobite is currently unknown. Mites are extremely diverse and difficult to identify to species (reference). The specimen possesses eye spots and no obvious troglomorphic features. While identity of this species is being sort, it seems unlikely to be a troglobite owing to its lack of troglomorphy.

Additional fieldwork is being carried out to determine the existence of these troglobites outside of the proposed mine footprint.

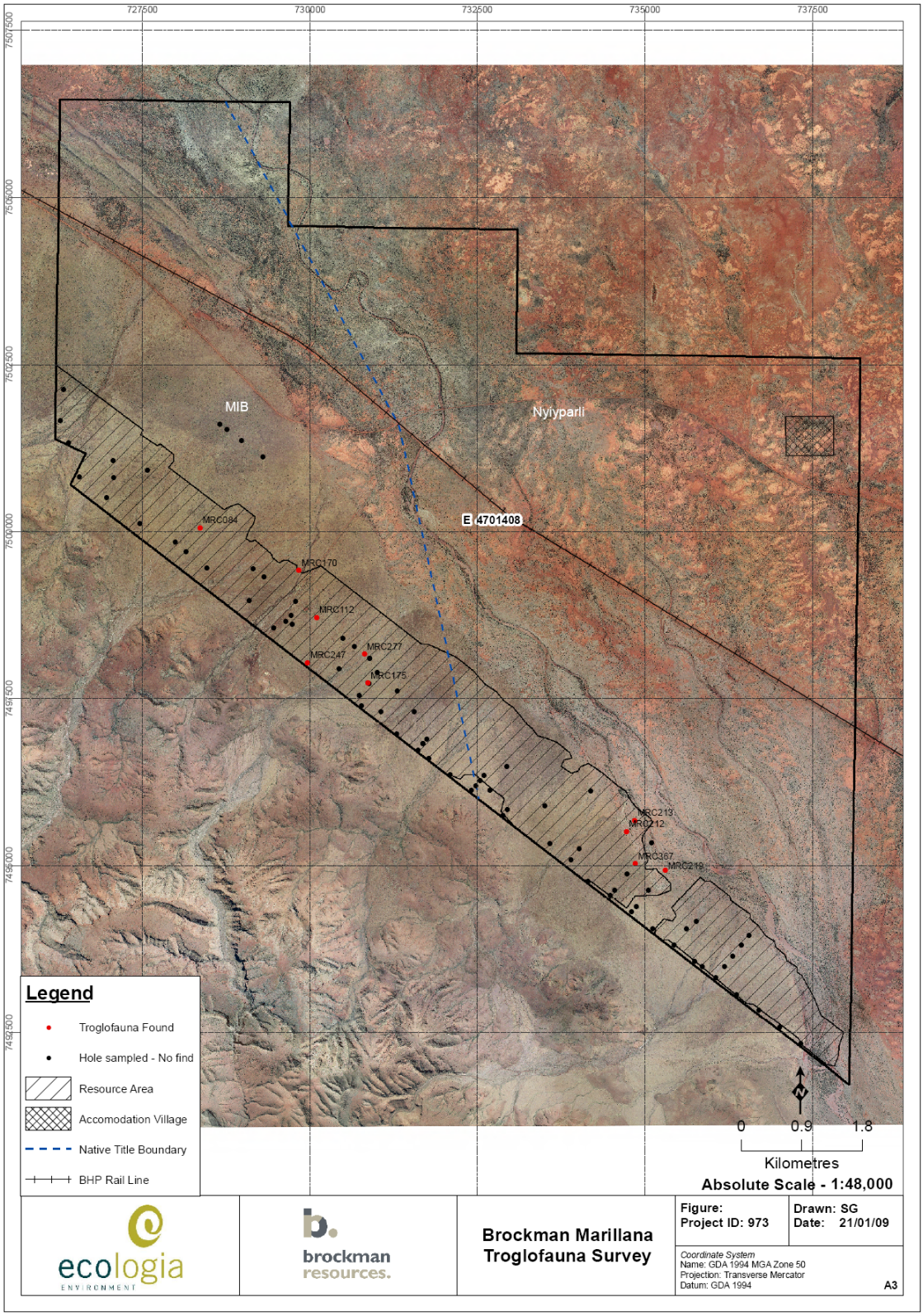

Figure 2.5: Troglofauna locations

2.3 RIVERS, CREEKS, WETALNDS AND ESTUARIES

The Project lies south of the Fortescue Marsh, and is intersected by distributaries of the Weeli Wolli Creek delta. The project infrastructure will be located wholly within Brockman's tenement and will be planned to minimise impacts to Weeli Wolli creek. Surface water drainage lines will be affected by the development of infrastructure and waste dumps. Some vegetation units occur on these drainage lines however are likely to be influenced by changes in surface water flow.

2.4 SIGNIFICANT AREAS

The Project area is not located in or adjacent to any existing or proposed national park area.

At the nearest point, the northern most part of the tenement lies approximately 8 km from the Fortescue Marshes Environmentally Sensitive Area. Mining activities will be more than 12 km away from the marsh, which will not be impacted in any way by the Project development.

2.5 COASTAL ZONES

The location of the Project results in no impact on coastal zones.

2.6 MARINE AREAS

The location of the Project results in no impact on marine areas.

2.7 WATER SUPPLY AND DRAINAGE

Water supply is for the project is discussed in sections 1.5.7, 1.5.9 and 1.5.10.

The mine tenement is located at the base of the Hamersley Range in an area subject to flooding during heavy rainfall. Weeli Wolli Creek, which is the main stream in the area, flows diagonally across the mine tenement from the south-east to the north-west.

Weeli Wolli creek has a large catchment area and produces large flood flows. Although the channel of the Weeli Wolli creek is wide and deep, it is not sufficient to hold the large flood flows and floodwaters break out of the channel and flow towards the BHPB Iron Ore railway embankment, which acts as a low dam with a number of openings in the form of bridges. Some flow passes under the bridges, whilst a significant amount bypasses each structure, as it flows in a north-westerly direction alongside the railway.

Flood protection measures will be incorporated in the development to prevent inundation of any flood water from Weeli Wolli Creek, including levee banks and/or elevated earth pads. Flood protection developments will be located away from the banks of Weeli Wolli Creek.

Developments impacting on the beds and banks of Weeli Wolli Creek may include one or a combination of new or upgraded floodways, a bridge or a series of culverts to improve the safety of vehicle crossings.

In addition there are numerous smaller streams that flow down the Hamersley escarpment and form deltas when they reach the flatter country at the base of the escarpment. These then flow as of sheet/overland flow until they reach Weeli Wolli Creek. These streams will be diverted using a combination of levees and/or drains to prevent inundation of operating mine pits.

Drainage from the site will be directed to Weeli Wolli Creek or feeder streams.

2.8 POLLUTION

Domestic and industrial waste products will be produced as a result of development and operation of the Project. This includes:

- domestic waste;
- recyclable products;
- waste oils, greases and lubricants;
- organic debris including vegetation;
- general refuse including waste metal, cardboard and packaging;
- sewage; and
- inert waste including excess fill.

These wastes have the potential to impact the environment if they are not managed appropriately.

Waste rock and tailings have potential environmental impacts, which includes:

visual impact;

- erosion/instability/sedimentation;
- Acid sulphate generation and discharge;
- loss of original land use; and
- invasion by feral fauna and weeds.

Waste rock and tailings produced at Marillana are anticipated to total 50 Mtpa. The mineralisation and overburden material at Marillana are very low in sulphur content <0.03%, and are therefore considered to be unlikely to result in acid sulphate generation and discharge.

The final design of the waste rock landforms of the Marillana Iron Ore Project will be based on waste rock landforms previously constructed at other mine sites in Western Australia.

Waste rock landforms will be constructed to retain water, minimise runoff, and enhance the establishment of self-sustaining native vegetation.

Waste rock and/or tailings will be used as mine backfill once mined out voids become available, after approximately 3 years of operation.

2.9 GREENHOUSE GAS EMISSIONS

Development and operation of the Marillana Iron Ore Project will directly release carbon dioxide into the atmosphere. As the Project will not be connected to the electricity grid, emissions will result from the burning of diesel fuel for power generation, and combustion engines in diesel vehicles.

The Project is likely to generate significant carbon-based emissions and reporting may be required under the *National Greenhouse and Energy Reporting Act 2007*.

Emissions will be generated by:

- diesel generators;

- machinery and light vehicle exhaust;
- locomotives; and
- the clearing of native vegetation.

Estimated greenhouse gas emissions include both direct and indirect emissions, consistent with Australian and international protocols for reporting greenhouse gases.

Total annual consumption of diesel is estimated to be 22 million litres for power generation and a further 24 million litres for mine machinery.

Using the *National Greenhouse Accounts (NGA) Factors* (November 2008) literature as a guide an estimate for the Marillana project greenhouse gas emissions has been prepared.

Assuming a total Project diesel usage of 46 (22 + 24) million litres per annum, the diesel energy content factor of 38.6 GJ/kL and a CO^2 emission factor of 69.2 kg CO2-e/GJ. It is estimated that the Project will emit 122,871.5 tonnes CO^2 per annum during operation.

2.10 CONTAMINATION

The property has been used historically for pastoral land, railroad transport and public road and has no known soil or groundwater contamination. The site has not been registered as a Contaminated Site under the Act 2003.

There is a potential risk of contaminating surface water, ground water and soils from hydrocarbon, dangerous goods and hazardous substances handling, storage and transport at the mine site. Appropriate management strategies will be implemented and detailed in a comprehensive site Environmental Management Plan to minimise the risk of contamination from any hazardous substances.

2.11 SOCIAL SURROUNDINGS

As there are no known registered heritage sites on the tenement the impacts of the Marillana Iron Ore Project will be negligible. Consultation between Brockman and the Nyiyaparli and Martu Idja Banjima (MIB) people will ensure that any impacts are managed in a way that recognises their customs and traditions.

The impacts of mining activities to surrounding communities and landholders will be minimal. This is due to the remote location of the Project area, some 60 km from any area of habitation and the nature of the surrounding land use, which is primarily mining and pastoral. There are no non-indigenous heritage sites listed in the Australian Heritage Database that intersect the project area. Geo-heritage values will be preserved by appropriate planning and design of waste dumps. Photographic control points will be fixed by GPS and utilised to assess the pre and post mining landscape form.

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 nearby town of Newman has developed as a result of mineral exploitation, and requires ongoing resource projects to provide revenue to the community. The development of the Marillana mine will provide financial and social benefits for the area through employment and flow-on effect to the non-mining sector.

The Marillana Iron Ore Project will have a significant beneficial impact on the Pilbara region, bringing revenue and jobs to the area.

3.0 MANAGEMENT

3.1 PRINCIPLE OF ENVIRONMENTAL PROTECTION

This Project has considered the Principles of Environmental Protection set out in Position Statement 7 and is consistent with the EPA's other Position Statements, particularly with respect to Position Statements 2, 3, 5, 6 and 8.

3.2 MANAGEMENT COMMITMENTS

Brockman has undertaken a number of baseline environmental studies of the proposed Marillana site. Surveys undertaken include vegetation and flora surveys and mapping and vertebrate fauna, SRE, troglofauna and stygofauna assessments.

Brockman intends to develop Environmental Management Plans for significant elements of the project which will impact on the environment. Some of these management plans include:

- Water Management Plan
- Vegetation and Flora Management Plan
- Fauna Management Plan
- Dust Management Plan
- Weed Management Plan
- Fire Management Plan
- Hydrocarbon and Chemical Management Plan
- Aboriginal Heritage Management Plan
- Rehabilitation Management Plan
- Topsoil Management Plan

A scoping document will identify the key environmental impacts and set out the strategies that Brockman will employ to minimise, manage or offset these.

3.3 SUMMARY OF STAKEHOLDER CONSULTATION

Brockman has been in consultation with regulatory and non-regulatory stakeholders regarding this project. The issues raised during consultations (Table 3.1) have been taken into account in the project design and in the development of this document.

Brockman takes a proactive approach to liaising with the stakeholders and interested parties. Understanding of local attitudes and community issues has been guided by an ongoing program of research, communication and consultation with key stakeholders and the broader community.

Table 3.1: Stakeholder Consultation

Stakeholder	Issues raised	Response
Department of Water (DoW)	Water consumption	Keeping DoW informed as the Project develops
Department of Environment and Conservation (DEC)	Troglofauna sampling	Agreement on sampling regime
Shire of East Pilbara (SEP)	Road Freight	Keeping SEP informed as the Project develops
Martu Idja Banjima (MIB)	Native Title	Agreement reached
Nyiyaparli	Native Title	Agreement pending

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4.0 REFERENCES

Aquaterra. 2008. *Marillana Iron Ore Project, Hydrological Investigations*. Unpublished for the Marillana Iron Ore Project Feasibility Study.

Beard, J S (1975). *Pilbara - Explanatory notes to Sheet 4, 1:1,000,000 series - Vegetation survey of Western Australia*. University of Western Australia Press, Perth.

Biota. 2005. *Barrow Island Gordon Gas Development*. Unpublished report for The Gordon Venture.

Biota. 2006. Mesa *A and Robe Valley Mesas Troglobitic Fauna Survey*. Unpublished report for Robe River Iron Associates.

Brusca, R. C. and G. J. Brusca (2003). *Invertebrates, 2nd edition*. Sunderland, Mass., USA., Sinauer Associates.

Department of Climate Change (November 2008) *National Greenhouse Accounts (NGA) Factors.* Accessed from: http://www.climatechange.gov.au/workbook/pubs/workbook-nov2008.pdf

Department of Industry and Resources (1995). *History of Iron Ore in Western Australia, Iron Ore Factsheet 11*. Accessed from: http://www.doir.wa.gov.au/documents/GSWA_IronOrePamphlet.pdf

Dames & Moore (1993): Flora *& Fauna Assessment, Oakajee Proposed Industrial Site.* Unpublished report for LandCorp Western Australia.

Desmond, A., and Chant, A. (2002). *Geraldton Sandplains 2 (GS2 – Geraldton Hills subregion). A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Kensington WA.

Eberhard, S. M. 2006. Jewel *Cave Precinct Management Plan in R*. p. f. t. A.-M. R. T. Association, ed.

ecologia (1997). *Vegetation and Flora Survey*. Unpublished report for Murchison Metals Limited.

EPA. 2003. *Guidance for the Assessment of Environmental Factors, Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia*. EPA.

EPA. 2005. *Managed Aquifer Recharge using Treated Wastewater on the Swan Coastal Plain, Perth*, Western Australia.

EPA. 2004. *Guidance for the Assessment of Environmental Factors No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*. Environmental Protection Authority, 28 June 2004

Gross, G. F. and M. B. Malipatil (2000). *Superfamily Reduvoidea. The Insects of Australia*. CSIRO. Carlton, Melbourne University Press. 1: 494-496.

Harvey, M. S. 1988. *A new troglobitic schizomid from Cape Range, Western Australia (Chelicerata:Schizomida)*. Records of the Western Australian Museum. 14:15-20.

Harvey, M. S. (1991). *Catalogue of the Pseudoscorpionida*. Manchester, Manchester University Press.

Harvey, M. S. (1991). *"New cave dwelling schizomids (Schizomida: Hubbardiidae) from Australia."* Records of the Western Australian Museum Supplement 64: 171-185.

Harvey, M. S. 1992. *The Schizomida (Chelicerata) of Australia*. Invertebrate Taxonomy. 6:77 - 129

Howarth, F. G. 1983. *Ecology of cave arthropods*. Annual Review of Entomology. 28:365-389.

Humphreys, W. F., and W. A. Shear. 1993. *Troglobitic millipedes (Diplopoda : Paradoxosomatidae) from semi-arid Cape Range, Western Australia: Systematics and biology*. Invertebrate Taxonomy. 7:173-195.

Humphreys, W. F. 1993. *The significance of the subterranean fauna in biogeographical reconstruction: examples from Cape Range peninsula, Western Australia. In Humphreys W.F. (Ed) The Biogeography of Cape Range, Western Australia*. Records of the Western Australian Museum. 45:165-192.

Humphreys, W. F. (2001). *"Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity."* Records of the Western Australian Museum, Supplement No. 64: Subterranean Biology in Australia 2000: 63-83.

Johnstone, R. E. and Storr, G. M. (1998). *Handbook of Western Australian Birds, Volume I - Non-Passerines (Emu to Dollarbird)*. Western Australian Museum, Perth.

Kendrick, P. (2001a). *Pilbara 1 (PIL2 – Fortescue Plains subregion). In: A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*.

Kendrick, P. (2001b). *Pilbara 3 (PIL3 – Hamersley subregion) IN: A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*.

Moore, B. P. 1995. *Two remarkable new genera and species of troglobitic Carabidae (Coleoptera) from Nullarbor caves*. Journal of Australian Entomological Society. 34:159-161.

Muir Environmental (1997). *August 1997 re-evaluation of flora and fauna: Oakajee proposed industrial estate and quarries*. Unpublished report for the Department of Resources Development Western Australia.

Strayer, D. L. 1994. *Bodysize and abundance of benthic animals in Mirror Lake, New Hamphshire*. Freshwater Biology. 32:83-90