NOVEMBER 2015

Providing sustainable environmental strategies,
management and monitoring solutions
to industry and government.

ecologia
ENVIRONMENT

SHEFFIELD RESOURCES LIMITED
THUNDERBIRD MINERAL SANDS PROJECT
EPA REFERRAL – SUPPORTING DOCUMENT

Document status						
Rev	**Author**	**Reviewer/s**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
A	B. How	S. Grein	20/11/2015	Wayne Groeneveld	Sheffield Resources Limited	20/11/15
B						

Restrictions on Use

This report has been prepared specifically for the Sheffield Resources. Neither the report nor its contents may be referred to or quoted in any statement, study, report, application, prospectus, loan, or other agreement document, without the express approval of the Sheffield Resources and *ecologia* Environment.

ecologia Environment
1/224 Lord Street
PERTH WA 6000
Phone: +61 8 6168 7208
Email: admin@ecologia.com.au

TABLE OF CONTENTS

TABLES

FIGURES

PLATES

ACRONYMS AND GLOSSARY

API	Assessment on Proponent Information
BOM	Bureau of Meteorology
CUP	Concentrate Upgrade Plant
DAA	Department of Aboriginal Affairs
DER	Department of Environment and Regulation (formerly DEC)
DoE	Department of the Environment (formerly DSEWPaC)
DMP	Department of Mines and Petroleum
DPaW	Department of Parks and Wildlife (formerly DEC)
DSEWPaC	Department of the Sustainability, Environment, Water, Population and Communities (now DoE)
DRF	Declared Rare Flora
ESA	Environmentally Sensitive Area
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GL	Gigalitres
Ha	Hectares
HAL	Hot Acid Leach
IBRA	Interim Biogeographic Regionalisation for Australia
IDP	Ilmentite Dry Plant
IMS	ilmentite magnetic separation
Km	Kilometre
LOM	Life of Mine
mAHD	metres above Australia Height Datum
mBGL	metres below ground level
Mtpa	Million tonnes per annum
MUP	Mining Unit Plant
MW	mega watt
RIWI Act	*Rights in Water and Irrigation Act 1914*
P1-P4	Priority flora species, rating 1-4
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
WAHERB	Western Australian Herbarium
WC Act	*Wildlife Conservation Act 1950*
WCP	Wet Concentrator Plant

EXECUTIVE SUMMARY

Sheffield Resources Limited (the Proponent) is planning to develop the Thunderbird Mineral Sands Project (the Proposal) located on the Dampier Peninsula, approximately 75 kilometres (km) west-southwest of Derby, Western Australia. The Proposal is for a mineral sands operation with an estimated 40 year life of mine (LOM). Mineral product will be mined from the Thunderbird Deposit and processed onsite before being transported by road to the Derby Wharf for storage and subsequent export.

This document describes the Thunderbird Proposal and provides an assessment of the Proposal against key preliminary environmental factors, identified through previous discussions with the Office of the Environmental Protection Authority. These factors are:

- Flora and Vegetation
- Terrestrial Fauna
- Hydrological Processes
- Rehabilitation
- Heritage.

Preliminary advice received from the OEPA on 22 July 2015 indicated that the Proposal was likely to require assessment under Part IV of the EP Act. The Proponent considers an Assessment on Proponent Information – Category A (API-A) is an appropriate level of assessment for the Proposal.

The significance of the implementation of the Proposal on the above environmental factors was assessed in line with the EPA's Environmental Assessment Guideline 9 Application of a significance framework in the environmental impact assessment process (EPA, 2013b).

The Proponent considers that the information and assessment presented in this referral adequately identifies and addresses the environmental aspects and issues relevant to the Proposal and is adequate to enable the EPA to set a level of assessment under Part IV of the EP Act.

1 INTRODUCTION

Sheffield Resources Limited (the Proponent) is planning to develop the Thunderbird Mineral Sands Project (the Proposal) located on the Dampier Peninsula, approximately 75 kilometres (km) west-southwest of Derby, Western Australia. The Proposal is for a mineral sands operation with an estimated 40 year life of mine (LOM). Mineral product will be mined from the Thunderbird Deposit and processed onsite before being transported by road to the Derby Wharf for storage and subsequent export.

This document has been prepared to provide detailed supporting information for the referral to the Environmental Protection Authority (EPA) under Section 38(1) of the *Environmental Protection Act 1986* (EP Act). The document provides a concise summary of the Proposal, results of baseline surveys and potential impacts to and management of, environmental factors.

The Proponent believes the Proposal requires formal environmental impact assessment by the EPA. Based on the anticipated low to moderate risk to surrounding environmental and heritage values, the Proponent considers an Assessment on Proponent Information – Category A (API-A) is an appropriate level of assessment for the Proposal.

1.1 PROPONENT

Sheffield Resources Limited is the Proponent for the Proposal and is an Australian listed Company (ACN 125 811 083).

Relevant Proposal contacts are provided below in Table 1.

Table 1: Proponent and Project Contact Details

Name	Company	Role	Details
Bruce McFadzean	Sheffield Resources Limited	Managing Director	P: +61 6424 8440 E: BMcFadzean@sheffieldresources.com.au A: Level 2, 41-47 Colin Street West Perth, WA 6005
Wayne Groeneveld	Sheffield Resources Limited	Sustainability Manager	P: +61 6424 8440 E: WGroeneveld@sheffieldresources.com.au A: Level 2, 41-47 Colin Street West Perth, WA 6005
Shaun Grein	*ecologia* Environment	Consultant	P: +61 6168 7208 E: Shaun.Grein@ecologia.com.au A: 1/224 Lord Street Perth, WA 6000


400000
450000
500000
550000
8200000
8150000
8100000
8050000
8000000
7950000
Karratha
Tom Price
Newman
Geraldton
Kalgoorlie
Perth
Bunbury
Albany
TALBOT BAY
STRICKLAND BAY
CAPE LEVEQUE
SUNDAY STRAIT
BARDI (ONE ARM POINT)
CONE BAY
LOMBADINA
LOMBADINA POINT
CASCADE BAY
KIMBOLTON RANGE
COMPASS HILL
PENDER BAY
BEAGLE BAY
LACEPEDE CHANNEL
KING SOUND
STOKES BAY
CAPE BASKERVILLE
CAPE BERTHOLET
COUNTRY DOWNS
COULOMB POINT
Port Facilities
DERBY
MOWANJUM
Proposal Area
MOUNT JOWLAENGA
YEEDA
KILTO
PANDANUS PARK
KENNEDYS COTTAGE
WATERBANK
Great Northern Highway
MANGUEL CREEK
ROEBUCK PLAINS
BROOME
UDIALLA
MOUNT ANDERSON
ROEBUCK BAY
THANGOO
DAMPIER DOWNS
BABRONGAN TOWER
Legend
Proposed Haulage Route
Existing Roads
Pastoral Lease Road
Thunderbird Proposal Area
Towns
ecologia
ENVIRONMENT
0 10 20
Kilometres
Absolute Scale - 1:1,037,196
Thunderbird Proposal
Locality Map
Figure: 1.1
Project ID: 1645
Drawn: BH
Date: 18.11.2015
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
A4

1.2 KEY PROPOSAL CHARACTERISTICS

The Proposal is located in the Kimberley region of Western Australia, specifically on the Dampier Peninsula approximately75 km west-southwest of Derby and 95 km north-east of Broome (Figure 1.1) and is part of the Proponents Dampier Project. The Proponent holds six mineral tenements granted under the *Mining Act 1978* (Mining Act) in which define the boundaries of Proposal Area, including one mining lease (pending) and seven miscellaneous licences (two pending) (Figure 1.2). Port facilities are also proposed within the Derby Wharf, under an access agreement granted by the Shire of Derby-West Kimberley.

The Proposal proposes to mine mineral sands from the Thunderbird Deposit over a 40 year LOM targeting zircon, ilmenite and HiTi88 leucoxene. The Deposit has a total Mineral Resource of 3.2 Billion tonnes (Bt) @ 6.9% HM (Measured, Indicated and Inferred), comprising 18.5 Mt, 61.8 Mt and 5.9 Mt of each mineral, respectively. Initially, the planned mining rate will be 12 Mtpa, increasing to 18 Mtpa by year eight.

The proposed mining technique involves the strip mining and backfill method. Ore will be initially screened and processed at the active mine face. Process water will be required to create a slurry which will be supplied from local groundwater resources adjacent to the mine pit and stored in a nearby dam. Mine waste will initially be stored within a designated tailings storage facility (TSF), until a sufficient mine void is created which will be then used for waste storage for the remainder of Proposal. Both the TSF and process plant will be located within an embayment in the orebody.

For the initial 12 years, all mining will be conducted above the groundwater table (at approximately 35 m below ground level (BGL)) and then dewatering activities will be required to access the remaining orebody.

Other infrastructure required to support the Proposal include a borefield, power station, communications facilities, waste and recycling facilities, administration offices, storage yards, workshops, a medical facility and accommodation camps (construction and mine camp). Figure 1.2 shows the proposed project layout plan.

Processed ore will be transported via road train to the Derby Wharf for storage, transhipment and export overseas. The haulage route extends south-east from the mine pit for approximately 28 km along one of two proposed routes that link with the Great Northern Highway. Existing roads within the Proposal Area will be utilised where possible and upgrades conducted where required. The Great Northern Highway will then be used for the remainder of the route, approximately 112 km, into Derby. The proposed haulage route is shown on Figure 1.1.

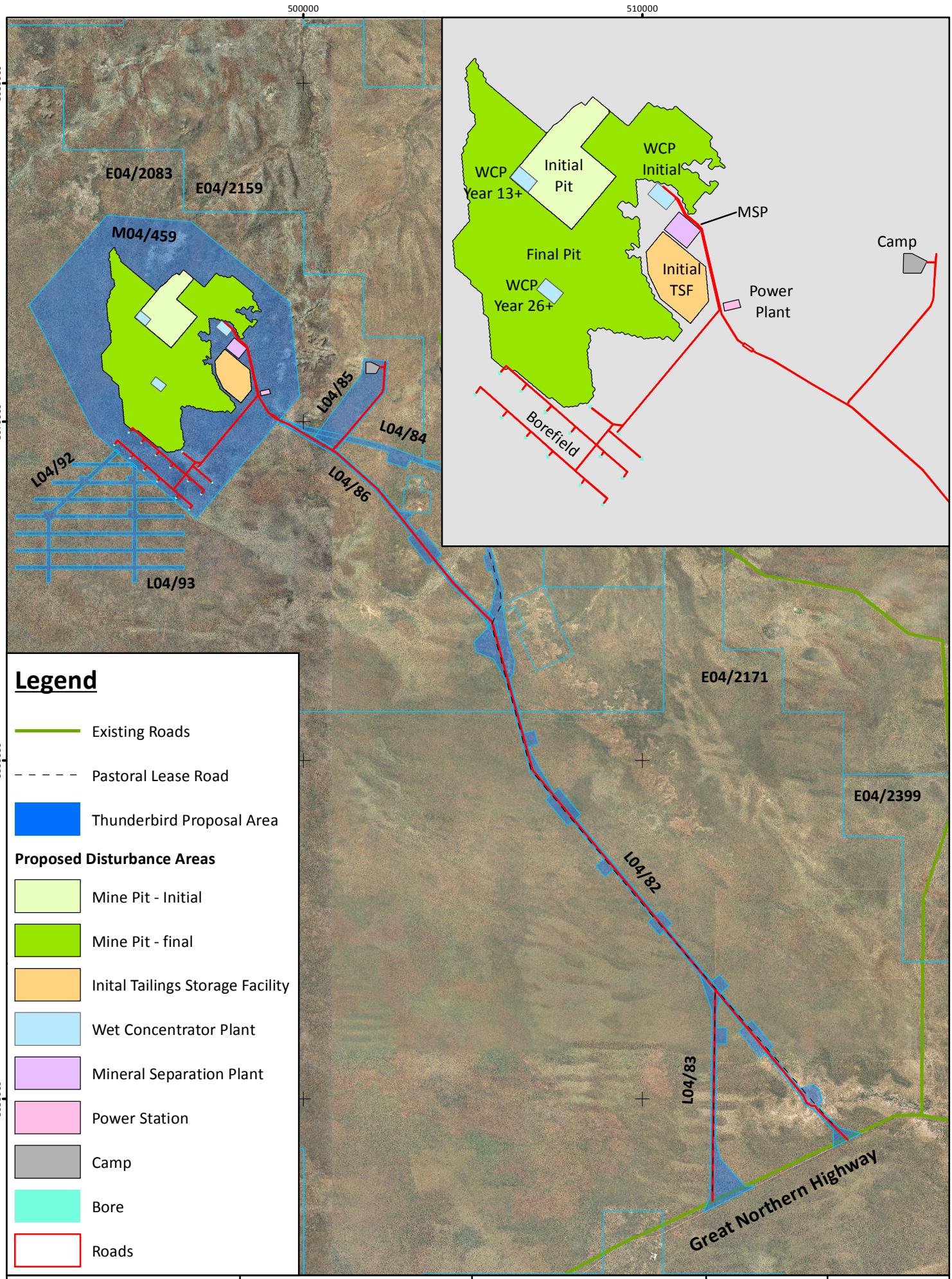
Port facilities are proposed at the Derby Wharf under an access agreement with the Shire of Derby/West Kimberley for the use of a bulk handling facility at the wharf as an export hub. This will include a storage warehouse facility and administration office, adjacent to the wharf. Mineral product ready for export will then be conveyed onto barges using an existing conveyor system and ship loader and towed approximately 20 nautical miles to Point Torment for transfer to an anchored vessel. These activities will be managed separately by the Shire of Derby/West Kimberley.

The Key Proposal Characteristics defined for the Proposal are outlined in the Table 2 below.

Table 2: Key Proposal Characteristics

Summary of Proposal	
Proposal Title	Thunderbird Mineral Sands Project
Proponent Name	Sheffield Resources Limited
Short Description	Mining of mineral sands from the Thunderbird Deposit, located on the Dampier Peninsula approximately 75 km west-southwest of Derby. The proposal includes the construction of associated mine infrastructure (borefield, storage dam, processing plants, power station, office and administration buildings, workshops, storage and waste facilities,

Summary of Proposal		
	accommodation camps, pipelines and roads) and discharge of waste to a tailings storage facility. Mineral sands product will be processed onsite and transported via road to the Derby Wharf for storage, transhipment and export overseas.	
Physical Elements		
Element	**Location**	**Proposed Extent Authorised**
Mine (open cut pit)	Figure 1.2	Clearing no more than 1,523 hectares within the 6,305 hectare Proposal Area (Development Envelope)
Tailings Storage Facility (initial)	Figure 1.2	Clearing no more than 106 hectares within the 6,305hectare Proposal Area (Development Envelope).
Associated Mine Infrastructure	Figure 1.2	Clearing no more than 65 hectares within the 6,305hectare Proposal Area (Development Envelope).
Accommodation Camp	Figure 1.2	Clearing no more than 12 hectares within the 6,305hectare Proposal Area (Development Envelope).
Borefield	Figure 1.2	Clearing no more than 15 hectares within the 6,305hectare Proposal Area (Development Envelope).
Operational Elements		
Element	**Location**	**Proposed Extent Authorised**
Mining Rate	n/a	Average annual production of up to 18 million tonnes per annum.
Ore Processing Waste	n/a	Average disposal of up to 11.5 million tonnes per annum to Tailings Storage Facilities (across both initial TSF and mine void) Average disposal of up to 17.5 million tonnes per annum to Tailings Storage Facilities (across both initial TSF and mine void)
Water Supply	n/a	Average annual use of up to 12 gigalitres per annum.
Mine Pit Dewatering	n/a	Average extraction of up to 13 gigalitres per annum from the Borefield Area.



Legend

- Existing Roads
- Pastoral Lease Road
- Thunderbird Proposal Area

Proposed Disturbance Areas

- Mine Pit - Initial
- Mine Pit - final
- Inital Tailings Storage Facility
- Wet Concentrator Plant
- Mineral Separation Plant
- Power Station
- Camp
- Bore
- Roads

ecologia ENVIRONMENT

0 2 4
Kilometres
Absolute Scale - 1:143,378

Proposal Layout Plan

Figure: 1.2
Project ID: 1645
Drawn: BH
Date: 18.11.15

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A4

2 DEFINING THE PROPOSAL

2.1 PROPOSAL LOCATION

The Proposal is located in the Kimberley region of Western Australia, specifically on the Dampier Peninsula approximately 75 km west-southwest of Derby and 95 km north-east of Broome (Figure 1.1). This Proposal is a component of the Proponents larger Dampier Project.

2.2 PROPOSAL DESCRIPTION

2.2.1 Proposed Disturbance

The Proposal proposes to disturb up to 1,723 hectares (ha) of land within the Proposal Area development envelope (6,305 ha), as shown on Figure 1.2. Table 3 summarises the proposed disturbances for each Proposal area.

Table 3: Proposed Disturbance Areas

Proposal Area	Area (ha)
Mine Pit Area	1,503
Tailings Storage Area (initial)	106
Accommodation Camp	12
Borefield (including access roads)	15
Supporting Infrastructure (including power station, processing plants, internal access roads, administration buildings, storage yards)	87
Total Disturbance	**1,723**

It should be noted that the proposed haulage route transporting ore from the Proposal Area to the Derby Wharf includes areas located within the previously disturbed port precinct boundary. For the purpose of this Proposal, these areas are classified as existing infrastructure and therefore are not included in the proposed disturbance calculations.

2.2.2 Proposed Operations

2.2.2.1 Mineral Resource

The Thunderbird mineral resource is significant at a global scale due to both the size of the deposit and high zircon and titanium mineral grades. The Thunderbird mineral resource, as summarised below in Table 4, is based on the update to the Prefeasibility Study (PFS) 31 July 2015 in accordance with the JORC Code 2012 (Sheffield 2015).

Table 4: Thunderbird Deposit Mineral Resource Summary

Resource Category	Cut-off (HM%)	Mineral Resources		In-situ HM (Mt)	Mineral Assemblage (%)			
		Material (Mt)	HM (%)		Zircon	HiTi Leucoxene	Leucoxene	Ilmenite
Measured	3.0	230	9.4	21	7.9	2.2	2.1	27
Indicated	3.0	2,410	6.9	167	8.4	2.7	3.1	28
Inferred	3.0	600	5.6	33	8.4	2.8	3.5	28
Total	**3.0**	**3,240**	**6.9**	**222**	**8.3**	**2.7**	**3.1**	**28**
Measured	7.5	110	14.9	16	7.3	2.1	1.9	27

Resource Category	Cut-off (HM%)	Mineral Resources		In-situ HM (Mt)	Mineral Assemblage (%)			
		Material (Mt)	HM (%)		Zircon	HiTi Leucoxene	Leucoxene	Ilmenite
Indicated	7.5	850	11.8	100	7.6	2.4	2.2	28
Inferred	7.5	130	10.7	14	7.6	2.3	2.2	28
Total	**7.5**	**1,090**	**11.9**	**131**	**7.6**	**2.3**	**2.1**	**28**

2.2.2.2 Mining Methods

Based on the current mine plan, mining is scheduled to commence in the north-eastern part of the deposit (referred to as the initial pit on Figure 1.2), then progress down-dip to the south-west before turning south-east.

The Proponent proposes to use the strip mining and backfill method for the Proposal. Earthworks will excavate an initial pit to expose the ore. Four large dozers will then deliver the ore to relocatable Mining Unit Plants (MUPs). The initial feed rate to the MUPs for the first seven years of operation (with a mining rate of 12 Mtpa) will be 1,620 tonnes per hour (tph). Two 810 tph skid-mounted dozer trap MUPs will be used during this phase, with a third MUP available on standby to minimise downtime during mine face relocation and maintenance works, and maintain consistent throughput. From year eight onwards, the mine rate will increase to 18 Mtpa with a ROM feed rate of 2,430 tph. This phase will require additional mining equipment, including an extra MUP.

Open pit stability studies indicate the overall design slopes between 40^{o} and 60^{o} should be feasible.

Ore mining will be supported by a fleet of loaders and 100 tonne trucks. Waste mining, oversize removal and dam wall construction and rehandling will be carried out with a fleet of loaders, trucks, excavators and scrapers.

Plate 1 provides an overview of the schematic mine design for the Proposal.

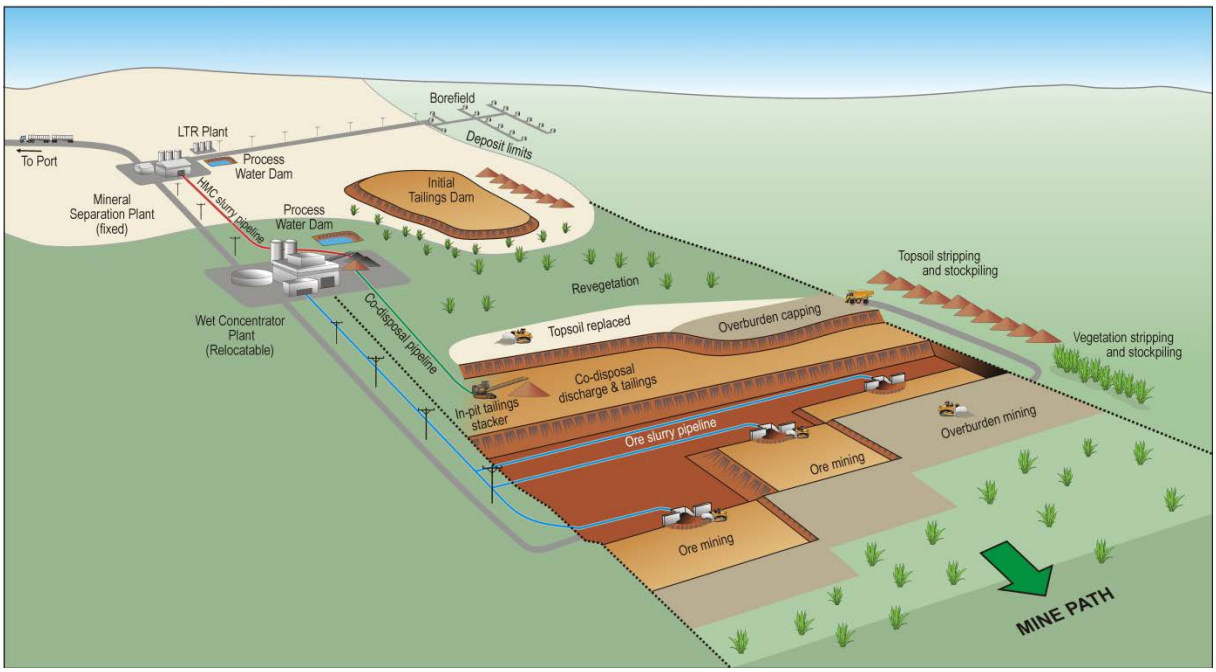


Plate 1: Schematic Mine Design

The groundwater table beneath the Proposal area lies at approximately 70 m above Australian Height Datum (mAHD), being approximately 35 m below ground level (mBGL).The first 12 years of mining will be conducted above the water table. Subsequent years will require dewatering of the mine pit in order to access ore below these depths.

2.2.2.3 Mineral Processing

Ore extracted from the mine pit will be initially sent to the MUPs. The MUPs will screen coarse oversized material and send the undersize fed to the scrubber trommel. The undersized material from the trommel will then be slurried and pumped to the Wet Concentrator Plant (WCP). Oversized material from the MUPs and the scrubber trommel will be sent to the slimes thickening unit for disposal to the TSF initially, and subsequently, once created, to the mine void.

The WCP is initially planned to be located to the south-east of the initial pit. To minimise pumping distances (to <2 km) between the MUPs (located near the mine face) and the WCP, the WCP is planned to the relocated at years 13 and 26 (locations shown on Figure 1.2). Locations are chosen within the LOM mine pit boundary to avoid unnecessary disturbance to surrounding environment.

Slurried ore from the MUPs will be combined at the WCP and screened at 2 millimetres (mm). All material less than 2 mm will be further slurried and deslimed on dual cyclone clusters. Cyclone underflow will report to two identical gravity circuits which will separate and from heavy minerals. Cyclone overflow will report to a deep cone thickener for recovery of process water. The heavy minerals concentrate (HMC) will be slurried and pumped to the Mineral Separation Plant (MSP). Thickened underflow and sand tails will be pumped to the slimes thickening unit for initial disposal to the TSF, and subsequently to the mine void once created.

The MSP is proposed to be located adjacent to the mine pit, south-east of the WCP. This location helps to minimise pumping distances between the WCP, TSF and the pit. The reduction in pumping distances also minimises disturbance to the surrounding environment.

At the MSP, the HMC will be received at the Concentrate Upgrade Plant (CUP) and screened at 850 microns. The undersize will then be separated using magnetic and gravity separation techniques to produce magnetic (ilmenite-bearing) and non-magnetic (HiTi88 and zircon-bearing) concentrate and tails.

Non-magnetic concentrate at the CUP will be upgraded using spiral concentrators then pumped to a Hot Acid Leach plant (HAL) for surface cleaning of mineral grains. Leached non-magnetics report to an attritioner to neutralise any acids, it then reports to a primary electrostatic circuit and magnetic separation stage where it is further separated to produce conductor (HiTi88-enriched) and non-conductor (zircon-enriched) concentrates. Non-conductor concentrate is further treated by magnetic, electrostatic and gravity circuits to produce a primary zircon product. Additional processing of magnetics stream from the primary zircon circuit will produce secondary and special zircon products.

Magnetic concentrate will be pumped to an attritioner to remove surface coatings and then pumped to an Ilmentite Dry Plant (IDP) for drying and further processing using screening and electrostatic separators to produce a primary ilmenite product. This product is then put through a low temperate roasting (LTR) plant to produce a high grade ilmentite product. The purpose of the LTR Plant is to condition ilmenite and iron-bearing minerals by partial reduction to increase the magnetic susceptibility of iron oxides, while keeping the ilmentite in a temperature range that avoids the solubility of TiO_2 being affected by rutilisation. After the material is cooled, partially reduced ilmenite is sent to an ilmentite magnetic separation plant (IMS), which removes the magnetized iron-bearing material from the ilmenite and upgrades the TiO_2 in the final product.

A preliminary radiological assessment (SGS, 2014) indicated that final processed products contain a total radioactivity of less than $10Bq.g^{-1}$ and therefore are not classified as radioactive substances from a transportation perspective.

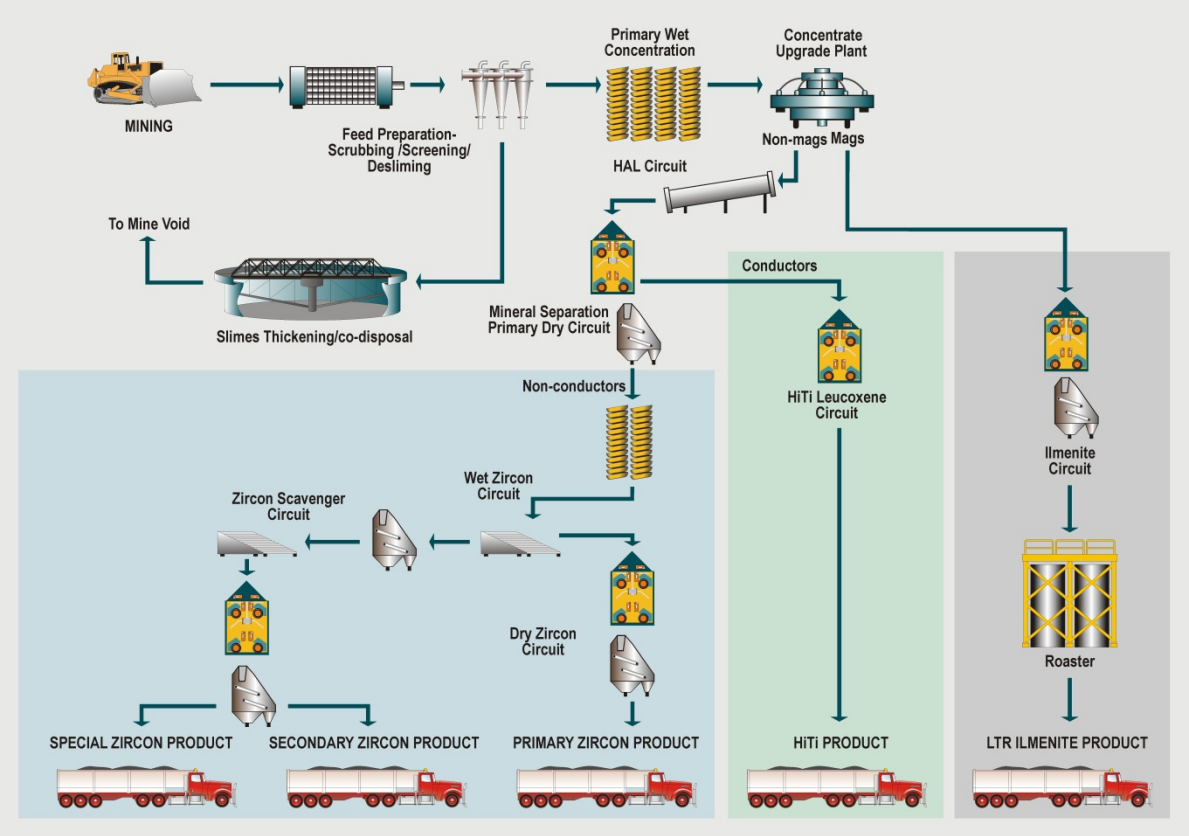


Plate 2: Schematic Process Flow Sheet for the Proposal

2.2.2.4 Mine and Tailings Waste

Initially, a TSF will be required to store all mine and tailings (processing) waste for a period of up to four years. Once a suitable mine void has been established, mine waste overburden and tails will then be used to build walls around the progressive mine voids where tailings will be returned for the remainder of the life of mine. The void will be progressively covered, contoured and rehabilitated in accordance with the Proposals Mine Closure Plan. The TSF will be decommissioned and appropriately rehabilitated once tailings waste has been re-directed to the mine void.

2.2.2.5 Product Transport

Mineral product will be transported via road trains from the Proposal Area along the Great Northern Highway to the Derby Wharf for overseas export. A fleet of four quad road trains is expected to be required to maintain the proposed mine rates of 12 Mtpa for the first seven years, ramping up to 18 Mtpa in year eight for the remainder of the Proposal.

2.2.2.6 Accommodation Facilities

An accommodation camp is proposed to be constructed approximately 5 km east of the Proposals active mining area. During the first seven years of operation, the camp will accommodate up to 140 personnel, expanding to 170 personnel coinciding with the mine rate production ramp up in Year 8.

2.2.2.7 Water Supply

Conservatively, it is estimated that the Proposal will require an initial water demand of up to 13 GL/year of water. Thereafter an estimated total of 6.7 GL/year of water is expected to be sourced from onsite borefields, 1.3 GL of moisture from the ROM and the remainder of water to be sourced from re-circulation from the ore processing system.

The majority of groundwater will be extracted from primary borefields established within the mine pit footprint. An additional makeup borefield will also be established within the designated borefield area, as shown on Figure 1.2. The peak yield of the primary bores is expected to achieve 10 L/s over nine bores, spaced approximately 500 m apart. The makeup borefield is expected to yield up to 25 L/s over 12 bores, spaced approximately 600 m apart.

To ensure that water resources are used efficiently and not wasted, the rate of dewatering abstraction at Thunderbird will only progress as fast as the operational water demand. Operational water consumption is expected to be greatest in the first year of operation in the commissioning stage prior to the realisation of water recovery from the tailings.

2.2.2.8 Supporting Infrastructure

Supporting infrastructure for the Proposal includes the following:

- Wet Concentrator Plant
- Mineral Separation Plant
- Power Station
- Internal access/haul roads.

The WCP and MSP, as discussed in Section 2.2.2.3, will be located adjacent to the mine pit, to the south-east. The WCP will require a mine administration office, contractor's office and workshop. The MSP will require an administration office, medical facility, dry storage area, laboratory and an electrical and mechanical workshop. Both areas will also require parking, recycling and communications facilities.

The power station will be located to the south of the processing plants, along the access road to the active mining area. It is proposed to be a 16 megawatt (MW) LNG/diesel power station. A power distribution network will also be required to deliver power to the processing plants and borefields. This is expected to run alongside access roads.

Internal access roads will be constructed to provide access to the active mining area, processing facilities, accommodation camp and all-weather access along Mt Jowlaenga Road to the Great Northern Highway. Approximately 41 ha of disturbance is allocated to internal haul roads for the Proposal, some of which has previously been cleared for pastoral access tracks. It should be noted that two options for the internal haul road have been included in this Proposal, leading to the intersection with the Great Northern Highway (refer to Figure 1.2). Whilst only one route is planned to be utilised, a second option has been included to allow for alternative access in the event of significant wet season flooding events. Both these route options comprise of existing tracks and fencelines which will be used but may require upgrades.

2.2.2.9 Mine Rehabilitation

A Mine Closure Plan will be developed for the Proposal in accordance with the *Joint Guidelines for Preparing Mine Closure Plan* (DMP and EPA, 2015). Further detailed mine planning is necessary in order to understand the complete decommissioning and rehabilitation requirements of the Proposal. This closure plan will be submitted to the DMP for assessment along with the submission of the Mining Proposal, both of which are required under the provisions of the *Mining Act 1978*.

2.2.2.10 Port Facilities

A storage warehouse facility and administration office will be constructed adjacent to the Derby Wharf. Product transported to the port facility will be off-loaded in the storage shed and stacked separately in preparation for shipment. When ready for export, product will be reclaimed from the stockpiles by front end loaders and transferred to the existing bulk handling facility located on the wharf. Products will then be transferred by conveyor system that forms part of the bulk handling

facility to barges. The barges will be towed approximately 20 nautical miles to Point Torment, with the product making the final transfer to an anchored vessel for export. The Proponent will utilise up to four barges towed by two tug boats in the transhipment process. Each barge will be loaded with 5,000 t of product.

2.3 LAND TENURE

The Proposal Area is located across eight mineral tenements granted and/or pending under the *Mining Act 1978* (Mining Act) through the Department of Mines and Petroleum (DMP). All tenements are held by the Proponent. Collectively these tenements cover an area of 6,305 ha and define the Proposal Area.

Tenement details are listed below in Table 5 and boundaries are shown on Figure 1.2.

Table 5: Mineral Tenements of the Proposal Area

Tenement ID	Holder	Date Granted	Area (ha)
M04/459	Sheffield Resources Limited	Application pending	4,525
L04/82	Sheffield Resources Limited	Application pending	633
L04/83	Sheffield Resources Limited	Application pending	219
L04/84	Sheffield Resources Limited	23-Apr-2015	120
L04/85	Sheffield Resources Limited	23-Apr-2015	237
L04/86	Sheffield Resources Limited	23-Apr-2015	191
L04/92	Sheffield Resources Limited	22-Jul-2015	196
L04/93	Sheffield Resources Limited	22-Jul-2015	184
Total Tenement Area			**6,305**

The port facilities will be located at and adjacent to the existing Derby Wharf. The Proponent has entered into an access agreement with The Shire of Derby/West Kimberley to construct and operate a bulk handling facility and product storage area at the Derby Wharf for the purposes of the Proposal.

3 STAKEHOLDER CONSULTATION

The Proponent has actively engaged with relevant stakeholders throughout the exploration and development phases of the Thunderbird Project. Sheffield engaged with the following stakeholders during 2014 and 2015:

- Government / Regulators:
    - OEPA
    - DMP
    - Department of Water (DOW)
    - Department of Parks and Wildlife (DPAW) *(scheduled)*
    - Department of Environment and Regulation (DER) *(scheduled)*
    - Department of Minerals and Petroleum (DMP)
    - Main Roads Department (DOT)
    - Department of Resource Development (DRD)
    - Department of State Development (DSD)
    - Shire of Broome
    - Shire of Derby/West Kimberley
    - Kimberley Port Authority (formerly Broome Port Authority)
- Indigenous Representative Groups (NNTT, KLC, KRED) and Traditional Owners
- Pastoral Lease holders (Mt Jowlaenga, Yeeda, Kilto & Country Downs)
- Kimberley Training Institute
- Morrgul
- ABC Kimberley
- Chamber of Mines and Energy (CME)
- Association of Mining and Exploration Companies (AMEC)
- Local service providers and contractors

Further to the consultation undertaken with the above stakeholders, Sheffield proposes to conduct community information sessions in Broome and Derby in December 2015 to present and discuss the Project with the general public.

A summary of relevant stakeholder consultation is provided below in Table 6.

Table 6: Summary of Stakeholder Consultation

Stakeholder	Date / Meeting Description	Topics / Issues	Proponent Response / Outcomes
OEPA	22 July 2015 (Pre-referral Meeting)	• Introduction to the Project • Identification of preliminary key environmental factors / impacts	• Project likely to be assessed under EP Act • API-Category A is likely • Preliminary key environmental factors
DMP	April 2014	• Project Overview (Broome Liaison Officer)	• Provided an understanding of Project and location
	May 2014	• Environmental aspects and impacts •	• Provided Project overview, identified key environmental aspects and impacts •
	May 2014	• Lead Agency Framework •	• Project awarded Level 2 Lead Agency Framework Status •
	June 2014	• Tenure and Native Title	• Applied for additional tenure and commenced Native Title negotiations
	July 2014	• Geological Presentation	• Provided overview of geological setting
	October 2014	• Lead Agency Framework	• Project update
	March 2015	• Project update (Broome Liaison Officer)	• Provided an update of Project activities undertaken and future work plans
	August 2015	• DMP Executive site visit	• Provided an understanding of Project and location and size
DOW	March 2015	• Introduction to the Project	• Submission of 5C Licence

Stakeholder	Date / Meeting Description	Topics / Issues	Proponent Response / Outcomes
		• Proposed Project water requirements	Application for the Project
DPAW	Schedule for December 2015	• Project overview, environmental surveys completed	• Provided overview of work completed to date
DSD	May 2014	• Introduction to the Project	• Provided an understanding of Project and location • Identified level of State significance
Shire of Broome	April 2014 March 2015 June 2015	• Introduction to the Project • Business forum • Business forum	• Provided an understanding of Project and location • Introduction to Broome stakeholders • Maintaining communications with Broome stakeholders
Shire of Derby/West Kimberley	November 2014 February 2015 October 2015	• Access to Derby Wharf for mineral export • Port use • Confirmation of usage	• Participated in Shire Expression of Interest • Successful Expression of Interest Application for usage of wharf bulk handling facilities • Exclusive access agreement granted to Sheffield
Kimberley Port Authority	May 2014 May 2014 November 2014 March 2015	• Introduction to the Project • Port consultative working group • Port consultative working group • Port consultative working group	• Provided an understanding of Project and location • Identified Port's capacity and capability • Port user communications • Port user communications • Port user communications
Indigenous Representative Groups and Traditional Owners	April 2014	• Aboriginal heritage impact assessment and site protection (KLC & KRED)	• Heritage protection agreements
	April 2014	• Proposed 2014 exploration (KRED & Traditional Owners)	• Heritage survey
	April 2014	• Native Title claimant application status (NNTT)	• Obtain status of Native Title claimant representatives and contacts
	March 2015	• Proposed 2015 exploration (KRED & Traditional Owners)	• Heritage surveys

Stakeholder	Date / Meeting Description	Topics / Issues	Proponent Response / Outcomes
	March 2015	• Native Title negotiations (KRED & Traditional Owners)	• Commenced negotiations on co-existence agreement with Native Title claimants who represent the Project area
	June 2015	• Native Title negotiations (KRED & Traditional Owners)	• Presentation of Project and plans
Pastoral Lease owners	July 2014	• Project overview, activity update (Mt Jowlaenga, Yeeda, Kilto & Country Downs pastoral leases)	• Understanding of pastoralist's activities and future plans
Kimberley Training Institute	March 2015	• Indigenous training	• Reviewed Broome training facilities. • Establish capabilities and maintaining regular communication
Morrgul	March 2015	• Project overview	• Identified capacity for Indigenous business training and support
General Public	Scheduled for December 2015	• Project overview, activity update	• Provide understanding of Project and opportunities

4 EXISTING ENVIRONMENT

4.1 CLIMATE

The Proposal is situated in the Kimberley region of Western Australia at the south-east edge of the Dampier Peninsula. The area has a dry, hot, tropical climate with two distinct seasons: the 'wet' from around December to March, and the 'dry' for the remainder of the year.

Rainfall is highly variable in the region due to the inconsistent nature of the movement and occurrence of thunderstorms and tropical systems. Tropical cyclones can occur as late as April, but are most common in January and February. Rainfall during the cooler months is usually associated with cloud bands originating from tropical waters to the north-west (BOM 2015).

The average temperature over summer is over 33°C, with warm overnight minima of around 26°C (BOM 2015). Winter temperatures are quite mild, with average maximum and minimum temperatures in July being 26.9 °C and 12.0°C respectively (BOM 2015).

4.2 BIOGEOGRAPHIC REGIONS

The Interim Biogeographic Regionalisation for Australia (IBRA Version 7, Australian Government Department of Sustainability 2012) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna and climate characteristics (DSEWPaC 2012). The Proposal lies within the Dampierland bioregion. The Dampierland bioregion is further subdivided into two subregions, these being the Fitzroy Trough (DL1) and Pindanland (DL2) subregions. The Proposal Area lies entirely within the Pindanland subregion and the port facilities lie within the Fitzroy Trough subregion.

The Pindanland subregion covers approximately 59% of the Dampierland bioregion. This subregion consists of sandplains of a fine-textured sand-sheet with subdued dunes and includes the paleodelta of the Fitzroy River. The vegetation is described primarily as pindan (Graham 2002). The dominant land uses are grazing, unallocated crown land, crown reserves and native pastures.

The Fitzroy Trough subregion comprises of the middle and lower catchments of the Fitzroy River, including alluvial plains and areas of sandplain and eroded dune surfaces derived from the Canning Basin. Major vegetation communities are mainly Pindan, Boab (*Adabsonia gregorii*) and Eucalyptus woodlands, with some rainforest patches and hummock grasslands present on limestone areas (Graham 2001).

4.3 LAND SYSTEMS

Land systems are described using the biophysical characteristic of geology, landform, vegetation and soils. The Proposal Area falls across four of these land systems; Fraser, Reeves, Wagnut and Yeeda.

The Fraser land system is characterised by sandplains and dunes with pindan woodlands and spinifex/tussock grasslands. Geologically, it is comprised of quaternary Aeolian sand with minor outcrops of gentle dipping Cretaceous sandstone (Payne and Schoknecht 2011).

The Reeves land system is characterised by sandplains and scattered hills and minor plateaux, with pindan woodlands and spinifex/tussock grasslands. The geological formation is subhorizontal or gently dipping sandstone, sandy siltstone and silicified quartz sandstone of Cretaceous age, with Quaternary Aeolian sand. Pindan vegetation can be subject to frequent fires, which induce short term changes in botanical composition, density and structure. The sandplains have minor susceptibility to wind erosion immediately after fire but stabilise rapidly after rain (Payne and Schoknecht 2011).

The Waganut land system is characterised by low-lying sandplains and dunefields with through-going drainage, with pindan woodlands and spinifex/tussock grasslands. Its geological formation is made up of quaternary Aeolian sands. Vegetation is primarily dense wattle shrub with pindan pastures and

is subject to fairly frequent fires, which induce short term changes in botanical composition, density and structure (Payne and Schoknecht 2011).

The Yeeda land system is made up of sandplains and occasional dunes with shrubby spinifex grasslands or pindan woodlands. Geologically, it is comprised of quaternary Aeolian sands. It is generally not prone to degradation or erosion (Payne and Schoknecht 2011).

4.4 GEOLOGY AND SOILS

The Dampier Peninsula is underlain by Phanerozoic rocks of the Canning Basin (Hickman and Kranendonk 2008). The Proposal Area lies within a single geological unit, sedimentary rocks from the Cretaceous. The major soil type on the Peninsula is pindan, which developed during the Quaternary period (the past two million years) on desert dune sandstone. The pindan soils form extensive undulating plains with little or no organised surface drainage. When the pindan soils dry out, they become very hard with a dusty surface, and become soft and greasy when wet, with the potential to erode rapidly and form deep, steep-sided gullies (Kenneally *et al.* 1996). The dominant soil types within the study area are (Bettenay *et al.* 1967):

- AB21 - Pindan country – gently undulating sand plain with a few small rocky sandstone residuals; no external drainage: chief soils are red earthy sands with associated and hummocks of siliceous sands.
- AB26 - Sand plain with longitudinal sand dunes and some active drainage-ways: chief soils are red earthy sands associated with (Uc5.22) and (Uc5.1 l) soils on the plains, with dunes and hummocks of red sands. Some (Gn2.21) and (Dy5.32) soils occur in lower sites often with a heavy surface layer of ferruginous gravel.
- My60 - Plains with minor sandstone residuals on which there is extensive rock outcrop: main soils on the plains are neutral red earths and sandy neutral red soils.
- My61 - Sand plain with irregular dunes; active drainage systems: chief soils are neutral red earths and red earthy sands. Associated are deep red sand dunes and (Uc1.23). Some (Dy5.42) soils occur in low-lying areas.

4.5 LAND USE

Within the Dampierland bioregion, pastoralism is the most extensive land use in the bioregion. Other land uses in the region include conservation, Aboriginal reserves and heritage areas, mining and exploration. Some area also remains Unallocated Crown Land.

The Proposal Area lies within two pastoral leases; Mt Jowlaenga Station (N050161) and Yeeda Station (N050691). Consequently, it is frequently grazed by cattle.

Mineral tenements held by the Proponent encompass 100% of the Proposal Area.

5 ENVIRONMENTAL STUDIES

The Proponent has conducted a number of environmental baseline surveys within the Proposal Area in order to gain an understanding of the existing environment and to facilitate identifying potential impacts that may result from the implementation of the Proposal. A comprehensive list of biological surveys completed is provided in Table 7.

It should be noted that the Proponent has not undertaken any biological studies for the Wharf component of this Proposal, which was successfully used by Western Metals for export of up to 5000,000 tonnes per annum of base metal concentrates from its Lennard Shelf operation. Regulation of port activities at the Derby Wharf will be managed separately by the Shire of Derby/West Kimberley.

Table 7: Summary of Environmental Studies

Factor	Consultant	Report Title / Date	Study Area, Type and Timing	Study Standards / Guidance and Limitations
Hydrological Processes - Groundwater	Pennington Scott	Bore Completion Report February 2014	**Study Area:** Proposal Area **Type:** Hydrogeological field investigations, including airborne geophysical survey, installation of test production bores, hydraulic aquifer testing, groundwater analysis and rain and groundwater level monitoring **Timing:** July – October 2014	*Minimum Construction Requirements for Water Bores in Australia* (National Water Commission 2012)
	Tetra Tech	Technical Memorandum: Thunderbird Groundwater Flow Model March 2015	**Study Area:** Proposal Area **Type:** Desktop - modelling **Timing:** n/a	n/a
	GPX Surveys	XTEM Heli Electromagnetic Survey, Thunderbird Project, Western Australia January 2014	**Study Area:** Proposal Area **Type:** Electromagnetic Survey **Timing:** November 2013 – January 2014	n/a
	Pennington Scott	H3 Hydrogeological Assessment – Thunderbird Mineral Sands Project March 2015	**Study Area:** Proposal Area **Type:** Desktop hydrogeological assessment **Timing:** n/a	*State-wide Policy No. 5.12 – Hydrogeological Reporting Associated with a Groundwater Well Licence* (DOW 2009)

Factor	Consultant	Report Title / Date	Study Area, Type and Timing	Study Standards / Guidance and Limitations
Flora and Vegetation	Ecologia Environment	Thunderbird Dampier Peninsula Project – Level 1 Flora and Fauna Assessment November 2012	**Study Area:** Proposal Area – mine pit, tailings, eastern portion of borefield, processing plants, power station, northern section of access roads **Type:** Level 1 Flora and Vegetation Survey **Timing:** June 2012	• *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004a) • *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) Limitation to the survey was the exclusion of an area in the northern portion of the study area that was burnt and due to lack of regeneration, the area was not surveyed for flora and vegetation.
	Ecologia Environment	Thunderbird Level 2 Flora and Vegetation Assessment March 2014	**Study Area:** Proposal Area – mine pits, tailings, borefield, processing plants, power station, northern section of access roads **Type:** Level 2 Flora and Vegetation Survey **Timing:** April 2013	Same as above for standards and guidelines.
	Ecologia Environment	Thunderbird Haul Road and Accommodation Camp Flora and Fauna Assessment July 2015	**Study Area:** Proposal Area – internal access roads and accommodation camp **Type:** Level 2 Flora and Vegetation Survey **Timing:** May 2015	• *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004) • *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002)
Terrestrial Fauna Terrestrial Fauna	Ecologia Environment	Thunderbird Dampier Peninsula Project – Level 1 Flora and Fauna Assessment	**Study Area:** Proposal Area – mine pit, tailings, eastern portion of borefield, processing plants, power station, northern section of access roads **Type:** Level 1 Fauna Survey **Timing:** June 2012	• *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2004b) • *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) • *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010).

Factor	Consultant	Report Title / Date	Study Area, Type and Timing	Study Standards / Guidance and Limitations
	Ecologia Environment	Thunderbird Project – Terrestrial and Subterranean Fauna Assessment March 2014	**Study Area:** Proposal Area – mine pits, tailings, borefield, accommodation camp, processing plants, power station, northern portion of internal haul roads **Type:** Level 2 Terrestrial Vertebrate Fauna and Short Range Endemic Invertebrate Survey Subterranean Fauna Survey **Timing:** Phase 1 - April 2013 (wet season) Phase 2 - October 2013 (dry season)	• *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2004b) • *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010). • *Guidance for the Assessment of Environmental Factors, Statement No. 20: Sampling of Short-range endemic invertebrates for Environmental Impact Assessment in Western Australia* (EPA 2009) • *Environmental Assessment Guideline No. 12: Consideration of Subterranean Fauna in Environmental Impact assessment in Western Australia* (EPA 2013) • *Guidance for the Assessment of Environmental Factors, Statement No. 54a (Technical Appendix to Guidance Statement No. 54)* (EPA 2007) • *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002).
	Ecologia Environment	Thunderbird Project – Short Range Endemic Invertebrate Targeted Survey December 2014	**Study Area:** Regional areas surrounding the Proposal Area **Type:** Targeted survey **Timing:** May 2014	• *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2004) • *Guidance for the Assessment of Environmental Factors, Statement No. 20: Sampling of Short-range endemic invertebrates for Environmental Impact Assessment in Western Australia* (EPA 2009) • *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002).
	Ecologia Environment	Thunderbird Haul Road and Accommodation Camp Flora and Fauna Assessment July 2015	**Study Area:** Proposal Area – internal haul roads and accommodation camp **Type:** Level 1 Fauna Survey	• *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2004) • *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002)

Factor	Consultant	Report Title / Date	Study Area, Type and Timing	Study Standards / Guidance and Limitations
			Timing: May 2015	
	Ecologia Environment	Targeted Greater Bilby Assessment November 2015 (in Draft)	**Survey Area:** Proposal Area – mine pits, tailings, borefield, accommodation camp, processing plants, power station, northern portion of internal haul roads **Type:** Targeted Fauna Survey **Timing:** September 2015	• *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004) • *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2004) • *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002).
Heritage	Cox Anthropology	Nyikina Mangala Native Title Claim Group And Other Traditional Owners. Sheffield Resources Dampier Project Tenement E04/2083 Mt Jowlaenga May 2012	**Study Area:** Proposal Area – mine pits, tailings, borefield, processing plants, power station, northern portion of internal haul roads **Type:** Clearance survey **Timing:** April 2012	n/a
	Banarra	Heritage Survey Report Sheffield Resource Tenement E04/2083: Argo Work Program November 2012	**Study Area:** Argo Prospect (outside Proposal Area) **Type:** Ethnographic and historical heritage sites survey **Timing:** October and November 2012	n/a
	Beit Holmes and Associates	Sheffield Resources Ltd Ethnographic Heritage Survey Report – Open July 2013	**Study Area:** Proposal Area **Type:** Ethnographic survey **Timing:** June 2013	n/a

Factor	Consultant	Report Title / Date	Study Area, Type and Timing	Study Standards / Guidance and Limitations
	Beit Holmes and Associates	Sheffield Resources Ltd Ethnographic Heritage Survey Report – Open June 2014	**Study Area:** Proposal Area **Type:** Ethnographic survey **Timing:** June 2014	n/a
	Beit Holmes and Associates	Sheffield Resources Ltd Ethnographic Heritage Survey Report – Open June 2015	**Study Area:** Proposal Area **Type:** Ethnographic survey **Timing:** June 2015	n/a
Radiation	SGS Radiation Services	Thunderbird Heavy Mineral Sands Project – Preliminary Radiological Assessment	**Study Area:** Proposal Area **Type:** Preliminary Radiological Assessment **Timing:** June 2014	www.radiologicalcouncil.wa.gov.au RPS 1. Code of Practice for Radiation Protection in Planned Exposure Situations as Applied to Workers, the Public and the Environment (2014) RPS 9. Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)