STRATEGEN
environmental consultants

Nammuldi-Silvergrass Expansion Project

Scoping Document

Prepared for

Rio Tinto Iron Ore

by Strategen

January 2012

Nammuldi-Silvergrass Expansion Project

Scoping Document

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Client: Rio Tinto Iron Ore

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
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Final Report	Rev 2	Client/EPA	A Chinnery, M Brook, K. Oliver	Hard copy	9/6/11
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Final to EPA	Rev 4	EPA	M Brook, K Oliver	10 x Hard copy	6/10/2011
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Revised Final to EPA	Rev 6	EPA	M Brook	1 x Hard copy	17/01/2012

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(contained on CD-ROM inside the back cover of this report)

1. Introduction

1.1 Background

Hamersley Iron Pty Limited (a wholly owned subsidiary of Rio Tinto Iron Ore [RTIO]) plans to expand and modify its Nammuldi-Silvergrass Iron Ore Project (the Original Project), located approximately 65 km north-west of the town of Tom Price, in the Pilbara region of Western Australia (Figure 1). This expansion of the Original Project is called the Nammuldi-Silvergrass Expansion Project, referred to hereafter as the Expansion Proposal.

The Original Project comprises the Nammuldi and Silvergrass mines, which are being implemented in accordance with Statement 558 issued under Part IV of the *Environmental Protection Act 1986* (WA) (EP Act). The Expansion Proposal was referred to the Environmental Protection Authority (EPA) in June 2010. The EPA determined the Expansion Proposal requires a Public Environmental Review (PER) level of assessment with a four week public review period under the EP Act and the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002* of the EP Act (EPA 2002a). In November 2010, new administrative procedures were introduced; however, as the Proposal was referred prior to gazettal of the new procedures it will continue to be assessed under the 2002 procedures.

1.2 Purpose of document

The purpose of this Environmental Scoping Document (ESD) is to:

1. Provide a broad overview of the environmental characteristics of the Project Area in which the expansion is proposed.
2. Identify potential environmental issues/risks related to the project area and possible regulatory requirements relating to these (e.g. investigations, management).
3. Recommend environmental investigations that are expected to be required to support an environmental impact assessment.
4. Identify environmental (and other) approvals that will/may be required.
5. Recommend a stakeholder consultation strategy to support the project environmental approval process.

The document has been prepared in accordance with the EPA (2009a) *Guide to Preparing an Environmental Scoping Document* and with Section 6.1 of the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002* of the EP Act (EPA 2002a).

1.3 Proponent details

The Proponent for the Expansion Proposal is Hamersley Iron Pty Ltd, which is a wholly owned subsidiary of RTIO.

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1.4 Existing environmental approvals

A Consultative Environmental Review (CER) (Hamersley Iron 2000) for the Original Project was assessed by the EPA in 2000 under Part IV of the EP Act. The EPA provided its advice to the Minister for the Environment (the Minister) in Bulletin 997. Statement 558 was subsequently issued by the Minister in November 2000 allowing the Original Project to be implemented.

The Original Project, as described in Figure 2 of Statement 558 comprised:

- open-cut mines at Nammuldi and Silvergrass with a total production rate of up to 20 Million tonnes per annum (Mtpa)
- dewatering to access ore below the watertable
- an ore transport link from Silvergrass to Nammuldi
- a wet or possibly dry processing plant at Nammuldi
- crushing facilities at Silvergrass and at the eastern Nammuldi pits
- tailings disposal (if wet processing occurs) into available mine void/s, plus a new tailings storage facility
- associated support infrastructure.

The environmental factors considered relevant to the Original Project (as described in the CER) were:

- flora and vegetation
- terrestrial fauna
- subterranean fauna
- watercourses
- groundwater
- landform
- particulates/dust
- greenhouse gases
- groundwater quality
- surface water quality
- solid waste
- noise
- Aboriginal culture and heritage.

In the Report and Recommendations of Bulletin 997 (EPA 2000a), the EPA considered the relevant environmental factors to be:

1. Riverine vegetation – impact on vegetation arising from dewatering.
2. Subterranean fauna – impacts on fauna habitat due to dewatering operations.
3. Aboriginal culture and heritage – clearing and disturbance of land.

Statement 558 addresses these and other factors via Ministerial Conditions and Proponent Commitments (included in full in Appendix 1).

The potential for the Original Project to affect subterranean fauna was determined through the assessment process due to the dewatering component of the project, which could in turn affect the habitat of groundwater-dwelling stygofauna. The Proponent committed to undertaking further subterranean fauna surveys as subterranean fauna investigations were incomplete at the time of release of the CER. Stygofauna sampling was undertaken and the results for Nammuldi were submitted to the Department of Environmental Protection (now Department of Environment and Conservation [DEC]) in 2003 to satisfy Condition 6 of Statement 558.

DEC conducts regular audits of the site and the 2006 audit found the Original Project to be compliant with conditions specified in Statement 558 to the extent that the Original Project has been implemented. To date only the above watertable (AWT) phase of mining at Nammuldi has commenced, thus the conditions and commitments relating to potential impact on riverine vegetation from dewatering are not applicable to current operations.

In addition to Statement 558, a number of environmental conditions apply under the DEC operating licence and Department of Water (DoW) groundwater licence held by the Proponent for the Original Project. Annual reporting conducted to ensure compliance with the specific conditions of each licence has indicated that impacts are within predicted limits.

Following release of Statement 558, the Proponent made an application under section 45C of the EP Act to vary aspects of the infrastructure requirements for the initial, AWT phase of the mine, namely:

- location of the processing plant at Nammuldi
- location of several waste dumps and stockpiles
- interim use of diesel generators as the primary power source
- extension of the Brockman 2 Camp and associated sewerage treatment facilities to accommodate the workforce.

This section 45C application was approved in December 2004. The Chairman of the EPA subsequently clarified that the approved variation to the Nammuldi AWT phase of the Original Project did not extinguish any subsequent phases of the Original Project.

1.5 Current operation

The Nammuldi-Silvergrass Iron Ore Project will be implemented in a series of overlapping phases:

1. Nammuldi above watertable (AWT) mining.
2. Nammuldi below watertable (BWT) mining.
3. Silvergrass AWT and BWT mining.

The layout of the approved Nammuldi-Silvergrass operation is provided in Figure 2.

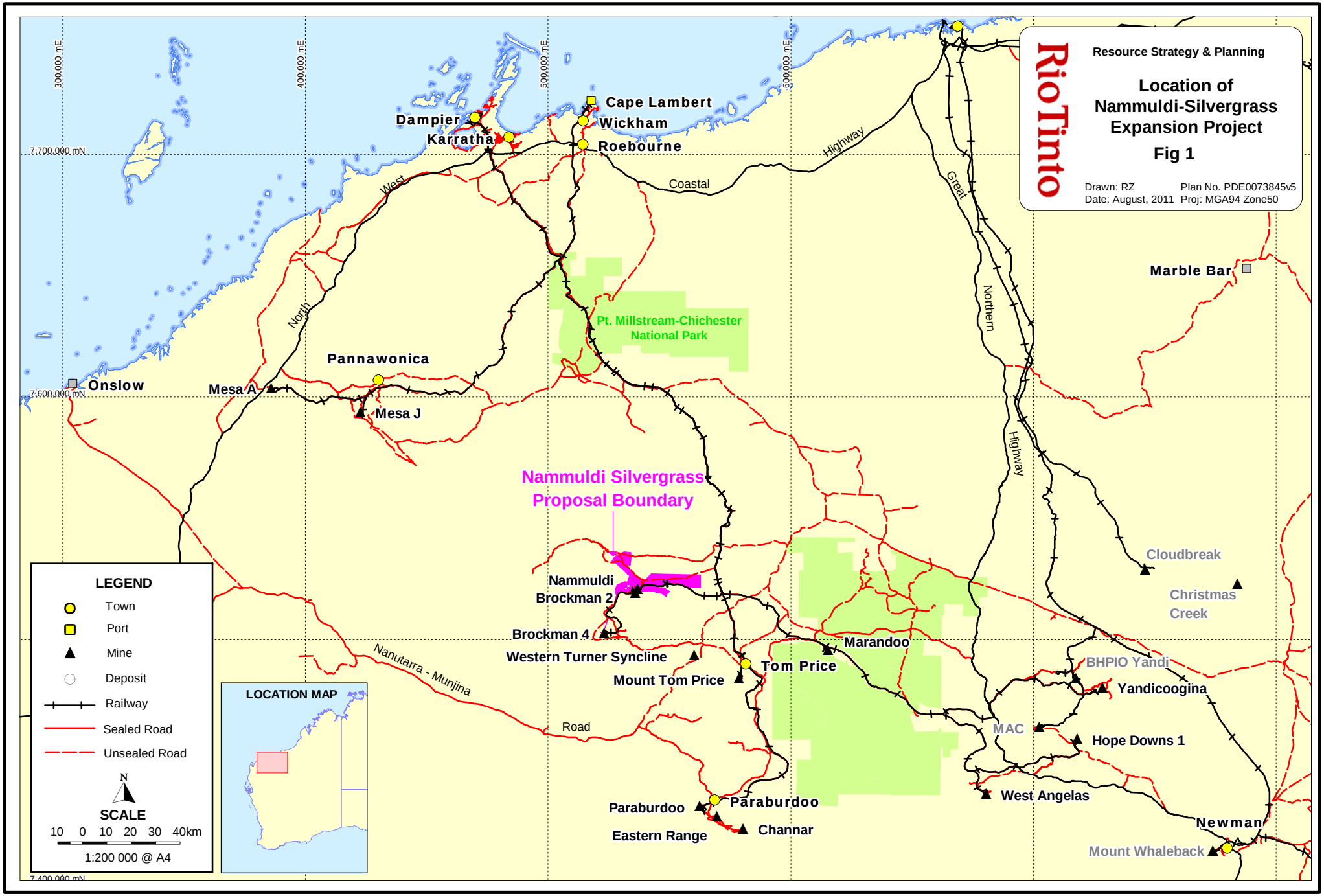
To date, only the AWT mining phase at Nammuldi has been implemented with some minor extraction of BWT ore being fed through the dry plant. Mining commenced at Nammuldi in 2006 and the current production rate for the Nammuldi operation is 6.6 Mtpa of iron ore. Approximately 820 ha of native vegetation has been cleared in association with the Nammuldi operation with approximately 1180 ha remaining uncleared under the current approval (Hamersley Iron 2000). No mining of the Silvergrass deposit has yet been undertaken.

The Proponent operates the Brockman 2 Iron Ore Detritals Mine, which is located immediately south of the Nammuldi mine. The Nammuldi and Brockman 2 mines are currently operated together, using some existing Brockman 2 infrastructure (including the Brockman 2 rail loop and accommodation camp). The following components of the Original Project have not yet been constructed:

- wet processing plant (20 Mtpa capacity)
- central thickened tailings facility
- rail loop and associated stockyards and load-out facilities
- in-pit crushing at Nammuldi or Silvergrass
- pit dewatering and surplus water discharge infrastructure
- ore transport (railway, haul road, conveyor) from Silvergrass to Nammuldi
- separate accommodation village.

At completion of the AWT mining phase, less than 50 Mt of Marra Mamba ore and less than 20 Mt of detritals will have been mined out of a total of 280 Mt specified in Statement 558.

As mining operations have focussed on AWT ore at Nammuldi, with only minor extraction of BWT ore, no active dewatering of the ore deposit has occurred. Some groundwater abstraction (approximately 1000 ML/yr) has been undertaken under licence to meet potable, construction and dust suppression water supply requirements at Nammuldi.


Resource Strategy & Planning
Location of Nammuldi-Silvergrass Expansion Project
Fig 1
Drawn: RZ
Plan No. PDE0073845v5
Date: August, 2011
Proj: MGA94 Zone50
300,000 mE
400,000 mE
500,000 mE
600,000 mE
7,700,000 mN
7,600,000 mN
7,400,000 mN
Cape Lambert
Wickham
Dampier
Karratha
Roebourne
Onslow
Pannawonica
Mesa A
Mesa J
Pt. Millstream-Chichester National Park
Marble Bar
Nammuldi Silvergrass Proposal Boundary
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Mount Tom Price
Tom Price
Marandoo
Cloudbreak
Christmas Creek
BHPIO Yandi
Yandicoogina
MAC
Hope Downs 1
West Angelas
Newman
Mount Whaleback
Paraburdoo
Eastern Range
Channar
Nanutarra - Munjina Road
North West Coastal Highway
Great Northern Highway
LEGEND
Town
Port
Mine
Deposit
Railway
Sealed Road
Unsealed Road
N
SCALE
10 0 10 20 30 40km
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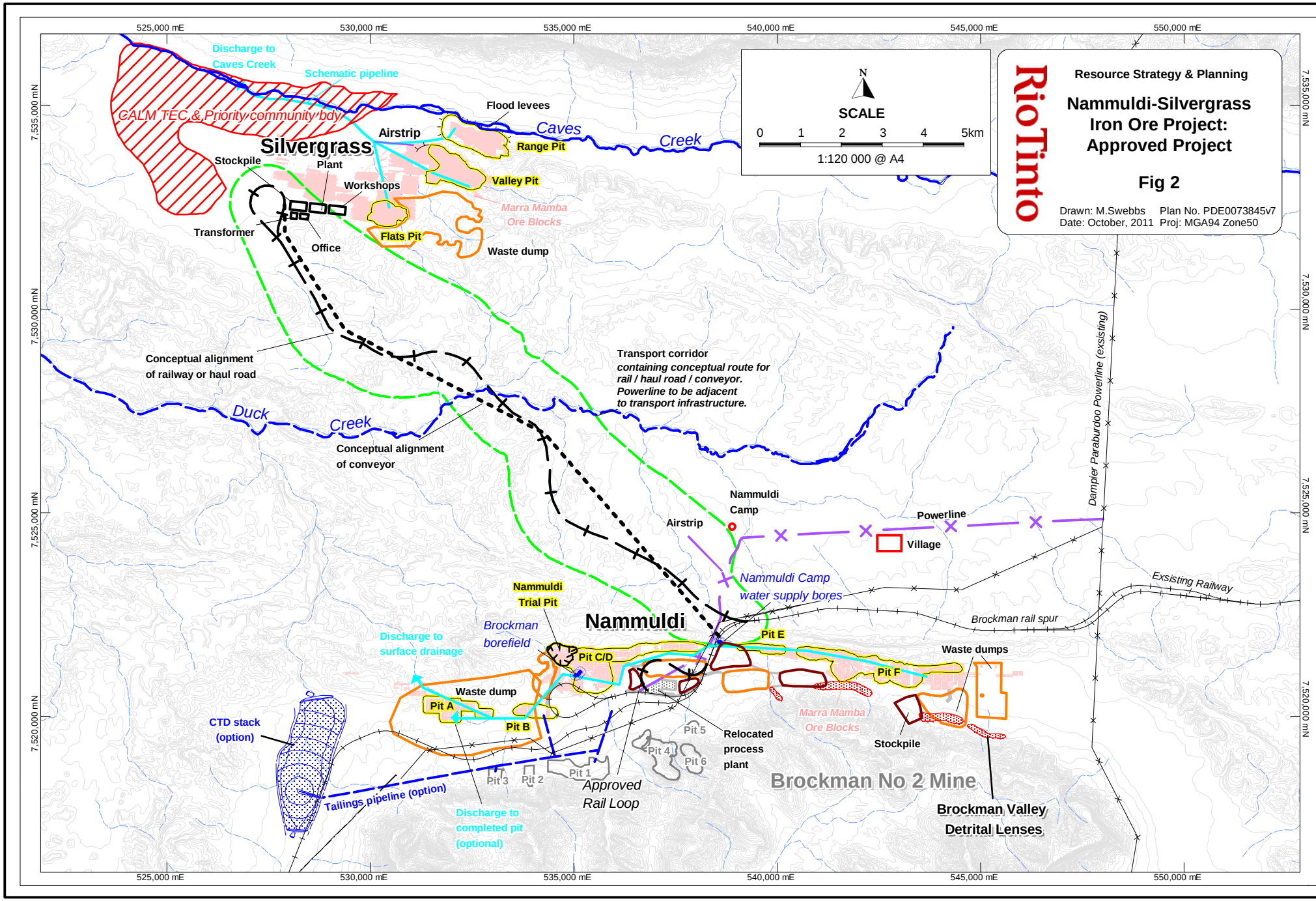
LOCATION MAP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Discharge to Caves Creek
Schematic pipeline
CALM TEC & Priority community bdy
Flood levees
Caves Creek
Airstrip
Silvergrass
Range Pit
Stockpile
Plant
Workshops
Valley Pit
Marra Mamba Ore Blocks
Transformer
Office
Flats Pit
Waste dump
Conceptual alignment of railway or haul road
Transport corridor containing conceptual route for rail / haul road / conveyor. Powerline to be adjacent to transport infrastructure.
Duck Creek
Conceptual alignment of conveyor
Nammuldi Camp
Airstrip
Powerline
Village
Dampier Paraburdoo Powerline (exsisting)
Nammuldi Camp water supply bores
Exsisting Railway
Brockman rail spur
Nammuldi Trial Pit
Nammuldi
Brockman borefield
Discharge to surface drainage
Pit C/D
Pit E
Waste dumps
Pit F
Waste dump
Pit A
Pit B
Marra Mamba Ore Blocks
CTD stack (option)
Pit 5
Pit 4
Pit 6
Relocated process plant
Stockpile
Pit 3
Pit 2
Pit 1
Approved Rail Loop
Brockman No 2 Mine
Tailings pipeline (option)
Discharge to completed pit (optional)
Brockman Valley Detrital Lenses
N
SCALE
0 1 2 3 4 5km
1:120 000 @ A4
Rio Tinto
Resource Strategy & Planning
Nammuldi-Silvergrass Iron Ore Project: Approved Project
Fig 2
Drawn: M.Swebbs Plan No. PDE0073845v7
Date: October, 2011 Proj: MGA94 Zone50

2. Description of the Expansion Proposal

2.1 Location

The Nammuldi-Silvergrass Expansion Proposal is located approximately 65 km north west of the town of Tom Price in the Pilbara region of Western Australia (Figure 1).

The Nammuldi and Silvergrass deposits are located within Mineral Lease No. 4SA which was granted under the *Iron Ore (Hamersley Range) Agreement Act 1963*. A section of the Silvergrass deposit is located within Mineral Lease No. 272SA which was also granted under the *Iron Ore (Hamersley Range) Agreement Act 1963*. A simplified tenement location map is provided in Figure 3.

The Proponent holds tenure for both deposits and the connecting ore transport corridor under the *Land Administration Act 1997*. This consists of Hamersley Pastoral Station, along with leases for the existing Brockman 2 rail, access road and accommodation village. The proposed irrigated agricultural operation will be located wholly within Hamersley Station. In addition, the Proponent has the Rocklea Pastoral Station that abuts Hamersley Station to the south and that underlies the existing infrastructure corridor between Brockman 2/Nammuldi and Brockman 4.

The Proponent holds a number of Miscellaneous Licences at Nammuldi and between Nammuldi and Brockman 4 that are suitable for existing and some of the proposed infrastructure.

Application has been made under the *Land Administration Act 1997* for additional leases to cover proposed processing and transport infrastructure between Nammuldi and Silvergrass. This process is ongoing in consultation with the Department of Regional Development and Lands, the Department of State Development and tenure is expected to be granted in mid. Options to acquire alternative tenure are also being investigated.

Figure 4 shows the conceptual layout of the Expansion Proposal, including the Proposal Boundary, which contains the extent of the proposed activities.

2.2 Key proposal characteristics

Since approval of the Original Project in 2000, the Proponent has conducted further geological investigations that have identified additional mineable resources at both Nammuldi and Silvergrass. On the basis of those findings a studies are underway to modify and expand aspects of the Original Project. The key changes that form the Expansion Proposal are:

- widening and deepening of Marra Mamba pits at Nammuldi and Silvergrass
- an additional BWT pit at Silvergrass
- additional pits at Nammuldi to mine BWT bedded Brockman ore south of Lens E/F
- increase in the capacity of ore transport infrastructure
- increase in the capacity of the processing plant to 40 Mtpa (nameplate)
- increase in the quantity of dewatering at Nammuldi and Silvergrass to access BWT ore
- variations to the surplus water management strategy
- increase in overall strip ratio (waste:ore) at Nammuldi and Silvergrass
- reduction in the proportion of waste to be backfilled to pits
- construction of additional accommodation for construction and operations workforces.

In accordance with section 45B of the EP Act, the Expansion Proposal is considered a revised proposal. Section 45B allows for the continued implementation of conditions specified in Statement 558, except where they have been revised as a result of the Expansion Proposal. The proposed changes to the relevant key characteristics table (Table 1, Schedule 1 of Statement 558) Nammuldi-Silvergrass are identified in Table 1.

Table 1 Indicative proposed changes to relevant key characteristics specified in Statement 558

Project characteristic	Approved under Statement 558 as amended	Proposed change
Plant	Dry or wet processing Initially 2-3 Mtpa increasing to 20 Mtpa	Dry or wet processing Plant capacity up to 40 Mtpa
Project life	15-20 years (production started in 2006)	17 years Nammuldi, 11 years Silvergrass mined concurrently or in sequence
Mine pits and mining	Approximately 80% of ore is BWT Nammuldi: • BWT Marra Mamba pits (A-F) • AWT: Marra Mamba pits at Lens A (Pits 1, 2) plus detritals near Pit F Silvergrass: • BWT Marra Mamba pits (Valley, Range and Flats)	>90% of ore is BWT Nammuldi: • BWT Marra Mamba pits (A – F), additional mining of bedded Brockman material south of Lens E/F • AWT: Marra Mamba pits at Lens A (Pits 1, 2) plus detritals near Pit F Silvergrass: • BWT Marra Mamba pits (Pits 1, 2, 4 and 5) and some detritals
Waste	Out-of-pit waste dumps, 30% of waste returned to pits Pit voids to be backfilled to 1 m above pre-mine watertable	Out-of-pit waste dumps, some direct backfilling where scheduling allows Post-mining voids to remain at Nammuldi, but backfilled at Silvergrass
Ground disturbance	Approximately 2000 ha	Approximately 6100 ha
Irrigated agriculture	N/A	Approximately 2500 ha for irrigated agriculture and infrastructure for the transfer of water to the Irrigated Agriculture Area
Stripping ratio	Overall 3:1 (waste:ore)	Overall approximately 4.5:1 (waste:ore)
Dewatering	Dewatering to allow mining of BWT ore Nammuldi: discharge of surplus water initially to drainage lines then to mined-out pits (if suitable pits available and is a feasible option) Silvergrass: discharge of surplus water to Caves Creek	Dewatering to allow mining of BWT ore. Nammuldi-Silvergrass: discharge of surplus water to: • supply on-site use (where practicable) • pastoral leases (where practicable) • supply offsite use (where practicable) • Duck Creek
Waste fines	Central thickened tailings facility (waste fines facility) and potential in-pit discharge	Tailings facility (waste fines storage facility)
Caves Creek	Construction of diversion levees to direct flow in Caves Creek around pits	Re-alignment of Caves Creek around pits

2.3 Ground disturbance

The Original Project includes clearing of approximately 2000 ha of native vegetation. An estimated additional ~ 4100 ha of additional ground disturbance is required for the Expansion Proposal based on the current conceptual layout and design, as shown in Table 2. In addition to this, approximately 2500 ha is expected to be required to for irrigated agriculture as specified in Section 2.12.

Table 2 Indicative disturbance area

Project component	Estimated area of disturbance (ha)
Mine pits	1700
Waste dumps and stockpiles	1500
Infrastructure (processing, transport, waste fines facility, water management, etc)	2200
Other	500
Total for Mining	**5900**
Total for Irrigated Agriculture	**2500**
Combined total	**8400**
Approved under Statement 558 as amended	2000
Preliminary estimate of additional disturbance	**~6400**

2.4 Timing

The Expansion Proposal is currently the subject of ongoing studies. Nammuldi is undergoing a Feasibility Study and Silvergrass is at the Pre-Feasibility stage. The proposed timeline for development is shown in Table 3.

Table 3 Proposed Expansion development schedule

Element	Timing
Construction of Expansion	Q3 2012
Commence dewatering – Nammuldi	Q1 2013
Production Nammuldi	Q2 2014
Commence dewatering – Silvergrass	Q1 2015
Production Silvergrass	Q1 2015

Construction of elements specified in Statement 558 that will be retained in the Expansion Proposal are considered to be authorised and may be constructed outside of the proposed timeline shown in Table 3. Production at Nammuldi will be maintained throughout the construction and commissioning of the Expansion Proposal.

2.5 Mining

The conceptual layout of the Expansion Proposal is shown in Figure 4. A comparison of key components of the approved BWT project and proposed Expansion is shown in Figure 5, with detailed layouts for Nammuldi and Silvergrass in Figure 6 and Figure 7, respectively.

Mining will involve conventional drill, blast, load and haul processes as currently occurs at Nammuldi.

Statement 558 currently allows for mining of Marra Mamba and detritals at a rate of up to 20 Mtpa of product over a 15 – 20 year life. The mine plan for the Original Project predicted an overall stripping ratio for the AWT and BWT pits of 3:1 (waste:ore). The majority of the waste was to be placed in permanent out-of-pit waste dumps, with approximately 30% of waste returned to mined-out pits.

The Expansion Proposal will increase the rate of mining to up to 40 Mtpa over a project life of approximately 17 years at Nammuldi and 11 years at Silvergrass, mined concurrently (or possibly in sequence depending on the wider RTIO production plan). More than 90% of the mined material will be from below the watertable and will

comprise Marra Mamba and detritals at Nammuldi and Silvergrass, with additional mineralised bedded Brockman material mined at Nammuldi from beneath the Brockman Valley detritals near Lens E/F.

Due to the increased depth of the additional resource, the quantity of low grade ore and waste generated will also increase, with the overall waste:ore stripping ratio expected to be approximately 4.5:1.

In order to achieve the required production rate, several pits will need to be mined concurrently, minimising the opportunities for progressive back-filling of pit voids. Direct in-pit placement of waste at Nammuldi and Silvergrass will be maximised; however, the majority of waste will be placed in permanent out-of-pit dumps (Figure 6 and Figure 7). Silvergrass Pits 1 and 5 are located within the extent of the pre-mining 100 year flood Average Recurrence Interval (ARI) for Caves Creek. Following completion of mining, these pits will be backfilled to a level that ensures floodwater will not be impeded in a 100 year ARI event. Where pits are outside the 100 year ARI level, pits will be backfilled to above the pre-mining groundwater level.

Topsoil removed for the Expansion Proposal will be stockpiled separately or directly applied to existing rehabilitation areas. Sub-surface soil will also be stockpiled separately for use in rehabilitation.

The Proponent has undertaken acid base accounting test work in accordance with RTIO standards. Analysis of sulphur concentrations within drillhole samples indicates that there is potential for a small percentage of the BWT waste at Nammuldi to be sulfidic (lignite and siderite in Marra Mamba pits and McRae Shale in Bedded Brockman pits). Similar work undertaken at Silvergrass indicates low potential for sulfidic material to be mined at that deposit. Any Potentially Acid Forming (PAF) material will be managed according to the RTIO standards as described in Section 5.6.

2.6 Re-alignment of Caves Creek

The Original Project included the mining of Range Pit (Pit 1) adjacent to Caves Creek at Silvergrass. Development of the pit at that location required the creation of levees on its northern edge to divert creek flow around the pit.

Widening Pit 1, as part of the Expansion Proposal, will require this section of Caves Creek to be realigned to ensure that flows in the creek bypass the pit (Figure 7). A conceptual diversion channel will be designed as part of ongoing Pre-Feasibility and Feasibility Studies.

2.7 Ore transport, processing and disposal of waste fines

The Original Project provides for the construction and operation of the following key infrastructure as part of the BWT mining phase:

- in-pit crushing at Nammuldi and Silvergrass
- ore transportation from Silvergrass via rail, conveyor or haul road to the processing plant at Nammuldi
- wet processing plant at Nammuldi with a production rate of up to 20 Mtpa product
- disposal of tailings (waste fines) into a central thickened tailings facility (to be built west of Nammuldi) and to pit voids at Nammuldi and the neighbouring Brockman 2 mine, which is also operated by the Proponent.

With the exception of a small dry processing plant at Nammuldi, this infrastructure has not yet been constructed. Review of the larger BWT project has resulted in a modified layout for these key components to improve the efficiency of site operation; with all components to be centralised in an area to the north of the Nammuldi mine (Figure 5). At this Pre-Feasibility stage, transport of ore from Silvergrass to Nammuldi via conveyor is the preferred option; however, selection of a final transport option and alignment is subject to further on-site geotechnical investigations, design and negotiations with relevant stakeholders.

In addition to the re-location of key infrastructure, the proposed increase in production rate will require an increase in the operating capacity of each infrastructure component. At full production the proposed wet processing plant

will receive feed from Nammuldi and Silvergrass simultaneously, the contribution from each mine will vary over the life of the project to allow for operational conditions.

Waste fines will be deposited into a central Waste Fines Storage Facility (WFSF) to be constructed to the north of Nammuldi. Waste fines will be transported from the processing plant to this facility via an overland pipeline.

This Expansion Proposal may include increasing the height allowance for waste dumps above 40 m, to reduce the footprint of the dumps. However waste material characterisation and waste dump design is ongoing. Out-of-pit dumps will be subject to geotechnical assessment and will need to comply with RTIO Landform Design Guidelines, to ensure long-term stability of both temporary and permanent dumps.

2.8 Rail

Ore product from Nammuldi is currently loaded onto the Brockman 2 rail spur. As part of the proposed centralisation of the processing plant and associated facilities, the Proponent plans to construct a new rail loop and stockyards to the north of Nammuldi. Connection of the new loop to the existing Brockman spur will therefore also be constructed north of Nammuldi (Figure 6).

2.9 Dewatering and water disposal

The Original Project included AWT and BWT Marra Mamba Iron Formation pits at both Nammuldi and Silvergrass, with 80% of the ore to be mined occurring below the watertable. The estimated dewatering requirements for the Original Project were based on hydrogeological modelling conducted by PPK (1999). On the basis of the hydrogeological data available at that time, both the Nammuldi and Silvergrass models assumed little vertical and lateral connection between the various stratigraphic groundwater units at both sites, and consequently predicted that drawdown would remain localised to the pit areas. Statement 558 specifies a total dewatering volume from Nammuldi of about 31 GL and from Silvergrass about 30 GL, with a combined dewatering rate of up to 18 ML/day.

Additional modelling at Nammuldi conducted by Liquid Earth (2005) modified the earlier predictions, but did not significantly change the expected dewatering volumes.

Since 2008, the Proponent has conducted substantial additional geological and hydrogeological investigations at Nammuldi and Silvergrass, which have led to significant improvements in the geological understanding of both sites. On the basis of this additional information, new models have been constructed by URS for both Nammuldi and Silvergrass (URS 2010a; URS2010b). The conceptual hydrogeological model for Nammuldi is now considered to be a “common aquifer system” formed by the valley-fill, Wittenoom Formation and Mineralised Mount Newman Member. Each of the units is laterally and vertically hydraulically connected and the combination forms a highly transmissive aquifer system beneath the Nammuldi Valley.

A similar revision has been undertaken at Silvergrass, where the previous modelling suggested that the ore body aquifer formed by Marra Mamba was locally confined by the overlying West Angela Member where it occurs. Recent investigations suggest that the valley-fill, Wittenoom Formation (Bee Gorge, Paraburdoo and West Angela Members) and Marra Mamba (Mount Newman Member) ore body are in hydraulic connection.

The current estimated peak dewatering requirement is 145 ML/day and 78 ML/day at Nammuldi and Silvergrass respectively, with a combined peak of approximately 190 ML/day and a total abstraction for the life of the project in excess of 600 GL. Geological and hydrogeological investigations are continuing in conjunction with mine design and scheduling. As the hydrogeological models continue to be updated with more recent mine plans and data gathered during these investigations, there is potential for changes to these dewatering estimations.

To date, limited hydrogeological investigations have been carried out in the area of the bedded Brockman Iron Formation south of Lens E/F. However, initial indications are that groundwater in these deposits may be discontinuous from the underlying Marra Mamba Iron Formation (i.e. mining BWT of these deposits may require a separate dewatering exercise, with estimated volumes to be determined subsequent to a further additional modelling phase).

2.10 Water supply

The Expansion Proposal will require water for wet processing, dust suppression, crib rooms and ablutions at a rate of approximately 3 ML/day at Nammuldi and 2 ML/day at Silvergrass. This demand will be met from groundwater abstracted to dewater the mine pits at Nammuldi and Silvergrass.

2.11 Surplus water management

As the volume of water produced from dewatering of mine pits at Nammuldi and Silvergrass will substantially exceed the on-site water requirements for wet processing and general on-site water requirements, the Proposal will have surplus water. Various options were considered for management of the surplus water, in accordance with the DoW list of water use options published in the Pilbara Water in Mining Guidelines (DoW 2009). The following options have been selected:

- **minimise the generation of surplus water** (configuration of bores and optimisation of dewatering to minimise abstraction volume)
- **maximise re-use on site** (preferential use of dewatering water for processing and potable supply)
- **maximise use off-site** (supply water to the RTIO Brockman 4 mine, supply to pastoral land for irrigated agriculture and future supply to third parties)
- **controlled discharge of water to natural watercourses** (periodic discharge to Duck Creek)
- **uncontrolled discharge of water to natural watercourses** (discharge to Duck Creek during emergency events e.g. equipment/pipeline failure).

The option to use surplus water for irrigated agriculture was excluded from the Expansion Proposal in the section 38 referral; however, after consultation with DEC this aspect of the surplus water management strategy has now been incorporated into the Expansion Proposal to provide a complete picture of the complete water management strategy. Further details of the proposed irrigated agriculture are provided in Section 2.12.

The discharge of surplus water to Duck Creek will comprise an auxiliary method of disposing excess water that cannot be used for irrigated agriculture (e.g. during winter months or when rainfall events exceed evapotranspiration rates) and as a contingency for when water cannot be directed to the irrigated agriculture project (e.g. when repair and maintenance is conducted to irrigation equipment).

2.12 Irrigated agriculture

Irrigated agriculture will involve the transfer of surplus water from mine dewatering to Hamersley Station. Investigations into a range of agriculture products determined that hay production was the most suitable enterprise as it provides the greatest flexibility in terms of water use, has synergies with RTIO pastoral operations and is of lowest social, economic and environmental risk.

An area has been identified as being suitable for irrigated agriculture to the north-east of the Nammuldi mine site (Figure 6). The area to be irrigated was determined by calculating the maximum water use capacity based on matching irrigation rates to evaporation rates. Based on a peak summer irrigation rate of 147 ML/day, up to approximately 2000 ha can be irrigated and sustained during the year, which is equivalent of up to forty 50 ha irrigation pivots. As plant water requirements are less during winter this equates to a maximum winter irrigation rate during the month of June of 90 ML/day.

To support the irrigation, up to 500 ha of additional disturbance will be required for supporting infrastructure. The area disturbed for irrigation will be rehabilitated once irrigated agriculture is no longer required.

2.13 Other infrastructure

2.13.1 Power

A 220 kV line already supplies power to the Nammuldi, Brockman 2 and Brockman 4 mines. New 33 kV power lines will be constructed and incorporated into the existing system to provide electrical reticulation to the proposed new infrastructure, including facilities at Silvergrass. Much of the required electrical reticulation may be installed under the existing approval, with only minor additional installation required for the Expansion Proposal.

2.13.2 Road access

The main vehicle access to the Nammuldi and Brockman 2 mines is currently via an unsealed road that extends west from the RTIO Tom Price-Dampier rail line and enters the mine to the south of the existing Brockman 2 accommodation camp. An alternative all-weather access road will be constructed between Brockman 4 and Brockman 2 (approved in November 2008 via a change to the Brockman Syncline 4 Statement 717 under Section 45C of the EP Act). Once this access road has been constructed it will service the existing Brockman 2 and Nammuldi AWT operations.

Additional access will be required to service the Expansion Proposal, in particular between Brockman 2 and the central processing facilities and there north to Silvergrass. This connection will provide an all-weather traffic route from Tom Price to Silvergrass via central Nammuldi.

Separate all-weather access roads will be constructed between Nammuldi and Silvergrass for light and heavy vehicles, and for maintenance access to the selected ore transport system.

A separate heavy vehicle road may be constructed between Nammuldi and Brockman 4 as part of the expansion to facilitate sharing of heavy equipment and heavy equipment maintenance facilities at each site.

2.13.3 Fuel storage

Bulk fuel storage facilities will be required to supply mining operations and camp/village operations as part of the Expansion Proposal. Storage facilities will be required at both mine sites and close to the central plant location.

2.13.4 Accommodation

The Original Project included extension of the existing Brockman 2 Camp to accommodate a construction workforce of 400; with construction of a permanent village on the existing mine site access road to accommodate an operations workforce of between 150 – 190 personnel on a fly-in fly-out (FIFO) basis. The Brockman 2 camp has been extended to accommodate the small operational workforce for the AWT phase of the Nammuldi mine.

Accommodation requirements in the area will increase due to the construction and operation of the Expansion Proposal. Locations for new combined construction/operations accommodation are currently under consideration.

Opportunities to use existing or already approved accommodation for the workforce will be assessed, and used wherever practicable to do so.

2.13.5 Other facilities

Other new facilities required as part of the Expansion Proposal include storage facilities for explosives, fabrication and heavy vehicle maintenance workshops, batching plant, offices, lay down areas, warehousing waste water treatment plants, sprayfields and landfill facilities. These facilities may be centralised and/or duplicated at each mine site, with the capacities and final locations for each facility to be finalised during the Feasibility Study and/or Detailed Design. Where appropriate, facilities will be subject to additional approvals (see Section 6.1).

2.14 Closure

The key change of the Expansion Proposal relating to closure is the reduction in the proportion of waste to be backfilled to pits. As specified in Section 2.5, several pits will need to be mined concurrently to achieve the required production rate, therefore opportunities for progressive back-filling of pit voids are reduced.

The priority for back-filling is Silvergrass Pit 1 and Pit 5, which will be backfilled and shaped within the 100 year ARI flood extent for Caves Creek, to ensure floodwater will not be impeded in a 100 ARI flood event. Where pits are outside the 100 year ARI flood extent, back-filling will be to a level above the pre-mining groundwater level.

2.15 Exclusions from the proposal

As the Original Project has existing approvals, aspects related to these approvals have been excluded from the Expansion Proposal, including:

- licences under the *Rights In Water and Irrigation Act 1914*, for the construction of investigation and monitoring bores
- pre-stripping, clearing and associated works for pits, dumps and infrastructure undertaken in accordance with the footprint and key characteristics originally specified in the CER
- provision of accommodation for part of the workforce in a regional accommodation hub being developed as part of the Proponent's long-term accommodation strategy.

2.16 Alternative options considered

Alternative options that have been considered for the Expansion Proposal include:

1. Backfilling options.
2. Mining and waste handling method to be implemented - use of truck and shovel or in-pit crushing and conveying.
3. Surplus water disposal options:
    - transfer to coastal supply or Tom Price
    - discharge to Duck Creek, Boolgeeda Creek, Caves Creek and/or Beasley River
    - evaporation from WFSF
    - storage and release
    - reinjection
    - discharge via pits
    - varying sizes/capacities for irrigated agriculture
    - various crops for irrigated agriculture.
4. Central vs. Nammuldi - locations for processing plant/rail /WFSF.
5. Locations and strategies for accommodation facilities.
6. Separate or joint processing plant for Nammuldi and Silvergrass.
7. Use and location of all approved infrastructure – e.g. WFSF location, accommodation locations, locations of waste dumps at Silvergrass and levees instead of creek diversion at Silvergrass.

Alternative options were also considered during the CER for the Original Project, and these are relevant to the Expansion Proposal. The location of the mine pits and waste dumps were essentially set by the location of the geological resource. However the following aspects of the Original Project considered alternative options:

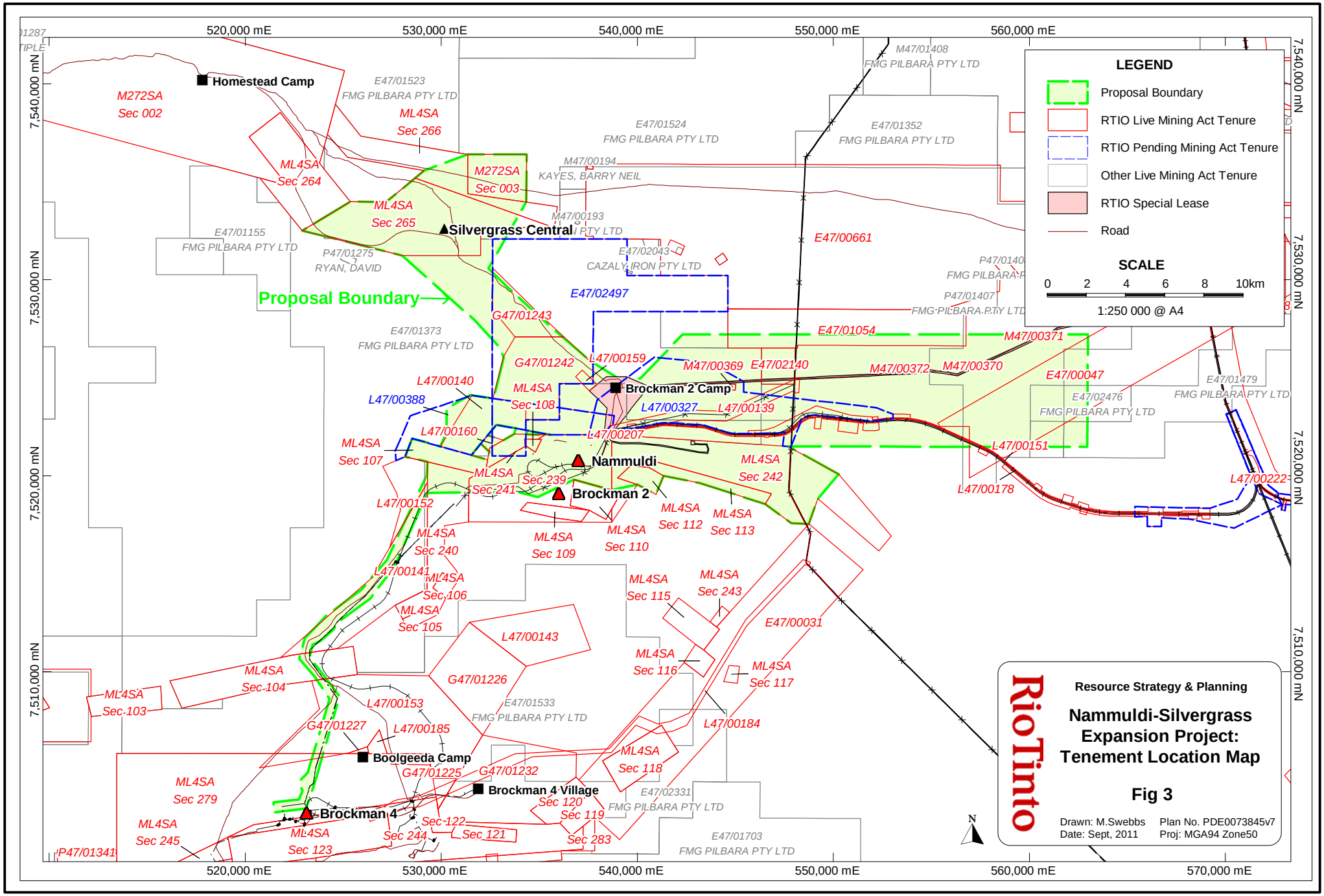
- transport of ore from Silvergrass to Nammuldi (refer to Section 1.4.1 of the CER) – conveyor is the preferred option to date
- handling and storage of tailings at Nammuldi (refer to Section 1.4.3 of the CER).

Some of these options were included in the CER and subject to environmental assessment by the EPA in 2000 to identify whether any undesirable environmental effects that require particular approaches to managing impacts were applicable to these options. Information identified from the CER was used by Hamersley Iron in selecting options.

2.17 Basis for justifying proposal and selecting preferred option

The Expansion Proposal is considered critical to ensuring the continued operation of Hamersley Iron business activities at Nammuldi-Silvergrass. The operation at Nammuldi currently produces approximately 6.6 Mtpa of iron ore. The Proponent has publicly announced its plan to expand its operations in the Pilbara to produce and ship 283 Mtpa of iron ore. Operation of the Nammuldi-Silvergrass mines is required in order to meet this target and sustain production at the required rate and product quality.

Iron ore is now the largest individual mineral sector by value in Western Australia accounting for 43.5% of the value of Western Australian resource output for 2008 (DMP 2009). Iron ore from Nammuldi is supplied to meet the growing demand from steel producing companies in Asia and Europe. The development of Nammuldi-Silvergrass will assist the proponent to continue to meet this demand.


520,000 mE
530,000 mE
540,000 mE
550,000 mE
560,000 mE
570,000 mE
7,540,000 mN
7,530,000 mN
7,520,000 mN
7,510,000 mN
Homestead Camp
Silvergrass Central
Proposal Boundary
Brockman 2 Camp
Nammuldi
Brockman 2
Boolgeeda Camp
Brockman 4 Village
Brockman 4
M272SA Sec 002
ML4SA Sec 264
ML4SA Sec 265
M272SA Sec 003
ML4SA Sec 266
ML4SA Sec 107
ML4SA Sec 108
ML4SA Sec 239
ML4SA Sec 241
ML4SA Sec 242
ML4SA Sec 109
ML4SA Sec 110
ML4SA Sec 112
ML4SA Sec 113
ML4SA Sec 240
ML4SA Sec 106
ML4SA Sec 105
ML4SA Sec 115
ML4SA Sec 243
ML4SA Sec 116
ML4SA Sec 117
ML4SA Sec 104
ML4SA Sec 103
ML4SA Sec 279
ML4SA Sec 245
ML4SA Sec 123
ML4SA Sec 122
Sec 244
Sec 121
Sec 120
Sec 119
Sec 283
ML4SA Sec 118
E47/01523 FMG PILBARA PTY LTD
E47/01524 FMG PILBARA PTY LTD
E47/01352 FMG PILBARA PTY LTD
M47/01408 FMG PILBARA PTY LTD
M47/00194 KAYES, BARRY NEIL
M47/00193
E47/01155 FMG PILBARA PTY LTD
P47/01275 RYAN, DAVID
E47/02043 CAZALY IRON PTY LTD
E47/00661
E47/02497
P47/01407 FMG PILBARA PTY LTD
E47/01373 FMG PILBARA PTY LTD
E47/01054
M47/00371
M47/00369
E47/02140
M47/00372
M47/00370
E47/00047
E47/01479 FMG PILBARA PTY LTD
E47/02476 FMG PILBARA PTY LTD
G47/01243
G47/01242
L47/00159
L47/00140
L47/00388
L47/00160
L47/00327
L47/00139
L47/00207
L47/00151
L47/00178
L47/00222
L47/00152
L47/00141
L47/00143
L47/00153
L47/00185
L47/00184
G47/01226
G47/01227
G47/01225
G47/01232
E47/01533 FMG PILBARA PTY LTD
E47/00031
E47/02331 FMG PILBARA PTY LTD
E47/01703 FMG PILBARA PTY LTD
P47/01341
LEGEND
Proposal Boundary
RTIO Live Mining Act Tenure
RTIO Pending Mining Act Tenure
Other Live Mining Act Tenure
RTIO Special Lease
Road
SCALE
0 2 4 6 8 10km
1:250 000 @ A4
N
Rio Tinto
Resource Strategy & Planning
Nammuldi-Silvergrass Expansion Project: Tenement Location Map
Fig 3
Drawn: M.Swebbs
Date: Sept, 2011
Plan No. PDE0073845v7
Proj: MGA94 Zone50

Resource Stratefy & Planning

Nammuldi-Silvergrass Expansion Project Conceptual Layout

Fig 4

Drawn: A.Eve
Date: Dec, 2011

Plan No. PDE0073845v8
Proj: MGA94 Zone50

510,000 mE 520,000 mE 530,000 mE 540,000 mE 550,000 mE 560,000 mE 570,000 mE 580,000 mE

7,540,000 mN 7,530,000 mN 7,520,000 mN 7,510,000 mN 7,500,000 mN 7,490,000 mN

Silvergrass
Nammuldi
Brockman 2
Brockman 4
Tom Price

Palm Springs (Aboriginal site)
South Mill Well
Caves Creek
Threatened Ecological Community (TEC)
Waterhole
Duck Creek
Donkey Hole
Waterhole
Semi permanent rockhole
Donkey Pool
Proposal Boundary
L 3114 1277
Hamersley Station - Pastoral
Irrigated Agriculture Area
Heavy Vehicle Transport Corridor
Creek
Spring
Boolgeeda
River
Beasley
L 3114 1166
Rocklea Station - Pastoral

LEGEND

- Proposal Boundary
- Marra Mamba BWT Pits
- Conceptual BWT Bedded Brockman Pit
- Proposed AWT Pits
- Waste Dump Area
- Pivots
- Pastoral Leases
- Threatened Ecological Community
- Proposed Infrastructure
- Contours
- Rio Tinto Tenure

N

SCALE
2 0 2 4 6km

525,000 mE 530,000 mE 535,000 mE 540,000 mE 545,000 mE 550,000 mE 555,000 mE 560,000 mE

7,535,000 mN 7,530,000 mN 7,525,000 mN 7,520,000 mN 7,515,000 mN

Threatened Ecological Community

Threatened Ecological Community

Transport Corridor

Transport Corridor

220kV Powerline
Dampier to Tom Price

Proposal Boundary

Process Plant

Waste Fines Storage Facility

Village Option (b)

Village Option (c)

Irrigated Agriculture Area

All Weather Road/ Powerline Corridor

Nammuldi Rail Loop

Central Thickened Tailings Facility

Pit 5

Pit4 & Pit6

Pit 3

Pit2

Pit 1

Pit 7

Brockman 2

Heavy Vehicle Corridor

LEGEND

Proposed Expansion

- Proposal Boundary
- Proposed BWT Marra Mamba Pits
- Conceptual BWT Bedded Brockman Pits
- Proposed AWT Pits
- Proposed Dumps
- Proposed Waste Fines Storage Facility
- Other Infrastructure

Approved Project

- Above Water Table Pits
- Below Water Table Pits
- Dumps
- Other Infrastructure & Disturbance

N

SCALE

1 0 1 2 3km

1:110 000 @ A3

RioTinto

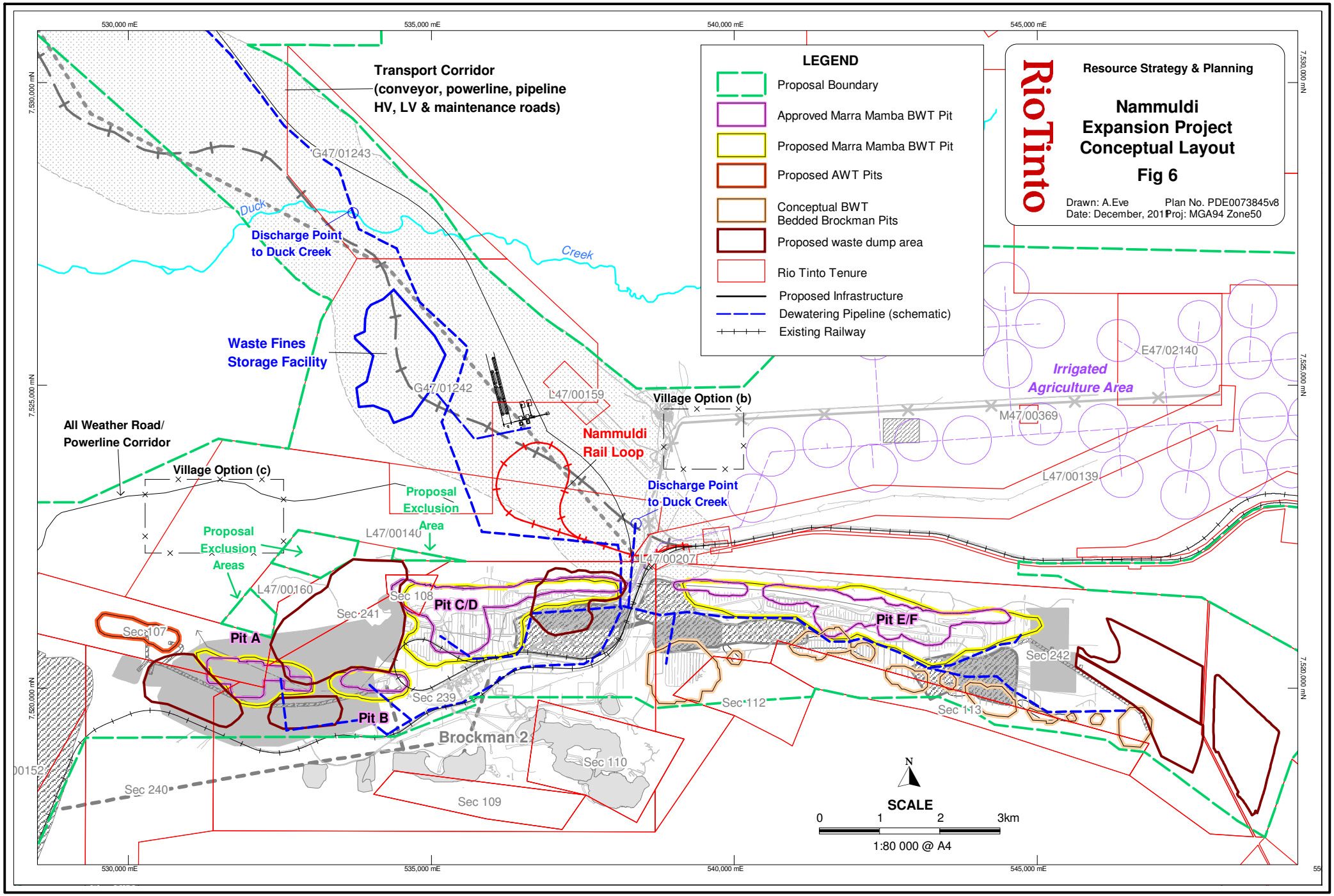
Resource Strategy & Planning

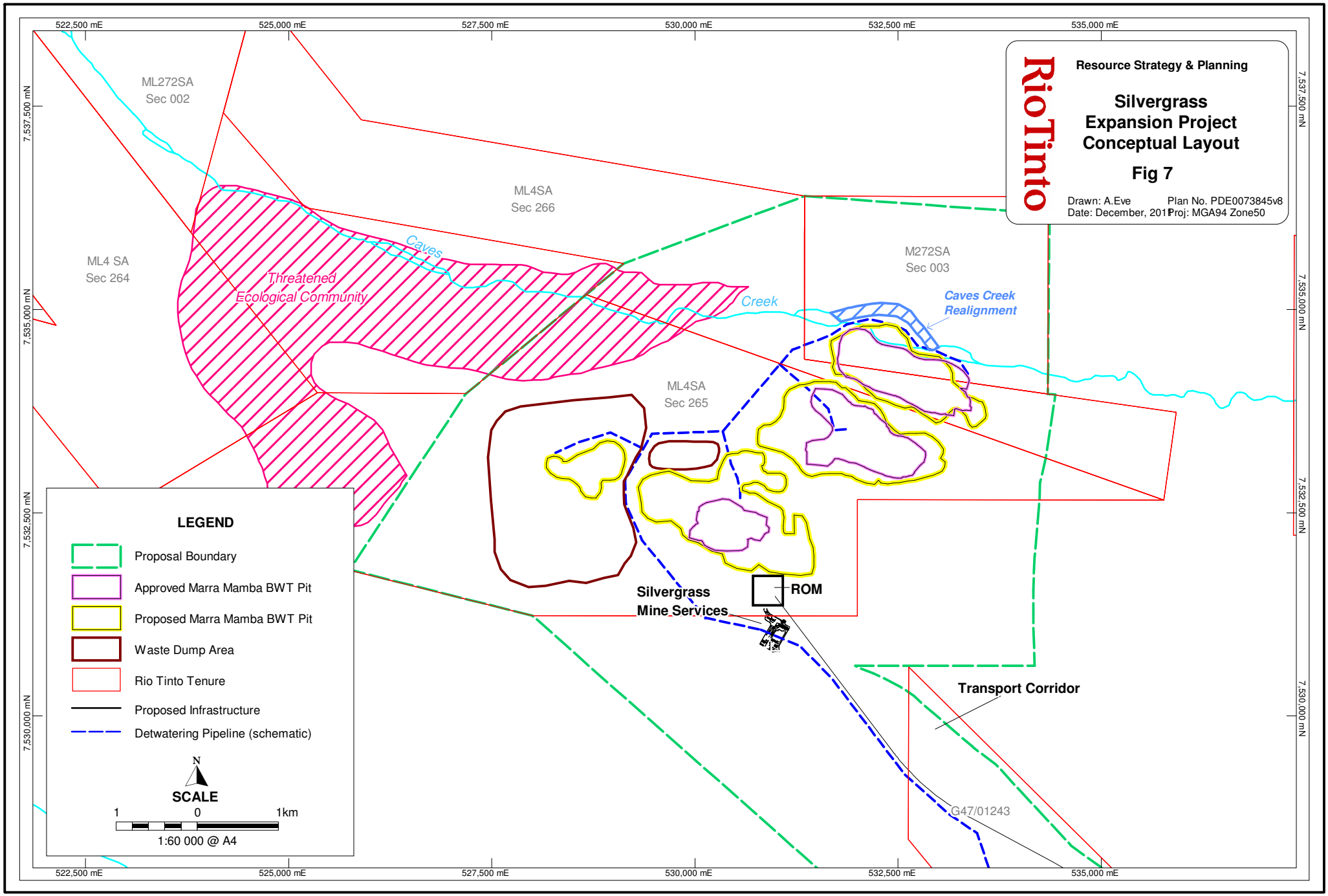
Nammuldi Silvergrass: Approved Project vs Proposed Expansion

Fig 5

Drawn: A.Eve
Date: December, 2011

Plan No: PDE0073845v8
Proj: MGA94 Zone50


LEGEND
Proposal Boundary
Approved Marra Mamba BWT Pit
Proposed Marra Mamba BWT Pit
Proposed AWT Pits
Conceptual BWT Bedded Brockman Pits
Proposed waste dump area
Rio Tinto Tenure
Proposed Infrastructure
Dewatering Pipeline (schematic)
Existing Railway
Resource Strategy & Planning
Nammuldi Expansion Project Conceptual Layout
Fig 6
Drawn: A.Eve
Date: December, 2011
Plan No. PDE0073845v8
Proj: MGA94 Zone50
Transport Corridor (conveyor, powerline, pipeline HV, LV & maintenance roads)
Discharge Point to Duck Creek
Waste Fines Storage Facility
All Weather Road/ Powerline Corridor
Village Option (c)
Village Option (b)
Nammuldi Rail Loop
Proposal Exclusion Area
Proposal Exclusion Areas
Irrigated Agriculture Area
Pit A
Pit B
Pit C/D
Pit E/F
Brockman 2
G47/01243
G47/01242
L47/00159
L47/00140
L47/00160
L47/00207
L47/00139
M47/00369
E47/02140
Sec 107
Sec 108
Sec 241
Sec 239
Sec 240
Sec 109
Sec 110
Sec 112
Sec 113
Sec 242
Duck Creek
530,000 mE
535,000 mE
540,000 mE
545,000 mE
7,530,000 mN
7,525,000 mN
7,520,000 mN
N
SCALE
0 1 2 3km
1:80 000 @ A4


Resource Strategy & Planning
Silvergrass Expansion Project Conceptual Layout
Fig 7
Drawn: A.Eve
Plan No. PDE0073845v8
Date: December, 2011
Proj: MGA94 Zone50
522,500 mE
525,000 mE
527,500 mE
530,000 mE
532,500 mE
535,000 mE
7,537,500 mN
7,535,000 mN
7,532,500 mN
7,530,000 mN
ML272SA
Sec 002
ML4SA
Sec 266
ML4 SA
Sec 264
M272SA
Sec 003
ML4SA
Sec 265
Caves
Creek
Threatened
Ecological Community
Caves Creek
Realignment
Silvergrass
Mine Services
ROM
Transport Corridor
G47/01243
LEGEND
Proposal Boundary
Approved Marra Mamba BWT Pit
Proposed Marra Mamba BWT Pit
Waste Dump Area
Rio Tinto Tenure
Proposed Infrastructure
Detwatering Pipeline (schematic)
N
SCALE
1
0
1km
1:60 000 @ A4

3. Regional setting of proposal

3.1 Physical environment

The climate of the Pilbara has been classified as arid tropical with two distinct seasons (Gentilli 1972). A hot summer period extends from November through to April and a cool winter period from May through to October. Daily maximum and minimum temperatures generally range from 25°C to 40°C during the summer months and from 12°C to 28°C during the winter months (BOM 2011). During the summer period, the relative humidity is extremely low, averaging between 10 - 20 %, rising only as high as 40 % in the mid winter.

Rainfall in the Pilbara is low with the mean annual rainfall for the Greater Nammuldi Area being only 400 mm (BOM 2011). The rainfall levels for the region are highly seasonal with up to 80% of the annual average falling between December and April. The number and intensity of tropical cyclones crossing the Pilbara coast is a major contributor to these seasonal rainfall fluctuations.

The Pilbara Region lies between two extensive sedimentary basins; the Canning Basin to the northeast and the Carnarvon Basin in the west. Geology in the area is dominated by Proterozoic meta-sediments which are overlain in the region by Tertiary regolith and valley-fill sediments. The Marra Mamba Iron Formation deposits at Nammuldi and Silvergrass share broad similarities in stratigraphy as the Nammuldi mine is located on the southern limb of the broad Jeerinah Anticline, while the Silvergrass mine is located on the northern limb.

The stratigraphy of the Nammuldi and Silvergrass mines is dominated by the Marra Mamba Iron Formation, with the Mount Newman Member (the orebody) containing high grade iron mineralisation. The Marra Mamba outcrop in the area is separated from the rugged Brockman Iron Formation outcrops by an area of variable valley-fill. Variably weathered Wittenoom Formation overlies the Marra Mamba in most intersected areas of the valley-fill. The Nammuldi and Silvergrass mines have experienced different patterns of folding and faulting but both have to some degree experienced low angle thrust faulting that has resulted in the repetition of the local stratigraphy and a greater thickness of Marra Mamba.

Overlying the Wittenoom Formation to the south of Lens E/F at Nammuldi is an isolated deposit of Brockman Iron Formation located to the north of the Brockman Iron Formation ridge line. Currently investigations are ongoing, but it is intended that this area will be the subject of additional smaller pits at Nammuldi to mine BWT Brockman ore.

The valley-fill sediments that overlay the ore bodies have a highly variable composition, dominated by clays and sandy clays. Modern drainage lines contain local accumulations of alluvial gravel and sands. At Silvergrass, terrestrial sedimentary deposits infill a steep palaeovalley called the Caves Creek Paleochannel, which contains alluvial deposits fining upwards from coarse sand and gravel. Local accumulations of alluvial sands and gravels occur in the modern Caves Creek drainage line.

Nammuldi is located at the headwaters of Duck Creek and Boolgeeda Creek regional catchments (Figure 4). Surface water flows exit the Nammuldi site through low points in the Nammuldi Range to the north, into the Duck Creek regional catchment; and to the south into the Boolgeeda Creek regional sub-catchment. Small catchments located above the deposits runoff into the site area. Surface flows are disrupted by existing road infrastructure associated with mining. There are no permanent pools or surface water in the immediate area of the Nammuldi site, although a seasonal soak is located to the east. Duck Creek has a total catchment of approximately 6500 km^2 and drains from east to west discharging into the Ashburton River.

Surface drainage at Silvergrass is dominated by Caves Creek, which flows towards the west and discharges to Duck Creek. Above Silvergrass, Caves Creek has a catchment of approximately 1100 km^2 that extends about 60 km. Caves Creek joins the Duck Creek approximately 40 km downstream of Silvergrass. The creek is underlain by valley-fill alluvium that has either eroded from the high Brockman Ridge to the north or been transported to the area by riparian forces. Palm Springs is a permanent groundwater-fed spring sourced from creek alluvium and is approximately 30 km downstream of Silvergrass where the creek is underlain by calcrete.

Pit 1 at Silvergrass directly intersects Caves Creek, and Pit 5 is located within the 100 ARI flood plain of the creek.

3.2 Biological environment

The Greater Nammuldi Area is located within the Hamersley sub-region of the Pilbara Biogeographic Region as per the Interim Biogeographic Regionalisation for Australia (IBRA) (Environment Australia 2000). The Hamersley sub-region is a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by basalt, shale and dolerite gorges. Ranges within the sub-region typically feature *Eucalyptus leucophloia* (Snappy Gum) over Spinifex on skeletal soils. Valley floors within the subregion generally comprise low mulga woodlands over hummock grasses on fine textured soils (Kendrick 2001).

The region has been heavily grazed, firstly by sheep then (since 1970) by cattle. Grazing and periodic wild fires (from lightning strikes) as well as construction and clearing in relation to mining activities; represent recent and historical threatening processes to flora and vegetation in the area.

Karijini National Park is located 60 km to the east of Nammuldi and is the second largest national park in WA, covering 6274 km^2. Millstream-Chichester National Park is 75 km to the north of Silvergrass and is the location of spectacular landforms and the fresh water springs of Millstream. Both Karijini and Millstream protect a variety of different wildlife habitats, landscapes, plants and animals of the Pilbara. They are also home to a variety of birds, mammals and reptiles, including a number of DEC listed Threatened species (DEC 2010a).

A number of biological surveys have been conducted in the Greater Nammuldi Area with the aim of recording species present as well as identifying species and communities of conservation significance. The key surveys in the area are detailed in Table 4.

Table 4 Biological surveys conducted in the vicinity of the Proposal Boundary

Survey	Reference
Vegetation and flora	
Homestead Biological Survey	Hamersley Iron 1996
Vegetation and Flora Survey of the Nammuldi Trial Operation	Halpern Glick Maunsell 1998
Vegetation, Flora and Soils survey of Nammuldi/Silvergrass	Halpern Glick Maunsell 1999a
Vegetation and Flora survey of the Nammuldi/Silvergrass transport corridor	Halpern Glick Maunsell 1999b
Various rare flora searches conducted by Pilbara Iron botanists	Pilbara Iron 2006
Botanical Survey Work for Silvergrass West – Marra Mamba Evaluation Drilling	Pilbara Iron 2007a
Botanical Survey Work for Nammuldi- Lens A&B	Pilbara Iron 2007b
Botanical Survey Work for the B4R Regrade & B4R Rail Construction Camp	Pilbara Iron 2007c
Vegetation and Flora Survey of Powerline corridor for the BS4 Project	Biota 2007a
Regional Survey for *Ptilotus* sp. Brockman, *Aluta quadrata* and *Geijera* aff. *salicifolia*	Biota 2007b
Vegetation and Flora Survey of Nammuldi Expansion Areas	Biota 2010a
Vegetation and Flora Survey of Nammuldi Infill Areas	Biota 2010b
Vegetation and Flora Survey of Silvergrass West	Biota 2010c
Flora and Vegetation of the Greater Nammuldi Irrigated Agriculture Survey Area	Mattiske 2011
Riparian vegetation	
Preliminary Ecological Assessment of Creek Systems Potentially Affected by Proposed Developments in the Greater Nammuldi Area August 2009	Biota 2010d
Greater Nammuldi Creeks Monitoring – Report on Riparian Vegetation 2010	Biota 2010e
Greater Nammuldi Creeks Monitoring – Report on Riparian Vegetation 2011	Biota 2011a, report in preparation

Survey	Reference
Terrestrial fauna	
Homestead Biological Survey	Hamersley Iron 1996
Biological Survey Report for the Nammuldi/Silvergrass Exploration Project	Hamersley Iron 1999
Level 1 Fauna Assessment of the Approved Powerline Corridor for the BS4 Project	Biota 2007c
Targeted Terrestrial Fauna Survey of Expansion areas at Nammuldi-Silvergrass	Biota 2009a
Targeted Terrestrial Fauna Survey of B2 Pit 7 Extension Areas	Biota 2009b
Survey of Vertebrate Fauna, SRE and Habitat at Silvergrass West	Biota 2009c
Fauna Survey of Nammuldi Infill Areas	Biota 2010f
Brockman 2 Sustaining Tonnes Targeted Fauna Survey	Biota 2010g
Vertebrate Fauna survey of the Agriculture Area	Ecologia 2011a, report in preparation
SRE survey of the Agriculture Area	Ecologia 2011b, report in preparation
Aquatic fauna	
Nammuldi-Silvergrass Project – November 2009 & April 2010 Sampling	WRM 2010
Nammuldi-Silvergrass Project October 2010 & March 2011 Sampling	WRM 2011, report in preparation
Subterranean fauna	
Subterranean Fauna Assessment of Nammuldi-Silvergrass	Biota 2010h
Nammuldi-Silvergrass Troglobitic Fauna Assessment	Biota 2011b

A number of vegetation types have been identified by the flora and vegetation surveys, which can be categorised according to the following seven major landform units:

1. **Low hills, slopes and rocky, undulating plains** dominated by Acacia shrubland over Spinifex (predominantly *T. pungens*) and Eucalyptus woodland (*Eucalyptus leucophloia*).
2. **Undulating valley floor** dominated by Acacia (*Acacia aneura*) tall open shrubland over Golden Beard Grass (*Chrysopogon fallax*) open tussock grassland over Spinifex (*Triodia epactia*) open hummock grassland.
3. **Drainage areas** dominated by dense Acacia (predominantly *Acacia aneura*) tall shrubland and tall Eucalyptus (*Eucalyptus camaldulensis/E. victrix*) woodland.
4. **Mesas** dominated by Eucalyptus (*Eucalyptus leucophloia*) low open woodland over Spinifex (*Triodia epactia*) hummock grassland.
5. **Plains and foothills** dominated by scattered low trees (*Corymbia hamersleyana* and *Eucalyptus leucophloia*) over Acacia shrubland (*Acacia atkinsiana, A. exilis*) over Spinifex (*Triodia epactia*) hummock grassland.
6. **Hillcrests and slopes** dominated by Eucalyptus (*Eucalyptus leucophloia*) and Acacia (*Acacia aneura*) low open woodland over Spinifex (*Triodia wiseana*) hummock grassland.
7. **Cracking clay soils;** dominated by low shrubland (*Senna artemisioides, Eremophila maculata*) over herbland.

The cracking clay site, located immediately east of Silvergrass, contains two vegetation communities of elevated conservation significance:

- *Themeda sp.* Grasslands Threatened Ecological Community (TEC) (46). The *Themeda sp.* grasslands on cracking clays (Hamersley Station, Pilbara) consist of grassland plains dominated by the perennial *Themeda sp.* (kangaroo grass) and many annual herbs and grasses (DEC 2009).
- Brockman Iron cracking clay Priority Ecological Community (PEC) (Priority 1). The Brockman Iron cracking clay PEC is a rare tussock grassland dominated by *Astrebla lappacea* in the Hamersley Range, on the Newman land system (DEC 2009).

Flora and vegetation values mapped within the Proposal Boundary are described in detail in Section 5.3.

Fauna habitats in the area have been defined and classified according to vegetation units (Biota 2010b). The habitat values within the Proposal Boundary are consistent with the available regional habitat, as there are no restricted or uncommon geological units or land systems within the Proposal Boundary (Biota 2010b). The fauna habitats associated with cracking clay soils may be considered to be of conservation significance due to local restriction, as outlined in Section 5.4.

The fauna assemblage present in the Proposal area is considered to comprise species that have either been recorded during pre-CER surveys or during more recent surveys as well as species that have either been indicated as potentially occurring on DEC NatureMap Database or the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) EPBC Act Protected Matters Database. Surveys conducted for the CER and recent surveys recorded a number of terrestrial species whose abundance and distribution is considered to be typical of the Pilbara region.

Recent surveys also covered potential Short-Range Endemic (SRE) species, which were not considered in the CER. Although a number of invertebrate fauna have been collected, these specimens are considered unlikely to represent SRE species as they did not appear to be restricted to particular habitat or vegetation types (Biota 2009a, 2009c and 2010c).

Details of terrestrial vertebrate fauna and invertebrate fauna found within the Proposal Boundary are addressed in further detail in Section 5.4.

There has been an increase in subterranean fauna surveys in WA over the past decade, revealing an exceptionally high diversity, particularly in the Pilbara region (Humphreys 2006, Humphreys et al. 2004). Research by the WA Museum has shown that calcrete and alluvial aquifers in the Pilbara and Yilgarn regions of Western Australia contain diverse stygofaunal communities (Humphreys 1999).

There have been a number of surveys conducted in the Greater Nammuldi Area in order to identify and record the presence of subterranean fauna. Five phases of stygofauna sampling were conducted at Nammuldi and Silvergrass (May 1999, October 1999, November 2000, May 2001, July 2002), after which stygofauna were no longer considered to be a factor at Nammuldi. Additional stygofauna sampling was conducted in May 2009 at Silvergrass. Troglofauna sampling was conducted at Silvergrass during May 2009 sampling period, and then at both Nammuldi and Silvergrass in April and July 2010.

The subterranean fauna values found to occur within the Proposal Boundary are discussed in Section 5.5.

3.3 Social environment

The Expansion Proposal is located 65 km north of the town of Tom Price, in the Shire of Ashburton, Western Australia (Figure 1). Tom Price was established in 1966 by the Proponent to support mining at Mt Tom Price and had a population of approximately 3600 in 2006. Nearby Paraburdoo (60 km south of Tom Price) was established in 1971 to support mining at Paraburdoo (and later Channar) and had a population of approximately 1700 in 2006. A large percentage of the employment in these towns is for RTIO projects. While Paraburdoo remains primarily dependent on mining, Tom Price also acts as a local government centre and a hub for tourism in the area.

The Nammuldi-Silvergrass operation is located on Hamersley Station, which covers an area of 302 000 ha. The Hamersley Pastoral Lease (CL No. 742/1993) is held by the Proponent and is operated by a Station Manager who, along with station staff, is housed at the station homestead situated approximately 40 km north east of the Nammuldi mine. The area has historically been used for pastoral purposes, namely sheep (until 1970) and cattle grazing, with the station being active for over 100 years.

The Nammuldi and Silvergrass deposits are located within Mineral Lease No. 4SA which was granted under the Iron Ore (Hamersley Range) Agreement Act 1963. A section of the Silvergrass deposit is located within Mineral Lease No. 272SA which was also granted under the *Iron Ore (Hamersley Range) Agreement Act 1963*.

The Proponent holds tenure for both deposits and the connecting ore transport corridor under the *Land Administration Act 1997*. This consists of Hamersley Pastoral Station, along with leases for the existing Brockman 2 rail, access road and accommodation village. The proposed irrigated agricultural operation will be

located wholly within Hamersley Station. In addition, the Proponent holds the Rocklea Pastoral Station that abuts Hamersley Station to the south and that underlies the existing infrastructure corridor between Brockman 2/Nammuldi and Brockman 4.

The Proponent also operates the Brockman 2 site immediately to the south and Brockman Syncline 4 approximately 20 km south west of Nammuldi.

The Expansion Proposal lies within the Eastern Guruma Native Title Determination Area and, therefore, the Eastern Guruma Native Title Holder is recognised as the group that can represent the area. The Proponent takes direction from Eastern Guruma in all matters, including which other groups may have an interest in the area and has an established Indigenous Land Use Agreement with Eastern Guruma. Other adjacent Native Title claimants, who also have an interest in this area, in particular Palm Springs, are Kuruma Marthudunera, and Puutu Kunti Kurrama and Pinikura (PKKP).

A number of archaeological and ethnographic surveys have been conducted in the area to identify and record sites of Aboriginal cultural significance. These surveys were mostly conducted in consultation with the Eastern Guruma Native Title Holder for the preparation of the CER.

4. Environmental impacts and management

4.1 General environmental management

Hamersley Iron mine sites operate under an ISO14001 certified Environmental Management System (EMS). ISO14001 is an internationally recognised continuous improvement model. The key elements of ISO14001 include assessing environmental risk and legal requirements, developing objectives and targets for improvement, training, operational control, communication, emergency response, corrective actions, audits and review.

The current Nammuldi operation is managed in conjunction with the adjacent Brockman 2 mine. However, the two mines are subject to different Ministerial Statements and have their own Environmental Management Plans (EMP). The current operation is managed under the Nammuldi AWT EMP.

A Construction Environmental Management Plan (CEMP) will be developed and implemented for construction and commissioning of the Expansion Proposal. The EMS and EMP will be updated as necessary to reflect the requirements of the Expansion Proposal.

4.2 Scoping of relevant factors

The scoping process utilised EPA guidelines, environmental risk assessment, Proponent experience and preliminary stakeholder consultation to identify environmental factors potentially affected by the Expansion Proposal. The process identified eight key environmental factors requiring detailed assessment (Table 5). Other factors not requiring detailed assessment that were not considered to have a significant environmental effect and/or can be readily managed, are listed in Section 4.4.

4.3 Key environmental factors identified

The environmental factors relevant to this Expansion Proposal that were identified through the scoping process are presented in Table 5, together with a reference to the section in which they are addressed.

Table 5 Key environmental factors identified

Category	Environmental factor	Section
Physical	Groundwater (including irrigated agriculture)	5.1
	Surface water (including aquatic fauna)	5.2
	Geochemical risks (including acidic and metalliferous drainage and asbestiform material)	5.6
	Closure	5.8
Biological	Flora and vegetation (including TEC and riparian vegetation)	5.3
	Terrestrial fauna	5.4
	Subterranean fauna (Stygofauna/Troglofauna)	5.5
Social	Aboriginal Heritage	5.7

4.4 Other environmental factors

Four environmental factors have been identified as requiring less detailed assessment in the environmental impact assessment process, as they can be managed through standard operating procedures and regulations that will be described in the impact assessment:

- noise
- waste (non-mineral)
- air quality (particulate emissions)
- greenhouse gas

A description of these environmental factors is provided in Section 5.9.

5. Scope of Work for Public Environmental Review

The Scope of Work proposed for Public Environmental Review (PER) of the key environmental factors is described in sections 5.1 to 5.8 below.

5.1 Groundwater

5.1.1 Overview

The EPA environmental objectives for groundwater are:

> *To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*
>
> *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.*

Nammuldi

The primary aquifer at Nammuldi is associated with the mineralised Mount Newman Member that forms the ore body at Nammuldi (the ore body aquifer). When saturated, the overlying Wittenoom Formation and valley-fill material host significant volumes of groundwater in hydraulic connection with the ore body aquifer. The underlying Marra Mamba Iron Formation Members (of the footwall) form an effective hydraulic barrier to groundwater flow. The overlying boundary to groundwater flow is generally considered to be where either un-weathered, competent Wittenoom Formation or the Mount Sylvia Formation crop out. No groundwater-dependent ecosystems have been identified within this valley.

Previous conceptual models of the hydrogeology suggested the ore body aquifer was confined by the overlying West Angelas Member; however, water levels from hydrogeological drilling programs in 2008 and 2009 show low hydraulic gradients between the different units (URS 2010a). Based on the available groundwater levels, the valley-fill, the Wittenoom Formation and the ore body appear to be in hydraulic connection (URS 2010a).

Information available to date in the area of the bedded Brockman Iron Formation south of Lens E/F is limited. It is currently proposed that this area will be the subject of further phases of investigation, with ongoing reports to be made available, additional to the information presented in the PER. The conceptual pit location has been included in the Expansion Proposal to identify the full extent of potential development.

Silvergrass

The primary aquifer in the Silvergrass area coincides with the mineralised sections of the Mt Newman Member of the Marra Mamba Iron Formation. The overlying Wittenoom Formation is highly variable in transmissivity, ranging from the highly transmissive Paraburdoo Member to the moderate to low transmissive West Angelas Member (URS 2010b). The valley-fill material in and around Caves Creek varies in transmissivity from moderate to high.

The watertable at Silvergrass generally follows the topography of Caves Creek. Groundwater flows from east to west along the ore body aquifer and valley-fill sediments. The gradient is not uniform, which probably reflects the distribution of transmissive units within a sequence that is generally clayey and of low transmissivity.

5.1.2 Potential sources of environmental impact to be addressed/managed

The following aspects of the Expansion Proposal may affect environmental values associated with groundwater levels and flows:

- **dewatering** of the mining area to allow access to the ore will lower the watertable in the ore body aquifer, which has the potential to affect sensitive groundwater-dependent ecosystems and heritage sites
- **discharging surplus water** to creek systems may elevate the watertable locally and provide a more constant flow regime, which may change the composition of vegetation communities over time
- **changes to landforms and hydraulic properties within backfilled pits after closure** will alter natural groundwater flow, which has the potential to affect groundwater levels and quality,
- **groundwater contamination** from Acid and Metalliferous Drainage (AMD) or hydrocarbon spills may affect groundwater quality
- **application of water for irrigated agriculture** has the potential to elevate the watertable locally, which can affect the composition of adjoining vegetation communities over time if rise is sufficiently high to saturate the rootzone of tree species.

5.1.3 Scope of assessment

The PER will:

- provide estimates of dewatering rate and the extent of groundwater drawdown associated with dewatering the Marra Mamba pits at Nammuldi and Silvergrass
- summarise known information on the bedded Brockman Iron Formation pit south of Lens E/F, with recommendations for further work to estimate any dewatering requirement
- outline the baseline water quality within the Proposal Boundary
- describe the connectivity of the groundwater in different lithologies within the Proposal Boundary
- provide an estimate of water use requirements and a preliminary site water balance
- assess potential environmental impacts of groundwater abstraction on groundwater-dependent vegetation and surface water values
- describe the proposed surplus water management strategy and assess the potential environmental and social impacts and economic and engineering constraints of each of the options, including discharge to creek lines
- describe proposed management strategies for potential sources of groundwater contamination
- include a Groundwater Management Plan within the Environmental Management Plan (EMP).

5.1.4 Supporting investigations and studies

Supporting investigations and studies for this factor include:

- hydrogeological investigations and modelling of the Marra Mamba Iron Formation at Nammuldi and Silvergrass, to update predictions of dewatering rates, extent of drawdown and hydraulic connectivity between the different lithologies within the Proposal Boundary
- sampling to determine existing water quality
- investigation of options for excess water disposal with consideration given to potential environmental and social impacts and economic and engineering constraints.

Supporting studies and investigations have been/will be undertaken by both internal RTIO hydrogeologists and external consultant hydrogeologists.

5.2 Surface water

5.2.1 Overview

The EPA environmental objectives for surface water are:

> *To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*
>
> *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.*

Both Nammuldi and Silvergrass sites occur on low undulating hills separated from the steep escarpments by an area of valley-fill. At Nammuldi, elevations of the site range from 630 m AHD in the east to 600 m AHD in the west. At Silvergrass, elevations range between 570 m AHD in the south to 560 m AHD in the north.

The Nammuldi deposit is located at the headwaters of the Duck Creek and Boolgeeda Creek regional catchments. The Nammuldi pits are situated in a valley sub-catchment where surface water flows exit the valley north through several low points in the Nammuldi Ridge to the Duck Creek regional catchment and south to the Boolgeeda Creek regional sub-catchment. The area receives runoff from small catchments above the deposits. Surface water flows are disrupted by road infrastructure associated with mining. There are no permanent pools or surface water in the immediate area of the deposit. There is an area to the east of Nammuldi that floods periodically.

The Silvergrass deposit is located between a steep Brockman range along the northern side of Caves Creek and a low-lying Marra Mamba ridge on the southern side. Surface drainage at Silvergrass is dominated by Caves Creek, which flows towards the west. Caves Creek has a considerable catchment that extends about 60 km to the east, upstream of Silvergrass and is subject to flooding following cyclonic rainfall events. The Caves Creek catchment joins with the Duck Creek catchment approximately 40 km downstream of Silvergrass.

East of the Hamersley Station Homestead and the Hamersley Iron Tom Price-Dampier railway, lies a large flat plain stretching 15 km with little change in elevation (596 – 600 m AHD). During floods, water on the plain can flow west down Caves Creek, but most water runs north down Weelumurra Creek and eventually into the Fortescue River.

No conservation significant wetlands occur on Caves Creek at Silvergrass although there are several permanent flowing pools throughout Caves and Duck creeks. The most substantial permanent pool in the vicinity of the Expansion Proposal, Palm Springs, is located 30 km downstream of Silvergrass on Caves Creek and is a permanent groundwater-fed spring sourced from creek alluvium.

5.2.2 Potential sources of environmental impact to be addressed/managed

The following aspects of the Expansion Proposal may affect surface water values associated with dewatering of the regional aquifers and discharge of excess water back into the environment, and construction of mine pits, dumps and related infrastructure:

- **dewatering** at Silvergrass will result in drawdown in the superficial aquifer along Caves Creek which may potentially modify the hydrological conditions of the watercourse and has the potential to affect vegetation and fauna habitats
- **discharging surplus water** into Duck Creek will locally saturate the alluvium and modify the hydrological regime (quantity and quality) including affecting permanent pools, riparian vegetation and aquatic fauna habitat
- **constructing the channel diversion** in Caves Creek at Silvergrass may increase the velocity of the water and cause erosion, which would alter water quality and flows in Caves Creek

- **modifying landforms** through the construction of pits, dumps and infrastructure will affect generation of sheet flow, which may affect vegetation that is dependent on flows (where flows are reduced) or affect vegetation sensitive to inundation (where flows are increased and/or ponding introduced/prolonged)
- **contamination** of surface water is possible from suspended solids, hydrocarbon spills, acidic and/or metalliferous drainage within mining areas
- **runoff from disturbed areas and overburden dumps** may result in increased sediment transport to watercourses.

5.2.3 Scope of Assessment

The PER will:

- characterise baseline hydrological regimes, water quality and aquatic fauna habitat for watercourses that may be affected by the proposal
- assess the potential impacts on surface water levels as a result of dewatering
- assess the potential impacts on water quality and aquatic fauna as a result of the discharge of surplus water into Duck Creek
- determine appropriate design criteria for the diversion of Caves Creek with regard to environmental and social impact and economic and engineering constraints
- identify hydrological drivers for the cracking clay TEC and assess the impact to the TEC from the modification of landform within the TEC sub-catchment
- describe proposed management strategies to minimise surface water contamination
- include an adaptive Surface Water Management Plan within the EMP for the discharge of surplus water to Duck Creek that includes potential monitoring regime, possible trigger levels and contingencies
- describe the proposed surplus water management strategy and assess the potential environmental and social impacts and economic and engineering constraints of each of the options, including discharge to creek lines
- assess the impact of discharging surplus water to natural creek lines on the basis of:
    - modelling of the extent of discharge, including hydrology and hydrogeology
    - environmental values
    - sensitivity of receiving environment
    - water quality (baseline and release)
    - ecology, including flora (including weeds) / fauna / invertebrate surveys of impact areas(baseline).
- assess the impact of providing water to the Irrigated Agriculture Area on the basis of:
    - modelling of the extent of clearing
    - environmental values
    - sensitivity of receiving environment
    - water quality (baseline and irrigation)
    - ecology, including flora (incl. weeds) ,fauna / invertebrate surveys of impact areas(baseline).

5.2.4 **Supporting investigations** and studies

Supporting studies and investigations for this factor include:

- results of investigations to determine baseline hydrological regimes, water quality, and aquatic fauna habitat for watercourses that may be affected by the proposal
- characterisation of the hydroecology (including the geomorphology of the creek bed, vegetation density and composition in the riparian zone) of the existing systems of Caves Creek and Duck Creek and assess the potential for surface water expression downstream of discharge location(s)
- investigation into hydrological drivers for cracking clay TEC at Silvergrass including study of overland flows and ARI flood levels
- investigation of the potential implications on flooding regimes of landform modification and surface water diversion.

Supporting studies and investigations have been/will be undertaken by both internal RTIO hydrologists and external consultant hydrologists (including URS), and aquatic fauna specialists (Wetland Research and Management).

5.3 Flora and vegetation (including threatened ecological community and riparian vegetation)

5.3.1 Overview

The EPA environmental objective for vegetation and flora is:

> *To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*

A number of flora and vegetation surveys have been undertaken in the Greater Nammuldi region with the aim of mapping vegetation communities and flora species present as well as identifying species and communities of conservation significance (Hamersley Iron 1996, 1999; Biota 2007a, 2010a, 2010b and 2010d; Mattiske 2011). The extent of vegetation surveys is shown in Figure 8.

Site surveys within the Proposal Boundary have collectively identified 51 vegetation communities, 14 of which were located within the irrigated agriculture area (Biota 2010a, 2010b, 2010c and Mattiske 2011). These communities can be categorised according to the following seven major landform units:

- low hills, slopes and rocky, undulating plains
- undulating valley floor
- drainage areas
- mesas
- plains and foothills
- hillcrests and slopes
- cracking clay soils.

The majority of vegetation types within the Proposal Boundary are considered to be widespread and representative of the Pilbara bioregion. However, several vegetation communities of locally high conservation significance were recorded, primarily the riparian vegetation of major creek lines and the vegetation communities of the cracking clay plains.

The cracking clay site, located immediately west of Silvergrass, contains two vegetation communities of elevated conservation significance:

- *Themeda sp*. Grasslands TEC (46). The *Themeda sp*. grasslands on cracking clays (Hamersley Station, Pilbara) consist of grassland plains dominated by the perennial *Themeda sp*. (kangaroo grass) and many annual herbs and grasses (DEC 2009).
- Brockman Iron cracking clay PEC (Priority 1). The Brockman Iron cracking clay PEC is a rare tussock grassland dominated by *Astrebla lappacea* in the Hamersley Range, on the Newman land system (DEC 2009).

As the PEC consists of small patches of *Astrebla lappacea* grasslands that fringe the TEC, the boundary used in the TEC (shown in Figure 4) includes the occurrences of the PEC. The PEC lies outside of the Proposal Boundary, in the western portion of the TEC.

These communities are considered to be threatened by heavy grazing, mining and infrastructure developments. The *Themeda sp*. Grasslands TEC occurs along Caves Creek, at two other locations upstream of the Silvergrass site, with the largest occurrence on Hamersley Station located south of the Hamersley Station Homestead (shown on Figure 4). Similar communities have been recorded at West Angelas, Newman and Tom Price (DEC 2009).

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* and listed by the DEC have been located within the Proposal Boundary to date. Further, a search of the DEC NatureMap Database conducted in February 2010 (area covering greater than 400 000 ha) indicated that no DRF species had the potential to occur in the area. Details of this search are included in full in Appendix 2.

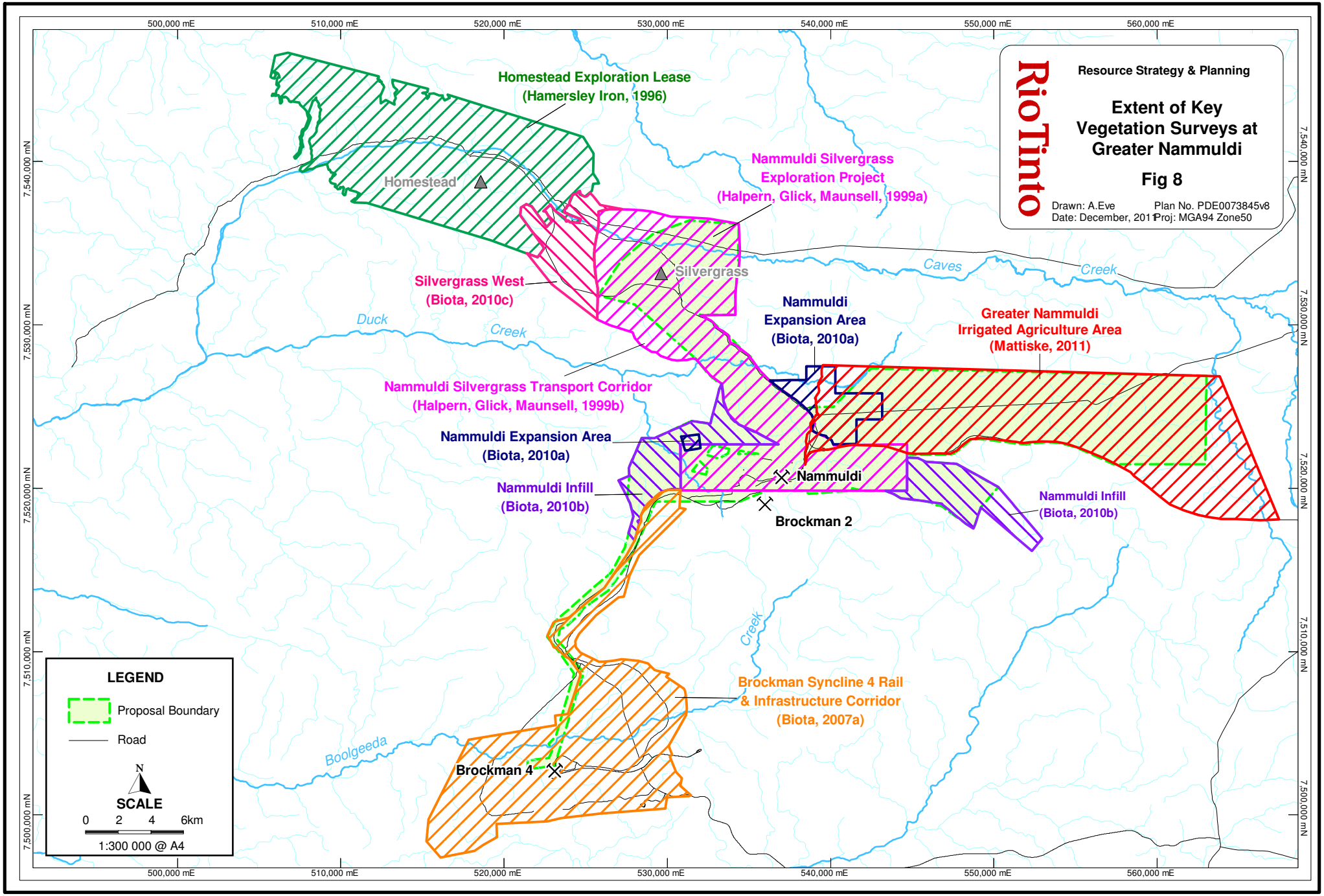
No plant taxon listed as Threatened pursuant to Schedule 1 of the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Australian Government) have been recorded during surveys conducted in the area. While the online EPBC Act protected matters search tool indicates that Hamersley Lepidium, Hamersley Catapycnon (*Lepidium catapycnon*) – Vulnerable, has the potential to occur in the area, extensive surveys have not recorded any populations within the Proposal Boundary.

The following Priority Flora species have been recorded during surveys of the Greater Nammuldi Area:

- *Calotis squamigera* (Priority 1)
- *Sida* sp. Hamersley Range (Priority 1)
- *Abutilon* sp. *Quobba* (Priority 2)
- *Spartothamnella puberula* (Priority 2)
- *Vigna* ?sp. Central (M.E. Trudgen 1626) (Priority 2)
- *Astrebla lappacea* (Priority 3)
- *Dampiera anonyma* (Priority 3)
- *Eremophila magnifica* subsp. *velutina* (Priority 3)
- *Gymnanthera cunninghamii* (Priority 3)
- *Indigofera gilesii* subsp. *gilesii* (Priority 3)
- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301) (Priority 3)
- *Ptilotus subspinescens* (Priority 3)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3)
- *Rostellularia adscendens* var. *Latifolia* (Priority 3)
- *Sida* sp. Barlee Range (Priority 3)
- *Swainsona* sp. Hamersley Station (A.A Mitchell 196) (Priority 3)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (Priority 3)
- *Acacia bromilowiana* (Priority 4)
- *Eremophila magnifica* subsp. *magnifica* ms (Priority 4)
- *Goodenia nuda* (Priority 4)
- *Ptilotus mollis* (Priority 4).

In addition, the search of the DEC NatureMap Database (report included in full in Appendix 2), indicated that the following priority species had the potential to occur in the Proposal Boundary:

- *Ptilotus mitchellii* (Priority 1)
- *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) (Priority 1)
- *Genus* sp. Hamersley Range hilltops (S. van Leeuwen 4345) (Priority 1)
- *Helichrysum oligochaetum* (Priority 1)
- *Spartothamnella puberula* (Priority 2)
- *Acacia bromilowiana* (Priority 3)
- *Glycine falcate* (Priority 3)
- *Iotasperma sessilifolium* (Priority 3)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3)
- *Rhynchosia bungarensis* (Priority 3)
- *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420) (Priority 3)
- *Livistona alfredii* (Priority 4)
- *Notoscincus butleri* (Priority 4).


RioTinto
Resource Strategy & Planning
Extent of Key Vegetation Surveys at Greater Nammuldi
Fig 8
Drawn: A.Eve
Plan No. PDE0073845v8
Date: December, 2011
Proj: MGA94 Zone50
Homestead Exploration Lease (Hamersley Iron, 1996)
Homestead
Nammuldi Silvergrass Exploration Project (Halpern, Glick, Maunsell, 1999a)
Silvergrass
Silvergrass West (Biota, 2010c)
Caves Creek
Duck Creek
Nammuldi Expansion Area (Biota, 2010a)
Greater Nammuldi Irrigated Agriculture Area (Mattiske, 2011)
Nammuldi Silvergrass Transport Corridor (Halpern, Glick, Maunsell, 1999b)
Nammuldi Expansion Area (Biota, 2010a)
Nammuldi
Nammuldi Infill (Biota, 2010b)
Brockman 2
Nammuldi Infill (Biota, 2010b)
Creek
Brockman Syncline 4 Rail & Infrastructure Corridor (Biota, 2007a)
Boolgeeda
Brockman 4
LEGEND
Proposal Boundary
Road
N
SCALE
0 2 4 6km
1:300 000 @ A4
500,000 mE
510,000 mE
520,000 mE
530,000 mE
540,000 mE
550,000 mE
560,000 mE
7,540,000 mN
7,530,000 mN
7,520,000 mN
7,510,000 mN
7,500,000 mN

5.3.2 Potential sources of environmental impact to be addressed/managed

The following aspects of the Expansion Proposal may affect flora and vegetation values:

- **clearing of additional vegetation** will directly reduce the extent of vegetation communities, including vegetation communities of local conservation significance, and potentially disturb Priority Flora species
- **disruption of sheet flows** through extension of mine pits, and construction of additional waste dumps, infrastructure and diversion structures has the potential to have an impact on vegetation communities that are sustained by sheet flow
- **additional dewatering at Silvergrass** will lower ground water levels in proximity to the pits and therefore may affect groundwater-dependent vegetation
- **discharge of surplus water** may alter the composition of vegetation communities downstream of the discharge
- **vehicle movements and earthworks** have the potential to introduce and spread weed species
- **dust generation** due to earthworks, mining, processing and vehicle movements has the potential to smother vegetation.

5.3.3 Scope of Assessment

The PER will:

- identify flora species and vegetation communities that are considered to be rare, threatened, vulnerable, are geographically restricted or occur as range extensions and assess their regional and local significance
- identify groundwater-dependent vegetation that may be affected by the Expansion Proposal
- report the baseline vegetation and flora monitoring data from transects established along Caves Creek and Duck Creek
- assess the potential impact of clearing for the Expansion Proposal on the identified vegetation and flora values, including Declared Rare Flora and Priority Flora species
- assess the potential impact on vegetation and flora values of the creek flow diversion, surface water discharge option and changes to sheetflow
- assess the potential impact of dewatering on groundwater-dependent vegetation
- assess the status of introduced plant species in the expansion area and identify the key management measures for minimising the potential for the introduction and spread of weeds and dust
- include a Flora and Vegetation Management Plan within the EMP.

5.3.4 Supporting investigations and studies

Supporting studies for this factor include:

- baseline surveys of the project area and surrounds conducted between 1995 and 2011 (Biota 2007a, 2010a, 2010b and 2010d; Hamersley Iron 1996, 1999; Halpern Glick Maunsell 1998, 1999a and 1999b; Pilbara Iron 2007a, 2007b and 2007c; Mattiske 2011)
- riparian vegetation baseline monitoring of transects along Caves Creek and Duck Creek (Biota 2010e, 2011a).

Studies have been undertaken by internal RTIO botanists and external botanical specialists (including Halpern Glick Maunsell, Biota and Mattiske).

5.4 Terrestrial fauna

5.4.1 Overview

The EPA environmental objective for fauna is:

> *To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.*

A number of extensive vertebrate fauna surveys have been undertaken in the Greater Nammuldi Area with the aim of mapping fauna habitat and species present as well as identifying species of conservation significance (Hamersley Iron 1996, 1999; Biota 2007b, 2009a, 2009c, 2010c; Ecologia 2011a).

Some surveys for Short-Range Endemic (SRE) invertebrates were conducted during recent vertebrate surveys (Biota 2009a, 2009c and 2010c; Ecologia 2011b). Surveys in the Nammuldi-Silvergrass/Brockman area indicate that potential SRE species are not restricted to particular habitat or vegetation types likely to be affected by the Expansion Proposal. Aquatic fauna surveys have been discussed in the surface water section (Section 5.2).

Fauna habitats values within the Proposal Boundary have been defined and classified according to vegetation units (Biota 2010b). The potential habitat within the Proposal Boundary is consistent with the available regional habitat, which indicates that no restricted or uncommon geological units or land systems occur within the study area (Biota 2010b). In total, the studies identified five habitats considered to be of local fauna significance as a consequence of the landform being restricted in the local area. These habitats are as follows:

- drainage lines
- Mulga woodland near Nammuldi
- cracking clay soils at Silvergrass
- breakaways, gorges and caves
- areas with deep alluvial soil at Nammuldi.

According to the CER, the majority of the disturbance associated with the Original Proposal, was within fauna habitats of low conservation significance, with limited disturbance to habitats of high conservation significance. The majority of the additional ~ 3900 ha of clearing within the Proposal Boundary (for mines and infrastructure) will also be undertaken in fauna habitats of low conservation significance. The vegetation of local significance in drainage areas and creeklines, breakaways, gorges and stony calcrete plains will be avoided where possible.

Surveys conducted for the CER and recent surveys recorded a number of terrestrial species whose abundance and distribution is considered to be typical of the Pilbara region (Table 6).

Conservation significant vertebrate fauna species indicated in searches of DEC NatureMap Database or the SEWPAC EPBC Act Protected Matters Database as potentially occurring within the Proposal Boundary, are summarised in Table 7.

Table 6 Number of native terrestrial vertebrate fauna recorded in the Greater Nammuldi Area

	Number of species recorded			
Report	**Mammalian**	**Avian**	**Reptilian**	**Conservation Significance**
Nammuldi/Silvergrass Exploration Project - Biological Survey Report (Hamersley Iron 1999)	21	76	66	6
A Targeted Terrestrial Fauna Survey of Expansion Areas at Nammuldi-Silvergrass (Biota 2009a)	7	16	9	1
Silvergrass West Vertebrate Fauna, SRE and Habitat Assessment (Biota 2009c)	17 (including 2 introduced species)	55	33	6
Nammuldi Infill Areas Fauna Survey Report (Biota 2010f)	12 (including 1 introduced species)]	37	26	2

Table 7 Potentially occurring conservation significant vertebrate fauna species

Species	Conservation status WA	Conservation status EPBC Act	Likely occurrence within Proposal Boundary
Dasyurus hallucatus (Northern Quoll)	Schedule 1	Endangered	Suitable habitat occurs within the Proposal Boundary along rocky ridgelines to the west of Nammuldi (Biota 2009a) and the rocky gorge habitat north west of the Nammuldi mining area (Biota 2010f). The Northern Quoll has been recorded within the Proposal Boundary (Hamersley Iron 1999) (one record from 10 785 trap nights in the surrounding area) but has not been recorded in more than 10 years). It is therefore not expected to be likely to occur within the Proposal Boundary.
Rhinonicteris aurantia (Pilbara Leaf-nosed Bat)	Schedule 1	Vulnerable	The Pilbara Leaf-nosed Bat was detected west of the TEC near Silvergrass through recording and identification of its echolocation calls (Biota 2009c), but was not recorded during the targeted (Biota 2009a) or other surveys (Hamersley 1999; Biota 2010f) within the Proposal Boundary. No other individuals have been recorded but several caves along Marra Mamba ridges north of Nammuldi, south of Silvergrass and in one area west of the Nammuldi may provide suitable roosts for this species (Biota 2009a, 2010c). These potential habitat caves are all outside of the Proposal Boundary. It is considered possible that the Pilbara Leaf-nosed Bat may fly over the Proposal area but it is unlikely to be reliant on the site for habitat.
Liasis olivaceus barroni (Olive Python)	Schedule 1	Vulnerable	The Pilbara Olive Python is widespread in rocky areas within the Pilbara, showing a preference for rocky habitats near water, particularly rock pools. The species has not been recorded in any of the surveys within the Proposal Boundary. However there is a small area of rocky hills, ridges and small breakaways outside the Proposal Boundary to the north west of the TEC near Silvergrass (Biota 2009c) and Caves Creek that provides intermittent water to the area. Suitable habitat also occurs to the west of Nammuldi (Biota 2010f). It is considered possible that the Pilbara Olive Python occurs within the Proposal Boundary.

Species	Conservation status WA	Conservation status EPBC Act	Likely occurrence within Proposal Boundary
Falco peregrinus (Peregrine Falcon)	Schedule 4	-	Recorded within the Proposal Boundary (Hamersley Iron 1999) but has not been recorded in recent surveys. Considered to potentially occur within the Proposal Boundary.
Lagorchestes conspicillatus leichardti (Spectacled Hare-wallaby)	Priority 3	-	Not recorded. Unlikely to occur within the Proposal Boundary due to a lack of suitable habitat (Biota 2009c, 2010c).
Pseudomys chapmani (Western Pebble-mound Mouse)	Priority 4		Recorded within the Proposal Boundary (Biota 2009a, 2009c, 2010c; Hamersley Iron 1999) and considered to be common to very common in suitable habitat within the Hamersley and Chichester subregions of the Pilbara bioregion.
Macroderma gigas (Ghost Bat)	Priority 4		A known Ghost Bat maternity roost has been recorded to the east of Silvergrass (outside of Proposal Boundary) near Caves Creek (Hamersley Iron 1999) and it was recently recorded opportunistically in the Silvergrass West area (Biota 2009c) and is considered likely to fly over the Proposal area.
Leggadina lakedownensis (Short-tailed Mouse)	Priority 4	-	Recorded in the cracking clay soil habitat of the TEC around Silvergrass (Biota 2009c; Hamersley Iron 1999).
Sminthopsis longicaudata (Long-tailed Dunnart)	Priority 4	-	Recorded in the area (Hamersley Iron 1999) but has not been recorded in recent surveys. Likely to occur within the Proposal Boundary.
Ardeotis australis (Australian Bustard)	Priority 4	-	Recorded within the Proposal Boundary (Biota 2009c, Hamersley Iron 1999).
Burhinus grallarius (Bush Stone-curlew)	Priority 4	-	Recorded only once within the Silvergrass West study area (Biota 2009c).
Neochmia ruficauda subclarescens (Star Finch [western])	Priority 4	-	Not recorded. Potentially occurs within the Proposal Boundary.
Notoscincus butleri	Priority 4	-	Recorded west of the TEC near Silvergrass (Biota 2009c) and in the Original Project Area (Hamersley Iron 1999).
Merops ornatus (Rainbow Bee-eater)	-	Migratory	Recorded within the Proposal Boundary (Biota 2009c, 2010c, Hamersley Iron 1999).
Haliaeetus leucogaster (White-bellied Sea-eagle)	-	Migratory	Not recorded. Species or species habitat may occur within area.
Ardea alba (Great Egret, White Egret)	-	Migratory	Not recorded. Species or species habitat may occur within area.
Ardea ibis (Cattle Egret)	-	Migratory	Not recorded. Species or species habitat may occur within area.
Charadrius veredus (Oriental Plover, Oriental Dotterel)	-	Migratory	Not recorded. Species or species habitat may occur within area.
Apus pacificus (Fork-tailed Swift)	-	Migratory	Not recorded. Species or species habitat may occur within area.

5.4.2 Potential sources of environmental impact to be addressed/managed

The following aspects of the Expansion Proposal may affect terrestrial fauna values:

- **clearing of additional vegetation** will directly disturb fauna habitat and may result in the loss of individual terrestrial fauna
- **disruption of sheet flow** through extension of mine pits, and construction of additional waste dumps, infrastructure and diversion structures has the potential to have an impact on vegetation communities that are sustained by sheet flow and subsequently affect fauna that may use this habitat
- **vehicle movements** within the Proposal Boundary may result in the loss of individual terrestrial fauna, especially less-mobile species
- **additional dewatering** will lower ground water levels in proximity to the pits and therefore may affect groundwater-dependent vegetation and subsequently affect fauna that use this habitat
- **discharge of surplus water** will increase the volume of available water and may alter the composition of vegetation communities downstream of the discharge and subsequently affect fauna that use this habitat.

5.4.3 Scope of Assessment

The PER will:

- identify potential habitat values within the Proposal Boundary, especially for conservation significant fauna
- report the baseline monitoring data for vertebrate and invertebrate assemblages within the Proposal Boundary
- assess the potential impact of the Expansion Proposal significant fauna species at a local and regional level on conservation
- assess status of introduced and feral animals within the Proposal Boundary
- contain a Terrestrial Fauna Management Plan within the EMP.

5.4.4 Supporting investigations and studies

Terrestrial fauna studies include:

- targeted survey work for conservation significant species
- systematic surveys within the Greater Nammuldi Area
- opportunistic sightings and collections of SRE
- trapping and echolocation recording of bat species.

Studies have been undertaken by external zoological specialists (including Biota and Ecologia).

5.5 Subterranean fauna

5.5.1 Overview

The EPA environmental objective for fauna is:

> *To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.*

Subterranean fauna can be classified into two main groups:

- stygofauna (obligate groundwater-dwelling aquatic fauna)
- troglofauna (obligate subterranean terrestrial fauna).

Both groups occur in fractured, karstic or cavernous geology types, with troglofauna occurring in air chambers in underground caves or humid air-filled voids. Subterranean fauna in Western Australia are generally invertebrates and often exhibit high levels of endemism (EPA 2003).

Stygofauna

The Subterranean Fauna Sampling Plan was implemented at Nammuldi in accordance with Condition 6-2 of Statement 558 and the results of the sampling submitted to the EPA in February 2003, in accordance with Condition 6.4. Five sampling exercises, recorded over a three year period, only recorded four individual stygal specimens from the Nammuldi area, each record being from a separate hole that yielded only one (or in one case, two) stygal specimens. All species recorded are well represented elsewhere. The sampling determined that the Original Project would be unlikely to affect the conservation status of stygofauna due to the lack of a significant stygofauna community at Nammuldi (Biota 2003). A letter from the EPA (dated March 2003) confirmed that the requirements of Condition 6-4 had been met at Nammuldi.

Identification of specimens collected from the Silvergrass valley by Biota (2010h) has revealed eight higher-order taxa. A total of 458 stygal invertebrates were collected from 24 of the 41 sites across the six sampling phases at Silvergrass. The stygofauna assemblage was dominated by crustacean orders, including Copepoda and Amphipoda. The survey concluded that the majority of taxa had a widespread distribution and all taxa had a distribution at least at the scale of the contemporary Caves Creek (a minimum of approximately 30 km). The specimens recorded from sampling in the Silvergrass valley, along with knowledge of the geology and hydrogeology in the valley indicates habitat connectivity and representation of species throughout the valley system.

In addition to undertaking stygofauna and troglofauna surveys, the Proponent has also sampled for fauna that occupy the hyporheic zone[1], within the creek alluvium of Duck and Caves creeks (WRM 2010, 2011).

Troglofauna

Sampling of troglofauna was not undertaken as part of the Original Project as it was considered unlikely they would occur due to the absence of karstic systems and vuggy material in the Original Project area. This was confirmed by diamond drill core that showed suitable habitat was not present.

Troglofauna sampling has since been undertaken in three phases by Biota both within and outside of the Proposal Boundary. Phase 1 sampling occurred as part of the May 2009 Silvergrass subterranean fauna survey. The Phase 2 sampling occurred in April 2010 and Phase 3 sampling in July 2010, with sampling at both Nammuldi and Silvergrass. Additional sampling was conducted in 2010 at reference sites at Cabbage Gum Bore and Robe Headwaters.

The sampling effort within both the Nammuldi and Silvergrass study area recorded a total of 9688 potentially troglobitic specimens from 19 orders. Of these, five orders were considered to display troglomorphic characteristics, therefore being potential SRE species: Blattodea (cockroaches), Diplura (diplurans, earwigs), Polyxenida (pincushion millipedes), Schizomida (Schizomids) and Geophilida (earth centipedes) (Biota 2011b). The Schizomida specimens and Polyxenida lineage D were only collected from Silvergrass West sampling sites – well outside of the potential area of impact of the Expansion Proposal.

The Phase 2 and Phase 3 sampling at Nammuldi collected a total of 14 specimens of troglofauna from the taxa Polyxenida and Blattodea, both of which have also been collected from a number of locations near Silvergrass. A

[1] The hyporheic zone is the region of saturated sediments below the channel as it has the potential to provide important relictual habitat for stygal invertebrates

total of 140 potentially troglobitic specimens were collected by the three phases of sampling within the Silvergrass study area, including Silvergrass West. The specimens represented five separate species; Blattodea, Diplura, Polyxenida, Schizomida and Geophilida.

Table 8 Troglofauna collected to date from Nammuldi and Silvergrass (including Silvergrass West) (Biota 2011b)

Order	Family	Lineage	No. Collected
Nammuldi			
Polyxenida	Polyxenidae	C	10
Blattodea	Nocticolidae	-	4
Silvergrass (including Silvergrass West)			
Polyxenida	Polyxenidae	A	107
		D	
		C	1
Blattodea	Nocticolidae	C	17
Diplura	-	-	2
Geophilida	-	-	1
Schizomida	Hubbardiidae	D	12

DNA sequencing was conducted on Polyxenida, Blattodea and Schizomida samples collected in Phase 1 and Phase 2 to facilitate identification at the species level. The results of the DNA analysis was compared to other specimens collected in Australia and the specimens classified into specific lineages to allow for regional genetic comparison. Additional DNA analysis was undertaken in 2011 (Biota 2011b) determining that:

- Schizomida Lineage D is an undescribed taxon collected only from the Silvergrass West area (outside the Proposal Boundary)
- the Polyxenida specimens can be divided into lineage A (only recorded at Silvergrass East) and lineage C (widespread in Pilbara)
- the Blattodea specimens belong to lineage A of the widespread cockroach family Nocticolidae.

5.5.2 Potential sources of environmental impact to be addressed/managed

The following aspects of the Proposal may affect subterranean fauna habitat:

- **expansion of mining activities** will remove potential subterranean fauna habitat and has the potential to result in the loss of individual fauna through the extraction of material or affect habitat quality through the generation of vibration
- **increasing the extent of groundwater drawdown** from dewatering will reduce the extent of stygofauna habitat
- **surface and groundwater contamination** through spills of hydrocarbons has the potential to degrade habitat for subterranean fauna
- **clearing of vegetation** beyond the mine footprint can potentially lead to a reduction of organic inputs.

5.5.3 Scope of Assessment

The PER will:

- report the results of baseline stygofauna and troglofauna sampling from Nammuldi, Silvergrass and reference sites and identify stygofauna and troglofauna specimens collected to species level, where possible
- assess the conservation significance of stygofauna and troglofauna within the Proposal Boundary
- assess the potential impact of dewatering, mining and excess dewatering water discharge on subterranean fauna within the Proposal Boundary.

5.5.4 Supporting investigations and studies

Further supporting studies for this factor include:

- baseline subterranean fauna sampling results and DNA analysis, where relevant, to resolve lineages.

5.6 Acid and metalliferous drainage and fibrous materials

5.6.1 Overview

The EPA environmental objective for geochemical risks is:

> *To ensure that emissions do not adversely affect environment values or the health, welfare, and amenity of people and land uses by meeting statutory requirements and acceptable standards*.
>
> *To maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*

The risks associated with acidic drainage and spontaneous combustion in waste rock of the Hamersley Group and overlying detritals are triggered by the presence of sulfides, in particular pyrite (FeS_2). Pyrite remains stable when it is saturated by water; however, if exposed to oxygen or ferric iron through the excavation process, it may oxidise and release dissolved sulfate, which results in increased acidity and iron concentrations. Site-specific test work has shown that potentially acid forming (PAF) material can be any material that contains pyrite and has a total sulfur concentration greater than 0.1%, but generally a total sulfur content of 0.3% for mineral waste is used to delineate PAF material from inert material.

Water in contact with PAF material may attain a low pH (pH ~ 2). In addition to causing high sulfate levels, it can potentially induce weathering of clay minerals in the host material, releasing other metals through mineral dissolution (such as aluminium, cadmium, manganese, selenium, zinc and/or copper) into the drainage. In addition to posing an AMD risk, an elevated sulfur content combined with organic carbon can also pose a self-heating risk potentially resulting in spontaneous combustion. The presence of PAF material also presents a risk to human health from the detrimental effects of pyritic dust particulates and gases produced by the oxidation of PAF material. The PAF material may also pose an operational risk by causing the premature detonation of nitrate based explosives such as Ammonium Nitrate-Fuel Oil (ANFO) (Rumball 1991).

In addition to the production of metalliferous drainage during oxidation of pyrite and persistence of such drainage following neutralisation, in certain circumstances metals and metalloids can also mobilise under other conditions. This is particularly the case for elements such as selenium and arsenic which form oxyanions and are sensitive to changes in redox conditions.

All of these mechanisms have been considered in the Ecological Risk Assessment that has been completed for the project (Equinox, 2011). The ERA was undertaken to assess the risk of AMD (including selenium) to both aquatic and terrestrial systems will be used in and appended to the PER.

The PER will address the risk of generation of metalliferous drainage especially selenium, and will describe the management measures that will be employed for this factor, including monitoring of groundwater bores and receiving environments for evidence of AMD generation, including selenium.

Substantial geochemical characterisation of mineral waste has been undertaken and will continue, in accordance with the process identified in DMP/EPA 2011. The proposal was referred in June 2010, twelve months prior to the release of these guidelines and therefore whilst the proponent is working to meet the requirements of the guidelines, not all of the work specified by the guidelines may be available for inclusion in the PER. This is consistent with discussions regarding application of the guidelines that have been held between the Proponent and the EPA. In particular kinetic testwork has been scheduled to commence in early 2012 and is expected to be completed in mid 2013. Therefore the results of this work will not be included in the PER, but will be used in design, operational management and closure of both mines and the waste fines storage facility.

Static elemental and liquid extract test work has been conducted on all waste types likely to be generated from Marra Mamba pits at Nammuldi and Silvergrass, from detritals at Nammuldi and on some waste fines materials. This work, conducted in accordance with RTIO standards, measured sulfur concentrations within drillhole samples as an indicator of the presence of PAF material and also assessed the potential for adverse metalliferous drainage from the extension of below watertable mining. This testwork has shown that a relatively small volume of waste material from Nammuldi has elevated sulphur content, posing a moderate risk of acidic drainage.

Acid base accounting (NAPP, NAG, ANC) tests conducted on lignite materials from Nammuldi have returned elevated sulphur values. In addition ANC testwork has been completed on calcrete and dolomite at Nammuldi which determined that buffering capacity significantly exceeds that required for the potential acid generation in the Nammuldi Marra Mamba ore.

Minor quantities of asbestiform material are likely to be encountered during mining. The risks associated with asbestiform material present a risk to human health during all phases of the mining operations. Asbestiform material will be strictly managed at all times in accordance with RTIO standards, particularly the RTIO (WA) Fibrous Mineral Management Plan (in draft).

5.6.2 Potential sources of environmental impacts to be addressed/managed

The following aspects of the Expansion Proposal associated with exposure, storage and handling of PAF and fibrous minerals material may affect groundwater, surface water and the health of site staff and local fauna:

- **exposure of PAF material to oxygen** has the potential to generate acid that could then be mobilised if it comes in contact with rainwater/runoff, which may result in groundwater or surface water contamination
- **exposure of PAF material to oxygen** has the potential to cause the release of metals through mineral dissolution, which may result in groundwater or surface water contamination
- **incorrectly storing PAF mineral waste** has the potential to cause spontaneous combustion and could generate acid water and metalliferous drainage if it comes in contact with infiltration or rainwater/runoff, which may result in groundwater or surface water contamination
- **extracting and exposing fibrous minerals during mining operations** has the potential to affect the health of mine workers, post-mining land users and fauna by exposure to harmful levels of fibrous minerals
- **dewatering** may expose PAF material to oxidising conditions as a result of the groundwater drawdown, which has the potential to make abstracted water acidic and/or metalliferous.

5.6.3 Scope of Assessment

The PER will:

- estimate of the amount of PAF material that will be mined and describe appropriate management measures for the material
- describe measures to be employed to manage material potentially subject to spontaneous combustion

- estimate the amount of PAF material that may be exposed in the final pit design walls and prescribe appropriate management measures
- present the results of an ecological risk assessment that assessed the potential for acidic or metalliferous drainage to affect aquatic and terrestrial systems
- identify appropriate sites and methodology for mineral waste disposal to ensure all extracted fibrous material is managed and stored appropriately and exposure of workers to harmful levels of fibrous minerals is prevented and the risk of impact to water systems is minimal
- include an Acidic and Metalliferous Drainage Management Plan within the EMP
- describe ongoing geochemical characterisation testwork that will be conducted during 2012, the results of which will be incorporated into mining and closure planning and will be documented in the Nammuldi and Silvergrass Closure Plans prior to extension of the BWT pits.

5.6.4 Supporting investigations and studies

Supporting studies for this factor include:

- geochemical investigations (static and liquid extract testwork, acid-base accounting) to determine waste rock and waste fines characteristics to identify potential for adverse geochemical and acid rock drainage contamination including metalliferous drainage
- design criteria for PAF material waste storage
- ongoing investigations for planning purposes to estimate the total volume of fibrous minerals to be extracted so the mine site layout is not significantly compromised
- an ecological risk assessment has been conducted by Equinox Environmental (Equinox 2011) to assess the risk of potential impacts on terrestrial and aquatic ecosystems from AMD

The supporting study for this factor will be undertaken by RTIO geologists and geochemists, with geochemical testwork undertaken at an external laboratory.

5.7 Aboriginal heritage

5.7.1 Overview

The EPA's environmental objective for Aboriginal heritage is:

> *To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.*

The Proponent has commissioned several archaeological and ethnographic investigations in the vicinity of the Nammuldi-Silvergrass and Brockman area. Archaeological surveys aim to identify Aboriginal heritage sites, such as stone tool scatters, that exist within or near the Proposal Boundary, while ethnographic surveys are designed to identify any areas of cultural significance to the traditional owner group that has native title claim over the area. Areas of ethnographic significance are usually landform features (hills, water), areas of cultural significance (lore grounds, increase/*thalu* sites) or historical places of interest (birthplaces, death places, gravesites).

The Expansion Proposal lies within the Eastern Guruma Native Title Determination Area and therefore the Eastern Guruma Native Title Holder is recognised as the group that can represent the area. The Proponent takes direction from Eastern Guruma in all matters, including which other groups may have an interest in the area, and has an established Indigenous Land Use Agreement with Eastern Guruma. Other adjacent Native Title claimants who also have an interest in this area, in particular Palm Springs, are Kuruma Marthudunera, and Puutu Kunti Kurrama and Pinikura (PKKP).

The majority of the proposed ground disturbance required for the mining, processing and transport components of the Expansion Proposal has already been covered by archaeological and ethnographic surveys. All areas of disturbance not covered by existing surveys, will be surveyed prior to ground disturbance. All such surveys are

undertaken in consultation with, and accompanied by, representatives of the Eastern Guruma via Eastern Guruma Pty Ltd.

Several archaeological and ethnographic sites have been identified as a result of extensive surveys conducted over the Greater Nammuldi Area. These sites have been found to be of varying degrees of significance, with many sites being artefact scatters which are generally regarded as being of lower cultural significance. Identified sites of significance include:

- graves adjacent to the old Brockman Homestead at Silvergrass
- cultural sites associated with Caves Creek and in the vicinity of the TEC
- rock art north west of the Nammuldi mine
- Palm Springs on Caves Creek downstream of Silvergrass (cultural significance).

As part of the RTIO heritage process, identified sites are registered with the WA Department of Indigenous Affairs.

5.7.2 Potential sources of environmental impacts to be addressed/managed

The following aspects of the Expansion Proposal have the potential to disturb Heritage sites and/or affect ethnographic significance:

- **physical disturbance to land** during construction, mining and associated activities
- **dewatering** the mining area to allow access to the below watertable ore has the potential to affect water courses in and around the Proposal Boundary, which may have heritage significance
- **discharge of surplus water** from dewatering has the potential to affect watercourses, which have ethnographic significance
- **drainage management** will alter flow paths with construction of diversion channels, mine pit, waste dumps and infrastructure and re-alignment of Caves Creek which may affect heritage values
- **modified landform after closure** may alter areas which may be of heritage significance.

5.7.3 Scope of Assessment

The PER will:

- report the results of Aboriginal heritage surveys within the Proposal Boundary consistent with *Aboriginal Heritage Act 1972,* EPA Guidance Statement No. 41 and native title agreements
- identify potential impacts of the Expansion Proposal on sites of Aboriginal heritage significance
- identify avoidance, mitigation and management measures to be implemented to protect sites of Aboriginal heritage significance from the potential impacts of the Expansion Proposal
- provide a summary of issues raised by Traditional Owners in relation to the Expansion Proposal
- include an Aboriginal Heritage Management Plan within the EMP.

5.7.4 Supporting investigations and studies

Aboriginal heritage values within the Proposal Boundary will be investigated through:

- continuing consultation with the Traditional Owners regarding the Expansion Proposal
- continuing the archaeological and ethnographic surveys programs.

5.8 Closure

5.8.1 Overview

The EPA environmental objective for closure is:

> *To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform that is consistent with the surrounding landscape and other environmental values.*
>
> *To maintain the abundance, diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.*

Mining and the establishment of associated infrastructure will result in the clearing of vegetation and disturbance to soil profiles and landforms. Closure management aims to restore post-mining landforms to be consistent with surrounding areas and to resemble the local environment to the maximum practicable extent. The closure planning process needs to ensure that closure management (including decommissioning and rehabilitation) will be sustainable, is in-line with best practice and will restore ecological values in areas disturbed by mining.

The objectives of mine closure are to ensure that closure planning and rehabilitation are carried out in a coordinated, progressive manner and are integrated with development planning, consistent with the Australian and New Zealand Minerals and Energy Council/Minerals Council of Australia (ANZMEC/MCA) *Strategic Framework for Mine Closure* (2000), to prevent adverse environmental impacts and to create a stable and self-sustaining natural ecosystem or an alternative land use based on an agreed set of end-use objectives. Closure planning is a dynamic process that requires regular review and development throughout the life of an operation, to take into account changes in legal obligations, corporate requirements, community expectations and changes in technical knowledge.

Regulatory agencies and industry bodies have established guidelines (industry best practice) to assist mining companies achieve acceptable standards of mine rehabilitation and closure. Industry best practice guidelines for rehabilitation and closure are included in the following key documents:

- Strategic Framework for Mine Closure (ANZMEC/MCA 2000)
- Mine Void Water Resource Issues in Western Australia (WRC 2003)
- Enduring Values – The Australian Minerals Industry Framework for Sustainable Development (MCA 2005)
- Mine Closure and Completion (Department of Industry, Tourism and Resources [DITR] 2006a)
- Mine Rehabilitation (DITR 2006b)
- Rehabilitation of Terrestrial Ecosystems, Guidance Statement No. 6 (EPA 2006)
- Guidelines for Preparing Mine Closure Plans (DMP/EPA 2011).

5.8.2 Scope of Assessment

Closure plans for Nammuldi and Silvergrass that have been developed in accordance with DMP/EPA 2011 will be provided with the PER. As previously stated, the proposal was referred in June 2010, twelve months prior to the release of these guidelines and therefore whilst the proponent is working to meet the requirements of the guidelines, not all of the work specified by the guidelines may be available for inclusion in the first versions of the closure plans which accompany the PER. This is consistent with discussions regarding application of the guidelines that have been held between the Proponent and the EPA.

The PER will summarise the key points of the closure plans, including:

- summation of legislative and corporate closure requirements
- identification of proposed closure vision, objectives and post-closure land use
- description of the proposed pit void configuration at decommissioning of the mine and assessment of potential mine void closure options
- estimation of the volume and suitability of waste material available for backfilling
- identification and description of closure scenarios
- identification of likely key decommissioning, decontamination and rehabilitation measures
- identification of likely long-term monitoring.

The PER will include a commitment to adhere to the closure planning processes described in the DMP/EPA 2011 guidelines, to ensure that the final closure strategy will achieve acceptable long term post closure outcomes: in particular in relation to safety and stability of landforms, adequacy of vegetation on rehabilitated surfaces and risks to sensitive receptors from AMD and other potential contaminants.

5.8.3 Supporting investigations and studies

In order to satisfy the requirements of the EPA Guidance Statement No. 6 *Rehabilitation of Terrestrial Ecosystems* (EPA 2006) and DMP/EPA guidelines (2011), Closure Plans will be prepared for Nammuldi and Silvergrass to support the PER.

Closure planning is an iterative process that begins in project design and continues throughout the life of the mine, with an increasing level of detail as more information is obtained (DMP/EPA 2011). The Proponent will prepare preliminary Closure Plans, which will incorporate the information available at that time, will identify key risks and gaps in knowledge and will set out a program of further work required to address those risks and gaps.

Closure planning will continue throughout the Part IV assessment process and will include stakeholder consultation, materials characterisation work and options for landform design. An updated Closure Plan will be prepared to include the results of work conducted during 2011 prior to extension of the below watertable pits. Rehabilitation planning will be conducted in accordance with EPA Guidance Statement No. 6 (EPA 2006).

5.9 Other environmental factors

Other environmental factors, while not requiring detailed assessment, will need to be addressed in the environmental impact assessment documentation and through the development of management measures. These are detailed below in Section 5.9.1 through Section 5.9.4.

5.9.1 Noise and vibration

The EPA environmental objective for noise is:

> *To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.*

Noise and vibration will be generated during construction and operational phases of the Expansion Proposal and thus vibration and ambient noise levels in the vicinity of Proposal area will increase as a result. Noise and vibration may be generated from sources such as blasting and operation of machinery, vehicles and equipment (including crushing/screening plant). Noise and vibration may affect fauna behaviour or surrounding residents/camps/mine sites; however, the effect is dependent on the distance from the source of noise/vibration and the location of sensitive receptor or the sensitivity of fauna. Noise and vibration impacts are primarily restricted to the health and safety of the workforce and, to a lesser extent, fauna disturbance due to the remoteness of the proposed operations. Preliminary noise modelling has been undertaken against the Environmental Protection (Noise) Regulations 2007, with the results taken into account in determining the location

and design of the accommodation village. Management measures that may need to be considered include (excluding health and safety specific management measures):

- use of low-noise equipment where practicable
- use of noise buffering measures ,if required
- monitoring blast noise near sensitive receptors to determine allowable blasting mass.

5.9.2 Dust

The EPA environmental objective for air quality is:

> *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.*

Background dust levels within the Proposal Boundary are expected to be high as it is located in an arid zone where dust lift off occurs from the sparsely vegetated landscape. The discussion paper for a State-wide Air Quality Environmental Protection Policy (EPA 2001) notes that airborne dust in the Pilbara (and Goldfields) can be a problem as background levels can be close to or higher than the National Environmental Protection Measure (NEPM) standard[2].

The main sources of dust from the proposed operation will originate from clearing of vegetation, general excavation activities (including mining), blasting, crushing and materials storage/handing/haulage. Dust has the potential to be of nuisance or affect health of nearby residents; however, due to the remoteness of the Proposal area from the town of Tom Price and surrounding homesteads there will be no effect on these residents. There is a potential risk to the workforce, and accommodation will be designed and located to meet the RTIO requirements for health.

Dust may have physical effects on plants such as blockage and damage to stomata, shading, abrasion of leaf surface or cuticle and cumulative effect (e.g. drought stress on already stressed species). Vegetation close to dust sources (e.g. adjacent to mining areas or haul roads) are more likely to be subject to such impacts. Management measures that may need to be considered include:

- controlling dust generation through ore moisture content control
- applying water or other suitable dust suppressants to reduce dust generation from unsealed areas
- installing signage and enforcing speed limits to reduce dust generation from unsealed roads
- minimising clearing of vegetation to reduce the area of exposed surfaces and staging clearing
- undertaking regular inspections to visually assess dust generation and to ensure the correct functioning of dust suppression equipment
- undertaking progressive rehabilitation, where possible, to minimise total exposed area
- implementing good house-keeping practices to ensure no accumulation of waste materials around conveyor, transfer points and hardstand areas under crushers (and associated plant).

The results of dust modelling undertaken will be presented in the PER. An appropriate dust management plan will be submitted as supporting documentation with the environmental impact assessment documentation to the EPA.

[2] The air quality measure was endorsed by the National Environment Protection Council (NEPC) in June 1998. The desired environmental outcome of this measure is ambient air quality that allows for the adequate protection of human health and well-being. This measure is to be achieved by meeting the prescribed air quality standards, which includes particulates (dust).

5.9.3 Waste

The EPA environmental objective for waste is:

> *To ensure that rehabilitation achieves an acceptable standard compatible with the intended land use, and consistent with appropriate criteria.*

Wastes that will be generated by the Expansion Proposal will require some level of management, including:

- domestic solid and liquid wastes (including food scraps, grey water and sewage)
- washdown water
- general mine-site waste (including scrap metal, drums, tyres and batteries)
- general office waste
- waste oils and lubricants
- overburden.

There are several options for disposal of the solid waste materials including constructing and operating an on-site landfill, collection and removal off-site by contractors, or a combination of both. An onsite landfill could be used for disposal of general domestic solid wastes including putrescibles, inert substances and other general waste. Depending on waste volumes, a landfill may require licensing under Part V of the EP Act. Scrap metal, batteries and oils/lubricants would typically require removal off-site for recycling/disposal.

Sewage treatment plants will need to be established in conjunction with construction camps, office areas and the permanent accommodation. Clean effluent (water) from these plants will be discharged via reticulation to dedicated sprayfields. Depending on volumes being treated, the sewage treatment plants may require licensing under Part V of the EP Act. All sewerage installations need approval under the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974* and that disposal of sludge from wastewater treatment plants will need to be by a licensed contractor.

Sediment control structures and grease and oil traps (or similar hydrocarbon treatment facilities) will need to be installed at washdown facilities. The treated water from this source could be utilised in the dust suppression water circuit.

Overburden will be managed throughout the mining phase. Topsoil and sub-surface soil will be stockpiled separately and used in rehabilitation.

The PER will describe the types of non-mineral waste that will be generated by implementation of the proposal and will identify the key management mechanisms by which potential impacts on the environment may be minimised and controlled. However the mechanism for detailed assessment and control of non-mineral waste impacts is via the Works Approval and licensing processes prescribed under Part V of the EP Act.

5.9.4 Greenhouse gases

The EPA environmental objective for greenhouse gases is:

> *To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.*

The greenhouse effect is a natural phenomenon where light energy from the sun passes through the atmosphere and heats the earth's surface. The two major greenhouse gases in the atmosphere are water vapour and carbon dioxide (CO_2). These gases trap heat reflected from the earth's surface maintaining temperature at a level capable of supporting life. The main anthropogenic greenhouse gas emission is CO_2, which has increased in concentration in the atmosphere by approximately 31% over the last 200 years. The main anthropogenic source of CO_2 is from the combustion of fossil fuels. It is accepted that anthropogenic emissions of greenhouse gases are contributing to climate change (enhanced greenhouse effect).

The main sources of greenhouses gases associated with the Expansion Proposal include:

- combustion of fuels by mobile plant, equipment and on-site vehicles
- indirectly from electrical power usage by processing plants
- use of explosives for blasting
- clearing of vegetation.

At the State level, the EPA (under current Guidance Statement No. 12 [EPA 2002b]) has an expectation that emissions of 100 000 tonnes per annum of CO_2 equivalents (TPA CO_2e-) or above will be offset. At the Commonwealth level, the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) establishes a single, national system for reporting greenhouse gas emissions, abatement actions, and energy consumption and production by corporations. On 1 July 2008, it became mandatory for controlling corporations to register and report annually under the NGER Act. The minimum values (thresholds) which trigger the requirement to register and report are:

- greenhouse gas emissions of 25 000 TPA of CO_2-e
- energy production of 100 terajoules
- energy consumption of 100 terajoules.

Greenhouse gas emission reduction measures will be considered during the design, construction and operation of mining activities. Potential measures include:

- conducting regular energy efficiency audits during the design and operation phases
- preventing unnecessary clearing of vegetation through clearing procedures (Section 5.3)
- connecting to existing power generation and rail infrastructure that currently service the Original Project and Brockman 2 operation, where possible
- increasing the efficiency of the operation through scheduling, pit optimisation and minimisation of rehandling
- increasing the efficiency of waste and ore haulage
- regularly maintaining and servicing equipment
- evaluating and adopting appropriate technology during the detailed design phase to improve greenhouse efficiency.

In accordance with the requirements under the NGER Act, the Proponent will report annually on:

- production of energy
- consumption of energy
- Scope 1 (direct) emissions
- Scope 2 (indirect) emissions.

An estimate of the increase in greenhouse gas emissions resulting from implementation of the Expansion Proposal will be included in the environmental impact assessment.

5.10 Key environmental factors and principles

Table 9 has been prepared in accordance with the EPA (2009) *Guide to Preparing an Environmental Scoping Document*. The relevant area for each area is the Proposal Boundary.

Table 9 Environmental Factors

Environmental Factor	EPA objective	Potential Impacts	Supporting investigations and studies	Potential Management	Applicable Standards, Guidelines and Policies
Groundwater	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	• dewatering of the mining area to allow access to the ore will lower the watertable in the ore body aquifer, which has the potential to affect sensitive groundwater-dependent ecosystems and heritage sites • discharging surplus water to creek systems may locally elevate the watertable and provide a more constant flow regime, which may change the composition of vegetation communities over time • changes to landforms and hydraulic properties within backfilled pits post-closure will alter natural groundwater flow, which has the potential to affect groundwater levels and quality • groundwater contamination from acid or metalliferous drainage (AMD) produced by PAF material or hydrocarbon spills may affect groundwater quality • application of water for irrigated agriculture has the potential to locally elevate the watertable, which can affect the composition of adjoining vegetation communities over time if rise is sufficiently high to saturate the rootzone of tree species.	• hydrogeological investigations and modelling at Nammuldi and Silvergrass to update predictions of dewatering rates, extent of drawdown and hydraulic connectivity between the different lithologies within the Proposal Boundary • sampling to determine existing water quality • investigation of options for excess water discharge with consideration given to potential environmental and social impacts and economic and engineering constraints.	• volume of groundwater to be abstracted will be minimised through optimisation of dewatering • hydrogeological modelling will be conducted to examine the potential effects of post-closure landform on groundwater flow and development of a conceptual closure strategy • groundwater levels will be monitored in the vicinity of the dewatering bores and the hydrogeological model will be updated throughout dewatering and post closure • groundwater levels near key ecosystems will be monitored, including at Palm Springs • a Groundwater Management Plan will be developed that includes adaptive management measures and contingencies measures as well as key internal accountabilities.	• Water and Rivers Commission (2000), Environmental Water Provisions Policy for Western Australia: Statewide Policy No. 5 • Department of Water (2009), Hydrogeological reporting associated with a groundwater well licence • ANZECC/ARMCANZ 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Environmental Factor	EPA objective	Potential Impacts	Supporting investigations and studies	Potential Management	Applicable Standards, Guidelines and Policies
Surface water	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	• dewatering at Silvergrass will result in drawdown in the superficial aquifer along Caves Creek which would potentially modify the hydrological conditions of the watercourse and has the potential to affect vegetation and fauna habitats • discharging surplus water into Duck Creek will saturate the alluvium and modify the hydrological regime (quantity and quality) including affecting permanent pools, riparian vegetation and aquatic fauna habitat • constructing the channel diversion in Caves Creek at Silvergrass may increase the velocity of the water and cause erosion, which would alter water quality and flows in Caves Creek • modifying landforms through the construction of pits, dumps and infrastructure will affect generation of sheet flow, which may affect vegetation that is dependent on flows (where flows are reduced) or affect vegetation sensitive to inundation (where flows are increased and/or ponding introduced/prolonged) • contamination of surface water is possible from suspended solids, hydrocarbon spills, acidic and/or metalliferous drainage within mining areas • runoff from disturbed areas and overburden dumps may result in increased sediment transport to watercourses.	• results of investigations to determine baseline hydrological regimes, water quality, and aquatic fauna habitat for watercourses that may be used for surplus water discharge • characterisation of the hydroecology (including the geomorphology of the creek bed, vegetation density and composition in the riparian zone) of the existing systems of Caves Creek and Duck Creek and assess the potential for surface water expression downstream of discharge location(s) • investigation into hydrological drivers for cracking clay TEC at Silvergrass including study of overland flows and ARI flood levels.	• an Adaptive Surface Water Management Plan will be implemented that includes monitoring and adaptive management measures as well as contingency measures to ensure to there is no adverse effect on the water quality from discharged water • the creek re-alignment will be designed to maintain natural flow conditions as far as practicable • the creek re-alignment channel will be constructed prior to the 'cut-over' from the old channel to ensure that it is completed prior to water being conveyed through it • sediment retention basins will be used to remove excess sediments prior to the release of stormwater runoff from within the Proposal Boundary to the environment • erosion protection will be installed at stormwater and surplus water discharge points.	• Water and Rivers Commission 2000, Environmental Water Provisions Policy for Western Australia: Statewide Policy No. 5 • ANZECC/ARMCANZ 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Environmental Factor	EPA objective	Potential Impacts	Supporting investigations and studies	Potential Management	Applicable Standards, Guidelines and Policies
Flora and Vegetation	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• clearing of additional vegetation will directly reduce the extent of vegetation communities, including vegetation communities of local conservation significance, and potentially disturb Priority Flora species • disruption of sheet flows through extension of mine pits, and construction of additional waste dumps, infrastructure and diversion structures has the potential to have an impact on vegetation communities that are sustained by sheet flow • additional dewatering at Silvergrass will lower ground water levels in proximity to the pits and therefore may affect groundwater-dependent vegetation • discharge of surplus water may alter the composition of vegetation communities downstream of the discharge • vehicle movements and earthworks have the potential to introduce and spread weed species • dust generation due to earthworks, mining, processing and vehicle movements has the potential to smother vegetation.	• baseline surveys of the project area and surrounds conducted between 1995 and 2011 • riparian vegetation baseline monitoring of transects along Caves Creek and Duck Creek. • numerous targeted searches for DRF and Priority Flora undertaken within and around the Proposal Boundary	• preparing a management plan for the potential irrigated agriculture development to minimise the spread of weeds • Environmental Exclusion Areas will be established and demarcated to prohibit disturbance covering significant areas such as the Themeda grasslands TEC • infrastructure layout and location will be modified wherever feasible to avoid significant species or vegetation • further flora and vegetation surveys will be conducted as required within the Proposal Boundary • the clearing of riparian vegetation for the Caves Creek channel alignment at Silvergrass will be minimised • a discharge management strategy will be implemented that takes account of the relative values of downstream vegetation and flora for each of the discharge locations, where practicable.	• EPA (2000b) Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia • EPA (2002c) Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection • EPA (2004a) Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.

Environmental Factor	EPA objective	Potential Impacts	Supporting investigations and studies	Potential Management	Applicable Standards, Guidelines and Policies
Terrestrial Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• clearing of additional vegetation will directly disturb fauna habitat and may result in the loss of individual terrestrial fauna • disruption of sheet flow through extension of mine pits, and construction of additional waste dumps, infrastructure and diversion structures has the potential to have an impact on vegetation communities that are sustained by sheet flow and may subsequently affect fauna that may use this habitat • vehicle movements within the Proposal Boundary may result in the loss of individual terrestrial fauna, especially less-mobile species • additional dewatering will lower groundwater levels in proximity to the pits and therefore may affect groundwater-dependent vegetation and subsequently affect fauna that may use this habitat • discharge of surplus water will increase the volume of available water and may alter the composition of vegetation communities downstream of discharge point, and subsequently affect fauna that may use this habitat.	• targeted survey work for conservation significant species • systematic surveys of within the Proposal Boundary • opportunistic sightings and collections of SRE • bat trapping and echolocation recording.	• as far as practicable, infrastructure and transport routes will be located preferentially in previously disturbed areas to minimise clearing of undisturbed native vegetation to prevent potential loss of fauna habitat • fauna habits of high conservation significance will be avoided wherever practicable • vegetation will be cleared in a deliberately outward manner that allows for the progressive movement of fauna into areas beyond of the disturbance footprint • low speed limits for mining equipment and light vehicles will be maintained by ensuring all roads are sign-posted, vehicle speeds are monitored and all personnel and contractors are educated.	• EPA (EPA 2004b) Guidance Statement No. 56: Terrestrial fauna surveys for Environmental Impact Assessment in Western Australia • EPA (2009b) Guidance Statement No. 20: Sampling of Short-Range Endemic invertebrate fauna for environmental impact assessment in Western Australia.
Subterranean Fauna	To maintain the abundance, diversity, geographic distribution and productivity of subterranean fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• expansion of mining activities will remove potential subterranean fauna habitat and has the potential to result in the loss of individual fauna through the extraction of material or affect habitat quality through the generation of vibration • increasing the extent of groundwater drawdown from dewatering, which will reduce the extent of stygofauna habitat • surface and groundwater contamination, through spills of hydrocarbons has the potential to degrade the habitat for subterranean fauna environment • clearing of vegetation beyond the mine footprint can potentially lead to a reduction of organic inputs.	• baseline subterranean fauna sampling results and DNA analysis, where relevant, to resolve lineages.	• implementing appropriate hydrocarbon storage and handling measures • minimise clearing of vegetation • dewatering of mining areas will be kept to a minimum, whilst allowing safe mining of the orebodies • groundwater levels in the vicinity of the dewatering area will be regularly monitored • mine pit disturbance will be restricted to areas approved in accordance with the Mine Plan, in compliance with legislative requirements including Schedule 1 of Ministerial Statement.	• EPA (2003)Guidance Statement No. 54: Consideration of subterranean fauna in groundwater and caves during environmental impact assessment in Western Australia • EPA (2007) Guidance Statement No. 54a (Draft): Sampling methods and survey considerations for subterranean fauna in Western Australia.

Environmental Factor	EPA objective	Potential Impacts	Supporting investigations and studies	Potential Management	Applicable Standards, Guidelines and Policies
Acid and metalliferous drainage and fibrous materials	To ensure that emissions do not adversely affect environment values or the health, welfare, and amenity of people and land uses by meeting statutory requirements and acceptable standards. To maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.	• exposing PAF material in the pit wall to oxygen has the potential to generate acid water if it comes in contact with rainwater/runoff, which may result in groundwater or surface water contamination • exposure of PAF material to oxygen has the potential to cause the release of metals through mineral dissolution, which may result in groundwater or surface water contamination • incorrectly storing PAF mineral waste has the potential to cause spontaneous combustion and could generate acid water and metalliferous drainage if it comes in contact with infiltration or rainwater/runoff, which may result in groundwater or surface water contamination • extracting and exposing fibrous minerals during mining operations has the potential to affect the health of mine workers, post-mining land users and fauna by exposure to harmful levels of fibrous minerals • dewatering may expose PAF material to oxidising conditions as a result of the groundwater drawdown, which has the potential to make abstracted water acidic and/or metalliferous.	• geochemical investigations (static and liquid extract testwork, acid-base accounting) to determine waste rock and waste fines characteristics to identify potential for adverse geochemical and acid rock drainage contamination including metalliferous drainage • design criteria for PAF material waste storage • ongoing investigations to estimate the total volume of fibrous minerals to be extracted for planning purposes to ensure the mine site layout is not significantly compromised.	• bunding will be constructed in accordance with the surface water management design to reduce surface runoff flowing over exposed PAF material in the pit face • PAF material waste dumps will be constructed in accordance with RTIO SCARD Management Plan in areas that are not likely receive runoff from surrounding areas • fibrous material waste dumps will be constructed in accordance with the RTIO Fibrous Minerals Management Plan • field inspections will be conducted during mining to ensure all PAF material is transported to the appropriate dumps • diverting surface water runoff around material that potentially poses geochemical risks • containing, treating and disposing of any acidic water in an appropriate manner	• Department of Industry, Tourism and Resources (DITR)(now Department of Resources, Energy and Tourism) (2007), Leading Practice Sustainable Development Program - Managing acid and metalliferous drainage • Water and Rivers Commission (WRC) (now Department of Water) (2000) Water Quality Protection Guidelines No. 9 for Mining and Mineral Processing – Acid mine drainage • EPA (2004c) Position Statement No. 7. Principles of Environmental Protection
Aboriginal Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	• physical disturbance to land during construction, mining and associated activities • dewatering the mining area to allow access to the below watertable ore has the potential to affect water courses in and around the Proposal Boundary, which may have heritage significance • discharge of surplus water from dewatering has the potential to affect watercourses which have ethnographic significance • drainage management will alter flow paths with construction of diversion channels, mine pit, waste dumps and infrastructure and re-alignment of Caves Creek which may affect heritage values • modified landform after closure may alter areas which may be of heritage significance.	• continuing consultation with the Traditional Owners regarding the Expansion Proposal • archaeological and ethnographic surveys for the Proposal Area.	• liaise with Eastern Guruma Traditional Owners and keep them informed of the progress of the development and implementation of the Expansion Proposal • where Aboriginal sites cannot otherwise be avoided, clearance to disturb those sites under section 18 *Aboriginal Heritage Act 1972* will be sought after consultation with Eastern Guruma Traditional Owners • ethnographic surveys of areas not yet surveyed to be undertaken in co-operation with Eastern Guruma Traditional Owners • workforce inductions to include Aboriginal cultural and heritage issues.	• EPA (2004d) Guidance Statement No. 41: Assessment of Aboriginal Heritage • Department of Housing and Works, (DoHW 2002) Western Australia, Aboriginal Heritage Procedures Manual • Department of Indigenous Affairs (DIA) (2006), Western Australia, section 18 Notice of Application for Ministers Consent to Use Land: Notes and Guidelines • DIA (2005), Western Australia, Guidelines for

Environmental Factor	EPA objective	Potential Impacts	Supporting investigations and studies	Potential Management	Applicable Standards, Guidelines and Policies
					preparing reports for applications to the Aboriginal cultural Material Committee under Section 18 of the Aboriginal Heritage Act.
Closure	To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform that is consistent with the surrounding landscape and other environmental values. To maintain the abundance, diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.	• insufficient allocation of funds/resources for closure, particularly in the event of unforseen closure, due to poor closure planning. • progressive and final rehabilitation not conducted in a timely manner • rehabilitation does not promote the establishment of the agreed post-mining land use. • final landforms not stable leading to erosion issues contaminating ground and surface water systems.	• management measures to maintain and manage landform values were developed for the Original Project. Further development of these factors is required for the Expansion Proposal • preliminary Closure Plans will be prepared for each of Nammuldi and Silvergrass, in consultation with the relevant agencies that align with the DMP/EPA Guidelines for Preparing Mine Closure Plans (2011) • hydrogeological modelling to examine the potential impacts of post-closure landform on groundwater flow and quality and development of a conceptual closure strategy	• temporary disturbed sites will be rehabilitated to achieve stable and vegetated surfaces • periodically revising the Preliminary Closure Plan throughout the life of the mine in consultation with relevant agencies, as required • rehabilitation planning will be conducted in accordance with EPA Guidance Statement No. 6 (EPA 2006).	• EPA (2006) Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems • ANZMEC & Minerals Council of Australia (2000), Strategic Framework for Mine Closure • The Proponent's Site Closure Standards • DMP/EPA (2011) Guidelines for Preparing Mine Closure Plans

Table 10 addresses EPA principles.

Table 10 EPA Principles

EPA Principle	Relevant Yes/No	If yes, consideration
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options.	Yes	RTIO includes a risk assessment process in the development of all new projects to identify potential issues and management actions early in the Project study phases. Part of this process includes undertaking detailed site investigations of the biological and physical environs. Infrastructure has been relocated to avoid damage to significant aspects of the environment, such as the cracking clay TEC. Closure planning has also been undertaken to prevent serious or irreversible damage to the environment, such as from PAF material waste dumps. Management measures will be presented in the PER to address any significant risks associated with the Expansion Proposal.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	Environmental Impact Assessment will be carried out for the Expansion Proposal to ensure that the proposed development aligns with RTIO sustainable development principles to ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations. This will be done by ensuring adequate resources are dedicated to adequate closure planning.
3. The principle of the conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	Baseline studies will address this principle. Management plans will be implemented as required, such as the Vegetation and Flora and Fauna Management Plans.
4. Principles relating to improved valuation, pricing and incentive mechanisms (1) Environmental factors should be included in the valuation of assets and services. (2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. (3) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. (4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	Yes	The full life cycle costs of the Expansion Proposal, including costs associated with decommissioning and closure will be estimated for internal purposes at various stages of the project life. RTIO recognises the polluter pays principle, and will design the development to ensure that pollution and waste are minimised and that any waste generated is managed in an acceptable way by the Proponent, prior to or during closure.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	The preferred management options are to avoid, reduce, reuse, recycle and recover waste.

6. Stakeholders

6.1 Decision Making Authorities

Key Decision Making Authorities (comprising State Government agencies) are:

- Office of the Environmental Protection Authority (OEPA)
- Department of Environment and Conservation (DEC)
- Department of Water (DoW)
- Department of State Development (DSD)
- Department of Agriculture and Food WA (DAFWA)
- Department of Mines and Petroleum (DMP)
- Department of Indigenous Affairs (DIA)
- Department of Regional Development and Lands (RDL)
- Pastoral Lands Board
- Department of Health (DoH)
- Shire of Ashburton.

6.2 Stakeholder consultation

RTIO will ensure that the key local, state and Australian Decision Making Authorities, non-government organisations and relevant Traditional Owner groups are consulted on the Expansion Proposal. A summary of consultation already undertaken are provided in Table 11.

Table 11 Stakeholder consultation undertaken for the Expansion Proposal to date

Date	Department / Organisation	Type	Topics
Apr 1998 - Jun 2009	Eastern Guruma	Aboriginal Heritage Surveys	Recording and assessment of archaeological and ethnographic sites.
Nov 2006 – May 2008	Puutu Kunti Kurrama & Pinikura	Aboriginal Heritage Surveys	Recording and assessment of archaeological and ethnographic sites.
Aug 2009 – Nov 2010	DSD	Monthly meetings	Part IV approvals, Tenure, Heritage surveys, dewatering, potential heritage impacts.
Aug 2009 – Nov 2010	DMP	Monthly meetings	Progressing clearances for leases, Applications for tenure.
Nov 2008	Eastern Guruma	Indigenous Land Use Agreement Monitoring & Liaison Quarterly Meeting	Overview of proposed expansion.
May 2009	Eastern Guruma	Indigenous Land Use Agreement Monitoring & Liaison Quarterly Meeting	Project update.
Dec 2009	Eastern Guruma	Indigenous Land Use Agreement Monitoring & Liaison Quarterly Meeting	Presentations on planned surveys, dewatering and surplus water, and RTIO Indigenous Employment, Training and Enterprise programs.
Quarterly 2010	Eastern Guruma	Indigenous Land Use Agreement Monitoring & Liaison Quarterly Meeting	-

Date	Department / Organisation	Type	Topics
Mar 2010	Mt Stuart Pastoral Station	Email correspondence	Contact to arrange creekline surveys on Mt Stuart Station.
April 2010	Puutu Kunti Kurrama & Pinikura	Puutu Kunti Kurrama & Pinikura Local Implementation Committee meeting	Brockman Syncline 4 Mine and Nammuldi BWT, including proposed water supply pipeline from NBWT to BS4.
Late 2010	DEC, DoW, DMP	-	Provision of referral supporting document.
Aug 2010	OEPA	Meeting	Overview of proposal, discussion of key environmental factors, discussion of level of assessment.
Aug 2010	Ecological Management Branch (EMB),	Phone call	Overview of proposal indicated that proposal has been referred and level of assessment set to PER.
Sep 2010	DEC Nature Conservation Pilbara Region (NCPR)	Phone call	Overview of proposal and indicated that proposal has been referred and level of assessment set to PER.
Sep 2010	DoW Pilbara, DEC Industrial Assessment Branch (Pilbara)	Meeting	Overview of project, discussion of key issues and PER requirements, explanation of water volume changes and surplus water management options.
Sep 2010	DEC EMB, DEC NCPR and DEC Science Division	Meeting	Overview of existing approvals and operations, outline of key issues.
Oct 2010	OEPA and DMP	Site visit	Site visit to view Brockman 2, Nammuldi and Silvergrass area, described proposal, layout and orebody details of dewatering and surplus water management. Inclusion of conceptual Bedded Brockman pits.
Nov 2010	Eastern Guruma	Meeting	Discussion of forward planning for the involvement of the Eastern Guruma group in the proposed dewatering process.
Nov 2010	DEC EMB, DEC NCPR DEC Science Division	Quarterly update meeting	Discussion of timelines, layout optimisation, accommodation strategy, dewatering and surplus water management and Brockman 4 water supply.
Mar 2011	DEC EMB, DEC Science Division	Meeting	Discussion of surplus water strategy, with detailed explanation of the proposed irrigated agriculture. Results presented for discharge modelling for Caves, Duck and Boolgeeda creeks. Update on fauna issues and results of Biota studies.
Mar 2011	Pastoral Lands Board	Phone calls	Discussion of proposed program of soil investigations for irrigated agriculture.
Mar 2011	OEPA	Comments regarding first ESD draft	Changes to document structure and figures were suggested. Discussion of further consultation requirements.

Date	Department / Organisation	Type	Topics
Mar 2011	DEC NCPR	Meeting	Discussion of surplus water management strategy, dewatering requirements. Outlined the details of irrigated agriculture including weed management and closure planning.
Mar 2011	DoW Perth	Meeting	Discussion of surplus water management strategy, previous reinjection and infiltration trials and the groundwater section of the ESD.
Mar 2011	Shire of Ashburton	Meeting	Overview and status of Expansion Proposal.
Mar and Apr 2011	Mt Stuart Pastoral Station	Email/letter correspondence Phone call	Contact to arrange creekline surveys on Mt Stuart Station.
Apr 2011	OEPA	Comments regarding ESD	Changes required with regards to inclusion of irrigated agriculture surveys in PER.
May 2011	DoW	Meeting	Discussion of current status of hydrogeological modelling and an overview of surplus water management strategy.
May 2011	Eastern Guruma	Site visit	Search for Aboriginal Heritage site Yantinha, possible location identified. Discussion of dewatering, water discharge to Duck Creek and the irrigated agriculture area. DVD outlining the proposal was provided to allow a greater proportion of the Eastern Guruma Group to be informed.
May 2011	Mt Stuart Pastoral Station	Information package and phone call	Overview of Expansion Proposal. Information on dewatering and surplus water discharge, including surface water quality monitoring, biological surveys and access to Mt Stuart station for monitoring. Information on irrigated agriculture.
August 2011	DoW	Site visit	Discussion of hydrogeological studies completed, potential impacts, current dewatering strategy and discharge water management plan.
September 2011	DMP	Meeting	Mine closure, waste characterisation and landform stability, tailings management and secondary use of mine water.

7. Assessment Timelines

The Proponent is expecting the PER to be available for the four week public review period during April-May 2012 (Table 12). The dates shown unshaded in the table are targets that have been identified through consultation with the OEPA. Duration of steps undertaken by the OEPA and EPA are based on *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002* of the EP Act (EPA 2002a). However, the timeframe may be affected by the results of investigations, consultation or appeals.

Table 12 Indicative timeline for assessment

Stage	Days	Expected Commencement	Completion
Proponent submitted Referral	-	-	June 2010
EPA sets level of assessment	-	-	August 2010
Proponent submits Draft Scoping Document to EPA	-	-	February 2011
Stakeholder review of Scoping Document and Proponent revision	-	February 2011	October 2011
Proponent submits revised Scoping Document to EPA	-	-	December 2011
EPA approves Scoping Document	28	-	January 2012
Proponent submits Draft PER	-	-	January 2011
EPA reviews Draft PER to determine if it is acceptable for public release	49	January 2011	Early March 2011
Proponent submits revised PER	-	-	Late March 2012
EPA approves public release of PER	14	Late March 2012	April 2012
Public Review of PER	28	April 2012	May 2012
EPA summarises submissions	14	May 2012	June 2012
Proponent prepares Response to Submissions Document	-	-	June 2012
EPA assessment of PER and prepares report to Minister	49	June 2012	Early August 2012
Consultation on EPA recommended conditions	14	Early August 2012	Mid August 2012

8. Peer review

Peer review of both the Nammuldi and Silvergrass conceptual hydrogeological models has been undertaken Seth Johnson (Director, Hydrogeology, Hydroconcept). The findings of the peer reviews will be included in the PER.

9. Environmental Offsets

The PER will address the State's Environmental offsets Policy and EPA Guidance Statement No. 19 *Environmental Offsets - Biodiversity* and will include a completed Environmental Offsets Reporting Form to determine if offsets are required for the proposal.

Consultation on the requirements for offsets will then be undertaken in the first instance with the OEPA for resolution during the Part IV assessment process.

10. References

Australian and New Zealand Minerals and Energy Council (ANZMEC) and Minerals Council of Australia (MCA) 2000, *Strategic Framework for Mine Closure*, National Library of Australia Catalogue.

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List of appendices

The following Supporting documents are contained on CD-ROM inside the back cover of this report:

Appendix 1:
Statement 558 (as amended)

Appendix 2:

Vegetation and Flora

Biota Environmental Sciences (Biota) 2010a, *A Vegetation and Flora Survey of Expansion Areas at Nammuldi*, unpublished report prepared for Rio Tinto Iron Ore, June 2010.

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