

# VEGETATION EMP

## THUNDERBIRD MINERAL SANDS PROJECT

PREPARED FOR:

**SHEFFIELD RESOURCES LIMITED**



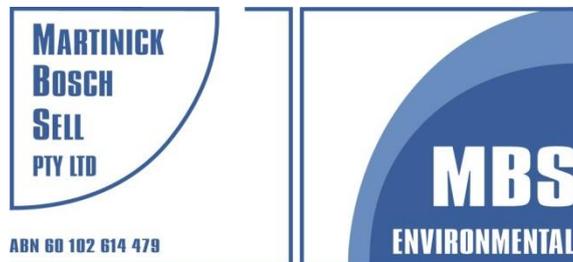
SheffieldResources

NOVEMBER 2016

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## THUNDERBIRD MINERAL SANDS PROJECT VEGETATION EMP

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Document Status	Prepared By	Authorised By	Date
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# TABLE OF CONTENTS

## EXECUTIVE SUMMARY

<b>1.</b>	<b>CONTEXT, SCOPE AND RATIONALE .....</b>	<b>1</b>
1.1	PROPOSAL .....	1
1.2	LOCATION .....	1
1.3	KEY ENVIRONMENTAL FACTOR: FLORA AND VEGETATION .....	5
1.4	REQUIREMENTS OF THE CONDITION .....	5
1.5	RATIONALE AND APPROACH IN MEETING THE ENVIRONMENTAL OBJECTIVE.....	5
1.5.1	Results of Baseline Surveys .....	5
1.5.2	Key Assumptions and Uncertainties .....	10
1.5.3	Management Approach .....	11
1.5.4	Rationale for Choice of Management Target/s .....	11
<b>2.</b>	<b>PRELIMINARY VEGETATION MANAGEMENT PLAN PROVISIONS .....</b>	<b>12</b>
2.1	PURPOSE.....	12
2.2	MANAGEMENT ACTIONS TO BE IMPLEMENTED .....	12
2.3	MANAGEMENT TARGETS AND MONITORING .....	15
2.4	REPORTING PROVISIONS .....	17
2.4.1	Annual Reporting.....	17
2.4.2	Reporting on Exceedance of Management Target.....	17
2.5	REVIEW AND REVISION .....	17
<b>3.</b>	<b>REFERENCES .....</b>	<b>18</b>

## TABLES

Table 1:	Environmental Management Targets.....	3
Table 2:	Thunderbird Project Tenements .....	4
Table 3:	Flora and Vegetation Surveys .....	6
Table 4:	Priority Flora Taxa Recorded Within Mine Site Development Envelope.....	7
Table 5:	Numbers of Priority Flora Recorded Within the Survey Areas.....	7
Table 6:	Risk-Based Management Actions to be Implemented* .....	13
Table 7:	Management Targets to Measure Efficacy of Management Actions .....	15

## FIGURES

Figure 1:	Location Plan.....	2
Figure 2:	Mine Site Development Envelope.....	3
Figure 3:	Vegetation Communities and Conservation Significant Flora within the Mine Site Development Envelope Survey Area.....	9

## EXECUTIVE SUMMARY

This Preliminary Condition Vegetation Environmental Management Plan (Vegetation EMP) is submitted in accordance with the Public Environmental Review (PER) document for the Thunderbird Mineral Sands Project which will be developed by Sheffield Resources Ltd (Sheffield).

Prior to commencement of mining, Sheffield will update this Preliminary Vegetation EMP in consultation with the Office of the Environmental Protection Authority (OEPA). As such, this Vegetation EMP remains a working document.

Table 1 presents the environmental management target/s to measure achievement of the conditioned environmental objective that must be met through implementation of this Vegetation EMP.

**Table 1: Environmental Management Targets**

<b>Title of Proposal</b>	Thunderbird Mineral Sands Project
<b>Proponent</b>	Sheffield Resources Limited
<b>Purpose of this Condition EMP</b>	The purpose of this Preliminary Vegetation EMP is to assist the OEPA in determining whether the OEPA's objective for the Key Environmental Factor can be met.
<b>EPA's Environmental Objective</b>	Flora and Vegetation: <i>To maintain representation, diversity, viability and ecological function at the species, population and community level.</i>

### Corporate Endorsement

I hereby certify that to the best of my knowledge, the provisions within this Preliminary Vegetation EMP are true and correct and address the Flora and Vegetation Key Environmental Factor identified in the Scoping Document for the Thunderbird Mineral Sands Project.

Name: \_\_\_\_\_ Signed: \_\_\_\_\_

Designation: \_\_\_\_\_ Date: \_\_\_\_\_

# 1. CONTEXT, SCOPE AND RATIONALE

## 1.1 PROPOSAL

The Thunderbird Mineral Sands Project is a greenfield project and will comprise:

- Mining of heavy mineral sands over a 40 plus year period from the Thunderbird deposit. The initial rate of mining will allow excavation of a nominal 7.5 million tonnes per annum (Mtpa) of ore for the first four to five years, before increasing to a nominal 15 Mtpa of ore for the remainder of the project life.
- Onsite primary and secondary processing of ore to produce a range of saleable mineral sands products (ilmenite, zircon premium, zircon concentrate, titano-magnetite and HiTi88 Leucosene). Construction of processing facilities will be staged with production doubled to 15 Mtpa after approximately year five.
- Abstraction and reinjection of groundwater from the Broome Sandstone Aquifer to allow mining and supply ore processing needs.
- Development of infrastructure to support the project including power generation facilities, accommodation village, administration and maintenance buildings, internal roads, communications infrastructure, and waste storage and disposal facilities.
- Upgrade and extension of the existing road (Mt Jowlaenga Road) from the Great Northern Highway to form a 30 km Site Access Road.
- Transport of mineral sands products from the Mine Site via the Site Access Road and Great Northern Highway to Derby or Broome Ports for storage prior to export.
- Export of bulk mineral sands products from Derby Port via King Sound and packaged mineral product from the Port of Broome to international customers.

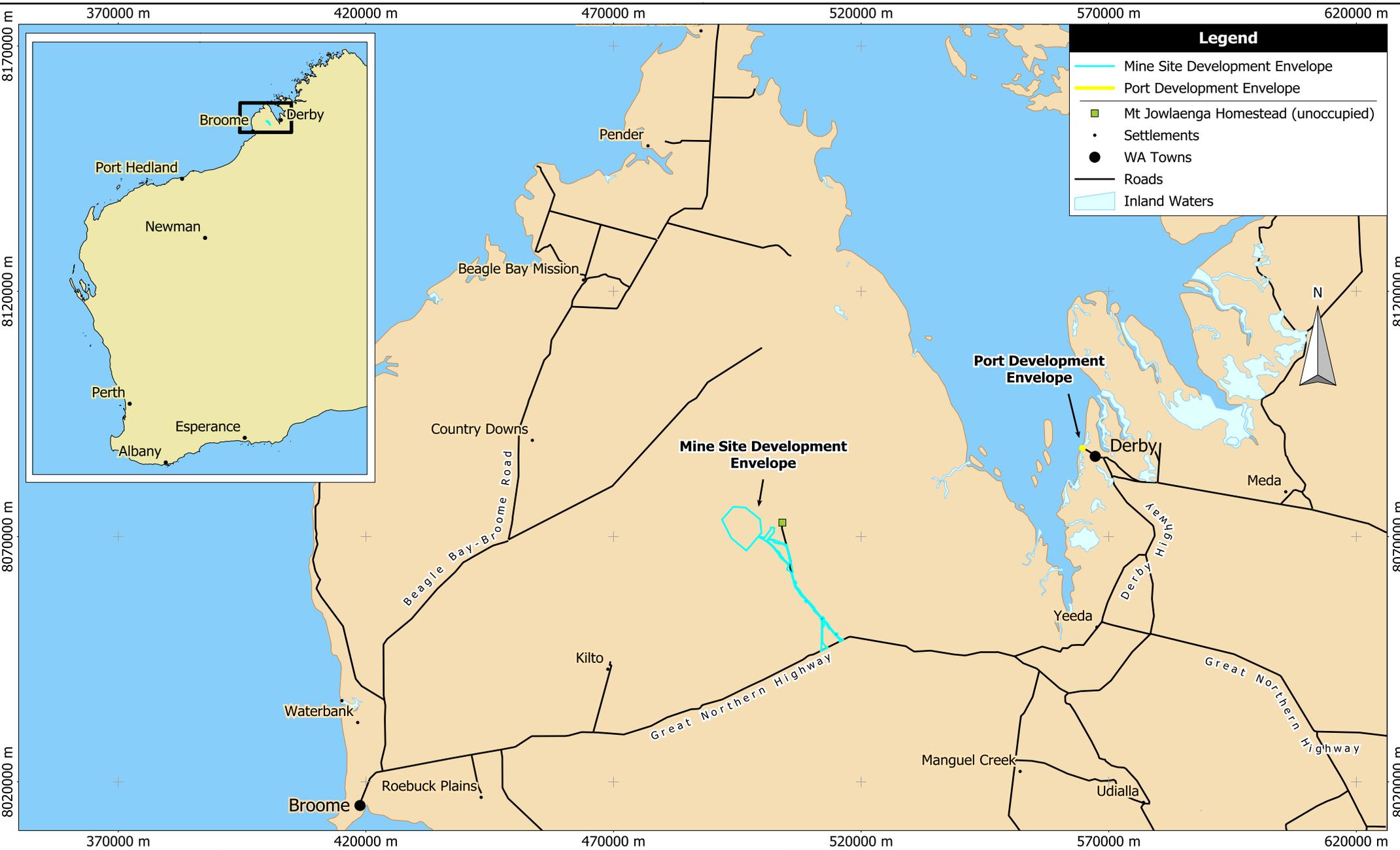
Construction of the project is scheduled to commence in Quarter 3 2017, with mining and production scheduled to commence in early 2019. The project will be fully operational in early 2019 with the first export of product anticipated by end of 2019.

## 1.2 LOCATION

The project is located on the Dampier Peninsula within the west Kimberley region of Western Australia (Figure 1). The project comprises two geographically separate locations, namely the Mine Site Development Envelope (including the Site Access Road) (Figure 2) and the Derby Port Development Envelope. Derby Port is an operational port and has been previously used for export of mineral products but is currently not being used for this purpose. Derby Port is located in King Sound, which is currently home to several aquaculture and pearling enterprises.

The Mine Site Development Envelope is located approximately 75 km west southwest of Derby and 95 km northeast of Broome (Figure 2). It is accessed from the Great Northern Highway via a proposed 30 km long Site Access Road.

The Mine Site Development Envelope is located within Mt Jowlaenga Pastoral Lease (H910623), held by the Yeeda Pastoral Company Pty Ltd. An existing pastoral road that connects the Great Northern Highway to the abandoned Mt Jowlaenga Homestead will be upgraded to form part of the Site Access Road for the project. The Site Access Road intersects the Great Northern Highway approximately half way between Broome and Derby; by road it is approximately 110 km to Derby and 100 km to Broome.



Legend	
	Mine Site Development Envelope
	Port Development Envelope
	Mt Jowlaenga Homestead (unoccupied)
	Settlements
	WA Towns
	Roads
	Inland Waters



**Port Development Envelope**

**Mine Site Development Envelope**

Scale: 1:1000000  
 Original Size: A4  
 Grid: MGA94(51)

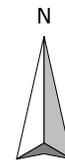
Sheffield Resources Limited  
 Thunderbird Mineral Sands Project

**Figure 1**  
**Project Location**

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500000 m

510000 m



8070000 m

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510000 m

M 04/459

L 04/85

L 04/84

L 04/86

L 04/82

L 04/83

**Legend**

-  Mine Site Development Envelope
- Thunderbird Tenements**
-  MINING LEASE
-  MISCELLANEOUS LICENCE
-  Great Northern Highway
-  Mt Jowlaenga Homestead (unoccupied)

Scale: 1:140000  
 Original Size: A4  
 Air Photo Date: 2015  
 Grid: Australia MGA94 (51)

0 4 km



Sheffield Resources Limited  
 Thunderbird Mineral  
 Sands Project

**Figure 2**  
 Mine Site Development  
 Envelope and  
 Tenements

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Several tenements are held by Sheffield for the Mine Site components of the project. Thunderbird project tenements are detailed in Table 2 and are shown in Figure 2. This Vegetation EMP applies only to the Mine Site Development Envelope.

**Table 2: Thunderbird Project Tenements**

Tenement	Area (hectares)	Holder	Granted	Expiry
M04/459	4,525	Sheffield Resources Ltd	Pending	N/A
L04/82	633	Sheffield Resources Ltd	Pending	N/A
L04/83	219	Sheffield Resources Ltd	Pending	N/A
L04/84	120	Sheffield Resources Ltd	23/04/2015	22/04/2036
L04/85	237	Sheffield Resources Ltd	23/04/2015	22/04/2036
L04/86	191	Sheffield Resources Ltd	23/04/2015	22/04/2036

### 1.3 KEY ENVIRONMENTAL FACTOR: FLORA AND VEGETATION

Potential impacts of the project on flora and vegetation within the Mine Site Development Envelope include:

- Clearing resulting in loss of vegetation communities or conservation significant species.
- Dust generated from construction and mining activities resulting in reduced vegetation health and condition.
- Increased presence of weeds resulting in reduced vegetation health and condition.
- Modification of surface water flows resulting in loss or reduced health and condition of native vegetation.
- Groundwater abstraction resulting in loss or reduced health and condition of groundwater dependent ecosystems (GDEs).
- Altered fire regimes resulting in loss or reduced health and condition of native vegetation.
- Radiation exposure resulting in loss or reduced health and condition of native vegetation.

### 1.4 REQUIREMENTS OF THE CONDITION

Specifically, this Vegetation EMP is submitted as an Appendix to the PER document in order to satisfy the EPA that Sheffield has taken into consideration the environmental objective set for flora and vegetation and are committed to undertaking a project that meets these objectives. This will occur through the application of management and monitoring measures as detailed in this Plan.

### 1.5 RATIONALE AND APPROACH IN MEETING THE ENVIRONMENTAL OBJECTIVE

Results of baseline surveys and a number of assumptions and uncertainties inform the management approach for meeting the environmental objective. The identified management actions, management targets and proposed review and revision of management actions are aligned with the overall management approach.

#### 1.5.1 Results of Baseline Surveys

Four flora and vegetation surveys have been undertaken for the Mine Site Development Envelope and surrounds between 2012 and 2016, as listed in Table 3. The flora and vegetation surveys were undertaken in accordance with EPA Guidance Statement 51 (EPA 2004) and the later surveys, also in accordance EPA and Department of Parks and Wildlife (DPaW) Technical Guide (EPA 2015). In 2016, Mattiske Consulting conducted a technical review of the Ecologia botanical reports (Ecologia 2012, 2014 and 2015). Following their technical review, an additional survey was commissioned to address the methodological gaps within earlier surveys.

These surveys covered an area of approximately 18,885.9 ha compared to the Mine Site Development Envelope of 5,875 ha.

**Table 3: Flora and Vegetation Surveys**

Survey Title	Author	Survey Time
Thunderbird Dampier Peninsula Project Level 1 Flora and Fauna Assessment (Ecologia 2012).	Ecologia	June 2012
Thunderbird Project Level 2 Flora and Vegetation Assessment (Ecologia 2014).	Ecologia	April 2013
Thunderbird Haul Road and Accommodation Camp Flora and Fauna Assessment (Ecologia 2015).	Ecologia	May 2015
Flora and Vegetation of the Thunderbird Mineral Sands Project Area (Mattiske 2016)	Mattiske	June 2016

A total of 255 vascular plant taxa, representative of 129 genera and 44 families were recorded in the survey area (Mattiske 2016). The majority of taxa recorded were representative of the *Poaceae* (46 taxa), *Fabaceae* (45 taxa), *Malvaceae* (18 taxa), *Cyperaceae* (14 taxa), *Myrtaceae* (14 taxa), *Amaranthaceae* (12 taxa) and *Convolvulaceae* (10 taxa) families.

#### 1.5.1.1 Conservation Significant Flora

No Threatened flora pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* or *Environment Protection and Biodiversity Conservation Act 1999* were recorded within the Mine Site Development Envelope by any survey (Ecologia 2012, 2014, 2015, Mattiske 2016).

Two Priority taxa were recorded within the flora survey area by Mattiske (2016) and Ecologia (2012, 2014, 2015),, *Triodia caelestialis* (P3) and *Pterocaulon intermedium* (P3) (Table 4, Figure 3). *Triodia caelestialis* was recorded widely, with *Pterocaulon intermedium* (P3) recorded infrequently. Neither taxon was associated with any specific landforms, soil types or vegetation communities.

Three other priority flora taxa were recorded infrequently in the survey area by Ecologia (2012, 2014, 2015) (Table 4, Figure 3). These taxa were *Fuirena incrassata* (P3), *Fuirena nudiflora* (P1), and *Tephrosia valleculata* (P3). *Eriachne* sp. *Dampier Peninsula* (K.F. Kenneally 5946) was previously reported as a Priority 3 (Ecologia 2014), however, is no longer listed as a priority taxon (DPaW 2016). None of these three taxa were recorded during the Mattiske (2016) survey of the Mine Site Development Envelope.

Poor rainfall conditions prior to the 2016 survey may have precluded *Fuirena incrassata* (P3), an annual species, from being recorded. However, according to DPaW (2016), the distribution of *Fuirena nudiflora* (P1) is restricted to the Victoria Bonaparte and Central Range IBRA regions, near to the borders of the Northern Territory and South Australia. Its presence in the Mine Site Development Envelope survey area would represent a range extension of approximately 1,000 km to the west (DPaW 2016). No specialist taxonomic identification was undertaken in 2014 to confirm its presence within the Mine Site Development Envelope survey area.

*Tephrosia valleculata* (P3) is known to occur within approximately 200 km of the Thunderbird Project Area (DPaW 2016) on rock outcrops and soil around sandstone (DPaW 2016). Due to poor seasonal conditions or possible opportunistic occurrence of the taxon, it was not recorded during the 2016 survey. It cannot be certain that the taxon was present as no specialist taxonomic identification was undertaken. Notwithstanding, given its preference for rocky outcrops (DPaW 2016), it is unlikely to be impacted by project development within the Mine Site Development Envelope (Mattiske 2016).

**Table 4: Priority Flora Taxa Recorded Within Mine Site Development Envelope**

Species	Conservation Listing	Within Development Envelope
<i>Pterocaulon intermedium</i>	P3	Yes by Matiske and Ecologia
<i>Triodia caelestialis</i>	P3	Yes by Matiske
<i>Tephrosia valleculata</i>	P3	Yes by Ecologia
<i>Fuirena incrassata</i>	P3	No
<i>Fuirena nudiflora</i>	P1	No

The number of plants of each Priority species within the survey area, Mine Site Development Envelope and disturbance footprint are shown in Table 5. Proposed impacts to Priority flora based on the Development Envelope are 8% and 17% respectively based on records in the survey area of Ecologia (2012, 2014, 2015) and Matiske (2016). Given the widespread distribution of both taxa within the survey area and the scarcity of surveys in the less-accessible parts of the Dampier Peninsula, there is a reasonable expectation that more of these taxa would be found outside the Mine Site Development Envelope beyond known records (Matiske 2016).

**Table 5: Numbers of Priority Flora Recorded Within the Survey Areas**

Species	CC	Plants Within Development Envelope	Plants Within Disturbance Areas	Total Population (Ecologia and Matiske)	Percentage Impact (%) Within Development Envelope**	Percentage Impact (%) Within Disturbance Areas
<i>Pterocaulon intermedium</i>	P3	16	5	94	17	5
<i>Triodia caelestialis</i>	P3	10,665	770	135,363	8	6
<i>Tephrosia valleculata</i>	P3	1	0	3	33	0
<i>Fuirena incrassata</i>	P3	0	0	1	0	0
<i>Fuirena nudiflora</i> *	P1	0	0	1	0	0

Notes: CC = Conservation Code. \* Unlikely to be correct identification.

\*\* Based on assumption all records within Development Envelope will be removed.

Some Ecologia data lacked population information. Where no data was provided, a count of one was assumed. Impacts are only based on site specific surveys, not regional population numbers, so percentage impacts are far higher than a total population count.

One taxon, *Aristida contorta*, had an approximately 300 km range extension from known records to either the east or southwest of the survey area (DPaW 2016b). This taxon is not considered to be of conservation significance as it is a common grass widely distributed throughout the state. Ecologia (2014) reported 26 taxa that represented range extensions of more than 100 km from their then known range. All range extensions are likely to be associated with the low level of survey of the less accessible areas of the Dampier Peninsula (Matiske 2016).

Another species of interest is *Tephrosia* aff. *crocea* (Matiske 2016).. This species was recorded across the survey area and not restricted to a unique landform, but predominantly collected on the red sandy soils containing Pindan vegetation on the flats. This species could not be fully identified due to only sterile specimens being collected. Should this species be observed in flower or fruit, specimens should be collected to permit an accurate identification.

### 1.5.1.2 Vegetation Communities

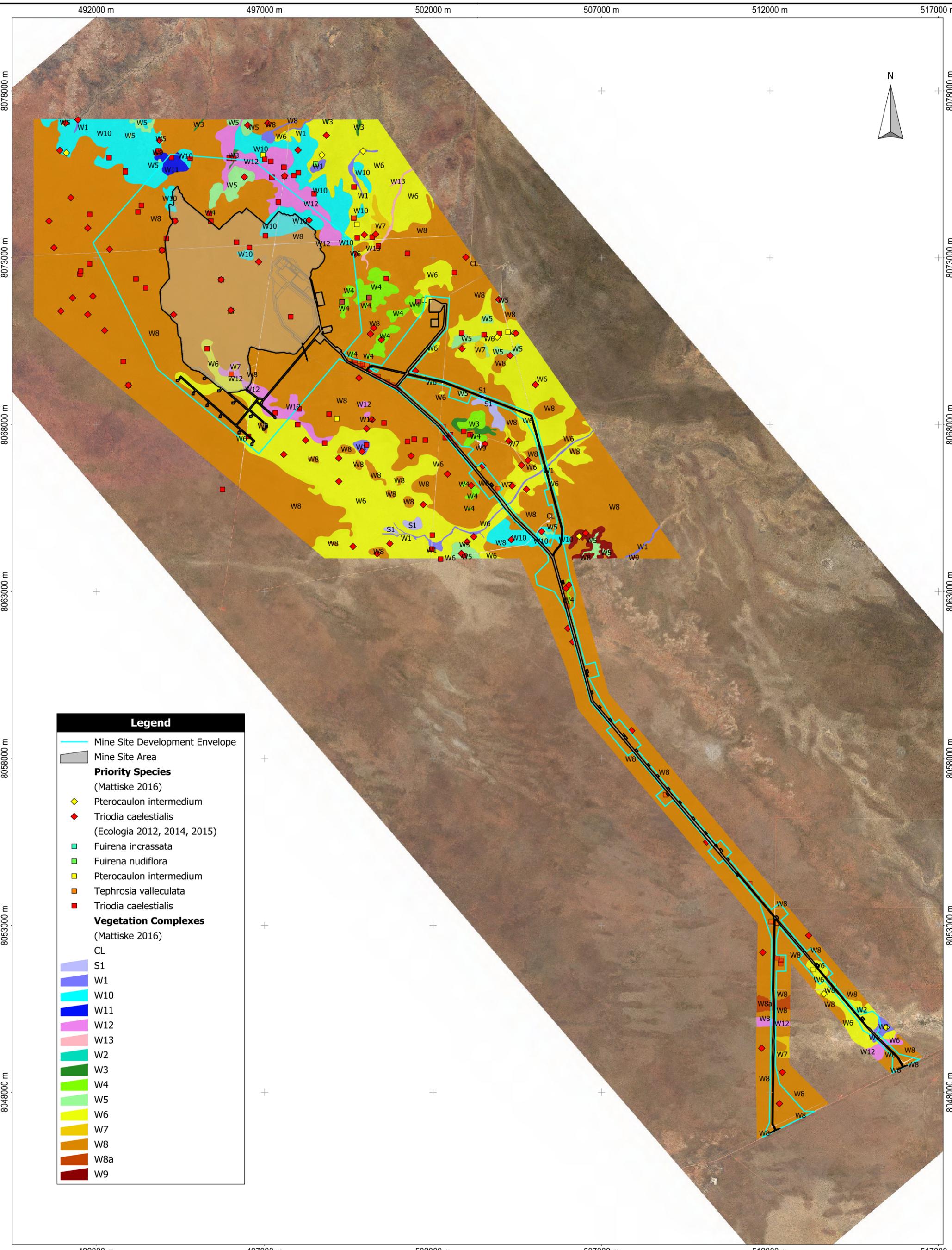
A total of 14 vegetation communities were defined and mapped, based on a statistical analysis of the combined data from (Ecologia 2012, 2014 and 2015) and Matiske (2016) (Figure 3).

Two of the pindan vegetation (low sparse Eucalypt woodlands over *Acacia tumida* shrubland over *Triodia/Chrysopogon* grasslands) vegetation communities, W6 and W8, accounted for approximately 86% of the surveyed area and were considered the most representative of the Mine Site Development Envelope (Matiske 2016).

The other main communities mapped were associated with the drainage channels (*Melaleuca viridiflora/Melaleuca alsophila* woodland) and rocky hills. Vegetation associated with the hills and drainage channels within the Mine Site Development Envelope were statistically different from the vegetation communities defined on the flats.

In broad terms, the vegetation of the Mine Site Development Envelope consists of vegetation, where there is a sparse overstorey of *Eucalyptus/Corymbia* species – typically *Corymbia greeniana/Eucalyptus tectifera* – over a mid-storey of *Acacia* species, dominated by *Acacia tumida* var. *tumida*, and a ground cover of mixed grasses, with *Triodia caelestialis* (P3), *Triodia schinzii*, and *Chrysopogon* species (*C. pallidus*, *C. timorense*) being dominant. Other common species in the upper storey included *Brachychiton diversifolius*, *Corymbia zygophylla*, *Erythrophleum chlorostachys*, and *Eucalyptus flavescens*. *Atalaya hemiglaucua*, *Bauhinia cunninghamii*, *Dolichandrone heterophylla*, *Ehretia saligna*, *Gardenia pyriformis* subsp. *keartlandii*, *Grevillea pyramidalis*, *Hakea arborescens*, and *Hakea macrocarpa* were common midstorey species. Some of these, such as *Bauhinia cunninghamii*, were often of sufficient size as to form a component of the upper storey. The vegetation is essentially pindan and is common and widespread through the broader Kimberley region.

Overall, the vegetation communities mapped and species recorded in the wider area surrounding and including the Mine Site Development Envelope are consistent with the historical mapping of Beard (1976) and the more recent land systems mapping of Kimberley by Schoknecht and Payne (2010).



**Legend**

- Mine Site Development Envelope
- Mine Site Area
- Priority Species**  
(Mattiske 2016)
- ◆ Pterocaulon intermedium
- ◆ Triodia caelestialis  
(Ecologia 2012, 2014, 2015)
- Fuirena incassata
- Fuirena nudiflora
- Pterocaulon intermedium
- Tephrosia valleculata
- Triodia caelestialis
- Vegetation Complexes**  
(Mattiske 2016)
- CL
- S1
- W1
- W10
- W11
- W12
- W13
- W2
- W3
- W4
- W5
- W6
- W7
- W8
- W8a
- W9

Scale: 1:100000  
 Original Size: A3  
 Air Photo Date: 2015  
 Grid: Australia MGA94 (51)

0 4 km

Sheffield Resources Limited  
 Thunderbird Mineral  
 Sands Project

**Figure 3**  
**Vegetation Communities and Conservation Significant  
 Flora within the Minesite Development Envelope  
 Survey Area**

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### 1.5.1.3 Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs), pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* or *EPBC Act* occur within 50 km of the Mine Site Development Envelope.

No Priority Ecological Communities (PECs) as listed by DPaW (2016f) currently intersect the Mine Site Development Envelope. There are currently three Priority 1 and five Priority 3 PECs, as listed by DPaW (2016f, DPaW Reference 01-0816EC), which occur within 50 km of the Mine Site Development Envelope.

A 14.5 ha drainage channel community consisting of *Melaleuca viridiflora*/*Melaleuca alsophila* (statistically groups with community W1) within the Mine Site Development Envelope was claimed by Ecologia (2014) to have some resemblance to the Lolly Wells Spring wetland complex Priority 3 PEC assemblage. The Lolly Wells Spring assemblage is groundwater dependant, as it is likely to exist in areas of permanent fresh water, such as areas with numerous low organic mound springs with moats. The assemblage supports groves of *Melaleuca cajuputi* and *Melaleuca viridiflora*, together with aquatic species such as *Nymphaea violacea*, *Nymphoides indica* and *Nymphoides beaglensis*.

The survey area does not contain areas of vegetation consistent with permanent water associated with springs (Mattiske 2016). The claim that community W1 was similar to the Lolly Wells Spring assemblage was not supported by any statistical analysis or reasonable argument. Mattiske (2016) reported that the potential PEC area is set in a low lying area amongst gentle slopes and receives internal surface water drainage

### 1.5.1.4 Potential Groundwater Dependent Ecosystems

Pennington Scott (2015) inferred potential GDEs within the project area and wider region as reported in Rockwater (2016).

Ecologia (2014) also indicated the potential presence of a PEC that is groundwater dependent. This potential PEC correlates to the “nearby soak” as identified by Pennington Scott (2015). However, the potential PEC was not supported by Mattiske (2016) and the area is likely to be a perched aquifer not connected to the deeper Broome Sandstone Aquifer (Rockwater 2016).

Pennington Scott (2015) as reported in Rockwater (2016), also identified the ephemeral drainage line of the Fraser River South valleys as potentially a GDE. However, it is also likely that creekline vegetation is sustained by the upper alluvial sands lenses, rather than any deeper aquifers. Depths to groundwater range from less than 5 m to more than 20 m. Mattiske (2016) also report that generally species within the drainage lines are commonly represented throughout the landscape.

### 1.5.1.5 Introduced Flora

A total of 11 introduced (exotic) plant taxa have been recorded within the wider survey area by Ecologia (2012, 2014) and Mattiske (2016). These include *\*Cyanthillium cinereum*, *\*Cynodon dactylon*, *\*Digitaria ciliaris*, *\*Echinochloa colona*, *\*Sida acuta*, *\*Stylosanthes hamata*, *\*Stylosanthes scabra*, *\*Tridax procumbens*, *\*Cenchrus ciliaris*, *\*Portulaca pilosa* and *\*Stylosanthes humilis*. *\*Sida acuta*, a Declared Pest common to the Kimberley, was recorded by Ecologia (2014b). However this weed was recorded outside the Mine Site Development Envelope.

## 1.5.2 Key Assumptions and Uncertainties

The proposed Mine Site Development Envelope and surrounds has been the subject of several investigations into terrestrial flora and vegetation for the purpose of the PER. It is assumed that investigations and studies undertaken for the PER and management plans that have been developed have adequately:

- Mapped vegetation communities within the Mine Site Development Envelope and immediate surrounds to ensure potential land clearing impacts are understood on a regional scale.
- Identified whether conservation significant flora species or ecological communities are present within the Mine Site Development Envelope and immediate surrounds.

- Calculated total area of potential vegetation loss.

### 1.5.3 Management Approach

The approach to management discussed in this document is based and developed around the mitigation hierarchy of avoid, minimise, rehabilitate and offset to ensure impacts to flora and vegetation have been avoided or reduced to as low as reasonably practicable.

Management actions detailed in this Vegetation EMP have been specifically designed to ensure the Thunderbird Mineral Sands Project meets its environmental objectives for the key environmental factor.

Risks and management actions were identified and prioritised using information gained from baseline surveys and other regional and local information within the public domain.

### 1.5.4 Rationale for Choice of Management Target/s

Environmental criteria have been developed based upon baseline surveys which have been undertaken between 2012 and 2016 as well as current scientific knowledge available in relation to the flora and vegetation and the impacts which may affect local populations. These studies identified a number of environmental parameters which are important to the conservation of the species and vegetation within the Dampier Peninsula.

## 2. PRELIMINARY VEGETATION MANAGEMENT PLAN PROVISIONS

This section identifies the legal provisions that Sheffield proposes to implement to ensure vegetation and flora is managed appropriately. It identifies management actions that will be implemented to mitigate and manage potential risks and management targets that will be used to measure the efficacy and performance of management actions.

### 2.1 PURPOSE

The purpose of this Vegetation EMP is to provide a framework to ensure that impacts on flora and vegetation attributable to the Thunderbird Mineral Sands Project are minimised and impacts do not conflict with the EPA objective for flora and vegetation which is *“to maintain representation, diversity, viability and ecological function at the species, population and community level”*.

### 2.2 MANAGEMENT ACTIONS TO BE IMPLEMENTED

Management objectives have been identified to address potential impacts detailed in Section 1.3 of this management plan. The purpose of management objectives is to define Sheffield's aims in context with potential impacts identified in Section 1.3 of this Vegetation EMP. To meet these management objectives, a series of fit for purpose risk-based management actions have been developed and prioritised to ensure potential impacts on flora and vegetation are minimised and are considered acceptable (Table 6). These management actions focus the greatest management effort on proposal activities that have the highest likelihood of causing adverse impact on flora and vegetation.

These actions were specifically developed to ensure the EPA's objective for flora and vegetation will be implemented for the project.

**Table 6: Risk-Based Management Actions to be Implemented\***

Risk and/or Key Impacts	Management Actions	Risk-Based Priority*	Timeframe / Project Phase
Clearing resulting in loss of vegetation communities or conservation significant species	<ul style="list-style-type: none"> <li>• Land disturbance will be kept to the minimum necessary for development of the project.</li> <li>• Existing disturbed areas will be used wherever possible to minimise total ground disturbance.</li> <li>• Land clearing will be undertaken progressively with the amount of active disturbance minimised.</li> <li>• Ground disturbance procedures and a permitting system will be implemented.</li> <li>• Progressive rehabilitation will be undertaken on disturbed areas as they become available.</li> <li>• Monitoring of analogue and rehabilitated areas will be undertaken to ensure short, medium and long-term rehabilitation objectives are achieved. Monitoring will be carried out on a regular basis to assess the success of revegetation in rehabilitated areas.</li> <li>• Ongoing development of monitoring methodology and rehabilitation techniques will occur during the life of the project. Further assessments over time will plot the development of rehabilitated areas against analogue sites and progression towards completion targets.</li> <li>• Topsoil and vegetation (including woody debris) will be respread over rehabilitated areas to act as a seed source and to protect the soil from erosion.</li> <li>• Local provenance seed and propagated material will be used, if required, to rehabilitate disturbed areas.</li> <li>• The site induction program will provide information on protection of flora and vegetation and ground disturbance authorisation procedures.</li> </ul>	Medium	Construction Operations Closure
Dust generated from construction and mining activities resulting in reduced vegetation health and condition or loss of conservation significant flora	<ul style="list-style-type: none"> <li>• Vehicles and mining equipment will keep to designated roads.</li> <li>• Dust suppression will be carried out during construction, operation and closure.</li> </ul>	Low	Construction Operations Closure
Increased presence and health of weeds resulting in reduced vegetation health and condition	<ul style="list-style-type: none"> <li>• A weed hygiene system will be developed and implemented in consultation with the pastoralist.</li> <li>• Weed inspections will be conducted following significant rainfall, and depending on results, appropriate management actions will be implemented if required.</li> </ul>	Low	Construction Operations

Risk and/or Key Impacts	Management Actions	Risk-Based Priority*	Timeframe / Project Phase
Modification of surface water flows resulting in loss or reduced health and condition of native vegetation	<ul style="list-style-type: none"> <li>• Roads and access tracks will be constructed with appropriate surface water drainage structures to minimise impacts on surface water flows.</li> <li>• Diversion bunds will be constructed around active mine pit areas to prevent surface water runoff from entering active mining areas.</li> <li>• Where necessary, suitable floodways, drains and culverts will be installed to transfer flow past infrastructure and return it to its natural flow path.</li> <li>• Pipelines will be buried when crossing watercourses to prevent impediment of flow.</li> </ul>	Low	Construction Operations
Altered fire regime resulting in loss or reduced health and condition of native vegetation	<ul style="list-style-type: none"> <li>• Firefighting equipment will be located on site and emergency personnel trained will be trained in fire response.</li> <li>• Lightning protection equipment will be installed as part of project design where necessary.</li> <li>• Vehicles will not be permitted to leave access tracks or cleared areas.</li> <li>• A Hot Work Permit system will be developed and implemented.</li> <li>• All machinery and vehicles undertaking clearing activities will be fitted with firefighting equipment.</li> <li>• Sheffield will work with the pastoralist and DFES to undertake prescribed burns and install and maintain firebreaks if required so that potential environmental damage from extreme and out of control wildfires is minimised and infrastructure and the community are protected throughout the life of the project.</li> <li>• The project site induction will include information on the prevention and management of fires.</li> </ul>	Low	Construction Operations

+ Management actions and monitoring relevant to Groundwater Dependent Ecosystems are addressed in the Preliminary Groundwater Management Plan.

\* Based on the level of residual risk documented in the Public Environmental Review as part of impact assessment.

## 2.3 MANAGEMENT TARGETS AND MONITORING

Management targets will be employed to measure the performance of management actions and ensure impacts on flora and vegetation communities are minimised to achieve the EPA's environmental objective for flora and vegetation. Proposed management targets are provided in Table 7.

To ensure that proposed management actions are effective, performance against management targets will be monitored. A variety of records and reports collected as part of operations will be utilised as part of the monitoring process. These will largely include incident reports and the results of routine inspections (daily, weekly and monthly), which will be reviewed on a quarterly basis to assess performance against management targets. Additional monitoring surveys will also be undertaken to ensure specific targets are monitored. Relevant records and reporting resources and the mechanisms for implementing monitoring relevant to management targets are provided in Table 7. If targets are not achieved then fit for purpose corrective actions will be developed and implemented.

**Table 7: Management Targets to Measure Efficacy of Management Actions**

Management Objectives	Management Targets	Relevant Records and Reports	Monitoring
Minimise land clearing	No land clearing outside of approved clearing areas.  Land clearing kept to minimum required for construction and mining activities.	<ul style="list-style-type: none"> <li>• Clearing Register.</li> <li>• Survey data.</li> <li>• Annual Mine Plan.</li> <li>• AER and MRF reports.</li> <li>• Incident reports.</li> <li>• Internal audits and inspections.</li> <li>• Aerial photography.</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly review of Clearing Register.</li> <li>• Quarterly review of incident and inspection reporting.</li> <li>• Quarterly review of Annual Mine Plan data.</li> <li>• MRF reporting.</li> </ul>
Re-establish native vegetation on completion of mining activities	Progressive rehabilitation as areas become available within the mining excavation.  Re-establishment of vegetation that is native to the area.	<ul style="list-style-type: none"> <li>• Aerial photography.</li> <li>• Annual Mine Plan.</li> <li>• Internal audits and inspections.</li> <li>• Monitoring reports.</li> </ul>	<ul style="list-style-type: none"> <li>• Quarterly review of Annual Mine Plan data.</li> <li>• Survey data.</li> <li>• Rehabilitation Monitoring Program for all new areas and progressive monitoring for older areas.</li> </ul>
Minimise loss of conservation significant flora	No land clearing outside of approved clearing areas.	<ul style="list-style-type: none"> <li>• Clearing Register.</li> <li>• Survey data.</li> <li>• Annual Mine Plan.</li> <li>• AER and MRF reports.</li> <li>• Incident reports.</li> <li>• Internal audits and inspections.</li> <li>• Aerial photography.</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly review of Clearing Register.</li> <li>• Quarterly review of incident and inspection reporting.</li> <li>• Quarterly review of Annual Mine Plan data.</li> <li>• MRF reporting.</li> </ul>
Minimise dust emissions	Dust emissions kept to a minimum required for construction and mining activities.	<ul style="list-style-type: none"> <li>• Internal audits and inspections.</li> <li>• Incident reports.</li> <li>• Opportunistic observations.</li> </ul>	<ul style="list-style-type: none"> <li>• Quarterly review of incident and inspection reporting.</li> <li>• Opportunistic observations.</li> </ul>

Management Objectives	Management Targets	Relevant Records and Reports	Monitoring
Prevent introduction of weeds	No new weeds introduced into the project area.	<ul style="list-style-type: none"> <li>Internal audits and inspections.</li> <li>Hygiene inspection records.</li> <li>Weed Register.</li> <li>Incident reports.</li> <li>Opportunistic observations.</li> </ul>	<ul style="list-style-type: none"> <li>Weed inspections.</li> <li>Hygiene inspections.</li> <li>Quarterly review of incident and inspection reporting.</li> </ul>
Minimise spread of weeds	Existing weeds eradicated or minimised.	<ul style="list-style-type: none"> <li>Internal audits and inspections.</li> <li>Weed Register.</li> <li>Incident reports.</li> <li>Opportunistic observations.</li> </ul>	<ul style="list-style-type: none"> <li>Weed inspections.</li> <li>Quarterly review of incident and inspection reporting.</li> </ul>
Prevent damage to vegetation due to project ignited fires	<p>Firefighting equipment and systems installed wherever necessary.</p> <p>No fires attributed to mining and associated activities.</p>	<ul style="list-style-type: none"> <li>Internal audits and inspections.</li> <li>Incident reports.</li> <li>Opportunistic observations.</li> <li>Aerial photography.</li> </ul>	<ul style="list-style-type: none"> <li>Annual review of the Northern Area Fire Information Database.</li> <li>Quarterly review of incident reporting.</li> </ul>
Minimise change to surface water flow patterns	Construct roads and access tracks with appropriate surface water drainage structures.	<ul style="list-style-type: none"> <li>Internal audits and inspections.</li> <li>Incident reports.</li> <li>Opportunistic observations.</li> <li>Aerial photography.</li> </ul>	<ul style="list-style-type: none"> <li>Quarterly review of incident and inspection reporting.</li> </ul>

A formal rehabilitation monitoring program will be developed and implemented. This is further discussed in the Mine Closure Plan. The objectives of rehabilitation monitoring with respect to vegetation components will be to:

- Collect information about vegetation establishment in rehabilitated areas over time.
- Determine if vegetation established on completion of mining is consistent with pre-existing vegetation.
- Determine if re-established vegetation provides suitable habitat for native fauna, particularly the Greater Bilby.

The rehabilitation monitoring program will be focused on monitoring areas progressively rehabilitated within the mining excavation area associated with disturbance from mining. Small areas able to be rehabilitated after completion of construction (borrow pits, laydown areas, topsoil stockpiles) and the initial Tailings Storage Facility will also be included in the monitoring program. Other areas will not be able to be rehabilitated until completion of the project. Monitoring of these areas will be consistent with the agreed Mine Closure Plan.

Sheffield, as part of project impact assessment documents, has committed to compare development of rehabilitated areas to analogue sites to allow understanding of progression towards completion targets. Completion targets relevant to rehabilitation are contained in the Mine Closure Plan. Information collected during baseline studies will be used as analogue sites. Permanent monitoring sites will be established as progressive rehabilitation is completed. Rehabilitation monitoring will be conducted annually. The frequency of monitoring at individual sites will be determined based on progression towards short, medium and long term completion criteria. It is anticipated that as the age of rehabilitation increases, the need for annual monitoring will decrease.

Rehabilitation monitoring with respect to flora and vegetation will record:

- Species diversity.
- Species cover.

- Vegetation structure.
- Plant density.
- Litter/debris cover.
- Weed presence.
- Grazing or fire or other disturbances.

## **2.4 REPORTING PROVISIONS**

### **2.4.1 Annual Reporting**

Sheffield will prepare Annual Environmental Reports (AERs) to be submitted to regulatory authorities. The format of these reports will be consistent with requirements stipulated by individual regulatory authorities.

A Compliance Assessment Report (CAR) will be submitted to the Office of the Environmental Protection Authority (OEPA) at an agreed date. The report will document compliance with conditions of approval including assessment of compliance with management plan requirements where management plans form part of approval conditions.

### **2.4.2 Reporting on Exceedance of Management Target**

In the event that the management target is exceeded (or not met), the CEO of the OEPA will be notified within 7 days of identification of the exceedance.

## **2.5 REVIEW AND REVISION**

The Vegetation EMP will be reviewed annually by Sheffield for the first five years of project life. After this period, the project is anticipated to reach a steady state where construction has been completed and operational activities will have become standardised. The risk of unexpected impacts on flora and vegetation after this period will be lower. Review of this Vegetation EMP will occur on a two yearly basis thereafter.

### 3. REFERENCES

Beard J.S. 1979. *Vegetation Survey of Western Australia - Kimberley. 1:1,000,000 Vegetation Series*. University of Western Australia Press, Nedlands, Western Australia.

Department of Agriculture and Food (DAFWA). *Western Australian Organism List (WAOL)*.  
<https://www.agric.wa.gov.au/pests-weeds-diseases/weeds/declared-plants> [Accessed 7 November 2016].

Department of Parks and Wildlife (DPaW). 2016. *Florabase, the Western Australian Flora*.  
<http://florabase.dpaw.wa.gov.au>. Accessed 11 July 2016.

Environmental Protection Authority (EPA). 2004. *Environmental Protection Authority Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986), Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No 51*.

Environmental Protection Authority (EPA), Department of Parks and Wildlife (DPaW). 2015. *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment*.

Ecologia Environment. 2012. *Thunderbird Dampier Peninsula Project Level 1 Flora and Fauna Assessment*. Unpublished report prepared for Sheffield Resources Limited.

Ecologia Environment. 2014. *Thunderbird Project Level 2 Flora and Vegetation Report*. Unpublished report prepared for Sheffield Resources Limited.

Ecologia Environment. 2015. *Thunderbird Project Haul Road and Accommodation Village Flora and Fauna Assessment*. Unpublished report prepared for Sheffield Resources Limited.

Hussey, B.M.J., Keighery, G.J., Dodd, J., Lloyd S.G. and Cousens, R.D. (2007). *Western Weeds: a guide to the weeds of Western Australia (Second Edition)*. The Weeds Society of Western Australia, Perth.

Mattiske Consulting Pty Ltd (Mattiske). 2016. *Flora and Vegetation of the Thunderbird Mineral Sands Project Area*. Unpublished report prepared for Sheffield Resources Limited.

Schoknecht, N. and Payne, A.L. 2010. *Land systems of the Kimberley region, Western Australia*. Department of Agriculture and Food, Western Australia. *Technical Bulletin 98*, 250p.