



## **Dongara Project**

Environmental Management Program

Prepared for

Tiwest Northern Operations

by Strategen

April 2012



# Dongara Project

## Environmental Management Program

Strategen is a trading name of  
Strategen Environmental Consultants Pty Ltd  
Level 2, 322 Hay Street Subiaco WA  
ACN: 056 190 419

April 2012



**Disclaimer and Limitation**

This report has been prepared for the exclusive use of the Client, in accordance with the agreement between the Client and Strategen ("Agreement").

Strategen accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any person who is not a party to the Agreement.

In particular, it should be noted that this report is a qualitative assessment only, based on the scope of services defined by the Client, budgetary and time constraints imposed by the Client, the information supplied by the Client (and its agents), and the method consistent with the preceding.

Strategen has not attempted to verify the accuracy or completeness of the information supplied by the Client.

Copyright and any other Intellectual Property arising from the report and the provision of the services in accordance with the Agreement belongs exclusively to Strategen unless otherwise agreed. This document may not be reproduced or disclosed to any person other than the Client without the express written authority of Strategen unless the document has been released for referral and assessment of proposals.

**Client: Tiwest Northern Operations**

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Preliminary Draft Report	RevA	For client review	KT, AC, CJ / LK, TB	Electronic	7/07/2011
Preliminary Draft Report	RevB	For client review (up to Section 3.2 only)	KT, AC / LK, TB	Electronic	01/08/2011
Draft Report	RevC	For client review	KT, AC / TB	Electronic	31/08/2011
Final Draft Report	RevD	For client review	KT, SW / TB	Electronic	02/11/2011
Final Draft Report	RevE	For client review	KT, SW / TB	Electronic	03/11/2011
Final Report	Rev0	For OEPA review	KT, SW / TB	Electronic	04/11/2011
Revised report	RevF	For client review	KT, SW / TB	Electronic	29/03/2013
Revised report	Rev G	For client review	KT, MB / TB	Electronic	03/04/2013
Final Report	Rev G	For OEPA review	KT, MB / TB	Electronic	04/04/2013

Filename: TIW11103 01 Environmental Management Plan Rev 1 - 4 April 2012

## Table of contents

<b>1. Introduction</b>	<b>1</b>
1.1 Background	1
1.2 Purpose, scope and structure of document	4
1.2.1 Purpose	4
1.2.2 Structure	5
1.3 Legislative and regulatory requirements	5
1.4 Environmental policy	6
1.4.1 Environmental management system	7
<b>2. Implementation</b>	<b>8</b>
2.1 Responsibility	8
2.1.1 Environmental induction	10
2.2 Communications	10
2.2.1 Community complaints	11
2.3 Incidents and corrective actions	11
2.3.1 Emergency response	11
2.4 Auditing	12
2.5 Monitoring	12
2.6 Reporting	12
2.6.1 External reporting	12
2.7 Document management	13
2.7.1 Review	13
2.7.2 Document control	13
<b>3. Environmental management plans</b>	<b>14</b>
3.1 Surface and groundwater management plan	14
3.1.1 Description	14
3.1.2 Environmental aspects to be managed	15
3.1.3 Performance management	15
3.1.4 Implementation strategy	16
3.1.5 Monitoring program	18
3.1.6 Contingencies	21
3.1.7 Potential remedial action	23
3.2 Groundwater Dependant ecosystems (including wetlands)	24
3.2.1 Description	24
3.2.2 Environmental aspects to be managed	24
3.2.3 Performance management	25
3.2.4 Implementation strategy	25
3.2.5 Monitoring program	26
3.2.6 Contingencies	26
3.2.7 Potential remediation action	26
3.3 Rehabilitation management plan	26
3.3.1 Description	27
3.3.2 Environmental aspects to be managed	28
3.3.3 Performance management	28
3.3.4 Implementation strategy	31
3.3.5 Monitoring program	33
3.3.6 Contingencies	35
3.4 Weed and Phytophthora cinnamomi management plan	36
3.4.1 Description	36
3.4.2 Environmental aspects to be managed	37
3.4.3 Performance management	38
3.4.4 Implementation strategy	38
3.4.5 Monitoring program	40
3.4.6 Contingencies	41
3.5 Fauna management plan	42
3.5.1 Description	42
3.5.2 Environmental aspects to be managed	42
3.5.3 Performance management	43

3.5.4	Implementation strategy	43
3.5.5	Monitoring program	45
3.5.6	Contingencies	46
<b>3.6</b>	<b>Dust management plan</b>	<b>47</b>
3.6.1	Description	47
3.6.2	Environmental aspects to be managed	47
3.6.3	Performance management	47
3.6.4	Implementation strategy	48
3.6.5	Monitoring program	49
3.6.6	Contingencies	49
<b>3.7</b>	<b>Greenhouse gas inventory and management plan</b>	<b>51</b>
3.7.1	Description	51
3.7.2	Environmental aspects to be managed	51
3.7.3	Performance management	52
3.7.4	Implementation strategy	52
3.7.5	Monitoring program	53
3.7.6	Contingencies	53
<b>3.8</b>	<b>Radiation management plan</b>	<b>54</b>
3.8.1	Description	54
3.8.2	Environmental aspects to be managed	54
3.8.3	Performance management	54
3.8.4	Implementation strategy	55
3.8.5	Monitoring program	56
3.8.6	Contingencies	57
<b>3.9</b>	<b>Acid sulfate soil management plan</b>	<b>59</b>
3.9.1	Description	59
3.9.2	Environmental aspects to be managed	59
3.9.3	Performance management	59
3.9.4	Implementation strategy	60
3.9.5	Monitoring program	60
3.9.6	Contingencies	61
<b>3.10</b>	<b>Waste management plan</b>	<b>62</b>
3.10.1	Description	62
3.10.2	Environmental aspects to be managed	62
3.10.3	Performance management	62
3.10.4	Implementation strategy	63
3.10.5	Monitoring program	64
3.10.6	Contingencies	65
<b>3.11</b>	<b>Hydrocarbon and hazardous materials management plan</b>	<b>67</b>
3.11.1	Description	67
3.11.2	Environmental aspects to be managed	67
3.11.3	Performance management	67
3.11.4	Implementation strategy	67
3.11.5	Monitoring program	70
3.11.6	Contingencies	71
<b>3.12</b>	<b>Fire management plan</b>	<b>72</b>
3.12.1	Description	72
3.12.2	Environmental aspects to be managed	72
3.12.3	Performance management	72
3.12.4	Implementation strategy	72
3.12.5	Monitoring program	73
3.12.6	Contingencies	74
<b>4.</b>	<b>Acronyms, abbreviations and definitions</b>	<b>75</b>
<b>5.</b>	<b>References</b>	<b>78</b>

## List of tables

Table 1	Commonwealth and state legislation and regulations relevant to environmental management of the Project	5
Table 2	Groundwater and surface water management objectives, targets and performance indicators	15
Table 3	Groundwater and surface water management actions	16
Table 4	Groundwater and surface water monitoring program	18
Table 5	Groundwater and surface water management contingency actions	21
Table 6	GDE management objectives, targets and performance indicators	25
Table 7	GDE management actions	25
Table 8	Rehabilitation management objectives, targets and performance indicators	28
Table 9	Rehabilitation management actions	31
Table 10	Rehabilitation management monitoring program	34
Table 11	Rehabilitation contingency actions	35
Table 12	Weed and P. cinnamomi Hygiene management objectives, targets and performance indicators	38
Table 13	Weed and P. cinnamomi Hygiene management actions	38
Table 14	Weed and P. cinnamomi Hygiene monitoring program	40
Table 15	Weed and P. cinnamomi Hygiene contingency actions	41
Table 16	Fauna management objectives, targets and performance indicators	43
Table 17	Fauna management actions	43
Table 18	Fauna monitoring program	45
Table 19	Fauna contingency actions	46
Table 20	Dust management objectives, targets and performance indicators	48
Table 21	Dust management actions	48
Table 22	Dust monitoring program	49
Table 23	Dust management contingency actions	50
Table 24	Greenhouse Gas emissions management objectives, targets and performance indicators	52
Table 25	Greenhouse Gas emissions management actions	52
Table 26	Greenhouse Gas emissions monitoring program	53
Table 27	Greenhouse Gas emissions contingency actions	53
Table 28	Radiation management objectives, targets and performance indicators	55
Table 29	Radiation management actions	55
Table 30	Radiation monitoring program	56
Table 31	Radiation contingency actions	57
Table 32	ASS management objectives, targets and performance indicators	59
Table 33	ASS management actions	60
Table 34	ASS monitoring program	60
Table 35	ASS contingency actions	61
Table 36	Waste management objectives, targets and performance indicators	63
Table 37	Waste management actions	63
Table 38	Waste monitoring program	65
Table 39	Waste contingency actions	65
Table 40	Hydrocarbons and hazardous materials management objectives, targets and performance indicators	67
Table 41	Hydrocarbons and hazardous materials management actions	68
Table 42	Hydrocarbons and hazardous materials monitoring actions	71
Table 43	Hydrocarbons and hazardous materials contingency actions	71
Table 44	Fire management objectives, targets and performance indicators	72
Table 45	Fire management actions	73
Table 46	Fire monitoring actions	74
Table 47	Fire contingency actions	74

## List of figures

Figure 1	Regional location	3
Figure 2	Tiwest Northern Operations environmental management organisational structure.	9





# 1. Introduction

## 1.1 Background

Tiwest Northern Operations (Tiwest) currently runs the Cooljarloo Mine in the mid-west region of Western Australia. Raw product (heavy mineral concentrate) from these operations is transported by road and processed at the Chandala Processing Plant, near Muchea, in Western Australia. Tiwest is proposing to develop an additional minerals sands mine approximately 25 km southeast of Dongara, Western Australia (Figure 1). The Tiwest's Dongara Titanium Minerals Project (referred hereafter as the Project) involves the mining and concentration of mineral sands bearing titanium and other valuable minerals. Concentrated material will be transported to the Tiwest Chandala Dry Mill for processing and separation into its various mineral components prior to sale or, in the case of ilmenite, further processing into synthetic rutile and ultimately, titanium dioxide pigment at the Tiwest Kwinana Pigment Plant. The Project is expected to have a life of at least ten years.

The Project was referred to the Environmental Protection Authority (EPA) for assessment by Tiwest in 2007 in accordance with Section 38 of the *Environmental Protection Act 1986* (EP Act). The EPA applied a Public Environmental Review (PER) level of assessment to the Project. An Environmental Scoping Document (ESD) was prepared by Tiwest to identify the key environmental factors for the Project, prior to developing the PER. The key environmental factors as determined in consultation with the EPA are:

- regional and local flora and vegetation
- fauna
- hydrology
- hydrogeology
- soil and soil landscapes
- heritage
- air emissions
- rehabilitation and decommissioning
- radiation
- noise
- fire management
- waste management.

The Project was referred to the Department of Environment, Water, Heritage and the Arts (now the Department of Sustainability, Environment, Water, Population and Communities [SEWPaC]) in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in August 2009. The Project was determined to be a controlled action under Section 75 of the EPBC Act based on the potential impacts of the Project on Threatened Communities and Species protected by the EPBC Act in November 2009 (DEWHA 2009). Following this decision, SEWPaC confirmed that the Project will be assessed using the bilateral agreement between the Commonwealth and the Western Australian Government. The bilateral agreement will utilise the EPA's assessment process at the PER level.

This document has been prepared concurrently with, and supports, the PER.

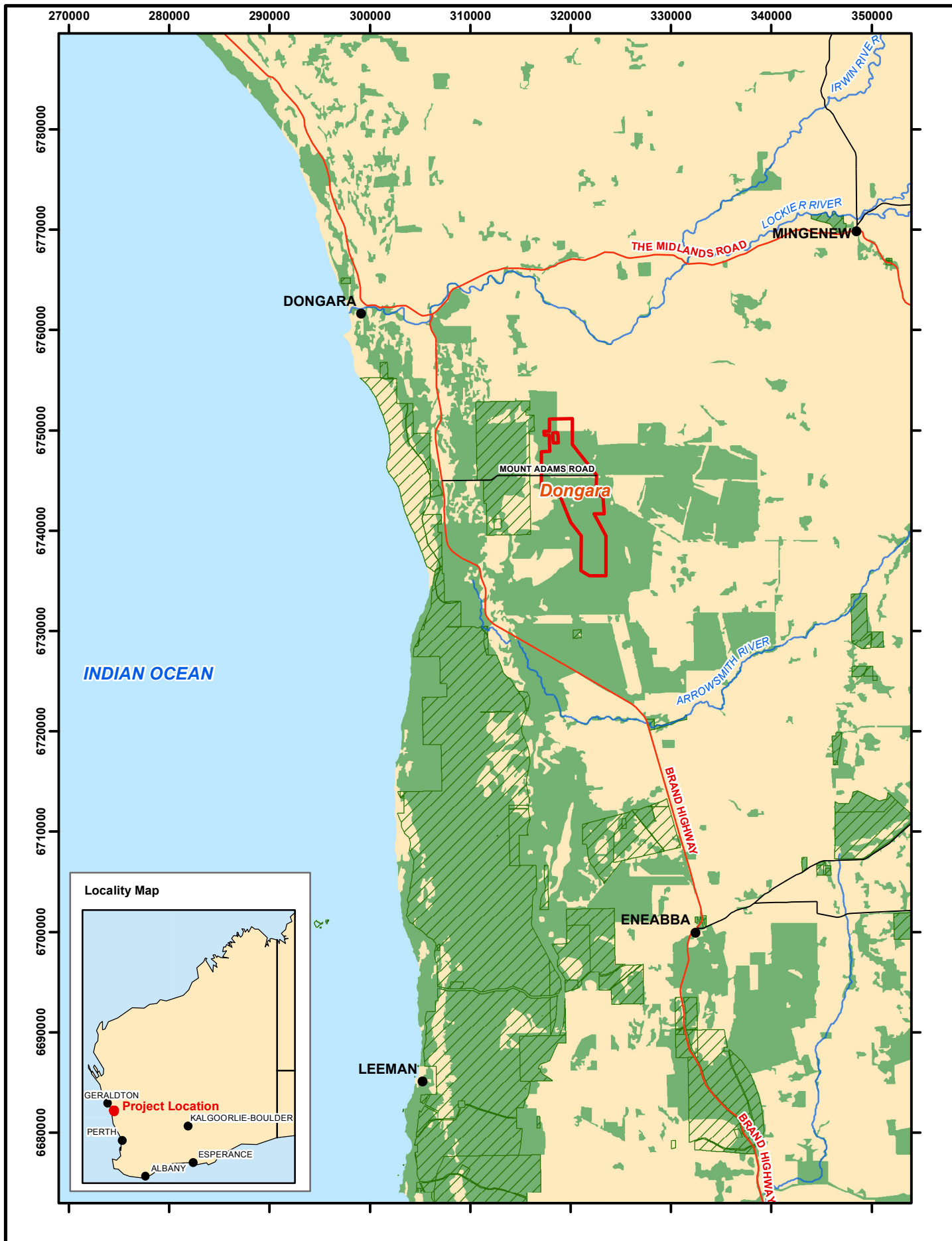


Figure 1 Regional location



**Scale**

0 3.5 7 10.5 14 17.5 km

Coordinate System: GDA 1994 MGA Zone 50  
Date: 28/03/2012  
Author: atomeo



1:500,000  
at A4

Source: Geoscience Australia online data centre,  
250k Topographic Mapsheets.  
Data sourced from Client.  
Note that positional errors may occur in some areas

**Legend**

- Road
- Principal Road
- River
- ▨ Reserve
- Native Vegetation
- ▭ Proposal Area

## 1.2 Purpose, scope and structure of document

### 1.2.1 Purpose

The purpose of this Environmental Management Plan (EMP) is to set out Tiwest's approach to the management of environmental impacts associated with the Project. It is an appended document to the Project PER and provides ongoing guidance to the Project with regard to the management of specific issues identified in the ESD. The EMP represents the implementation vehicle for management commitments within the Project PER. This EMP has also been developed within the context of:

- Tiwest Corporate Environmental Policy.
- Tiwest Corporate Safety Health and Environment (SHE) Management Standards (Tiwest 2010a).
- Tiwest Corporate Environmental Performance Standards (Tiwest 2011a).

Other Tiwest environmental management documentation that has been developed for the Project that is to be used in conjunction with this EMP includes:

- Tiwest Draft Wellfield Operating Strategy for the Dongara Mineral Sands Project (Tiwest 2011b).
- Tiwest Joint Venture Northern Operations Radiation Management Plan (Tiwest 2010b).
- Tiwest Dongara Exploration Environmental Management Plan (EEMP) (Tiwest 2011c) (Note; it is expected that this EMP will replace the Dongara EEMP within the active Mining Lease areas once the Project commences).

The management plans included within this document are:

1. Surface and groundwater management plan
2. Rehabilitation management plan.
3. Weed and *P. cinnamomi* hygiene management plan.
4. Fauna management plan.
5. Dust management plan.
6. Greenhouse gas emissions management plan.
7. Radiation management plan.
8. Acid sulfate soil management plan
9. Waste (non processing) management plan.
10. Hydrocarbon and hazardous materials management plan.
11. Fire management plan.

## 1.2.2 Structure

Each individual management plan includes:

- an action plan detailing objectives, key performance indicators, prevention, minimisation and mitigation measures for each issue
- a monitoring plan for each action plan to provide evidence that management is meeting targets, including timing and location
- a contingency plan should monitoring reveal deficiencies in current management.

The EMP is a continually evolving document and will be revised regularly, particularly in response to monitoring and internal audit feedback and to reflect changes in objectives and commitments.

## 1.3 Legislative and regulatory requirements

The legislative and regulatory requirements relating to this document are listed in Table 1. Tiwest maintain a legal register and regularly review changes (proposed and implemented) to relevant legislation, standards and other guidance information in accordance with Tiwest systems procedure Legal and Other Requirements (NO0020). Site specific legal obligations (e.g. Ministerial Statements, Site Environmental Licences) are described in Tiwest system document Environmental Responsibilities and Obligations (NO036). At this time this document does not address Dongara Project specific legal conditions as these have not yet been set.

Table 1 Commonwealth and state legislation and regulations relevant to environmental management of the Project

Legislation/Regulation	Application
<b>Commonwealth</b>	
<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i>	Recognition and protection of Aboriginal and Torres Strait Islander Heritage
<i>Energy Efficiency Opportunities Act 2006</i>	Energy use reporting
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Protects matters of National Environmental Significance
<i>National Greenhouse and Energy Reporting Act 2007</i>	Greenhouse gas emissions reporting
<i>Native Title Act 1993</i>	Recognition and protection of native title
<b>State</b>	
<i>Aboriginal Heritage Act 1972</i>	The protection of Aboriginal sites
<i>Agriculture and Related Resources Protection Act 1976</i>	Management, control and prevention of certain plants and animals and protection of agriculture and related resources
<i>Bush Fires Act 1954</i>	Prevention, control and extinguishment of bushfires
<i>Conservation and Land Management Act 1984 (CALM Act)</i>	Impact on public land and on specially listed flora and fauna
<i>Contaminated Sites Act 2003 (CS Act)</i>	Identification, recording, management and remediation of contaminated sites

Legislation/Regulation	Application
<i>Dangerous Goods Safety Act 2004</i>	Risks associated with dangerous goods and the responsibilities when storing, handling and transporting dangerous goods, including explosives
<i>Electricity Act 1945</i>	Licensing of persons carrying out works relating to electricity
<i>Environmental Protection Act 1986 (EP Act)</i>	Environmental impact assessment and pollution control
<i>Explosives and Dangerous Goods Act 1961</i>	Relating to the storage and handling of explosives or dangerous goods
<i>Health Act 1911</i>	Regulations concerning emissions, disposal of sewage
<i>Heritage of Western Australia Act 1990</i>	An act to provide for the conservation of places which have cultural heritage significance to the state
<i>Land Administration Act 1997</i>	Management of Crown Land
<i>Land Drainage Act 1925</i>	Drainage of land, use of drainage water, and the constitution of drainage districts
<i>Local Government (Miscellaneous Provisions) Act 1960</i>	Provides a system for building licences and other related matters
<i>Main Roads Act 1930</i>	The construction of roads
<i>Mining Act 1978</i>	Relating to the establishment of mines and regulation of associated matters through the Mining Regulations 1981
<i>Mines Safety and Inspection Act 1994</i>	Provides for the safe operations of mines in the state including regulation under the Mines Safety and Inspection Regulations 1985
<i>Native Title (State Provisions) Act 1999</i>	Provides alternative provisions to the Australian Government Native Title Act 1993 in relation to the protection of Aboriginal sites
<i>Occupational Safety and Health Act 1984</i>	Determination and promotion of occupational health and safety standards
<i>Planning and Development Act 2005</i>	Relating to land use planning and development in the state
<i>Poisons Act 1964</i>	Possession, sale, and use of poisons and other substances
<i>Rights in Water and Irrigation Act 1914 (RIWI Act)</i>	Interference with watercourse bed and/or banks, abstraction of water
<i>Soil and Land Conservation Act 1945</i>	Conservation of soil and land resources
<i>Waste Avoidance and Resource Recovery Act 2007</i>	Avoidance of waste generation, and recovery of resources from 'waste'
<i>Waterways Conservation Act 1976</i>	Conservation management of designated waterways and environments
<i>Wildlife Conservation Act 1950</i>	Listed threatened species

## 1.4 Environmental policy

Tiwest is committed to the principle of sustainable development and recognises the benefits of integrating economic, social and environmental considerations in its business planning and practices. These principles are documented in the Tiwest Corporate Environmental Policy (Tiwest 2011a). All personnel employed by Tiwest

either directly or as agents, consultants and contractors are required to comply with Tiwest policies so as to maintain the company's reputation as a trusted and responsible corporate citizen. To achieve its objectives, Tiwest recognise the importance of developing a mutual understanding of stakeholders' concerns and expectations by actively engaging and consulting in an open and honest manner.

#### 1.4.1 Environmental management system

Tiwest has operated in accordance with International Standard AS/NZS ISO 14001:2004 since 2004, subsequent to the development of an Environmental Management System (EMS) for its Western Australian Operations. The EMS has been developed in the context of Tiwest's Corporate SHE Systems and Performance Standards. The purpose of the EMS is to manage the impact of Tiwest's operations on the environment and ensure that these operations are conducted in accordance with existing legislative requirements. The Proposal Area will be included in the existing Tiwest Safety Health and Environmental Management System.

The EMS includes the following corporate standards:

- policy, leadership and commitment
- risk and opportunity management
- change management
- legal and other requirements
- objectives, targets and improvement plans
- operational control
- communication and consultation
- training and competency
- structure and responsibility
- crisis and emergency management
- contractor selection and management
- document and records management
- incident management
- monitoring, measurement and reporting
- action management
- management review

The standards are supported by corporate documents and processes, site systems standards, and other key supporting documents.

## 2. Implementation

This EMP will be implemented at Dongara within the context of the overall Tiwest EMS. The main elements of the implementation of the EMP are described below.

### 2.1 Responsibility

The current environmental management structure of Tiwest Northern Operations is shown in Figure 2. Ultimate responsibility for operational environmental management rests with the General Manager Northern Operations. Site performance will be the responsibility of the Operations Manager (who is also the Registered Mine Manager). The Manager: Safety, Health, Environment and Human Resources (SHEHR) will be responsible for both advising and assisting the General Manager and Operations Manager in meeting their environmental accountabilities. More specifically these include:

- ensuring the dissemination and understanding of Tiwest's environmental philosophy and commitment to all employees
- ensuring the adherence to and review of the Dongara Project Environmental Management Program
- ensuring the preparation and implementation of site Environmental Action Plans
- ensuring the preparation and maintenance of the Dongara Project Environmental Reporting Systems
- ensuring the monitoring of compliance with environmental regulations.

Environmental specialists within the environmental department assist the Manager: Safety, Health, Environment and Human Resources in ensuring that implementation of programs, activities and procedures are in place to ensure effective and proactive environmental management for the Project.



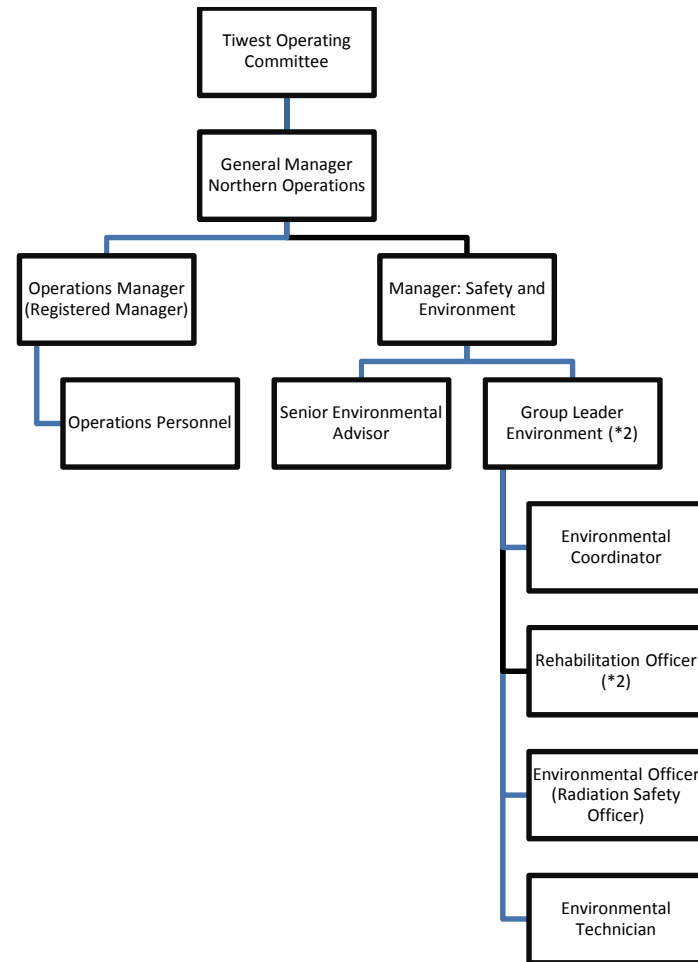


Figure 2 Tiwest Northern Operations environmental management organisational structure.

### 2.1.1 Environmental induction

All employees (including contractors) accessing the Dongara Project site will receive suitable environmental training, to ensure they are aware of their responsibilities and are competent to carry out their work in an environmentally acceptable manner. Environmental requirements for the Dongara Project will be explained to all onsite personnel during a site induction. Ongoing instruction will be provided via issue specific / targeted training, toolbox meetings and other day to day procedural items. Records of training will be maintained.

The environmental induction will include the following items:

- explanation of the purpose and objectives of the Environmental Management Program
- roles and functions of personnel onsite in relation to environmental management
- brief explanation of their responsibilities under the environmental management procedures contained within this EMP
- potential consequences of departure from procedures
- incident reporting procedures
- emergency procedures and responses
- identification of their legal obligations.

## 2.2 Communications

Internal communications will be used to address concerns and questions raised by construction and mining personnel and any incidents (environmental and general) that may occur. In addition, these mechanisms will be used to communicate any new environmental management procedures or information to ensure effective implementation. The internal communications methods may include the following, as applicable:

- business plans
- meetings (Site Environmental Committee and SHE Leadership meetings)
- briefings (Site Operations Manager and SHE)
- performance reports
- notice boards
- onsite personnel inductions, training and toolbox sessions (as required)
- contractor coordination meetings.

### 2.2.1 Community complaints

All community complaints will be recorded on a complaints register and investigated. A summary of the complaint and the subsequent investigation, including any monitoring results and corrective action (proposed mitigation measures) will be prepared and reported in the Annual Environmental Report (AER).

## 2.3 Incidents and corrective actions

As at other Tiwest operations, the Project will maintain an environmental incident reporting system. The purpose of this will be to:

- ensure all relevant people are notified in order to take necessary remedial action
- ensure the Department of Environment and Conservation (DEC) and other Government agencies are notified in accordance with regulatory requirements
- ensure the appropriate investigations are completed to determine any environmental impacts
- ensure appropriate preventative measures are identified and implemented.

All internal environmental reporting will be conducted using the "Incident Report Form", which will be made available to all on-site personnel and contractors. The form is to be used to raise any environmental concern, and also provides reporting guidelines and time frames. An Environmental Incident Register will be maintained by the Environmental Coordinator, recording each report with an allocated report number. The register will be used to track the progress and closure of each incident report.

All incidents will be reviewed to determine if they require reporting to the appropriate authority. If reporting is required, it will be carried out in writing to the appropriate authority within 24 hours of the incident occurring. An Incident Report is not closed until the four involved parties (the observer, Environmental Coordinator, Superintendent and Site Operations Manager) have indicated their satisfaction with the outcome of the report.

### 2.3.1 Emergency response

Emergency response procedures have been established for a range of scenarios including, hydrocarbon spills, tailings dam wall or pipe failures, and spillage / contamination from waste disposal activities as part of the EMS.

The emergency response plan details:

- potential environmental emergencies
- associated measures required to mitigate environmental harm
- communication procedures and emergency contact details.

Basic emergency response training will be provided to all personnel, and selected dedicated personnel will undergo further training to form an Emergency Response Team. Appropriate emergency response equipment will be available on site, including fire tender and ambulance.

## 2.4 Auditing

External environmental audits will be conducted at the Dongara site in accordance with Corporate Auditing Schedules and requirements to maintain ISO14001 certification. This is generally undertaken annually for both requirements. These audits will investigate compliance with the key performance indicators and management actions within this EMP; environmental policies; and legal requirements, conditions and commitments. It is expected that annual compliance audits against site environmental Licence (issued under Part V of the EP Act 1986) and relevant Ministerial Conditions (issued under Part IV of the EP Act 1986) will be required. Where auditing finds environmental management actions are not being effective, there may be recommendations for changes to procedures and / or management actions.

## 2.5 Monitoring

A comprehensive environmental monitoring program will be established for the Project to verify compliance with environmental conditions and commitments, satisfy regulatory and reporting requirements, track environmental performance and measure the effectiveness of environmental management measures. Supervisors will be responsible for inspecting their work areas on a daily basis, with formal inspections conducted monthly and reviewed by the site committee. Internal inspections are conducted across Tiwest sites via such activities as Management (Visible Felt Leadership) Inspections, Environmental Inspections (by Environmental Personnel) and workplace inspections (by all personnel). The site inspections will include various components of the monitoring requirements listed in each sub-plan of this EMP. Key monitoring data will be presented to senior management. The monitoring data will also be reviewed during internal audits.

## 2.6 Reporting

### 2.6.1 External reporting

By 30<sup>th</sup> June each year, Tiwest will submit an AER to the Department of Mines and Petroleum (DMP) Environment Division and the DEC Environmental Management Branches of Jurien and Geraldton and Office of Environmental Protection Authority. This report will address the period covering 1 January to the 31 December of the reporting year and detail:

- work completed during the program and status of rehabilitation activities against corresponding approvals (Program of Works, clearing permits etc)
- significant species affected during work programs (listing of numbers “removed” based on pre-works survey)
- results of Rehabilitation / Closeout audits
- any issues or incidents and corresponding preventative and corrective actions
- revisions to the EMP
- any other items of environmental significance.

This report is also expected to support the annual compliance reports expected under Part IV and Part V of the EP Act 1986.

## 2.7 Document management

### 2.7.1 Review

This document reflects current knowledge and design of the Project. In order to maintain the relevance of the management plans included, the EMP will be subject to regular review and modification to accommodate changes in knowledge, technology and mining operations. The SHEHR Manager (or delegate) will formally review the EMP annually, with any significant changes made to the EMP reported in the annual reports made to Government departments.

### 2.7.2 Document control

The EMP document for the Dongara Project will be owned by the SHEHR Manager Northern Operations.

All environmental management documentation will be electronically controlled in accordance with document control and records management procedures for all Tiwest Northern Operations. This relies on a centralised database for storing and accessing site documents (procedures, plans etc). When updates are required, all personnel will be notified of the update and the database updated accordingly. Previous versions are retained for records but are no longer accessible.

A review of all documents will be conducted at least once every two years. A summary of the outcomes of this review will be provided as part of the Project's AER. Where the review identifies the need for significant changes to the EMP, the document will be updated and submitted for approval.

### 3. Environmental management plans

The current environmental conditions of the Proposal Area and surrounds have been thoroughly investigated through flora and vegetation, fauna, soil, hydrogeological and hydrological studies. The results of these studies and a detailed description of the environmental setting of the Proposal Area are discussed in the PER. The environmental aspects of the Proposal Area will be managed according to the management plans within this EMP. These plans will cover the management of direct and indirect environmental impacts during the mine's construction and operation.

#### 3.1 Surface and groundwater management plan

##### 3.1.1 Description

The site's surface water and groundwater related characteristics comprise:

##### *Groundwater*

- Local hydrogeology consists of the superficial aquifer overlaying the Yarragadee aquifer.
- The depth to water table is 30 to 40 metres at the eastern mine sites, decreasing to ten metres at Zeus deposit and to less than two metres north-northwest of Zeus deposit.
- Mining will extend below the existing watertable at Zeus, Heracles and Hebe. Hades is in close proximity to the water table in parts. Other orebodies are well above the watertable.
- Groundwater from the superficial formations will be abstracted to allow dewatering of mine pits to facilitate safe mining practices proposed below the depth of the existing watertable.
- Groundwater from the Yarragadee Formation will be abstracted for the water supply needed for mining and mineral processing activities.

##### *Surface Water*

- There are no permanent surface water bodies near to the proposed mine sites, however, several drainage lines (including Mt Adams Creek and Tomkins Rd Creek) flow off the Gingin Scarp and disappear in the sand plain where the water infiltrates. It is likely that most stream flow infiltrates either before it reaches the sand plain at the foot of the scarp or flows only a short distance on the sand plain before it disappears into the sand.
- There is a gazetted water reserve just west of Zeus deposit. DoW indicates this water reserve has mainly conservation and tourism values rather than water protection values (Hydrosearch 2011).
- Hydrocarbons will be used and stored on-site.

### ***Subterranean Fauna***

- A low abundance and low diversity of subterranean fauna is expected to exist within the Project area due to the absence of any highly prospective geology (Rockwater 2011).

A detailed description of the groundwater and surface water in the mining area is included in the Project PER.

### **3.1.2 Environmental aspects to be managed**

The potential impacts of the Project on groundwater and surface water values and the causal aspects of the Project requiring management are as follows:

- **loss of flora (including significant wetland areas) or fauna (including subterranean fauna habitats)** due to groundwater drawdown resulting from mine dewatering and abstraction for mine water supply
- **lowering of the watertable** due to mine dewatering
- **impacts to neighbouring groundwater users** due to over-abstraction of groundwater for mining activities and water supply
- **alteration of surface and subsurface flows** due to groundwater abstraction
- **impacts on Yordanogo Nature Reserve** due to dewatering of the superficial aquifer for mining activities
- **alteration of groundwater or surface water quality** due to mining (acidification from potentially acid forming soils), groundwater abstraction, contamination from hydrocarbons or uncontrolled wastewater discharge.

This Groundwater and Surface Water Management Plan is supported by the site's *Wellfield Operating Strategy Draft* (Tiwest 2011b). Groundwater abstraction will be undertaken in accordance with licences to abstract water under the *Rights in Water and Irrigation Act 1914* as issued by the Department of Water (DoW). Potential ASS issues will be managed in accordance with the ASS Management Plan (Section 3.9).

### **3.1.3 Performance management**

Environmental targets and performance indicators have been developed based on groundwater and surface water management objectives at Dongara (Table 2).

Table 2 Groundwater and surface water management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To protect the integrity of subterranean populations occurring within and adjacent to the Proposal Area	No changes to subterranean habitat conditions (at habitats predicted to be affected by the Project) which are significantly different to those observed in reference sites when natural variability is taken into account	Results of groundwater monitoring (levels and quality)

Management objective	Target	Performance indicators
To protect groundwater and surface water quality	Compliance with Proponent's corporate standards, relevant legislation, including meeting ANZECC guidelines (taking into consideration natural background water quality and environmental values of the receiving environment)	Results of groundwater quality monitoring Results of other opportunistic reporting such as Environmental Incident Reports
To comply with legislative requirements for water abstraction	Water abstraction to occur only from licensed sources in compliance with licence conditions and limits and abstraction is measured and reported.	Regular reconciliation of results from monitoring groundwater extracted against licence conditions and limits
To minimise impact of the Project on neighbouring groundwater users	No significant impact on groundwater quality or availability for neighbouring users	Results of groundwater monitoring
To minimise impact of the Project on the existing surface water hydrological regime, geomorphology and value of the dependant ecology	No significant disturbance to local drainage patterns beyond natural variation (external to Project area –excluding excess water discharge)	Results of monitoring of site drainage Incident reports relating to: <ul style="list-style-type: none"> <li>• flooding or ponding</li> <li>• ecological and hydro-geomorphological and vegetation assessments along drainage features, ephemeral creeklines and surface water sheet flow areas</li> </ul>

### 3.1.4 Implementation strategy

Specific actions have been identified to assist in achieving groundwater and surface water management objectives (Table 3).

Table 3 Groundwater and surface water management actions

Parameter	Action	Timing
Risk Assessment	A risk assessment (using the Tiwest Risk Matrix) shall be conducted on the potential for water related legal breaches, environmental impacts, community concerns and protection of human health. The risk assessment will address the requirements outlined in <i>Environmental Performance Standard no. 30</i> .	Prior to commencement of mining
Water Use	Where practicable, opportunities for water recycling will be evaluated and implemented.	Throughout the duration of construction and mining operations
	Targets will be developed to drive continuous improvements in on-site and off-site water management, and actions will be implemented to meet such targets.	Prior to commencement of mining and throughout the duration of construction and mining operations
	Groundwater will only be taken as licensed by the DoW.	Throughout the duration of construction and mining operations
	The amount of groundwater abstracted will be reconciled regularly against the licence limit, and will not exceed the licensed limit.	Throughout the duration of construction and mining operations



Parameter	Action	Timing
Water Quality	Copies of all compliance documentation, water licences, permits and operating strategies will be held on-site.	At all times
	A water quality monitoring program and schedule will be established for groundwater prior to groundwater abstraction. The monitoring program will clearly identify the applicable legal compliance limits.	Prior to commencement of mining and throughout operations
	Equipment used to monitor groundwater quality will be calibrated and associated records maintained.	Before each use, records updated after each use
	Safety inspection procedures, including the detailed verification of all identified hazards, will be maintained for all major water storage facilities.	Throughout the duration of construction and mining operations
	Wastewater management will be managed in accordance with the Waste Management Plan.	Throughout the duration of construction and mining operations
Groundwater drawdown	Drawdown of groundwater will be minimised as much as practicable in the areas of shallow water table (where it is within ten metres of ground surface) at all times.	Prior to commencement of mining and during mining operations
Groundwater flow	Backfilling will be undertaken as soon as possible to enable reinstatement of the aquifer and thereby through flow across the mine void.	During mining and dewatering
Excess water discharge	Where possible excess clean water from mineral processing activities will be returned to the aquifer via ponds, dams or other impoundments; or during tailing activities.	Throughout the duration of construction and mining operations
Drainage Management	Surface water drainage will be designed and managed in accordance with <i>Environmental Performance Standard no. 30</i> . This will include: <ul style="list-style-type: none"> <li>• stabilising diversion structures and drains to reduce erosion and associated water quality impacts</li> <li>• ensuring that natural or artificial drainage channels are protected from hydrocarbon contamination</li> <li>• installing settling ponds and sediment traps/basins where appropriate to reduce sediment loads in runoff from the mining area.</li> </ul>	Prior to commencement of mining
	Site facilities will be designed in accordance with <i>Environmental Performance Standard no. 30</i> to prevent potentially contaminated water streams entering water-ways or unsealed ground. These streams include: <ul style="list-style-type: none"> <li>• stormwater running off areas contaminated with hydrocarbons or other chemicals</li> <li>• sediment-laden stormwater, including that from dumps and stockpiles, potentially flowing into watercourses</li> <li>• sewage, tailings and other process waste streams potentially flowing to uncleared areas of vegetation.</li> <li>• uncontrolled discharges from tailings ponds</li> </ul>	Prior to commencement of mining

Parameter	Action	Timing
	Safety inspection procedures, including the detailed verification of all identified hazards, will be maintained for all major water and tailings storage facilities.	Throughout the duration of construction and mining operations
	Sedimentation traps/basins and artificial drainage structures within the mining area will be inspected regularly and maintained appropriately.	Throughout the duration of construction and mining operations
Induction and Communication with personnel	<p>Prior to engagement on site, all staff will be inducted on:</p> <ul style="list-style-type: none"> <li>• potential for fuel and chemical spillages to contaminate groundwater</li> <li>• consequences of groundwater contamination</li> <li>• proper storage and handling of hydrocarbons and other chemicals</li> <li>• spill response procedures</li> <li>• potential for drainage and stormwater management to affect vegetation, fauna and surface water values</li> <li>• general tailings and slimes management.</li> <li>• drainage and stormwater management procedures.</li> </ul>	Throughout the duration of construction and mining operations

### 3.1.5 Monitoring program

The monitoring program for groundwater and surface water at the Dongara mining area (Table 4) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 4 Groundwater and surface water monitoring program

Item	Location	Frequency	Parameters	Procedure	Purpose
1	Where required across the sites (inside and outside area of groundwater drawdown, in a known area of <i>Banksia elegans</i> ).	At least two years prior to commencement of mine dewatering	Transect establishment	<p>Establish five east-west GDE monitoring transects in the areas predicted to have low to large change (impact transects) and at least two east-west transects that are outside the area predicted to be affected by groundwater drawdown (control transects).</p> <p>At least one impact transect and one control transect must include a known occurrence of <i>Banksia elegans</i> (P3).</p> <p>All FCTs predicted to be impacted by groundwater drawdown must be represented in at least one impact and one control transect. Control transect should also be representative of a similar hydrological state (as determined by depth to groundwater) to impact transects.</p> <p>Establish permanent vegetation condition monitoring sites at an interval of 100 m along transects.</p>	To establish adequate baseline vegetation conditions and suitable control monitoring sites

Item	Location	Frequency	Parameters	Procedure	Purpose
2	At established transects	Once a year in Autumn	<ul style="list-style-type: none"> <li>species composition</li> <li>species distribution</li> <li>species mortality</li> <li>community structure</li> <li>vegetation height and diameter</li> <li>vegetation density and frequency.</li> </ul>	<p>Conduct vegetation condition monitoring at the permanent monitoring sites along transects (from Item 1) measuring the following parameters:</p> <ul style="list-style-type: none"> <li>species composition (specifically for evidence of encroachment of drought tolerant species)</li> <li>species distribution (specifically for change in species distribution of drought tolerant and overstorey species for evidence of increased numbers of drought tolerant species)</li> <li>species mortality (specifically for dominant species to determine if there has been a reduction in the abundance of dominant species relative to baseline conditions and identification of % decrease)</li> <li>community structure (specifically for evidence of changes in the relative dominance of different elements, e.g. trees, perennial shrubs, sedges)</li> <li>vegetation density and frequency (specifically for evidence of crown dieback in overstorey species and cover of understorey species)</li> <li>vegetation height and diameter for plants greater than 1 m in height (specifically for loss of canopy and/or reduced diameter of adult stems)</li> <li>repeatable photographs of community composition to ensure photos are comparable</li> </ul>	<p>To establish adequate baseline vegetation conditions and suitable control monitoring sites.</p> <p>To identify changes in vegetation condition.</p>
3	Where required	Once a year, at least two years prior to commencement of mine dewatering	Remote sensing survey	Conduct remote sensing (aerial multi-spectral imagery or similar) of the area of predicted impact and appropriate controls	<p>To monitor areas outside formal transects for change in vegetation condition.</p> <p>To identify changes in vegetation condition.</p>
4	From monitoring transects	Once a year	Review and mapping of vegetation	<p>Review data from Item 2 and Item 3, including controls, to identify where there has been a change in vegetation condition in at least two of the criteria identified in Froend, Bowen &amp; Associates (2011) for Moderate and Large change.</p> <p>Map the extent of change in vegetation condition utilising the scale</p>	To identify and map extent of area subject to change in vegetation condition.
5	NA	Following vegetation condition assessment	Comparison of vegetation maps	Compare result of Item 4 to predicted impacts to identify	To identify exceedence of predicted impact.

Item	Location	Frequency	Parameters	Procedure	Purpose
6	Within proximity of transects	At least two years prior to commencement of mine dewatering	Groundwater monitoring bore installation	Establish at least two superficial groundwater monitoring bores in proximity to each of the transects	To establish adequate baseline groundwater monitoring sites.
7	Groundwater monitoring bores	Quarterly, once in Spring, Summer, Winter and Autumn. At least 12 months prior to mine dewatering	Analyse groundwater for (but not limited to): pH, electrical conductivity, dissolved oxygen, temperature, groundwater level.	Conduct monitoring of groundwater levels in monitoring bores	To establish baseline groundwater levels.
8	NA	Prior to mining	NA	Recalibration of groundwater model using the results of Item 6 and 7, with further recalibration required if there are significant changes to mining scenario	To predict groundwater levels at the groundwater monitoring bores.
9	Groundwater monitoring bores	At least 3months prior to mine dewatering, commence monthly monitoring in areas of predicted drawdown, concluding once water levels have recovered	Groundwater levels	Conduct monitoring of groundwater levels in monitoring bores	To determine changes in groundwater levels and compare with predicted groundwater levels.
10	NA	Following groundwater monitoring	Analysis of groundwater level data	Identify where groundwater levels are more than 10% lower than predicted by Item 8	To identify exceedence of predicted drawdown.
11	Yarragadee Production and associated observation bores	Monthly	Depth to water.	<i>Wellfield Operating Strategy</i>	To closely monitor borefield to ensure minimal impact on the environment.
12	Yarragadee Production bores	Continuously	Metering of volume abstracted	<i>Wellfield Operating Strategy</i>	To record volume of water abstracted from the Yarragadee aquifer.
13	Dewatering pump/s	Continuously	Metering of dewatering volume	<i>Wellfield Operating Strategy</i>	To record volume of water abstracted from the superficial aquifer.

Item	Location	Frequency	Parameters	Procedure	Purpose
14	Surface water monitoring locations (Mt Adams Creek).	Monthly when flowing	pH, total dissolved solids, total suspended solids, chloride, oils/grease for surface water quality	Conduct water quality testing.	To monitor surface and groundwater quality during mining operations.
15	Groundwater monitoring locations (including general site observation bores and abstraction/dewatering locations).	Quarterly (spring, summer winter and autumn).	pH, electrical conductivity, dissolved oxygen, temperature, groundwater level for groundwater quality	Conduct water quality testing.	To monitor surface and groundwater quality during mining operations.

### 3.1.6 Contingencies

Contingency actions have been developed to be undertaken if monitoring indicates that the environmental objectives and targets for groundwater and surface water management are not being achieved (Table 5).

Table 5 Groundwater and surface water management contingency actions

Trigger	Action
Rates of groundwater decline (as determined from three or more successive monitoring events) exceed predictions	<ol style="list-style-type: none"> <li>1. Investigate cause, which could include analysis of drawdown model</li> <li>2. Review Operational Management measures and escalate where possible.</li> <li>3. Increase frequency of monitoring of vegetation (impact and control transects) to Quarterly</li> <li>4. If vegetation condition has not declined following three successive rounds of sampling recommence biannual sampling</li> </ol>
Groundwater levels are lower than predicted but vegetation condition has not declined more than predicted	<ol style="list-style-type: none"> <li>1. Investigate cause, which could include analysis of drawdown model</li> <li>2. Review Operational Management measures and escalate where possible.</li> <li>3. Increase frequency of monitoring of vegetation (impact and control transects) to Quarterly</li> <li>4. If vegetation condition has not declined following three successive rounds of sampling recommence biannual sampling</li> </ol>

Trigger	Action
Groundwater levels are not lower than predicted but vegetation condition has declined more than predicted	<ol style="list-style-type: none"> <li>1. Investigate cause, which could include analysis of GDE impact model</li> <li>2. Review Operational Management measures and escalate where possible.</li> <li>3. Increase frequency of monitoring of vegetation (impact and control transects) and groundwater monitoring to Quarterly</li> <li>4. If area subject to Moderate Change has crossed predicted Low Change extent, or area subject to Large Change has crossed predicted extent of Moderate change implement remedial action on a trial basis</li> <li>5. Monitor success of remedy.</li> </ol>
Groundwater levels are lower and vegetation condition has declined more than predicted	<ol style="list-style-type: none"> <li>1. Investigate cause, which could include analysis of groundwater model</li> <li>2. Review Operational Management measures and escalate where possible.</li> <li>3. Increase frequency of monitoring of vegetation (impact and control transects) and groundwater monitoring to Quarterly</li> <li>4. If area subject to Moderate Change has crossed predicted Low Change extent, or, are subject to Large Change has crossed predicted extent of Moderate change implement remedial action on a trial basis</li> <li>5. Monitor success of remedy.</li> </ol>
Results from remote imagery analysis indicate vegetation has declined more than predicted.	<ol style="list-style-type: none"> <li>1. Ground truth remote data (visit area to verify change)</li> <li>2. If degree of change is clearly beyond that predicted investigate cause and implement remedial measures.</li> <li>3. Monitor location and success of remedy quarterly.</li> <li>4. If no change monitor annually.</li> </ol>
Integrity of on-site drainage management system compromised	<ol style="list-style-type: none"> <li>1. Investigate cause</li> <li>2. Modify the on-site drainage management system as required</li> </ol>
Surface water (e.g. hydrocarbon) contamination	<ol style="list-style-type: none"> <li>1. Investigate cause and extent</li> <li>2. If source is identified, implement corrective and preventative actions to remedy</li> <li>3. Report as appropriate in accordance with legislation (Contaminated Sites)</li> <li>4. Monitor success (or if no source found repeat monitoring) monthly</li> </ol>
Excess debris and sediment accumulation within on-site drainage management system	<ol style="list-style-type: none"> <li>1. Investigate cause</li> <li>2. Undertake maintenance as required (e.g. remove accumulated material and ensure on-site drainage management system remains effective)</li> <li>3. Review the drainage maintenance schedule</li> <li>4. Review Operational Management measures and escalate where possible</li> </ol>

### 3.1.7 Potential remedial action

The potential remedial actions that could be applied to the Proposal should trigger values be exceeded include:

- modifying Disturbance Boundary to use hydraulic placement of sand tailings to offset drawdown and promote water level recovery recharge
- modifying Yarragadee abstraction practices
- modifying mining plan to reduce pit size.

The selection of the remedial action will be chosen and undertaken in consultation with DEC.

## 3.2 Groundwater Dependant ecosystems (including wetlands)

### 3.2.1 Description

There are six major types of groundwater dependent ecosystems (GDE) (Sinclair Knight Mertz 2001):

1. Terrestrial vegetation – vegetation communities and dependent fauna that have seasonal or episodic dependence on groundwater.
2. River base flow systems – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow.
3. Aquifer and cave ecosystems – aquatic ecosystems that occupy caves or aquifers.
4. Wetlands – aquatic communities and fringing vegetation dependent on groundwater fed lakes and wetlands.
5. Terrestrial fauna – native animals that directly use groundwater rather than rely on it for habitat.
6. Estuarine and near-shore marine ecosystems – coastal, estuarine and near shore marine plant and animal communities whose ecological function has some dependence on discharge of groundwater.

The GDEs potentially subject to impacts from implementation of the Proposal are wetlands, terrestrial vegetation and associated fauna.

The Proposal sites comprise of the following characteristics associated with GDE:

- the Proposal lies within the Beharra Spring consanguineous wetland suite, which contains a relict palaeo-lake system blanketed by Bassendean Sands forming damplands of irregular morphology (Endemic 2011)
- the majority of these wetlands are only seasonally inundated, with the period of inundation dependent on winter rainfall
- a chain of damplands (within the Yardanogo Nature Reserve) where the water table is five metres or less from the ground surface occurs to the west and north of the Zeus mineral deposits. During seasonal peak groundwater conditions the northernmost extent of the Yardanogo Nature Reserve contains surface water (~0.5 m depth) for approximately two to four months in most years
- it is likely that some vegetation communities in the area of shallow water table to the west of Zeus deposit are groundwater dependent and will be impacted by water table decline as the Zeus pit is dewatered.

### 3.2.2 Environmental aspects to be managed

The potential impacts of the Project on GDE are as follows:

- **dewatering** to enable safe access to ore will alter groundwater level and flow and has the potential to affect GDE
- **potential acid sulfate soils** below the watertable may be exposed to oxygen potentially affecting groundwater quality, which could affect wetlands
- **abstraction of water** from the Yarragadee aquifer for on-site water supply has the potential to affect GDE
- **hydrocarbon spills** have the potential to affect groundwater quality, which could affect wetlands.



### 3.2.3 Performance management

Environmental targets and indicators have been developed based on GDE management objectives at Dongara Table 6:

Table 6 GDE management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To protect vegetation that may be supported by groundwater sources.	No significant decline in the status of health of vegetation (beyond natural variability) as a result of groundwater drawdown activities outside predicted impact areas.	Results of vegetation and groundwater monitoring.

### 3.2.4 Implementation strategy

Specific actions have been identified to assist in achieving GDE management objectives at Dongara Table 7.

Table 7 GDE management actions

Parameter	Action	Timing
Risk Assessment	A risk assessment (using the Tiwest Risk Matrix) shall be conducted on the potential for water related legal breaches, environmental impacts, community concerns and protection of human health. The risk assessment will address the requirements outlined in <i>Environmental Performance Standard no. 30</i> .	Prior to commencement of mining
Water use	An appropriate understanding of the cumulative demands and impacts being placed on water resources and dependent ecosystems will be developed and maintained. This will include an assessment of current water requirements and prediction of future water requirements which will contribute to the development of an appropriate 'site water balance'.	Prior to commencement of mining and throughout the duration of construction and mining operations
Groundwater drawdown	Surveys will be undertaken in areas of predicted impact to groundwater dependent vegetation and at suitable control locations to further characterise vegetation and groundwater interactions and verify GDE risk assessment model (as per Froend Bowen and Associates 2011).	Prior to commencement of mining
	Groundwater drawdown impact trigger levels identified in Table 5 (water levels and vegetation status) will be established for areas with groundwater dependent vegetation that are predicted (from the Risk assessment and the PER) to be impacted.	Prior to commencement of mining

### 3.2.5 Monitoring program

The monitoring program for GDEs is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets. The monitoring of GDEs has been integrated with the monitoring of groundwater and is included in Table 4.

### 3.2.6 Contingencies

Contingency actions have been developed to be undertaken if monitoring indicates that the environmental objectives and targets for GDEs are not being achieved). As the monitoring of GDEs has been integrated with the monitoring of groundwater the contingency actions for groundwater are included in Table 5.

### 3.2.7 Potential remediation action

The potential remedial actions that could be applied to the Proposal should trigger be exceeded include:

- ensuring that dredge (and not dry) mining is used in selected areas
- modifying Disturbance Boundary to use hydraulic placement of sand tailings to offset drawdown and promote water level recovery recharge
- modifying mining plan to reduce pit size
- investigating the use of irrigation on affected vegetation
- investigating the use and feasibility of a groundwater supplementation
- investigating the use of fire to generate regrowth of vegetation communities; and / or
- implementing restoration, such as distribution of locally sourced seed, control of weeds and use of germination.

The selection of the remedial action will be chosen and undertaken in consultation with DEC.

## 3.3 Rehabilitation management plan

This management plan sets out the framework within which Tiwest will plan and undertake rehabilitation at the Dongara Project. In doing so it defines the objectives of rehabilitation, the procedures to be followed in fulfilling this objective in the post mining landscape, and addresses some of the elements of mine closure and related rehabilitation criteria. Mine closure and rehabilitation completion criteria are discussed briefly in this plan. They are addressed separately, and in accordance with DMP Mine Closure Guidelines (DMP 2011) in a comprehensive Mine Closure Plan for the Project. It also sets out some of the measures of performance and processes for addressing poor rehabilitation. The Mine Closure Plan and the Rehabilitation Management Plan will work in conjunction to achieve rehabilitation and closure goals for the Project.

This Rehabilitation Management Plan is a preliminary plan and will evolve throughout the life of the Project, subject to review by key internal and external stakeholders. The Project is intended to operate for approximately ten years. Consequently, planning for closure and rehabilitation at this stage remains preliminary and flexible so that technological and societal changes that may ensue can be incorporated into the final plan. Changes to the plan may also be made in response to progressive rehabilitation monitoring results.

### 3.3.1 Description

Tiwest undertakes rehabilitation in order to remediate any residual environmental impacts following mining. Although it is preferable to avoid residual impacts, this is not possible for this Project and, rehabilitation works are to be undertaken to minimise these.

The key aims of rehabilitation are to (EPA 2006):

- ensure the long-term stability of soils, landforms and hydrology required for the sustainability of sites
- partially or fully repair the capacity of ecosystems to provide habitats for biota and services for people.

With these EPA objectives, and Tiwest's overall goals for rehabilitation across the Northern Operations, in mind Tiwest aim to rehabilitate mined land at Dongara to a state that is safe and stable and, in areas of unallocated Crown Land (UCL), generally capable of supporting self sustaining native ecosystems. Tiwest also consider target final land use when planning rehabilitation. In a practical sense this means developing and executing achievable, realistic, and effective plans to repair the land (following mining) to a state that meets the expectations of key relevant stakeholders. Tiwest anticipates the post mining land use will be pastoral (freehold) or conservation / bushland (uCL). Detailed objectives for both of these end land uses have been described in the main body of the PER. Stakeholder consultation will be undertaken to determine post mining land use.

Tiwest will plan and undertake rehabilitation of significant residual environmental impacts with the aim of returning a self sustaining ecosystem with ecological function and value similar to pre-disturbance setting, acknowledging that the environment will, to some extent, be permanently altered as a result of mining activities. As such, the native ecosystem returned in rehabilitation will be somewhat different from the pre-disturbance state.

Although it is not possible to return the Proposal Area to its original state, this Rehabilitation Management Plan aims to restore the site to a sustainable condition that resembles the original environmental conditions of the site as closely as possible.

The purpose of this Rehabilitation Management Plan is to:

- consider legislative requirements, corporate standards and appropriate industry guidelines
- describe the closure strategy for the Project and outline the post closure land use and objectives for closure to meet the aims of the strategy
- outline the closure planning and review process
- outline the possible closure approach.

Materials identification and management has been incorporated into this Rehabilitation Management Plan.

This Rehabilitation Management Plan applies to the whole of the Dongara Project and will operate concurrently with all other management plans detailed in this EMP.

### 3.3.2 Environmental aspects to be managed

The following environmental aspects associated with the Project have been identified as requiring rehabilitation to ensure that residual impacts are mitigated to the greatest possible extent and to ensure that the area is successfully relinquished for the agreed final land use. The aspects to be managed include:

- **physical disturbance of the land surface** associated with construction of mining infrastructure, access and haul roads, mine pits, waste dumps and landfill
- **clearing of vegetation/habitat** associated with mine construction and mining activities
- **interruption to natural surface water and groundwater features** associated with mining, construction of access roads, haul roads and artificial drainage features, and groundwater abstraction
- **contamination of sites** that may occur as a result of any spills or leaks of hydrocarbons and/or inappropriate disposal of waste material.

### 3.3.3 Performance management

Environmental targets and performance indicators have been developed based on rehabilitation management objectives for the Dongara Project (Table 8). Targets and performance indicators were also based on those developed for the Cooljarloo Minesite, as an example of progressive rehabilitation success, and adapted to the specific Dongara environment. Some of the key differences in the environment at Dongara include; lower quantities but likely higher intensity and more episodic rainfall, different distribution of recruitment strategies and species/structural distribution within the local flora.

Table 8 Rehabilitation management objectives, targets and performance indicators

Management objective	Target	Timing	Performance Indicators
Construction of landforms that are stable, free draining, non-polluting and aesthetically compatible with the surrounding landscape.	<p>All slopes are designed to ensure reconstructed landform can withstand 1:100 year rainfall event.</p> <p>Reconstructed landforms and drainage lines are tied into pre disturbed topography (step up or step down between rehabilitation and pre-existing landform is no steeper than 1:12 and drainage is maintained).</p> <p>Absence of channelised flow resulting in gullies greater than 30cm deep and 25cm wide (excepting specifically constructed drainage lines) at, and leading up to, 3 yrs post rehabilitation works.</p>	During progressive rehabilitation.	<p>Design criteria and modelling results</p> <p>Rehabilitation monitoring results.</p> <p>Post-closure criteria.</p>

Management objective	Target	Timing	Performance Indicators
	<p>Topsoil will be stripped prior to mining and retained for use in rehabilitation. This will be undertaken in two stages:</p> <ul style="list-style-type: none"> <li>removal of the first cut topsoil up to 100 mm depth containing the majority of organic materials and propagules for rehabilitation; and</li> <li>removal of up to 200 mm (as second cut topsoil).</li> </ul> <p>Some topsoil will be able to be directly used in areas undergoing rehabilitation at the time of removal. However, the majority will need to be stockpiled. In order to preserve the seed, nutrient and organic stores of the soil, first cut topsoil will be stripped and stockpiled dry wherever practical, with a maximum stockpile height of 2 m.</p>	Prior to mining	
	<p>Soil profiles in the post mining landscape are capable of supporting the end landuse:</p> <ul style="list-style-type: none"> <li>Upper soil profile to comprise Class 1<sup>1</sup> material. The minimum depth of Class 1 material on sloping (steeper than 1:100) areas is 1m and 0.3m on non-sloping/low lying areas.</li> <li>Lower soil profile to comprise either Class 1 or Class 2 material. The combination of the upper profile and lower profile is &gt;3m on all sloping (steeper than 1:100) native areas and &gt;2m on all non sloping areas.</li> </ul>	During progressive rehabilitation.	
	No contaminated sites (as defined by the <i>Contaminated Sites Act 2003</i> ) requiring ongoing management beyond five years post-closure.	Prior to handover.	
Surface water hydrology is suitable for the proposed land use.	Reconstructed drainage lines are tied into pre-disturbance topography (i.e. drainage is maintained).	Prior to handover.	<p>Surface water monitoring results (pre and post-closure).</p> <p>Environmental incident reports.</p> <p>Vegetation monitoring results.</p>

<sup>1</sup> Defining Class 1, 2, 3 Materials: Materials are characterised prior to placement to ensure the soil profiles are constructed as planned and unstable dispersive soils are treated or buried at depth as required. Materials are classified according to particle size distribution (clays %), exchangeable sodium percentage, aggregate stability and dispersion percentage. There are four classes of material characterised prior to reconstruction of the soil profile:

Topsoil – Distinguished by colour change indicating horizon change

Class 1 – Sandy stable material used in the upper or lower soil profile

Class 2 – Stable sandy material with a higher clay content used in the lower soil profile

Class 3 – Material that is deemed to be unsuitable for use in the upper profile due to such factors as instability due to the presence of dispersive clays.

Management objective	Target	Timing	Performance Indicators
Proposal Area is successfully relinquished for final land use.	Agreement with stakeholder regarding final land use.		Rehabilitation monitoring results. Rehabilitation and closure completion criteria.
Cultural, historical, and archaeological heritage values in the Proposal Area are maintained.	No sites are disturbed without appropriate permissions/ permits (both site specific and legislative permissions and permits).	Project duration.	Annual reconciliation of permits against actual clearing (verified via site survey records and annual aerial orthophoto)
Establishment of self-sustaining vegetation / habitats (composed of local provenance species) consistent with reconstructed landforms, soil profiles, and surrounding vegetation, that is suitable for the support of the future land use option.	Establish self sustaining vegetation communities (taking into account agreed post mining land use): <ul style="list-style-type: none"> <li>The community types in rehabilitated areas broadly represent those present in pre-disturbance environment (i.e. include dry and wet woodlands and dry and wet heaths) and are located appropriately.</li> <li>Species richness <math>\geq 60\%</math> of mean recorded in reference sites for same vegetation group.</li> <li>All key structural components are present (e.g. trees for woodlands, perennial shrubs, grasses, sedges etc).</li> </ul>	Prior to handover.	Aerial photographs. Reference sites (intermediate and end-point). Revegetation monitoring results.
	Declared Weeds are not present and total combined projected foliar cover of other weeds is not significantly greater than that measured in reference plots.	Prior to handover.	
Rehabilitation is suitable for fauna colonisation.	Trees/shrub species ( <i>Banksia attenuata</i> , <i>Banksia menziesii</i> , <i>Banksia prionotes</i> as well as other species from genera <i>Hakea</i> , <i>Grevillia</i> , <i>Allocasuarina</i> , and <i>Eucalyptus</i> (where applicable) are included in native seed mixes at appropriate densities to provide a feeding resource for Carnaby's Black-Cockatoo. Upper soil profile is of sufficient depth (>300mm) and with Class 1 properties (see previous footnote to provide habitat suitable for burrowing species). Key fauna habitat characteristics are present in rehabilitation, including a developing soil profile, vegetation structure, a diversity of flowering species and a developing litter layer.	Prior to handover.	Vegetation/habitat condition monitoring results. Reference sites (intermediate and end-point). Revegetation monitoring results. Rehabilitation and closure completion criteria.
Rehabilitation is sustainable and resilient to fire, disease and drought.	Rehabilitation will regenerate following burning. Soil nutrient resources are sufficient to support the end land use. Nutrient cycling processes (e.g. litter breakdown) have developed in soil profiles	Prior to handover.	Burning trial results. Complete a vegetation resilience assessment based on quantitative monitoring data during periods of drought. Assess the nutrient status of soil profiles and plant nutrition at various ages (i.e. 2, 5, 7 yrs) after establishment.

### 3.3.4 Implementation strategy

Specific management actions (Table 9) have been identified to assist with achieving the rehabilitation objectives and meeting standards as detailed in Table 8. These management actions may be subject to change during rehabilitation and closure in order to best achieve the nominated rehabilitation standards. Although the management actions may change, the standards will not change unless agreed with stakeholders to ensure the desired outcome will still be achieved.

Table 9 Rehabilitation management actions

Parameter	Action	Timing
Ground disturbance.	All ground disturbance and rehabilitation will be planned in detail and approved by the Site Operations Manager.	Annually for the duration of operation.
	All ground disturbance will be within planned and approved areas.	For duration of operation.
	Topsoil, land reconstruction, and any other materials once identified should be stockpiled for rehabilitation.	Prior to commencement of mining and excavations, and throughout the duration of operations.
Preparation and planning for rehabilitation.	Appropriate sites will be selected that provide reference information for rehabilitation. Characteristics of these reference sites will be measured and recorded (written and photographic) e.g. landform structure, vegetation structure and composition, ecosystem processes. Reference sites will be revisited (monitored) at an interval no greater than 3 years.	Prior to commencement of progressive rehabilitation.
	A site species database will be maintained to capture and make readily available all known information pertinent to rehabilitation for each species known from site	For duration of operation.
	Target rehabilitation types will be developed from reference datasets to guide rehabilitation resource planning and development of numerical performance measures (in accordance with Completion Criteria). These will be based on grouping communities that occur within the disturbance area and across the wider surrounds that have similarities in composition and soil/hydrological situation.	Prior to the commencement of progressive rehabilitation
	Identify and characterise sources of materials on site that will be used for rehabilitation. These materials will include topsoil material (soils that will be suitable for rehabilitation and contain propagules and organic materials critical to vegetation establishment), soil profile reconstruction material (materials suitable to use in the upper soil profile to produce stable landforms and soils capable of supporting the vegetation), and other landform reconstruction materials (materials not necessarily suited to the upper profile but required for contouring, void backfill and other such matters). Topsoil and mulch materials will be identified and collection, storage (where required) and distribution planned in accordance with vegetation type groupings. Target seed lists for each vegetation grouping will be developed and seed picking scheduled.	Prior to commencement of mining and excavations, and throughout the duration of operations.
Landform planning.	Landform reconstruction will be survey controlled and records of final and interim surfaces will be kept. Surveys of constructed profiles will be conducted and reported.	Prior to topsoil placement and rehabilitation.

Parameter	Action	Timing
	Overburden materials will be classified and managed so that the most suitable overburden type is uppermost in the restored profile.	During the rehabilitation process.
	Material management will be undertaken which includes measures to: <ul style="list-style-type: none"> <li>• prevent compaction of the material</li> <li>• facilitate drainage.</li> </ul>	Throughout the duration of mining operations through to closure.
	Mine voids will be backfilled to a maximum hill slope gradient of 1:12 and a hilltop gradient of 1:100. Backfilled waste will be directly placed behind the mine path where practicable.	Progressively throughout the life of the Project
	Steep slopes at either side of waste dump haul roads will be pushed down to maximum slope angles	During the rehabilitation process.
	The access tracks and haul road will have the windrows pushed in, and natural landform and drainage patterns will be re-established	During the rehabilitation process.
	The area will be reformed so that it blends in with the surrounding landscape, including knocking down spoil piles and reinstating any drainage lines that were present prior to clearing.	During the rehabilitation process.
	The area will be reformed such that it does not pose a risk to public or environmental safety.	During the rehabilitation process.
Rehabilitation planning / revegetation	Topsoil management will be undertaken which includes measures to: <ul style="list-style-type: none"> <li>• determine characteristics of topsoil prior to rehabilitation</li> <li>• prevent compaction of the topsoil</li> <li>• facilitate drainage</li> <li>• reduce the risk of erosion</li> <li>• maintain an active population of soil microbes</li> <li>• conserve native seed banks and other propagules within topsoil to maximise vegetation establishment.</li> </ul>	Throughout the duration of mining operations through to closure.
	Stripping of topsoil will occur in two cuts: <ul style="list-style-type: none"> <li>• the top 50 – 100 mm organic layer</li> <li>• the 100 – 300 mm lighter underlying material (where required).</li> </ul>	During topsoil stripping.
	Topsoil will be stockpiled in discrete heaps in dry areas free of contamination.	During operation, prior to rehabilitation activities
	Topsoil stockpiles will be stabilised against wind and water erosion (where required).	During operation, prior to rehabilitation activities
	Site stabilisation will apply to: <ul style="list-style-type: none"> <li>• backfilled mine pits</li> <li>• waste dump surfaces and reformed slopes</li> <li>• over tracks and haul roads.</li> </ul>	During the rehabilitation process.
	Areas spread with topsoil and mulch will be deep ripped and seeded with local provenance seed. Tracks and roads will be ripped or scarified, depending on the amount of compaction present.	Following spread of topsoil and mulch on rehabilitated areas



Parameter	Action	Timing
Revegetation	Local provenance seed will be collected from site and/or surrounding areas in accordance with picking targets.	Prior to land clearing and during quarrying.
	Native seed will be stored in dry, temperature controlled conditions	Prior to direct seeding activities
	Landform reconstruction and revegetation preparation will include the following measure for preparation of soil profiles and sowing of native seed: <ul style="list-style-type: none"> <li>• topsoil will be spread over reconstructed landforms</li> <li>• reconstructed landforms and rehabilitated areas will be deep ripped along the contour (and seeded with provincially collected seed from appropriate endemic flora species</li> <li>• available mulched vegetation will be spread over reconstructed landforms and rehabilitated areas during final rehabilitation works.</li> </ul>	During the rehabilitation process.
Pollution Prevention	Areas prone to contamination (i.e. refuelling areas, workshop areas) will be investigated to determine the presence and / or level of contamination.	Prior to closure.
	Any soils that are determined to be hydrocarbon contaminated will be remediated or encapsulated in accordance with the relevant requirements at the time of remediation.	Prior to closure.
	All rubbish and above-ground infrastructure, including foundations, will be removed from the site to be recycled or reused where practicable, or disposed of in accordance with relevant legislation and guidelines, before rehabilitation is carried out.	During the rehabilitation process.
Surface and groundwater.	All areas will be reshaped and contoured to blend with adjacent relief and drainage. This will include: <ul style="list-style-type: none"> <li>• the removal of all windrows and other impediments to run-off except where required to prevent erosion.</li> </ul>	During the rehabilitation process.
Stakeholder consultation.	Appropriate stakeholder consultation will be undertaken during all stages of closure and rehabilitation, including planning, implementation of closure and rehabilitation activities, and post-closure monitoring.	Prior to commencement of mine closure and rehabilitation until satisfactory achievement of all completion criteria.
Reporting and review.	Rehabilitation measures will be regularly reviewed based on knowledge obtained from trials, monitoring performance of existing rehabilitation and site-specific information on material characterisation and performance and the latest rehabilitation practices and procedures.	During the rehabilitation process.
	Reports on the progress of rehabilitation efforts will be submitted to relevant authorities as required.	During rehabilitation until handover.

### 3.3.5 Monitoring program

Table 10 provides monitoring actions to enable an assessment of the effectiveness of the rehabilitation process and progress toward completion criteria.

Table 10 Rehabilitation management monitoring program

Aspect	Frequency	Parameter	Procedure	Purpose
Baseline and reference sites	Triennially	Vegetation abundance and diversity.	Visual inspection.	Maintain reference data set to compare rehabilitation performance.
Rehabilitation vegetation	At year 2, 5, 7 and 10	Vegetation abundance and diversity.	In accordance with an agreed vegetation monitoring procedure. Establishment monitoring (visual observation of transects) annually (years 1, 2, 4, 6, 8, 9).	To ensure rehabilitation objectives are achieved.
Landform stability	Annually.	Number of rills and gullies and their width and depth at monitoring sites.	Inspect permanent monitoring sites.	To ensure reconstructed landforms are stable, free draining, non-polluting and aesthetically compatible with the surrounding landscape.
Vertebrate fauna (rehabilitation and baseline)	Annually.	Abundance and diversity. Habitat parameters (leaf litter, vegetation structure)	Visual inspection.	Monitor trends in the recruitment of fauna into rehabilitation areas.
Revegetation sites.	Annually, in Spring.	Weed species and abundance.	In accordance with an agreed vegetation monitoring procedure.	To ensure weed control is of a standard that achieves rehabilitation objectives.
Location of previous spills and leakages if any.	After occurrence of spill or leakage and prior to closure.	Hydrocarbon and waste monitoring results.	Sample area and establish level of contamination.	To ensure zero contaminated sites remain.

### 3.3.6 Contingencies

Table 11 Rehabilitation contingency actions

Trigger	Action
Occurrence of landform erosion.	<ol style="list-style-type: none"> <li>1. Identify cause.</li> <li>2. Consult expert to determine appropriate remedy.</li> <li>3. Implement remedy.</li> <li>4. Monitor success of remedy.</li> </ol>
Insufficient provenance seed volumes or plants collected and propagated.	<ol style="list-style-type: none"> <li>1. Determine if additional seed and plants can be obtained from other seed collectors and native nurseries. Revegetation may need to be postponed, or staged introduction of species incorporated should sufficient seed not be available.</li> </ol>
Inappropriate flora species used in revegetation areas.	<ol style="list-style-type: none"> <li>1. Identify the cause.</li> <li>2. Remove inappropriate species and replace with appropriate species.</li> <li>3. Ensure inappropriate species are not used in future.</li> </ol>
Unacceptable weed infestations.	<ol style="list-style-type: none"> <li>1. Identify cause.</li> <li>2. Identify the weeds, their location and coverage and determine measures to control them.</li> <li>3. Implement weed control measures.</li> <li>4. Monitor success of weed control.</li> </ol>
Insufficient seed, topsoil, landform reconstruction, or mulch materials found on site.	<ol style="list-style-type: none"> <li>1. Source appropriate material from offsite.</li> <li>2. Undertake risk assessment and decide whether to stockpile material on site, or wait until closure to transport materials to site.</li> </ol>
Soil and groundwater contamination.	<ol style="list-style-type: none"> <li>1. Determine location of contamination source.</li> <li>2. Implement corrective actions in consultation with the DEC to remediate and prevent further contamination of the surrounding environment.</li> </ol>
Rehabilitation does not meet closure and/or rehabilitation completion criteria and in turn, may lead to (1) failure to relinquish the tenure; (2) reputational exposure; and (3) ongoing cost post closure.	<ol style="list-style-type: none"> <li>1. Investigate cause.</li> <li>2. Review rehabilitation process and remediate the problem.</li> <li>3. Implement adequate monitoring procedures of the revised rehabilitation measures to ensure closure and/or rehabilitation completion criteria are being met.</li> </ol>

### 3.4 Weed and *Phytophthora cinnamomi* management plan

#### 3.4.1 Description

##### *Phytophthora cinnamomi* (Dieback)

Dieback is a term referring to the plant disease (and the effect) caused by a microscopic 'water slime mould' *Phytophthora cinnamomi* (*P. cinnamomi*), which survives on the root and stem tissue of living plants. It is spread through the movement of contaminated vegetation or soil on vehicles, equipment and footwear. It can also be spread through the movement of soil by water erosion or via soil root zones in forested areas. *P. cinnamomi* requires moist warm conditions to survive and spread.

Dieback can detrimentally effect the structure, abundance and diversity of vegetation communities, which in turn has the potential to ultimately affect native fauna through reduction in food and habitat.

The vegetation of the Proposal Area is dominated by species which are susceptible to infection by *P. cinnamomi* and is considered to be marginally vulnerable to infestation (Woodman 2011).

Dieback is known to occur in the vicinity of Eneabba, which lies approximately 40 km south of the Proposal Area. The disease has not been recorded to date within the Proposal Area or surrounds (Woodman 2009).

An infestation is known within and adjacent to Tiwest's Cooljarloo mine site, requiring strict management to control further spread of the disease. Knowledge and experience from dieback management conducted previously by Tiwest have contributed to the development of this management plan. Tiwest have a well established history in regards to dieback management and infestation control, including collaborative research with Curtin University, the Centre for *Phytophthora* Science and Management, and were a founding member of the Northern Sandplains Dieback Working Party.

##### *Weed infestation*

Vegetation surveys have found 36 introduced taxa within the Proposal Area to-date (Woodman 2009). None of these species are listed as Declared Plants by the Department of Agriculture and Food Western Australia (DAFWA 2011). The weeds recorded within the Proposal Area to date are as follows:

- *\*Aira caryophylla*
- *\*Aira cupaniana*
- *\*Anagallis arvensis var. caerulea*
- *\*Avena barbata*
- *\*Brassica tournefortii*
- *\*Briza maxima*
- *\*Lolium sp.*
- *\*Melilotus ?indicus*
- *\*Mesembryanthemum crystallinum*
- *\*Mesembryanthemum nodiflorum*
- *\*Oxalis corniculata*
- *\*Pentstemon airoides*

- *\*Briza minor*
- *\*Bromus diandrus*
- *\*Centaurea melitensis*
- *\*Centaurium ?tenuiflorum*
- *\*Chenopodium murale*
- *\*Cotula coronopifolia*
- *\*Ehrharta longiflora*
- *\*Erodium sp.*
- *\*Galium murale*
- *\*Hypochaeris glabra*
- *\*Hordeum leporinum*
- *\*Isolepis marginata*
- *\*Phyllopodium cordatum*
- *\*Plantago coronopus*
- *\*Polypogon monspeliensis*
- *\*Raphanus raphanistrum*
- *\*Schismus ?barbatus*
- *\*Sonchus oleraceus*
- *\*Spergularia ?diandra*
- *\*Spergularia ?rubra*
- *\*Ursinia anthemoides*
- *\*Vulpia ?bromoides*
- *\*Vulpia sp.*
- *\*Wahlenbergia capensis*

### 3.4.2 Environmental aspects to be managed

The potential drivers of dieback introduction or spread into rehabilitated vegetation areas and bushland adjacent to the Proposal Area include:

- **vehicles and equipment entering the site could import dieback** into the Proposal Area if not cleaned of soil before arriving at the Proposal Area
- **pumping of slurry** has the potential to spread dieback if the area surrounding the mine pits becomes infected
- **imported topsoil, mulch or fill** could contain infected soil or vegetative material
- **introduced material** through mining in the vicinity of adjacent farming properties (including windblown material)
- **surface (alterations to drainage lines) or subsurface flow** could wash infected soil from the Proposal Area to unaffected areas or provide conditions ideal for disease establishment and spread.

Weeds can be introduced and spread throughout the site by several different mechanisms during operation including:

- **vehicles and equipment** entering site could import weed seeds into the Proposal Area if not clean before arriving
- **imported topsoil, mulch or fill** could contain weed seeds
- **weed seed in degraded areas within the Proposal Area could be spread** into rehabilitated vegetation areas or bushland adjacent to the Proposal Area by uncontrolled vehicle, machinery and personnel movement
- **surface (alterations to drainage lines) or subsurface flow** could wash soil containing weed seed from weed infested areas or washdown areas into uninfested areas.

### 3.4.3 Performance management

Environmental targets and performance indicators have been developed based on weed and dieback hygiene management objectives for the Dongara Project (Table 12).

Table 12 Weed and *P. cinnamomi* Hygiene management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To prevent the introduction of declared weed species that are not present prior to mining.	No introduction of declared weeds in the Proposal Area or adjacent to the site boundary, throughout the life of the Project	Absence / presence of declared weed species.
Minimise the spread of weed species.	No increase in the prevalence of weeds in the Proposal Area or adjacent to the site boundary, throughout the life of the Project	Weed density Monitoring results for weed distribution, abundance and density / cover.
Prevent the spread of <i>P. cinnamomi</i> on-site from outside the Proposal Area.	No incidence of <i>P. cinnamomi</i> infection in rehabilitated vegetation areas or to vegetation adjacent to the site boundary during the mine life	Monitoring results for rehabilitated vegetation and adjacent vegetation areas showing no decline in vegetation health due to dieback infection.
	All vehicles and machinery are free of soil before arriving on site.	Vehicle / machinery logs confirm mandatory check for soil material before entering each time to the Proposal Area

### 3.4.4 Implementation strategy

Specific actions have been identified to assist in achieving weed and dieback hygiene management objectives (Table 13).

Table 13 Weed and *P. cinnamomi* Hygiene management actions

Parameter	Action	Timing
Weed management	The distribution of weeds along the perimeter boundary of the Proposal Area will be reported, recorded, mapped and monitored.	Throughout the duration of mining operations
	Weed control will be undertaken on-site, where required.	Throughout the duration of mining operations
	An Annual Weed Control Program will be developed and implemented in and around the Proposal Area to monitor and control weeds.	Prior to construction, continuing during construction and throughout operations
<i>P. cinnamomi</i> management	Retained bushland areas are to be clearly demarcated on the ground by signage.	During construction, prior to commencement of mining and throughout operations
	Rehabilitated vegetation areas are to be clearly demarcated on the ground by signage, and temporary fences in the case of areas that are at high risk of access. .	Throughout the duration of mining operations

	Install signs at access points in the site stating that the site is dieback free and all vehicles and personnel must report to the main gates (used for vehicle entry) for inspection.	Prior to construction, continuing during construction period and throughout operations
Hygiene procedures	Hygiene measures for vehicles entering and leaving the Proposal Area will be implemented, including: <ul style="list-style-type: none"> <li>• inspecting the equipment</li> <li>• ensuring that equipment (including dust bowls and filters) is clean prior to entry and exit to site via inspection and/or washdown</li> <li>• washdown facilities will be established at appropriate locations (e.g. on leaving Mt Adams or sealed internal road) to facilitate inspection and washdown (maps showing washdown facilities will be developed as the Project planning commences), as required.</li> </ul>	Throughout the duration of construction and mining operations
	Effluent from washdown will be controlled and treated to prevent disease introduction and then discharged to ground in a suitable manner.	Throughout the duration of construction and mining operations
	Washdowns at alternative (temporary) locations will only occur at a location/s as approved by the Environment/Environmental Specialist, generally at the site boundary.	Throughout the duration of construction and mining operations
	Small permanent sumps and sloped washdown surfaces will be installed at washdown locations to ensure runoff from the washdown is directed away from the "clean" area.	Throughout the duration of construction and mining operations
	Washdown pads and washdown effluent retention sumps will be prepared under dry soil conditions as far as practicable.	Throughout the duration of construction and mining operations
	After washing vehicles, the hygiene station pad is washed to remove all potential contaminated material.	Throughout the duration of construction and mining operations
	Vehicles accessing the site for purposes other than the Project works (i.e. access to Beharra Spring or maintaining the Dampier Bunbury Natural Gas Pipeline and the Parmelia Pipeline) will be predominantly restricted to existing gravel roads. If access to areas outside sealed roads is required, permissions will be sought from Tiwest personnel, and vehicles will be subject to the above hygiene procedures.. All users entering the site will be required to comply with Tiwest washdown procedures.	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Prior to engagement on site, all staff will be inducted on the requirements to prevent the spread of weeds and <i>P. cinnamomi</i> . This will include: <ul style="list-style-type: none"> <li>• identification and reporting of weeds</li> <li>• appropriate training for site personnel on the importance of site hygiene and the correct use of hygiene facilities (e.g. wash down stations).</li> </ul>	Prior to staff entering site

	<p>Updated information regarding weeds and <i>P. cinnamomi</i> will be provided to personnel during mine operations by way of:</p> <ul style="list-style-type: none"> <li>• toolbox meetings</li> <li>• site HSE meetings</li> <li>• training and awareness sessions</li> <li>• visual displays in prominent locations on site.</li> </ul>	Throughout the duration of construction and mining operations
--	--	---

### 3.4.5 Monitoring program

The monitoring program for weed and dieback at the Dongara Project (Table 14) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets

Table 14 Weed and *P. cinnamomi* Hygiene monitoring program

Location	Frequency	Parameters	Procedure	Purpose
Proposal Area	Annually and opportunistically	General weed species and abundance	Locations of weed infestations will be recorded by GPS and mapped at high risk locations.	To monitor weed encroachment
Vegetation adjacent to site boundary				
Proposal Area	Annually	Fencing and signage	Fencing of bushland areas and signage will be inspected for damage and/or breaches	Maintain integrity of fencing and signage around retained bushland.
Proposal Area	Opportunistically	Vehicle condition .	Spot checks of vehicles for cleanliness and weed/seed presence.	To ensure compliance with Weed and <i>P. cinnamomi</i> Hygiene Management Plan.
High risk areas (identified through a risk criteria, but projected to be areas such as active ponds, wet areas adjacent to roads, washdown discharge etc)	Annually	Presence of weed indicators (as assessed by a suitably qualified person).	Inspection of high risk areas, including vegetation health and sampling where required.	To monitor high risk areas for <i>P. cinnamomi</i> and vegetation condition.
Rehabilitated vegetation areas	Annually	Vegetation condition	Investigation of vegetation to identify potential <i>P. cinnamomi</i> infestation	Identification and monitoring of the boundaries of any <i>P. cinnamomi</i> infestations.
Vegetation adjacent to site boundary				



### 3.4.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for the management of weeds and dieback at Dongara are not being achieved (Table 15).

Table 15 Weed and *P. cinnamomi* Hygiene contingency actions

Trigger	Action
Introduction of a new weed species within the remaining native vegetation on-site	<ol style="list-style-type: none"> <li>1. Map the distribution of the newly introduced weed species.</li> <li>2. Identify activities that may have potentially introduced the weed species.</li> <li>3. Plan and implement a weed control treatment program (may involve seeking advice from relevant authorities).</li> <li>4. Apply hygiene control and education measures.</li> <li>5. Undertake follow-up monitoring to gauge success.</li> </ol>
Increase in distribution, abundance or density/cover of previously recorded weed species on-site	<ol style="list-style-type: none"> <li>1. Map the revised extent of the specific weed species within the site.</li> <li>2. Identify activities that may have potentially spread the weed species.</li> <li>3. Plan and implement a weed control treatment program (may involve seeking advice from relevant authorities).</li> <li>4. Apply hygiene control and education measures.</li> </ol>
Non-adherence to hygiene procedure	<ol style="list-style-type: none"> <li>1. Investigate cause.</li> <li>2. Implement remedy, which could include: <ul style="list-style-type: none"> <li>• Review of hygiene measures to determine the requirement for modification/addition to requirements;</li> <li>• Improve induction for staff/contractors;</li> <li>• Increase education campaign amongst staff/contractors;</li> <li>• Improve integrity of soil quarantine areas; and/or fencing pathways where straying from paths is an issue.</li> </ul> </li> <li>3. Assess need for remedial action (e.g. removal of infected soil) to avoid infection.</li> <li>4. Monitor success of remedy and continue monitoring Weed and <i>P. cinnamomi</i> management plan or hygiene procedure.</li> </ol>
Observations suggest the possibility that <i>P. cinnamomi</i> is present on site	<ol style="list-style-type: none"> <li>1. Investigate suspected infestation to confirm whether <i>P. cinnamomi</i> is present</li> <li>2. If <i>P. cinnamomi</i> is not confirmed, treat suspect area with caution and increase hygiene practices in the area</li> </ol>
Confirmed <i>P. cinnamomi</i> has infested the site.	<ol style="list-style-type: none"> <li>1. Identify potential sources of <i>P. cinnamomi</i> spread and determine likely cause.</li> <li>2. Map the distribution of <i>P. cinnamomi</i> affected areas.</li> <li>3. Review treatment and control methods, seeking further advice from relevant authorities if required. Control methods may include phosphate treatment to minimise the spread of <i>P. cinnamomi</i>.</li> <li>4. Implement revised <i>P. cinnamomi</i> control methods and continue monitoring.</li> </ol>

### 3.5 Fauna management plan

#### 3.5.1 Description

The fauna assemblage present within the Proposal Area was investigated as part of a broader fauna study conducted for the proposed expansion of the Proponents activities in the area (Metcalf and Bamford 2011). The study area encompassed the Proposal Area and surrounding locality. The detailed results of this study including the fauna assemblage and fauna habitats present within the Proposal Area are discussed in the Project PER.

Field surveys conducted in the study area identified 118 of the species identified as potentially occurring within the Proposal Area. Ten of these potential species are considered to be of elevated conservation significance and/or to have the greatest potential of being impacted upon by the Project (Metcalf and Bamford 2011):

- *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo)
- *Aspidites ramsayi* (Woma or Ramsay's Python)
- *Morelia spilota imbricata* (South-western Carpet Python)
- *Pezoporus wallicus flaviventris* (Western Ground Parrot)
- *Neelaps calonotos* (Black-striped Snake)
- *Macropus irma* (Brush Wallaby)
- *Eopsaltria georgiana* (White-breasted Robin)
- *Antichiropus* (Eneabba millipede).

The Carnaby's Black Cockatoo has been identified as requiring additional management with relation to the Project due to the presence of suitable feeding habitat for this species. In addition to the actions presented in this management plan, the Proponent has committed to establish environmental offsets as required by SEWPaC under the EPBC Act. Details of these offsets are outlined in the Dongara Project PER.

#### 3.5.2 Environmental aspects to be managed

The Proposal Area contains many different types of fauna that will be affected by construction and other activities on-site during the life of the mine in different ways. As the conservation significance fauna require special management strategies, other fauna that are not listed as conservation significant will benefit from the more stringent management strategies, particularly fauna relocation and habitat conservation. Potential aspects of the Project that may affect fauna include:

- **clearing of vegetation for mine construction and mining** will remove or fragment fauna habitat (including breeding habitats) potentially causing fauna displacement and will likely cause injury or death to some species
- **groundwater drawdown from dewatering** may affect fauna habitat vegetation
- **contamination of soil** may affect fauna habitat vegetation and subterranean fauna habitat
- **mining activities and groundwater drawdown from dewatering** may reduce available habitat for subterranean fauna

- **impact with vehicles and equipment moving on-site** during clearing and operation may result in direct injury or fatality
- **introduction or increase in presence of feral species** can have an impact on fauna through predation or competition
- **unauthorised access to revegetated areas or areas of retained vegetation** may damage fauna habitat or directly disturb fauna
- **linear infrastructure such as pipelines** may obstruct fauna movements and alter fauna behaviour.

This Fauna Management Plan is supported by Tiwest's *Environmental Performance Standard no.22 – Biodiversity* (Tiwest 2011a).

### 3.5.3 Performance management

Table 16 details the environmental targets based on management objectives for fauna protection and management.

Table 16 Fauna management objectives, targets and performance indicators

Management objective	Target	Performance indicators
Minimise impacts on adjacent bushland	No clearing or disturbance outside pre-defined boundaries of the approved Proposal Area throughout the duration of the Project	Visual observations of clearing operations Environmental Incident Reports Adherence to clearing procedure
Minimise the impact on local fauna populations.	No death or injury to fauna caused from vehicle or machinery collisions during clearing and Project operation	Environmental incidents relating to collisions with fauna
	Minimal impact from feral animals during Project operation	Number of feral animal encounters
Minimise habitat fragmentation	Limit instances of linear infrastructure where practicable	Future fauna surveys Visual observations

### 3.5.4 Implementation strategy

Specific actions have been identified to assist in achieving groundwater and surface water management objectives (Table 17).

Table 17 Fauna management actions

Parameter	Action	Timing
Habitat retention and protection	Clearing will be undertaken in stages and along one front to allow fauna to vacate the area.	Prior to commencement of mining and throughout construction and operations
	Confine clearing of vegetation to designated clearing areas only. Within this, where possible, adjust clearing areas to incorporate lower conservation significance areas rather than higher conservation significance areas (e.g. areas of high habitat value).	Throughout the duration of construction and mining operations

Parameter	Action	Timing
	Vehicle and material storage lay down areas will be in existing cleared or disturbed areas within the Proposal Area to limit impacts on the remaining fauna habitat.	During planning and during mining operations
	Install signage to restrict access to retained vegetation areas and areas of rehabilitation.	Prior to commencement of mining and throughout operations
	Minimise time between clearing and rehabilitation.	During planning and during mining operations
Fauna encounter procedures	Native animals' encountered onsite will be given the opportunity to move on if there is no threat to personnel safety in doing so.	Throughout the duration of construction and mining operations
Subterranean fauna	The extent of excavation will be restricted to that required for the successful implementation of the Proposal	During planning and during mining operations
	Dewatering impact will be limited to predicted zones and will be minimised where practicable (refer to surface and groundwater management)	During planning and during mining operations
Personnel and on-site activities	Restrict vehicles, machinery and personnel to designated areas.	Throughout the duration of construction and mining operations
	Dispose of food waste into covered waste facilities to ensure that feral or other animals are not attracted to the site.	Throughout the duration of construction and mining operations
	All waste materials will be appropriately disposed of to onsite waste disposal bins, restricting access to fauna.	Throughout the duration of construction and mining operations
	Install signs on internal roads warning of the potential for fauna to be mobile in the area.	Prior to commencement of mining and throughout operations
	The feeding of fauna, hunting, or keeping of pets onsite will be prohibited.	At all times
	All personnel will observe onsite vehicle speed limits to prevent the likelihood of road kill.	At all times
Environmental incident reporting	Environmental incidents related to fauna will be reported as per Section 2.3. Public complaints relating to fauna will be treated as an environmental incident and reported as per Section 2.2.1	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Prior to engagement on site, all staff will be inducted on fauna management, including: <ul style="list-style-type: none"> <li>• requirement to remain within demarcated clearing boundary or existing clearing areas</li> <li>• potential for construction activities to affect fauna and fauna habitat</li> <li>• identification of Carnaby's Black-Cockatoo and the care to be taken in avoiding clearing areas if they are present</li> <li>• fauna encounter procedures.</li> </ul>	Throughout the duration of construction and mining operations

Parameter	Action	Timing
	<p>Updated information regarding fauna management will be provided to personnel during mine operations by way of:</p> <ul style="list-style-type: none"> <li>• toolbox meetings</li> <li>• site HSE meetings</li> <li>• training and awareness sessions</li> <li>• visual displays in prominent locations on site.</li> </ul>	Throughout the duration of construction and mining operations

### 3.5.5 Monitoring program

The monitoring program for fauna at the Dongara site (Table 18) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 18 Fauna monitoring program

Location	Frequency	Parameters	Procedure	Purpose
Bushland areas adjacent to the Proposal Area	Once during the non-breeding period from mid October to early July.	Signs of Carnaby's Black-Cockatoo use of the adjacent vegetation including sightings or evidence of feeding.	Conduct a detailed bird census of the Proposal Area and adjacent bushland areas. Opportunistic sightings will be recorded in addition to detailed bird census.	To determine the effects of altering the availability of non-breeding feeding habitat for Carnaby's Black-Cockatoo by decreasing during clearing and increasing during rehabilitation.
Bushland areas adjacent to the Proposal Area	Annually	Signs of Western Ground Parrots using adjacent vegetation including sightings, aural observations or evidence of feeding.	Conduct a targeted Western Ground Parrot survey, pre-mining, during and post-mining.	To determine if the project is having any impact to the species and the effect of altering habitat by decreasing during clearing and increasing during rehabilitation
Bushland areas adjacent to the Proposal Area	Annually	Fauna species utilising the adjacent bushland areas	Conduct a fauna survey for reptiles, birds and SREs	To determine if the Project is having any impact beyond the boundary of the Proposal Area
Bushland areas adjacent to the Proposal Area and within the Proposal Area	Opportunistic.	Number of fauna encounters/collisions.	Record fauna sightings	To determine if further fencing or warning signs are needed beyond those existing.
Bushland areas adjacent to the Proposal Area and within the Proposal Area	Opportunistic.	Number of feral animals recorded	Record feral animal sightings	To determine the requirement to undertake control of feral animals.

### 3.5.6 Contingencies

In the event that management objectives and / or targets for fauna are breached then contingency actions (Table 19) will be undertaken.

Table 19 Fauna contingency actions

Trigger	Action
Conservation significance fauna injured or trapped during construction	<ol style="list-style-type: none"> <li>1. Contain animals within boundary to ensure minimal disturbance</li> <li>2. Call fauna experts and wait for guidance or instructions</li> </ol>
Significant (statistical) decrease in species diversity or prevalence in adjacent bushland areas	<ol style="list-style-type: none"> <li>1. Investigate cause.</li> <li>2. Undertake intervention or remediation works (e.g. engineering solutions).</li> </ol>
Excessive vehicle collision with fauna	<ol style="list-style-type: none"> <li>1. Investigate cause</li> <li>2. Undertake intervention or remediation works (e.g. further reduce speeds, new relocation effort).</li> <li>3. Monitor success.</li> </ol>
Increased prevalence of feral species	<ol style="list-style-type: none"> <li>1. Investigate cause</li> <li>2. Undertake intervention or remediation works (e.g. baiting)</li> <li>3. Monitor success</li> </ol>

## 3.6 Dust management plan

### 3.6.1 Description

Mineral sands mining can generate dust which, if not adequately managed, may adversely impact environmental values. Analysis of the composition of the overburden and ore materials at Dongara indicate that it is most likely to present a risk in terms of physical processes including smothering of vegetation, nuisance / irritation of lungs, and aesthetic impacts.

The Project is located in a remote area, with the nearest large population centre being Dongara some 27km northwest. The closest landholders located on large farming properties are approximately 3 km away. Due to this remote location, the only nearby sensitive receptor to dust emissions, aside from the Project workforce, is the adjacent vegetation and flora.

The generation of dust from the Project will depend upon:

- the volume of material being mined, and the operating hours at the site
- meteorological conditions, such as wind speed
- moisture content of the dust source
- composition of dust, including particle size distribution, particle density
- the condition of the dust source.

### 3.6.2 Environmental aspects to be managed

The following aspects of the Project have been identified as potential sources of dust and require management to ensure dust emissions are minimised:

- **physical disturbance to the land surface** during construction of infrastructure and mining (e.g. removal of vegetation and mining excavations)
- **transport of material** both on-site and off-site
- **exposure** of soil to wind erosion
- **haulage and light traffic** on unsealed roads.

This Dust Management Plan is supported by Tiwest's *Environmental Performance Standard no.21 – Air Emissions* (Tiwest 2011a).

### 3.6.3 Performance management

Environmental targets and performance indicators have been developed based on dust management objectives for the Dongara Project (Table 20).

Table 20 Dust management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To ensure that there is no significant environmental impact on the natural or social environments from the generation of dust.	All reasonable measures are undertaken to control dust.	All dust control equipment is operational.
	Vegetation adjacent to Proposal Area is not smothered by dust.	Vegetation health and condition monitoring (dust accumulation on plants), as well as results from regular airborne dust monitoring).
	No public complaint relating to dust.	Number of public complaints received relating to dust.
Ensure compliance with dust emission levels stated in DEC guidelines.	Dust generated does not exceed guidance from DEC standards during construction.	Dust monitoring at boundaries or down wind.

### 3.6.4 Implementation strategy

Specific actions have been identified to assist in achieving dust management objectives (Table 21).

Table 21 Dust management actions

Parameter	Action	Timing
Tracks and Roads	Implementation of speed limits to minimise dust generation on roads.	Throughout the duration of construction and mining operations
	Roads on-site will be subject to dust minimisation activities.	Throughout the duration of construction and mining operations
Vegetation Clearing	Implement annual stabilisation plan in areas of disturbance , stockpiles and dumps, for dust reduction and control. The plan will address the stabilisation of non-active disturbed areas utilising such measures as cover crops, slimes (clay tailings, and chemical stabilising agents).	Throughout the duration of construction and mining operations
	Vegetated areas are retained until required ahead of mine development in order to minimise the extent of soil surface exposed at any time.	Throughout the duration of construction and mining operations
	Do not undertake dust generating activities (e.g. topsoil stripping, excavation of dry materials continuing fines) activities with dry materials in high winds.	Throughout the duration of construction and mining operations
Progressive Rehabilitation	Progressive rehabilitation of disturbed areas is undertaken, which minimises dust through the reduction of exposed soil.	Throughout the duration of construction and mining operations
Water Application	Dust suppression watering using water trucks is undertaken over disturbed/unsealed active mining areas within the operation and other areas (e.g. roads) prone to dust generation.	Throughout the duration of construction and mining operations
Plant and equipment	Haulage trucks and earthmoving equipment will be clean on entry and exit to and from the site to prevent dust generating material tracking onto internal and external roads.	Throughout the duration of construction and mining operations



Housekeeping	Maintain good housekeeping practices to prevent an accumulation of material in or around the site that may result in airborne dust.	Throughout the duration of construction and mining operations
	Cover HMC during transport and storage.	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Induction to include measures for reducing dust levels including: <ul style="list-style-type: none"> <li>• potential impacts of high levels of dust</li> <li>• hygiene and washdown procedures</li> <li>• speed limit restrictions on-site.</li> </ul>	Throughout the duration of construction and mining operations
	Updated information regarding dust management will be provided to personnel during mine operations by way of: <ul style="list-style-type: none"> <li>• toolbox meetings</li> <li>• site HSE meetings</li> <li>• training and awareness sessions.</li> </ul>	Throughout the duration of construction and mining operations

### 3.6.5 Monitoring program

The monitoring program for dust at the Dongara Project (Table 22) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets

Table 22 Dust monitoring program

Location	Frequency	Parameters	Procedure	Purpose
Proposal Area	Daily	Level of visible dust or dust lift-off	Opportunistic inspections where there is potential for dust emissions	To assess the effectiveness of dust management actions
Water carts	Weekly or during windy periods	Water cart availability and utilisation levels	Inspect availability of suitable dust suppression methods	To ensure that there is an adequate level of and capacity for dust suppression
Boundary of Proposal Area	Monthly to establish baseline, and targets then quarterly.	Dust levels via depositional sampling.	Inspect results of ongoing monitoring	To ensure air quality levels are within the approved range

### 3.6.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for the management of dust at Dongara are not being achieved (Table 23).

Table 23 Dust management contingency actions

Trigger	Action
Excessive dust generation as determined by visual observation results	<ol style="list-style-type: none"> <li>1. Investigate cause.</li> <li>2. Implement appropriate dust control measures, which may include: <ul style="list-style-type: none"> <li>• reduce activity levels and rate</li> <li>• increase rate of application of dust control measures or seek alternative measures, e.g. cap or otherwise remove dust source material from exposure to wind erosion</li> </ul> </li> <li>3. Monitor success of control measure. If the measure is inadequate, seek alternative measures (consultation with relevant agencies may be required) or Cease operations until the wind speed decreases or dust can otherwise be controlled effectively.</li> </ol>
Complaints received from the public	<ol style="list-style-type: none"> <li>1. Any complaints will be considered Environmental Incidents and will be managed as such. Dust monitoring and data recording may be initiated to provide information to support development of a management response.</li> <li>2. Monitoring must be carried out in accordance with NEPC, DEC and EPA.</li> <li>3. If deemed necessary, mitigation measures including stopping works activities will be implemented.</li> </ol>
Dust levels above internal targets based on baseline ranges	<ol style="list-style-type: none"> <li>1. Investigate location to determine if activities in the area are sources</li> <li>2. Identify and implement additional controls</li> <li>3. Monitor success of control measure. If the measure is inadequate, seek alternative measures (consultation with relevant agencies may be required).</li> </ol>

### 3.7 Greenhouse gas inventory and management plan

#### 3.7.1 Description

Greenhouse gas emissions produced by the combustions of fuels contribute to human induced climate change. Similarly, consumption of other forms of energy, and resources, including land clearing, carry similar potential. The Kyoto Protocol is an international agreement designed to foster action to manage the human enhanced greenhouse effect. The six greenhouse gases covered by the Kyoto Protocol are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), perfluorocarbons (CF<sub>x</sub>), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF<sub>6</sub>) and nitrous oxide (N<sub>2</sub>O). Other greenhouse gases include water vapour (H<sub>2</sub>O), chlorofluorocarbons (CFCs), ozone (O<sub>3</sub>), oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO<sub>2</sub>).

Although the duration and magnitude of the Project is such that the resulting contribution to human induced climate change is very low, the nature of the problem is such that a multitude of small scale contributions add up to produce significant combined contribution on a national or global scale. As such, Tiwest will maintain this Greenhouse Gas Emission Inventory and Management Plan to track and improve efficiency and decrease combustion emissions. The carbon emissions profile for the Project will be quantified and improvement opportunities identified. These will be incorporated into business improvement systems.

The National Greenhouse and Energy Reporting Act 2007 introduced a national framework for the reporting and dissemination of information about the greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations. The Australian Government's Energy Efficiency Opportunities program encourages large energy-using businesses to improve their energy efficiency by improving the identification, evaluation and resulting implementation of cost effective energy savings opportunities. Participation in the program is mandatory for corporations that use more than 0.5 petajoules (PJ) of energy per year, which is approximately equivalent to:

- 139,000 megawatt hours of electricity;
- 9000 tonnes of LNG or 10,000 tonnes of LPG;
- 13 megalitres of diesel; or
- spending of approximately \$5-10 million on electricity, \$1.5-2.5 million on gas or \$1113 million on diesel (depending on prices).

All Tiwest operations are registered and report under the Energy Efficiency Opportunities program.

#### 3.7.2 Environmental aspects to be managed

The main sources of greenhouses gases associated with the Project include:

- **combustion** of fuels by mobile plant, equipment and onsite vehicles
- **clearing** of vegetation
- **decomposition** of waste (landfill)
- **indirectly** from electrical power usage by processing plants, dewatering pumps and conveyors.

This Greenhouse Gas Emission Inventory and Management Plan is supported by Tiwest's *Environmental Performance Standard no.23 – Greenhouse Gas/Energy* (Tiwest 2011a).

### 3.7.3 Performance management

Environmental targets and performance indicators (Table 24) have been developed based on greenhouse gas emissions management objectives for the Dongara Project.

Table 24 Greenhouse Gas emissions management objectives, targets and performance indicators

Management objective	Target	Performance indicators
Improve energy efficiency by improving the identification, as required by the Australian Government's Energy Efficiency Opportunities program.	To reduce the amount of Greenhouse Gas emissions from the Project.	Annual target reporting on greenhouse gas emissions.

### 3.7.4 Implementation strategy

Specific actions have been identified to assist in achieving Greenhouse Gas emissions management objectives (Table 25).

Table 25 Greenhouse Gas emissions management actions

Parameter	Action	Timing
Targets	Set annual emissions and energy intensity targets for the Project.	Prior to commencement of mining, update annually
Efficiency	Investigate opportunities to reduce emissions, by increasing efficiency and continually updating to more efficient technology.	Prior to commencement of mining and during operation
Clearing	Progressively clear and rehabilitate vegetation wherever practicable	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Induction to include measures for reducing greenhouse gas emissions including: <ul style="list-style-type: none"> <li>• potential impacts of greenhouse gases</li> <li>• methods of reducing greenhouse gases</li> </ul>	Throughout the duration of construction and mining operations
	Updated information regarding greenhouse gases will be provided to personnel during mine operations by way of: <ul style="list-style-type: none"> <li>• toolbox meetings</li> <li>• site HSE meetings</li> <li>• training and awareness sessions.</li> </ul>	Throughout the duration of construction and mining operations

### 3.7.5 Monitoring program

The monitoring program for Greenhouse Gas emissions at the Dongara Project (Table 26) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets

Table 26 Greenhouse Gas emissions monitoring program

Location	Frequency	Parameters	Procedure	Purpose
Proposal Area	Monthly	Greenhouse gas emissions	The amount of greenhouse gases produced from the operation is calculated and reported	To ensure that emissions are measured

### 3.7.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for the management of Greenhouse Gas emissions at Dongara are not being achieved (Table 27).

Table 27 Greenhouse Gas emissions contingency actions

Trigger	Action
Greenhouse emissions exceed annual target	Determine cause and establish new annual targets if required.

### 3.8 Radiation management plan

#### 3.8.1 Description

The Radiation Management Plan has been developed in accordance with Tiwest Radiation Management Plan for Northern Operations (Tiwest 2010). Tiwest has made a commitment to responsible radiation management and compliance with all laws and regulations concerning radiation protection. Tiwest prescribes to the ALARA principle, that is, As Low As Reasonable Achievable, in respect to radiation exposure.

Radiation sources at the site are mainly associated to naturally occurring radioactive minerals, and static density gauges.

The Dongara Project Heavy Metal Concentrate (HMC) contains naturally occurring radioactive elements, principally Uranium (U) and Thorium (Th) and associated decay series. Monazite has the highest content of these radionuclides and constitutes on average 1.02% by weight of the HMC in the Dongara ore bodies. Other heavy minerals in the ore also contain Th and U but at concentrations, in general, several of orders of magnitude less. The ore bodies Dionysus, Heracles and Zeus, represent the greatest percentage of the Dongara HMC. Given that Dongara produces HMC and all further concentration of mineral streams and disposal of associated non-valuable minerals, (including monazite rich ones) occurs offsite, HMC is the material at Dongara that carries the highest radiological content. The activities levels of HMC represent a low risk to personnel, the wider public and the environment.

Radiation risks associated downstream mineral processing activities and waste disposal will be managed in accordance with existing provisions of the Northern Operations Radiation Management Plan (Tiwest 2010).

#### 3.8.2 Environmental aspects to be managed

The potential impacts of the radiological activity at the Dongara Project operations are as follows:

- **contamination of soil and groundwater** through release of radioactive streams
- **impacts to ecological and human receptors** from radioactive emitters (including gamma radiation and dust)
- **alteration of the existing surface radiation levels** at the site
- **contamination of soil and groundwater** through accidental release during transport.

#### 3.8.3 Performance management

Environmental targets and performance indicators have been developed based on radiation management objectives (Table 28).

Table 28 Radiation management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To comply with the Mines Safety and Inspection Act 1994 and Regulations 1995	Full compliance with legal conditions	Audits show full compliance with conditions under the Mines Safety and Inspection Act 1994 and Regulations 1995
Ensure compliance with Department of Mines and Petroleum guideline: Managing naturally occurring radioactive material (NORM) in mining and mineral processing (DMP 2010)	Full compliance with NORM guidelines	Audits show no breaches of guidelines
Limit exposure of public and workforce to below ARPANSA guidelines	Below guidelines	Exposure monitoring data at source and for key personnel show no exceedances
To manage sources of radiation to avoid contamination.	No increase in activity levels in environment.	Environmental monitoring (specifically, post mining gamma survey results relative to post rehabilitation, annual site gamma survey, groundwater monitoring, alpha counts on dust samples etc)
To ensure radioactive waste materials are transported offsite in a manner compliant with overarching Radiation Management Plan (Tiwest 2005).	No contamination of soil, groundwater during transport	Radioactive material loaded onto trucks successfully. Radioactive material transported to Chandala without incident

### 3.8.4 Implementation strategy

Specific actions have been identified to assist in achieving radiation management objectives (Table 29).

Table 29 Radiation management actions

Parameter	Action	Timing
Induction and training	Instruct new employees about radiation, exposure, protection methods, and radiation work procedures. Run refresher courses for existing employees every second year.	Throughout the duration of construction and mining operations
Exposure	Reduce exposure to radiation through the use of radiation protection and radiation work procedures. Thermoluminescent dosimeter (TLD) monitoring of personnel to detect exposure above safe levels. Area gamma monitoring to ascertain surface gamma radiation levels at the site. Groundwater gamma monitoring to ascertain radiation levels in groundwater. Gross alpha, gross beta and potassium40 conducted at site boundary bores.	Throughout the duration of construction and mining operations

Parameter	Action	Timing
Product	Correct classification of radioactive product streams for offsite transport.	Throughout the duration of construction and mining operations
Waste	Correct classification of radioactive waste streams for offsite transport. Waste transported offsite and disposed of at appropriately licensed disposal site. Monitoring of water deposited in tailings dams.	Throughout the duration of construction and mining operations
Plant and Equipment	All plant and equipment leaving and entering site will be screened for radiation levels. Equipment should be below established limits before being allowed to leave site (with the exception of vehicles transporting product or waste)	Throughout the duration of construction and mining operations
Transport	Maintenance of transport equipment to reduce incidents of vehicle failure. Training of all drivers of transport vehicles to ensure they are aware of risks, safety precautions, and emergency procedures.	Throughout the duration of construction and mining operations
Dust Generation	Measures in place to reduce the amount of dust generated during operations (refer to Dust Management)	Throughout the duration of construction and mining operations

### 3.8.5 Monitoring program

The monitoring program for radiation at the Dongara Project (Table 30) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets

Table 30 Radiation monitoring program

Location	Frequency	Parameters	Procedure	Purpose
HMC products and waste streams	Monthly	Radionuclide content of HMC product and solid waste streams	X-Ray Fluorescence (XRF) analysis of product and solid waste by an accredited laboratory.	To assess the radionuclide level in product and waste
Groundwater: Boundary extents of the site	Quarterly	Radionuclide suite (including but not limited to, radium-226, radium-228, gross alpha, gross beta, potassium40)	Sampling dedicated monitoring bores and submitting samples to accredited radiation testing laboratories.	To monitor radionuclide levels at the site boundary.
Groundwater: Potable water bores	Quarterly	Radionuclide suite (including but not limited to, gross alpha, gross beta, potassium40)	Sampling dedicated monitoring bores and submitting samples to accredited radiation testing laboratories.	To monitor radionuclide levels in potable water bores.



Personal Gamma for key personnel (i.e. working in supervised or controlled areas)	Twelve week rotating monitoring periods based on type of work and exposure risk	Radioactivity exposure through TLD badges	TLD badges attached to personnel, with exposures compared to control TLDs. One TLD will remain in a lead lined box, while several other control TLDs will be placed on boards in various work areas, to record background radioactivity exposure in each work area.	To monitor exposure of personnel to radioactivity
Area Gamma	Six monthly	Gamma radiation	Gamma monitoring will be conducted at the site boundaries, using a portable gamma survey meter.	To monitor gamma radiation at the boundaries of the site, assists in ascertaining whether radioactive exposure is extending off site.
Personal Air Sampling	Various, dependant on work area and duties	Gross alpha in dust	Personal air samplers will pump a volume of air across a fibre glass filter. This filter will then be analysed by an accredited laboratory for gross alpha.	To monitor the exposure of personnel to radioactive dust particulates.
Positional Air Sampling	Six monthly	Gross alpha in dust	Positional air samplers will pump a volume of air across a fibre glass filter. This filter will then be analysed by an accredited laboratory for gross alpha.	To monitor radioactivity of dust particles at the site

### 3.8.6 Contingencies

Table 31 identifies the appropriate contingency actions to be initiated in the event that the radiation objectives are not met.

Table 31 Radiation contingency actions

Trigger	Action
Radionuclides in groundwater trend upwards	<ol style="list-style-type: none"> <li>1. Re-test water from affected bore(s)</li> <li>2. If a second sample confirms an exceedence then: <ul style="list-style-type: none"> <li>• Report as an Environmental Incident and initiate Incident Response Procedure</li> <li>• If exceedence persists, investigate extent and cause of quality exceedence</li> <li>• Undertake appropriate remedial action</li> <li>• Revise operational procedures if possible to prevent recurrence</li> </ul> </li> </ol>
Incident of personal gamma level above prescribed exposure limits	<ol style="list-style-type: none"> <li>1. Investigate exceedence</li> <li>2. If investigation confirms exceedence is real and not related to equipment malfunction then: <ul style="list-style-type: none"> <li>• Report as an Environmental Incident and initiate Incident Response Procedure</li> <li>• Undertake appropriate remedial action</li> <li>• Revise operational procedures if possible to prevent recurrence</li> </ul> </li> </ol>

Trend indicates area gamma is extending beyond site boundaries	<ol style="list-style-type: none"> <li>1. Re-test area</li> <li>2. If a second sample confirms trend then: <ul style="list-style-type: none"> <li>• Report as an Environmental Incident and initiate Incident Response Procedure</li> <li>• Undertake appropriate remedial action</li> <li>• Revise operational procedures if possible to prevent recurrence</li> </ul> </li> </ol>
Trend indicates radionuclides in dust are above prescribed limits	<ol style="list-style-type: none"> <li>1. Re-test dust</li> <li>2. If a second sample confirms an exceedence then: <ul style="list-style-type: none"> <li>• Report as an Environmental Incident and initiate Incident Response Procedure</li> <li>• Undertake appropriate remedial action</li> <li>• Revise operational procedures if possible to prevent recurrence</li> </ul> </li> </ol>

### 3.9 Acid sulfate soil management plan

#### 3.9.1 Description

Acid sulfate soils (ASS) are naturally occurring soils and sediments containing iron sulfides, most commonly pyrite.

When ASS are exposed to air the iron sulfides in the soil react with oxygen and water to produce a variety of iron compounds and sulfuric acid. Initially a chemical reaction, the process can be accelerated by soil bacteria. The resulting acid can release other substances, including heavy metals, from the soil and into the surrounding environment.

Inappropriate disturbance of these soils can generate large amounts of sulfuric acid and leaching of contaminants naturally occurring in the soils. Flushing of acidic leachate to groundwater and surface water can cause off site impacts including:

- ecological damage to ecosystems (including aquatic and riparian)
- contaminations of groundwater with arsenic, aluminium and other heavy metals
- reduction in agricultural productivity through metal contamination of soils (predominantly by aluminium)
- damage to infrastructure through the corrosion of concrete and steel pipes, bridges and other sub-surface assets
- effects on estuarine and aquaculture projects. (DEC 2009)

#### 3.9.2 Environmental aspects to be managed

The potential impacts of poor acid sulfate soil management practices are:

- **contamination of soil and/or groundwater** through improper handling and/or treatment of acid sulfate soil materials.

#### 3.9.3 Performance management

Environmental targets and performance indicators have been developed based on ASS management objectives (Table 32).

Table 32 ASS management objectives, targets and performance indicators

Management objective	Target	Performance indicators
No ASS impacts during operations	No exposure of untreated ASS materials during mining works	Water and soil quality monitoring results show no acid generation.

### 3.9.4 Implementation strategy

Specific actions have been identified to assist in achieving ASS management objectives (Table 33).

Table 33 ASS management actions

Parameter	Action	Timing
Assess the risk of encountering ASS material	Undertake additional investigation and assessment of ASS in areas identified as of risk in Geoprocc 2010.	Prior to mining each area
Contaminant release to groundwater	Additional POS and SPOCAS testing undertaken prior to dewatering and/or mining in areas of risk identified in Geoprocc (2010).	Prior to dewatering activities, dependant on risk potential
Monitoring	Regular soil and groundwater monitoring to be undertaken to confirm ASS has not been encountered.	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Prior to engagement on site, all staff will be inducted on ASS management and risks	Throughout the duration of construction and mining operations
	Updated information regarding ASS management will be provided to personnel during mine operations by way of: <ul style="list-style-type: none"> <li>• toolbox meetings</li> <li>• site HSE meetings</li> <li>• training and awareness sessions.</li> </ul>	Throughout the duration of construction and mining operations

### 3.9.5 Monitoring program

The monitoring program for ASS at Dongara (Table 34) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 34 ASS monitoring program

Location	Frequency	Parameters	Procedure	Purpose
Within areas of pits dependent on risk identified during POS and SPOCAS testing undertaken pre mining	Before mining in pits at risk in Geoprocc 2010,.	Soil quality	Soil testing as DEC ASS guidelines	To ascertain status of disturbance of potential ASS containing material. To ensure no release of contaminants to the surrounding environment

Active mining pit in areas of ASS risk.	Weekly	Soil and water characterisation	Undertaken inspection of input materials to identify potentially acid forming horizons. Test pit water for field pH and conductivity. Review mining limits against plan	Identify if ASS materials are encountered and / or being managed according to plan (field verification)
Active pits and connected water storage facilities	Weekly during mining of pits with identified areas of risk	Groundwater quality	Groundwater testing as DEC ASS guidelines	To ascertain status of disturbance of potential ASS containing material. To ensure no release of contaminants to the surrounding environment
Bores within surrounding vicinity	Monthly during mining of pits at risk in Geoprocc 2010	Groundwater quality	Groundwater testing	To monitor whether acid generation is occurring in areas surrounding mining pit.
Bores within surrounding vicinity	Weekly during mining of pits with identified areas of risk	Groundwater levels	Water levels	To ascertain groundwater levels within areas of potential ASS containing material.

### 3.9.6 Contingencies

Contingency actions have been developed to be undertaken if monitoring indicates that the environmental objectives and targets for ASS management at Dongara are not being achieved (Table 35).

Table 35 ASS contingency actions

Trigger	Action
Soil quality results prior to mining indicate ASS are present	<ol style="list-style-type: none"> <li>1. Confirm sample results.</li> <li>2. Consult DEC ASS guidelines for treatment options, consult with DEC if required.</li> <li>3. Incorporate management measures into ASS Management Plan and implement</li> <li>4. Communicate changes to ASS Management Plan to DEC and other relevant government departments</li> </ol>
Water quality results above relevant water quality guidelines	<ol style="list-style-type: none"> <li>1. Re-test affected bore(s)/pit water sample</li> <li>2. If a second sample confirms trend then report as an Environmental Incident</li> <li>3. Consult DEC ASS guidelines for treatment options</li> <li>4. Undertake appropriate remedial action.</li> <li>5. Monitor bores/pit weekly to determine success of remedial action</li> </ol>

### 3.10 Waste management plan

#### 3.10.1 Description

This Waste Management Plan outlines the management of non-processing waste streams which will typically include:

- domestic solid and liquid waste
- food scraps from the accommodation and construction camp
- scrap metal/drums
- rubber products (e.g. tyres)
- batteries
- hydrocarbon waste
- sewage
- washdown water.

This management plan will be implemented under the premise that all domestic and non-process waste will be sent offsite to licensed landfill facilities, with the exception of inert materials (such as concrete, pipes, tyres etc) which will be disposed of on site in the mine void as backfill.

#### 3.10.2 Environmental aspects to be managed

The potential impacts of poor waste management practices are:

- **contamination of soil, surface water and/or groundwater** through incorrect non-processing waste handling, storage and disposal. This may have indirect vegetation or fauna impacts and cause poor visual amenity or health and safety issues
- **inefficient use of resources** through failure to reduce, recycle, re-use or recover waste.

This Waste Management Plan is supported by Tiwest's *Environmental Performance Standard no. 29 – Waste Management* and *no. 30 – Water Management* (Tiwest 2011a).

#### 3.10.3 Performance management

Environmental targets and performance indicators have been developed based on waste management objectives at the site (Table 36).

Table 36 Waste management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To ensure that all waste is disposed of in a manner compliant with DEC requirements that does not have unacceptable impacts on the environment.	All waste is managed appropriately.	All domestic and non-processing waste is sent offsite to landfill, with the exception of inert material.
		No contaminated material kept on site or disposed of in mine voids.
		All grey/sewage water and waste is disposed of appropriately.
		All rubber is disposed of appropriately.
		All hazardous waste is managed appropriately and sent off site for disposal.
		No waste management non-compliances.
		Nil incidents require reporting to the contaminated sites register
Minimise the volume of non-process wastes generated through the adoption of practicable waste reduction strategies.	Recycling is undertaken as a standard practice.	An increase in the number of items recycled.
Ensure that contaminated sites do not pose a risk of harm to human health or environmental values.	Keep records of all potential contaminated sites.	All contaminated and potentially contaminated sites have been identified and registered.
	Determine risks and impacts of contaminated sites.	The character and extent of the contamination of each identified site has been defined and the risks and impacts have been identified and prioritised.
	Manage and contain contaminated sites.	A management plan has been developed for each site identified.

### 3.10.4 Implementation strategy

Specific actions have been identified to assist in achieving waste management objectives (Table 37).

Table 37 Waste management actions

Parameter	Action	Timing
Risk Assessment	A risk assessment (using the Tiwest Risk Matrix) shall be conducted on the potential impacts of each waste stream and included in the site risk register. The risk assessment will address the requirements outlined in <i>Environmental Performance Standard no. 29</i> .	Prior to commencement of mining, updated throughout operation life
Waste Segregation:	All hazardous and recyclable waste from the operation is segregated prior to disposal and disposed.	Throughout the duration of construction and mining operations

Waste Management	Littering on-site is prohibited and work and office sites are to be kept clean and tidy. Rubbish containers are to be provided at all work sites.	Throughout the duration of construction and mining operations
Hazardous Wastes	All hazardous waste management and removal from site must occur in accordance with regulatory requirements (i.e. via licensed waste carrier)	Throughout the duration of construction and mining operations
Spent Chemicals	Spent chemicals, such as coolants, solvent and inhibitors are disposed of off-site by a licensed contractor.	Throughout the duration of construction and mining operations
Rubber Disposal	Used tyres and other large rubber products are disposed of in accordance with regulatory requirements (i.e. controlled waste regulations).	Throughout the duration of construction and mining operations
Materials Balance Sheet	Identify and quantify significant solid and liquid waste streams and maintain a materials balance sheet for all regulated wastes (e.g. controlled wastes such as tyres and waste oil) to allow reconciliation of materials received on site against materials leaving or stored.	Prior to commencement of mining and during operation
Wastewater Treatment Plant (WWTP)	The WWTP will be designed, constructed, operated, maintained and inspected in accordance with regulatory requirements.	During mine planning, and during operation
Waste Reduction Reviews	Periodic reviews will be undertaken to identify opportunities for more effective means of reducing waste generation or waste disposal.	Throughout the duration of construction and mining operations
Recyclable Materials	Recyclable and re-useable materials (such as some steel and batteries) will be stored in designated areas and made available for re-use or periodic collection.	Throughout the duration of construction and mining operations
Contaminated Sites	Contamination or spills reported to the environmental personnel on site will be recorded, and advice will be sought from DEC regarding whether further investigation is required.	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Prior to engagement on site, all staff will be inducted on waste management, including: <ul style="list-style-type: none"> <li>the requirement to segregate and recycle waste</li> <li>encouragement of waste minimisation</li> <li>the impact of incorrect handling, storage and disposal of non-processing waste.</li> </ul>	Throughout the duration of construction and mining operations
	Updated information regarding waste management will be provided to personnel during mine operations by way of: <ul style="list-style-type: none"> <li>toolbox meetings</li> <li>site HSE meetings</li> <li>training and awareness sessions.</li> </ul>	Throughout the duration of construction and mining operations

### 3.10.5 Monitoring program

The monitoring program for waste at Dongara (Table 38) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.



Table 38 Waste monitoring program

Location	Frequency	Parameters	Procedure	Purpose
Effluent storage or treatment systems	Daily	Spills and leaks	Visual observation	To ensure that no spills or leaks from storage tanks and pipelines are occurring
Proposal Area	Opportunistically	Litter/rubbish	Visual observation	To ensure domestic and industrial wastes (including putrescible wastes) are disposed of properly
On-site waste facilities	Monthly	Design and maintenance	Visual observation	To ensure effective function of all on-site waste facilities, and storage areas
Chemical use and storage points	Monthly	Chemical disposal	Visual observation and comparison to chemical register.	To ensure hazardous chemical wastes are disposed of correctly
Proposal Area	Quarterly	Controlled Waste Transport Certificates	Review Certificates of third party contractors	To ensure the Certificates are up to date and comply with regulatory requirements
WWTP	Quarterly	Discharge effluent quality	Analyse discharge water from WWTP	To ensure water quality is appropriate for discharge method
Proposal Area	Quarterly	Quantities of waste	Review registers and waste balance sheets.	To ensure all waste has been recorded and accounted for
Contaminated sites	Six Monthly	Boundary of contaminated site (only applicable is a contaminated site is registered).	Visual observation	To ensure that contaminating material is contained and has not spread beyond boundaries to larger area
Sites with potential contaminates	Six Monthly	Status of potentially contaminating material	Visual observation	To ensure that all potentially contaminating materials are managed appropriately to prevent the creation of new contaminated sites

### 3.10.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for waste management at Dongara are not being achieved (Table 39).

Table 39 Waste contingency actions

Trigger	Action
Incorrect disposal of waste	<ol style="list-style-type: none"> <li>1. Mitigate (initiate spill response procedure) and investigate cause</li> <li>2. Report as an Environmental Incident.</li> <li>3. Implement corrective actions, including correct disposal of wastes and re-educating personnel of correct disposal procedures as required.</li> </ol>

Trigger	Action
Spills/leaks	<ol style="list-style-type: none"> <li>1. Mitigate (initiate spill response procedure) and investigate cause</li> <li>2. Report as an Environmental Incident.</li> <li>3. Implement corrective actions, including correct disposal of wastes and re-educating personnel of correct disposal procedures as required.</li> </ol>
Poor Water Quality from WWTP discharge	<ol style="list-style-type: none"> <li>1. Mitigate and investigate cause</li> <li>2. Report as an Environmental Incident.</li> <li>3. Implement corrective actions</li> </ol>
Bins or waste facilities overflowing	<ol style="list-style-type: none"> <li>1. Arrange for more frequent waste collection and/or larger receptacles.</li> </ol>

### 3.11 Hydrocarbon and hazardous materials management plan

#### 3.11.1 Description

During construction and operation of the Project, hydrocarbons and hazardous materials will be required for a range of Project activities. The Dongara site is expected to carry very few hazardous materials of any significant volume.

For the purposes of this management plan, hazardous materials refer to any solid or liquid material (other than waste), which if released into the environment, has the potential to cause direct or indirect alteration to the environment, to its detriment or degradation. This may include some classes of dangerous goods as defined by the *Dangerous Goods Safety Act 2004*.

Management of waste is prescribed in the Waste Management Plan (Section 3.10).

#### 3.11.2 Environmental aspects to be managed

The following aspects have been identified as requiring management to minimise the risk of hydrocarbon or hazardous material discharges:

- **operation of vehicles/machinery** has the potential to result in discharges due to accidents and faults
- **transportation of hydrocarbons and hazardous materials** has the potential to result in discharges due to accidents or inappropriate handling and storage
- **operation of processing and other facilities** has the potential to result in discharges due to faulty equipment or inappropriate handling and storage.

#### 3.11.3 Performance management

The following objectives and targets relate to management of hydrocarbons and hazardous materials (Table 40).

Table 40 Hydrocarbons and hazardous materials management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To prevent contamination of the surrounding environment from release of hydrocarbons and hazardous materials.	No major environmental incidents relating to hydrocarbons and hazardous materials.	Number and severity of environmental incidents relating to hydrocarbons and hazardous materials.

#### 3.11.4 Implementation strategy

Management actions for meeting objectives regarding hydrocarbons and hazardous materials are listed in Table 41.

Table 41 Hydrocarbons and hazardous materials management actions

Parameter	Action	Timing
Hazardous material identification	A procedure will be developed and implemented to ensure that no hazardous materials are brought to site unless subject to risk assessment and approval by an authorised person. Documentation of this authorisation process shall be maintained for auditing purposes.	Throughout the duration of construction and mining operations
	Personnel authorised to approve hazardous materials being used on the Project must undergo relevant Project training.	Throughout the duration of construction and mining operations
Storage and containment	All hydrocarbons and hazardous materials will be stored in areas where there is no potential for runoff to reach watercourses or undisturbed areas.	Throughout the duration of construction and mining operations
	Hydrocarbon and hazardous material storage will be designed/constructed to protect storage and containment areas from stormwater ingress.	Throughout the duration of construction and mining operations
	All hydrocarbon and hazardous material storage areas will display relevant signage (e.g. dangerous classification) and basic hazard information (e.g. flammability, corrosiveness).	Throughout the duration of construction and mining operations
	All storage vessels will be tested and labelled as required by legislation.	Throughout the duration of construction and mining operations
	Incompatible materials will be physically isolated when stored.	Throughout the duration of construction and mining operations
	Large quantities of chemicals and hydrocarbons will be stored to meet the requirements of AS 1940:2004 - The Storage and Handling of Flammable and Combustible Liquids, including the following: <ul style="list-style-type: none"> <li>chemicals and hydrocarbons will be located in bunded compounds so at least 100% of the capacity of the largest tank plus at least 10% of the second largest tank is contained</li> <li>chemicals stored in drums will be bunded to contain at least 25% of the maximum stored quantity of chemicals</li> <li>areas will be designated to store hazardous materials, and any runoff will be designed to control flow away from those areas</li> <li>waste chemicals and hydrocarbons will be stored in appropriate compounds prior to removal from site for recycling by approved contractors.</li> </ul>	Throughout the duration of construction and mining operations
	All minor storage (<500 litres) will be secondarily contained in bunded areas or chemical storage cabinets.	Throughout the duration of construction and mining operations
	Bulk liquid transfer points will be fully bunded.	Throughout the duration of construction and mining operations
	Unless authorised, all storage tanks and any associated pipelines will be located above ground.	Throughout the duration of construction and mining operations

Parameter	Action	Timing
	All hydrocarbon and hazardous materials transfer infrastructure (including pipelines) will be appropriately labelled, signposted or otherwise and will be fitted with protection from accidental damage/dislodgement by mobile plant/vehicles (e.g. earthen windrows, bollards).	Throughout the duration of construction and mining operations
Refuelling	Refuelling will not be allowed within 200 m of any watercourse.	Throughout the duration of construction and mining operations
	Refuelling vehicles will be equipped with the following to enable quick response to spillages: <ul style="list-style-type: none"> <li>• spill kits</li> <li>• spill tray(s) or absorbent material</li> <li>• shovel</li> <li>• containers for temporary storage and transport of contaminated soil.</li> </ul>	Throughout the duration of construction and mining operations
	Spill kits will be provided as follows: <ul style="list-style-type: none"> <li>• all bulk fuel storages will have spill kits immediately available</li> <li>• all refuelling vehicles will carry spill kits</li> <li>• all vehicles fitted with hydraulic hoses will have immediate access to spill kits</li> <li>• all crews handling hazardous chemicals will have immediate access to spill kits</li> <li>• all supervisors' vehicles will carry spill kits.</li> </ul>	Throughout the duration of construction and mining operations
	All bulk fuel tanks and mobile refuelling vehicles will be fitted with auto-shut-off valves or other appropriate devices to prevent overfilling.	Throughout the duration of construction and mining operations
	All plant, vehicles and equipment will be adequately maintained.	Throughout the duration of construction and mining operations
Plant maintenance	Plant, vehicle and equipment maintenance and servicing will occur within designated areas located at least 200 m from any watercourse.	Throughout the duration of construction and mining operations
	All plant, vehicles and equipment shall undergo regular servicing (at a minimum in accordance with manufacturer's recommendations) to reduce the likelihood of equipment failure, spills or leaks.	Throughout the duration of construction and mining operations
MSDS and records	Material Safety Data Sheets (MSDS) will be kept in a register at the site office along with a copy located near the chemical storage facility. Records will be kept on existing inventory, storage location, personnel training and disposal of waste for any hazardous materials used on-site.	Throughout the duration of construction and mining operations

Parameter	Action	Timing
	A Hazardous Materials Register to record each material received and stored on-site will be prepared and maintained with details including: <ul style="list-style-type: none"> <li>• name of material</li> <li>• description</li> <li>• standards and procedures for storage and use</li> <li>• regulations and standards</li> <li>• MSDS</li> <li>• volumes received</li> <li>• volumes dispensed.</li> </ul> The register will be located on-site and made accessible to all relevant personnel.	Throughout the duration of construction and mining operations
	The Hazardous Materials Register will be reconciled weekly and where any discrepancy indicates that leakage or loss may be occurring, it shall be reported immediately.	Throughout the duration of construction and mining operations
	Maintenance (including testing) logs and inspection records will be kept with all relevant vehicles, plant or equipment and made available on request.	Throughout the duration of construction and mining operations
Spill preparedness and response	All relevant personnel will be trained in appropriate handling and spill clean-up requirements.	Throughout the duration of construction and mining operations
	Containment of any spillages or leakage will be a priority, and spills will be cleaned up immediately.	Throughout the duration of construction and mining operations
	An Emergency Response Plan will be prepared and implemented to enable a rapid response in the event of a significant spill or loss of potentially contaminating material.	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Prior to engagement on site, all staff will be inducted on hydrocarbons and hazardous materials management, including: <ul style="list-style-type: none"> <li>• the impact of incorrect use, handling or storage of hydrocarbons and hazardous materials</li> <li>• hydrocarbons and hazardous materials management procedures.</li> </ul>	Throughout the duration of construction and mining operations
	Updated information regarding hydrocarbons and hazardous materials management will be provided to personnel during mine operations by way of: <ul style="list-style-type: none"> <li>• toolbox meetings</li> <li>• site HSE meetings</li> <li>• training and awareness sessions.</li> </ul>	Throughout the duration of construction and mining operations

### 3.11.5 Monitoring program

The monitoring program for hydrocarbons and hazardous materials (Table 42) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 42 Hydrocarbons and hazardous materials monitoring actions

Location	Frequency	Parameters	Procedure	Purpose
All relevant Project areas.	Weekly.	Storage, containment and refuelling.	Visual inspections.	To ensure compliance with required control measures and identify any spills or leaks.
On-site Hazardous Materials Register.	Fortnightly.	Hazardous Materials Register.	Review.	To assess the adequacy of information being recorded and to detect unaccounted loss.

### 3.11.6 Contingencies

Table 43 identifies actions that are to be undertaken in the event of a breach in target or objective.

Table 43 Hydrocarbons and hazardous materials contingency actions

Trigger	Action
Hazardous material spill	<ol style="list-style-type: none"> <li>1. Identify type and characteristics of hazardous material (hydrocarbon, chemical etc.).</li> <li>2. Comply with safety and environmental recommendations within the relevant MSDS.</li> <li>3. Identify potential sources of spill.</li> <li>4. Respond to spills using the following response priorities: <ul style="list-style-type: none"> <li>• Control – find the source of the discharge and prevent further discharges.</li> <li>• Contain – Use spill kits and other response capabilities to contain the spill and prevent further spread. Priority should be given to preventing spill from entering sensitive areas such as surface waters.</li> <li>• Clean up - Use spill kits and other response capabilities to remove the spilt material from the affected area and clean up the site. Priority should be given to sensitive areas such as surface waters.</li> </ul> </li> <li>5. Inspect on-site containment measures and repair, redesign or replace facilities if required.</li> <li>6. Perform visual inspection to confirm the success of contingency measures.</li> <li>7. Review and revise procedures as appropriate.</li> <li>8. Advise all staff of procedure revision and requirements.</li> </ol>
Review of Incident Register identifies adverse frequencies or trends associated with spills of hazardous materials.	<ol style="list-style-type: none"> <li>1. Investigate issue to determine potential causes.</li> <li>2. Review and revise procedures as appropriate.</li> <li>3. Advise all staff of procedure revision and requirements.</li> </ol>

### 3.12 Fire management plan

#### 3.12.1 Description

Wildfires or bushfires have the potential to cause major damage to the environment, threaten lives and property and destroy grazing area. Therefore, it is important that the outbreak of fires caused by operations is prevented and that any fires are controlled.

#### 3.12.2 Environmental aspects to be managed

The following aspects have been identified as requiring management to minimise fire risk are:

- **storage and use of flammable material** may increase the potential risk of fire outbreak
- **onsite machinery** may increase the risk of fire through the use of fuels and by providing ignition sources
- **repair and maintenance** of vehicle, plant and equipment may pose a fire risk.

This Fire Management Plan is supported by Tiwest's Northern Operations Hot Work Procedure, NO0008 (Tiwest 2010c). As a part of this procedure, all 'hot works' being undertaken at Tiwest sites require approval through the use of a hot work permit. This permit requires precautions against fire to be taken dependant on the level of risk, including PPE, signage, fire fighting equipment, fire watchers, and isolation of associated equipment.

#### 3.12.3 Performance management

The following objectives and targets relate to fire management (Table 44).

Table 44 Fire management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To prevent the outbreak of fires caused by the operation.	There are no accidental fires caused by the operation.	Absence of fire
To ensure that any fires from the operation or bushfires are contained and controlled so that any damage to the environment and to existing facilities or property is minimised.	There is no damage resulting from fires caused by the operation.	No fire-related damage to vegetation, property or infrastructure
	There is no impact on the operation from bushfires	Incident report

#### 3.12.4 Implementation strategy

Management actions for meeting site objectives regarding fire are listed in Table 45.



Table 45 Fire management actions

Parameter	Action	Timing
Open fires	Open ground fires are banned, except for purpose of fire training.	Throughout the duration of construction and mining operations
Burning of rubbish	The burning of rubbish anywhere on site is banned.	Throughout the duration of construction and mining operations
Hot work	Hot work (work with a high risk of fire, use of electrical tools, etc) will only be undertaken following the granting of a hot work permit. The permit will include measure for fire prevention, and the requirement for a fire spotter during high risk works.	Throughout the duration of construction and mining operations
Fire fighting equipment	Appropriate fire fighting equipment is available to control localised bushfires under coordinated supervision.	Throughout the duration of construction and mining operations
	Fire fighting equipment will be maintained to comply with relevant fire safety standards.	Throughout the duration of construction and mining operations
	Subset of mine-site personnel trained in fire suppression to FESA standards.	Throughout the duration of construction and mining operations
Firebreaks	Firebreaks have been established around key facilities and will be maintained annually.	Throughout the duration of construction and mining operations
Fire risk assessments	Visual assessments for identifying potential fire risks are made at periodic intervals as part of safety audits.	Throughout the duration of construction and mining operations
	Inclusion of a bushfire response plan in site emergency procedures.	Throughout the duration of construction and mining operations
Induction and Communication with personnel	Prior to engagement on site, all staff will be inducted on fire risks and management, including: <ul style="list-style-type: none"> <li>• Emergency Procedures</li> <li>• prohibition of fire on-site</li> </ul>	Throughout the duration of construction and mining operations

### 3.12.5 Monitoring program

The following management actions (Table 46) will be undertaken to ensure firebreaks and access are open and that ignitions sources are managed appropriately.

Table 46 Fire monitoring actions

Location	Frequency	Parameters	Procedure	Purpose
Firebreaks and access	Quarterly. Not necessary during winter rainfall periods.	Condition of the fire breaks.	Visual assessment	To ensure that the firebreaks around structures are maintained to required standards.
Ignitions sources	Monthly	Hydrocarbon storage areas and other ignition sources (e.g. machinery).	Visual assessment of area and sources, as well as regular updating of a hydrocarbon register	To identify potential onsite fire risks.

### 3.12.6 Contingencies

Table 47 identifies actions that are to be undertaken in the event of a breach in target or objective.

Table 47 Fire contingency actions

Trigger	Action
Fire incident.	<ol style="list-style-type: none"> <li>1. Respond to fire in accordance with fire response procedures.</li> <li>2. Investigate cause of the fire.</li> <li>3. If fire was a result of mining operations, confirm operations are being undertaken in accordance with the fire management actions.</li> <li>4. If operations are found to differ from the fire management actions, make necessary changes to operations.</li> <li>5. If operations are being undertaken in accordance with the fire management actions, investigate and implement preventative measures to reduce future fire risk.</li> <li>6. An Environmental Incident Report will be completed.</li> </ol>
Unauthorised burning onsite.	<ol style="list-style-type: none"> <li>1. Immediately extinguish fire.</li> <li>2. Investigate to identify responsible person(s).</li> <li>3. Reinforce person(s) of the onsite fire prohibitions.</li> <li>4. Reinforce all onsite personnel of the onsite fire prohibitions via internal communications procedures</li> </ol>

## 4. Acronyms, abbreviations and definitions

Actual Footprint - the current conceptual layout and design (completely contained within the Disturbance Boundary)

AER – Annual Environmental Review

ALARA - As Low As Reasonably Achievable

ANZECC – Australian and New Zealand Environment Conservation Council

ARPANSA – Australian Radiation Protection and Nuclear Safety Agency

ASS – Acid Sulfate Soils

CFC – Chlorofluorocarbons

CFx – Perfluorocarbons

CH<sub>4</sub> – Methane

CO – Carbon Monoxide

CO<sub>2</sub> – Carbon Dioxide

DAFWA - Department of Agriculture and Food Western Australia

DEC – Department of Environment and Conservation

DEP – Department of Environmental Protection

Disturbance Boundary – refers to the area within which clearing may be undertaken

DMP - Department of Mines and Petroleum

DoH – Department of Health

DoW – Department of Water

EMP – Environmental Management Plan

EMS – Environmental Management System

EPA – Environmental Protection Authority

EPBC – Environment Protection and Biodiversity Conservation

ESD – Environmental Scoping Document

FESA – Fire and Emergency Services Authority

HFC – Hydrofluorocarbons

HMC – Heavy Metal Concentrate

H<sub>2</sub>O – Water

HSE – Health, Safety and Environment

Impact Area – includes the Disturbance Boundary and the predicted area of subject to measureable change in vegetation condition from groundwater drawdown

LNG – Liquefied Natural Gas

LPG – Liquefied Petroleum Gas

NEPC – National Environmental Protection Council

NEPM – National Environment Protection Measure

NMVOC - Non-methane Volatile Organic Compounds

NO<sub>x</sub> – Nitrogen Oxides

NORM – Naturally Occurring Radioactive Material

O<sub>3</sub> – Ozone

PEC – Priority Ecological Community

PER – Public Environmental Review

PJ - Petajoule

POS - Peroxide Oxidisable Sulfur

POW – Program of Works

Proposal Area – refers to the area within the tenement boundary for the Dongara Project

SEWPaC - Department of Sustainability, Environment, Water, Population and Communities

SF - Sulphur Hexafluoride

SHE – Safety, Health and Environment

SHEHR – Safety, Health, Environment and Human Resources

SO<sub>2</sub> – Sulphur Dioxide

SPOCAS - Suspension Peroxide Oxidation Combined Acidity and Sulfur

SRE – Short Range Endemic

TLD - Thermoluminescent dosimeter

Trigger – a measureable outcome identified in the EMP that requires contingency measure/s to be implemented.

WWTP – Waste Water Treatment Plant

XRF - X-Ray Fluorescence

## 5. References

- Department of Agriculture and Food Western Australia (DAFWA) 2011, *Declared Plants List*, declarations made under sections 35 and 36 of the *Agriculture and Related Resources Protection Act 1976*, Australian Government, Perth, January 2011.
- Department of Environment and Conservation 2009, *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes*, Government of Western Australia, Acid Sulfate Soils Guidelines Series, May 2009.
- Department of Environment, Water, Heritage and the Arts 2009, *Notification of Referral Decision and Designated Proponent-Controlled Action*, Government of Western Australia, November 2009.
- Department of Mines and Petroleum 2010. *Managing Naturally Occurring Radioactive Material (NORM) in Mining and Mineral Processing Guidelines*. Resources Safety, Department of Mines and Petroleum, Western Australia. 2010.
- Department of Mines and Petroleum 2011. *Guidelines for Preparing Mine Closure Plans*. Department of Mines and Petroleum, Western Australia. June 2011
- Environmental Protection Authority 2006, *Guidance for the Assessment of Environmental Factors No. 6 – Rehabilitation of Terrestrial Ecosystems*, Environmental Protection Authority, Western Australia, January 2006.
- Geoprocc Pty Ltd 2010. *Assessment of Acid Sulfate Soil in the Tiwest Dongara Project Area*, report prepared for Tiwest, August 2010.
- Endemic 2011. *Wetland Mapping and Management, Mt Adams Road, Dongara*, report prepared for Tiwest, 2011.
- Hydrosearch Pty Ltd 2011, *Hydrogeological Appraisal of the Proposed Titanium Minerals Project near Dongara, Western Australia*, report prepared for Tiwest Pty Ltd, November 2011.
- Metcalf, B & Bamford, M (trading as M.J & A.R Bamford Consulting Ecologists) 2011, *Fauna Assessment of the Mt Adams Road Project*, report prepared for Tiwest Pty Ltd, July 2011
- Rockwater Pty Ltd 2011, *Dongara Mineral Sands Project: Subterranean Fauna Sampling Programme*, report prepared for Tiwest Pty Ltd, June 2011.
- Sinclair Knight Merz 2001, *Environmental Water Requirements of Groundwater Dependent Ecosystems*, Environmental Flows Initiative Technical Report Number 2, report prepared for Department of Environment and Heritage, Canberra, Australian Capital Territory.
- Tiwest 2010a, *Corporate Safety, Health and Environment (SHE) Management Standards*, Tiwest Pty Ltd, 2010.
- Tiwest 2010b, *Radiation Management Plan, Tiwest Joint Venture Northern Operations*, Tiwest Pty Ltd, January 2010.

---

Tiwest 2010c, *Hot Work Procedure (NO0008)*. Tiwest Pty Ltd, reviewed internally, September 2010.

Tiwest 2011a, *Corporate Environmental Performance Standards*, Tiwest Pty Ltd, reviewed internally, March 2011.

Tiwest 2011b, *Wellfield Operating Strategy for the Dongara Mineral Sands Project*, Tiwest Pty Ltd, April 2011.

Tiwest 2011c; *Exploration Environmental Management Plan Dongara Project (NO0037)*, Tiwest Pty Ltd, May 2011.

Woodman Environmental Consulting (Woodman) 2009, *Dongara Tenements: Flora and Vegetation Studies Regional FCT Analysis*, report prepared for Tiwest Pty Ltd, October 2009

Woodman Environmental Consulting (Woodman) 2010, *Dongara Mineral Sands Project: Flora and Vegetation Impact Assessment*, report prepared for Tiwest Pty Ltd, October 2010.