DRAFT ENVIRONMENTAL MANAGEMENT PLAN

Central West Coal Project

Prepared for

Central West Coal Pty Ltd

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1.1 Background

This Draft Environmental Management Plan (EMP) has been developed in support of, and is appended to, the Public Environmental Review (PER). It will be finalised following Ministerial approval of the Central West Coal Project (the Project), with consideration of comments made in public submissions on the PER.

1.2 Objective of this EMP

The purpose of this EMP is to provide measures proposed by CWC to mitigate or manage potential impacts to the environmental values in the project area during construction and operation of the Project. This draft EMP has been structured in accordance with the 2003 Guidelines for the Preparation of Environmental Management Plans prepared by the Environmental Audit Section of the Department of Environment and Conservation (DEC), and was developed to address the key environmental impacts identified during the environmental risk assessment process undertaken during preparation of the PER. In addition, stakeholder input has been considered during preparation of this document. In consultation with the Environmental Protection Authority Service Unit (EPASU), the key environmental aspects to be addressed in this EMP were identified as:

- water;
- flora and vegetation;
- terrestrial fauna;
- subterranean fauna;
- acid mine drainage (AMD);
- dust;
- greenhouse gas emissions;
- noise.
- aboriginal heritage

Rehabilitation, including management of dispersive soils, is addressed in a separate Draft Progressive Rehabilitation Plan.

Mine closure is addressed in a separate Preliminary Mine Closure Plan.

1.3 Structure of this EMP

Section 1 of this EMP provides the context and reason for the EMP, outlines the structure of the EMP and lists the relevant environmental legislation, regulations and codes of practice.

Section 2 of this document provides information on the Project, the Proponent and responsibilities for environmental management roles, and the environmental and social setting of the Project.

Sections 3 to 10 provide the management plans for each of the key environmental factors relevant to the Project (i.e. water, flora and vegetation, terrestrial fauna, subterranean fauna, ARD, dust, greenhouse gas emissions and noise).

Section 1 Introduction

Each management plan addresses the following:

- Current status – this provides a brief statement on the nature of the receiving environment relevant to the issues being managed.
- Potential impacts – this outlines the potential impacts associated with the Project.
- Environmental objectives – this identifies the desired environmental outcomes.
- Performance indicators – this lists the criteria applicable to monitoring the environmental performance of the Project. Where appropriate, trigger and limit criteria have been defined.
- Management actions – this outlines the management measures that will be applied to the construction and operation of the Project, and defines who is responsible for implementing the management measures.
- Monitoring – this describes the parameters to be monitored, the location and frequency of monitoring, and other relevant information.
- Contingency actions – this outlines the actions that may be implemented in the event that the monitoring data indicate that environmental objectives may not be fulfilled, or complaints are received.

Information on stakeholder consultation, auditing, review and revision, and reporting are provided in **Sections 12 to 15**. The key environmental management actions are summarised in Section 15.

A Preliminary Closure Plan has also been developed to address the final rehabilitation and closure of the Project. This is provided as a separate document (URS, 2008).

This EMP should be considered a living document. As best practice for environmental management evolves, this plan will be reviewed and updated in light of new management techniques and strategies.

1.4 Relevant Legislation and Standards

The following Commonwealth Acts are relevant to the environmental management of this Project:

- *Australian Heritage Council Act 2003*;
- *Commonwealth Native Title Act 1993*;
- *Energy Efficiency Opportunities Act 2006*;
- *Environment Protection and Biodiversity Conservation Act 1999*; and
- *National Greenhouse and Energy Reporting Act 2007.*

A number of WA State Acts are relevant to this Project, including:

- *Aboriginal Heritage Act 1972*;
- *Agriculture and Related Resources Protection Act 1976*;
- *Bush Fires Act 1954*;
- *Conservation and Land Management Act 1984*;
- *Contaminated Sites Act 2003*;

- *Dangerous Goods Safety Act 2004*;
- *Dangerous Goods (Transport) Act 1998*;
- *Environmental Protection Act 1986*;
- *Explosives and Dangerous Goods Act 1961*;
- *Health Act 1911*;
- *Heritage of Western Australia Act 1990*;
- *Land Administration (Amendments) Act 1997*;
- *Local Government Act 1995*;
- *Rights in Water and Irrigation Act 1914*;
- *Main Roads Act 1930*;
- *Mines Safety and Inspection Act 1994*;
- *Mining Act 1978*;
- *Occupational Safety and Health Act 1984*;
- *Planning and Development Act 2005*;
- *Pollution of Waters by Oil and Noxious Substances Act 1987*;
- *Port Authorities Act 1999*;
- *Wildlife Conservation Act 1950*;
- *Waterways Conservation Act 1976*; and
- *Water and Rivers Commission Act 1995*.

The following WA guidelines are relevant to the Project:

- Mine Closure Guideline for Mineral Operations in Western Australia (Chamber of Minerals and Energy WA Inc., 2000).
- Water Quality Protection Guidelines No. 10 - Mining and Mineral Processing, Above-ground Fuel and Chemical Storage (DEC, 2000).
- Review of Waste Classification and Waste Definitions 1996 (as amended) (DEC, 2005).
- Contaminated Sites Management Series Bioremediation of Hydrocarbon-Contaminated Soils in Western Australia (DEC, 2004).
- Mining in Arid Environments, Mining Environmental Management Guidelines (DMP, 2006a).

The following Environmental Protection Authority (EPA) Position Statements apply to the Project:

- No. 2 - Environmental Protection of Native Vegetation in Western Australia (2000).

- No. 3 - Terrestrial Biological Surveys as an Element of Biodiversity Protection in Western Australia (2002).
- No. 6 – Towards Sustainability (2004).
- No. 7 – Principles of Environmental Protection (2004).
- No. 9 – Environmental Offsets (2006).

The following EPA Guidance Statements apply to the Project:

- No. 12 – Minimising Greenhouse Gases (2002).
- No. 18 − Prevention of Air Quality Impacts from Land Development Sites (2000).
- No. 41 – Assessment of Aboriginal Heritage (2004).
- No. 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment (2004).
- No. 54 – Sampling of Subterranean Fauna in Groundwater and Caves (2003).
- No. 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment (2004).

Other Guidance is provided by:

- EPA Interim Industry Consultation Guide to Community Consultation (2003).
- DEC Western Australian State Greenhouse Strategy - WA Greenhouse Task Force (2004).
- Mine Closure and Completion (Department of Resources, Energy and Tourism, 2006a).
- Mine Rehabilitation (Department of Resources, Energy and Tourism, 2006b).
- Managing Acid and Metalliferous Drainage Handbook (Department of Resources, Energy and Tourism, 2007).
- National Environmental Protection Measure (NEPM) for Ambient Air Quality (2003).

The following National and International standards are relevant to the Project:

- Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia (2000) Strategic Framework for Mine Closure.
- Control of Major Hazard Facilities – National Standard and Code of Practice (National Occupational Health and Safety Commission [NOHSC] 2002).
- Standards Australia AS/NZS 4801 (2001): Occupational Health and Safety Management Systems.
- United Nations Framework Convention on Climate Change (1992).

2.1 The Proponent

Central West Coal Pty Ltd, a wholly owned subsidiary of Aviva Corporation Ltd (Aviva), is the proponent for the Project.

Proponent Details:

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The contact person for this Project is Robert Griffiths, Environmental Manager, Aviva.

Aviva is a Perth-based integrated energy company and is listed on the Australian Stock Exchange. Aviva also has an international presence and is listed on the Botswana Stock Exchange. The company has a portfolio of energy assets, including the Central West Coal Project (and associated Coolimba Power Project) in WA and the Mmamantswe Project in Botswana.

2.2 The Project

Central West Coal Pty Ltd (CWC) proposes to develop the Project located approximately 15 km south-west of Eneabba, in the Mid West region of Western Australia (WA) based on the mining of the Central West Coal Deposit as an energy source for the adjacent proposed Coolimba Power Station. The resource comprises a 75 million tonne (Mt) sub-bituminous coal deposit approximately 12 km long and ranging from 0.3-2.0 km wide. The Project footprint will be approximately 1,700ha. Approximately 860ha will require clearing of native vegetation.

The Project is being assessed under Part IV of the WA *Environmental Protection Act 1986* and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A bilateral agreement between the Commonwealth and WA governments accredits the State Environmental Impact Assessment (EIA) process. This means that a single assessment process will be carried out that satisfies the State and Commonwealth requirements.

The main components of the proposed Project comprise:

- Open cut mine;
- Waste dump;
- Mine backfill with co-disposal of coal combustion ash and saline residue;
- Stockpile management corridor (SMC);
- Run-of-Mine (ROM) pad;
- Coal handling plant and coal stockpiles;
- Access roads;

Section 2 Project Overview

- Raw water storage dam
- Dewatering bores and associated pipelines;
- Laydown areas;
- Workshop;
- Stores
- Fuel storage;
- Borrow pits;
- Landfill; and
- Administration offices.

Mining will occur progressively and will comprise an open-cut mine to extract approximately 2 to 2.5 million tonnes per annum (Mtpa) of sub-bituminous coal. Based on the current estimate of reserves, the anticipated life of the mine is 30 years.

The mine will progress along the orebody, with a disturbed open area of approximately 120 ha at any one time. A continuous backfill and progressive rehabilitation programme will also be implemented. Overburden will be transported to the waste dump to be used to backfill the pit. The coal will be trucked to the ROM area, crushed, screened and stockpiled ready to be conveyed to the power station.

This Project is related to the Coolimba Power Project proposed by Coolimba Power Pty Ltd (a wholly owned subsidiary of Aviva), but will undergo a separate EIA. Coolimba Power Pty Ltd proposes to construct a 450 megawatt (MW) coal fired power station. The Power Station will also provide up to 358 MW of peak load capacity from gas-fired turbines. Electricity generated from the gas-fired turbines will provide energy during periods of peak demand on the grid, and to backup the coal-fired generators during outages.

The key characteristics of the Project are presented in Table 2-1.

Table 2-1 Key Characteristics of the Central West Coal Project

Element	Description
Life of Operations (excluding construction and closure activities)	Approximately 30 years
Size of the Ore Body	75 million tonne resource
Mining Method	Open cut mining
Rate of Mining	2 to 2.5 million tonnes per annum (Mtpa)
Waste to Ore Strip Ratio	7:1 (7 bank cubic metres [bcm] waste to 1 tonne [t] coal)
Waste Dump	Approximately 40 million cubic metres (Mm^3)
Estimated Footprint of Disturbance	Approximately 1,700 ha (860 ha of native vegetation and 840 ha of cleared farmland)
Estimated Volume of Overburden	Approximately 516 Mm^3
Water Supply and Mine Dewater	Up to 2 megalitres per day (Ml/d) for dust suppression, and up to 25 Ml/d for power station cooling
Workforce	Construction – 100 people Operations – 50 people

2.3 Environmental and Social Setting

The proposed Central West Coal and the Coolimba Power Projects will be located in the Mid West Region of WA, 15 km south east of the Eneabba townsite, approximately 278 km north of Perth.

2.3.1 The Project

The CWC Project will be developed for the sole purpose of supplying coal as the primary fuel for the coal-fired power generating units of the Coolimba Power Station. The power station has been proposed for development by Coolimba Power Pty Ltd as it assists in alleviating a number of issues facing the South West Interconnected System (SWIS), which is the major interconnected electricity network supplying power to southern WA.

2.3.2 Climate

The area experiences a Mediterranean climate of hot, dry summers and mild winters.

Regular weather observations are available for Eneabba, 15 km north of the project area (BoM, 2008b).

Mean maximum monthly temperatures range from 19.6˚C (July) to 36.1˚C (February). Mean minimum monthly temperatures range from 9.0˚C (August) to 19.5˚C (February).

Mean annual rainfall is 504mm over 60.5 rain days. The highest and lowest mean monthly rainfall of 104mm and 7mm occurs in June and January respectively. Annual evaporation is approximately 2400mm.

2.3.3 Geology, Soils and Landforms

The Central West Coal Deposit occurs within the Jurassic Cattamarra Coal Measures, which form part of a sedimentary sequence associated with the Dandaragan Trough, a major fault bounded subdivision in the deepest part of the Perth Basin. Three main coal horizons have been identified within the project area.

The deposit contains Measured and Indicated resources for the Eneabba Main Seam (EMS) of 75.4 Mt to a depth of 130 m, of which 42.4 Mt is Measured Resources with the potential to be extracted by open cut methods. A further 11.3 Mt of Inferred Resources has also been estimated to be present in the EMS to a depth of 130 m. Inferred Resources of approximately 2.5 Mt to a depth of 130 m occurs in the Eighty seam (McElroy Bryan Geological Services Pty Ltd, 2007).

From these resources a mineable reserve has been calculated to be approximately 72 Mt, of which approximately 44.5 Mt is classified as Proven Reserve and approximately 27.5 Mt has been classified as Probable Reserve (Minserve, 2006). Heavy minerals are known to exist in and near the project area. The rights to any heavy mineral resources in the project area are held by Iluka Resources Ltd and associated companies (Iluka).

The project area lies within the Eneabba Plain, a subdivision of the northern Swan Coastal Plain which stretches east up to 25 km from the coast to the base of the Gingin Escarpment which links the plain to more elevated inland areas to the east.

The Eneabba Plain is generally flat, and includes areas of low undulations and small isolated rises often associated with ferricrete. The broad undulations arise from erosion by the numerous ephemeral drainages that have gradually cut very broad shallow valleys into the landscape.

The Gingin Scarp is characterised by a westerly facing slope of a generally uniform gradient rising from around 80 m AHD to 290 m over 10 km. It is the source area of a number of drainage systems that discharge onto and through the project area. The drainage systems present today are relicts of a larger palaeo drainage system that operated during much wetter periods, probably during the Pleistocene. These systems were modified by the onset of aridity, which resulted in an increase in sediment loads, and reduced periodicity of discharge events.

The soils present in the project area are the result of a complex geomorphic prehistory, and have been strongly influenced by erosion of laterites on the Gingin and Dandaragan Scarps and their subsequent deposition on the coastal plain in outwash fans and extensive channel deposits. These materials have then been buried by fluvial and aeolian sands. Ferricretes form a major component of the project area, occurring as both exhumed and buried masses.

Topsoils within the project area are generally chemically and physically infertile. Nitrogen is deficient, and phosphorus and potassium levels are low. Organic carbon levels are low (<1%) at six sites, and moderate (1-2%) at four sites. The pH of soils across the project area ranges from 6 (slightly acid) to 8.5 (strongly alkaline).

2.3.4 Surface Water

The project area and surrounding areas are drained by the ephemeral Bindoon Creek, Erindoon Creek and an un-named creek. These drainages flow to the north and west and discharge into Lake Indoon.

Lake Indoon, and the nearby Lake Logue, lie to the northwest of the project area and form part of a north-south chain of wetlands perched on aoelian sands (ATA Environmental, 2001). The Lake Logue-Indoon System is listed on the Directory of Important Wetlands in Australia.

Lake Logue is a large seasonal freshwater lake and lies within the Lake Logue Nature Reserve. Lake Indoon is a permanent brackish lake within a recreation reserve.

Due to high soil infiltration rates, most rainfall infiltrates into the ground. Surface water runoff is only generated during high intensity rainfall events. Little data is available on water quality of the catchment; however, surveys indicate that the water quality in Lake Indoon is within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) for wetlands.

Two distinct landforms have been identified within the Lake Indoon catchment. Land in the west or upstream portion of the catchment is steeper, mostly cleared pastures and rocky outcrops, which is likely to produce larger volumes of surface runoff from significant rainfall events.

A number of tributaries of Erindoon Creek will be temporarily intersected by the mine until backfilling and rehabilitation restores them, and another small tributary obstructed by the waste rock dump will be permanently diverted to Bindoon Creek. A more detailed description of surface water can be found in (URS, 2009a)

2.3.5 Groundwater

In the project area, the hydrology is characterised by three deep aquifers; the Yarragadee Formation aquifer, the Cattamarra Coal Measures aquifer and the Eneabba Formation aquifer. These are overlain by a thin superficial aquifer. With hot dry summers, no permanently running streams, and an annual average rainfall of around 500 mm, groundwater is important to domestic, agricultural and mining activities in the locality and in the wider region, particularly the superficial aquifer, and the Yarragadee Formation aquifer.

De-watering of the coal mine will mainly affect groundwater in Cattamarra Coal Measures aquifer in the eastern part of a fault block, between the Warradarge Fault to the east and the Peron Fault to the west. The faults strike

north to north-west, with upward vertical displacement to the west. The superficial aquifer is interpreted to be in hydraulic connection with the Cattamarra Coal Measures aquifer, and will also be affected by mine de-watering.

Groundwater levels in the project area vary from around 65 m AHD in the south to 50 m AHD in the north and depth to groundwater varies from a maximum of around 20 m in the south to 0 m in the north.

Localised perched groundwater is also known to occur, particularly in winter months within or overlying low-permeability layers, such as the clays beneath laterite.(Rockwater, 2009)

The salinity of the Cattamarra Coal Measures groundwater in the vicinity of the project area ranges from 1,000 mg/L to 3,500 mg/L. The salinity of groundwater in the superficial aquifer is more variable, ranging from about 200 mg/L to 7,000 mg/L. The Yarragadee Formation aquifer has a lower salinity ranging from 300 mg/L to 700mg/L TDS (Rockwater, 2009).

There are a number of Groundwater Dependent Ecosystems (GDE) listed by DoW near the project area. These include Lake Indoon north-west of the project area, Erindoon Creek north-west of the project area, and a Threatened Ecological Community (TEC No 72) at Rocky Spring 1.5 km east of the project area. Vegetation generally, in and near the project area, may also be dependent on groundwater (Mattiske, 2009), probably perched water or vadose water (Blandford, 2008).

Domestic and stockwater is obtained from groundwater sources in and near to the project area from presumably the superficial formation aquifer. The neighbouring mineral sand mine also draws large volumes of groundwater from the Yarragadee Formation aquifer,

2.3.6 Vegetation

The vegetation of the project area includes kwongan vegetation which exists extensively in this part of the Mid West region. Kwongan vegetation is characterised by low level (1.3 m) hardy evergreen vegetation. Stands of taller eucalypt species are located sporadically across the landscape. About 40% of the project area has been cleared for farming or mining. Some remnant vegetation has been retained in low-lying areas.

Within the native vegetation remaining within the project area, 14 plant communities were recorded (Mattiske, 2009).

The following 14 plant communities were recorded in the project area, with the remaining areas consisting mainly of cleared paddocks, with localised remnant trees:

- **H1** - Mixed heath of *Melaleuca leuropoma* with emergent *Banksia* species with occasional *Eucalyptus todtiana* and *Actinostrobus arenarius* on sand with exposed lateritic rises.
- **H2** - Heath or low shrubland of *Conospermum triplinervium, Verticordia nitens, Adenanthos cygnorum, Stirlingia latifolia* and *Jacksonia floribunda* on sand.
- **H3** - Heath or scrub of *Melaleuca leuropoma, Banksia sphaerocarpa* var. *sphaerocarpa, Dryandra nivea* subsp. *nivea, Eremaea beaufortioides* var. *lachnosanthe* and *Hibbertia subvaginata* on lateritic rises.
- **H4** - Mixed heath of Proteaceae and Myrtaceae spp. with occasional *Eucalyptus todtiana* on sand.
- **H5** - Mixed heath or shrubland of *Xanthorrhoea drummondii, Allocasuarina humilis* and *Hibbertia* spp. and Proteaceae spp. on lateritic uplands.
- **T1** - Scrub or thicket of *Banksia attenuata, Banksia menziesii over Banksia sphaerocarpa var. sphaerocarpa, Adenanthos cygnorum, Banksia hookeriana* and *Conospermum triplinervium* on sand.

- **T2** - Thicket or scrub of *Acacia blakelyi* over *Melaleuca leuropoma, Banksia sphaerocarpa* var. *sphaerocarpa, Verticordia densiflora* var. *densiflora* on sand.
- **T4** - Thicket or scrub of *Melaleuca rhaphiophylla* and *Melaleuca lanceolata* over sedges and rushes on low-lying sandy loams.
- **E1** - Low woodland of *Eucalyptus todtiana* and *Nuytsia floribunda* over *Adenanthos cygnorum, Eremaea beaufortioides* var. *lachnosanthe, Melaleuca leuropoma, Banksia sphaerocarpa* var. *sphaerocarpa* and *Hibbertia hypericoides* on sand.
- **E4** - Open low woodland of *Eucalyptus todtiana* and *Nuytsia floribunda* over *Banksia menziesii* and *Stirlingia latifolia* on sandy drainage lines.
- **E5** - Open low woodland of *Eucalyptus todtiana, Nuytsia floribunda* over *Banksia menziesii* and *Conospermum triplinervium* on sandy uplands.
- **E6 -** Open low woodland of *Eucalyptus todtiana* and *Nuytsia floribunda* over mixed low shrubs and herbs on sandy lowlands.
- **S1** - Open scrub of *Acacia blakelyi* and *Hakea psilorrhyncha* over *Gahnia trifida, Melaleuca leuropoma, Conostylis aculeata* subsp. *breviflora, *Ursinea anthemoides, *Trifolium campestre* and **Vulpia bromoides* on rehabilitated land.
- **S2** - Open scrub of *Acacia blakelyi* with occasional *Eucalyptus todtiana* over annual grasses and herbs.
- * These are weed species.

One recognised Threatened Ecological Community (TEC) occurs immediately to the east of the project area; Community 72 Ferricrete Floristic Community or the Rocky Springs Ferricrete Community. This TEC is listed as Vulnerable by the DEC (2008c), but is not currently listed under the Commonwealth EPBC Act.

A total of 512 taxa (including subspecies and varieties) from 182 genera and 64 families were recorded within the wider survey area which comprises the proposed coal mine and power station project areas (Mattiske, 2009).

The dominant families are *Proteaceae* (96 taxa), *Myrtaceae* (106 taxa), *Papilionaceae* (51 taxa), *Cyperaceae* (24 taxa) and *Haemodoraceae* (31 taxa).

Twenty six of these taxa are introduced (weed) species, but none of these are declared weeds listed by the Department of Agriculture and Food (2008) pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976*.

A total of 16 Priority Flora species were recorded within the proposed CWC project area as follows.

- *Acacia lasiocarpa* var. *lasiocarpa* Cockleshell Gully variant (E A Griffin 2039) (P2).
- *Calytrix purpurea* (P2).
- *Comesperma rhadinocarpum* (P2).
- *Verticordia argentea* (P2).
- Acacia flabellifolia (P3).
- *Calytrix superba* (P3).
- *Grevillea biformis* subsp. *cymbiformis* (P3).
- *Haemodorum loratum* (P3).

- *Hemiandra* sp. Eneabba (H. Demarz 3687) (P3).
- *Mesomelaena stygia subsp. deflexa (*P3).
- *Schoenus griffinianus* (P3).
- *Verticordia fragrans* (P3).
- *Calytrix eneabbensis* (P4).
- *Stylidium aeonioides* (P4).
- *Georgeantha hexandra* (P4).
- *Verticordia aurea* (P4).

Several species classified as Declared Rare Flora (DRF) (*Eucalyptus crispata*, *Eucalyptus impensa* and *Eucalyptus johnsoniana*) have been recorded previously in the region but none of these species have been recorded within the project area by Mattiske.

A further 6 Priority Flora species, including one DRF. two Priority 3, and three Priority 4, were recorded by Mattiske within the Coolimba Power Station Project area, mainly within the proposed infrastructure corridor, within the South Eneabba Nature Reserve.

2.3.7 Fauna

A total of 11 native mammal species, four introduced mammal species, 31 bird species, 22 reptile species, and three amphibian species were recorded during vertebrate fauna surveys conducted during 2007 and 2008.

Four vertebrate species recorded during the surveys are protected by Commonwealth and/or State legislation. These are:

- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act and as a Schedule 1 species under the *Wildlife Conservation Act 1950*.
- Rainbow Bee-eater (*Merops ornatus*) is listed as Migratory under the EPBC Act.
- Rufous Fieldwren (*Calamanthus campestris montanellus*, western wheatbelt population) is listed as a Priority 4 species on DEC's Declared Threatened and Priority Fauna List.
- The Black-striped Snake (*Neelaps calonotos*) is listed as a Priority 3 species on DEC's Declared Threatened and Priority Fauna List.

A further ten vertebrate species likely to occur in the project area are gazetted under the Department of Environment and Conservation (DEC) Priority Fauna List. These are described in Table 2.2.

Table 2-2 Priority Fauna

Common Name	Scientific Name	Conservation Significance	Description
Australian Bustard	*Ardeotis australis*	DEC Priority 4	Australian Bustards are large nomadic birds that utilise a number of open habitats, including heathlands in the south of WA. There are no recent records of the Australian Bustard from Eneabba; however, there are a number of historical records in the region. It is possible that the species could use the open vegetation, particularly the cleared agricultural land and regenerating heath, within the project area and the adjacent SENR.
White-browed Babbler	*Pomatostomus superciliosus ashbyi* - western wheatbelt subspecies	DEC Priority 4	This species is most often found in thickets of mulga, wattle and acacia as well as uncleared road verges in farmlands, and more than 50% of its former habitat has been cleared for agriculture. The White-browed Babbler has been previously recorded in the region. No suitable habitat was identified within the project area, although vegetation with sufficient structural complexity was observed nearby.
Crested Bellbird	*Oreoica gutturalis*	DEC Priority 4	The Crested Bellbird is listed as a conservation significant species due to the contraction of its current range to less than 50% of its past distribution. Crested Bellbirds have frequently been recorded in the region, and in the Eneabba area occur on open banksia scrubs and heathland. Crested Bellbirds are likely to occur in the few parts of the project area that have adequate trees and shrubs, and are less likely to occur in very open, largely treeless areas and in SENR.
Brush Bronzewing	*Phaps elegans*	DEC Priority 4	Formerly widespread across the south-west of WA, the Brush Bronzewing is now locally extinct across much of this range. This species prefers dense shrublands with significant vertical vegetation structure and access to water, which is not found within the project area. However, records exist of Brush Bronzewings in the nearby Iluka mine site and Southern Beekeepers Reserve.
Hooded Plover	*Charadrius rubricollis*	DEC Priority 4	Hooded Plovers are restricted to coastal areas, estuaries and salt lakes and were recorded at Eneabba in 2006. However, they are not expected to occur within the project area due to a lack of suitable habitat.
Fork-tailed Swift	*Apus pacificus*	EPBC Act Migratory	Fork-tailed Swifts are a migratory species that spends winter in Australia after breeding in Mongolia and China. Fork-tailed Swifts have previously been recorded from the Lesueur area and are attracted to thunderstorms. Due to the aerial lifestyle and migratory nature of this species, it is expected to be an infrequent visitor and would not directly utilise the fauna habitats of the project area.

Table 2.2 (continued)

Common Name	Scientific Name	Conservation Significance	Description
Peregrine Falcon	*Falco peregrinus*	*Wildlife Conservation Act 1950* Schedule 4	The Peregrine Falcon breeds on all continents except Antarctica. Australia is considered one of the strongholds of the species, as numbers have declined in many other parts of the world. Peregrine Falcons commonly prefer cliffs along the coast, rivers, ranges, wooded watercourses and lakes, and will nest primarily on cliff ledges, granite outcrops and in quarries. Peregrine Falcons have been recorded in the region. No potential breeding sites are present in or near the project area but the species may utilise the project area for foraging.
Eastern Great Egret	*Ardea alba*	EPBC Migratory	The Eastern Great Egret are most commonly found in both fresh and saline shallow waters neither of which are found in the project area. This species has been recorded in the region, but due to a lack of suitable habitat it is unlikely to be present in the project area.
Woma	*Aspidites ramsayi* (south-west population)	*Wildlife Conservation Act 1950* Schedule 4; DEC Priority 1	The Woma python is a moderately large snake that prefers woodlands, heaths and shrublands on sandplains. Several populations have been identified across Australia, including the south-west population, which has a range that covers the project area. However, this population has not been recorded since 1989. Clearing of much of its natural habitat and predation by foxes and cats has resulted in a major population decline. Suitable habitat in the form of heath on sand plains is present within the project area, but due to its scarcity and the prevalence of introduced predators in the project area, it is unlikely to be present.
Gilled Slender Blue-tongue	*Cyclodomorphus branchialis*	*Wildlife Conservation Act 1950* Schedule 1; DEC Vulnerable	The Gilled Slender Blue-tongue is a large skink found in semi-arid shrublands in an area between the Murchison and Irwin Rivers. This species has also previously been recorded in the area. Due to the close proximity of these records and the suitable habitat in the project area, it is likely that the Gilled Slender Blue-tongue could potentially occur. However, if a population is present, it is likely this would have experienced a large population decline due to the large-scale burn in 2005.

Source: ecologia (2008)

Approximately half of the project area contains remnant native vegetation, while the other half is disturbed land considered to be of little value as fauna habitat. No particularly significant individual fauna habitat was located within the project area (ecologia 2007).

Three Short Range Endemic (SRE) terrestrial invertebrate species of conservation significance were collected. These were an undescribed species of scorpion from the *Urodacus* genus, an unknown species of *Bothryembrion* snail and an unknown species of millipede from the *Antichiropus* genus. These are all found outside the project area.

2.3.8 Subterranean Fauna

Rockwater Pty Ltd (Rockwater) conducted two stygofauna surveys between January 2007 and March 2008 from 58 bores over two seasons (Rockwater, 2008b). These surveys were designed to cover the project area for both

the Coolimba Power Project and the Central West Coal Project. The following section outlines the findings of these surveys.

The surveys comprised sampling sites both within and outside the project area, and were undertaken in accordance with the EPA Guidance Statement No. 54 – Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA, 2003b).

There was only one known stygobitic taxon recorded by the investigation; the undescribed Syncarida, Bathynellidae sp. 1. This species is classed as a short range endemic, meaning that it is restricted to an area that satisfies its key habitat characteristics. Given the sampling intensity employed for the investigation, the aquifers of the project area are not considered to contain a diverse stygobitic fauna.

A risk assessment was undertaken by Bennelongia Pty Ltd (Bennelongia) to assess the impact of mining (dewatering) on Bathynellidae (Bennelongia, 2008). The assessment found that mining was unlikely to impact on the conservation status of Bathynellidae Sp. 1.

The potential for the presence of troglofauna within the project area is dependent upon the presence of suitable habitat determined by the geology and geomorphology, especially the likelihood of open air-filled cavities developed above the water table. Suitable subsurface cavities for troglofauna habitat are unlikely to be developed in unconsolidated fine sands like that present in the project area above the water table. While subsurface cavities may develop by piping processes in unconsolidated sediments, such cavities are typically short-lived and of highly localised extent, and thus unlikely to provide suitable long-term habitat for troglofauna (Subterranean Ecology, 2007).

2.3.9 Land Use and Population

The nearest towns to the project area are Eneabba, Leeman and Greenhead. The main industries associated with the towns are mining (mineral sands), rock lobster fishing, deep sea fishing, agriculture, tourism and holidaying.

There are numerous and extensive conservation reserves and National Parks in the region, including locally, South Eneabba Nature Reserve (SENR) and Lake Logue Nature Reserve (LLNR), and regionally, Leseuer National Park and Beekeepers Nature Reserve.

Eneabba is the nearest populated centre, with a population of between 250 – 300 inhabitants. A number of scattered farm residences exist within the wider area. The closest farm residence is located approximately 1.5 km south-west from the project area boundary.

2.3.10 Aboriginal Heritage and Native Title

Archival research found no previously recorded Aboriginal sites within the survey areas, however, an ethnographic survey conducted in 2008 revealed that the project area contains moodjar trees, which are potential ethnographic features. The moodjar trees are considered to have ethnographic significance and are also referred to as “spirit trees”.The surveys conducted to date have not covered all areas requiring disturbance. Further surveys are planned.

No parts of the CWC project area are subject to Native Title Claims.

2.3.11 European Heritage

No European heritage sites are known to occur within the CWC project area.

2.3.12 Noise

2.3.12.1 Regional Setting

The Mid West Region of Western Australia is typified by sporadic mining operations, extensive broad-acre farming and large tracts of conservation estate and other remnant native vegetation. Given the large land holdings in the region, there are often significant distances between noise sources and subsequent sensitive noise receptors.

2.3.12.2 Project Area

The project area is located approximately 15 km south south-west of Eneabba and approximately 4 km from the closest Iluka Resources Ltd mineral sands mining operations. The closest residential receptor is approximately 2 km south-west of the proposed site. SVT Consulting Engineers (SVT) conducted a noise impact assessment for the CWC Project, which is presented as Appendix P. As part of this study, background noise monitoring and subsequent noise modelling was conducted to determine the current noise levels experienced by the nearest residential receptor. The findings are discussed briefly in the following sections.

Existing Sources of Noise

The Iluka mining operations approximately 6km east of the project area, and traffic along the Brand Highway, approximately 3 km to the east, are the two main background noise sources other than wind noise. However, given the distances between the project area and these sources, the background levels in low wind conditions are generally very low.

Monitoring Results

Continuous noise monitoring was conducted over a two-week period between 10 and 25 March 2008 at the closest residential receptor. During this time L_{A1}, L_{A10} and L_{A90} noise levels were recorded at 15-minute intervals.

- L_{A1} refers to the noise level exceeded for 1% of the time;
- L_{A10} refers to the noise level exceeded for 10% of the time; and
- L_{A90} refers to the noise level exceeded for 90% of the time.

The L_{A90} noise level is applicable in this case for representing background noise levels. The monitoring data recorded at the closest residential receptor (R6) is outlined in Table 2.3.

Table 2-3 Background Noise Monitoring Levels at Closest Residential Receptor

Period	Assigned Level dB(A)	Average LA10 dB(A)	Standard Deviation in L_{A10} dB	Average L_{A90} dB(A)	Standard Deviation in L_{A90} dB	L90 of L_{A90} dB(A)
Day (07:00 to 19:00 hrs)	45	49.9	10.7	38.5	11.6	22.5
Evening (19:00 to 22:00 hrs)	40	44.8	10.8	35.1	9.4	21.5

Period	Assigned Level dB(A)	Average LA10 dB(A)	Standard Deviation in L_{A10} dB	Average L_{A90} dB(A)	Standard Deviation in L_{A90} dB	L90 of L_{A90} dB(A)
Night (22:00 to 07:00)	35	40.4	16.2	33.6	13.6	<20
All data	n/a	45.3	13.8	36.0	12.3	<20

Source: SVT

To put these noise exposure levels into context, Table 2-4 provides a guide of noise levels and sources.

Table 2-4 Typical Sounds and their Loudness

Noise Level dB(A)	Typical sources of these levels of noise
75-80	Trucks passing in the street, chainsaw nearby, burglar alarm next door.
65-70	Dog barking or leaf blower operating next door, rock concert on oval nearby light plane passing overhead.
55-60	Highway traffic, lawnmower or electric drill operating next door, light aircraft in the distance
45-50	Busy local traffic, strong wind in the trees, noisy air conditioner next door
35-40	Distant suburban traffic, light wind in the trees, quiet air conditioner next door
25-30	Rural area at night, light wind in the grass, far distant traffic

Source*: EPA Guidance Statement 33, May 2008*

The results show that background noise levels are very low, with applicable noise levels not exceeding 38.5 dB. The relatively high standard deviation is due to wind generated noise. The first week of monitoring was characterised by calm weather conditions, but windier conditions experienced during the second week had a significant effect raising measured noise levels.

3.1 Current Status

3.1.1 Climate

The project area is located in the Mid West region of WA, approximately 15 km south, south-west of the closest Bureau of Meteorology (BoM) weather station (No. 008225) located in the town of Eneabba. The area experiences hot, dry summers and mild, wet winters, which are characteristic of a Mediterranean climate (BoM, 2008a). The Eneabba data are considered representative of the site for temperature, rainfall and humidity. The wind speed and direction from Eneabba is considered adequate for describing the climate of the region, however wind speed and direction can vary over short distances and be influenced by site specific topography.

Rainfall in the region is low, with extremely low levels during the summer months. Eneabba has an average of 60.5 rain days per year and an average annual rainfall of 502.8 mm. The highest annual rainfall ever recorded was 850.6 mm in 1999, while the lowest rainfall ever recorded was 296.6 mm in 1969. The highest average number of rain days per month was 11, occurring in July. However, the highest average rainfall of 104.1 occurs in June. January is the driest month of the year with an average rainfall of 7.1mm on one rain day.

Evaporation is not recorded at the BoM Eneabba weather station, nor at the three nearest stations (Jurien, Carnamah and Badgingarra). Therefore, average climatic zone evaporation data has been used. According to BoM (2008b) evaporation mapping, Eneabba and the site are located within the zone which experiences an average 2,000 to 2,400 mm total annual evaporation. The highest evaporation is experienced in January, while the least evaporation occurs over June and July.

3.1.2 Surface Water

Project Area

The project area is located in a catchment draining north-west towards Lake Indoon. The catchment is intersected in a north-south direction by the Brand Highway and includes three main drainage lines.

The majority of the area covered by the Project is encompassed by the Lake Indoon catchment (sub-catchments A, B and C). The Lake Indoon catchment drains north-west towards Lake Indoon and covers an area of approximately 373 km^2. There are three main drainage channels within the Lake Indoon catchment that relate to the project area, as shown in Table 3-1.

Landform

Two distinct landforms have been identified within the Lake Indoon catchment. Land in the west or upstream portion of the catchment is steeper, mostly cleared pastures and rocky outcrops, which is likely to produce larger volumes of surface runoff from significant rainfall events.

The eastern low lying areas of the catchment are sandy with flatter gradients. This landform is likely to absorb a greater proportion of runoff before it crosses the Brand Highway, due to its particularly high infiltration rate. This control is addressed by subdividing sub-catchments A and B into upper and lower catchments based on soil and land cover type.

The Brand Highway transects sub-catchments A and B in the north-south direction and would provide a level of hydraulic control to surface flow. The location of the highway was also used to further sub-divide the sub-catchments.

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Table 3-1 Lake Indoon Catchment Area

Catchment			Area (km^2)	% of total
A	Erindoon Creek	Upstream	56	15
		Downstream	43	11
B	Bindoon Creek	Upstream	17	5
		Downstream	184	49
C	Lake Indoon	Upstream	52	14
		Downstream	21	6
Total		Upstream	125	34
		Downstream	245	66
		Total	373	100 %

The creeks in the catchment area are ephemeral. Stream flow is observed for short periods of time following high intensity rainfall events.

The baseline surface water assessment has established catchment areas, episodic rainfall characteristics and catchment infiltration rates. The parameters that were used to characterise the impacts of the Project on the local surface runoff regimes are as follows:

- The peak flow rate in the three main creeks draining into Lake Indoon.
- The runoff volume from the Project catchment area.
- Water quality impacts on Lake Indoon.

Observed stream flow

The correlation between instantaneous stream flow rate at the Indoon Creek sampling site and recorded rainfall at Eneabba shows that recorded rainfall does not consistently correlate directly with high instantaneous flow rates at the Indoon Creek site. This may indicate considerable variation in the runoff properties of the Lake Indoon catchment, particularly with regards to soil infiltration variability.

The Bindoon Creek site flow rate versus rainfall shows a more consistent correlation between recorded rainfall amounts and flow rates. This agrees with field observations, that sub-catchment C of the project area regularly experiences surface flow and is more responsive in terms of rainfall runoff than the rest of the Lake Indoon catchment.

Runoff volumes

Due to the high infiltration rates (range of 110-1,400mm/hr) most rainfall will infiltrate into the ground in preference to providing runoff. Surface water runoff is only generated during high intensity rainfall events. The relatively large infiltration rates, which vary considerably throughout the catchment but exceed the design rainfall intensities, and the lack of observed stream flow data, mean the estimation of runoff volumes from the various drainage lines into Lake Indoon cannot be estimated with a reasonable degree of accuracy.

To establish the baseline runoff volumes, a surface water monitoring program collecting stream flow data is required.

Peak discharge rates

The 1:100 year ARI peak flow rate of the project area at the critical rainfall duration was determined using the Rational Method. Design parameters for the region have been adopted, with extrapolation to the catchment runoff coefficient (C factor). The peak flow rate in a 1:100 year ARI and 6 hr duration rainfall event were determined using two different methods. The first is the method which uses regional parameters and is known to give fairly conservative outcomes. The second uses a peak discharge model which makes provision for the use of the infiltration data in calculating peak flow rates. The comparison of the results of the two methods is shown in Table 3-2.

Table 3-2 Peak Discharge Rates (100 yr ARI) for Critical Storm Durations

Catchment	Sub-catchment ID	AR&R Peak Discharge (m^3/s)	Peak Discharge using Infiltration (m^3/s)
A	**A**	431	6.4
B	**B1L**	64.0	1.21
	B1U	218.3	2.04
	B2	14.4	0.18
	B3	4.4	0.06
	B4	12.7	0.27
	B5	37.0	0.49
	B6	76.1	0.91
	B7	231.6	2.89
	B8	47.3	0.84
	Pit	16.4	0.20
C	**CL**	9.6	0.19
	CU	107.5	2.52
	Lake Indoon	0.4	0.02

The AR&R method tends to be a conservative estimate of peak flow rates, generally used for engineering designs. Using the infiltration test results reduces the peak flow estimates by nearly two orders of magnitude. The post-infiltration peak discharge rates are in the same order of magnitude as those observed at the Department of Water (DoW) stations, and are therefore considered to be more likely.

Due to the lack of observed stream flow data and relatively large infiltration rates which vary considerably throughout the catchment area, but exceed the design rainfall intensities, the peak flow rates are an order of magnitude estimate. To establish the baseline peak flows more accurately a surface water monitoring programme collecting hourly rainfall and stream gauging is required. This data will provide a more accurate assessment of the catchment response to rainfall events.

Surface water quality

There is little surface water quality data available for this catchment. The DoW has three sampling sites in the catchment. The status and record period for each of these sites is provided in

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Table 3-3.

Table 3-3 Location and Status of DoW Water Quality Sampling Sites

Location	DoW Ref #	Status	Recording Period
Indoon Creek	6171014	Inactive	1969 – 1975
Bindoon Creek	6171027	Inactive	1973 – 1975
Lake Indoon	6171226	Active	Since 2/12/06

The only water quality data collected at the two presently inactive sites is the chloride concentration. Over the period of 1969 to 1975, the minimum load was 121 mg/L with a maximum of 2,487 mg/L.

The Lake Indoon site has a single water quality record, which is provided in Table 3-4.

Table 3-4 Water Quality at Lake Indoon

Description	Measurement
Arsenic (As)	< 0.001 mg/L
Cadmium (Cd)	0.0001 mg/L
Chlorophyll a	0.012 mg/L
Chlorophyll b	< 0.001 mg/L
Chlorophyll c	0.002 mg/L
Chlorophyta	8753 cells/mL
Chromium (Cr)	< 0.01 mg/L
Cryptophyta	31310 cells/mL
Copper (Cu)	0.002 mg/L
Cyanophyta	4040 cells/mL
Diatoms (planktonia)	4713 cells/mL
Mercury (Hg)	< 0.0001
Nitrogen (NOx)	0.052
Nitrogen (TKN)	6.2 mg/L
Nitrogen (Total N)	6.2 mg/L
Total Phosphorus	0.1 mg/L
Phosphate (PO_4)	0.006 mg/l
Lead (Pb)	< 0.001 mg/L
Phaephytin a	0.003
Phytoplankton	49153 cells/mL
Total Suspended Solids (TSS)	31 mg/L
Zinc (Zn)	< 0.001 mg/L

The water quality data indicates that the water quality in Lake Indoon is within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) for wetlands.

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3.2 Hydrogeology

3.2.1 Region

In the wider regional setting, the northern Perth Basin hydrology is characterised by three aquifers; the Yarragadee and Cattamarra Coal Measures (Cattamarra CM) aquifers and the Eneabba Formation aquifer. These are overlain by a thin superficial aquifer. With hot dry summers and an annual average rainfall of approximately 500 mm, groundwater is heavily depended on by both agricultural and mining activities in the region.

3.2.2 Project Area

General

The Project lies on the Cattamarra CM aquifer in the eastern part of a fault block, between the Warradarge Fault to the east and the Peron Fault to the west (Figure X). The faults strike north to north-west, with upward vertical displacement to the west. Figure X shows a cross section east-west through the geology of the site.

East of the Warradarge Fault, the Yarragadee Formation aquifer comes in contact with the overlying unconfined aquifer. Water levels are generally 10 to 15 m higher in the Yarragadee aquifer compared with the Cattamarra CM aquifer on the western side of the Warradarge fault. Despite the extent of the fault, site investigations have shown that there is likely to be some recharge from the Yarragadee aquifer to the Cattamarra CM aquifer across the Warradarge Fault (Rockwater, 2008a).

The Eneabba Formation aquifer is found to the west of the Peron Fault and is characterised by horizontal strata. These strata are likely to impede hydraulic connection to the Cattamarra CM aquifer east of the Peron Fault. The dipping Cattamarra CM strata, lying east of the fault have a low vertical permeability due to layers of shale which are tend to impede groundwater movement from east to west across the fault (Rockwater, 2008a).

The superficial formations have created a composite aquifer system, known as the superficial aquifer, which overlies the Yarragadee, Cattamarra CM and Eneabba Formation aquifers west of the Gingin Scarp. At the base of the Gingin Scarp the superficial aquifer is thin and discontinuous and a large portion of the formation is unsaturated. Elsewhere, the groundwater surface closely matches the total head of groundwater of the Cattamarra CM suggesting that the two aquifers are hydraulically connected (Rockwater, 2008a).

Localised perched water is also known to occur, particularly in the winter months within or overlying geological strata of low-permeability, such as the clays beneath laterite (Rockwater, 2008a).

Investigation

A drilling program carried out in November and December 2006 established 13 monitoring bore sites to various depths, down to a maximum depth of 108 m within and around the project area. At 12 of the 13 sites (with the exception of CW047P) one bore was drilled to a comparatively shallow depth within the superficial or Cattamarra CM aquifers, and a second bore was drilled to a deeper level in the Cattamarra CM aquifer.

Three additional monitoring bores and four production (or pit-dewatering) bores within the Cattamarra CM aquifer were drilled subsequently to the original programme. Figure X shows the position of each of the established bores in the vicinity of the site.

Groundwater Levels

Groundwater levels in the Cattamarra CM aquifer in the project area generally vary from around 50 m to 65 m Australian Height Datum (AHD) and slope downwards in a north-west direction at a shallow gradient. Elevated water levels of approximately 90 m AHD were reported for CW044/45P and CW071P which are likely to be due to a perched water system or a datum error (Rockwater, 2008a). West of the Peron Fault groundwater levels are less than 45 m AHD (Kern, 1996) and continue to slope downward to sea level at the coast.

Groundwater Quality

Water samples were collected from monitoring bores and production bores and the key items are summarised in the paragraphs which follow.

Salinity, measured as Total Dissolved Solids (TDS), was above the aesthetic Australian Drinking Water Guidelines (ADWG) 2004 (National Health and Medical Research Council [NHMRC], 2004) limit of 500 mg/L in all bores. Bores situated in the Yarragadee Formation aquifer had the lowest salinity values ranging from 280 mg/L to 740 mg/L TDS. The bores in the Cattamarra CM aquifer had higher salinities ranging from 870 mg/L TDS up to 12,750 mg/L (although the higher measurements may have been affected by drilling fluids). The Cattamarra CM aquifer samples were generally higher in the deeper bores and averaged approximately 2,500 mg/L TDS.

The pH values ranged from 6.1 to 8.1, indicating slightly acidic to slightly alkaline conditions, but neutral on average.

Iron concentrations were high and were above the aesthetic Australian Drinking Water Guidelines 2004 (ADWG) (NHMRC, 2004) limit of 0.3 mg/L, with the exception of CW048P (0.15 mg/L) and CW068PB which was below the limit of reporting (0.02 mg/L). Samples from the remaining bores had concentrations between 0.76 mg/L and 31 mg/L for iron. These high concentrations could lead to precipitation of iron oxide when the water is aerated.

Soluble manganese was above the aesthetic ADWG limit of 0.1 mg/L in all bores, with the exception of CW048P (0.045 mg/L). The remaining bores had concentrations ranging from 0.13 mg/L to 2.2 mg/L. The health guideline limit is 0.5 mg/L (NHMRC, 2004) and was exceeded in five of the bores.

Sulphate concentration was below ADWG limits in the majority of the bores sampled. CW036P was above the health guideline limit (500 mg/L) with a concentration of 540 mg/L and CW035P was equivalent to the aesthetic guideline limit (250 mg/L) at 260 mg/L.

Turbidity in bores CW069PB and CW072PB had readings at 48 and 12 NTU, respectively; both well above the aesthetic guideline of 5 Nephelometric Turbidity Unit (NTU) (NHMRC, 2004).

A Ryznar stability analysis for corrosion tendencies of bores CW069PB and CW072PB produced values of 11.6 and 11.4 respectively, indicating tendency for corrosion activity.

Groundwater Users

Within the Cattamarra CM aquifer system there are privately-owned agricultural bores 1.5 km south-west of the project area and the currently non-operational Eneabba West Project about 4 km north of the project area. East of the Warradarge Fault and in the Yarragadee aquifer is the borefield supplying Iluka's East Eneabba Operations. The Cattamarra CM aquifer may also support some Groundwater Dependent Ecosystems (GDEs).

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3.3 Potential Impacts

3.3.1 Potential Surface Water Impacts

Surface water impacts of the Central West Coal Project are:

- Impacts on project area runoff volume;
- Impacts on water quality in receiving water bodies;
- Acid rock drainage from waste material;
- Disposal of water from pit dewatering; and
- The effect of climate change on the project area.

These impacts are discussed in the following sections.

Impacts on Project Area runoff volume

The Project is located within the Lake Logue-Indoon catchment and changes to surface flows may impact on the system, including the Erindoon Creek GDE and on the Lake Indoon GDE.

The mine excavation will intersect watercourses in the Erindoon Creek upper catchment at different points during the life of the mine.

These watercourses will be diverted around the excavation area, and re-established at mine closure. A small tributary of Erindoon Creek obstructed by the waste dump will be diverted permanently to Bindoon Creek.

The mine excavation, water storages, and other surface water management structures will divert potential rainfall run-off away from the existing drainages, effectively causing the potential surface water run-off to be lost to the downstream systems.

Losses of potential surface water due to rainfall capture are estimated as follows:

- The bunded mine pit, estimated to have a maximum area of 1.7 km^2 at any one time, based on preliminary designs.
- Evaporation and storage ponds, estimated to have a surface area of 1.5 km^2, which are located within sub-catchment B.

These potential surface flows are effectively lost to the natural system. The maximum amount of rainfall runoff lost to the system can be quantified as shown in Table 3-5.

Table 3-5 Runoff Loss Calculations

Catchment	Total Area (km^2)	Mine Area Loss (km^2)	Other Infrastructure (km^2)	Total Area Loss (km^2)	Percentage Loss (%)
A	99.32	0	0	0	0
B	200.55	1.7	1.5	3.2	1.6
C	72.99	0	0	0	0

Additionally, runoff that drains the sub-catchment area directly upstream of the waste rock dump will be diverted to Bindoon Ck. The approximate area of this small sub-catchment area is 2.87 km^2, which equates to 1.43% of sub-catchment B's total area. This amount of surface flow will have to be diverted from behind the waste rock dump. The topography of the area indicates a diversion drain to nearby Bindoon Creek (sub-catchment C) is needed. This means effectively 1.43% of surface flows from Erindoon Creek will be diverted into Bindoon Creek.

Water quality

The area of disturbed ground associated with mining operations may increase the sediment load carried by natural drainage channels in the project area. This includes the waste rock dump, ROM pad, haul road, lay-by area and stockpiles. Water quality may also be chemically affected by runoff from the fuel storage and workshop areas.

Acid rock drainage

Terrenus Earth Sciences (2008) in its report "Geochemical Assessment of Overburden, Potential Coal Reject and Coal Combustion Ash for the Central West Coal Project and Coolimba Power Station" has determined that the overburden generated by the proposed Project is likely to be relatively benign and is expected to generate pH-neutral and low-to-moderately saline runoff and seepage following surface exposure.

The overburden was reported as having a low oxidisable sulphur content. Over 80% of overburden samples tested was classified as non-acid forming (NAF), with a further 8% classified as uncertain-NAF. The remaining 10% (approximately) were classified as potentially acid forming (PAF). The assessment recommended all potential coal reject materials (including coal) will need to be carefully managed to minimise oxidation, generation of acid and potential release of metals (and salts) into the environment. This PAF material will have to be sealed within NAF material and removed from oxidising environments and the hydrologic cycle of the project area.

Disposal of water from pit dewatering

The pit will be dewatered during operation to provide suitable conditions for mining. Dewatering bores will be installed in a 100 m wide dewatering infrastructure corridor on the western perimeter of the pit. The findings of the pit de-watering assessment indicate that there will be an excess of 8 GL/annum of water from the dewatering of the pit. This water will be used by the Coolimba Power Station for cooling purposes and will be lost to the atmosphere as water vapour. No discharge of mine dewatering to surface water or groundwater is proposed.

Effect of climatic change on the Project Area

The statistical analysis of the SILO generated long term rainfall data (1889-2007) for Eneabba suggests that annual rainfall has been declining over the past 40 years. The analysis of seasonal rainfall data identifies a decline in winter rainfall from the 1960s to 2007, whilst the trend for summer rainfall is increasing slightly although the overall impact of this is minimal.

Any reduction in rainfall will result in a reduction of water in the catchment areas and their associated GDEs.

3.3.2 Potential Groundwater Impacts

The proposed mining operations include pit dewatering and backfilling of mineral wastes including overburden and coal combustion ash. The potential for mine dewatering, and ash and saline residue co-disposal to alter the quantity and quality of groundwater has been assessed and is described in detail in the following reports:

- Pit dewatering assessment and bore completion report (Rockwater, 2009).
- Flora and vegetation survey (Mattiske 2009).
- Soil and soil landscape (Blandford, 2008).
- Geochemical assessment (Terranus, 2008).
- Groundwater quality and solute transport modelling (URS, 2009).

The potential impacts comprise the following:

- Reduced groundwater levels affecting vegetation, including GDEs, and domestic and stockwater water supplies.
- Reduced groundwater quality affecting groundwater users and downstream eco-systems, including vegetation and GDEs..
- Reduced surface water flows (where those flows are supported by groundwater).

Reduced groundwater levels and impacts on vegetation and other users

Mine dewatering will occur in the Cattamarra Coal Measures. Dewatering impacts on groundwater levels were assessed by Rockwater using a groundwater flow model.

Based on the modelling, the following impacts on groundwater levels are expected.

- Drawdown is expected to range from 1.5 m to 110 m in the Cattamarra Coal Measures aquifer and in the overlying superficial aquifer. The largest drawdowns occur within the mined area.
- Drawdown outside the mined area is expected to be considerably less. The predicted drawdown after 30 years of dewatering is less than 1 m at distances beyond 13.5 km north and beyond 12.5 km south of the mine, and in areas to the east of the Warradarge Fault.
- In the vicinity of the mine, drawdown in areas immediately south and west of the mine, and east of the Peron Fault are expected to range up to 5 m.
- The area west of the Peron Fault is unlikely to experience groundwater drawdown due to mine dewatering.

The most important water dependent ecosystems potentially affected by mine dewatering are the Lake Indoon and Lake Logue systems situated to the west of the Peron fault, in an area where the depth to regional watertable (before mine dewatering) ranges from 5 m to more than 20 m.

Given that modelling predicts negligible drawdowns to the west of Peron Fault, and that these surface water bodies are unlikely to be dependent on regional groundwater on account of the depth to groundwater being >5m, they are unlikely to be affected by mine dewatering.

The lower reaches of Bindoon Creek and Erindoon Creek run through a shallow watertable area where the predicted drawdown after 30 years of dewatering is not expected to be more than 5m.

Areas with a shallow watertable (< 5 m) are located to the west and south of the project area and within the proposed mine pit (Figure X). Groundwater in these areas could potentially support vegetation. The predicted drawdown, after 30 years of dewatering, within the shallow watertable areas is between 0 and 2 m in the west, and up to 5 m in the south of the project area (Figure X).

Plant communities present within the shallow watertable area are listed in **Error! Reference source not found.**. Changes to groundwater availability may impact these plant communities.

Table 3-6 Plant Communities Distributed in the Shallow Groundwater Area

Code	*Description*
CL	Cleared paddocks and grassland.
C1	Low open forest of *Casuarina obesa* over *Tecticomia indica* subsp. *bidens* and mixed invasive herbs on flats on whit/grey sand.
F1	Tall shrubland of Melaleuca Rhaphiophylla over *Tecticomia indica* subsp. *bidens* and other shrubs and sedges on minor flowlines on grey/white sand.
F2	Low open shrubland of *Tecticomia indica* subsp. *bidens* with mixed herbs and grasses on flats on grey/white sand.
H1	Mixed heath of *melaleuca leuropoma* with emergent Banksia spp, and occasional *Eucalyptus todtiana* and *Actinostrobus arenarius* on sand.
H2	Heath or low shrubland of *Conospermum triplinervium*, *Verticordia* spp., *Adenanthos cygnorum* subsp. *Cygnorum*, *Stirlingia latifolia* and *Jacksonia floribunda* on sand.
H3	Heath or scrub of *Melaleuca leuropoma*, *Banksia sphaerocarpa* var. *Sphaerocarpa*, *Dryandra nivea* subsp. *Nivea, Eremaea beaufortioides* var. *Lachnosanthe* and *Hibbertia subvaginata* on lateritic rises.
H4	Mixed heath of Proteaceae and Myrtaceae spp. With occasional *Eucalyptus todtiana* on flats and swales on white/grey sand.
H5	Mixed heath or shrubland of *Xanthorrhoea drummondii*, *Allocasuarina humilis* and *Hibbertia* spp.
S2	Open scrub of *Acacia blakelyi* with occasional *Eucalyptus todtiana* over annual grasses and herbs.
T1	Scrub or thicket *Banksia attenuata*, *Banksia menziesii, Banksia sphaerocarpa* var, *sphaerocarpa*, *Adenanthos cygnorum* subsp. *Cygnorum*, *Banksia hookeriana* and *comospermum triplinervium* on sand.
T2	Thicket or scrub of *Acacia blakelyi* over *melaleuca leuropoma*, *Banksia sphaerocarpa* var, *sphaerocarpa*, *Verticordia densiflora* var. *densiflora* on sand.
T3	Thicket or scrub of *Melaleuca hamulosa*, *Melaleuca concreta*, *Viminaria juncea*, and *Kunzea recurva* on sand or loam flats.
T4	Thicket or scrub of *Melaleuca rhaphiophylla* and *Melaleuca lanceolata* over sedges and rushes on low-lying sandy loams.
T5	Scrub or thicket of *Banksia attenuata* and *banksia menziesii* over *Eremaea Beaufortioides*, *Hibbertia hypericoides*, *Melaleuca systena*, *Stirlingia latifolia*, and herbs with occasional *Xylomelum augustifolium* on slopes and swales and flats on white/grey sand.

Field surveys suggest that vegetation in the project area generally, including plant communities in shallow groundwater areas, is significantly dependent on perched aquifers or soil moisture both of which are replenished by seasonal rainfall (Blandford, 2008).

Of the plant communities listed in Table 3.6, only the *Melaleuca* species represented in T4 have deeper root systems and could potentially rely on deeper groundwater and be affected by groundwater drawdown.

Groundwater drawdown may affect supplies from licensed bores located south and west of the project area and the borefield supplying Iluka East Eneabba Operations.

Reduced groundwater quality and impacts on downstream ecosystems and other users

An assessment of the potential impacts of waste backfill, and co-disposal of ash and saline residue was undertaken using a solute transport model. (URS, 2009b).

The solute transport processes include hydrodynamic transport of solutes such as metals by groundwater infiltration and through flow, and concentration dispersion based on the concentration gradient between the source area (pit) and local watertable. The model delineated the potential concentration plumes of leachate (dissolved chemical parameters) and their changes with space and time based on the mining and dewatering scheduling.

The modelling results indicated that:

- Substantial solute dilution occurred upon entry to the watertable. Simulated concentrations in the plumes are well below the relevant guideline values and background values in groundwater.
- Solute transport plume distributes and move along the flow paths.
- Solute transport occurred in the top 3 model layers.
- The highest concentrations always followed the backfill scheduling, probably due to dilution of the solutes over time.
- Simulations did not take into account geochemical processes such as reactions and absorption. The geochemical processes commonly occur to the metals in the aquifer and have effects to reduce the dispersion of the metal plumes. In this respect the simulations represent a worst case scenario.

In summary, the model predicts negligible impacts on groundwater quality for waste rock disposal and ash co-disposal.

The modelling results for saline residue co-disposal are considered preliminary and will require further modelling. Until demonstrated otherwise, saline residue will be disposed of in lined cells located above the groundwater table where they are predicted to have negligible impact on groundwater,

3.4 Environmental Objectives and Management

Although the major concern of this document is on the environmental aspects, operational objectives and management actions are also discussed as they are interrelated and form an integral part of the Water Management Plan.

3.4.1 Surface Water Objectives

The main objectives for the Project in relation to the management of surface water include:

- Manage water related to the Project so that existing and potential environmental values are maintained.
- Minimise the impact on the natural hydrological regime in terms of maximum flood water level, peak flow rates and flow volume.
- Minimise inundation and damage to access roads and other mine infrastructure.
- To maintain a sustainable water balance.

3.4.2 Groundwater Objectives

The Project objective for the management of groundwater is:

- To ensure that changes to groundwater flows and quality do not have a material adverse impact on beneficial or environmental uses of the water and that the integrity, function and environmental value of groundwater are maintained.

3.4.3 Regulatory Requirements and Management Standards

The regulatory requirements for the Project are defined under the following documents.

Activities that emit to the environment are managed under a licence issued by the DEC under the *Environmental Protection Act 1986*. CWC is committed to managing these aspects of surface water and groundwater to meet licence requirements and the following standards:

- Ministerial Conditions issued pursuant to the approvals for the Project.
- DoW Water Quality Protection Guidelines.
- ANZECC and ARMCANZ guidelines for the protection of marine and freshwater ecosystems.
- Conditions of Groundwater Licences issued by DoW.

The objectives of the *Rights in Water and Irrigation Act 1914* are to:

- Provide for the management of water resources in WA, and in particular:
  - for their sustainable use and development to meet the needs of current and future users; and
  - for protection of the ecosystems and the environment in which water resources are situated, including the regulation of activities detrimental to them.
- Promote the orderly, equitable and efficient use of water resources;
- Foster consultation with members of local communities in the local administration, and to enable them to participate in that administration; and
- Assist the integration of the management of water resources with the management of other natural resources.

Other legislation and standards relevant to this Water Management Plan include:

- *Environmental Protection and Biodiversity Conservation Act* 1999.
- *Conservation and Land Management Act* 1984.
- *Wildlife Conservation Act* 1950.
- EPA Position Statement No. 2 (Environmental Protection of Native Vegetation in Western Australia, 2000).
- Policy on Environmental Water Provisions 2000
- Australian Drinking Water Guidelines;
- Environmental Water Provisions for Western Australia, Statewide Policy No 5 (WRC, 2000);
- National and State Water Quality Management Strategy;

- Provisions under the *Environmental Protection Act 1986* and the *Mining Act 1978* to control discharge of acid minewater from mine sites;
- ANZMEC and MCA (2000) Strategic Framework for Mine Closure;
- *Conservation and Land Management Act* 1984; and
- *Soil and Land Conservation Act* 1945.

3.5 Performance Indicators

The effectiveness of the WMP will be assessed through a range of performance indicators associated with the monitoring programmes within the Central West Coal project area and the surrounding environment.

Table 3-7 presents the measurable hydrological, physical, chemical and biological performance indicators for assessing the impact of the Central West Coal Project on the water environment and the associated targets.

Table 3-7 Water Resources Monitoring Programme Performance Indicators and Targets

Type	Location	Indicator	Criterion (Targets)
Stream flows	Central West Coal site outlet	Flood Levels and Peak Flow rates for 1:100 year 72 hour event Reduction in potential stream flows	Site infrastructure designed to meet 1:100 year 72-hour storm event so that flood levels and peak flow rates will not cause: (a) damage to power station infrastructure; (b) flooding of areas of the power station site; and (c) prolonged submergence of vegetation in run-off areas below the Power Station. Reduction in volume of stream flow of modified drainages not to exceed 10% of the potential flow (calculated after allowance for water which is permanently diverted).
Surface Water Chemistry	Bindoon Creek, Erindoon Ck Lake Indoon	pH	Runoff water from the Mine Site should not cause the pH of the receiving water body to fall outside the known seasonal range monitored in baseline sampling by more than $\pm$0.5 unit.
		EC and Total Dissolved Solids (TDS)	Runoff water from the Mine Site should not cause the EC and TDS of the receiving water body to increase by more than 10% of the known seasonal range.
		Dissolved oxygen (DO)	Runoff water from the Mine Site DO concentrations should not cause the DO concentration of the receiving water body to decrease by more than 10% of known seasonal range.
		SO_4^{2-}/HSO_4^-	Runoff water from the Mine Site should not cause the ionic sulphate concentration of the receiving water body to increase by more than 10% of the known seasonal range monitored in baseline sampling.
		Suspended solids/turbidity	Runoff water from the Mine Site should not cause the suspended solids/turbidity of the receiving water body to increase by more than 10% of the known seasonal range.
		Floatable matter	Runoff water from the Mine Site should not be the cause of visible floating oil, foam, grease, scum, litter or other objectionable matter in the receiving water body.
		Odours and colours	Runoff water from the Mine Site should not produce discernible variation in odour or colour in the receiving water body.
		Temperature	Runoff water from the Mine Site should not cause the receiving water temperature to vary by more than 2^{o}C from its seasonal baseline.

Type	Location	Indicator	Criterion (Targets)
		Toxicants, Soluble Metals and Radionuclides	The level of toxicants (including metals) in run-off water should not cause the concentration of toxicants in the receiving water body to increase by more than 10% of the known seasonal range.
		Nutrients	Runoff water from the Mine Site should not add nutrient substances or other growth stimulants (e.g. phosphorus, nitrogen) in quantities sufficient to cause excessive or nuisance algal growth in the receiving environment.
Groundwater levels	Bindoon Creek and Erindoon Creek	Groundwater levels	Groundwater levels in the shallow groundwater areas around Bindoon Creek and Erindoon Creek should not affect any groundwater dependent species or GDEs
	Mine site and adjacent observation bores	Groundwater levels	Groundwater levels are within 10% of the levels predicted by modelling given the allowed abstraction limits, and do not impact on any other groundwater users in the area.
Groundwater Chemistry	Mine site	pH, EC, TDS, DO, Redox potential	Water quality for these parameters not to vary by more than 10% of the known seasonal variation except where linked to increased salinisation due to stratification of the aquifer systems.
		Soluble Metals	The soluble metals concentration of the aquifers should not increase by more than 10% of maximum seasonal range monitored in baseline sampling except where the aquifer system is stratified and throughflow is intercepted.
		Major ions	Ca, Na, K, Mg, Fe, Al, As, HCO_3, CO_3, SO_4, Cl concentration of the aquifers should not increase by more than 10% of maximum seasonal range monitored in baseline sampling except where the aquifer system is stratified and throughflow is intercepted.

3.6 Management Actions

3.6.1 Surface Water Management

To address the defined issues and impact of the Project, the following surface water management strategies have been formulated.

Diversion of drainage lines

The pit, together with the finished pad level of the power station, will disrupt the surface water drainage pattern. To effectively divert this surface water flow around the mine infrastructure, a series of diversion drains and bunds will be constructed. When re-instated, the diversion channels will be reinstated. The layout of the temporary diversion drains and bunds for three separate surface water diversion stages are briefly described below.

The Stage 1 surface water diversion stage consists of the following components:

- A 2 km long drain at the southern end of the mine path and power station to divert water to the upper B1 catchment. This drain crosses the 75 m wide Power and Gas Corridor Easement for the Coolimba Power Station. The drain will remain in place throughout the life of the mine and after closure.
- A 7 km long second diversion drain runs from south to north along the eastern side of the pit to prevent surface water ingress from the eastern highwall of the pit. This diversion channel discharges into the first major natural watercourse (from the south end) crossing the mine path. This arrangement remains as long as the active pit is still south of this first natural drainage line.

In Stage 2, the moving pit has progressed to a location where it starts to obstruct the first natural drainage line. Drain 2 will be diverted behind the moving pit to allow the pit to progress northward. The relocated Drain 2 will be built on the spoil dump which backfills the mine void trailing behind the moving pit.

A wide flat drain has been designed to divert surface water from the second and third natural watercourses at the northern end of the mine path. It is 2.45 km in length and has a width of 60 m. This drain is designed with no slope so that it serves as a bi-directional drain which can be used to divert flows between the two channels (hereafter called South Channel and North Channel) in different directions at Diversion stages 2 and 3, respectively. In Stage 2 when the moving pit is obstructing the South Channel, a cut-off embankment will be built across the South Channel and water will be diverted into the North Channel through the bi-directional diversion channel.

In Stage 3, this arrangement will be “switched over” when the moving pit has progressed passed the South Channel and begins to obstruct the North Channel. The cut-off embankment in the South Channel will be removed and its section demolished by the pit will be reinstated on the backfilled spoil dump. A cut-off embankment will now be built across the North Channel to divert the water into this reinstated South Channel.

Sediment control measures

Sediment ponds are required to reduce the sediment load in runoff from the initial waste rock dump and other disturbed ground associated with the development of the Project. For the waste rock dump, a catch drain at the toe will divert the runoff from the waste rock dump into the sediment pond(s) at the lowest point along its perimeter. As for other disturbed areas, the sediment ponds will be positioned at the exit points to catch and treat the water before it is released into the environment.

Management of PAF runoff

The geochemical assessment by Terrenus Earth Sciences has determined that the overburden generated by the proposed Project is likely to be relatively benign and is expected to generate pH-neutral runoff. Furthermore most of this overburden will be backfilled into the mine void which will be lower than the surrounding ground level, hence the overburden will not produce any surface runoff. If any of the 10% PAF material anticipated from the overburden is to be placed in the waste rock dump, it will be encapsulated with NAF material. Therefore, the risk of PAF surface runoff will be minimal. However, the quality of the surface runoff and seepage water collected at the toe drain of the waste rock dump will be monitored periodically during the operation of the mine to ensure that there is no PAF water discharging into the environment.

Disposal of water from pit dewatering

Water from pit dewatering will be used by the Coolimba Power Station for cooling. The 8 GL/annum of water from the dewatering will be entirely consumed by the power station. A raw water storage dam will receive and store mine water.

Surface water monitoring programme

To safeguard the downstream environment from adverse impacts from the mine site, a Surface Water Monitoring Programme will be implemented.

Regular water quality sampling and testing at strategic locations will be carried out to monitor any changes in the water quality over time and spatially (comparing locations upstream and downstream of the mine).

Continuously recording stream gauges and rainfall intensity recording gauges (i.e. tipping bucket gauge) will be installed to collect hydrological data. The data will help to monitor any changes in the hydrological regime. It will also be used to finetune the hydrological and hydraulic model, to enable more accurate prediction of hydrological events and better management of their impacts.

Considerations regarding climatic trend

The declining trend in annual rainfall depth detected in the statistical analysis of the long term record of Eneabba will be taken into consideration when designing the infrastructure for the mine site. As lower rainfall produces less runoff, there is an opportunity to reduce the design capacity of surface water drainage infrastructures such as channel sections, pond sizes and dewatering facilities.

Summary of Management Actions

Surface water management for the project area will take into account the effects of the mining infrastructure on changes in drainage and surface water velocity, in order to manage effects such as erosion, increased sedimentation, reductions in amount of water available to the natural system and decreased water quality.

Surface water management initiatives will include:

- Compliance with DEC Licence conditions.
- Monitoring and analysis to ascertain accurate rainfall runoff volumes for design purposes. Instrumentation may include stream gauges, rainfall gauges and v-notch weirs in the drainage lines.

- Establish continuously recording stream gauges and corresponding rainfall intensity recording gauges (i.e. tipping bucket gauge) within the project area to calibrate the rainfall runoff model. This will also aid in the accurate estimation of rainfall yield.
- Obtain information on the existing main roads in the area which may have a hydraulic effect on water levels upstream.
- Conduct modelling based on final design of mine pit and power station (including haul road, access roads and associated creek crossings) to obtain final design flood levels.
- Designing infrastructure located within the 100 year ARI flood plain to incorporate mitigation measures to divert surface flow and minimise the impact of the development on the upstream and downstream flow regimes.
- Locating and sizing sedimentation and water treatment ponds downstream of any developed area intersecting surface flow, so that the water re-entering the natural system conforms to recommended water quality guidelines, and erosion is minimised.
- Establish a water quality monitoring program, aimed at monitoring the impact of mine development and process operations on water quality in streams and in Lake Indoon.

3.6.2 Groundwater management

The key management measures are as follows:

- Groundwater level monitoring will be conducted, particularly in the shallow groundwater areas around Bindoon Creek and Erindoon Creek, which may be affected by drawdown impact on the watertable, and could potentially impact any groundwater dependent species or GDEs. The water level criteria would be established based on the baseline water level data and an ecological water requirement (EWR) assessment.
- Drawdown impact on licensed bores located southwest of the project area and the borefield supplying Iluka East Eneabba Operations will be monitored to determine any potential negative impacts for other bore users in the area.
- Further assessments and field monitoring will be undertaken in order to :
  - Further develop the drawdown model and refine the predicted drawdown;
  - Improve the knowledge of vegetation groundwater dependency and tolerance to regional watertable changes; and
  - Increase the understanding of the hydraulic connectivity between the perched watertable and regional groundwater.
- A groundwater level and vegetation health monitoring program will be developed to monitor the drawdown effect on groundwater and vegetation. Mitigation plans, such as watertable supplementation, may be developed to manage the impact if the vegetation species and populations be affected by the dewatering impact.

3.6.3 Implementation Strategy

The WMP is designed to ensure that the environmental impact issues are adequately addressed and the impacts of the Central West Coal Project on the surrounding environment are minimised. This can be achieved by management actions which can be grouped under the following categories:

(a) Environmental Management;

(b) Water Management; and

(c) Monitoring and Impact Assessment Programme.

The implementation strategies for the environmental and water management actions are outlined in Table 3-8. The management actions are grouped under the environmental and operational objectives which they are designed to achieve. The management actions are the provision of suitable infrastructure, and operational rules.

(Note: some the management actions are repeated in the table where they help to achieve multiple objectives.)

Table 3-8 Management Actions, Timing and Responsibility for Achievement of Objectives

Objective	Management Action	Responsible Personnel	Timing
Manage water related to the Project so that existing and potential environmental values are maintained	Establish a water quality monitoring program, aimed at monitoring the impact of mine development and process operations on water quality in streams, including Erindoon and Bindoon Creeks and in Lake Indoon.	Project Director/ General Manager	Design/ Operations
	Monitor water flows in disturbed drainages (Erindoon Ck) to ensure that environmental flows are maintained to the maximum level possible	Project Director/ General Manager	Design/ Operations
	Monitor quality of the surface runoff and seepage water collected at the toe drain of the waste rock dump to ensure that there is no PAF water discharging into the environment. If there is any sign of PAF runoff in this water, the sediment pond will be modified to become an evaporation pond in order to dispose of this PAF water through evaporation.	General Manager	Operations
	Prompt response to unsatisfactory water quality monitoring results –eg quality or volume outside +/-10% of baseline; immediate remedial actions to rectify the associated problems.	General Manager	Operations
Minimise the impact on the natural hydrological regime in terms of maximum flood water level, peak flow rates and flow volume	Construction of diversion drains and bunds around the pit to divert water away from the pit and direct surface water into the natural drainage lines as it leaves the site.	Project Director	Design/ Construction
	Construction of detention ponds to capture sediment load in the run-off from the site. The sediment ponds will be positioned at the exit points to catch and treat the water before it is released into the environment.	Project Director	Design/ Construction
	Minimise the extent of disturbed areas to avoid exposure of bare soil and increased sediment loading in runoff.	Project Director/ General Manager	Construction/ Operations

Objective	Management Action	Responsible Personnel	Timing
	All development pads must be constructed to the 100 year flood level plus 500mm freeboard.	Project Director	Design/ Construction
	All development located within the 100 year ARI flood plain must incorporate mitigation measures to divert surface flow and minimise the impact of the development on the upstream and downstream flow regimes	Project Director/ General Manager	Construction/ Operations
Ensure that alterations to groundwater flows and quality do not have an adverse impact on beneficial or environmental uses of the water and that the integrity, functions and environmental values of watercourses are maintained.	A groundwater level and vegetation health monitoring program will be developed to monitor the drawdown effect on groundwater and vegetation. Mitigation plans, such as watertable supplementation, may be developed to manage the impact if the vegetation species and populations be affected by the dewatering impact.	Project Director/ General Manager	Design/ Operations
	Groundwater level monitoring will be conducted, particularly in the shallow groundwater areas around Bindoon Creek and Erindoon Creek	General Manager	Operations
	Drawdown impact on licensed bores located southwest of the project area and the borefield supplying Iluka East Eneabba Operations will be monitored to determine any potential negative impacts for other bore users in the area	General Manager	Operations
No legacy after mining completed.	Any surface water diversions where possible will be re-instated to their former location at the end of mining.	General Manager	Mine closure
	Rehabilitation of mine site - Revegetation of the disturbed area to restore the natural catchment characteristics.	General Manager	Operations/ Mine Closure
	Monitoring of groundwater will be continued for a period after mining finishes to ensure that groundwater levels and quality return to baseline conditions.	General Manager	Operations

Section 3 Water Management Plan

3.7 Monitoring

The water monitoring plan will be implemented throughout the life of the mine. This plan will enable a better understanding of the surface water and groundwater environments and improvements to the Water Management Plan.

3.7.1 Monitoring Parameters

Typically, the following parameters will be monitored:

- Surface water quantity – rainfall, evaporation and stream flow;
- Water balance;
- Groundwater levels; and
- Surface water and groundwater quality.

Hydrological processes

The major hydrological parameters such as rainfall, evaporation and stream flow data will be monitored throughout the life of mine. The data will be used to verify the modelling results, which will then allow management and design changes to be made if necessary. The monitoring of hydrological parameters will also help in forward planning of future activities such as mine closure planning.

Water balance

Monitoring of the Project water balance encompassing surface water, groundwater, water usage (ore processing and potable water) and wastewater disposal is important for the optimal use of water resources and minimising environmental impacts. Water fluxes will be monitored in terms of pumped volumes, surface runoff volumes, changes in storage volumes, estimated evaporation and seepage loss.

Groundwater levels

Monitoring of the groundwater levels, GDE's and other users is important in understanding the impacts of groundwater abstraction. Groundwater level monitoring around the waste rock dump, and evaporation and storage ponds will also provide indications of seepage, with mounding of the water table likely to be detected prior to changes in the groundwater quality.

The groundwater level monitoring provides information on the aquifer and its properties enabling sustainable management of the water resources. The groundwater levels will be used in verification of the existing groundwater flow models.

Surface and groundwater quality

Water quality monitoring will include all major physical, chemical and biological parameters which will be used as performance indicators for the Water Management Plan. The important issue is to maintain the health of downstream ecosystems including Erindoon Creek GDE, Lake Indoon, and groundwater flows exiting the mining area.

A correct and adequate sampling strategy is crucial in the identification of acid generating waste. Monitoring will be in accordance with *Water Quality Protection Guidelines No. 5 – Minesite water quality monitoring (2000)* by the Department of Water.

3.7.2 Monitoring Phases

There are three distinct phases of hydrological monitoring:

- Baseline monitoring to establish pre-mining quantity and quality levels.
- Operational monitoring, during the active mining period.
- Post-mining monitoring, after the mine has been decommissioned.

Baseline monitoring

Targets for assessing performance are heavily dependent on baseline data and a set of key indicators measuring the natural variability of climate and water quality prior to Project development.

Operational monitoring

Operational water monitoring will be undertaken for environmental and operational purposes. Iterations may be required to the Water Management Plan if the monitoring results reveal that performance indicators have not been correctly set. The water resources monitoring programme includes analysing pH and EC, acidity, soluble metals and soluble sulphate concentration on a quarterly basis (or opportunistically following significant rainfall events) during the operational phases of the Project. The frequency and range of analyses should be reviewed on an annual basis to ensure that it remains appropriate.

Post-mining monitoring

The water resources monitoring programme will continue after mine closure until agreed closure criteria have been met. Monitoring of surface water and groundwater will demonstrate that quality management strategies have been effective and that quality is within the agreed standards.

As the mine will not be manned after closure, most of the monitoring will be automatic/remotely accessed or conducted at a low frequency.

3.7.3 Proposed Monitoring Programme

Monitoring of water resources will be conducted in accordance with the *Environmental Protection Act 1986* License, the *Rights in Water and Irrigation Act 1914* Licenses and the CWC Groundwater Operating Strategy. The monitoring commitments are shown in Table 3-9.

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Table 3-9 Summary of the Monitoring Programme

Domain	Parameter	Location	Frequency	Timing
Climate	Rainfall	Project Office	Continuous	Operations
	Evaporation	Project Office	Weekly	Operations
	Other meteorological parameters including, wind speed and direction, humidity, barometric pressure, and temperature	Project Office	Daily	Operations
Surface Water courses	Flow rates in water courses above and below the mine, esp Erindoon Ck, Bindoon Ck.	Surface water catchments, drains on-site	Weekly following major rainfall events, when flowing or monthly otherwise.	Operations
	Water Quality	Surface water flows	Monthly, following major rainfall event Annual	Operations
Drainage lines	Sediment Quality	Areas above and below the site	Annual	Operations
Mine site	Groundwater Levels beneath the mine and within the drawdown zone	Monitoring Bores	Monthly	Operations
	Groundwater Quality beneath the mine, near the drawdown zone, and downstream of the drawdown zone.	Monitoring Bores	Monthly, then reviewed after three months Monthly, then review to Annual	Operations
Water Use Efficiency	Water Use Efficiency	Calculate	Quarterly	Operations
	Implementation of Water Management Initiatives	Onsite	Quarterly	Operations
	Site water balance to include all water production, usage, and losses, including inflows to the project area, and outflows (to Lake Indoon).	Onsite	Quarterly	Operations

3.8 Contingency Actions

The design of some infrastructure such as drainage capacity is based on 1:100 year ARI rainfall events. It is still possible that this ARI interval is exceeded in extreme weather. In such situations, the infrastructure may not function as expected.

Under such circumstances, contingency plans may have to be implemented. Examples of contingency plans, possible trigger conditions and responsible personnel are outlined in Table 3-10 below.

Table 3-10 Contingency Plans

Trigger Condition	Contingency Action	Responsible Personnel
Surface water quality exceeding tolerance limit.	Corrective measures to improve water quality which may be one or a combination of the following actions: (a) lime to correct the pH to within the acceptable range; and (b) desilting of silt traps and detention ponds on site.	General Manager
Groundwater levels in observation bores exceed expected drawdown levels	Review modelling of groundwater behaviour Investigate potential GDEs for any impacts of excessive drawdown Re-adjust the abstraction regime to ensure acceptable drawdown	General Manager
Groundwater quality trends adverse	Review modelling of groundwater behaviour. Determine cause and instigate remedial action.	General Manager

4.1 Current Status

The Project's footprint will encompass 1,700 ha, with 860 ha of native vegetation to be cleared for the mine and supporting activities.

4.1.1 Vegetation

A total of 15 plant communities were recorded on 861 ha within the project area. All of these plant communities extend outside the project area. However, the extent of these communities in the region have been modified by agricultural activities and mining activities.

4.1.2 Flora

A total of, four Priority 2 (P2), eight Priority 3 (P3) and four Priority 4 (P4) taxa were recorded within the project area, as shown below.

- *Acacia lasiocarpa* var. *lasiocarpa* Cockleshell Gully variant (P2).
- *Calytrix purpurea* (P2).
- *Comesperma rhadinocarpum* (P2).
- *Verticordia argentea* (P2).
- *Acacia flabellifolia* (P3).
- *Calytrix superba* (P3).
- *Grevillea biformis* subsp. *cymbiformis* (P3).
- *Haemodorum loratum* (P3).
- *Hemiandra* sp. Eneabba (H. Demarz 3687) (P3).
- *Mesomelaena stygia* subsp. *deflexa* (P3).
- *Schoenus griffinianus* (P3).
- *Verticordia fragrans* (P3).
- *Calytrix eneabbensis* (P4).
- *Georgeantha hexandra* (P4).
- *Stylidium aeonioides* (P4).
- *Verticordia aurea* (P4).

4.1.3 Groundwater Dependent Ecosystems

Ecosystem dependence on groundwater is affected by a range of factors, but vegetation studies in WA have shown that groundwater dependence is most closely related to groundwater depth and the presence of surface water. In general, the greater the water depth, the lower the inferred dependency and the more tolerant the vegetation is to groundwater fluctuations.

An assessment of the probability that vegetation within and adjacent to the project area would be groundwater dependent was conducted. Two of the vegetation types within the survey area may have a larger dependence on groundwater, but it is considered that there is a low probability that these would be GDEs. (Mattiske, 2009)

4.1.4 Dieback

Phytophthora cinnamomi (P. cinnamomi) is an introduced soil-borne water mould that causes a disease known as “dieback”, which leads to the death of a vast and diverse range of plant species in south-west WA. The disease enters through the plant roots, gradually breaking down the structure of the roots, and ultimately causing the roots to rot. As a result, the vascular system is no longer able to transport water and nutrients to the rest of the plant (Glevan, 2007).

P. cinnamomi has the greatest and most widespread impact in areas where the average annual rainfall exceeds 600 mm. However, in WA, disease may also occur in stream zones and water-gaining sites in the 400-600 mm zones. There is no record of *P. cinnamomi* establishing in natural ecosystems in regions receiving less than 400 mm annual rainfall (CALM, 2003).

According to mapping by CALM (2003), now incorporated into the DEC, the Mid West region is located in the zone with annual average rainfall of 400-600 mm, and contains some known locations of dieback.

The long-term average annual rainfall is 502.8 mm, and data over the last seven years range from 489 mm maximum in 2003 to 307 mm minimum in 2007. This indicates that the project area may be susceptible to dieback, but would likely be marginal to the survival of the *P. cinnamomi* pathogen. It would therefore be expected that the disease expression throughout the majority of the project area would be episodic rather than progressive disease expression observed in areas of higher rainfall. This expression may be impacted by localised conditions, such as water gaining sites or areas with a higher water table.

4.2 Potential Impacts

4.2.1 Clearing Impacts on Plant Communities of Conservation Significance

The only vegetation type of conservation interest that will be affected by clearing is the H1 heath community (Mixed heath of *Melaleuca leuropoma* with emergent *Banksia* species with occasional *Eucalyptus todtiana* and *Actinostrobus arenarius* on sand with exposed lateritic rises), as it includes pockets of lateritic rises, which may overlap with the Threatened Ecological Community (TEC [ferricrete floristic community - Rocky Spring type]). There are 49.3 ha of this community in the project area.

However, the flora and vegetation assessment determined that the majority of the flora recorded in the Rocky Spring Ferricrete communities are represented elsewhere. In addition, the ferricrete layer extends well beyond the designated Rocky Spring TEC location. It is also important to note that the Project does not impact directly on the listed Rocky Springs TEC, which is shown on Figure X.

4.2.2 Clearing Impacts on Flora of Conservation Significance

Individual specimens belonging to species with a priority categorisation in the project area will be avoided, where possible, however it is probable that the majority of individuals will be cleared as a result of the Project. However, the impact of the clearing of these species is anticipated to be minimal as all species are known to occur elsewhere outside the project area.

4.2.3 Additional Impacts

In addition to clearing, vegetation within the project area could be affected by:

- Groundwater drawdown (see below);
- Changes to surface water patterns;

- Increase in human-induced wild fire episodes;
- Deposition of dust and other air emission constituents;
- Weed development; and
- Potential spread of dieback (see below).

Groundwater drawdown

Two of the plant communities recorded within the area subject to groundwater table drawdown may have a larger dependence on groundwater, but it is considered that there is a low probability that these would be GDEs (Mattiske, 2009). These plant communities are:

- **T4 -** Thicket or Scrub of *Melaleuca rhaphiophylla* and *Melaleuca lanceolata* over sedges and rushes on low-lying sandy loams. This vegetation type was recorded in the northern part of the proposed project area. The T4 plant community appears to be restricted to areas within the mine footprint and in the Lake Logue Nature Reserve, where the pre-mining watertable is between 5 m and 10 m from the ground surface. In the shallower areas (5 m to groundwater), plant community T4 is significantly degraded, suggesting that elevated groundwater may be adversely affecting the deeper rooted species present.
- **E3 –** Woodland and open woodland of *Eucalyptus camaldulensis* var. *obtusa* over *Melaleuca viminea* subsp. *viminea, Acacia saligna, Melaleuca lateriflora* subsp. *acutifolia* and *Macrozamia fraseri* on sandy loam. This plant community was recorded in the southern part of the survey area and outside of the project area. The E3 plant community is recorded in an area where the pre-mining watertable is greater than 20 m from the natural ground surface, suggesting that groundwater would be in the form of perched groundwater or soil moisture not supported by underlying aquifers.

Dieback

Three discrete dieback infestations have been identified in the northern project area and are illustrated in . Figure X. (Glevan, 2007). A further infestation is known to exist outside the Project area, in the lake Logue Nature Reserve.

The main issue regarding dieback is the spread of the disease into un-infested areas of vegetation, including the nearby nature reserves (South Eneabba and Lake Logue). There is potential for the disease to spread as a result of natural processes or human activities. This could potentially occur in either of two ways:

1. There is potential for the dieback pathogen to be transported across any areas that are subject to flooding, such as water gaining sites or areas with a higher water table.
2. Vehicles and road building machinery brought to site may contain infested soil or plant material, either from travelling through dieback infested areas adjacent to the project area or from other infested areas off-site.

The spread of dieback has the potential to severely impact vegetation as it can cause the death of a vast and diverse range of plant species, affecting the abundance, diversity, geographic distribution and productivity of flora.

The rainfall of the area indicates that the area would likely be marginal to the survival of the *P. cinnamomi* pathogen. It is therefore likely that the risk of dieback spread would be low. Additionally, it is expected that if the disease were to spread into the project area or nearby nature reserves, the disease would occur in episodes rather than as progressively spreading, as experienced in areas of higher rainfall.

Section 4 Flora and Vegetation Management Plan

4.3 Environmental Objectives

The objectives for this Project are to:

- Minimise the impacts on the abundance, species diversity, geographic distribution and productivity of plant communities, including GDEs;
- Protect flora of conservation significance, where practicable; and
- Minimise the potential spread of dieback associated with Project activities.

4.4 Performance Indicators

The performance indicators relevant to flora and vegetation comprise the following:

- Abundance and condition of known Priority Flora populations.
- Vegetation health in areas where ground water dependency is suspected, esp downstream.
- Stability of rehabilitated landforms.
- Revegetation density, cover and species composition.
- Diversity and abundance of introduced weed species.

These criteria will be assessed against predetermined analogue sites outside the project area.

Rehabilitation programmes implemented by CWC will aim to advance techniques likely to result in an improvement in the rehabilitation rate and outcome. Performance indicators will then be reviewed as the knowledge base improves. Performance indicators will also be reviewed every three years, or as monitoring requires.

A summary of performance indicators and targets is shown in Table 4-1.

Table 4-1 Performance Indicators and Targets

Performance Indicator	Site	Target (site averages)		
Abundance and condition of known Priority Flora populations.	Within project area – in undisturbed permanent monitoring plots	No significant decrease in the abundance and condition of known Priority Flora populations not affected by clearing operations over the life of the mine.		
Stability of rehabilitated landforms.	Waste rock dump	To be determined once baseline stability assessments have been conducted on landforms within the project area.		
Revegetation density, cover and species composition.	Within project area – in rehabilitation monitoring plots	**During Year 1**	**During Year 3**	**During Year 8**
		Average target of >1% of projected foliage cover of local native species. Average species diversity >5% of analogue sites.	Average target of >10% of projected foliage cover of local native species. Average species diversity >30% of analogue sites.	Average target of >50% of projected foliage cover of local native species. Average species diversity >50% of analogue sites.
Vegetation Health where groundwater drawdown may affect GDE's	Down stream of the project area, Erindoon Ck, and Lake Indoon	**<10% change relative to baseline/control quadrats**	**<10% change relative to baseline/control quadrats**	**<10% change relative to baseline/control quadrats**
Diversity and abundance of introduced weed species.	Within project area – in rehabilitation monitoring plots	**During Year 1**	**During Year 3**	**During Year 8**
		Weeds provide <50% increase in pre-disturbance projected foliage cover.	Weeds provide <30% increase in pre-disturbance projected foliage cover.	Weeds provide <10% increase in pre-disturbance projected foliage cover.
	Within project area – in undisturbed permanent monitoring plots	No significant increase in the diversity or abundance of introduced weed species due to mining activities over the life of the mine.		

Section 4 Flora and Vegetation Management Plan

4.5 Management Actions

4.5.1 General Management

The key management measures are as follows.

Vegetation

The key management measures are as follows:

- Clearance of native vegetation will be restricted to the project area.
- Access to all non-operational areas will be restricted and personnel shall remain on designated roads and tracks.
- Topsoil and vegetation will be respread as soon as possible to assist in rehabilitation programs.
- As many of the flora species are susceptible to the dieback fungal disease (*P. cinnamomi*) vehicle hygiene will be maintained at all times and a vehicle (including light and heavy vehicles) will be established on site. Vehicles that arrive on site will not access site unless clean and cleared for access.
- Undertake monitoring and assessments regarding vegetation, GDEs and drawdown.

Priority flora species

- Avoid populations of priority flora species wherever possible.
- Clearance of native vegetation will be restricted to the construction project area.
- Seeds and propagules of priority flora species will be collected and stored for future research needs to assist in their re-establishment in rehabilitation areas.
- Further field studies will be undertaken during the operation phase to assist in locating further populations of the species offsite.
- Access to all non-operational areas will be restricted and personnel shall remain on designated roads and tracks.
- As many of the flora species are susceptible to the dieback fungal disease (*Phytophthora cinnamomi*) vehicle hygiene will be maintained at all times.
- Topsoil and vegetation will be respread as soon as possible to assist in rehabilitation programs.
- Rehabilitation programs will include trials on Flora species.

Completion Criteria

- Completion criteria will include coverage Priority Flora species.

4.5.2 Additional Weed Management Actions

CWC recognises that the proposed Project has the potential to cause weed infestations in the surrounding environment. Impacts related to weeds may include:

- An increase in abundance of weeds within the project area;

- Introduction of new weed species to the project area;
- An increase in weed abundance in areas adjacent to the project area; and
- Introduction of new weed species to regions adjacent to the project area.

There are a number of mechanisms whereby new species may be introduced to the project area or re-introduced following their eradication. These mechanisms include natural introduction (e.g. feral animals, birds and wind) or deliberate and accidental introductions (e.g. shade trees, lawns, plant matter and soil).

All weed species found within the project area are common within the region. Therefore, given the range of predicted constraints (weed control technology, manpower, funding) it may be necessary to identify those species which pose a particular problem (threat) to the region's ecology or accepted uses in order to assign priorities for their control/eradication.

In contrast to their potential negative impacts, weeds may have a positive effect by reducing soil erosion in the initial stages of rehabilitation. Therefore, a monitoring programme may be required to determine whether weed species are a positive or negative attribute to the rehabilitation process. If negative, there is a need to identify the most threatening of the weed species and what methods need to be implemented in order to decrease their effect. The rapid identification of weeds will facilitate eradication and provide information that will lead to the prevention of future occurrences.

The following monitoring procedures will be implemented:

- Permanent monitoring sites will be identified and surveyed to map the type, location, extent and density of weed species present, within and adjacent to the disturbance areas.
- Weeds will be monitored in conjunction with the permanent site vegetation monitoring programme. This involves the monitoring of permanent vegetation plots to measure the abundance and diversity of weed species (and a number of other factors) throughout the project area. These permanent monitoring plots will generally be located in two different areas. These areas include:

    1. Disturbance areas. These plots will be located within the project area and are designed to provide data on the abundance and diversity of weed species at sites prior to mining. Once these plots have been cleared and rehabilitation has occurred, these plots will be re-established at the same GPS locations and then used to assess the abundance and diversity of weeds within the rehabilitation area.
    2. Adjacent areas. These plots will be located outside of the project area. These plots will provide data on the abundance and diversity of weed species at sites not physically disturbed by the mining process. Given their close proximity to the rehabilitation sites, monitoring of these plots will provide early identification of an increase in abundance and diversity of weed species within undisturbed sites. Any significant increase in abundance or diversity of weed species may trigger contingency actions.

- In addition to the permanent weed monitoring plots, opportunistic visual site inspections will be undertaken to check for weed outbreaks.

Further weed control methodology will be detailed in the site EMS, which will be developed prior to operations. The DEC will be consulted during the design of the weed management aspects of this document.

4.5.3 Dieback

The key management measures for dieback are as follows:

- All machinery entering the project area will be free of soil, gravel and plant material.
- Any uncleaned machinery will be cleaned at a hygiene point to be positioned at the project area entrance.
- Any fill required will be sourced from dieback disease free areas and transported in cleaned vehicles.
- Dieback assessments will continue to be undertaken throughout the life of the Project.
- The CALM *Phytophthora cinnamomi* Management Guidelines will be adopted as part of the dieback management strategies in the Project Flora and Vegetation Management Plan.
- Access to non-essential tracks will be discouraged by signs and/or physical barriers.
- Access to nature reserves will be prohibited, except for any requirements to undertake monitoring, where prior approval from the DEC will be sought.
- Any tracks used within the project area will be well drained with culverts installed to prevent any water flow from adjacent disease infested areas running over the road. If this is not possible, roads will be closed in moist-soil conditions, or wash-down facilities will be installed on both sides of the affected road surface.
- The on-site induction will advise contractors and employees of the current dieback mitigation processes.
- Central West Coal Pty Ltd will liaise with Iluka in regards to management measures and any known infestations at the two sites.

Table 4-2 shows the implementation plans for vegetation and flora management. The management actions are grouped under the environmental and operational objectives which they are designed to achieve. The management actions can be in the forms of on-ground actions (e.g. fencing of flora) and operational rules.

Table 4-2 Management Actions, Timing and Responsibility for Achievement of Objectives

Objectives	Management Action	Responsible Personnel	Timing
Protect flora of conservation significance, where practicable	Priority Flora species will be marked using flagging tape.	General Manager	Prior to ground disturbing activities
	The baseline vegetation map showing the locations of all Priority Flora populations within the project area will be updated to include any populations cleared or disturbed due to clearing activities and any populations re-established through revegetation.	General Manager	Prior to ground disturbing activities/ construction/operations/ rehabilitation
	A permit system will be established to avoid any unauthorised vegetation clearing. Flagged and mapped Priority Flora populations will be avoided during clearing activities where possible.	General Manager	Construction/operations/ rehabilitation
	A research programme will be initiated into the protection, conservation and rehabilitation of Priority Flora species impacted by operations, including but not limited to: • Seed bank methodology; • Germination ecology; • Restoration technology for taxa where seeding or propagation of cuttings fails; • Restoration ecology for reinstatement of the species.	SHE Manager	Construction/operations/ rehabilitation
	Seed will be collected from dominant Priority Flora species in plant communities prior to clearing where practical.	Project Director/ General Manager	Prior to clearing activities
	Investigate measures to include Priority Flora and conservation species in rehabilitation programs.	Project Director/ General Manager	Construction/operations
	Investigate options of avoiding populations of Priority Flora and conservation species along the access roads.	Project Director/ General Manager	Prior to clearing activities

Section 4 Flora and Vegetation Management Plan

Objectives	Management Action	Responsible Personnel	Timing
Minimise the impacts on the abundance, species diversity, geographic distribution and productivity of plant communities	The extent of the proposed clearing will be clearly marked by flagging tape.	General Manager	Prior to ground disturbing activities
	Equipment will be placed on flattened vegetation rather than clearing if practical.	Project Director/ General Manager	Construction/operations/ rehabilitation
	Maps will be produced that detail areas to be cleared, including the timing of the clearing operations and areas rehabilitated. These maps will be updated on a regular basis.	General Manager	Prior to ground disturbing activities
	Cleared areas and associated maps will be regularly audited to ensure adherence to the plan.	SHE Manager	Construction/operations/ rehabilitation
	Growth media will be stored in stockpiles less than 2 m in height. The stockpiles will be located a minimum of 5 m from any existing trees and shrubs if possible, and will be revegetated or may be covered with an emulsion or cover crop to help stabilise the soil, combat wind erosion and maintain soil viability as much as possible.	Project Director/ General Manager	Construction/operations/ rehabilitation
	Cleared vegetation, where practical, will be directly returned to rehabilitation areas. This helps to protect seeds, seedlings and soil against wind erosion. Where cleared vegetation is to be stored for future rehabilitation, the dozer blade/fork/rake will be raised slightly above the soil surface in order to preserve rootstock. Cleared vegetation will not be burnt but stored in separate piles to topsoil, subsoil or overburden.	Project Director/ General Manager	Construction/operations/ rehabilitation
	Rehabilitation will be conducted progressively.	Project Director/ General Manager	Construction/operations/ rehabilitation
Minimise the impacts on the abundance, species diversity, geographic distribution and productivity	All employees and contractors shall undergo site specific environmental awareness training during inductions. This will include information pertinent to the management of flora and vegetation in the surrounding area, and PF and their legal obligations under the Wildlife Conservation Act 1950.	Project Director/ General Manager	Construction/operations/ rehabilitation

Objectives	Management Action	Responsible Personnel	Timing
of plant communities (Cont.).	Off-road recreational activities, including off-road use of vehicles, will be strictly prohibited.	Project Director/ General Manager	Construction/operations/ rehabilitation
	Tracks will be closed off or access restricted by signage where tracks are not currently needed.	Project Director/ General Manager	Construction/operations/ rehabilitation
	Existing tracks will be utilised where possible.	Project Director/ General Manager	Construction/operations
Minimise the likelihood of introduction of dieback pathogens into the project area	Vehicle hygiene will be maintained at all times and a vehicle wash facility (including light and heavy vehicles) will be established on site. Vehicles that arrive on site will not access site unless clean and cleared for access.	Project Director/ General Manager	Construction/operations

4.6 Monitoring

CWC will implement a monitoring programme to assess the impact of the Project on flora and vegetation with, and adjacent to, the project area. Monitoring will be conducted to determine:

- If adverse impacts are occurring as a result of groundwater drawdown and seepage from the water rock dump, and evaporation and storage ponds.
- The progress of the rehabilitation programme.

Permanent vegetation plots will be established within the potential zone of impact as well as in unaffected areas.

Monitoring of flora and vegetation within undisturbed areas, both within the project area and within the survey area, will be conducted. Should the performance indicators in Section 4.4 not be achieved, contingency actions may need to be implemented. These actions will be dependent on the monitoring programmes identified within the Water Management Plan and Acid Rock Drainage Management Plan, and the follow-on contingency actions within these plans.

4.7 Contingency Actions

Should the performance indicators not be achieved, contingency actions may need to be implemented.

Failure to achieve each performance indicator may initiate the following contingency actions:

- Abundance and condition of known Priority Flora populations.
  - Direct transplant of conservation significant flora, if possible.
  - Seeding of rehabilitated areas, including conservation significant flora seed.
- Health of plant communities where groundwater drawdown may be a factor in plant health
  - Investigation to confirm trends
  - Possible watering/flooding of affected areas
  - Other measures
- Stability of rehabilitated landforms.
  - Rehabilitated soil profile testing (e.g. soil compaction, soil moisture etc.).
  - Use of emulsions for soil stabilisation.
  - Mulching of returned vegetation.
  - Cover crops.
  - Re-assess engineering designs of landforms.
- Revegetation density, cover and species composition.
  - Seed treatment.
  - Propagation and direct planting of seedlings.

  - Herbivore proof fencing.
  - Herbivore control.
  - Fertilisers.
  - Refine seed mixture.
  - Dominant species control.
  - Modification of groundwater abstraction programme.
- Diversity and abundance of introduced weed species.
  - Weed monitoring and eradication in disturbed areas.
  - Fire management.

5.1 Current Status

5.1.1 Vertebrate Fauna

Two vertebrate fauna surveys have been conducted by *ecologia* Environment (*ecologia*) to provide an assessment of the vertebrate fauna assemblage and fauna habitats within, and adjacent to, the project area. These surveys comprised a Level 2 survey in Spring 2007, and a Level 1 survey in Autumn 2008, in accordance with EPA Guidance Statement No. 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2004) and the principles set out in EPA Position Statement No. 3 - Terrestrial Biological Surveys as an Element of Biodiversity Protection in Western Australia (EPA, 2003a). A definition of conservation value categories is provided in Appendix A.

The surveys recorded:

- 11 native mammal species.
- Four introduced mammal species.
- 31 bird species, of which three are of conservation significance.
- 22 reptile species, of which one is of conservation significance.
- Three amphibian species.

Potentially occurring fauna

Desktop studies conducted prior to the surveys identified an additional 10 species of conservation significance which may occur in the project area, but were not recorded during the surveys. These comprise eight bird species and two reptile species, which are described in Table 5-1.

Section 5 Terrestrial Fauna Management Plan

Table 5-1 Potentially Occurring Vertebrate Fauna

Species	State Level	Federal Level	Distribution	Project area Presence
Australian Bustard (*Ardeotis australis*)	DEC Priority 4		Heathlands in the south of Western Australia.	Not recorded. There are a number of historic records in the region.
White-browed Babbler (*Pomatostomus superciliosus ashbyi* - western wheatbelt subspecies)	DEC Priority 4		Thickets of mulga, wattle and acacia as well as uncleared road verges in farmlands.	Not recorded. Has been previously recorded in the region.
Crested Bellbird (*Oreoica gutturalis*)	DEC Priority 4		Open banksia scrubs and heathland.	Not recorded. Crested Bellbirds have frequently been recorded in the region, and in the Eneabba area.
Brush Bronzewing (*Phaps elegans*)	DEC Priority 4		Dense shrublands with significant vertical vegetation structure and access to water in the South West of WA.	Not recorded. Records exist of Brush Bronzewings in the nearby Iluka mine site and Southern Beekeepers Reserve.
Hooded Plover (*Charadrius rubricollis*)	DEC Priority 4		Coastal areas, estuaries and salt lakes.	Not recorded. Were recorded at Eneabba in 2006.
Fork-tailed Swift *Apus pacificus*		EPBC Act Migratory	Spends winter in Australia after breeding in Mongolia.	Not recorded. Previously been recorded from the Lesueur area.

Table 5-1 (continued)

Species	State Level	Federal Level	Distribution	Project area Presence
Peregrine Falcon (*Falco peregrinus*)	WAWC Act Schedule 4		Cliffs along the coast, rivers, ranges, wooded watercourses and lakes, and will nest primarily on cliff ledges, granite outcrops and in quarries. Peregrine.	Not recorded. Falcons have been recorded in the region.
Eastern Great Egret (*Ardea alba*)		EPBC Migratory	Most commonly found in both fresh and saline shallow waters.	Not recorded. Has been recorded in the region.
Woma (*Aspidites ramsayi*) (south-west population)	WC Act Schedule 4; DEC Priority 1		Prefers woodlands, heaths and shrublands on sandplains. Several populations have been identified across Australia, including the south-west population.	Not recorded. Has a range that covers the project area
Gilled Slender Blue-tongue (*Cyclodomorphus branchialis*)	DEC Vulnerable; WC Act Schedule 1		Found in semi arid shrublands in an area between the Murchison and Irwin Rivers.	Not recorded. This species has previously been recorded in the area.
Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*)	WC Act Schedule 1	EPBC Act endangered	Known to live in proteaceous scrubs and heaths, eucalypt and pine forests. Mainly feed in shrubland or kwongan heath.	26 individuals were seen feeding on Banksia sp. during the Level 1 survey.

Table 5-1 (continued)

Species	State Level	Federal Level	Distribution	Project area Presence
Rainbow Bee-eater (*Merops ornatus*)		EPBC Act Migratory	Migrates within Australia and up to Indonesia and New Guinea.	Recorded.
Rufus Fieldwren (*Calamanthus campestris montanellus*, western wheatbelt population)	DEC Priority 4		Heath and low shrubland on sandplains, lateritic ridges and saltmarsh or samphire, with or without emergent trees.	Recorded in kwongan heath in two southern areas of the mine project area, and in the South Eneabba Nature Reserve.
Black Striped snake (*Neelaps calonotos*)	DEC Priority 3		Preferred habitat comprises dunes and sandplains vegetated with heaths and eucalypt/banksia woodlands between Mandurah and Lancelin.	Recorded.

Commonwealth Protected Fauna

Two species known to occur in the vicinity of the project area are protected under the EPBC Act, as follows:

- **Carnaby's Black-Cockatoo** – is listed as endangered under the EPBC Act and as a Schedule 1 species under the WC Act. This species has been recorded in previous studies in the region, and is known to live in proteaceous scrubs and heaths, eucalypt and pine forests. The species mainly feed in shrubland or kwongan heath, foraging on seeding proteaceous species. It is estimated that the total wild population has declined by 50% in the past 45 years and is now likely to be approximately 40,000. Factors contributing to the decline in numbers include habitat fragmentation, clearing of heathland surrounding breeding sites, poaching of eggs and young and invasive species such as the Galah and the Western Long-billed Corella, which compete for nest hollows. Carnaby's Black-cockatoo was recorded in the South Eneabba Nature Reserve once during the Level 2 Survey, while 26 individuals were seen feeding on Banksia sp. in the during the Level 1 survey. As the vegetation in the nature reserve is similar to the adjacent natural vegetation of the Central West Coal project area, Carnaby's Black-Cockatoos are likely to use both areas for feeding. Therefore, Carnaby's Black-Cockatoos are likely to be seasonal but regular visitors to the project area, feeding in remnant native vegetation after moving from inland breeding areas (such as Three Springs and Carnamah) to non-breeding, feeding areas closer to the coast.

- **Rainbow Bee-eater** – is listed as Migratory under the EPBC Act. This species has been recorded from multiple surveys in the Eneabba region, and are generally common in the region. This species migrates within Australia and up to Indonesia and New Guinea, and is found almost anywhere suitable for obtaining insects. Breeding occurs in both New Guinea and Australia between the months of October and December. The nests are burrows which are dug, usually at a slight angle, on flat ground, sandy banks or cuttings, and often at the margins of roads or tracks. It is expected that the individuals recorded during the surveys of the project area are breeding visitors, due to the timing of the survey and the sandy soil types of the region that are suitable for nest burrows.

Desktop surveys have identified that two other species listed under the EPBC Act may also occur in the project area. These are:

- **Fork-tailed Swift** – are a migratory species that spends winter in Australia after breeding in Mongolia and China. Fork-tailed Swifts have previously been recorded from the Lesueur area and are attracted to thunderstorms. Due to the aerial lifestyle and migratory nature of this species, it is expected to be an infrequent visitor that would not directly utilise the fauna habitats of the project area.

- **Eastern Great Egret** – are most commonly found in both fresh and saline shallow waters neither of which are found in the project area. This species has been recorded in the region, but due to a lack of suitable habitat it is unlikely to be present in the project area.

State Protected Fauna

The fauna surveys also identified a further two vertebrates that are gazetted under the DEC Priority Fauna List. These are:

- **Rufous Fieldwren** – the western wheatbelt subspecies of the Rufous Fieldwren prefers heath and low shrubland on sandplains, lateritic ridges and saltmarsh or samphire, with or without emergent trees. This species breeds between July and October in ground-level globular dome shaped nests. This species of Rufous Fieldwren was once widespread across most of the south west of Western Australia, but is now restricted to remnant vegetation due to clearing. The Rufous Fieldwren was recorded in kwongan heath in

two southern areas of the mine project area, and in the South Eneabba Nature Reserve. It is expected that the individuals recorded are post-breeding residents occupying territories in the remnant vegetation.

- **Black-striped Snake** – this has previously been recorded between Mandurah and Lancelin, with a single specimen recorded from Port Denison (70 km south of Geraldton). Therefore, this record is approximately 200 km from the nearest previous record. This species is rarely seen, and its preferred habitat comprises dunes and sandplains vegetated with heaths and eucalypt/banksia woodlands. This snake is locally abundant on the Swan Coastal Plain but is considered threatened due to the continued clearance of banksia woodlands near Perth. The Black-striped Snake is expected to occur throughout the heathy sandplains surrounding the project areas.

Desktop surveys have identified an additional eight vertebrate species likely to occur in the project area but were not recorded during fauna surveys that are gazetted under the Wildlife Conservation Act or DEC Priority Fauna List. These are:

- **Australian Bustard** – are large nomadic birds that utilise a number of open habitats, including heathlands in the south of Western Australia. There are no recent records of the Australian Bustard from Eneabba; however, there are a number of historic records in the region. It is possible that the species could use the open vegetation, particularly the cleared agricultural land and regenerating heath, within the Central West Coal project area and the adjacent South Eneabba Nature Reserve.

- **White-browed Babbler** – this species is most often found in thickets of mulga, wattle and acacia as well as uncleared road verges in farmlands, and more than 50% of its former habitat has been cleared for agriculture. The White-browed Babbler has been previously recorded in the region. No suitable habitat was identified within the project area, although vegetation with sufficient structural complexity was observed nearby.

- **Crested Bellbir –** the Crested Bellbird is listed as a conservation significant species due to the contraction of its current range to less than 50% of its past distribution. Crested Bellbirds have frequently been recorded in the region, and in the Eneabba area occur on open banksia scrubs and heathland. Crested Bellbirds are likely to occur in the few parts of the project area that have adequate trees and shrubs, and are less likely to occur in very open, largely treeless areas and in South Eneabba Nature Reserve.

- **Brush Bronzewing** – formerly widespread across the south west of Western Australia, the Brush Bronzewing is now locally extinct across much of this range. This species prefers dense shrublands with significant vertical vegetation structure and access to water, which is not found within the project area. However records exist of Brush Bronzewings in the nearby Iluka mine site and Southern Beekeepers Reserve.

- **Hooded Plover** – are restricted to coastal areas, estuaries and salt lakes and were recorded at Eneabba in 2006. However, they are not expected to occur within the project area due to a lack of suitable habitat.

- **Peregrine Falcon** – the Peregrine Falcon breeds on all continents except Antarctica. Australia is considered one of the strongholds of the species, as numbers have declined in many other parts of the world. Peregrine Falcons commonly prefer cliffs along the coast, rivers, ranges, wooded watercourses and lakes, and will nest primarily on cliff ledges, granite outcrops and in quarries. Peregrine Falcons have been recorded in the region. No potential breeding sites are present in or near the project area but the species may utilise the project area for foraging.

- **Woma** – this python is a moderately large snake that prefers woodlands, heaths and shrublands on sandplains. Several populations have been identified across Australia, including the south-west population,

which has a range that covers the project area. However, this population has not been recorded since 1989. Clearing of much of its natural habitat and predation by foxes and cats has resulted in a major population decline. Suitable habitat in the form of heath on sand plains is present within the project area, but due to its scarcity and the prevalence of introduced predators in the project area it is unlikely to be present.

- **Gilled Slender Blue-tongue** – is a large skink found in semi arid shrublands in an area between the Murchison and Irwin Rivers. This species has also previously been recorded in the area. Due to the close proximity of these records and the suitable habitat in the Central West Coal project area, it is likely that the Gilled Slender Blue-tongue could potentially occur. However, if a population is present, it is likely this would have experienced a large population decline due to the large-scale burn in 2005.

Native mammals

Eleven species of native mammal were recorded during the survey, comprising three dasyurids (*Sminthopsis crassicaudata*, *S. dolichura* and *S. granulipes*), two macropods (*Macropus robustus* and *M. fuliginosus*), three bats (*Chalinolobus gouldii*, *Nyctophilus geoffroyi* and *Vespadelus regulus*), one rodent (*Pseudomys albocinereus*), the Honey Possum (*Tarsipes rostratus*) and the Echidna (*Tachyglossus aculeatus*). No mammal species of conservation significance were recorded during the surveys.

Introduced Mammals

Four species of introduced mammal were recorded within the project area. These were the fox (*Vulpes vulpes*), cat (*Felis catus*), rabbit (*Oryctolagus cuniculus*) and house mouse (*Mus musculus*).

Habitats of significance

Approximately half of the project area contains remnant native vegetation, while the other half is disturbed land considered to be of little value as fauna habitat. No particularly significant individual habitat was located within the project area.

As vertebrate fauna habitat, the vegetation is relatively uniform, whereas the soil substrate varies from lateritic uplands to sandplains. Therefore, the presence of burrowing fauna within the different habitats is expected to vary accordingly. A few burrowing species were recorded during the study, but none of these species were recorded at the site characterised by a hard lateritic ridge. It is therefore likely that these landforms may represent a significant barrier to burrowing species.

5.1.2 Invertebrate Fauna

Two surveys have been undertaken by *ecologia* to identify invertebrate fauna within the project area. The surveys focused on SRE fauna, which are species that exhibit tight local range restrictions due to habitat and physiological factors. Such factors that limit the species' range might include life history, physiology, habitat requirements and availability, biotic and abiotic interactions, historical conditions and the ability and opportunity to disperse. SREs typically refer to species with distributions up to 10,000 km^2, SRE invertebrates are more common than SRE vertebrates because of their small size and often socialised behaviour. Due to these poor dispersal capabilities and their preference for specific or specialised environmental characteristics, SREs are sensitive to changes in their environment.

ecologia's first survey was carried out between April and May 2008 and covered the Central West Coal Project footprint as well as the adjacent Coolimba Power Project footprint. A total of 20 sites were sampled during this period using conventional trapping and foraging techniques. Specific areas were targeted which covered a

range of habitats. Species found were collected and subsequently sent to the laboratory for specialised identification.

A follow-up foraging survey was then undertaken at a later stage in the season (27-30 September 2008) which was designed to confirm some of the conclusions derived from the first visit. The site surveys trapped flightless arthropods representing five Arthropod orders from 12 of the 20 trap and foraging sites, three of which are in areas currently planned for development (AV01, AV05, AV09) and two sites are adjacent to development areas (AV3 and AV4).

Of the species collected three species of conservation significance were collected. These were an undescribed species of scorpion from the *Urodacus* genus, an unknown species of *Bothryembrion* snail and an unknown species of millipede from the *Antichiropus* genus.

Figure X presents the locations of the samples that returned positive identifications. The findings are summarised in Table 5-2.

Table 5-2 Site Survey Results

Specimens collected		Quantity of sites	
		Within footprint	External to footprint
Arachnids	Trap-door spiders – Sub-order Mygalomorphae, Family Actinopodidae, actinopodid species, genus *Missulena*) (SRE status unknown)	X	X
	Family Barychelidae (SRE status unknown)	X	X
	Family Idiopidae (SRE status unknown)	X	X
	Family Nemesiidae (SRE status unknown)	X	X
Scorpions	*Urodacus* species (known SRE)	X	X
Pseudoscorpions	Family Chthonidae (not known to be SREs)	X	-
	Family Olpiidae (SRE status unknown)	X	X
Millipedes (Diplopoda)	Order Polydesmida, Family Paradoxosomatidae, *Antichiropius* species (high probability of having SRE status)	X	X
Phylum Mollusca	Stylommatophora, Genus *bothriembryon (considered to have SRE status)*	-	X

Note: Bold text denotes taxa of interest.

5.2 Potential Impacts

5.2.1 Potential Impacts on Vertebrate Fauna

The Project is expected to have both direct and indirect impacts on terrestrial fauna, which are discussed below. The main impact to vertebrate fauna will come from clearing 860 ha of fauna habitat over the 30 year mine life.

The Project may directly impact on fauna through the following:

- Direct loss of fauna, including conservation significant fauna.

  The clearing and alteration of the landscape may lead to the direct loss of sedentary fauna, as they are unable to move out of the area ahead of disturbance. During breeding seasons, this will include the young of almost all species.

- Habitat loss and fragmentation through clearing of native vegetation.

  Fauna habitat will be removed from the project area when clearing occurs. Clearing may also lead to habitat fragmentation, which has the potential to influence movement or migration out of the area, or may lead to increased predation when fauna cross cleared areas. Habitat fragmentation is likely to occur as a result of clearing approximately 30 ha of native vegetation in the project area adjoining the South Eneabba Nature Reserve. This clearing on the southern edge of the reserve will reduce the effective size of the vegetation block although the reserve itself will remain intact. Although clearing for the Project will result in the loss of some habitat, areas of similar habitat exist to the north, immediately adjacent to the area proposed for clearing. Therefore, it is anticipated that there will be no significant impacts to the abundance or diversity of fauna in the Lesueur Sandplain subregion.

The Project may indirectly impact on fauna through the following:

- Altered fire regimes and increased risk of fire associated with movement of people and machinery.

  Fire is considered the greatest potential threat to fauna habitats and fauna in the area, especially in remnant vegetation.

  Much of the project area adjoins the South Eneabba Nature Reserve, which could provide refuge and allow for recolonisation after fire. Large-scale fires have occurred in the region in the past, such as those experienced in 2005, which burnt both the reserve and much of the natural vegetation within the project area.

- Alteration, degradation or destruction of fauna habitat and/or food resources due to the invasion and spread of weeds, altered hydrological processes, fragmentation and the introduction of dieback.

  Fragmentation has the potential to cause degradation through weed and disease invasion, erosion, impacts from the adjacent land use and impacts to edges (such as by chemical and fertiliser drift from adjacent farmland, stock trampling and grazing, fire, recreational disturbance and littering). The impacts of altered hydrological processes are discussed in Sections 3.3.1 and 3.3.2 and dieback is discussed further in Sections 4.1.4 and 4.2.3

- Disruption to fauna due to increased noise, light and dust pollution.

  The effects of noise, light and dust pollution on native fauna are not well known or understood. As discussed in Section 8.2, dust has the potential to damage vegetation, which may in turn cause altered ecosystem stress and impact on fauna. The pre-strip waste dump has the potential to pose a significant dust risk to the South Eneabba Nature Reserve if it is not managed correctly. Therefore, there is potential for indirect impacts from coatings of dust affecting vegetation photosynthesis and respiration, resulting in degradation of the fauna habitat. Noise and light pollution may disrupt fauna species. Bats are particularly sensitive to both light and noise pollution, especially around the breeding season in spring.

- Potential increase in feral fauna.

  The fox, feral cat, rabbit and house mouse are already present in the area, and these species often increase in frequency with major disturbance and/or an increase in human activity. If numbers were to increase, this would result in increased predation and resource competition pressure on native species. As these species are already prevalent in the area and appropriate management measures will be implemented, feral fauna are not expected to spread or increase in abundance.

The South Eneabba Nature Reserve could also be affected by the above indirect impacts, reducing habitat quality and thereby reducing biodiversity in the local area.

5.2.2 Potential Impacts on Invertebrate Fauna

As discussed in Section 5.1.2, Short Range Endemics (SREs) have a restricted range, and are therefore susceptible to impacts that directly or indirectly affect their habitat. The potential impacts on SREs are:

- The direct removal of species; and
- The direct or indirect disturbance of invertebrate fauna habitat.

Direct impacts include destruction or degradation of habitat that occurs within the Project boundary due to ground preparation, construction activities and mining activities. Indirect impacts from the Project include changes to hydrology, changes to nutrient and microclimate regimes, contamination of water supplies, reduced habitat area, and reduced population viability. The zone of influence for indirect impacts may be larger than the project area.

The SRE Invertebrate survey results recorded by *ecologia* are set out in Section 5.1.2. The results recorded three key invertebrate taxa which are identified as SREs or have a high potential to be SRE species. These were the *Urodacus* scorpion, *Antichiropius* millipede and *Bothriembryon* mollusc. Of these, the Urodacus scorpion and the *Antichiropius* millipede were found both within and outside the project area, while the *Bothriembryon* mollusc was found only outside of the project area.

Figure X shows the sample locations of these organisms and Table 5-3 summarises whether they are likely to be affected directly or indirectly by the Project.

Table 5-3 Likely Impacts on Identified SRE Invertebrates

Organisms Recorded	Direct Impacts	Indirect impacts
Urodacus scorpion	X	X
Antichiropius millipede	X	X
Bothriembryon mollusc	-	X

Direct effects

The two surveys undertaken by *ecologia* identified that two of the three target species (the *Urodacus* scorpion and the *Antichiropius* millipede) will be affected by the Project, as they were located within the project area. However, they have also been positively identified outside the project footprint. Subsequently, any removal of the species during site preparation will not have a significant effect on the species.

Indirect effects

The indirect effects on SREs arise through the potential for the Project to disturb habitat characteristics which SREs rely on. The habitat characteristics of each of the species varies considerably; such as reliance on moist ground conditions, permanent shade characteristics etc. The surveys found that the *Urodacus* scorpion is highly sand specialised and unlike any forms previously described in Western Australia. The species lives in shallow burrows in grey sands in and around the impact site and well within the South Eneabba Nature Reserve. The millipede *Antichiropius*, found in two localities characterised as open heath on lateritic substrates

and sandstone outcropping with lateritic substrates, whilst the land snail *Bothriembryon* was found in areas of open heath on lateritic substrates only outside the project area.

Two offsite impacts are considered here that can be attributed to the Project, these are the alteration of surface water flows due to the Project location and the generation of dust emissions from construction and mining activities.

Redirection of Surface Water

The general environmental effects of realigning the surface water channels so as to accommodate the placement of the Project are discussed in Section 3.6.1. Given the extended dry periods which are characteristic of the area, SREs' reliance on surface water is limited. However, they do rely on the health of vegetation that uses groundwater to maintain their habitat. The healthy vegetation, for example, may support SREs through providing areas of shade and leaf litter.

The *Urodacus* species was sampled to the south of the mine pit footprint as well as inside the South Eneabba Nature Reserve. The southern most sampled scorpion is not likely to be affected by surface water diversions which occur downstream of the catchment area in which it was found, surface water effects on *Urodacus* are therefore considered negligible.

The *Antichiropius* species were sampled in two locations in close proximity to the mine pit as well as in two locations south of the project area. These locations are also at a substantial distance from the site boundary and upstream of the catchment area. Surface water effects on *Antichiropius* are therefore considered negligible.

The land snail *Bothriembryon* was found in similar locations to the south of the project area in a similar zone of the catchment. Surface water effects on the Bothriembryon are therefore considered negligible.

Dust generation and deposition

Dust deposition can have a number of potential effects on SRE habitats and subsequently on SREs themselves. Effects on vegetation health and in turn SRE habitat health, may occur by dust deposition which can hinder photosynthesis and potentially cause blockages of leaf stomata which therefore reduces the plant's ability to transpire and exchange gases.

Dust deposition has also been known to affect the burrowing ability of some SREs. This occurs when the dust deposited is of a different size and composition to the sandier soils surrounding the site. The extent to which the deposition can modify the structure of the surface soil depends on the origin, composition and size of the dust particles. Soil health within the SRE habitat may be adversely affected by dust deposition from dust generated by the construction and mining activities. All key species are found outside the anticipated dust range, and are therefore not considered susceptible to affects from dust generation at the Project either during construction or operation.

5.3 Environmental Objectives

The objectives of the Terrestrial Fauna Management Plan are to:

- Maintain the abundance, species diversity and geographical distribution of terrestrial fauna;
- Protect species listed under the EPBC Act;
- Protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950*;

- Protect rare and endangered species listed under the *Wildlife Conservation Act 1950*;
- Monitor and protect where possible species listed under the DEC Priority Fauna List;.and
- Protect other fauna species of particular conservation significance (e.g. undescribed taxa, range extensions, outliers).

Threatened fauna are protected by DEC under the provisions of the *Wildlife Conservation Act 1950*. Threatened and migratory fauna are also protected under the provisions of the EPBC Act. Migratory birds are listed under the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements.

Relevant legislation and standards include:

- EPBC Act 1999;
- *Conservation and Land Management Act 1984*;
- *Wildlife Conservation Act* 1950; and
- EPA Guidance Statement No. 56 (Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, 2004).

5.4 Performance Indicators

The effectiveness of the Terrestrial Fauna Management Plan will be assessed through a range of performance indicators associated with monitoring programmes within the project area. The performance targets set are heavily dependent on baseline data obtained, natural fluctuations within species abundance, and access to the DEC's regional monitoring data if required. While the DEC's data can be used for comparative purposes, conditions at the DEC monitoring sites can differ significantly from those in the project area. Thus, targets may need to be amended, in consultation with stakeholders after this information has been acquired.

The maintenance of fauna within the project area is also heavily reliant upon the success of the site rehabilitation. The success of the Preliminary Closure Plan will be reflected in achieving the performance criteria set for the return of native fauna to rehabilitated areas. Fauna are likely to return if the rehabilitated ecosystem is able to provide the required amount of food and protection from predators and environmental extremes. However, regardless of the success of the rehabilitation, it is unlikely that the current fauna diversity will be re-established completely upon site closure.

Performance indicators used are as follows:

- Diversity of keystone fauna species present;
- Abundance of native fauna species present; and
- Diversity and abundance of feral animals.

It is important to note that most conservation dependent species will not be included in the performance indicators. The baseline fauna surveys conducted suggest that most of the threatened species actually trapped or seen are present in very low numbers, therefore, there is the likelihood of future monitoring not recording the species when they are actually present, or recording many more species than were recorded in the baseline studies.

Table 5-4 presents the targets associated with these performance indicators. These indicators assume the initial movement of some species away from the project area due to noise, vibration and light effects, however, these species are expected to return to the area once they acclimatise to these disturbances.

Table 5-4 Performance Indicators and Targets

Performance Indicator	Site	Target (site averages)			
Diversity of native fauna species present	Within project area – in areas with no ground disturbing activities	**Year 1**	**Year 3**	**Year 5**	**Year 8**
		> 20% of original native fauna species present	> 50% of original native fauna species present	> 50% of original native fauna species present	> 50% of original native fauna species present
Abundance of keystone fauna species present	Within project area – in areas with no ground disturbing activities	**Year 1**	**Year 3**	**Year 5**	**Year 8**
		> 20% abundance of each original native fauna species present	> 50% abundance of each original native fauna species present	> 50% abundance of each original native fauna species present	> 50% abundance of each original native fauna species present
Diversity and abundance of feral animals present	Within project area – in areas with no ground disturbing activities	No significant increase in the diversity or abundance of feral animals due to mining activities over the life of the mine			

5.5 Management Actions

A specific focus of this Terrestrial Fauna Management Plan is the protection of the threatened species that presently occupy habitat within, or adjacent to the project area. Management actions that are intended to benefit specific threatened species have been identified below, and the relationship between these management actions and each threatened species is provided in .

Table 5-5 Management Action Effects on Threatened Species Located During Fauna Surveys

(x = expected positive effect of management action on species)

Species	State Level	Federal Level	Action Number												
			1	2	3	4	5	6	7	8	9	10	11	12	13
Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*)	Schedule 1	Endangered	x	x	-	x	x	x	x	x	x	x	x	-	-
Rainbow Bee-eater (*Merops ornatus*)	-	Migratory	x	x	-	x	x	x	x	x	x	x	-	-	x
Rufous Fieldwren (*Calamanthus campestris montanellus*, western wheatbelt population)	Priority 4		x	x	-	x	x	x	x	x	x	x	-	x	-
Black-striped Snake (*Neelaps calonotos*)	Priority 3		x	x	-	x	x	x	x	x	x	x	-	-	-

Section 5 Terrestrial Fauna Management Plan

The key management measures for terrestrial fauna (presented in **Error! Not a valid bookmark self-reference.**) are as follows:

1) Vegetation clearing will be restricted to that which is necessary, and disturbed areas (including construction areas) will be rehabilitated as soon as practicable.
2) Fire prevention strategies will be an integral component of risk assessments for construction contractors. All vehicles will be fitted with fire extinguishers and site personnel will be trained in their use.
3) All waste products, particularly food scraps, will be isolated and removed from the work area to minimise the attraction of feral species.
4) Dust control and suppression measures will be implemented in accordance with the Dust Management Plan, which is discussed in 8.
5) Directional lighting will be used to minimise light spill outside of the project area.
6) Dieback management will be undertaken in accordance with the Flora and Vegetation Management Plan, as described in Section 4.5.3.
7) Weed management practices will be implemented in accordance with the Flora and Vegetation Management Plan which is discussed in Section 4.5.
8) Driving on site at dusk or dawn and at night will be minimised to reduce impacts to fauna which are active during these times.
9) Speed restrictions will be in force around the site and fauna on roads will be avoided, if this can be done safely.
10) All ponds associated with the Project will be fenced to prevent entry by fauna.
11) Sightings of Carnaby's Black-Cockatoo and any observations of Carnaby's Black-Cockatoo activities will be reported to on site environmental personnel for collation and reporting to relevant stakeholders.
12) Wherever possible, clearing will be minimised between July and January to reduce impacts to breeding Rufous Fieldwrens that could potentially be nesting. Any areas that require clearing during this time frame will be surveyed to determine if there are any breeding Rufous Fieldwrens present.

13) The potential for Rainbow Bee-eaters to breed in sandy areas and embankments will be monitored and if present, nest tunnels will be avoided if possible.

Table 5-6 Management Actions, Timing and Responsibility for Achievement of Objectives

Objective	Management Action	Responsible Personnel	Timing
Maintain the abundance, species diversity and geographical distribution of terrestrial fauna	Vegetation clearing will be restricted to that which is necessary, and disturbed areas (including construction areas) will be rehabilitated as soon as practicable.	Project Director/ General Manager	Prior to clearing activities
	Fire prevention strategies will be an integral component of risk assessments for construction contractors. All vehicles will be fitted with fire extinguishers and site personnel will be trained in their use.	General Manager	Construction/operations/ rehabilitation
	All waste products, particularly food scraps, will be isolated and removed from the work area to minimise the attraction of feral species.	General Manager	Construction/operations/ rehabilitation
	Dust control and suppression measures will be implemented in accordance with the Dust Management Plan, which is discussed in Section 8.	General Manager	Construction/operations/ rehabilitation
	Directional lighting will be used to minimise light spill outside of the project area.	General Manager	Construction/operations/ rehabilitation
	Dieback management will be undertaken in accordance with the Flora and Vegetation Management Plan, as described in Section 4.5.3.	Project Director/ General Manager	Design/ Operations
	Weed management practices will be implemented in accordance with the Flora and Vegetation Management Plan which is discussed in Section 4.5.	General Manager	Construction/operations/ rehabilitation
	Driving on site at dusk or dawn and at night will be minimised to reduce impacts to fauna which are active during these times.	General Manager	Construction/operations/ rehabilitation
	Speed restrictions will be in force around the site and fauna on roads will be avoided, if this can be done safely.	General Manager	Construction/operations/ rehabilitation

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Objective	Management Action	Responsible Personnel	Timing
	All ponds associated with the Project will be fenced to prevent entry by fauna.	Project Director/ General Manager	Design/ Operations
	Fire prevention strategies will be an integral component of risk assessments for construction contractors. All vehicles will be fitted with fire extinguishers and site personnel will be trained in their use.	General Manager	Construction/operations/ rehabilitation
Protect species listed under the EPBC Act	Sightings of Carnaby's Black-Cockatoo and any observations of Carnaby's Black-Cockatoo activities will be reported to on site environmental personnel for collation and reporting to relevant stakeholders.	General Manager	Construction/operations/ rehabilitation
Protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950*	Vegetation clearing will be restricted to that which is necessary, and disturbed areas (including construction areas) will be rehabilitated as soon as practicable.	Project Director/ General Manager	Prior to clearing activities
	Wherever possible, clearing will be minimised between July and January to reduce impacts to breeding Rufous Fieldwrens that could potentially be nesting. Any areas that require clearing during this time frame will be surveyed to determine if there are any breeding Rufous Fieldwrens present	Project Director/ General Manager	Prior to clearing activities
	The potential for Rainbow Bee-eaters to breed in sandy areas and embankments will be monitored and if present, nest tunnels will be avoided.	General Manager	Construction/operations/ rehabilitation

5.6 Monitoring

5.6.1 Carnaby's Black Cockatoo

CWC will conduct regional annual surveys of Carnaby's Black-Cockatoo. This will include compilation of reported sightings for the previous 12 month period.

5.6.2 Other Fauna

Sightings of priority species will be recorded

5.6.3 Inspections of the Evaporation and Storage Ponds

Should fauna be found in the evaporation and storage ponds during daily inspections, the contingency actions below may be considered:

- Inspections of areas of higher incidences of trapped fauna may need to occur more frequently;
- Inspection of additional self-release mats around ponds; and
- Contact made with DEC's Wild Care 24 hour hotline on (08) 9474 9055 for advice.

5.6.4 Waste Enclosure Inspections

When weekly inspections of waste enclosures, including garbage and food waste containers, indicate that feral or native animals have breached the integrity of enclosures, the following contingency actions will be considered:

- Repair any fences that have been breached and investigate possible ways to secure the area;
- Replace garbage and waste containers, after a review of waste disposal and containment technology; and
- Review waste disposal and containment procedures.

6.1 Current Status

6.1.1 Stygofauna

Stygofauna occupy groundwater across a diverse range of geologic/geomorphic settings, including karstic carbonate rocks, fractured rock aquifers, and porous unconsolidated sediments (e.g. alluvium). They may be found in deep groundwater habitats tens to hundreds of metres below the surface, in addition to shallow groundwater habitats including springs and spring-brooks where groundwater discharges to the surface, also in hyporheic and parafluvial settings (saturated sediments beneath and alongside surface water courses). Stygofauna are found in oxygenated groundwater ranging from fresh to brackish, but may occur in salinities up to seawater concentrations (Humphreys, 1999).

In Western Australia, stygofauna have been documented from most regions and areas including the Kimberley, Pilbara (Pilbara craton and Barrow Island), Carnarvon (Cape Range), Murchison, Goldfields, South West (Perth Basin and Leeuwin Naturaliste Ridge), South Coast (Albany and Nullarbor Plain). In the Pilbara region, sampling conducted in the last decade has revealed the Pilbara to be a globally significant hotspot for stygofauna diversity (Humphreys, 2000; Eberhard, Halse and Humphreys, 2006). Stygofauna are widespread and occur in a range of hydrogeological environments including karstic, fractured rock, vuggy Channel Iron Deposits (CID) and porous aquifers, in addition to springs, parafluvial and hyporheic environments (Eberhard et al., 2005).

Rockwater (2008b) conducted two stygofauna surveys between January 2007 and March 2008 from 58 bores over two seasons. These surveys were designed to cover the project area for both the Central West Coal Project and the Coolimba Power Project. The following section outlines the findings of these surveys.

The surveys comprised sampling sites both within and outside the project area, and were undertaken in accordance with the EPA Guidance Statement No. 54 – Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA, 2003b). The surveys comprised:

- Initial surveys in February and May 2007. Fifteen bores were sampled in February, including six farm bores, three disused production bores and three pairs of deep piezometers. In May, a total of 31 bores were sampled which included most of the bores sampled during February.
- A second set of surveys approved by the DEC were conducted in February and March 2008. The 2008 surveys included regional bores within approximately 10 km of the Project (including 29 bores from surrounding farms, Lake Logue Nature Reserve and South Eneabba Nature Reserve); in addition to one farm bore which yielded an undescribed bathynellid syncarid during the 2007 survey.

Samples were taken from both the superficial aquifer and sedimentary rocks of the underlying Cattamarra coal measures, with a total of 96 samples collected during the 2007 and 2008 surveys. The location of sites sampled during the 2007 and 2008 stygofauna sampling programme are presented in Figure X.

The survey results are summarised below:

- Stygobitic taxa, (stygofauna) - There was only one known stygobitic taxon recorded by the investigation; the undescribed Syncarida, Bathynellidae sp. 1. This species is classed as a SRE, meaning that it is restricted to an area that satisfies its key habitat characteristics.
- No stygofauna were recovered from the bores known to access the deeper formation.

- All other species found were not classed as stygofauna.
- The 45 samples collected from 31 bores in the 2007 surveys yielded six aquatic invertebrate taxa including Crustacea (Copepoda, Ostracoda, Syncarida), Acariformes (Prostigmata), Diptera (Muscidae) and Nematoda.
- The 51 samples collected from 30 bores in the 2008 surveys yielded six aquatic groups including the Oligochaeta, Syncarida and Nematoda recovered during the 2007 survey, plus Oligochaeta (two additional taxa), Platyhelminthes, Ceratopogonidae, Chironomidae, and Amphipoda.
- Fourteen aquatic invertebrate taxa in total were recorded over the 2007 and 2008 surveys; five of these (36%) were taxa not confined to the groundwater environment (stygophiles), three (21%) are considered stygoxenes (aquatic larvae of terrestrial insects) and five (36%) are currently not able to be assessed as their dependence on groundwater is unclear due to limitations in taxonomy for these groups (Oligochaeta, Nematoda and Platyhelminthes).

Given the sampling intensity employed for the investigation, the aquifers of the project area are not considered to contain a diverse stygobitic fauna. The groundwater taxa are of less concern from a conservation perspective. The taxonomy of the Nematoda and Oligochaeta are too poorly described to assess their conservation status or degree of groundwater dependence. However, groundwater Oligochaeta generally have widespread distributions (Rockwater, 2008b).

6.1.2 Troglofauna

Troglofauna are found in geologic/geomorphic environments with air-filled subsurface cavities that are humid and dark. A critical habitat requirement for troglobitic species is the maintenance of a high relative humidity because of their generally reduced cuticular impermeability (Howarth, 1983). It was thought that troglobites were generally restricted to caves in karstic terrains. In Australia, there has been little sampling of troglofauna in non-karstic terrains, but recently troglobitic species have been recorded from lava caves in Queensland (Howarth, 1988), dolerite talus caves in Tasmania (Eberhard et al., 1991), and vuggy pisolite ore in the Pilbara (Biota, 2006). The emerging understanding is that species specialised to subterranean existence are not necessarily restricted to caves and karst but are more widely distributed and may potentially occur where suitable habitat exists (Eberhard and Humphreys, 2003).

The nature and structure of cavity development is likely to be important in determining potential habitat for troglofauna. Diverse subterranean fauna are typically found in habitat matrices where well developed secondary and/or tertiary (conduit) porosity enhances the circulation of water, gases, and nutrients, and allows animal movements. Shear and fracture zones where secondary porosity is well developed via open and integrated fracture systems represent potential troglofauna habitat, especially where permanent groundwater maintains a humidified environment in the unsaturated portion of the aquifer.

Subterranean Ecology (2007) conducted a desktop assessment to identify the likelihood of prospective troglofauna habitat in the project area. The project area geology is typical of the regional geology and comprises sand overlying the Cattamarra Coal Measures Member of the Cockleshell Gully Formation. The sand, composed of fine to silt sized particles is believed to be less than 10 m thick and overlies interbedded to interlaminated sandstone and siltstone, claystone and coal seams (URS, 2006). The upper strata typically become less weathered with increasing depth below ground level. The sandstone is generally fine grained and tends to be more weathered than the siltstone.

The geomorphic setting for the project area is the Eneabba Plain, a low lying area between the Spearwood Dune System and the Gingin Scarp (Mory, 1994). Winter flowing streams on the Eneabba Plain drain

westwards into a series of seasonally inundated lakes developed on the flank margin of the Spearwood Dune System which is located between 5 km and 12 km to the west of the project area. The Spearwood Dune System comprises Tamala Limestone which is karstified and contains cave systems developed in association with the westward flowing streams and flank margin wetlands (Subterranean Ecology, 2007).

Based on the results of the desktop assessment, the potential for the presence of troglofauna within the project area is dependent upon the presence of suitable habitat determined by the geology and geomorphology, especially the likelihood of open air-filled cavities developed above the water table. Suitable subsurface cavities for troglofauna habitat are unlikely to be developed in unconsolidated fine sands like that present in the project area above the water table. While subsurface cavities may develop by piping processes in unconsolidated sediments, such cavities are typically short-lived and of highly localised extent, and thus unlikely to provide suitable long-term habitat for troglofauna (Subterranean Ecology, 2007). Subterranean Ecology (2007) stated that troglofauna are unknown from unconsolidated fine sands in Australia, and at present have not been described from this type of substrate anywhere in the world. However, outside the project area significant troglofauna communities are present in the karst system developed within the Tamala Limestone (Subterranean Ecology, 2007).

6.2 Potential Impacts

Western Australian stygofauna and troglofauna exhibit high levels of endemism. Therefore, the most significant potential impact on subterranean fauna is the potential for Project activities to eliminate a species.

The potential impacts of mining on subterranean fauna may arise through direct or indirect impacts (Hamilton-Smith and Eberhard, 2000). Direct impacts comprise the destruction or degradation of habitat through either removal during pit excavation, or as part of ground preparation for mine infrastructure such as the ROM pad, waste dump and roads.

Indirect impacts tend to be less obvious as the effect of the impact can occur some distance from the source. Examples include changes to hydrology, changes to nutrient and microclimate regimes, contamination, reduced habitat area and reduced population viability. Generally, the zone of influence for indirect impacts may be considerably larger than the area of the pit and the Project footprint (Subterranean Ecology, 2007).

6.2.1 Potential Impacts on Stygofauna

The only known stygobitic taxon recorded was an undescribed *bathynellid* syncarid (*Bathynellidae* sp. 1). Owing to the lack of knowledge of the taxonomy and distribution of bathynellids and other Syncarida its conservational significance is unknown. Figure X presents the locations of the samples in relation to the Project footprint and the groundwater drawdown zone of influence.

The *Bathynellidae* sp. is a potentially endemic species, and will be directly impacted by the Project through the excavation of the coal from the pit and dewatering activities.

However, it is possible that the *bathynellid syncarid* is widespread within the upper Cattamarra CM aquifer system which extends both north and south of the project area and contains similar habitat to that of the project area. Rockwater (2008b) identified areas of similar geology, hydrogeology and habitat characteristics to that of the bore containing *Bathynellidae* sp.

The Cattamarra CM extends from near Cervantes in the south to Mount Hill in the Shire of Greenough. The superficial formation near the project area is largely unsaturated, however, elsewhere it is shown to be in hydraulic connection with the underlying Cattamarra CM. This indicates that the superficial aquifer may also provide suitable habitat for local stygofauna populations.

Section 6 Subterranean Fauna Management Plan

At the request of the DEC, a risk assessment was undertaken for the *bathynellid* species to outline the level of risk associated with removal of habitat in the project area. The risk assessment was undertaken by Bennelongia Pty Ltd for the bathynellid species to outline the level of risk associated with removal of habitat in the project area. The results of the risk assessment show that there is strong morphological evidence that the species extends beyond the zone of influence of the proposed mine to a bore some 33 km north of any groundwater drawdown associated with the Project. It is also possible the species has also been recorded to the north-east.

In addition, a wider regional survey targeting the *bathynellid* species has been instigated but results are unlikely to be available until March 2009.

6.2.2 Potential Impacts on Troglofauna

Subterranean Ecology (2007) conducted a desktop assessment to identify the likelihood of prospective troglofauna habitat in the project area. The survey concluded that the geology and geomorphology of the project area would not provide suitable habitat for troglofauna. Therefore, there will be no direct impacts to troglofauna. Any potential effects on troglofauna are likely to occur outside of the project area. According to the desktop assessment, troglofauna are likely to occur in the Tamala Limestone (Subterranean Ecology, 2007). There is potential for these troglofauna to be indirectly impacted by the Project through groundwater drawdown and the potential alteration of stream flows and water quality.

As discussed in Section 3.3.2, groundwater drawdown is not anticipated to be significant within the Tamala Limestone. Rockwater (2008b) concluded that there appears to be negligible likelihood that the dewatering proposed by Central West Coal Pty Ltd would have any effect on groundwater levels in the Tamala Limestone. Therefore, the impact to troglofauna is expected to be negligible.

6.3 Environmental Objectives

The objectives of the Subterranean Fauna Management Plan are to:

- Maintain the biological diversity of subterranean fauna;
- Maintain the key ecological processes relevant to subterranean ecosystems within the project area by avoiding or managing adverse impacts due to mining or construction activities; and
- Improve the knowledge base of subterranean fauna in the local area.

6.4 Performance Indicators

The effectiveness of the Subterranean Fauna Management Plan will be assessed through a range of performance indicators associated with relevant monitoring programmes within the project area.

Given the very low catch percentage in comparison to trap nights (especially with troglofauna), it is very difficult to use population monitoring to determine the stability of a population. For example, mass breeding (lifecycles) of subterranean insects are likely to follow that of their terrestrial counterparts and have a large natural variation in population densities (boom and bust). As such, it is deemed that the only logical form of monitoring would be to determine whether any changes are occurring in the subterranean habitat due to mining operations. Therefore, the following performance indicators will be used:

- No significant changes to the quality of groundwater due to mining activities over the life of the mine.
- No significant changes to the quality of surface water due to mining activities over the life of the mine.

6.5 Management Actions

The key management measures are as follows:

- Monitor groundwater quality in accordance with this EMP.
- Monitor surface water quality in accordance with this EMP.
- Implement procedures for surface water run-off and spill/contamination minimisation and management in accordance with this EMP.
- Implement site infrastructure and operational controls to prevent contamination of surface water and groundwater. These include appropriate management of hydrocarbons, dust, run-off, waste water, and emergency response in the event of a pipeline failure.

The management actions will be implemented to assess performance indicators, and will minimise adverse effects on subterranean fauna during the construction and operational phases of the Project.

CWC has lodged the bathynellid specimens recovered from bore EFB2 to the Western Australian Museum to be compared with bathynellid specimens collected near the project area, and for inclusion within the current Western Australian Museum research project into the taxonomy and phylogeny of Bathynellacea in Australia.

These management actions have been identified in Table 6-1.

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Table 6-1 Management Actions, Timing and Responsibility for Achievement of Objectives

Objective	Management Action	Responsible Personnel	Timing
Maintain the biological diversity of subterranean invertebrate fauna.	Inform workforce of importance of conserving species and their habitat.	Project Director/General Manager	Construction/operations
	Minimise hydrocarbon spillage during construction of production and monitoring bores.	Project Director/General Manager	Construction
	No litter will be deposited in boreholes.	Project Director/General Manager	Construction/operations/ rehabilitation
	Drill holes external to the pit will be temporarily capped on completion of drilling and permanently capped as soon as possible. Drill holes will be regularly monitored to ensure caps remain in place.	Project Director/General Manager	Construction/operations/ rehabilitation
	Establish and implement a water supply strategy that will allow for rotational usage of water bores to minimise groundwater drawdown in areas of known subterranean fauna populations, where possible.	Project Director/General Manager	Construction/operations
	Standard precautions for protecting groundwater quality will be established and adhered to and will address: • sediment runoff; • salination; and • seepage from infrastructure and plant equipment.	Project Director/General Manager	Construction/operations/ rehabilitation

Table 6-1 (Continued)

Objective	Management Action	Responsible Personnel	Timing
Maintain the key ecological processes relevant to subterranean ecosystems within the project area by avoiding or managing adverse impacts due to mining or construction activities.	Protect subterranean fauna habitats from clearing, where possible, to minimise the reduction of organic carbon influx from surface sources.	Project Director/General Manager	Construction/operations
	Erect signage where appropriate to protect habitat from inadvertent access and disturbance.	Project Director/General Manager	Construction/operations/ rehabilitation
	Establish and implement a water supply strategy that will allow for rotational use of water bores – refer to the Water Management Plan	Project Director/General Manager	Construction/operations
	Manage hydrocarbon and other potential contaminant storage to minimise any adverse environmental impact on subterranean habitats.	Project Director/General Manager	Construction/operations
	CWC and contractors to establish and train personnel in emergency spill procedures.	Project Director/General Manager	Construction/operations

	Regularly review the success of the Subterranean Fauna Management Plan and associated actions by teams with appropriate expertise and community standing.	Project Director/General Manager	Construction/operations

6.6 Monitoring

The subterranean fauna monitoring programme for the Project will include regular monitoring of subterranean habitat.

6.6.1 Subterranean Fauna

Monitoring of the quality of groundwater and surface water within the project area will be regularly conducted and will indicate whether the subterranean habitats potentially occupied by stygofauna and troglofauna are being impacted by the Project.

6.6.2 Drill Hole Cap Inspections

Regular inspections of the project area will be conducted to check and record that drill holes, external to the pit, are capped. Drill holes, external to the pit, will be temporarily capped on completion of drilling and permanently capped as soon as possible. This monitoring procedure is the responsibility of the geology department and will be conducted throughout construction, operations and rehabilitation of the Project.

6.7 Contingency Actions

Contingency actions will be initiated if problems are identified during the monitoring process, stakeholders become concerned with an aspect of the mining process, or a factor that is exacerbated by the mining process becomes apparent. These contingency actions have been outlined in the Water Management Plan (see Section 3).

7.1 Current Status

7.1.1 Geological Setting

The geology of the region is characterised by tertiary sands overlying Jurassic sediments including locally, the Yarragadee Formation, the Cadda Formation, the Cattamarra Coal Measures and the Eneabba formation. The Cattamarra Coal Measures consists of interbedded shale, sandstone and coal seams.

Coal resources in the region occur within the Cattamarra Coal Measures.

Three main coal horizons have been identified; the Eneabba Main seam (EMS), the Eighty seam (ETYE), and the Maxwell seam (MAX).

The coal horizons are characterised by sequences of sandstones, siltstones grading to mudstones and claystones/shales and finally coals.

The EMS splits into two major plies in the northern section of the project area. The upper ply ranges from 4.5 to 5.5 m thick, averaging 5 m thick. The lower ply comprises several seams ranging from approximately 3 to 4.5 m thick, with considerable lateral variation. The ETYE and MAX seams are considerably thinner and less prospective (Minserve, 2006).

7.2 Current status

7.2.1 Geochemistry

Acid generation from mineral waste materials, such as overburden, is commonly caused by the exposure of sulphide minerals (most commonly pyrite), to atmospheric oxygen and water.

Terrenus Earth Sciences (Terrenus) geochemically characterised the overburden, interburden and potential coal reject material, as well as coal combustion material from the pilot-scale furnace to identify their acid forming potential. Potential coal reject materials were included in case this material should be generated as part of coal mining and handling activities. The coal combustion ash was included due to the proposed in-pit disposal of power station ash.

The assessment conducted by Terrenus comprised a desktop review of available Project data followed by a geochemical sampling and testing programme.

Geochemical Characterisation and Assessment of Overburden

Over 80 per cent of the overburden samples tested have been classified as non-acid forming (NAF), with a further 8% classified as uncertain-NAF. The remaining 10% (approximately) are classified as potentially acid forming (PAF).

The results from the overburden indicate that:

- The overburden is likely to be relatively benign generating pH-neutral and low to moderately saline runoff and seepage following surface exposure;
- Over half of the overburden material is expected to have very low total sulphur content and can be classified as barren;
- The risk of acid generation is expected to be low given the general lack of oxidisable sulphur content;

- The concentration of metals in overburden materials (solids) are within the applied guideline criteria for soils;
- The concentration of soluble metals and salts in runoff and seepage from overburden is likely to remain well within the applied water quality guideline criteria; and
- All overburden materials tested are strongly sodic, with significant exchangeable cation imbalances.

Geochemical Characterisation and Assessment of Coal

After mining, coal will be held in stockpiles and will therefore potentially constitute a source of acid rock drainage. In testwork by the Australian Coal Industry Research Laboratory (ACIRL), reported in Minserve (2006), coal was found to have relatively low pyritic sulphur (0.2%), and is therefore unlikely to be especially reactive.

Coal was not specifically tested by Terranus for its acid rock generation capacity, because coal is normally kept for a short time in storage and is consequently not regarded as a long term source of acid rock drainage. However, the test results for potential coal reject may be applied to the consideration of coal as a source of acid rock drainage. On that basis, coal will be classified and managed as a PAF material. The characterisation of coal reject is discussed in the following paragraphs.

Geochemical Characterisation and Assessment of Potential Rejects

The assessment of potential rejects comprised testing coal seam roof, coal seam floor and poor coal samples. CWC will not wash coal, so this material will be fed as coal, or despatched as waste rock.

The key findings from the assessment were as follows:

- These materials are expected to generate weakly acidic and moderately saline runoff/seepage following surface exposure;
- The potential rejects are classified as PAF, although the floor of the EMS lower seam has a mixed NAF-PAF acid-generation classification;
- The concentrations of metals in potential reject materials are generally within the applied guideline criteria for soils; and
- The concentration of soluble metals and salts in runoff and seepage is generally likely to remain within the applied water quality guideline criteria, provided these materials do not undergo further oxidation, given their PAF classification.

Geochemical Characterisation and Assessment of Coal Combustion Ash

As the ash waste samples for the assessment were generated from a pilot process, the operational ash materials may have different geochemical characteristics. It is therefore important to note that the assessment should be considered indicative only. The coal combustion ash testing indicated the following:

- The ash is expected to generate alkaline and relatively low-salinity runoff/seepage following surface exposure;
- All of the ash samples tested were NAF;

- The solid ash materials are expected to have total metals and nutrient concentrations (in solids) well below the applied guideline values;
- Leachate from coal combustion ash is likely to contain some dissolved metals in concentrations that may exceed the applied water quality guidelines. The key metals of concern are arsenic (As), boron (B), chromium (Cr), copper (Cu), molybdenum (Mo), selenium (Se) and zinc (Zn).

7.3 Potential Impacts

The information from the geological and geochemical assessment of the materials that will be affected by mining suggests that overall, the risk of acid rock drainage into surface water or groundwater is low given the general lack of oxidisable sulphur content in all materials. However, there will be some materials that have a potential to generate weakly acidic seepage after exposure.

Approximately 10 per cent of the overburden material is classified as potentially acid forming (PAF). The remaining overburden is either barren (with very low sulphur content), or relatively benign, generating pH-neutral and low to moderately saline runoff and seepage following surface exposure.

Reject material including coal seam roof, coal seam floor and poor coal samples are expected to generate weakly acidic and moderately saline runoff/seepage following surface exposure. The concentration of soluble metals and salts in runoff and seepage is generally likely to remain within the applied water quality guideline criteria, provided these materials do not undergo further oxidation, given their PAF classification.

The coal combustion ash that will be disposed of in the pit is expected to generate alkaline and relatively low-salinity runoff/seepage following surface exposure.

7.4 Environmental Objectives

The environmental objectives of the ARD Management Plan are to:

- Identify PAF materials prior to mining and handling;
- Extract, handle, process and/or store mine materials in a manner that minimises potential risk of environmental harm;
- Limit potential contact of water with PAF materials stored above the water table, and manage runoff and seepage from PAF materials; and
- Rehabilitate storage facilities containing PAF materials in a manner that minimises potential risk of environmental harm.

The relevant legislation and standards in regards to ARD management include:

- *Environmental Protection Act 1986*;
- *Contaminated Sites Act 2003*;
- Guidelines for Mining Proposals in Western Australia (Section 4.3.2 Acid Generation from Waste Rock and Tailings) (DMP, 2006b);
- ANZMEC and MCA Strategic Framework for Mine Closure (ANZMEC and MCA, 2000);
- Leading Practice Sustainable Development Program for the Minerals Industry. Mine Closure and Completion (Department of Resources, Energy and Tourism, 2006a);

- Leading Practice Sustainable Development Program for the Minerals Industry. Mine Rehabilitation (Department of Resources, Energy and Tourism, 2006b);
- Leading Practice Sustainable Development Program for the Minerals Industry. Managing Acid and Metalliferous Drainage (Department of Resources, Energy and Tourism, 2007); and
- Mine Void Water Resource Issues in Western Australia (Water and Rivers Commission, 2003).

This ARD Management Plan should be considered a living document. As best practice in ARD management evolves, this plan will be reviewed and updated in light of any applicable new management techniques and strategies.

7.5 Performance Indicators

The effectiveness of Acid Rock Drainage Management Plan will be assessed through a range of performance indicators associated with the monitoring programmes within the Central West Coal project area and the surrounding environment.

Table 7-1 presents the measurable hydrological, physical, chemical and biological performance indicators for assessing the impact of potential acid forming (PAF) materials on the environment.

Table 7-1 Performance indicators - Acid Rock Drainage

Type	Location	Indicator	Criterion (Targets)
Identification of PAF materials	Mine.	Percentage of materials identified as being PAF	10 per cent of material expected to be PAF
Extract, handle, process and/or store mine materials in a manner that minimises potential risk of environmental harm	Waste dumps, and in mine backfill.	Degree of encapsulation of PAF materials	All PAF materials safely encapsulated
Limit potential contact of water with PAF materials stored above the watertable, and manage runoff and seepage from PAF materials	Waste dumps, surface runoff from all coal handling areas.	Seepage and run off levels of pH, EC, TDS, acidity, alkalinity, and soluble SO_4, Cl, Ca, Mg, Na, K, Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Sb, Se and Zn. The frequency of water quality monitoring will be reduced to quarterly following the first three months of operation.	Surface water and groundwater quality parameters downstream of sampling points within 10 per cent of background
Rehabilitate storage facilities containing PAF materials in a manner that minimises potential risk of environmental harm	Waste dumps, Mine backfill.	Degree of encapsulation of PAF materials in a stable final form	On-going monitoring does not reveal deterioration in runoff quality after closure

Section 7 Acid Rock Drainage Management Plan

7.6 Management Actions

7.6.1 Waste Rock

During the life of the operational phase approximately 516 Mbcm of waste rock will be mined. This waste will be disposed of either in the mine backfill, or in waste dumps within the stockpile management corridor. The majority of waste rock will be utilised in the backfill within the limits of the pit excavation.

CWC has adopted several measures to minimise the potential for environmental harm from mine waste materials and ore as a result of the Project. These measures comprise identification of PAF materials, appropriate placement/storage of PAF materials, water management, and monitoring of stockpiles/storage facilities. Relevant site personnel will be trained in awareness and use of this Management Plan and ARD management will be monitored and reviewed during both mine construction and operations.

Rehabilitation of the backfill and stockpile management corridor will ensure functional compatibility with existing landforms, and drainage lines disturbed during mining will be returned to their original form and function after passage of mining.

A waste rock dump will be constructed to permanently store approximately 40 Mm^3 of waste rock from the initial excavation.

- The waste dump will be built up during mine development, and will include management of any potentially acid forming overburden materials, dispersive soils and other introduced waste streams from the Mine and Power Station construction activities.
- Vegetation and topsoil will be stripped and stockpiled beside the waste dump until it can be used in rehabilitation. Stockpiles will be no more than 2 m high to maintain biological integrity.

Up to 2500 tonnes per day (tpd) of combined fly and bottom ash produced from the Coolimba Power Project will be returned to the mine for disposal with waste rock. The ash will be trucked from the power station storage bin to the mine backfill by truck. It will be dumped at the base of advancing backfill such that it is covered by the advancing backfill. Given that this material is mildly alkaline, mixing it with PAF materials contained in the overburden being returned to the pit can be expected to reduce the potential for acid generation.

7.6.2 Groundwater

Groundwater in the vicinity of the mine will be monitored throughout the operational phase of mining to confirm modelled behaviour and detect changes in chemistry. In the event that changes are detected, potential impacts will be considered and remediation measures implemented if necessary.

After closure, monitoring and any remediation necessary will continue in accordance with the Closure Plan.

7.6.3 Surface Water

Surface water drainage from the permanent waste rock dump, the rehabilitated mine backfill surfaces, temporary coal stockpile hardstands, ROM coal and coal product stockpile hardstands, and other disturbed surfaces will be managed to ensure that poor quality water streams are isolated and treated before release to the downstream environment. The criteria for release are indicated in Table 7.2 below. Surface run-off that is outside these limits will be evaporated on site.

Management actions are detailed in Table 7-2.

Table 7-2 Management Actions, Timing and Responsibility for Achievement of Objectives

ARD Source	Priority	Objective	Management Action	Responsibility	Timing
Waste rock and combustion ash placed on the waste rock dump or returned to the mine as backfill.	1	Identify PAF waste rock in the mining face prior to mining	Geochemical testing of drill core and active bench face samples (NAGpH and total sulphur).	Mining Manager	Design/ Operations
	1	Mine, handle, process and/or store PAF overburden in a manner that minimises potential risk of environmental harm	Selectively mine, handle, place and encapsulate PAF overburden with NAF overburden in the permanent waste rock dump, or in mine backfill.	Mining Manager	Operations
			Develop site procedures for PAF waste rock and combustion ash.	Mining Manager	Design/ Operations.
			Complete employee inductions and ongoing environmental awareness training.	Mining Manager	Operations
	1	Limit potential contact of surface water and groundwater with PAF waste rock materials stored above the watertable, and manage runoff and seepage from PAF waste rock materials	Divert clean surface water runoff away from the base of the waste rock dump and other disturbed surfaces.	Mining Manager	Design/ Operations
			Monitor seepage quality below the waste rock dump and the pit and in downstream groundwater bores	Mining Manager	Operations/ Post Closure
	1	Rehabilitate storage facilities containing PAF overburden and reject material in a manner that minimises potential risk of environmental harm.	Add nominal 0.1m topsoil layer to WRD1 and revegetate	Mining Manager	Operations/ Closure

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Table 7-2 (Continued)

ARD Source	Priority	Objective	Management Action	Responsibility	Timing
Groundwater and Surface Water	1	Identify acidic/saline groundwater and surface water prior to mining and mineral processing	Water pump rate/flow and quality testing as part of conceptual and detailed design study programs.	General Manager/ SHE Manager	Design
			Use acquired data as input into site Water Management Plan in advance of mining and mineral processing.	SHE Manager/ General Manager	Design/ Operations
	1	Limit potential contact of groundwater with acidic/saline seepage in the pit and from the permanent waste dump.	Develop and implement Water Management Plan.	General Manager/ Processing Manager/ Mining Manager/ SHE Manager	Design/ Operations
			Develop site procedures associated with Water Management Plan.	General Manager/ Processing Manager/ Mining Manager/ SHE Manager	Design/ Operations
			Complete employee inductions and ongoing environmental awareness training.	SHE Manager/ General Manager	Operations
	1	Limit potential contact of clean surface water with acidic/saline seepage in the pit and from the permanent waste dump.	Develop and implement Water Management Plan.	General Manager/ Processing Manager/ Mining Manager/ SHE Manager	Operations

			Construct and operate surface water diversion structures and other surface water management infrastructure, and use them to prevent discharge of acidic/ saline run-off to the environment. The surface water management infrastructure will be provided to service all areas where PAF or potential PAF materials are handled or stored, and include the waste rock dump, temporary coal stockpile hardstands, ROM coal stockpile hardstands, and coal product stockpile hardstands.	Project Director/ General Manager	Design/ Operations
			Update hydro-geological models, including the solute transport model used to simulate surface water and groundwater behaviour downstream of the mine workings.	General Manager/ SHE Manager	Design/ Operations

7.7 Monitoring

The effectiveness of the ARD Management Plan will be determined through a monitoring programme designed to identify PAF materials, confirm appropriate placement and storage of PAF materials, secure PAF materials stored above the watertable against contact with water, manage seepage and run-off, and rehabilitate surfaces. Specific components of the proposed monitoring programme are presented in the following sections.

7.7.1 Waste Rock

- Geochemical characterisation of waste rock and coal (NAGpH and total sulphur) during the detailed design and operational phases of the Project.
- Weekly monitoring of seepage quality (pH and EC) in the mine, from the permanent waste rock dump. The monitoring frequency will be reduced when the predicted geochemical nature of the overburden, reject material and seepage water chemistry is confirmed, or when trends indicate.
- Monthly groundwater sampling of selected groundwater monitoring bores. The monitoring frequency will be reduced when the predicted geochemical nature of the overburden, reject material and seepage water chemistry is confirmed, or when trends indicate.
- Any seepage present in the mine, from the permanent waste rock dump, and in downstream groundwater monitoring bores will be assayed for a more extensive range of analytes on a quarterly basis when the mine is operational. Analyses will include pH, EC, TDS, acidity, alkalinity, soluble SO_4, Cl, Ca, Mg, Na, K, Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Sb, Se and Zn. The frequency of water quality monitoring may be varied if trends indicate changes could be occurring.
- If monitoring indicates that the PAF overburden and/or reject material is generating acid more quickly than predicted in the geochemical laboratory assessment tests, further assessment of the PAF materials management practices will be conducted.
- The effectiveness of the PAF, barren overburden and coal combustion ash placement in the mine will be validated on an annual basis by completing a sampling program at strategic areas on the dump surfaces, including the permanent dump surfaces, and the mine backfill surfaces. Samples will be tested for NAGpH and total sulphur.
- When operational, the waste rock dump will be subject to regular audits, and if required, appropriate corrective action taken.

7.7.2 Groundwater and Surface Water

Groundwater

Design Phase:

- Groundwater quality testing will be conducted leading up to and including the construction phase.
- The data will be used to extend existing baseline information and used in design.

Operational Phase:

- Quantity and quality of mine dewatering will be recorded;

- Quantity and quality of mine surface water will be recorded; and
- Quality of groundwater adjacent to the mine void, waste rock dumps, ROM pad,and any other significant facility storing water (e.g. evaporation ponds).

Post-Closure, final void monitoring will continue for a period of five years or otherwise in accordance with criteria agreed with regulators and include:

- Final mine void lake levels and quality.
- Selected groundwater monitoring upstream and downstream of the final void; and
- Annual review and assessment of all monitoring data.

Surface water

Data will be collected, assessed and reported on during the:

Design Phase:

- Water flow and quality testing will be conducted as part of detailed design; and
- Acquired data will be used as an input into the Water Management Plan.

During Operations:

- Volume and quality of significant surface water storages will be measured.

Post-Closure

- Annual review and assessment of all surface water monitoring data, including data collected downstream of temporary coal stockpile areas, ROM coal stockpile, crushing plant area, and coal product stockpile area
- An environmental site assessment will be conducted to include significant surface water storage areas.

7.7.3 Inspections and Audits

The implementation of this ARD Management Plan will provide the framework for reducing the likelihood of adverse impacts arising from Project activities. The following inspections and audits will be implemented:

- Monthly housekeeping inspections of all sites used for storage of PAF materials or acidic/saline water will be undertaken. The checklists for these will be developed during the detailed design phase and refined during operations.
- All sites used for storage of PAF materials or acidic/saline water will be assessed annually.
- An ARD audit will be undertaken biennially by an experienced external geochemical consultant and will include a review of all sites used for storage of PAF materials or acidic/saline water storage facilities.
- Visual opportunistic monitoring by the management team will occur across the entire site in regard to ARD management.

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7.8 Contingency Actions

Contingency plans will be initiated when problems are identified during the monitoring process as issues arise. If a performance indicator has not been met, a range of management actions may be triggered. Potential actions are described in Table 7-3.

Table 7-3 Contingency Table

Performance Indicator	Trigger	Typical Management Actions
Water quality	Water quality parameters exceed licence limits	Investigation and corrective action
Correct transfer and disposal of PAF materials	Non compliances identified in site inspections and audits	Incorporation of remedial actions into operational procedures
Correct storage and rehabilitation of PAF materials	Non compliances identified in site monitoring, inspections and audits	Removal and/or correct disposal of PAF materials Rollout induction/awareness training information to all crews again
Correct storage/treatment of acid/saline water	Non compliances identified in site monitoring, inspections and audits	Incident investigation

The key elements of the contingency plan are:

- All site personnel working with PAF materials and acid/saline water will be provided with adequate training to take appropriate precautions to minimise the risk of leakage/spillage and non-compliance. Documented procedures will be maintained for management of PAF materials and acid/saline water and allocate responsibility and accountability to appropriate site personnel.
- A spillage register and/or incident tracking system will be developed and maintained.

8.1 Current Status

The mine site is located approximately 15 km south west of Eneabba. The closest residential receptor is R7 as shown on Figure 8.1a of the CWC PER, approximately 1.4km south west of the mine and stockpile area.

The predominant winds range through east, north-east and west, south-west for approximately 79.4 per cent of the time. The winds vary in strength, but tend to be less than 5 m/s for 63.7% of the time and less than 2 m/s for approximately 20 per cent of the time.

Current levels of dust generation from natural bushland are expected to be low. Dust generation from farming land is expected to be seasonal.

8.2 Potential Impacts

The introduction of a coal mine to the area will increase the levels of ambient dust compared to existing concentrations. The mine life is 30 years, during which time the mine will advance from south to north at approximately 400 m per year. Thus the effects on receptors sensitive to dust will change throughout the life of the Project.

Assessment of the expected level of dust generation has used dispersion modelling to examine any likely effect on 11 receptors indentified in the study area (within 10 km of the mine site). The receptors include residences and also surrounding vegetation.

Construction

Removal and placement of topsoil are likely to be the most dust intensive operations. However, construction, mining and hauling of coal and waste rock and movement of vehicles near and on the site will also contribute to dust emissions.

During the construction phase, mine development, and preparation of areas for construction activities will be undertaken, including vegetation clearing, topsoil removal and storage, and civil earthworks.

There will also be a range of infrastructure development, including roads, pipelines, power lines, water storages buildings, and laydown areas.

Mining Operations

Mining activities will include the excavation, loading, transporting and dumping of overburden and coal. The impact of wind erosion has been accounted for in relation to disturbed areas prior to rehabilitation and those areas that are undergoing rehabilitation. All relevant sources of fugitive dust emissions have been accounted for in the development of the dispersion model results. Modelling was conducted to depict three scenarios, comprising three stages of mining including an early stage, a mid-life stage and an end life stage.

Modelling results

Overall, the modelling demonstrates that the mine is likely to cause adverse impacts at the nearest sensitive receptors unless management measures effectively reduce dust emissions.

Compliance with the USEPA standard of 150 µg/m³ is achieved at all sensitive receptors without management measures applied.

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But compliance with the NEPM(Air) standard for 24 hour average PM_{10} is not achieved at one receptor (R7) to the west of the mine area on one occasion annually without management measures applied.

When considering the combined impacts of the Coolimba Power Station, and an allowance for background dust of 30 µg/m^3, R7 would experience exceedences against this standard on 17 occasions annually, and 4 other sensitive receptors would experience exceedances more than 5 times annually, unless management measures effectively reduced emissions.

Considering the low frequency of impact, the stringent application of an urban standard to crustal matter, conservative nature of the emission rates and ability to manage dust generating activities, the impact on local air quality due to the proposed Central West Coal Project will be low.

8.3 Environmental Objectives

The objective of the air quality assessment and proposed management activities is to ensure that dust generated by the Central West Coal Project do not adversely affect environmental values or the health, welfare and amenity of people and land users.

- Air quality in WA is assessed according to standards specified by the NEPM National Environment Protection Measure (Ambient Air Quality) (NEPM (Air)) through the National Environment Protection Council (Western Australia) Act 1996 (WA DEC, 1996). Compliance with NEPM(Air) standard for particulate primarily applies to particulate matter with an aerodynamic diameter less than 10µm (PM_{10}) and is based on international studies and guidelines published by the World Health Organisation (WHO).
- The WHO suggest that PM_{10} be used as an indicator of the level of particulate matter in the atmosphere because there is more extensive measurement data throughout the world than any other indicator of particulate matter.

8.4 Performance Indicators

There are currently two guidelines on particulate matter applicable to Western Australia. One is the NEPM (Air) - Ambient Air Standard, which addresses respirable particulate (PM_{10}) as shown in Table 8-1.

Table 8-1 Summary of Ambient Air Quality Concentrations Stated in the NEPM (Air) Standard

Pollutant	Averaging Period	Maximum Concentration	Goal within 10 years Maximum Allowable Exceedences
Particulates PM_{10}	24-hour	50 µg/m^3	5 days a year

The other is the Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1992 and Environmental Protection (Kwinana) (Atmospheric Waste) Regulations, which applies directly to the Kwinana Industrial Area South of Perth (

Table 8-2).

Table 8-2 Relevant Air Quality Guidelines

Particle Size	Averaging Time	Concentration ($\mu g/m^3$)	Reference
PM_{10}	24-hours	150	USEPA
	Annual	30	NSW DECC
Total Suspended Solid	24 hours	90	Kwinana
	Annual	90	NSW DECC
Dust Deposition rate	Annual	2 g/m^2/month 4 g/m^2/month	NSW DECC
Note	a maximum increase in deposited dust level b Maximum total deposited dust level		

8.5 Management Actions

To ensure that the dust does not cause an amenity nuisance to surrounding land users, dust suppression measures will be employed. The dust suppression measures will include:

- Limiting speeds of vehicles;
- Watering and grading haul roads;
- Use of surface treatments or sealing of selected roads;
- Covering of conveyors;
- Moisture conditioning of coal and waste on conveyors as necessary;
- Progressive revegetation of disturbed areas;
- Additional dust suppression (watering) of stockpiles and backfill operations during adverse meteorological conditions;
- Developing a forecasting system to assist in anticipating adverse meteorological conditions that give rise to dust generation;
- Dust monitoring in real time at selected sensitive receptor sites, including adjacent native vegetation in the SENR, and the LLNR adjacent to mine operations, to confirm that the current modelling is conservative, and to identify potential problems;
- Developing a Trigger Action Response Plan as part of the Dust Management Plan. This would require implementation of a range of strategies including suspending certain activities, increasing dust suppression activity, to assisting sensitive receptors to manage effects of extreme meteorological conditions; and
- Applying best practice design of fixed plant with particular attention to dust suppression and capture in materials handling processes, including at loading, transfer and discharge points.

8.6 Contingency Actions

When a threshold concentration is reached, the following actions will be undertaken.

- All reported exceedences will be investigated, and remedial actions implemented.

9.1 Current Status

The 'Greenhouse effect' is the process by which the absorption of infrared (long wave) radiation by certain gases present in the atmosphere, commonly known as the greenhouse gases, will warm a planet's surface and lower atmosphere. Greenhouse gases of particular importance are those that are found in the troposphere in substantial concentrations, and those which possess a strong radiative forcing. Important greenhouse gases include:

- Water vapour (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)

9.2 Potential Impacts

The main greenhouse gas emissions from the Project will be from electricity usage and fuel consumption by vehicles and mining equipment. As a result, the Project will contribute to WA's greenhouse gas emissions. A greenhouse gas assessment has been conducted by URS (2008).

Greenhouse gas emissions are reported in terms of tonnes of CO_2 equivalent (tCO_2-e). CO_2 equivalents are calculated as the sum of the emission rate of each greenhouse gas multiplied by the global warming potential.

As follows: tonnes CO_2-e = (tonnes CO_2 x 1.0) + (tonnes CH_4 x 21) + (tonnes N_2O x 310).

The Central West Coal project CO_2-e calculation takes into account the key greenhouse gas producing activities shown in

Section 9 Greenhouse Gas Management Plan

Table 9-1. The largest component is fugitive emissions from the mined coal. The emission factor for all production of coal (fugitive) from open cut mines in WA is 0.017 t CO_2-e/t of raw coal[1] and has been included in the estimation of GHG emissions from the project.

However, this level of emissions is relatively low compared to other coal mining operations in Australia, due to the lack of methane in the fugitive emissions.

[1] Table 8, page 21, National Greenhouse and Accounts (NGA) Factors, October 2008

Table 9-1 Greenhouse gas generating activities, and the estimated quantities (over life of project)

Emission source	Activity level over project life		Total GHG emissions (Tonnes CO_2-e)
	Unit	Quantity	
Electricity consumption by equipment on the minesite	MWh	249,507	233,955
Fuel consumption including LPG and natural gas used in equipment and workshop facilities	No data available		negligible
Fleet fuel consumption – including both contractor and company owned vehicles	kL	54,030	156,834
Stationary/Back up power generation – diesel generators			
Fugitive emissions - Coal seam gas	0.017 t CO_2-e/ t coal	60 to 75 million tonnes	952,000 to 1,190,000
Fugitive emissions - Waste coal oxidation,			negligible
Fugitive emissions - Land use and clearing			negligible
	Total over 30 years		**1,342,789 to 1,580,789**
	Average per annum		**44,760 to 52,693**
	Emissions per unit of production (t CO_2-e/t coal mined)		**0.022 to 0.021**

9.3 Environmental Objectives

The objective for the Project in regard to greenhouse gases is to minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.

The relevant legislation and guidelines include:

- EPA Guidance Statement No. 12 – *Minimising Greenhouse Gas Emissions*;
- *National Greenhouse and Energy Reporting Act* 2007;
- *Energy Efficiency Opportunities Act* 2006; and
- Kyoto Protocol.

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9.4 Performance Indicators

Kyoto Protocol and the Australian Greenhouse Gas Emissions Target

In December 2007, the Australian government ratified the Kyoto Protocol, an international agreement designed to restrict the growth in the emission of greenhouse gases in developing countries to the quantity being emitted in 1990. This target was expected to be met over the five year period from 2008 – 2012.

The Kyoto Protocol was established in 1997, and to date 178 countries have ratified the agreement. Each developed country's target was negotiated and agreed internationally on an individual basis. Australia committed to monitor and report greenhouse gas emissions and has set a target level for emissions of 108% of the emissions for 1990.

The Australian Greenhouse Office (AGO) is a part of the Commonwealth Department of Climate Change. The AGO monitors and compiles databases on anthropogenic activities that produce greenhouse gases in Australia. The AGO has published greenhouse gas emission factors for a range of anthropogenic activities. The AGO methodology for calculating greenhouse gas emissions is published in the National Greenhouse Accounts (NGA) Factors workbook (AGO 2008) and is based on Australian data. This workbook is updated regularly to reflect current compositions in fuel mixes and evolving information on emission sources. The most recent publication at the time of the preparation of this PER was released in October 2008.

Western Australian Government Policy

In February 2007, the Premier of Western Australia released the Greenhouse and Energy Taskforce "*A Cleaner Energy Future*" report. The Taskforce recommends that **long-term costs and impacts of greenhouse gas emissions need to be "factored into the decision process"** and also recommends that ***"as a general principle, all new stationary energy developments should be liable for the full cost of future GHG emission compliance"*.**

The report encourages the State to "continue its efforts to achieve a national emissions trading scheme, fair to all participants, as a precursor to global trading arrangements". The Taskforce recommends national emissions trading, with prices capped at $25 to $35 per tonne CO_2-e through 2030.

Environmental Protection Authority (EPA) Guidance Notes

WA EPA Guidance Statement #12, "Minimising Greenhouse Gas Emissions", specifically addresses the minimisation of GHG emissions from significant new or expanding operations and requires proponents to clearly indicate in their environmental review documentation of the following:

- GHG emissions inventory and benchmarking;
- Measures to minimise GHG emissions annually and over the life of the project;
- Carbon sequestration e.g. bio-sequestration, geo-sequestration, chemical, soil uptake and reuse; and
- Benefits of reduced GHG emissions on a National or Global scale.

The Guidance Statement also suggests that proponents adequately address/commit to:

- applying best practice to maximise energy efficiency and minimise GHG emissions;
- undertaking comprehensive analysis to identify and implement appropriate offsets; and

- undertaking ongoing programmes to monitor and report emissions and periodically assess opportunities to further reduce GHG emissions over time.

Carbon Pollution Reduction Scheme (CPRS)

While the Carbon Pollution Reduction Scheme (CPRS) is not yet legislated, the Federal Government has released two green papers and advised that the legislation will be in effect in 2010. It works by mandating that every organisation with a facility that emits 25 kilotonnes of CO_2-e or more per year must report and purchase a permit for every tonne of CO_2-e it releases.

Permits will be auctioned throughout the year. Where not enough permits are available, or where they are too expensive, some carbon offsets may be supplemented into the scheme; from various forestry projects or from those under Kyoto Protocol's Clean Development Mechanisms (CDMs).

The design of the scheme outlined in the Green Paper[2] provides no scope for voluntary offsets under the scheme and will render programs like the Greenhouse Friendly™ and GreenPower™ ineffective.

National Greenhouse and Energy Reporting (NGER) Act

The National Greenhouse and Energy Reporting Act was passed in September 2007 establishing a mandatory corporate reporting system for GHG emissions, energy consumption and production. From 1 July 2008, corporations will be required to register and report for the financial year 08/09 if:

- They control a facility that emits 25 kilotonnes or more of greenhouse gases (CO_2-e), or produce or consume 100 terajoules or more of energy; or
- Their corporate group emits 125 kilotonnes or more greenhouse gases (CO_2-e), or produces or consume 500 terajoules or more of energy.

9.5 Management Actions

The Project will be required to report its CO_2 equivalent emissions under the National Reporting Scheme. The Project will seek to reduce its emissions where ever possible and will work with its related project, the Coolimba Power Station, to advance the reduction of CO_2 across both projects including through support of the Coolimba Carbon Capture and Storage Readiness activities.

The following outlines further potential opportunities to address the growth in greenhouse gas emissions and to offset the emissions associated with the development of the Central West Coal Project. The key aspects of GHG emissions reduction strategy for the Project will include the following actions.

- The company will undertake a detailed feasibility analysis, regularly update its knowledge of climate change legislation and monitor carbon prices to identify a portfolio of options to help meet its GHG emissions commitments as per the state, federal and international legislation.
- Central West Coal will estimate its actual GHG emissions inventory. One important aspect of this is the identification and isolation of the typical production and utilisation variables that best track the Central West Coal's GHG emissions so that the impact of changes in these variables can be monitored. In line with the NGERs Act, Central West Coal will measure and report the GHG emissions it is responsible for generating.

[2] http://www.climatechange.gov.au/greenpaper/index.html

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- Central West Coal will integrate energy efficiency into the design and procurement processes – especially for electric and diesel powered equipment (including vehicles). Energy efficiency measures are most cost effective when implemented at the design/procurement stage, with retrofitting usually more costly and disruptive.
- Alternative fuels (e.g. compressed natural gas, liquid petroleum gas, bio-diesel) will be used where practicable and feasible in powering stationary and mobile diesel equipment.
- Central West Coal will explore options with other companies that can create offsets through sequestration, energy efficiency projects, low emission energy production processes and broader market mechanisms, to reduce its emissions profile.

Various abatement and offsetting opportunities are currently available in the market, which can be used to reduce either part or all the greenhouse gas emissions generated by the Project. Abatement and offsetting activities are subject to a detailed feasibility analysis, and are defined as follows:

- Abatement Project – projects such as energy efficiency projects, implemented within the Project's boundary, that result in a reduction of greenhouse gas emissions from BAU; and
- Offset Project – projects such as renewable energy, tree plantation etc. that result in partial or complete reduction of greenhouse emissions.

10.1 Current Status

There are large land holdings in the Mid West region, which means that there are often great distances between noise sources and subsequent sensitive noise receptors.

The project area is located approximately 15 km south-west of Eneabba and approximately 4 km from the closest Iluka Mineral Sands mining operations at Eneabba West Mine. The closest residential receptor is approximately 2 km north-west of the proposed site. The Iluka mining operations at Eneabba West Mine and the traffic along the Brand Highway, approximately 6 km to the east are the two main background noise sources. However, given the distances between the proposed site and these sources, the background levels are generally very low. Figure X shows the site in relation to the noise receptors and the identified noise sources.

SVT Consulting Engineers conducted a noise impact assessment for the Project. As part of this study, background noise monitoring and noise modelling was conducted to determine the current noise levels experienced by the nearest residential receptor. The results show that background noise levels are very low, with applicable noise levels not exceeding 38.5 dB. The relatively high standard deviation is due to wind-generated noise. The first week of monitoring was characterised by calm weather conditions, but windier conditions were experienced during the second week.

10.2 Potential Impact

The development of the proposed Coal Mine will introduce a number of new noise sources to the immediate area. Detail on technical specifications is not yet provided at this phase of the project design. The SVT assessment provides an indication of those measures that can be included that will achieve the appropriate noise levels experience by residents in the area.

As outlined in the Environmental Scoping Document issued to the EPA in September (URS 2008), the focus of the assessment has been on the noise generated during operation of the Power Station both in isolation and the noise generated cumulatively with the adjacent Coal Mine operations. The construction phase has not been examined in detail due to the temporary nature of the phase. Noise management measures appropriate to the construction phase are provided at the end of this noise section.

The Environmental Protection (Noise) Regulations require that noise emissions do not exceed, or significantly contribute to exceedances of, the assigned noise levels. Where it is likely that the cumulative noise emissions from more than one noise emitting premises will cause an exceedence of the assigned noise levels then noise emissions from each individual noise emitting premises must be at least 5 dB(A) below the assigned noise levels to demonstrate compliance with the Regulations.

The noise assessment has focused on the six nearest sensitive receptors to the Power Station. Given the very low ambient noise levels on site, the noise model has not included existing ambient noise levels as they are considered negligible in this location. The assessment examined two scenarios; day-time (0700-1900) operations and night-time (1900-0700) operations.

Construction activities are expected to be at their peak from the 18th month of construction to the 36th month of construction. It is unlikely that significant exceedences of noise limits will arise from Power Station construction work at the site during normal operating conditions, given industry standard noise attenuation measures. However, mine construction activities, which will be conducted on a 24/7 basis, will likely cause exceedences under some conditions, at certain stages of mine development.

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The assessment of cumulative effects for the operational phase of both Projects includes the contribution of noise from the CWC Project and the noise generated by the Coolimba Power Station Project. The effects from the mine will vary according to the stage in the mines lifetime, because the position of the mining is continuously moving northwards. The noise impact assessment for the Central West Coal Project has been modelled for different stages of the mine life; early, mid and late mine life (SVT, 2008). The findings show that there will be a consistent exceedence of the night-time assigned noise pressure level of 35 dB(A) at residence R6 (2 km south-south west of the mine site). Compliance with regulatory noise limits is demonstrated at all other locations considered. Table 10-1 provides a summary of the predicted noise levels.

Table 10-1 Cumulative Noise Levels for the Combined Power Station and Coal Mine Projects for Each Identified Receptors

Receptor	Cumulative Sound Pressure Level – dB(A)		
	Early mine life position	Mid mine life position	Late mine life position
R1 (6.4 km north-west)	17.6	22.8	26.4
R2 (7.0 km west, north-west)	16.1	19.4	20.5
R4 (4.8 km south-west)	26.2	25.5	25.1
R5 (3.1 south, south-west)	34.3	33.4	33.2
R6 (2.0 south-west)	40.6	40.2	40.1

10.3 Environmental Objectives

The objective of the noise assessment and management is to ensure that noise emissions, both individually and cumulatively do not adversely affect local amenity.

Relevant legislation and standards include:

- EPA Draft Guidance No. 8, Guidance for Environmental Noise (EPA, 2007);
- EPA Draft Guidance No. 14, Road and Rail Transportation Noise (EPA, 2000c); and
- Environmental Protection (Noise) Regulations 1997.

10.4 Performance Indicators

The Environmental Protection (Noise) Regulations 1997 govern the maximum permissible noise level at noise sensitive premises. These levels are presented in Table 10-2.

Table 10-2 Assigned Ambient Noise Levels - Environmental Protection (Noise) Regulations 1997

Type of Premises Receiving Noise	Time of Day	Assigned Level dB(A)		
		LA_{10}	LA_1	LA_{MAX}
Noise Sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Sunday	45 + influencing factor*	55 + influencing factor	65 + influencing factor
	0900 to 2200 hours Sundays and Public Holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and to 0900 hours Sunday and Public Holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor

Note: The influencing factor at this site is zero (SVT, 2008)

10.5 Management Actions

10.5.1 Construction Phase Management Measures

The Project is anticipated to be constructed during daytime hours, between 7am and 7pm on any day which is not a Sunday or Public Holiday. Therefore, the noise limits provided in the Environmental Protection Noise Regulations 1997 will not apply provided that:

- The construction work is carried out in accordance with control of noise practices set out in Section 6 of Australian Standard 2436-1981 “Guide to Noise Control on Construction, Maintenance and Demolition Sites; and
- The equipment used for the construction is the quietest reasonably available.

In the event that construction work is required outside daytime hours then:

- The construction work will be carried out in accordance with control of noise practices set out in Section 6 of Australian Standard 2436-1981 “Guide to Noise Control on Construction, Maintenance and Demolition Sites: and
- The equipment used for the construction is the quietest reasonably available.

Furthermore, if noise emissions are likely to exceed the assigned noise levels then:

- The contractor will advise all nearby occupants or other sensitive receptors who are likely to receive noise levels which fail to comply with the standard under Regulation 7, of the work to be done at least 24 hours before it commences;
- The contractor will show that it was reasonably necessary for the work to be done out of hours; and
- The contractor will submit a noise management plan at least seven days before the work starts The plan will include details of:
  - Need for the work to be done out of hours;

- Types of activities which could be noisy;
- Predictions of the noise levels;
- Control measures for noise and vibration;
- Procedures to be adopted for monitoring noise emissions; and
- Complaint response procedures to be adopted.

10.5.2 Operation Phase Management Measures

The main contributors to the noise likely to be experienced at residence R6 from the Power Station are the gas turbines, the coal fired boilers, the cooling towers and coal crushing and handling operations. Achieving full compliance for both assigned noise levels mentioned in the assessment will require noise reductions from the Power Station and the Coal Mine. These measures are described below.

In the absence of design specific details for the plant to be used, it is not possible to confidently specify the noise control measures that would categorically achieve the reductions required. However, the following are provided as typical attenuation options that are available to make these reductions. Coolimba will select the most appropriate measures during the detailed design of the Project.

- Installation of high performance acoustic enclosures (or buildings) over the gas turbine generator packages.
- Installation of high performance air inlet, exhaust and ventilation silencers to the gas turbine generator packages.
- Acoustic cladding of the boilers.
- Low noise specifications for auxiliary equipment associated with the boilers, or location of this equipment within acoustic enclosures or buildings.
- Use of low noise fans for the cooling towers and or the use of variable speed drives to allow lower running speeds at night when noise limits are most stringent.

At the Coal Mine, noise from the ROM pad and coal stockpile area is most significant and the contribution from the overburden dozers and conveyors is also significant. However, no single item of equipment dominates noise received at R6 and, therefore, a combination of noise reduction and control measures will be required to achieve compliance with regulatory noise limits. It is likely that some or all of the following noise reduction measures will be required:

- Screening or enclosing of fixed plant (crushing and screening plant and transfer stations).
- Covering of conveyors.
- Provision of bunding around ROM pad and stockpile areas.
- Implementing low noise specifications for dozers and loaders.
- Restricting night time operations, if possible, based upon prevailing meteorological conditions.
- Regular monitoring of noise levels generated by mobile and fixed plant.
- Regular monitoring of noise levels experienced at sensitive receptors.

These measures will be reviewed during future design stages to ensure that the most effective noise mitigation solutions are identified and implemented.

10.6 Contingency Actions

Should the performance indicators not be achieved, contingency actions may need to be implemented. Failure to achieve each performance indicator may initiate the following contingency actions:

- All noise exceedences at sensitive receptors will be reported and investigated;
- Where exceedences result from management failures, appropriate management changes will be made.
- Where exceedences result from underlying design issues, appropriate plant modifications and/or management changes will be made.

11.1 Current Status

Two ethnographic surveys have been undertaken of the project area. It comprises land within the Yued people's Native Title Claim area.

11.2 Potential Impact

Two distinct features were revealed during the surveys; a moodjar tree and a collection of quartz stones.

Both of these sites were located within the project area. It is likely that these areas will require clearing in order for mining to occur in this area.

There may be other sites which have not yet been identified, which may require clearing.

11.3 Environmental Objectives

The objective for the Project in relation to the protection of Aboriginal heritage is to:

- Protect heritage and culturally sensitive sites.
- Comply with the requirements of the *Aboriginal Heritage Act 1972* and EPA Guidance Statement No. 41, Assessment of Aboriginal Heritage (EPA, 2004e).
- Ensure that changes to the biological and physical environment resulting from the Project do not adversely affect the cultural associations of the area.

The relevant legislation and standards are the *Aboriginal Heritage Act 1972* and the EPA Guidance Statement No. 41 (Assessment of Aboriginal Heritage, 2004).

11.4 Performance Indicators

- Compliance with the Aboriginal Heritage Act and EPA Guidance Statement No. 41, Assessment of Aboriginal Heritage (EPA, 2004e).
- Support from Aboriginal Traditional Owners for Central West Coal's approach to, and management of cultural heritage issues.

11.5 Management Actions

Heritage surveys have not yet been completed for the entire project area. Due to the size of the project area, the surveys covered the areas affected by construction and the early stages of mining. Further surveys will be conducted of the remaining areas.

Aviva has a Heritage Agreement with the Yued people for the Project. However, no agreement has yet been made with the Amangu and Franks groups. Aviva and CWC have made a request to the groups for the completion of heritage surveys across the remainder of the project area.

The following management measures and good practice measures will be adhered to throughout the life of the Project:

- CWC will consult with Traditional Owners and will seek all relevant approvals under the *Aboriginal Heritage Act 1972* in the event that disturbance of an Aboriginal heritage site is required.

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- CWC will undertake ongoing consultation with the Yued, Amangu and Franks groups and additional Aboriginal heritage surveys will occur for any future works.
- If the Project requires the clearing of the moodjar tree stand, CWC will consult with the Yued people and will work with the DIA to ensure compliance with the *Aboriginal Heritage Act* 1972.
- If the Project requires the clearing of the quartz stones, CWC will consult with the Yued people and will work with the DIA to ensure compliance with the *Aboriginal Heritage Act* 1972.
- In the unlikely event that buried or unidentified sites are discovered works will be halted, and traditional owners and DIA will be consulted to determine appropriate action.
- Further studies will be conducted over the remainder of the project area, including those areas covered by the Amangu and Franks groups.
- All ground disturbance activities within the project area are limited to only those Cleared Work Areas that have been the subject of a formal heritage survey to ensure compliance with the *Aboriginal Heritage Act* 1972.
- Continued consultation will be conducted with the Native Title Claimant Working Groups to determine the appropriate levels of monitoring of ground disturbing activity, with regard to the possible discovery of subsurface cultural materials.
- The Native Title Claimant Working Groups, will be provided with a copy of any Report pertaining to environmental studies and approvals required for the Project as a key stakeholder to the Project.
- Additional Aboriginal heritage surveys using the Work Program Clearance methodology will occur for any future proposed works in the project area.
- The Native Title Claimant Working Groups will be kept informed of its progress throughout the development of the Project as a key stakeholder to the Project.

Table 11-1 Heritage Survey Register

Project Component	Land Area of Component Approximate	Existing Land Use	Status of Heritage Survey	Identification of Heritage Issues
Mine Path and related Infrastructure	840 ha	All cleared private farm land	Requested	N/A
Mine Path and related Infrastructure	860 ha	Native Vegetation private land	Approx 100ha complete remainder requested	Two heritage features identified within proposed area of disturbance.

11.6 Contingency Actions

Should the performance indicators not be achieved, contingency actions may need to be implemented.

Failure to achieve each performance indicator may initiate the following contingency actions:

- Determining a program of mitigation with the Department of Indigenous Affairs and the Yued Native Title Claimant Working Group through the South West Aboriginal Land and Sea Council (SWALSC); and
- Further training of Central West Coal employees in cultural awareness and cultural heritage obligations and management.

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Stakeholder Consultation Section 12

The environmental approvals process in WA is a public process that includes stakeholder engagement. CWC acknowledges the importance of conducting a comprehensive stakeholder consultation programme and maintaining engagement with all relevant stakeholders throughout the life of the Project.

The objective of CWC's consultation programme is to enable individuals, groups and agencies with an interest in the Project to have access to up-to-date, relevant information regarding the Project It also provides a means for stakeholders to raise issues and concerns, and allows CWC to respond to these.

During the initial phases of the environmental assessment process, CWC developed a plan that identified the key stakeholders that would need to be consulted in relation to the Project. These included the following:

- State Government
  - Office of Development Approvals Coordination
  - Office of the Appeals Convenor
  - Office of Energy
  - DMP
  - DEC
  - DoW
  - Department for Planning and Infrastructure
  - Department of Indigenous Affairs
  - Department of Commerce
  - Department of Agriculture and Food
  - Department of Health
  - Main Roads Western Australia
  - EPA
- Local Government
  - Shire of Carnamah
  - Shire of Coorow
- WA Political Representatives
  - Minister for State Development
  - Minister for Environment
  - Minister for Energy
  - Minister for Mines and Petroleum
  - Minister for Regional Development

  - Minister for Community Services
  - Minister for Local Government and Heritage
  - Minister for Housing and Works
  - Minister for Health and Indigenous Affairs
  - Minister for Planning
  - Minister for Water
- Non-Government Organisations and Community Groups
  - Conservation Council
  - Wildflower Society
  - Northern Heathlands Conservation Group
  - Northern Wildflower Conservation Council
  - Urban Bush Land Council
  - Chamber of Minerals and Energy WA
  - West Midlands Natural Resource Group Team
- Utility and Interest Groups
  - Western Power
  - Synergy
  - Landcorp
- Local and Regional Business Councils
  - Mid West Development Commission
  - Mid West Chamber of Commerce and Industry
- Indigenous Stakeholders
  - Yued Native Title Claimant Group
  - Amangu Native Title Claimant Group
  - Franks Native Title Claimant Group
  - South West Aboriginal Land and Sea Council (SWALSC)
- Local Communities
  - Eneabba Community Members
  - Leeman Community Members
  - Greenhead Community Members

- Local Land Users
  - Numerous meetings with individuals in the vicinity of the Project
  - Western Flora Caravan Park

CWC is committed to continuing stakeholder consultation throughout the life of the Project, including the construction, operation and decommissioning phases. Consultation will involve presentations and briefings to the key stakeholders.

CWC recognises that effective consultation with stakeholders throughout the life of the operations facilitates the incorporation of stakeholder concerns and objectives into the closure plan from the outset, and reduces the risk of delay to closure.

12.1 Consultation during PER and EMP Preparation

Central West Coal Ltd is committed to an inclusive and comprehensive approval process. In keeping with this objective, the company has consulted widely throughout the process to maximise the possibility of addressing all potential concerns in the most appropriate way. Consultation has been conducted with the following primary objectives:

- Identification of interested or affected parties and individuals and an understanding of the nature of their stakeholder interest;
- Provision of accurate, relevant and updated information on the project and its potential impacts
- Anticipation of regulatory requirements and early initiation of consultation; and
- Initiate the process of continuous consultation beyond the approvals process, through construction and into operation and closure.

Direct consultation took the following forms:

- Community briefings in local towns;
- Agency and authority briefings and technical discussions; and
- Landholder briefings including native title claimants.

Indirect consultation has occurred via regular updates on the projects in regional and statewide publications and through the provision of a project website with contact opportunities.

The environmental issues identified during consultation conducted to date are listed in Section 5 of the PER, with the main issues relevant to this EMP being:

- Vegetation and Flora: How much vegetated land will be cleared, what are the potential direct and indirect impacts that may occur on vegetation within the project area and surrounding Nature Reserves,
- Fauna: A number of species of conservation significance, including terrestrial and subterranean fauna use the area for breeding and/or foraging, and may be impacted by loss of habitat or by conflict with operational activities.
- Water: protection of surface and groundwater quality, potential for acid rock drainage.

Section 12 Stakeholder Consultation

- Air quality: greenhouse gas emissions, other emissions that could impact on human health, health and nuisance issues arising from particulate emissions(dust),
- Noise Impacts: The Projects will introduce noise sources to an area with very low background noise levels.
- Carbon management: how will the Project respond to Climate Change and related issues.
- Aboriginal heritage: heritage survey requirements, heritage agreement,

Rehabilitation and closure planning are also important aspects of the project and are the subject of separate plans.

12.2 Consultation during Construction and Operation

Central West Coal Ltd will establish a Stakeholder Register and maintain contact with all stakeholders on a regular basis through the life of the Project.

As described in the Preliminary Closure Plan, CWC will consult with relevant stakeholders during the preparation of the Final Closure Plan, which will be prepared at least five years prior to the planned closure date.

The aim of CWC's stakeholder consultation plan for the closure planning process is to provide a framework that will enable stakeholders to be provided with accurate information about, and be involved to an appropriate degree, in mine closure.

CWC is confident that concerns raised by stakeholders regarding the above environmental management issues resulting from the Project can be managed in a safe and effective manner. CWC will continue to consult with all relevant government agencies throughout the life of the Project.

Auditing Section 13

CWC will establish and maintain a programme and procedures for periodic audits of the management plans that make up this EMP. Maintenance and implementation of the audit programme will be the responsibility of CWC's General Manager.

Environmental audits can occur in many forms, but generally aim to assess the environmental performance of a facility in order to identify risks and potential liabilities. The format of the audit will depend on the issue or area being reviewed but could include the following phases:

- Development of the audit protocol;
- Completion of a questionnaire by site personnel prior to a site visit by the auditor;
- Site visit, comprising interviews, site inspections and/or direct measurement;
- Review of relevant documentation and records; and
- Preparation and submission of the audit report.

Environmental performance will be audited on an annual basis and the outcomes included in the relevant reports required under the Ministerial approvals. Information on the results of the audits will also be provided to CWC management for review.

In addition to formal audits by internal or external auditors, internal area or facility inspections will be conducted to assess the effectiveness of day-to-day environmental management. This will allow opportunities for improvements in environmental performance to be identified and acted upon as soon as possible. The inspections will occur on a weekly, monthly or less frequent basis, depending on the area or facility being reviewed.

Review and Revision

Section 14

This EMP will be reviewed every three years or more frequently if required, to address the following:

- Any changes in Project design or operation that require modifications to the environmental management procedures outlined in this EMP;
- Any issues identified as a result of internal and external audits, and CWC management review of the audit outcomes, in relation to the suitability, adequacy and effectiveness of this EMP in meeting the agreed objectives; and
- Corrective or preventative actions developed in response to environmental incidents and non-conformances.

15.1 Internal Reporting

Environmental records are evidence of the ongoing environmental performance of the Project and demonstrate conformance with legal and other requirements. Environmental records to be maintained by CWC and/or its contractors will include:

- A register of legal and other regulatory requirements including licences and permits;
- A register of environmental aspects and impacts;
- Incident reports;
- Training records;
- Inspection, calibration and maintenance records;
- Monitoring data;
- A register of non-conformances;
- Public complaints and responses to these; and
- Internal and external audits and reviews.

15.2 External Reporting under the Ministerial Approvals

Any reporting requirements defined in the State and Commonwealth Ministerial approvals will be incorporated into this EMP following completion of the environmental approvals process.

15.3 External Reporting under Mining Lease Conditions

Any reporting requirements defined under the Mining Lease conditions will be incorporated into this EMP following completion of the environmental approvals process.

15.4 External Reporting under the Pollution Prevention Licence

Any reporting requirements defined under the Licence to Take Water will be incorporated into this EMP following completion of the environmental approvals process.

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Appendix A

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Categories under the Environment Protection and Biodiversity Conservation Act.

Endangered - The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate, or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.

Vulnerable - Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.

Migratory - Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including:

- the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a range state;
- the Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA); or
- the Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Schedules under the Wildlife Conservation Act 1950

Schedule 1 - Fauna which are Rare or likely to become extinct, are declared to be fauna that is in need of special protection.

Schedule 2 - Fauna which are presumed extinct are declared to be fauna that is in need of special protection.

Schedule 3 - Birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction are declared to be fauna that is in need of special protection.

Schedule 4 - Declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned above.

Definition of Conservation Value Categories

Appendix A

Definition of DEC Priority Codes

Priority 1 - Taxa with few, poorly known populations on threatened lands.

Taxa which are known from few specimens or sight records from one or a few localities, on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 2 - Taxa with few, poorly known populations on conservation lands.

Taxa which are known from few specimens or sight records from one or a few localities, on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 3 - Taxa with several, poorly known populations, some on conservation lands.

Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 4 - Taxa in need of monitoring.

Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

Priority 5 - Taxa in need of monitoring

Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Definition of Conservation Value Categories