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October 2007

Kanmantoo Copper Project Mining Lease Proposal

Appendices
Volume 4

HILLGROVE
RESOURCES



HILGROVE RESOURCES

Kanmantoo Copper Project

Mining Lease Proposal Appendices Volume 4



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Summary Information

Mine owner:	Hillgrove Copper Pty Ltd and Kelaray Pty Ltd
Mine operator:	Hillgrove Copper Pty Ltd
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Tenements:	MC 3510, MC 3833, MC 3834, MC 3835, MC 3836
Name of mining operation:	Kanmantoo Copper Project
Commodity to be mined:	Copper, gold, silver and garnet
MLP date:	October 2007

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Kanmantoo Copper Project Surface Water Management Conceptual Design

2.3 Contamination

Both the Tailings Storage Facility (TSF) outer banks and the Waste Rock Storage (WRS) have the potential to discharge sediment laden water into the natural environment. In addition, the Run of Mine (ROM) pad and associated stockpiles, the process plant, laydown areas, and other mining related infrastructure, all have the potential to contaminate stormwater with chemicals, including hydrocarbons.

Section 7 proposes water management measures to mitigate the potential impacts on downstream runoff water quality.

3 STORMWATER DEFINITIONS

Definitions of runoff sources for the Kanmantoo Copper-Gold Project are outlined below:

- ! *Clean Runoff*: Runoff generated from undisturbed areas, typical of baseline water quality.
- ! *Sediment Runoff*: runoff generated from disturbed areas but not containing any process or waste rock runoff, i.e. haul roads, vehicle tracks, borrow pits, with a higher sediment load than baseline water quality.
- ! *Waste Rock Runoff*: runoff generated from the WRS and outer embankment of the TSF, with a higher than baseline quality sediment loads and the potential for acid and metalliferous drainage (AMD) to develop from the interaction of reactive waste rock (PAF) with air and/or water.
- ! *Process Runoff*: runoff and water generated from the processing plant areas, ROM pad, associated stockpiles, mine lay-down areas, and workshop areas with high sediment loads and elevated chemical concentrations when compared to baseline water quality samples.

TSF decant and underdrainage water, any water from the existing open-pit are dealt with separately to this report.

4 STORMWATER MANAGEMENT PRINCIPLES

The plan is based on the following principles:

- ! Capture of 'clean runoff' and diversion water around disturbed mining areas using channels or bunds.
- ! Capture of 'sediment runoff' from haul roads, vehicle tracks, borrow pits, rehabilitated areas etc. for sediment load reduction before discharging off-site or re-use.
- ! Capture of 'waste rock runoff' from the outer batters of the TSF and the unrehabilitated WRS, to enable sediment load reduction before diversion to the decant water storage or process water storage for re-use in the mine processing plant, or to constructed wetlands for treatment and disposal.
- ! Capture and treatment of 'process runoff' from the processing plant areas, ROM pad, associated stockpiles, mine lay-down areas, and workshop areas for treatment and management near the source.

5 FEATURES OF ON-SITE SURFACE WATER MANAGEMENT

The main features of the on-site surface water management plan as indicated in Figure 2 and explained in more detail in Section 7 are:

- ! The use of bunding and diversion channels around the toe of the WRS and TSF to prevent the 'clean runoff' coming into contact with either the 'waste rock runoff' and/or the 'process runoff'.
- ! Diversion of 'clean runoff' entering from the creek line to the west of the site around the TSF.
- ! The use of sediment basins, wetlands and silt traps to maximise the capture and treatment of 'sediment runoff' and 'waste rock runoff' prior to reuse in processing plant or discharge.
- ! Management and treatment of runoff from disturbed areas at the source through the use of contour banks, bunding and progressive rehabilitation.
- ! Management of 'process runoff' through the use of bunding and diversions.

6 DESIGN STORMS

The daily rainfall record and intensity frequency-duration (IFD) data for Kanmantoo weather station was used to calculate the runoff volumes for the Kanmantoo Copper-Gold Project. Rainfall for events of 24 hours and 72 hours duration, for 5 to 100 year Average Recurrence Interval (ARI) is presented in Table 1.

**Table 1:
Kanmantoo Station Rainfall for Selected Storms (mm), (BOM, 1987)**

Duration	Average Recurrence Interval (ARI)			
	5 Year	20 Year	50 Year	100 Year
24 hours	57.8	77.5	94.1	107.5
72 hours	72.0	95.0	113.8	129.6

7 CONCEPTUAL STORMWATER MANAGEMENT STRATEGY

The conceptual stormwater management strategies outlined below are designed to address the above potential impacts. Figure 1 presents the breakdown of each infrastructure area into average recurrence interval (ARI) runoff volumes, assuming no initial loss and no continuing loss for the purposes of conceptual design (conservative).

7.1 Proposed Runoff Storages

7.1.1 Decant Water Storage

A storage will be constructed on the tributary of the Dawesley/Nairne Creek up-gradient of the railway embankment culvert. The storage will be sized to TSF decant water, process water and the 1 in 100 year ARI design storm runoff volume collected in the southern drainage channels from the slopes of the WRS and TSF. The runoff volume is estimated to be 23.5ML. The storage will be lined for the purposes of containing potentially contaminated decant water from the TSF (refer elsewhere for further details of the proposed lining system). There is also capacity for storage of water from the pre-existing open pit.

7.1.2 Process Area Sediment Basin

A sediment basin will be installed on the drainage line adjacent to the processing plant. This basin will have the capacity to contain runoff from the ROM pad, process plant area and the south-eastern batter of the WRS. It is estimated that basin will need to contain approximately 19.5 ML of runoff during a 1 in 100 year ARI 72 hour design storm. This basin would need to be emptied within 14 days of a storm event with the water used in the process plant.

7.1.3 Northern Sediment Basin/Wetland

A series of sedimentation basins will be installed near the north eastern toe of the TSF to treat runoff from the northern banks of the WRS and outer TSF banks. The sedimentation basins will be designed to remove sediment down to a particles size of 0.01 mm for a 1 in 5 year, 24 hour design storm. This basin will be designed to operate wet, i.e. it does not need to be emptied between storm events. The sedimentation basins will also have a higher level capacity to cope with the excess runoff from a 1 in 100 year 72 hour design storm which is estimated to be 32ML.

Overflow from this basin will then be discharged into the existing evaporation pond for disposal.

7.2 Infrastructure Stormwater Management

7.2.1 Tailings Storage Facility Outer Batters

The proposed TSF will produce increased runoff from its outer batters. This runoff has the potential to contain elevated sediment loads from the outer TSF batters.

To calculate total runoff potential from the TSF during a 1 in 100 year ARI 72 hr storm event, the TSF was divided into two areas based on potential runoff paths as per Figure 1. Runoff from Area G will head towards

the Northern Sediment Basin/Wetland, whilst runoff from Area F will drain towards the Decant Water Storage where it will be collected.

Estimated runoff volumes for these two areas are shown in Table 2.

**Table 2:
Runoff Volumes for the outer batters of the TSF**

Area	Area Identifier	Area Runoff Coefficient	Area (ha)	Total Discharge (ML) 1: 100yr ARI 72hr Design Storm
Tailings Disposal Facility Batters	F	1	12	16
	G	1	10	13

The proposed TSF footprint will intercept a tributary of the Dawesley/Nairne Creek. A diversion channel will be constructed to enable ‘clean runoff’ to flow around the toe of the TSF, bypassing the Decant Water Storage to reunite with the Dawesley/Nairne Creek tributary immediately up-gradient of the railway culvert on the southern boundary of the site.

A diversion bund will be located at the base of the TSF outer toe to separate ‘sediment runoff’ from the ‘clean runoff’ diversion channel. The channel behind the bund will be sized so that runoff will be channelled at non-scouring velocities to the Decant Water Storage or the Northern Sediment Basin/Wetland. To reduce the sediment load in this runoff, contour banks will be located on the batter of the TSF.

7.2.2 Waste Rock Storage

The former WRS from past mining activity at Kanmantoo is located on top of the ridgeline central to the site, and little in the way of runoff is intercepted by the storage. Surface runoff from the trafficked waste rock storage surface currently spills to the side of the waste rock storage.

The current mining proposal includes increasing the height and footprint of the existing waste rock storage, extending to the south-west towards existing drainage lines.

Prior to and during rehabilitation, runoff from the WRS will contain sediment. Runoff will be collected in a series of contour banks around the batters of the WRS to reduce sediment load. Runoff volume calculations from the exposed surface of the WRS have been estimated as presented in Figure 1.

**Table 3
Potential 1 in 100 year ARI runoff from the Waste Rock Storage**

Area	Area Identifier	Area Runoff Coefficient	Area (ha)	Total Discharge (ML) 1: 100yr ARI 72hr Design Storm
Waste Rock Storage	A	0.45	11	6
	B	0.45	17	10
	C	0.45	13	8
	D	0.45	14	8
	E	0.45	5	3

As for the TSF batters, a diversion bund will be located at the base of the WRS outer toe to separate ‘sediment runoff’ from the ‘clean runoff’ diversion channel. The channel behind the bund will be sized so that runoff will be channelled at non-scouring velocities to the Decant Water Storage, Process Area Sediment Basin or the Northern Sediment Basin/Wetland. Around the process areas, runoff will be directed towards these channels so that both ‘process runoff’ and ‘waste rock’ runoff are separated from any ‘clean’ water.

Progressive rehabilitation of the exposed waste rock storage slopes will reduce the surface area exposed to rainfall and production of acid drainage (refer elsewhere for further information on management of PAF material). Rehabilitation will reduce the total volume of 'waste rock' runoff but may increase the volume of 'sediment runoff' due to the increased slope lengths caused by the flattening of these slopes in the rehabilitation process.

7.2.3 ROM Pad

Similar to the WRS, the ROM pad will produce sediment laden surface water runoff. This runoff may also contain trace elements from the ore stock piles. Bunding and small scale sediment traps will be used to treat the stormwater at the ROM pad. Overflow will be directed into the Process Area Sediment Basin located on the drainage line southeast of the main processing plant as shown conceptually on Figure 2. The eastern end of the ROM pad will be raised to minimise surface water runoff from upgradient entering the ROM pad.

Calculated runoff from the ROM pad from a 1 in 100 year ARI design storm is approximately 4 ML.

7.2.4 Processing Plant and Mining Services

The processing plant and mining services area includes all areas which have the potential to create contaminated runoff. The majority of these areas are situated upstream of the identifiable drainage lines, minimising the requirement to divert up-gradient surface flow. Surface runoff generated from these areas will be directed to the Decant Water Storage for re-use in the process plant or the Process Area Sediment Basin.

To protect the downstream environment from potential contamination, bunding and chemical containment/treatment will be included (where required) as close as possible to the source of the potentially contaminating activity. Diversion drains will also be incorporated around the processing plant and mining services to minimise the entry of 'clean water' into these areas. Raising haul roads and service roads around the processing plant will enable water streams to be kept separate, reducing the risk of cross contamination and benefit access around the site during wet periods.

The runoff volume estimated for the processing plant is 4 ML from a 1 in 100 year ARI design storm whilst runoff from the mining services area is estimated to be 3 ML. It is proposed that at least 1.5 ML of this runoff will be directed towards the Decant Water Storage and the remaining 5.5 ML will be directed towards the Process Area Sediment Basin.

Where possible, roofed areas will be connected to rainwater tanks for use in garden beds etc.

7.2.5 Haul Roads and Access Tracks

Runoff from haul roads and access tracks will contain high sediment loads. It is proposed that a series of interconnecting drains and culverts will enable this water to be directed to a number of small sediment traps located around the site. These sediment traps will be designed to remove particles down to 0.01 mm for the 1 in 5 year ARI 24hr storm discharge. Roads across identifiable drainage lines will have culverts installed to allow through flow of surface water, limiting the need for remediation work after rainfall events.

Once the sediment load in this runoff is reduced the clean water will be discharged into the pre-existing drainage paths.

7.3 Flood Defence

As the current planned location of pits are situated in elevated locations, the ability of a 1 in 100 year ARI flood to pose a risk to pit operations is limited, but may require further investigation.

Considering the layout of the site and the orientation of the mining associated infrastructure, the consequences of a flood will be limited to the localised disruption of mining services. The installation of diversion banks around the site, to limit the contamination of the different runoff streams, should ensure protection from a 1 in 100 year ARI flood. All bunding installed should be designed to limit the extent of flooding. Designing this bunding with a free board of approximately 0.5m would suitably control the potential for flooding and minimise the risk to life and property.

8 MINE CLOSURE

Mine closure will involve extensive reshaping and rehabilitation of disturbed areas to a natural condition. The implementation of leading practice techniques will enhance the long term sustainability of the rehabilitation works.

Memo /.. Continued

At closure, the TSF and WRS will be shaped for natural surface drainage and erosion rates similar to those of natural landforms in the area. Most of the preparatory work required to protect the environment is being undertaken as part of the Mining and Rehabilitation Plan (MARP) and will be implemented throughout the operations phase.

The closure phase will consist largely of the last stages of decommissioning, including demolition of infrastructure, final land-forming, revegetation and commencement of a post-closure monitoring program.

Rock filled gullies on the outer slopes of the waste rock storage should be constructed to handle excessive rainfall runoff as other drainage lines in the region show signs of significant erosion. Concave slope profiles, which mimic natural slopes, limit the loss of sediment from the slope. The Decant Water Storage liner will be removed and existing storages modified to operate as permanent sediment basins. Natural drainage paths will be reinstated, where possible.

9 CONCLUSIONS AND RECOMMENDATIONS

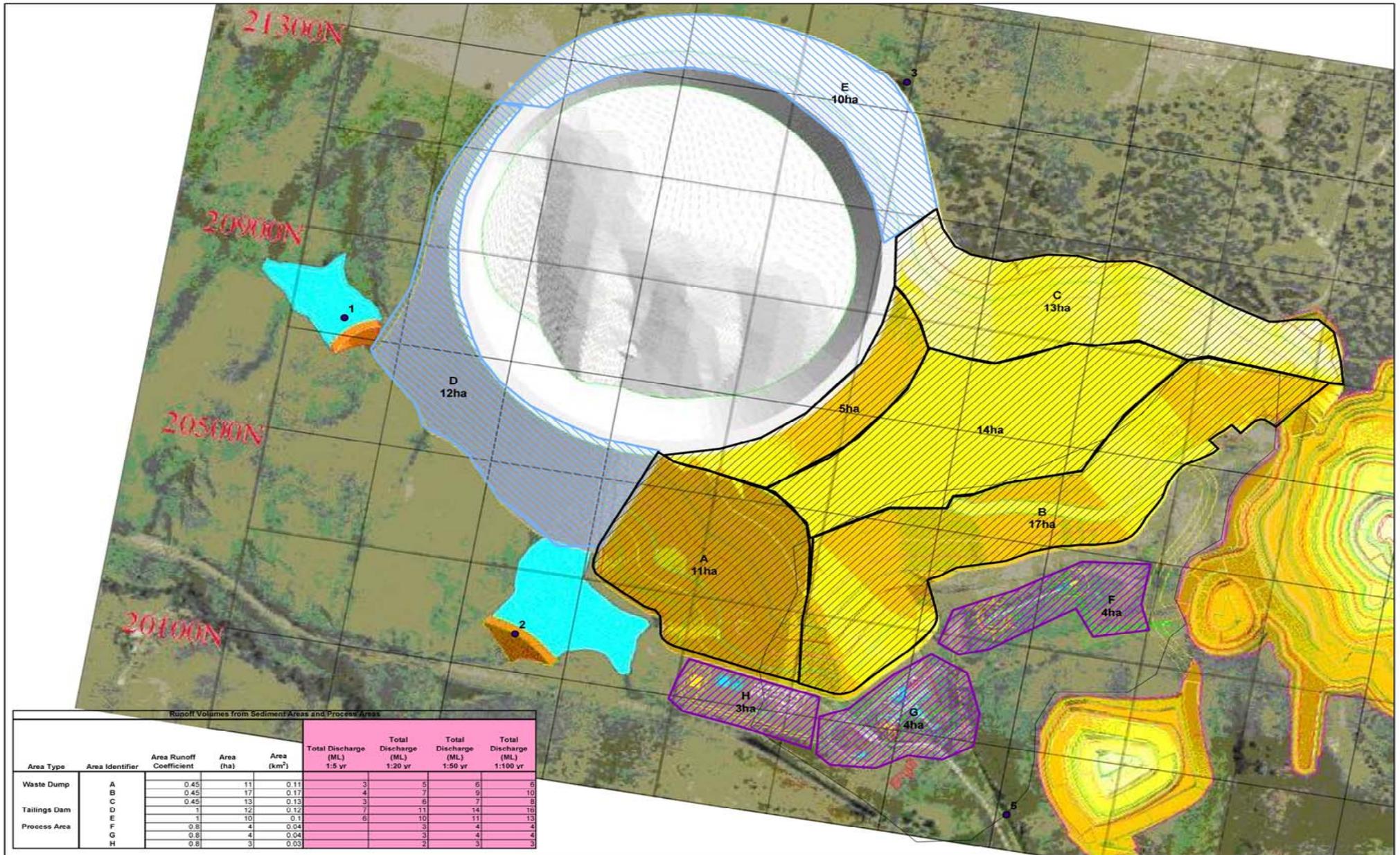
The conceptual surface water management plan for the Kanmantoo Copper Gold Project is to:

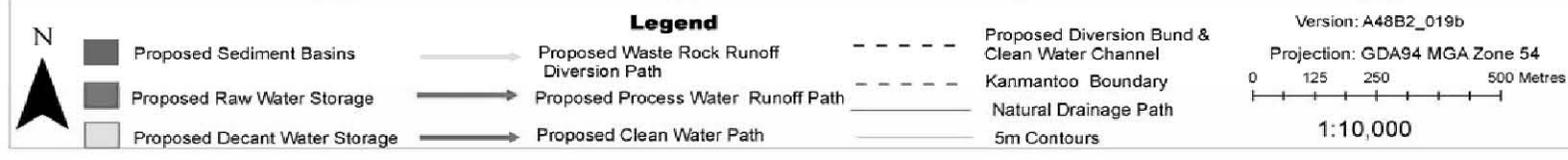
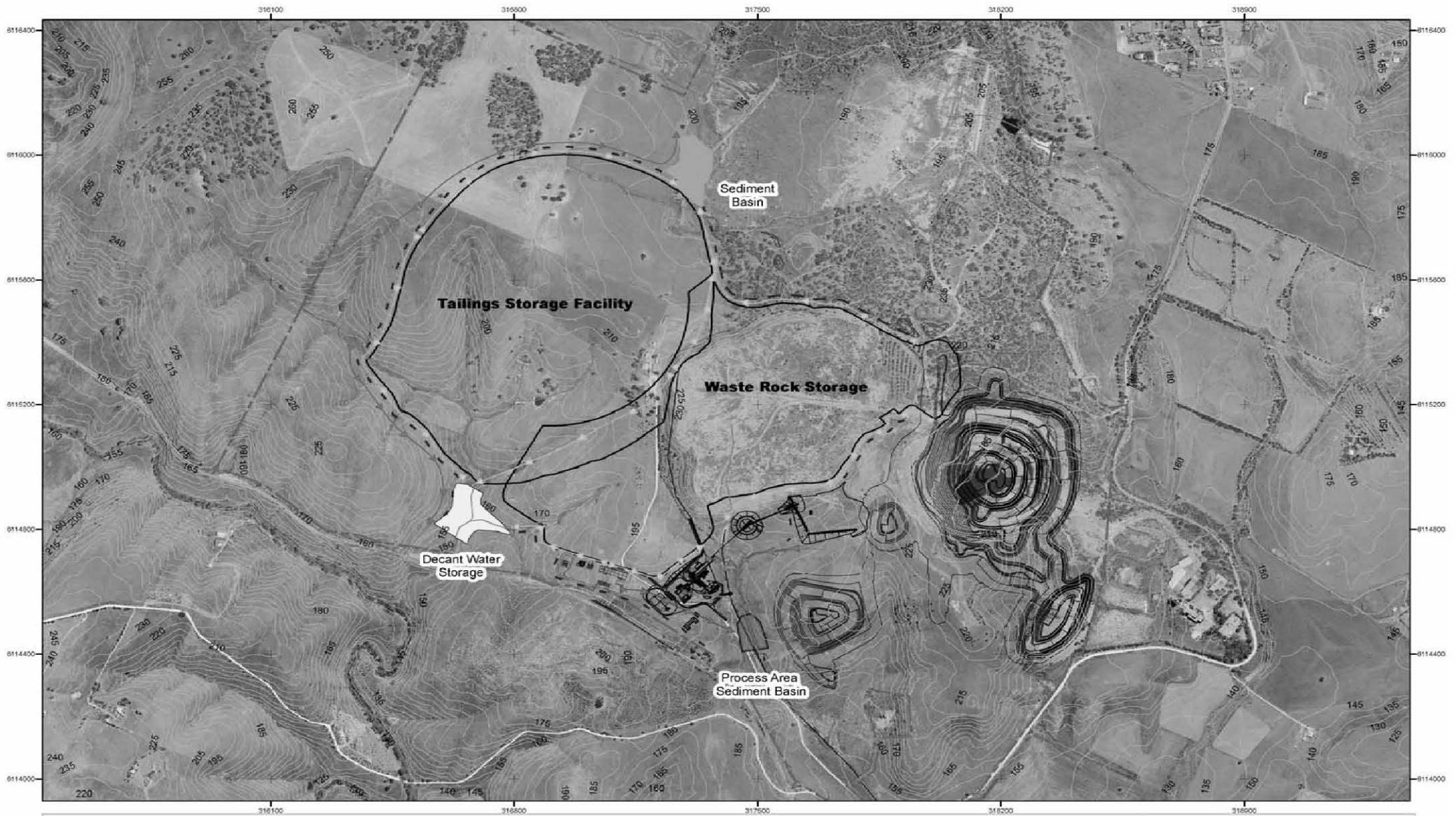
- ! Maintain discharge from site of *clean runoff*
- ! Capture *sediment runoff* for treatment in silt traps prior to discharge
- ! Capture *waste rock runoff* and reuse the water in the processing circuit or treatment in sediment basins/wetlands
- ! Capture and treat *process runoff* at the source, diversion to sediment basin for treatment prior to discharge or storage in lined storage facilities and reuse in the processing circuit.

Regards,
Aquaterra

Matt Driver
Water Resources Engineer

Glenn Passfield
Senior Water Resources Engineer





Kanmantoo Proposed Site Drainage Plan

aquaterra
working with you to develop practical water resources and environmental solutions

Appendix 14

Kanmantoo Copper Project Native Vegetation Management Plan

Hillgrove Resources Limited

Kanmantoo Copper Project

**Native Vegetation
Management Plan**



September 2007
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1. Introduction

1.1 Background

Hillgrove Resources Limited (Hillgrove) is an emerging Australian copper-gold producer that has been listed on the Australian Stock Exchange since 2003. Hillgrove, and its subsidiary Hillgrove Copper Pty Ltd, has business interests in Eastern Star Gas and exploration projects in Mount Rhine, Mount Torrens and Alford in South Australia. Hillgrove has offices in Sydney, Perth and Callington.

The Kanmantoo Copper Project is located in South Australia approximately 44 km east-southeast of Adelaide within the Mount Barker District Council Area (Figure 1). The two closest townships to the proposed project area are Kanmantoo, approximately 1.5 km to the northeast, and Callington, approximately 4 km to the southeast.

Hillgrove holds a series of tenements for the project (Table 1). The proposed project area is approximately 2.5 km long and 2 km wide (approximately 4.44 km² or 436 ha).

Table 1 Summary of tenements

Tenement Number	Tenement Name	Area	Date Granted	Date Expired	Registered Titleholder(s)
EL 3277	Kanmantoo	489 km ²	3/11/2004	2/11/2006	Hillgrove (90%) and Kelaray Pty Ltd (10%)
EL 3298	Kanmantoo Mine	1.5 km ²	18/1/2005	17/01/2007	Hillgrove Copper Pty Ltd
ML 5776	Kanmantoo Mine	0.46 km ²	9/12/1991	8/12/2012	Hillgrove
MC 3510	Kanmantoo Mine	0.46 km ²	30/3/2005	29/03/2006*	Hillgrove Copper Pty Ltd

* Under application for retention lease. Remains current until lease is granted.

Hillgrove proposes to expand the existing Kanmantoo Copper Mine using open pit mining techniques over an initial mine life of eight years. Ore will be mined and processed at a rate of 250 tonnes per hour (tph) using a conventional crushing, grinding and floatation circuit to produce approximately 80,000 tonnes per annum (tpa) of copper-gold concentrate. The concentrate will be transported by road to the Port of Adelaide for shipment to an overseas smelter.

The environmental aspects of the project are being assessed under the South Australian *Mining Act 1971*, whereby the principal assessment document is a Mining Lease Proposal (MLP) and the assessment process includes stakeholder consultation, assessment of environmental impacts and management measures, and description of the proposed monitoring and reporting strategy.

This report addresses native vegetation clearance associated with the development of the proposed project and associated infrastructure. All necessary work has been undertaken to determine the extent and nature of vegetation clearing likely to occur in the project area and actual clearance footprints will be recorded in a geographic information system as the project is constructed.



Source:
Place names, roads, ra and drainage from GEO DATA TOPO 250K (opium sca e 1:250,000)



Date:
14.02.07
MXD:
HillgroveResources_KanmantooGIS
Job No:
5000_05_F001_GIS_AI

Hillgrove Resources Ltd
Kanmantoo Copper Project



Project location

Figure No:
1

1.2 Regulatory Framework

1.2.1 Mining Act 1971

The principal legislation for the regulation of mining in South Australia is the *Mining Act 1971*, which is administered by Primary Industries and Resources SA (PIRSA). Under this act, the proponent must obtain a mining lease (ML) in order to proceed with a mining project.

To obtain a mining lease, the proponent must prepare and submit a MLP that identifies the risks of the proposal and outlines management measures to minimise these risks. Before the commencement of mining, the proponent must obtain approval for a Mining and Rehabilitation Program (MARF). The MARF includes more detailed and specific information on environmental control measures and establishes outcome-based performance criteria for the project. Once approved, the MARF becomes the key operational document for the mining project and is the document PIRSA uses to regulate the construction and ongoing operations of the project.

1.2.2 Native Vegetation Act 1991

All native vegetation in South Australia is protected under the provisions of the *Native Vegetation Act 1991*, where the South Australian Native Vegetation Council (NVC) must approve any clearance of vegetation not exempted under regulations. Under this act, clearance means:

- the killing or destruction of native vegetation
- the removal of native vegetation
- the severing of branches, limbs, stems or trunks of native vegetation
- the burning of native vegetation, and
- any other substantial damage to native vegetation, including the draining or flooding of land, or any other act or activity, that causes the killing or destruction of native vegetation, the severing of branches, limbs, stems or trunks of native vegetation or any other substantial damage to native vegetation (DWLBC, 2005).

Under the *Native Vegetation Act 1991* and associated Native Vegetation Regulations 2003, there are exemptions for native vegetation clearance undertaken as part of operations under the *Mining Act 1971*. The exemption allows native vegetation clearance for mining operations (with the exemption of exploration), provided it is undertaken in accordance with a management plan that details to the satisfaction of the NVC how the project will result in a significant environmental benefit (SEB) (DWLBC, 2005). This document is known as the native vegetation management plan (NVMP) for the project.

PIRSA has been delegated the authority from the NVC to administer the SEB requirements as they apply to mining operations under the *Mining Act 1971*, on the basis that PIRSA will apply the policies of the NVC on clearance and revegetation as part of the requirements of a MARF under Regulation 42 of that act (DWLBC, 2005).

In administering the Native Vegetation Regulations 2003, PIRSA has agreed that the following objectives should be established for mining operations (DWLBC, 2005):

- That there is no practicable alternative that would avoid the clearance of native vegetation, the clearance of less vegetation or the clearance of less significant vegetation.
- The retention and enhancement of biodiversity, native vegetation and landscape values.
- The restoration of native vegetation by land users to maintain and enhance biodiversity, protect water quality and conserve soil resources.
- Biological diversity of vegetation is maintained through appropriate land management practices, including a suite of measures from vegetation retention and re-establishment.
- Where native vegetation clearance is unavoidable, measures are undertaken to counterbalance the loss of that vegetation with a significant environmental benefit either on the site or within the same region, either by works undertaken by the proponent, or through payment of money into the native vegetation fund (as established under the *Native Vegetation Act 1991*).
- The clearance of higher value vegetation should be offset by a higher significant environmental benefit.
- The significant environmental benefit should support the highest possible biodiversity outcomes in terms of quality, position in the landscape, and ongoing management.

1.2.3 Environment Protection Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) enables the Australian Government to join with the states and territories to provide a national scheme of environment protection and biodiversity conservation.

Under the EPBC Act, actions that are likely to have a significant impact on a matter of National Environmental Significance are assessed. The Australian Government's Department of Environment and Water Resources (DEWR) is responsible for administering the act. Matters considered to be of National Environmental Significance are:

- World Heritage properties.
- National Heritage places.
- Ramsar wetlands of international significance.
- Threatened species and ecological communities.
- Migratory species.
- Nuclear actions.
- Commonwealth marine areas.
- Additional matters of national environmental significance (prescribed actions).

Where there is the potential for an action to have a significant impact to a matter of National Environmental Significance, a referral and assessment process determines the application of the EPBC Act.

Hillgrove submitted a referral for the project to DEWR on 26 February 2007. On 28 February 2007, the DEWR placed the referral on its website with an invitation for public

comment for the statutory period of 10 business days. On 30 March 2007 the DEWR deemed that the project was not a controlled action and as such, assessment and approval under the EPBC Act was not required.

In June 2007, two ecological communities were listed as critically endangered and are therefore covered by Section 18A of the EPBC Act:

- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.
- Iron-grass Natural Temperate Grassland of South Australia.

It is understood that the controlling provisions of the EPBC Act are not retrospectively applied; however, should Hillgrove substantially amend their proposed action, re-assessment under the EPBC Act will be triggered. Hillgrove have made no substantial changes to their project since this time. Indeed, refinement of pit design has reduced the area of these vegetation communities to be disturbed by the project by approximately 15% or 5.0 ha to those discussed in the referral.

1.3 Purpose of this Plan

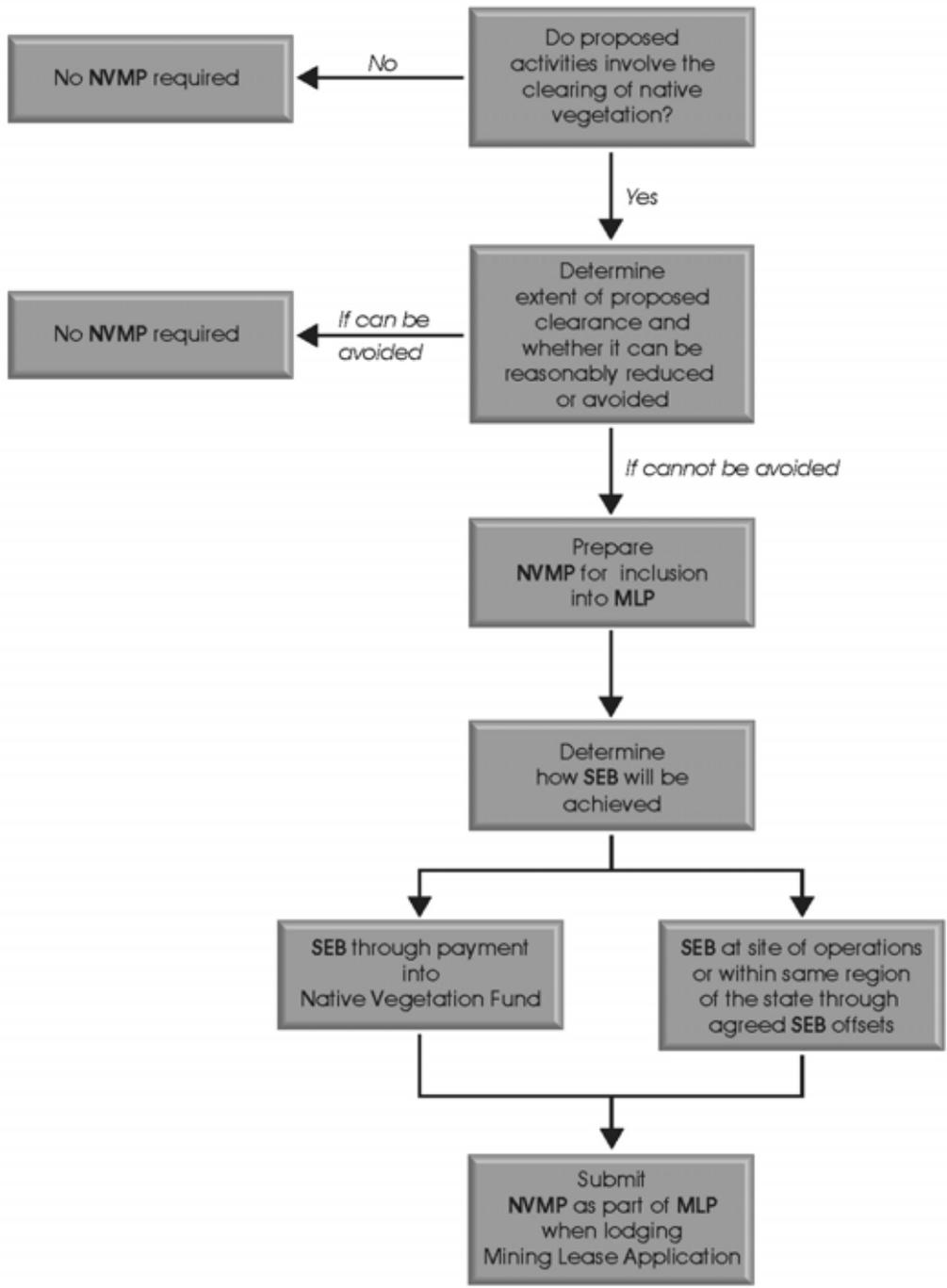
This NVMP has been developed in accordance with the Draft Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the Clearance of Native Vegetation Associated with the Minerals and Petroleum Industry (DWLBC, 2005) (hereafter referred to as the Native Vegetation SEB Guidelines). It provides a framework for managing and mitigating the potential impacts due to vegetation clearing as a result of the project, and outlines how the project will achieve a SEB.

The process for seeking approval of this NVMP will take place as part of the normal assessment process for the MLP. Figure 2 provides a summary of the steps required to achieve this.

1.4 Report Structure

This report comprises a title page, a table of contents and six chapters:

- Chapter 1 (this chapter)—background, regulatory framework, purpose of plan and report structure.
- Chapter 2—description of the site and vegetation.
- Chapter 3—management and mitigation measures that will be implemented.
- Chapter 4—SEB calculation, including detail on extent of vegetation clearance, significance and condition of vegetation to be cleared, impacts of clearance and SEB determination.
- Chapter 5—description of how SEB will be provided.
- Chapter 6—references.



MLP - Mining Lease Proposal
 NVMP - Native Vegetation Management Plan
 SEB - Significant Environmental Benefit

2. Site and Vegetation Description

The characterisation of the composition, structure and diversity of flora species and ecological communities in the project area and associated impacts from the clearing of vegetation is summarised from Ecological Associates (2007) which builds on previous flora assessments undertaken in the area.

2.1 Land Use History

The Kanmantoo Copper Project lies in an area that has a long history of mineral exploration and mining. Mining at Kanmantoo began in 1846 and continued to 1874, with intermittent prospecting continuing in the area until the 1960s. In the early 1970s, Kanmantoo Mines Limited commenced open cut mining over the northernmost workings of the earlier Kanmantoo mines. The mine operated for six years. Mining infrastructure remaining on the site from these operations includes an open pit (approximately 120 m deep), processing plant (now used as a site for fertiliser manufacture), a partially revegetated waste rock dump and a tailings dam.

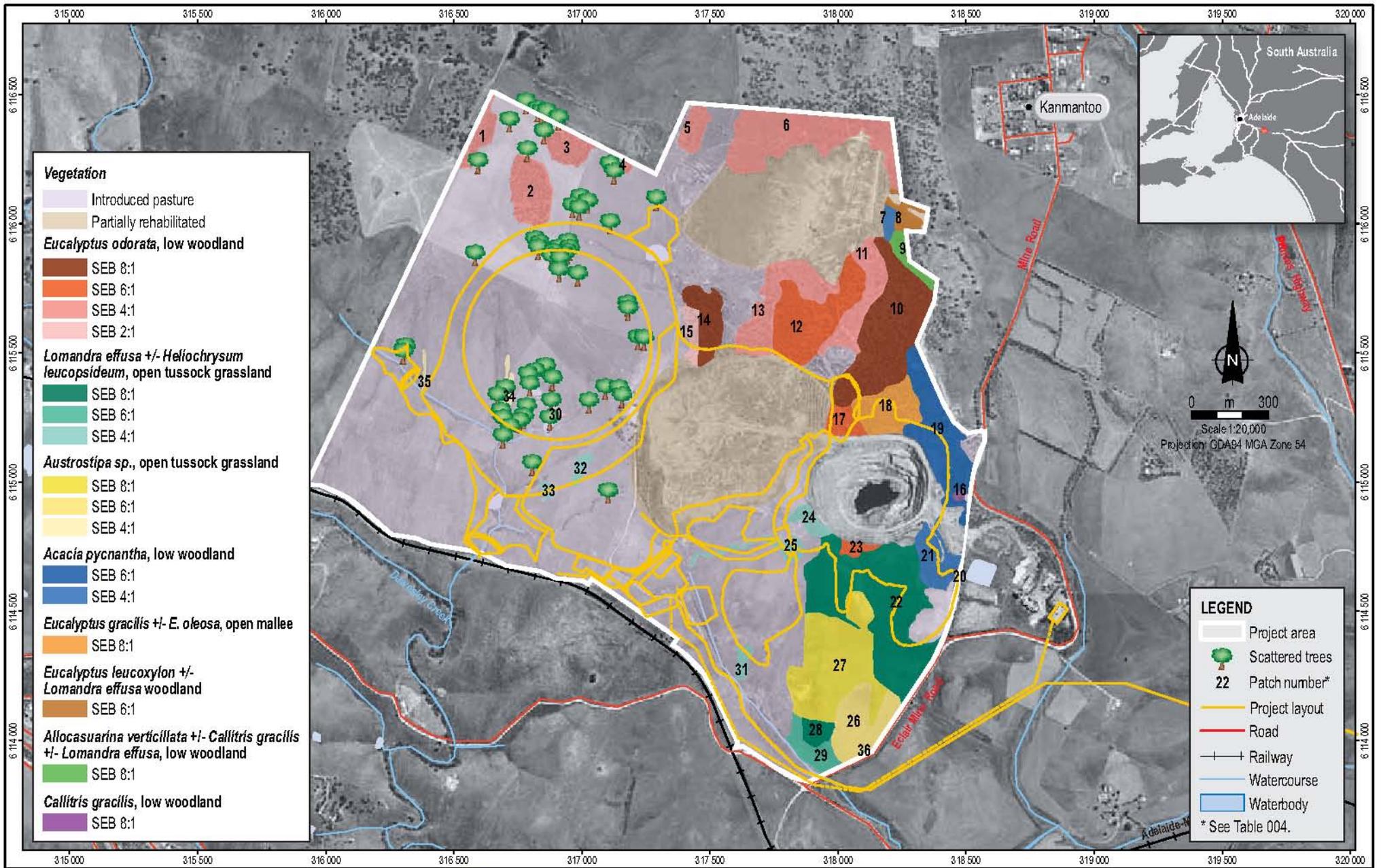
In late 2003, Hillgrove began an exploration program in the Kanmantoo area and, in April 2004, the company acquired the Kanmantoo Copper Mine mining lease (ML 5776).

Grazing in the region has been occurring for approximately 100 years and the land in and around the project area has historically been intensively grazed. Woody weeds occur in all remnant stands of vegetation and introduced grasses occupy large parts of the project area.

2.2 Vegetation Communities

The project area occurs within the region covered by the Biodiversity Plan for the South Australian Murray–Darling Basin and within the Eastern Mount Lofty Ranges Regional Ecological Area (REA). There has been extensive clearance of native vegetation within the Eastern Mount Lofty Ranges REA, with only 6% of the pre-European settlement vegetation cover remaining (Ecological Associates, 2007).

Eight vegetation communities are present in the project area and occupy approximately 112 ha (Figure 3). Vegetation communities are summarised in Table 2 and described in detail below.



- Vegetation**
- Introduced pasture
 - Partially rehabilitated
 - Eucalyptus odorata*, low woodland**
 - SEB 8:1
 - SEB 6:1
 - SEB 4:1
 - SEB 2:1
 - Lomandra effusa* +/- *Heliochrysum leucopsideum*, open tussock grassland**
 - SEB 8:1
 - SEB 6:1
 - SEB 4:1
 - Austrostipa* sp., open tussock grassland**
 - SEB 8:1
 - SEB 6:1
 - SEB 4:1
 - Acacia pycnantha*, low woodland**
 - SEB 6:1
 - SEB 4:1
 - Eucalyptus gracilis* +/- *E. oleosa*, open mallee**
 - SEB 8:1
 - Eucalyptus leucoxyton* +/- *Lomandra effusa* woodland**
 - SEB 6:1
 - Allocasuarina verticillata* +/- *Callitris gracilis* +/- *Lomandra effusa*, low woodland**
 - SEB 8:1
 - Callitris gracilis*, low woodland**
 - SEB 8:1

- LEGEND**
- Project area
 - Scattered trees
 - Patch number*
 - Project layout
 - Road
 - Railway
 - Watercourse
 - Waterbody
 - * See Table 004.

Table 2 Vegetation communities in the project area.

Vegetation community	Conservation significance	Condition (SEB ratio) ¹ (A)	Area (ha) to be cleared (B)	Area total of community (ha) within MLA area (C)	% to be cleared (B/C x 100)
<i>Eucalyptus odorata</i> low woodland	National level, critically endangered. State level, priority 3.	8:1	1.23	14.90	8.25
		6:1	2.02	9.70	20.82
		4:1	0.32	28.50	1.12
		2:1	0.34	1.00	34.00
<i>Lomandra effusa</i> ± <i>Heliochrysum leucopsideum</i> open tussock grassland	National level, critically endangered. State level, priority 1.	8:1	9.59	17.80	53.88
		4:1	2.54	3.50	72.57
<i>Austrostipa</i> sp. open tussock grassland	Regional level, threatened.	8:1	0.21	11.60	1.81
		6:1	0.00	4.70	0.00
		4:1	0.61	0.70	87.14
<i>Eucalyptus leucoxylo</i> woodland	Regional level, threatened	6:1	0.00	1.27	0.00
<i>Allocasuarina verticillata</i> , +/- <i>Callitris gracilis</i>	Not listed	8:1	0.00	1.84	0.00
<i>E. gracilis</i> ± <i>E. oleosa</i> open mallee	Not listed	8:1	2.79	4.00	69.75
<i>Acacia pycnantha</i> low woodland	Not listed	6:1	4.26	7.70	55.32
		4:1	2.57	3.50	73.42
<i>Callitris gracilis</i> low woodland	Regional level, threatened.	8:1	0.19	0.19	100
Scattered trees		n/a	56 trees (containing 24 hollows)	Not assessed	
Total			26.67	110.9	24.05

¹ The SEB ratio was determined by Ecological Associates (2007) in accordance with the Draft Native Vegetation SEB Guidelines (DWLBC, 2005) by assessing the impact of the project on the condition of the vegetation to be cleared. SEB ratios are assigned on the basis of existing vegetation condition as indicated by vegetation structure, weed dominance, and disturbance 8:1 - very good condition, 6:1 - good condition, 4:1 - moderate condition, 2:1 - poor condition (Attachment 1).

2.2.1 *Eucalyptus odorata* low woodland

This is the most extensive vegetation community in the project area, occupying 54.1 ha. *Eucalyptus odorata* low woodland in the project area is one of the largest remnants in the eastern slopes of the Southern Mount Lofty Ranges. It represents approximately one third of the high quality vegetation of this type and about 10% of the entire population (292.5 ha) in this region (Ecological Associates, 2007). A summary of the occurrence of *E. odorata* low woodland in the project area is as follows:

- The best examples of this vegetation occur to the north (12.1 ha) and northwest (2.8 ha) of the existing open pit (condition score of SEB 8:1) (Plate 1). These areas have all vegetation strata intact, a low cover of weeds, evidence of recent regeneration of overstorey trees and some old, hollow bearing trees.
- Areas with condition score of SEB 6:1 are located immediately north of the open pit (1.4 ha), a short distance further north (7.7 ha) and south of the existing pit (0.6 ha). These areas have an intact overstorey and some evidence of regeneration of overstorey trees but an understorey with considerable weed infestation. Considerable physical disturbance, mainly vehicular tracks, is apparent within this area.
- Areas with a condition score of SEB 4:1 occur adjacent to these areas, immediately north of the open pit (9.0 ha), along the northern boundary (12.5 ha) and in the north west corner of the project area (7.0 ha). The understorey of these areas are either very heavily invaded by weeds or largely absent with bare ground. An intact overstorey is present but there is no recent regeneration of overstorey trees. These areas have been subjected to extended periods of stock grazing.
- Two small areas, near the centre of the project area (0.9 and 0.1 ha respectively) have a have a condition score of SEB 2:1. These areas have a completely absent understorey, considerable soil disturbance and show trampling from intensive stock grazing.

2.2.2 *L. effusa* ± *Heliochrysum leucopsideum* open tussock grassland

This vegetation community occupies 23.3 ha of the project area and occurs predominantly to the south of the existing open pit on the crest and slopes of MacFarlane Hill.

Although MacFarlane Hill has been grazed by stock, approximately 19.9 ha of this remnant is of high quality and represents a small proportion (approximately 1.5%) of the high quality remnants of the vegetation community on the eastern slopes of the Southern Mount Lofty Ranges. A summary of the occurrence of *L. effusa* ± *Heliochrysum leucopsideum* open tussock grassland in the project area is as follows:

- Areas with a condition score of SEB 8:1 occur to the immediate south of the existing open pit (16.8 ha) and close to the southern boundary of the project area (1.0 ha). These areas feature an intact structure of dense *L. effusa* interspersed with native grasses and few weeds (Plate 2). Emergent trees, typically *Allocasuarina verticillata*, are present in some areas.



Plate 1 *Eucalyptus odorata* low woodland with a condition score of SEB 8:1.



Plate 2 *Lomandra effusa* ± *Heliochrysum leucopsidium* open tussock grassland with a condition score of SEB 8:1.



Plate 3 *Austrostipa* sp. open tussock grassland with a condition score of SEB 8:1.



Plate 4 Bare ground (foreground and distance) interspersed by patches of good condition vegetation.



Plate 5 *Eucalyptus odorata* low woodland with condition score of SEB 2:1 (right of fence).



Plate 6 *Lomandra effusa* ± *Heliochrysum leucopsidium* open tussock grassland with a condition score of SEB 4:1.

- At the extreme south of the project area is a remnant patch (2.0 ha) with a condition score of 6:1. This area has an intact structure and feature dense *L. effusa*, but with considerable weed invasion, predominantly the grass *Avena barbata* (bearded oat).
- Smaller remnants occur immediately southwest (2.1 ha), further south (0.6 ha) and west (0.8 ha) of the open pit. These areas have a condition score of SEB 4:1 as they are more degraded, with sparse *L. effusa*, few native grasses and considerable soil disturbance.

2.2.3 *Austrostipa* sp. open tussock grassland

Remnant patches of *Austrostipa* sp. open tussock grassland occupy 17 ha within the project area. The community is floristically quite similar to *L. effusa* open tussock grassland; however, *L. effusa* is absent and the native grass *Austrostipa* sp. is the dominant species. *Austrostipa* sp. open tussock grassland occurs predominantly on the southern crest and slopes of MacFarlane Hill. A summary of the distribution of this vegetation community in the project area is as follows:

- Vegetation with a condition score of SEB 8:1 occurs on the western slope of MacFarlane Hill (11.6 ha). In this area the vegetation has a low cover and diversity of weeds and a relatively high diversity of native grasses and herbs and a relatively high density of grass tussocks (Plate 3).
- On the southern slope of MacFarlane Hill, vegetation (4.7 ha) has a condition score of SEB 6:1 as it is intact but with a greater proportion of weeds.
- Two small remnants on the former “Paringa” property (0.1 and 0.6 ha respectively) have been subjected to extended grazing and feature stock tracks, bare ground and considerable weed invasion. These areas have a condition score of SEB 4:1.

2.2.4 *Acacia pycnantha* low woodland

Remnant patches of *Acacia pycnantha* low woodland occur to the immediate east and northeast of the existing pit and occupy 11.2 ha within the project area. Anecdotal reports and the absence of overstorey eucalyptus species suggest that this community has been subject to past disturbance or clearance and has regenerated naturally. It is likely that, if left undisturbed, this community would develop into one of the adjoining vegetation communities, i.e., either *E. odorata* low woodland, *E. gracilis* ± *E. oleosa* open mallee or a combination of both. A summary of the distribution of this vegetation type in the project area is as follows:

- To the northeast of the existing pit, this vegetation community is dominated by an overstorey of low *A. pycnantha*, has an intact understorey dominated by native grasses, particularly *Austrostipa* sp., and low shrubs and has a low cover of weeds. This vegetation (7.7 ha) has a condition score of SEB 6:1.
- Vegetation with a condition score of SEB 4:1 occurs to the south of the existing pit, at the base of the eastern side of MacFarlane Hill (3.0 ha) and south of the tailings dam in the northeast of the project area (0.5 ha).

2.2.5 Other Vegetation Communities

Remnant Native Vegetation

Vegetation communities present in the project area, but in relatively low abundances, include:

- *Callitris gracilis* low woodland:
A very small (0.2 ha) area is located east of the existing open pit adjacent to the mine entrance gate. This vegetation is relatively intact with overstorey trees and understorey shrubs, grasses and herbs. Weed cover in this area is low and the area has a condition score of SEB 8:1. Plant species likely to be present are those present in the adjacent *Acacia pycnantha* low woodland, with the addition of *Callitris gracilis*.
- *E. gracilis* ± *E. oleosa* open mallee:
A 4.0 ha area of this vegetation community is located to the immediate north of the existing open pit. There is evidence of past timber gathering in this area; however, the vegetation is relatively intact with a diverse native understorey and low weed cover. This vegetation has a condition score of SEB 8:1.
- *Allocasuarina verticillata* ± *Callitris gracilis* ± *L. effusa* low woodland:
A 1.8 ha remnant of this vegetation community is located in steep, rocky terrain to the south of the tailings dam in the northeast of the project area. The vegetation structure is intact, with overstorey trees and understorey shrubs, grasses and herbs all present at close to natural densities. Some weedy grass species are present but weed cover is low. This vegetation has a condition score of SEB 8:1:
- *E. leucoxylon* ssp. *leucoxylon* ! *L. effusa* open woodland:
A remnant patch, 1.3 ha in size, occurs to the immediate south of the tailings dam near the northeast corner of the project area. The vegetation is in good condition with all strata intact and has a condition score of SEB 8:1.

Access Road Vegetation

Patches along the proposed route for the road have been revegetated with native species, and small areas of significantly degraded *L. effusa* tussock grassland are present at isolated intervals. However, the majority of vegetation is pasture and introduced species such as sharp-rush (*Juncus acutus*), wild oats (*Avena* sp.) and artichoke thistle (*Cynara cardunculus* ssp. *flavescens*).

2.3 Scattered Trees

Approximately 56 scattered trees occur within the proposed project footprint (see Figure 3). Fifty-five of these trees are *E. odorata* and there is one *Allocasuarina verticillata*. Twenty-four trees have hollows. Tree height ranges from 4 to 13 m and canopy diameter from 2 to 17 m. Diameter at breast height ranges from 8 to 120 cm. Mistletoe is not present on any trees. Foliage dieback ranges from 0 to 90%. All scattered trees are located a considerable distance from vegetation of high quality.

2.4 Flora of Conservation Significance

2.4.1 Plant Species of Conservation Significance

No plant species of national (EPBC Act-listed) conservation significance have been recorded in the project area, and none are considered likely to be present.

Two flora species of state-listed conservation significance (i.e., listed under the NPW Act) are present in the project area:

- ***Diuris behrii* (Behr's cowslip orchid)**. Listed as vulnerable. Some of the known *Diuris behrii* sites fall within the proposed project footprint. A targeted search was undertaken by Ecological Associates in September 2006 but no individuals of this species were identified (Cooling, pers. com., 2007).
- ***Ptilotus erubescens* (hairy-tails)**. Listed as rare. The single known location of this species is to the north of the existing open pit. An additional 52 records are also listed at the same location, indicating that the record location may represent an amalgamation of records for a wider area.

Nineteen species of regional-listed conservation significance, including four species listed as rare in the Murray botanical region, occur in the project area.

The shrub *Acacia iteaphylla*, listed under the NPW Act as rare in South Australia, occurs within the project area; however, this species was growing outside of its natural range and can be considered introduced. The species is commonly planted for revegetation projects.

2.4.2 Vegetation Communities of Conservation Significance

Five threatened communities occur within the project area:

- ***E. odorata* low woodland**. This vegetation community is significant at the national level, listed as a critically endangered ecological community (as Peppermint Box (*E. odorata*) Grassy Woodland) under the EPBC Act (DEWR, 2007), at a state level, listed as Priority 3 for conservation under the NPW Act, and at the regional level, listed as threatened within the South Australian Murray–Darling Basin (Ecological Associates, 2007).

This vegetation community is poorly conserved in South Australia, with most remnants small and/or degraded and atypical. *E. odorata* low woodland in the project area is one of the largest remnants on the eastern slopes of the Southern Mount Lofty Ranges (Ecological Associates, 2007).

- ***L. effusa* ± *Heliochrysum leucopsideum* open tussock grassland**. This vegetation is significant at the national level, listed as a critically endangered ecological community (as Iron-grass Natural Temperate Grassland) under the EPBC Act (DEWR, 2007), at the state level, listed as Priority 1 for conservation in South Australia under the NPW Act, and at the regional level, listed as threatened within the South Australian Murray–Darling Basin (Ecological Associates, 2007).

Occurrences of *L. effusa* open tussock grassland within the project area represent a small proportion (approximately 0.4%) of the high quality remnants of the vegetation

community on the eastern slopes of the Southern Mount Lofty Ranges (Ecological Associates, 2007).

- ***Austrostipa* sp. open tussock grassland, *E. leucoxylo* ssp. *leucoxylo* ! *L. effusa* open woodland and *Callitris gracilis* low woodland** are significant at the regional level, listed as threatened within the South Australian Murray–Darling Basin.

2.5 Fauna of Conservation Significance

The following fauna species of national and state-listed conservation significance are present in the project area:

Birds

The **rainbow bee-eater** (*Merops ornatus*), a marine-listed species under the EPBC Act, was recorded across the project area. Rainbow bee-eaters recorded in the project area may be significant at the local level as they are likely to breed in sandy banks along water courses and use woodland habitat within the project area, however, the presence of this species is unlikely to be significant at the regional, state or national level due to its wide distribution and transient nature.

The **diamond firetail** (*Stagonopleura guttata*), listed as vulnerable under the NPW Act, has declined over most of its historical range across southeastern and eastern Australia in both extent and density (Ecological Associates, 2007). The *E. odorata* low woodland in the project area is likely to provide significant habitat for this species and the population in the project area is likely to be significant at the local and regional level.

The **peregrine falcon** (*Falco peregrinus*) is listed as rare under the NPW Act. The species has a worldwide distribution; however, it has declined significantly in most countries other than Australia. In Australia the population is substantial, widespread and viable, while in South Australia the resident population is small, with the total population estimated at less than 3000 mature individuals (Ecological Associates, 2007). A study in Victoria (Ecological Associates, 2007) suggests that nesting pairs of this species are tolerant to disturbance associated with mines and quarries.

Mammals

No mammal species of listed conservation significance under either the EPBC Act or NPW Act were recorded, or considered likely to be present, within the project area. However, the **brushtail possum** (*Trichosurus vulpecula*), which has been nominated for listing as rare under the NPW Act, was present in the project area. This species has the widest distribution of any Australian mammal, being found across southern, eastern, and northern Australia. In the Murray Darling Basin the loss of food trees, hollow trees and hollow branches is reducing the area of habitat available to this species and concomitantly increasing the competition between species that require similar habitat resources (Ecological Associates, 2007). This loss of habitat, in combination with high predation pressures, may be underlying the continuing decline of this species in South Australia. The relatively large and floristically diverse *E. odorata* low woodland habitat in the project area is considered important to this species at the local and regional level.

2.6 Distribution of Weed Species

Introduced Species

Forty-seven introduced plant species have been recorded in the project area, including:

- **Grasses.** Wild oats (*Avena barbata*) is the most abundant grass species and is very common throughout the agricultural regions of South Australia. Within the project area, it was most abundant within the *Austrostipa* sp. open tussock grassland and *L. effusa* open tussock grassland.
- **Herbs.** Herb species include bridal creeper (*Asparagus asparagoides*), South African weed orchid (*Disa bracteata*), artichoke thistle (*Cynara cardunculus* ssp. *flavescens*) and small amounts of Salvation Jane (*Echium plantagineum*).
- **Shrubs.** Shrub species include red-head cotton-bush (*Asclepias curassavica*), Flinders Ranges wattle (*Acacia iteaphylla*), western coastal wattle (*Acacia cyclops*) and boneseed (*Chrysanthemoides monilifera* ssp. *monilifera*).
- **Woody weeds.** Woody weeds recorded within the project area include olive (*Olea europaea* ssp. *europaea*), Aleppo pine (*Pinus halepensis*) and African boxthorn (*Lycium ferocissimum*).

3. Management and Mitigation Measures

Avoidance, management and mitigation measures have been developed to reduce the potential impacts on the flora and fauna of the area (as described in Chapter 4). The ongoing implementation of site-specific management and mitigation measures will ensure that impacts to vegetation communities and threatened species are minimised.

3.1 Vegetation Clearing

Measures designed to manage the risks associated with vegetation clearing include:

- Avoiding areas with communities of conservation value. This includes *E. odorata* low woodland in good condition (7.7 ha) to the north of the existing open pit and patches along the northern boundary (12.5 ha) and in the northwest corner of the project area in moderate condition (7.0 ha), *L. effusa* open tussock close to the southern boundary of the project area in very good and good condition (1.0 and 2.0 ha) and *Austrostipa* sp. open tussock grassland in good condition (4.7 ha) to the south of the existing open pit.

Since project onset, Hillgrove has reduced vegetation to be cleared from 31.6 to 26.7 ha. In particular, *E. odorata* low woodland to be cleared has reduced from 8.6 ha to 3.9 ha and *Austrostipa* open tussock grassland to be cleared has reduced from 3.7 ha to a nominal 0.8 ha.

- Minimising clearing of areas with communities of conservation value. This includes patches of vegetation in very good condition (*E. odorata* low woodland to the north (12.1 ha) and northwest (2.8 ha) of the existing open pit, *L. effusa* open tussock grassland to the immediate south of the existing open pit (16.8 ha) and 11.6 ha of *Austrostipa* sp. open tussock grassland on the western slope of MacFarlane Hill), good condition (4.0 ha of *E. leucoxydon* open woodland) and moderate condition (0.6 ha of *L. effusa* open tussock).

Since project onset, *E. odorata* low woodland in very good condition to be cleared has reduced from 3.8 ha to 1.23 ha. This was achieved in part by relocating the tailings storage facility and designing the open pit and, in particular, the haul road (relocating it to the western side of the pit) to avoid disturbance to *E. odorata* low woodland. Clearing of very good condition *E. odorata* low woodland is now limited to small segments of larger patches to the north and northwest of the existing pit.

Austrostipa open tussock grassland in very good condition to be cleared has reduced from 2.80 ha to 0.21 ha. This has been achieved through reduction in the size of the open pit.

- Only clearing areas immediately prior to their development.
- Minimising the area of direct land clearing in areas sensitive to disturbance.
- Minimising the clearing of remnant vegetation by locating access tracks outside vegetation remnants where possible and minimising the length and number of access tracks in vegetation remnants.

- Erecting flagging tape to mark 'no go' zones to ensure areas to be protected are clearly defined, identified and avoided.
- Ensuring the development and implementation of vegetation clearance protocols (including an internal clearance procedure) and assessing performance against them.
- Avoiding introduction of soil pathogens to areas of remnant vegetation by identifying and clearly demarcating soil stockpile sites.
- Ensuring clearing and ground disturbance is only undertaken within designated areas.
- Progressively rehabilitating disturbed areas and avoiding unnecessary future disturbance of these areas.
- Revegetating, using appropriate species, to link isolated vegetation remnants within the project area.
- Establishing a seed and cutting collection protocol and seed bank as soon as possible.
- Implementing methods to monitor and maintain progressively rehabilitated and revegetated areas, including:
 - Establishing 360° photo monitoring points throughout the project area.
 - Conducting post closure follow up visits to the project area on a regular basis (decreasing frequency with time) to monitor the success rate of seedling emergence and survival, weed invasion, browsing levels (i.e., insect and animal attack of regenerating vegetation) and erosion, using photo monitoring points to track progress.
 - Ensuring that the monitoring program reflects agreed closure criteria established through consultation with stakeholders.
 - Where monitoring has identified erosion, weed invasion, failure of revegetation (to a material degree) or excessive browser damage to regenerating vegetation, maintenance activities will be implemented to ensure regeneration progresses successfully and rapidly. These may include:
 - Repairing eroded areas.
 - Weed control (chemical, mechanical, and manual methods).
 - Pest control (baiting, fencing, ripping etc.).
 - Infill planting.
 - Spot sowing.
 - Reseeding.
- Researching methods to propagate *L. effusa* open tussock grassland.
 - Working with local interest groups and other stakeholders to maximise the benefits of the revegetation programs.

- The establishment of in-house environmental capabilities to develop, implement and manage revegetation programs.

3.2 Weed Infestation and Introduction

Eradicating existing weeds in the project area will be difficult due to the well-established nature of many of these species. As a result, effort will initially concentrate on eradicating any new populations of previously unknown weed species and controlling the density and distribution of existing known weed infestations in these areas. Measures designed to avoid, minimise and manage the risks associated with weed infestations as a result of the project include:

- Reducing the area of vegetation to be cleared.
- Ensuring that vehicles and project equipment arrive on site clean and free of vegetative matter, seeds and mud.
- Focussing on the control of declared weed species present in the project area (e.g., bridal creeper (*Asparagus asparagoides*)), and the prevention of their spread during the life of the project.
- Liaising with government agencies such as DWLBC, PIRSA and the Kanmantoo–Callington Landcare Group on appropriate measures to eradicate or control weed outbreaks, should they occur.
- Targeted implementation of weed control measures for any observed significant increase in the distribution or density of existing weeds.
- Targeted implementation of weed control measures for new populations of weeds identified in previously uninfested areas.
- Inspecting construction areas for weed outbreaks following rainfall events.
- Regularly monitoring areas with a high potential for, or susceptibility to, weed invasion, such as along roadsides, recently cleared areas.
- Controlling and/or preventing weed infestations in topsoil stockpiles to minimise the likelihood of weed introduction during respreading of topsoil.
- Instigating the progressive rehabilitation of disturbed areas as outlined in the Mine Closure and Rehabilitation Plan (Enesar, 2007). This will reduce the potential for weed species to become established.

3.3 Grazing Animals

Measures designed to avoid, minimise and manage the risks associated with an increased attraction to grazing animals include:

- Maintaining perimeter fencing to prevent stock accessing the site.
- Managing revegetated areas that form part of SEB offsets to prevent overgrazing from native fauna (e.g., wallabies and kangaroos), introduced pest animals (e.g., rabbit and hare) and stock.

- Minimising the potential for water to pool in areas where it is applied as a dust suppressant (e.g., along unsealed access roads), thereby reducing the attraction for animals.
- Implementing a pest animal management program including baiting, burrow ripping and monitoring to control rabbit and hare populations, should this be necessary.

4. SEB Calculation

4.1 Extent of Vegetation Clearance

Vegetation will be cleared to accommodate project components such as the open pit, tailings storage facility and waste rock storage area, run-of-mine (ROM) pad, processing plant, workshops, administration buildings, water storage areas and access and other site roads (Figure 4). In total, 26.67 ha and six of the eight vegetation communities occurring in the project area will be impacted by the project (Table 3 and Figure 4). The condition of vegetation to be impacted ranges from very good to poor (Ecological Associates, 2007).

Table 3 Vegetation to be cleared for the project

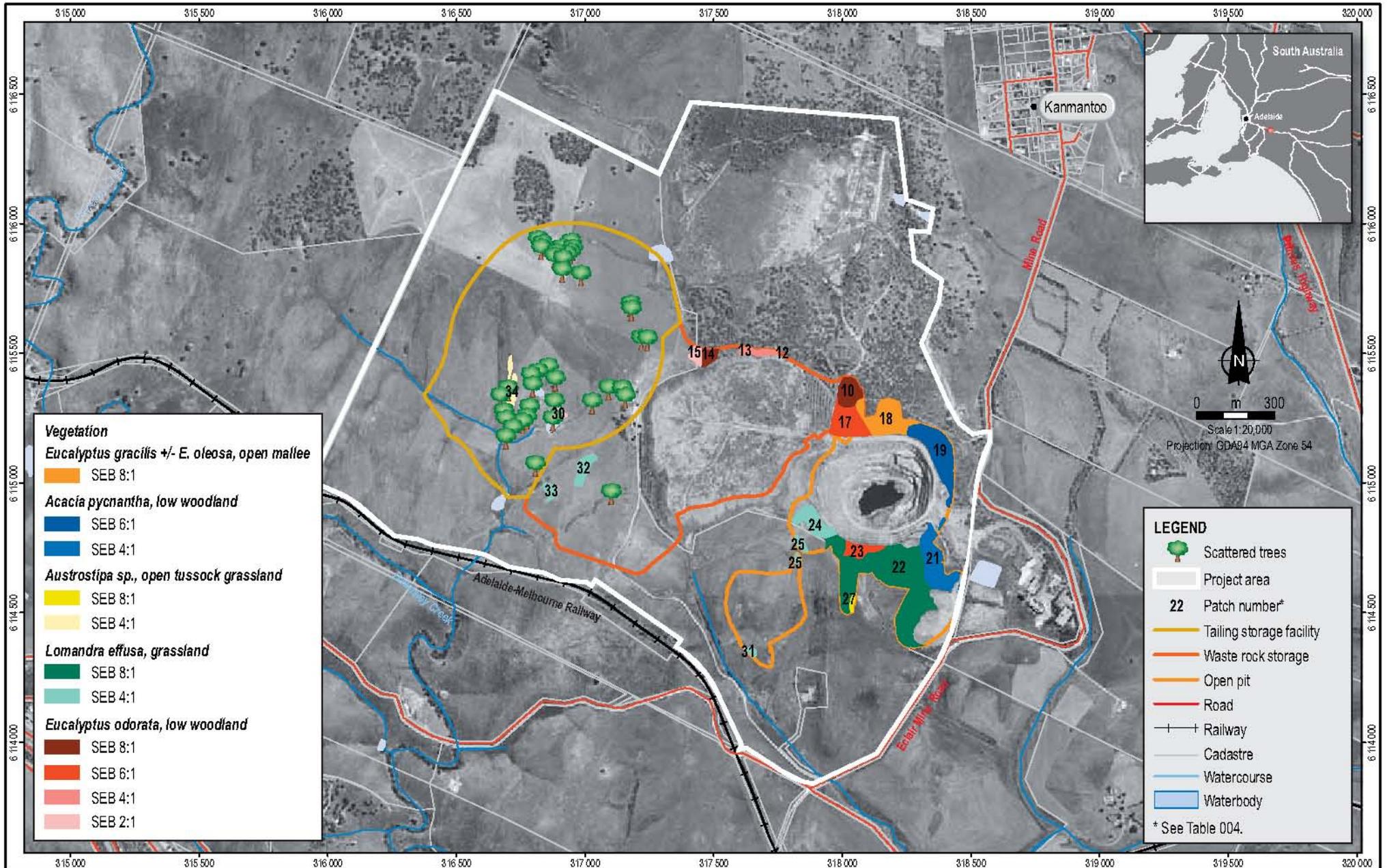
Vegetation Community	Area (ha)				Total Area to be Cleared (ha)
	8:1	6:1	4:1	2:1	
<i>Eucalyptus odorata</i> low woodland	1.23	2.02	0.32	0.34	3.91
<i>Lomandra effusa</i> open tussock grassland	9.59		2.54		12.13
<i>Austrostipa</i> sp. open tussock grassland	0.21		0.61		0.82
<i>Eucalyptus gracilis</i> open mallee	2.79				2.79
<i>Callitris gracilis</i> low woodland	0.19				0.19
<i>Acacia pycnantha</i> low woodland		4.26	2.57		6.83
Scattered trees	56 trees (containing 24 hollows)				
Total					26.67

Of the 12.13 ha of *L. effusa* open tussock grassland to be cleared, 9.59 ha has a condition score of 8:1, representing the largest amount of very good condition vegetation to be cleared for the project. In total, 3.91 ha of *E. odorata* low woodland will be cleared for the project. Of this, 1.23 ha is of very good condition. The only areas of *E. gracilis* ± *E. oleosa* open mallee and *C. gracilis* low woodland (2.79 and 0.19 ha respectively) are in very good condition. *Austrostipa* sp. open tussock grassland to the south and west of the existing open pit (0.21 and 0.61 ha) is of very good and moderate condition. *Acacia pycnantha* low woodland to the south and northeast of the existing open pit (4.26 and 2.57 ha) is of good and moderate condition.

4.1.1 Vegetation Significance

The significance of the vegetation associated with threatened species and communities is described in Section 2.4. Vegetation clearing associated with the development will affect four significant vegetation types: *E. odorata* low woodland and *L. effusa* open tussock grassland which are of declared conservation significance at a national and state level. *Austrostipa* sp. open tussock grassland and *Callitris gracilis* low woodland, which are of declared significance at a regional level. These vegetation types, and *E. odorata* low woodland in particular, is known to support threatened fauna species in the project area.

Eucalyptus leucoxylon woodland, of declared significance at a regional level, will not be impacted by the project



Source:
 Place names, roads, drainage and cadastral from DEH, SA (optimum scale 1:50,000)
 Mine layout from Hillgrove Resources
 Vegetation survey from Ecological Associates



Date: 02.07.07
 MXD: HillgroveResources_KanmantooGIS
 Job No: 5006_05_F004_GIS_AI

Hillgrove Resources Ltd
 Kanmantoo Copper Project



Native vegetation to be impacted by the project

Figure No:
 4

Diuris behrii (Behr's cowslip orchid) and *Ptilotus erubescens* (hairy-tails), species of conservation significance at the state level, occur in areas to be impacted by the project.

4.1.2 Conservation Values

The Draft Native Vegetation SEB Guidelines (DWLBC, 2005) list five conservation values that should be considered in association with vegetation clearing (summarised from Table 3 of DWLBC, 2005):

- Threatened vegetation communities.
- Wetland environments.
- Remnant vegetation.
- Threatened flora.
- Threatened fauna habitat.

The vegetation to be cleared is of conservation value for four of the five points (wetland environments of conservation value do not occur within the project area).

4.2 Impacts of Vegetation Clearance

Some vegetation clearing is an unavoidable result of the project (see Table 3 for extent of vegetation clearing to be undertaken). The residual impacts of the project to flora and fauna (taking into account proposed management measures in Chapter 3) as a result of vegetation clearance include:

- Significant impacts to threatened vegetation communities.
- Significant impacts to threatened species (both flora and fauna).
- Reduced conditions favourable for plant growth due to dust.
- Reduced abundance of individual species (both flora and fauna).
- Increased abundance of introduced species (pest plant and animals).

4.3 Estimated Significant Environmental Benefit

4.3.1 Initial SEB Assessment

Based on the SEB ratios assigned to vegetation to be cleared (Ecological Associates, 2007), 192.7 ha of vegetation is required as an offset for the Kanmantoo Copper Project to achieve a SEB (Table 4).

4.3.2 On-site Restoration SEB

The initial SEB ratio can be reduced by approximately 50% where on-site ecological restoration activities will be achieved on completion of mining (DWLBC, 2005).

Ecological restoration is achieved by:

'returning the ecosystem to as a close approximation of its natural condition prior to disturbance. The goal is to emulate a natural, functioning self regulating system that is integrated with the landscape in which it occurs' (DWLBC, 2005).

Ecological restoration is likely to be achieved where vegetation will be removed for the tailings storage facility and waste rock storage area. This will result in approximately 4.6 ha of the existing waste rock dump, TSF and ROM pad that has been revegetated or has regenerated naturally being returned to the same condition upon completion of mining (Table 5). This will reduce the SEB offset by 50% in the 4.6 ha where ecological restoration can be achieved, reducing the total SEB offset ratio from 192.6 to 179.8 ha (see Table 4).

Table 4 SEB for the project

Vegetation Community	Condition (SEB ratio)	Patch Number	Area to be Cleared (ha)	Project Component	Offset Area (ha)	Area to be Restored	SEB Offset Area with Restoration Reductions (i.e., 50% reduction for areas to be restored)	Area where Measures Additional to On-site Ecological Restoration can be Applied	SEB Offset Area with Mitigation and Restoration Reductions (i.e., further 50% reduction)
<i>E. odorata</i> low woodland	8:1	10	0.90	WRD	7.17	0.90	3.58	0.90	1.79
	8:1	14	0.34	WRD	2.71	0.34	1.35	0.34	0.68
	6:1	17	0.26	Open pit	1.57		1.57	0.26	1.83
	6:1	17	0.01	Ab. bund	0.06		0.06	0.01	0.07
	6:1	17	1.10	WRD	6.57	1.10	3.29	1.10	1.64
	6:1	12	0.02	WRD	0.12	0.02	0.06	0.02	0.03
	6:1	23	0.64	Open pit	3.82		3.82	0.64	4.45
	4:1	13	0.32	WRD	1.27	0.32	0.64	0.32	0.32
	2:1	15	0.24	WRD	0.47	0.24	0.24	0.24	0.12
	2:1	30	0.11	TSF	0.22	0.11	0.11	0.11	0.05
<i>L. effusa</i> open tussock grassland	8:1	22	6.81	Open pit	54.49		54.49		54.49
	8:1	22	2.78	Ab. bund	22.26		22.26		22.26
	4:1	24	0.95	Open pit	3.81		3.81		3.81
	4:1	25	0.24	Open pit	0.97		0.97		0.97
	4:1	25	0.49	Ab. bund	1.95		1.95		1.95
	4:1	25	0.06	ROM	0.24	0.06	0.12		0.12
	4:1	31	0.11	Open pit	0.42		0.42		0.42
	4:1	32	0.51	WRD	2.04	0.51	1.02		1.02
	4:1	33	0.23	WRD	0.94	0.23	0.47		0.47
<i>Austrostipa</i> sp. open tussock grassland	8:1	27	0.12	Ab bund	0.95		0.95		0.95
	8:1	27	0.09	Open pit	0.72		0.72		0.72
	4:1	34	0.61	TSF	2.43	0.61	1.21		1.21
<i>E. gracilis</i> , +/- <i>E. oleosa</i> open mallee	8:1	18	1.00	Ab. bund	8.03		8.03		8.03
	8:1	18	1.61	Open pit	12.86		12.86		12.86
	8:1	18	0.18	WRD	1.43	0.18	0.71		0.71
<i>Callitris gracilis</i> low woodland	8:1	16	0.19	Ab. bund	1.53		1.53		1.53
<i>Acacia pycnantha</i> low woodland	6:1	19	2.05	Open pit	12.29		12.29		12.29
	6:1	19	2.21	Ab. bund	13.26		13.26		13.26
	4:1	20	0.06	Open pit	0.26		0.26		0.26
	4:1	21	0.67	Ab. bund	2.67		2.67		2.67
	4:1	21	1.84	Open pit	7.34		7.34		7.34
Scattered trees					17.80	0.00	17.80		17.80
Total			26.73		192.66	4.60	179.86	3.92	176.14

Note: apparent discrepancies in totals are due to rounding. TSF refers to tailings storage facility, WRD to waste rock storage area and Ab. bund to abandonment bund.

Table 5 Total site disturbance area and revegetation within the project area

Component	Total Disturbance Area (ha)	Revegetated Area (following project completion) (ha)
Main pit and O'Neil pit combined	39.0	0.0
Emily Star	8.0	8.0
Abandonment bund (minus pit areas)	14.0	0.0
Raw water dam	0.3	0.3
Mill pond	0.2	0.2
Fresh water dam	1.6	1.6
TSF return water storage	4.0	4.0
Process plant	2.9	2.9
ROM	2.5	2.5
Workshop	2.0	2.0
TSF*	76.3	76.3
Waste rock storage*	60.7	60.7
Subtotal	211.5	158.6
Overlap between waste rock storage and TSF	7.9	7.9
Overlap between waste rock storage and main pit	2.1	2.1
Total	201.5	148.6

*Does not include surface area (i.e., surface plus batters)

It is anticipated that ecological restoration of the pit area will be impossible, as the pit is likely to remain as a void on closure and the abandonment bund will be steep and difficult to revegetate. Ecological restoration of areas of vegetation in good to very good condition is unlikely to be achieved.

The revegetation plan is described in detail in the Kanmantoo Copper Project mine closure and rehabilitation plan (Enesar, 2007).

4.3.3 Mitigation of Conservation Criteria SEB

The SEB ratio can be further reduced by 50% when a project is likely to impact upon one or more of the conservation values, e.g., threatened flora and fauna and vegetation communities, but the proponent will commit to mitigating that impact through measures additional to on-site ecological restoration (DWLBC, 2005) (see Table 4).

As described in Section 4.2 the project will have an impact on threatened fauna habitat, threatened flora species, vegetation communities of conservation significance and remnant patches.

Mitigation of potential impacts to significant vegetation communities and threatened species has already occurred during the design phase of the project by minimising the disturbance footprint and avoiding the placing of infrastructure to the north and south of the existing open pit (i.e., no infrastructure will be placed in these areas and impacts will result solely from the location of the resource (i.e., the open pits)). Further mitigation measures include the development and implementation of a rehabilitation and closure plan, threatened species management plan and pest plant and animal management plan. These plans will incorporate mitigation measures such as:

- Clear demarcation of 'no go zones' (areas to be protected).
- Relocation of individual threatened flora species¹ such as *Diuris behrii* and *Ptilotus erubescens* from directly impacted areas.
- Control of feral animals.
- Relocation of threatened species such as the diamond firetail and brushtail possum from directly impacted areas.

Additional mitigation measures reduce the SEB offset for patches of *E. odorata* low woodland providing habitat for threatened fauna species (3.9 ha) by 50%. This reduces the SEB offset marginally from 179.9 ha to 176.1 ha (see Table 4).

4.3.4 Final SEB Agreement

The SEB offset required for the project is therefore 176.1 ha of land (see Table 4). This has been determined on the basis of the TSF, waste rock storage area and ROM being restored on project completion and the implementation of additional mitigation measures for impacts to threatened fauna and flora species, threatened vegetation communities and remnant patches as described above.

¹ Hillgrove will consult with SADEH and other qualified professionals regarding any relocation of threatened species.

5. Provision of SEB

The rationale for SEB is based on the premise that the clearance of native vegetation will result in a loss of biological diversity values (which include fauna habitat), with the degree of loss dependent on the quality and amount of vegetation to be cleared (PIRSA, 2004).

To compensate for the loss in biological diversity values, the SEB should not only replace the environmental values lost through clearing, but also lead to a net gain that contributes to improving the condition of the environment, either on the site of the operations or within the same region of the state.

5.1 Potential Options

Potential activities to achieve SEB include (PIRSA, 2006):

- Acquiring land, protecting and funding ongoing management of those areas (this may include monetary donations to organisations for conservation) and/or undertaking revegetation or restoration activities on that land to re-establish habitats.
- Supporting research into rehabilitation of ecosystems or habitats.
- Supporting regionally based natural resource management projects with a biodiversity focus.
- Removal of threats and management of existing vegetation, e.g., weed management on roadsides.
- Working with local government or other bodies to undertake environmental remediation or revegetation in areas under the control of such bodies.
- Funding or undertaking projects in Crown estate parks and reserves in the region.
- Targeted feral animal reduction programs aimed at assisting the recovery of specific species.
- Other approved activities, as identified by the proponent, that are likely to have a significant environmental benefit.
- Payment into the Native Vegetation Fund, managed by the Native Vegetation Council.

5.2 Preferred Option

Hillgrove's preferred option to meet the SEB requirements for the Kanmantoo Copper includes:

- Providing for the ongoing protection and management of the remaining 86 ha of remnant native vegetation within the project area, including 13.67 ha of *E. odorata* low woodland, 8.21 ha of *L. effusa* open tussock grassland, 11.39 ha of *Austrostipa* sp. open tussock grassland and 1.21 ha of *E. gracilis* open mallee, all in very good condition. This represents 91.7%, 46.1%, 98.2% and 30.2% of very good condition

vegetation of these types within the project area and includes large areas of communities of declared national and state conservation significance.

- Upon project onset, commencing rehabilitation of areas dominated by introduced pasture (approximately 20-100 ha to the south and west of the TSF and waste rock storage area). Vegetation communities dominated by eucalyptus are likely to be successfully replanted through revegetation, although the ecological complexity of ecosystems, especially those in very good and good condition, will be impossible to re-establish in the short term. In the long term it is anticipated that these areas will be able to recover full ecological function, particularly as fauna habitat. The results of revegetation programs will be used to guide ongoing progressive rehabilitation of other disturbed areas during the life of the project.
- Upon project completion, approximately 60 ha of the TSF and 70 ha of the waste rock storage area (see Table 5) will be revegetated. *L. effusa* will be the dominant species used in revegetation of the surface of the tailings storage facility and waste rock storage area. Failing successful establishment of this and other species common in *L. effusa* open tussock grassland, offset areas outside the project area will be sourced (see Section 5.3).
- Supporting community initiatives occurring offsite through donation of plants, equipment and funding (if necessary).
- If applicable, revegetating and improving vegetation on adjoining (recently purchased) properties (at least 253 ha is likely to be purchased). Areas of existing *E. odorata* open woodland, *L. effusa* open tussock grassland and *Austrostipa* sp. open tussock grassland will preferentially targeted.

Hillgrove will work with the local community and other relevant stakeholders (e.g., Kanmantoo-Callington Landcare Group) to develop the best method to maximise the benefits of revegetation.

The rationale for the development of this SEB offset program is:

- To protect, through improved management all remaining vegetation within the project area (86 ha). This includes approximately 10.0 and 7.5 ha of very good and good condition *E. odorata* low woodland and 7.0 and 1.0 ha of very good and moderate condition *L. effusa* open tussock grassland, which are of declared conservation significance at state and national levels.
- To expand areas of *E. odorata* low woodland and *L. effusa* open tussock grassland. Revegetation will focus on areas that are dominated by introduced pasture (Plate 4) which intersperse patches of good condition vegetation to the north and south of the existing pit. It is likely that areas of *Acacia pycnantha* low woodland to the north of the existing open pit that are not disturbed will, in time, develop into one of the adjoining vegetation communities, i.e., either *E. odorata* low woodland, *E. gracilis* ± *E. oleosa* open mallee or a combination of both.
- To improve existing areas of vegetation communities (*E. odorata* low woodland) that provide habitat for the threatened diamond firetail and brushtail possum (listed and nominated for listing under the NPW Act). Areas of *E. odorata* low woodland to the

north of the existing pit with condition scores of SEB 6.1 or lower (Plate 5) will be improved through weed control and revegetation using understorey species. Patches of *L. effusa* open tussock grassland with an SEB ratio of 6:1 or lower (Plate 6) will be improved through stock exclusion and weed control.

- Activities will replace the same habitat/vegetation types as those disturbed by the project. Patches of *E. odorata* low woodland and *L. effusa* open tussock grassland within the TSF, waste rock storage area and ROM will be replaced. Other vegetation communities impacted will be replaced in currently bare or highly degraded areas.
- Isolated vegetation remnants will be connected across the landscape providing, in time, links for dependant fauna. Patches of *E. odorata* low woodland in the north of the project area will be linked through revegetation of currently bare or highly degraded areas.
- Remaining vegetation in poor, medium and good condition will be improved through weed management and exclusion of stock.
- Hillgrove can manage parts of the offset area (e.g., existing vegetation and revegetated bare and degraded areas) initially as part of its operations (i.e., up until mine closure). The main advantage of this is that resources will be readily available and newly planted and demarcated areas can be closely monitored and managed.
- Vegetation surveys on adjoining (recently purchased) properties can be undertaken to assess their conservation value. If deemed appropriate to do so, Hillgrove will undertake revegetation or restoration activities on purchased land to re-establish habitats. Where possible, links to vegetation communities within the project area will be strengthened and/or established. If appropriate and necessary, the option to enter into Heritage Agreements will be considered.

Revegetation activities on purchased land will enable Hillgrove to closely monitor the success of plantings and use information to improve methods used for the progressive rehabilitation of areas disturbed during construction and operations within the project area. Specific management and monitoring measures for the offset area will be developed as part of the SEB offset management and monitoring plan to be prepared by Hillgrove, but will include an annual survey of vegetation transects to be undertaken together with surveys of revegetated areas. A spring survey is planned for 2007.

The primary management objectives of the offset area will be the protection and enhancement (and control of threatening processes such as weed invasion, grazing and reduced conditions favourable to plant health) of the two national and state listed vegetation communities and habitat for dependant fauna species. The management measures will include the prevention of impacts from stock grazing, overgrazing by native species and weed invasion and revegetation.

5.3 SEB Offset Contingencies

Where an environmental benefit is not achievable on the property, the Native Vegetation Council will seek to achieve an environmental gain in the region of the proposed clearance (PIRSA, 2006). In the event that revegetation and rehabilitation of offset areas is unsuccessful, other offset activities will be considered and implemented if necessary, including:

- Offering incentives to existing landholders to enter into Heritage Agreements to conserve or re-establish native vegetation on their properties.
- Payment into the Native Vegetation Fund.

5.3.1 Incentives to Existing Landholders

Where significant stands of vegetation occur on nearby or adjoining properties, Hillgrove could provide monetary incentives to landholders to enter into Heritage Agreements. This would guarantee in perpetuity protection for vegetation communities. Vegetation communities on adjoining or nearby land proving links between vegetation communities for threatened fauna species would be preferentially targeted.

5.3.2 Native Vegetation Fund Payment

Options for financial payment in lieu of on-ground SEB actions will be Hillgrove's fall back SEB option. This will require:

- Staged payments into the Native Vegetation Fund.
- Delayed payment into the Native Vegetation Fund until the operation is receiving returns on the commodity (delayed payment may be subject to an additional payment depending on the length of the delay).
- An assessment of payment schedule and/or offsets, undertaken on an annual basis, or on renewal of the mining lease.

A formula provided by Department of Water, Land and Biodiversity Conservation (DWLBC, 2005) determines the relative amount required to be contributed. Should Hillgrove wish to meet their offset obligation through payment into the Native Vegetation Fund, the following calculation applies:

Hectares multiplied by land value
 $(y \text{ ha} \times \$x/\text{ha} = \$z)$
 plus management costs (\$800/h)
 $(\$800 \times \text{area cleared} = \$w)$
Total costs: $\$z + \$w = \$v$

Therefore, the number of hectares required to be offset by land value (176.1 ha x \$600 = \$105,660), plus management costs multiplied by the number of hectares to be cleared (\$800 x 26.7 ha = \$21,360)

$\$105,660 + \$21,360 = \$127,020.$

5.4 Implementation

Following a decision to proceed with the project, Hillgrove will make all necessary arrangements for the preferred option; ongoing protection of the 86 ha of existing vegetation that will not be impacted by the project. At project onset, the area will be designated a 'no go' zone and demarcated appropriately. Following this, appropriate management strategies for the area including revegetation strategies will be developed.

Revegetation trials will be reviewed to determine the success of rehabilitation of *L. effusa* open tussock grassland communities.

A management and monitoring program will be established in consultation with relevant experts, government agencies and local interest groups.

Offset contingencies will be implemented if SEB offsets cannot be achieved on site.

A notional timetable for the establishment of the offset area and management program is shown in Table 6.

Table 6 Notional timetable for SEB offset area implementation

Month	Action
0	Decision to proceed with project.
0	Demarcation of 'no go' zones around existing vegetation.
0 to 12	Prepare draft management strategies including Threatened Species Management Plan, Pest Plant and Animal Management Plan and SEB Offsets Management and Monitoring Plan.
12 to 15	Finalise and implement management strategies.
15+	Ongoing management and monitoring. Implementation of Mine Closure and Rehabilitation Plan. Implementation of offset contingencies and Heritage Agreements if necessary.

6. References

- DEWR. 2007. EPBC Policy Statement 3.7 Nationally Threatened Species and Ecological Communities. Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia. Department of Environment and Water Resources, Government of Australia. June 2007.
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- PIRSA. 2004. Earth Resources Information Sheet M30. Interim Guidelines on Requirements for Mineral Exploration and Mining under the *Native Vegetation Act 1991* and Regulations 2003. Mining Regulation and Rehabilitation Branch, Minerals Group, Minerals and Energy Resources, Primary Industries and Resources SA.
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- Enesar. 2007. Kanmantoo Copper Project Conceptual Mine Closure and Rehabilitation Plan. June. Report prepared by Enesar Consulting Pty Ltd for Hillgrove Resources Limited.

6.1 Personal Communications

- Cooling, M. Ecological Associates, Wayville, South Australia. Telephone conversation. 26 July 2007.

Attachment 1 Initial SEB assessment guidelines

Vegetation Condition	Indicators for Condition	SEB Ratio
Poor. Weed-dominated with only scattered areas or patches of native vegetation	Vegetation structure no longer intact (e.g., removal of one or more vegetation strata).	2:1
	Scope for regeneration, but not to a state approaching good condition without intensive management.	
	Dominated by very aggressive weeds.	
	Partial or extensive clearing (greater than 50% of area).	
	Evidence of heavy grazing (tracks, browse lines, species changes, no evidence of solid surface crust).	
Moderate. Native vegetation with considerable disturbance	Vegetation structure substantially altered (e.g., one or more vegetation strata depleted).	4:1
	Retains basic vegetation structure or the ability to regenerate it.	
	Very obvious signs of long-term or severe disturbance.	
	Weed dominated with some very aggressive weeds.	
	Partial clearing (10 to 50% of area).	
	Evidence of moderate grazing (tracks, browse lines, soil surface crust extensively broken).	
Good. Native vegetation with some disturbance	Vegetation structure altered.	6:1
	Most seed sources available to regenerate original structure.	
	Obvious signs of disturbance.	
	Minor clearing (less than 10 % of area).	
	Considerable weed infestation with some aggressive weeds.	
	Evidence of some grazing (tracks, soil surface crust patchy).	
Very good. Native vegetation with little disturbance	Vegetation structure intact (e.g., all structure intact).	8:1
	Disturbance minor, only affecting individual species.	
	Only non-aggressive weeds present.	
	Some litter build-up.	
Intact vegetation	All strata intact and botanical composition close to original.	10:1
	Little or no signs of disturbance.	
	Little or no weed infestation.	
	Soil surface crust intact.	
	Substantial litter cover.	

Source: Table 1 of DWLBC (2005).

Appendix 15

Kanmantoo Copper Project Noise Assessment

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HILLGROVE RESOURCES KANMANTOO COPPER PROJECT

ENVIRONMENTAL NOISE ASSESSMENT

**FOR ENESAR CONSULTING PTY LTD
2-3 GREENHILL ROAD
WAYVILLE SA 5034**

AUGUST 2007



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EXECUTIVE SUMMARY

An assessment has been made of the potential environmental noise from the construction and operation of the proposed Hillgrove Resources Kanmantoo Copper Project.

Based upon the best available estimates of noise from the operation of the proposed mine, initial modelling indicated that with no specific acoustic treatment incorporated, noise levels from the operation of the mine would exceed relevant environmental noise criteria at the surrounding residences. As a result, predictions have been made to determine the level and feasibility of acoustic treatment that would be required to ensure that noise levels at the closest dwellings from the operating plant do not exceed maximum instantaneous (L_{max}) noise levels of 60 dB(A), and equivalent (L_{eq}) levels of 47 dB(A) during the daytime, and 40 dB(A) during the night. These levels are equal to the relevant requirements of the Draft Environment Protection (Noise) Policy for development situations. The assessment indicates that the achievement of the noise criteria for the operation of the mine is acoustically feasible.

It should be noted that the specific acoustic treatment detailed within this report is not considered to be the only method of achieving the relevant noise criteria. The exact nature of acoustic treatment required will be determined based on the final equipment selections. The treatment presented within this report is provided as a tool to help determine the feasibility of achieving acceptable noise levels from the mine at residences in the vicinity.

As part of this assessment, consideration has also been given to noise levels associated with the construction of the mine. This assessment indicates that the noise from some aspects of the mine will exceed sleep disturbance criteria and these activities should therefore be limited to day time.

The assessment has also given consideration to noise and vibration levels from blasting activities at the mine, and the noise from trucks travelling on public and private roads to and from the mine site. These assessments have concluded that the noise and vibration from blasting can be adequately controlled by the size, number, and type of the blast charges used, whilst the noise from trucks on the road will achieve reasonable levels with no specific acoustic treatment in place.



1 INTRODUCTION

Hillgrove Resources Limited is currently seeking approvals to re-open and expand the Kanmantoo Copper Mine located approximately 1.5km south west of the Kanmantoo township, 44 km east of Adelaide in South Australia.

As part of the Mining Lease Proposal (MLP), Enesar Consulting have engaged Sonus to provide an environmental noise assessment of the proposed development. The assessment is to determine likely noise levels from the mine during construction and operation of the project, and to assist in determining the feasibility of applying acoustic treatment to the mine to achieve relevant environmental noise criteria. This report summarises the results of this assessment.

The proposed operation will include activities within the open pits, processing plant, run of mine stockpile, waste rock storage and tailings storage facility. The layout of the proposed operation is shown in Appendix A.

This assessment considers noise levels from the operation of the mine, the noise and vibration from blasting activities, the noise from truck movements to and from the mine site, and the noise from the construction required prior to commencement of the mine operation.

The proposed mine is located within the Rural (Kanmantoo) Zone of the District Council of Mount Barker Development Plan (consolidated 1 March 2007). The closest noise-sensitive receivers to the proposed development are located to the east and south west within the Residential Zone ("Receiver 1") or Rural (Kanmantoo) Zone ("Receiver 2" to "Receiver 10"). The Neutrog Fertilizer facility is located to the east within the Industry (Kanmantoo) Zone. The locations and co-ordinates (using the GDA94 MGA Zone 54 map datum) of these receivers are shown in Appendix B.

The existing acoustic environment in the vicinity of the site is controlled by natural sounds (such as birds and wind) as well as the noise from distant traffic on the South Eastern Freeway, trains, and the noise from the Neutrog Fertilizer facility.

A report on the noise in the vicinity of the site was prepared by Vipac Engineers and Scientists (Ref:50B-06-5856-TRP-200705-0). The report indicates that levels recorded are typical of a country town, with some activity during the day and low noise levels at night. Tables which summarise the existing noise levels in the area have been reproduced from the Vipac report, and are presented as Appendix D of this report.



2 CRITERIA

To provide an objective assessment of the noise from the construction and the operation of the mine, reference is made to the *Draft Environment Protection (Noise) Policy 2007*.

2.1 Noise from Construction

The Draft Policy places restrictions on construction activity where the noise from the activity results in sleep disturbance, and therefore “an adverse impact on amenity”, at noise-sensitive locations during the night. The Draft Policy deems this “adverse impact” to occur where the noise exceeds an equivalent (L_{eq}) level of 45 dB(A), or a maximum instantaneous (L_{max}) level of 60 dB(A).

Where construction noise exceeds these levels, the Draft Policy restricts the construction activity to the following hours:

- ! between 7:00am and 7:00pm on the same day, other than a Sunday or other public holiday; or
- ! between 9:00am and 7:00pm on a Sunday or other public holiday

For construction activity occurring within these hours, the Draft Policy requires that “all reasonable and practicable measures” be taken to minimise the noise from the activity.

2.2 Noise from Mine Operations

The Draft Policy provides guidance to the noise from industries in development situations using “indicative noise factors” for different land use categories as follows:

Land Use Category	Indicative Noise Factor (dB(A))	
	Day (7:00am – 10:00pm)	Night (10:00pm – 7:00am)
Rural Living	47	40
Residential	52	45
Rural or Light Industry	57	50
Commercial	62	55
General Industry	65	55
Special Industry	70	60

Under the Draft Policy, the applicable land use category for an area is determined based upon the zoning under the relevant Development Plan, and the provisions of the zone/s. With regard to these indicative noise factors, the Draft Policy states:

“If the land uses principally promoted by the relevant Development Plan provisions for the noise source and those principally promoted by the relevant Development Plan provisions for the noise-affected premises all fall within a single land use category, the indicative noise level for the noise source is the indicative noise factor for that land use category.”

“If the land uses principally promoted by the relevant Development Plan provisions for the noise source and those principally promoted by the relevant Development Plan provisions for the noise-affected premises do not all fall within a single land use category, the indicative noise level for the noise source is the average of the indicative noise factors for the land use categories within which those land uses fall.”



2.2.1 Zoning and Land Use

The mine site and "Receiver 2" to "Receiver 10" are all located within the "Rural (Kanmantoo)" zone of the District Council of Mount Barker Development Plan (consolidated 1 March 2007), whilst "Receiver 1" is located within a "Residential" zone. Objective 1 for the "Rural (Kanmantoo)" zone states:

"An agricultural zone primarily comprising cropping and graining activities on large rural holdings with intensive animal keeping in appropriate locations."

Given the zoning and the above objective, the mine site and "Receiver 2" to "Receiver 10" are considered to be best described as within a "rural or light industry" land use area, whilst "Receiver 1" is within a "Residential" land use area. Application of these categories provides indicative noise factors as follows:

- ! For "Receiver 1", 55 dB(A) during the daytime and 48 dB(A) at night
- ! For "Receiver 2" to "Receiver 10", 57 dB(A) during the daytime and 50 dB(A) at night

2.2.2 Development Situations

The Draft Policy also provides specific requirements for noise levels in development situations. In particular, the Draft Policy requires that the predicted noise levels for a development should not exceed:

- ! the relevant indicative noise level less 5 dB(A), and;
- ! where the receiver is located in a "quiet locality":
 - o a maximum instantaneous (L_{max}) noise level of 60 dB(A) at night, and;
 - o equivalent (L_{eq}) noise levels that are the lesser of:
 - ! the relevant indicative noise level less 5 dB(A), or
 - ! 52 dB(A) during the daytime and 45 dB(A) at night.

The relevant indicative noise levels less 5 dB(A) are:

- ! For "Receiver 1", 50 dB(A) during the daytime and 43 dB(A) at night
- ! For "Receiver 2" to "Receiver 10", 52 dB(A) during the daytime and 45 dB(A) at night

2.2.3 Application of Penalties

When measuring or predicting levels for comparison with the Draft Policy, penalties may be applied for each of the characteristics of tone, impulse, low frequency and modulation. A 5 dB(A) penalty is applied to the equivalent (L_{eq}) noise levels for one characteristic, 8 dB(A) for two characteristics, and 10 dB(A) for three or four characteristics.

Based upon the nature of activities that are envisaged for the mine, it is expected that the noise from the mine will fluctuate. From the existing ambient noise levels measured in the area and the predicted noise levels from the mine, it is expected that this modulation will be above existing ambient noise levels at the rural dwellings of "Receiver 2" to "Receiver 10", but within the general rise and fall of ambient levels at the residential dwelling of "Receiver 1". In these circumstances, a single 5 dB(A) penalty is considered appropriate for noise levels at "Receiver 2" to "Receiver 10", but no penalty is considered appropriate for "Receiver 1".



2.2.4 Applicable Noise Criteria

Therefore based upon the above, the applicable noise criteria under the Draft Policy for the noise from mine operations are considered to be:

- ! For "Receiver 1", equivalent (L_{eq}) levels of 50 dB(A) during the daytime and 43 dB(A) at night
- ! For "Receiver 2" to "Receiver 10", equivalent (L_{eq}) noise levels of 47 dB(A) during the daytime and 40 dB(A) at night
- ! For all receivers, maximum instantaneous (L_{max}) noise levels of 60 dB(A) at night.



3 NOISE MODELLING

3.1 Assumptions

The noise modelling for the development has been based upon the following understanding:

- ! Existing noise levels in the vicinity of the subject site are as per those detailed in a report prepared by Vipac Engineers and Scientists (Ref:50B-06-5856-TRP-200705-0), dated 26 April, 2006.
- ! Noise sources throughout the site are as follows:
 - o Waste Rock Dump:
 - ! continuous dump truck and bulldozer movements
 - o Tailings Storage Facility:
 - ! dump truck, bulldozer, compactor, water truck, and excavator movements
 - o Processing Plant:
 - ! crusher operation – daytime hours (7am to 10pm) only
 - ! continuous front end loader movements
 - ! continuous operation of general processing plant equipment (such as surge bins, feeders, SAG mill, screening machines)
 - o Run of Mine (ROM)
 - ! continuous dump truck, excavator, and front end loader movements
 - ! operation of a rock breaker
 - ! water truck movements
 - o Within open pits
 - ! continuous dump truck and excavator movements
 - ! drilling
 - ! water truck and service truck movements
 - o General dump truck movements around the site
 - o Light vehicles operating around the site
 - o Trucks delivering supplies such as diesel and reagents, and transporting concentrate
- ! Dump trucks used at the site will have a nominal capacity of 100 tonnes;
- ! Excavators used at the site will have a nominal capacity of 160 tonnes;
- ! In addition to dump trucks operating within the open pits and trucks dumping rock at the waste rock dump, a total of two 100 tonne dump trucks will be moving around the site at any one time, and;
- ! Mining activity will occur in a maximum of two of the six open pit areas at any one time.

The sound power levels used for the noise modelling are presented in Appendix C of this report. These sound power levels have been based upon noise measurements undertaken at a number of similar quarry and mining sites, including the works currently being undertaken for the construction of the Terramin mine at Strathalbyn.



3.2 Meteorological Conditions and Atmospheric Effects

When predicting or measuring noise levels over significant distances, it is convenient to describe the meteorological conditions between the noise source and the receiver using the CONCAWE¹ weather category system. The CONCAWE system divides the range of possible meteorological conditions into six separate “weather categories”, from CONCAWE weather category 1 to CONCAWE weather category 6. Considering wind speed, wind direction, time of day, and level of cloud cover, weather category 1 provides “best-case” (ie lowest noise level) weather conditions for the propagation of noise, whilst weather category 6 provides “worst-case” (ie highest noise level) conditions. Weather category 4 provides “neutral” weather conditions for noise propagation.

For the purposes of comparison, weather category 1, 2, or 3 conditions are generally characterised by wind blowing from the receiver to the noise source during the daytime with little or no cloud cover. Category 4 conditions can be characterised by no wind and an overcast day, whilst no wind and a clear night sky represent Category 5 conditions. Category 6 conditions can be characterised by a clear night sky and wind blowing from the noise source to the receiver.

Category 6 meteorological conditions have been used for the prediction of noise from the proposed development.

3.3 Predicted Noise Levels With No Specific Acoustic Treatment

With no specific acoustic treatment incorporated to the mine, the following table details the predicted noise levels at each of the noise-sensitive receivers from the operation of the mine (under CONCAWE weather category 6 conditions):

Receiver	Predicted L _{eq} Noise Level With No Treatment, dB(A)
1	47
2	43
3	42
4	46
5	44
6	41
7	48
8	46
9	44
10	42

¹ CONCAWE

The oil companies’ international study group for conservation of clean air and water – Europe
“The propagation of noise from petrochemical complexes to neighbouring communities”, May 1981
www.concawe.be



3.4 Acoustic Treatment

Based upon the above, and the sound power levels presented in Appendix C, the noise modelling indicates that acoustic treatment will be required to ensure that the noise from the mine achieves the relevant environmental noise criteria at the surrounding noise-sensitive receivers. The following acoustic treatment represents one method of achieving the acoustic criteria:

- ! Ensuring that all reversing tone alarms fitted to mobile equipment at the mine are “white noise” back alarms, such as the “BBS-Tek Back Alarms”;
- ! For activities within an open pit of the mine, ensuring that any excavator located less than 20 metres below the top of the pit is operated only between the hours of 7:00am and 10:00pm, and;
- ! Construction of a barrier to block line of sight between the processing plant and noise-sensitive receivers 2, 3, 4, 5, 6, 7, 8 and 9. This barrier would need to be constructed to a height of at least 3 metres above the height of the highest noise source within the processing plant.

3.5 Predicted Noise Levels

Based upon the incorporation of the above recommended acoustic treatment to the mine and project-related activities, the below table details the predicted noise levels at each of the noise-sensitive receivers from the operation of the mine (under CONCAWE category 6 conditions):

Receiver	Predicted L_{eq} Noise Level With Treatment, dB(A)	
	Daytime	Night-time
1	47	40
2	44	37
3	42	36
4	45	39
5	44	38
6	38	35
7	44	40
8	44	40
9	42	40
10	40	34

In addition, maximum instantaneous (L_{max}) noise levels from the mine are predicted to be no greater than 60 dB(A) at any of the noise-sensitive receivers.



The table indicates that with the acoustic treatment described above, the noise from mine operations will achieve the relevant environmental noise criteria. With the criteria achieved, noise levels at the residences from the operation of the mine would achieve the relevant acoustic requirements of the Environment Protection Authority, and would not be expected to have an adverse impact on surrounding noise-sensitive receivers.

It is noted that a daytime noise level of 53 dB(A) and a night-time noise level of 44 dB(A) are predicted at the Neutrog Fertilizer facility. These levels are well below the level that may interfere with any industrial or commercial activity, and would not be expected to impair or interrupt the regular activities of any Neutrog employees. Although no specific noise measurements have been undertaken at the Neutrog facility, it is expected that the noise at Neutrog employee positions from typical activity at the facility would be greater than the 53 dB(A) daytime level predicted from the operation of the mine.



4 NOISE MONITORING AND REPORTING PROGRAM

To both confirm the results of the noise modelling and ensure that the noise from the operation of the mine achieves all relevant environmental noise criteria, it will be important to undertake a noise monitoring and reporting program once the mine is operating.

In these circumstances, it is proposed to undertake attended night-time noise measurements at a number of locations in the vicinity of the mine site. The measurement locations will be chosen such that they are equivalent to the closest noise-sensitive receivers, taking into account factors such as distance, topography, and existing ambient noise levels.

As the use of various areas over the mine site will change over time, it is considered appropriate to undertake noise monitoring on a regular basis. This monitoring will provide a measure of noise levels at each of the receivers as activity at the mine site changes.



5 CONSTRUCTION NOISE

The *Draft Environment Protection (Noise) Policy* restricts the hours of construction activity where sleep disturbance criteria are exceeded. That is, the allowable hours of construction are limited to 9am to 7pm on Sundays and Public Holidays and 7am to 7pm on all other days, where the noise from the activity exceeds 45 L_{Aeq} or 60 L_{Amax} .

The major noise sources associated with the construction of the mine will be the earthmoving equipment associated with preparing the pits, roadways, tailings storage facility and the waste rock storage facility. There will also be noise associated with the construction of the processing plant. Much of this noise will occur prior to (or during) the construction of noise barriers, which will be required to control the noise from the operation of the processing plant.

To provide an indication of the likely noise from construction, the noise from earthmoving at ground level without the benefit of noise barriers has been combined with the noise from construction of the processing plant. It is estimated that the equivalent (L_{Aeq}) noise from construction at the closest dwellings will be in the order of 48 dB(A).

As it is anticipated that the noise from construction will exceed the sleep disturbance criteria, it is recommended that the construction activity that exceeds the criteria should be restricted to the hours described in the *Draft Environment Protection (Noise) Policy*.



6 BLASTING OPERATIONS

6.1 Criteria

The most relevant criteria for ground vibration and airblast noise due to blasting operations are found within Australian Standard AS2187.2-2006 "Explosives – Storage, Transport and Use – Pt 2: Use of Explosives". The Standard provides "human comfort limits" for different types of sites as follows:

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site	Operations lasting longer than 12 months or more than 20 blasts	5 mm/s for 95% blasts per year. 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Sensitive site	Operations lasting for less than 12 months or less than 20 blasts	10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below the manufacturer's specifications or the levels that can be shown to adversely effect the equipment operation.

Category	Type of blasting operations	Peak sound pressure level (dBL)
Sensitive site	Operations lasting longer than 12 months or more than 20 blasts	115 dBL for 95% blasts per year. 120 dBL maximum unless agreement is reached with the occupier that a higher limit may apply
Sensitive site	Operations lasting for less than 12 months or less than 20 blasts	120 dBL for 95% blasts. 125 dBL maximum unless agreement is reached with the occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below the manufacturer's specifications or the levels that can be shown to adversely effect the equipment operation.

The Standard defines a "sensitive site" as including "houses and low-rise residential buildings, hospitals, theatres, schools, etc., occupied by people".

As blasts at the mine site are likely to occur throughout the lifespan of the mine, it is appropriate to ensure that vibration and airblast levels at the residences do not exceed the levels of the standard for "sensitive sites", for "operations lasting longer than 12 months".



6.2 Ground Vibration and Airblast Levels

The levels of airblast and ground vibration experienced at residences from mine blasting operations are generally dependent on a number of factors, including:

- ! the distance between the blast site and the residence
- ! the type, size and number of charges used, and;
- ! the depth and manner in which the charge is installed.

Ground vibration and airblast levels from blasting at the Kanmantoo mine site will be adequately controlled using these factors, such that airblast and ground vibration levels and the surrounding noise-sensitive receivers are no greater than the limits for “sensitive sites”, for “operations lasting longer than 12 months”.



7 TRAFFIC NOISE

In addition to dump truck movements on the mine site, a number of heavy vehicle movements associated with access to and from the mine will also occur either on a private access road, or on existing public roads between the mine site and the South-Eastern Freeway. An assessment of the noise at nearby residences from these truck movements has been undertaken.

Based upon information provided from Hillgrove, it is understood that:

- ! Heavy vehicle movements to and from the mine site will occur either:
 - o along a new private access road constructed between the mine site and the Princes Highway, as indicated in Appendix E of this report, or;
 - o along the two public road routes indicated in Appendix E;
- ! If constructed, the route of the private access road will be such that the closest residences are located no closer than approximately 300 metres from the nearest residences;
- ! In addition to the routes shown in Appendix E, access between the South-Eastern Freeway and the Princes Highway will be via East Terrace, Callington. It is understood that East Terrace is already gazetted as a B-Double route;
- ! Regardless of the access road option chosen (i.e. private or public roads), movements will occur during daytime hours only. That is, between the hours of 7:00am and 10:00pm, and;
- ! Once the mine is operating at full capacity, 17 to 25 heavy vehicle movements (on average and depending on vehicle type) will occur along the proposed routes each day.

The above information has been used to predict and assess the noise levels at residences along the proposed routes from heavy vehicle movements that are associated with the mine site.

7.1 Criteria

To provide an objective assessment of the noise from truck movements on the proposed routes, reference is made to the Department of Transport, Energy and Infrastructure (DTEI) Road Traffic Noise Guidelines.

DTEI has recently upgraded the Road Traffic Noise Guidelines which are used for assessing the impacts of road traffic noise from new or significantly upgraded roads. Although the Guidelines are not strictly applicable to new traffic flows on existing roads (as is proposed for the public road routes), they are the best indication of suitable levels of traffic noise at residences when changes to the road network are proposed.

The Guidelines provide “desirable ranges” of noise levels for both daytime (7am to 10pm) and night-time (10pm to 7am) periods. Under the Guidelines, the lowest (most stringent) end of the daytime “desirable ranges” is a level of 55 dB(A).



7.2 Assessment

To determine the location of residences along the proposed routes, both of the proposed public road routes were inspected on the 31st of May, 2007.

In addition to this inspection, measurements of the noise from trucks on public roads were undertaken near the intersection of Gomersal Road and the Barossa Valley Highway, Tanunda, on the 30th of May, 2007, and in and around Kanmantoo and Callington on the 31st of May, 2007. Noise measurements were undertaken from trucks travelling within 60 km/hr zones, 80 km/hr zones, 100 km/hr zones, accelerating from intersections, and decelerating to intersections.

The results of the route inspections and the noise measurements were then used to predict noise levels at residences along the proposed routes from trucks travelling along the routes, to and from the mine site.

7.2.1 Public Road Routes

Based upon the information provided by Hillgrove, the inspection of the proposed routes, and the noise measurements of trucks on public roads, the following table details the predicted $L_{eq,daytime}$ noise level at the closest residences to the proposed public road routes from heavy vehicle movements to and from the mine site:

	Distance to Closest Road Lane	Predicted $L_{eq,daytime}$ Level
Within 60 km/hr zone	7 metres	51 dB(A)
Within 80 km/hr zone	20 metres	44 dB(A)
Within 100 km/hr zone	40 metres	41 dB(A)

As indicated in the table, the noise levels from truck movements are predicted to be below the 55 dB(A) lower (most stringent) end of the daytime “desirable range” of the DTEI Guidelines. In these circumstances, no acoustic treatment is considered to be warranted to control the noise from heavy vehicles that travel to and from the mine site on public roads.

7.2.2 Private Access Road Route

For a distance of 300m between the proposed private access road and the closest residence, and a speed limit of 100 km/hr along the road, predictions indicate that noise levels at the closest residences from truck movements on the road will be no greater than 35 dB(A). Lower speed limits would result in lower noise levels.

A level of 35 dB(A) is significantly lower than the 55 dB(A) lower end of the daytime “desirable range”, indicating that no specific acoustic treatment would be required in order to control heavy vehicle noise from the private access road to the closest residences.



8 CONCLUSION

An environmental noise assessment has been made of the proposed re-opening and expansion of the Kanmantoo Copper Mine.

Based upon the recommendations of the *Draft Environment Protection (Noise) Policy 2007* and discussions with the South Australian Environment Protection Authority (EPA), it is considered appropriate to ensure that:

- ! noise levels at the closest noise-sensitive receivers from the operation of the mine do not exceed
 - o equivalent (L_{eq}) noise levels of 47 dB(A) during the daytime (7am to 10pm), and 40 dB(A) during the night (10pm to 7am), and;
 - o maximum instantaneous (L_{max}) noise levels of 60 dB(A) during the night;

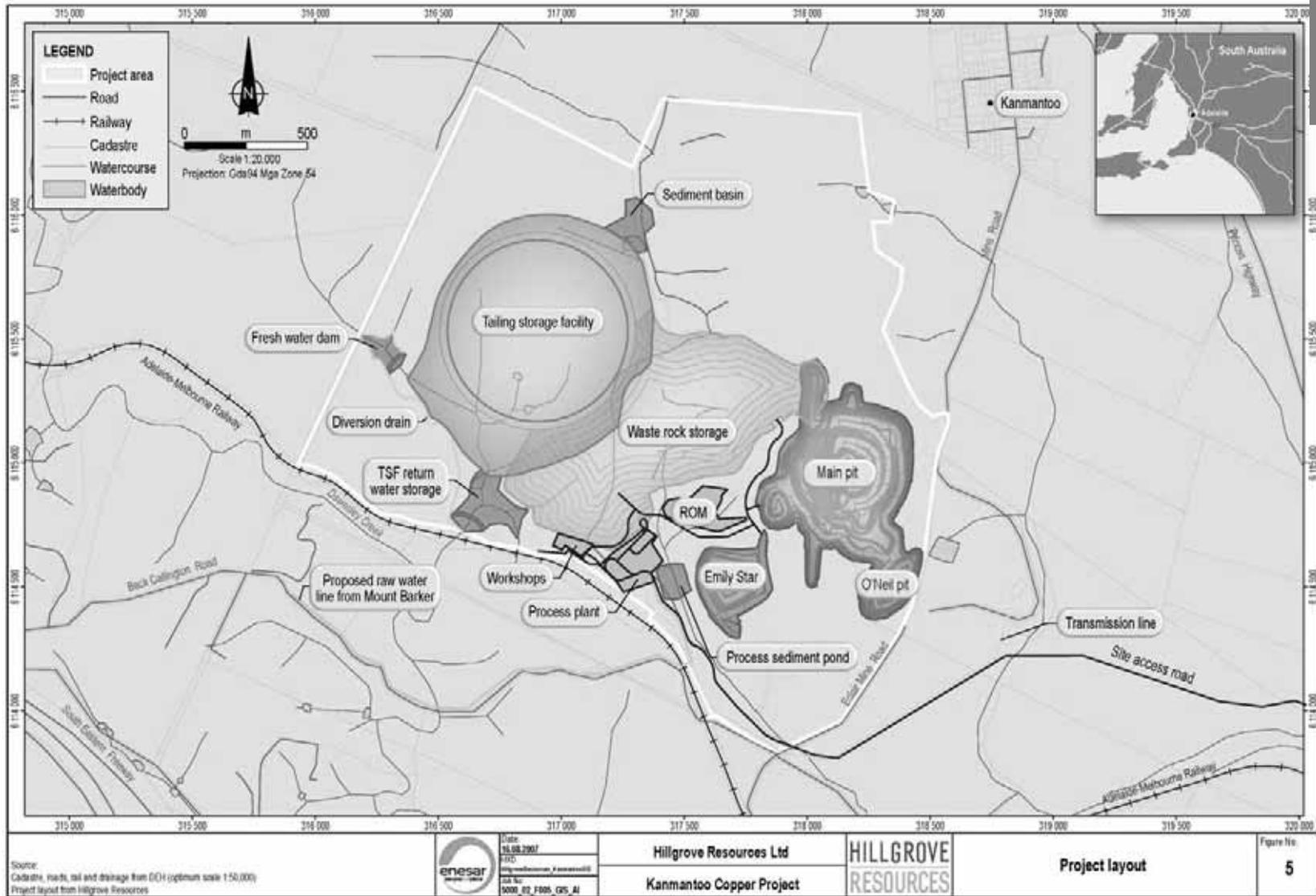
- ! where the noise at the closest noise-sensitive receivers from construction activity exceeds sleep disturbance criteria, that the hours of construction activity are limited. That is, the allowable hours of construction are limited to 9am to 7pm on Sundays and Public Holidays and 7am to 7pm on all other days, where the noise from the activity exceeds 45 L_{Aeq} or 60 L_{Amax} .

With no specific acoustic treatment in place, predictions indicate that noise levels from construction activity at the closest noise-sensitive receivers may be up to 48 dB(A), and therefore exceed levels to protect against sleep disturbance, whilst the noise from the operation of the mine will be up to 47 dB(A), and therefore exceed the relevant night-time noise criterion of the Draft Policy.

To ensure that the noise criteria are achieved at all times, recommendations for acoustic treatment to equipment and activities at the mine have been provided. These recommendations include the restriction of certain activities to daytime hours only, and the construction of barriers around certain equipment. With the recommendations incorporated, the noise from the construction and operation of the mine is predicted to achieve the relevant daytime and night-time criteria of the Draft Policy, and ensure that the noise from the mine does not adversely impact the surrounding residences.

It is noted that the recommendations for acoustic treatment provided within this report represent one method of achieving the relevant noise criteria. As the design progresses, the recommendations will be reviewed to ensure that the most appropriate noise mitigation measures are incorporated into the final design, whilst continuing to ensure that the noise levels at all surrounding residences from the construction and operation of the mine achieve the relevant criteria.

APPENDIX A – PROPOSED MINE LAYOUT



APPENDIX B – NEAREST NOISE-SENSITIVE RECEIVERS





Receiver Co-ordinates (GDA94 MGA Zone 54 Map Datum)

Receiver	Easting	Northing
1	318600	6116320
2	319591	6115212
3	319690	6114687
4	319408	6114547
5	319640	6114497
6	319086	6113744
7	316311	6114160
8	315851	6114672
9	315710	6114213
10	317511	6112694
Neutrog	318828	6114638

APPENDIX C – NOISE MODELLING SOUND POWER LEVELS

Octave Band Frequency (Hz)	TOTAL, dB(A)
100 tonne dump truck	115
Dumping of rock (including truck and bulldozer movements)	112
160 tonne Excavator	116
Front End Loader	112
Rock Breaker	110
Crusher	117
Drilling Rig	116
Processing Plant (all equipment combined)	122



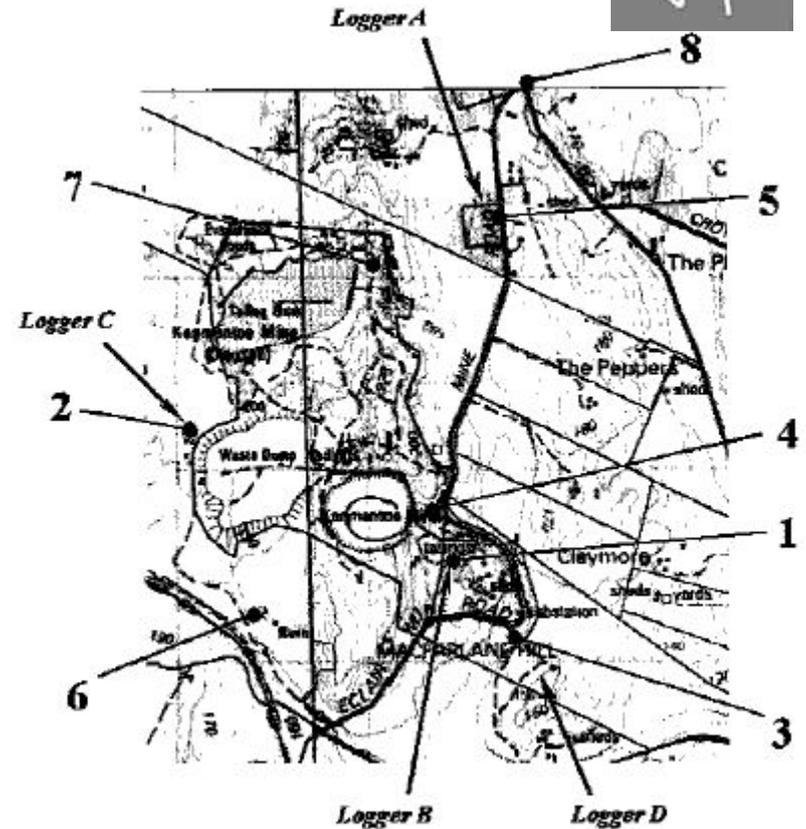
APPENDIX D – EXISTING BACKGROUND NOISE LEVELS (FROM VIPAC ENGINEERS AND SCIENTISTS REPORT)

Spot Measurements results conducted at night time (10pm – 7am)

Site	Date	Time	L _{Aeq} dB(A)	L _{Amax} dB(A)	L _{A10} dB(A)	L _{A90} dB(A)
1	27/06/06	00:08	35	52	37	Note 1
2	27/06/06	02:02	32	51	34	Note 1
3	27/06/06	00:42	31	47	34	Note 1
4	26/06/06	22:15	33	57	34	Note 1
5	27/06/06	01:08	Note 1	Note 1	Note 1	Note 1
6	26/06/06	23:02	49	67	55	32
7	26/06/06	23:35	33	55	36	Note 1
8	27/06/06	01:28	32	57	32	Note 1

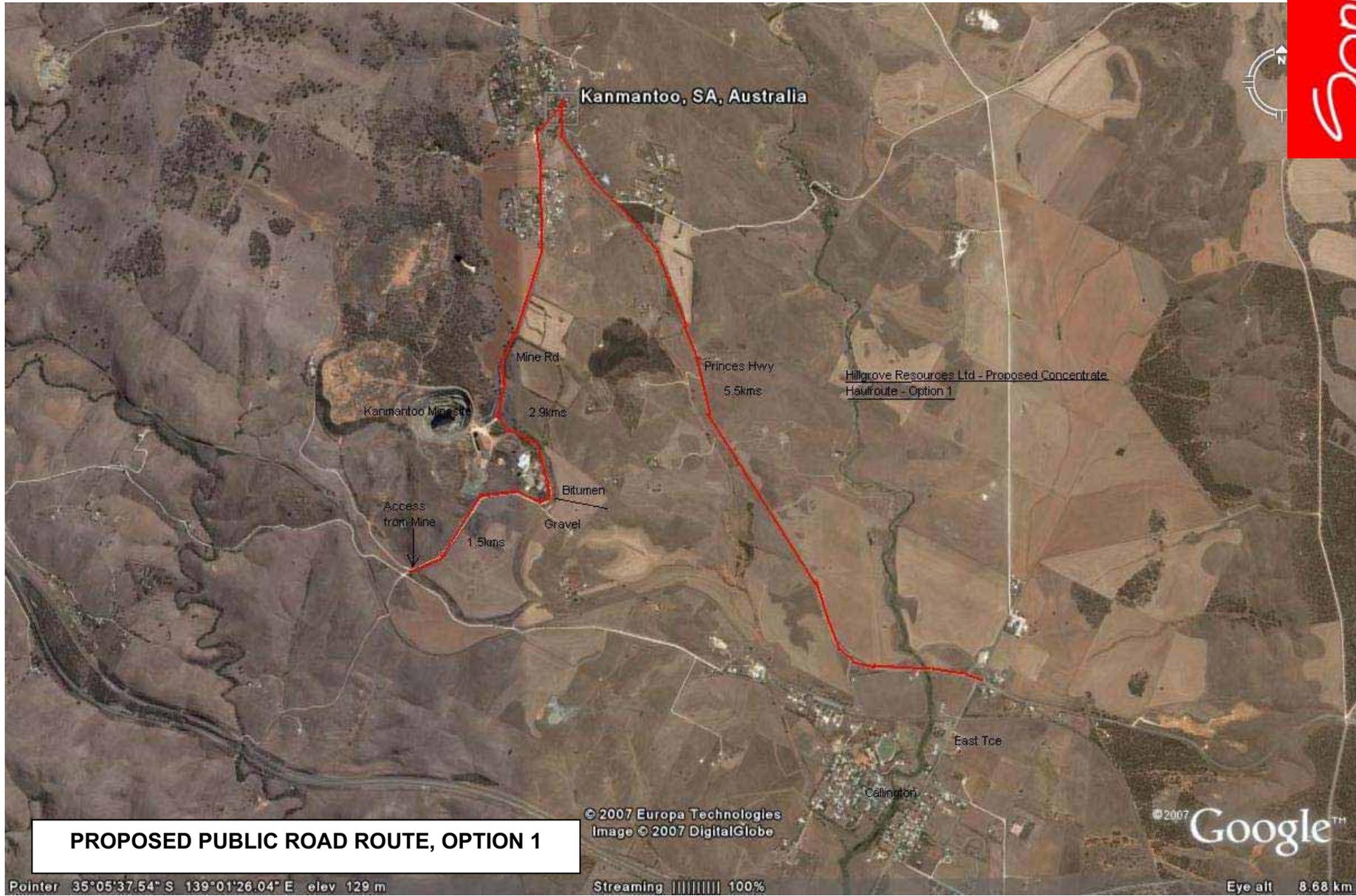
Spot Measurements results conducted at day time (7am – 10pm)

Site	Date	Time	L _{Aeq} dB(A)	L _{Amax} dB(A)	L _{A10} dB(A)	L _{A90} dB(A)
1	26/06/06	16:31	52	57	53	51
2	28/06/06	12:51	41	60	43	33
3	28/06/06	13:15	43	63	44	38
4	28/06/06	14:57	41	62	42	36
5	28/06/06	15:26	56	78	56	43
6	28/06/06	14:02	41	59	41	Note 1
7	28/06/06	14:32	33	54	36	Note 1
8	28/06/06	15:42	58	72	63	41

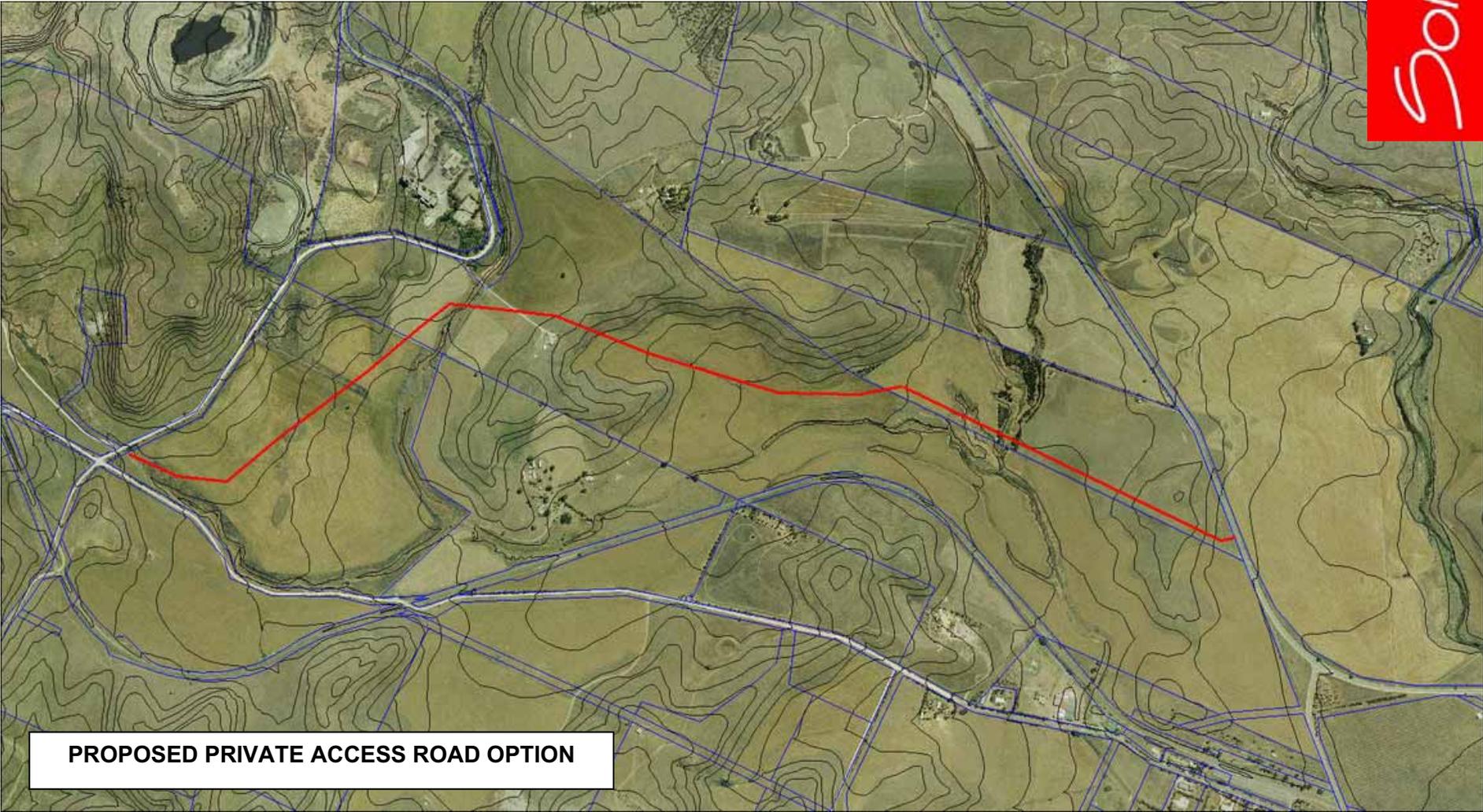


Note 1: Noise measurement was under-range (i.e. The noise measured by the Sound Level Meter (SLM) was too low for its available range of 25-130 dB(A))

APPENDIX E – PROPOSED HEAVY VEHICLE ROUTES







PROPOSED PRIVATE ACCESS ROAD OPTION

Appendix 16

Kanmantoo Copper Project Blasting Impact Assessment

Report Prepared
for
Hillgrove Resources Limited

Blasting Impact – Kanmantoo Copper Gold Project



June, 2007.

Reference #67020

Prepared by C.K. McKenzie



Report to Hillgrove Resources Limited

Blasting Impact – Kanmantoo Copper Gold Project

EXECUTIVE SUMMARY

Hillgrove Resources Limited is currently undertaking a Definitive Feasibility Study for the mining of copper/gold ore at the Kanmantoo Copper Gold Project in South Australia. This report has been prepared as part of that study to consider the environmental impact of blasting operations on nearby residential properties, in terms of ground vibration, overpressure (peak sound pressure level) and flyrock.

The mining area currently has a buffer zone of approximately 1 km separating proposed mining areas and nearest residential or commercial structure. As mining is proposed using relatively small hole diameters and bench heights, not dissimilar to those used in quarries throughout the country, this buffer distance is considered to be sufficiently large that all impacts can be controlled and maintained below levels recommended in Australian Standard AS 2187.2: 2006. Blasting at the Kanmantoo Copper Gold Project will adopt world's best practice as regards explosives, initiation systems, and blasting impacts, and all blasts will be designed and supervised by qualified, trained and experienced personnel.

Maximum levels for both vibration and sound pressure level recommended in AS 2187.2: 2006 represent the tightest restrictions on blasting impacts observed in any country in the world, and will provide a high degree of protection in terms of human comfort, and personal amenity. Compliance with these levels will ensure that blasting will have no possibility of causing any degree of damage to surrounding residences. The impacts will, however, be perceptible, and the company will prepare an information brochure for the purposes of informing surrounding residents of the nature of the impacts from blasting operations.

To meet production requirements, the operation needs the ability to blast 365 days per year. Initial blasting at the commencement of mining operations will be cautious and heavily monitored to fully understand and record the impacts in all directions. The scale of blasting, i.e. the height of benches and diameter of blasthole, will be adjusted to ensure that at all times blasting impacts are maintained within the recommendations of AS 2187.2: 2006. Complaints as regards blasting impacts will be promptly investigated by monitoring, with results presented to both the complainant and the Department of Primary Industries and Resources of South Australia.

Explosives storage, transport and handling on site will be done in strict accordance with statutory regulations. Closure of some roads will be required when blasting in some parts of the mine. Road closure is likely to take approximately 15 minutes, with no vehicles permitted to pass until the blasting site has been declared safe by trained and experienced shot-firers. Blasting will generally occur at the same time each day, and will be coordinated so as to not coincide with the passage of trains on the Melbourne – Adelaide rail line.

Report to Hillgrove Resources Limited

Blasting Impact – Kanmantoo Copper Gold Project

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Report to Hillgrove Resources Limited

Blasting Impact – Kanmantoo Copper Gold Project

1. INTRODUCTION

Blastechology has undertaken a review of the expected environmental impact from blasting operations at the Hillgrove Resources, Kanmantoo Project, located 55 km from Adelaide, South Australia (*Figure 1*).

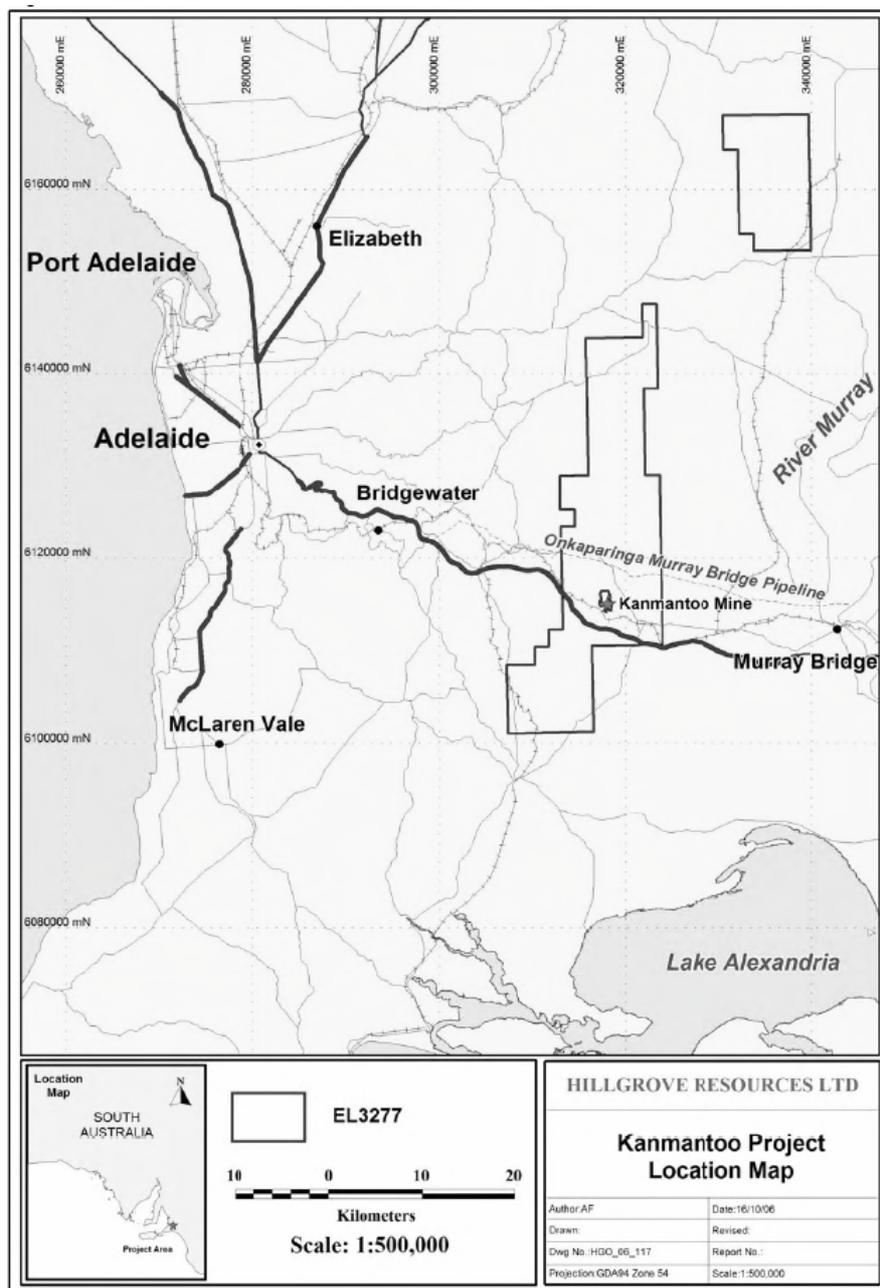


Figure 1. Location map, Kanmantoo Copper Project

The report includes a review of the anticipated blast overpressure and ground vibration impacts, in the context of levels recommended in Australian Standard AS 2187.2: 2006, based on anticipated scales of blasting as advised by Hillgrove Resources. As site-specific impact data are not available, the report considers “average” and “worst case” impact levels based on experience of the author, and guidelines from AS 2187.2: 1993.

2. RECOMMENDED MAXIMUM IMPACTS (AS 2187.2: 2006)

It is anticipated the Department of Primary Industries and Resources of South Australia (PIRSA) will apply environmental impact limits for blasting based on the limits recommended in Australian Standard AS 2187.2: 2006, which specify for vibration and overpressure impacts from operations of more than 12 month duration:

Table 1. Blasting impact limits recommended by Australian Standard AS 2187.2: 2006.

Category	Type of Blasting Operations	Peak Component Particle Velocity (mm/s)
Sensitive site*	Operations lasting longer than 12 months or more than 20 blasts	5 mm/s for 95% blasts per year 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum unless agreement is reached with occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer’s specifications, or levels that can be shown to adversely affect the equipment operation
Category	Type of Blasting Operations	Peak Sound Pressure Level (dBL)
Sensitive site*	Operations lasting longer than 12 months or more than 20 blasts	115 dBL for 95% blasts per year 120 dBL maximum unless agreement is reached with the occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum unless agreement is reached with occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer’s specifications, or levels that can be shown to adversely affect the equipment operation
* A sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.		

It is stressed that the limits recommended in the table above from AS 2187.2: 2006 relate to human comfort limits. The limits shown will be distinctly perceptible, since human perception commences for vibration levels in the range 0.5 to 1 mm/s, and for sound pressure around 105 dBL. Limits for the onset of minor or cosmetic damage are considerably higher, as also presented in AS 2187.2: 2006. Compliance with the limits in *Table 1* implies levels considerably lower than those required to produce even minor or cosmetic damage. The impact limits in AS 2187.2: 2006 represent the tightest known international blasting impacts, and provide a very high level of protection of personal amenity, and demand the application of world’s best practices at the mine site. By example, British Standard BS 6472:1992 specifies 8.3 mm/s, the US OSMRE standard specifies between 12 and 19 mm/s depending on house construction, and the German Standard DIN 4150 specifies 15 mm/s. Peak sound

pressure levels for these countries are typically around 133 dBL, or approximately 8 times higher than the 115 dBL limit in AS 2187.2: 2006.

Hillgrove Resources Limited will prepare a brief and informative brochure on the impacts of blasting operations on surrounding residences, and will circulate the brochure to interested residents. The objective of the brochure is to inform residents and allay possible concerns.

3. BLASTING OPERATIONS

Blasting will occur in benches between 5 and 10 metres in height, with appropriate blasthole diameters in the range 89 mm to 165 mm. Within this range, blastholes will contain between approximately 30 and 180 kg of emulsion, so that a large scope exists for adjustment to practices to guarantee full compliance with the limits in *Table 1*. Initial blasting operations will be cautious, and accompanied by monitoring of impacts at several nearby residences to permit fine tuning of blasting operations and to develop appropriate impact management protocols.

Blasts will be initiated using “silent” pyrotechnic initiation systems, with delays selected so as to minimise the quantity of explosives initiating at any particular instant (i.e. single hole delaying). Stemming quantities will be utilised such as to ensure that rock is never projected beyond the boundaries of the mining operation. The size of blasts, in terms of tons of rock blasted, will be controlled by production rate requirements, but with the application of modern delays, peak impact levels will not be affected by the size of blasts. Secondary breakage of oversize material will not involve explosives.

Production requirements require that the mine have the ability to fire blasts 365 days per year. Blasts will normally be fired at lunch time, around midday, though exceptions may occur due to unforeseen delays and disruptions to operations. Hillgrove Resources will regularly advertise anticipated firing times, and changes to firing times to inform all nearby and potentially affected residences. No blasting will occur after daylight hours.

Blasting agents will be stored on site in silos, and blasting accessories will be stored in secure magazines in full compliance with statutory requirements. Bulk blasting agents stored in silos are not explosives by themselves, and only explosives when mixed at the collars of blastholes as they are loaded. The quantities of explosive agents and blasting accessories stored on site will depend on the drill and blast contractor.

All blasts will be designed and supervised by qualified and experienced personnel. Full personnel clearance will occur for all blasts, to a safe evacuation distance which will be determined based on standard mining practices for the blasthole diameter and charge weights adopted. Where appropriate, personnel will be evacuated from offices and roads closed to all traffic during blasting operations until the blast area has been inspected and declared safe by trained and experienced shotfirers. Road closure would normally apply for a period of around 15 minutes. Some blasting will occur in pits near to the Melbourne to Adelaide railway which runs adjacent to parts of the southern boundary of the operation. Blasting times will be coordinated with the railway company to ensure that blasting never occurs while trains are passing.

Complaints regarding blasting impacts will be promptly investigated by monitoring at the site of the complainant for several blasts, and results of monitoring will be reported to both the

complainant and to PIRSA. As much as possible, practices will be adjusted to reduce impact levels to minimise complaint and nuisance. All monitoring will be conducted according to the guidelines presented in AS 2187.2: 2006.

4. EXPECTED BLASTING IMPACTS

Blasting impacts from the Kanmantoo operations have been estimated under “average” and “worst case” scenarios. The impact contours presented in this section represent “whole of life” contours, and any one blast will have a greatly reduced impact relative to the contours displayed in the following sections. Actual vibration and overpressure propagation conditions of the area are unknown, and trial blasting is not considered necessary due to the relatively large distances separating the blasting operations and the surrounding residences. Quarry operations throughout Australia typically operate with buffer distances between 350 and 500 metres, and are able to comply with the same impact standards shown in *Table 1*. Since quarry operations typically use very similar charge weights per blasthole as is proposed at the Kanmantoo operation, it is considered that trial blasting is not necessary, and full compliance is confidently anticipated.

4.1 Vibration Impacts

The equation almost universally used to estimate vibration impacts from blasting, and found in AS 2187.2: 2006 has the general form:

$$PPV = K \left(\frac{Dist}{\sqrt{Wt}} \right)^n$$

where K and n are site-specific parameters, $Dist$ is the distance (m)

separating the blast from the point of measurement, and Wt is the weight (kg) of blasthole per blasthole. AS 2187.2: 2006 presents values of 1140 and -1.6 respectively for K and n , for “average” vibration impact levels. AS 2187.2: 1993 also presented “worst case” parameter values of 5000 and -1.6 respectively.

Given that blasthole diameter and bench height may both change according to mine production and efficiency requirements, it is appropriate to consider the impacts from blasting in 5 metre benches and 10 metre benches separately. *Figure 2* presents the impact contours for the “Average Impact” and “Maximum Impact” when blasting with 5 metre benches. The “Average Impact” is considered to be when the propagation conditions conform with the “average” conditions in AS 2187.2: 2006, and when the blasthole diameter is 89 mm, with 28 kg of explosive per hole. The “Maximum Impact” is considered to be when the propagation conditions conform with the “worst case” conditions in AS 2187.2: 1993, and when the blasthole diameter is 127 mm, with 43 kg of explosive per hole.

Similarly, *Figure 3* presents the impact contours for the “Average Impact” and “Maximum Impact” when blasting with 10 metre benches. The “Average Impact” is considered to be when the propagation conditions conform with the “average” conditions in AS 2187.2: 2006, and when the blasthole diameter is 127 mm, with 119 kg of explosive per hole. The “Maximum Impact” is considered to be when the propagation conditions conform with the “worst case” conditions in AS 2187.2: 1993, and when the blasthole diameter is 165 mm, with 177 kg of explosive per hole.

It is important to note that these contours may considerably overestimate the actual impacts, as it is very common that actual vibration attenuation conditions are lower than those obtained by using the “average” parameter values in AS 2187.2: 2006. This is especially the case when the propagation distances are large, i.e. in excess of 500 metres.

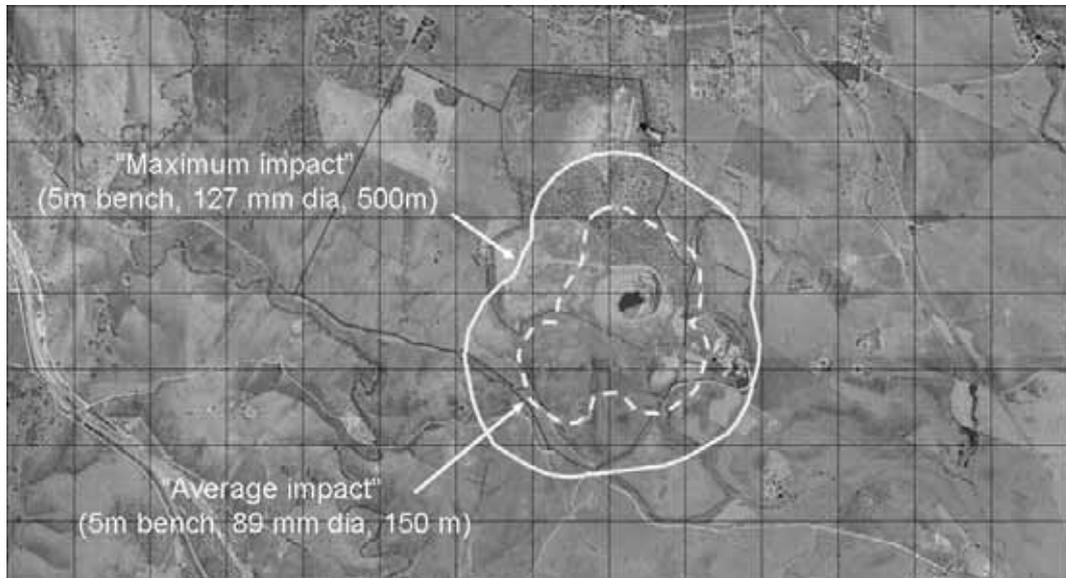


Figure 2. Range of expected vibration impacts from blasting with 5 m benches, with blasthole diameters in the range 89 mm to 127 mm (blue circles indicate nearest residences).

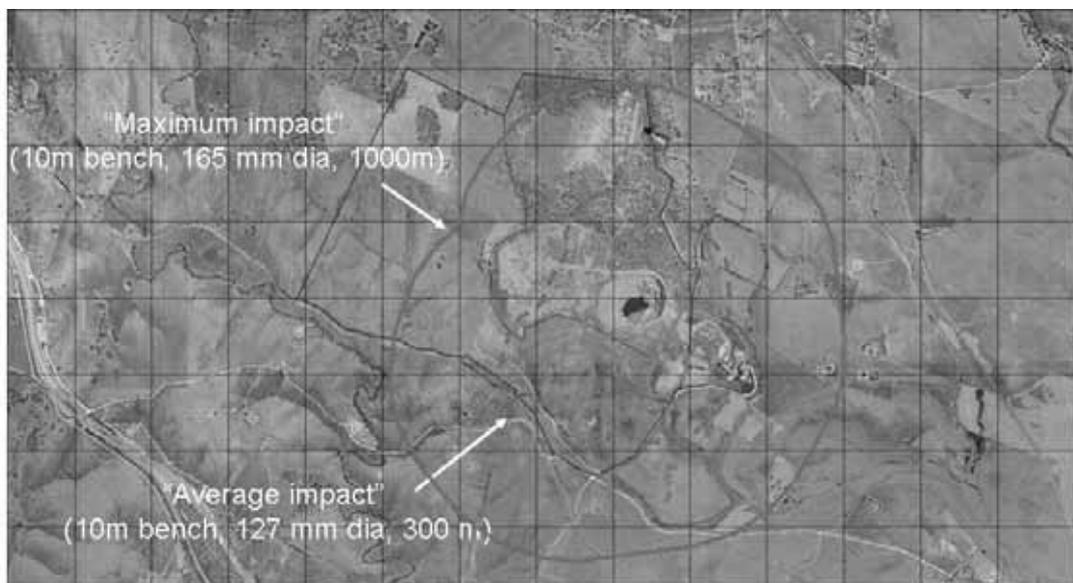


Figure 3. Range of expected vibration impacts from blasting with 10 m benches, with blasthole diameters in the range 127 mm to 165 mm (blue circles indicate nearest residences).

Under “maximum impact” conditions, blasthole diameter may be restricted to less than 165 mm. Monitoring of impacts during the early stages of operation will enable the company to identify the actual, site-specific conditions for Kanmantoo, and blasting operations will be adjusted to ensure full compliance with the conditions recommended in AS 2187.2: 2006.

4.2 Overpressure (Peak Sound Pressure) Impacts

The equation commonly used to estimate the overpressure impact, dBL , from blasting has the general form:

$$dBL (dBL_0) m ' \text{Log} \frac{\xi Dist \#}{\sqrt[3]{Wt}} \text{ "}$$

distance (m) separating the blast from the point of measurement, and Wt is the weight (kg) of blasthole per blasthole. This equation is a modified form of the equation presented in AS 2187.2: 2006, expressing impact levels in decibels (dBL) rather than Pascals. The decibel unit is considered to be the universal way to express blasting overpressure levels. In the experience of the author, “average” conditions are expected to correspond to parameter values of 168 and 29 for dBL_0 and m respectively. Parameter values of 180 and 29 are considered to reflect “worst case” conditions.

Given that blasthole diameter and bench height may both change according to mine production and efficiency requirements, it is appropriate to consider the impacts from blasting in 5 metre benches and 10 metre benches separately. *Figure 4* presents the overpressure contours for the “Average Impact” and “Maximum Impact” when blasting with 5 metre benches. The “Average Impact” is considered to be when the propagation conditions conform with the “average” conditions above, and when the blasthole diameter is 89 mm, with 28 kg of explosive per hole. The “Maximum Impact” is considered to be when the propagation conditions conform with the “worst case” conditions above, and when the blasthole diameter is 127 mm, with 43 kg of explosive per hole.

Similarly, *Figure 5* presents the overpressure contours for the “Average Impact” and “Maximum Impact” when blasting with 10 metre benches. The “Average Impact” is considered to be when the propagation conditions conform with the “average” conditions above, and when the blasthole diameter is 127 mm, with 119 kg of explosive per hole. The “Maximum Impact” is considered to be when the propagation conditions conform with the “worst case” conditions above, and when the blasthole diameter is 165 mm, with 177 kg of explosive per hole.

Again, these contours may considerably overestimate the actual impacts, and real impacts will be better known in the very early stages of pit development. The practice of blasting always into pre-blasted rubble will have a significant impact in terms of reducing peak overpressure levels, and this effect has not been considered in the above calculations. Further, the above calculations make no account of the shielding which will occur as blasting occurs deeper in the proposed pits.

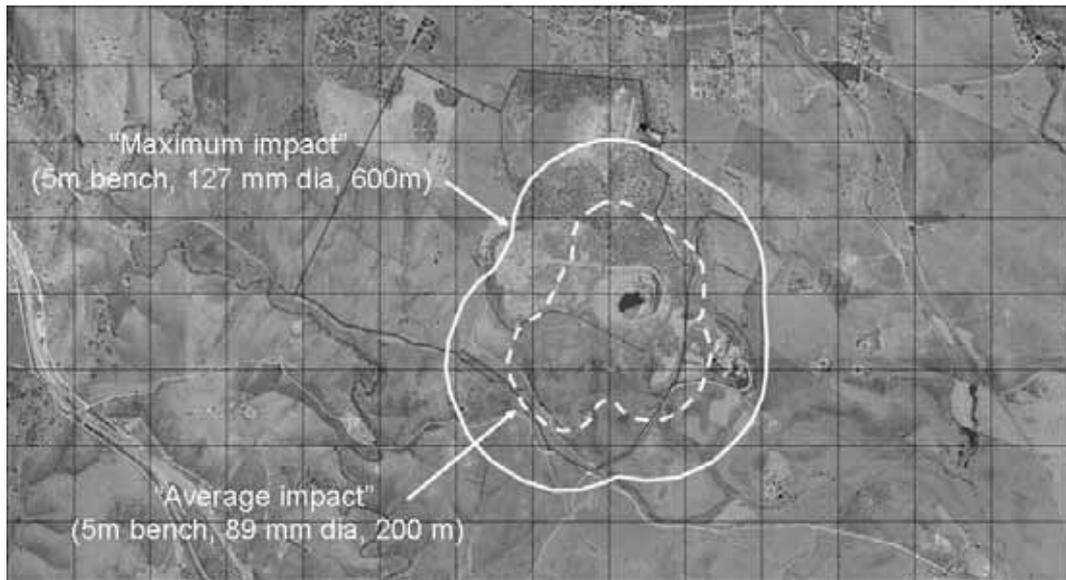


Figure 4. Range of expected overpressure impacts from blasting with 5 m benches, with blasthole diameters in the range 89 mm to 127 mm (blue circles indicate nearest residences).

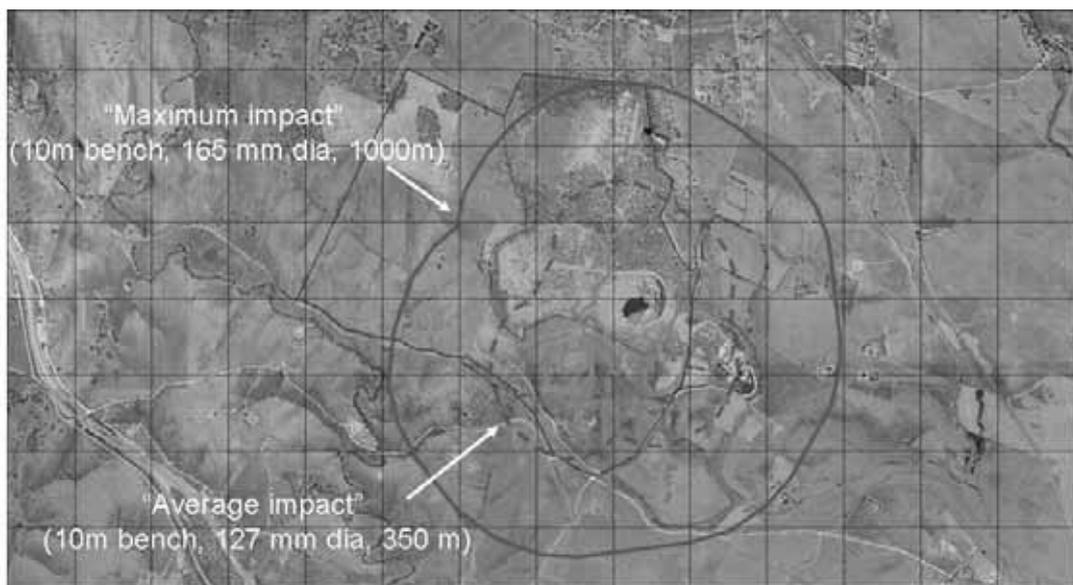


Figure 5. Range of expected overpressure impacts from blasting with 10 m benches, with blasthole diameters in the range 127 mm to 165 mm (blue circles indicate nearest residences).

These contours again indicate that, under “maximum impact” conditions, blasthole diameter may be restricted to less than 165 mm. Monitoring of impacts during the early stages of operation will enable the company to identify the actual, site-specific conditions for Kanmantoo, and blasting operations will be adjusted to ensure full compliance with the conditions recommended in AS 2187.2: 2006.

4.3 Flyrock Control

Flyrock is the unplanned projection of rock fragments beyond the blasting zone. As flyrock has been observed to travel large distances, and represents a potential risk to safety, all blast design will be undertaken in awareness of the risk, and will use best methods to control and eliminate the risk. Flyrock has two source of emanation – from the free face of bench blasts and from the hole collar. At Kanmantoo, blasting will not be conducted using free faces, so that the presence of pre-blasted rubble material will eliminate this source.

To control flyrock from the hole collar area, blasting will utilise a graded aggregate material for stemming, and the length of stemming will be selected to ensure that flyrock is always tightly controlled. *Figure 6* presents a guideline for selection of stemming length to control the maximum flyrock range.

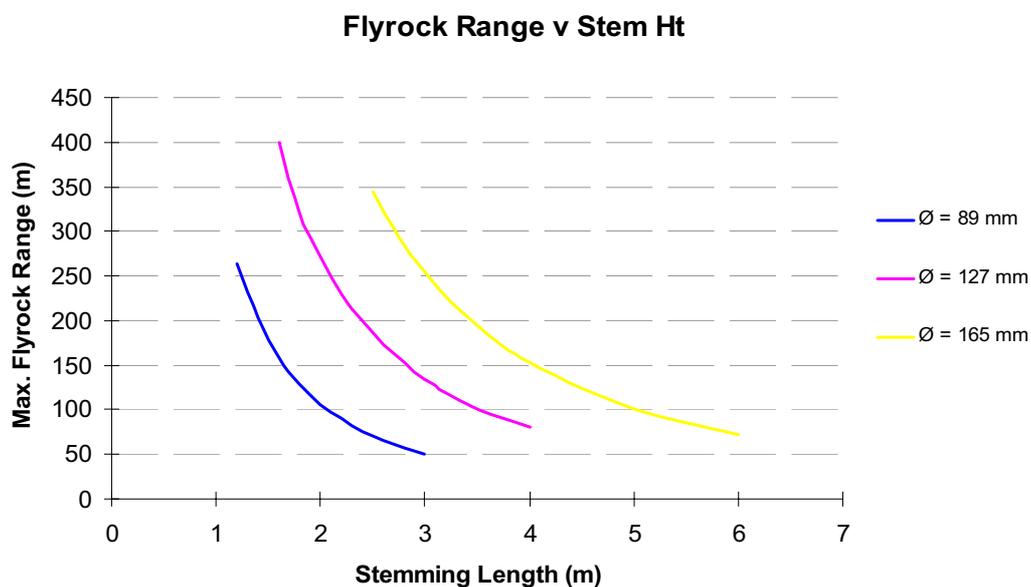


Figure 6. Maximum flyrock range as a function of stemming length and hole diameter (assumes fresh rock, 1.3 g/cc pumped emulsion explosive, aggregate stemming material).

Blast clearance distances will be chosen to ensure no risk to site personnel, to the public, or to passing vehicles.

5. IMPACT MANAGEMENT & MITIGATION

Blasting impacts from the Kanmantoo operations will be managed through a period of intense monitoring and modelling commencing with the first blasting operations on site. Monitoring of ground vibration and air overpressure impacts will be conducted at all nearby properties over a period of sufficient duration to ensure that radiation patterns of both impacts are well understood. At all times, monitoring will be conducted by a third party specialist group, in full compliance with conditions described in AS 2187.2: 2006. These measurements will be collated to form reliable models relating blast design and blasting impacts, thereby allowing company engineers to adjust the blast design process according to established impacts. The models will allow site engineers to adjust the blast design process in terms of appropriate

blasthole diameter, operating bench heights, delay timing, and even the size of blasts if appropriate. Monitoring will also be repeated as operations move to new areas, or as new pits are opened for operation, to ensure that radiation patterns remain tightly controlled.

Monitoring will also be conducted in response to complaints. In these cases, monitoring will be conducted at, or as near as practical to, the complainant's residence, for a sufficient period to ensure that impact levels are, and will remain below the levels in AS 2187.2: 2006. The results of the monitoring will be reported both to the complainant and to PIRSA. In the event that impact levels require an adjustment to the blast design and implementation processes, these changes will be made and also reported to both the complainant and PIRSA, and monitoring will continue until full compliance has been demonstrated.

6. CONCLUSIONS

The proposed Kanmantoo Copper Gold Project will involve blasting operations of a scale similar to that found in most quarrying operations throughout Australia. The minimum separation distance between proposed blasting operations and existing residences is significantly greater than is normally found in the vast majority of Australian quarrying operations. Since separation is the most effective means of controlling blasting impacts, it is anticipated that the mining operation will be able to comply fully with the maximum limits recommended in Australian Standard AS 2187.2: 2006.

In order to meet production requirements, the company reserves the right to blast 7 days per week. Blasting operations will only be conducted during daylight hours, and the storage, handling, and use of explosives will be conducted in strict requirements with statutory requirements by trained and experienced personnel at all times.

At the commencement of blasting operations, ground vibration and air overpressure impacts will be monitored closely in all directions around the operation to ensure that radiation impact patterns are well understood. Monitoring results will be collated to permit reliable models to be developed relating actual impact levels to blast design and implementation practices. Blast design will then be adjusted to ensure that impact levels are tightly controlled at all times, for all nearby residences. On various occasions, such as the opening of a new pit, detailed monitoring programs will be re-conducted to ensure that impact patterns remain well understood and tightly controlled.

Monitoring will be conducted by third party specialist groups with experience and training in the measurement of ground vibration and overpressure, in full compliance with the guidelines in Australian Standard AS 2187.2: 2006. An information circular will be prepared by the company for circulation to nearby residents explaining the issues of personal perception, the potential for damage to structures from vibration and overpressure, and the procedures to be followed by the company to control impact levels. Blasting will normally be conducted only once per day, during the lunch break, though on occasions it may be necessary to blast several times. A schedule of blasting times will be regularly published in local newspapers to advise nearby residents of blasting times. At all times, blasting operations will include clearance of personnel, and where necessary, closure of roads to ensure public safety at all times. Blasting will be coordinated to occur at times which do not conflict with rail activity on the Melbourne to Adelaide rail line.

Appendix 17

Kanmantoo Copper Project Mine Closure and Rehabilitation Plan

Hillgrove Resources Limited

Kanmantoo Copper Project

**Conceptual Mine Closure and
Rehabilitation Plan**



September 2007
CR 5000_4_v1

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1. Introduction

1.1 Background

The Kanmantoo Copper Project is located in South Australia approximately 44 km east-southeast of Adelaide within the Mount Barker District Council Area (Figure 1.1). The two closest townships to the proposed project area are Kanmantoo, approximately 1.5 km to the northeast, and Callington, approximately 4 km to the southeast.

Hillgrove Resources Limited (Hillgrove) propose to expand the Kanmantoo Copper Mine using open pit mining techniques over an initial mine life of eight years. Ore will be mined and processed at a rate of 250 tonnes per hour (tph) using a conventional crushing, grinding and floatation circuit to produce approximately 70,000 tonnes per annum (tpa) of copper-gold concentrate. The concentrate will be transported by road to the Port of Adelaide for shipment to an overseas smelter. Components of the project are shown in Figure 1.2.

This report presents a conceptual mine closure and rehabilitation plan (MCRP) for the Kanmantoo Copper Project.

1.2 Project History

The Kanmantoo Copper Project lies in an area that has a long history of mineral exploration and mining. Mining at Kanmantoo began in 1846 and continued to 1874 when a collapse in world copper prices forced the mine to close. Intermittent prospecting continued in the area until the 1960's when advancements in mining and refining technologies improved the viability of the deposit.

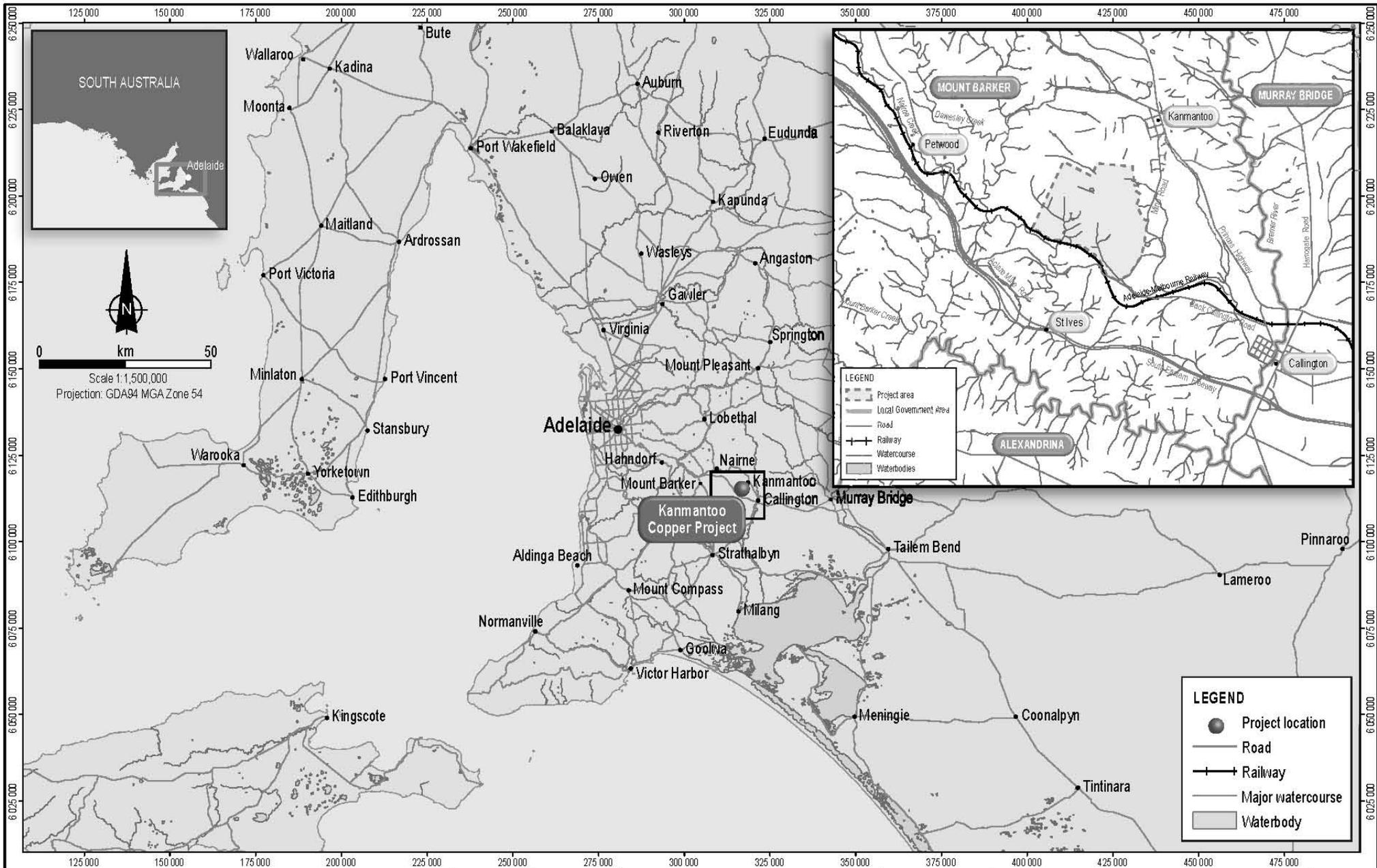
In the early 1970's, Kanmantoo Mines Limited commenced open cut mining over the northernmost workings of the earlier Kanmantoo mines. The mine operated for six years when once again low copper prices forced the mine to close. Mining infrastructure remaining on the site from these operations includes an open pit (approximately 200 m deep), old processing plant (now utilised as a fertilizer manufacturing facility) and a partially revegetated waste rock dump and tailing dam.

1.3 Mine Closure Planning

Mine closure planning is a continuous process which starts prior to project development, i.e., now, with this MCRP. Closure planning is progressively refined and adapted in light of project experience, further site information that becomes available during construction and operations, and changes in regulations, stakeholder expectations, technology, knowledge and mine planning.

This MCRP considers the relevant aspects of the following codes and best practice guidelines:

- PIRSA Guidelines for Preparation of a Mining and Rehabilitation Program or Mining Lease Proposal (Version 4.8, Section 3.6) (PIRSA, June 2007).
- The 10 principles of 'Enduring Value', i.e., the Australian minerals industry framework for sustainable development (MCA, 2004).



Source:
Place names, road, rail and drainage from GEODATA TOPO 250K (optimum scale 1:250,000)



Date:
14.02.07
M/D:
Hillgrove Resources - Kanmantoo GIS
Job No:
5000_04_F01.01_GIS_A1

Hillgrove Resources Ltd

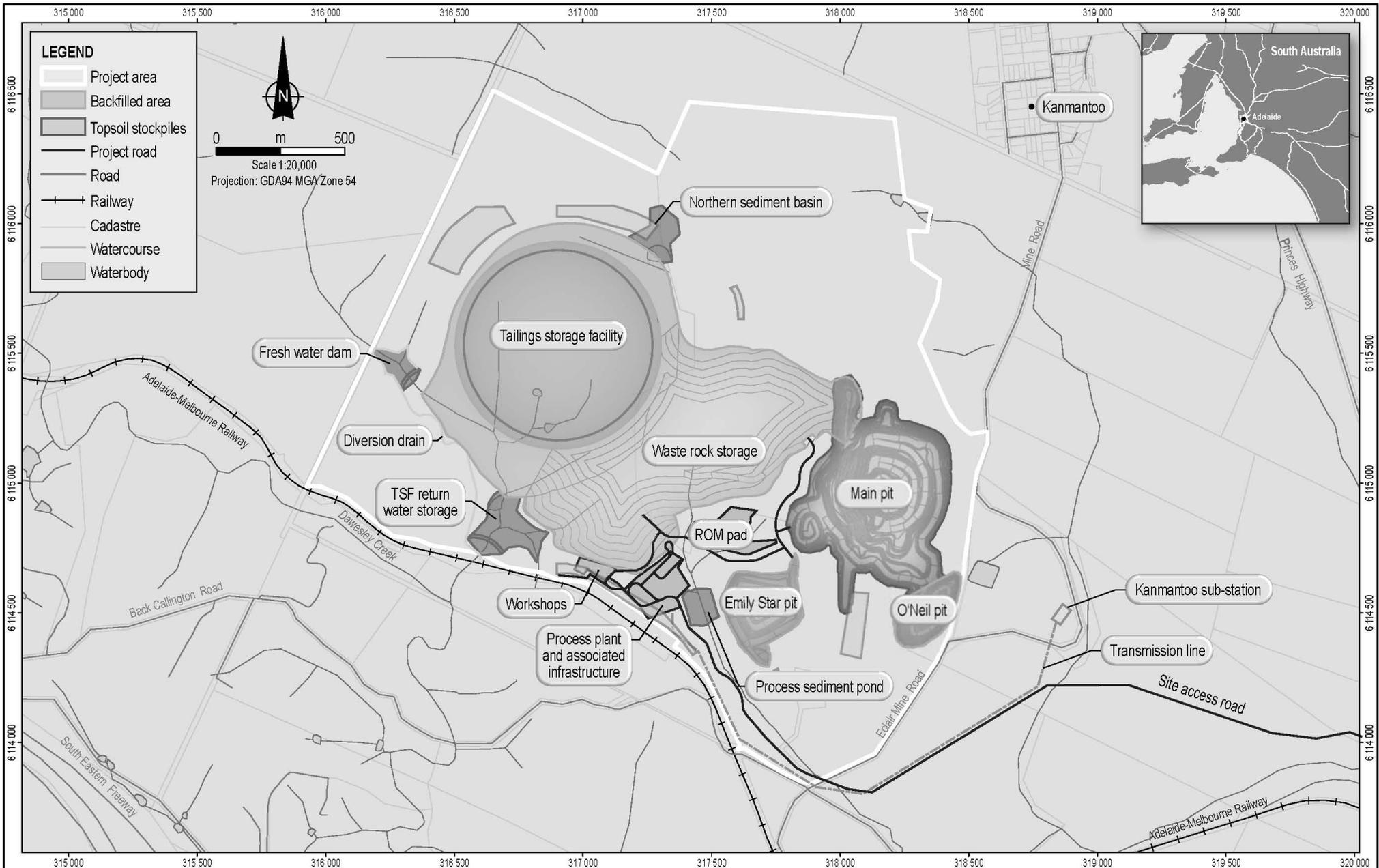
Kanmantoo Copper Project



Project location

Figure No:

1.1



- Strategic Framework for Mine Closure (ANZMEC, 2000).
- Best Practice Environmental Management in Mining – Mine Decommissioning (Environment Australia, 2002).

1.4 Purpose of a Conceptual Mine Closure and Rehabilitation Plan

The purpose of the MCRP is to:

- Establish a base closure plan that can be reviewed and updated throughout the project life.
- Identify potential future land uses for the site as a basis for future discussion.
- Provide relevant information upon which stakeholders can comment and have input through the Mining Lease Proposal (MLP) approvals process.
- Ensure that closure planning (including accountability and resourcing) is incorporated into project development, construction and operations.
- Estimate the costs for implementing the MCRP to enable Hillgrove to provision for mine closure over the life of the mine.

1.5 Scope and Review

The scope of this MCRP includes the proposed above-ground mining activities associated with the Kanmantoo Copper Project for the projected mine life of 8 years.

In accordance with regulatory requirements, the MCRP will be reviewed, and if necessary revised, every three years in conjunction with the environmental management plan such that with successive reviews the MCRP will inform the preparation of a Final Mine Closure and Rehabilitation Plan that will be implemented on permanent closure.

Regular review of the MCRP will allow PIRSA to review Hillgrove's bond so that it can be recalculated to reflect the current level of disturbance and rehabilitation liabilities. Review of the bond is undertaken every year or as otherwise determined by the Minister for Mineral Resources and Development.

Closure planning and management of rehabilitation activities through operations will be the responsibility of the General Manager for Kanmantoo Operations. Post-closure, mine decommissioning and rehabilitation activities will also be the responsibility of the General Manager for Kanmantoo Operations.

1.6 Report Structure

This MCRP is organised as follows:

Section 1: Introduction.

Section 2: Outlines Hillgrove's legislative closure requirements, commitments and obligations, as well as performance standards.

- Section 3: Describes the existing site conditions.
- Section 4: Describes the consultation process to facilitate community and stakeholder participation in mine closure and rehabilitation planning.
- Section 5: Describes the proposed final land use, closure objectives, including closure criteria and targets.
- Section 6: Details the key environmental, economic and social impacts associated with mine closure.
- Section 7: Outlines the proposed closure strategy for each domain.
- Section 8: Sets out progressive rehabilitation activities proposed during operations.
- Section 9: Details post closure monitoring and maintenance requirements.
- Section 10: Describes Hillgrove's financial provision to implement the MCRP.
- Section 11: Describes Hillgrove's long term management of the site
- Section 12: Recommends future work to further understand mine closure concepts to determine final strategy
- Section 13: References.

2. Closure Requirements

Closure requirements for the Kanmantoo Copper Project follow legislative requirements, relevant policies, codes and frameworks, conditions of land use permits, Hillgrove company requirements, relevant approvals, and performance standards. Each has implications for the development of this conceptual MCRP and ultimately the final Mine Closure and Rehabilitation Plan.

2.1 Legislative Requirements

Relevant state and local government departments regulate the closure of a mine, initially through the environmental impact assessment process and then annually during the review of the Mining and Rehabilitation Program. Closure plans are increasingly becoming a requirement of land use permits, and are to be submitted before, or shortly after, the commencement of mining operations.

The environmental and planning assessment and approval process is governed by the following key legislation:

- *Mining Act 1971.*
- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Commonwealth).*

For the preparation of the MCRP, other South Australian legislation needs to be taken into consideration, and in particular:

- *Environment Protection Act 1993.*
- *River Murray Act 2003.*

2.2 Policies, Codes and Frameworks

2.2.1 Preparation of a Mining Lease Proposal or Mining and Rehabilitation Program

Primary Industries and Resources SA (PIRSA) have developed a guideline for the preparation of a Mining Lease Proposal and Mining and Rehabilitation Program (PIRSA, 2007). Within the guideline a section on mine closure outlines that the mine closure and rehabilitation plan should aim to achieve the following standards:

General Economic Standards

- ! The community and future generations are left with no residual liability for site rehabilitation or maintenance.
- ! Any additional adverse economic effects are minimised.
- ! Provision is made for reasonable access for future mining (or reprocessing) of any remaining resource.

General Social Standards

- ! Demonstration of effective ongoing community engagement.
- ! Closure is planned to minimise the disruption/impact on the community, e.g., that caused by reduction in access to infrastructure.
- ! Development of programs, driven by the needs of the community, that contribute to the sustainability of the community.
- ! Future public health and safety are not compromised.

General Environmental and Rehabilitation Standards

- ! The return of disturbed land to 'a stable, productive and self sustaining condition, after taking into account the beneficial uses of the site and the surrounding land'. This includes:
 - Physical, geochemical and ecological stability.
 - The protection of the quality of the surrounding water resources.
 - A condition where the risk of adverse effects to people, livestock, other fauna and the environment in general has been reduced as far as practicable to a level acceptable to all stakeholders.
- ! The establishment to the satisfaction of the community and Government, of:
 - Clearly defined realistic beneficial and sustainable post mining land use (taking account of both the capability of the land and practicalities).
 - Monitoring and reporting criteria for successful final and progressive rehabilitation. These criteria may include reference to:
 - ! Appropriate mechanisms for formal 'sign-off' of rehabilitation as completed.
 - ! Australian Standards as they apply at the time rehabilitation is 'signed off'.
 - ! Comparative measures, e.g., reference photographs.
 - ! Agreed times for the proving of rehabilitation actions.
 - ! Requirements under other legislation, e.g., Environment Protection Act.
 - Arrangements for post surrender action and funding.

2.2.2 Enduring Value

Enduring Value is a sustainable development framework, developed by the Australian minerals industry to provide guidance to industry managers about sustainable development in the minerals sector. The framework builds on the Australian Minerals

Industry Code for Environmental Management (1996), which was formally retired on the 31 December 2004.

Enduring Value sets out ten Sustainable Development principles that aim to ensure that investments in minerals projects are financially profitable, technically appropriate, environmentally sound and socially responsible (MCA, 2004).

While all the principles in Enduring Value impact on mine closure planning and procedures, it is principle six – to seek continual improvement of our environmental performance – that provides specific implementation guidance about mine closure. Elements 6.3 and 6.5 are most relevant to this closure plan.

Element 6.3 Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses.

- Consult relevant stakeholders and develop a closure plan that clearly defines the post-closure land use.
- Where appropriate, rehabilitate progressively over the life of the operation:
 - Monitor success criteria agreed with relevant stakeholders.
 - Report performance.
- Undertake and support research into land and water rehabilitation practices.
- Use appropriate technologies to reduce negative environmental impacts, and improve, site rehabilitation techniques.
- Manage and, where appropriate, rehabilitate historical disturbances to an appropriate standard.

Element 6.5 Design and plan all operations so that adequate resources are available to meet the closure requirements of all operations

- Plan operations to minimise costs and risks; comply with relevant law, standards and guidelines; maximise sustainable development opportunities; and deliver post-closure landforms that are safe and stable from physical, geochemical and ecological perspectives.
- Provide adequate resources to achieve social objectives of closure including any costs associated with community dislocation.
- Set aside funds externally held and not accessible for other purposes to implement the closure plan and to undertake post closure monitoring and maintenance, taking risk into account.
- Periodically review closure plans in the light of changing regulatory requirements and community expectations.

Hillgrove, while not a signatory to the new Enduring Value framework, will be guided by the Enduring Value principles and implementation advice.

2.2.3 ANZMEC and MCA Strategic Framework for Mine Closure

The Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) have jointly developed a Strategic Framework for Mine Closure (ANZMEC and MCA 2000). The framework is designed to provide a broadly consistent approach to mine closure across the various Australian jurisdictions.

The framework is structured around a set of objective and principles grouped under six key areas:

- Stakeholder involvement.
- Planning.
- Financial provision.
- Implementation.
- Standards.
- Relinquishment.

This MCRP draws upon the principles outlined in the ANZMEC and MCA strategic framework, as appropriate.

2.3 Performance Standards

This MCRP has considered the relevant aspects of the following codes and best practice guidelines:

- Best Practice Environmental Management booklet series (Environment Australia):
 - Contaminated Sites (1999) – aimed at minimising the risk of land contamination, implementing management systems to limit contamination threats and assessing and the remediation of contaminated land.
 - Landform Design (1998) – contains detailed guidelines for land rehabilitation and revegetation.
 - Mine Decommissioning (2002) – guidelines for the decommissioning of mines.
 - Rehabilitation and Revegetation (1995) – contains detailed guidelines for land rehabilitation and revegetation.
 - Community consultation and involvement (1995) – contains the basic consultation principles and describes planning and consultation techniques appropriate to the key stages of mineral development (including closure and post-operational monitoring).
- Guidelines on Dam Safety Management (ANCOLD, 2003) – provides relevant guidelines for the design, construction, operation and rehabilitation of large dams.
- Environmental risk management–Principles and process (Standards Australia/Standards New Zealand, 2000) – presents an integrated framework of

principles, practices and criteria for implementing best practice in environmental risk management.

- National Environment Protection Measure of Assessment of Site Contamination (NEPC, 1999) – aimed at establishing a nationally consistent approach to site contamination assessment and provides a recommended general process for assessment of site contamination.
- Strategic Framework for Mine Closure (ANZMEC and MCA, 2000) – provides a framework for mine closure in Australia without prescriptive measures. It outlines strategies for stakeholder involvement, planning, financial provisions and closure implementation.

3. Existing Site Conditions and Baseline

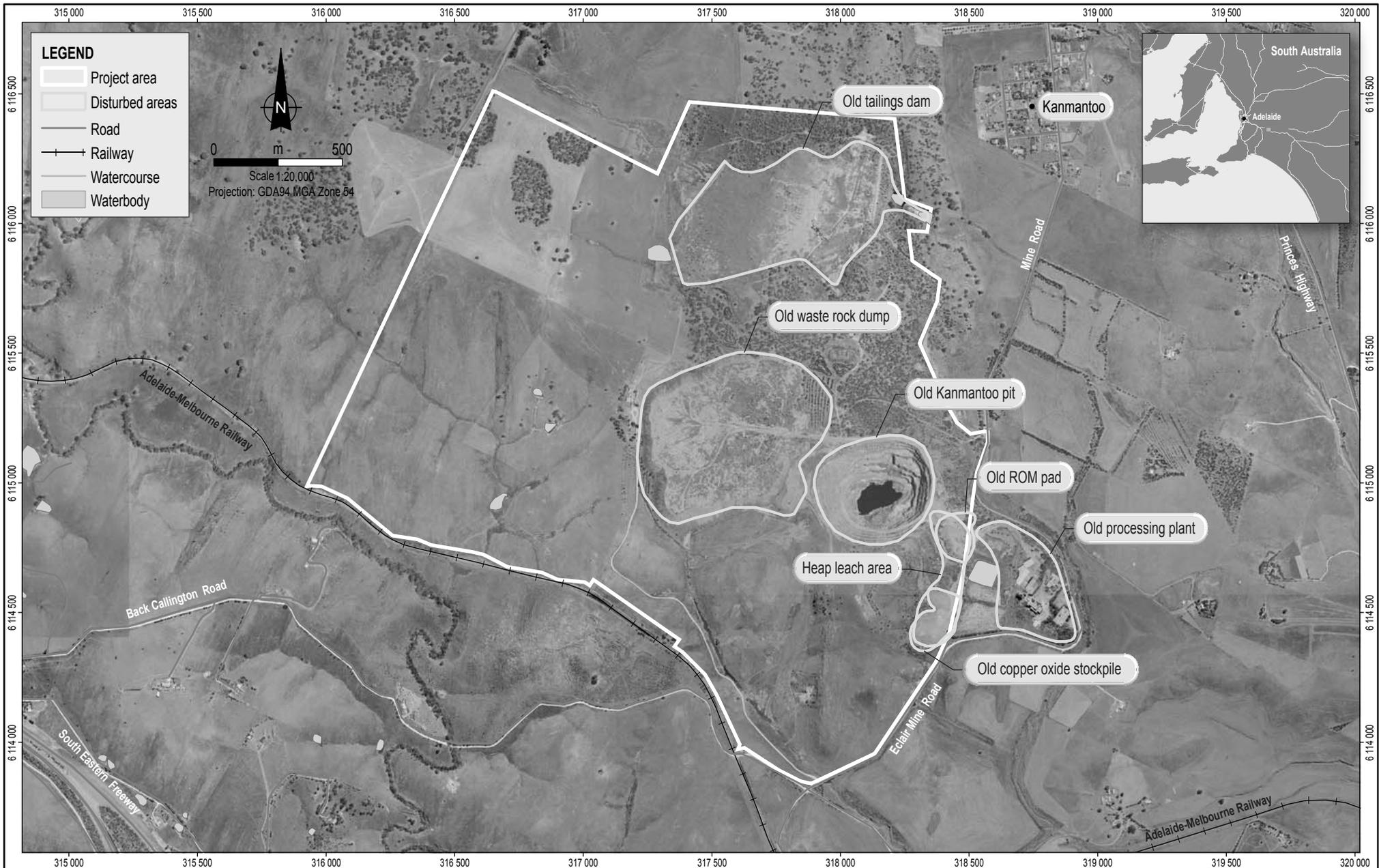
3.1 Existing Site

The last period of mining ceased on June 30 1976. Following closure some attempts were made to rehabilitate the site with the covering of the tailing dam and the top of the waste rock dump. A description of the components of the site is outlined below, with Figure 3.1 showing the existing infrastructure from previous mining operations.

3.1.1 Open Pit

The existing open pit is 480 m long, 410 m wide and 200 m deep. The site had been fenced to prevent public access and in particular from Mine road however. Standard industry practice is to construct an earth bund around the perimeter of the pit to prevent accidental vehicle access. Currently no such bund exists.

The open pit currently contains approximately 100,000 KL of water which has a pH of 2.8 and is high in metals (see Table 3.1). The cause of the acid water in the open pit is due to the oxidation of pyrite present in the walls of the open pit. The oxidised pyrite forms sulphuric acid when coming into contact with water. Monitoring bores were established in November 2006 (REM December 2006) around the open pit. Data from this program found that groundwater flow conditions beneath the open pit flowed towards the open pit. The open pit was acting as a groundwater sink with high evaporation rates lowering the water table resulting in groundwater flow towards the open pit. It is also thought that the groundwater flow regime in the area may also be seasonally influenced with groundwater flow down hydraulic gradient of the pit occurring in winter and then towards the pit in summer.



Source:
 Place names, cadastre, roads, rail and drainage from DEH (optimum scale 1:50,000)
 Project layout from Hillgrove Resources

	Date: 21.05.07
	MXD: HillgroveResources_KanmantooGIS
	Job No: 5000_04_F03.01_GIS_AI

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Disturbed areas from
 previous mining activities

Figure No:
3.1

Table 3.1 Groundwater monitoring results surrounding the existing open pit.

Element	Units	SA EPA EPP (Water Quality) 2003 Potable Use	SA EPA EPP (Water Quality) 2003 Irrigation	SA EPA EPP (Water Quality) 2003 Livestock	SA EPA EPP (Water Quality) 2003 Aquatic Ecosystems	KMB 001 Open pit	KMB 002 Open pit	KMB003 Open pit	KMB004 Waste rock dump
Calcium	mg/L					520	240	150	400
Magnesium	mg/L					410	230	140	430
Potassium	mg/L					140	52	48	66
Sodium	mg/L					420	280	470	740
Chloride	mg/L					220	150	590	310
Nitrate	mg/L	10		30		0.2	9.6	2.4	6.3
Sulphate	mg/L	500		1000		1300	870	340	1100
Aluminium	mg/L		1	5	0.1	15	91	<0.005	<0.005
Arsenic	mg/L	0.007	0.1	0.5	0.05	<0.041	0.006	0.009	0.008
Beryllium	mg/L		0.1	0.1	0.004	-	-	-	-
Barium	mg/L	0.7				-	-	-	-
Cadmium	mg/L	0.002	0.001	0.01	0.002	0.051	0.024	<0.0002	0.0057
Chromium	mg/L		1	1		<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L		0.05	1		9.4	3.6	0.096	0.29
Copper	mg/L	2	0.2	0.5	0.01	14	10	0.09	0.14
Iron	mg/L		1		1	120	1.2	1.7	3.8
Lead	mg/L	0.01	0.2	0.1	0.005	0.06	0.23	<0.001	<0.001
Manganese	mg/L	0.5	2			21	17	0.71	1.8
Mercury	mg/L	0.001	0.002	0.002	0.0001	0.0003	<0.0005	<0.0001	<0.001
Nickel	mg/L	0.02	0.2	1	0.15	3	2.5	0.023	0.27
Selenium	mg/L	0.01	0.02	0.02	0.005	0.24	0.039	0.063	0.074
Vanadium	mg/L		0.1	0.1		-	-	-	-
Zinc	mg/L		2	20	0.05	8.1	1.3	0.013	0.066

3.1.2 Waste Rock Dump

The existing waste rock dump covers an area of 34 ha and is 55 m high at its highest point. The waste rock dump was constructed by end dumping rock over an advancing face. Separation of non acid forming (NAF) waste rock and potentially acid forming (PAF) waste rock does not appear to have been undertaken with evidence of PAF rock around the dump. A groundwater monitoring bore was drilled in November 2006 by REM who found that groundwater contained heavy metals exceeding SA EPA criteria (Table 3.1). REM concluded that it was likely the existing waste rock dump has had an impact on that groundwater.

Visual assessment of the waste rock dump indicates that vegetation on its top is being impacted by the presence of salts. These are likely as a result of oxidation of pyrite and the subsequent formation of acid conditions, which is supported by the groundwater monitoring results.

No shaping of the waste rock dump batters has occurred with all batters being at the angle of repose (rill angle of rock). Revegetation of the waste rock dump has been limited to the top of the dump. Vegetation establishment and colonization of the surface has been poor. It is likely that the reasons for the poor establishment of vegetation are due to:

- Poor growing medium due to both the depth and type of material (it is unknown if the soil placed on top was topsoil, subsoil or soil impacted by previous mining activities).
- Acid rock drainage and in particular the presence of salts and low pH conditions.
- The surface of the waste rock dump is very exposed and likely to present difficult growing conditions.
- Grazing by introduced animals, i.e., rabbits.

No attempts have been made to revegetate the batters of the waste rock dump and these remain largely devoid of vegetation. The steep batter slopes (approximately 37°) and no medium for plants to grow in make any vegetation establishment almost impossible.

3.1.3 Process Plant Area

The former process plant area was sold and is contained on freehold land and does not form part of this mining lease proposal. It is currently used by Neutrog for the manufacture of fertilizers.

3.1.4 Heap Leach Facilities

South Australian Mining Resources established a heap leaching operation in 2003 to heap leach the low grade oxidized ore stockpile which remained following the closure of the mine in 1976. The current operation involves the placement of low grade oxidized ore onto leach pads which are then irrigated with acid water from the open pit to leach copper from the ore. The leachate is collected in plastic lined drains and then pumped to the plant where scrap iron is used to attract the copper. The copper is then stripped from the iron and sold.

3.1.5 Tailing Dam

The former tailing dam was constructed as a valley fill facility with a wall constructed across a valley and tailings contained behind. While the design of the tailing dam required a compacted clay layer for the base of the facility it is understood that this clay liner was not constructed. On the downstream side of the TSF wall is a containment pond which captures seepage from the tailing dam. The water in this pond is acidic, indicating that the tailing material contains pyrite which has oxidised and has subsequently come into contact with water, resulting in acid drainage. No engineered cover system for the tailing dam was developed to prevent acid drainage. Subsequently, the TSF is currently covered with approximately 300 mm of soil. Vegetation has established on parts of the tailing dam surface. During the winter months water ponds behind the upstream wall of the TSF and it is believed that over time this water seeps into the tailing material and ultimately to the downstream containment pond.

4. Consultation

The closure consultation process aims to keep stakeholders informed by developing and agreeing on final closure objectives and criteria, and on a process for the handover and relinquishment of the lease following closure. Specific objectives are to:

- Ensure that stakeholders are included in the closure process, have their interests considered, and have the resources to participate meaningfully in the process.
- Ensure that all outcomes agreed to are achievable and sustainable, and ensure that the long-term integrity of the site is maintained.
- Ensure that requirements of the government and community are met.

The closure consultation process will be part of Hillgrove's broader stakeholder consultation, involving both formal and informal processes. This is summarised below and also documented in the MLP.

4.1 Consultation for the Kanmantoo Copper Project

4.1.1 Consultation During Project Approval

During the preparation of this MCRP consultation occurred with the following:

- ! Hillgrove Resources.
- ! Engineering teams responsible for the design of the TSF, open pit, waste rock storage, process plant and infrastructure.
- ! Environmental specialists (flora, fauna, groundwater and surface water).
- ! Government agencies.

A presentation was also made to the Kanmantoo Callington Community Consultation Committee (KCCC) on 21 June 2007. Following the presentation the KCCC provided feedback and recommendations. A total of 10 recommendations were made:

- Basing the Mine Closure and Rehabilitation Plan on best practice environmental management and continuing to apply these principles as the detailed mine closure plan evolved over the life of the mine;
- Committing to further work through the life of the mine to enable detailed designs to be developed;
- Conducting landform design testing and evaluation to confirm the landform design and assist in materials selection;
- Refining cover design from the range of options in consultation with local community and government;
- Continuing to research final land use options including water storage and backfilling the main pit from satellite pits;

- Commencing collection of native seed from the mine site for use in revegetation programs and continuing research into propagation of *Lomandra effusa* in particular;
- Placing special emphasis on consultation with the local community and recognising the benefit of local knowledge in final land use design;
- Comprehensive photographic records of the current site should be collected as a benchmark against which the improvements delivered by the Mine Closure and Rehabilitation Plan can be measured;
- The principle of consulting with the community on potential future land uses after mine closure, particularly where they involve a change to existing land use that can be seen elsewhere in the district, should be strongly endorsed;
- Responsive action should be taken to collect seed when and where it becomes available. This applies particularly to species such as *Lomandra effusa* which show wide variation in seed patterns as a result of environmental stress. Similarly plant propagation programs should be expedited to ensure appropriate stocks of specimens from the local gene pool.

Hillgrove Resources accepted all of the above recommendations in its response to the KCCCC recommendations.

4.1.2 Consultation During Operations

Consultation undertaken as part of the mine closure and rehabilitation process will include the following stakeholder groups:

- Company representatives.
- Relevant state and local government agencies.
- Community groups or other organisations.
- Other users of the land, including lease operators or contractors.

Specifically, Hillgrove will:

- Identify and engage key stakeholders in a consultation program, where their concerns and interests can be considered during mine closure planning. Key stakeholders are likely to include:
 - Hillgrove: employees, contractors, management and shareholders.
 - Community: nearby landholders, residents, Kanmantoo-Callington Landcare Group and Mount Barker District Council.
 - State government: PIRSA, DWLBC, DEH, EPA.
 - Other interest groups.
- Prepare a consultation plan that outlines stakeholder issues in relation to the closure of the mine, describes the consultation strategies used to engage stakeholders and provides a schedule for regular stakeholder consultation.

The nominated timing for the preparation of the consultation plan is within 18 months of the commencement of operations.

5. Closure Objectives and Criteria

5.1 Final Land Use

Determining the final land use (that is the land use after mining has ceased) is a critical component in the development of a MCRP. Since the last period of mining in the 1970's different parts of the site have been used for sheep grazing, fertilizer manufacture and production of copper from heap leaching. The different land uses of the site over the past 30 years highlights that identification of a land use does not necessarily require only one land use be identified—potentially, multiple land uses for the site may be possible.

In considering what is an appropriate land use, assessment of the land capability of the various areas of the site is required. Assessment of land capability is a common tool to determine the appropriateness of a particular activity. In some cases land capability can be improved by improving drainage or the provision of irrigation, while for other areas no opportunities may exist for improving the land capability due to terrain or climatic factors.

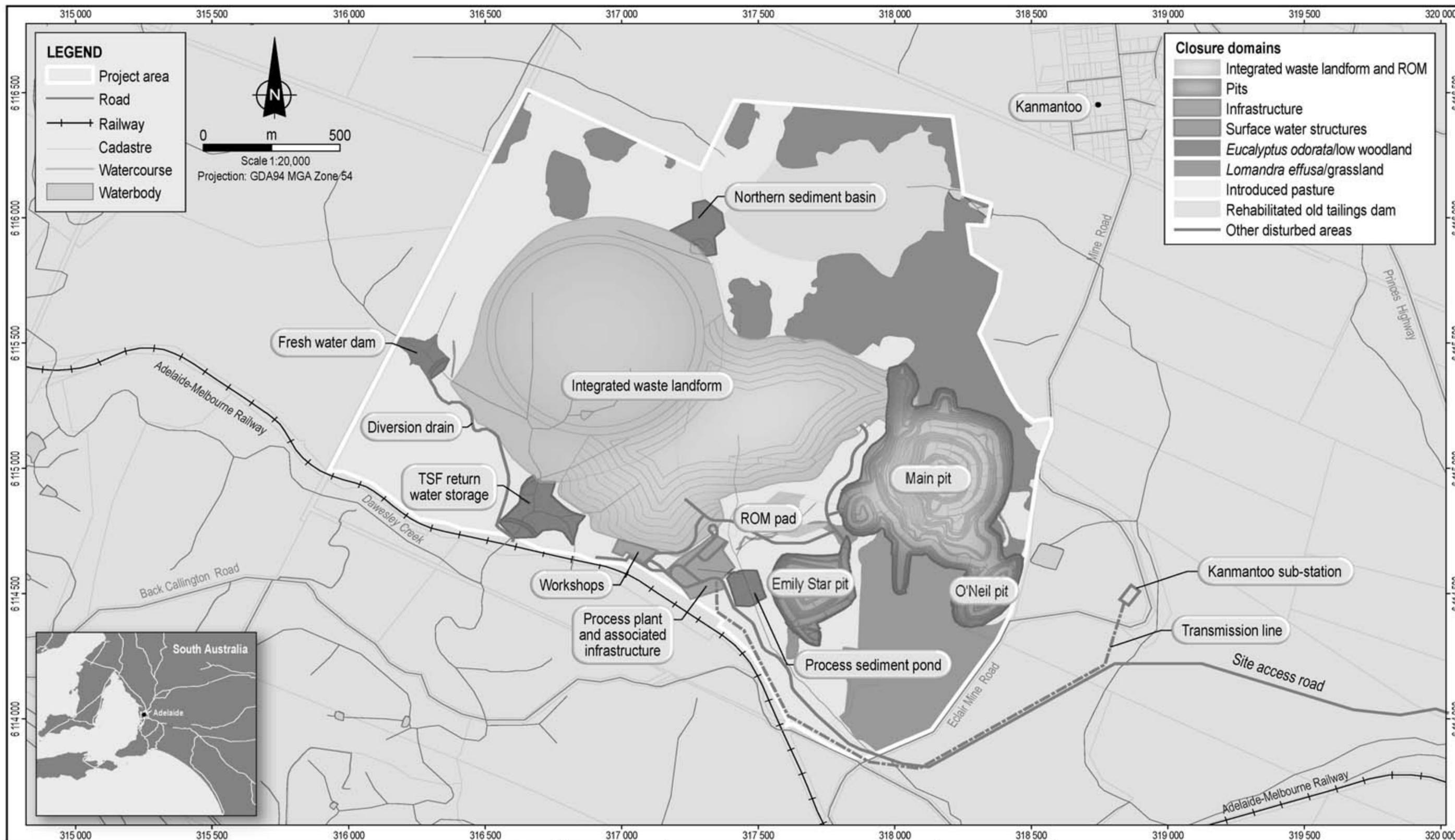
The Kanmantoo Copper Mine can be divided into a number of areas or domains from which an assessment of land capability following mining can be undertaken. The following domains have been identified:

- Open Pit(s).
- Integrated Waste Landform (Tailing Storage Facility, Waste Rock Stockpile and ROM pad).
- Process Plant, Infrastructure and Administration.
- Surface water structures.
- *Eucalyptus odorata* / woodland.
- *Lomandra effusa* and other native grassland.
- Introduced pasture.
- Rehabilitated Old Tailings Dam.
- Other disturbed areas.

These areas are shown in Figure 5.1.

As for any land, limitations will exist on future possible uses. For example, the integrated waste landform will have an engineered cover system to minimise the potential for water to infiltrate into the tailing and waste rock below and therefore any future land use involving this area will require that the integrity of the cover and vegetation is not compromised. Subsequently, the use of this area for annual cropping, i.e., wheat or barley, would not be possible, however the establishment of trees/shrubs/grasses for seed production may be possible.

A number of final land uses have been considered for the Kanmantoo Copper Mine following mine closure. Ongoing consultation and discussion are likely to identify other land uses for consideration as part of the development of the final MCRP. For the purpose of this conceptual MCRP the proposed land uses for each area (Table 5.1) have been identified with a preference towards land uses which complement each other rather than have land use conflicts between different areas.



Source:
Cadastre, roads, rail and drainage from DEH (optimum scale 1:50,000)
Project layout from Hillgrove Resources


 Date: 22.08.2007
 MXD: HillgroveResources_KanmantooGIS
 Job No: 5000_04_F05.01_GIS_AI

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Closure domains

Figure No: 5.1

Table 5.1 Proposed land uses for each domain

Domain	Proposed land use
Open pit(s)	Open pit void
Integrated Waste Landform	Native vegetation
Process plant/infrastructure	Native vegetation
<i>Surface water structures</i>	Native Vegetation
<i>Eucalyptus odorata</i> woodland	Enhancement of existing area
<i>Lomandra effusa</i> grassland	Enhancement of existing area
Introduced pasture	Native vegetation
Rehabilitated Old Tailings Dam	No change
Other disturbed areas	Native vegetation

5.2 Closure Objectives

The overall closure objectives are to:

- Protect human health and safety.
- Reduce the need for long term monitoring and maintenance through design of and construction of landforms that are geotechnically and geochemically stable.
- Develop landforms that are consistent with the surrounding landscape.
- Rehabilitate the site to an appropriate land use consistent with the standards identified for that land use.
- Reinstate native vegetation.
- Improve the visual amenity of the existing site.
- Develop an environmental monitoring and reporting program which is focused towards demonstrating the achievement of closure outcomes.
- Undertake progressive rehabilitation of the site during operations.
- Ensure that the full cost of decommissioning and rehabilitation is understood and that a mechanism for funding exists.
- Ensure that residual risks and liabilities are identified and controlled to an acceptable level.

5.3 Closure Criteria

Closure criteria have been developed for each domain that will be applied to the end land use of the Kanmantoo Copper Project and define performance measures for each closure criterion. These assessment criteria will be updated and refined during the closure planning process.

The definition of end land uses and the closure criteria and performance measures nominated in Table 5.2 will be reviewed, modified and revised as necessary once operations begin and mine closure planning commences in earnest. Where appropriate, the method for assessing progress or conformance with the criteria is included in brackets. It is often not feasible for closure assessment criteria to be based on measurable standards, guidelines or similar that allow numerical comparison, hence other criteria have been developed that relate to the implementation of specific measures that require a simple yes/no, or comparison with baseline or control site data.

Table 5.2 Closure objectives and criteria

Domain	Objective	Assessment Criteria
General	Reduce environmental and financial liability by progressive rehabilitation.	Maintain a progressive rehabilitation plan that is updated in conjunction with clearance areas, changes in the mine plan or schedule, and rehabilitation progress (environmental auditing).
		Periodically revise the closure plan including cost estimate (environmental auditing).
		Periodically review results of environmental monitoring to ensure results are consistent with objectives and adverse findings are addressed (environmental auditing).
	All topsoil and vegetation reclaimed from disturbed area footprints to be stockpiled in an appropriate manner for later use.	Develop and implement a topsoil management procedure that is designed to ensure that topsoil is maintained in a condition where it can be used in revegetation.(environmental auditing).
		Monitor topsoil stockpiles to ensure practices are appropriate and issues that may become apparent are identified and addressed (environmental auditing).
	All Aboriginal and non-Indigenous heritage sites within the project area to be protected and maintained, during closure/rehabilitation activities.	No disturbance to non-Indigenous heritage sites during closure.
All personnel involved in closure activities to be educated on their responsibilities with regard to the South Australian <i>Heritage Places Act 1993</i> (auditing of training register).		
Integrated Waste Landform	Integrated Waste Landform to be progressively rehabilitated to form safe, stable, non-polluting land systems that exhibit environmental characteristics consistent with the surrounding environment.	All disturbed areas to be sheeted with topsoil where practicable, ripped on the contour and seeded with local native species representative of the surrounding environment (environmental auditing).
		Trials/investigations concerning the capacity for revegetation of the TSF cover to be conducted. Strategies to include topsoil and subsoil analysis from recoverable materials, seeding trials and rock-armouring/topsoil/subsoil and waste material cover trials. Progress of the trials to be reported annually until such time as a submission to determine final TSF rehabilitation treatments is proposed to PIRSA.
		Trails/investigations of the landform of the IWL to be undertaken to determine appropriate outer slopes of waste landforms that ensures long-term geotechnical and physical surface stability is maintained, with consideration given to the physical characteristics of waste and topsoil used in the construction of the final batters.
		All PAF material to be isolated/encapsulated and generally made safe within the waste landform to limit contact with rainfall. Long-term environmental risk associated with potential acid rock drainage (ARD) issues to be minimised and addressed in the specific approved design of the landform (environmental auditing).
		Final surfaces and structure of the IWL to be optimised to facilitate fauna habitat (e.g., crevices for reptiles and small birds/mammals), and establishment of a self-sustaining vegetation community.

Table 5.2 Closure objectives and criteria (cont'd)

Domain	Objective	Assessment Criteria
Integrated Waste Landform	Integrated Waste Landform to be progressively rehabilitated to form safe, stable, non-polluting land systems that exhibit environmental characteristics consistent with the surrounding environment.	Outer embankments to be progressively rehabilitated during operations (environmental auditing).
		Outer embankments of TSF to have long-term geotechnical and physical surface stability with limited sediment loss from erosion to the surrounding environment (erosion monitoring).
		Upper TSF surface to provide conditions for establishment of a self-sustaining vegetation community.
Other Disturbed Areas	All disturbances resulting from exploration activity to be progressively rehabilitated.	All exploration drill holes to be capped and rehabilitated in accordance with PIRSA Guidelines for Mineral Exploration Drillholes – General Specifications for Construction and Abandonment 2002 (Document M21).
		All costeans and sumps to be backfilled and rehabilitated in accordance with the PIRSA Statement of Environmental Objectives and Environmental Guidelines for Mineral Exploration Activities in South Australia 2002 (Document M33).
		All access tracks, grid lines and drill pads to be rehabilitated as per PIRSA Statement of Environmental Objectives and Environmental Guidelines for Mineral Exploration Activities in South Australia 2002 (Document M33).
		Rehabilitation of exploration disturbances to be completed before closure.
Surface Water Structures	Impacts of the project on surface hydrology to be minimised following cessation of mining activity.	Water quality downstream of the project area to be consistent with pre-mining or analogue conditions (opportunistic creek flow water sampling).
		Hydraulic structures including diversion channels, drainage systems, sediment traps and bunding to minimise sediment laden and/or contaminated stormwater runoff exiting the project area (environmental auditing).
		Sediment generated from erosion of the IWL to be consistent with the capacity of the natural environment to facilitate the assimilation of that sediment into the surrounding ecosystems (environmental auditing and vegetation monitoring).

Table 5.2 Closure objectives and criteria (cont'd)

Domain	Objective	Assessment Criteria
Surface Water Structures	Impacts on groundwater quality and volumes to be minimal following the cessation of the processing operations.	Groundwater quality and reserves to show no material impact from the project (groundwater monitoring program).
Eucalyptus Odorata and Lomandra effusa grassland	Areas of native vegetation to be enhanced during and following operations.	Native vegetation management procedure to be developed to ensure that only approved areas of native vegetation are disturbed (environmental auditing).
		Construction, operations and closure workforce to be inducted/educated on the presence and protection of significant flora (high quality <i>Eucalyptus odorata</i> and <i>Lomandra effusa</i> vegetation communities) prior to commencing work.
		Declared weeds to be controlled within the project area during the post closure monitoring period (environmental auditing).
Process Plant, Administration and Workshops	Environment, public health and safety to be protected through the identification and clean up of contaminated areas.	Contaminated areas to be remediated in accordance with Best Practice Guidelines (environmental auditing).
		At the completion of operations, all mining and processing infrastructure, associated infrastructure and supporting services to be removed from site or demolished and disposed of in a suitable manner, with the exception of structures established for the agreed protection of the environment or for agreed heritage or other purposes. Large concrete footings, such as those used for the construction of the plant, to be buried in situ (environmental auditing).
		All remaining hydrocarbons, processing reagents and chemicals to be removed from site in an approved manner and returned either to the manufacturer or to an approved disposal site (environmental auditing).
Open Pits	Environment, public health and safety to be protected by using safe and responsible closure practices.	Abandonment bunding to be constructed around the pit perimeter to restrict inadvertent access to the pit void, with the location of the bund to be determined by a geotechnical specialist (environmental auditing).
		Pit ramps to be blocked to prevent inadvertent access (environmental auditing).

6. Potential Environmental, Economic, and Social Impacts of Mine Closure

The closure of an operation such as the Kanmantoo Copper Project has a number of environmental, economic and social risks and issues associated with it. Each must be considered, in turn, in accordance with regulations and guidelines, and involving consultation with stakeholders, to produce a comprehensive mine closure and rehabilitation plan. The potential environmental, economic and social impacts considered in this section relate to issues that may remain after mine closure

6.1 Potential Risks for each Domain

An assessment of each domain has been undertaken to determine the potential risks that could remain following mine closure and these have then been risk assessed. These are listed below for each domain.

6.1.1 Integrated Waste Landform

- Failure of part of the cover system resulting in acid rock drainage.
- Insufficient NAF material to protect buried PAF material.
- Failure of a section of revegetation.
- Erosion of the IWL.
- Poor quality surface water runoff.
- Seepage of poor quality water to groundwater.
- Fire.

6.1.2 Open Pits

- Failure of pit wall.
- Contamination of groundwater.

6.1.3 Process Plant, Administration and Workshops

- Contaminated areas remain following closure.
- Failure of a section of revegetation.
- Erosion of rehabilitated area.
- Poor quality surface runoff.
- Seepage of poor quality water to groundwater.
- Fire.

6.1.4 Surface Water Structures

- Failure of structure during rainfall event.
- Seepage of contaminated water to groundwater.
- Safety of structures i.e. fauna death.

6.1.5 Disturbed Areas

- Contaminated areas remain following closure.
- Failure of a section of revegetation.
- Erosion of rehabilitated area.
- Poor quality surface runoff.
- Seepage of poor quality water to groundwater.
- Fire.

6.1.6 Eucalyptus Odorata Woodland

- Fire.
- Invasion of exotic species.
- Introduction of disease or invasion by pests.

6.1.7 Lomandra Effusa Grassland

- Fire.
- Invasion of exotic species.
- Introduction of disease or invasion by pests.

6.1.8 Introduced Pasture

- Fire.
- Invasion of exotic species.
- Introduction of disease or invasion by pests.

6.2 Economic and Social Risks

Economic and social risks of closure are more difficult to quantify given the operations relatively short operating period of 8 years. However, they are likely to include:

- Public safety and human health.
- Social impact of closure, especially in relation to the communities of Kanmantoo and Callington.
- Post-closure monitoring and maintenance.

7. Closure Concept for each Domain

7.1 Integrated Waste Landform (Tailing and Waste rock storage)

The Integrated Waste Landform (IWL) will constitute the most significant closure feature within the landscape, and the largest area of disturbance requiring rehabilitation. As described in Table 5.1, the foremost rehabilitation objective for the IWL is to ensure that the final landform will be stable (physically and chemically), conditions suitable to establish a self sustaining ecosystem, will have minimal no long-term monitoring and maintenance requirements, will not be a source of dust or water pollution, will be hydrologically compatible with the surrounding area, improves the aesthetics from the existing landform and will have no or acceptable associated future risks or liability.

7.1.1 Cover System

Geochemical assessment of the waste rock and tailing has indicated the potential for both waste rock and tailing to be potentially acid forming (PAF). The presence of PAF material will require a detailed engineered cover system to be designed to manage this risk. Prevention of acid rock drainage can be achieved by three types of cover systems;

- Water cover
- Dry (soil) cover
- Synthetic cover.

Water Cover

Placement of PAF material under water is a proven technique to minimise the oxidation of pyrite. The water acts as a barrier to the diffusion of oxygen from the atmosphere to the PAF material below and subsequently prevents oxidation. Water covers are only feasible in wet climates where rainfall exceeds evaporation. The application of a water cover system at Kanmantoo is not feasible given the significant deficit between rainfall and evaporation.

Dry (Soil) Cover

Dry cover systems (also known as a store and release cover system) are a common prevention and control technique for PAF waste rock and tailings used at numerous mine sites around Australia and the world. Dry covers can involve a single layer of oxidised rock or soil or they can be quite complex involving several layers of different material types.

The purpose of a dry cover system is to control or limit the quantity of water infiltrating into the PAF waste below. The amount of infiltration through the dry cover is therefore the key consideration in the design of the cover system. The volume of water which infiltrates through the cover system is dependent on:

- Rainfall.
- Evaporation.
- Transpiration.
- Soil moisture storage properties.

- Runoff.

Synthetic Cover

A synthetic cover is a variation to the use of a soil cover. A synthetic barrier (usually a liner made of high-density polyethylene (HDPE)) is used to cover PAF tailing or waste rock and then this synthetic liner is covered with soil and vegetation established. The synthetic liner prevents / minimises the infiltration of water into the PAF material below while the soil layer above allows the establishment of vegetation.

7.1.2 Closure of Integrated Waste Landform

Two approaches are being used for the closure of the IWL. These two approaches are both aimed at minimising infiltration into the PAF material below.

Tailings Storage Facility

The surface of the TSF is to be domed, using tailings. The tailings deposition pattern will be reversed during the final year of operation such that tailings are deposited through a series of risers constructed on wing walls from the decant to create the domed tailings surface.

A HDPE liner, 0.75 mm, will be placed over the tailings and covered with waste rock from waste stored surrounding the TSF supplemented with soil to form a growth medium. A HDPE liner was selected for the TSF as the tailings have been finely crushed and therefore do not present a risk with regard to puncturing the liner. The placement of the waste rock and soil over the top of the liner will occur only after a layer of fine material has been placed over the liner to protect it against puncture. The area will be seeded with grasses and shrubs only. No large trees are to be planted on this surface. Topsoil removed from the IWL areas prior to construction, will be respread over the prepared top surface.

Waste Rock Storage

The majority of dry covers constructed in Australia have a cover depth of between 1 to 2 metres of soil and/or waste rock. Some cover systems also have a compacted layer or capillary break (coarse gravel layer) at the interface between the PAF waste rock and the loose soil above. The actual final configuration (depth and whether a compacted layer is required) of the dry cover will be determined following extensive test work of material properties once mining recommences and representative samples are available. For the purposes of this conceptual closure plan it has been assumed that a dry cover consisting of 0.5 m of compacted clay and 1.5 m of uncompacted soil or oxidised waste rock will be used.

Establishment of vegetation is critical in the performance of the cover. On the surface of the IWL it is proposed that *Eucalyptus odorata* woodland be established and that this would link up with the remnant woodland on the eastern boundary. Further work is

required on the areas where *Eucalyptus odorata* currently exists to understand depth of roots etc. to determine if the proposed depth of cover is suitable. On the slopes of the IWL the preferred option is to create a *Lomandra effusa* grassland. Research is currently being undertaken by State Flora into the propagation of *Lomandra effusa* and should this fail to develop a technique, other native species would be used.

ROM Pad

On completion of mining, the remaining ore on the ROM stockpile will be fed to the concentrator. Any contaminated material will be removed and either processed or placed in the TSF. The ROM pad will then be rehabilitated following the same approach for the waste rock storage as described above.

7.1.3 Landform of IWL

The IWL will have a surface area of 59 Ha and batter slopes of 68 Ha. The key issues in terms of landform stability are:

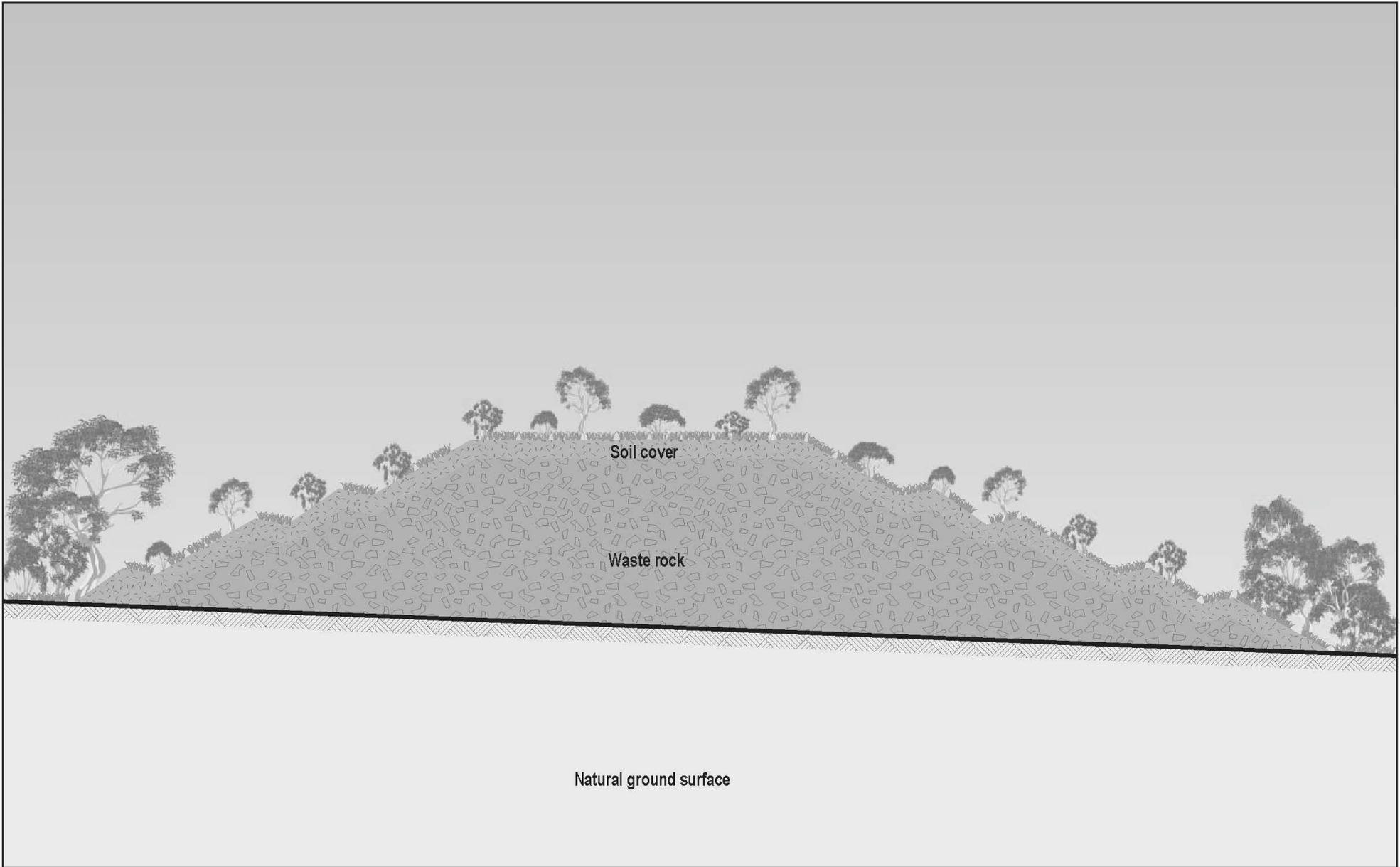
- Management of surface water runoff from the top and batters of the IWL.
- Safe discharge of surface water runoff from the top and batters of the IWL.
- Stability of the outer batter slopes.

The dry cover system (including the synthetic liner for the TSF) as described above will be designed to store rainfall within the cover system and this will then be released via evaporation and evapotranspiration. During high intensity rainfall events the infiltration capacity of the cover system will be exceeded (as occurs naturally) and therefore surface runoff will occur. Management of surface runoff is critical to prevent uncontrolled flows discharging from the top of the IWL onto the batters resulting in erosion and ultimately failure of the cover system.

Determining the appropriate slope of external batters is critical in building a stable landform. The oxide rock which will be mined is likely to provide a source of material which is competent enough to withstand erosion. Testing will be required on determining the right mix of topsoil and rock for a particular slope angle.

Traditionally waste rock stockpiles have been constructed with a series of batters and benches (Figure 7.1). These landforms have often failed as no provision has been included to remove surface runoff. Consequently the bench fills with water which overtops resulting in erosion of the batter below. Engineered structures to manage surface runoff have in some instances been incorporated into this traditional approach however they require ongoing maintenance which does not meet the broad closure objectives of minimising long term maintenance.

Based on experience at other sites it is proposed that the batters of the IWL will be shaped to form a concave profile with a steeper slope angle at the top, e.g., 25⁰ and a shallower angle at the bottom, e.g., 12⁰. This landform shape mimics that of surrounding landforms where the upper sections are steeper while the lower sections have a gentler slope. Once mining commences and large representative samples of the waste rock are available test work of the waste rock together with topsoil will be possible to determine the most stable landform.



Note: This diagram is not to scale



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Kanmantoo Copper Project



**Traditional approach to rehabilitation of
waste rock dumps**

Figure No:
7.1

7.2 Open Pits

Two open pits will be developed as part of the project. Main Pit, which is an enlargement of the existing pit, and Emily Star, which is a smaller satellite pit to the south of Main Pit.

7.2.1 Emily Star

The Emily Star pit will be mined early in the project and provides an opportunity to backfill this pit with waste rock from Main Pit. Once Emily Star has been mined additional exploration drilling will occur from the bottom of the pit to determine if there is any potential for underground extensions of the orebody. At this stage the mine plan has assumed that no opportunities to develop an underground mine under the base of Emily Star pit are available and therefore the pit will be backfilled with waste rock from Main Pit and the surface rehabilitated.

Rehabilitation of the backfilled Emily Star pit will involve the same approach as that used for the IWL with a 0.5 m compacted clay layer and 1.5 m of oxide rock/soil. The backfilled pit will be shaped to form a water shedding profile and to allow for settlement. It is proposed that revegetation of this area would involve establishment of a *Lomandra effusa* grassland or other native species if the current research into establishment of *Lomandra effusa* is unsuccessful.

7.2.2 Main Pit

The final pit void will remain as a permanent feature in the landscape, with the main issue being public safety and protection of groundwater. An abandonment bund that cannot be crossed by vehicles will therefore be constructed of competent rock to prevent inadvertent public access (Figure 7.2). This will be located around the pit, 10 m beyond the zone of potential pit wall failure.

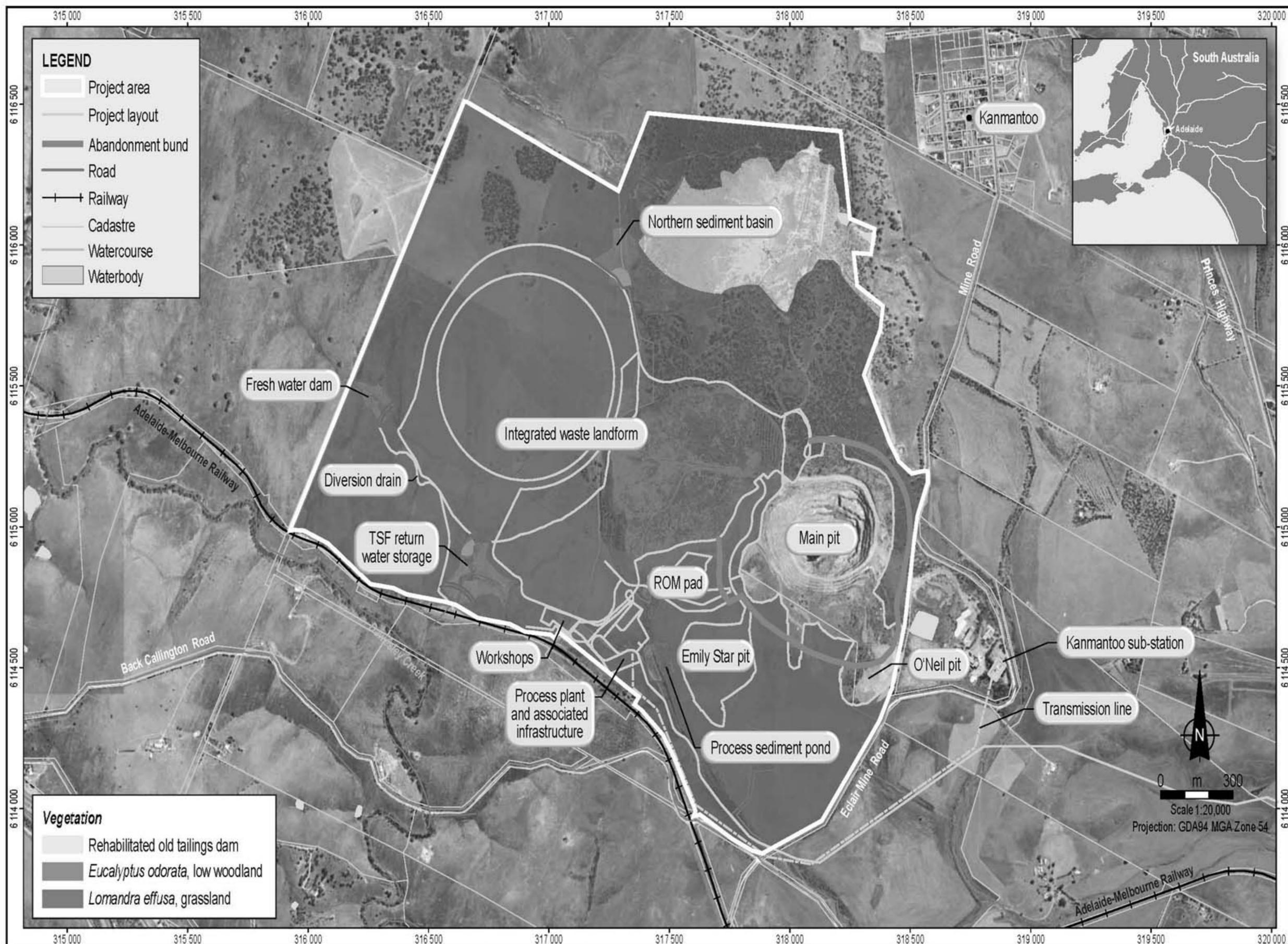
Groundwater levels around the pit are expected to recover following the cessation of mining and processing and the subsequent stopping of dewatering from the pit and pumping from the groundwater bores. The recovery rate of pit water levels will reduce as groundwater inflows reduce (due to reduced head of water above the pit water level) and evaporative losses from the water in the pit.

Studies by REM 2007 indicate that groundwater levels will not recover fully to pre mining levels. Modelling has indicated that the water levels are expected to stabilise at about 15 – 50 m below the surrounding pre-mining water table in the Main and O'Neil pits.

Currently the Main pit acts as a groundwater sink with groundwater inflows from the southern and eastern site boundaries being captured in the pit. This existing condition will not change as a result of the expanded open pit.

Water quality in the Main and O'Neil pits is expected to decline with time and can be expected to be similar to that of the current pit water. This water will be contained within the pit as the water level will be below surrounding groundwater levels.

Some backfilling of Main Pit is possible and in particular the O'Neil pit and the north western end of Main Pit. Further opportunities for backfilling of sections of Main Pit may be possible following further refinement of the mining schedule.



Source:
 Place names, roads, drainage and cadastre from DEH, SA (optimum scale 1:50,000)
 Mine Layout from Hillgrove Resources
 Vegetation inferred from vegetation mapping undertaken by Ecological Associates.



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**Proposed post-closure vegetation distribution
 in the project area following rehabilitation**

Figure No:
7.2

An option considered during the preparation of this MCRP is the possible use of the open pit as a water supply. As a water supply, the open pit would provide some habitat for native wildlife but any benefit is likely to be limited due to the depth of water and lack of shallow areas that could support wetland type habitats. The depth of water, however, is what makes use of the open pit as a water supply an attractive option. It is estimated that following mining the open pit would have the capacity to store 25,000 -35,000 ML. This storage capacity would place the Kanmantoo open pit as the fourth largest storage in South Australia behind Mt Bold, South Para and Blue Lake (Table 7.1). The small surface area means that evaporation losses are low compared with the other storages which cover a large area but are relatively shallow in comparison. Subsequently, the Kanmantoo open pit would be a highly efficient water storage in terms of low evaporative losses.

The potential for the pit to remain as a permanent source of water will be further investigated with SA Water, Mount Barker District Council, DWLBC and PIRSA.

Table 7.1 Storage capacity of SA Water reservoirs and Kanmantoo open pit.

Reservoir	Storage Capacity (ML)
Kanmantoo Open Pit	25,000-35,000
Barossa	4,515
Happy Valley	11,600
Hope Valley	2,840
Kangaroo Creek	19,160
Little Para	20,800
Millbrook	16,500
Mount Bold	46,180
Myponga	26,800
South Para	45,330
Baroota	6,140
Beetaloo	3,180
Bundaleer	6,370
Blue Lake	36,000
Middle River	470
Tod River	11,300
The Warren	4,790

7.3 Process Plant, Administration and Workshops

On completion of the project, all equipment will be removed from the site. All infrastructure will be dismantled and removed from the project area. Depending on their condition, major items, e.g., crusher, conveyors and modular buildings, will be sold for re-use on other projects. The remaining items will be sold as scrap metal.

Concrete will be broken up and either disposed of onsite, used as clean landfill in areas of existing disturbance where the landform is amenable to filling, or transported off site for disposal in an appropriate clean fill facility.

Contaminated concrete, e.g., concrete contaminated with hydrocarbons, will be cleaned on site and disposed at an appropriate registered facility.

Once plant and equipment are removed, contaminated material will be removed and remediated or disposed at an appropriate registered facility. Large concrete footings and foundations will be made safe and buried in situ. Topsoil will be placed over the area followed by ripping and seeding with a combination of native trees and grasses.

7.4 Surface Water Structures

Four surface water retention structures are proposed to manage surface water during operations. These structures include the following:

- Fresh water dam.
- TSF Decant water dam.
- Process Sediment pond.
- Northern Sediment pond.

Following closure residue material in the dams will be analysed to determine contaminant concentrations. If enriched with metals, the residue may be removed and reprocessed. Otherwise, the material will be placed in the TSF. All pipework and infrastructure will be removed.

Immediately following closure it is likely that these dams will continue to be required to capture any sediment from the recently rehabilitated areas and demonstrate that water quality objectives have been achieved.

Once vegetation has established and runoff water quality from the previously disturbed areas meets water quality objectives the water storages:

- Remove completely, reshape, topsoil, and seed with local native plant species.

Minor surface drainage structures such as sediment traps, established during operations will be retained post-closure. The reasons for this are:

- Surface drainage established during operations will be complete and stable.
- Clean water will remain separated from water draining areas of disturbance.
- Although vegetation will establish, sediment traps will continue to provide a final filter for runoff from the rehabilitated site.
- These areas may have been colonised by fauna, thereby creating new habitat areas.

7.5 *Eucalyptus odorata* woodland

Flora surveys by Ecological Associates (EA, 2007) have identified areas of high quality *Eucalyptus odorata* woodland existing on the site and in particular to the north of Main Pit. Other areas of lesser quality also exist and the opportunity exists during operations

to manage these areas with the goal of improving the quality of the woodland by reducing exotic weeds, encouraging the development of native species and reducing the presence of grazing. This area of woodland will also be an important source of seed for use in rehabilitation of areas around the site.

During operations a weed management plan will be initiated to control weeds within the woodland and subsequently encourage the regeneration of native species. If required feral animal control will also be undertaken to reduce grazing pressure from rabbits etc.

7.6 Lomandra effusa grassland

The *Lomandra effusa* grassland occurs mainly to the south of Main pit, with some scattered plants also occurring to the west of the old pit where the integrated waste landform will be constructed. Expansion of the old pit will remove areas of grassland permanently.

Research is currently being undertaken by State Flora into the propagation of *Lomandra effusa*. Assuming that this research is successful, it is proposed to establish a *Lomandra effusa* grassland over large areas of the integrated waste landform and over the backfilled Emily Star pit.

7.7 Introduced pasture

Large areas of introduced pasture exist across the site, although the establishment of the integrated waste landform will cover a large area of introduced pasture. Some of the resulting areas of pasture around the integrated waste landform will be too small to support commercial grazing and hence it is proposed to establish native vegetation in these areas as part of the project's significant environmental benefit offset plan.

Establishment of a *Eucalyptus odorata* woodland will commence early in the project. Direct seeding to establish the woodland is the favored approach. Hillgrove will use the information gained by revegetating areas of introduced pasture to assist with revegetation of the IWL.

7.8 Rehabilitated Old Tailings Dam

No activities are planned within this domain. Subsequently no rehabilitation activities are proposed.

7.9 Other disturbed Areas

Maintenance of a road into the site will be required to enable monitoring and maintenance activities to be undertaken. Roads and hardstand areas not required for long term monitoring and maintenance will be re-spread with cleared topsoil and vegetation, ripped and seeded. It is expected that, during rehabilitation, deep ripping of these areas will be required to break the compacted surface and enable infiltration of rainwater and root penetration. The following will be undertaken for those access tracks and roads that are no longer required:

- Remove any contaminants such as hydrocarbons. .

- Remove pipes and culverts to re-establish water courses.
- Rip surfaces to retain topsoil and any moisture.
- Replace stockpiled topsoil, seed and fertilise.
- Redirect local drainage as necessary to minimise erosion until regrowth is established.

On completion of mining, magazine compounds will be dismantled and all infrastructure removed from the site for reuse elsewhere or recycling. Concrete pads will be removed and disposed of in an appropriate manner. Topsoil will be replaced on the disturbed area, which will then be ripped and seeded.

Unless otherwise agreed, groundwater bores, above ground pipeline infrastructure, power lines, electrical substations and communication towers will be removed, with the recovered materials sold for recycling, reused or disposed of at the local landfill. The bores will be capped below ground level and the upper casings removed. Buried metal plates will be installed to allow bores to be located, using a metal detector and geographical positioning system, if required for future re-establishment. The well pads will be spread with topsoil, ripped and seeded.

Following revegetation the site will consist of extensive areas of *Eucalyptus odorata* woodland and *Lomandra effusa* grassland creating an important conservation area for these two ecological communities (Figure 7.2)

8. Progressive Rehabilitation

8.1 Background

Progressively rehabilitating the Kanmantoo mine site during the operational life of the mine is important in being able to demonstrate the success of closure strategies prior to actual closure and to enable adjustments to strategies as a result of the experience gained. The ability to complete large areas of rehabilitation during operations is influenced by the mine schedule, areas being available (e.g., surface of TSF will not be available until closure) the availability of materials and site conditions.

8.2 Operations

Between the start of construction (2008) and the end of Year 3 (December 2010), Hillgrove's operations at Kanmantoo will include:

- Expansion of open pit.
- Construction of process plant and ore stockpiles.
- Development of IWL including construction and operation of the TSF and waste rock storage.
- Construction of surface water structures.
- Development of site infrastructure and services.
- Rehabilitation of:
 - Road verges.
 - Lower embankments of the TSF and waste rock storage.
 - Areas around the process plant and office buildings.
 - General construction disturbance outside areas of permanent operations.
 - Visual screening along project boundary.

From 2012 to 2016 progressive rehabilitation will consist of continued rehabilitation of the IWL and in particular the batters of the TSF and waste rock storage.

8.3 Progressive Rehabilitation

8.3.1 Prior to Disturbance of an Area

Prior to the disturbance of an area the following tasks will be completed:

- Topsoil to a depth of 150 mm will be removed and stockpiled for later use in the rehabilitation of the site. Stockpiles of cleared soil will be as low in height as possible (<2m), with a large surface area, revegetated to protect the soil from erosion.
- Topsoil will be kept separate from other overburden, subsoil and cleared vegetation matter and protected from erosion and surface runoff.

- Where possible, clearing and soil stripping will take place after seed set of the dominant plant species in spring, to maximise the stores of seed in the soil for future regeneration.

8.3.2 Progressive Rehabilitation During Operations

Where practicable disturbed and or disused sections of the site will be rehabilitated concurrently with continuing activities on other sections of the site.

Many of the rehabilitation measures are designed to indirectly assist and enhance the final post-closure rehabilitation of the mine site. For example, by reducing erosion, establishing native vegetation and controlling surface water runoff, all of which are aspects of progressive rehabilitation, potential future problems are minimised. Progressive rehabilitation will also facilitate the trial of a range of rehabilitation procedures and processes throughout the operational life of the mine, which can be used to further refine and improve the success of post-closure rehabilitation.

In areas available for progressive rehabilitation during operations, the revegetation of sites will include site preparation, selection of seed and plant species mix, planting methods, weed control, and monitoring and maintenance.

Site Preparation

- Where necessary, sites available for progressive rehabilitation will be prepared by:
 - Deep ripping compacted areas of soil.
 - Re-profiling ripped or stockpiled soil.
 - Respreading topsoil.

Species Selection

- The species seed mix and planting densities for revegetation (along with fertiliser requirements) in disturbed areas will be determined in consultation with relevant experts, the Kanmantoo-Callington Landcare Group and DWLBC. Species will be of local provenance (i.e., seed collected from indigenous plants on site where ever possible), with potential shrub and tree species for revegetation including:
 - *Acacia pycnantha*
 - *Allocasuarina verticillata*
 - *Callitris gracilis*
 - *Eucalyptus odorata*
 - *Eucalyptus leucoxylon*
- In areas where stability is a priority while maintaining structural integrity, e.g., IWL batters, species will be selected from the following:
 - *Austrostipa* spp.
 - *Heliochrysum leucopsidium*
 - *Lomandra effusa*
- The planting of tube stock will be considered where the rapid establishment of native vegetation is required, such as along watercourses.

Planting Methods

- Consideration will be given to the appropriate use of the following planting methods:
 - Seed broadcasting.
 - Direct seeding.
 - Spreading of seed-bearing slash (especially for eucalypt and acacia species).
 - Nursery-grown tube stock.
 - Transplantation.

Timing

- Revegetation will be undertaken in early autumn (March and April) where possible, when autumn rains stimulate the growth of seed shed during summer. Revegetation undertaken in autumn also ensures that winter rains in the following months provide adequate moisture for maximum seedling survival and growth.

Weed Control

- Areas progressively rehabilitated will be carefully monitored for evidence of the introduction and establishment of weeds, with the objective of identifying and treating them before they become persistent.
- Where weeds have become established in progressively rehabilitated areas, appropriate weed control measures will be undertaken. These will include:
 - Hand-pulling.
 - Spraying of weeds with an appropriate herbicide.

Monitoring and Maintenance

Methods to monitor and maintain progressively rehabilitated and revegetated areas will include:

- Establishing 360°-photo-monitoring points throughout the project area.
- Conducting surveys to monitor the success rate of seedling emergence and survival, weed invasion, browsing levels (i.e., insect and animal attack of regenerating vegetation) and erosion, using the photo monitoring points to track progress.
- Where monitoring has identified erosion, weed invasion, failure of revegetation (to any material degree) or excessive browser damage to regenerating vegetation, maintenance activities will be implemented to ensure regeneration progresses successfully and rapidly. These may include:
 - Repairing eroded areas.
 - Weed control (chemical, mechanical and manual methods).
 - Pest control (baiting).
 - Infill planting.
 - Spot sowing.
 - Reseeding.
- A database that summarises disturbed areas and their rehabilitation will be established.

8.3.3 Revegetation Trials

Progressive rehabilitation will be used to assess the success of rehabilitation and revegetation procedures and determine whether trials are needed to refine and improve revegetation procedures for rehabilitation.

State Flora with support from Hillgrove, is currently conducting propagation trials for *Lomandra effusa*. The results of these trials will be used to inform the use of *L. effusa* in revegetation and rehabilitation activities in the project area.

Revegetation trials will also include trials for revegetation of the TSF cover.

9. Post Closure Monitoring and Maintenance

This section will be reviewed in accordance with the nominated review schedule for the MLP, and will reflect monitoring and maintenance requirements at the time of decommissioning.

9.1 Post-closure Monitoring

9.1.1 Water Quality

Ongoing sampling and monitoring of groundwater boreholes (water level and quality), selected surface water sampling and mine water from the pit will continue for a period of not less than three years from the cessation of operations. Monitoring will continue until the nominated criteria have been achieved or stable conditions have been reached and water quality reflects the agreed closure criteria.

9.1.2 Integrated Waste Landform

The IWL will be monitored and audited regularly to assess whether closure objectives have been achieved. In addition to water quality monitoring described above, visual monitoring will include checking for:

- Slumping.
- Erosion.
- Excessive seepage.
- Revegetation success.
- Ponding.

Dam safety inspections will be carried out on a regular basis in accordance with ANCOLD guidelines.

Monitoring of the cover system will be undertaken to validate the model results. Monitoring of the cover system is likely to involve the installation of lysimeters and soil moisture probes.

9.1.3 Revegetation Works Across the Site

Methods to monitor and maintain rehabilitated and revegetated areas will include:

- Establishing 360°-photo monitoring points throughout the project area.
- Conducting post-closure follow-up visits to the project area on a regular and frequent basis (frequency decreasing with time) to monitor the success rate of seedling emergence and survival, weed invasion, browsing levels (i.e., insect and animal attack of regenerating vegetation) and erosion, using the photo monitoring points to track progress.
- Ensuring that the monitoring program reflects the agreed closure criteria established through consultation with stakeholders.

- Where monitoring has identified erosion, weed invasion, failure of revegetation (to any material degree) or excessive browser damage to regenerating vegetation, maintenance activities will be implemented to ensure regeneration progresses successfully and rapidly. These may include:
 - Repairing eroded areas.
 - Weed control (chemical, mechanical and manual methods).
 - Pest control (baiting, fencing, etc.).
 - Infill planting.
 - Spot sowing.
 - Reseeding.

Monitoring will continue until all lease conditions and criteria outlined in the Mining and Rehabilitation Program have been achieved.

9.2 Maintenance

Following rehabilitation of the site there will be a requirement for maintenance and in particular during the initial 1-2 years following closure. These activities are likely to involve repair to surface water drainage structures, repair of any erosion areas or the reseeded of areas due to poor vegetation establishment.

Maintenance of the site will continue until all lease conditions and closure criteria outlined in the Mining and Rehabilitation Program have been achieved.

9.3 Schedule

The schedule for progressive rehabilitation in relation to the areas described in Section 8.2 will be determined once the construction phase of the project is complete and the mine has been commissioned.

Post-closure rehabilitation is not expected to commence until 2016 when the mine and process plant has been decommissioned.

10. Financial Provision

The cost estimate for rehabilitation of the site has been prepared using the NSW Department of Primary Industries Rehabilitation Cost Calculation Tool. The estimated cost (Table 10.1) is AUD\$12.9 million (this does not include the revenue from resaleable items). Financial provision for mine rehabilitation and closure activities will be in the form of a bank guarantee.

Table 10.1 Summary of estimated closure costs

Aspect	Estimated Cost (\$AUD)
Infrastructure areas	1,551,382
Tailings storage facility	5,030,285
Waste rock storage	2,926,160
Active mine and voids	32,540
Other	221,825
Sub Total (domains and other sundry items)	9,762,192
Contingency	1,179,463
Third-party management	2,032,438
Total	12,974,093

11. Long-term Site Management Provision

A detailed post-closure management plan will be established as part of the closure planning process. Post-closure management and monitoring requirements are expected to reduce over time, and the ML will be relinquished when all closure objectives have been met.

As the ML area is on privately-owned land, Hillgrove will ensure that a land use restriction is included in any sale of land to ensure that the area continues to be appropriately used (e.g., large trees are not permitted to become established on the surface of the TSF, the IWL is not grazed by sheep and erosion is controlled).

Costs involved with the long-term management of the site will be estimated and funds for this will be provided in the form of a trust, bond or similar fund established by Hillgrove.

12. Recommendations

While this conceptual MCRP has identified technically and economically feasible options for closure of the Kanmantoo Copper Mine, further work is required before they can be implemented. Consultation with stakeholders is likely to identify other potential options to be considered as part of the development of a final mine closure and rehabilitation plan. To further investigate the options outlined in this document the following is recommended:

- Material Balance - develop a detailed material balance of PAF, NAF, subsoil and topsoil and incorporate into mine schedule.
- Landform Design – testing and evaluation of non acid forming waste rock to determine the most stable landform design.
- Cover Design – testing and modelling of cover design options for covering of the waste stockpile and Tailings storage facility (note that the cover designs for both areas may differ).
- Open Pit – discussion and evaluation of the potential for the Kanmantoo open pit to become a water storage following closure.
- Open Pit – continue to evaluate options to backfill parts of Main Pit.
- Revegetation – collection of native seed from the mine site and in particular *Eucalyptus odorata* and *Lomandra effusa* for use in future revegetation programs.
- Revegetation – continued research into the propagation of *Lomandra effusa* with the objective of being able to establish on the batters of the IWL.

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