

## **EXECUTIVE SUMMARY**



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## **Snapper Mineral Sands Project Environmental Assessment**

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## ES1 INTRODUCTION

This document is an Environmental Assessment (EA) for the proposed development of the Snapper Mineral Sands Project (the Snapper Mine). The publicly listed company BEMAX Resources Limited (BEMAX) is the Proponent of the Snapper Mine.

The Snapper Mine site is located in far western New South Wales (NSW), approximately 10 kilometres (km) to the south-west of BEMAX's Ginkgo Mineral Sands Project (the Ginkgo Mine) and approximately 170 km south of BEMAX's other operation in the region, the Broken Hill Mineral Separation Plant (MSP) (Figure ES-1). The Snapper Mine includes the development of the Snapper mineral deposit, extensions of the existing Ginkgo Mine electricity transmission line (ETL) and highway access road (HAR) and use of a mineral concentrate transport route from the Snapper Mine to the MSP (Figures ES-1 and ES-2).

The Snapper Mine would produce up to approximately 450,000 tonnes per annum (tpa) of mineral concentrate for transport to the MSP where final separation into saleable products would occur. The Snapper Mine would employ a peak construction workforce of approximately 250 employees and an operational workforce of approximately 110 employees. The Snapper Mine would operate 24 hours per day, seven days per week over a life of approximately 16 years.

A mineral reserve of approximately 117 million tonnes (Mt) of mineral sands ore at a grade of 5% heavy minerals has been delineated for the Snapper mineral deposit. The reserve contains approximately 10% zircon, 16% rutile and 55% ilmenite (9% of which is altered ilmenite or leucoxene).

The Snapper Mine would produce a heavy mineral concentrate (HMC) after primary ore separation and leucoxene-rich, ilmenite-rich and non-magnetic (i.e. rutile-rich and zircon-rich) concentrates after subsequent separation. The concentrates would be transported off-site to the MSP for final separation into saleable products.

## ES1.1 INTERACTION WITH OTHER BEMAX ACTIVITIES

The proximity of the Snapper Mine to the Ginkgo Mine and similarity in orebody characteristics would deliver a significant overall economic advantage to BEMAX through extensions/sharing of infrastructure as well as shared utilisation of the MSP. Although both the Ginkgo and Snapper Mines would be economically viable as stand-alone operations (BEMAX, 2003), BEMAX's Murray Basin operations<sup>1</sup> (which currently incorporate the Ginkgo Mine and the MSP) would benefit from both mines operating in conjunction (i.e. development of the Snapper Mine would allow BEMAX to recoup significant infrastructure costs incurred during the development of the Ginkgo Mine in 2005).

## ES1.2 SNAPPER MINE DESCRIPTION

### *Snapper Mine Summary*

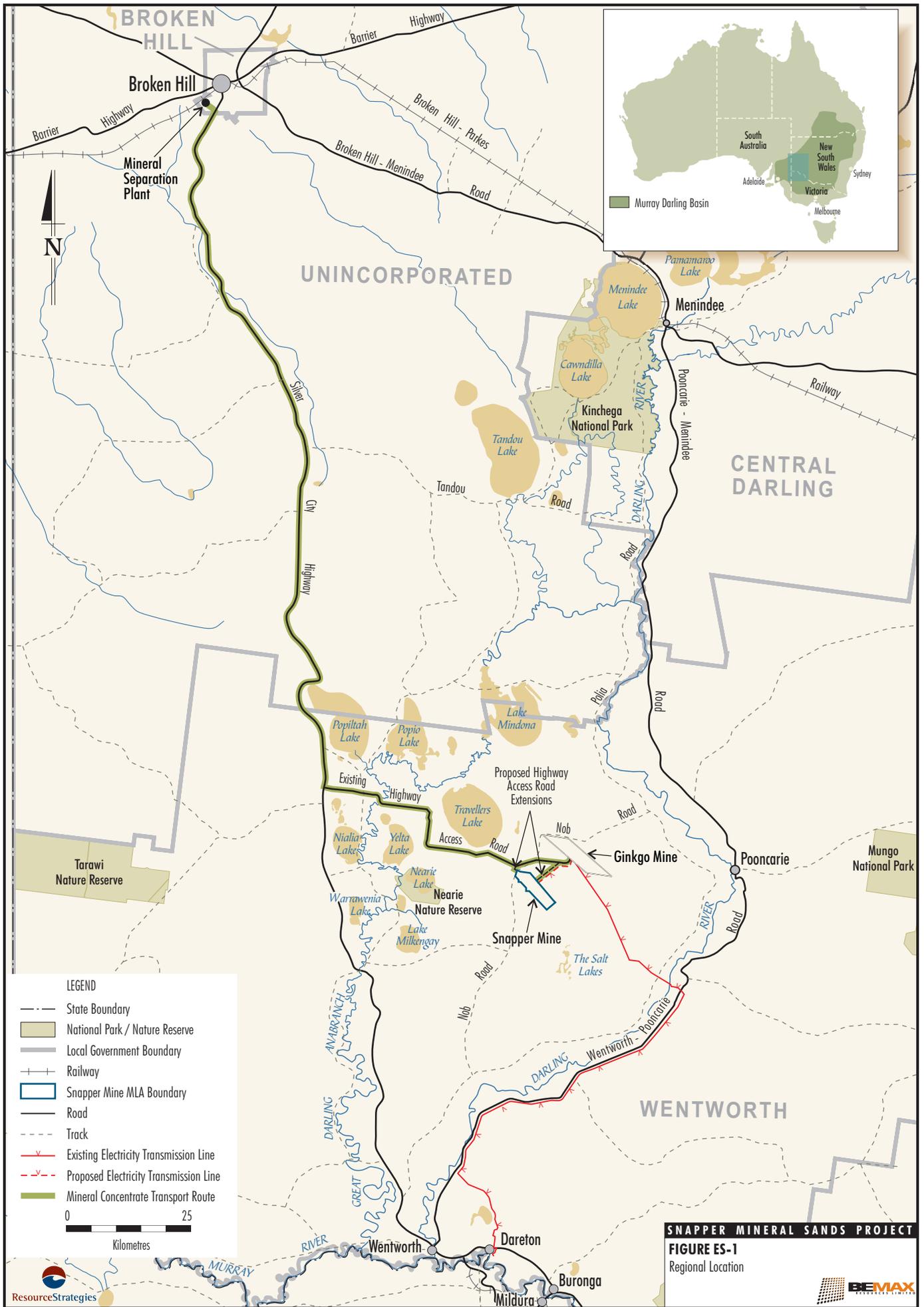
As per the Ginkgo Mine, conventional mineral sands dredge mining would be the primary method of mining at the Snapper Mine.

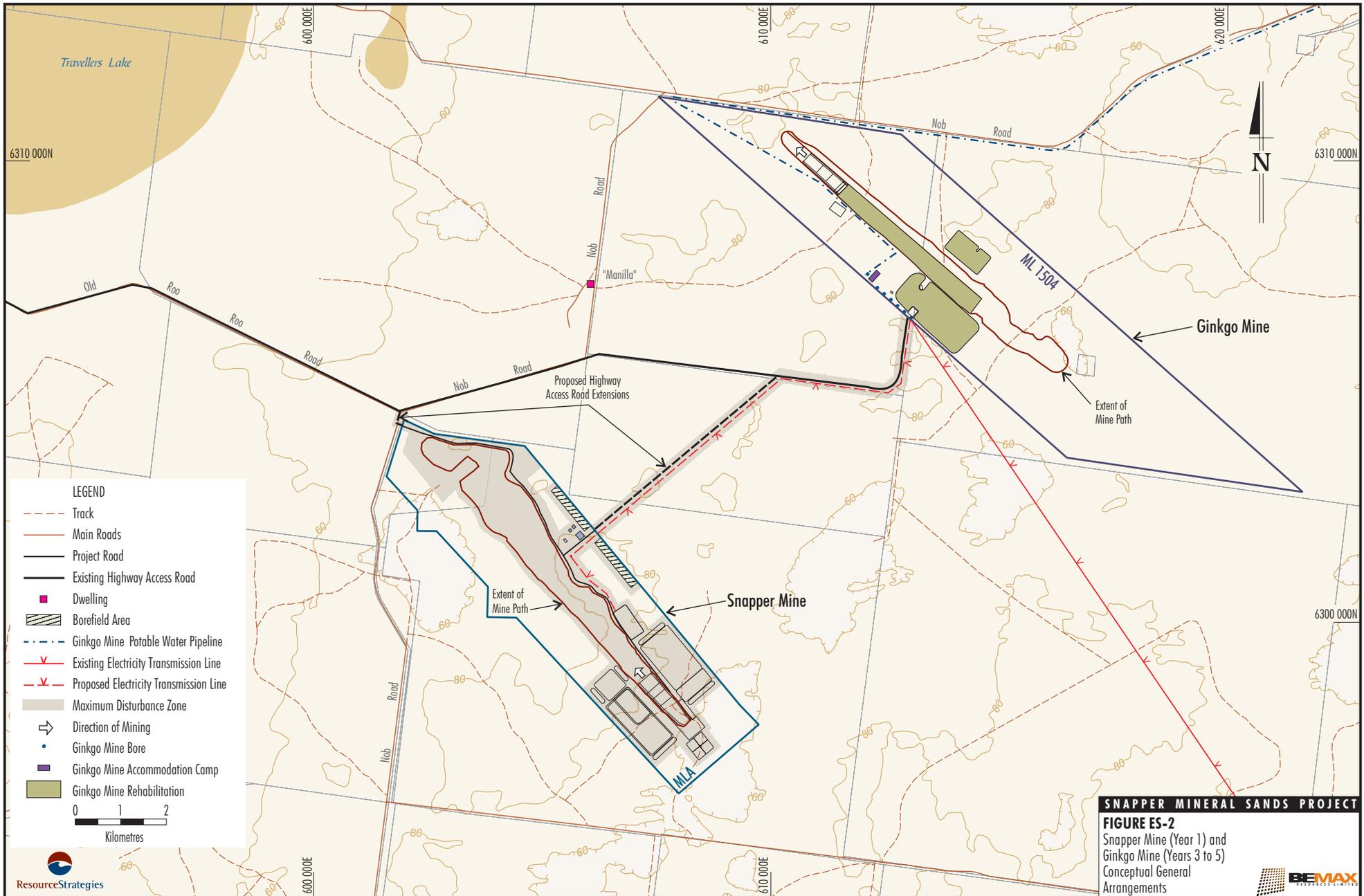
Construction of the Snapper Mine would commence approximately between Years 3 and 5 of the Ginkgo Mine life.

The mining operation would comprise the following:

- clearance of vegetation and stripping of soils on a campaign basis ahead of the advancing mine operation;
- overburden stripping, slurring and direct placement;
- predominantly dredge mining of ore by a conventional floating bucket wheel dredge located in the dredge pond;
- adjustment of dredge pond levels to maintain dredge access to the ore;
- supply of water from the borefields;
- disposal of water to the water disposal dam when lowering dredge pond levels;

<sup>1</sup> These operations have also been referred to as the "Pooncarie Project" in BEMAX announcements to the Australian Stock Exchange.





- secondary mining of ore by conventional mobile equipment (i.e. dozers and/or scrapers), depositing ore in front of the dredge;
- ore concentration in the primary gravity concentration unit to produce HMC;
- stockpiling of HMC;
- supply of desalinated water from the reverse osmosis (RO) plant for HMC salt washing;
- HMC separation via the Wet High Intensity Magnetic Separators (WHIMS) circuit either at the Snapper Mine or at the MSP, to produce three types of mineral concentrates (i.e. ilmenite-rich, leucoxene-rich and non-magnetic [rutile-rich and zircon-rich] concentrates);
- stockpiling of mineral concentrates;
- transport of HMC and/or mineral concentrates to the MSP;
- placement of wastes from the primary gravity concentration unit (i.e. sand residues) at the rear of the dredge pond as mining advances;
- treatment of process water to remove fines material (i.e. particles less than 53 microns in diameter);
- transport and placement of backloaded process waste from the MSP;
- replacement of overburden on top of sand residues; and
- staged replacement of soils and progressive rehabilitation.

Additional components of the Snapper Mine include:

- associated minor infrastructure, plant equipment and activities;
- an ETL from the Ginkgo Mine; and
- road access to the Mine via two extensions of the HAR linking both the Ginkgo and Snapper Mines with the Silver City Highway.

The Snapper Mine area comprises the Snapper Mine Mining Lease Application (MLA) area, the ETL from the Ginkgo Mine and the HAR extensions (Figure ES-2).

The Snapper Mine has been designed to integrate with Ginkgo Mine ancillary infrastructure and facilities as far as practicable. For example, ancillary infrastructure for the Snapper Mine comprises extensions/sharing of the existing Ginkgo Mine ETL and HAR and expansion of the Ginkgo Mine accommodation camp to accommodate Snapper Mine workers (Figure ES-2).

### **Snapper Mine Snapshot**

Key Snapper Mine information is summarised in Table ES-1.

### **Mineral Deposit**

The Ginkgo and Snapper mineral deposits both occur within the Loxton-Parilla Sands host unit. The Snapper mineral deposit is overlain on average by 30 to 35 metres (m) of overburden.

The approximate 117 Mt of mineral reserve identified for the Snapper Mine represents some 5.9 Mt of the valuable minerals of ilmenite, leucoxene, rutile and zircon.

### **Construction**

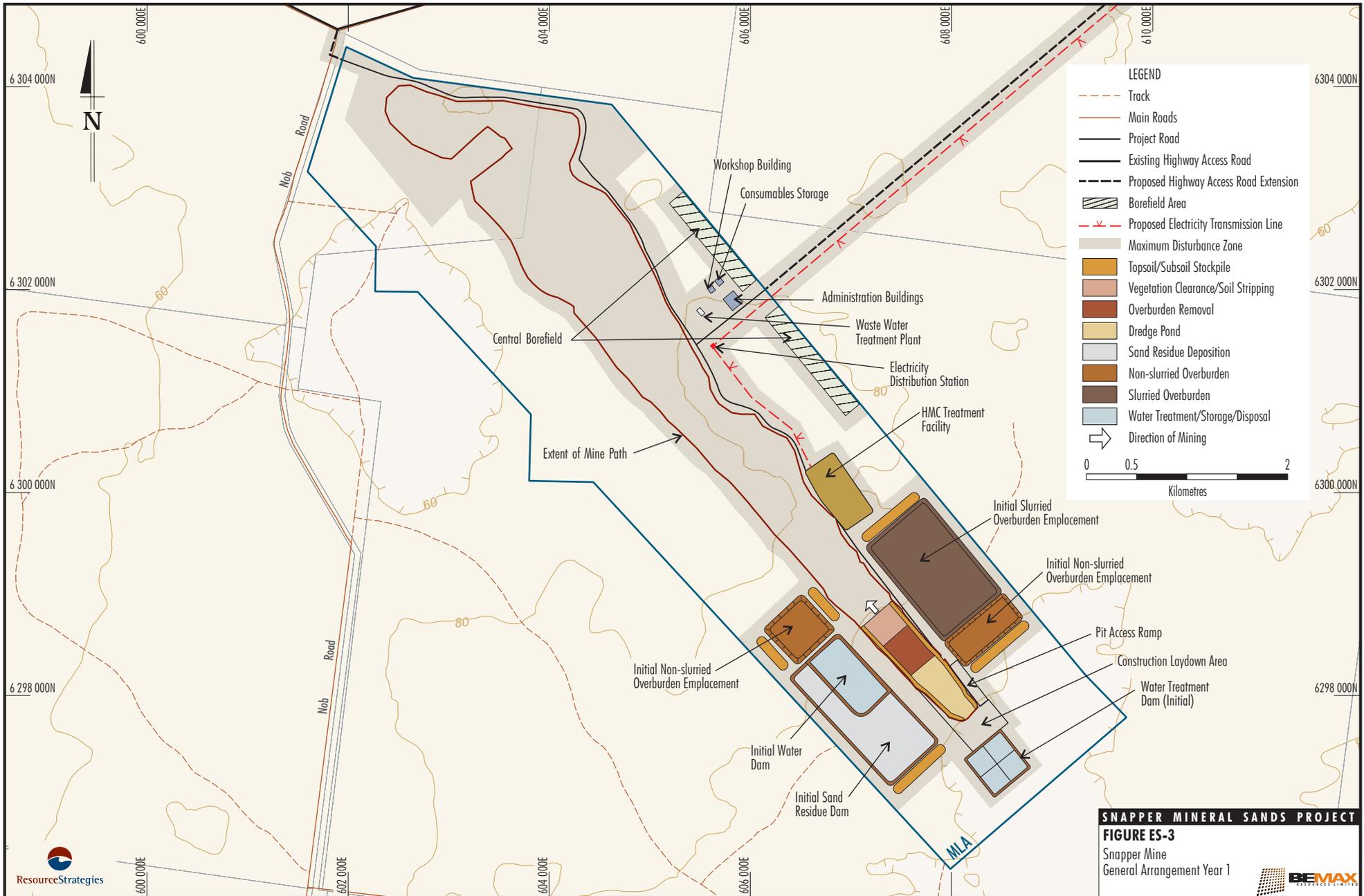
The general construction phase would involve the installation and commissioning of surface facilities to allow access to the orebody and the commencement of mining. An approximate 15 month construction period is expected.

During the construction period, a construction pit would be excavated within the mine path where the dredge and primary gravity concentration unit would be assembled. The majority of site components would also be constructed within the construction period, including roads, HAR extensions, the ETL, the HMC treatment facility, the central borefield, initial water dam, initial slurried overburden emplacement, initial non-slurried overburden emplacements and water treatment dam (initial). These components are shown on Figures ES-2 and ES-3.

**Table ES-1  
Snapper Mine Snapshot**

Summary Description	
Proponent	BEMAX Resources Limited.
Tenement Status	BEMAX has applied for two overlapping mining leases (MLs) (MLA 210 and MLA 272) which cover portions of BEMAX's exploration licences (ELs) (EL 5474 and EL 6024).
Land Tenure	Four pastoral leases, namely, "Trelega", "Carstairs", "Manilla" and "Aston".
Mining	Predominantly dredge mining of approximately 8.2 million tonnes per annum (Mtpa) of ore.
Life of Mine	Approximately 16 years.
Timing*	Mining at the Snapper Mine is planned to commence approximately between the third and fifth years of the Ginkgo Mine operation.
Mineral Concentration	Mineral concentration to be undertaken in a primary gravity concentration unit (comprising a screen, surge bin and wet concentrator). HMC produced would either be separated through the WHIMS circuit on-site or at the MSP. The WHIMS circuit would separate the HMC into an ilmenite-rich concentrate, leucoxene-rich concentrate, a non-magnetic concentrate and waste products. Concentrates would be further separated and treated at the MSP.
Concentrate Transport	Double road trains or other NSW Roads and Traffic Authority (RTA)-approved vehicles (e.g. AB-triple vehicles) would be used to transport mineral concentrate from the Snapper Mine to the MSP via the mineral concentrate transport route.
Overburden Management	Replacement of the majority of deeper overburden would be undertaken by slurrying. Replacement of the majority of shallow overburden would be undertaken by conventional earthmoving equipment. Slurried overburden material would be covered by an appropriate depth of non-slurried material, to provide a suitable revegetation medium.
Sand Residue Management	Sand residues from the primary gravity concentration unit would be placed in an initial sand residue dam for approximately the first six months of operation. For the remainder of the Snapper Mine life, sand residues would be stacked directly into the back of the dredge pond.
Backloaded MSP Process Waste Management	Following transport from the MSP, backloaded MSP process waste would be deposited in a designated stockpile at the mine site.  Backloaded MSP process waste would be slurried and deposited or placed directly on the sand residue beach and/or with overburden and covered with overburden.
Water Supply	Water requirements would be supplied primarily by two borefields within the MLA area.  The maximum water supply requirement from either borefield would be 370 litres per second (L/s), much of which is returned to the water table after use.  Water would be recycled on-site (where practicable) to minimise the quantity of water extracted from the borefields.
Rehabilitation Works	Progressive rehabilitation would be undertaken as mining advances. Rehabilitation trials and investigations would be undertaken to assess the effectiveness of rehabilitation techniques, cover depths and the performance of different plant species over the life of the Snapper Mine.
Access	Snapper Mine traffic would share the existing 64 km HAR from the Ginkgo Mine to the Silver City Highway. The HAR would be extended in two locations to access the Snapper Mine site.
Electricity Supply	A 10 km long 66 kilovolt (kV) ETL would be constructed to extend the existing ETL from the Ginkgo Mine to the Snapper Mine.
Hours of Operation	24 hours per day, seven days per week.
Establishment Cost	Approximately \$105 million (M).
Employment	Construction workforce averaging around 200 people with a maximum of approximately 250 employees required during peak construction activity.  Operational workforce of approximately 110 employees.

\* Subject to Project Approval.



**SNAPPER MINERAL SANDS PROJECT**  
**FIGURE ES-3**  
 Snapper Mine  
 General Arrangement Year 1

Major construction activities are included in the provisional Snapper Mine construction schedule (Table ES-2).

### **Operation**

The general arrangement of the Snapper Mine site at Year 1, Year 14, and post-mining is shown on Figures ES-3 to ES-5.

Dredge mining has been selected as the most efficient method of mining the Snapper deposit due to the location of the orebody with respect to the standing groundwater table, the presence of suitable quantities of groundwater resources and the physical characteristics of the sands that make up the orebody.

Secondary mining of ore by conventional mobile equipment would be undertaken in various locations along the mine path where ore is located at levels above the groundwater table such that dredge mining is not feasible. This mining method would be supplementary to the main dredge mining and would not be a significant method of ore extraction. Secondary mining of ore would involve the use of conventional mobile equipment (i.e. dozers and/or scrapers) depositing ore in front of the dredge.

### *Snapper Mine Production*

The combined development of the Snapper and Ginkgo Mines would result in a maximum mineral concentrate production rate of approximately 650,000 tpa. The maximum production rate from the Snapper Mine alone during its 16 year life would be approximately 450,000 tpa.

### *Mineral Concentrate Handling*

The stages of mineral concentrate processing to be undertaken at the Snapper Mine are shown on Figure ES-6. Primary separation of the valuable minerals would occur in a primary gravity concentration unit located behind the dredge within the dredge pond. The HMC produced by the primary gravity concentration unit would be pumped to the shore-based HMC treatment facility located adjacent to the mine path (Figures ES-3 and ES-4).

Due to the saline nature of the groundwater at the Snapper Mine site, HMC pumped from the primary gravity concentration unit would have a high salt content. The HMC would be washed with desalinated water in the salt washing facility to enhance mineral separation efficiency.

Following washing, the mineral concentrate would be pumped into the WHIMS circuit. The WHIMS circuit separates the HMC into the ilmenite-rich, leucoxene-rich and non-magnetic (rutile-rich and zircon-rich) concentrates using magnetic separation methods. The leucoxene-rich and non-magnetic concentrates would then be transported to the MSP. The ilmenite-rich concentrate would be stockpiled and transported to the MSP during the latter years, or it would be transported for sale without further processing (depending upon prevailing market conditions) subject to relevant approvals being obtained.

### *Sand Residue Disposal*

The dredge pond would be progressively enlarged until it reaches its design dimensions. During this period, the initial sand residue dam would be used to contain barren sand material that cannot be returned behind the dredge pond. This material would rapidly settle out and supernatant water would be returned to the dredge pond.

Once the dredge pond reaches design dimensions, sand residues would be stacked directly into the rear of the dredge pond (Figure ES-6).

### *Overburden*

Overburden would be handled by a combination of slurring and conventional load and haul methods. The majority of the overburden would be slurried. The type and amount of overburden to be slurried would be dependent on its clay content.

For an initial period when there is insufficient area behind the dredge pond, overburden would be deposited in an initial slurried overburden emplacement and initial non-slurried overburden emplacements (Figure ES-3).

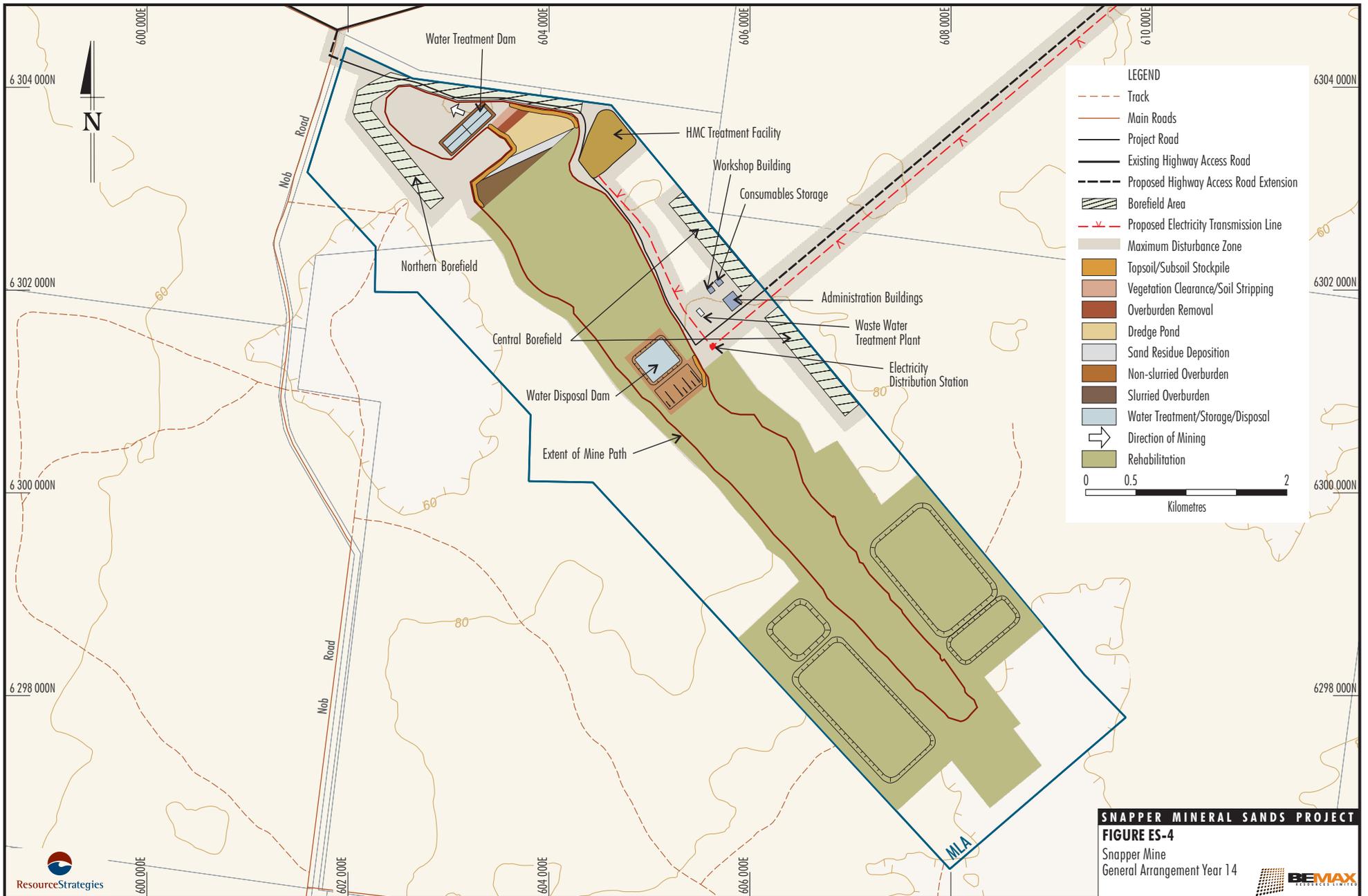
Following this initial period, overburden would be replaced behind the dredge pond. Replacement behind the dredge pond would include placement of slurried overburden on top of the sand residues and replacement of non-slurried overburden on top of the slurried overburden.

### *Mineral Concentrate Transport*

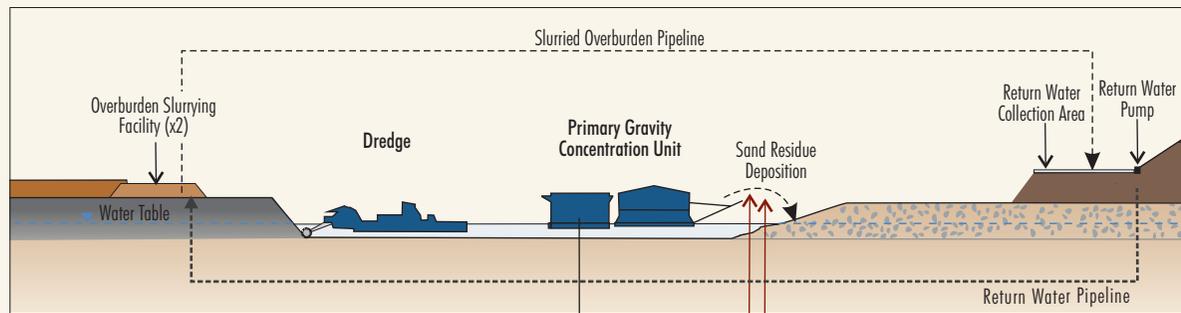
The Snapper and Ginkgo Mines would transport up to approximately 735,000 tpa of concentrate to the MSP after an initial period when ilmenite-rich concentrate would be stockpiled. The maximum frequency of combined Snapper and Ginkgo Mines double road trains would be approximately 37 trips per day.

**Table ES-2  
Provisional Snapper Mine Construction Schedule**

Activity	Snapper Mine Month																
	Pre-Cons	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Engineering Design	=====																
Procurement of Major Items	=====																
Expansion of Ginkgo Mine Accommodation Camp	=====																
Access Road		=====															
Roads		=====															
Laydown Area		=====															
Construction Pit		=====															
Initial Overburden Emplacements		=====															
Dredge and Primary Gravity Concentration Unit Design and Assembly		=====															
Process Water Reticulation System							=====										
Initial Sand Residue and Water Supply Dams								=====									
Water Treatment Dam (Initial)								=====									
ETL								=====									
Overburden Removal																=====	
Overburden Slurrying System																	=====
Reverse Osmosis Plant																	=====
Salt Washing Facility																	=====
WHIMS																	=====
Commissioning of the Dredge and Primary Gravity Concentration Unit																	=====
Mineral Concentrate Production																	=====

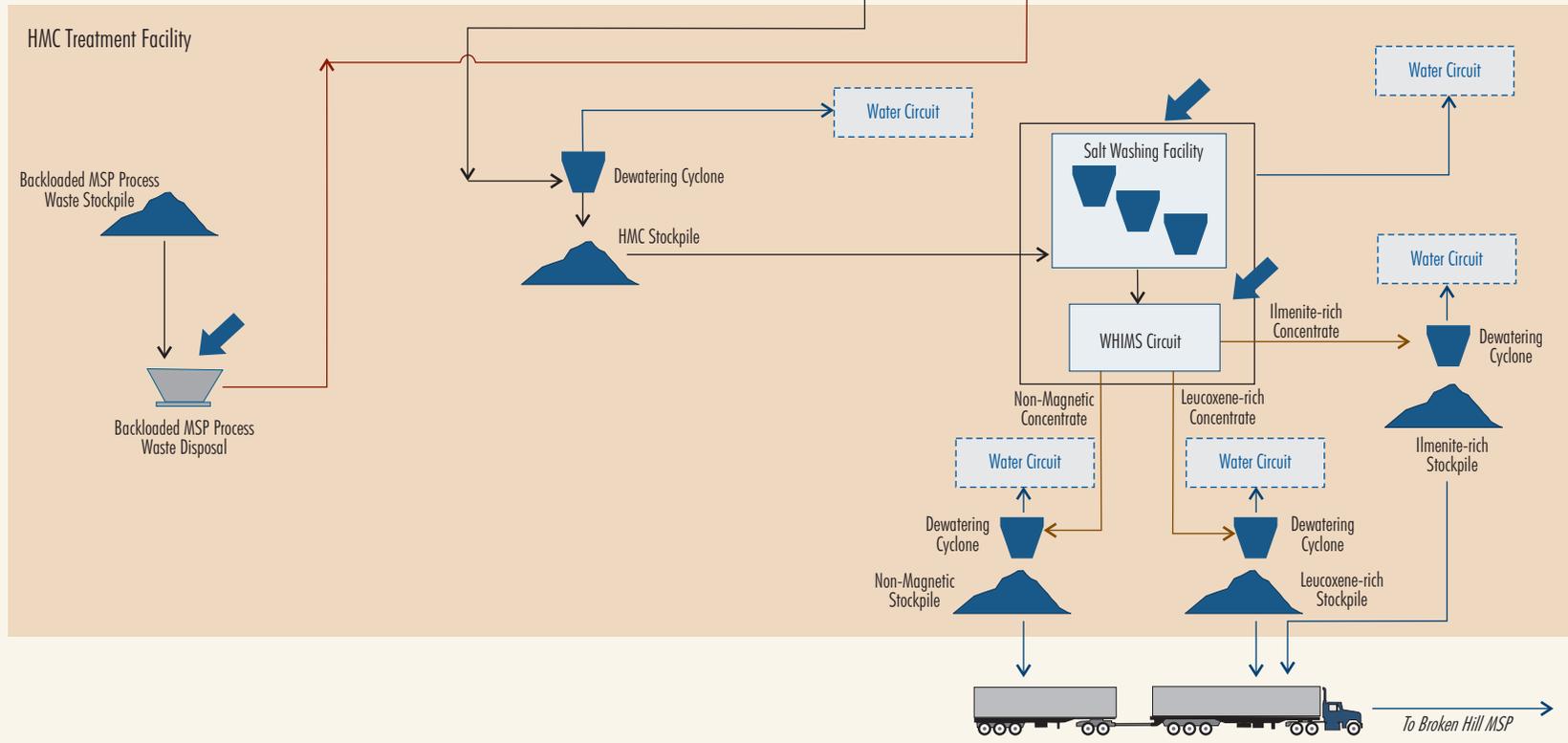






**LEGEND**

- Reject
- Processing Flow
- Product
- Water Flow
- Water Input



**SNAPPER MINERAL SANDS PROJECT**  
**FIGURE ES-6**  
 Process Flowsheet

### *Backloaded MSP Process Waste*

A proportion of waste material from MSP separation would be backloaded to the Snapper Mine. Some of this waste would include monazite, a naturally occurring radioactive material.

The Snapper Mine backloaded MSP process waste is expected to have similar physical and chemical properties to the backloaded Ginkgo Mine MSP process waste. The backloaded MSP process waste would therefore be classified as *hazardous waste* under the *Protection of the Environment Operations Act, 1997* (POEO Act).

Radioactivity levels would be assessed to identify relevant requirements to keep levels below occupational health and safety and environmental exposure limits outlined in outlined in *Recommendations for Limiting Exposure to Ionizing Radiation and National Standard for Limiting Occupational Exposure to Ionizing Radiation* (ARPANSA and NOHSC, 2002) throughout Snapper Mine operation.

Backloaded MSP process would be deposited on sand residues and/or with overburden and would be covered under a minimum of 10 m of overburden.

### *Water Requirements*

In addition to water sourced directly from the dredge pond, the central and northern borefields shown on Figures ES-3 and ES-4 would provide the water required for the Snapper Mine. The major water requirements for the Snapper Mine would be generated by dredge pond level adjustments. Adjustments would be required to maintain dredge access to the orebody and minimise dilution.

The scale of the dredge pond level adjustments would vary according to the level of the existing water table relative to the orebody. The standing water table lies at an average depth of 45 m below the ground level. The maximum adjustments required would occur at the northern end of the mine path where the orebody dips below the 20 m range of the dredge. In this area, water table lowering, by extracting water from the dredge pond and/or northern borefield (Figure ES-4), would induce the maximum water requirement (370 L/s) from either of the borefields during the Snapper Mine life.

### *Water Management Structures*

The main water management structures (i.e. those used to manage relatively significant volumes of water at the Snapper Mine) include the initial water dam, water treatment dams and water disposal dam. Additional water management structures (e.g. erosion and sediment control structures) would be utilised for relatively minor volumes of water.

#### Initial Water Dam

Water from the borefield would be used to fill the initial water dam during the final six months of construction. The water within the initial water dam, together with water from the central borefield, would then be piped to flood the construction pit, thereby creating the dredge pond ready for commencement of dredge mining.

#### Water Treatment Dams

Water treatment dams would be constructed to facilitate the removal of fines material which is collected in the process water from the primary gravity concentration unit. A number of water treatment dams would be constructed as mining advances along the mine path.

A flocculant would be added to the overflow water prior to it entering the water treatment dam to enhance particle coagulation and minimise settling times.

After approximately 48 hours of settling time, approximately 50% of the process water would be decanted from the surface of the dam and returned to the dredge pond. The remainder would be lost in evaporation, minor seepage or retained with the fines material. After 14 to 21 days, the fines material would be collected and disposed of in the mine path area thereby re-establishing storage capacity.

#### Water Disposal Dam

The water disposal dam would be constructed within the mine path on permeable slurried overburden and sand residues. The dam walls would be clay-lined to minimise lateral seepage. The base of the dam would not be clay-lined, to allow vertical seepage to the groundwater table. To reduce the dredge pond water level sufficiently to mine in Years 14, 15 and 16, water would be pumped to the water disposal dam from Year 12.

### ES1.3 RELEVANT STATUTORY PROVISIONS

#### **Approval Process**

This EA has been prepared to accompany the July 2006 Snapper Mine Project Application made in accordance with Part 3A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act).

The Snapper Mine will be assessed in accordance with the framework established by the EP&A Act and the *Environmental Planning and Assessment Regulation, 2000* (EP&A Regulation) and approval for the Snapper Mine will be sought under Part 3A of the EP&A Act. Accordingly, the Director-General notified BEMAX, on 17 August 2006, of the Director-General's Requirements (DGRs) (referred to in the EP&A Act as "environmental assessment requirements") for the Snapper Mine.

A summary of the DGRs is provided in Table ES-3. Table ES-3 also provides the relevant section of the EA where each issue raised in the DGRs is addressed.

Statutory provisions relevant to the Snapper Mine are described in the EA.

#### **The Ginkgo Mine**

From a planning framework perspective, interaction between the Snapper and Ginkgo Mines would not trigger a requirement to modify the Ginkgo Mine Development Consent.

#### **MSP**

Interaction between the Snapper Mine and the MSP (including changes to the processing rate, fuel requirements, emissions and amount of mineral product railed from the MSP) would trigger a requirement to modify the MSP Development Consent. An application under Section 96(2) of the EP&A Act is proposed to seek approval for the changes proposed at the MSP triggered by the development of the Snapper Mine.

## ES2 CONSULTATION

BEMAX is committed to an open and constructive consultation programme, which aims to:

- inform government and public stakeholders of the nature and status of its regional operations;
- present information to stakeholders to facilitate a clear understanding of its regional operations;

- identify issues of concern to stakeholders for consideration in this EA; and
- establish dialogue between BEMAX and government and community stakeholders that would be on-going, should the Snapper Mine be approved.

#### **Government Agencies**

Consultation with relevant NSW government agencies commenced in 2003. A Planning Focus Meeting (PFM) was held on 20 August 2003. A range of Commonwealth, State and local government agencies were consulted during preparation of the EA, including:

- Department of Environment and Heritage (DEH);
- Department of Planning (DoP);
- DEC;
- RTA;
- Wentworth Shire Council (WSC);
- Broken Hill City Council (BHCC);
- Department of Primary Industries – Mineral Resources (DPI-MR);
- DPI-Agriculture; and
- Department of Natural Resources (DNR).

#### **Public Consultation**

BEMAX has been engaged in consultation with the local community since the initiation of the Ginkgo Mine exploration programme in 1998. With respect to the Ginkgo Mine, BEMAX has developed a formal on-going programme of public consultation. This programme commenced in July 2001. Further, BEMAX has implemented the *Ginkgo Mineral Sands Project Community Consultation Plan (CCP)* (BEMAX, 2004a), in accordance with Ginkgo Mine Development Consent. The Ginkgo Mine CCP (*ibid.*) outlines the mechanisms for on-going consultation with local residents, regarding the Ginkgo Mine.

At the MSP, consultation with local landholders commenced in September 2001. Further, in accordance with the MSP Development Consent, BEMAX has established a Community Consultation Program to liaise with the community (for the life of the MSP) on matters affecting the local community and the environmental performance of the MSP.

**Table ES-3  
Snapper Mine DGRs – Reference Summary**

General/Key/Consultation Requirements	Document Reference
<b>General Requirements</b>	
The Environmental Assessment must include:	
Executive Summary.	Executive Summary – front of EA document
Description of the proposal including a justification of the need for the Snapper Mine, alternatives considered and the various components and stages of the Snapper Mine.	Sections 1, 2 and 3.9
Consideration of relevant statutory provisions.	Section 3
A general overview of the environmental impacts (General Overview) of the Snapper Mine, identifying the key issues for further assessment and taking into consideration the issues raised during consultation.	Section 3.8 and Appendix L
A detailed assessment of the key issues for the Snapper Mine (and any other significant issues identified in the General Overview for the Snapper Mine), including a description of the existing environment, an assessment of potential impacts of the Snapper Mine and a description of the measures, that would be implemented to avoid, minimise, mitigate, offset, manage, and/or monitor the impacts of the Snapper Mine.	Section 4 and Appendices A to L
Draft Statement of Commitments.	Section 6
A conclusion justifying the Snapper Mine, taking into consideration the environmental impacts of the Snapper Mine, the suitability of the site and the benefits of the Snapper Mine.	Section 3.9
Certification by the author of the Environmental Assessment.	Front of EA document
<b>Key Issues</b>	
The Environmental Assessment must include assessment of the following key issues:	
Flora and Fauna – an assessment of impacts on critical habitats, threatened species, populations, ecological communities and native vegetation. A comprehensive offset strategy must be included as part of the mitigation measures.	Sections 4.9 and 4.10 and Appendices D and E
Surface Water and Groundwater – an assessment of surface and groundwater impacts including detailed modelling of potential surface and groundwater impacts and a site water balance.	Sections 2.7, 4.4 and 4.5 and Appendix A
Noise – an assessment of noise impact including construction, operation and road noise impacts.	Section 4.11 and Appendix F
Air Quality – an assessment of air quality including a greenhouse gas assessment.	Section 4.12 and Appendix G
Traffic and Transport – an assessment of traffic and transport impacts.	Section 4.8 and Appendix C
Hazard and Risk – an assessment of the hazards and risks associated with the transport, handling and disposal of waste in accordance with the requirements of its classification.	Section 4.15 and Appendices H, I, K and L
Heritage – an assessment of Aboriginal and non-Aboriginal heritage.	Sections 4.6 and 4.7 and Appendix B
Social and Economic – an assessment of social and economic impacts.	Sections 4.13 and 4.14 and Appendix J
Rehabilitation and Final Landform – a justification of the proposed final landform, a detailed description of how the site would be progressively rehabilitated and management measures that would be put in place for the long-term protection of the site after cessation of mining operations. An assessment of the risks to the success of rehabilitation and revegetation of the site associated with the use of saline slurry in the overburden emplacements.	Sections 2 and 5 and Appendix H
Cumulative Impacts – an assessment of the cumulative impacts which may arise from the combined operation of the Snapper Mine and the Ginkgo Mine, particularly on flora and fauna, surface water, groundwater and transport.	Section 4
<b>Consultation</b>	
During the preparation of the Environmental Assessment, consultation must be undertaken with the relevant local, state or commonwealth government authorities, service providers, community groups or affected landowners. In particular consultation must be undertaken with:	Section 3.7
<ul style="list-style-type: none"> <li>• NSW Department of Environment and Conservation;</li> <li>• NSW Roads and Traffic Authority;</li> <li>• Wentworth Shire Council; and</li> <li>• Broken Hill City Council.</li> </ul>	

Informal consultation with the local community regarding the Snapper Mine commenced with the initiation of the exploration programme in 1999. Communication with directly-affected landholders was conducted during the preparation of the EA.

Consultation with the Aboriginal community included interested individuals as well as the following groups:

- the Barkindji Elders Committee (BEC); and
- the Webster Family.

Relevant issues raised by Aboriginal stakeholders were considered in the Cultural Heritage Assessment, including development of the management measures.

A range of service providers have been consulted with respect to the services likely to be required for the Snapper Mine. This included consultation with providers of electricity, health, education, real estate and regional development services.

## ES3 ENVIRONMENTAL ASSESSMENT

### ES3.1 GENERAL OVERVIEW

In accordance with the DGRs, a General Overview of Environmental Impacts (General Overview) was undertaken to identify key issues for the Snapper Mine. This included a review of the scope of the EA studies to confirm that the key issues identified during the General Overview and consultation would be addressed in the EA. The General Overview did not identify any further assessment requirements beyond that included in the EA.

### ES3.2 FLORA AND FAUNA

The Flora and Fauna Assessments were prepared generally in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005) and with consideration of the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC, 2004a). FloraSearch conducted flora surveys and Western Research Institute conducted fauna surveys in the Snapper Mine area and surrounds.

The surveys included targeted searches for species and ecological communities listed as threatened under the *Threatened Species Conservation Act, 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act).

#### Existing Environment

##### Flora

The Snapper Mine is located near the centre of the Far South Western Plains Botanical Division of NSW. It is also located within the Murray-Darling Depression (MDD) Region as defined by the *Interim Biogeographic Regionalisation for Australia* (Thackway and Cresswell, 1995; DEH, 2006a).

Seven plant communities were identified in the Snapper Mine area as shown on Figure ES-7 and listed below:

- Black Box Woodland.
- Black Oak-Rosewood-Wilga Woodland.
- Chenopod Mallee Woodland/Shrubland.
- Irregular Dune Mallee Shrubland.
- Turpentine Shrubland.
- Bluebush Shrubland.
- Austrostipa Grassland.

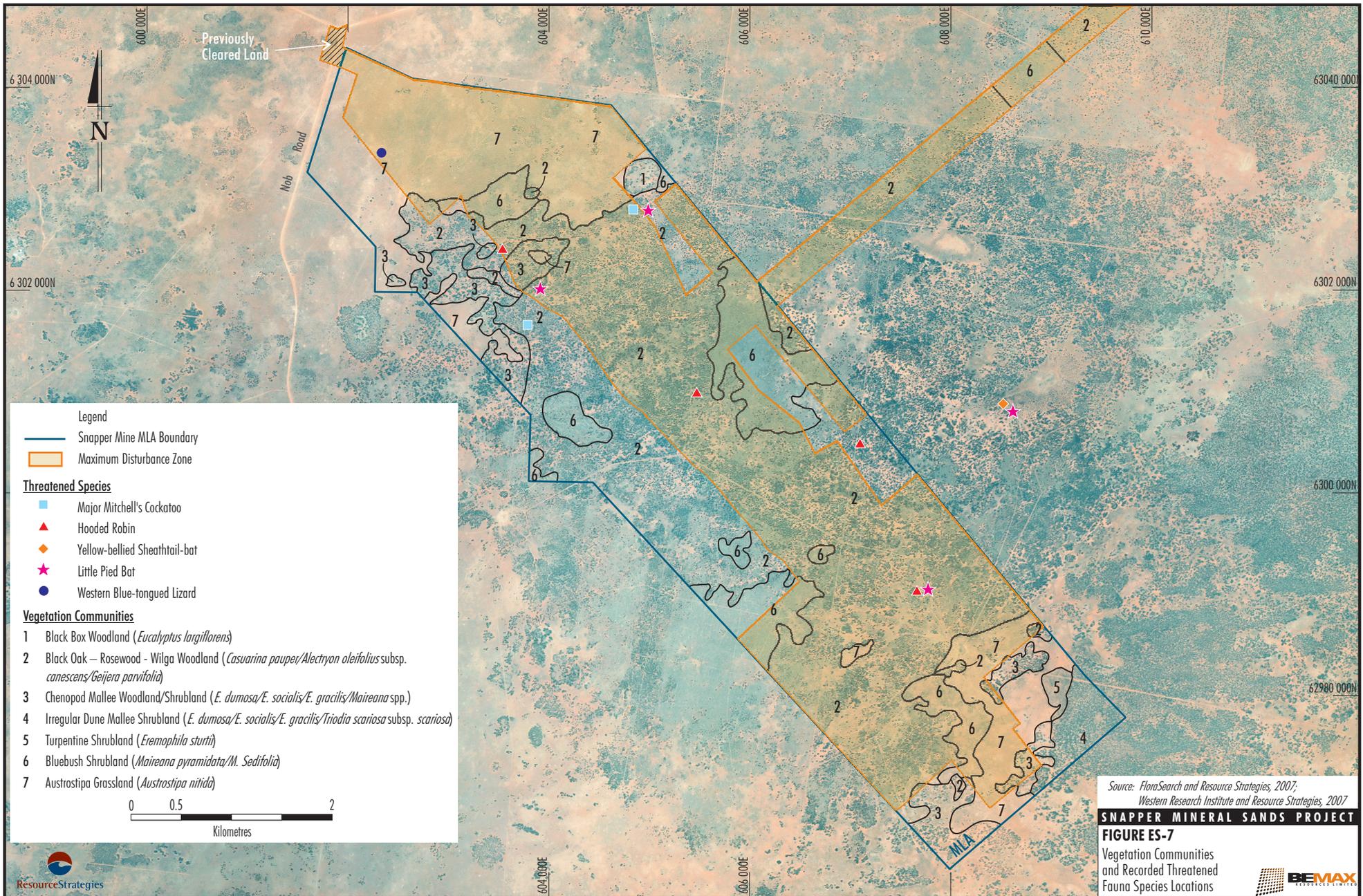
The vegetation communities form a mosaic through the Flora Assessment study area such that the degree of connectivity within each vegetation community varies (Figure ES-7). The condition of the vegetation in the Snapper Mine area is degraded mainly due to pastoral land management practices (e.g. grazing, thinning and burning).

No flora species listed as threatened under the TSC Act or the EPBC Act were identified in the Snapper Mine area and surrounds. In addition, no threatened ecological communities listed under the TSC Act or the EPBC Act were identified.

##### Fauna

Three major fauna habitat types were identified in the study area as follows:

- Mixed Woodland.
- Open Grassland/Shrubland with Scattered Trees.
- Mallee Shrubland - characterised by open Mallee to approximately 6 m in height.



All three habitat types have a medium to a high level of degradation due to pastoral land management practices.

Five threatened fauna species were recorded within the Snapper Mine area and surrounds, namely the Western Blue-tongued Lizard, Major Mitchell's Cockatoo, Hooded Robin, Yellow-bellied Sheath-tail-bat and Little Pied Bat.

An additional 13 threatened species were recorded in the wider area by Mount King Ecological Surveys (2001) during Ginkgo Mine surveys in 2001.

### **Potential Impacts**

Approximately 1,630 hectares (ha) of vegetation would be cleared or modified for the Snapper Mine (including the HAR and ETL extensions) comprising approximately:

- 1,075 ha of Black Oak – Rosewood - Wilga Woodland;
- 325 ha of Austrostipa Grassland;
- 200 ha of Bluebush Shrubland; and
- 30 ha of Chenopod Mallee Woodland/Shrubland.

Twenty-four threatened fauna species and 10 threatened flora species were assessed generally in accordance with the draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). The assessment included species recorded at the Ginkgo Mine site and considered the potential cumulative impact of the Snapper and Ginkgo Mines.

The Flora and Fauna Assessments concluded the following:

- The Snapper Mine would be unlikely to reduce the long-term viability of any local population of fauna and flora species.
- The Snapper Mine would be unlikely to lead to the extinction of any fauna and flora species or population or place any at risk of extinction.
- The Snapper Mine would be unlikely to adversely affect critical habitat as no critical habitats are known to occur in the vicinity of the mine.
- The Snapper Mine would be unlikely to adversely affect areas of high conservation value.

- The habitat removal would be considered unlikely to adversely impact the long-term viability of any fauna and flora species, population or ecological community.
- Adverse impacts from the Snapper Mine on fauna and flora are likely to continue to diminish throughout the life of the mine. At the time of mining lease relinquishment, the DPI-MR would ensure that relevant relinquishment requirements (e.g. demonstration of a stable final landform which is generally consistent with the surrounding landscape) have been fulfilled. It should be noted that appropriate impact mitigation measures would be implemented from the commencement of the Snapper Mine.
- Given the above, from a regional perspective, adverse impacts from the Snapper Mine on fauna and flora are unlikely to be permanent or irreversible.
- The fauna and flora values of the region would be likely to be maintained, and possibly improved, considering the Snapper Mine's measures to avoid, mitigate and/or offset potential impacts.

### **Potential Cumulative Impacts**

Potential cumulative impacts from the combined operation of the Snapper and Ginkgo Mines on flora and fauna predominantly relate to potential impacts associated with habitat disturbance and alteration which are primarily associated with the clearance of vegetation.

The assessment of potential cumulative impacts on flora and fauna has taken into consideration the results of flora surveys within the vicinity of the Snapper and Ginkgo Mine areas, the characteristics of the existing vegetation, existing landuses and the extent and type of vegetation disturbance associated with the Snapper Mine. The assessment of potential cumulative impacts on fauna has taken into consideration the results of fauna surveys within the vicinity of the Snapper and Ginkgo Mine areas.

The extent of potential cumulative impacts would be minimised by management and mitigation measures required and/or implemented at the Ginkgo Mine and proposed for the Snapper Mine.

### **Mitigation Measures and Management**

Flora and fauna values in the area would be maintained such that there would be no net loss of flora and fauna values in the medium to long-term. The following components of the Snapper Mine would achieve this:

- impact avoidance and mitigation measures;
- progressive rehabilitation and revegetation; and
- the Snapper Mine vegetation offset.

#### *Impact Avoidance and Mitigation Measures*

Impact avoidance and mitigation measures include:

- a Flora and Fauna Management Plan (FFMP);
- a Vegetation Clearance Protocol (VCP);
- a Threatened Species Management Protocol (TSMP);
- grazing management;
- control of introduced flora species;
- control of introduced animal species;
- dust suppression;
- bushfire risk management; and
- vehicular traffic management.

#### *Flora and Fauna Monitoring*

Flora and fauna monitoring which would be conducted is described below:

- Photographic monitoring of rehabilitation areas and vegetation surrounding the mine path and initial overburden emplacement.
- The presence of the Painted Burrowing Frog.
- Presence of pests and weeds and the effectiveness of pest and weed control measures.

#### *Rehabilitation/Revegetation of Disturbance Areas*

While approximately 1,630 ha of native vegetation would be removed over the life of the Snapper Mine, the Snapper Mine disturbance areas would be progressively rehabilitated and revegetated as mining proceeds and infrastructure is decommissioned. Proposed revegetation provides for the selective planting of species characteristic of the vegetation communities cleared.

### *Comprehensive Snapper Mine Offset Strategy*

Consultation with respect to establishing a Snapper Mine vegetation offset strategy was undertaken with the DoP, NSW Department of Environment and Conservation (DEC) and DNR during the preparation of this EA. During this consultation it was agreed that a process for offsetting the vegetation clearance associated with the Snapper Mine would be provided. As described below, this offset strategy provides for either a process for establishing an offset landholding and/or participation in the BioBanking Scheme, or an alternative arrangement that is acceptable to the Director-General of DoP.

This offset strategy would result in the conservation of an equivalent area of vegetation to that disturbed by the Snapper Mine (i.e. 1,630 ha) (or an alternative area to the satisfaction of the Director-General of DoP).

If an offset landholding is to be established, BEMAX would prepare and submit a Snapper Mine Vegetation Offset Proposal to DoP within 12 months of Project Approval.

Regardless of the offset approach adopted (i.e. an offset landholding, participation in BioBanking and/or an alternative arrangement to the satisfaction of the Director-General of DoP), the long-term security of the Snapper Mine vegetation offset measures would be established within three years of Project Approval or within a period to the satisfaction of the Director-General of DoP.

## **ES3.3 SURFACE AND GROUNDWATER**

### **ES3.3.1 Surface Water**

#### *Existing Environment*

The Snapper Mine area is located within the lower Darling River system, which extends from the Menindee Lakes to the junction of the Darling River and the Murray River at Wentworth. The Darling River and Great Darling Anabranch are significant regional surface water features which, at their closest points are located some 30 km south-east and 23 km north-west of the MLA area respectively.

There are no well defined natural drainage channels within the MLA area. Overland flow does occur during prolonged rainfall events and surface waters accumulate in topographic depressions and then evaporate or seep into the groundwater table over time.

### **Potential Impacts**

The potential impacts of the Snapper Mine on surface water systems are limited due to the distance of the mining activity from any significant surface water systems (Figure ES-1).

There is some potential for diesel or oil spills from mobile equipment and sediment or salt runoff to localised short-term water features during heavy rain. There is also potential for a truck or light vehicle accident on the HAR or Silver City Highway to result in pollution of surface water features (e.g. a spill of fuel to the Great Darling Anabranch).

### **Potential Cumulative Impacts**

The areas in and around the Ginkgo and Snapper Mines characteristically have almost no traces of channel flow, and in cases where channels occur, they are shallow, narrow and discontinuous. There are no defined surface drainage features (e.g. drainage channels) that link the Ginkgo and Snapper Mine areas. Potential cumulative impacts on regional surface water features as a result of surface water runoff would be unlikely.

### **Mitigation Measures and Management**

To manage potential impacts on surface water resources, the Snapper Mine water management system would contain and control waters generated from Snapper Mine development and operation areas, while diverting other runoff water around such areas.

Areas disturbed by mining would be minimised and the site would be segregated into undisturbed runoff areas and operation runoff areas through the use of bunding.

A Site Water Management Plan (SWMP) would be developed and would detail measures to minimise potential impacts relating to erosion and sedimentation of topsoil, subsoil and overburden materials to be handled during construction and operation of the Snapper Mine.

#### **ES3.3.2 Groundwater**

A Hydrogeological Assessment of the local and regional groundwater systems in the vicinity of the Snapper Mine was undertaken by Golder Associates.

### **Existing Environment**

The Snapper Mine lies within a large aquifer system that extends west of the Great Darling Anabranch and Silver City Highway, east of the Darling River and south to the Murray River. The main aquifer of interest to the Snapper Mine is the Loxton-Parilla aquifer which is also the case for the Ginkgo Mine

The Loxton-Parilla aquifer at the Ginkgo and Snapper Mine sites varies little in groundwater quality or groundwater levels for tens of kilometres. The regional groundwater flow is very slow from the north and east margins of the aquifer basin toward the south-west to areas of discharge predominantly at the Murray River and a general area west of the Silver City Highway. Evaporative discharge also occurs from areas with shallow water tables such as The Salt Lakes.

The saline groundwater in the Loxton-Parilla aquifer receives recharge from the Darling River, Menindee Lakes and intermittently from the Great Darling Anabranch at very slow rates from freshwater alluvial aquifers which occur beneath these regional hydrological features. There is no significant connection between these alluvial aquifers and the deeper Loxton-Parilla aquifer.

The saline groundwater in the Loxton-Parilla aquifer is comparable to seawater. The Ginkgo Mine is the only significant user (i.e. agricultural or industrial) of groundwater from the Loxton-Parilla aquifer in the vicinity of the Snapper Mine. In general, little groundwater between the Darling River and the Great Darling Anabranch is withdrawn and used for agricultural purposes due to either its poor quality and/or limited availability in comparison to fresh water piped from the Darling River and the Great Darling Anabranch systems.

Other groundwater use in the region includes extraction for local stock watering from isolated fresh groundwater sources such as isolated lenses (which occur in localised topographic depressions overlying the denser and more saline water of the Loxton-Parilla aquifer) and the alluvial aquifer associated with the Darling River.

### **Site Water Balance**

A site water balance was prepared by Golder Associates for the Snapper Mine which considers the following inputs to and outputs from the water management system:

- water required to fill the initial water dam;
- water required to flood the construction pit using initial water dam and borefield water;

- water required during deepening and extending the dredge pond to the required operation dimensions;
- dredge pond water level adjustments;
- water retained in the tailings sand residue and slurried overburden;
- water retained in fines;
- water consumed in the HMC treatment facility including that transported off-site; and
- water lost to evaporation.

During operation, the average groundwater requirement from the borefields would be approximately 165 L/s. The maximum water supply requirement from either borefield (370 L/s) would be pumped during Years 14 to 16.

### **Potential Impacts**

#### *Groundwater Drawdown*

The regional groundwater model indicates that the level of drawdown of the Loxton-Parilla aquifer would increase over the mine life, with groundwater level recovery commencing at the end of the mine life when pumping from the borefields would cease. When borefield pumping ceases, drawdown in the mining area would reduce in depth while the overall extent of the shallow drawdown area would continue to extend until the cone of depression stabilises, after which the depth of shallow drawdown would gradually reduce towards zero.

#### *Other Groundwater Users*

Existing stock watering bores surrounding the Snapper and Ginkgo Mines which access isolated trench groundwater lenses would potentially experience a reduction in water levels as a result of lowering the underlying saline aquifer.

The regional groundwater model indicates a groundwater drawdown at landholder bores, such as Greenvale Well, Chalky Well and Court Nareen Well (Figure ES-8). The maximum drawdown at a bore can be expected to closely mirror the drawdown predicted for the saline Loxton-Parilla aquifer at the bore location. In the event that freshwater lenses are lowered, no significant impact on groundwater quality would be anticipated.

#### *Regional Hydrological Features*

No significant drawdown of the saline aquifer beneath the Darling River and Great Darling Anabranch is predicted. Any mine drawdown of the Loxton-Parilla aquifer beneath these features that does occur (i.e. potentially in the order of centimetres) would be within the range of natural variations and would not result in any significant changes to the loss of surface water from the Great Darling Anabranch or Darling River to the saline aquifer.

The reduction in the water table in the vicinity of the Snapper Mine would potentially have the effect of reducing the flux of saline groundwater to areas of aquifer discharge (e.g. the Murray River and areas west of the Silver City Highway). However, due to the significant distances between the centre of the cone of depression (i.e. relatively shallow hydraulic gradient), any change in flux is estimated to be negligible when compared to that of natural variation (Appendix A).

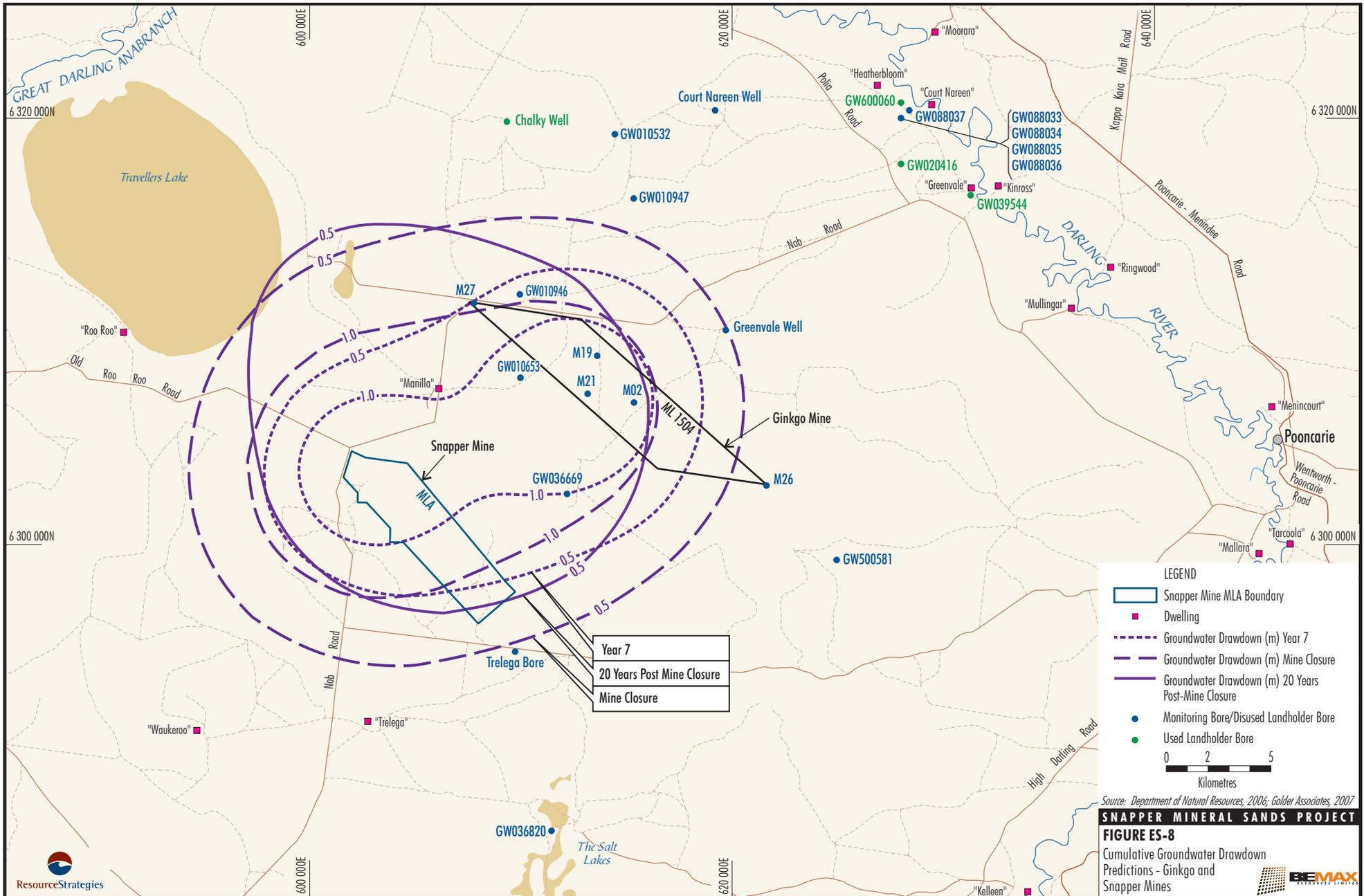
While some minor reduction in the rate of groundwater loss via evaporation at The Salt Lakes would be likely, they would remain a net groundwater loss area and no alteration of the surface features at The Salt Lakes (e.g. a surface salt crust when not inundated by surface runoff) would be expected.

#### *Lateral Saline Seepage*

Saline seepage from mine water, sand residue and slurried overburden disposal and storage areas could potentially move laterally into adjoining near surface materials and adversely affect both soils and vegetation. This potential would be limited by the high permeability of the sands that form the majority of the materials involved.

#### **Potential Cumulative Impacts**

In order to assess the potential impacts of the Snapper Mine water use, a regional numerical groundwater model was used to assess groundwater availability and to predict the extent of groundwater drawdown in the Loxton-Parilla aquifer in the vicinity of hydrological features. The model included assessment and consideration of the potential cumulative effects of the Ginkgo Mine.



### **Mitigation Measures and Management**

A revision of the *Ginkgo Mineral Sands Project Borefield Impact Management Plan (BIMP)* (BEMAX, 2006a) would address potential Snapper and Ginkgo Mine cumulative impacts. The BIMP would provide:

- a method for identifying variance to modelled groundwater impact;
- the requirement for investigations or remedial measures where relevant;
- bore monitoring trigger levels for relevant landholder bores;
- an investigation methodology to examine any exceedance of relevant triggers; and
- suitable remedial measures in the event of a significant adverse affect on a landholder bore that is attributable to the mines.

#### *Lateral Seepage Management*

The Snapper Mine initial water dam, initial slurried overburden emplacement and initial sand residue dam would be constructed with seepage controls which reflect those implemented at the Ginkgo Mine. These would include clay lining, moisture conditioned foundation preparation and compaction, embankment cut-off key trenches, toe drains and spoon drains. In addition, disposal of fines material from the water treatment dams within the backfilled Snapper Mine path would be undertaken to avoid development of a continuous fines layer across the mine path.

#### *Groundwater Monitoring*

Groundwater depth and quality monitoring in local and regional bores would be conducted for the Snapper Mine to identify drawdown of the water table or changes in groundwater quality if they occur as a result of the Snapper Mine. Monitoring of the ground surface around dams for seepage, salt deposition and effects on vegetation would also be conducted.

## **ES3.4 NOISE**

An assessment of the existing noise environment and potential noise emissions of the Snapper Mine has been undertaken by Holmes Air Sciences.

### **Background Noise**

Background noise surveys to characterise and quantify the acoustical environment in the area surrounding the Snapper Mine were conducted in August and September 2006. Analysis of the background noise monitoring in accordance with the NSW *Industrial Noise Policy (INP)* (EPA, 2000) determined that the rating background level (RBL) for the two closest residences (i.e. “Manilla” and “Trelega” homesteads) is 30 A-weighted decibels (dBA) for day, evening and night periods.

Holmes Air Sciences found that the existing traffic noise on the Silver City Highway exceeds the relevant night-time real time traffic noise criteria at distances of 10 m during weekday periods and during weekends. The calculated existing traffic noise also exceeds the daytime criteria during weekdays at a distance of 10 m. Traffic flows on the HAR are very low and the nearest residence is some 800 m from the road. No existing exceedance of the traffic noise criteria at homesteads near the HAR is anticipated.

### **Noise Criteria**

The intrusiveness criterion is met if the equivalent continuous noise level ( $L_{Aeq}(15 \text{ minutes})$ ) is less than or equal to the RBL plus 5 dBA. Analysis of the background noise monitoring in accordance with the INP determined that the RBL for the two closest residences is 30 dBA. Thus the Snapper Mine specific intrusiveness criterion is 35 dBA for the assessment for day, evening and night periods.

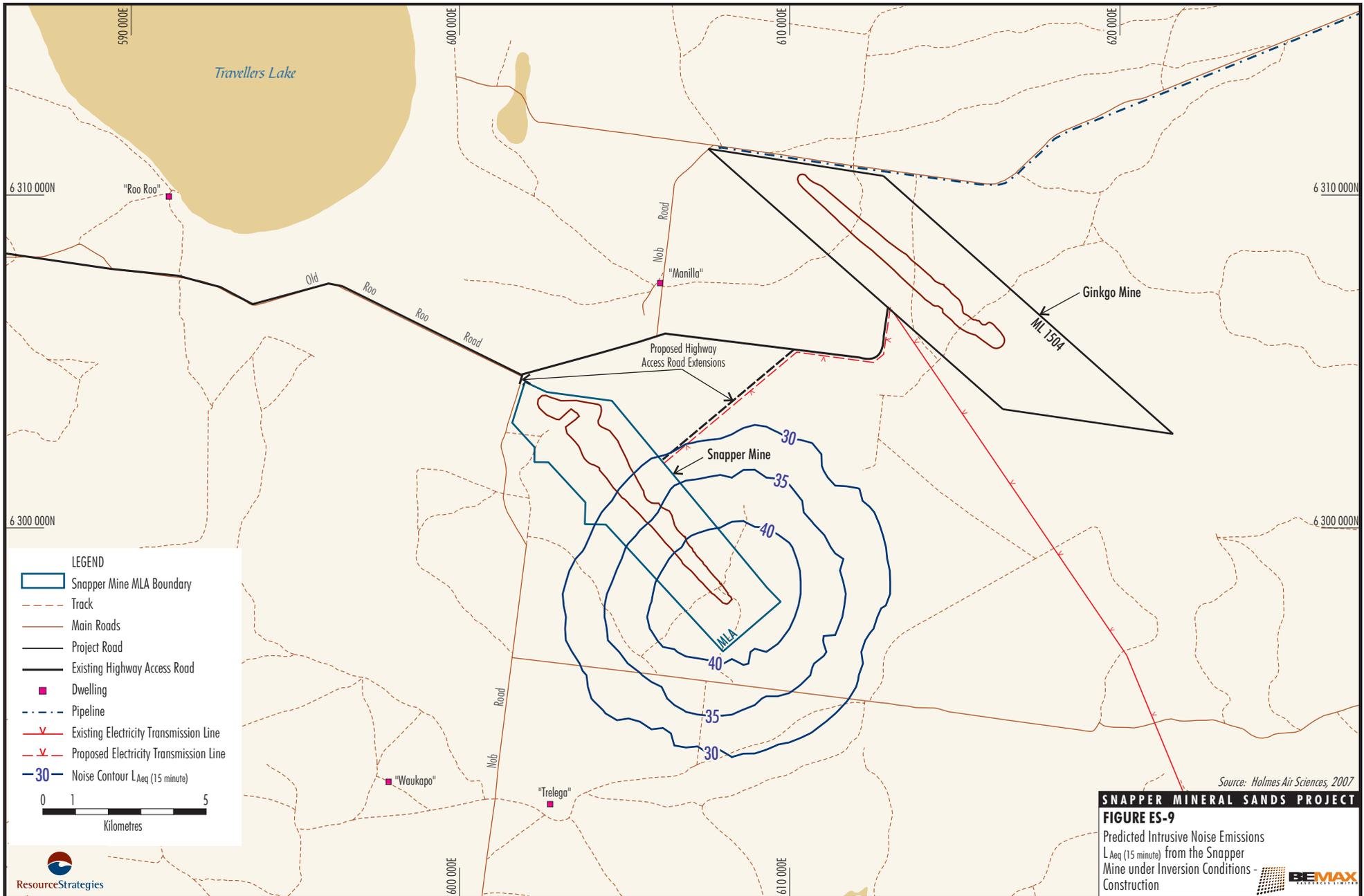
### **Potential Impacts**

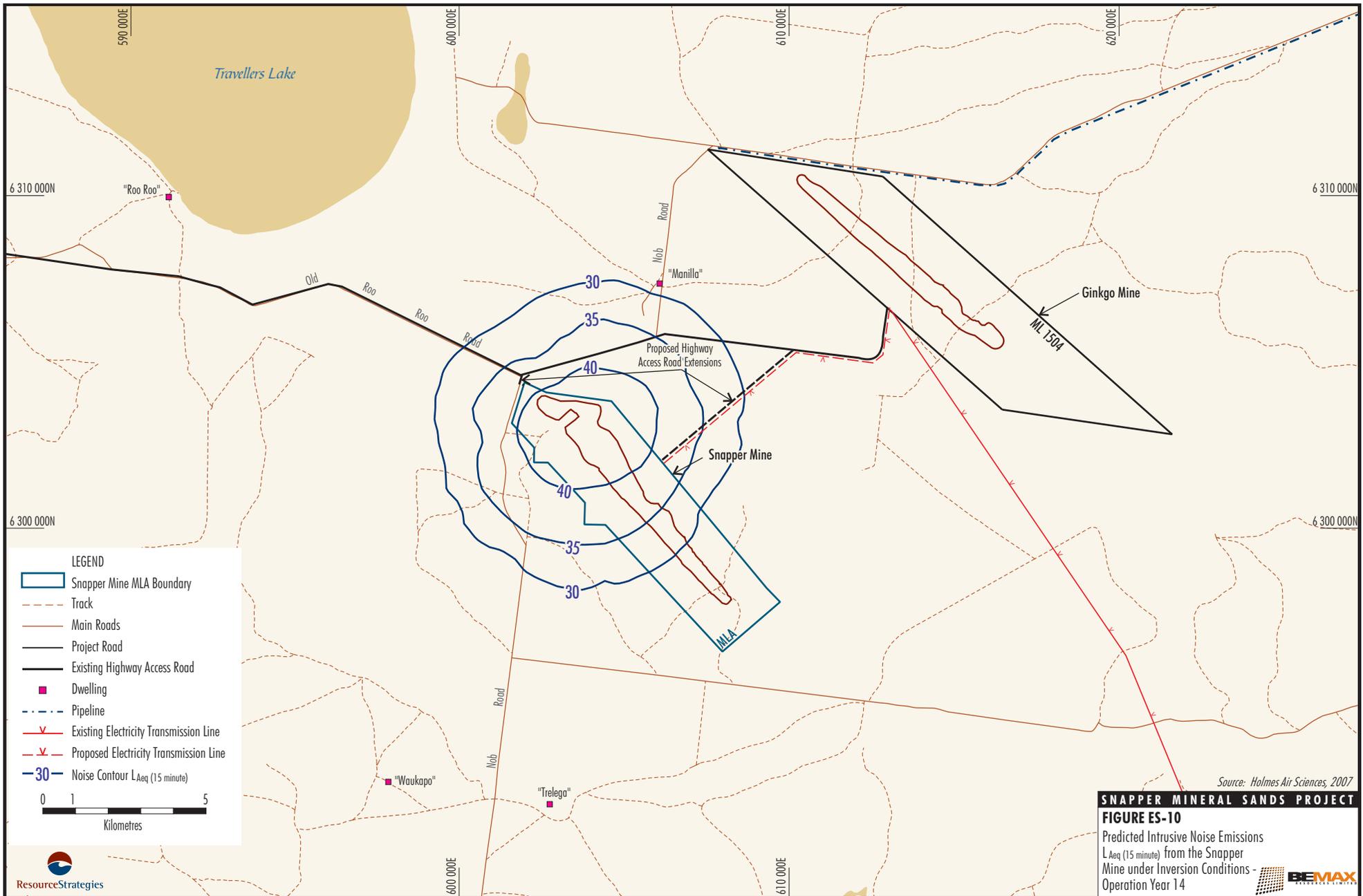
#### *Construction Noise*

A construction modelling scenario was developed to predict the noise levels likely to be experienced at the “Trelega” and “Manilla” homesteads during construction. Predicted Snapper Mine intrusive construction noise emissions are below the project-specific criteria for the closest residence (Figure ES-9).

#### *Operation Noise*

A modelling scenario was developed to predict the noise levels likely to be experienced at the “Trelega” and “Manilla” homesteads during operation. Predicted Snapper Mine operation intrusive noise emissions are below the project-specific criteria for the closest residence (Figure ES-10).





### Road Noise

Due to the 800 m distance of the closest residence to the HAR, no exceedance of applicable criteria is expected.

A comparison of existing predicted transport noise levels on the Silver City Highway with the additional Snapper Mine haulage vehicles indicates that existing noise levels would not increase by more than approximately 0.8 dBA for residences within 1 km of the road and this increase would not be discernible.

### Potential Cumulative Impacts

The closest residence to both mines would be “Manilla”. Simultaneously, the closest location of the mine noise sources from “Manilla” would be approximately 3.5 km and 5 km from the Snapper and Ginkgo Mines respectively. The potential for significant cumulative operation noise impacts is limited by these distances.

### Mitigation Measures and Management

#### Mine Noise Mitigation Measures

The following noise control measures would be applied at the Snapper Mine:

- development and implementation of an equipment maintenance schedule to maintain equipment noise emission levels and reduce the likelihood of tonal noise impacts; and
- administration of a noise awareness programme for employees on the effects of noise and quiet work practices.

A Noise Management Plan (NMP) would be prepared which provides a range of noise management measures which would be employed to reduce noise emissions of the Snapper Mine. The NMP would detail specific actions for responding to exceedances of criteria and complaints should they occur. The results of the noise monitoring programme would be used to optimise noise controls, validate the noise modelling predictions and would be reported to relevant authorities.

### Road Transport Noise Mitigation Measures

The following transport noise mitigation strategies would be implemented for road transport associated with the Snapper Mine:

- road train driver training to minimise noise for the Ginkgo Mine haulage fleet would be updated with the commencement of Snapper Mine haulage;
- provision for monitoring to assess compliance with applicable road transport noise criteria;
- provision for noise management measures; and
- inclusion of transport activities relevant to the Snapper Mine in the *Ginkgo Mineral Sands Mine and Broken Hill Mineral Separation Plant Traffic Code of Conduct (TCC)* (BEMAX, 2006b).

### Noise Monitoring

A noise monitoring programme would be provided in the NMP.

## ES3.5 AIR QUALITY

An Air Quality Assessment for construction and operation of the Snapper Mine has been undertaken by Holmes Air Sciences.

### Air Quality Criteria

#### Dust Deposition

The DEC amenity criteria for dust deposition seek to limit the maximum increase in the mean annual rate of dust deposition from a new development to 2 grams per square metre per month ( $\text{g}/\text{m}^2/\text{month}$ ) and total dust deposition (i.e. including background air quality) to 4  $\text{g}/\text{m}^2/\text{month}$ .

#### Concentrations of Suspended Particulate Matter

Suspended particulate matter criteria, standards and goals used in the assessment comprise:

- The National Environment Protection Measure (NEPM) 24-hour reporting standard for particulate matter less than 10 microns in size ( $\text{PM}_{10}$ ) of 50 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ) (with five exceedances allowed per year) and the DEC 24-hour  $\text{PM}_{10}$  assessment criterion of 50  $\mu\text{g}/\text{m}^3$ .

- The DEC annual assessment criterion for PM<sub>10</sub> of 30 µg/m<sup>3</sup> has been interpreted as a concentration that should be met within the region (concentrations due to the Snapper Mine and background).
- The National Health and Medical Research Council's (NHMRC) annual goal for total suspended particulates (TSP) of 90 µg/m<sup>3</sup> (which has been interpreted as the assessment criterion for TSP concentrations due to the Snapper Mine and background air quality).

### **Background Air Quality**

Conservatively, it has been assumed that the annual average background dust deposition rate in the Snapper Mine area is 2.4 g/m<sup>2</sup>/month based on a monitoring programme which was commenced in December 2004. No suspended particulate monitoring data is available for the Snapper Mine area. An inferred annual average of 54 µg/m<sup>3</sup> TSP background concentration and an inferred annual average background PM<sub>10</sub> concentration of 22 µg/m<sup>3</sup> has been adopted for the purposes of the Air Quality Assessment.

### **Potential Impacts**

Emissions associated with operation of the Snapper Mine would be primarily derived from the mechanical disturbance of soils and overburden when using conventional mining equipment, the particles from diesel exhausts from the transport of mineral concentrates and activities where diesel powered equipment is used, as well as wind blown emissions from open areas. Potential impacts on the closest homesteads of "Manilla" and "Trelega" have been assessed.

#### *Dust Deposition*

Incremental increases in annual average dust deposition due to the Snapper Mine only are not predicted to be above the applicable 2 g/m<sup>2</sup>/month DEC amenity criterion at either the "Manilla" or "Trelega" homesteads.

Annual average dust deposition due to the Snapper Mine plus the assumed background was also not predicted to be above the applicable 4 g/m<sup>2</sup>/month DEC amenity criterion at either homestead.

### *Suspended Particulates*

Predicted annual average PM<sub>10</sub> (Snapper Mine plus background) concentrations were not predicted to be above the DEC assessment criterion at either the "Trelega" or "Manilla" homesteads during construction or operation.

Annual average TSP (Snapper Mine plus background) concentrations were not predicted to be above the NHMRC goal of 90 µg/m<sup>3</sup> at either the "Trelega" or "Manilla" homesteads during construction or operation.

Maximum 24-hour average PM<sub>10</sub> concentrations during construction and operation (Snapper mine only) are not predicted to exceed the DEC assessment criterion of 50 µg/m<sup>3</sup> at either the "Trelega" or "Manilla" homesteads.

Holmes Air Sciences have assessed the potential for the Snapper Mine to cause additional exceedances of the 24-hour average PM<sub>10</sub> air quality criteria and concluded that the potential would be very low.

### *Greenhouse Gas Assessment*

The major source of greenhouse gas emissions from the Snapper Mine development would be generated by the combustion of diesel in mobile equipment on-site and indirectly by the use of electricity to power the dredge, primary gravity concentrator and associated equipment.

An assessment of the Snapper Mine greenhouse gas emissions was conducted using empirical emission factors provided by the Australian Greenhouse Office (AGO). The average annual emission estimate for the life of the Snapper Mine (including construction) is approximately 0.098 Mt carbon dioxide equivalent per annum (CO<sub>2-e</sub>/year).

The average annual greenhouse gas emission estimate can be compared with the following 2004 estimates provided by the latest National Greenhouse Gas Inventory report:

- estimate of Australia's 2004 net emissions, 564.7 Mt CO<sub>2-e</sub>;
- estimate of Australia's 2004 net emissions for the energy sector, which is the major contributor to carbon-dioxide emissions, 387.2 Mt CO<sub>2-e</sub>; and
- estimate of Australia's 2004 net emissions for the industrial sector, 29.8 Mt CO<sub>2-e</sub>.

### **Potential Cumulative Impact**

Holmes Air Sciences concluded that the only area where particulate concentrations or dust deposition levels would be enhanced would be between the Snapper Mine and Ginkgo Mine operations (to the north-east of the Snapper Mine and to the south-west of the Ginkgo Mine) and the enhancement would be negligible.

The cumulative assessment indicated there would be no change to the maximum 24-hour average PM<sub>10</sub> concentration model prediction calculated for the Snapper Mine only at the “Manilla” and “Trelega” homesteads and only a small effect on annual average PM<sub>10</sub>, TSP and dust deposition levels at the “Manilla” and “Trelega” homesteads. The potential cumulative effect of the two mining operations would not cause exceedances of annual average air quality criteria. Predicted cumulative air quality emissions are shown on Figure ES-11.

### **Mitigation Measures and Management**

The following particulate emission control measures would be applied at the Snapper Mine:

- land clearing would be minimised;
- exposed mined areas would be rehabilitated as soon as practicable;
- mineral stockpiles would be maintained at a contained moisture content of 6 to 8%;
- haul roads and trafficked areas would be watered using water carts to minimise the generation of dust;
- where the HAR passes the “Manilla” and “Woodlands” stations, the road would be treated with a dust suppression system if required;
- development of minor roads would be limited and the locations of these would be clearly defined;
- regularly used minor roads would be watered;
- obsolete roads would be revegetated;
- mineral concentrate haulage truck trailers would be covered; and
- long-term topsoil stockpiles would be revegetated with a cover crop.

An Air Quality Management Plan (AQMP) would be prepared for the construction and operation of the Snapper Mine. The AQMP would detail specific actions for responding to exceedances of criteria and complaints should they occur.

### **Air Quality Monitoring**

The AQMP would provide an air quality monitoring programme to optimise air quality controls and validate the air quality modelling predictions. Two additional dust deposition gauges would be installed at the two closest residences.

### **Greenhouse Gas Emissions**

Minimising fuel and electricity usage would be an inherent objective of Snapper Mine planning and cost control systems. Additional measures to mitigate greenhouse gas emissions associated with the Snapper Mine would include:

- consideration of energy efficiency in plant and equipment selection/purchase;
- regular maintenance of plant and equipment to minimise fuel consumption and associated emissions; and
- the implementation of a vegetation offset strategy.

## **ES3.6 TRAFFIC AND TRANSPORT**

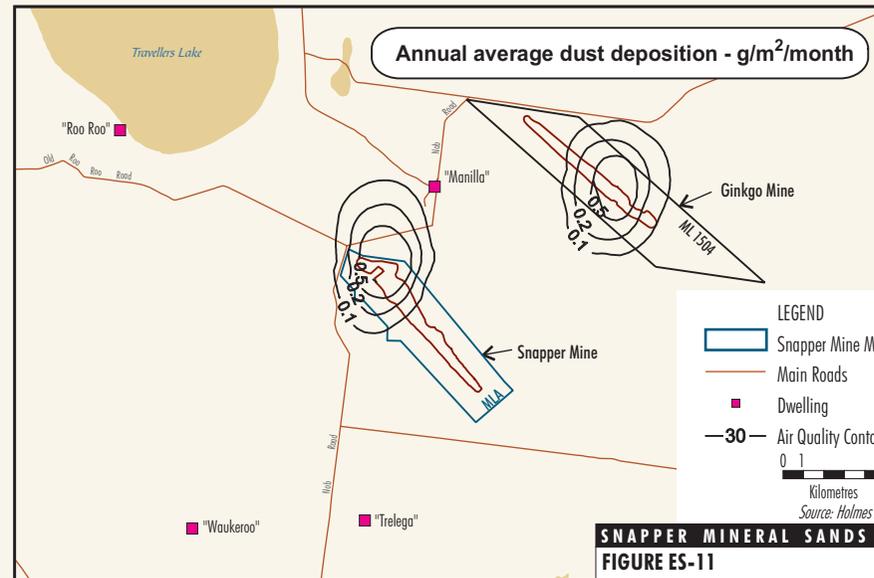
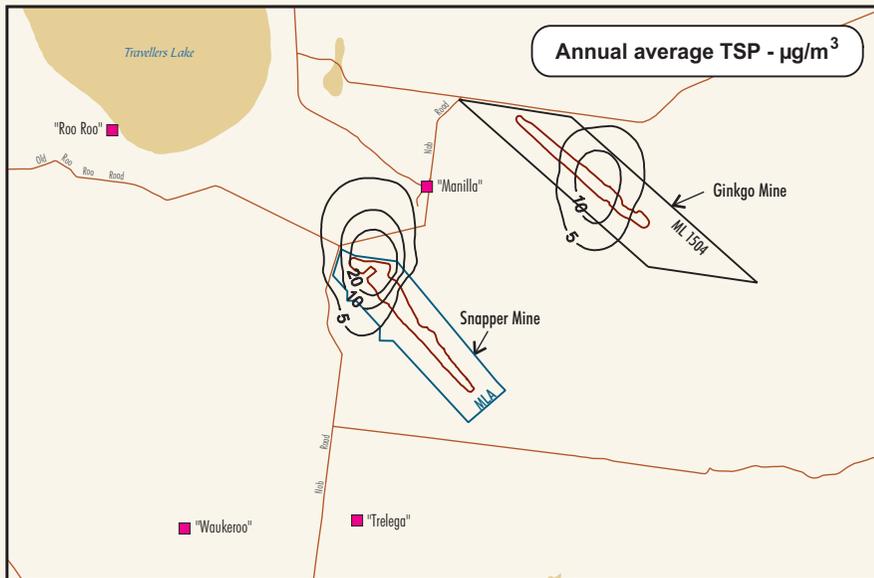
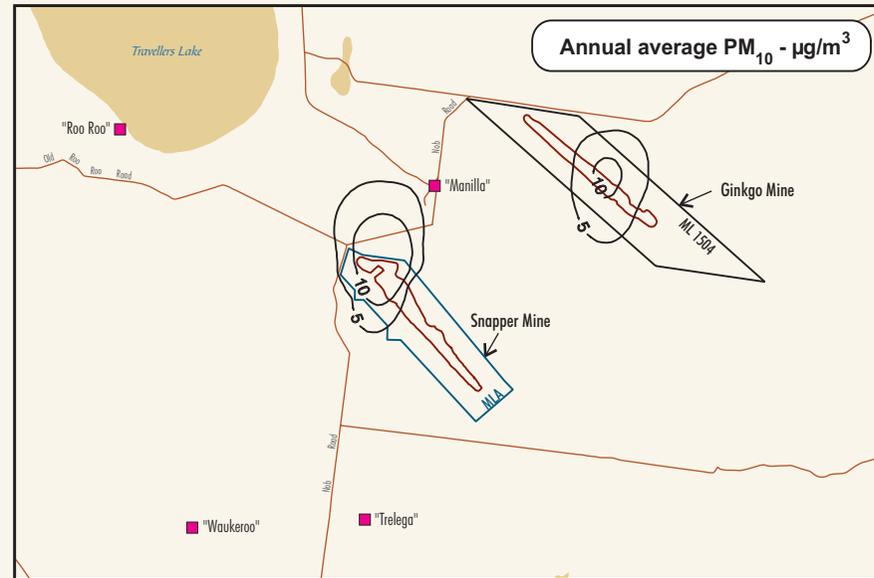
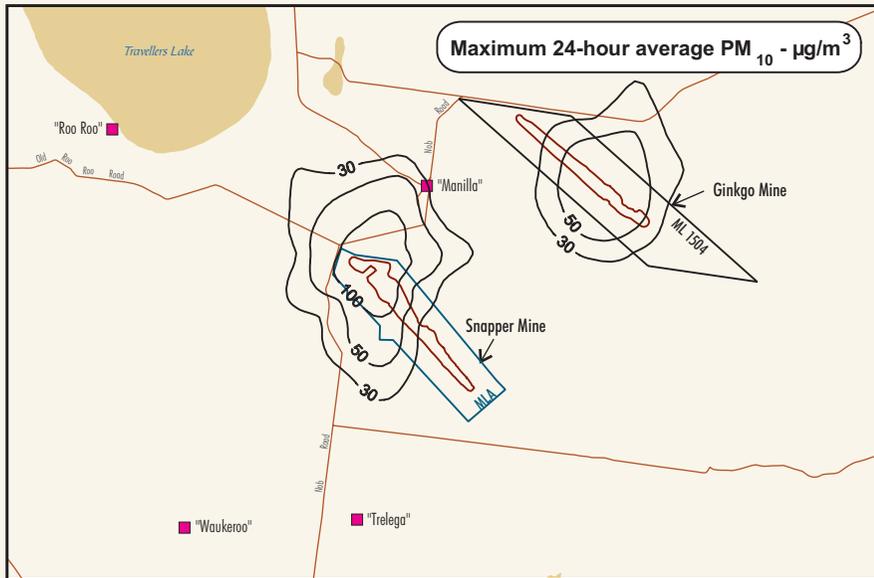
A Road Transport Assessment that considers potential traffic impacts during both the construction and operation phases of the Snapper Mine has been undertaken by Traffix.

### **Existing Environment**

#### **Road Hierarchy**

The main arterial road in the Snapper Mine area is State Highway No. 22 (Silver City Highway), which provides a sealed north-south route connecting Mildura to the south with Broken Hill in the north. State Road (SR) 68 provides a north-south arterial route to the east of the Ginkgo Mine, connecting the township of Wentworth with Pooncarie and Menindee in the north.

Local unsealed roads in the vicinity of the Snapper Mine include Old Roo Roo Road, and Nob Road, which provide unsealed east-west routes connecting the Silver City Highway with SR No. 68. The existing 64 km HAR from the Ginkgo Mine to the Silver City Highway comprises an unsealed road (including sections of Old Roo Roo and Nob Roads). The section of the HAR to the east of Nob Road is a private road maintained by BEMAX.



**LEGEND**

- Snapper Mine MLA Boundary
- Main Roads
- Dwelling
- Air Quality Contour

0 1 5  
Kilometres

*Source: Holmes Air Sciences, 2007*

**SNAPPER MINERAL SANDS PROJECT**  
**FIGURE ES-11**  
 Predicted Cumulative Air Quality Emissions from the Snapper and Ginkgo Mines (Snapper Year 14)



### *Ginkgo Mine Haulage*

The Ginkgo Mine presently uses a fleet of 55 tonne (t) payload double road trains to transport materials to and from the MSP via the HAR and Silver City Highway.

### **Potential Impacts**

Additional sections of HAR would be constructed to provide access to the Snapper Mine. Predicted Snapper Mine daily traffic generation during the construction and operation phases would include light traffic associated with workforce and visitor movements as well as heavy vehicle deliveries and haulage of mineral concentrates and backloaded MSP process waste. The predicted additional Snapper Mine traffic would have little effect on the existing ease of travel (level of service) on the road network.

### **Potential Cumulative Impacts**

The Road Transport Assessment included vehicles to account for the Snapper and Ginkgo Mines at full production. Little change to the levels of service at relevant intersections, is predicted due to the overall low traffic volumes involved.

### **Mitigation Measures and Management**

Traffic management measures to be undertaken include:

- Inclusion of transport activities relevant to the Snapper Mine in the TCC.
- Inclusion of transport activities relevant to the Snapper Mine in the *Ginkgo Mineral Sands Mine and Broken Hill Mineral Separation Plant Transport of Hazardous Materials Plan* (THMP) (BEMAX, 2006c).
- Extensions of the HAR to be designed and constructed as per the specifications for the existing Ginkgo Mine HAR.
- Any roadworks that are required on the public road network to be designed in accordance with relevant guidelines.
- Traffic management plans would be completed to address any roadworks on public roads.
- Inclusion of transport activities relevant to the Snapper Mine in the existing Ginkgo Mine road pavement condition monitoring programme along the mineral concentrate route.

- Assessment relevant vehicle parameters in consultation with the RTA prior to the use of longer haulage vehicles than the currently operating double road trains.
- Car pooling (e.g. use of shuttle buses from the Ginkgo Mine accommodation camp).

### **ES3.7 HAZARDS AND RISK**

Four separate assessments have been conducted as part of the EA to address key issues and associated hazards and risks, including a Preliminary Hazard Analysis (PHA), the General Overview, Process Waste Materials Risk Assessment and Saline Slurried Overburden Risk Assessment.

#### ***Hazard Identification and Risk Assessment***

##### *PHA*

Potential hazards identified in the PHA which was conducted in accordance with the general principles of risk evaluation and assessment provided in the NSW Department of Urban Affairs and Planning (DUAP) *Multi-Level Risk Assessment* (1999) related to the following Snapper Mine elements/activities:

- the operation of the initial sand residue dam and initial slurried overburden emplacement;
- the transport and storage of diesel for use during operation (e.g. fires and leaks/spills); and
- the haulage of mineral concentrates to the MSP and the backloading of MSP process waste products by double road trains or other RTA-approved vehicles (e.g. AB-triple vehicles) (e.g. vehicle accidents and leaks/spills).

Risk treatment measures have been proposed, where required, to produce a low level of risk in accordance with the risk acceptance criteria.

##### *General Overview*

The General Overview was conducted to identify key issues for the construction and operation of the Snapper Mine, taking into consideration issues raised during consultation.

All of the key issues (and associated hazards and risks) identified in the General Overview were considered to be incorporated within the EA scope. Therefore, no further assessment beyond the scope of the EA is required.

### *Transport, Handling and Disposal of Waste - Process Waste Materials Risk Assessment*

The Process Waste Materials Risk Assessment was conducted to identify risks associated with the handling and disposal of waste (including backloaded MSP process waste) at the Snapper Mine. Potential hazards identified in the Process Waste Materials Risk Assessment related to the following elements/activities:

- inadequate containment of the MSP process waste on-site resulting in land and or surface water contamination;
- disposal of backloaded MSP process waste below the groundwater table resulting in groundwater contamination;
- inaccurate classification of wastes (in accordance with *Environmental Guidelines: Assessment, Classification & Management of Liquid and Non-liquid Wastes* [DEC, 2004b]) resulting in inappropriate disposal;
- on-site roll-over of a vehicle transporting backloaded MSP process waste resulting in spillage of radioactive waste to land and surface waters;
- wind-blown backloaded MSP process waste;
- leaks or ruptures of the pipe carrying slurried backloaded MSP process waste; and
- disposal of waste tyres.

Following the identification of risks associated with the handling and disposal of wastes, a qualitative assessment of risks to the public, property and the environment associated with the operation of the Snapper Mine was undertaken. Control measures have been proposed, where required, to produce a low level risk in accordance with the risk acceptance criteria.

### *Saline Slurried Overburden Risk Assessment*

The Saline Slurried Overburden Risk Assessment was conducted to identify and assess risks to the success of rehabilitation and revegetation of the Snapper Mine site associated with the use of saline slurry in the overburden emplacements. Potential hazards identified were relevant to:

- capillary rise;
- saline seepage to rehabilitated and revegetated areas;
- airborne salts; and
- clay lining failure.

Risk treatment measures have been proposed, where required, to produce a low level of risk in accordance with the risk acceptance criteria.

### **Mitigation Measures and Management**

#### *PHA*

A number of hazard preventative and mitigative measures would be described in management plans for the Snapper Mine, including the Mining Operations Plan (MOP), SWMP, Snapper Mine Landfill Environmental Management Plan (LEMP), update of the Ginkgo Mine and MSP TCC, update of the Ginkgo Mine and MSP THMP and Emergency Response Plan (ERP).

In addition, the following hazard treatment measures would be adopted for the Snapper Mine:

- maintenance of all mobile and fixed plant and equipment;
- staff training;
- mining and civil engineering structures would be constructed in accordance with applicable codes, guidelines and Australian Standards (AS);
- the storage of diesel would be designed, constructed and operated in accordance with the requirements of AS 1940:2004 *The Storage and Handling of Flammable and Combustible Liquids*;
- the disposal of backloaded MSP process waste would be conducted in accordance with the appropriate guidelines; and
- a Site Emergency Response Team.

#### *Process Waste – Risk Treatment Measures*

Measures to address potential hazards associated with MSP process waste materials are described below:

- Emergency response procedures including spill clean-up procedures to reduce the risk of land and or surface water contamination.
- Dedicated bunded storage area for waste hydrocarbons at the workshop to reduce the risk of land and or surface water contamination.
- Disposal of MSP process waste in accordance with DEC requirements to reduce the risk of groundwater contamination.

- Appropriate classification of backloaded MSP process waste by laboratory testing of radioactivity levels, waste tracking procedures and transporter training.
- Appropriate vehicle signage/placarding.
- Transport of waste in accordance with the *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (Mining and Minerals Processing Code).
- Minimising the size of waste stockpiles within a bunded area fitted with sprinklers.
- Daily inspection of the pipeline containing the slurried backloaded MSP process waste to identify leaks or ruptures.
- Off-site disposal of tyres.

#### *Saline Slurried Overburden – Proposed Control Measures*

Measures proposed to address potential hazards associated with saline slurried overburden are described below:

- Implementation of a strategy to cover slurried overburden material to minimise the potential for an increase in salinity levels within the non-slurried material via capillary rise.
- Lateral salt movement from the initial slurried overburden emplacement would be minimised by clay lining the emplacement, preparing and constructing the foundation as well as providing a cut-off key trench, a toe drain and spoon drains.
- Permeability testing of clay lining during construction to minimise the potential for failure of clay lining in initial slurried overburden emplacements.

### **ES3.8 HERITAGE**

#### ***Aboriginal Heritage***

A Cultural Heritage Assessment was prepared for the Snapper Mine by Landskape which assessed Aboriginal cultural heritage. The assessment included an archaeological survey of the Snapper Mine area. The assessment was prepared in accordance with the general requirements of the *DEC Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005a). The completion of the Cultural Heritage Assessment included input from, and consultation with, the Aboriginal community.

The DEC Aboriginal Heritage Information Management System (AHIMS) site database indicates six registered Aboriginal archaeological sites (isolated silcrete stone artefacts) within approximately 10 km of the Snapper Mine area. The closest of these sites is an isolated stone artefact (DEC site number 39-3-0043) recorded by Witter approximately 1 km north of the ETL extension.

The Snapper Mine archaeological survey identified 22 Aboriginal archaeological sites (SN01-22) (Figure ES-12). Types of sites included isolated artefact finds, hearths, artefact scatters and quarried silcrete outcrops.

#### *Potential Impacts*

Nineteen Aboriginal cultural heritage sites would be subject to direct disturbance during the life of the Snapper Mine (Figure ES-12). These comprise ten sites of low-to-moderate significance (e.g. stone artefact scatters) and nine sites of low significance (e.g. isolated finds).

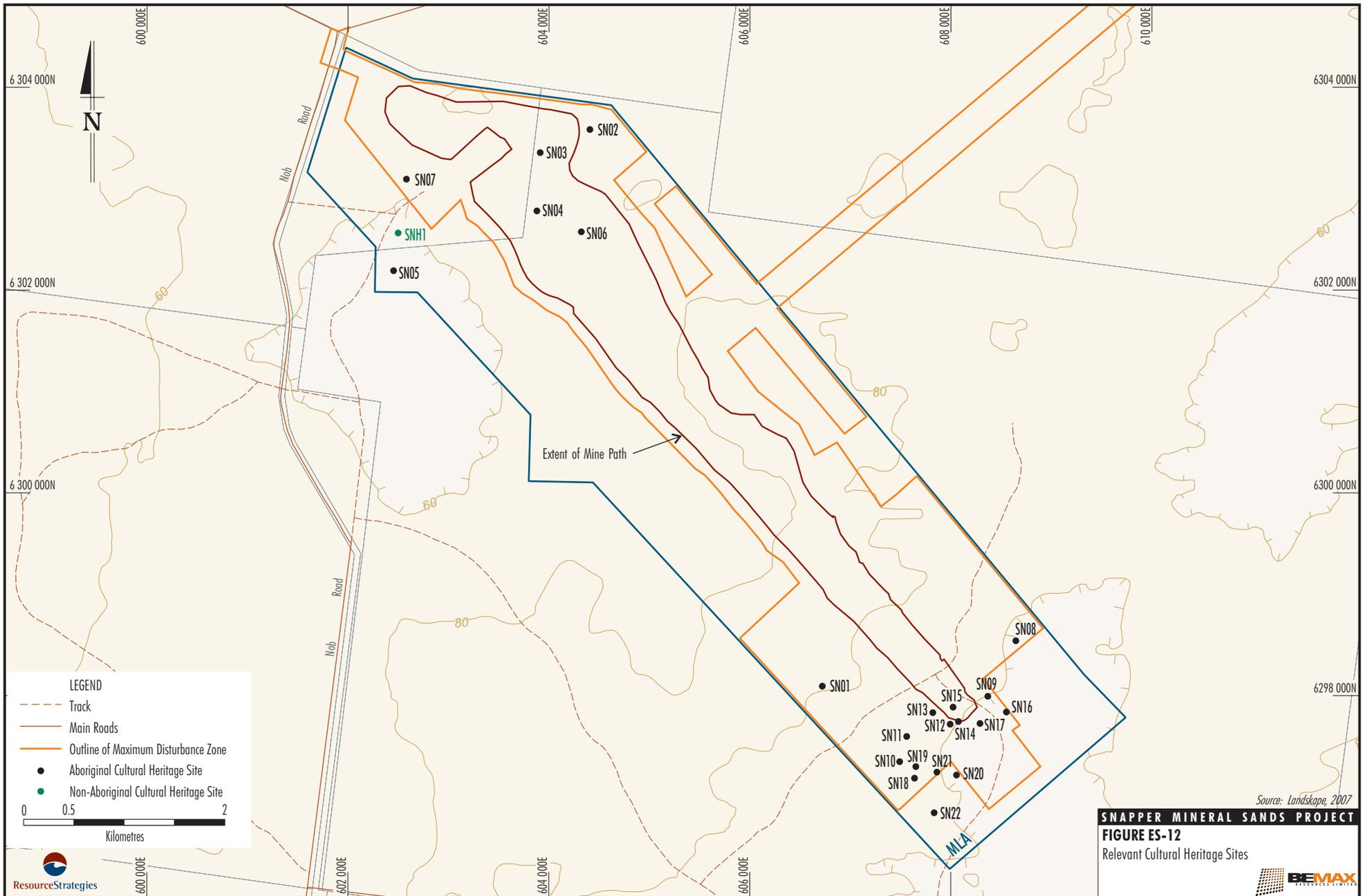
Snapper Mine operation would also disturb the current land surface and the archaeological material associated with the affected landforms (including archaeological material that may occur in the soil profile that has not been identified during the site survey) and alter the substrate and landscape context.

Three Aboriginal cultural heritage sites have been identified outside the proposed Snapper Mine disturbance area. Two cultural heritage sites are of moderate to high significance (stone quarries with associated stone artefact scatters – Sites SN20 and SN22) and one is of low significance (stone artefact – SN05). The sites could be indirectly impacted upon by the Snapper Mine (i.e. deposition of dust generated by mining, accidental disturbance by peripheral activities, and inappropriate visitation) in the absence of relevant mitigation measures.

#### *Mitigation Measures and Management*

Mitigation and management measures for the Snapper Mine are described below:

- An Aboriginal Cultural Heritage Management Plan (ACHMP) would be prepared in consultation with the local Aboriginal community and the DEC.
- On-site personnel training would be undertaken.



- Lithic technologies and reduction strategies adopted at Aboriginal cultural heritage sites within the Snapper Mine disturbance area would be investigated.
- Procedures would be prepared and implemented if human skeletal remains are encountered.
- A representative sample of scientifically and culturally significant items would be recorded and collected. These items would be properly curated and stored in the “Keeping Place” at BEMAX’s Ginkgo Mine, and would be replaced within rehabilitated areas in consultation with the local Aboriginal community and the DEC.
- Consultation with the relevant local Aboriginal community members would be undertaken.
- Hearths from SN02 would be dated by radiocarbon and/or luminescence techniques.
- Temporary barriers would be erected around sites SN05, SN20 and SN22.

Indirect impacts to archaeology sites would be minimised by the implementation of dust control measures.

#### **Non-Aboriginal Heritage**

The Cultural Heritage Assessment prepared for the Snapper Mine by Landskape also assessed historic (i.e. non-Aboriginal cultural heritage).

One non-Aboriginal heritage site (“Kertne Nob” outstation and stockyard ruin [SNH1]) was identified in the Snapper Mine MLA area (Figure ES-12). Site SNH1 is of low to moderate local/regional significance and there are better preserved and more original examples of rural outstations in the region.

SNH1 is not located within the Snapper Mine disturbance area and would not be subject to direct impacts, but would potentially be subject to indirect impacts from accidental damage and visitation. To avoid accidental disturbance of site SNH1, a temporary protective barrier would be erected around the site if works are to be undertaken in its vicinity.

### **ES3.9 SOCIAL AND ECONOMIC**

Regional economic and community infrastructure assessments and a cost benefit analysis prepared for the Snapper Mine by Gillespie Economics as part of the Socio-Economic Assessment. The regional economic assessment was based on the Broken Hill, Far West Unincorporated, Wentworth and Mildura region and the community infrastructure assessment was based on the main regional centres of Wentworth, Broken Hill and Mildura.

The cost benefit analysis applies to the Australian society including at the region, state and national levels.

#### **Existing Environment**

The Snapper Mine is located in the Wentworth statistical local area (SLA), which contains the towns of Pooncarie, Wentworth and Dareton. The services sector is the most significant sector in terms of employment and contribution to the gross product and output of the regional economy. The population of the Wentworth Shire is ageing and declining.

Broken Hill is the largest regional centre in the western half of NSW, however, the city’s population has also fallen in the past few decades. Census data indicates that while, historically, mining was the largest employer in Broken Hill, this sector has declined significantly over the past decade. The population of Mildura has been growing steadily during the period 1996 to 2001.

The Socio-Economic Assessment considered the existing housing, education facilities and community services at the regional centres.

#### **Potential Impacts**

The development of the Snapper Mine would employ up to 250 people during the construction period and would employ approximately 110 people when operating. In addition, the development would facilitate flow-on employment in the region. The primary potential impact of the Snapper Mine on community infrastructure therefore relates to population growth and related effects on housing and community facilities.

Using input-output analysis, it was estimated that the construction phase of the Snapper Mine would contribute the following to the regional economy:

- \$38M in annual direct and indirect regional output or business turnover;
- \$19M in annual direct and indirect regional value-added;
- \$11M in annual household income; and
- 250 direct and indirect jobs.

The Snapper Mine operation phase was estimated to potentially contribute the following to the regional economy:

- \$91M in annual direct and indirect regional output or business turnover;
- \$42M in annual direct and indirect regional value-added;
- \$8M in annual household income; and
- in the order of 140 direct and indirect jobs.

The contributions during construction and operation would be felt across a range of sectors.

The Socio-Economic Assessment includes an assessment of the economic efficiency of the Snapper Mine and incorporates environmental costs by calculating the net present value (NPV) (i.e. the sum of the discounted benefits less the sum of the discounted costs) as a threshold value. A NPV of \$144M is estimated for the Snapper Mine. This threshold value represents the opportunity cost to society of not proceeding with the Snapper Mine. Interpreted another way, any environmental impacts from the Snapper Mine, after mitigation by BEMAX, would need to be valued at greater than \$144M to make the Snapper Mine undesirable from an economic efficiency perspective.

#### *End of Snapper Mine Life*

The construction and operation of the Snapper Mine would stimulate demand in the regional and NSW economies leading to increased business turnover in a range of sectors and increased employment opportunities. Cessation of the Snapper mine would, however, lead to a reduction in economic activity.

The socio-economic significance of cessation of the Snapper mine would depend on the relative significance of the Snapper Mine to the regional economy and other regional economic factors at the time. Impacts associated with Snapper Mine cessation would be likely to be greater in a declining economy than in a growing diversified economy.

### **ES3.10 REHABILITATION AND FINAL LANDFORM**

Rehabilitation of mine disturbance areas is typically a formal requirement under the *Mining Act, 1992*, and is regulated by conditions included in mining leases. Snapper Mine rehabilitation would be undertaken in accordance with relevant mining lease conditions and the principles and objectives described below.

Principles to be implemented in the Snapper Mine rehabilitation programme would include:

- preservation of existing vegetation and landforms where practicable;
- progressive campaign-based rehabilitation;
- passive drainage and flow diversion structures where required;
- where appropriate, the use of authorised hybrid cover crops to provide initial erosion protection on newly prepared (i.e. topsoiled) landforms prior to the establishment of long-term native vegetation;
- revegetated landforms to be contiguous with existing vegetation where practicable;
- fencing and/or bunding to selectively exclude livestock from rehabilitation areas;
- flexible rehabilitation concepts to allow for adjustments, based on investigations, to improve the programme; and
- annual rehabilitation programmes and budgets to be approved by site management.

Snapper Mine rehabilitation objectives include:

- developing final landforms that are stable and generally consistent with the surrounding landscape;
- developing final landforms that are suitable for a final landuse determined in consultation with relevant landholders and regulatory authorities;
- implementing practices demonstrated to be effective by investigations at both the Snapper and Ginkgo Mines;
- managing mining and overburden handling to minimise reshaping, recontouring and material double handling; and
- progressive rehabilitation to make best use of favourable climatic conditions.

Final rehabilitation requirements would ultimately be formulated in consultation with key government authorities and other relevant stakeholders. In accordance with the *Mining Act, 1992*, rehabilitation would be subject to regulatory authority agreement and approval. The rehabilitation concepts should therefore be regarded as provisional to allow for the consideration of future studies and consultation with regulatory agencies. The results of rehabilitation investigations and final rehabilitation proposals would be documented in the Snapper Mine MOP for approval prior to implementation.

### ***Justification of the Final Landform***

The proposed Snapper Mine final landform design concepts include consideration of the issues associated with the progressive development of the final landform over the Snapper Mine life, drawing on relevant experience from the Ginkgo Mine.

Final landform construction would be based on objectives for long-term stability, general consistency with the surrounding landscape and suitability for a final landuse determined in consultation with relevant landholders and regulatory authorities.

The proposed mining method for the Snapper Mine would involve placement of sand residues, overburden and soils at the rear of the dredge pond as mining advances. Where practicable, these materials would be direct-placed to reduce the requirement to double-handle these materials. This method also reduces the distance materials would otherwise be moved, allowing rehabilitation of the mine path to be effective and economically efficient.

The final landform concept for the mine path would result in a slightly mounded landform along the alignment of the mine path, which would be consistent with the surrounding landscape.

Operational requirements for the initial overburden emplacements, sand residue and water dams necessitate that these structures be located as close as practicable to the initial location of the dredge pond, but out of the mine path (given the insufficient area behind the dredge pond for replacement of material and the need to store water outside the construction pit during the construction period). These out-of-path landforms would have heights up to approximately 20 m, which would minimise the required surface disturbance area whilst maintaining appropriate slope length and run-off velocities (i.e. vegetation clearance would be minimised and the design of out-of-path final landforms would consider slope stability).

At the completion of mining, the final landform would include two final voids (associated with the final dredge pond and water disposal dam) (Figure 2-4). Mine planning would target minimising the size of the final voids as much as practicable.

Final landform concepts would be revised and refined throughout the Snapper Mine life, utilising the outcomes of on-going consultation with relevant regulatory authorities, stakeholders and the results of rehabilitation investigations. The final landform would also incorporate the mitigation measures identified to address risks to rehabilitation and revegetation associated with the use of saline slurried overburden materials assessed as suitable growth medium would also be used in the final landform. Upon consideration of the above, the final landform is justified.

### ***Assessment of Rehabilitation Materials***

A Rehabilitation Materials Assessment was conducted to analyse and assess the suitability of materials for use as rehabilitation growth media. These materials include topsoil, subsoil, slurried overburden, non-slurried overburden, sand residues and backloaded MSP process waste.

Topsoils as well as some subsoil material would be suitable for use as a rehabilitation growth medium. The depth of soil stripping operations would be guided by landform unit type and a carbonate layer, located immediately beneath the topsoil horizon, which is not considered suitable for use as a rehabilitation growth medium. Some non-slurried overburden was identified as potentially suitable rehabilitation growth media.

### ***Assessment of Risks to Rehabilitation***

The Saline Slurried Overburden Risk Assessment conducted to identify and assess risks to the success of rehabilitation and revegetation (discussed above) identified mitigation measures which are proposed to address the risks. A summary of the proposed measures is presented above (Section ES3.7).

### ***Monitoring***

A monitoring programme (including a photographic monitoring programme) would be developed to assess the performance of rehabilitation areas. Information collected from monitoring would be incorporated into rehabilitation strategies, such as the overburden cover depth design.

## ES4 POTENTIAL CUMULATIVE IMPACTS

The potential for cumulative impacts resulting from the operation of the both the Snapper and Ginkgo Mines has been assessed in the EA. The Snapper Mine is not considered to result in any significant cumulative impacts on environmental aspects. Mitigation and management measures are provided to minimise cumulative impacts where practicable.

## ES5 DRAFT STATEMENT OF COMMITMENTS

BEMAX has prepared a Draft Statement of Commitments for the Snapper Mine which provides a summary of the environmental mitigation and management measures and environmental monitoring proposed for the Snapper Mine.

## ES6 SNAPPER MINE JUSTIFICATION

Whilst mineral sand production in Australia from existing mines will decline over coming years due to depletion of mining reserves in Western Australia, new mines in the Murray Darling Basin and associated production facilities have the opportunity to fill this shortfall in supply.

The Murray Darling Basin has a number of advantages over projects awaiting development in both other parts of Australia and in other countries, including low political and sovereign risk and a sophisticated mining environment with well-developed infrastructure.

### ***Export Demand and Supply of Mineral Sands***

The Snapper Mine would produce ilmenite-rich, leucoxene-rich and non-magnetic concentrates for further separation at the MSP to produce ilmenite, leucoxene, rutile and zircon products.

Ilmenite, leucoxene and rutile are sources of titanium dioxide. Demand for titanium dioxide is driven by the pigment, plastic, printing, inks, food colourings, fabric delustering agents, sunscreens, cosmetics, and paper industries. Rutile is used to make titanium metal used for aircraft component manufacture, golf clubs, sports equipment, surgical implants and water desalination plants. New technology for production of titanium metal is being developed which is likely to increase existing demand.

Zircon is a key raw material used in the production of pacifiers, floor tiles, sanitary ware, glass and steel refractories, metal castings, specialised glass as well as faceplates for television monitors and computer screens.

Australia is the world's largest supplier to the global titanium feedstock industry and is also the leading supplier of zircon to the ceramics, refractory and foundry industries. The demand for mineral sand products has been recently forecast to grow over the next five years. The current outlook for demand is better than it has been for a number of years, due mainly to the very rapid and continuing industrialisation of China. With the majority of global pigment producers running at capacity, the Snapper Mine would contribute to servicing this demand.

### ***The Role of the Snapper Mine***

The Socio-Economic Assessment indicates that the development of the Snapper Mine would potentially have significant economic benefits to the regional, NSW and Australian economies.

The Snapper Mine would provide an average of approximately 200 and up to approximately 250 direct full-time construction jobs and would provide approximately 110 operational jobs.

Employment and expenditure associated with the Snapper Mine is also predicted to have significant flow-on effects in the regional economy. The Socio-Economic Assessment indicates that, on average, construction of the Snapper Mine is likely to lead to the creation of some 250 direct and indirect jobs in the regional economy.

Similarly, the operation of the Snapper Mine is predicted to generate some 140 direct and indirect jobs in the regional economy.

### ***Consideration of Alternatives to the Snapper Mine***

The Snapper Mine location is determined by the mineral sand resource and the location relevant BEMAX exploration tenements. In addition, the Snapper Mine site has access to electricity (given the nearby location of the Ginkgo Mine ETL and power supply), main roads and other general services.

The Snapper Mine has been designed to integrate with Ginkgo Mine ancillary infrastructure and facilities as far as practicable. For example, major ancillary infrastructure for the Snapper Mine comprises extensions/sharing of the existing Ginkgo Mine ETL, HAR and expansion of the Ginkgo Mine accommodation camp to accommodate Snapper Mine workers. Also, the mine production schedule for the Snapper Mine complements the schedule for the Ginkgo Mine (i.e. operation at the Snapper Mine would increase when ore grades at the Ginkgo Mine start to decline). Potential alternatives which were considered included (but were not limited to) production rate and scale, mining method, transport of mineral concentrate, water supply, and power supply, however these alternatives were not economically optimal when considering capital requirements and efficient use of existing measures.

BEMAX has considered the alternative of not proceeding with the Snapper Mine. Were the Snapper Mine not to proceed, the following consequences are inferred:

- a peak of up to approximately 250 direct construction and up to approximately 110 direct operational phase employment opportunities, and associated flow-on effects, would not be created;
- the NPV of \$144M would not be realised;
- tax revenue from the Snapper Mine would not be generated; and
- royalties to the State of NSW would not be generated.

#### ***Ecologically Sustainable Development (ESD)***

The Snapper Mine design, planning and assessment have been carried out applying the principles of ESD, through:

- incorporation of risk assessment and analysis at various stages in the Snapper Mine design and environmental assessment and within decision-making processes;
- adoption of high standards for environmental and occupational health and safety performance;

- consultation with regulatory and community stakeholders; and
- optimisation of the economic benefits to the community arising from the development of the Snapper Mine.

An assessment of potential long-term impacts of the Snapper Mine was carried out during the preparation of this EA on aspects of water management, cultural heritage, road transport, ecology (flora and fauna), noise emissions, air quality emissions (including greenhouse emissions), rehabilitation, process waste management, socio-economics, land resources and visual amenity.

#### ***Summary Consideration of the Potential Impacts and Benefits of the Proposal***

Potential significant contributions to the regional economy Snapper Mine construction and operation are described above (Section ES-3.9) along with an estimated NPV threshold value of \$144M.

#### ***Conclusion***

The proximity of the Snapper Mine to BEMAX's existing Ginkgo Mine would allow for a significant economic advantage to be gained through extensions/sharing of existing Ginkgo Mine infrastructure as well as shared use of the MSP. The Snapper Mine would also provide the opportunity to realise significant social and economic benefits, stimulating regional economic activity during both the construction and operation phases.

This EA and associated supporting studies provide a comprehensive consideration of the potential environmental impacts of the Snapper Mine and demonstrate, through the findings and conclusions of the assessments and studies and the Draft Statement of Commitments, that BEMAX would mitigate, manage and/or offset the potential environmental impacts of the Snapper Mine.

Given the above, it is considered likely that any residual environmental impacts after mitigation and/or offset management would not be valued at higher than the significant benefits of the Snapper Mine. The Snapper Mine is therefore considered to be justified.