APPENDIX F

NOISE ASSESSMENT

Snapper Mineral Sands Project
Environmental Assessment

NOISE ASSESSMENT:
SNAPPER MINERAL SANDS PROJECT

February 2007

Prepared for
BEMAX Resources Limited

Version: 6

by
Holmes Air Sciences

Suite 2B, 14 Glen St
Eastwood NSW 2122
Phone : (02) 9874 8644
Fax : (02) 9874 8904
Email : has@holmair.com.au

CONTENTS

LIST OF TABLES

LIST OF FIGURES

(all figures are at the end of the report)

F1 INTRODUCTION

This report has been prepared by Holmes Air Sciences for BEMAX Resources Limited (BEMAX). The purpose of this report is to provide a quantitative assessment of the noise impacts associated with the development of the Snapper Mineral Sands Project (the Snapper Mine). The Snapper Mine involves the construction and operation of a mineral sands mine located approximately 10 kilometres (km) to the south-west of the existing Ginkgo Mineral Sands Project (the Ginkgo Mine) and approximately 170 km south of the Broken Hill Mineral Separation Plant (MSP) in western New South Wales (NSW) (Figure F-1). The Ginkgo Mine and the MSP are operated by BEMAX.

The Snapper Mine includes the development of the Snapper Mine mineral deposit, together with the extension/sharing of existing Ginkgo Mine infrastructure (Figure F-2).

The Noise Assessment has been conducted for two main Snapper Mine components *viz.*, the mine site and the mineral concentrate transport route. The basis of the assessment has been to review the way in which the mine and transport route are planned to operate, identify noise sources and noise generating activities and predict noise levels under worst-case noise emission assumptions. The assessment has been undertaken in accordance with the NSW Department of Environment and Conservation (DEC) Industrial Noise Policy (INP) (EPA, 2000) and Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). Accordingly, the report also provides information on the meteorological conditions in the area so that the effect of noise enhancing meteorological conditions can be taken into account. Additionally, it also accounts for noise generated currently at the Ginkgo Mine (i.e. a cumulative assessment).

The main components of the Snapper Mine, (i.e. the mine and extensions of the existing Ginkgo Mine electricity transmission line [ETL] and highway access road [HAR]) are located in a sparsely settled area, remote from noise sensitive receivers.

F2 DESCRIPTION OF THE SNAPPER MINE FROM A NOISE PERSPECTIVE

Construction of the Snapper Mine would commence approximately between Years 3 to 5 of the Ginkgo Mine life. The construction phase would involve the installation and commissioning of surface facilities (including out-of-pit infrastructure [i.e. initial overburden emplacements, initial sand residue dam and initial water dam]) to allow access to the orebody and the commencement of mining. An approximate 15 month construction period is expected.

The operation phase covers an approximate 16 year period during which the open cut dredge pond would progress through an area approximately 8 km long and approximately 1 km wide. Dredge mining would be the primary method of mining and would involve the same method of mining as the Ginkgo Mine (i.e. conventional mineral sands dredge mining). Secondary mining of ore would occur simultaneously with the dredge mining as required, and would be undertaken by conventional mobile equipment (i.e. dozers and/or scrapers) depositing ore in front of the dredge.

The Snapper Mine would progress in a single pass from the south-east to the north-western end of the Mining Lease Application (MLA) area. The surface of the dredge pond would be 20 to 50 metres (m) below natural ground level. Equipment would operate at various levels, from the surface down to approximately 50 m below the ground level.

At any time, the activities would predominantly occur within the following major areas:

- pre-stripped area (vegetation and topsoil/subsoil removal) across the mine path;
- overburden removal area;
- dredge pond;
- sand residue deposition area; and
- overburden and topsoil/subsoil replacement area to the rear of the mine.

The abovementioned areas are contained within the Snapper Mine MLA area (Figure F-2). The Snapper Mine area comprises the Snapper Mine Mining Lease Application (MLA) area and the electricity transmission line (ETL) and highway access road (HAR) extensions. Mining would occur 24-hours per day, seven days per week. Major mine site components would include:

- floating dredge and primary gravity concentration unit for mining and primary minerals separation;
- borefields supplying water to the overburden slurrying facility, dredge pond, primary gravity concentration unit, water disposal dam and heavy mineral concentrate (HMC) treatment facility;
- overburden slurrying and pumping system;
- reverse osmosis (RO) plant to supply the salt washing facility and potable water;
- salt washing facility;
- Wet High Intensity Magnetic Separators (WHIMS) circuit;
- administration and workshop buildings (including ablutions);
- a wastewater (including sewage) treatment plant;
- laydown areas;
- roads and ETL;
- towers and stackers for stockpiling mineral concentrates;
- overburden, soil and mineral concentrate stockpiles;
- fuel and consumables storage facilities;
- initial water supply dam;
- initial sand residue dam;
- initial overburden emplacements;
- water treatment dams;
- water disposal dam; and
- other associated infrastructure, plant, equipment and activities.

The general arrangement of the MLA area at Year 1, Year 14 and post-mining is shown on Figures F-3 to F-5.

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, slurrying 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;
- 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 RO plant for HMC salt washing;
- HMC separation via the 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.

A provisional life of mine production schedule is provided in Table F-1. The 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). The schedule shows the combined development of the Snapper and Ginkgo Mines and maintenance of up to 650,000 tonnes per annum (tpa) of mineral concentrate. As shown in Table F-1, the maximum rate of production from the Snapper Mine alone would be approximately 450,000 tpa.

Table F-1 Provisional Production Schedule*

Snapper Mine Development Year	Mineral Concentrate Production (kilotonnes [kt])			Mineral Concentrate Transport (kt)
	Ginkgo Mine	Snapper Mine	Total	
-	500	0	500	350
-	550	0	550	385
Construction	475	0	475	333
1	375	250	625	444
2	300	350	650	464
3	200	450	650	735
4	200	450	650	735
5	200	450	650	735
6	250	400	650	735
7	250	400	650	735
8	250	400	650	735
9	250	400	650	735
10	200	400	600	685
11	200	375	575	660
12	200	350	550	609
13	200	350	550	550
14	150	275	425	425
15	0	275	275	275
16	0	250	250	250
Total	**4,750**	**5,825**	**10,575**	**10,575**

* Production and transport rates are indicative only.

This arrangement provides for a conservative transport scenario (i.e. maximum road movements).

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. Stockpiled ilmenite-rich concentrate would be transported when market conditions are appropriate. The mineral concentrate transport route and mine sites are shown in Figure F-1.

The transport of mineral concentrate from the Ginkgo Mine site to the MSP is currently undertaken by a haulage contractor operating a fleet of 55 tonnes (t) payload double road trains. It is proposed that either double road trains or other vehicles approved by the NSW Roads and Traffic Authority (RTA) (e.g. AB-triple vehicles) would be used to transport mineral concentrate from the Snapper and Ginkgo Mines to the MSP.

During operation of the Snapper Mine, transport of mineral concentrate to the MSP would increase (beyond the existing number of trips from the Ginkgo Mine), given the increase from the approved concentrate haulage of 576,000 tpa for the Ginkgo Mine alone, to the combined concentrate haulage of approximately 735,000 tpa from the Snapper and Ginkgo Mines. The frequency of double road trains would increase to a maximum of approximately 37 trips per day (74 vehicle movements per day). Movement frequencies of larger vehicle types (e.g. AB-triple vehicles) would be less than those for double road trains and the Noise Assessment is based on the higher frequency of vehicle movements as this represents a worst-case.

The primary sources of noise at the Snapper mine during construction and operation would be due to:

- clearing vegetation in front of the mine and infrastructure areas using dozers;
- removing and stockpiling topsoil, subsoil and overburden using scrapers;
- general construction activities;
- dredging and primary separation of ore; and
- covering sand residues and slurried overburden with non-slurried overburden and replacement topsoil and subsoil using scrapers, dozers and graders; and
- road transport of mineral concentrates and backloaded MSP process waste.

The plant and equipment that would be required for the Snapper Mine are discussed in Section F5.

F3 EXISTING NOISE AND METEOROLOGICAL ENVIRONMENT

F3.1 Noise Environment

Snapper Mine Area and Surrounds

Background noise surveys to characterise and quantify the acoustical environment in the area surrounding the Snapper Mine were conducted between 25 August 2006 and 7 September 2006. This involved the positioning of two unattended noise loggers at the two nearest receptors to the Snapper Mine, the “Manilla” and “Trelega” homesteads (Figure F-6). The “Manilla” homestead is approximately 3.5 km north of the Snapper Mine MLA boundary. The “Trelega” homestead is approximately 7 km south of the Snapper Mine MLA boundary.

Noise levels at “Manilla” and “Trelega” (Figure F-6) have been sampled using an environmental noise logger (Model EL125), which automatically samples sound levels 10 times a second. Data collected when wind speed exceeded 5 metres per second (m/s) have been excluded from the data. The noise data have been analysed in accordance with the requirements of the INP procedure to derive the Rating Background Level (RBL).

The first step in the INP procedure is to determine background noise levels by identifying the 'underlying level of noise present in the ambient noise when all extraneous noise is removed'. For assessment purposes, the 24-hour day is divided into three periods, day (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night (10.00 pm to 7.00 am).

The INP procedure involves measuring ambient noise levels and using the ambient noise data to determine the existing equivalent continuous noise level (L_{Aeq}) for the day, evening and night-time assessment periods and to determine the Assessment Background Level (ABL) (from which the RBL is derived).

The ABL is determined using procedures set out in the INP and is derived from $L_{A90(15minute)}$[1] values. It represents the lower value of the noise levels that apply in the quietest period of the day, evening and night periods.

The analysis of the noise monitoring results at "Trelega" and "Manilla" homesteads are summarised in Tables F-2 and F-3 respectively and plots of the raw data are provided in Attachment FA.

Table F-2 Unattended Background Noise Environment at "Trelega"

Date (at end of monitoring session)	Assessment Background Level		
	Daytime (A-Weighted Decibels [dB(A)]+	Evening (dB[A])+	Night-time (dB[A])+
25 August 2006	24.6	24.8	
26 August 2006	24.8	24.8	25.1
27 August 2006	25.5	24.7	25.5
28 August 2006	25.9	24.9	26.2
29 August 2006	26.3	24.8	26.3
30 August 2006	25.8	24.6	25.8
31 August 2006	25.8	24.7	25.8
1 September 2006	27.5	24.6	27.5
2 September 2006	26.9	25.9	26.9
3 September 2006	37.7	24.9	37.7
4 September 2006	26.4	25.2	26.4
5 September 2006	26.1	24.8	26.1
6 September 2006	42.6*	35.7	25.7
Median	**26.1**	**24.8**	**26.3**

* Excluded because wind speed above 5 m/s in accordance with the INP procedure.
\+ Note the quieter levels are clearly determined by the instrument noise floor

[1] The $L_{A90,\ 15\text{-minutes}}$ for a particular measurement period (day, night or evening) is defined as the lowest 90-percentile of *A-weighted* noise measurements made over 15-minute intervals over the measurement period. *A-weighting* refers to an adjustment made to a measured noise level, based on its tonal composition, to ensure that it best matches the loudness of the noise as perceived by the average human ear. The subscript "15-minute" that appears in this term refers to measurements made over 15-minutes.

Table F-3 Unattended Background Noise Environment at "Manilla"

Date (at end of monitoring session)	Assessment Background Level		
	Daytime (dB[A])+	Evening (dB[A])+	Night-time (dB[A])+
25 August 2006	29.6	24.5	-
26 August 2006	24.7	24.5	24.5
27 August 2006	25.2	24.6	24.6
28 August 2006	27.8	24.5	25.1
29 August 2006	26.5	24.6	24.6
30 August 2006	25.5	24.5	24.7
31 August 2006	25.7	24.6	24.6
1 September 2006	26.1	24.5	24.5
2 September 2006	26.9	24.6	24.5
3 September 2006	35.5	24.5	24.5
4 September 2006	25.2	24.4	24.4
5 September 2006	24.3	24.3	24.6
6 September 2006	44.4*	38.1	25.1
Median	**26.1**	**24.5**	**24.6**

* Excluded because wind speed above 5 m/s in accordance with the INP procedure.
\+ Note the quieter levels are clearly determined by the instrument noise floor

The data show that ambient noise levels in the vicinity of the Snapper Mine are usually very low (i.e. less than 30 dB[A]). Most of the recorded low levels are determined by the lower threshold of sensitivity of the instrument known as the noise floor.

The RBL is the median value of all the ABLs derived over the day, evening and night-time periods. It is important to note that all the derived RBLs are less than 30 dB(A). Where the RBL is found to be less than 30 dB(A) the RBL is set to 30 dB(A), in accordance with the INP procedure. The RBL for the Snapper Mine would therefore be 30 dB(A).

It should be noted that the background noise surveys were undertaken during Year 1 of Ginkgo Mine operation (i.e. the noise environment includes the existing Ginkgo Mine). During Year 1 of operation, the Ginkgo Mine path is approximately 5 km from where it would be closest to the "Manilla" homestead (which would occur in approximately Years 5 to 7 of the Ginkgo Mine). Assessment using the noise survey results incorporating Year 1 of Ginkgo Mine operation would be relevant since the Ginkgo Mine would be further away (to the south-east) from the "Manilla" homestead when the Snapper Mine is at its closest point to this receptor (i.e. Year 14 of Snapper Mine operation). Further, the existing ABLs are well below the Ginkgo Mine intrusive noise limits of 35 dB(A).

Silver City Highway

Access to the Snapper Mine would be via the HAR connecting the mine facilities area to the Silver City Highway. Existing RTA traffic counts (i.e. available RTA traffic flow data for Station 98.002 [2002]) and predicted Ginkgo Mine maximum daily traffic movements indicate that a daily total of approximately 543 vehicles per day pass along the section of the Silver City Highway to be utilised by Snapper Mine traffic. The predicted Ginkgo Mine maximum daily traffic movements incorporate both light vehicles and heavy vehicles, including 52 heavy vehicle movements per day associated with the haulage of materials between the Ginkgo Mine and the MSP. Heavy vehicle proportions for the Silver City Highway are assumed to be approximately 35% of total daily traffic on weekdays and 10% on weekends, based on additional RTA data and road traffic surveys undertaken for the Road Transport Assessment (Appendix C of the Environmental Assessment [EA]).

The calculated weekday and weekend existing noise levels at various distances from the highway (calculated from typical sound power levels from light and heavy vehicles) are presented in Table F-4. These have been estimated using the procedure outlined in Section F6.2 and assuming a maximum pass-by noise level of 88 dB(A) and 78 dB(A) at 7.5 m distance for trucks and cars respectively. These noise levels would vary depending on the local road surface and the precise type of vehicle. Hourly traffic volumes have been estimated by assuming that all the traffic is evenly distributed over a 15 hour period to generate a conservative calculation of existing vehicle noise.

This information is to be used later (Section F6) in a comparative way (comparing the existing noise levels with the noise levels when Snapper Mine trucks are on the road) and the absolute levels are not critical.

Table F-4 Calculated Existing Vehicle Traffic Noise – Silver City Highway (South of Broken Hill)

Distance from Highway to Receiver (m)	$L_{Aeq\ (1\ hour)}$ (dB[A]) Week Day	$L_{Aeq\ (1\ hour)}$ (dB[A]) Weekend
10	62.6	59.2
50	52.6	49.3
100	49.7	46.4
1,000	39.7	36.7

F3.2 Meteorological Environment

The Bureau of Meteorology collects climatic information from Patton Street, Broken Hill. A range of meteorological data collected from this station is presented in Table F-5 (Bureau of Meteorology, 2006), which is indicative of the local climatic conditions at the Snapper Mine. The station has been collecting meteorological information since 1889.

Temperature data show that January is typically the warmest month with a mean daily maximum of 32.7°C. July is the coldest month with a mean daily minimum of 5.3°C. Rainfall data collected at Broken Hill show that October is the wettest month with a mean rainfall of 24.9 millimetres (mm) over 5 rain days. Annually the area experiences, on average, 253 mm of rain per year.

Table F-5 Climate Information for Broken Hill

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean daily maximum temperature - °C	32.7	32.2	28.9	23.9	19.1	15.6	15.1	17.2	21	24.9	28.6	31.3	24.2	106.3
Mean no. of days where Max Temp > = 40.0°C	2.4	1.4	0.1	0	0	0	0	0	0	0	0.4	1.3	5.7	40.4
Mean no. of days where Max Temp > = 30.0°C	20.3	18.1	12.6	3.4	0	0	0	0.1	1.3	4.9	11.2	17.1	88.9	40.4
Highest daily Max Temp - °C	46.8	46.6	41.1	36.7	31	26.1	26.7	31.5	37.2	39.7	42.7	43.9	46.8	89.3
Mean daily minimum temperature - °C	18.4	18.2	15.5	11.7	8.5	6.2	5.3	6.3	8.8	11.7	14.6	17.1	11.9	106.4
Mean no. of days where Min Temp < = 2.0°C	0	0	0	0	0.1	1.6	2.4	1.1	0.3	0.1	0	0	5.5	40.4
Mean no. of days where Min Temp < = 0.0 °C	0	0	0	0	0	0.4	0.4	0.1	0	0	0	0	0.8	40.4
Lowest daily Min Temp - °C	7.7	7.8	4.4	3.1	-1.1	-2.8	-2.2	-2.2	0.3	1.1	1.1	5	-2.8	89.3
Mean 9am air temp - °C	23.4	22.8	20.2	16.3	12.5	9.4	8.7	10.5	14	17.4	20.2	22.6	16.5	85.3
Mean 9am wet bulb temp - °C	16	16.2	14.5	12	9.7	7.5	6.7	7.5	9.6	11.5	13.4	15.2	11.6	82.4
Mean 9am dew point - °C	10.1	10.6	9.3	7.9	6.9	5.3	4	3.7	4.9	5.6	6.7	8.4	6.9	33.7
Mean 9am relative humidity - %	44	48	51	58	69	76	73	64	54	47	43	42	56	83.5
Mean 9am wind speed - km/h	15	13.6	12.8	10.8	9.2	9.4	10.2	11.6	13.6	15.1	15.3	15	12.7	37.5
Mean 3pm air temp - °C	31	30.5	27.7	22.8	18.1	14.9	14.5	16.4	20.2	23.5	26.8	29.6	23	83.2
Mean 3pm wet bulb temp - °C	18.8	19	17.5	14.8	12.3	10.3	9.6	10.2	12.1	14	15.8	17.7	14.3	79.3
Mean 3pm dew point - °C	9.5	10.1	8.7	7.4	6.5	5.3	3.6	2.7	3.6	4.2	5.7	7.5	6.2	33.6
Mean 3pm relative humidity - %	28	30	32	39	48	54	49	41	34	30	27	27	37	78.4
Mean 3pm wind speed - km/h	14.6	14.6	14.1	13.3	12.9	13.9	15.2	15.7	16.1	16.1	15.8	15.2	14.8	37.4
Mean monthly rainfall – mm	23.1	24.6	19.7	17.7	22.8	21.4	18.7	18.7	20.4	24.9	19.8	21.5	253.4	108.8
Median (5th decile) monthly rainfall - mm	9.3	10.6	7.1	7.1	13	14.7	15.4	15.7	12.3	15	10.8	9.1	241.8	108
9th decile of monthly rainfall - mm	73.6	78.3	58.2	43.7	63	48	38.6	40.9	46.1	56.1	49.3	62.8	399.7	108
1st decile of monthly rainfall - mm	0	0	0	0	1	2	2.1	2.5	1.5	1.5	0.8	0	135.2	108
Mean no. of raindays	3.1	3.1	2.8	2.9	4.5	5.2	5.6	5.2	4.4	4.7	3.6	3.4	48.4	108.7
Highest monthly rainfall - mm	215.8	112.4	258.8	219	93.3	143.6	88.7	91	154.8	129.1	122.4	180.4	N/A	108.8
Lowest monthly rainfall - mm	0	0	0	0	0	0	0	0	0	0	0	0	N/A	108.8
Highest recorded daily rainfall - mm	73.6	94.8	139.4	93.5	62.2	54.1	32.8	46.5	91.4	55.1	103.1	87.2	139.4	108.8

Climate averages for Station: 047007 BROKEN HILL (PATTON STREET). Commenced: 1889; Last record: 2004; Latitude (deg S): -31.9759; Longitude (deg E): 141.4676; State: NSW.

Source : Bureau of Meteorology (2006)
N/A Not applicable

A meteorological station was installed at the Ginkgo Mine in June 2005. Hourly records of temperature, wind speed, wind direction, relative humidity, solar radiation and rainfall have been made available for this study. The data covered a period from 18 June 2005 to 7 September 2006, although some data were unavailable. To cover the periods of unavailable data and to obtain a full year of meteorological information, the 48 days (31 March 2005 to 17 June 2005) prior to 18 June 2005 have been simulated by CSIRO's prognostic model, The Air Pollution Model (TAPM). TAPM is a prognostic model which has the ability to generate meteorological data for any location in Australia (from 1997 onwards) based on synoptic information determined from the six hourly Limited Area Prediction System (Puri *et al.,* 1997).

Annual and seasonal wind-roses prepared from the Ginkgo Mine and TAPM data are shown in Figure F-7. It can be seen from the wind-roses that, annually, the most common winds are from the south or the north. In summer, the winds are generally from the south while in winter the winds are from the north. Autumn and spring winds exhibit a mix of both summer and winter patterns.

The INP requires that the effects of wind be taken into account in certain circumstances. The INP states that a wind assessment can assume that wind is a feature of the area and a 'maximum impact' scenario can be applied. A conservative 'maximum impact' wind scenario has therefore been adopted by this assessment (presented in Section F6.1).

In the autumn data, which has been predominantly derived by TAPM, the percentage of calms (that is, when winds are less than or equal to 0.5 m/s) is lower than for the other seasons. TAPM has a tendency to over-predict the very low wind speeds. Discussion in relation to temperature inversions is provided in Section F5.

F4 ENVIRONMENTAL NOISE QUALITY CRITERIA

F4.1 On-site Noise

The assessment procedure for assessing the potential impacts of industrial noise sources in NSW is set out in the INP. The INP assessment procedure for industrial noise sources has two components:

- controlling intrusive noise impacts in the short-term for residences; and
- maintaining noise level amenity for particular landuses, for residences and other landuses.

Intrusive Noise Criterion

The intrusiveness criterion is met if the $L_{Aeq(15minute)}$ is less than or equal to the RBL plus 5 dB(A), where the RBL is determined from monitoring data following the INP procedures discussed in Section F3.1. As discussed in Section F3.1, RBL is 30 dB(A). Thus in effect the most stringent criterion for the Snapper Mine would be 35 dB(A). This is the intrusive noise criterion that will be used in the current assessment for day, evening and night periods.

Amenity Noise Criteria

The INP-based acceptable and recommended maximum noise amenity criteria for the Snapper Mine locality are summarised in Table F-6.

Table F-6 Recommended L_{Aeq} Noise Amenity Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1]	Recommended L_{Aeq} Noise Level dB(A)	
			Acceptable	Recommended Maximum
Residence	Rural	Day (7.00 am to 6.00 pm)	50	55
		Evening (6.00 pm to 10.00 pm)	45	50
		Night (10.00 pm to 7.00 am)	40	45

Source: EPA (2000)
[1] For Sundays and Public Holidays, Day is 8.00 am to 6.00 pm, Evening is 6.00 pm to 10.00 pm and Night is 10.00 pm to 8.00 am.

When compared to the amenity noise criteria identified in Table F-6, it can be seen that the intrusive noise criterion (i.e. 35 dB[A]) is the most stringent of the criteria that need to be satisfied. Provided that the Snapper Mine is predicted to result in L_{Aeq} levels (over the relevant averaging period) of less than 35 dB(A) then impacts would fall within the acceptable range required by the INP.

F4.2 Off-site Transport Noise

The DEC outlines the procedures for establishing noise goals for public roads and for assessing impacts from road noise in their publication ECRTN (EPA, 1999). The DEC's ECRTN specifically addresses mining operations in relatively remote locations and notes that the ways of managing impacts on these roads, which are referred to as 'principal haulage routes' have not yet been fully developed.

However, when these routes are recognized by local authorities the noise criteria applied should be those that apply for a 'collector road'. The goals for the Silver City Highway then become as follows:

- $L_{Aeq(1hour)}$ 60 dB(A) for 7.00 am to 10.00 pm, and;
- $L_{Aeq(1hour)}$ 55 dB(A) for 10.00 pm to 7.00 am.

The calculated existing vehicle traffic noises for the Silver City Highway (south of Broken Hill) (Section F3.1) indicate that the abovementioned criteria are exceeded by existing levels of road traffic noise. Where existing levels of road traffic noise exceed the criteria, the DEC's ECRTN states:

> *New industrial, commercial or residential developments that generate additional traffic on existing roads are likely to provide limited potential for noise control, because such developments are not usually linked to road improvements. The criteria recognise the difficulties in these cases by specifying that any road traffic noise increase should be limited to 2 dB above existing levels before the development takes place, where it is shown that meeting the criteria is not feasible and reasonable.*

Therefore, the incremental impact of road traffic noise from the Snapper Mine along the Silver City Highway should not be more than 2 dB(A).

For roads that are not recognized by local authorities as 'principal haulage routes' the road category would be a 'local road in a rural area'. Therefore, the goals for the HAR are:

- $L_{Aeq(1hour)}$ 50 dB(A) for 7.00 am to 10.00 pm; and
- $L_{Aeq(1hour)}$ 45 dB(A) for 10.00 pm to 7.00 am.

As will be seen later, the approach to the assessment that is followed in Section F6.2 has been to estimate the contribution that a single truck pass would make to receptors at 10 m, 50 m, 100 m and 1,000 m from the road. In this way, the change in road transport noise that would result at typical receivers due to haulage traffic generated by the Snapper Mine can be determined.

F5 MODELLING NOISE AND NOISE EMISSION SOURCES

Noise levels (due to emissions from the mine) in the area surrounding the mine have been predicted using a computer-based noise prediction model known as NOISE7. This model was developed to predict the impacts of mining noise. A technical description of the basic model and an assessment of the performance of the model are provided by Holmes and Smith (1987) although the model has been progressively updated since the initial version. In summary, in its current form, the model includes the following main features:

1. Allowance for the decrease in sound pressure level with distance due to geometrical spreading of the sound wave.
2. Allowance for temperature inversions.
3. Allowance for absorption of sound by the atmosphere taking account of temperature and humidity effects using the approach described by Harris (1979).
4. Allowance for attenuation due to barriers using the approach described by Harris (1979).
5. Allowance for the effects of ground absorption as described by Harris (1979).

The modelling uses terrain information from the space shuttle lidar[2] survey (available from the US Geological Survey). The data proved information on terrain elevations at approximately 90 m intervals in the horizontal over the Snapper Mine site.

With regard to the allowance for the effects of inversion strength, Section 5.2 of the INP states:

> *Default values for inversion strength and wind speed have been specified for use in the noise assessment to avoid the need for potentially costly on-site monitoring. These default values have been chosen based on the analysis of available field data. Essentially, the following default parameters are specified for non-arid and arid areas:*
>
> …
>
> *Arid and semi-arid areas (annual average rainfall less than 500 mm):*
>
> *Strong (G-class stability category) inversions*
>
> • *8°C/100 m temperature inversion strength for all receivers, plus a 1 m/s source-to receiver component drainage-flow wind speeds for those receivers where applicable. (See below for applicability of drainage-flow wind.)*

2 Lidar is a laser-based remote sensing system that operates in much the same way as a radar.

With regard to the allowance for the effects of drainage-flow wind, Section 5.2 of the INP states:

> *Applicability of drainage-flow wind*
>
> *The drainage-flow wind default value should generally be applied where a development is at a higher altitude than a residential receiver, with no intervening higher ground (for example, hills). In these cases, both the specified wind and temperature inversion default values should be used in the noise assessment for receivers at the lower altitude.*

An analysis of the meteorological data used in the Air Quality Assessment (Appendix G of the EA) shows that inversions (Pasquill stability classes F and G) occur for 80% of night-time hours (6.00 pm to 6.00 am) in the winter (June, July and August). This is significantly more than the threshold of 30% considered by the INP as the point where the effect of inversions is such that inversions need to be considered in the assessment. Table D1 of Appendix D of the INP provides estimates of the increase in noise levels at given distances because of inversions. Where the applicable temperature inversion strength is 8°C/100 m and the receptor is approximately 3 km away, the default increase in noise level is 4.5 dB(A).

The land in the Snapper Mine area is gently undulating with some minor hills rising no more than a few tens of metres above the lower ground. Given that the difference in altitude between the Snapper Mine and the "Manilla" and "Trelega" homesteads is approximately 1 m and there is varying terrain in between, the drainage-flow wind default value (i.e. 1.5 dB[A]) specified in the INP has not been applied to the model. However, as stated in Section F3.2, wind is assumed to be a feature of the area and a conservative 'maximum impact' wind scenario has been adopted by this assessment for both receptors.

The assessment provided in Section F6.1 uses the default drainage-flow wind enhancement values suggested by Table D1 of Appendix D of the INP, in order to provide for a conservative 'maximum impact' scenario. That is, the assessment incorporates a 1 m/s source-to-receiver wind speed in addition to the default inversion effect resulting from a temperature inversion strength of 8°C/100 m. This increases the effect of the enhancement of an 8^0C/100 m inversion alone, from 4.5 dB(A) to 6.0 dB(A) (i.e. the enhancement increases by 1.5 dB(A) after the effects of the wind have been included). This is considered to provide for a conservative 'maximum impact' scenario since it assumes a wind effect plus a temperature inversion effect.

It should be noted that the effects of inversions on noise propagation as simulated by NOISE7 (the noise model used in this assessment) are significantly greater than those predicted by the Environmental Noise Model (ENM), which is used in the INP as the basis of most of its examples including those to assess the effects of inversions and wind. Thus, the NOISE7 model is conservative compared with ENM when it comes to predicting the effect of inversions.

For the Snapper Mine, two phases need to be considered:

(1) the construction phase including initial development of the open cut dredge pond; and

(2) the operation phase.

The provisional equipment fleet relevant to the Noise Assessment is listed in Table F-7. The dredge and primary gravity concentration unit are also included in noise emission calculations. The dredge would contain a rotating bucket wheel to cut/collect the ore and deposit it at the suction pipe inlet to the dredge pump. The primary gravity concentration unit would comprise a screen, surge bin and wet concentrator. A summary of the noise emissions data used in the modelling is provided in Attachment FB.

Table F-7 Provisional Equipment Fleet Relevant to the Noise Assessment

Equipment	Primary Purpose	Number of items of equipment	
		Snapper Mine Construction	Snapper Mine Operation
Dozer (D7R)	Overburden excavation/replacement, secondary mining of ore	1	1
Dozer (D10)	Overburden excavation/replacement, secondary mining of ore	2	2
Dozer (D11R)	Overburden excavation/replacement, secondary mining of ore	3	3
Dozer (Tiger 690)	Overburden excavation/replacement, secondary mining of ore	1	1
Excavator (330B)	Overburden excavation/replacement	1	1
Excavator (330C)	Overburden excavation/replacement	1	1
Front End Loader (Cat 966)	Loading haulage vehicles/multi-purpose	0	1
Front End Loader (Cat 972)	Loading haulage vehicles/multi-purpose	0	1
Grader (16G)	Overburden contouring, road grading	1	1
Lighting Tower	Diesel-generated floodlight	8	3
Scraper (657E)	Topsoil, subsoil and overburden excavation/replacement	4	4
Scraper (657 Auger)	Topsoil, subsoil and overburden excavation/replacement	1	1
Scraper (651)	Topsoil, subsoil and overburden excavation/replacement	4	4
Overburden Slurrying System (Dozer Trap) (feed conveyor, hopper and slurrying unit)	Slurrying overburden	0	2
Water Truck	Dust suppression	1	2
55 t Payload Double Road Trains (fleet shared with the Ginkgo Mine)	Mineral concentrate haulage	0	13
100 t Payload AB-Triples (fleet shared with the Ginkgo Mine) (subject to approval)	Mineral concentrate haulage	0	7

Source: BEMAX (2006)

Modelling of the Snapper Mine includes all plant items operating concurrently to simulate the overall maximum energy equivalent (i.e. $L_{Aeq[15minute]}$) intrusive noise level. Haulage vehicles used to transport materials between the Snapper Mine and the MSP have not been included in noise emission modelling as they would be intermittent activities. However, water trucks have been included since they are likely to be operating continuously. It should be noted that equipment other than scrapers may be used for hauling topsoil, subsoil or overburden. However, the emission factor used for scrapers provides for a conservative assessment of noise emissions from hauling topsoil, subsoil or overburden.

F6 ASSESSMENT OF IMPACTS

F6.1 Mine Noise Impact Assessment

Construction (Section F6.1.1) and Year 14 of operation (Section F6.1.2) have been assessed for mine noise impacts, since they provide the worst-case noise impact scenarios (i.e. when activities at the Snapper Mine would be closest to the nearest noise sensitive receptors).

F6.1.1 Construction Snapper Mine

During construction (in the Year 1 operation location [Figure F-3]), the "Trelega" homestead would be the nearest sensitive receptor to the Snapper Mine, located approximately 7 km to the south-west. A modelling scenario (Construction Scenario) has been set up to predict the noise levels likely to be experienced at the "Trelega" and "Manilla" homesteads during construction.

The Construction Scenario comprises the provisional construction fleet presented in Table F-7. The Ginkgo Mine would also be operational (approximately Years 2 to 4) at this time, with operations located towards the northern end of the Ginkgo Mine path.

The model results for the Construction Scenario under neutral conditions are shown on Figure F-8. The predicted $L_{Aeq(15minute)}$ noise level at the "Manilla" homestead is approximately 8 dB(A) and the predicted $L_{Aeq(15minute)}$ noise level at the "Trelega" homestead is approximately 10 dB(A). Both of these levels are well below the intrusiveness criterion of 35 dB(A) (Section F4.1) for the Snapper Mine and would remain below even if an allowance of 1.5 dB(A) to allow for the effects of wind were to be included.

The results for the Construction Scenario under inversion conditions are shown on Figure F-9. The predicted $L_{Aeq(15minute)}$ noise level at the "Manilla" homestead is approximately 19 dB(A) and the predicted $L_{Aeq(1hour)}$ noise level at the "Trelega" homestead is approximately 22 dB(A). Both of these levels are well below the intrusiveness criterion of 35 dB(A) (Section F4.1) for the Snapper Mine and would remain below even if a allowance of 1.5 dB(A) to allow for the effects of wind were to be included.

F6.1.2 Operation Year 14

During Year 14 of operation (Figure F-4), the "Manilla" homestead would be the nearest sensitive receptor to the Snapper Mine, which would be, located approximately 3.5 km to the north. A modelling scenario (Operation Year 14 Scenario) has been setup to predict the noise levels likely to be experienced at the "Manilla" homestead during construction.

The Operation Year 14 Scenario comprises the provisional operation fleet presented in Table F-7. At that time, mining operations at the Ginkgo Mine would be located towards the southern end of the Ginkgo Mine path, approximately 8 km from the "Manilla" homestead. The background noise survey (Section F3) includes background noise levels at the "Manilla" homestead with the Ginkgo Mine operating approximately 7 km east of the homestead.

It should be noted that the background noise surveys were undertaken during Year 1 of Ginkgo Mine operation and the Ginkgo Mine would be closest (i.e. approximately 5 km) to the "Manilla" homestead during approximately Years 5 to 7 of operation. Assessment using the noise survey results incorporating Year 1 of Ginkgo Mine operation would be relevant since the Ginkgo Mine would be further away (at least 8 km to the east) from the "Manilla" homestead when the Snapper Mine is at its closest point to this receptor. Further, the existing ABLs are well below the Ginkgo Mine intrusive noise limit of 35 dB(A).

The model results for the Operation Year 14 Scenario under neutral conditions are shown in Figure F-10. The predicted $L_{Aeq(15minute)}$ noise level at the "Manilla" homestead is approximately 21 dB(A) and the predicted $L_{Aeq(15minute)}$ noise level at the "Trelega" homestead is approximately 3 dB(A). Both of these levels are below the intrusiveness criterion of 35 dB(A) (Section F4.1) for the Snapper Mine and would remain below even if an allowance of 1.5 dB(A) to allow for the effects of wind were to be included.

The results for the Operation Year 14 Scenario under inversion conditions are shown on Figure F-11. The predicted $L_{Aeq(15minute)}$ noise level at the "Manilla" homestead is approximately 28 dB(A) and the predicted $L_{Aeq(15minute)}$ noise level at the "Trelega" homestead is approximately 14 dB(A). Both of these levels are below the intrusiveness criterion of 35 dB(A) (Section F4.1) for the Snapper Mine and would remain below even if an allowance of 1.5 dB(A) to allow for the effects of wind were to be included.

F6.2 Road Transport Noise Assessment

Road transport noise has been assessed for haulage traffic only. The potential road transport noise impact associated with light vehicle movements to and from the Snapper Mine has not been assessed. The majority of light vehicle movement increases would be associated with Snapper Mine workers, the majority of whom would be present on-site for extended periods and would commute only between the Ginkgo Mine accommodation camp and the Snapper Mine on a daily basis. The potential road transport noise impact associated with light vehicle movements would therefore be generally limited to tidal flows (of approximately 1 to 2 hours) when Snapper Mine workers are commuting to and from the Ginkgo Mine accommodation camp (e.g. Mondays and Fridays). Haulage traffic is therefore considered to represent the worst-case scenario for potential road transport noise emissions.

The mineral concentrate transport route would follow the route shown in Figure F-1. The road would pass no closer to "Manilla", "Roo Roo" and "Woodlands" homesteads than approximately 0.8 km (the closest approach is approximately 800 m from the "Woodlands" homestead). As discussed below, traffic noise beyond 50 m from the road do not exceed DEC road criteria levels. No exceedance of DEC traffic noise criteria is therefore predicted at "Manilla" or other homesteads that lie near the HAR.

On reaching the Silver City Highway, haulage traffic would turn north and travel to Broken Hill. The existing traffic levels and associated noise levels for the route have been characterized (Section F3.1) and the impact of haulage traffic on these levels is determined below.

A single truck would be expected to generate a maximum noise level of 88 dB(A) at 7.5 m as it passes by. In practice, this noise would become apparent as the truck approached the observer by the side of the road and increase to the peak level that would depend on the distance from the observer to the road and thereafter decrease as the truck receded. The rise and fall in noise level can be approximated by a triangular function.

The United States Environmental Protection Authority (US EPA) (1974) provides a procedure that allows the L_{Aeq} for a series of *[n]* triangular time patterns to be calculated as follows:

$$L_{AeqL} = L_{Ab} + 10\log\left[1 + \frac{nt}{T}\left[\left(\frac{10^{\frac{dL}{10}} - 1}{2.3}\right) - \frac{dL}{10}\right]\right]$$

where,

L_{Ab} = *the A – weighted background noise level* (*taken as* 30 *dB*(*A*)),

n = then number of trucks per hour,

t = the time for the noise to reduce by 10 *dB during a drive past*,

dL = the difference between thebackground and max*imum noise as the truck passes.*

Equation 1.

For receivers at 10, 50, 100 and 1,000 m and a truck speed of 80 kilometres per hour (km/h), t is 2.8 seconds (s), 7.1 s, 14.2 s and 142 s respectively.

Section F3.1 shows that the existing vehicle traffic noise exceeds DEC day and night-time goals for 'collector roads' (of 60 dB(A) and 55 dB[A] respectively) at a receiver distance of 10 m, but by a distance of 50 m the goals are met.

During operation of the Snapper Mine, transport of mineral concentrate to the MSP would increase (beyond the existing number of trips from the Ginkgo Mine), given the increase from the approved concentrate haulage of 576,000 tpa for the Ginkgo Mine alone to the combined concentrate haulage of approximately 735,000 tpa from the Snapper and Ginkgo Mines. The frequency of double road trains would increase from approximately 52 vehicle movements per day (26 in, 26 out) to a maximum of approximately 74 vehicle movements per day (37 in, 37 out). Movement frequencies of larger vehicle types (e.g. AB-triple vehicles) would be less than those for double road trains.

In addition to these movements, up to 10 visits to the site per day could be expected associated with maintenance, spare parts deliveries etc., equating to a total of 20 heavy vehicle trips per day (10 in, 10 out). These visits would occur via the Silver City Highway from the north and south.

In summary, there would be up to approximately 42 additional heavy vehicle movements per day (i.e. 21 in, 21 out, additional to the existing traffic flow).

Thus, the heavy vehicle movements associated with the Snapper Mine would increase the total existing vehicle movements from approximately 543 (which incorporates Ginkgo Mine traffic [Section F3.1]) to approximately 585 per day.

The calculated noise levels for existing and proposed total vehicles (i.e. existing vehicles plus heavy vehicles associated with the development of the Snapper Mine) along the Silver City Highway are presented in Table F-8.

Table F-8 Predicted Existing and Total Vehicle Noise (Weekdays) – Silver City Highway

Distance to Receiver (m)	Existing Vehicles $L_{Aeq(1hour)}$	Total Vehicles including Vehicles Associated with Snapper* $L_{Aeq(1hour)}$
10	62.6	63.3
50	52.6	53.4
100	49.7	50.4
1,000	39.7	40.3

* Existing traffic levels plus Snapper Mine haulage vehicles.

A comparison of existing noise levels with the proposed total noise emissions indicates that existing noise levels would not increase significantly; no more than approximately 0.8 dB(A) increase for distances less than or equal to 1,000 m. This increase would not be discernible.

F6.3 Cumulative Assessment

The existing Ginkgo Mine is operated by BEMAX, approximately 10 km to the north-east of the Snapper Mine. The effect of existing operational noise emissions from the Ginkgo Mine has been captured by the noise surveys conducted between 25 August 2006 and 7 September 2006 (Section F3.1). As stated in Section F3.1, the background noise surveys were undertaken during Year 1 of Ginkgo Mine operation. During Year 1 of operation, the Ginkgo Mine is approximately 5 km from where it would be closest to the "Manilla" homestead (which would occur in approximately Years 5 to 7 of the Ginkgo Mine). Assessment using the noise survey results incorporating Year 1 of Ginkgo Mine operation would be relevant since the Ginkgo Mine would be further away (to the south-west) from the "Manilla" homestead when the Snapper Mine is at its closest point to this receptor (i.e. Year 14 of Snapper Mine operation). Further, the existing ABLs are well below the Ginkgo Mine intrusive noise limit of 35 dB(A).

The predicted Ginkgo Mine maximum daily traffic movements have been added to the traffic count data available for the section of the Silver City Highway along the mineral concentrate transport route, thereby capturing the effect of existing road transport noise emissions from the Ginkgo Mine. The existing vehicle traffic noise exceeds DEC day and night-time goals for 'collector roads' (of 60 dB(A) and 55 dB(A) respectively) at a receiver distance of 10 m, but by a distance of 50 m the goals are met. The increase associated with the Snapper Mine would only add marginally to the existing traffic volume. That is, the increase in noise as a result of Snapper Mine vehicle movements (i.e. up to 0.8 dB[A]) would not be discernible.

F7 CONCLUSIONS

This study has assessed the likely effects of noise from construction and operation and off-site mineral concentrate transport associated with the Snapper Mine.

This study identifies the major equipment items that would produce noise during construction and operation.

Background noise surveys to characterise and quantify the acoustical environment in the area surrounding the Snapper Mine were conducted at the two nearest receptors to the Snapper Mine, the "Manilla" and "Trelega" homesteads. The results of the monitoring have been used to determine appropriate noise assessment criteria for the two locations. An assessment level of 35 dB(A) has been identified as being appropriate to protect against intrusive noise impacts. This study noted that the background noise surveys were undertaken during Year 1 of Ginkgo Mine operation and the Ginkgo Mine would be closest (i.e. approximately 5 km) to the "Manilla" homestead during approximately Years 5 to 7 of the of operation. Assessment using the noise survey results incorporating Year 1 of Ginkgo Mine operation would be relevant since the Ginkgo Mine would be further away (at least 8 km to the south-west) from the "Manilla" homestead when the Snapper Mine is at its closest point to this receptor. Further, the existing ABLs are well below the Ginkgo Mine intrusive noise limit of 35 dB(A).

A noise model has been used to predict noise levels at the "Manilla" and "Trelega" homesteads for two cases: the Construction Scenario and Operation Year 14 Scenario, since they provide the worst-case noise impact scenarios (i.e. when activities at the Snapper Mine would be closest to the nearest noise sensitive receptors. Conservative estimates have also been used for:

- plant items (i.e. assumes all operating concurrently to simulate the overall maximum energy equivalent);
- Ginkgo Mine daily traffic movements (i.e. predicted maximum);
- existing noise levels at various distances from the highway (i.e. these have been estimated assuming a maximum pass-by noise level); and
- the increase in noise levels at given distances as a result of temperature inversions (i.e. default for 3 km has been used in all scenarios, when in fact receptors would be further away).

The assessment also assumes that wind is a feature of the area and applies a 'maximum impact' wind scenario in this regard. That is, it assumes a wind effect plus a temperature inversion effect.

Noise levels at the closest residence ("Trelega" homestead) during the Construction Scenario (under inversion conditions) are predicted to be approximately 22 dB(A) (or 23.5 dB[A] including the effects of wind), which is well below the 35 dB(A) criterion set to protect against intrusiveness impacts defined in the INP.

Noise levels at the closest residence ("Manilla" homestead) during the Operation Year 14 Scenario (under inversion conditions) are predicted to be approximately 28 dB(A) (or 29.5 dB(A) including the effects of wind), which is below the 35 dB(A) criterion set to protect against intrusiveness impacts defined in the INP.

The assessment of off-site traffic noise impacts concludes that noise levels are likely to be well within the goals set by the DEC for the mineral concentrate transport route. Along the mineral concentrate transport route, existing traffic noise levels are assessed to exceed DEC goals for residences very close to the road (e.g. around 10 m from the road edge). Predicted incremental noise emissions from the haulage vehicles, however, were not found to significantly increase the existing noise environment and the increase would be indiscernible.

The cumulative effects of noise emissions from the Ginkgo Mine in the Snapper Mine area are considered to be small and do not change the conclusions presented above.

F8 REFERENCES

Bureau of Meteorology (2006)
"Climate Averages Australia".
(www.bom.gov.au).

Environmental Protection Authority (EPA) (1999)
"Environmental Criteria for road traffic noise", Published by Environmental Protection Authority, 59-61 Goulburn Street, Sydney South 1232.
(www.epa.gov.au).

Environmental Protection Authority (EPA) (2000)
"Industrial Noise Policy" Published by: Environment Protection Authority, 59-61 Goulburn Street, Sydney South, NSW 1232.

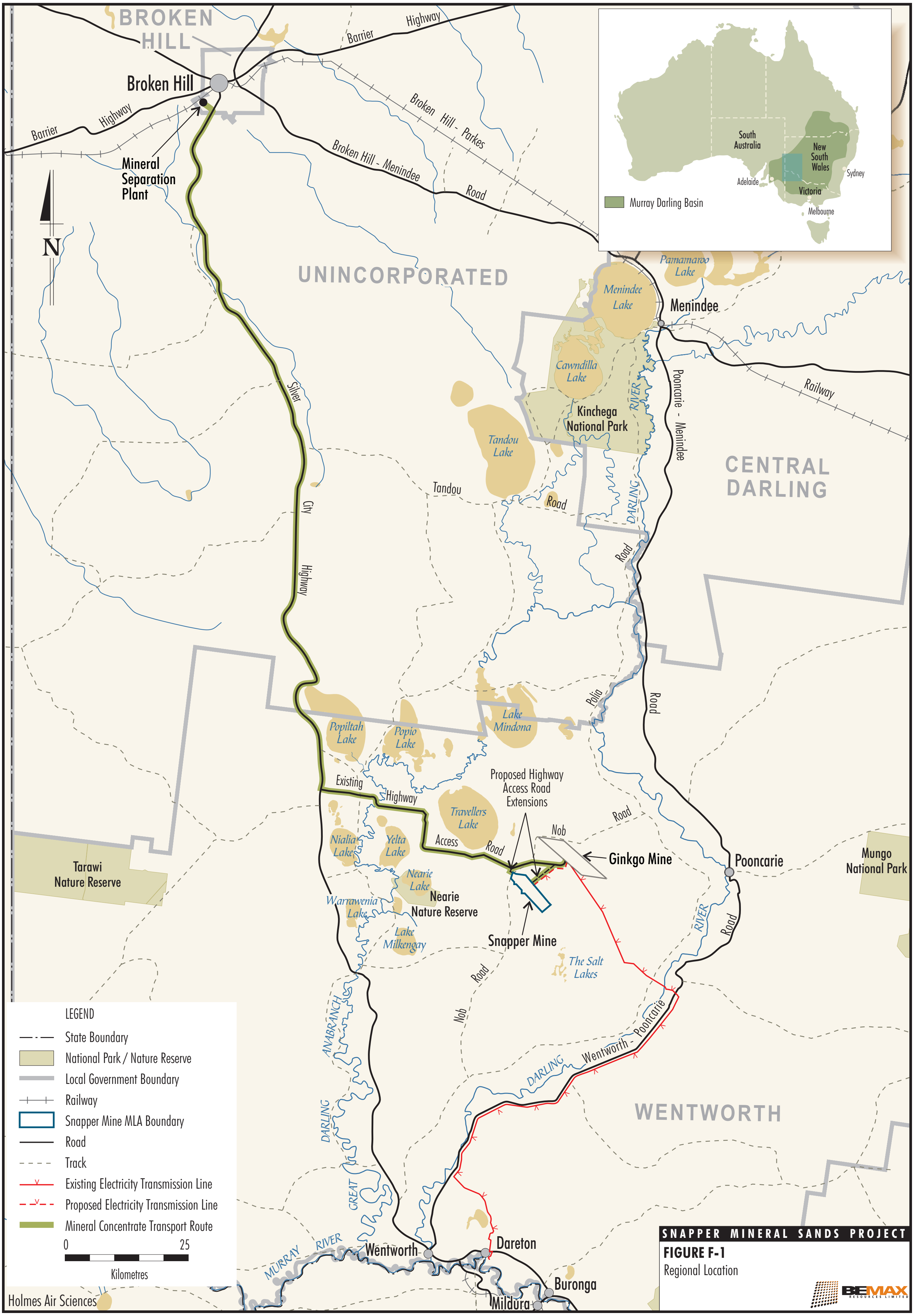
Harris, C. M. (1979)
"Handbook of Noise Control", Published by McGraw-Hill Book Company.

Holmes, N. E. and Smith, C. (1987)
"Monitoring and Modelling of Noise Levels around Open Cut Mines" In Preprints of papers Published for Environmental Management in the Coal Industry, University of Sydney November 17-19.

Puri, K., Dietachmayer, G. S., Mills, G. A., Davidson, N. E., Bowen, R. A., and Logan, L. W (1997)
"The BMRC Limited Area Prediction System, LAPS". Aust. Met. Mag., **47**, 203-223.

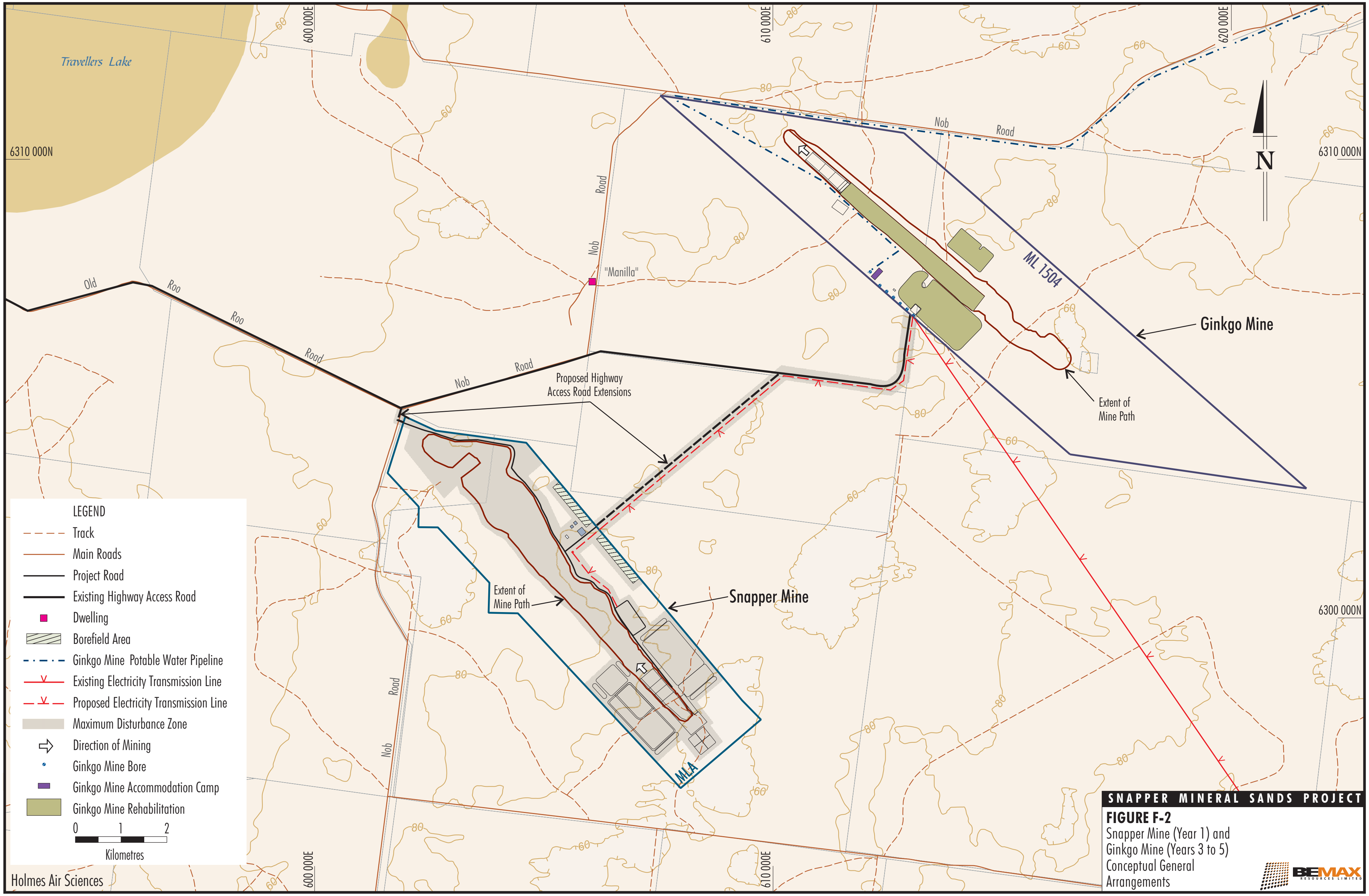
United States Environmental Protection Agency (US EPA) (1974)
"Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" Report Number 550/9-74-004, Published by NTIS, US Department of Commerce, Springfield VA 22151.

FIGURES



SNAPPER MINERAL SANDS PROJECT

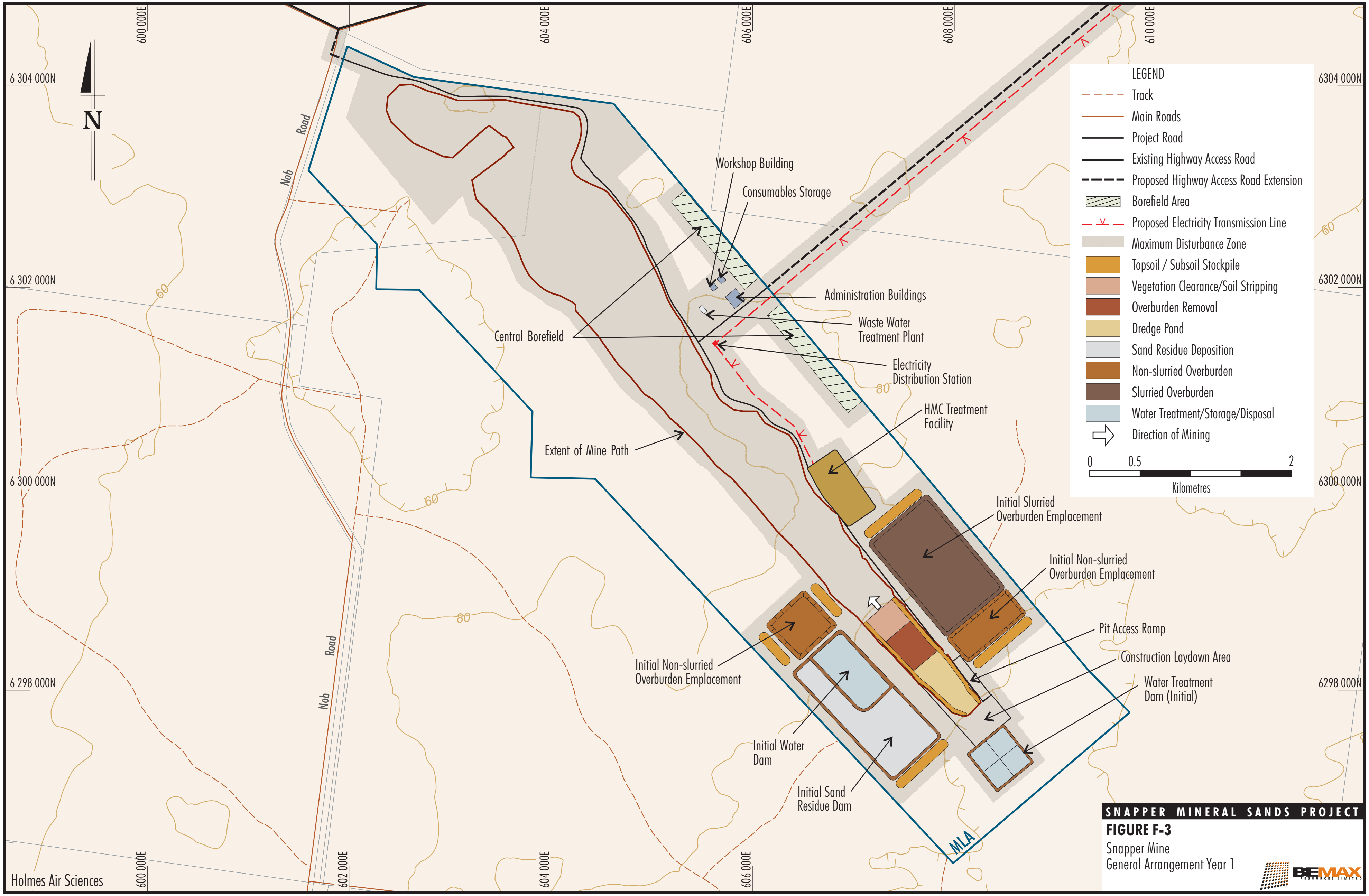
FIGURE F-1
Regional Location



SNAPPER MINERAL SANDS PROJECT

FIGURE F-2
Snapper Mine (Year 1) and Ginkgo Mine (Years 3 to 5) Conceptual General Arrangements

BMX-03-09 App Noise_002F



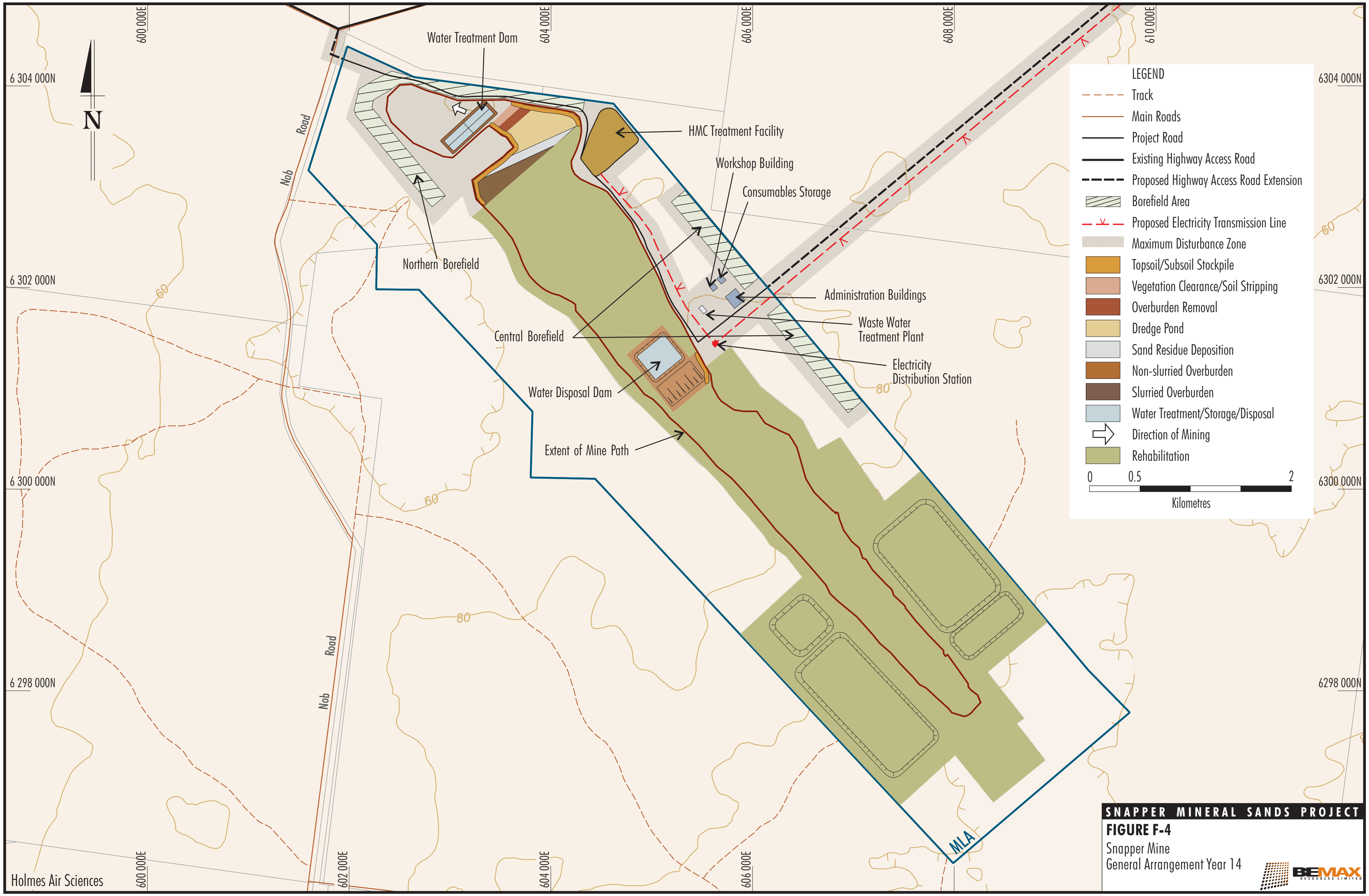
SNAPPER MINERAL SANDS PROJECT

FIGURE F-3

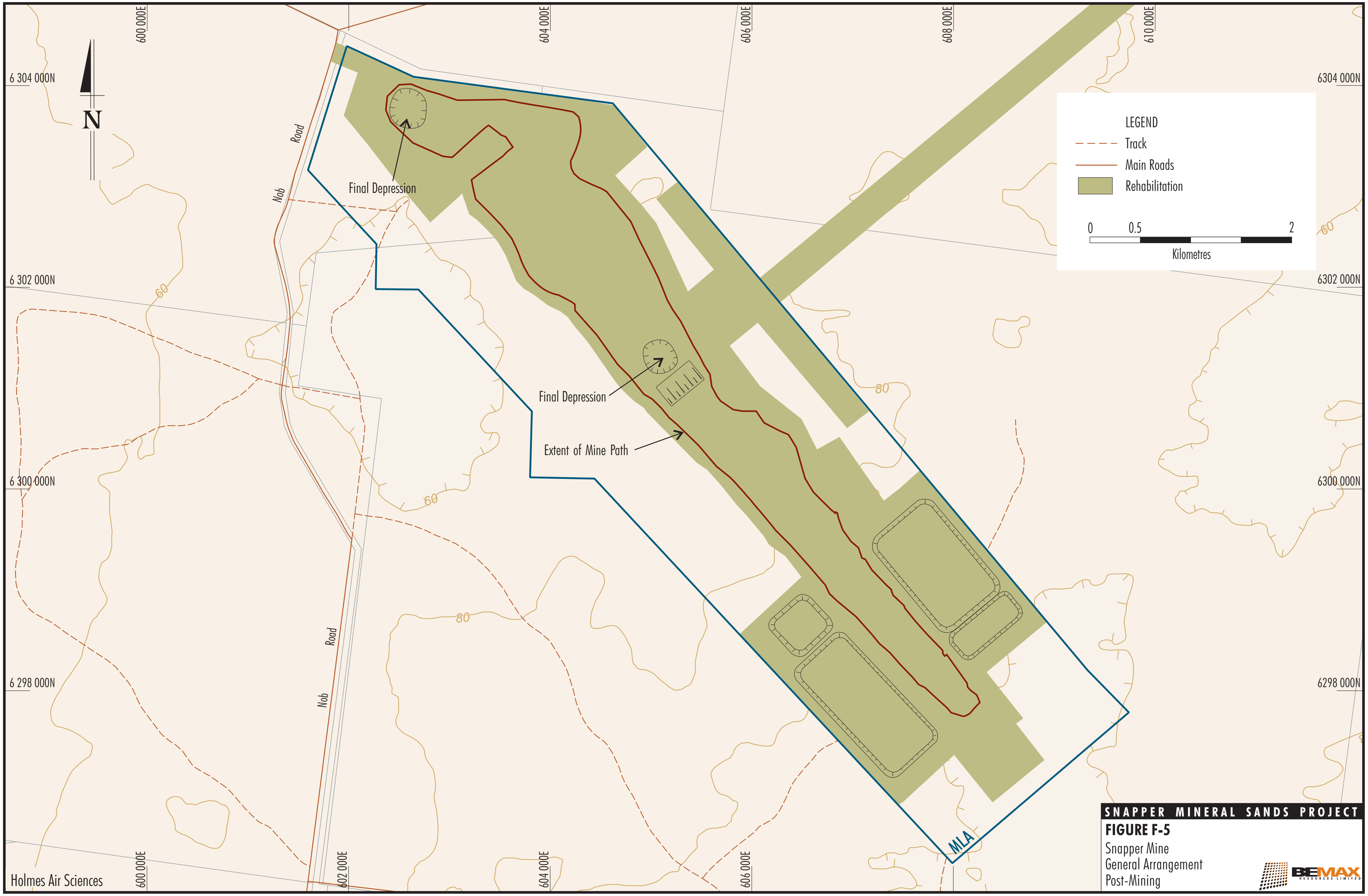
Snapper Mine
General Arrangement Year 1

BEMAX RESOURCES LIMITED

BMX-03-09 App Noise_003F



BMX-03-09 AppNoise_004G



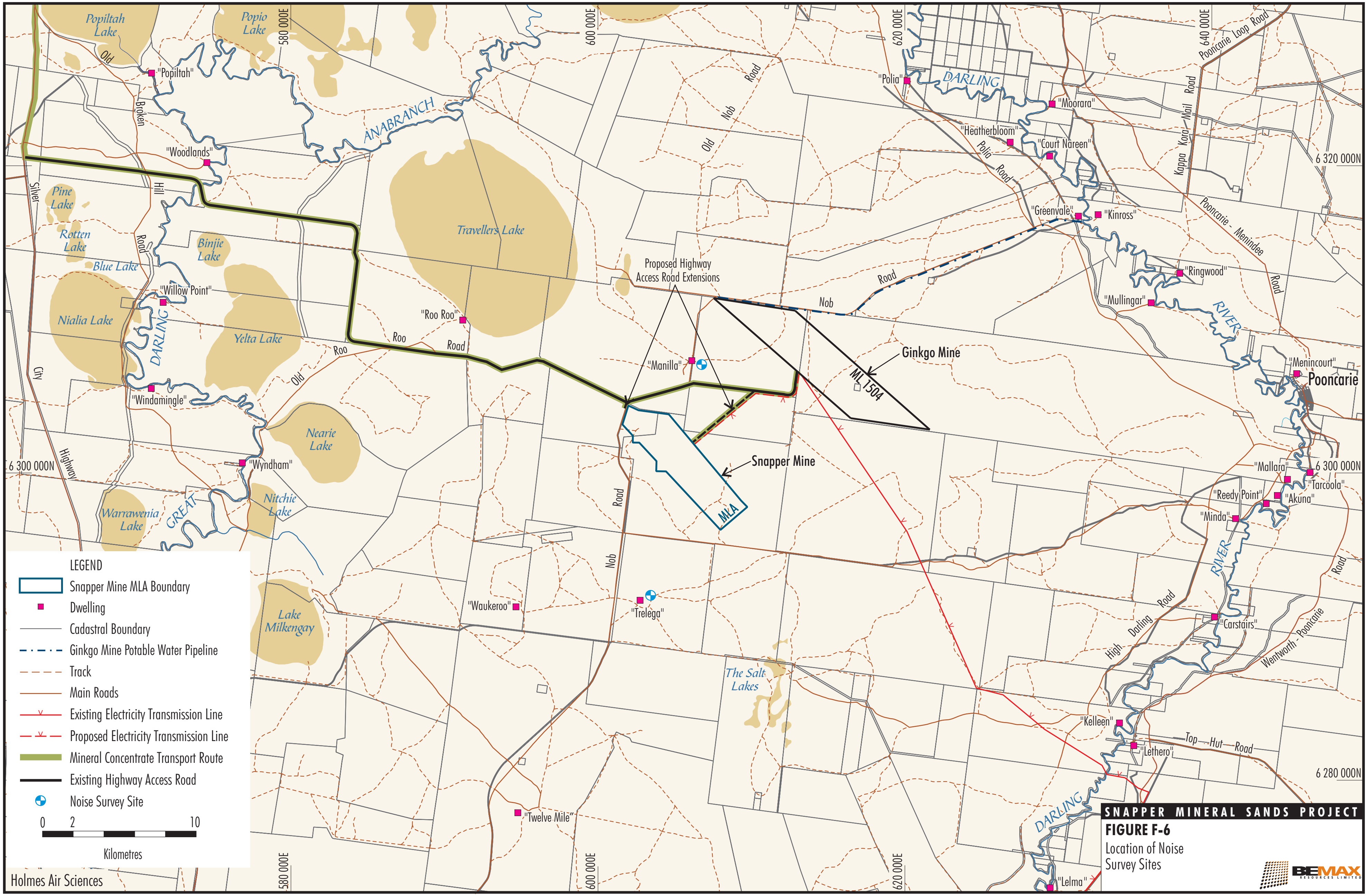
SNAPPER MINERAL SANDS PROJECT

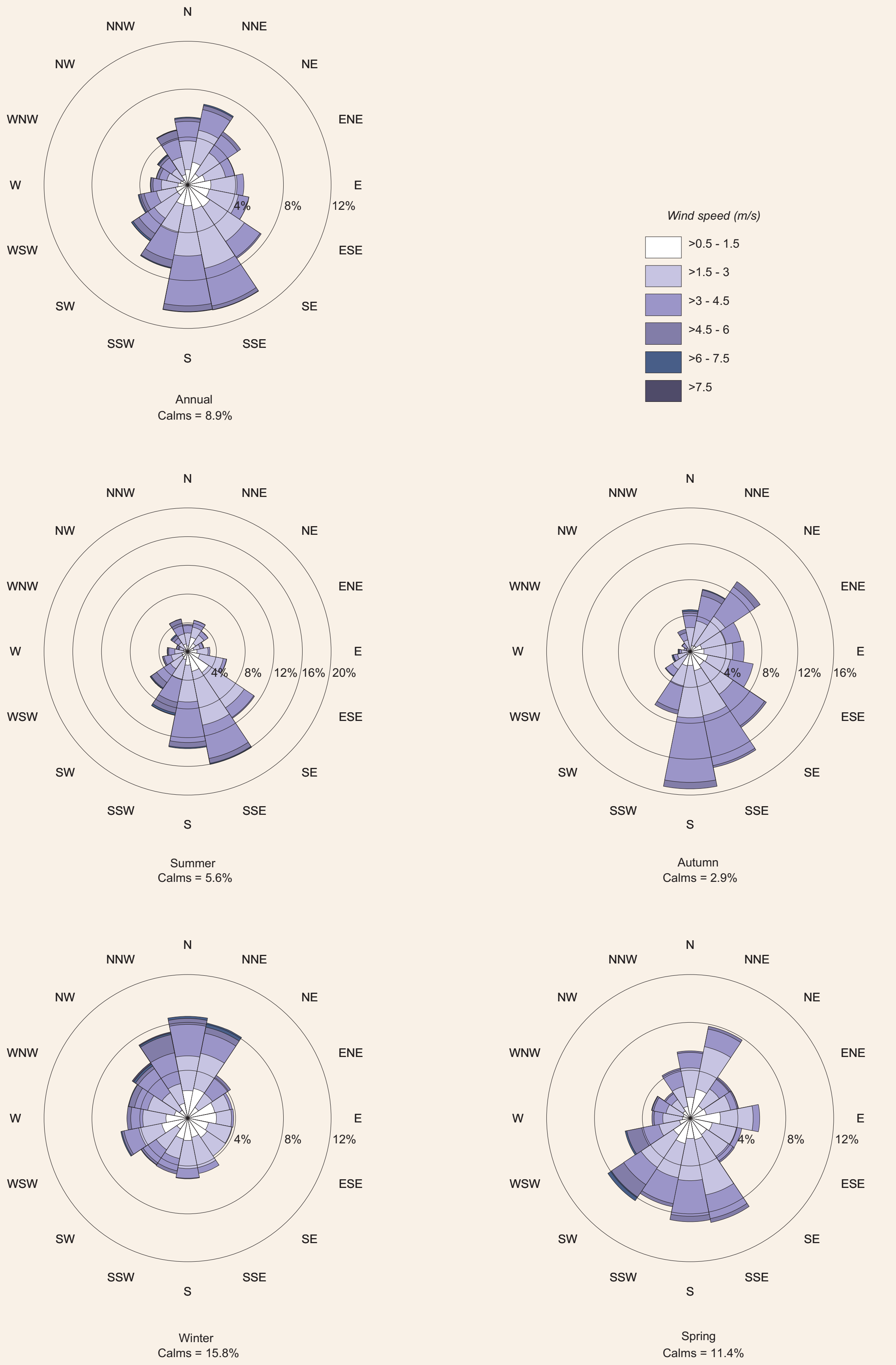
FIGURE F-5

Snapper Mine
General Arrangement
Post-Mining

BEMAX

BMX-03-09 App Noise_005F


SNAPPER MINERAL SANDS PROJECT
FIGURE F-6
Location of Noise Survey Sites
BEMAX
LEGEND
Snapper Mine MLA Boundary
Dwelling
Cadastral Boundary
Ginkgo Mine Potable Water Pipeline
Track
Main Roads
Existing Electricity Transmission Line
Proposed Electricity Transmission Line
Mineral Concentrate Transport Route
Existing Highway Access Road
Noise Survey Site
0
2
10
Kilometres
Holmes Air Sciences
Proposed Highway Access Road Extensions
Ginkgo Mine
Snapper Mine
ML 1504
MLA
Pooncarie
"Manilla"
"Trelega"
"Waukeroo"
"Twelve Mile"
"Roo Roo"
"Woodlands"
"Popiltah"
"Willow Point"
"Windamingle"
"Wyndham"
"Polia"
"Moorara"
"Heatherbloom"
"Court Nareen"
"Greenvale"
"Kinross"
"Ringwood"
"Mullingar"
"Menincourt"
"Mallara"
"Tarcoola"
"Reedy Point"
"Akuna"
"Minda"
"Carstairs"
"Kelleen"
"Lethero"
"Lelma"
Popiltah Lake
Popio Lake
Pine Lake
Rotten Lake
Blue Lake
Binjie Lake
Nialia Lake
Yelta Lake
Travellers Lake
Nearie Lake
Nitchie Lake
Warrawenia Lake
Lake Milkengay
The Salt Lakes
ANABRANCH
GREAT
DARLING
RIVER
Old Broken Hill Road
Silver City Highway
Old Roo Roo Road
Old Nob Road
Nob Road
Polia Road
Kappa Kara Mail Road
Pooncarie Loop Road
Pooncarie - Menindee Road
Wentworth - Pooncarie Road
High Darling Road
Top Hut Road
580 000E
600 000E
620 000E
640 000E
6 320 000N
6 300 000N
6 280 000N



SNAPPER MINERAL SANDS PROJECT

FIGURE F-7

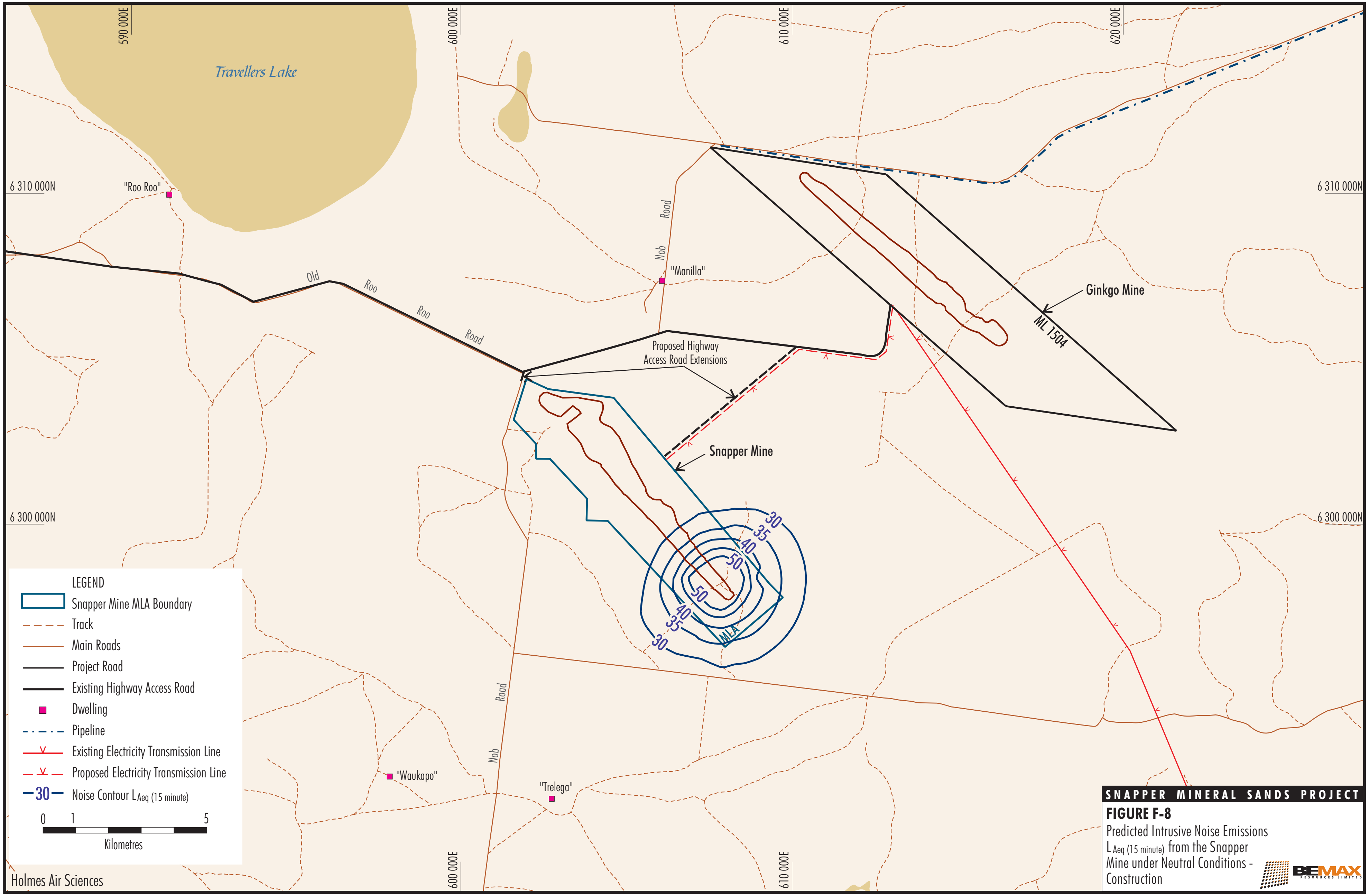
Annual and Seasonal Wind Roses for the Ginkgo Mine - April 2005 to March 2006 (1 April 2005 to 17 June 2005 by TAPM)

BEMAX RESOURCES LIMITED

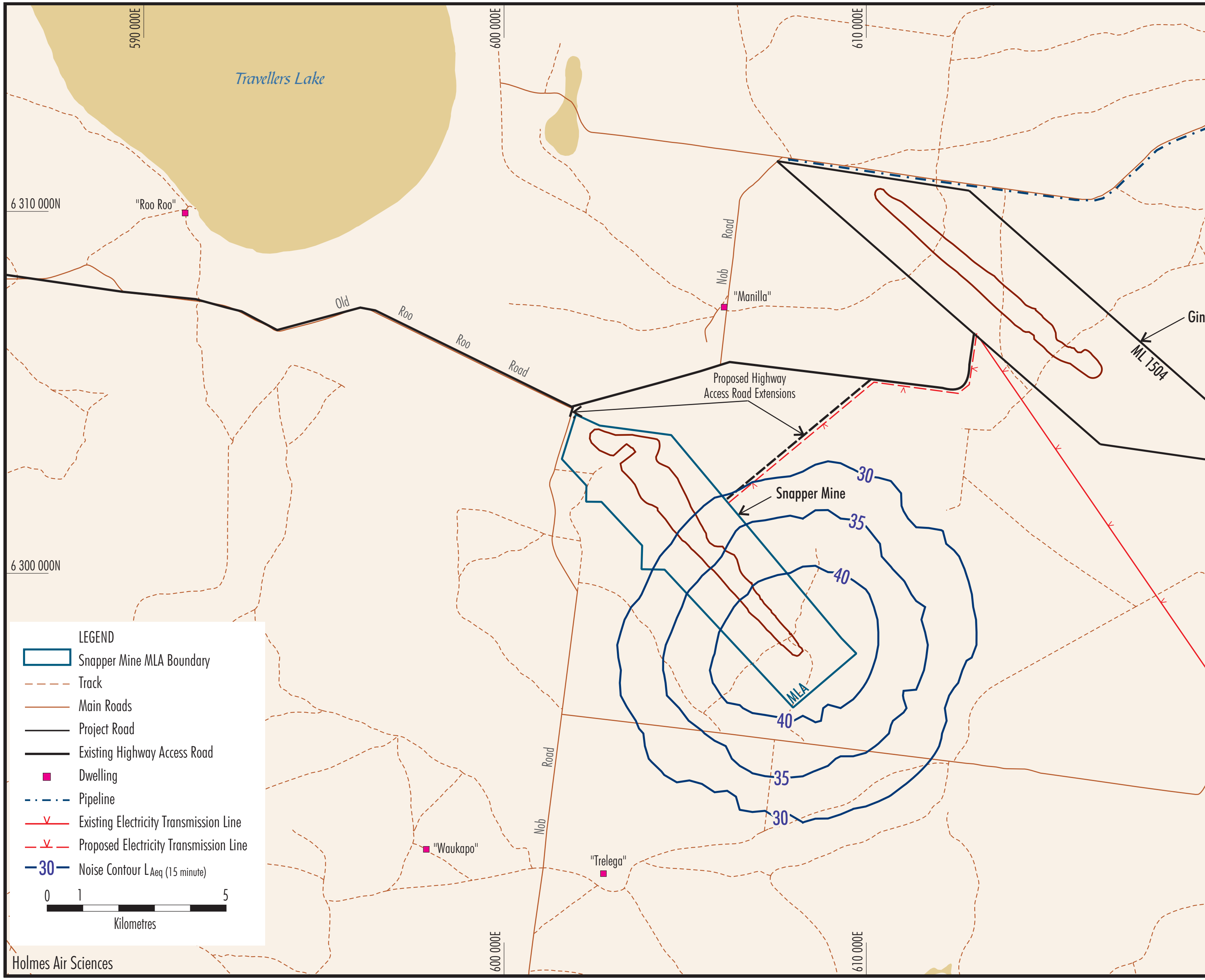
Holmes Air Sciences

BMX-03-09 App Noise_011C

< TOC Home >



BMX-03-09 App Noise_007H



SNAPPER MINERAL SANDS PROJECT

FIGURE F-9

Predicted Intrusive Noise Emissions $L_{Aeq\ (15\ minute)}$ from the Snapper Mine under Inversion Conditions - Construction

BEMAX RESOURCES LIMITED

BMX-03-09 App Noise_008H

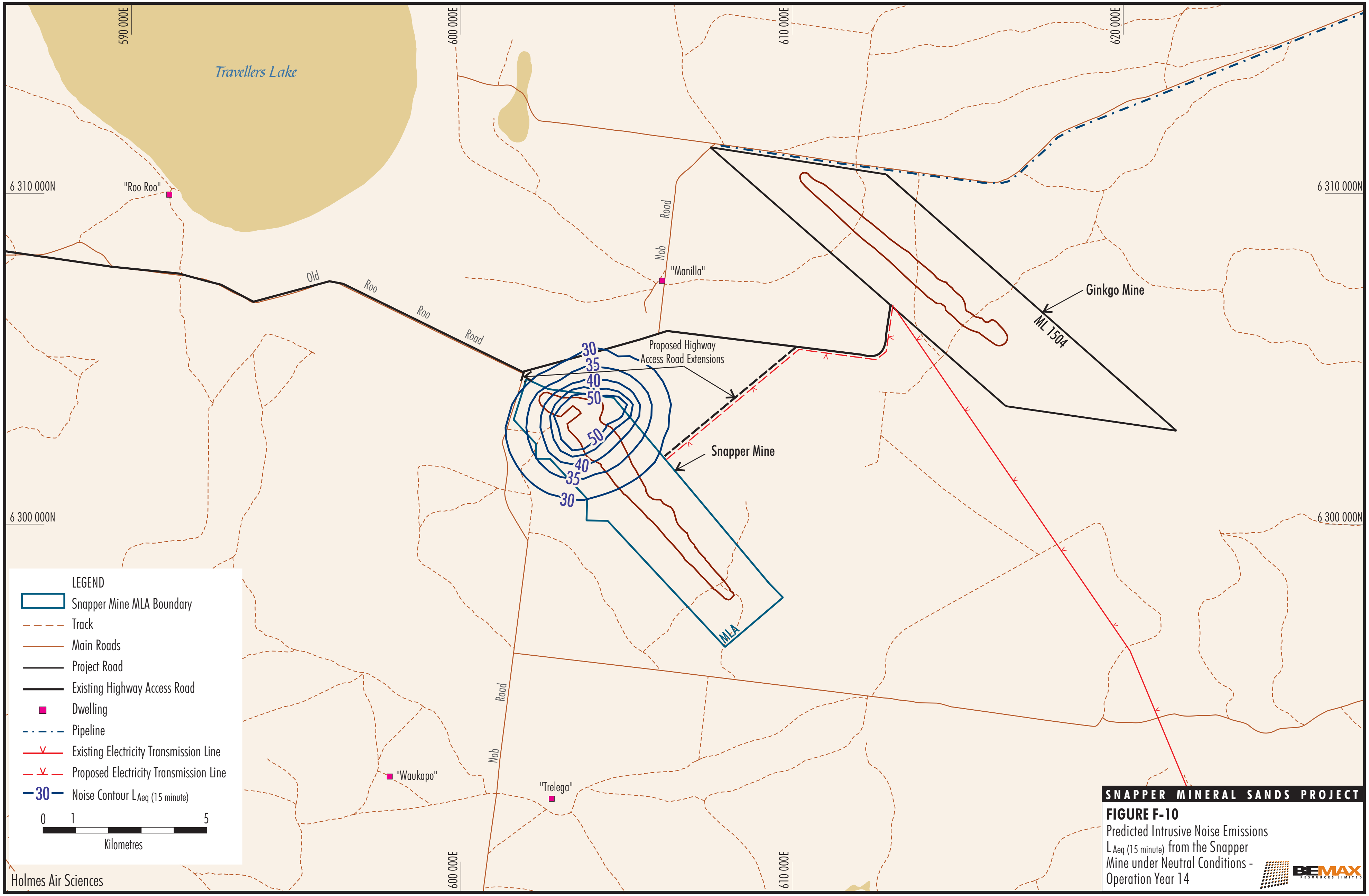


FIGURE F-10
Predicted Intrusive Noise Emissions L_{Aeq} (15 minute) from the Snapper Mine under Neutral Conditions - Operation Year 14

BMX-03-09 App Noise_009H

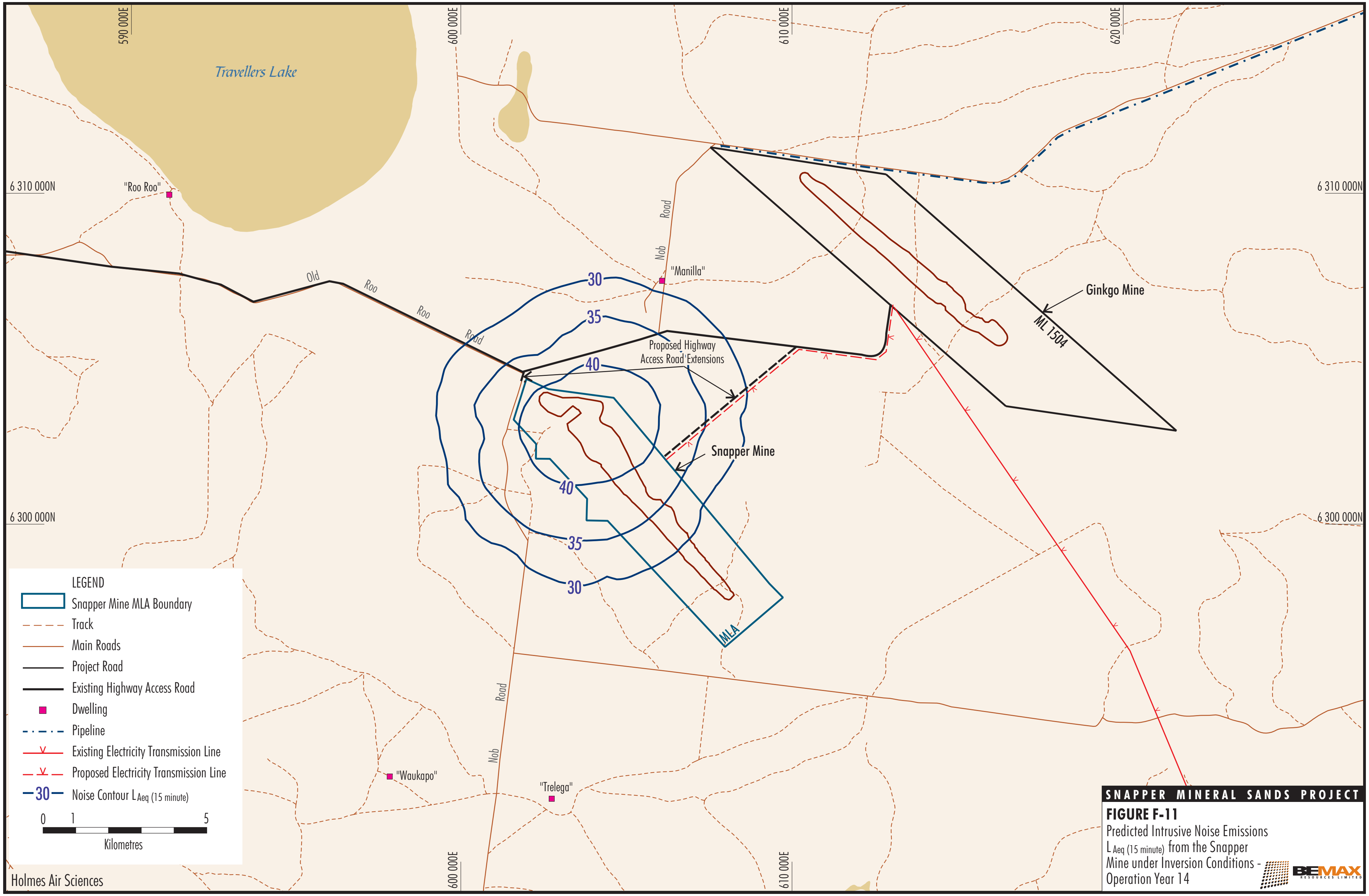
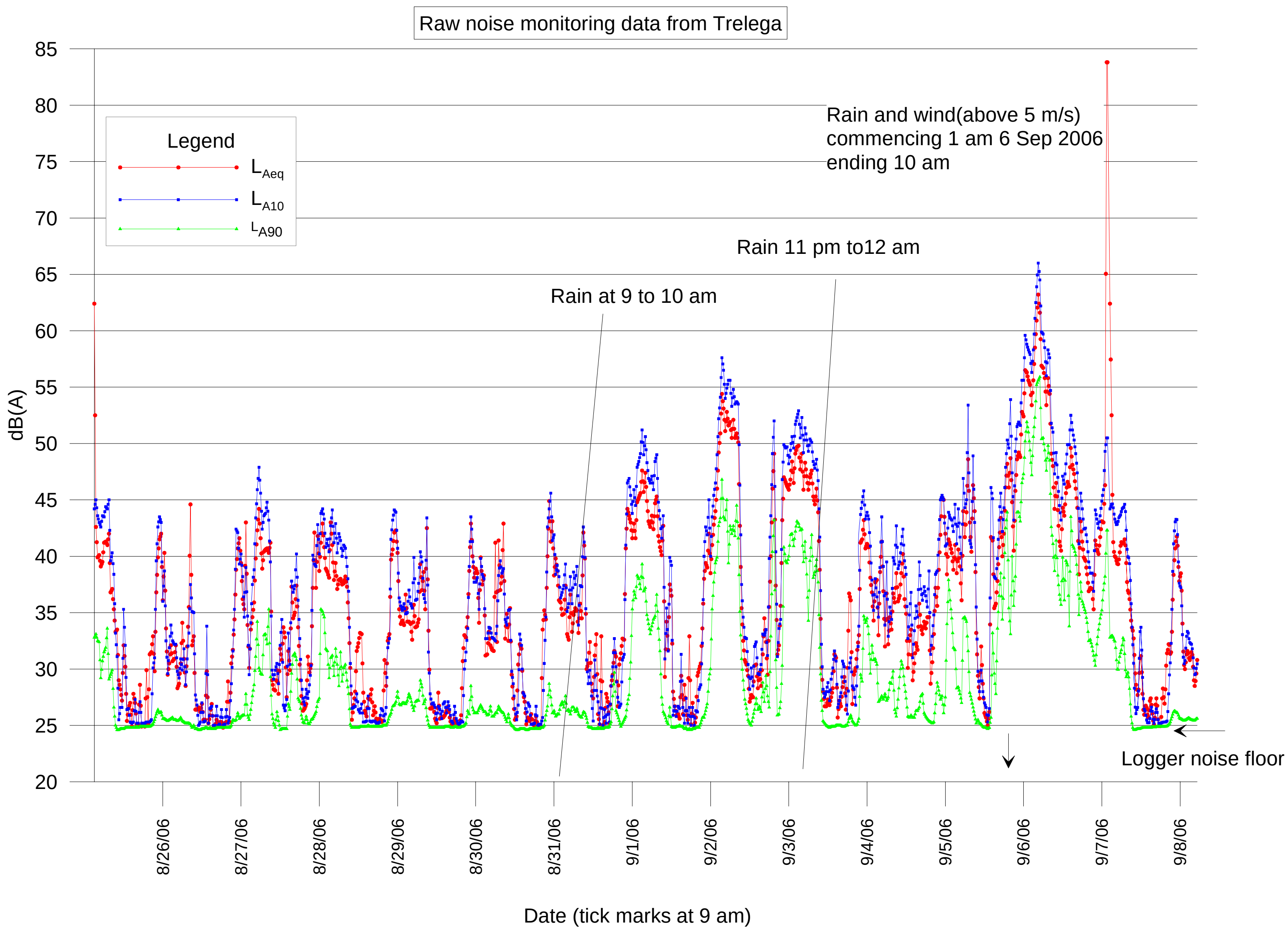
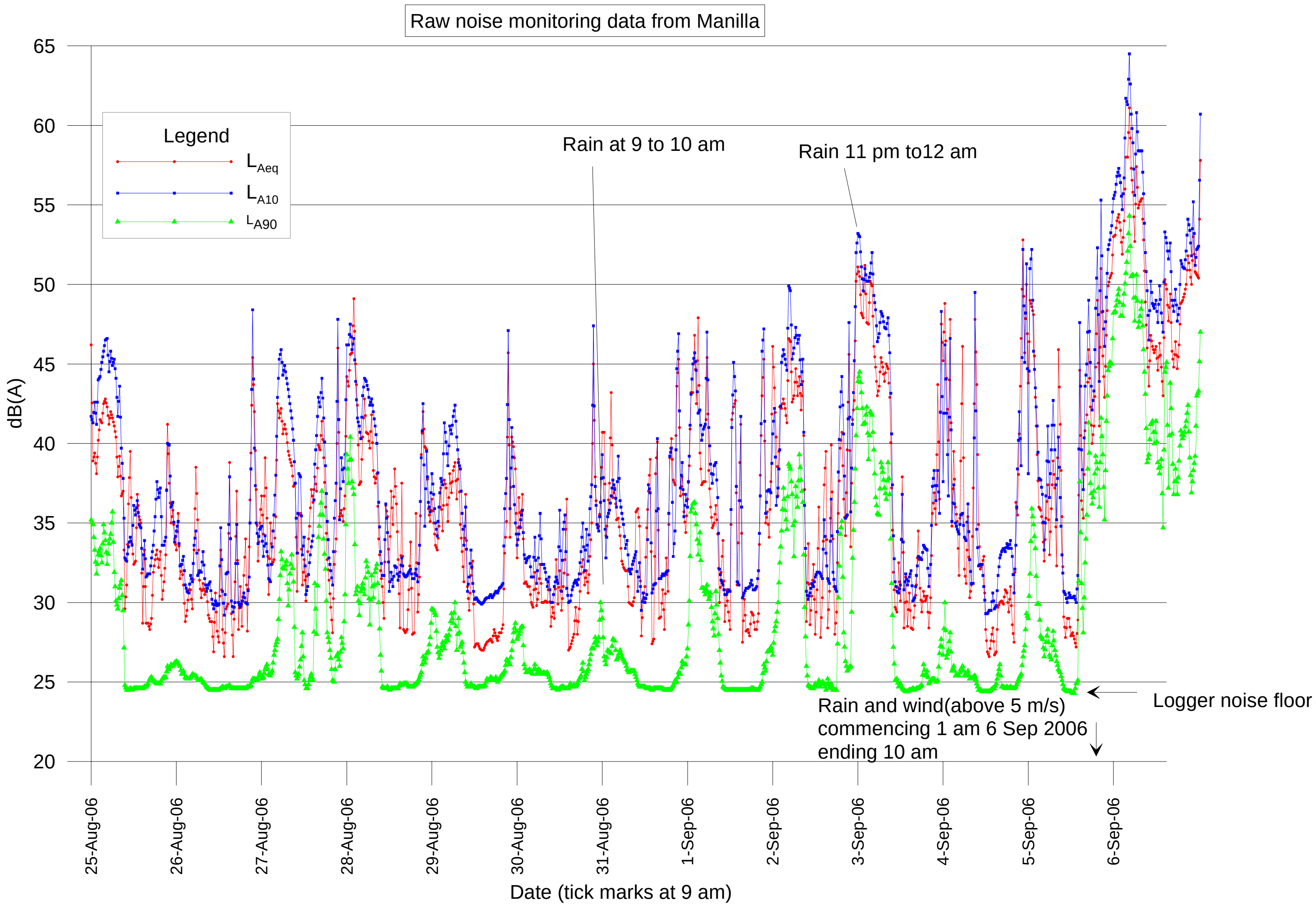


FIGURE F-11
Predicted Intrusive Noise Emissions $L_{Aeq\ (15\ minute)}$ from the Snapper Mine under Inversion Conditions - Operation Year 14

BMX-03-09 App Noise_010H

Attachment FA
Plots of Raw Noise Monitoring Data


Raw noise monitoring data from Trelega
85
80
75
70
65
60
55
50
45
40
35
30
25
20
dB(A)
Legend
LAeq
LA10
LA90
Rain and wind(above 5 m/s)
commencing 1 am 6 Sep 2006
ending 10 am
Rain 11 pm to12 am
Rain at 9 to 10 am
Logger noise floor
8/26/06
8/27/06
8/28/06
8/29/06
8/30/06
8/31/06
9/1/06
9/2/06
9/3/06
9/4/06
9/5/06
9/6/06
9/7/06
9/8/06
Date (tick marks at 9 am)


Raw noise monitoring data from Manilla
Legend
L Aeq
L A10
L A90
Rain at 9 to 10 am
Rain 11 pm to12 am
Logger noise floor
Rain and wind(above 5 m/s) commencing 1 am 6 Sep 2006 ending 10 am
dB(A)
65
60
55
50
45
40
35
30
25
20
25-Aug-06
26-Aug-06
27-Aug-06
28-Aug-06
29-Aug-06
30-Aug-06
31-Aug-06
1-Sep-06
2-Sep-06
3-Sep-06
4-Sep-06
5-Sep-06
6-Sep-06
Date (tick marks at 9 am)

Attachment FB
Summary of Noise Emissions Data used in Construction Scenario and Operation Year 14 Scenario Modelling

Table FB-1
Noise Emissions Data for Construction Scenario Modelling

Easting MGA (metres [m])	Northing Map Grid of Australia (MGA) (m)	Height (m)	Sound power level re 10^{-12} W for indicated frequency in Herz (Hz)								A-Weighted Decibels (dB[A])	Description
			63	125	250	500	1,000	2,000	4,000	8,000		
607741	6298232	72	90	97	108	105	107	103	98	93	113	Scraper 1
607738	6298169	71	68	88	88	96	94	97	92	82	102	Lighting tower 2
607744	6298126	70	90	97	108	105	107	103	98	93	113	Scraper 3
607824	6298202	70	90	97	108	105	107	103	98	93	113	Scraper 4
607787	6298086	70	88	93	106	101	103	99	94	89	109	Dozer 5
607857	6298152	70	88	93	106	101	103	99	94	89	109	Dozer 6
607890	6298229	70	68	88	88	96	94	97	92	82	102	Lighting tower 7
607857	6298083	70	88	93	106	101	103	99	94	89	109	Dozer 8
607910	6298040	69	88	93	106	101	103	99	94	89	109	Excavator 10
607943	6298013	69	88	93	106	101	103	99	94	89	109	Excavator 11
607937	6297930	69	70	77	81	92	96	94	89	84	100	Truck Cat 740 12
607983	6297977	69	70	77	81	92	96	94	89	84	100	Truck Cat 740 13
608029	6298026	68	70	77	81	92	96	94	89	84	100	Truck Cat 740 14
607893	6297831	68	68	88	88	96	94	97	92	82	102	Lighting tower 15
608043	6297887	68	88	93	106	101	103	99	94	89	109	Dozer 16
608023	6298235	69	68	88	88	96	94	97	92	82	102	Lighting tower 17
607966	6298481	74	90	97	108	105	107	103	98	93	113	Scraper 18
608023	6298434	72	90	97	108	105	107	103	98	93	113	Scraper 19
608092	6298368	70	90	97	108	105	107	103	98	93	113	Scraper 20
607966	6298394	72	92	96	100	112	111	110	101	94	116	Grader 16G 21
607937	6298375	72	70	77	81	92	96	94	89	84	100	Water Truck (25 kilolitres [kL]) 22
607874	6298414	74	70	77	81	92	96	94	89	84	100	Truck Cat 740 23
607917	6298358	72	70	77	81	92	96	94	89	84	100	Truck Cat 740 24
607956	6298308	71	70	77	81	92	96	94	89	84	100	Truck Cat 740 25
607754	6298713	78	68	88	88	96	94	97	92	82	102	Lighting tower 27

Table FB-1 (Continued)
Noise Emissions Data for Construction Scenario Modelling

Easting MGA (m)	Northing MGA (m)	Height (m)	Sound power level re 10^{-12} W for indicated frequency in Hz									Description
			63	125	250	500	1,000	2,000	4,000	8,000	dB(A)	
607801	6298603	76	92	96	100	112	111	110	101	94	116	Backhoe 29
607088	6298434	86	88	93	106	101	103	99	94	89	109	Dozer 30
607307	6298255	81	88	93	106	101	103	99	94	89	109	Dozer 31
607270	6298229	81	90	97	108	105	107	103	98	93	113	Scraper 32
607330	6298186	78	90	97	108	105	107	103	98	93	113	Scraper 33
607403	6298242	78	68	88	88	96	94	97	92	82	102	Lighting tower 34
607758	6297682	68	90	97	108	105	107	103	98	93	113	Scraper 35
608023	6298235	69	88	93	106	101	103	99	94	89	109	Dozer 36

Table FB-2
Noise Emissions Data for Operation Year 14 Scenario Modelling

Easting MGA (m)	Northing MGA (m)	Height[1] (m)	Sound power level re 10^{-12} W for indicated frequency in Hz									Description
			63	125	250	500	1,000	2,000	4,000	8,000	dB(A)	
603077	6303218	72	88	93	106	101	103	99	94	89	109	Dozer 1
603296	6303464	75	88	93	106	101	103	99	94	89	109	Dozer 2
603462	6303682	81	88	93	106	101	103	99	94	89	109	Dozer 3
603203	6303092	71	90	97	108	105	107	103	98	93	113	Scraper 4
603382	6303291	62	90	97	108	105	107	103	98	93	113	Scraper 5
603502	6303483	60	90	97	108	105	107	103	98	93	113	Scraper 6
603614	6303643	68	90	97	108	105	107	103	98	93	113	Scraper 7
603754	6303841	80	68	88	88	96	94	97	92	82	102	Lighting tower 8
603336	6303006	60	90	97	108	105	107	103	98	93	113	Scraper 9
603435	6302966	60	88	93	106	101	103	99	94	89	109	Dozer 11
603654	6303125	60	68	88	88	96	94	97	92	82	102	OB Slurry 12
603800	6303172	60	88	93	106	101	103	99	94	89	109	Dozer 14
603933	6303344	60	88	93	106	101	103	99	94	89	109	Dozer 15
604012	6303457	61	68	88	88	96	94	97	92	82	102	Lighting tower 16
603807	6303052	60	80	85	91	97	91	92	92	1	100	Dredge 17
603893	6303172	60	78	86	87	84	89	82	89	42	95	Primary concentrator 18
603767	6302887	60	93	97	106	101	101	100	97	85	110	Excavator 19
604025	6303185	60	93	97	106	101	101	100	97	85	110	Excavator 20
603667	6302675	60	90	97	108	105	107	103	98	93	113	Scraper 21
603773	6302801	60	90	97	108	105	107	103	98	93	113	Scraper 22
603946	6302960	60	70	77	81	92	96	94	89	84	100	Water Truck (25 kL) 23
604171	6303318	70	68	88	88	96	94	97	92	82	102	Lighting tower 24
603780	6302628	60	90	97	108	105	107	103	98	93	113	Scraper 25
603893	6302728	60	90	97	108	105	107	103	98	93	113	Scraper 26
604052	6302880	60	92	96	100	112	111	110	101	94	116	Grader 16G 27

[1] Note any source height equal to 60 m is in the pit approximately 10 m below local ground level

Table FB-2 (Continued)
Noise Emissions Data for Operation Year 14 Scenario Modelling

Easting MGA (m)	Northing MGA (m)	Height[2] (m)	Sound power level re 10^{-12} W for indicated frequency in Hz									Description
			63	125	250	500	1,000	3,000	4,000	8,000	dB(A)	
604171	6303106	60	88	93	106	101	103	99	94	89	109	Dozer 28
603369	6302569	69	92	96	100	112	111	110	101	94	116	Grader Cat 140 30
603216	6302688	70	70	77	81	92	96	94	89	84	100	Water Truck (25 kL) 31
604257	6303503	76	92	96	100	112	111	110	101	94	116	Backhoe 32
604788	6303331	67	70	77	81	92	96	94	89	84	100	IT208 33
604708	6303596	70	88	93	106	101	103	99	94	89	109	FEL Cat 966 34
604854	6303470	68	88	93	106	101	103	99	94	89	109	FEL Cat 972 35
603170	6303457	74	68	88	88	96	94	97	92	82	102	Lighting tower 36
604622	6303490	70	68	88	88	96	94	97	92	82	102	Lighting tower 37
604178	6302774	68	68	88	88	96	94	97	92	82	102	Lighting tower 38

[1] Note any source height equal to 60 m is in the pit approximately 10 m below local ground level