13 Noise and Vibration

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13 NOISE AND VIBRATION

13.1 INTRODUCTION

This section provides a summary of the key findings of the EIS noise and vibration assessment, undertaken by Bridges Acoustics. The detailed results of the assessment are provided in the *Noise and Vibration Report* (Appendix J).

The Environmental Risk Assessment presented in Section 4 identifies all potential project risks in relation to noise and vibration and determines the consequence and likelihood of each risk, and the overall risk rating. Risk ratings are provided for the risk both with and without the application of mitigation measures. The risk assessment has concluded that, with the application of the proposed mitigation measures, the majority of risks associated with noise and vibration are low risks, and that there are no high or extreme risks. This section provides further detail on the impacts on noise and vibration that have been identified for the project, as well as the mitigation measures that will be applied.

13.2 PROJECT SITE AND SENSITIVE RECEPTORS

The project site is characterised by elevated rocky outcrops and gently sloping valleys. Elevations within the project site range from approximately 10 m Australian Height Datum (AHD) to 120 m AHD. The project activities will predominantly take place in the low lying valley areas of the project site. The project site comprises natural bushland, with no existing development or infrastructure within or adjacent to the project site. The existing mine is located approximately 2 km to the west of the Southern Eastern Lease (Southern EL) at the closest point (Figure 13-1).

There are four sensitive receptors identified in proximity to the project site. These are listed in Table 13-1 and shown on Figure 13-1. These receptors are the nearest residences or recreation areas to the project site.

Table 13-1 Sensitive Receptors

RECEPTOR ID	NAME	TYPE	EASTING (GDA94)	NORTHING (GDA94)	NEAREST DISTANCE TO PROJECT SITE
R1	Angurugu	Township	658061	8453390	6.5 km to the north-west of the Northern Eastern Lease (Northern EL)
R2	Yedikba	Outstation	657336	8443030	2.2 km to the west of the Southern EL
R3	Wurrumenbumanja	Outstation	663633	8436591	3.5 km to the south of the Southern EL
R4	Leske Pools Swimming Hole	Recreation Area	665871	8437377	2.4 km to the south of the Southern EL

Coordinates in GDA94 MGA53

The township of Angurugu (R1) is home to approximately 850 residents. It is located in close proximity to the existing mine (Figure 13-1). The closest Angurugu residence to the existing mining operations is located approximately 500 m to the north-east of the concentrator product stockpile.

Yedikba (R2) and Wurrumenbumanja (R3) are Aboriginal outstations, comprising a small number of residential buildings. The outstations are not permanently occupied, and their level of use is understood to vary from occasional visitation to sporadic residency.

The Leske Pools Swimming Hole (R4) is a public recreation area used by Groote Eylandt residents and visitors to the island for swimming, camping and fishing activities. There are no facilities, such as toilets or treated drinking water, at Leske Pools and the area is not permanently occupied.

13.3 EXISTING NOISE ENVIRONMENT

A baseline noise monitoring program was undertaken for the EIS. It included long-term measurements using noise monitors and short term operator-attended noise surveys (to assist in identifying and quantifying dominant sources of noise). Long-term noise monitoring was undertaken from 20 June to 1 July 2014 at locations in close proximity to R1, R2 and R3 (Figure 13-1). Short-term attended noise surveys were undertaken at each sensitive receptor.

Noise monitoring data indicates that R1 experiences noise from activities at the existing mine (e.g. horns, dozers, engines of mining vehicles, reversing alarms), as well as noise from background sources such as wind, insects, barking dogs and traffic.

The existing acoustic environment in the vicinity of R2, R3 and R4 is primarily influenced by natural sources such as wind, insects and water flowing in nearby watercourses. Noise from vehicle movements is also expected to be intermittently audible at these locations, but no vehicle movements were noted during the short-term attended noise survey. As expected, given the significant distance between these receptors and the existing mine, mining activity is currently not audible at these receptors.

13.4 REGULATORY REQUIREMENTS

In the absence of defined policies in the NT relating to mining noise, and overpressure and ground vibration from blasting, the noise assessment adopted the following policies:

- *NSW Industrial Noise Policy* (INP) for defining noise criteria (NSW EPA, 2000);
- *Draft Ecoaccess Guideline for the Assessment of Low Frequency Noise* (Queensland EPA, 2004); and
- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZEC, 1990).

The adopted project noise criteria aim to achieve an acceptable level of acoustic amenity at sensitive receptors.

The NT Department of Transport has developed a road traffic noise policy, entitled *Road Traffic Noise on NT Government Controlled Roads*, available from its website. This policy was used in the assessment of road traffic noise.

The application of these policies to the noise and vibration assessment is provided in the following sections.

13.4.1 Mining and Construction

Criteria for Intrusive Noise

The INP prescribes a process for calculating intrusive noise criteria. These criteria are applicable to noise from the project alone. The intrusive noise criteria relevant to the project are shown in Table 13-2. Intrusive criteria are only applicable at permanent residences and consequently are not relevant to R4, which is a recreational area.

The intrusive criteria in Table 13-2 have been derived from background noise monitoring data (termed the rating background level – RBL), as per the method outlined in the INP. The INP sets the intrusive criteria at 5 dBA above the RBL. Intrusive criteria are assessed as LAeq,15min (i.e. noise level measured over 15 minutes). According to the INP, 30 LAeq,15min is the minimum RBL that can be applied to an assessment. In instances where measured

background levels are lower than 30 LAeq,15min (as occurred in a number of cases in this assessment), 30 LAeq,15min should be used as the RBL.

Table 13-2 NSW INP Intrusive Noise Criteria (LAeq,15min)

	R1			R2			R3		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Rating Background Level (LA90,15min)	30	30	30	30	30	30	30	31	30
Intrusive Criteria (LAeq,15min)	35	35	35	35	35	35	35	36	35

Note: Day (7 am to 6 pm), Evening (6 pm to 10 pm), Night (10 pm to 7 am) with night ending and day beginning at 8 am on Sundays and public holidays.

Noise Amenity Criteria

In addition to the criteria for intrusive noise described above, the INP prescribes noise amenity criteria. Noise amenity criteria are for cumulative noise from the project plus other industrial noise sources. Noise amenity criteria are prescribed based on the category of the receptor in terms of its land use and general noise environment. The categories used in this assessment are suburban residences (i.e. R1), rural residences (R2 and R3) and passive recreation area (R4). The noise amenity criteria for the project are provided in Table 13-3.

Table 13-3 Noise Amenity Criteria (LAeq)

RECEPTOR	INP RECEPTOR CATEGORY	AMENITY CRITERIA		
		Day	Evening	Night
R1	Suburban Residence	55	45	40
R2	Rural Residence	50	45	40
R3	Rural Residence	50	45	40
R4	Passive Recreation Area	50	50	50

Note: Day (7 am to 6 pm), Evening (6 pm to 10 pm), Night (10 pm to 7 am) with night ending and day beginning at 8 am on Sundays and public holidays.

13.4.2 Sleep Disturbance

Sleep disturbance potentially occurs when short, sharp sounds that intrude above the ambient level can be heard within a bedroom or sleeping quarters during the night.

The NSW EPA recommends a sleep disturbance criterion set at 15 LAmax above the adopted background noise level during the night. A minimum background noise level of 30 dBA was adopted for this noise assessment (Section 13.4.1). This implies a sleep disturbance criterion of 45 LAmax (i.e. 30 + 15).

13.4.3 Low Frequency Noise

Low frequency noise (any noise less than 200 Hz) is typically encountered from pieces of plant or equipment that have the ability to emit high amounts of energy (e.g. train locomotives, power stations, wash plants, concentrators). The project does not include this type of equipment, and there are very limited sources of low frequency noise for this project. Potential sources from the project are a small amount of low frequency noise from diesel powered mobile equipment, such as trucks, dozers and excavators.

The *Draft Ecoaccess Guideline for the Assessment of Low Frequency Noise* (Queensland EPA, 2004) provides a low frequency criterion of 50 dBL for frequencies up to 200 Hz to minimise the potential for impacts on noise

sensitive receptors. The criterion applies inside a dwelling with the windows and doors closed and would be approximately equivalent to a criterion of 60 dBL outside a dwelling.

13.4.4 Road Traffic Noise

The NT Department of Transport's *Road Traffic Noise on NT Government Controlled Roads* recommends a noise criterion of 68 LA10,18hr for existing roads and residences. This criterion applies to residences located in close proximity to the Rowell Highway.

13.4.5 Blasting

ANZEC (1990) contains criteria for ground vibration and overpressure from blasting. Overpressure (air blast) is a pressure wave (sound) that is produced by a blast and transmitted through the air and is perceived as a low frequency rumble. These criteria are residential amenity criteria, designed to limit disturbances to residents. The ANZEC (1990) criteria have been applied to the project, and are as follows:

- Noise limit (overpressure): 115 dBL peak for 95% of blast events in a 12 month period, with an absolute limit of 120 dBL peak for all blasts; and
- Ground vibration limits: 5 mm/s Peak Particle Velocity (PPV) for 95% of blast events in a 12 month period, with an absolute limit of 10 mm/s PPV.

Criteria to protect against structural damage are provided in British Standard 7385-2:1993. The criteria in the British Standard are well above the residential amenity criteria listed above. The criteria that have been adopted for the project would therefore prevent damage to structures, in addition to minimising disturbance to occupants of residences.

13.5 PREDICTION METHODOLOGY

Environmental noise levels expected to be produced by the project have been calculated using RTA Technology's Environmental Noise Model (ENM) software. ENM is a general purpose noise modelling package that combines terrain and noise source information with other input parameters such as weather conditions to predict noise levels at specific receptor locations or as contours over a specified receptor area. ENM was developed in conjunction with the NSW Environment Protection Authority and is widely used within Australia for noise assessments of this type.

Noise contour figures are presented in the *Noise and Vibration Report* (Appendix J).

13.5.1 Operational Noise Sources

Noise emissions that will be produced by equipment operating as part of the project have been determined from noise measurements taken from similar equipment at other operating mines. Safety considerations precluded the measurement of noise levels from equipment at the existing mine. The sound power levels for each noise source, together with the source locations, are provided in the *Noise and Vibration Report* (Appendix J). The sound power levels used in the assessment represent maximum noise levels produced by each machine or noise source operating continuously, with no correction for operating duration or duty cycle. The assumed situation is therefore likely to overstate average noise levels and provides a measure of conservatism.

13.5.2 Selection of Representative Project Years

Noise modelling was undertaken for three representative project years, namely Project Year 3, Project Year 9 and Project Year 13. These project years represent the worst case years for noise impacts at the four sensitive receptors, as follows:

- Project Year 3 is the worst case year for R1 because all mining activities are taking place in the Northern EL, which is the closest point to R1.
- Project Year 9 has been selected as a worst case year for R3 and R4, with the noise model assuming that the majority of mining equipment will be located in the Southern EL at the closest point to these receptors.
- Project Year 13 is the worst case year for R2, with the noise model assuming that the majority of equipment will be located in the Southern EL at the closest point to R2.

13.5.3 Weather Conditions

Meteorology is an important consideration in a noise assessment because weather conditions such as temperature inversions and winds from the noise source to the receiver can enhance noise. Weather conditions in the vicinity of the project site were assessed based on data from the Bureau of Meteorology's Groote Eylandt Meteorological Station (Figure 13-1) and a meteorological model prepared as part of the *Air Quality Report* (Appendix I).

Weather conditions were considered in the assessment in accordance with the requirements of the INP.

The review of weather conditions indicated that there are no winds during the day that would significantly enhance noise. The noise model therefore only considered calm conditions during the day, with no inversion and no noise enhancing winds. A set of noise contours has been produced for daytime conditions for each project year.

Winds during the evening and night occur from similar directions and consequently the evening and night periods were combined in the noise model. The noise model was run under four different evening/night weather conditions for each project year assessed. These included:

- 3^{o}C/100 m inversion, with no wind;
- 3 m/s north-east wind;
- 3 m/s south-east wind; and
- 3^{o}C/100 m inversion, plus a 1.5 m/s drainage flow wind that would enhance noise.

The north-east and south-east winds that were modelled represent winds commonly experienced in the evening/night period for all seasons. Four sets of contours were produced for evening/night for each project year assessed (i.e. using the four sets of weather conditions). For each project year, a single set of contours was then produced to represent the maximum, or worst case contours. The worst case contours were produced by using software that effectively superimposes the four sets of contours and traces around the outer contours. These are the contours that are provided in the *Noise and Vibration Report* (Appendix J) and the noise predictions discussed in Section 13.6.1.

13.6 IMPACT ASSESSMENT

13.6.1 Mine Noise

Table 13-4 provides predicted worst case noise levels at each sensitive receptor, along with the intrusive noise criteria.

Table 13-4 Predicted Project Noise Levels and Intrusive Criteria (LAeq,15min)

PROJECT YEAR	R1			R2			R3		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Project Year 3	<25	34	34	<25	32	32	<25	<25	<25
Project Year 9	<25	30	30	<25	33	33	<25	41	41
Project Year 13	<25	31	31	<25	35	35	<25	35	35
Intrusive Criteria	***35***	***35***	***35***	***35***	***35***	***35***	***35***	***36***	***35***

Note: Predictions are not provided for R4 (a recreation area) because intrusive criteria are only relevant to residences.

Predicted noise levels indicate compliance with relevant noise criteria, with the exception of R3 in Project Year 9 during the evening and night periods. Noise levels at R3 are predicted to reach 41 LAeq,15min when mining activity is at its closest point to this receptor, under reasonable worst case noise enhancing conditions. Wurrumenbumanja Outstation R3 is only intermittently occupied. The following points are relevant in relation to this prediction:

- The predicted noise levels at R3 consider a worst case scenario of simultaneous operation of 12 dozers stripping overburden at the closest point to the receptor. A more typical mining activity, such as overburden or ore removal using an excavator and a fleet of haul trucks, would be at least 6 dBA lower and would comply with the adopted noise criteria. Therefore predicted exceedances of the noise criteria would only occur intermittently, for occasional periods of a few weeks, with significantly lower noise levels at other times.
- Noise levels at R3 will be lower as mining progresses further from the receptor. Noise levels in Project Year 13, for example, are predicted to comply with the criteria with the dozers operating approximately 6.3 km from R3. Short periods of noise above the criteria would therefore be limited to a few years either side of Project Year 9 as mining activity passes the closest point to R3.

The proponent will undertake discussions with the Anindilyakwa Land Council (ALC), as representatives of the Traditional Owners, to resolve any issues that may arise from predicted noise levels at R3. These discussions may be held as part of the negotiation of a Mining Agreement for the project under the Commonwealth *Aboriginal Land Rights (Northern Territory) Act 1976* (ALRA). The project cannot proceed until a Mining Agreement with the ALC has been agreed.

13.6.2 Cumulative Impacts

Potential cumulative noise sources are restricted to the project and the existing mine. No other significant industrial developments with the potential to generate cumulative noise impacts exist or have been proposed in the vicinity of the project.

Noise levels from the existing mine were estimated using noise monitoring data recorded near R1, which is located in close proximity to the existing mine. Table 13-5 provides estimated noise levels from the existing mine, and predicted worst case noise levels from the project. The predicted noise levels for the project were derived from the data in Table 13-4 (the values in Table 13-4 differ from those in Table 13-5 because of different averaging periods – 15 minutes versus 9 hours). The values shown in Table 13-5 are for the worst case project years for each sensitive receptor (i.e. Project Year 3 for R1, Project Year 13 for R2 and Project Year 9 for R3 and R4). Table 13-5 indicates cumulative noise levels are predicted to remain within relevant criteria at all assessed receptors.

Table 13-5 Predicted Cumulative Noise Levels (LAeq,9hr) – Night

RECEPTOR	PREDICTED NOISE LEVEL			AMENITY CRITERION
	PROJECT	EXISTING MINE	CUMULATIVE NOISE LEVEL	
R1	31	37	38	40
R2	32	37	38	
R3	38	<30	38	
R4	43	<30	43	50

13.6.3 Sleep Disturbance

An assessment of sleep disturbance requires sources of maximum noise to be considered and noise levels from these sources to be calculated at residential receptors. The loudest noise sources from the project will be track dozers "tramming", with track noise producing a maximum sound power level of approximately 132 dBA as a dozer operates in reverse. Calculated maximum noise levels from the dozers operating on the project site were produced for the night period (sleep disturbance is not considered during the day) and the noise levels are provided in Table 13-6. Sleep disturbance criteria only apply to residential receptors and therefore do not apply to R4.

Calculated maximum noise levels shown in Table 13-6 are predicted to meet the adopted sleep disturbance criterion of 45 LAmax at all residential receptors. Sleep disturbance is therefore unlikely to occur at any residential receptor as a result of the project operating at night.

Table 13-6 Predicted Noise Levels and Sleep Disturbance Criteria (LAmax)

EVENING/NIGHT PREVAILING				
RECEPTOR	PREDICTED NOISE LEVEL			RESIDENTIAL SLEEP DISTURBANCE CRITERIA – NIGHT
	PROJECT YEAR 3	PROJECT YEAR 9	PROJECT YEAR 13	
R1	36	32	33	***45***
R2	34	35	37	***45***
R3	<27	43	37	***45***

13.6.4 Low Frequency Noise

Noise model results, with worst-case prevailing weather conditions at night, indicate that the following low frequency noise levels will be produced by the project:

- 43.5 dBL at R1;
- 49.5 dBL at R2; and
- 47.2 dBL at R3.

The results indicate that low frequency noise levels are predicted to be at least 10 dBL lower than the criterion of 60 dBL at all residential receptors. Low frequency noise criteria only apply to residential receptors and therefore do not apply to R4.

13.6.5 Construction Noise

Construction activities proposed to be undertaken as part of the project were reviewed as part of the noise and vibration assessment. These activities are predominantly earthmoving activities, involving equipment such as dozers, excavators, scrapers, trucks, graders and a roller. These machines would typically operate individually or in small groups and would produce less noise than the full mining equipment fleet (which includes 12 dozers) that has been assessed in the noise modelling undertaken for the operations phase.

Construction noise levels would therefore remain at least 5 dBA below worst case operations phase noise levels and would, therefore, be below the relevant noise criteria shown in Table 13-2 at all receptors. Given that a straightforward comparison can be made between noise levels produced by the construction and operations phases, a more detailed construction noise assessment is not warranted for this project.

13.6.6 Road Traffic Noise

The project will give rise to a small increase in road traffic along the Rowell Highway during the two construction phases. The noise from this additional traffic was assessed at residential receptors located along the highway, with the nearest receptor (Malkala) to the highway being located 110 m west of the road (Figure 13-1).

Calculations indicate that the project will give rise to a construction traffic noise level of 36 LA10,18hr at this point, which is insignificant compared to the criterion of 68 LA10,18hr. This represents less than a 1 dBA increase to existing traffic noise levels.

As detailed in Section 3 – Project Description (Subsection 3.9.1), the project will not give rise to any additional traffic during its operations phase. The project operations phase will consequently have no impact on traffic noise from the Rowell Highway.

13.6.7 Blasting

Residential Amenity

Overpressure and ground vibration have been calculated using the methodology outlined in *AS 2187.2-2006 Explosives – Storage and use, Part 2: Use of explosives*. Predicted blast effects have been calculated from the closest mining areas to residential receptors and are shown in Table 13-7. The predictions in Table 13-7 assume a maximum instantaneous charge (MIC) of 11,300 kg, which is the worst case MIC for the project.

Predicted overpressure and ground vibration levels are well below the criteria, primarily due to the large setback distances between the closest blast sites and each receptor. As noted in Section 13.4.5, although the criteria in Table 13-3 are residential amenity criteria, compliance with the criteria will also ensure that blasting does not give rise to any structural damage to buildings.

Table 13-7 Predicted Blast Impacts to Residential Receptors

	CRITERION	R1	R2	R3
Overpressure (dBL)	***115***	99	106	104
Ground Vibration (mm/s)	***5***	0.4	0.5	0.7

Cultural Heritage

As described in the *Archaeology Report* (Appendix L), summarised in Section 16 – Archaeology, there are a number of rock shelters on the project site that contain archaeological sites, including art. Section 16 – Archaeology contains figures showing the location of the rock shelters. The rock shelters are a significant distance from the nearest mining operations, with the nearest shelters being 400 m away and the majority of shelters being over 1 km away.

The geotechnical integrity of the rock shelters will be a key factor in determining the extent to which the shelters will be sensitive to ground vibration from blasting. Use of published blasting guidelines that contain ground vibration limits for structures would not be appropriate in this instance, given that these guidelines are designed for built structures, rather than rock formations. The proponent will therefore undertake a geotechnical survey of the rock shelters prior to mining to assess their condition, and to determine a suitable ground vibration limit to protect the integrity of the shelters. Blasts will then be designed to ensure compliance with these ground vibration limits. Section 13.7.2 describes the techniques that will be effective in reducing the MIC of the blasts, and hence reducing the ground vibration levels. The rock shelters will be periodically monitored to confirm their integrity.

13.7 MITIGATION MEASURES

13.7.1 Noise

Predicted noise levels are expected to meet relevant noise criteria at all sensitive receptors, with the exception of an exceedance of the evening and night noise criteria at R3 during Project Year 9. R3 is an intermittently occupied outstation. The proponent will undertake discussions with the ALC in order to resolve any community related issues that may arise from predicted noise levels at R3.

The proponent will also continue the operation of its complaints handling procedure to respond to any noise-related complaints.

13.7.2 Blasting

No blast management measures are required for residential receptors, given that overpressure and ground vibration from blasting are predicted to be well within the criteria at sensitive receptors.

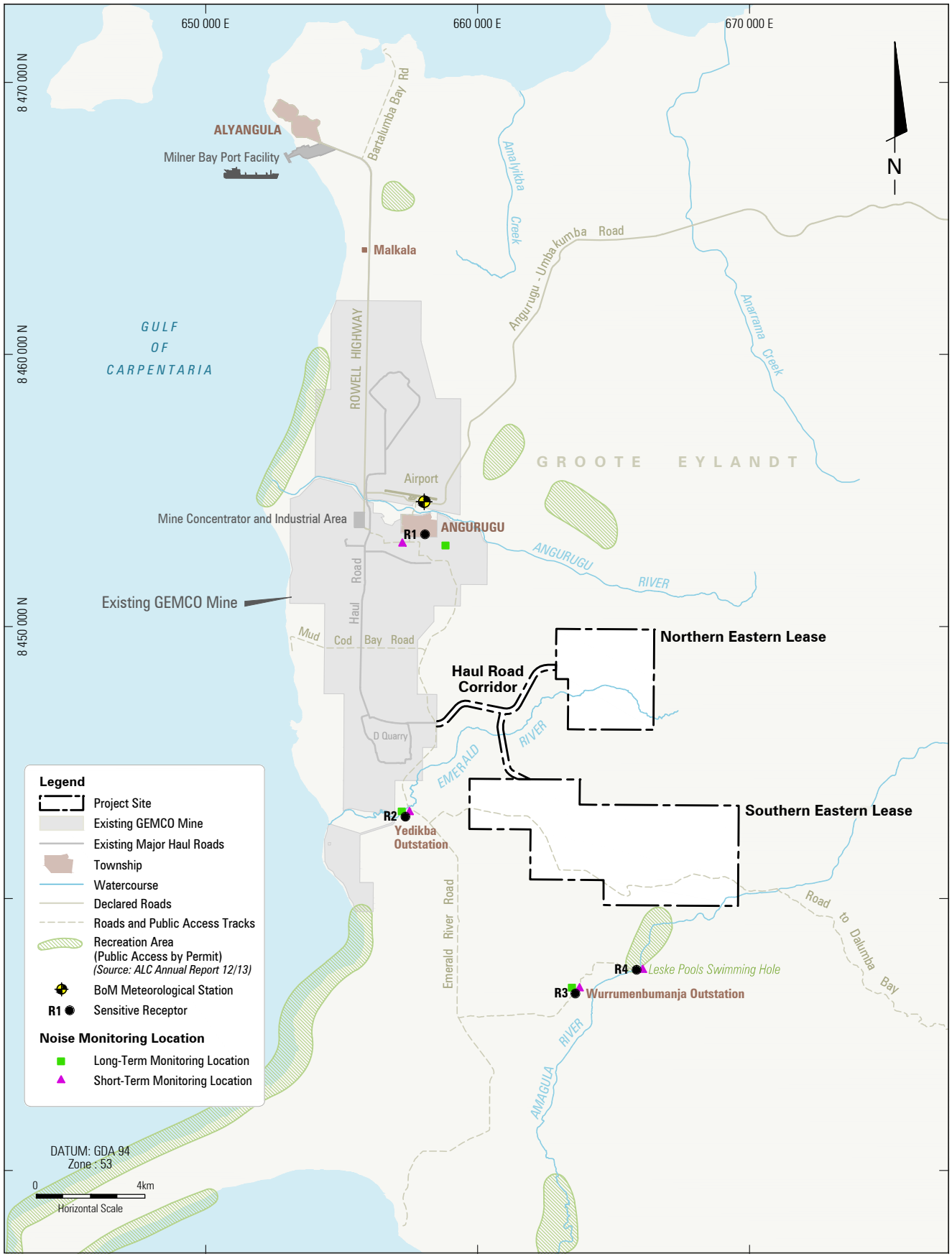
The following management strategy will be adopted to ensure that blasting does not give rise to impacts on rock shelters that contain archaeological sites:

- A geotechnical survey of the rock shelters that contain archaeological sites will be undertaken prior to blasting in the project site. The purpose of the survey is to determine a ground vibration limit for the individual sites that would minimise the risk of damage to the sites.
- The survey will be conducted by a suitably qualified and experienced person such as a geotechnical engineer.
- Blasting in close proximity to the rock shelters will be undertaken in a manner that ensures that ground vibration levels from blasting will be within the nominated limits at the archaeological sites. The following techniques would be effective in reducing the MIC of the blasts, and hence reducing the ground vibration levels:
  - Detonating shots on a daily basis, rather than accumulating charged holes over multiple days and detonating the accumulated holes;
  - Dividing the blast holes into groups and introducing detonation delays between groups of blast holes;
  - Initiating blasts in the direction away from the closest rock shelter; and
  - Scheduling blasts in the open pit quarries so that they do not occur simultaneously.

The rock shelters will be monitored periodically to confirm the integrity of the sites.

A Blast Management Plan will be prepared for the project, prior to the commencement of blasting, to document the procedure for blasting in close proximity to rock shelters that contain archaeological sites.

FIGURES



EASTERN LEASES PROJECT

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Sensitive Receptors and Noise Monitoring Locations

FIGURE 13-1