Graphinex – Esmeralda Graphite Project Environmental Impact Statement

Appendix I – Noise and Vibration Impact Assessment

GRAPHINEX

GRAPHINEX ESMERALDA PROJECT



Noise and Vibration Impact Assessment

PREPARED FOR
QLD Aus Graphite Pty Ltd

September 2026

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List of abbreviations

AARC	AARC Environmental Solutions Pty Ltd
BMP	Blasting Management Plan
CONCAWE	Conservation of Clean Air and Water in Europe
DES	Department of Environment and Science
DESI	Department of Environment, Science and Innovation
EA	Environmental authority
EIS	Environmental impact statement
EP Act	Environmental Protection Act 1994
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPP	Environmental protection policy
ERA	Environmentally relevant activity
EV	Environmental value
ktpa	Kilotonnes per annum
kt wet	Kilotonnes wet
ISO	International Organization for Standardization
LOM	Life of mine
MIA	Mine infrastructure area
ML	Mining lease
MLA	Mining lease application
MPP	Mineral processing plant
Mt	Million tonnes
Mtpa	Million tonnes per annum
MW	Megawatt
NICH	Non-indigenous cultural heritage
NMP	Noise Management Plan
STP	Sewage treatment plant
TSF	Tailings storage facility
WRD	Waste rock dump

1 Introduction

AARC Environmental Solutions Pty Ltd (AARC) has been commissioned by QLD Aus Graphite Pty Ltd (Graphinex) to prepare this noise and vibration impact assessment report for the proposed Esmeralda mine (the Project) in north Queensland.

The Project is a greenfield open-cut graphite mine and processing plant located approximately 70 km south of Croydon, and approximately 215 km south-east of the Gulf of Carpentaria (refer Figure 1). There are potential sensitive receptors near to the Project which are considered when selecting appropriate locations for baseline noise monitoring.

The Project proposes to mine up to 3.5 million tonnes per annum (Mtpa) of Run-of-Mine (ROM) ore over an operational phase of approximately 53 years using conventional surface mining equipment (excavator, trucks, dozers, drill rig, grader) or equivalent. The proposed life-of-mine (LOM) is approximately 65 years, including periods of construction (2 years), operation (53 years), and final rehabilitation (10 years).

The Project will include an open-cut pit, out-of-pit waste rock dumps, ROM pad, Mineral Processing Plant (including crushing and flotation), Tailings Storage Facilities, onsite workers accommodation, solar farm, and water management structures.

The purpose of this report is to present a noise and vibration impact assessment of the Project, including:

- present the results of background noise level monitoring at sensitive receptors near the Project;
- outline the proposed mining equipment and respective noise source levels;
- predict and assess noise levels from the Project at nearest sensitive receptors over the life of the project;
- predict and assess vibration and airblast levels associated with blasting at the Project at nearest sensitive receptors; and
- recommend noise mitigation and management measures.

To aid in the understanding of the terms in this report a glossary is included in Appendix A.

1.1 Terms of reference

The Terms of reference (ToR) for the Project (September 2025) include requirements for noise and vibration (Section 24 of the ToR). The requirements are addressed in this report, as per Table 1.

Table 1: Terms of reference

Item	Requirement	Where addressed in this report
24.1	The following guidance is relevant for the assessment of noise and vibration: (a) Queensland Government, Noise and vibration – EIS information guideline, ESR/2020/5305 (b) Queensland Government, Guideline – Application requirements for activities with noise impacts, ESR/2015/1838.	These guides are addressed in this report, and are included in the references.
Existing environment		
24.2	Identify and map the location of any sensitive places and environmental values of the project footprint and surrounding areas that may be impacted by noise emissions or vibrations from the project.	Sensitive places are identified in Section 3, and specifically in Table 5 and Figure 8.

Item	Requirement	Where addressed in this report
24.3	Describe the existing background noise within the project footprint, including noise and vibration sources. The data must be collected in accordance with quality-assured, best practice methodologies and as per the Noise Measurement Manual.	Existing background noise is described and quantified in Section 4. Existing vibration is described and quantified in Section 8.1.
Impact assessment		
24.4	Identify and quantify the noise and vibration sources emitted from the project (point and general emission sources). Describe whether the sources will be continuous, intermittent, fluctuating, vibrating or impulsive.	Noise sources are described in Sections 6.3 and 6.4. Off-MLA road and aircraft noise sources are described in Section 7.
24.5	Tabulate the noise and vibration objectives applicable to the noise and vibration emissions from the project.	The noise objectives are in Table 14, and the vibration objectives are in Table 15. Off-MLA road and aircraft noise objectives are in Section 5.9.1 and Section 5.9.2 respectively.
24.6	Detail the potential impacts of noise and vibration emissions from the project on environmental values and sensitive places, including identifying any exceedances of the acoustic quality criteria. The assessment must address low-frequency (<200 Hz) noise emissions.	The predicted noise levels are presented and assessed in Section 6.5. This section includes a low frequency noise assessment. Potential off-MLA road and aircraft noise impacts are described in Section 7.
24.7	If the project involves blasting, describe the locations, frequency and expected size of blasts, and predict the noise levels, air blast overpressure, and ground vibration that would result from the blasts.	Blasting details are included in Section 8.
24.8	Detail the compatibility of noise and vibration impacts from the project on existing and approved land uses in the project footprint and surrounding area.	Noise and vibration summary of compatibility is included in Section 9.
24.9	Demonstrate how the project will meet the environmental objectives and performance outcomes relevant to noise in Schedule 8 of the EP Regulation.	As per Section 5.3, adverse effects on environmental values from noise emissions are considered to be prevented through compliance with the proposed criteria, which are demonstrated to be achieved in Section 6.5 and Section 7.
Mitigation measures		
24.10	Describe the mitigation measures that will be applied to the project to: (a) achieve the noise and vibration criteria that have been developed for the project (b) avoid, minimise and/or mitigate adverse noise and vibration impacts to sensitive receptors (c) protect the environmental values of the acoustic environment (d) control background creep in noise as outlined in the Environmental Protection (Noise) Policy 2019.	Predictions indicate that mitigation measures are not required (refer Section 9), though it is recommended that a Noise Management Plan be implemented, which could include potential noise management and mitigation measures.

Item	Requirement	Where addressed in this report
24.11	Describe the monitoring and auditing processes to achieve the noise and vibration criteria developed for the project.	Refer to Section 9 – this is to be included in the NMP. Given the predicted compliance, it is recommended that complaint triggered monitoring be a condition of approval, rather than regular or continuous noise monitoring.
24.12	Describe the process for corrective actions to address any exceedance of the noise and vibration criteria.	Refer to Section 9 – this is to be included in the NMP.

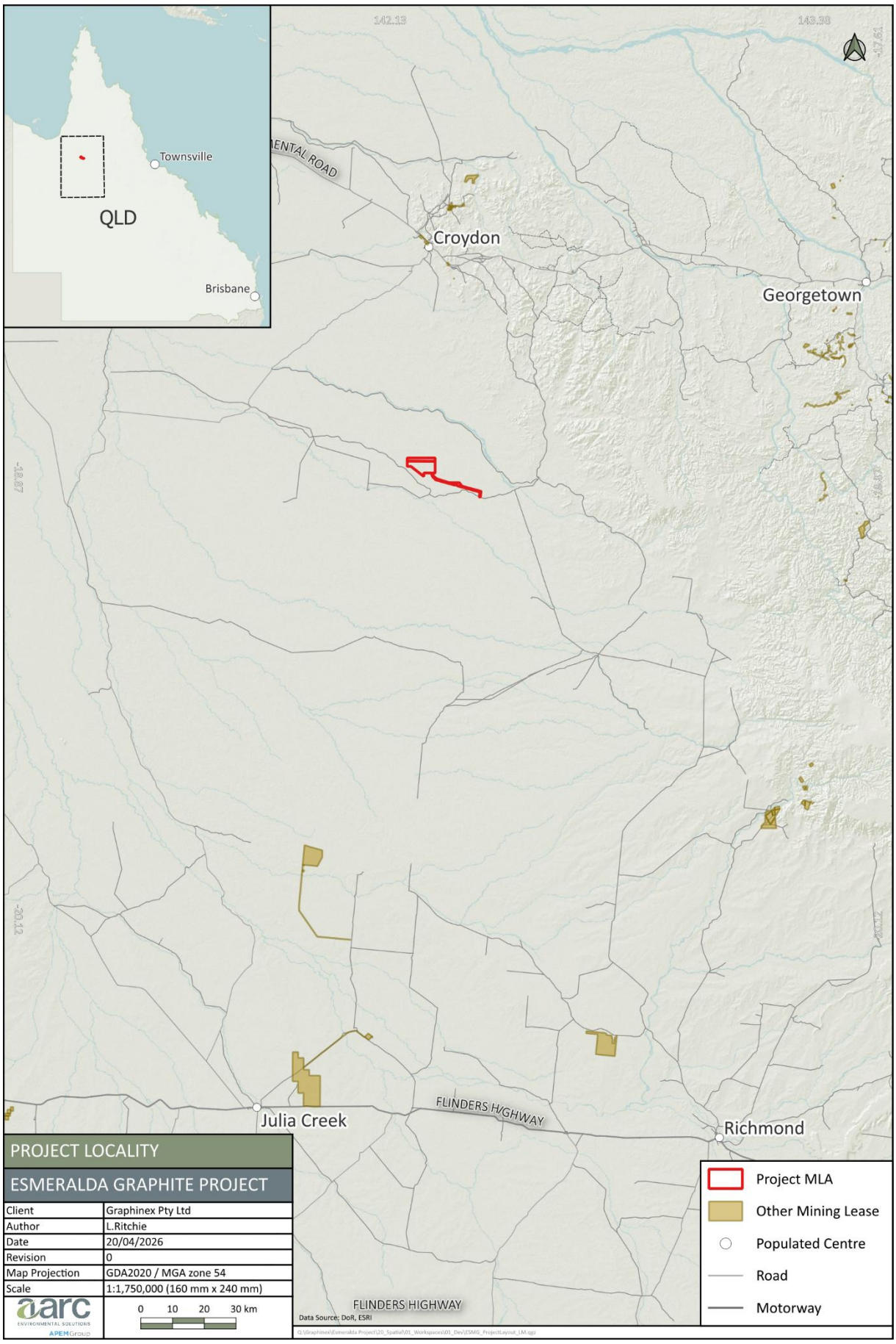


Figure 1: Project location

2 Project background

There has been a recent global increase in demand for critical minerals such as graphite. To respond to this increased demand, Graphinex is seeking approval to develop the Esmeralda Graphite Project. The Project objective is to develop graphite, to be primarily used as battery anode material.

The Proponent is proposing to develop a greenfield mine and processing plant located within Far North Queensland's Croydon Shire local government area, 70 km south of Croydon (Figure 1).

Key activities within the scope of the Project include:

- construction, operation and rehabilitation of an open cut graphite mine within Mining Lease Application (MLA) 100431 and MLA 100430;
- mineral processing of ore to produce a graphite concentrate;
- haul road construction and transport of concentrate along a private road, to an intersection with the public road network at Esmeralda Prospect Road; and
- transport of graphite concentrate using road trains on the public road network to Townsville for export.

2.1 Project objectives and scale

The Project proposes to develop an open cut mining operation that will mine up to 3.5 Mtpa of ROM ore over an operational phase of approximately 53 years, mining a total of approximately 170 Mt graphite ore. The resource base consists of a granite hosted ore body with approximately 150 metres of thickness, located beneath 70 to 100 metres of weathered sedimentary overburden.

The proposed LOM is approximately 65 years, including periods of construction (2 years), operation (53 years), and final rehabilitation (10 years). The mine will operate 24 hours per day, seven days per week.

Ore will be mined to an approximate maximum depth of 250 m below ground level. Excavated overburden and non-ore-bearing material will be deposited in out-of-pit waste dumps located adjacent to the mining void. The majority of waste movement will occur within the first 18 years of the mine life, with a total of 143.8 Mt estimated to be moved over the entire production life of the Project. Extracted graphite ore will be trucked to the mineral processing plant (MPP) for stockpiling and concentration via conventional flotation methods.

The specific objectives of the Project are to:

- operate profitable mining operations to locally produce high-quality critical mineral products for markets;
- support economic development in rural Queensland and in Townsville, through the creation of employment and procurement of local goods and services;
- assist the renewable energy transition by enabling graphite production for use in batteries, renewable energy products and other markets;
- design, construct, and operate the Project in a manner that avoids and minimises adverse impacts on the social and natural environments; and
- comply with all relevant statutory obligations and continue to improve processes which enhance sound environmental management.

The maximum area proposed to be disturbed within the MLA footprint ('limit of disturbance' extent' in Figure 2 and Figure 3) is 2,413.7 ha. This footprint includes a buffer zone, serving as an environmental protection buffer, whereby additional disturbance outside of the direct impact from the development may be necessary to ensure safe operations and minimise risks, such as those associated with fires and storms.

2.2 Project components

The project layout is shown in Figure 2 and Figure 3. The main components of the Project include:

- site preparation works that include clearing vegetation, removing topsoil, stockpiling, earthworks, and temporary drainage works;
- open-cut mining of approximately 3.5 Mtpa of ROM ore, using conventional surface mining equipment (excavator, trucks, dozers, drill rig, grader) or equivalent;
- construction and use of a ROM pad for ore stockpiling and handling of ore;
- construction and operation of a Mineral Processing Plant, including an initial crushing and milling circuit, followed by a conventional flotation circuit consisting of rougher and flotation stages;
- product load-out area for stockpile and loading of graphite concentrate;
- construction of dedicated Tailings Storage Facilities (TSFs) for storage of process waste streams;
- construction of an on-site workers accommodation facility, ablutions, and sewage treatment plant;
- construction of an on-site airfield for transport of workers to and from the site. Subject to final engineering designs, the airstrip is anticipated to be approximately 1200 m long, exclusive of buffers for approach/take-off, and will be used approximately four times per shift changeover day, or during emergency use by the royal flying doctor service, with the largest plane being a Dash-8 300;
- installation of water management infrastructure including a watercourse diversion, flood levee, dams, drains, and bunds;
- power supply through installation of an on-site solar array and energy storage system with back-up diesel generation and energy distribution infrastructure and grid power when available;
- potable water supply through on-site water treatment and/or importing water to site;
- supply of processing water from recycled sources on the mine site, including pit dewatering groundwater abstracted to enable the mining operations;
- construction of a private access road connecting the mine to the public road network at Esmeralda Prospect Road, located within the southern lease application area;
- backfilling of the mining void to natural surface level using a combination of tailings waste and waste rock stockpiled on the site. No final voids are proposed in perpetuity; and
- progressive rehabilitation commencing late in the mine life, as land becomes available for reclamation. Final landforms will be reshaped, topsoiled and revegetated to ensure safe, stable and non-polluting landforms post-mining.

Graphite concentrates produced at the mine through on-site processing will be transported to Townsville for export and distribution.

Outside of the Project scope, other infrastructure and services that might be utilised over the life of the Project includes:

- public road networks for transport of product, equipment, materials, reagents and personnel. If required, any upgrade to public road infrastructure will be outside of the EIS scope;
- future power distribution infrastructure if available;
- future water supply infrastructure if available;
- temporary accommodation and services offered from local towns such as Croydon;
- occasional use of local airfields; and
- the Port of Townsville or suitable alternative for export.

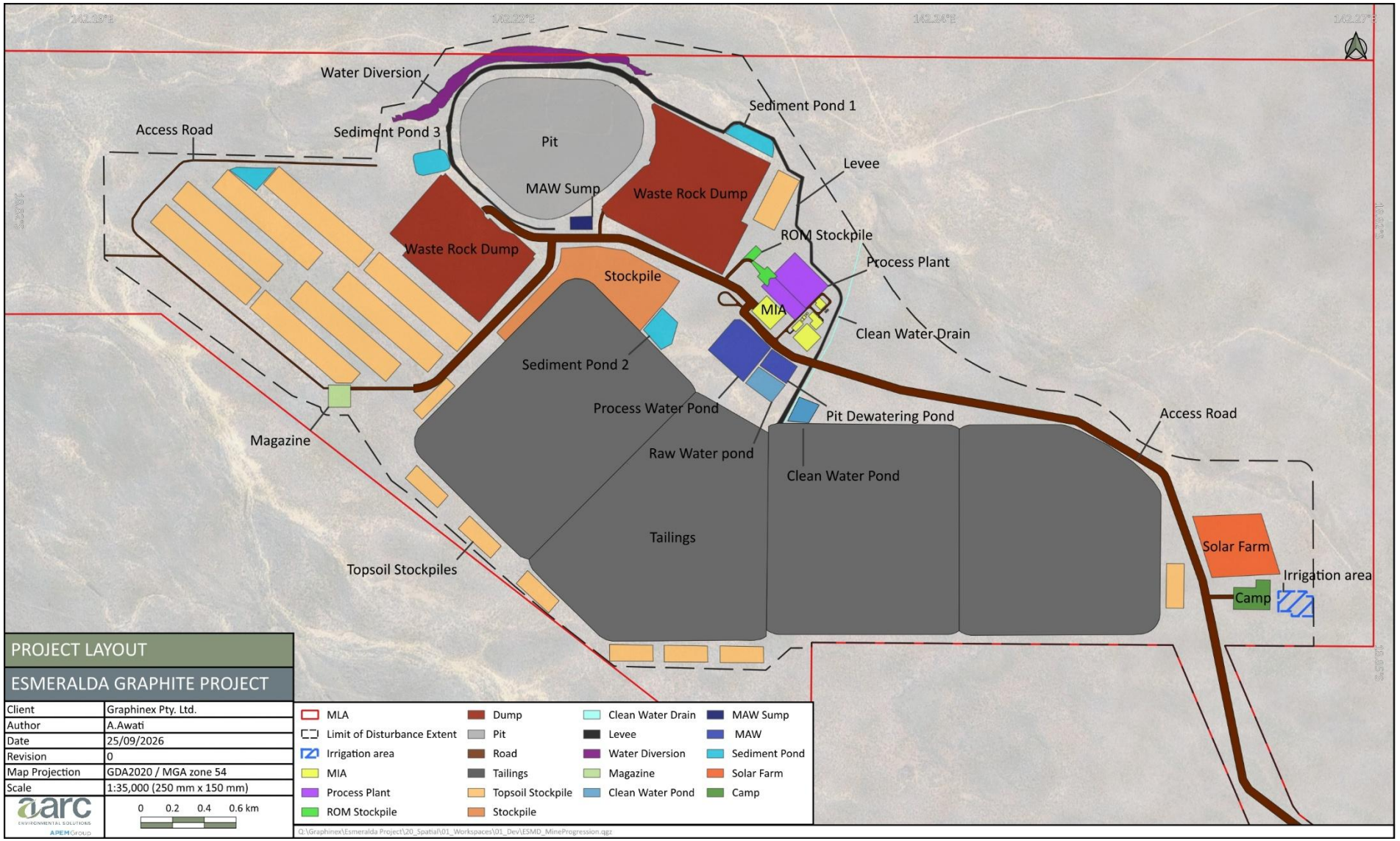


Figure 2: Project layout

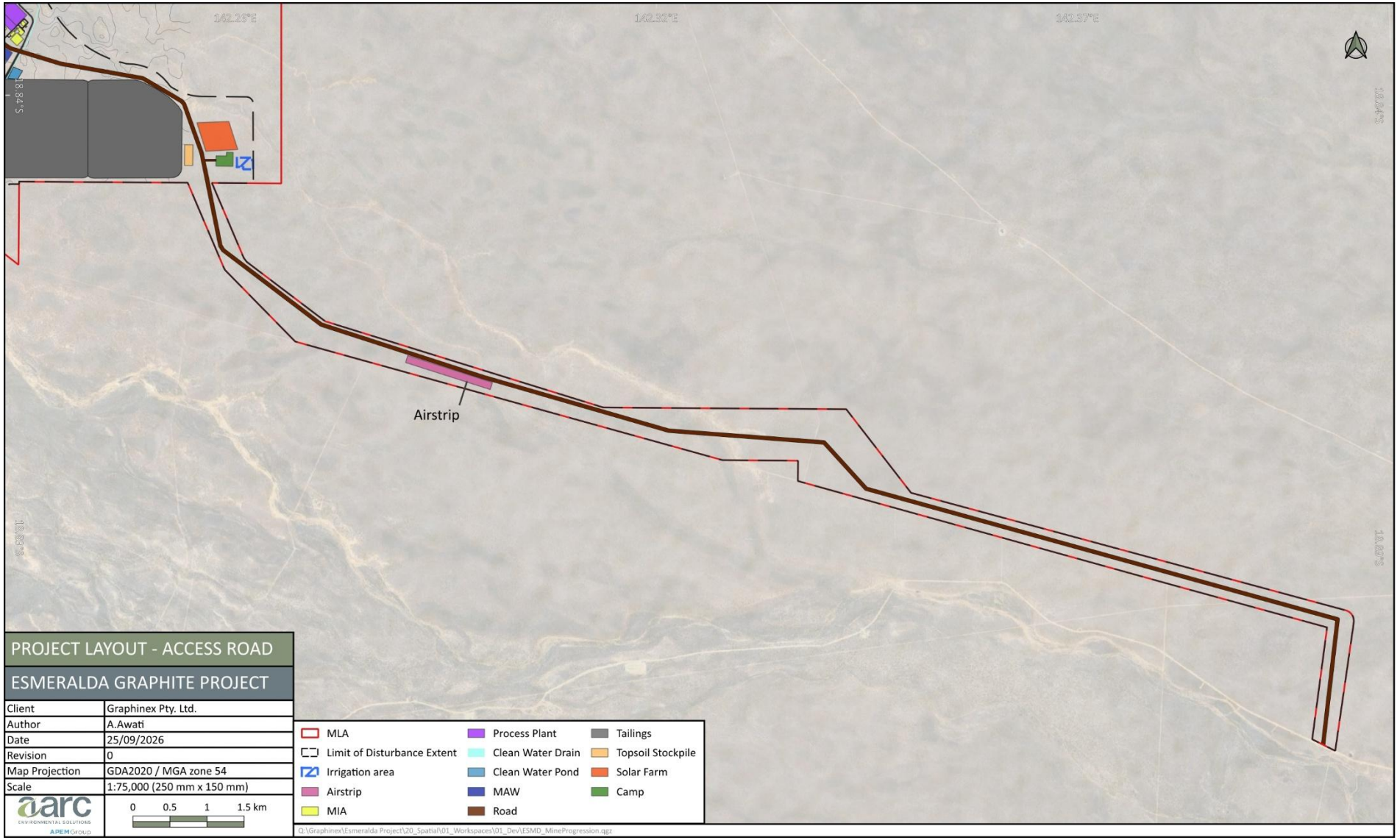


Figure 3: Project layout – mine access

2.3 Schedule of work

It is anticipated that construction activities associated with the Project will commence within 12 months of approvals being obtained. The construction phase, identified as Project 'Year -2' and 'Year -1', is expected to occur across a period of approximately 2 years. Mineral production will commence in 'Year 1' and be sustained for approximately 53 years. Project phases are summarised in Table 2.

Rehabilitation will occur progressively, with areas of waste rock dumps (WRDs) and tailings cells becoming available for rehabilitation late in the project life. Following the cessation of operations, a period of 10-years is anticipated for the removal and rehabilitation of non-retained infrastructure and rehabilitated landforms.

Table 2: Project phases

Approximate timeframe	Project phase
Year -2 to Year -1	**Construction** Project site works commence and is expected to occur over a period of approximately 2 years. This includes pre-strip, topsoil stockpiling, development of on-site accommodation, mine infrastructure area and mine-access road, and waste/overburden removal in Year -1.
Year 1	**Operation** Mining production commences. 100 ktpa production output from processing plant. Low-grade or unused ROM ore stockpiled for later use. First tailings storage facility constructed.
Year 3	Ramping up to full production of 3.5 Mtpa plant feed. Doubling of the processing plant capacity and output, from 100 ktpa to 200 ktpa. Watercourse diversion commences development.
Year 12	Second tailings storage facility constructed.
Year 18	Third tailings storage facility constructed.
Year 28	Fourth tailings storage facility constructed.
Year 35	In-pit waste backfill commences on small scale.
	Ex-pit tailings would be progressively reclaimed to fill the large pit void.
Year 46	In-pit waste backfill ramped up, including waste rock dump material.
Year 48	Mining operations progressively cease. Plant and vehicle movements continue, associated with use of any remaining stockpile and initial rehabilitation.
Year 54 – Year 63	**Decommissioning and rehabilitation** Decommissioning and removal of non-retained infrastructure, final rehabilitation and ongoing environmental monitoring and maintenance works.

2.4 Mine accommodation

Due to the remote location of the mine, the work force will be accommodated in an on-site accommodation village. There are no alternate accommodation options available within a safe daily driving distance. During site

preparation and primary construction, temporary accommodation will be available for non-resident workers on-site. Options for on-site accommodation will include mobile accommodation facilities. During operation, the workforce will be accommodated in the on-site workers village located in the southern section of the Project area (Figure 2). Access to the workers village will be via the mine access road (Figure 3).

The workers accommodation village will include sleeping quarters, associated facilities, including adjacent sewage treatment plant (STP). The camp will have capacity to accommodate up to 200 persons. While the majority of workers will travel to the mine via air travel to the site's purpose-built airfield, then bus from the accommodation village, some personnel will travel via light vehicle with or without carpooling from the Croydon Shire Council area. The on-site accommodation village is intended to ensure worker safety by reducing fatigue and daily travel time.

2.5 Mineral processing and product

ROM ore extracted from the mine pit will be trucked to the MPP for stockpiling and concentration via conventional flotation methods.

The processing method includes an initial crushing and milling circuit that liberates the graphite in 106-micron product. Adequately sized ore is then fed to a flotation circuit consisting of rougher, scavenger and cleaner flotation stages. A combination of standard flotation reagents will be used such as diesel and MIBC. Flotation tailings produced from the mineral processing circuit will be transferred to one of three purpose designed storage facilities, to be constructed in stages over the production life of the mine.

Graphite concentrate produced at the mine will be transported by truck to Townsville to a separate facility for refinement and distribution.

Process plant tailings will be pumped by the tailings thickener underflow pumps to the TSF. Floatation tailings will discharge into the TSF via pumped discharge spigots around the perimeter of the TSF. Water produced from the tailings as it settles, along with rainfall, will be decanted in the TSF and pumped back for recycling in the MPP. The volume of tailings and decant water is monitored throughout to process and checked for leakages during routine maintenance checks.

2.6 Production quantities

Mining will be carried out in a single pit, with material dumped to the south and east in out of pit dumps, and used to form the walls of the TSFs.

The life of the operational open cut mine is estimated to be 53 years, plus construction and rehabilitation.

The material quantities across the the Project life are summarised in Table 3. The material quantities are the sum of the following:

- Waste and low grade ore to waste rock dumps;
- Waste to in-pit backfill in waste and ore zones;
- Low grade ore stockpiled;
- Low grade ore reclaimed; and
- High grade ore direct feed mine to plant.

Table 3: Total material yearly quantities

Year	Total Material (kt wet)	Year	Total Material (kt wet)	Year	Total Material (kt wet)
-1	11,012*	18	8,316	36	6,840
1	12,863	19	6,821	37	25,063

Year	Total Material (kt wet)	Year	Total Material (kt wet)	Year	Total Material (kt wet)
2	13,642	20	5,080	38	23,859
3	13,642	21	3,980	39	7,738
4	14,612	22	3,736	40	8,343
5	13,642	23	3,682	41	13,683
6	13,985	24	5,232	42	29,227
7	13,642	25	5,855	43	30,751
8	13,680	26	4,716	44	21,970
9	13,642	27	4,566	45	13,305
10	13,642	28	6,840	46	10,089
11	14,556	29	6,821	47	22,280
12	13,680	30	6,821	48	22,770
13	13,642	31	6,821	49	20,175
14	13,642	32	6,840	50	20,175
15	7,883	33	6,821	51	20,175
16	3,610	34	7,061	52	20,175
17	3,605	35	6,821	53	4,278

Note: * Year -1 material movement consists of overburden and/or waste.

Movement in the rehabilitation phase would be related to landform profiling, shaping, and some topsoil for areas of infrastructure that are moved.

The data in Table 3 shows the increased material being moved in years -1 to 14 due to waste removal, years 37 and 38 due to transfer of tailings to in-pit backfill, and from years 41 to 52 due to transfer of tailings to in-pit backfill and waste from out of pit dumps to in-pit, and resource recovery from ROM stockpiles.

A list of major mobile equipment quantities is included in Table 4. From this table it can be seen that haul truck numbers vary significantly, but other equipment is more constant in quantity.

Table 4: Mining equipment quantities

Fleet	Equipment	Equipment quantity range across all years
Mobile	Excavator Komatsu PC2000	2 (years -1 to 14 & 37 to 52) and 1 (years 15 to 36 & 53)
Mobile	Truck Komatsu HD785	7 to 11 (years -1 to 14), 6 to 8 (years 15 to 36), 17 (years 37 to 41), 20 (years 42 to 48), 15 (years 49 to 52) and 4 (year 53)

Fleet	Equipment	Equipment quantity range across all years
Mobile	Wheel loader Komatsu WA480	1 (years -1 & 1) and 2 (years 2 to 48)
Mobile	Track dozer Komatsu 155	4 (years -1 to 14) and 3 (years 15 to 53)
Mobile	Water truck Komatsu HD785	2
Mobile	Grader Caterpillar 12	2
Mobile	Compactor SD200	1
Mobile	Road train	refer note 1
Mobile	Drill presplit 125mm	1 (years -1 to 42)
Mobile	Drill blasthole DTH 165mm	1 to 3 (years -1 to 42)
Auxiliary	Small excavator 40t	1
Auxiliary	Lighting Plant	4
Auxiliary	Small Construction Truck (20t)	2
Auxiliary	Tyre Handler/Forklift	1
Auxiliary	Mobile crane	1
Auxiliary	Fuel/Service Truck	1
Auxiliary	Dewatering Pump	3
Auxiliary	Light Vehicle (4 x 4)	7 to 10
Auxiliary	Crew transport van 4wd	2
Fixed	Processing plant, including crusher & mill and diesel generators	refer note 2

Note: 1. An average 26 road trains per day during peak operations are expected (Burchills 2026). This equates to about one trip every 55 minutes. The model includes 2 road trains in the modelled period (a 15 minute window) as a conservative assumption.

2. Processing plant and diesel generators will vary in usage.

2.7 Mine plans

From Table 3 and Table 4 it can be seen that equipment quanties increase significantly from Year 37 onwards due to the large increase in material to be rehandled. This stage of the Project can be considered the period of maximum disturbance from a noise perspective.

The proposed mine plans for years 40, 45, 50 and 53, are shown in Figure 4 to Figure 7.

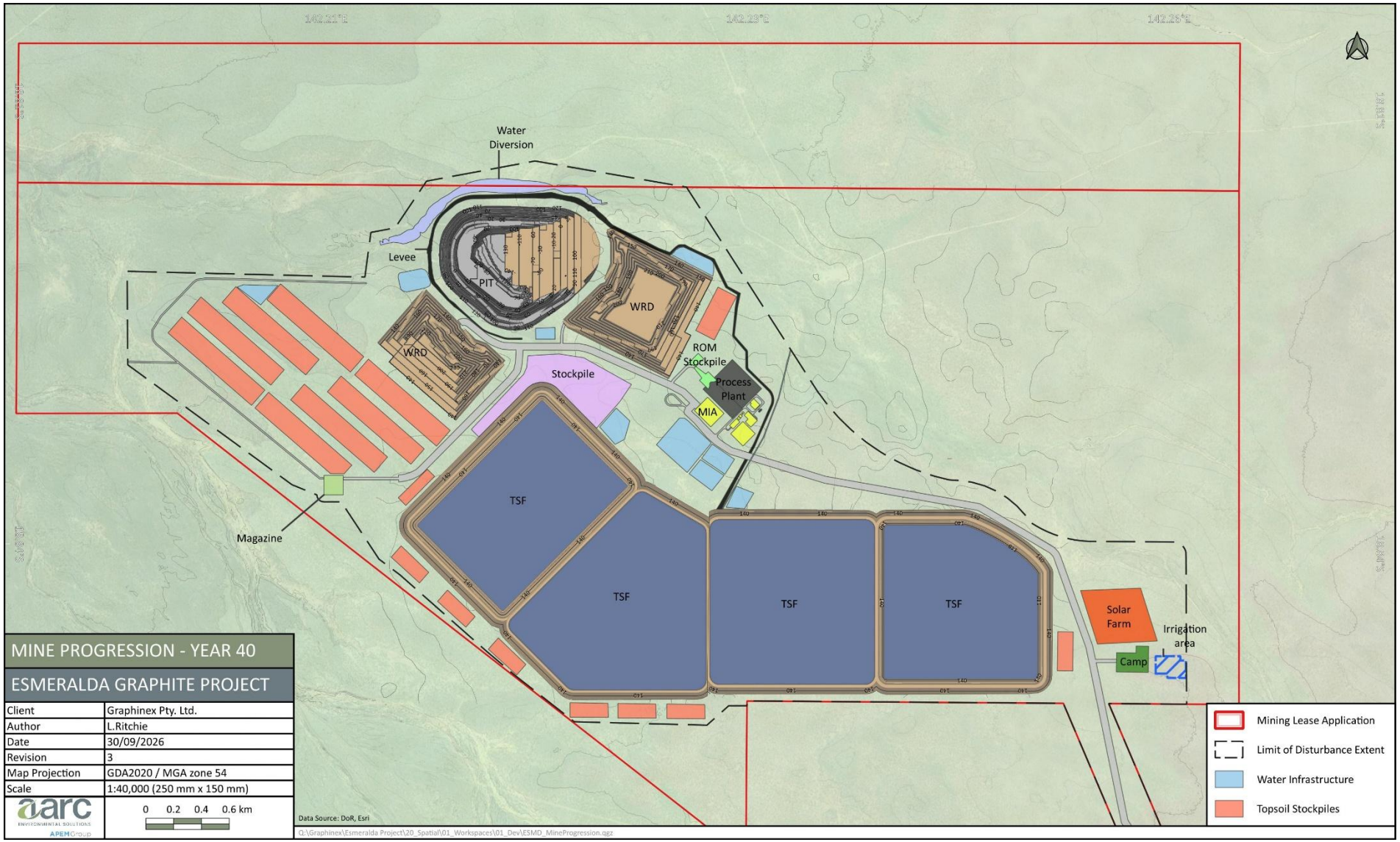


Figure 4: Year 40 mine plan

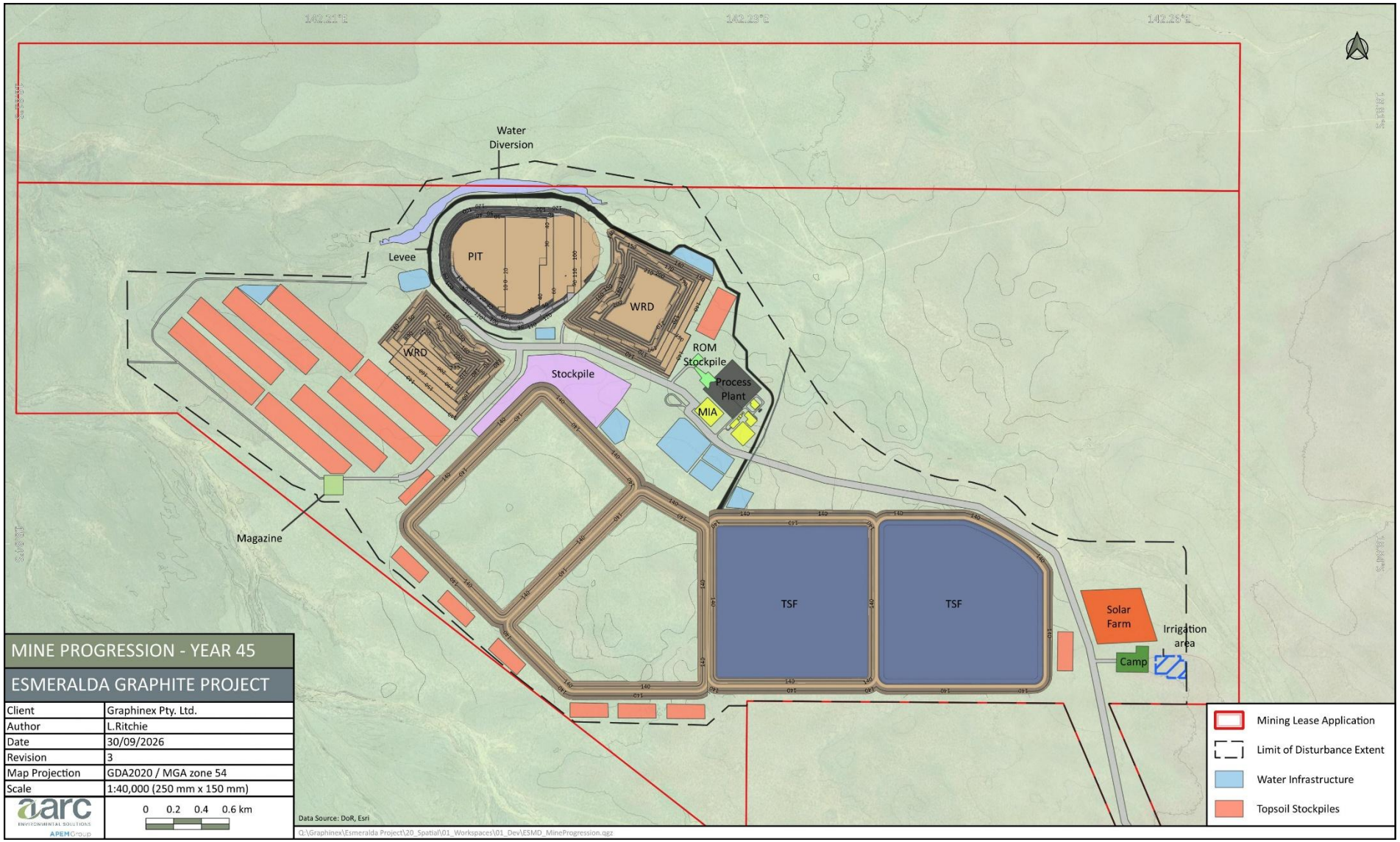


Figure 5: Year 45 mine plan

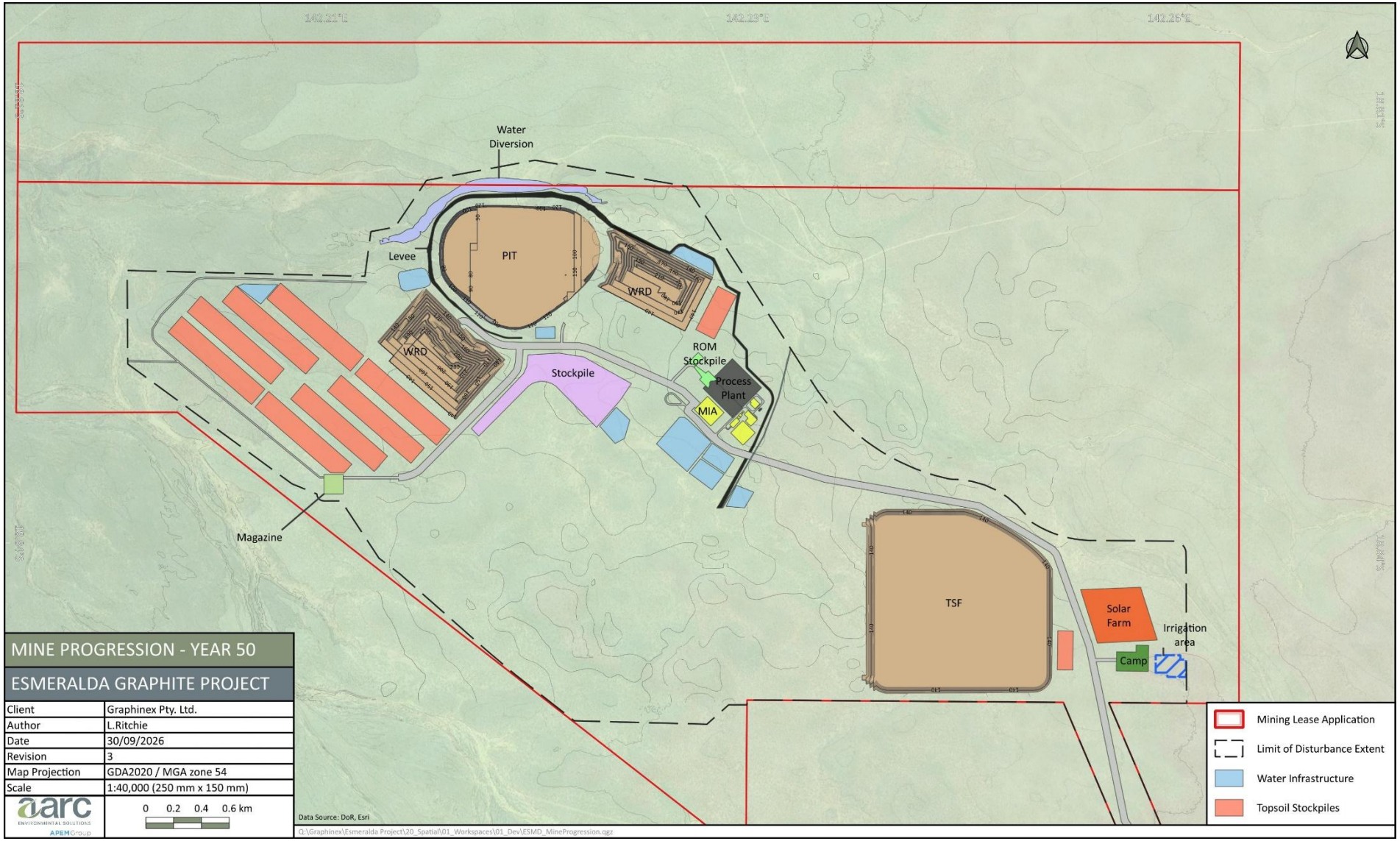


Figure 6: Year 50 mine plan

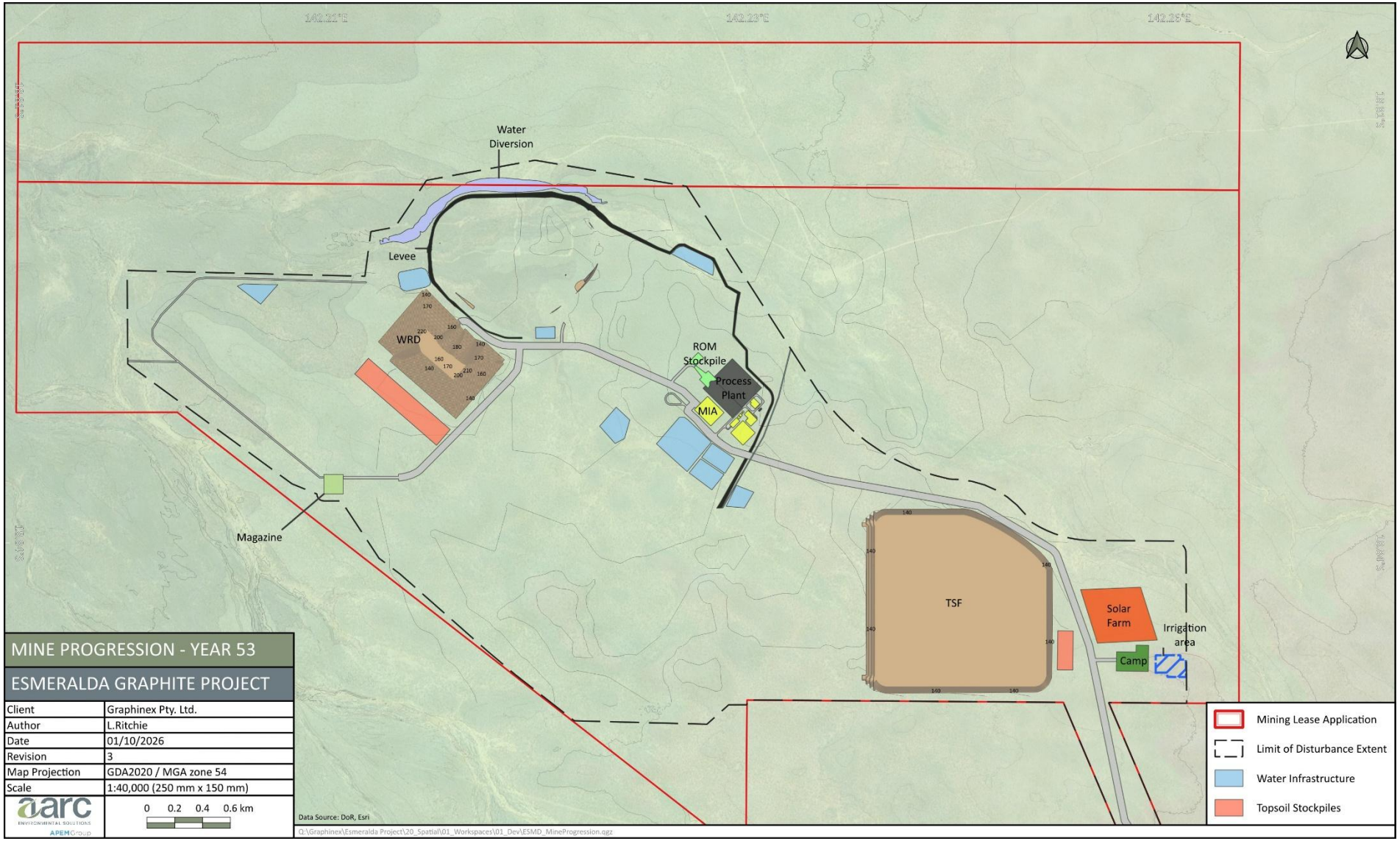


Figure 7: Year 53 mine plan

2.8 Other activities

Environmental noise impact assessments in Queensland are generally expected to consider *"sources of noise during the different phases of the project, such as construction, commissioning, operation, decommissioning and closure, and include upset and maintenance conditions."* (DESI 2024a). Operational phase is considered in more detail later in this report, and the other phases are considered as follows.

2.8.1 Construction and commissioning phase

The construction of Project infrastructure will occur prior to mining operations commencing, over a period of approximately 2 years.

Mine infrastructure - including the MPP, and ancillary infrastructure such as the solar array, potable water supply system, water pipelines, and the sewage treatment plant - will be developed within the proposed construction phase (Years -2 and -1). Construction activities will be undertaken 24 hours per day split between day shift and night shifts. Equipment used during construction will include excavators, haul trucks, dozers, graders, front-end loaders and water trucks. The start-up mining fleet will also be delivered to the Project during the construction stage. A concrete batching plant will be set up on the site.

The noise emissions due to the construction activities are expected to be less than noise emissions from mining operations based on the operating equipment and nature of the activities. The activities will also be relatively short-lived. Hence, noise emissions from these sources were not modelled in this assessment.

A recent open-cut coal mine noise assessment evaluated 30 to 36 plant items with a combined sound power level of 125 to 126 dBA and assumed a worst-case, conservative scenario where all construction equipment was operating simultaneously (AARC 2025). This is less than the overall mining stage sound power levels of 133 dBA as modelled in this assessment (refer Section 6.4).

Due to the lower noise emissions in construction and commissioning phase, it was not independently modelled in this assessment.

2.8.2 Closure, rehabilitation and decommissioning phase

Closure of the Project will include decommissioning and rehabilitation of the facilities onsite. The activities will include:

- disconnection and removal of all infrastructure including buildings, machinery, equipment, road base, concrete slabs, water management structures, pipelines, and fences not part of the PMLU;
- investigation of potentially contaminated land and where necessary, remediation activities undertaken;
- landform development where backfilling, reprofiling, reshaping and/or compaction works are required;
- revegetation involving topsoil application, ripping and seeding (or planting) and the application of soil ameliorants, as required;
- the mine affected water dams will be subject to sediment removal, and re-profiling and seeding of the dam banks. Sediment removed from the dam shall be disposed of in the residual voids;
- open cut pit will be backfilled with waste rock material and tailings, and treated with appropriate surface preparation;
- any retained waste material stockpiles will be recontoured including grading and compaction to create stable landforms that are compatible with the surrounding landform. The geotechnical stability of waste rock dumps is to be assessed;
- ongoing monitoring of the physical and chemical stability of rehabilitated areas; and
- certification of rehabilitated areas meeting and/or exceeding completion criteria.

Noise emissions during the closure phase will be less than during mining operations. This is due to a reduction in the amount of equipment operating within the same location.

Due to the reduced noise emissions in closure, rehabilitation and decommissioning phase, it was not modelled in this assessment.

2.8.3 Upset and maintenance conditions

Potential upset and maintenance conditions for the project include malfunctioning equipment and extreme weather conditions. Their effects on noise emissions are discussed as follows:

- If a piece of equipment malfunctions, this could result in an increased noise level for that item of equipment, although the overall effect on noise emissions from the whole site would likely be minor.
- When equipment malfunctions, it will be quickly taken out of operation, and adverse noise impacts are not expected to occur. In addition, all equipment will be maintained routinely, and malfunctions that increase noise levels are expected to be rare.
- Severe weather conditions could cause mining activities to reduce or stop. This would result in lower noise emission levels.
- Strong winds blowing away from the mine would have a lowering effect on sensitive receptors. However, strong winds blowing from the direction of the mine towards sensitive receivers could increase the mining noise levels. However, in both cases the likely increase in the background noise levels would significantly mask any such mining noises, and the noise modelling in this report considers the worst-case scenario of low to moderate wind speeds.

It is not expected that upset conditions pose a risk of additional noise impact and therefore it was not modelled in this assessment.

2.9 Power generation

The project will not be connected to the regional electricity grid, and will have power demand for all Project phases, including for mining, accommodation, administration and processing demands.

Power to the mine will be supplied by an onsite solar farm, batteries and diesel generators. It is currently calculated that 10 x 2.7 MW diesel generators will be required onsite. Not all diesel generators will be required at all times due to solar power supply, but they are assumed to be all operational when the processing plant is operating.

3 Sensitive receptors

The Project is located in a rural area surrounded by grazing land. There are isolated residences in the vicinity of the Project. The closest town is Croydon, which is located approximately 70 km north of the Project (refer Figure 1).

A noise impact assessment must identify and address impacts onto any nearby sensitive places, where a sensitive place includes a sensitive receptor for the purpose of the EPP (Noise) 2019 (DESI 2024a).

3.1 Selection of receptors

Sensitive receptors are listed in Schedule 1 of the EPP (Noise) as follows:

- residences (including a building, or part of building, capable of being used as a dwelling);
- library and educational institution (including a school, college and university);
- childcare centre or kindergarten;
- school or playground;
- hospital, surgery or other medical institution;
- commercial and retail activity;
- protected area (see *Nature Conservation Act 1992*) or critical area (means an area identified in a conservation plan under the *Nature Conservation Act 1992*, section 120H as, or as including, a critical habitat or an area of major interest);
- marine park (see *Marine Parks Act 2004*, schedule); and
- park or garden that is open to the public (whether or not on payment of an amount) for use other than for sport or organised entertainment.

According to the model mining conditions (DES 2024b), "*the terms 'sensitive place' and 'commercial place' … do not include places that are within the boundaries of the mining lease, nor places that are owned or leased by the holder of the authority or its related companies. For example, a mining camp operated by the EA holder would not be a sensitive place.*"

It is noted that according to DES (2024b) sensitive places are considered separately to commercial places, though the EPP (Noise) includes a place of commercial activity as a sensitive receptor. For the purpose of this report, there are no nearby commercial places to be considered.

3.2 Existing receptors

The nearest receptors for potential noise, vibration and/or airblast emissions from the Project are listed in Table 5 and shown in Figure 8. The receptors have been identified initially by AARC using aerial photography and confirmed by the Client by ground-truthing. The tabled receptors are the nearest to the Project in their respective directions and have the potential to be impacted by the Project.

It is noted that the proposed on-site mine camp (R4) is subject to special conditions which limit its applicability for consideration as a sensitive receptor. As per the comment above in Section 3.1, based on the model mining conditions (DES 2024b) this mining camp is not considered a sensitive place. As such, this is not considered in detail within this assessment. Notwithstanding this, it is acknowledged that human health related considerations will be monitored by Graphinex to ensure protection of the health and safety of resident contractors and employees.

Table 5: List of nearest receptors and distance from MLA

Receptor ID[1]	Receptor description	Easting (GDA2020, Zone 54)	Northing (GDA2020, Zone 54)	Approximate distance (km) from the Project footprint and direction	Approximate distance (km) from the Project access road and direction
R1 – Esmeralda Homestead	Residential	665762	7914629	33 km east	18 km east
R2 – Prospect Homestead	Residential	631806	7908655	7 km south	5 km south-west
R3 – Homestead	Residential	612870	7910311	16 km south-west	20 km west
R4 – Camp[1]	Mining lease camp	632773	7915899	0.5 km east	0.2 km east

Note 1. Receptor R4 is located within the MLA and is not considered a sensitive receptor.

3.3 Other receptors

3.3.1 Cultural heritage

The non-indigenous cultural heritage (NICH) report (Converge 2026) has indicated there are no potential NICH sites. Therefore, no NICH sites exist that could be considered sensitive receptors.

The Aboriginal and Torres Islander Strait cultural heritage database and register search report (DSDSATIP 2025) includes a number of search results, however, the nearest cultural heritage site is over 20 km from the pit and 15km from the haul road. Noise and vibration impacts would be insignificant over these distances, given that compliance would be required at a residential receptor located only 5 km from the access road and 7 km from the project footprint. Therefore, no Aboriginal and Torres Islander Strait cultural heritage sites exist that could be considered sensitive receptors.

3.3.2 Cattle and native fauna

Adjacent properties include cattle grazing stations, and are approximately 3 km from the proposed pit and process plant. Some areas of disturbance (refer Figure 8) are closer, with setback distances of 0.5 km to 1 km from the property boundaries, and the mine haul road is directly adjacent potential cattle grazing properties.

It is not expected that noise impacts onto cattle will cause concern, as cattle grazing frequently occurs near to mining sites in Queensland.

Reference is made to previous court case proceedings[1] regarding Olive Downs Coking Coal Project, where noise impacts on cattle were considered. That case referred to the New Acland Noise and Dust Project (NDP) which compared the grazing habits, weight gain and carcass data for cattle grazing adjacent to the operating coal mine with a control group grazing 5.6 km from the mine. The trial was conducted over a 42-day period. It showed similar weight gain and that the animals grazing near the mine were no more stressed than animals grazing the control site. Ultimately, the author of the NDP concluded the cattle are unlikely to be impacted as a result of potential pollutants, including noise, dust, light or variation in water quality associated with the adjacent mine. It was further noted that cattle quickly adjusted to disturbance and did not alter their grazing behaviour because of mining activities or during blasting events. Nor did cattle avoid grazing near the mine. The NDP author noted most noise associated with mining is low frequency noise, out of the audible range of hearing for cattle.

[1] Pembroke Olive Downs Pty Ltd v Sunland Cattle Co Pty Ltd & Ors [2020] QLC 27. Refer to paragraphs 248 to 255.

With respect to noise impacts on native fauna, there are no protected areas or marine parks nearer to the Project than the residential receptors listed in Table 5. Therefore, compliance with noise criteria at the listed residential receptors R1 to R3 will result in compliant noise levels for fauna.

3.3.3 Other

There are no other receptors located near the mine that could be impacted by noise and/or vibration emissions from the project.



Figure 8: Receptors near Project

4 Existing noise environment

The existing noise environment is consistent with the land uses surrounding the Project, which around the area are predominantly rural agricultural land uses, particularly grazing.

There are no other nearby mining lease production permits. There are several other projects in the vicinity of this Project as per the list in Section 4.1.5 of the EIS; however, at the time of publication, AARC is not aware of any operations that are sufficiently close to the sensitive receptors in Table 5 to cause any significant noise levels.

The existing noise environment at the nearest receptors to the Project (see Table 5) is dominated by natural noises (e.g. birds, insects, wind in grass and trees), vehicles, and agricultural activities.

4.1 Noise monitoring

Baseline noise monitoring was conducted in November 2025 (spring) at the nearest receptors to the Project, the Esmeralda and Prospect homesteads.

4.1.1 Locations

The selection of noise monitoring locations considered potential impacts of the Project. Noise measurements were undertaken at the following locations in Table 6.

The two monitoring locations are at receptors which are those closest to the mine (R1) and closest to the access road (R2). Nearby receptor R3 (refer Figure 8) is further from the mine than R1, and further from the access road than R2. Given the remote rural nature of these receptors, it is expected that the existing noise levels at R3 would be similar to those at R1 and R2, and hence did not require additional monitoring.

Table 6: Noise monitoring locations

Location ID (Receptor)	Description (refer aerials and photos in Appendix B)	Easting (GDA2020, Zone 54)	Northing (GDA2020, Zone 54)
A (R1)	The noise logger was 200 m from Esmeralda homestead (R1), and 30 m from the storage shed at the property entrance.	665541	7914729
B (R2)	The noise logger was 200 m from Prospect homestead (R2), and 40 m from the storage shed at the property entrance.	631892	7908753

The noise monitoring was undertaken in generally accordance with Australian Standard AS1055 Acoustics – Description and measurement of environmental noise and the DESI Noise Measurement Manual v4.01 (2020). The monitoring was conducted in accordance with quality assured best practice methodology, including the use of both attended and unattended measurements, with consideration of noise spectra and audio recordings.

4.1.2 Weather

A Davis weather station was installed adjacent Location A (R1) for the duration of the noise monitoring. Data from this monitoring station is summarised as follows:

- Nil rainfall;
- Temperature range of 16 to 39 °C;
- Relative humidity range of 13 to 87 %;

- Wind speed range of 0 to 6.3 m/s (average 1.4 m/s, median 1.3 m/s). The wind speed exceeded 3 m/s for 11% of the monitoring period, and exceeded 5 m/s for 1% of the monitoring period; and
- Wind direction variable, with dominant directions of NNW to NNE, and SSE to SSW.

The EIS Guideline (DESI 2024a) proposes that data be excluded when wind speed was over 3 m/s. In this instance, the wind speed was only over 3 m/s for 11% of the monitoring period, and therefore, the noise monitoring data is considered acceptable for use in future noise assessment of this Project.

4.1.3 Noise descriptors

Noise levels are described using the L_{10}, L_{eq} and L_{90} descriptors. These noise level descriptors are defined in the glossary in Appendix A, and are summarised as follows:

- L_{10}: The top 10% of noise levels in the measurement period (15 minutes).
- L_{eq}: The average noise level in the measurement period (15 minutes).
- L_{90}: The bottom 10% of noise levels in the measurement period (15 minutes).

Noise levels with the above descriptors are presented in this report as-measured, and also with high frequency insect noise removed. Insect noise can often be a dominant noise source in warmer months, and particularly in the evening, but it only affects the higher frequency bands. At this site, it is considered that the majority of insect noise can be removed from the measurement result by removing the octave band noise data at 4 kHz and above, and summing the remaining frequency bands. An example noise spectrum measured at A (R1) in the evening is shown in Figure 9.

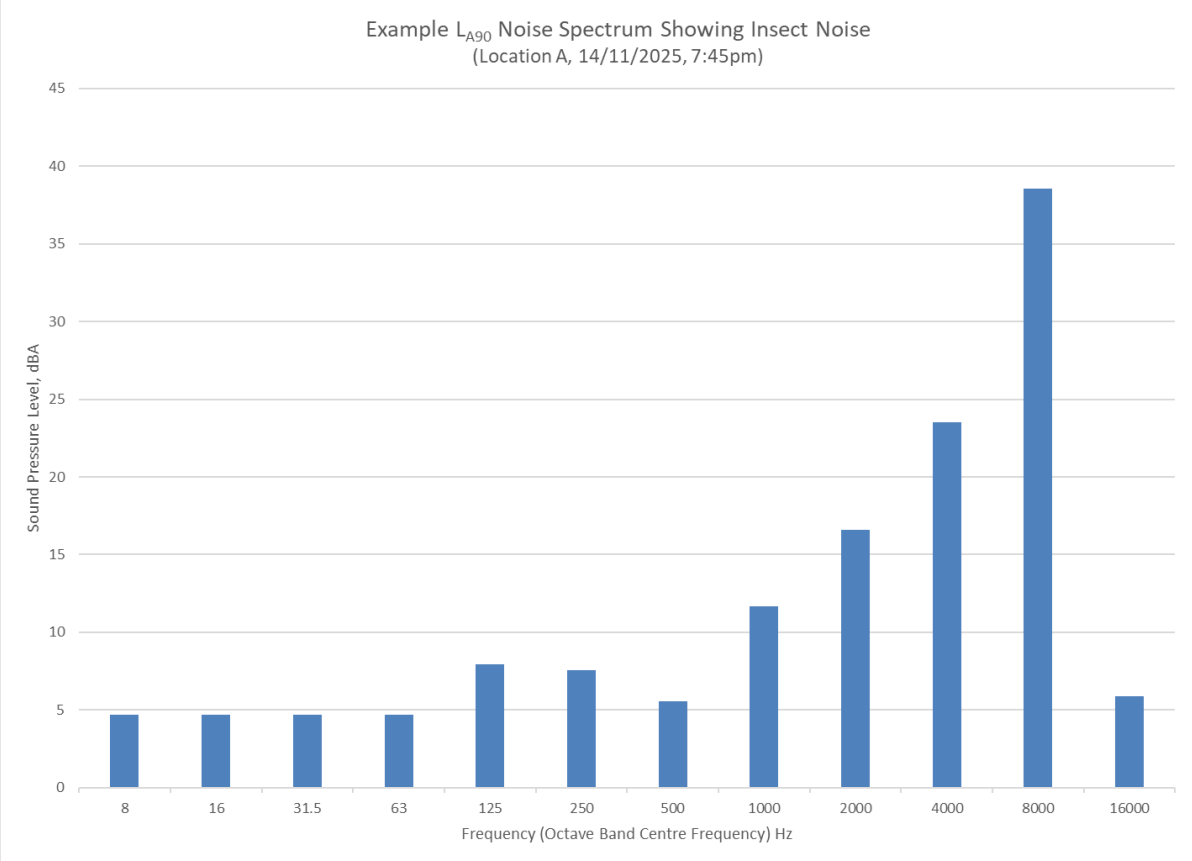


Figure 9: Example noise spectrum showing insect noise

Removing insect noise, will result in noise levels that are more representative of a winter noise environment, when insects are quieter. However, removing these higher frequency bands may result in under reported

noise levels, where the higher frequency bands are not affected by insect noise, so the resulting levels should be considered approximate and conservative.

4.1.4 Noise logging

Noise logging was undertaken at Locations A and B with the equipment and monitoring periods shown in Table 7.

Monitoring was conducted over a period of 5 days at each site. Whilst the EIS Guideline (DESI 2024a) proposes a minimum 1-week monitoring period, a shorter period was considered justifiable for this site. Due to the remote nature of the site, a shorter monitoring period was considered sufficient to demonstrate that the sensitive receptors near the site experience low background noise levels, which would be below typical minimum background noise levels used for determination of noise criteria (refer Section 5.2.2).

Table 7: Noise logging equipment and periods

Location ID (Receptor)	Equipment	Start Date and Time	End Date and Time
A (R1)	Larson Davis 831 Type 1, Serial # 10995	14/11/2025, 12:26 PM	19/11/2025, 15:00 PM
B (R2)	Larson Davis 831 Type 1, Serial # 11871	14/11/2025, 14:42 PM	19/11/2025, 14:30 PM

Logging was undertaken using field and laboratory calibrated environmental noise loggers. Noise logging was undertaken in the free-field at each location.

When the loggers were set up by the Graphinex employee, they noted that birds and wind in the trees/grass could be heard.

Noise logging results are shown graphically in Figure 12 to Figure 15. Two graphs are presented for each of the two monitoring locations as follows:

- Graph of L_{eq} and L_{90} noise levels, with each having had high frequency insect noise removed; and
- Graph of L_{90} noise levels, with and without high frequency insect noise removed, and with a 24-hour X-axis so as to show the variation of background noise level (L_{90}) by time of day.

The average $L_{eq,15min}$ noise levels are shown in Table 8.

Table 8: Noise logging results – average $L_{Aeq,15min}$ levels

Location ID (Receptor)	Average noise levels $L_{eq,15min}$ dBA by Period of Day (Values in brackets have high frequency insect noise removed)		
	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
A (R1)	40 (39)	37 (30)	33 (28)
B (R2)	41 (40)	39 (33)	33 (29)

The rating background noise levels (RBL), calculated using the lowest 10th percentile method in accordance with the DES "Planning for Noise Control" guideline[2], are shown in Table 9. The guideline demonstrates this method of calculating RBLs using a 5-day monitoring period; the monitoring duration used for this Project.

[2] The "Planning for Noise Control" guideline was released by the (then) Queensland EPA on 20/07/2004. It can no longer be found on the DETSI website, but is referenced in the Noise measurement manual (DES 2020) and Model mining conditions (DESI 2024b).

Table 9: Noise logging results – rating background noise levels

Location ID (Receptor)	Rating background noise levels $L_{90,15min}$ dBA by Period of Day (Values in brackets have high frequency insect noise removed)		
	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
A (R1)	25 (23)	25 (19)	24 (18)
B (R2)	27 (26)	27 (22)	20 (18)

From the above results it is apparent that background L_{90} noise levels were generally very quiet (i.e. up to 26 dBA L_{90} with high frequency noise removed), as would be expected in a remote rural area. The background noise levels (with high frequency noise removed) are similar between the two sites, and would also be expected to be similar at receptor R3.

Most noise sources that contributed to the noise levels were intermittent, such as birds, distant traffic and wind, resulting in very low background noise levels when these sources were not producing noise.

From the results in Figure 12 and Figure 14, it can be seen that the L_{90} noise level varies as the wind speed varies. In a quiet rural area it is expected that wind noise is often a dominant noise source, and thus the noise levels will vary proportionally to wind speed.

Overall, the measurement results indicate the areas are often very quiet, as is typical of a rural environment.

4.2 Seasonal variability

Ambient noise levels are affected by many noise sources including wind, rustling grass and leaves, rural activities and machinery, insects, birds and other animals.

The noise monitoring was conducted in spring (i.e. November) when insect noise levels are present in the data. During cooler months, the noise from insects will tend to be quieter and thus background noise levels would generally be lower. Presenting noise levels with and without high frequency insect noise demonstrates the likely range in background noise levels across the seasons.

Background noise levels can also increase when wind speeds increase, but this could occur at various times of the year and is therefore generally not seasonal.

Whilst the EIS Guideline (DESI 2024a) proposes the monitoring data set include winter noise levels, the noise monitoring data set is considered sufficient because winter noise levels could be estimated by removing insect noise from the spring noise levels, and the adjusted background noise levels are already below typical minimum background noise levels used for determination of noise criteria (refer Section 5.2.2).

For this Project, additional monitoring at other times of the year is not considered to be required, as the existing monitoring already indicates low background noise levels, and seasonal insect noise has been considered in the analysis.

5 Legal obligations and criteria

Noise and vibration criteria for the Project are to be determined from a variety of sources, including the following noise legislation and guidelines:

- *Environmental Protection Act 1994 (Qld)*
- *Environmental Protection Regulation 2019 (Qld)*
- Environmental Protection (Noise) Policy (DES 2019)
- Guideline – Noise and vibration from blasting (DES 2022)
- Noise and vibration – EIS information guideline (DESI 2024a)
- Guideline – Model mining conditions (DESI 2024b)
- Guideline – Application requirements for activities with noise impacts (DESI 2025)
- Australian Standard (AS) 2021:2015 Acoustics – Aircraft noise intrusion, Building siting and construction (AS2021)

5.1 Environmental Protection Act 1994

In Queensland, the environment is protected under the *Environmental Protection Act 1994* (EP Act). It defines environmental nuisance as inclusive of interference of an environmental value by noise, where noise is inclusive of vibration. Environmental values are identified under an environmental protection policy or regulation.

5.2 Environmental Protection (Noise) Policy 2019

The purpose of the *Environmental Protection (Noise) Policy* 2019 is to achieve the object of the EP Act in relation to the acoustic environment. The purpose is achieved by providing environmental values, acoustic quality objectives, and a *"framework for making consistent, equitable and informed decisions that relate to the acoustic environment."*

5.2.1 Acoustic quality objectives

Acoustic quality objectives are included in Schedule 1 of the EPP (Noise). The objectives for residences and protected areas are reproduced in Table 10.

Table 10: Acoustic quality objectives for residences and protected areas

Sensitive receptor	**Time of Day**	**Acoustic quality objectives (measured at the receptor) dBA**		
		$L_{Aeq,adj,1hour}$	$L_{A10,adj,1hour}$	$L_{A1,adj,1hour}$
Residences (for outdoors)	Daytime and evening	50	55	65
Residences (for indoors)	Daytime and evening	35	40	45
	Night-time	30	35	40

It is preferable not to apply noise criteria at a sensitive receptor based on indoor noise limits, and hence, equivalent outdoor noise limits can be determined based on the typical noise reduction from noise outside a residence to inside a residence.

The EPP (Noise) already includes limits for outdoors, as shown above, but compliance with those outdoor limits will not necessarily result in compliance with the indoor noise limits, as they assume a noise difference of 15 to 20 dBA which is generally not achieved with open windows at a residence.

Noise reductions for the façade of a timber dwelling with open windows are typically reported as 5 to 10 dBA. The DESI Noise and vibration—EIS information guideline (2024b) recommends to *"use an outdoor to indoor attenuation value of 7dB, which is appropriate for typical Queensland buildings with open windows."* Therefore, the indoor noise limits in Table 10 can be recalculated as outdoor noise limits as per Table 11.

Table 11: Calculated outdoor acoustic quality objectives for residences

Sensitive receptor	**Time of Day**	**Acoustic quality objectives (measured at the receptor) dBA**		
		$L_{Aeq,adj,1hour}$	**$L_{A10,adj,1hour}$**	**$L_{A1,adj,1hour}$**
Residences (outdoors)	Daytime and evening	42	47	52
	Night-time	37	42	47

The L_{Aeq} parameter is most commonly applied to new mining projects. It corresponds to the average noise level, and extraneous noise (e.g. from insects, birds, cars) can readily be mathematically removed from the measured levels for assessment purposes. The L_{A1} parameter is also regularly applied, as a way to contain brief high noise level events. With the use of the L_{Aeq} and L_{A1} parameters, it is not considered necessary to also include an L_{A10} limit.

5.2.2 Background creep

The current version of the EPP (Noise) contains the following reference to background creep:

> *To the extent it is reasonable to do so, noise must be dealt with in a way that ensures….. background creep in an area or place is prevented or minimised.*

And defines background creep as:

> *background creep, for noise in an area or place, means a gradual increase in the total amount of background noise in the area or place as measured under the document called the 'Noise measurement manual' published on the department's website.*

There is no specific criterion in the EPP (Noise), however, a past version of the EPP (Noise) used to include the criterion:

> *for noise that varies over time measured by $L_{Aeq,adj,T}$—more than 5 dBA greater than the existing acoustic environment measured by $L_{A90,T}$.*

The explanatory notes for the EPP (Noise) acknowledge that:

> *In some situations it may be reasonable to allow a greater increase to the background noise in an area or place. That may be the case in an area or place with very low background noise where an activity will increase the background noise levels but only to the extent the environmental values of the area are still protected.*

Whilst the RBL near the site has been measured as 18 to 25 dBA (refer Table 9), the application of background creep criteria for mining projects can[3] reference minimum deemed background noise levels from other legislation and guidelines. For example, the "Model mining conditions" (DESI 2024b) includes a minimum background noise level of 30 dBA L_{90}, and the "Noise assessment – prescribing noise conditions for environmental authorities for petroleum activities" (DES 2013) includes a minimum daytime background noise level of 35 dBA L_{90}. In conjunction with the background creep criterion, these minimum background levels could be interpreted as resulting in noise limits of 35 dBA $L_{Aeq,adj,T}$ at night and 40 dBA $L_{Aeq,adj,T}$ in the day.

5.3 Environmental Protection Regulation 2019

Schedule 8 of the Environmental Protection Regulation 2019 provides the following objectives and performance outcomes for noise:

> *Environmental Objective*
>
> *The activity will be operated in a way that protects the environmental values of the acoustic environment.*
>
> *Performance Outcomes*
>
> *1 Sound from the activity is not audible at a sensitive receptor.*
>
> *2 The release of sound to the environment from the activity is managed so that adverse effects on environmental values, including health and wellbeing and sensitive ecosystems, are prevented or minimised*

The purpose of this report section is to nominate criteria that, when achieved by the Project, will prevent or minimise adverse effects on environmental values, including health and wellbeing and sensitive ecosystems as per Schedule 8. Therefore Schedule 8 requirements are considered to be addressed by the nominated criteria in Section 5.8.

5.4 Guideline – Model mining conditions

The DESI guideline 'Model mining conditions' includes noise criteria that may be used as a basis for proposing noise protection commitments for mining projects.

For noise environments with a background noise level less than 30 dBA L_{90}, as is the case near this Project (refer Table 9), the outdoor noise limits are calculated as per Table 12.

Table 12: Calculated outdoor noise limits from Model mining conditions

Receptor	Parameter	Monday to Saturday			Sundays and public holidays		
		Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am	Day 9am to 6pm	Evening 6pm to 10pm	Night 10pm to 9am
Sensitive	$L_{Aeq,adj,15min}$	35	35	30	35	35	30
	$L_{A1,adj,15min}$	40	40	35	40	40	35
Commercial	$L_{Aeq,adj,15min}$	40	40	35	40	40	35

[3] New Acland Coal Pty Ltd v Ashman & Ors and Chief Executive, Department of Environment and Heritage Protection (No. 4) [2017] QLC 24. Refer to paragraphs 718, 755 and 768.

It can be seen that the Model mining condition limits (Table 12) are 7 dB stricter than the Acoustic quality objective derived limits (Table 11) with respect to the L_{eq} parameter, and 12 dB stricter with respect to the L_1 parameter.

This guideline also includes airblast and vibration limits for blasting as per Table 13.

Table 13: Model mining conditions blasting noise and vibration criteria

Blasting effect	**Sensitive or commercial place criteria**	
	Daytime 7am to 6pm	**Evening and night 6pm to 7am**
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time	No blasting
Ground vibration peak particle velocity (PPV) (vector sum)	5 mm/second PPV for 9 out of 10 consecutive blasts and not greater than 10 mm/second PPV at any time	No blasting

5.5 Guideline – Noise and vibration, EIS information guideline

The "Noise and vibration, EIS information guideline" (DESI 2024a) advises proponents about the information and assessment requirements in relation to noise and vibration when preparing an environmental impact statement (EIS). The document indicates that the EIS must address the following three key areas relating to noise matters:

- environmental values of the receiving environment and sensitive receptors including any nearby sensitive places;
- potential impacts, and all associated risks, of the proposed activity on the environmental values; and
- measures to avoid, minimise and mitigate the identified impacts and risks to the environmental values.

The three key areas defined in the guideline and listed above are addressed by this report.

The guideline prescribes the use of the acoustic quality objectives within the EPP (Noise) and confirms the use of a 7 dB façade reduction for open windows, as applied when determining the noise limits in Table 11.

5.6 Guideline – Application requirements for activities with noise impacts

The "Application requirements for activities with noise impacts guideline" (DESI 2025) focuses on the types of impacts that environmentally relevant activities (ERAs) can have in relation to noise, and outlines the information to be provided to the department as part of the ERA application process. In general, there are three key areas to be identified and addressed through the ERA application process:

- Identify the environmental values of the receiving acoustic environment including the identification of any nearby sensitive places.
- Identify the possible impacts due to the proposed activity and all associated risks to environmental values.
- Identify the strategies to mitigate the identified risks to the environmental values.

The three key areas defined in the guideline and listed above are addressed by this report.

5.7 Guideline – Noise and vibration from blasting

The effects of blasting are described in AS 2187.2 – 2006 Explosives – Storage and Use, Part 2: Use of Explosives, as follows:

- Airblast is the pressure wave (sound) produced by the blast and transmitted through the air.
- Ground vibration from blasting is the radiation of mechanical energy within a rock mass or soil.

This guideline includes blasting criteria to minimise the impacts of airblast and ground vibration. The proposed criteria for the mining industry, and specifically surface mining, are the same as the Model mining conditions (refer Table 13).

5.8 Proposed mine noise and vibration criteria

For mine noise emissions, it is proposed to adopt a conservative version of the EPP (Noise) derived limits in Table 10, which are consistent with other similar mining projects.

The proposed noise criteria are shown below in Table 14.

Table 14: Proposed Project noise limits

Noise level dBA measured as:	**All days**		
	Day (7am to 6pm)	**Evening (6pm to 10pm)**	**Night (10pm to 7am)**
Sensitive Place - Residences			
$L_{Aeq,adj,15min}$	40	40	35

Further to Table 14 it is noted that:

- The noise limits relate to noise generated by Graphinex Esmeralda mining activities, and exclude noise from extraneous noise sources such as road traffic (off the MLA), wind, insects, birds, residential activities and other mines.
- The noise limits are to be adjusted ('adj') for tonality and impulsiveness. Generally, the noise from such mining is not expected to be tonal or impulsive when considered over a 15-minute period, however, this will be considered further when results are assessed.
- Mine noise levels can be audible in rural areas at lower noise levels than the proposed noise limits. Therefore, compliance with the proposed noise limits does not necessarily indicate predicted mine noise levels will be inaudible.

The proposed blasting noise and vibration criteria are shown below in Table 15.

Table 15: Blasting noise and vibration limits

Blasting noise and vibration limits	**Sensitive place and commercial place criteria**	
	Monday to Friday 7am to 6pm; **Saturday, Sunday and Public Holidays 9am – 6pm**	**Other times**
Airblast overpressure	115 dB (Linear peak) for 9 out of 10 consecutive blasts and not greater than 120 dB (Linear peak) at any time	No blasting
Ground vibration	5 mm/second peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/second peak particle velocity at any time	No blasting

Further to Table 15 it is noted that the criteria include consideration of human comfort and are well below levels at which damage to typical residential type buildings is known to occur. It is also noted that vibration can be felt at a much lower level than those that could result in damage to structures, and at lower levels than are included in this table.

5.9 Road and aircraft noise criteria

5.9.1 Road noise criteria

Noise emissions from vehicles on the MLA are required to comply with the project mine noise criteria (refer Table 14). Those noise criteria do not apply to road vehicles on public roads. Queensland Department of Transport and Main Roads (DTMR) has an environmental duty to assess and manage the impact of road traffic noise on the built environment.

DTMR does not provide specific noise criteria for a development which produces road traffic noise, but does provide a criterion for their existing roads, which is a limit of 68 dBA $L_{A10(18hour)}$. Priority for treatment of road noise on existing roads is given where there is a:

- sudden increase in traffic volumes (at least double, which corresponds to a 3 dB increase); or
- high percentage of heavy vehicles (greater than 20%), particularly at night.

The NSW road noise policy (NSW EPA 2011) includes noise criteria for existing residences affected by additional traffic on existing local roads generated by land use developments, as follows:

- Daytime (7am to 10pm): 55 dBA $L_{Aeq(1hour)}$; and
- Night (10pm to 7am): 50 dBA $L_{Aeq(1hour)}$.

Additionally, the NSW policy includes a relative increase criterion for land use developments affecting larger roads (freeway, arterial, sub-arterial and transitways), which is that the total traffic noise level increase should not exceed the existing traffic noise level by 12 dB, measured as the $L_{Aeq(15hour)}$ in the daytime and $L_{Aeq(9hour)}$ in the night.

The NSW policy also indicates that *"In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person."*

These road noise criteria will be considered for this Project, with the DTMR criteria considered a noise limit and the NSW policy criteria considered a noise guide as they are not legally binding in Queensland.

5.9.2 Aircraft noise criteria

Noise emissions from aircraft are proposed to comply with the noise criteria contained in Australian Standard 2021:2015 Acoustics – Aircraft noise intrusion, Building siting and construction (AS2021). AS2021 includes noise criteria for small airports (Appendix E), and a methodology for calculating aircraft noise levels.

The proposed aircraft noise criteria for residential receptors (Table E1 of AS2021) are shown below in Table 16.

Table 16: Aircraft noise criteria

Number of flights per day*	**Aircraft noise level, average maximum dBA**		
	Acceptable	**Conditionally acceptable**	**Unacceptable**
Greater than 30	< 70	70 – 75	> 75
15 to 30	< 80	80 – 85	> 85
Less than 15	< 90	90 – 95	> 95

Note: * Each night flight between 7pm and 7am is to count as 4 operations.

For this Project, a maximum of four flights per day are expected, i.e. two arrivals and two departures. If all these flights occurred in the night period (i.e. morning flight before 7am, and evening flight after 7pm), this would count as a total of 16 operations. If the flights occurred between 7am and 7pm, they would count as a total of 4 operations. Based on the criteria in Table 16, the acceptable average maximum noise level limit may be 80 or 90 dBA.

An aircraft noise criterion of 80 dBA (average maximum) will be considered for this Project as a conservative approach.

6 Mine operational noise assessment

6.1 Modelling software

Noise modelling has been undertaken with the SoundPLAN (version 9.1) computer program, which is widely used by Acoustic Consultants for modelling mine noise and is accepted by DETSI for this purpose.

The noise model takes into account the mine and local topography, noise levels and locations of equipment, distance attenuation, ground and air absorption, natural and artificial barriers, and meteorological effects.

The model has been run using the CONCAWE algorithms, which enable predictions with different meteorological conditions, and ISO 9613-2:2024 (ISO 9613) algorithms, which enable prediction under a single typical worst-case meteorological condition. CONCAWE algorithms are widely used in Queensland for modelling noise from mining projects, however, the Australian distributor of SoundPLAN (Marshall Day Acoustics (MDA)) recommends the use of ISO 9613 algorithms. ISO 9613 is recommended by MDA as it is a newer standard and subject to updating, and the CONCAWE algorithms originally only applied for receptors within 2 km of the noise source.

Both the CONCAWE and ISO 9613 algorithms can provide appropriate noise level prediction results and are used in this assessment.

6.2 Meteorological effects

Meteorological conditions can have a large impact on noise levels around the noise sources, particularly due to wind speed and direction, and vertical temperature gradients (e.g. temperature inversions). Noise level variations of up to 20 dB can be recorded due to these meteorological effects.

Standard meteorological conditions used for noise modelling are described as calm (nil wind), and downwind, and day and night conditions, as shown in Table 17. Each meteorological condition would be expected to be prevalent in a rural location. It is expected that higher noise levels will be predicted under night and/or downwind conditions.

Table 17: Noise modelling meteorological conditions

Meteorological parameter	**CONCAWE algorithm**				**ISO 9613-2:2024 algorithm**
	Calm – day conditions **(experienced in the day,** evening and night**)**	**Downwind**-day conditions **(experienced in the day,** evening and night**)**	**Calm – night conditions (mostly experienced in the evening and night)**	**Downwind-night conditions (mostly experienced in the evening and night)**	**Downwind conditions (mostly experienced in the evening and night)**
Temperature (°C)	25	25	10	10	10
Relative Humidity (%)	40	40	70	70	70
Wind Speed (m/s)	Nil	2	Nil	2	ISO 9613-2:2024
Wind direction	NA	Towards receivers	NA	Towards receivers	Towards receivers

Meteorological parameter	CONCAWE algorithm				ISO 9613-2:2024 algorithm
	Calm – day conditions **(experienced in the day,** evening and night**)**	**Downwind**-day conditions **(experienced in the day,** evening and night**)**	**Calm – night conditions (mostly experienced in the evening and night)**	**Downwind-night conditions (mostly experienced in the evening and night)**	**Downwind conditions (mostly experienced in the evening and night)**
Pasquill Stability Class	D (neutral conditions)	D (neutral conditions)	F (moderately stable condition, which is typical of a moderate temperature inversion)	F (moderately stable condition, which is typical of a moderate temperature inversion)	NA (Moderate temperature inversion)

6.3 Noise source data

Graphinex has provided information on equipment type and locations for the modelling scenarios. Noise source data for the proposed equipment has been obtained from AARC's noise source records, equipment supplier noise specifications, other noise assessment reports and scientific papers.

The noise source level is based on the equipment sound power level (L_w or SWL). The sound power level of a noise source is a fixed number that can be used to determine the sound pressure level at any distance from the source.

Noise sources and locations are listed in Table 18. Equipment is located to represent a typical worst-case scenario for noise levels, e.g. with trucks and dozers atop a dump near a sensitive receptor. Light vehicles and other lower noise equipment are not included in the noise modelling due to their expected low noise emissions.

The equipment modelled has been chosen to most accurately reflect the anticipated mining fleet. However, there is potential for alternate makes and models of equipment to be used in the operating mine. If the equipment model is changed, the sound power level of the alternative model should be reviewed, and if the noise level increases, attenuation may be required.

The octave band sound power level data associated with the above equipment is included in Table 19.

A mine operator may choose to use a different combination of equipment, or use attenuated equipment in a different manner to achieve the same noise level outcomes.

Table 18: Mining equipment and locations

Equipment	Location and use in noise model
Excavators	Located in pit to dig ore and waste material or located on dumps and TSFs when reclaiming material to place in-pit as part of ongoing rehabilitation. Assumed to operate continuously within the 15-minute assessment period. Assumed not to move substantially within the 15-minute assessment period, and therefore modelled as a point source.
Tracked dozer	Located with the excavators. A fixed location and therefore modelled as a point source.
Haul trucks	Trucks to transport waste, rejects, and ore, and therefore travelling to/from pit, dumps, TSF and ROM. Assumed to operate continuously and to move significantly within the 15-minute assessment period, and therefore modelled as line sources.

Equipment	Location and use in noise model
Processing plant and generators	Crushing, milling, flotation and concentration plant is located east of the dumps. A fixed location and covering a reasonable area and therefore modelled as an area source. An array of 10 generators has been modelled at this location.
Wheel loader	Located either at the processing plant (MIA) to load from the ROM stockpile into the jaw crusher and to load crushed ore into the feed to the primary mill. Assumed to operate continuously. Assumed not to move substantially within the 15-minute assessment period, and therefore modelled as a point source.
Grader, water truck and compactor	To move along all the roads used by haul trucks and other fleet. Assumed to operate continuously and to move significantly within the 15-minute assessment period, and therefore modelled as sources.
Auxiliary plant (small excavator, lighting plant, small construction truck, tyre handler/forklift, mobile crane, fuel/service truck, dewatering pump, light vehicles, crew transport 4WD)	Smaller (lower noise level) plant/vehicles that could be located at the pit, dumps, TSF or MIA areas, and therefore modelled as a collective area source over all these areas.
Road trucks (A-Triple)	To move along all the roads from the MIA to the south-east end of the MLA (a distance of approximately 22 km). Assumed to operate continuously and to move significantly within the 15-minute assessment period, and therefore modelled as a line source.

Table 19: Sound power level data for modelled equipment

Item	Source height (m)	Overall and octave band sound power level ($L_{w,eq,15min}$) dBA (per item)								
		Overall	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Excavator Komatsu PC2000	3.5	114	99	103	101	111	107	103	100	94
Truck Komatsu HD785	4.0	118	94	104	112	111	110	112	107	106
Wheel loader Komatsu WA480	3.0	113	77	94	104	106	109	105	99	93
Track dozer Komatsu 155	3.0	116	89	104	106	110	113	107	101	97
Water truck Komatsu HD785	4.0	118	94	104	112	111	110	112	107	106
Grader Caterpillar 12	3.0	110	82	99	103	101	104	103	99	89
Compactor SD200	3.0	113	77	94	104	106	109	105	99	93
Road train	2.0	109	83	91	96	101	105	104	97	83
Drill presplit 125mm	2.0	115	83	95	102	107	110	110	107	100
Drill blasthole DTH 165mm	2.0	118	97	102	110	113	113	110	105	94

Item	Source height (m)	Overall and octave band sound power level ($L_{w,eq,15min}$) dBA (per item)								
		Overall	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Processing plant, including generators	5.0	126	98	110	115	120	120	120	113	108
Auxiliary plant	5.0	118	97	103	104	112	113	112	105	98

6.4 Model scenarios

The major determinants of noise impacts over the life of the mining operation are (i) the quantity of equipment used, which is dependent on both the quantity of material handled, and (ii) the location and elevation of equipment noise sources relative to the receptors.

Estimated material handling quantities and equipment numbers over the life of the mine are provided in Table 3 and Table 4 respectively. The location of activities throughout the mine life can be ascertained from the mine layouts in Figure 4 to Figure 7.

From Table 3 and Table 4 it can be seen that equipment quanties increase significantly from Year 37 onwards due to the large increase in material to be rehandled. The figures show that material is rehandled from several different locations, being the TSFs and dumps. Based on a review of this process, four scenarios (1 to 4) have been modelled, which are described in Table 20.

Table 20: Noise model scenarios

Scenario	Representative mine year/s	Scenario description and location of noise sources in noise model
1	40 to 42	TSF being rehandled into pit, process plant operating The model includes: • Pit operations: 3 drills, an excvator and a dozer in the pit, and 2 trucks hauling overburden to the southern dump and 3 trucks hauling ore to the ROM. • Dozer on the southern dump. • Excavator removing tailings from the TSF and 12 trucks hauling it to the in-pit dump, with a dozer located in the in-pit dump. • 2 graders, 2 water trucks and a compactor working over all the dirt roads. • Process plant and auxiliary plant operating, and 2 wheel-loaders at the plant and ROM area. • 2 road trains operating between the site and extent of MLA.
2	47	TSF walls being rehandled into pit, process plant operating The model includes: • Excavator and dozer removing TSF walls and 20 trucks hauling it to the in-pit dump, with an excavator and 2 dozers located in the in-pit dump. • 2 graders, 2 water trucks and a compactor working over all the dirt roads. • Process plan and auxiliary plant operating, and 2 wheel loaders at the plant and ROM area. • 2 road trains operating between the site and extent of MLA.
3	48 to 49	East dump being rehandled into pit, process plant operating The model includes: • Excavator and dozer removing eastern dump and 20 trucks hauling it to the in-pit dump, with an excavator and 2 dozers located in the in-pit dump. • 2 graders, 2 water trucks and a compactor working over all the dirt roads.

		• Process plant and auxiliary plant operating, and 2 wheel-loaders at the plant and ROM area. • 2 road trains operating between the site and extent of MLA.
4	52	South dump being rehandled into pit The model includes: • Excavator and dozer removing southern dump and 20 trucks hauling it to the in-pit dump, with an excavator and 2 dozers located in the in-pit dump. • 2 graders, 2 water trucks and a compactor working over all the dirt roads. • Auxiliary plant operating. • 2 road trains operating between the site and extent of MLA. Note: Conservative assumption, as road trains likely not operating as process plant is no longer processing.

Equipment quantities included in Table 4 were provided by the Project Mining Engineers. The model assumes that all equipment is operational within the modelled 15-minute noise period. This is considered conservative as in practice, some equipment may only be operational for approximately 50 to 65% of the day.

The overall sound power levels of the equipment modelled is as follows:

- Scenario 1: $L_{w,eq,15min}$ 133 dBA (141 dBZ).
- Scenario 2: $L_{w,eq,15min}$ 133 dBA (141 dBZ).
- Scenario 3: $L_{w,eq,15min}$ 133 dBA (141 dBZ).
- Scenario 4: $L_{w,eq,15min}$ 132 dBA (140 dBZ).

The locations of equipment are described in Table 20, and for Scenario 2[4] are shown in Figure 16 in Appendix D.

6.5 Predicted noise levels and assessment

The predicted A-weighted noise levels are shown in Table 21 for the four mine year scenarios. The results include results using the CONCAWE and ISO 9613-2:2024 calculation algorithms. The highest noise level of 31 dBA occurs at Receptor 2 (Prospect homestead) under calm[5] Night conditions with the CONCAWE algorithms for Scenario 2.

The highest noise levels are experienced under Scenario 2, and therefore the predicted noise levels for each of the five meteorological conditions in Table 21 are also shown graphically as noise contours in Figure 17 to Figure 21 in Appendix E.

From the results in Table 21 it can be seen that A-weighted noise levels are compliant, including a minimum 14 dBA margin below the proposed daytime noise limit of 40 dBA, and minimum 4 dB below the proposed night-time noise limit of 35 dBA. Compliance with the proposed limits results in compliance with EPP (Noise) acoustic quality objectives and background creep requirements.

[4] Scenario 2 is selected, because it is shown to result in the highest noise levels in the following section of the report.

[5] Using CONCAWE algorithms, noise levels will tend to be higher under downwind conditions at close distances to the mine, but at the greater distances of receptors R1 to R3, the calculated mining noise levels will tend to be higher under calm wind conditions. This is explained with reference to the CONCAWE (1981) report which includes the calculations methodology: With calm conditions, the CONCAWE meteorological category is 5, but this increases to category 6 with a 2m/s wind speed. The CONCAWE meteorological attenuation curves at dominant mine sound frequencies (125Hz and 250Hz) indicate that attenuation is higher (i.e. mine noise levels are lower) for category 6 (downwind) than category 5 (calm) when looking at distances greater than approximately 2 km.

Noise levels are generally higher under night conditions, and for this model, are highest under calm night conditions. The daytime meteorological conditions results (including the ISO 9613-2:2024 results) are assessed against the proposed day time noise limit. The night meteorological condition results (including the ISO 9613-2:2024 results) are assessed against the proposed nighttime noise limit.

The mining noise at receptors is not predicted to have tonal or impulsive components, and hence no corresponding penalties are added to the predicted noise levels.

Z-weighted (or un-weighted) noise levels have been calculated for Scenario 2, established as the noisiest year in the analysis above, and are shown in Table 22. The highest noise level is 50 dBZ at Receptor 2 (Prospect homestead) as calculated using the ISO 9613-2:2024 algorithms. These levels can be used for a low frequency assessment.

A low frequency criterion is not proposed to be conditioned for the Project due to the low noise levels, but a screening assessment is proposed to be conducted. The proposed screening criterion consists of two components:

- a maximum Z-weighted outdoor noise level of 55 dBZ (which approximately corresponds to an indoor limit of 50 dBZ when allowing for a 5 dB façade reduction with open windows); and
- an unbalanced spectrum (i.e. the Z-weighted noise level minus the A-weighted noise level is greater than 15 dB).

From the results in Table 22, predicted noise levels comply with the low frequency criteria, being at least 5 dB below the 55 dBZ limit. No low frequency noise criterion should be included in the Project EA conditions, as the proposed L_{Aeq} noise limit is considered better suited and sufficient to limit noise emissions from the Project.

Table 21: Predicted A-weighted noise levels from mining activities at sensitive receptors

Receptor	Predicted A-weighted noise levels from mining activities									
	Noise Level $L_{Aeq,adj,15min}$ dBA					Exceedance of 40 dBA day and 35 dBA night noise limits				
Met' condition:	CONCAWE Day-calm	CONCAWE Day-downwind	CONCAWE Night-Calm	CONCAWE Night-Downwind	ISO 9613-2:2024	CONCAWE Day-calm	CONCAWE Day-downwind	CONCAWE Night-Calm	CONCAWE Night-Downwind	ISO 9613-2:2024
Scenario 1										
R1 – Esmeralda	0	0	8	2	9	nil	nil	nil	nil	nil
R2 – Prospect	19	25	29	26	28	nil	nil	nil	nil	nil
R3 – Homestead	7	13	18	13	19	nil	nil	nil	nil	nil
Scenario 2										
R1 – Esmeralda	0	2	10	5	9	nil	nil	nil	nil	nil
R2 – Prospect	20	26	31	27	29	nil	nil	nil	nil	nil
R3 – Homestead	9	15	20	16	20	nil	nil	nil	nil	nil
Scenario 3										
R1 – Esmeralda	0	1	9	4	9	nil	nil	nil	nil	nil
R2 – Prospect	18	24	28	25	28	nil	nil	nil	nil	nil
R3 – Homestead	6	12	17	12	19	nil	nil	nil	nil	nil
Scenario 4										
R1 – Esmeralda	0	1	9	4	8	nil	nil	nil	nil	nil
R2 – Prospect	14	20	24	21	27	nil	nil	nil	nil	nil
R3 – Homestead	3	8	13	9	19	nil	nil	nil	nil	nil

Table 22: Predicted Z-weighted noise levels from mining activities at sensitive receptors for low frequency review

Receptor	Predicted Z-weighted noise levels									
	Noise Level $L_{Zeq,adj,15min}$ dBZ					Exceedance of 55 dBZ noise limit				
Met' condition:	CONCAWE Day-calm	CONCAWE Day-downwind	CONCAWE Night-Calm	CONCAWE Night-Downwind	ISO 9613-2:2024	CONCAWE Day-calm	CONCAWE Day-downwind	CONCAWE Night-Calm	CONCAWE Night-Downwind	ISO 9613-2:2024
Scenario 2										
R1 – Esmeralda	13	19	27	22	35	nil	nil	nil	nil	nil
R2 – Prospect	37	42	44	42	50	nil	nil	nil	nil	nil
R3 – Homestead	26	32	36	33	44	nil	nil	nil	nil	nil

6.6 Cumulative noise impacts

There are no other mines near this Project or the nearby receptors (R1 to R3), as noted in Section 4. Given the significant distance from other existing or proposed projects, cumulative noise impacts from multiple mines will not be an issue.

Overall, cumulative noise is not expected to result in exceedances of proposed noise criteria.

7 Road and aircraft noise assessment

The Project will utilise a fly-in fly-out (FIFO) workforce for the mine, arriving by aircraft landing within the MLA. Therefore, FIFO and shuttle bus trips will not be generated on the external road network. The remaining vehicle movements are relatively limited and have been assessed in Section 7.1. Noise from aircraft transporting the FIFO workforce is detailed further in Section 7.2.

According to the transport assessment (Burchills 2026), the construction, operation and decommissioning phases will operate with two (2) daily workforce rosters. The workforce will operate over a 12-hour shift per roster, for five (5) days on and two (2) days off. It is understood that roster changeover will occur every 14 days. The timing of shift change is unknown at this time, however, the transport assessment (Burchills 2026) utilises a full shift change in both the AM and PM peak hours to complete a conservative assessment (on the high side).

7.1 Road traffic noise assessment

7.1.1 Overview

Road traffic noise generated by the Project on external roads, i.e. those not contained within the MLA, are assessed in this section. The relevant criteria is presented in Section 5.9.1, and include as follows:

- Noise limit: 68 dBA $L_{A10(18hour)}$; and
- Noise guide: 55 dBA $L_{Aeq(1hour),day}$, 50 dBA $L_{Aeq(1hour),night}$, and 2 dB increase.

7.1.2 Data

The following traffic data has been derived from the EIS transport assessment (Burchills 2026).

From Table 19 it can be seen that the Project contribution to road traffic is minor with a maximum of 62 vehicle trips per day, and that heavy vehicles are the dominant vehicle. Heavy vehicles would also be the dominant noise source. Heavy vehicles (road trucks) were already assessed on the MLA, as noted in Table 18, Table 19 and Table 20

Table 23: Traffic data

Road	Road condition	Speed limit	2024 traffic AADT & HV%	Project traffic trips	2027* traffic including Project AADT & HV%
Flinders Highway A6	Sealed	60-110 km/h	423 (43%)	52 heavy/day 10 light/day (Worst-case Project traffic occurs at opening of construction)	498 (48%)
Larsen Street	Sealed	60 km/h	423 (43%)		498 (48%)
Goldring Street	Sealed	60 km/h	870 (9%)		958 (14%)
Crawford Street	Sealed	50 km/h	870 (35%)		958 (38%)
Richmond-Croydon Road	Sealed	80-100 km/h	155 (22%)		222 (39%)
Esmeralda Prospect Road	Gravel	100 km/h	<50 (52%)		<114 (69%)
Proposed Mine Access	Gravel	100 km/h	<50 (50%)		<114 (68%)

Note: Includes 2024 traffic, 1% increase per annuum from 2024 to 2027, and Project generated traffic.

7.1.3 Noise calculations and assessment

Calculated road traffic noise levels are presented in Table 24. Noise levels have been determined based on two approaches:

1) Acoustic formula for mobile plant on roads[6]:

$$L_{Aeq,T} = L_w - 33 + 10.\log(Q) - 10.\log(V) - 10.\log(d) + C$$

where

L_w = sound power level of vehicle, inclusive of correction for gravel roads (dBA)

Q = number of vehicles in time period T

V = average speed of vehicles (km/h)

d = distance from centre of road to receiver position (m)

C = 0 dB for single engined vehicles.

2) Road traffic noise algorithms (Calculation of Road Traffic Noise [CoRTN]), noting that these algorithms should be considered indicative only as they are not directly applicable to traffic volumes of less than 1000 vehicles per day, as experienced on these roads. A correction is included for traffic on gravel roads.

Using approach (1), the $L_{A10,18hour}$ traffic noise levels have been determined from the $L_{Aeq,24hour}$ noise levels by adjusting for L_{10} descriptor using a correction of + 3 dB, and adjusting for the 18 hour traffic noise level using a correction of + 1 dB.

The reported $L_{A10,18hour}$ traffic noise levels in Table 24 are based on the higher of the two calculation methods.

Table 24: Road traffic noise levels

Road	**Road condition**	**Speed limit (km/h)**	**2027 traffic noise level including Project (increase due to project) $L_{A10,18hr}$ at 10 metres dBA**	**2027 traffic noise increase due to Project Construction phase / Operational phase $L_{Aeq,1hr}$ dBA**
CRITERIA			Limit 68 dBA	Guide 2 dBA
Flinders Highway A6	Sealed	110	64 (1)	1 / 1
Larsen Street	Sealed	60	65 (1)	1 / 1
Goldring Street	Sealed	60	64 (1)	2 / 1
Crawford Street	Sealed	50	68 (0)	1 / 0
Richmond-Croydon Road	Sealed	100	60 (3)	4 / 3
		80	60 (4)	4 / 3
Esmeralda Prospect Road	Gravel	100	62 (4)	4 / 3
Proposed Mine Access	Gravel	100	62 (4)	4 / 3

From Table 24 it can be seen that the future 2027 traffic noise levels, including Project traffic, would comply with the DTMR noise limit of 68 dBA $L_{A10(18hour)}$ at distances as close as 10m from the side of the roads due to the relatively low traffic numbers. There are no dwellings within 10m of the roads, and therefore the Queensland DTMR noise limit is achieved for the Project.

[6] Reference Strutt 2025

Review of road traffic noise levels against the proposed noise level guides, based on NSW noise policy limits, is undertaken as follows.

Calculations indicate that for the sealed roads from Flinders Highway to Crawford Street, the relative traffic increase is small, resulting in a $L_{eq,1hour}$ noise level increase of 0 to 2 dB (refer Table 24), which under NSW policy (refer Section 5.9.1) is considered a minor impact being up to 2 dB. Road traffic noise from these road segments is therefore considered acceptable, and is not considered further.

For road segments expected to be subject to traffic noise level increases greater than 2 dB, further review of overall noise levels is conducted as follows. This analysis is based on a review of online aerial photography of potential residences or other sensitive receptors adjacent the roads.

The relative increase along Richmond-Croydon Road and the gravel roads near the site is 3 to 4 dBA (refer Table 24), due to the low existing road traffic on these roads. The nearest residences to these roads are approximately 200 m from the side of the road, except at the southern end of Richmond-Croydon Road in the township of Richmond. At a setback distance of 200m, the calculated road traffic noise level on these roads is less than 50 dBA $L_{eq,1hour}$, which achieves the NSW road noise criteria outlined in Section 5.9.1 for daytime and nights.

It is noted that the northern portion of the Richmond-Croydon Road is contained within the Croydon Shire Council planning scheme area. This planning scheme (2019) indicates that this road (referred to as Richmond Road) is an important main road to support Croydon's grazing area, and therefore for use by heavy vehicles.

On the northern side of Richmond township, adjacent Richmond-Croydon Road between Goldring Street and Woolgar Road, there appear to be several residences setback approximately 60 m to 80 m from Richmond-Croydon Road. At these distances, the resulting traffic noise level is calculated to be 51 to 52 dBA $L_{eq,1hour}$ during construction, and 50 to 51 dBA $L_{eq,1hour}$ during operation. With appropriate parameter adjustments, these noise levels readily comply with the DTMR 68 dBA $L_{10(18hour)}$ noise limit. The noise levels also comply with the NSW daytime criteria (55 dBA) but are marginal with respect to the NSW night criteria (50 dBA). This is considered acceptable for the following reasons:

- The noise levels are readily compliant with Queensland DTMR noise criteria, and the NSW EPA noise criteria are proposed as a guide only;
- The noise levels are only 1 to 2 dBA above NSW night criteria, which is marginal and a difference that would likely not be detectable by ear;
- The NSW criteria are for local roads, i.e. neighbourhood streets, whereas Richmond-Croydon Road is also used as a more significant connector between communities. The NSW noise criterion for sub-arterial roads (i.e. the NSW classification above local roads) is 5 dBA higher, which is achieved by the calculated noise levels;
- The road is identified by Council as an important road for heavy vehicle traffic for existing grazing areas;
- The southern section of Richmond-Croydon Road is a designated heavy vehicle route, as shown in Figure 4.12 in the EIS transport assessment (Burchills 2026; and Qld Globe);
- Peak hour traffic conditions are likely to occur in daytime hours and would be compliant with the higher noise limit, rather than at night with the lower noise limit; and
- The higher noise levels during construction occurs only for a limited time at the start of the Project.

Overall, the road traffic noise levels are considered compliant.

7.2 Aircraft noise assessment

7.2.1 Overview

Approximately 95% of Project staff are expected to arrive by air (FIFO) due to the remoteness of the site, and therefore an airstrip has been included in the Project. The airstrip is located adjacent the access road, as

shown in Figure 3. The airstrip is 1200 m long as per Royal Flying Doctor Services Airstrip Standard. Beside the western end of the airstrip are aircraft parking and carparking areas.

The airstrip is proposed to be used during construction, operational and decommissioning phases of the Project.

7.2.2 Data

The following data has been used for calculation of aircraft noise levels:

- It is expected that aircraft will land from the east and take-off to the east, as the planes head to an east coast destination (e.g. Townsville) and the parking area is located at the western end of the airstrip.
- The expected largest plane type is a Dash 8-300, which has a capacity of approximately 50 to 56 passengers.
- The nearest sensitive receptors to the airstrip are R1 to R3 as shown in Figure 8.

7.2.3 Noise calculations and assessment

Aircraft noise calculations are undertaken using AS2021 based on the proposed aircraft type and the distances between the airstrip and sensitive receptors.

Aircraft types are listed in Table 3.1(A) and Table 3.1(B) of AS2021. The Dash 8-300 is included in Table 3.1(B) 'Non-jet fixed-wing aircraft' as number 3.40. That is, arrival and departure noise levels are included in Tables 3.40(A) and 3.40(B) of AS2021 respectively.

The aircraft noise levels are tabled based on the following receptor distance information:

- Centre-line distance (DL), m: The distance in metres from the closer end of the runway to the sensitive receptor, measured parallel to the runway.
- Centre-line distance (DT), m: The distance in metres from the further end of the runway to the sensitive receptor, measured parallel to the runway.
- Sideline distance (DS), m: The perpendicular distance, in metres, from the extended runway centreline to the sensitive receptor.

Additional notes regarding calculation of aircraft noise levels are provided as follows:

- Flights paths are assumed to be remain parallel to the runway for the distances to the nearest receptors R1 to R3. This assumption is discussed further, after the calculations.
- Where the DL or DT value is greater than the 20,000 m DL/DT range in Tables 3.40(A) and 3.40(B), then it is conservatively assumed that the DL or DT value is 20,000 m.
- Where the DS is greater than the DS ranges in Tables 3.40(A) and 3.40(B), the additional sideline distance attenuation is calculated using a 6dB per doubling of distance calculation.
- AS2021 states that where an aircraft noise level for a particular pair of distance coordinates is not included in the noise level tables (Tables 3.40(A) and 3.40(B)) then the resulting noise level will not generally be significant in terms of noise reduction requirements for the receptor building. Therefore, the above noise level extrapolation techniques are considered conservative, that is, aircraft noise levels are being evaluated for receptor locations where the aircraft noise levels are likely acceptable.

The measured distances (DL, DT and DS) and calculated aircraft noise levels (from Tables 3.40(A) and 3.40(B) of AS2021) are presented in Table 25.

Table 25: Aircraft noise level calculations

Receptor	Distances from airstrip to receptors, m			Aircraft noise level, average L_{max}, dBA	
	Landing DL	Take-off DT	Sideline DS	Landing	Take-off
R1	27,000	28,200	9,000	29	31
R2	2,300	3,500	5,000	32	40
R3	21,000	22,200	8,000	30	32

The highest calculated aircraft noise level in Table 25 is 40 dBA L_{max} at Receptor R2 for aircraft taking off. This noise level is well below the 80 dBA criterion conservatively proposed in Section 5.9.2, as determined from AS2021. Even allowing for flight path or aircraft type variations, the aircraft noise levels will be compliant with the 80 dBA criterion.

7.3 Road and aircraft vibration levels

There are no specific road traffic vibration criteria, and generic vibration criteria would generally be achieved at close distances (e.g. 10 metres) from most roadways. It is further noted that these roads already carry heavy vehicles, and therefore vibration levels from project traffic would be similar to vibration levels generated by existing similar vehicles. The exception could be if a road was damaged, e.g. with a pothole, and this resulted in localized higher vibration levels. In this instance, road repairs would be undertaken as part of normal road maintenance.

There is no specific vibration limit at sensitive receptors for aircraft, as it is expected that compliance with aircraft noise criteria would result in acceptable vibration levels.

8 Vibration and airblast assessment

The only significant vibration and airblast source at the Project will be associated with blasting within the open-cut pit.

8.1 Existing vibration sources

It is anticipated that the existing vibration levels around the Project and at the location of sensitive receptors will generally be negligible, except at locations which are close (e.g. within 20 m) to roads or major items of agricultural equipment.

Site specific vibration measurements have not been undertaken (as they normally aren't measured as part of baseline work), but we would expect existing vibration levels below 0.1 mm/s (PPV) except if affected by existing mines or in close proximity to existing mobile or fixed plant associated with agricultural activities, where higher levels may be expected.

8.2 Blast sources

8.2.1 Criteria

The relevant criteria were outlined in Table 15 and could be summarised as follows:

- Vibration: 115 dB (Linear peak) for majority of blasts.
- Airblast: 5 mm/s for majority of blasts.

8.2.2 Data

The maximum blasts size for the Project is proposed to be up to 200 kg maximum instantaneous charge (MIC). The pit is the nearest blast location to receptors at a minimum distance of 10 km from Receptor 2.

8.2.3 Airblast

The following formula for estimation of airblast pressure levels is from AS 2187.2 – 2006:

$$P = K_a (R / Q^{1/3})^a$$

where

P = pressure, in kilopascals (kPa)

Q = explosives charge mass, in kilograms (kg)

R = distance from charge, in metres (m)

K_a = site constant

a = site exponent

For confined surface charges, in situations that are not affected by meteorological conditions, a good estimate may be obtained by using a site exponent (a) of −1.45, (which corresponds to an attenuation rate of 8.6 dBL with doubling of distance), and a site constant (K_a) in the range of 10 to 100. Based on a review of similar projects, calculations are proposed to be conducted with a site exponent (K_a) in the range 30 to 60.

The sound pressure level (L_p Lin Peak) can be determined using the formula:

$$L_p = 10 \log_{10} (P / P_0)^2$$

Where:

P = pressure, in kilopascals (calculated from formula above)

P_0 = reference pressure, 20 µPa

Using the above method and a maximum instantaneous charge (Q) of 200 kg, the calculations result in the following airblast levels at various distances (Table 26). The calculations have also been conducted with a Q of 1000 kg to demonstrate the sensitivity of the calculations.

Table 26: Calculated airblast levels at various distances from blast

Distance	**Airblast level dB(Lin Peak) (Q = 200 kg, a = -1.45, K_a = 30 to 60)**	**Airblast level dB(Lin Peak) (Q = 1,000 kg, a = -1.45, K_a = 30 to 60)**
0.5 km	127 to 134	134 to 140
1.0 km	119 to 125	126 to 132
2.0 km	110 to 116	117 to 123
3.0 km	105 to 111	112 to 118
4.0 km	101 to 107	108 to 114
5.0 km	98 to 105	105 to 111
6.0 km	96 to 102	103 to 109
7.0 km	94 to 100	101 to 107
8.0 km	93 to 99	99 to 105
9.0 km	91 to 97	98 to 104
10.0 km	90 to 96	97 to 103

It is noted that the above calculations do not account for meteorological effects (e.g. wind conditions) and terrain effects (e.g. shielding by pit walls and dumps), and these effects could be considered in a detailed blast design process.

Given the nearest receptor (R2) is approximately 10 km from the mine pit, the predicted airblast levels are up to 96 dB(Lin Peak) with the proposed Q of 200 kg, and therefore comply with the 115 and 120 dB(Lin Peak) limits in Table 15. It is further noted that airblast levels would remain compliant at 10 km with a much larger blast Q of 1000 kg.

8.2.4 Vibration

The following formula for estimation of ground vibration levels is from AS 2187.2 – 2006:

$$V = K_g (R / Q^{1/2})^{-B}$$

Where:

V = ground vibration as vector peak particle velocity (PPV), in millimetres per second (mm/s)

Q = maximum instantaneous charge (effective charge mass per delay), in kilograms (kg)

R = distance from charge, in metres (m)

K_g, B = site constant related to site and rock properties for estimation purposes

Ground vibration levels depend on the maximum instantaneous charge (effective charge weight per delay), and not the total charge weight, provided the effective delay interval is appropriate.

The site values in the above equation have been estimated based on other similar projects as follows: K_g (site constant) = 1140 to 3000, and B (site exponent) = 1.6.

Using the above method and a maximum instantaneous charge (Q) of 200 kg, the calculations result in the following mean vibration levels at various distances (Table 27).

Table 27: Calculated vibration levels at various distances from blast

Distance	**Blast vibration level mm/s (PPV) (Q = 200 kg, B = 1.6, K_g = 1140 to 3000)**	**Blast vibration level mm/s (PPV) (Q = 1,000 kg, B = 1.6, K_g = 1140 to 3000)**
0.5 km	2.1 to 10.0	7.7 to 36.2
1.0 km	0.7 to 3.3	2.5 to 11.9
2.0 km	0.2 to 1.1	0.8 to 3.9
3.0 km	0.1 to 0.6	0.4 to 2.1
4.0 km	0.1 to 0.4	0.3 to 1.3
5.0 km	0.1 to 0.3	0.2 to 0.9
6.0 km	0 to 0.2	0.1 to 0.7
7.0 km	0 to 0.1	0.1 to 0.5
8.0 km	0 to 0.1	0.1 to 0.4
9.0 km	0 to 0.1	0.1 to 0.4
10.0 km	0 to 0.1	0.1 to 0.3

Given the nearest receptor (R2) is approximately 10 km from the mine pit, the predicted vibration levels are up to 0.1 mm/s with the proposed Q of 200 kg, and therefore comply with the 5 and 10 mm/s limits in Table 15. It is further noted that vibration levels would remain compliant at 10 km with a much larger blast Q of 1000 kg.

9 Noise and blast management

Modelling determined that under the modelled meteorological conditions, noise levels at receptors are compliant with the proposed criteria with margins of (i) at least 14 dBA during the daytime; and (ii) at least 5 dBA during the night. Noise levels are therefore considered compatible with land uses around the Project.

Vibration and airblast from blasting has been assessed and is compliant with the proposed criteria. Vibration levels are therefore considered compatible with land uses around the Project.

Given the models predicts compliance with a reasonable margin under various adverse meteorological conditions, it is proposed that complaint triggered monitoring be a condition of approval, rather than regular or continuous noise monitoring.

It is recommended that a mine Noise Management Plan (NMP) be implemented, and that it addresses:

- The process to enable the mine to promptly respond to community noise and vibration complaints. Should a non-vexatious complaint be received, the mine should investigate the noise and if mine-related, then complaint noise monitoring and investigation should be undertaken. Any noise exceedances are to be result in a review and implementation of noise management and mitigation measures.
- The process to enable the mine to promptly respond to noise exceedances, should monitoring determine such an occurrence.
- Requirements for noise monitoring, including that it be undertaken in accordance with the latest version of the Noise Measurement Manual (DES 2020) and relevant Australian Standards. Weather date (i.e. wind direction and speed, rainfall, temperature and humidity) should be measured and reported with the noise data.
- Though noise modelling results indicate that noise exceedance is unlikely, and that noise mitigation measures are not required, the NMP should include potential noise management and mitigation measures including:
    - Management of mining equipment locations, such as operating at lower elevation or shielded areas;
    - Reducing the numbers of equipment in operation;
    - Attenuation of equipment;
    - Construction of bund walls; and/or
    - Noise monitoring to ascertain the effectiveness of any noise control measures.

Vibration and airblast monitoring devices should be implemented where required as part of the Blasting Management Plan (BMP) for the mine. The BMP could be either stand-alone or combined with the NMP, and should include:

- Vibration and airblast monitoring during initial or all blasts, with monitoring sites at or near the worst-affected receptor/s. The sites could be at receptors (e.g. nearest Receptor 2 to the south), or at a reference location/s between the blasting and the receptors.
- Processes to enable the mine to promptly react to high community vibration/airblast levels and/or related complaints. Such processes should advise on how the mine will respond.
- Vibration and airblast mitigation options including revised blast design.

10 Conclusion

A noise and vibration impact assessment has been conducted for the proposed Graphinex Esmeralda Project.

The following comments are made regarding the assessment:

- Three sensitive receptors (R1, R2 and R3) have been identified in the local of the Project, at distances of 7 to 33 km of the Project footprint, and 5 to 20 km of the Project access road. Only one receptor (R2) is within 15 km of the Project footprint or access road, being 7 km from the Project footprint and 5 km from the mine access road.
- Cultural heritage, fauna and other sensitive receptors were considered, but were determined not to be a constraint on the Project noise and vibration assessment.
- Baseline noise monitoring was conducted at two (2) sensitive receptor locations near the Project, which are equal or comparable to the baseline noise levels at receptors nearer to this Project. Overall, the measurement results indicate the areas are regularly quiet in the absence of local activity at the homestead, as is typical of a rural environment.
- The noise modelling considers four (4) mine-year scenarios when equipment numbers are highest, and equipment locations are likely to result in higher emissions (e.g. nearest sensitive receptors, elevated atop a dump). Noise emissions during construction and closure phases, and during upset and maintenance conditions were evaluated and considered to have a lower noise impact than operations and hence were not required to be modelled. Noise calculations include vehicle movements within the MLA.
- The noise modelling considers four meteorological conditions under the CONCAWE algorithms and also default adverse meteorological conditions under the ISO 9613-2:2024 algorithms.
- Calculations have also been made to predict vibration levels due to blasting.
- Noise from road traffic between the Project site and Richmond township, and aircraft landing and take-off from the airstrip, have been assessed. It is noted that the airstrip is on the MLA and therefore FIFO vehicle movements will also occur on the MLA.

The proposed noise criteria are shown below (refer Table 14).

Noise level dBA measured as:	**All days**		
	Day (7am to 6pm)	**Evening (6pm to 10pm)**	**Night (10pm to 7am)**
Sensitive Place - Residential			
$L_{Aeq,adj,15min}$	40	40	35

The proposed blasting (airblast and vibration) criteria are shown below (refer Table 15).

Blasting noise and vibration limits	**Sensitive place and commercial place criteria**	
	Monday to Friday 7am to 6pm; **Saturday, Sunday and Public Holidays 9am – 6pm**	**Other times**
Airblast overpressure	115 dB (Linear peak) for 9 out of 10 consecutive blasts and not greater than 120 dB (Linear peak) at any time	No blasting
Ground vibration	5 mm/second peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/second peak particle velocity at any time	No blasting

The conclusions of the assessment are as follows:

- Noise
  - Mine noise levels at the receptors are predicted to be compliant with the proposed mine noise limits, including a minimum 14 dBA margin below the proposed daytime noise limit of 40 dBA, and minimum 4 dB margin below the proposed night-time noise limit of 35 dBA.
  - A low frequency noise assessment has been conducted for the modelled scenario and is compliant with a minimum 5 dB margin below the proposed noise limit of 55 dBZ.
  - Cumulative noise has been assessed and is predicted to be compliant.
  - Noise levels from Project road traffic, within and external to the MLA, have been assessed and are compliant.
  - Noise levels from the aircraft movements associated with the Project airstrip have been assessed and are compliant.
- Vibration
  - Mine blasting vibration and airblast levels at the receptors are predicted to be compliant with the proposed blasting limits.

It is recommended that the mine EA should include the noise and blasting criteria as proposed in Table 14 and Table 15. Noise and Blast Management Plans, either separate or combined, should be prepared prior to construction commencing as per Section 9.

With the inclusion of the proposed recommendation, noise and vibration impacts are predicted to be compliant with the relevant regulations and have no significant impact on sensitive receptors.

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Standard Australia 2018, *Acoustics – Description and measurement of environmental noise (AS1055:2018)*, Standards Australia (Standards Association of Australia).

Appendix A. Terminology and descriptors

Table 28: Terminology and descriptors

Term or Descriptor	Definition
Noise	Noise is unwanted, harmful or inharmonious (discordant) sound. Noise usually includes vibration as well as sound.
Audible	Audible refers to a sound that can be heard. There are a range of audibility grades, varying from "barely audible", "just audible" to "clearly audible" and "prominent".
Ambient noise	The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' ($L_{Aeq,T}$).
Decibel or dB	The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from 10 $\log_{10}(10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB.
'A' frequency weighting	The 'A' frequency weighting roughly approximates to an equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.
'Z' frequency weighting	The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. A Z-weighted noise level will be higher than the A-weighted noise level for the same noise source due to the different weightings.
Sound pressure level, L_p	The level of sound measured on a sound level meter and expressed in decibels (dB). Where $L_P = 10 \log_{10}(Pa/Po)^2$ dB (or 20 $\log_{10}$(Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20 x 10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.
Sound power level, L_w	The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. $L_w = L_p + 10$ log10 'a' dB, re: 1pW, (10-12 watts) where 'a' is the measurement noise-emission area (m^2) in a free field.
Free-field	In acoustics a free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall or inside an anechoic chamber.
Frequency	The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

Term or Descriptor	Definition
Loudness	The volume to which a sound is audible to a listener is a subjective term referred to as loudness. Humans generally perceive an approximate doubling of loudness when the sound level increases by about 10 dB and an approximate halving of loudness when the sound level decreases by about 10 dB.
Equivalent continuous sound level, L_{Aeq}	Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. Most modern sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short-term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.
LP L_{Aeq} (also LP L_{eq})	The low pass (LP) L_{Aeq} (see definition above) is summed over the lower frequency range of 20 to 630 Hz.
Statistical noise levels, L_n (e.g. L_1, L_{10}, L_{90})	Noise which varies in level over a specific period of time 'T' (standard measurement times are often 15-minute periods) may be quantified in terms of various statistical descriptors with some common examples: • The noise level, in decibels, exceeded for 1 % of the measurement time period, is reference to as L_1. This may be used for describing short-term noise levels such as could cause sleep arousal during the night. • The noise level, in decibels, exceeded for 10 % of the measurement time period, is reference to as L_{10}. In most countries the L_{10} is measured over periods of 15 minutes and is used to describe the average maximum noise level. The noise level, in decibels, exceeded for 90 % of the measurement time period, is reference to as L_{90}. In most countries the L_{90} is measured over periods of 15 minutes and is used to describe the average minimum or background noise level.
Background noise level, L_{90}	Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' ($L_{A90,T}$). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15-minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.
RBL, Rating background (noise) level	Background noise levels, in dB, that are usually determined for daytime, evening and night periods, and that consider L_{90} levels measured over a period of typically 4 to 10 days. They are calculated using the lowest 10th percentile method in accordance with the DES "Planning for Noise Control" guideline, which was released by the (then) Queensland EPA on 20/07/2004. It can no longer be found on the DETSI website, but is referenced in the Noise measurement manual (DES 2020) and Model mining conditions (DESI 2024b). The methodology is used by other regulatory authorities.
LP L_{A90} (also L_{90LF}, L_{A90LF}, LP L_{90}, or $L_{A90(20\text{-}630Hz)}$)	The low pass (LP) L_{A90} (see definition above) is summed over the lower frequency range of 20 to 630 Hz.
Maximum noise level, L_{max}	The maximum sound pressure level measured with sound level meter over a time period. If referring to a calculated noise level it may be referring to an average maximum noise level, though this should be clear in the report text.
Minimum noise level, L_{min}	The minimum sound pressure level measured with sound level meter over a time period.
Blasting related terminology	

Term or Descriptor	Definition
Amplitude	The measurement of energy or movement in a vibrating object. Amplitude is measured and expressed in three ways: Displacement (commonly in mm Pk-Pk); Velocity (commonly in mm/s Pk); and Acceleration (commonly in m/s2 RMS). Amplitude is also the y-axis of the vibration time waveform and spectrum; it helps define the severity of the vibration.
Blast monitor	An instrument that measures seismic waves along three mutually perpendicular axes (x, y, z) to determine Peak Particle Velocity.
Decibel or dB	A unit of sound measurement which quantifies pressure fluctuations associated with noise and overpressure.
dB (Lin Peak)	Decibel associated with the maximum excess pressure in the overpressure wave. Lin represents linear - indicating that no weighting or adjustment is made to the measurement.
Frequency	The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.
Ground vibration	Motion of the ground caused by the passage of seismic waves originating from a blast. The rate of the ground vibration movement is called Peak Particle Velocity (PPV) and is measured in millimetres per second (mm/sec).
Hertz (Hz)	Vibration can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. The frequency of vibration and sound is measured in hertz (Hz). Once hertz is one cycle per second. Structural Vibration is generally measured over the frequency range from 1Hz to 500Hz (0.5kHz).
Maximum Instantaneous Charge (MIC)	Maximum amount of explosive detonated per delay.
Overpressure	A pressure wave in the atmosphere which is caused by the detonation of explosives. Overpressure consists of both an audible (noise) and inaudible energy is measured in dB (Lin Peak).
Peak to peak (Pk-Pk)	This is the measure of the vibration amplitude, maximum to minimum, equal to twice the RMS value of a sine wave.
Peak particle velocity (PPV)	Vibration velocity can be measured in a number of ways. For some projects vibration levels can be given in terms of Peak Particle Velocity (PPV).
Peak vector sum	The resultant particle velocity magnitude or vector sum of the transverse, vertical and longitudinal particle velocity components.
RMS velocity	For most applications where there is continuous vibration, vibration is measured in terms of root mean square RMS velocity (mm/sec).
Spectrum	The spectrum is the result of transforming a time domain signal to the frequency domain. Spectrum analysis is the procedure of doing the transformation, and it is most commonly done with an FFT analyser.

Note: References include (1): https://aaac.org.au/Terminology, (2) Blasting and the NSW Minerals Industry, NSW Minerals Council

Appendix B. Noise monitoring locations



Figure 10: Aerial photo of monitoring location A (R1)



Plate 1: Photo of monitoring location A (R1)



Figure 11: Aerial photo of monitoring location B (R2)



Plate 2: Photo of monitoring location B (R2)

Appendix C. Noise monitoring results

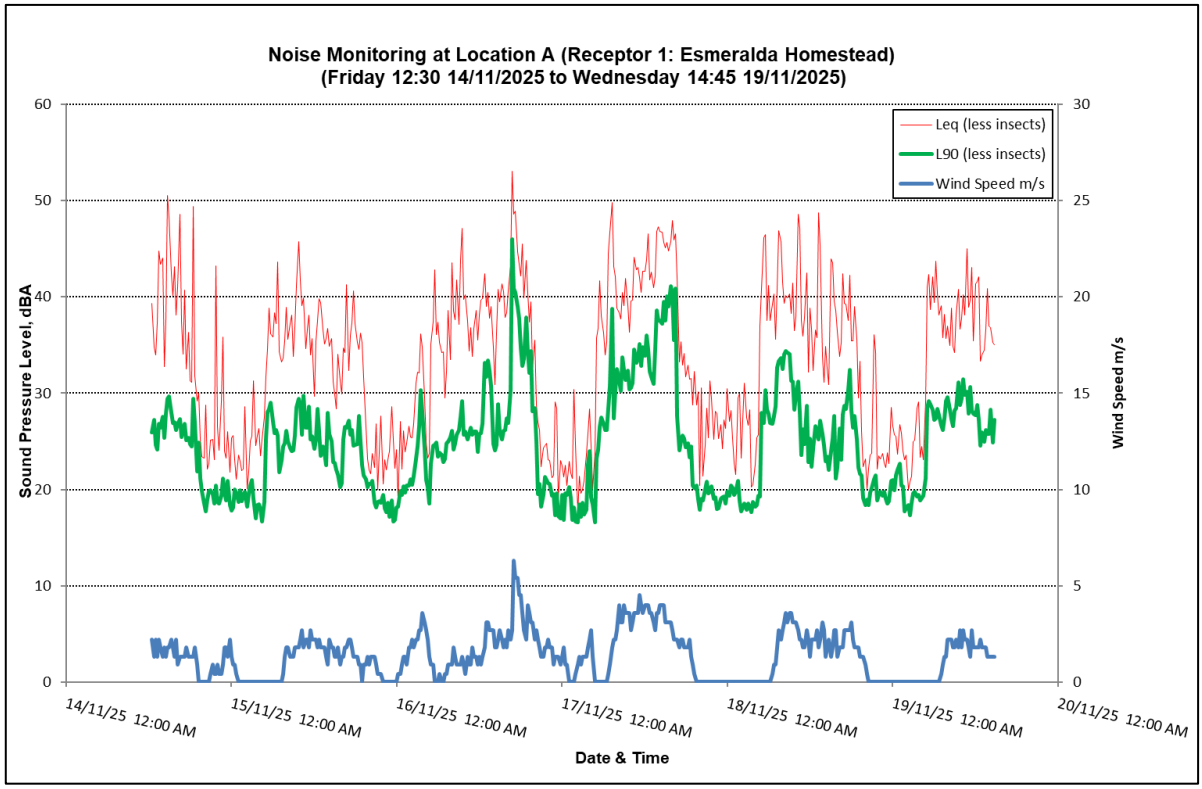


Figure 12: Graph of noise level monitoring results at location A (R1)

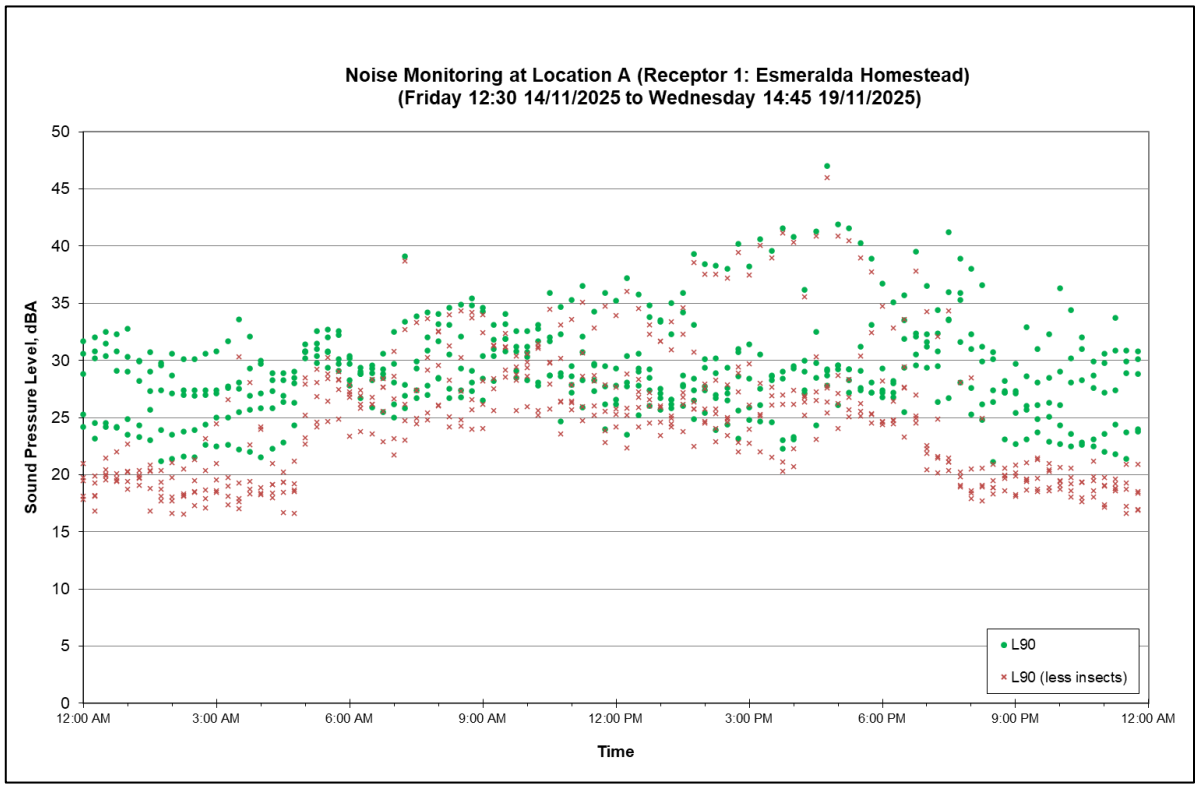


Figure 13: Graph of 24-hour background noise level monitoring results at location A (R1)

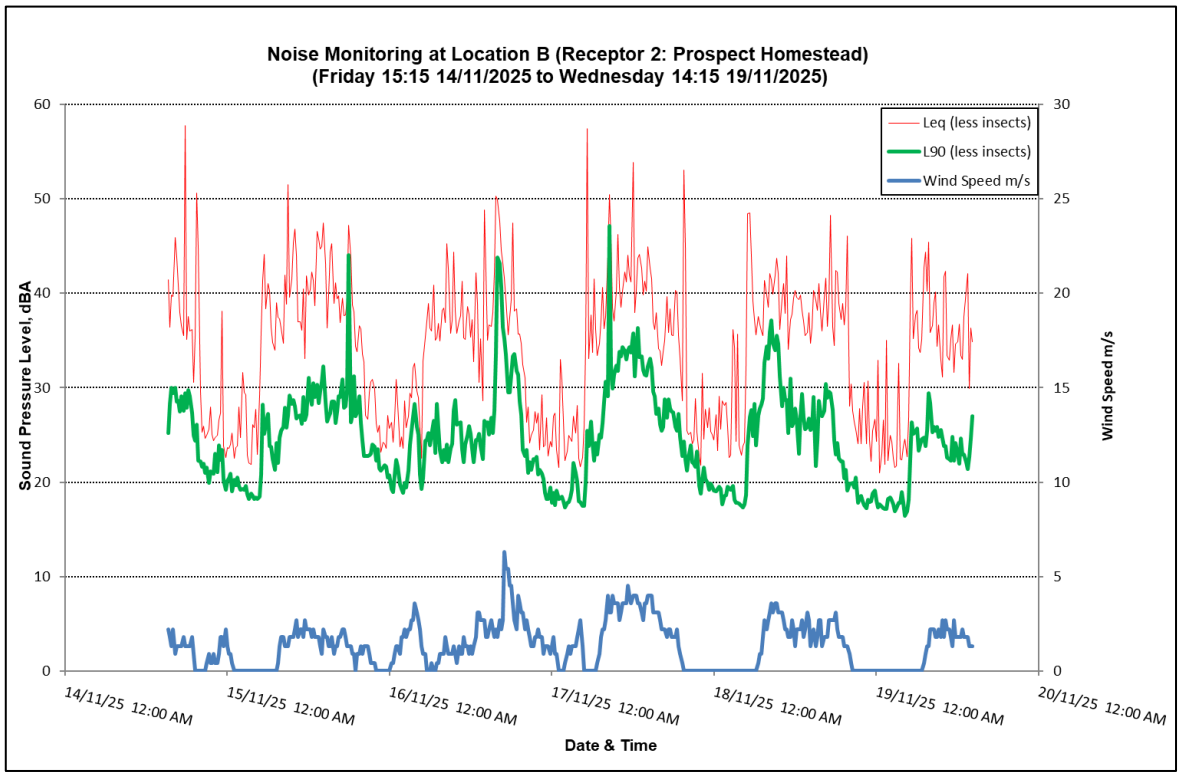


Figure 14: Graph of noise level monitoring results at location B (R2)

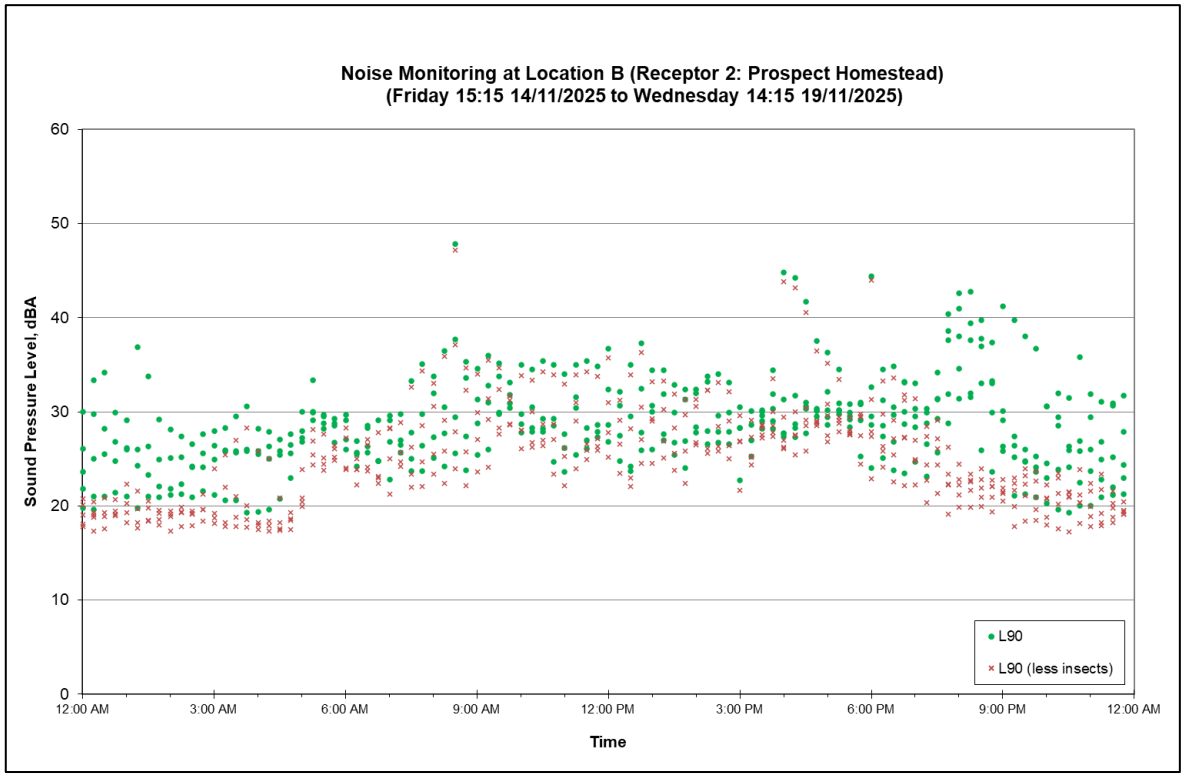


Figure 15: Graph of 24-hour background noise level monitoring results at location B (R2)

Appendix D. Modelled equipment locations

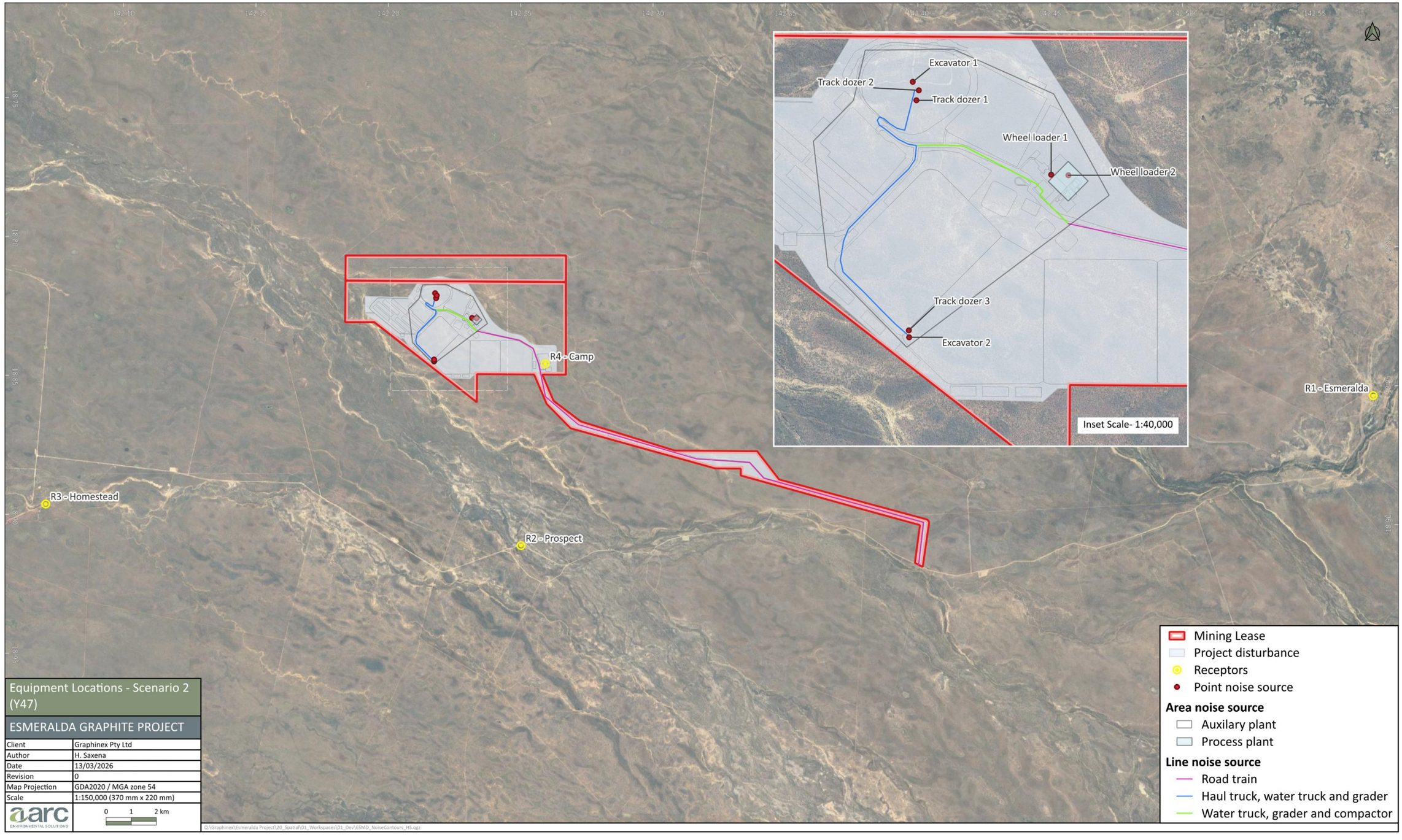


Figure 16: Modelled equipment locations –Scenario 2: Mine year 47

Appendix E. Noise contours

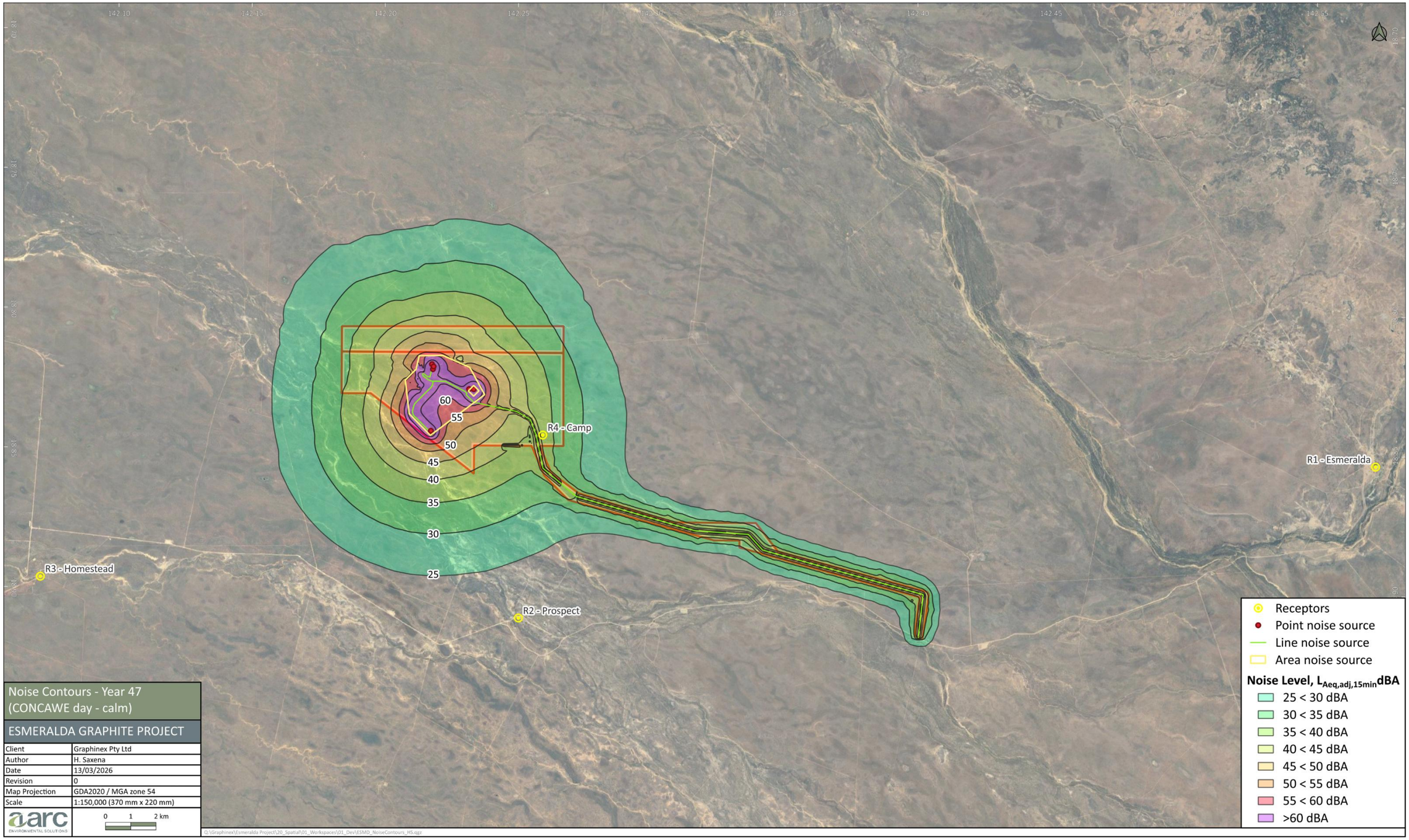


Figure 17: Noise contours – Scenario 2, Year 47 (CONCAWE day-calm)

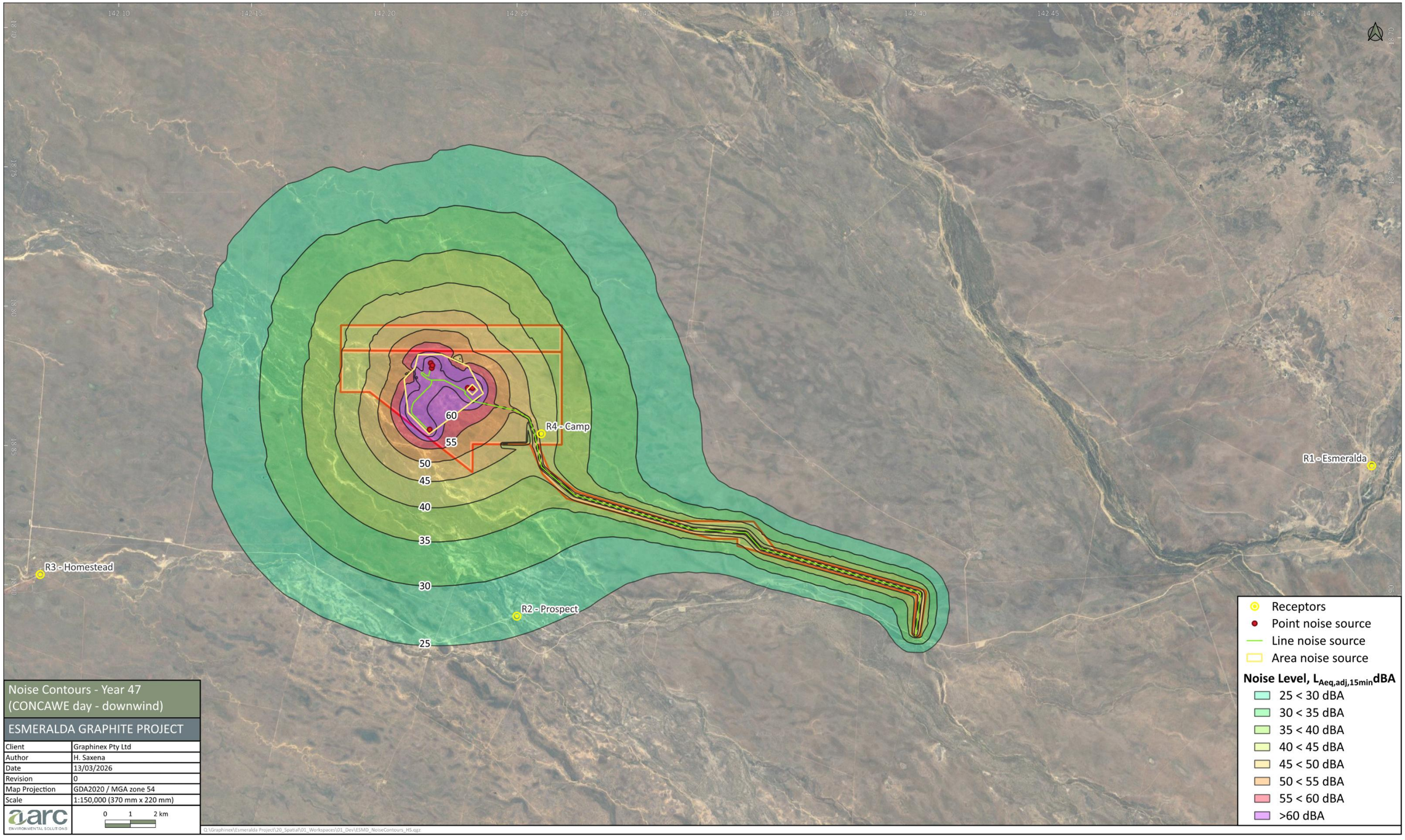


Figure 18: Noise contours – Scenario 2, Year 47 (CONCAWE day-downwind)

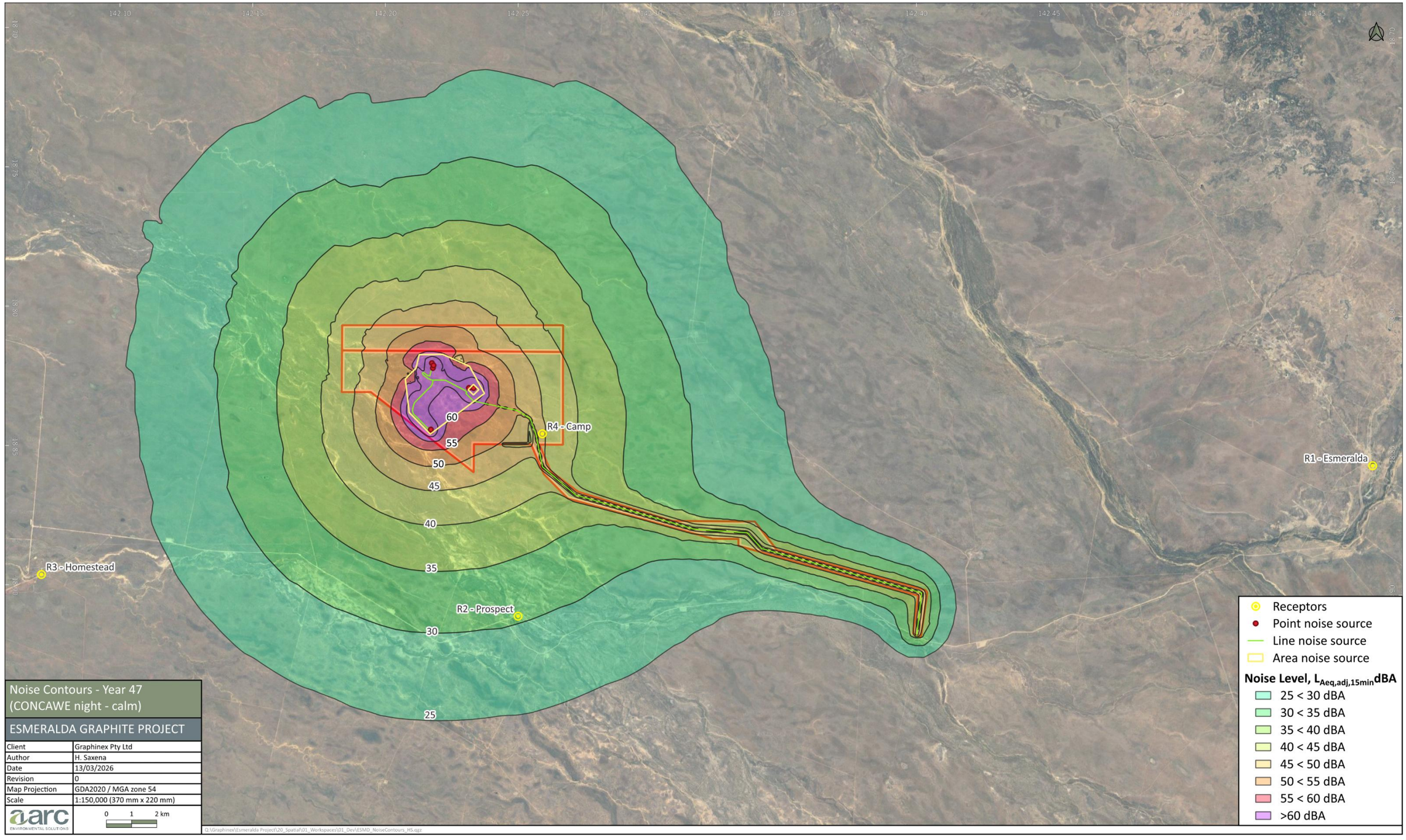


Figure 19: Noise contours – Scenario 2, Year 47 (CONCAWE night-calm)

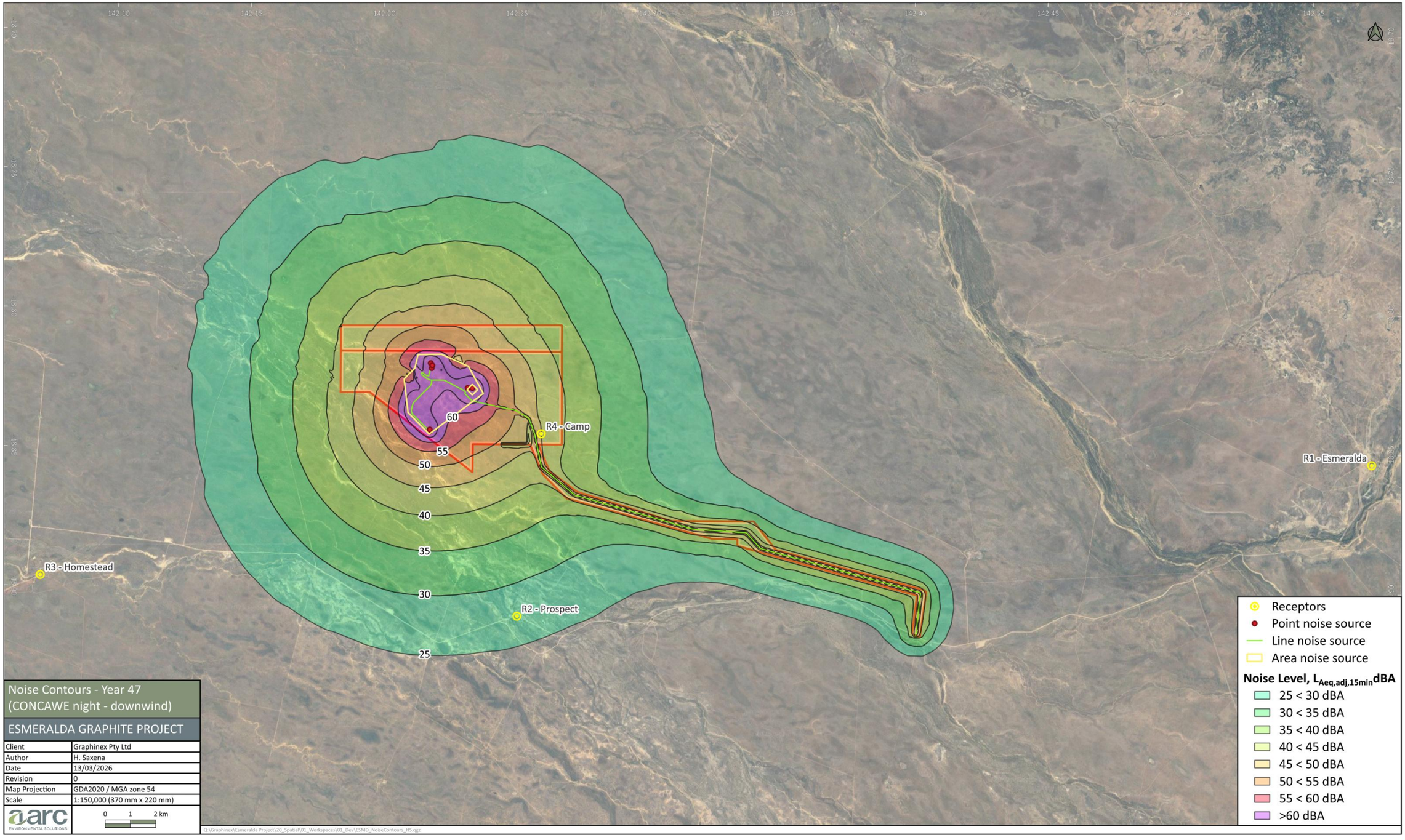


Figure 20: Noise contours – Scenario 2, Year 47 (CONCAWE night-downwind)

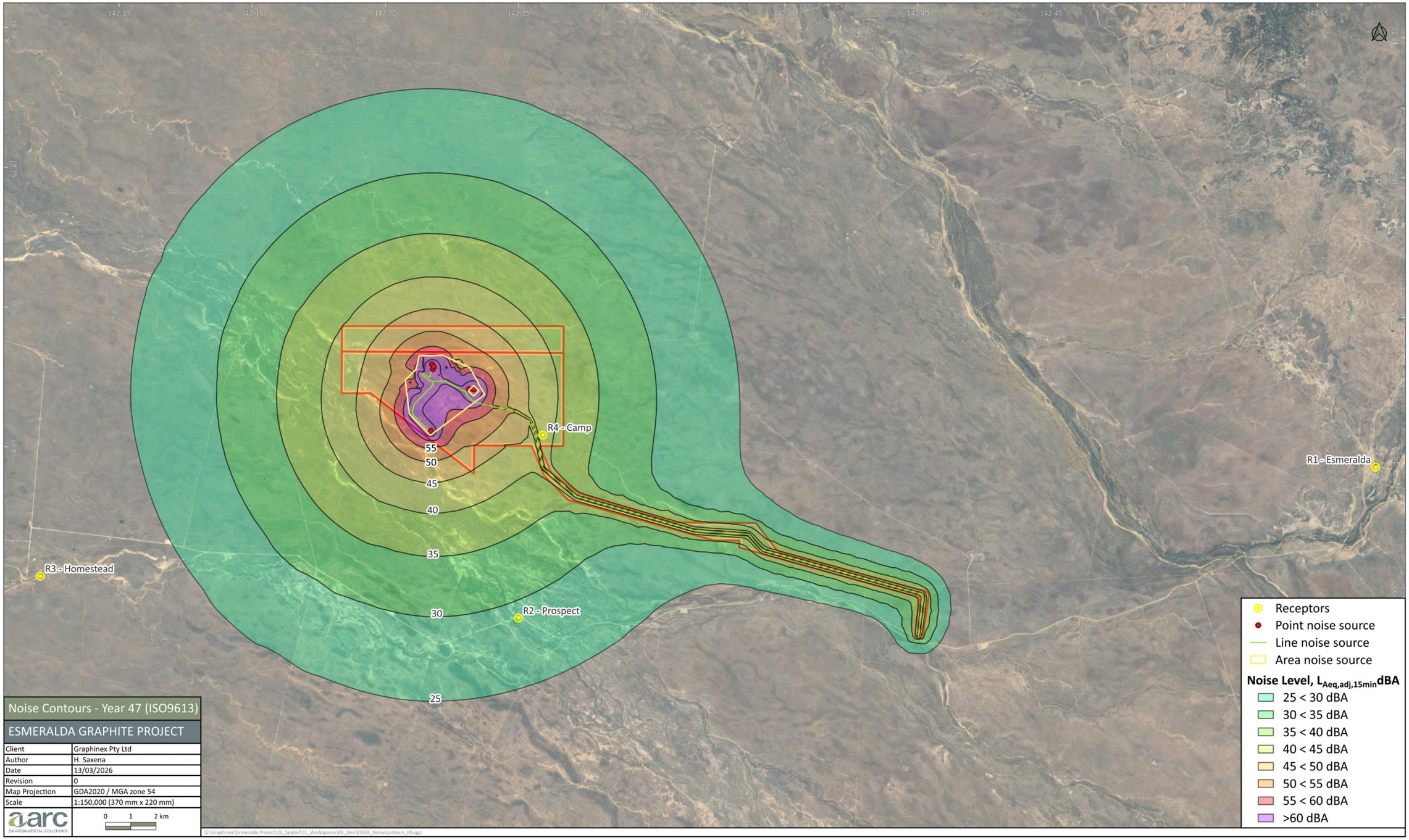


Figure 21: Noise contours – Scenario 2, Year 47 (ISO 9613-2:2024)