APPENDIX 13: NOISE MODELLING ASSESSMENT

ENVIRONMENTAL NOISE IMPACT ASSESSMENT FOR KEYSBROOK MINING OPERATIONS WESTERN AREAS EXTENSION

DORAL MINERAL SANDS

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EXECUTIVE SUMMARY

Ministerial Statement No. 1089 (MS1089) [1] stipulates separation distances required to be maintained between Doral's Keysbrook mining operations and noise-sensitive areas unless an amenity agreement is in place with the owner and occupier of the noise sensitive premises.

Mining and tails/rehabilitation works are planned to be extended in to the "Western Areas". Mining activities will be restricted to weekdays and Saturdays only and mineral processing activities will be undertaken continuously on a 24-hour basis. This report describes noise modelling undertaken to demonstrate how mining and rehabilitation operations can be managed to achieve compliance with the project noise limits. The project noise limits are based on the requirements of MS1089 and the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

In accordance with condition 14-2 of MS1089, daytime noise emissions from mining and minerals processing operations are not subject to noise limits for receptors with amenity agreements within prescribed separation distances. However, indoor noise limits will apply during evening and night-time periods. Since mining operations are restricted to daytime hours only, these indoor limits are applicable to noise emissions at receptors within 2km of mineral processing activities. Beyond 2km, or for receivers without amenity agreements, noise emissions must comply with the Assigned Levels defined in the Regulations.

A range of noise modelling scenarios have been developed representing worst-case noise impacts at the noise sensitive premises.

The noise modelling was used to determine the noise management and mitigation measures required to achieve compliance with the project noise limits, and the modelling scenarios presented assume the implementation of these measures. Tonal characteristics have been assumed to be present in noise emissions and are accounted for in the demonstration of compliance.

The noise modelling results demonstrate that mining and rehabilitation operations can be undertaken within in the western areas while maintaining compliance with the project noise limits for all receivers with amenity agreements within the 2km buffer zone surrounding the mining operations. Compliance was demonstrated assuming implementation of the following noise mitigation measures:

- Noise bunds at mobile screening plants oriented to attenuate sound propagation towards the nearest affected receptors.
- Only 1 screening plant to be used for operations within 700 m of receptors 14 and 17.
- Noise barriers at field pumps oriented to attenuate sound propagation towards the nearest affected receptors.

No specific noise management measures are required for mobile equipment (other than not exceeding the sound power levels and numbers of equipment items operating simultaneously assumed in the modelling scenarios).

Predicted noise levels do not exceed the Assigned Levels at any receptors beyond the 2km buffer zone surrounding the mining operations.

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1 INTRODUCTION

1.1 Context

Keysbrook Leucoxene Pty Ltd (KLPL), a subsidiary of Doral Mineral Sands Pty Ltd (Doral), operate the Keysbrook Mineral Sands Mine (Keysbrook), located approximately 70 km south of Perth. The surface mining operation migrates across the land, and the shallow mine void is generally backfilled to pre-disturbance contours and rehabilitated within two years following mining.

Ministerial Statement No. 1089 (MS1089) [1] sets out conditions applying to noise emissions from the mining operations. Condition 14-1 stipulates separation distances required to be maintained between mining operations and noise-sensitive areas unless an amenity agreement is in place with the owner and occupier of the noise sensitive premises.

Conditions 14-3 through to 14-7 of the Ministerial Statement provide an allowance and process for the separation distances to be varied based on the preparation of a Noise Management and Monitoring Plan (NMMP) which demonstrates that reduced distances will achieve compliance with the *Environmental Protection (Noise) Regulations 1997* (the Regulations) [2].

The mining process involves:

- Clearing & topsoil removal;
- Excavating and trucking ore to minerals processing facilities including Mine Field Units (MFU) or mobile screens, from where it is pumped to a Wet Concentrator Plant (WCP); and
- Tails return and land rehabilitation works.

Other activities include preparation and maintenance of haul roads and dust suppression using water carts. Mining and land rehabilitation works are limited to daytime hours only. Minerals processing is a 24-hour operation.

Mining and tails/rehabilitation works are planned to be extended in to the "Western Areas" as depicted in Figure A-1. This report provides an assessment of the environmental noise impacts of the proposed operations based on noise modelling.

1.2 Noise Sensitive Premises

The locations of noise sensitive premises within the vicinity of the proposed mining operations are shown in Figure A-1. The figure also shows the extent of the 2 km zone surrounding the mining operations. Amenity agreements will be in place for all noise sensitive premises within the buffer. Several receptors are located within the proposed mining area which are under current amenity agreements (receptors 20, 24, 26 & 30) and it is anticipated that these properties will be vacated for the duration of the mining activities.

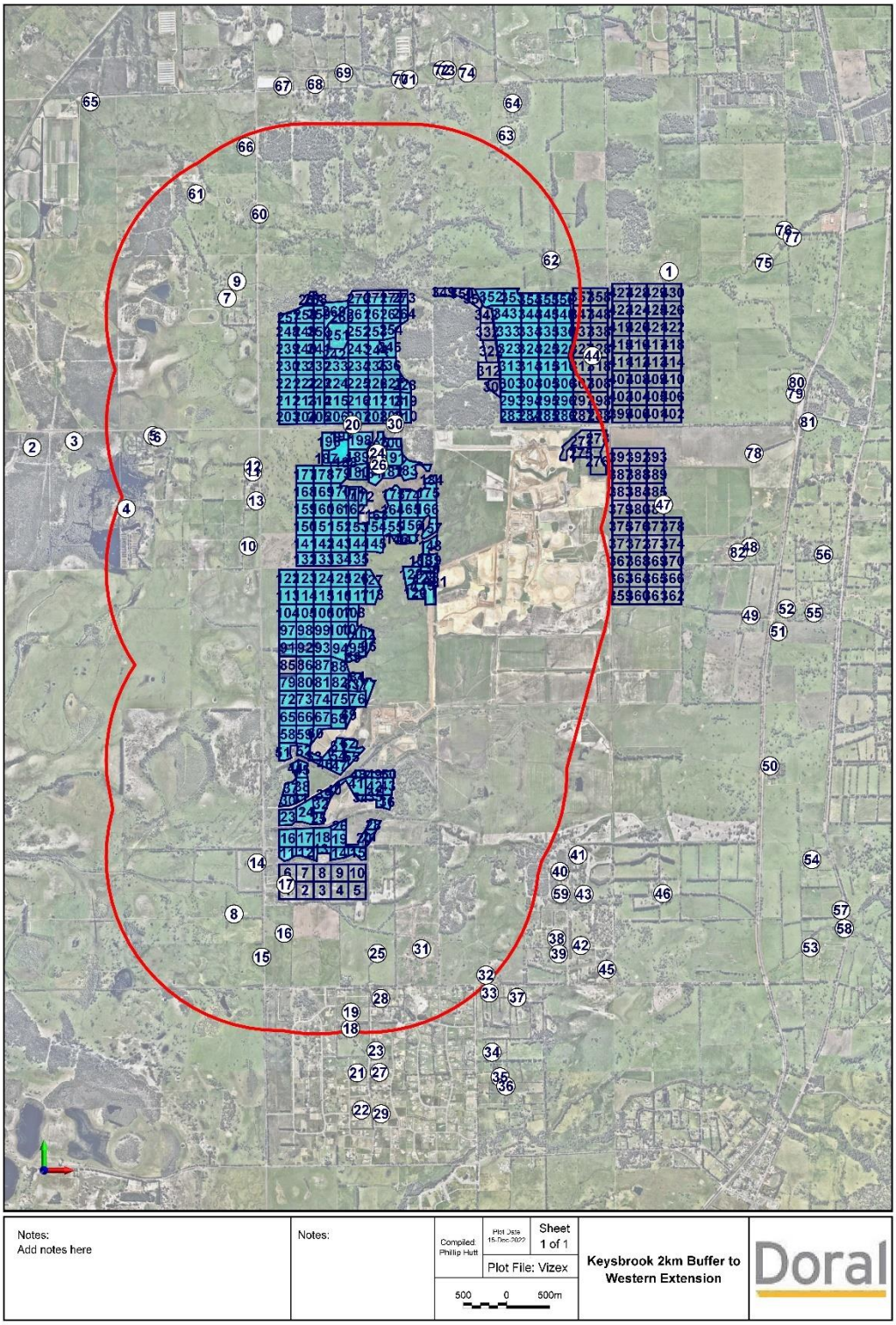

Figure A-1 – Locations of Noise Sensitive Receptors within 2km of Proposed Mining Operations

1.3 Scope of This Report

This report describes noise modelling undertaken to demonstrate how mining operations can be managed to achieve compliance with Ministerial Statement 1089 and the Regulations.

The modelling includes seven scenarios with mining equipment situated at locations representing worst-case operational impacts for receptors within the 2km zone surrounding the operations. Results are presented for night-time minerals processing and for daytime mining operations (including tails and rehabilitation activities).

Noise management measures required to achieve compliance are also described.

1.4 Relevant Documents

[1] Ministerial Statement No. 1089, *Statement to Amend Conditions Applying to a Proposal (Pursuant to the Provisions of Section 46 of the Environmental Protection Act 1986)*.

[2] Environmental Protection (Noise) Regulations 1997.

[3] Draft Guideline *Assessment of Environmental Noise Emissions*, May 2021, Department of Water and Environmental Regulation.

[4] Wood Report 1404025-4-100-Rev0-2.Oct 2019 Doral Keysbrook Lot 57 Noise Assessment.

[5] Wood Report 1404025-5-200-RevB-19.May. 2019 *Risk Assessment for Internal Dwelling Noise.*

2 MAXIMUM ALLOWABLE NOISE LEVELS

In accordance with condition 14-2 of MS1089, daytime noise emissions from mining and minerals processing operations are not subject to noise limits for receptors with amenity agreements within prescribed separation distances. However, indoor noise limits will apply during evening and night-time periods. Since mining operations are restricted to daytime hours only, these indoor limits are applicable to noise emissions at receptors within 2km of mineral processing activities. Beyond 2km, noise emissions must comply with the Assigned Levels defined in the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

The relevant aspects of the Regulations and MS1089, and the corresponding project noise limits are summarized in the following sections.

2.1 Assigned Levels

Noise management in Western Australia is implemented through the *Environmental Protection (Noise) Regulations 1997* (the Regulations) which operate under the *Environmental Protection Act 1986*. The Regulations specify maximum noise levels (Assigned Levels) which are the highest noise levels that can be received at noise-sensitive residential premises, as well as commercial and industrial premises. The Assigned Levels apply at receptors without amenity agreements[1].

Assigned Levels have been set differently for noise sensitive premises, commercial premises, and industrial premises. For noise sensitive premises, e.g. residences, an "influencing factor" is incorporated into the assigned noise levels. The influencing factor depends on land use zonings within circles of 100 m and 450 m radius from the noise receiver. For the noise sensitive premises surrounding the proposed operations, the influencing factor is 0.

The regulations define three types of Assigned Level:

- L_{Amax} Assigned Level means a noise level which is not to be exceeded at any time;
- L_{A1} Assigned Level which is not to be exceeded for more than 1% of the time; and
- L_{A10} Assigned Level which is not to be exceeded for more than 10% of the time.

The L_{A10} Assigned Level is the most significant for this study since this is representative of continuous noise emissions from the proposed mining and rehabilitation operations.

The Regulations also require that noise emissions are adjusted by adding 5 dB where tonality is evident in received noise and that the adjusted levels must comply with the Assigned Levels.

[1] All receptors within the 2km buffer zone surrounding the mining operations are expected to have amenity agreements.

Table 2-1 presents the L_{A10} Assigned Levels (excluding adjustments for tonality) for noise sensitive premises without an amenity agreement.

Table 2-1 – Assigned Levels (L_{A10})

Location	Influencing Factor	Assigned levels (L_{A10}) in dB(A)		
		Weekday[2]	Evening and Sunday[3]	Night[4]
All sensitive receptors without an agreement	-	45	40	35

2.2 Ministerial Statement MS1089

MS1089 requires that LA10 noise emission levels received indoors during evening and night-time periods do not exceed 30 dB(A) and 25 dB(A) (+ influencing factor) respectively. Indoor noise levels (which assume that doors and windows are closed) are affected by the sound transmission loss provided by the building structure. Wood has previously assessed the risk of non-compliance of indoor noise limits based on the external noise level and has concluded that the risk of exceedance is low for an outdoor-to-indoor sound reduction of 15 dB[5].

Furthermore, condition 14-4(1) of MS1089 requires that tonal characteristics must be assumed to be present at all times when modelling noise impacts as part of a noise management and monitoring plan. Therefore, as per the Regulations, a +5dB adjustment for tonality is applicable to the noise received at a noise sensitive receiver.

2.3 Project Noise Limits

The following project noise limits are based on the requirements of MS1809 and the Regulations as well as assumed operating times (i.e. 24 hours for mineral processing and daytime only for mining and tailing/rehabilitation operations). They represent external noise limits (assuming an outdoor-to-indoor reduction of 15 dB where appropriate) and assume that tonality is present in noise emissions.

Table 2-2 – Project Noise Limits in dB(A)

Receptors	Weekday	Evening and Sunday/Public Holiday	Night
Sensitive receptors with an amenity agreement	-	40	35
Sensitive receptors without an agreement	40	35	30

[2]Weekday: 0700 to 1900 hours Monday to Saturday.

[3]Evening and Sunday: 1900 to 2200 hours all days, and 0900 to 1900 hours Sunday and public holidays.

[4]Night: 2200 hours on any day to 0700 hours Monday to Sunday and 0900 hours Sunday and public holidays.

[5] Wood Report 1404025-5-200-RevB-19.May. 2019 *Risk Assessment for Internal Dwelling Noise*

3 METHODOLOGY

Seven noise modelling scenarios have been developed with mining equipment situated at locations representing worst-case operational impacts for receptors within the 2km zone surrounding the operations. For each scenario noise level predictions have been undertaken for:

- Night-time mineral processing operations; and
- Daytime mining (including tails and rehabilitation) and mineral processing operations;

The noise modelling initially assumed no restrictions on equipment selection nor on the number of items of equipment operating simultaneously. Where the noise predictions showed exceedances of the project noise limits, the model was used to investigate the noise mitigation measures required to achieve compliance.

The results presented in this report are for the operating scenarios where compliance with the project noise limits has been demonstrated. The management measures required to achieve compliance are also stated (see section 6).

3.1 Noise Modelling

A numerical computer model has been developed using the SoundPlan program developed by SoundPLAN LLC. This program calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. SoundPlan can be used to model different types of noise, such as industrial noise, traffic noise and aircraft noise, and it is recognized internationally including in Australia, and has been accepted by WA Department of Water and Environment Regulation (DWER) as appropriate for environmental noise prediction. The inputs required in SoundPlan are noise source data, ground topographical data, meteorological data and receiver locations.

The noise model has been used to predict noise levels at the nearest noise sensitive receptors and to generate noise contours surrounding the operations.

The noise model does not include noise emissions from any source other than the proposed operations. Therefore, noise emissions from road traffic, aircraft noise, animals, domestic sources, etc. are excluded from the modelling.

3.1.1 Sound Level Prediction Algorithm

SoundPlan provides a range of published noise propagation prediction algorithms that can be selected by the user. The CONCAWE prediction algorithms were selected because, in previous noise modelling undertaken for the site that evaluated different algorithms, they provided the closest agreement between measured and predicted noise levels. The CONCAWE algorithms are also recommended by the DWER Draft Guideline "*Assessment of Environmental Noise Emissions*" (the Guidelines) [3].

3.1.2 Meteorological Conditions

SoundPlan calculates predicted noise levels for defined meteorological conditions. In particular, the following variables are included in the prediction algorithms and will affect the predicted noise level: atmospheric temperature, Pasquill stability class (representing temperature inversion), relative humidity, wind speed, and wind direction.

Wood has used the default worst-case meteorological conditions as suggested by the Guidelines for the study. Table 3-1 presents the meteorological conditions used in the noise modelling.

Table 3-1 – Noise Model Meteorological Inputs

Noise Model Application	Temperature	Pasquill Stability	Wind speed	Wind Direction	Relative Humidity
Night-time	15 °C	Class F	3 m/s	Worst-case	50%
Daytime	20 °C	Class E	4 m/s	Worst-case	50%

3.1.3 Topography, Bunds and Screens

Ground elevation data (topography) has been provided by Doral and input into the noise model. The topography data was sourced from sourced from DiMap Australia who acquired LiDAR data in 2012.

The topography contours have a resolution of 0.5m and represent the natural terrain prior to commencement of mining operations. As the landscape is relatively flat and the mining pits are shallow, post mining terrain contours are not expected to have a significantly different influence on sound propagation to noise sensitive receptors.

8m high L-shaped noise bunds are included for mobile screening plant locations, oriented to minimise sound propagation towards the nearest relevant receptors. Similarly, noise barriers are included for all field pumps.

3.1.4 Ground Absorption

The acoustic properties of the ground surface can have a considerable effect on the propagation of noise. Flat non-porous surfaces such as concrete, asphalt, and calm water reflect noise, while porous surfaces, such as loam and soft grass, absorb noise.

The ground absorption factors used in the model were selected during previous model iterations to provide best agreement between measured and predicted values. (See Section 3.1.6.)

For farmland areas ground absorption factors of 0.4 and 0.45 have been used. The mining areas feature soft loose sand and have been modelled with higher ground absorption factors (0.7).

A reflective ground (ground factor 0) has been used for propagation over hard surfaces within the site and for propagation over water.

3.1.5 Noise Source Definition

In recent years, Wood has measured sound power levels for both fixed plant and mobile equipment deployed at Keysbrook and other Doral sites. This includes measurements recorded in May 2022 of a low-noise screening plant which has been assumed for the noise modelling. The sound power levels for all equipment included in the noise modelling scenarios described in this report are based these measurements. Overall sound power levels are summarized in Section 4.4. Appendix A also provides octave band sound power levels as well as the date on which the relevant site measurements were recorded.

3.1.6 Model Validation

The noise model developed for Doral's Keysbrook mining operations was validated by comparison of predicted and measured noise levels in February and May 2019. Details of this validation are provided in Wood report no. 1404025-4-100-Rev0-2.Oct 2019. [4]

The sound power levels of the low-noise mobile screening plant were verified by comparing sound pressure levels measured at 10 – 20 m from the plant with noise level predictions at the same locations.

4 NOISE MODELLING SCENARIOS

Seven noise modelling scenarios have been developed with mining equipment situated within various lots throughout the proposed mining area. The locations were selected to represent worst-case noise impacts at the nearest noise sensitive receptors. The scenarios include operations within the following lots:

- Scenario 1, Lot 507;
- Scenario 2, Lot 508;
- Scenario 3, Lot 201;
- Scenario 4, Lot 64;
- Scenario 5, Lot 63;
- Scenario 6, Lot 62; and
- Scenario 7, Lot 20.

The locations of the lots are shown in Figure A-1.

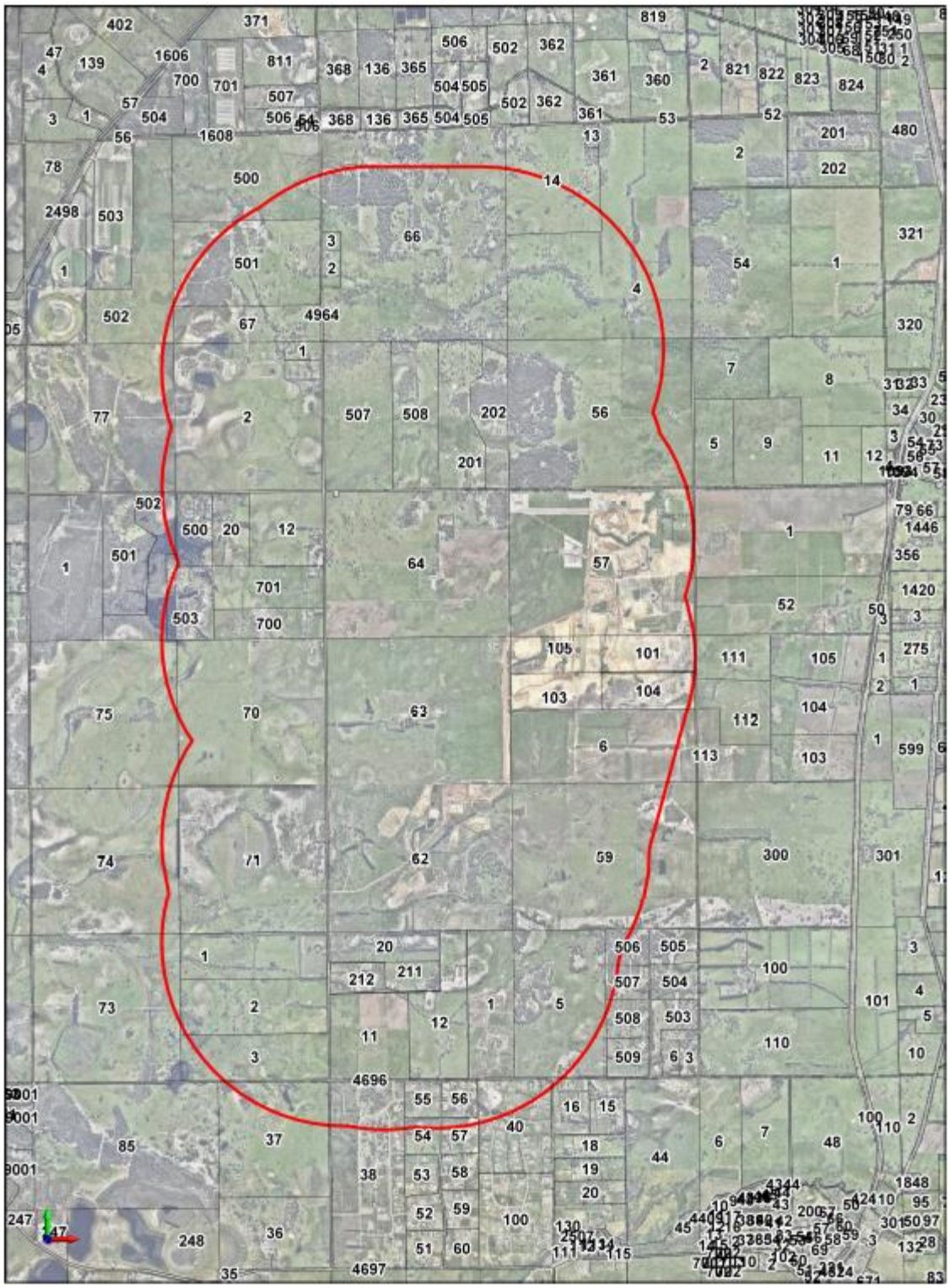

Figure A-1 – Lot Numbers

For each scenario, noise level predictions are presented for the following day and night-time operating conditions:

- **Night-time**: Minerals processing operations only; and
- **Daytime**: Mining operations including ore extraction and transport, road maintenance and dust suppression, tailing and rehabilitation, plus minerals processing operations.

Further detail of the plant and equipment included for the day and night-time periods are provided below.

4.1 Minerals Processing

Minerals processing involves feeding ore into the mobile screening plants (otherwise referred to as mobile field units or MFUs) using a front-end loader. Two similar screening plants spaced 200m apart are assumed to be operating in all scenarios except for operations within Lot 20 were a single MFU was assumed. (See section 6.) Each mobile screening plant comprises a feed unit (the JDM feeder) which receives ore via a hopper from the front-end loaders. The ore from the JDM feeder is transferred by a short conveyor to a secondary screen. The following sources for each mobile screening plant are included in the modelling scenarios:

- 1 x JDM feeder
- 1 x Secondary screen
- 1 x CAT 988 Front-end loader. The loader is assumed to be operating at high-idle in an elevated position on the ramp to JDM feeder.

8m high L-shaped noise bunds spaced 15m from the screening plants and oriented to attenuate sound propagation towards the nearest affected receptors are included in all scenarios.

Other noise emitting equipment associated with minerals processing includes the equipment at the wet concentrator plant (WCP) and field pumps.

Noise sources at the WCP include:

- Cyclone;
- Process / MFU water pumps;
- WCP building;
- Deslime cyclone feed pump;
- Rougher feed pump;
- Thickener overflow pump; and
- Thickener hydraulic power unit (HPU).

The number of field pumps varies depending on the distance between the mobile screening plants and the wet concentrator plant. 2.8m high noise barriers spaced 6m from each pump and oriented to attenuate sound propagation towards the nearest affected receptors are included in all scenarios.

4.2 Mining, Tails & Rehabilitation Operations

During mining, ore is extracted using an excavator and is transferred to the mobile screening plant using either a front-end loader or haul trucks. Tails / rehabilitation and road preparation / maintenance activities involve operation of the excavators, haul trucks dozers, graders and water trucks.

The locations and numbers of items of mobile equipment will vary. In order to represent a worst-case scenario, it is assumed that all available equipment will be operating simultaneously within 500m of the MFUs. In addition to the equipment listed above for minerals processing operations, the following additional equipment is assumed to be operational during daytime hours:

- 1 x Komatsu PC1250 excavator;
- 1 x CAT390F excavator within 150m of the MFUs;
- 1 x CAT 988 Front-end loader. The loader is assumed to be operating at high-idle between the PC1250 excavator and the MFUs;
- 3 x CAT 745 haul trucks operating between the PC1250 excavator and the MFUs (1 at high idle, 1 driving and 1 at low idle);
- 1 x Komatsu FG655 grader operating between the PC1250 excavator and the MFUs;
- 1 x CAT740 watercart operating between the PC1250 excavator and the MFUs; and
- 2 x CAT D7R dozers operating within 500m of the MFUs.

4.3 Equipment Locations

Figure A-1 to Figure A-7 show the locations of the noise sources for each scenario, including equipment operating during daytime and night-time hours. For clarity, the wet concentrator plant (which is located in the northeastern section of Lot 62) is excluded from these figures.

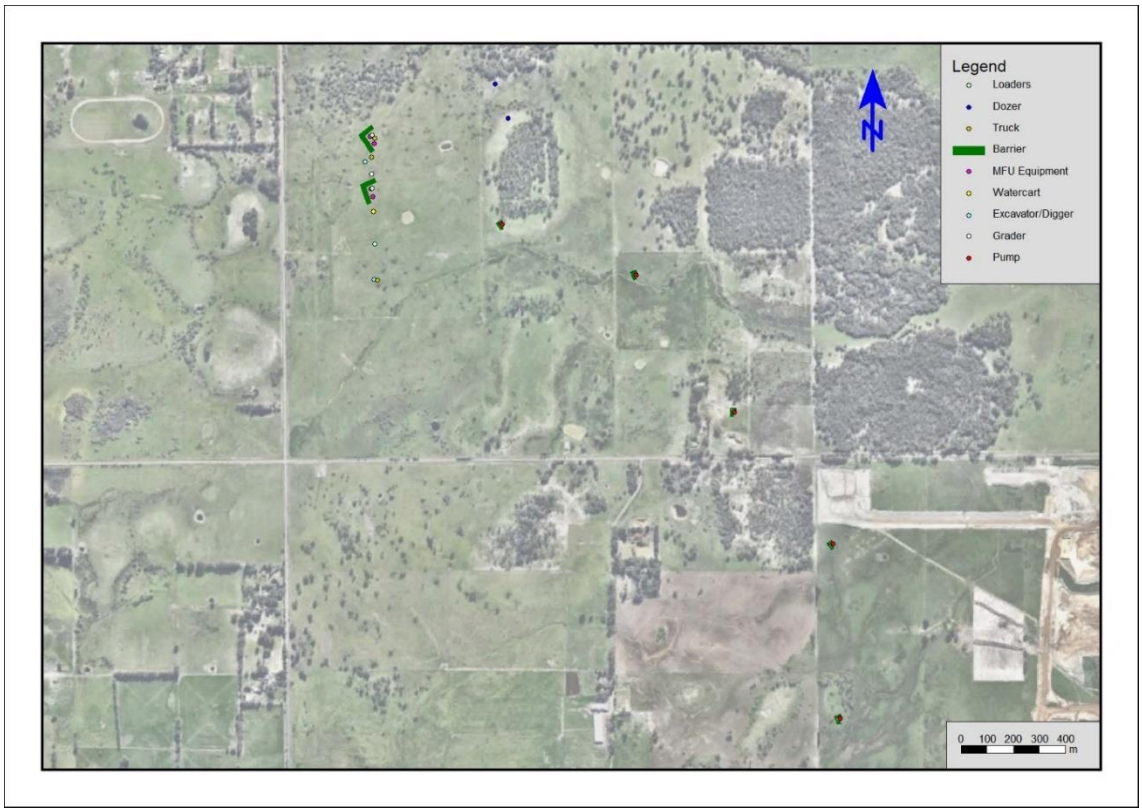

Figure A-1 – Noise Source Locations for Lot 507 Scenario

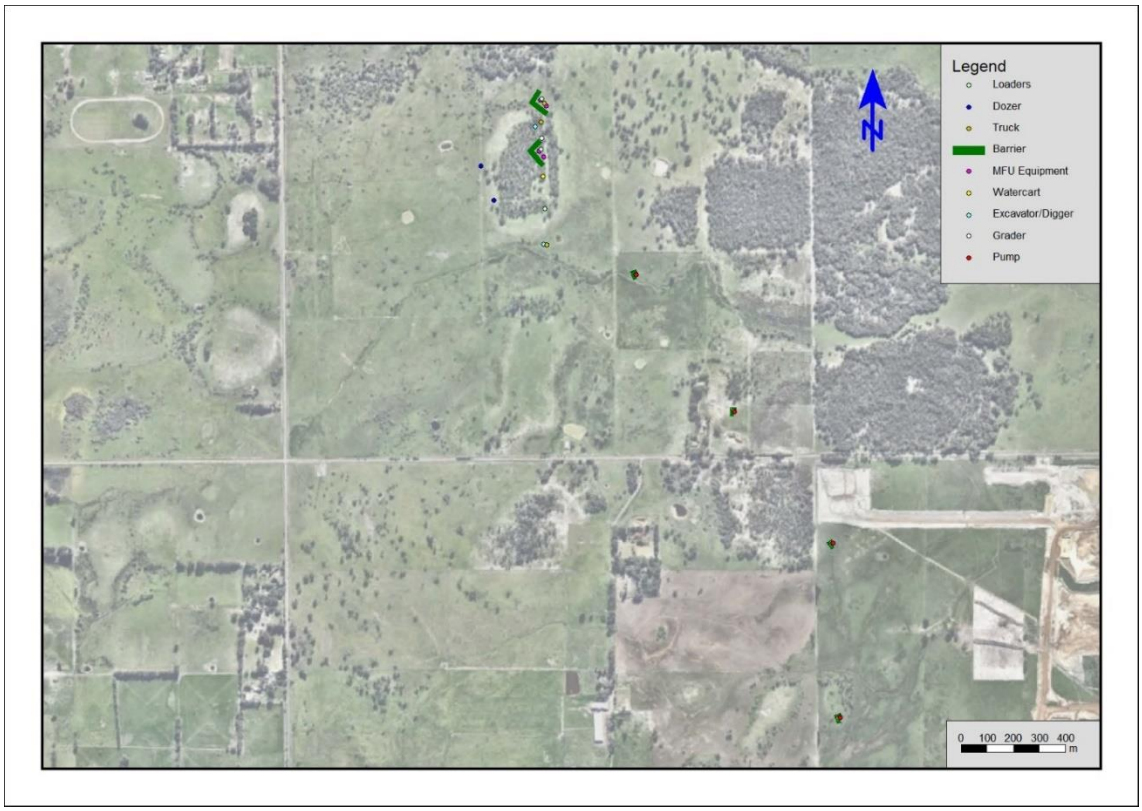

Figure A-2 – Noise Source Locations for Lot 508 Scenario

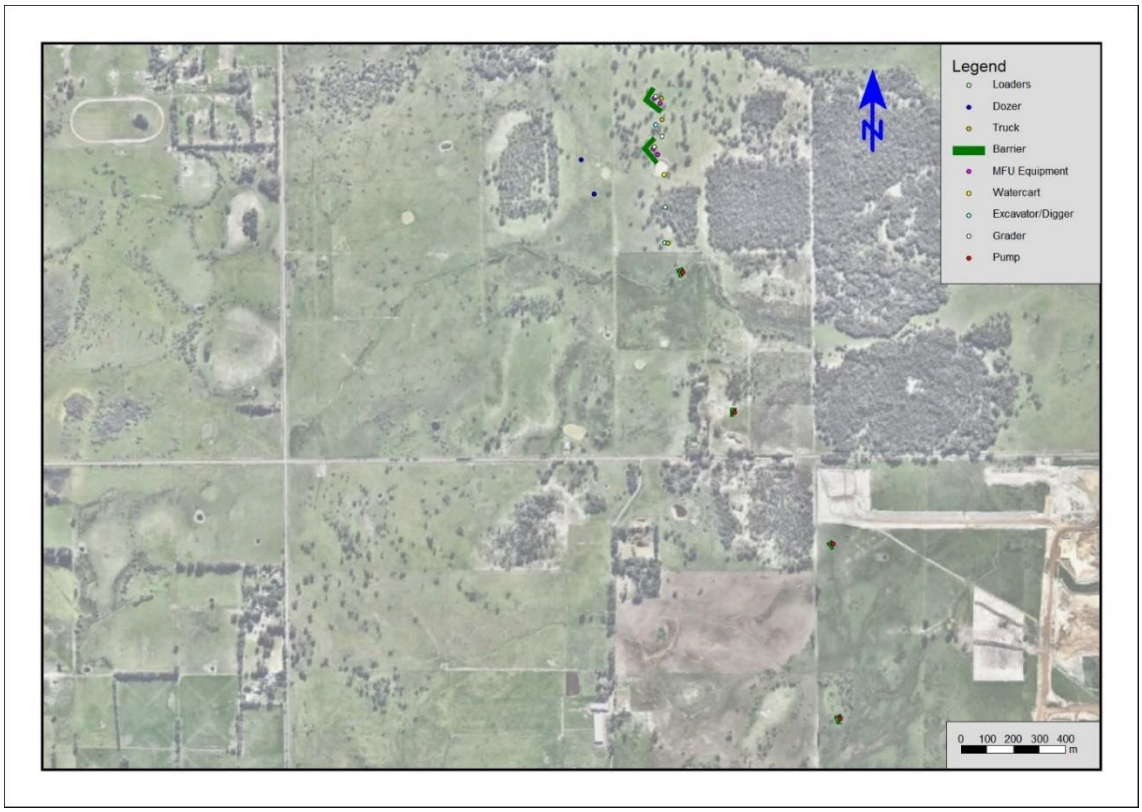

Figure A-3 – Noise Source Locations for Lot 201 Scenario

Figure A-4 – Noise Source Locations for Lot 64 Scenario

Figure A-5 – Noise Source Locations for Lot 63 Scenario

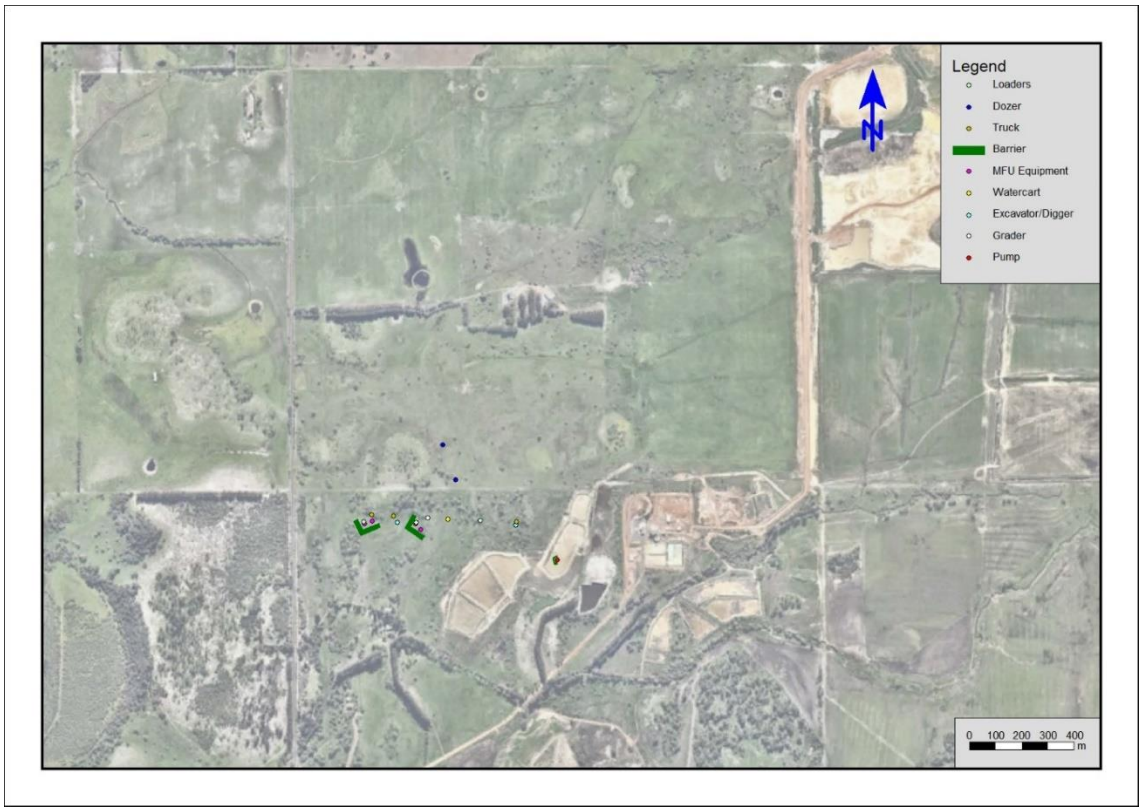

Figure A-6 – Noise Source Locations for Lot 62 Scenario

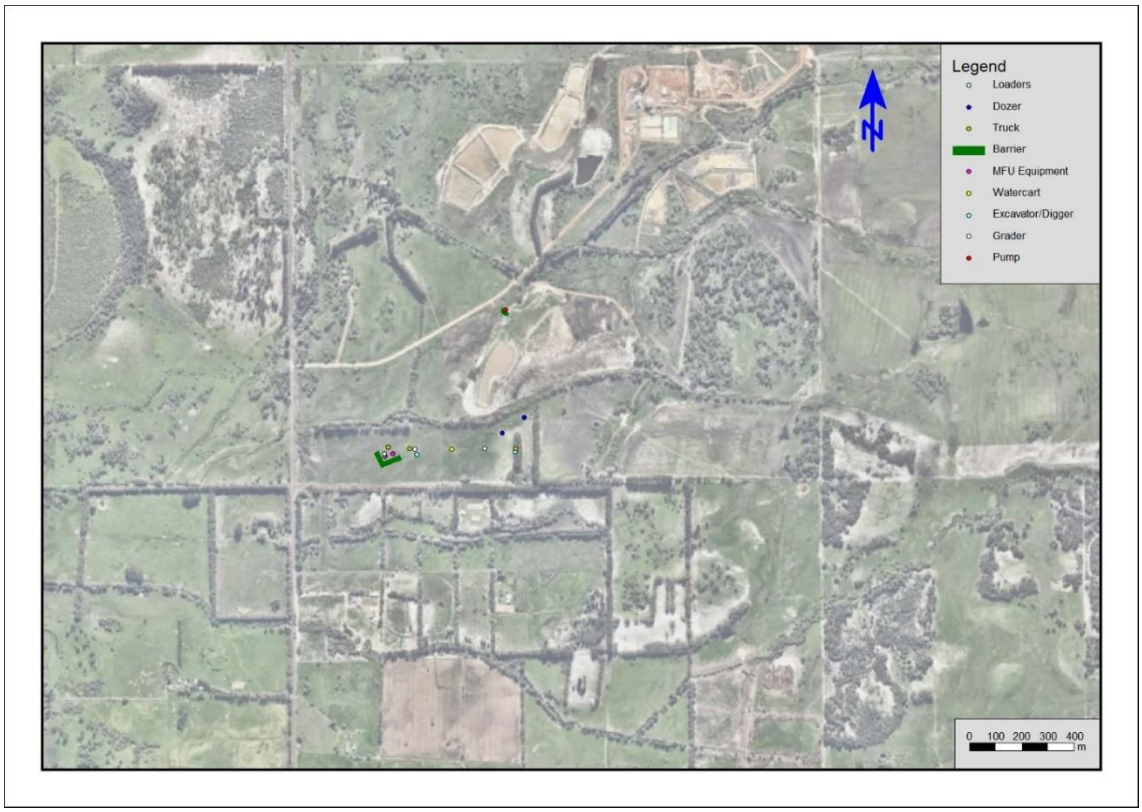

Figure A-7 – Noise Source Locations for Lot 20 Scenario

4.4 Equipment Sound Power Levels

Table 4-1 summarizes the sound power levels and numbers of items of equipment operating in each of the scenarios described in the preceding sections. Octave band sound power levels data and dates of measurement are provided in Appendix A.

Table 4-1 – Sound Power Levels and Numbers of Sources

Source	Overall Sound Power [dB(A)]	Number of Equipment Items Operating in Each Scenario						
		Lot 507	Lot 508	Lot 201	Lot 64	Lot 63	Lot 62	Lot 20
Minerals Processing Noise Sources								
JDM Feeder	97	2	2	2	2	2	2	1
Secondary Screen	100	2	2	2	2	2	2	1
CAT 988 Front-end Loader – high idle	108	2	2	2	2	2	2	1
Field pumps	102	5	4	4	2	1	1	1
Cyclone at WCP	106	1	1	1	1	1	1	1
Process/MFU Water Pumps at WCP	107	1	1	1	1	1	1	1
WCP Building	98	1	1	1	1	1	1	1
Deslime Cyclone Feed Pump at WCP	99	1	1	1	1	1	1	1
Rougher Feed Pump at WCP	99	1	1	1	1	1	1	1
Thickener Overflow Pump at WCP	97	1	1	1	1	1	1	1
Thickener HPU at WCP	88	1	1	1	1	1	1	1
Additional Sources Operating During Daytime								
CAT 390 Excavator – high idle	104	1	1	1	1	1	1	1
Komatsu PC1250 Excavator – high idle	109	1	1	1	1	1	1	1
CAT 988 Front-end Loader – high idle	108	1	1	1	1	1	1	1
CAT 745 Haul Truck – drive by	109	1	1	1	1	1	1	1
CAT 745 Haul Truck – high idle	105	1	1	1	1	1	1	1
CAT 745 Haul Truck – low idle	95	1	1	1	1	1	1	1
Komatsu GF655 Grader - grading	102	1	1	1	1	1	1	1
CAT 740 Water Cart – drive by	114	1	1	1	1	1	1	1
CAT D7 Dozer – drive by and dig	113	2	2	2	2	2	2	2

5 NOISE MODELLING RESULTS

Noise level predictions are presented below for all properties within the 2km zone surrounding the proposed operations for the scenarios described in Section 4.

Results presented in bold font indicate noise level predictions which exceed the Assigned Levels (when adjusted for tonality[6]) at the receptor. This is for information only, to highlight the most affected receptors. It is anticipated that all receptors within the 2km buffer zone will have noise amenity agreements and noise emissions will need to comply with the project noise limits defined in section 2.3.

Composite noise contours for daytime and night-time operations are also presented which represent the worst-case envelope derived from the individual scenarios. (Noise contours for each individual scenario are presented in Appendix B.)

5.1 Night-time Mineral Processing

Table 5-1 – Noise Level Predictions for Night-time Operating Scenarios

Receptor[7]	Predicted Noise Level for Night-time Operating Scenarios						
	Lot 507	Lot 508	Lot 201	Lot 64	Lot 63	Lot 62	Lot 20
4	24.7	23.5	23.3	24.9	24.0	26.5	23.9
5	26.8	24.7	24.1	24.4	22.8	26.1	22.1
6	26.8	24.8	24.2	24.5	22.9	26.3	22.2
7	**34.3**	29.3	26.9	23.8	24.5	22.3	18.8
8	15.8	15.8	15.8	20.2	23.3	24.6	27.9
9	**34.1**	29.7	27.1	24.4	24.0	21.9	18.4
10	**31.8**	28.9	28.7	**33.8**	**33.6**	**33.8**	28.5
11	**33.1**	28.9	28.5	**32.2**	**32.3**	29.8	25.3
12	**33.4**	29.1	28.6	**32.1**	**32.3**	29.6	25.1
13	**33.3**	28.9	28.6	**34.1**	**32.5**	**31.6**	26.8
14	19.8	19.8	19.8	23.1	26.1	28.1	**34.8**
15	14.6	14.6	14.6	14.6	23.4	23.1	26.4
16	16.3	16.3	16.3	21.5	24.5	24.5	28.6

[6] The values presented in the table have not been corrected for tonality.

[7] The locations of the receptors is shown in Figure A-1.

Receptor[7]	Predicted Noise Level for Night-time Operating Scenarios						
	Lot 507	Lot 508	Lot 201	Lot 64	Lot 63	Lot 62	Lot 20
17	19.6	19.6	19.6	23.0	26.6	27.2	**34.8**
18	12.1	12.1	12.1	12.1	21.4	22.6	21.4
19	13.1	13.1	13.1	13.1	22.2	23.5	22.4
25	16.7	16.7	16.7	20.6	24.9	27.1	25.6
28	13.3	13.3	13.3	13.3	22.4	23.9	22.4
31	17.5	17.5	17.5	21.0	25.0	27.8	25.4
32	15.0	15.0	15.0	15.0	23.2	25.3	25.0
60	**32.2**	28.9	26.3	24.9	22	19.9	16.7
61	26.5	24.5	22.9	20.2	20.2	19.1	15.9
62	**31.8**	**33.0**	**34.7**	26.7	23.5	20.4	17.3
66	27.9	27.7	23.8	22.2	19.7	18.1	15.1

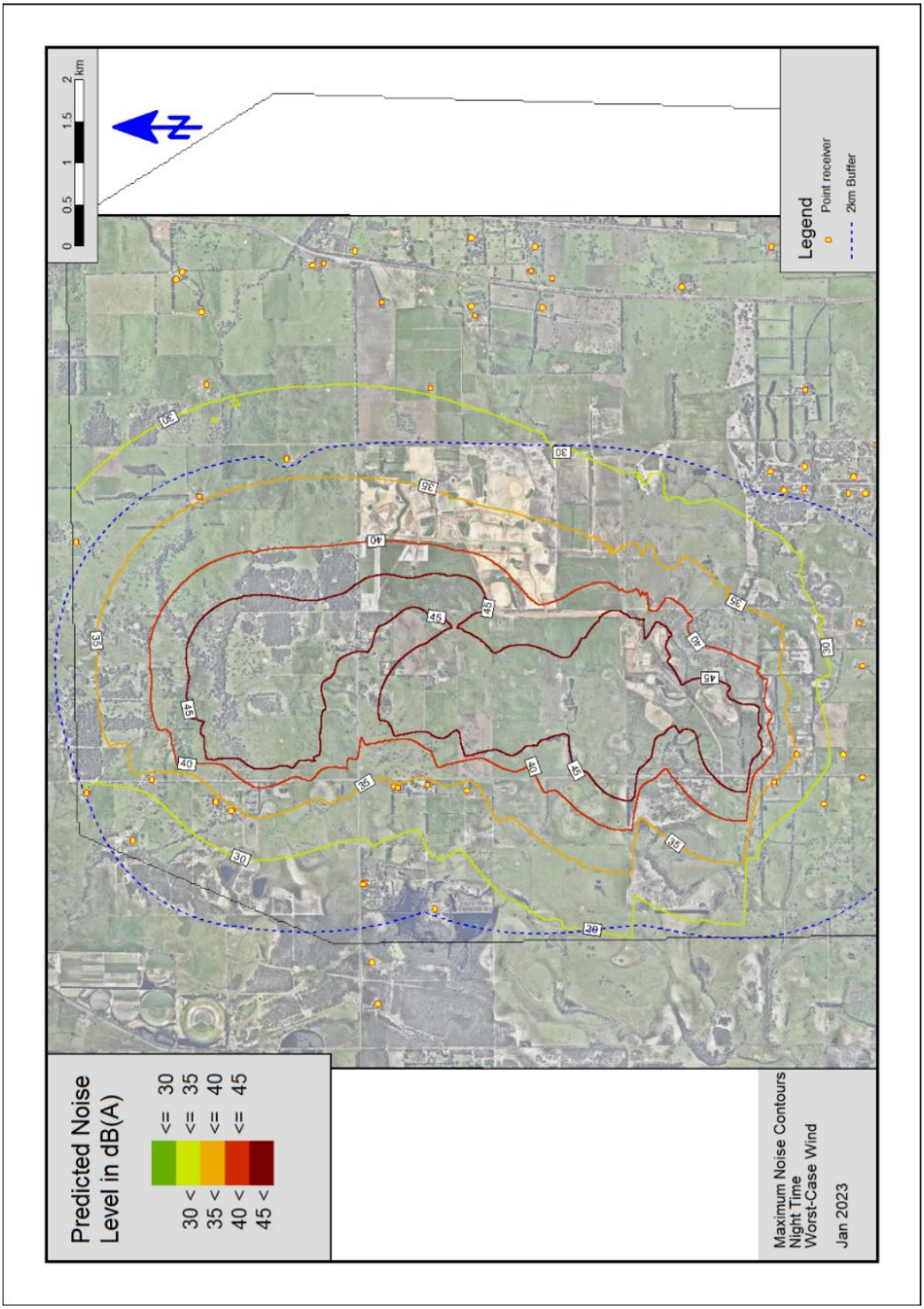

Figure A-1 – Composite Noise Contours for all Night-time Operating Scenarios

The results demonstrate that some receptors are likely to receive noise above the Assigned Levels. However, none are located beyond 2km and, therefore, predicted levels are below the project limits for all receptors with amenity agreements.

5.2 Daytime Mining & Mineral Processing

Table 5-2 – Noise Level Predictions for Daytime Operating Scenarios

Receptor[8]	Predicted Noise Level for Daytime Operating Scenarios						
	Lot 507	Lot 508	Lot 201	Lot 64	Lot 63	Lot 62	Lot 20
4	35.9	34.8	33.2	38.3	37.2	35.1	30.3
5	**40.3**	38.6	36.4	39.3	36.1	33.1	28.2
6	**40.3**	38.6	36.4	39.5	36.3	33.2	28.3
7	**49.2**	**46.2**	**43.0**	37.2	32.8	28.7	24.6
8	15.4	15.4	15.4	27.3	32.2	37.5	**44.9**
9	**49.1**	**46.3**	**43.3**	36.5	32.2	28.2	24.2
10	38.6	37.9	36.9	**48.2**	**47.6**	**41.5**	34.2
11	**43.6**	**42.2**	**40.5**	**49.3**	**43.2**	37.1	31.1
12	**44.0**	**42.6**	**40.8**	**49.4**	**42.9**	36.8	30.9
13	**41.2**	**40.3**	39.0	**50.0**	**45.6**	39.0	32.5
14	19.4	19.4	19.4	30.6	35.1	**41.5**	**49.7**
15	14.2	14.2	14.2	14.2	30.9	35.7	**43.5**
16	16.0	16.0	16.0	26.2	32.0	37.2	**46.2**
17	19.3	19.3	19.3	30.0	34.4	**40.4**	**51.8**
18	11.7	11.7	11.7	11.7	28.0	32.0	38.6
19	12.7	12.7	12.7	12.7	28.8	33.0	39.9
25	16.3	16.3	16.3	20.3	31.3	35.9	**44.0**
28	12.9	12.9	12.9	12.9	28.7	32.9	39.9
31	17.0	17.0	17.0	20.6	31.2	35.6	
32	14.5	14.5	14.5	14.5	29.5	32.8	38.0
60	**44.9**	**43.4**	**41.7**	33.7	29.6	26.0	22.4
61	**40.7**	39.1	37.4	31.5	28.1	25.0	21.6
62	37.4	38.4	**40.6**	32.9	29.5	25.9	22.8
66	39.4	38.6	37.4	30.5	37.2	23.9	20.4

[8] The locations of the receptors are shown in Figure A-1

Figure A-1 – Composite Noise Contours for all Daytime Operating Scenarios

The results demonstrate that some receptors are likely to receive noise above the Assigned Levels. However, none are located beyond 2km and, therefore, predicted levels are below the project limits for all receptors with amenity agreements.

6 SUMMARY OF NOISE MITIGATION REQUIREMENTS

The noise mitigation requirements assumed in the noise modelling described above, and which are required to demonstrate compliance with the project noise limits, are summarised below.

The mitigation measures relate to the implementation of noise bunds and barriers, and the number of MFUs running simultaneously. No specific noise management measures are required for mobile equipment (other than not exceeding the sound power levels and numbers of equipment items operating simultaneously assumed in the modelling scenarios).

Table 6-1 Noise Mitigation Measures

Equipment	Mitigation Included in Noise Modelling
Mobile Screening Plants	• 8m high L-shaped noise bunds oriented to attenuate sound propagation towards the nearest affected receptors and spaced no more than 15m from the screening plant. • Only 1 screening plant to be used for operations within 700m of receptors 14 and 17. (Lot 20 Scenario).
Field Pumps	• 2.8m noise barriers spaced 6m from pumps and oriented to attenuate sound propagation towards the nearest affected receptors[9].

[9] Barrier heights and locations can be optimised to achieve compliance. For example, lower height barriers could be specified if they are installed closer to the pumps.

7 CONCLUSIONS

The noise modelling results presented in this report demonstrate that mining and rehabilitation operations can be undertaken within in the western areas while maintaining compliance with the project noise limits for all receivers with amenity agreements within the 2km buffer zone surrounding the mining operations. Compliance was demonstrated assuming implementation of the following noise mitigation measures:

- Noise bunds at mobile screening plants oriented to attenuate sound propagation towards the nearest affected receptors.
- Only 1 screening plant to be used for operations within 700 m of receptors 14 and 17.
- Noise barriers at field pumps oriented to attenuate sound propagation towards the nearest affected receptors.

No specific noise management measures are required for mobile equipment (other than not exceeding the sound power levels and numbers of equipment items operating simultaneously assumed in the modelling scenarios).

Predicted noise levels do not exceed the Assigned Levels at any receptors beyond the 2km buffer zone surrounding the mining operations.

Mineral processing can be undertaken at all times; however, mining operations are restricted to weekdays (Monday to Saturday)[10] only.

[10] Weekday: 0700 to 1900 hours Monday to Saturday, excluding public holidays.

APPENDIX A MODEL SOUND POWER LEVELS

Equipment Type	Description	Overall Sound Power [dBA]	1/1 Octave Band Sound Power Level [dB(L)]										Operating Conditions / Comment
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Date	
Minerals Processing Noise Sources													
Mobile Screen	JDM Feeder	97	107	112	99	95	93	92	87	86	78	10/05/2022	Normal Operating Condition
Mobile Screen	Secondary Screen	100	107	112	105	99	97	94	92	89	88	10/05/2022	Normal Operating Condition
Front-end Loader At Mobile Screen	CAT 988	108	103	111	118	101	103	104	99	92	93	05/08/2021	High Idle
Field Pump	Pioneer Diesel Pump	102	100	113	116	103	97	92	88	84	76	03/07/2019	Normal Operating Condition
Cyclone	Wet Concentrator Plant	106	103	104	101	100	98	98	99	99	97	4/11/2016	Normal Operating Condition
Process / MFU Water Pumps	Wet Concentrator Plant	107	96	94	103	93	102	103	100	97	88	4/11/2016	Normal Operating Condition
WCP Building	Wet Concentrator Plant	98	107	114	104	101	91	91	89	88	85	13/12/2016	Normal Operating Condition
Deslime Cyclone Feed Pump	Wet Concentrator Plant	99	99	98	94	95	92	94	92	93	85	4/11/2016	Normal Operating Condition
Rougher Feed Pump	Wet Concentrator Plant	99	100	101	98	95	94	93	91	90	88	4/11/2016	Normal Operating Condition

Equipment Type	Description	Overall Sound Power [dBA]	1/1 Octave Band Sound Power Level [dB(L)]										Operating Conditions / Comment
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Date	
Thickener Overflow Pump	Wet Concentrator Plant	97	97	95	93	90	90	93	89	88	86	4/11/2016	Normal Operating Condition
Thickener HPU	Wet Concentrator Plant	88	84	86	83	83	84	84	81	77	72	4/11/2016	Normal Operating Condition
Additional Sources Operating During Daytime													
Excavator	CAT 390	104	99	119	110	99	99	98	98	91	89	05/08/2021	High Idle
Excavator	Komatsu PC1250	109	106	115	115	107	108	104	100	95	90	03/07/2019	High Idle
Haul Truck	CAT 745	109	108	122	109	109	106	104	101	95	90	05/08/2021	Drive by
Haul Truck	CAT 745	105	103	-	111	100	100	102	97	89	84	05/08/2021	High Idle
Haul Truck	CAT 745	95	110	108	93	88	91	92	88	80	72	05/08/2021	Low Idle
Grader	Komatsu GF655	102	95	99	114	102	99	95	91	86	78	02/07/2019	Grading
Water Cart	CAT 740	114	109	118	111	108	110	108	108	102	95	05/08/2021	Drive by
Dozer	CAT D7	113	105	104	119	112	111	108	104	101	98	14/02/2018	Drive by and dig

APPENDIX B NOISE CONTOURS

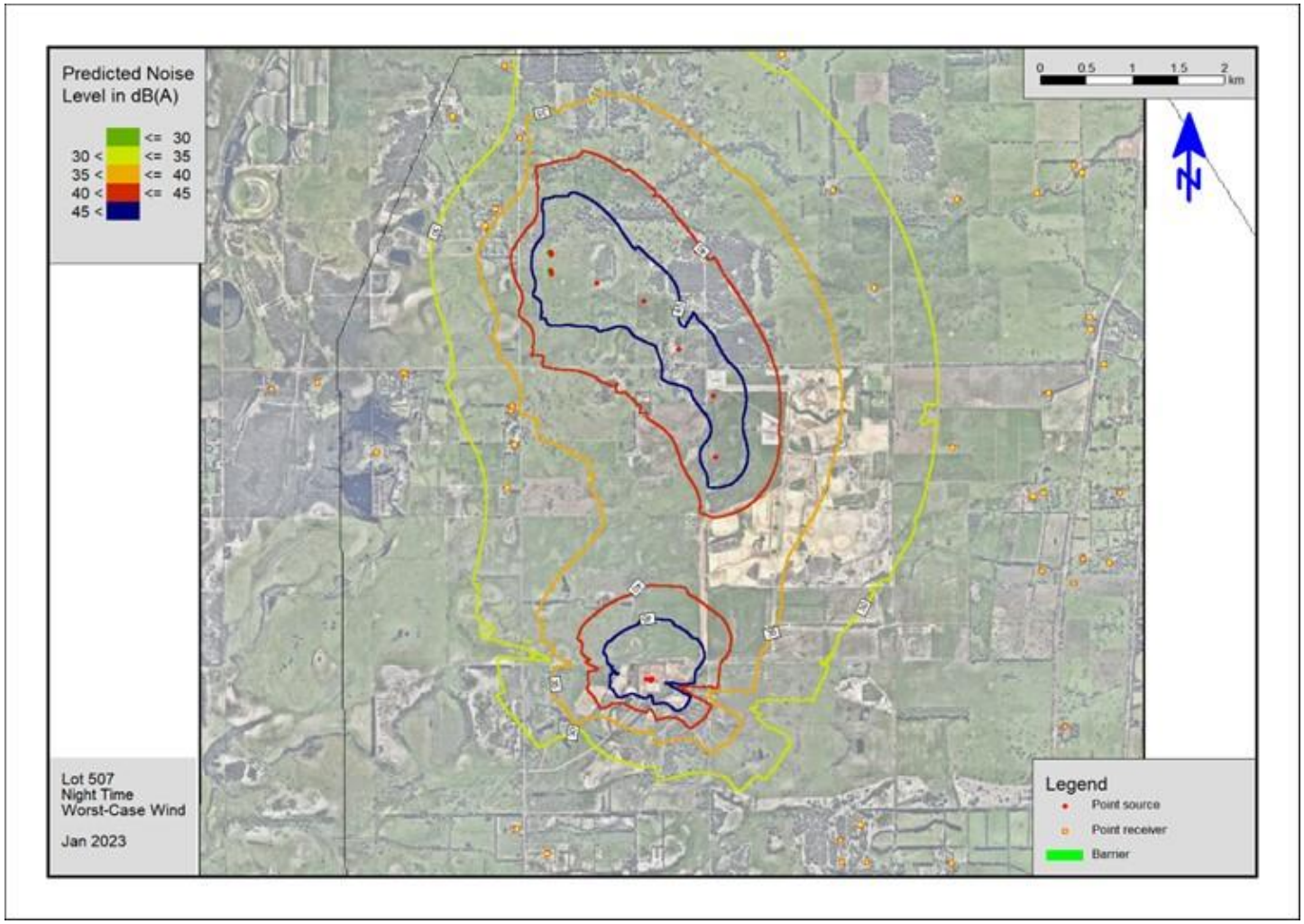

Figure B-1 – Night-time contours for Lot 507

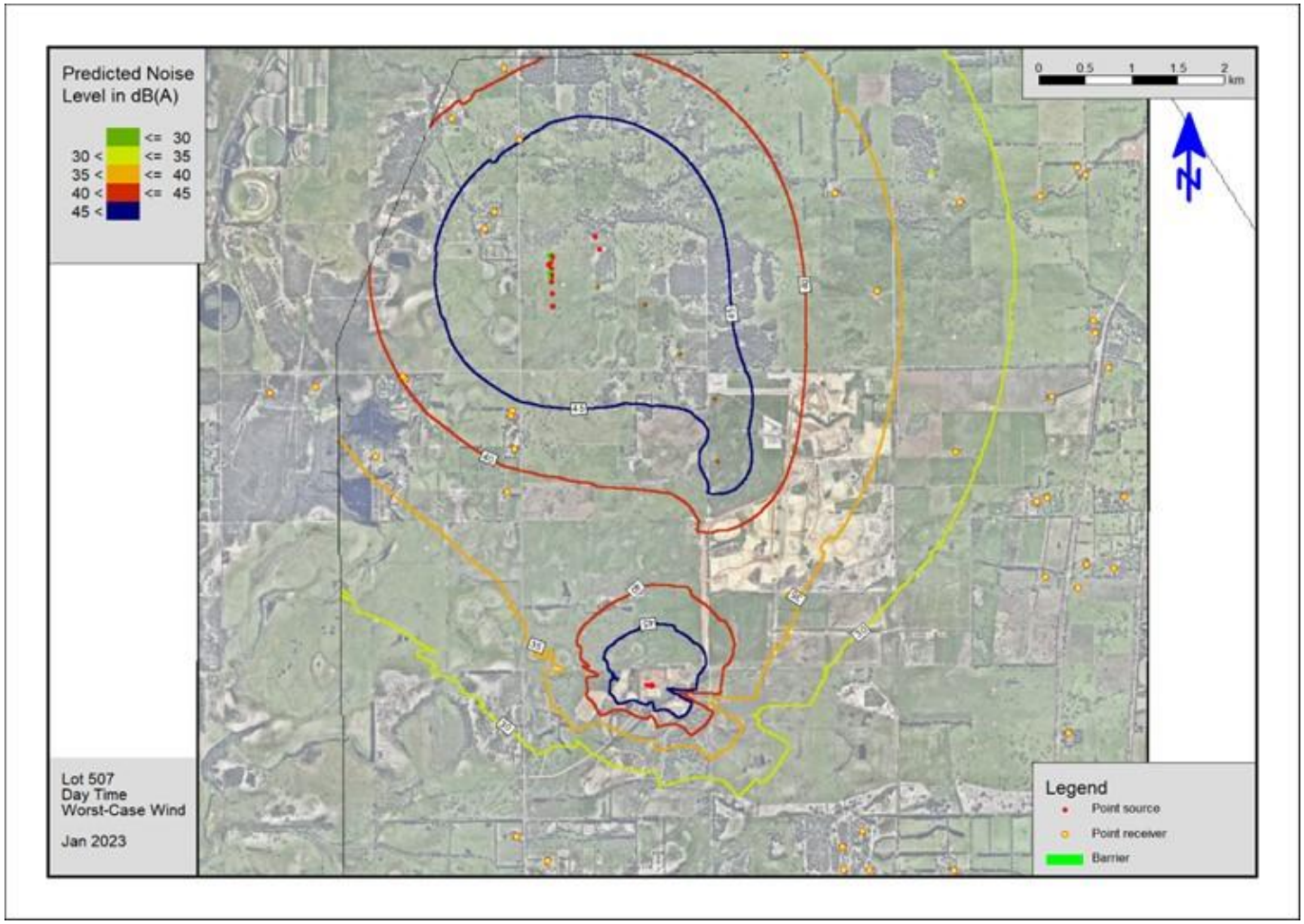

Figure B-2 – Daytime Contours for Lot 507

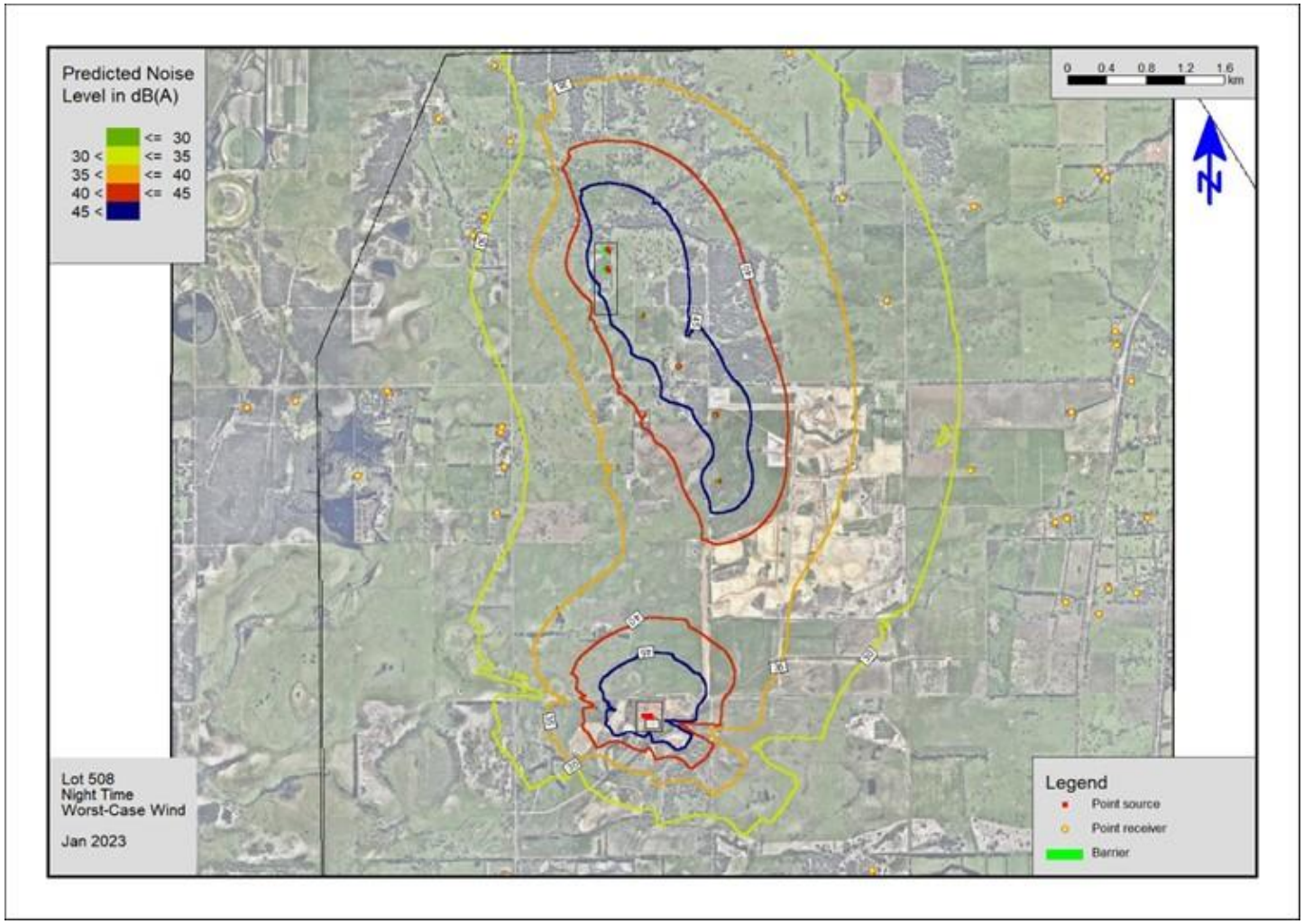

Figure B-3 – Night-time contours for Lot 508

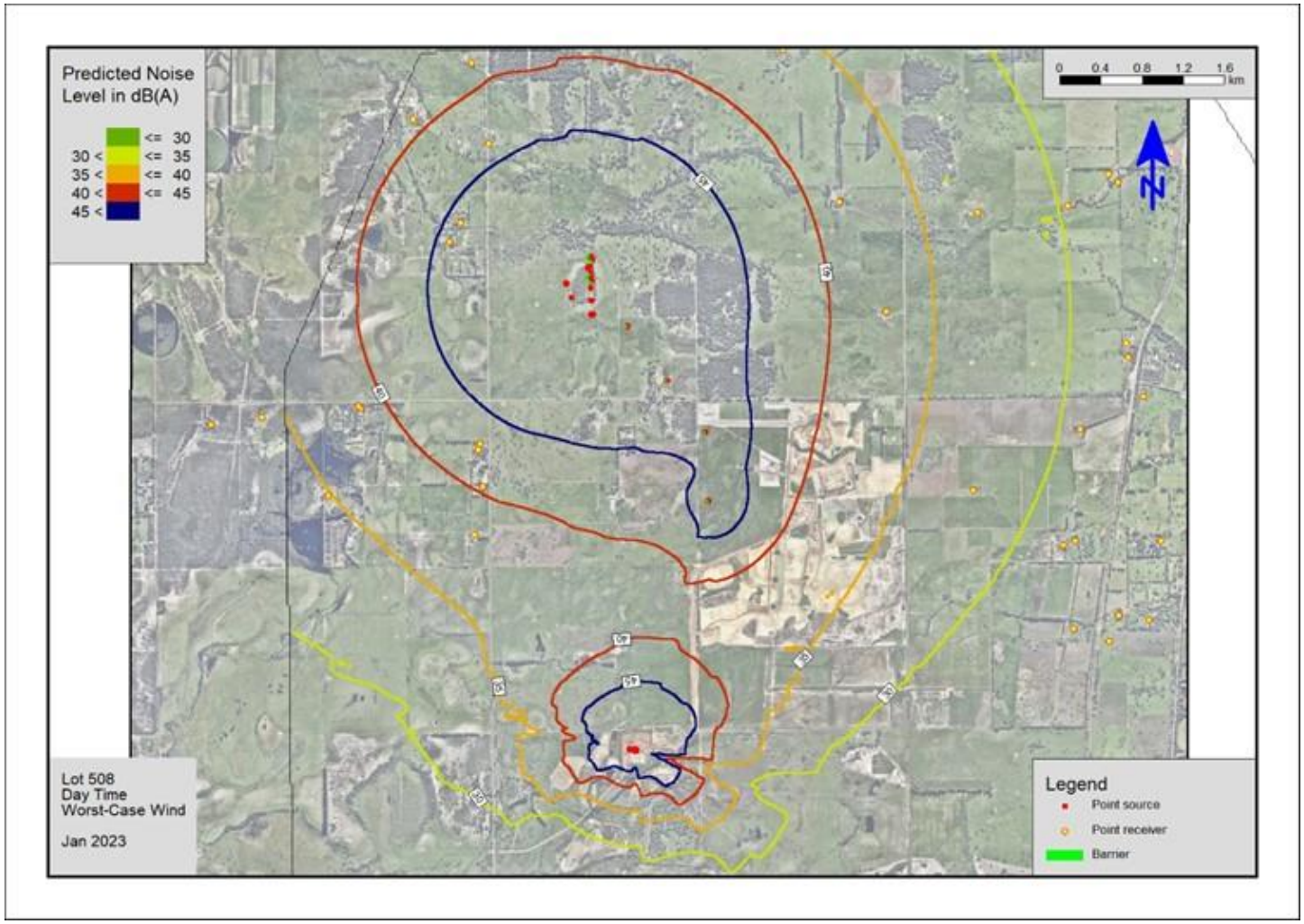

Figure B-4 – Daytime Contours for Lot 508

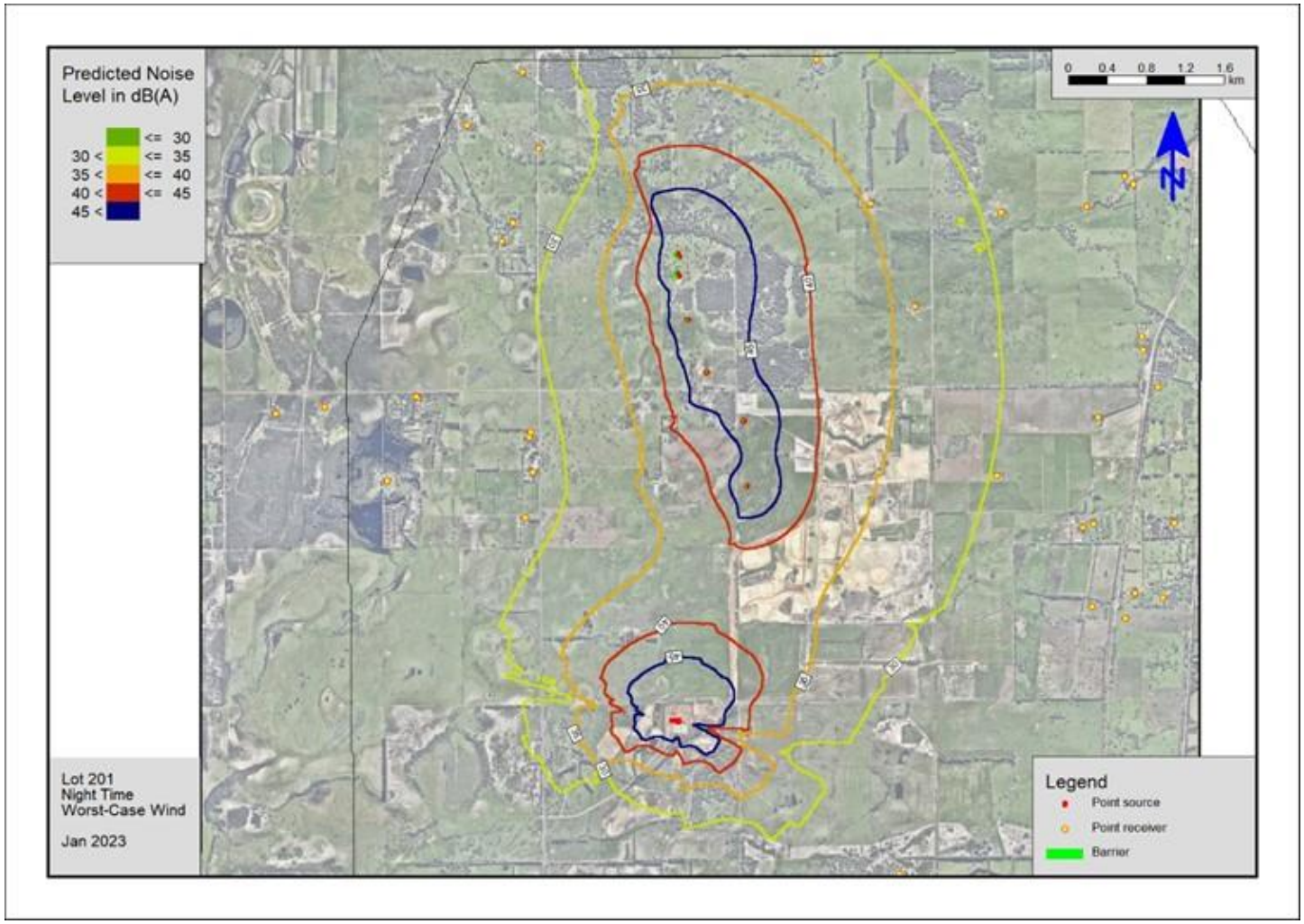

Figure B-5 – Night-time Contours for Lot 201

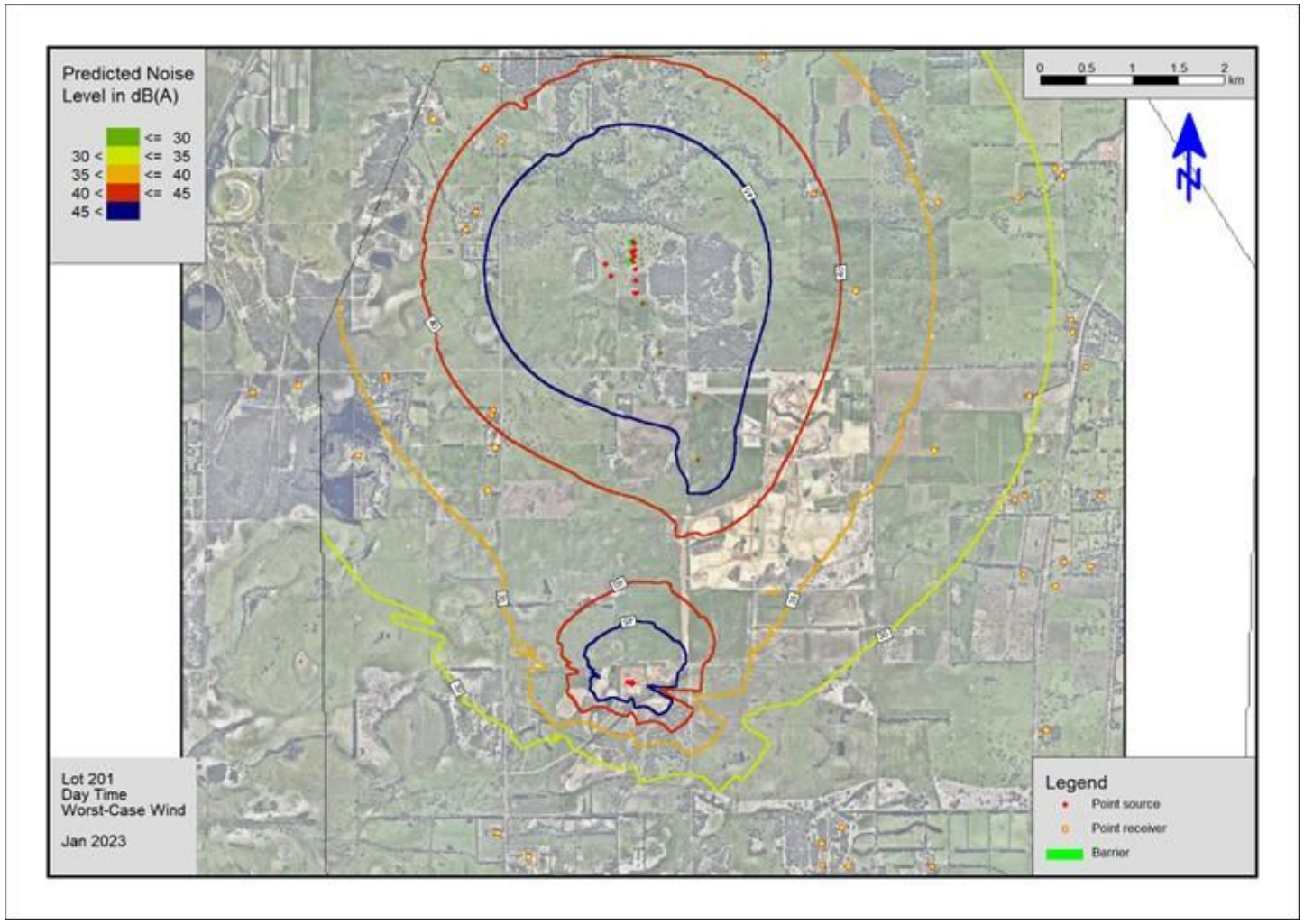

Figure B-6 – Daytime Contours for Lot 201

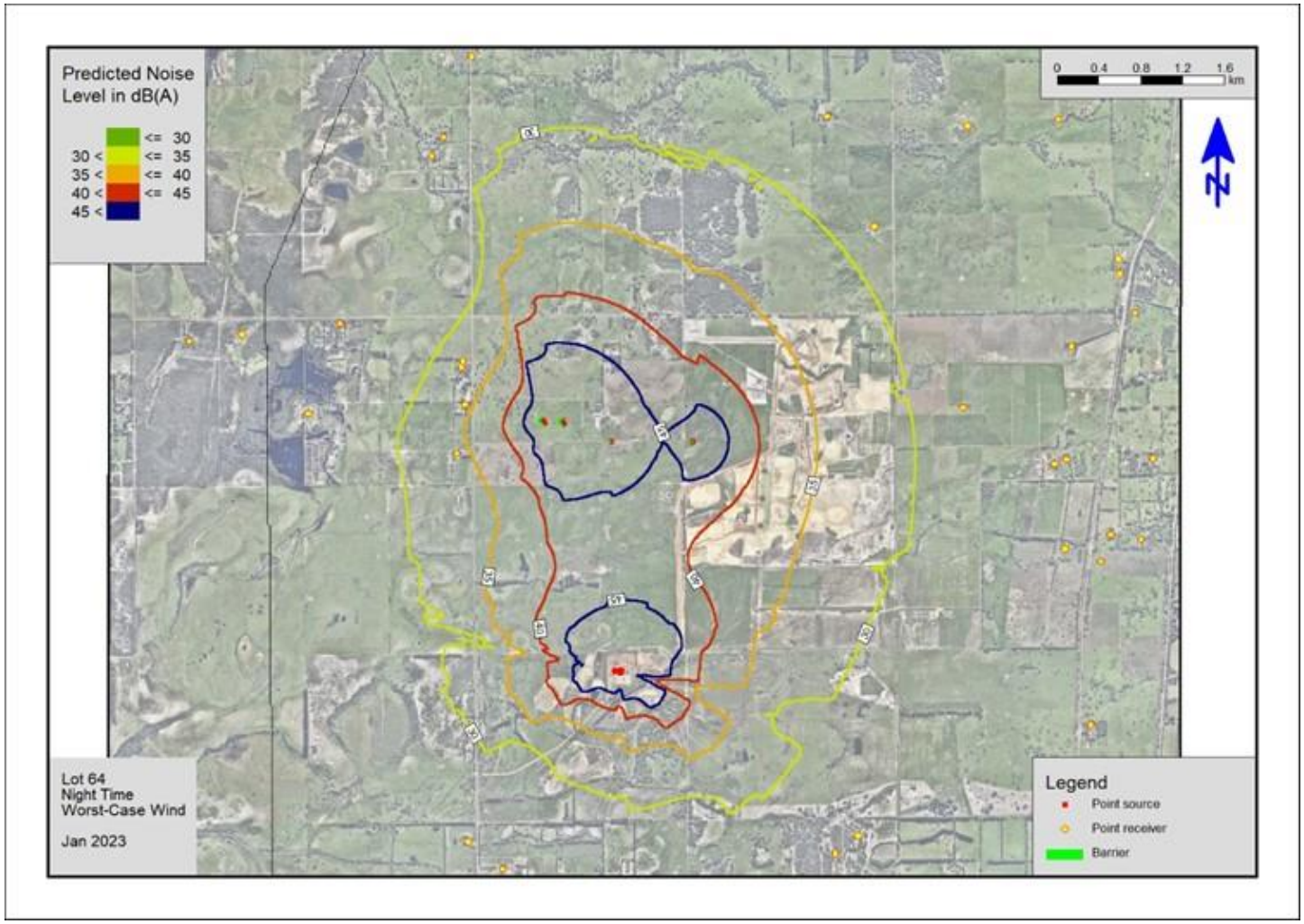

Figure B-7 – Night-time contours for Lot 64

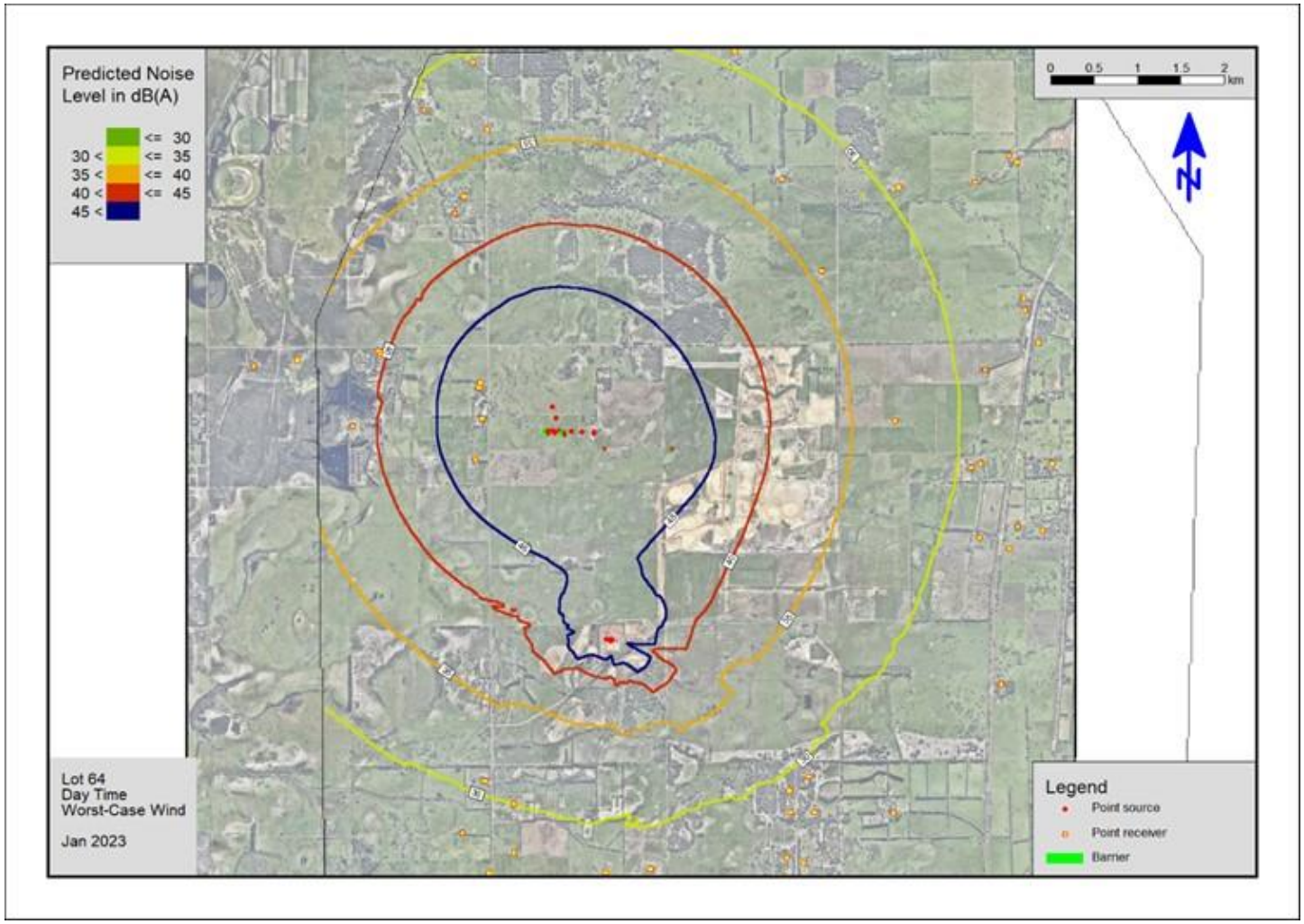

Figure B-8 – Daytime Contours for Lot 64

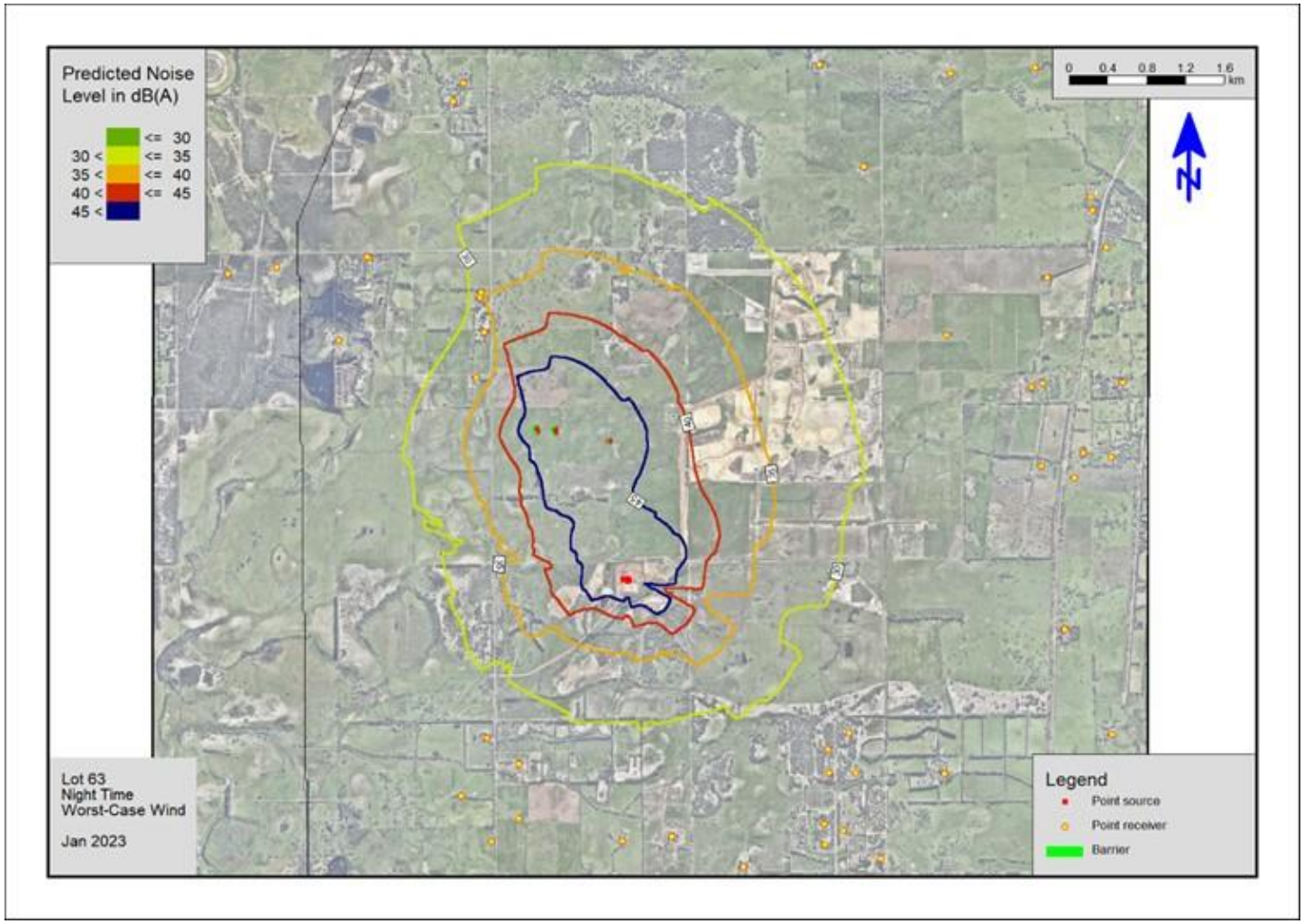

Figure B-9 – Night-time contours for Lot 63

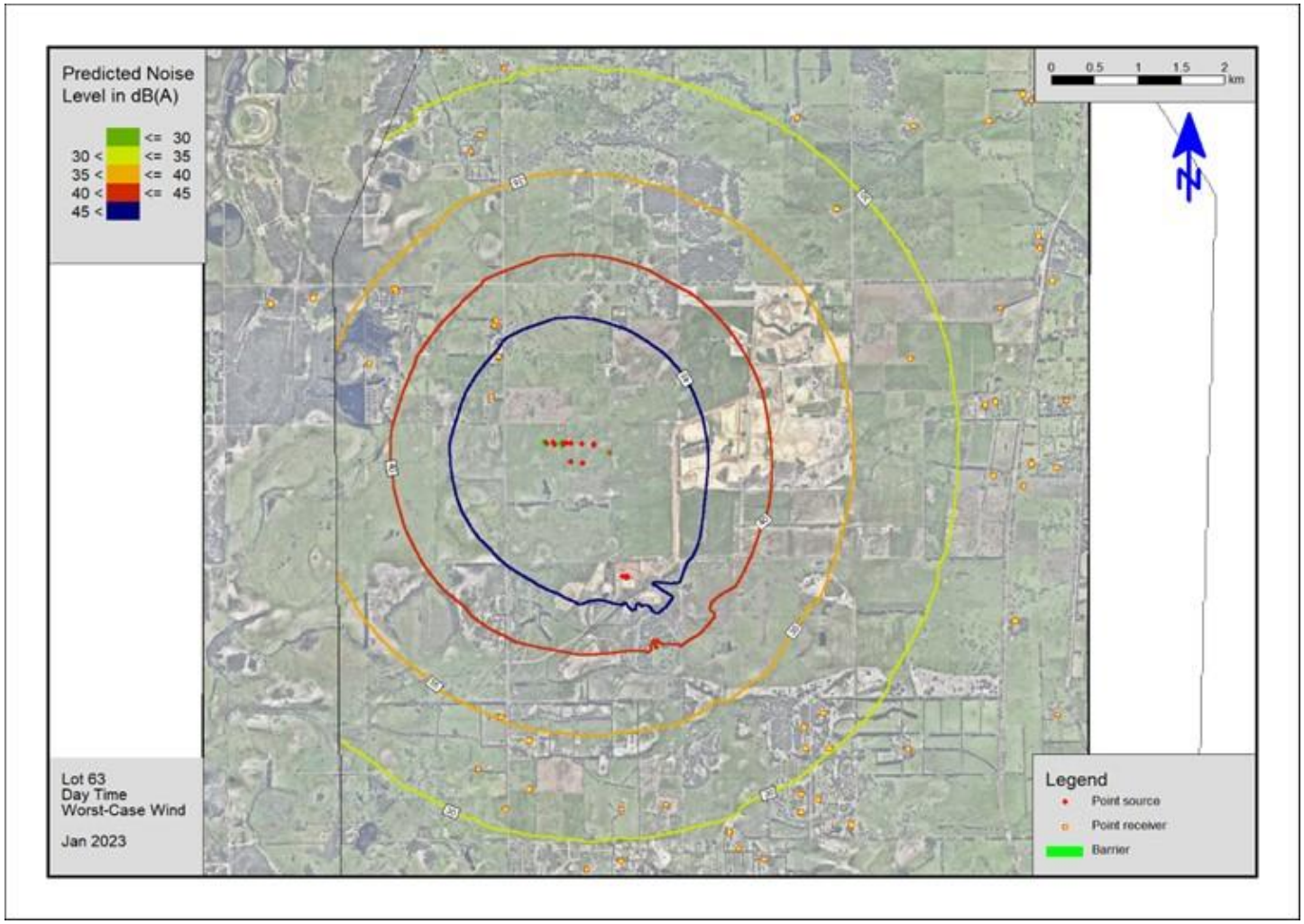

Figure B-10 – Daytime Contours for Lot 63

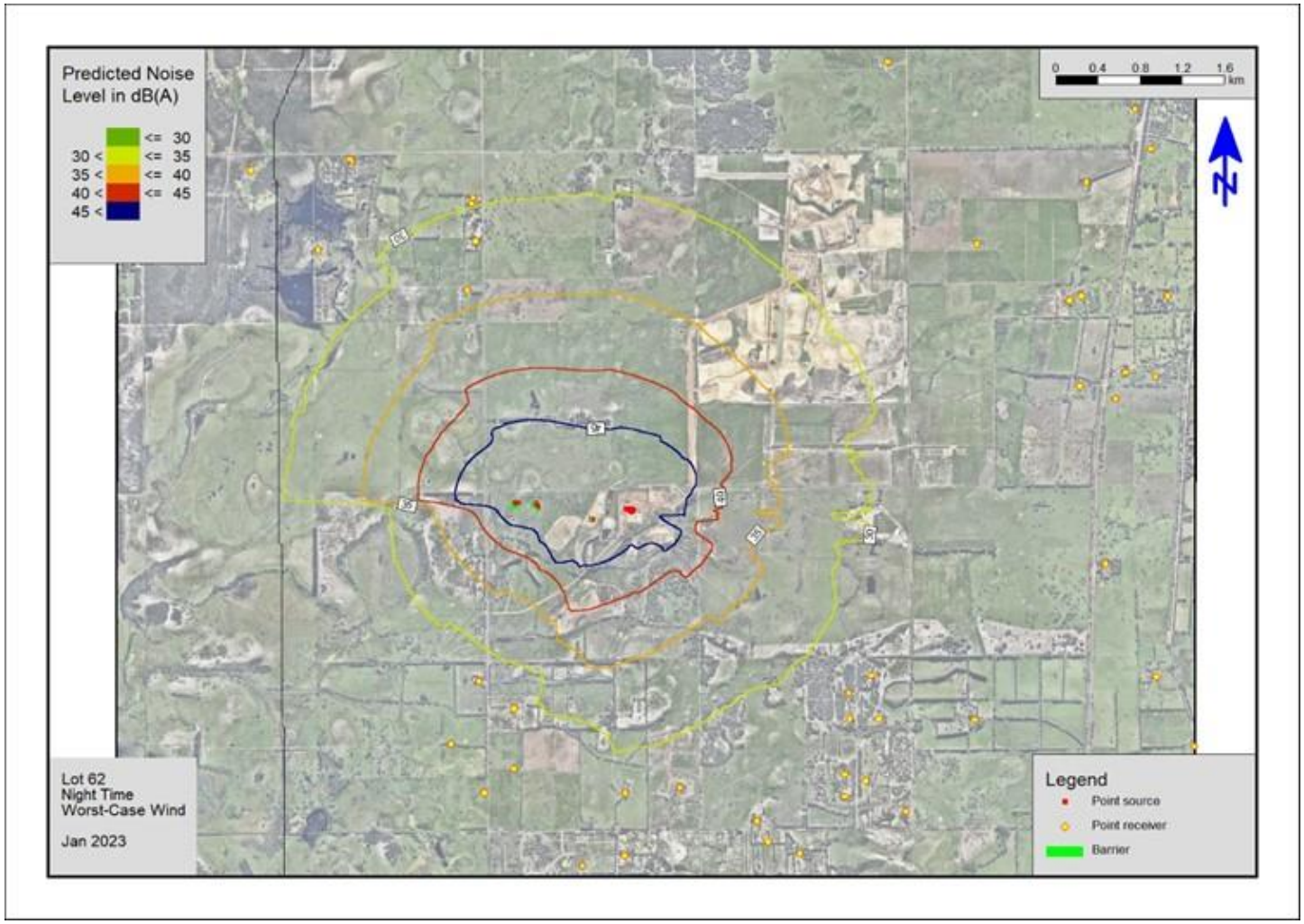

Figure B-11 – Night-time contours for Lot 62

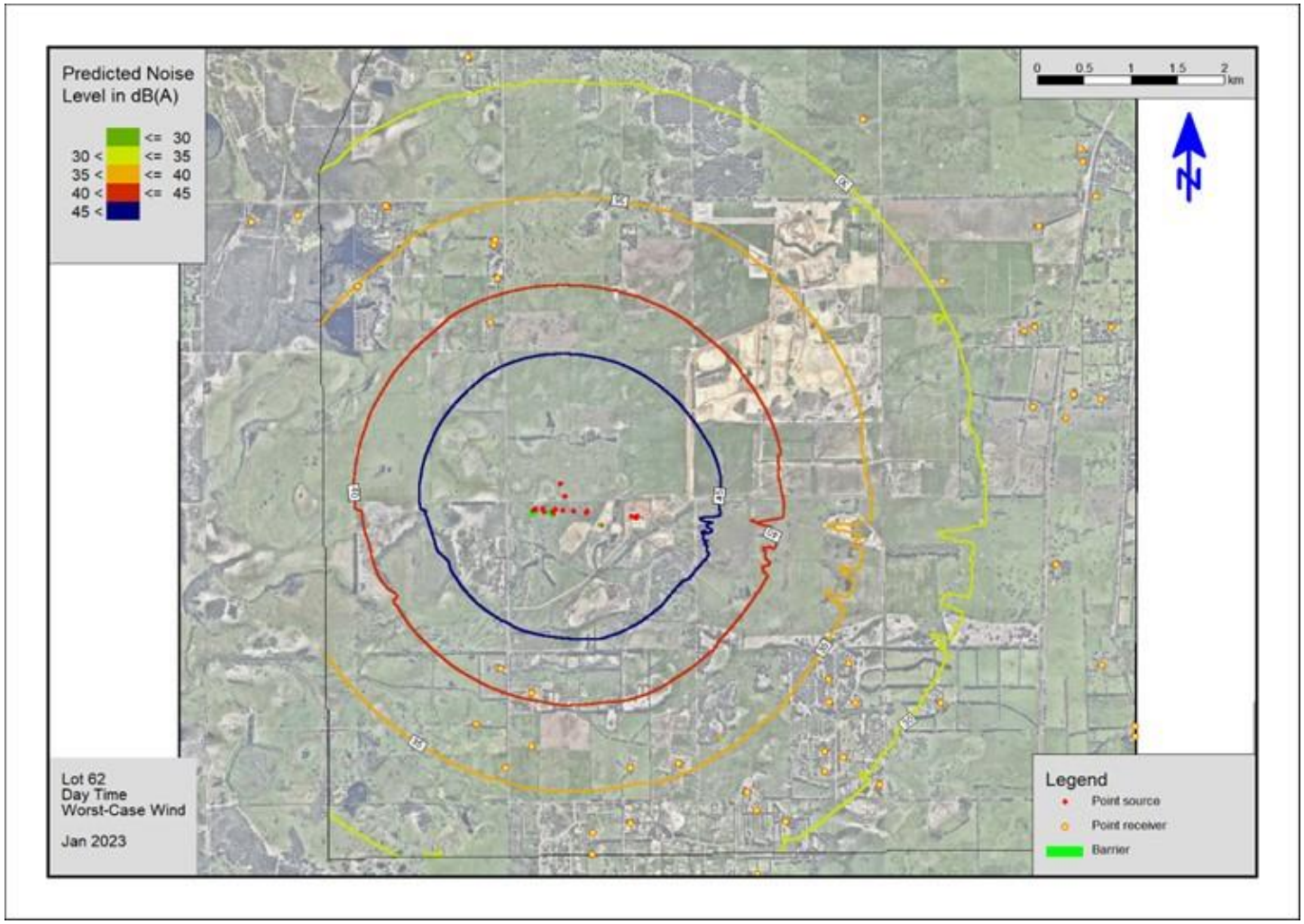

Figure B-12 – Daytime Contours for Lot 62

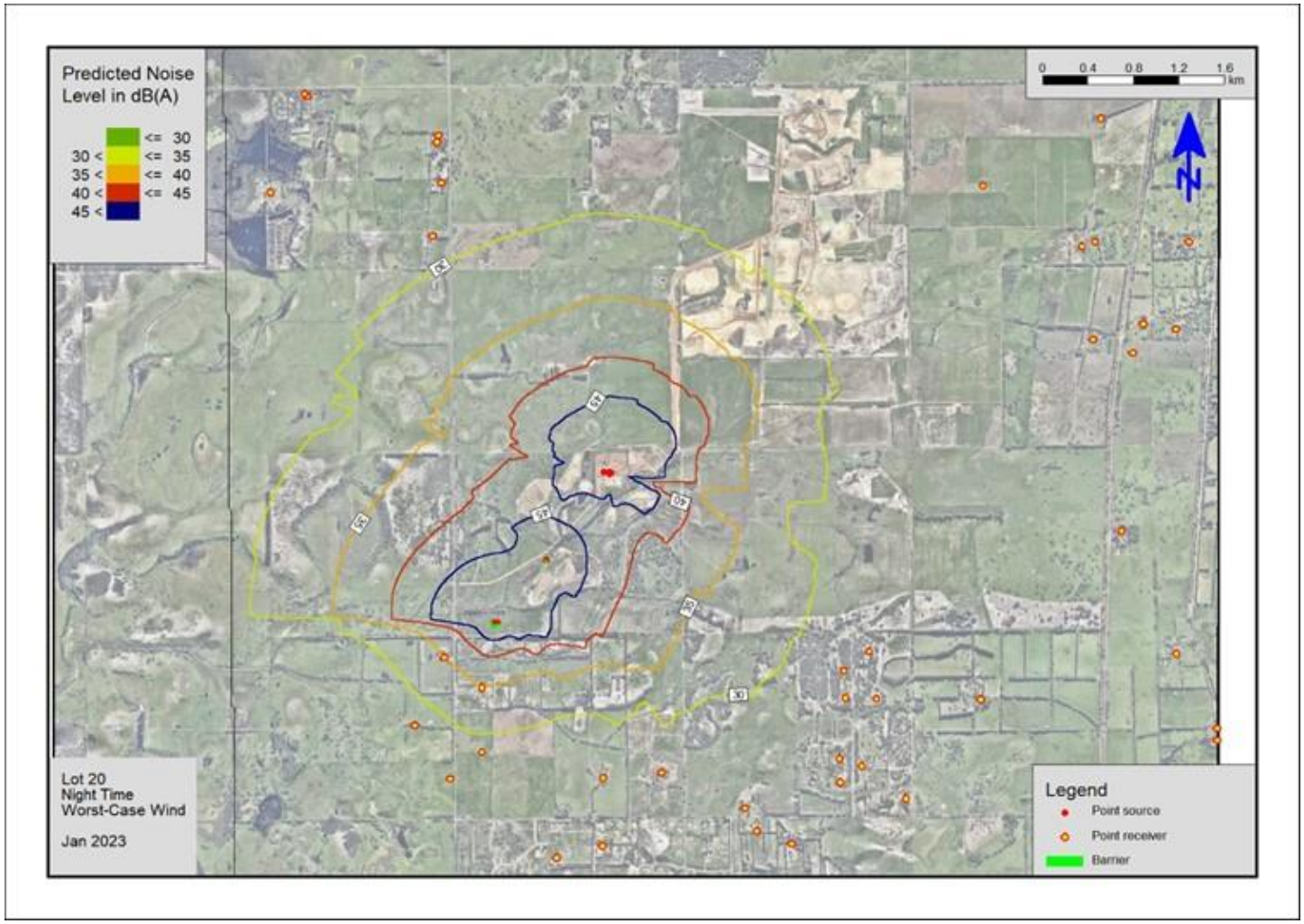

Figure B-13 – Night-time contours for Lot 20

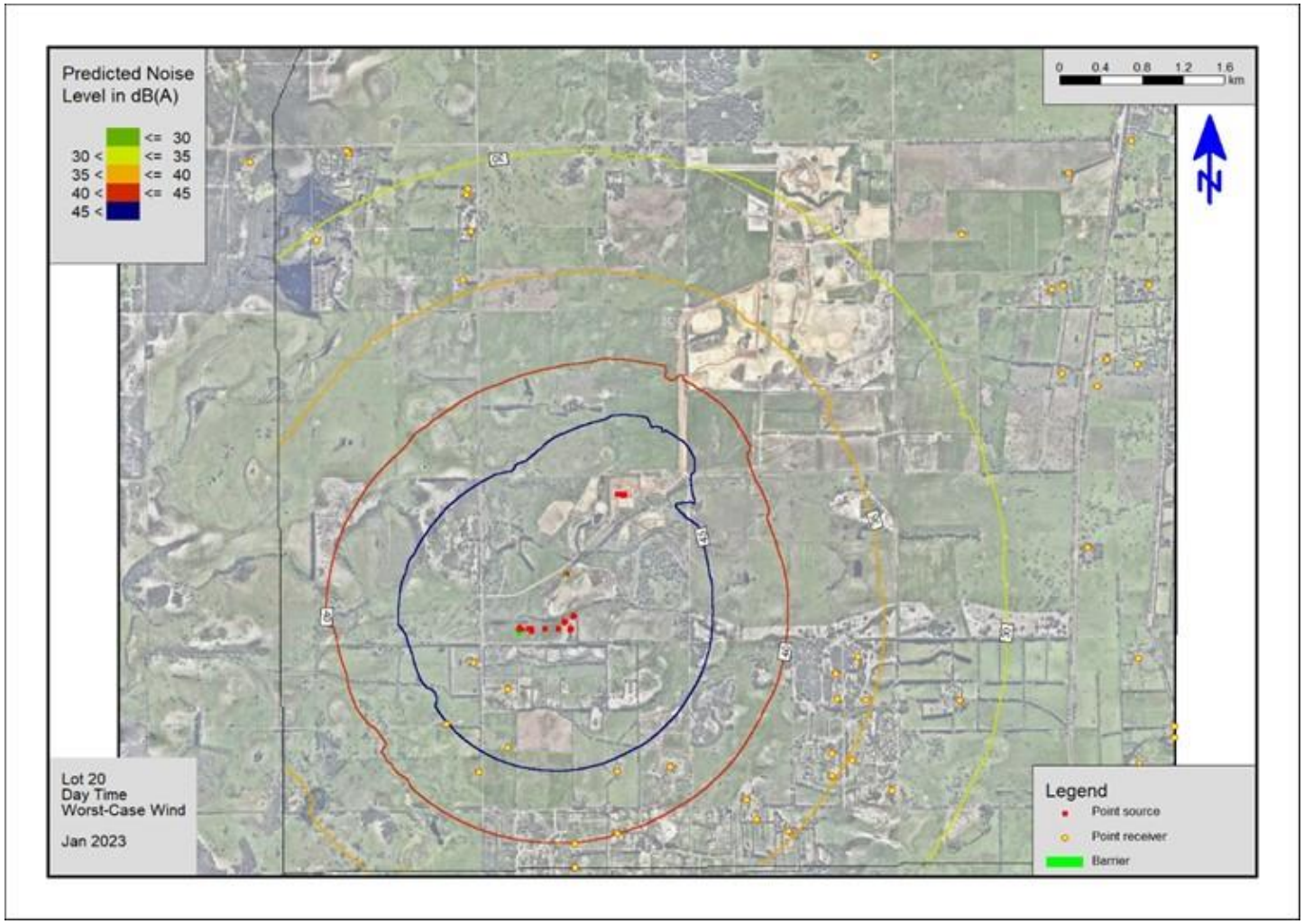

Figure B-14 – Daytime Contours for Lot 20