East Pilbara Generation Hub and Pilbara Transmission Project 6: Environmental Noise Assessment

Prepared for Fortescue

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Executive Summary

This report is a summary of an environmental noise assessment for the East Pilbara Generation Hub (EPGH) and the Pilbara Transmission Project 6 (the Project). The Project includes the construction and operation of up to 200 wind turbines that will be used to generate power for the Iron Bridge mine located approximately 100km from the wind farm.

The aim of this study is to quantify the potential noise impacts from the Project's construction activities and wind farm operations on surrounding areas including and cultural points of interest, during construction and operation of the wind farm.

The findings of the noise study are as follows:

Construction activities:

- The noisiest construction activity modelled is clearing/earthworks.
- The model predicts that construction noise levels at locations NM3 and NM4 will be higher than the LA90 background noise level that was measured to be between 33 and 38 dB(A). As a result, the construction activities will be audible at the monitoring locations. Additionally, the modelling results also show that the predicted levels at NM3 and NM4 are higher than the noise target levels for Ethnographic Places of Interest (see section 2.3.4).
- As construction activities are spread over a wide area, the higher levels at NM3 and NM4 only occur when construction is being undertaken close to those locations. A mitigation approach that could therefore be adopted is to limit construction activities to locations further from NM3 and NM4 when they are being used by Traditional Owners.

Wind farm operations:

- The predicted received levels are higher than the noise target at locations NM3 and NM4 for WTG hub-height wind speeds ≥5m/s[1]. The predicted received levels are below the noise target at location NM2 for all windspeeds.

- The hub-height wind speeds when translated to 10m above ground vary between 2.2 and 6m/s. It is recognised that at the higher windspeeds (i.e. > 4m/s @ 10m) localised noise generated by the wind as it moves through the foliage will increase. As a result, background noise will be higher and potentially mask noise from the WTG's.

- For the lower windspeeds (i.e. between 2.2 and 4m/s @10m) where localised background noise sources are not likely to mask WTG noise, a mitigation approach that could be considered is to feather the blades of nearby WTG's (i.e. so they are no longer operational) when the area is being used by Traditional Owners.

[1] WTG hub-height wind speed 5m/s= 2.2m/s @10m

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Definitions, Abbreviations and Acronyms

	Description
Definitions	
Point of interest	A place / area of potential cultural or other interest that may be impacted by noise generated from the proposed development.
Decibel or dB	The unit of measurement for noise
Decibel A-weighted or dB(A)	Decibel or dB is the unit of measurement for noise, and "A" weighting represents the hearing bandwidth and capability of humans.
Noise sensitive receiver	A premises defined as noise sensitive in the Environmental Protection (Noise) Regulations 1997.
Noise sensitive area	An area visited where a noise value activity is undertaken.
Noise sensitive activity	An activity which has the potential to be affected by high noise levels. For Native Title Stakeholders, this may include traditional activities such as camping, hunting, and ceremonial use.
Acronyms and Abbreviations	
AS	Australian Standard
CONCAWE	Conservation of Clean Air and Water in Europe
dB	Decibel
dB(A)	Decibel A-weighted
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
IF	Influencing Factor
ISO	International Standardisation Organisation
Km	Kilometre
m	metre
DE	Development Envelope
PSC	Pasquill Stability Class
SA	Study Area
SLM	Sound Level Meter
SWL	Sound Power Level
UTM	Universal Transverse Mercator

1 Introduction

This report is a summary of an environmental noise assessment for the East Pilbara Generation Hub (EPGH) and the Pilbara Transmission Project 6 (the Project), which involves the construction and operation of up to 200 wind turbines that will supply power to the Iron Bridge mine.

1.1 Aim

The aim of this noise study is to quantify the potential noise impacts from the Project's construction activities and wind farm operations on surrounding areas including towns, mine camps and cultural points of interest/ethnographic places, during construction and operations phases of the Project.

1.2 Operations Overview

Pilbara Energy (Generation) Pty Ltd, a wholly owned subsidiary of Fortescue Limited (Fortescue), are proposing to construct and operate a wind farm which will supply power to the Iron Bridge mine located approximately 100 km away. The wind farm will include the following elements:

- Up to 200 Wind Turbine Generators (WTG's) and power line infrastructure to transfer power to Iron Bridge.
- Construction including wind turbine and construction camp (loudest activities include clearing, earthworks) .
- Wind farm operations.

1.3 Receivers

The Project's wind farm is in a remote area of Western Australia, approximately 40 km from the nearest noise Sensitive Receivers (as defined in the Environmental Protection (Noise) Regulations 1997) at Marble Bar (40 km) and Nullagine (60 km). Figure 1-1 shows the location of the Sensitive Receivers and Points of Interest (POI's) used in the study.

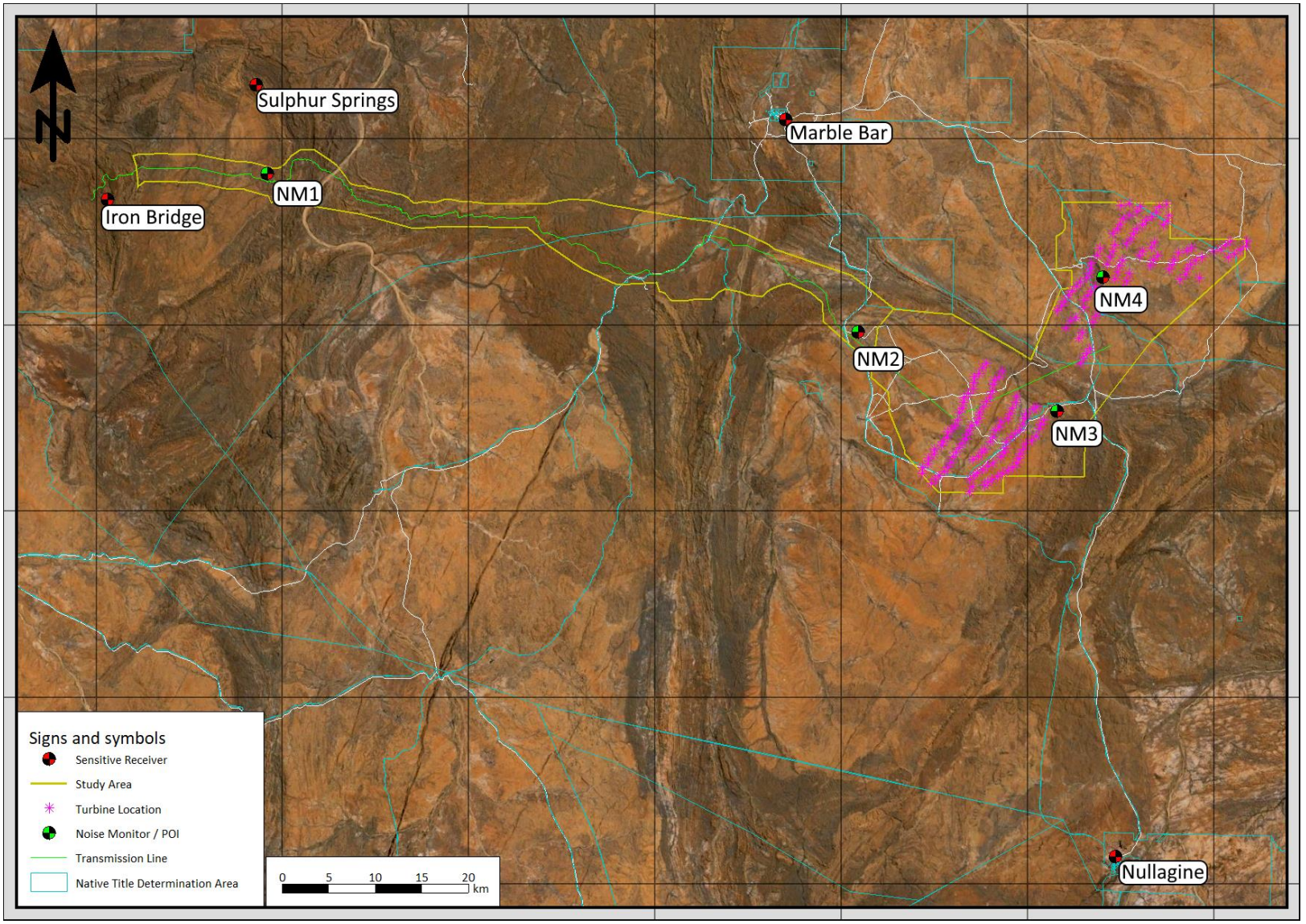


Figure 1-1 Sensitive Receiver and Noise Monitoring Sites

1.4 Noise Level Overview

Noise is measured using a decibel (dB) scale which makes it a non-linear number. This means that every 3 dB is a doubling of acoustic energy (for example 10 dB + 10 dB = 13 dB). The measured levels are quoted as dB(A) which means it is an A-weighted decibel value. The A-weighting is necessary as the human ear does not hear all frequencies equally well and the A-weighting is used to simulate the human ear so that the number provided is similar to what a person will hear.

Hearing sound at 70 to 75 dB(A) is equivalent to someone shouting at 1m from your ear, 60 to 65 dB(A) is equivalent to someone speaking at 1 m from your ear and 30 to 35 dB(A) is equivalent to someone whispering at 1 m from your ear (see Figure 1-2 for some additional examples).

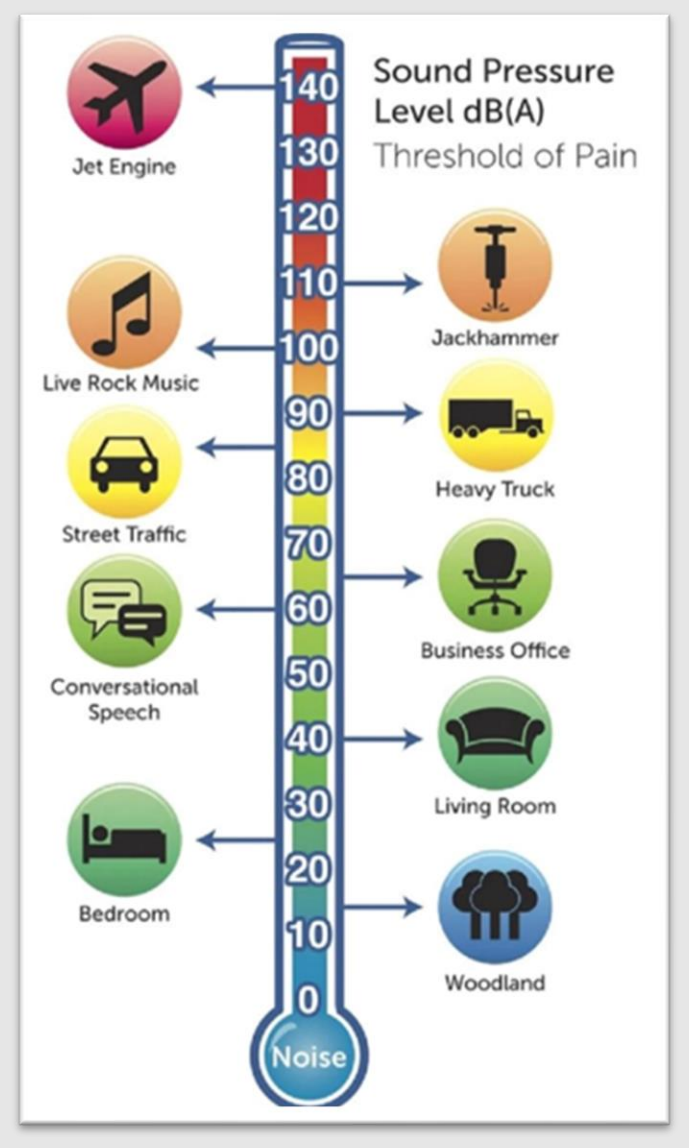


Figure 1-2 Noise Thermometer

2 Assessment Criteria

2.1 Overview of Applicable Regulatory Documents

Table 2-1 presents the Regulatory documents that have been considered for determining applicable noise threshold levels for the impact assessment.

Table 2-1 Applicable Documents

Ref	Document Name	Application
[1]	*Environmental Protection Act 1986*	The Act defines noise as an emission which is considered to be unreasonable if it interferes with the health, welfare, convenience, comfort, or amenity of any person. The Act requires the occupier of any prescribed premises who causes an emission or alters the nature or volume of noise from the prescribed premises to ensure that their noise emissions are not unreasonable.
[2]	Environmental Protection (Noise) Regulations 1997 (the Regulations)	The Regulations defines noise emissions that, if found to be in contravention of the standard prescribed in the regulations, will be considered as unreasonable.
[3]	DWER Draft Guideline "Assessment of environmental noise emissions", May 2021	The Guideline ensures adequate information is provided to the Department of Water and Environment Regulation for assessing applications with noise emissions, as regulated under the *Environmental Protection Act 1986* (EP Act).
[4]	EPA Environmental Factor Guideline: Social Surroundings, November 2023	The Guideline communicates how the factor Social Surroundings is considered by the Environmental Protection Authority (EPA) in the environmental impact assessment (EIA) process.
[5]	AS2107 Acoustics - Recommended design sound levels and reverberation times for building interiors	AS2107 defines maximum noise levels for internal spaces, including sleeping areas. It has been used, in combination with the Regulations, to determine noise impacts on Heritage Points of Interest.
[6]	South Australia EPA "Wind farms – environmental noise guidelines", July 2009	The Guideline provides information on how to assess the noise impact of wind farms on the surrounding environment.

Ref	Document Name	Application
[7]	Planning Bulletin 67 – "Guidelines for Wind Farm Development", May 2004	The Planning Bulletin provides a guide to the assessment of land-based wind farm developments in Western Australia.
[8]	EPA Technical Guidance Environmental impact assessment of Social Surroundings – Aboriginal cultural heritage, November 2023	This Technical Guidance has been developed to: • Outline the Environmental Protection Authority (EPA) environmental impact assessment (EIA) process for Social Surroundings – Aboriginal cultural heritage (ACH) under the Environmental Protection Act 1986 (EP Act). • Provide the information requirements for the EPA to decide: º whether a proposal is likely to have a significant effect on the social surroundings environmental factor, as it relates to ACH, and if it should be assessed by the EPA; º if ACH is being assessed by the EPA, the information needed for assessment; and º if the EPA decides the proposal may be implemented, whether reasonable conditions can be applied to protect ACH from significant harm. • Outline how the EPA may take into account the statutory decision-making processes outlined in the *Aboriginal Heritage Act 1972* (AH Act). The EPA is releasing this Technical Guidance in response to the commencement of amendments to the AH Act in 2023, and will update this document as required.

2.2 Wind Farm Noise Guidelines

The potential noise impact from WTG's have been assessed against the criteria defined in the South Australian Wind Farms environmental noise guidelines [6]. These guidelines have been endorsed by the Western Australian EPA and the Western Australian Planning Commission (see Planning Bulletin 67 [7]), as an appropriate approach for assessing noise impacts from Wind Farms.

The South Australian guideline states that the predicted equivalent noise level (LAeq,10min), adjusted for tonality in accordance with these guidelines, should not exceed:

- 35 dB(A) at relevant receivers in localities which are primarily intended for rural living, or
- 40 dB(A) at relevant receivers in localities in other zones, or
- The background noise (LA90, 10min) by more than 5 dB(A).

Whichever of the above values is greater, for wind speeds from cut-in to rated power of the WTG.

Note that "Locality" is defined as "an approximation of the officially recognised areas outside cities and larger towns as defined by the State and Territory governments of Australia.[2]

2.3 Social Surroundings

2.3.1 Overview

The EP Act defines Social Surroundings as, '*the social surroundings of man are his aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by his physical or biological surroundings (Subsection 3(2))'.* A more detailed overview of the guidance documentation is provided in Appendix A.

The EPA's environmental objective for the factor Social Surroundings is '*To protect social surroundings from significant harm*'. The objective recognises the importance of ensuring that social surroundings are not significantly affected because of implementation of a Project or scheme.

Noise has the potential to unreasonably interfere with the health, welfare, convenience, and comfort of people. As a result, the EPA requires that the following noise considerations be included:

- Emissions of noise are considered in the context of relevant legislation, criteria, or standards.
- The level of confidence with which the predicted impacts to social surroundings have been made and the risk should those predictions be incorrect.
- Analysis, modelling, and predictions of impacts from noise, including likely impacts during the worst, best and most likely case scenarios.
- Model predictions could be validated with on-site measurements.
- Characterisation of proximity to sensitive receptors.
- Summary of proposed technologies, emission reduction equipment and management practices.
- Description of proposed management and monitoring arrangements.
- Analysis of cumulative impacts, including existing and reasonably foreseeable emissions.

2.3.2 Details of Points of Interest

No specific areas or places of noise sensitivity were identified during consultation with Nyamal Traditional Owners. However, concerns were raised about the level of noise during construction and operation phases of the project, and how far these could be heard from the project area. Based on an understanding of Nyamal use the area and key places they may choose to visit, several Points of Interest were identified for use in the noise modelling. Table 3-1 and Figure 1-1 show the locations of

[2] As defined in "Australian Statistical Geography Standard (ASGS) Edition 3 - https://www.abs.gov.au/statistics/standards/australian-statistical-geography-standard-asgs-edition-3/jul2021-jun2026/non-abs-structures/suburbs-and-localities

the four Points of Interest used for the noise modelling. These also corelate to the location of the noise monitors.

2.3.3 Identified Noise Sensitive Activities

For all Native Title Groups, it is assumed that continued or sporadic access may occur for cultural and recreational purposes including camping, hunting, fishing, and ceremonial use. Therefore, noise target levels based on these activities have been suggested in this report for the impact assessment.

These predicted noise levels were also compared against background noise monitoring undertaken from March 23 to June 6 2024 to provide an indication of locations where the Project's construction activities and operations may be audible.

2.3.4 Proposed Applicable Noise Criteria for Noise Sensitive Activities

Activities which have noise related value (e.g. Hunting, Ceremonial use, and Camping) are not defined in the Regulations. There is also a lack of previous information and proxy data to inform the assessment, and the appropriate noise target criteria.

To determine reasonable noise target levels for the different noise sensitive activities, the following legislative documents, standards, and guidance documentation have been considered:

- The EP Act requires that noise emissions received at another premises are reasonable. The Regulations consider receiver types and not activities. The assigned noise levels defined in the Regulations are the levels below which the Regulator considers noise to be reasonable. Compliance with the assigned levels does not imply that the noise is inaudible.
- Australian Standard AS2107 considers appropriate internal noise levels for different types of rooms in which various activities are undertaken. The activities have been related back to noise related values.
- Neither the Regulations nor AS2107 consider hunting activity. It has therefore been assumed that hunting at night, where the hunter is dependent on auditory senses, will require similar background noise levels to sleeping areas and night-time assigned noise levels defined in the Regulations.

Table 2-2 details the proposed target noise levels for each noise sensitive activity that may be undertaken within the project area. In-line with AS2107, both satisfactory and maximum levels have been provided.

Based on understood traditional uses of the area, there are three activities that need to be considered when developing appropriate noise levels for noise sensitive activities (and the areas they are undertaken). These are as follows:

- **Camping (night-time)**: Noise could result in sleep disturbance and annoyance. Threshold levels need to take this into account.
- **Hunting (daytime)**: It is expected that hunting will only take place during daylight hours where the hunter uses visual cues. Night-time hunting is not expected but if undertaken will require low noise levels as the hunter is dependent on auditory cues.
- **Day Use / Ceremonial**: Speech intelligibility and annoyance needs to be considered when considering activities during the day or ceremonial use.

2.4 Applicable Noise Limits for the Project

Table 2-2 gives the proposed target noise levels adopted for noise sensitive activities likely to be undertaken at Points of Interest within the Project.

Table 2-2 Activity Based Noise Target Levels for Points of Interest

Activity	Target Noise Level (dB(A))		Comment
	Satisfactory	Maximum	
Camping (night-time)	25	30	The night-time threshold levels are based on avoiding noise induced sleep disturbance and annoyance. The threshold levels adopted have used the Regulations and AS2107 noise levels for sleeping areas.
Hunting (daytime)	40	45	The threshold levels are based on avoiding annoyance. It should be noted that these levels are for hunting activities undertaken during the daytime only where the hunter can use visual cues.
Daytime use / Ceremonial	30	35/45	The threshold levels are based on avoiding annoyance. It should be noted that these levels are set for activities where speaking to others is involved. The threshold levels adopted are based on AS2107 levels for educational buildings. 45 dB(A) applies to ceremonies if amplification through a microphone speaker system is used.

3 Noise Monitoring – Baseline Noise Environment

3.1 Overview

To develop an understanding of current background noise levels in the area, baseline noise monitoring was undertaken at four locations from March 23 to June 6, 2024. The monitoring has been used to estimate the expected increase in noise levels due to the Project's construction and operations in the area, at ethnographic places and points of interest.

The noise monitoring systems were setup to measure overall and statistical noise levels at 15-minute intervals, so that minimum, average and maximum background noise levels during day, evening and night-time periods could be determined.

3.2 Monitoring Locations

Table 3-1 provides details and locations of the baseline noise monitoring. **Figure 3-1** shows photos of each location and Figure 4-2 is an aerial view showing the location of each logger.

Detailed graphs of the noise logging results can be found in Appendix C.

Table 3-1 Monitoring Locations (UTM, Zone 50K)

POI Name	Logger Ref	X [m]	Y [m]	Description of surrounding area
NM1	Logger 1	730045	7650131	West end of transmission corridor. Flat, rocky terrain with sparse shrubbery.
NM2	Logger 2	793490	7633161	East end of transmission corridor. Flat, rocky terrain with shrubbery.
NM3	Logger 3	814814	7624625	Within the proposed wind farm area (South). Flat, rocky terrain with shrubbery.
NM4	Logger 4	819781	7639054	Within the proposed wind farm area (North). Flat, rocky terrain with shrubbery.

Figure 3-1 Logger 1 (left), Logger 2 (centre left), Logger 3 (centre right), Logger 4 (right)

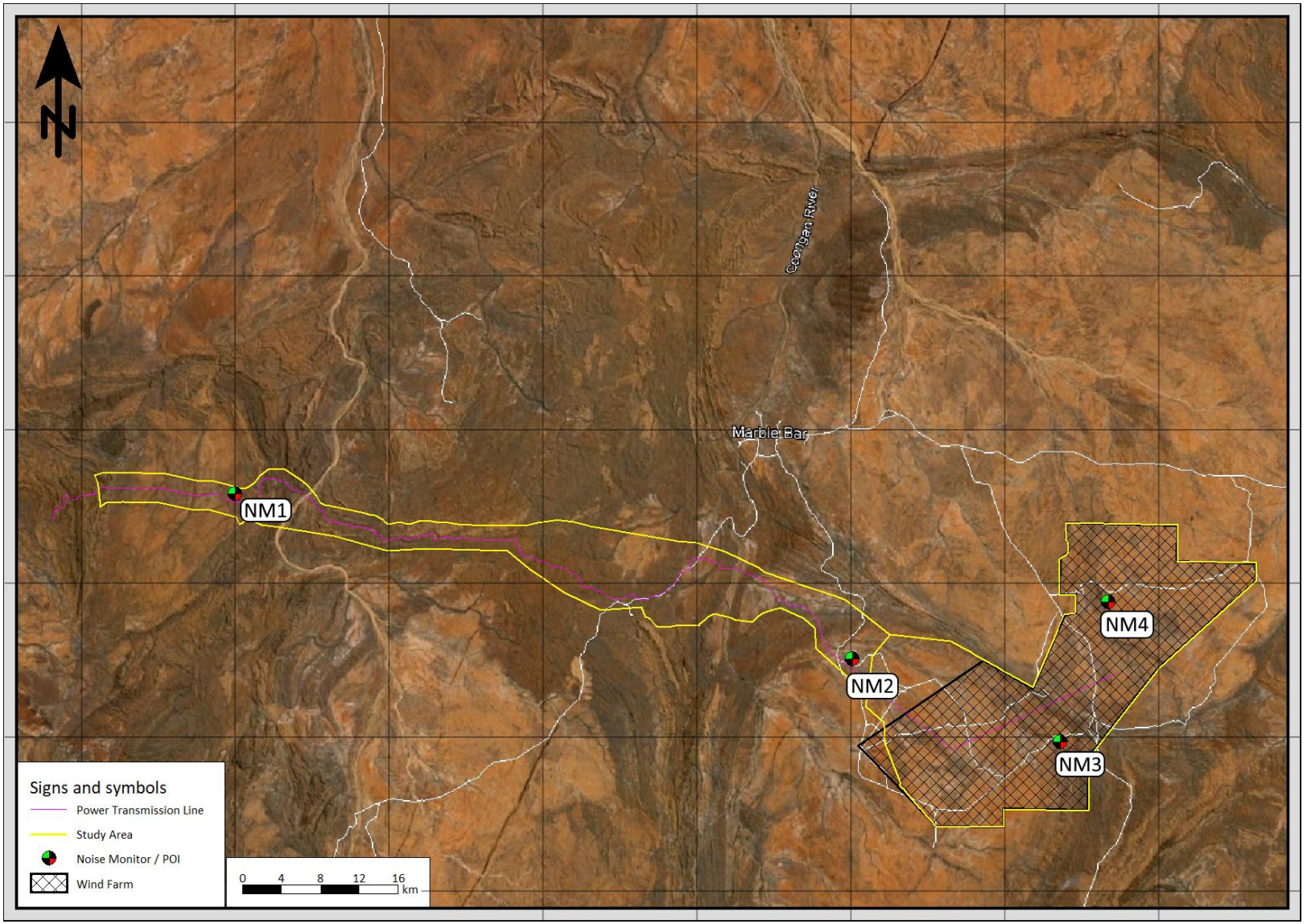


Figure 3-2 Noise Monitoring Locations at Points of Interest

3.3 Monitoring Results

Table 3-2 provides a summary of the noise results at each location, separated into day (7am to 7pm), evening (7pm to 10pm) and night (10pm to 7am). The noise parameters include:

- **LA10:** the average LA10[3] measured noise level during each time of day.
- **LA90**: the lowest measured LA90[4] noise level during each time of day.

The data shows that minimum (i.e. LA90 minimum) noise levels in the area are <32 dB(A) which is very quiet background noise levels. The average LA90 noise levels were between 32-41 dB(A) at all times of day. A time series graphs of the monitoring can be found in APPENDIX C.

Table 3-2 Baseline Noise Monitoring Results Summary (dB(A))

Name	Time of Day	LA90	
		Minimum	Average
NM1	Day	28	**38**
	Evening	28	**32**
	Night	29	**33**
NM2	Day	19	**37**
	Evening	18	**38**
	Night	17	**35**
NM3	Day	28	**35**
	Evening	28	**33**
	Night	25	**33**
NM4	Day	31	**41**
	Evening	33	**39**
	Night	32	**38**

Note: Baseline levels that are above the suggested target levels have been highlighted in red.[5]

[3] LA10 is the noise level that is present for 10% of time.

[4] LA90 is the noise level that is present for 90% of time.

[5] Maximum levels: Camping (night-time) = 30 dBA, Daytime / Ceremonial use / Hunting (daytime) = 45 dBA.

4 Noise Modelling Overview

4.1 Noise Model Software

A desktop environmental noise model was created to simulate the Project using SoundPLAN v8.2 software program. This software package calculates sound pressure levels at nominated receiver locations and produces noise contours over a defined area of interest. SoundPLAN can be used to model different types of noise, such as industrial noise, traffic noise and aircraft noise.

The inputs required by the SoundPLAN modelling software are noise sources, ground topographical and absorption data, meteorological data, and sensitive receiver point locations. SoundPLAN has been setup for the study to utilise ISO9613 "Acoustics - Attenuation of sound during propagation outdoors" for calculating the attenuation of sound during outside propagation and the CONCAWE[6,7] prediction algorithm. The CONCAWE algorithm is accepted by the Department of Water and Environment Regulation (DWER).

The model has been used to predict point received noise levels and to generate noise contour maps for the wider area.

4.2 Noise Model Inputs

4.2.1 Noise Sensitive Receivers

The receiver locations as listed in section 1.3 have been included in the noise model as point receivers, used to undertake the noise assessment.

4.2.2 Topography and Ground Absorption

Topographical data for the area was provided by Fortescue, which was used to create a digital ground map. The acoustic properties of the ground surface influence noise propagation. Flat non-porous surfaces such as concrete, asphalt and water are more reflective whereas soft, porous surfaces such as foliage and grass are more absorptive. A CONCAWE ground factor of 0.5 was applied to the model, which is indicative of hard ground and considered representative of the area.

4.2.3 Meteorological Conditions

SoundPLAN calculates noise levels for defined meteorological conditions. Temperature, relative humidity, wind speed and direction data are required as inputs to the model. Table 4-1 presents the worst-case meteorological conditions applied to the model, which are defined in the DWER "*Draft Guideline on Environmental Noise for Prescribed Premises*".

[6] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry.

[7] The propagation of noise from petroleum and petrochemical complexes to neighbouring communities, CONCAWE Report 4/81, 1981.

Table 4-1 : Worst-Case Meteorological Conditions used for modelling.

Time of day	Temperature	Relative Humidity	Wind Speed	Wind Direction	Pasquil Stability Category (PSC)
Night (19:00 - 07:00)	15° Celsius	50%	3 m/s	worst case	F

4.2.4 Noise Sources

Table 4-2 presents a summary of the noise source Sound Power Levels (SWLs) and quantities of each equipment type which have been used to develop the model, including construction activities and wind farm operations. A detailed list of SWLs is presented in Appendix B.

For the wind farm noise sources, 189 noise sources were modelled based on the positional information provided, though there is potential to expand up to 200 WTGs. The noise emissions of WTGs increase with hub-height wind speeds from 5m/s (cut-in speed) to 12 m/s (rated power and maximum noise emissions). SWLs have been calculated and allocated to the WTG's using vendor information for 6MW WTG's, operating at every 1m/s wind speed integer from cut-in to rated power and highest SWL emission. The modelling is based on a wind speed at 10 m above ground level. The hub-height wind speeds have therefore been back calculated to 10m for the noise modelling using the wind profile law[8].

The noise sources were placed at a height of 250m above the topographical ground layer, to represent the WTG hub-heights.

A summary of the SWL's used in each modelled scenario are given in Table 4-2. Spectral data for each modelled source can be found in Appendix A.

Table 4-2 Activities and Sound Power Levels

Activities	Equipment	Sound Power Level (dBA)	Quantity
Construction Activities			
Clearing	Excavator	116.5	1
	Moxy Truck	112.6	2
	Dozer	113.7	1
	Loader	112.6	1
	Scraper	111.8	2

[8] Touma, J.S., 1977, Dependence of the wind profile power law on stability for various locations, J. Air Pollution Control Association. v2=v1*ln(h2/z0)/ln(h1/z0), where z0 is the roughness length of which 0.1 was used.

Activities	Equipment	Sound Power Level (dBA)	Quantity
	Rock Breaker	107.4	1
Concreting	Concrete Vibrator	112.2	1
	Concrete Truck	109.0	2
	Concrete Pump	108.6	2
	Compressor	102.4	1
Wind farm operations			
Wind speed Hub-Height 5m/s[9]	Wind Turbine	98.5	189
Wind speed Hub-Height 6m/s	Wind Turbine	102.4	189
Wind speed Hub-Height 7m/s	Wind Turbine	105.8	189
Wind speed Hub-Height 8m/s	Wind Turbine	108.2	189
Wind speed Hub-Height 9m/s	Wind Turbine	109.7	189
Wind speed Hub-Height 10m/s[9]	Wind Turbine	110.5	189
Wind speed Hub-Height 11m/s	Wind Turbine	110.3	189
Wind speed Hub-Height 12 m/s[9]	Wind turbine	110.6	189

4.3 Noise Model Layout

The locations of the WTGs were provided by Fortescue, which were used to position construction activities and WTG noise sources in the noise model.

4.4 Noise Model Scenarios

The following model scenarios have been run:

- **Construction Activities** – Construction activities (see Table 4-2) will be undertaken at the base of each WTG, at the base of powerline poles, and at each camp location. Noise model outcomes have been presented for construction at various locations including at the closest WTG to each noise monitoring location, as well as at the North, South, Central areas of the study area.

[9] Hub-height wind speed 5m/s = 2.2m/s @ 10m; Hub-height wind speed 10m/s = 4.3m/s @ 10m; Hub-height wind speed 12m/s = 5.2m/s @ 10m

- **Wind Farm Operations** – includes all 189 WTG's operating simultaneously at various wind speeds (i.e. SWL levels for each WTG).

5 Noise Modelling Results

5.1 Construction

Table 5-1 shows predicted received noise levels from construction activities (such as clearing and earthworks), with the noise sources positioned at the closest WTG or Transmission Line location to each noise monitoring and Sensitive Receiver location. From the noise modelling the following has been concluded:

- The noisiest construction activity modelled is clearing/earthworks using mobile equipment.
- The model predicts construction noise levels at NM3 and NM4 will be higher than the LA90 background noise level that was measured to be between 33 and 38 dB(A). As a result, the construction activities will be audible at the monitoring locations.
- The model results also show that the predicted levels at NM1, NM2 and NM4 are all higher than the noise target levels for Points of Interest for Daytime use(see section 2.3.4). Similarly, the predicted levels at all Points of Interest exceed the noise target levels for night-time activities. As the construction activities are spread over a wide area the higher levels, at NM3 and NM4 the noise level exceedances only occur when construction is being undertaken close to those locations. Figure 5-1 to Figure 5-3 show that when construction activities are further away from NM3 and NM4, then the predicted levels at these locations are less than the target levels for Points of Interest. A mitigation approach that could therefore be adopted is to limit construction activities to locations further from NM3 and NM4 when they are being used by Traditional Owners.

Table 5-1 - Noise Model Results (LA10) – Construction

Receiver	Target Level	Noise model result LA10
Points of Interest		
NM1	Camping (night time) = 30 dBA (Max) Hunting / Daytime use / Ceremonial = 45 dBA (Max)	54.2
NM2		52.4
NM3		42
NM4		46
Sensitive Receivers		
Marble Bar Town	35 dBA	<10
Sulfur Springs		<20
Iron Bridge Mine Site		<10

5.2 Wind Farm Operations

Table 5-2 presents the model results for wind farm operations. From the results, the following has been concluded:

- The predicted received levels are higher than the noise target levels for Points of Interest (see section 2.3.4) at NM3 and NM4 for WTG hub-height wind speeds ≥5m/s[10]. The predicted received levels are below the noise target at NM1 and NM2 for all windspeeds.

- WTG hub-height windspeeds translated to 10m above ground vary between 2.2 and 6 m/s. It is recognised that for windspeeds @ 10m > 4m/s, localised noise generated by the wind as it moves through the foliage will increase. As a result, background noise will be higher and potentially mask noise from the WTG's.

- For the lower windspeeds (i.e. between 2.2 and 4m/s) where localised background noise sources are not likely to mask WTG noise, a mitigation approach that could be considered is to feather the blades of nearby WTG's (i.e. so they are no longer operational) when the area is being used by Traditional Owners.

Table 5-2 – Noise Model Results (LA10) – Wind Farm Operations

Receiver	Target Level	Wind Speed (hub height)					
		5m/s	6m/s	7m/s	8m/s	9m/s	10 to 12 m/s
Points of Interest							
NM1	Camping (night time) = 30 dBA (Max)	Cannot be heard					
NM2		6	9	14	17	18	19
NM3	Hunting / Daytime use / Ceremonial = 45 dBA (Max)	28	32	36	38	40	41
NM4		35	38	42	44	46	47
Sensitive Receivers							
Marble Bar Town	35 dBA	Cannot be heard					
Sulphur Springs		Cannot be heard					
Iron Bridge Mine Site		Cannot be heard					

[10] WTG hub-height wind speed 5m/s= 2.25m/s @10m

5.3 Noise Contour Maps

Figures 5-1 to Figure 5-7 are predicted noise contour maps for the worst case meteorological scenarios from construction activities and wind farm WTG's.

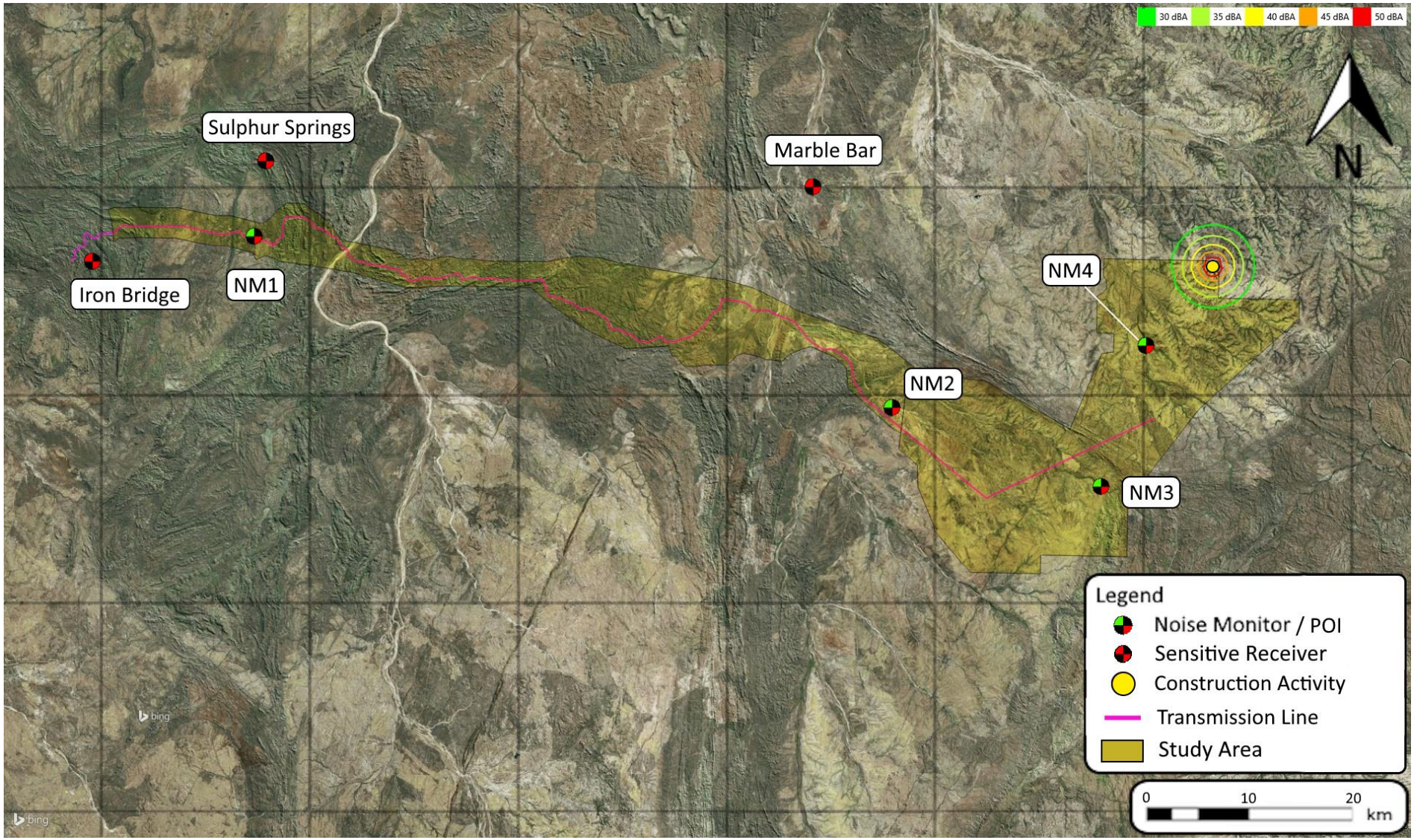


Figure 5-1 – Noise Contour Map – Construction North

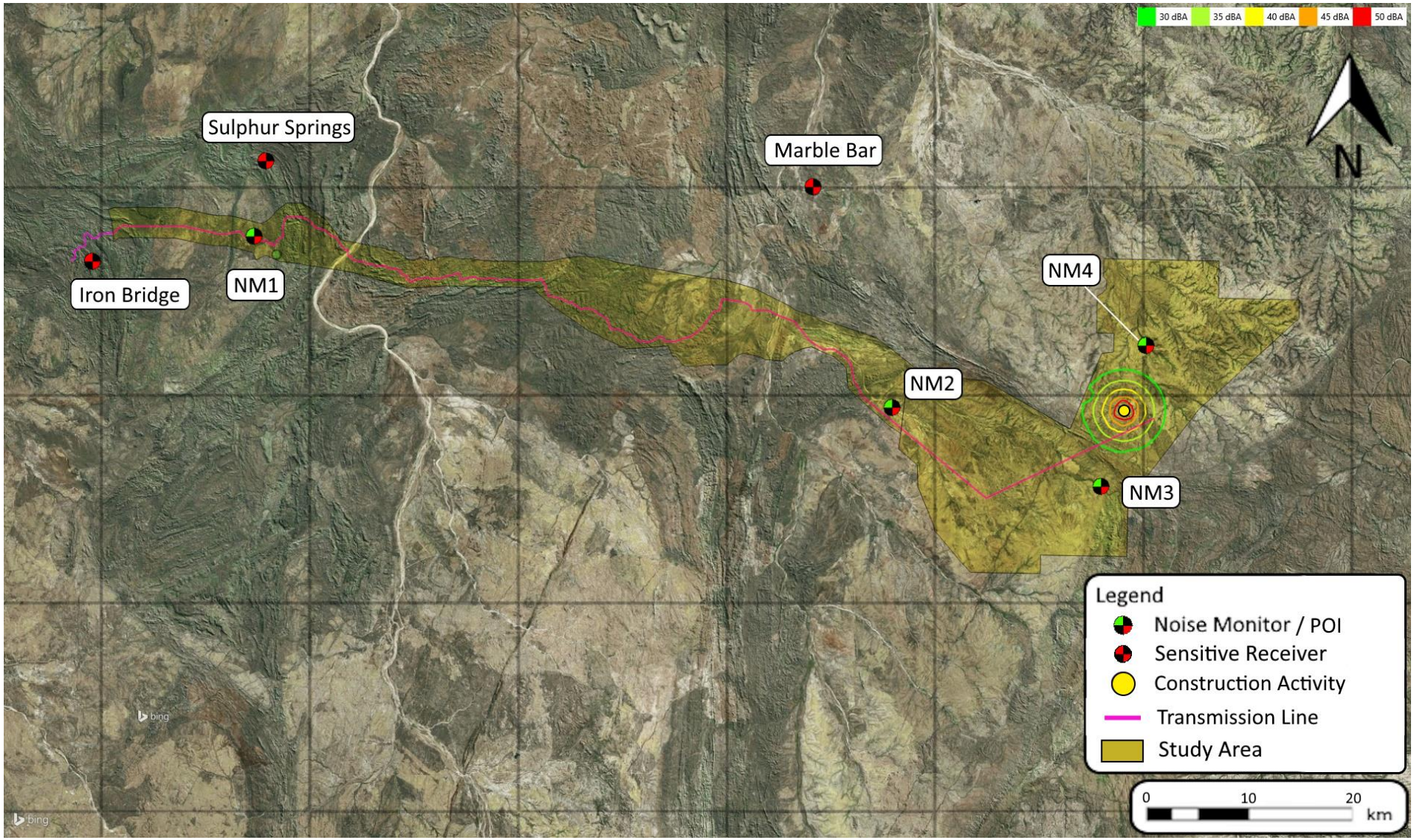


Figure 5-2 – Noise Contour Map – Construction Middle

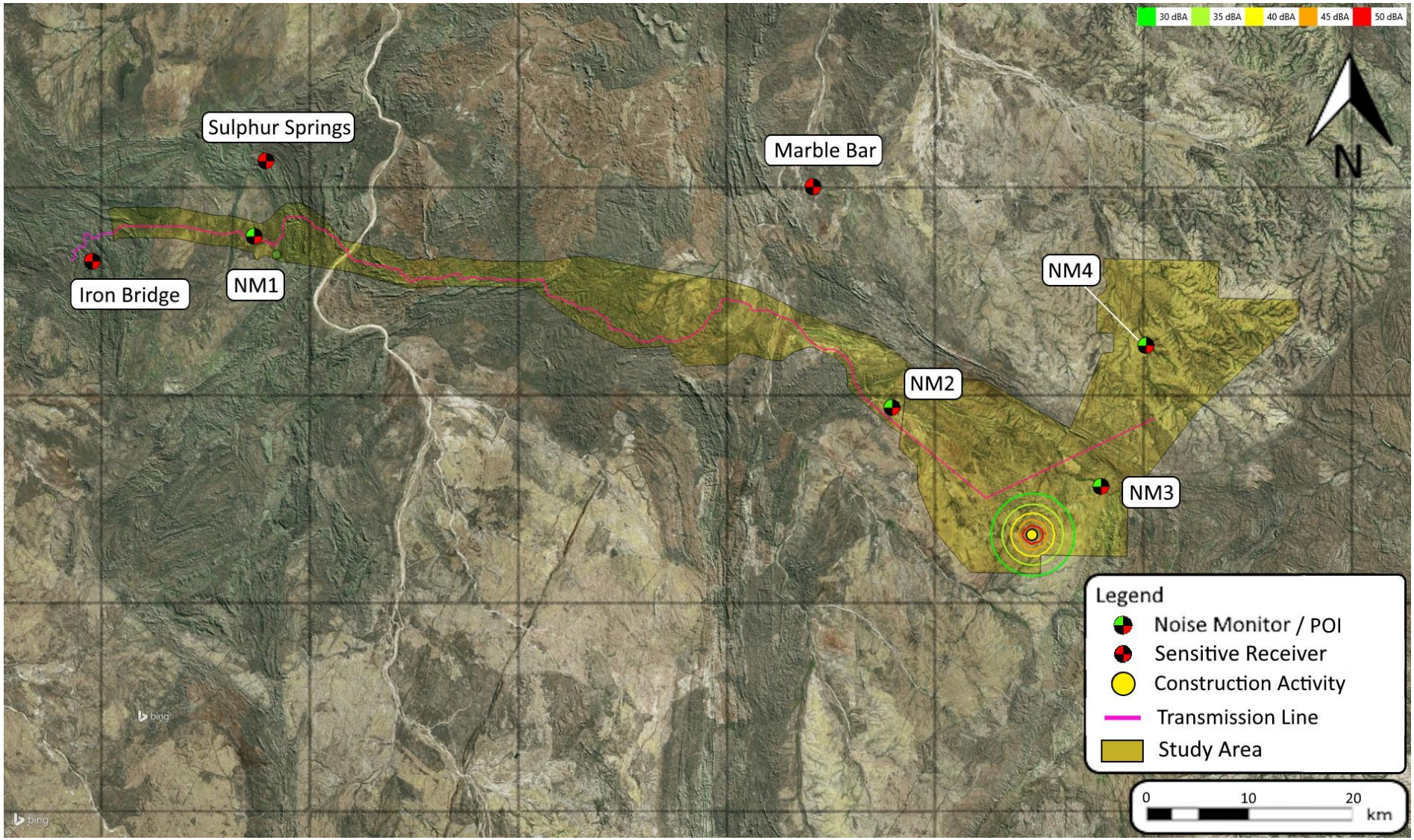


Figure 5-3 – Noise Contour Map – Construction South

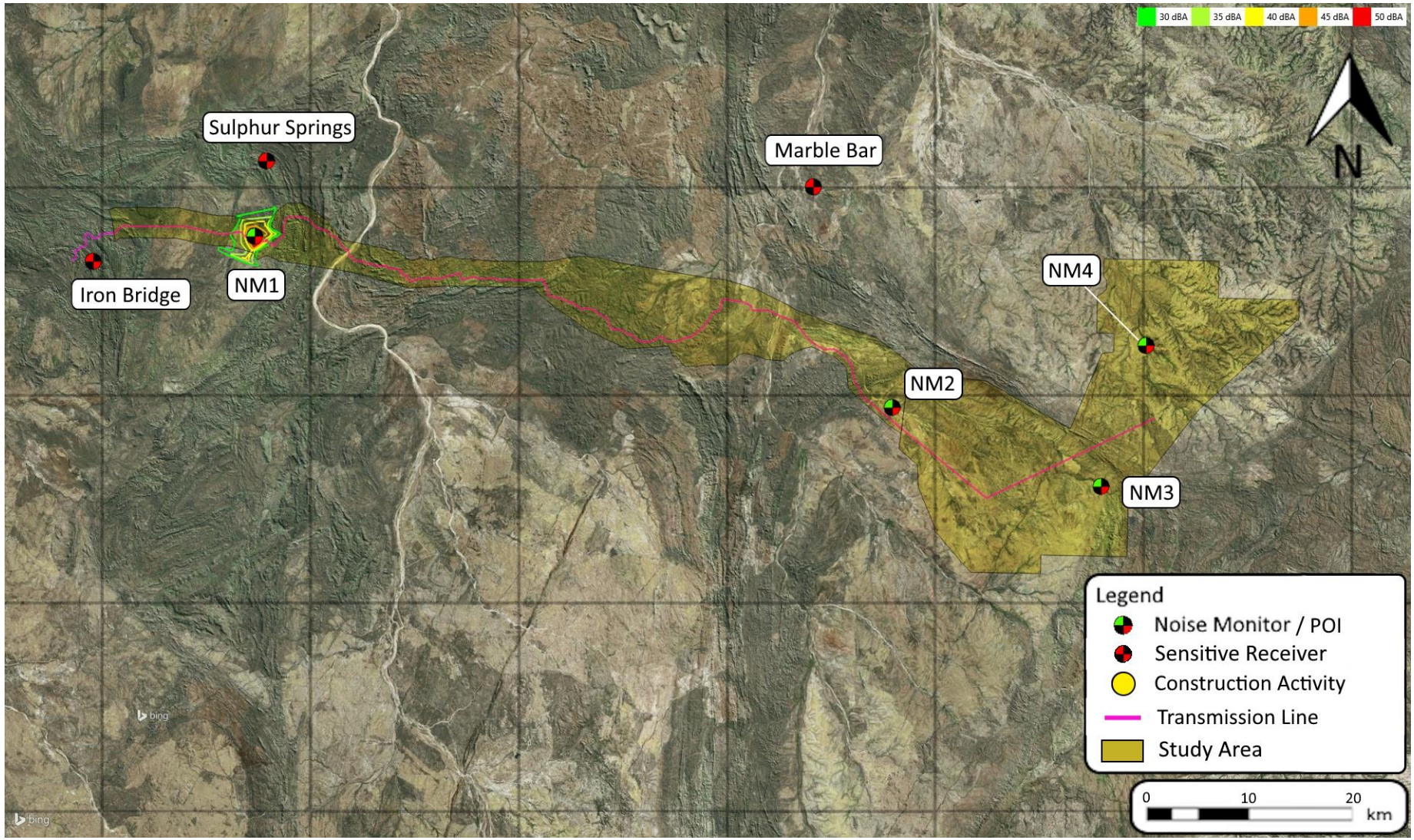


Figure 5-4 – Noise Contour Map – Construction Near NM1

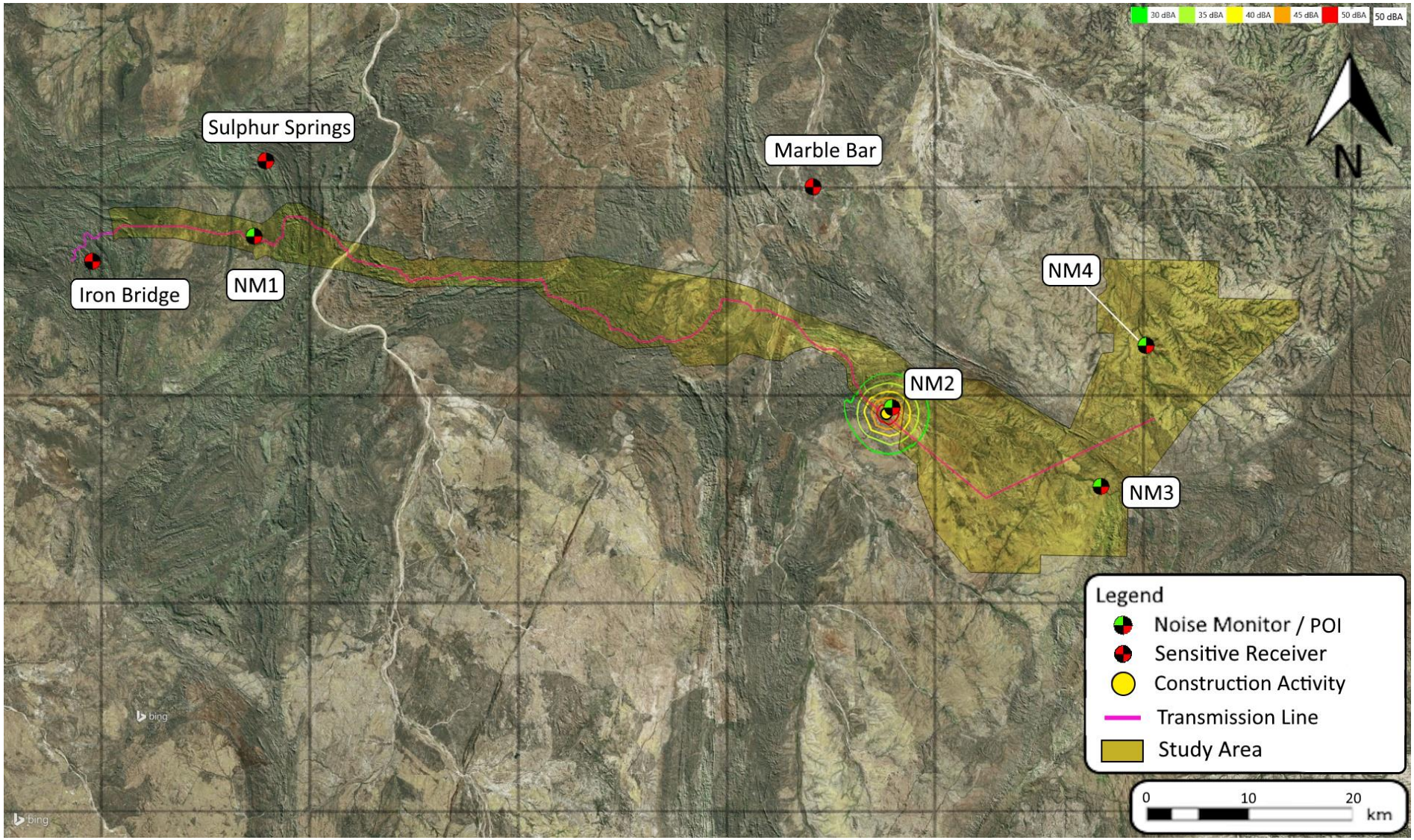


Figure 5-5 – Noise Contour Map – Construction Near NM2

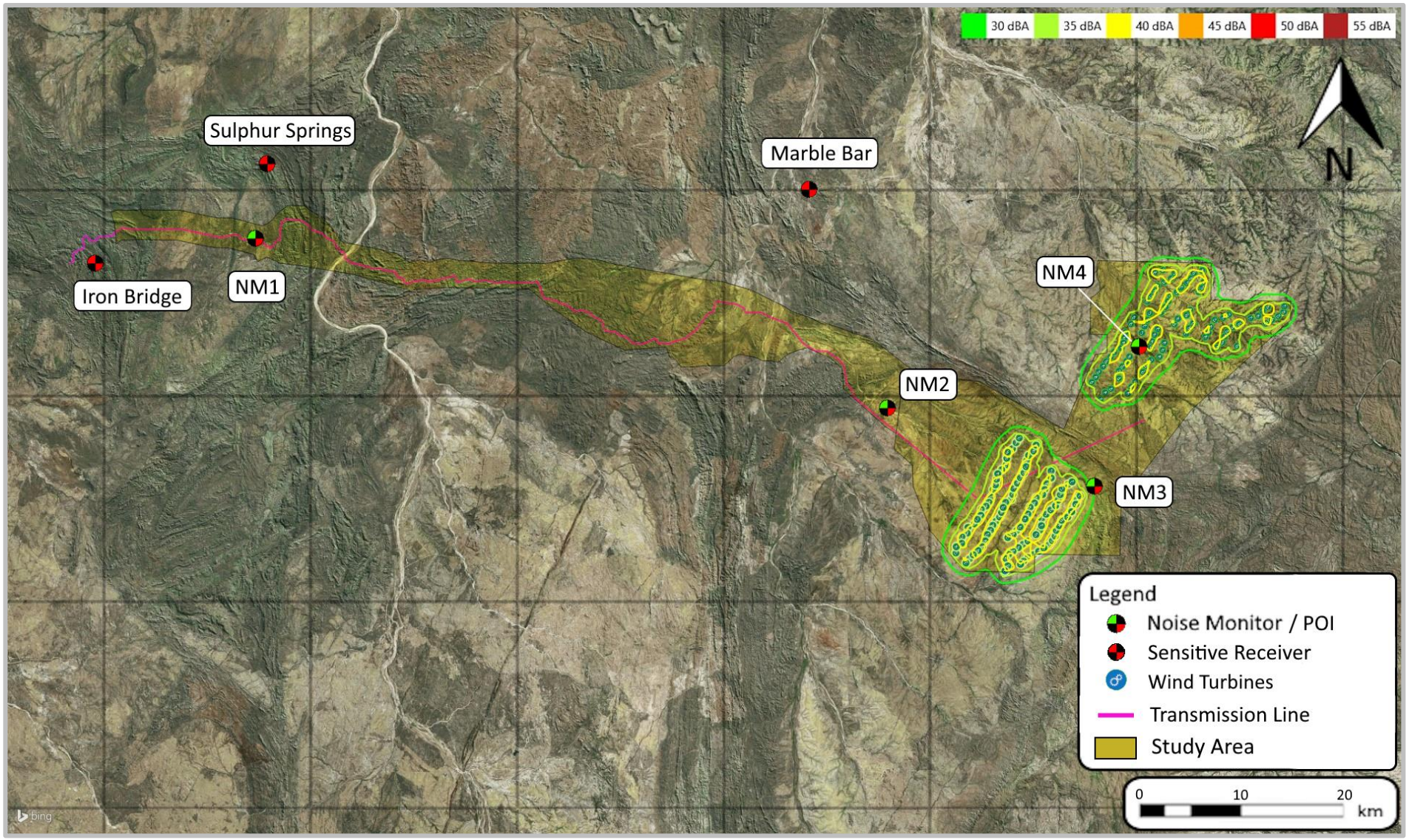


Figure 5-6 – Noise Contour Map – Wind Farm Operations 5m/s

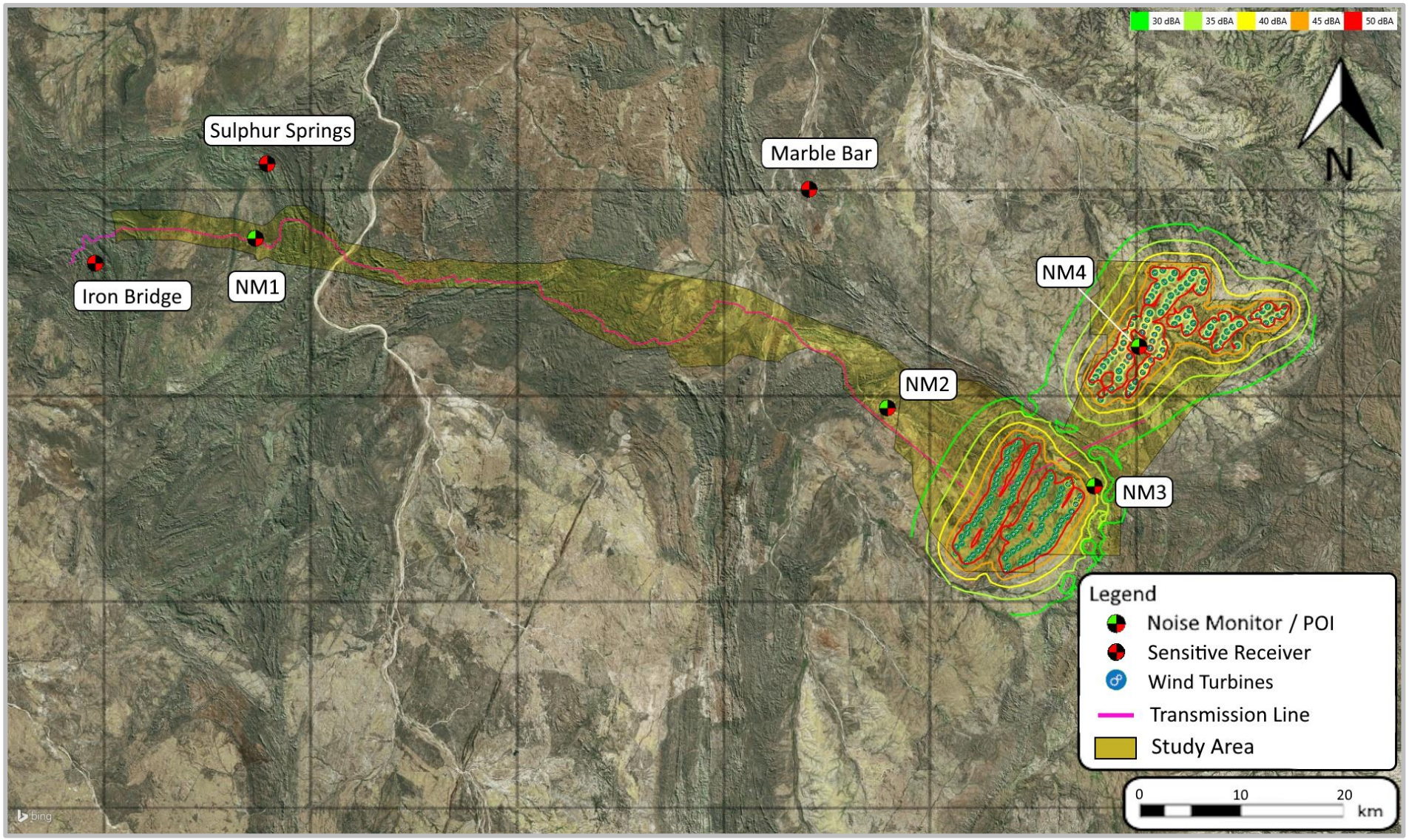


Figure 5-7 – Noise Contour Map – Wind Farm Operations 12m/s

6 Conclusions

Based on the modelling and analysis undertaken, the following has been concluded:

Construction activities:

- The noisiest construction activity modelled is clearing/earthworks.
- The model predicts construction noise levels at NM3 and NM4 will be higher than the LA90 background noise level that was measured to be between 33 and 38 dB(A). As a result, the construction activities will be audible at the monitoring locations. Additionally, the modelling results also show that the predicted levels at NM3 and NM4 are higher than the noise target levels for Ethnographic Places of Interest (see section 2.3.4).
- As the construction activities are spread over a wide area, the higher levels at NM3 and NM4 only occur when construction is being undertaken close to those locations. A mitigation approach that could therefore be adopted is to limit construction activities to locations further from NM3 and NM4 when they are being used by Traditional Owners.

Wind farm operations:

- The predicted received levels are higher than the noise target at NM3 and NM4 for WTG hub-height wind speeds ≥5m/s The predicted received levels are below the noise target at NM2 for all windspeeds.

- The hub-height windspeeds when translated to 10 m above ground vary between 3 and 6 m/s. It is recognised that at the higher windspeeds (i.e. > 4 m/s @10m) localised noise generated by the wind as it moves through the foliage will increase. As a result, background noise will be higher and potentially mask noise from the WTG's.

- For the lower windspeeds (i.e. between 2.2 and 4m/s @10m) where localised background noise sources are not likely to mask WTG noise, a mitigation approach that could be considered is to feather the blades of nearby WTG's (i.e. so they are no longer operational) when the area is being used by Traditional Owners.

APPENDIX A
Noise Legislation

A.1 Environmental Protection (Noise) Regulations 1997

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 noise levels) which are the highest noise levels that can be received at noise-sensitive (residential), commercial and industrial premises.

Assigned noise levels are defined differently for noise sensitive premises, commercial premises, and industrial premises. For noise sensitive premises, an Influencing Factor (IF) is included in the assigned noise levels. The IF depends on the presence of major/minor roads and commercial/industrial land use zonings within circles of 100 metres and 450 metres radius from the noise receiver.

For noise sensitive residences, the time of day also affects the assigned levels. The regulations define three types of assigned noise level:

- L_{ASMAX} means an assigned level that is not to be exceeded at any time;
- L_{AS1} means an assigned level that is not to be exceeded for more than 1% of time;
- L_{AS10} means an assigned level that is not to be exceeded for more than 10% of time.

Table A 1: Assigned Noise Levels for Noise Sensitive Receivers

Type of premises receiving noise	Time of day	Assigned Levels (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor

Type of premises receiving noise	Time of day	Assigned Levels (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours	65	80	90
Industrial and utility premises in the Kwinana Industrial Area	All hours	75	85	90

Environmental Protection (Noise) Regulations 1997

Influencing Factors

The Influencing Factor (IF) is based on the surrounding land use adjacent to each of the noise sensitive receivers, including the amount (%) of industrial and commercial premises as well as the number and proximity of major and secondary roads.

The following steps were taken to calculate IF.

1. Two circles of radius 100m and 450m centred on each of the identified receivers were drawn.
2. The circles were used to determine and calculate the area of industrial and commercial premises and the presence major/secondary roads within the circles.

The calculated IF is 0.

Adjustments for intrusive or dominant characteristics

Received noise levels are subject to adjustments if the noise exhibits intrusive or dominant characteristics i.e. if the noise is impulsive, tonal or modulating. These adjustments, shown in Table A 2, are cumulative up to a maximum of 15 dB.

Section 9 of the Regulations sets out objective tests to assess whether the received noise is free of these characteristics.

Table A 2 Adjustments for intrusive and dominant characteristics

Tonality	Modulation	Impulsiveness
+ 5dB	+5 dB	+10 dB

A.2 EPA Environmental Factor Guideline: Social Surroundings

The EPA's environmental objective for the factor Social Surroundings is: '*To protect social surroundings from significant harm*'. The objective recognises the importance of ensuring that social surroundings are not significantly affected because of implementation of a Project or scheme.

Considerations for EIA for the factor Social Surroundings include:

- Application of the mitigation hierarchy to avoid or minimise impacts on social surroundings, where possible.
- The aesthetic, cultural, economic and/or social values which may be impacted, and whether those values are significant.
- The contribution implementation of the Project or scheme may make to existing or predicted cumulative impacts to aesthetic, cultural or social values.
- That emissions of noise, odour or dust are considered in the context of relevant legislation, criteria or standards.
- The level of confidence with which the predicted impacts to social surroundings have been made, and what is the risk should those predictions be incorrect
- whether proposed management or mitigation of impacts to aesthetic, cultural, economic and/or social surroundings is technically and practically feasible.

Aboriginal heritage and culture

It is an offence to interfere with any Aboriginal site knowingly or where it would be reasonable to know, regardless of whether or not it is registered. In addition to Aboriginal heritage, matters of Aboriginal cultural associations, including traditional Aboriginal customs, directly linked to the physical or biological aspects of the environment, may also be considered significant. This may include, for example, traditional hunting and gathering activities for native fauna and flora as bush tucker.

Amenity

Amenity is a broad term that generally means the qualities, attributes and characteristics of a place that make a positive contribution to quality of life. For the purpose of EIA, amenity values include both visual amenity, and the ability for people to live and recreate within their surroundings without any unreasonable interference with their health, welfare, convenience and comfort. Noise has the potential to unreasonably interfere with the health, welfare, convenience and comfort of people. Amenity values can be highly subjective. What may have amenity value for one person, may not be valued by another. Similarly, people have different levels of perception or tolerance for things that may impact amenity, such as noise, odour and dust.

Predicting the impacts of noise, dust and odour

While modelling the potential impacts of noise and dust may be technically complex, methodologies and practices are generally well understood and accepted. Predictions can also be validated with on-site measurements or proxy data, as noise and dust can be quantitively measured.

Information required for EIA

Where social surroundings has been identified as an environmental factor the EPA may require the proponent to include information or studies within the following broad topics:

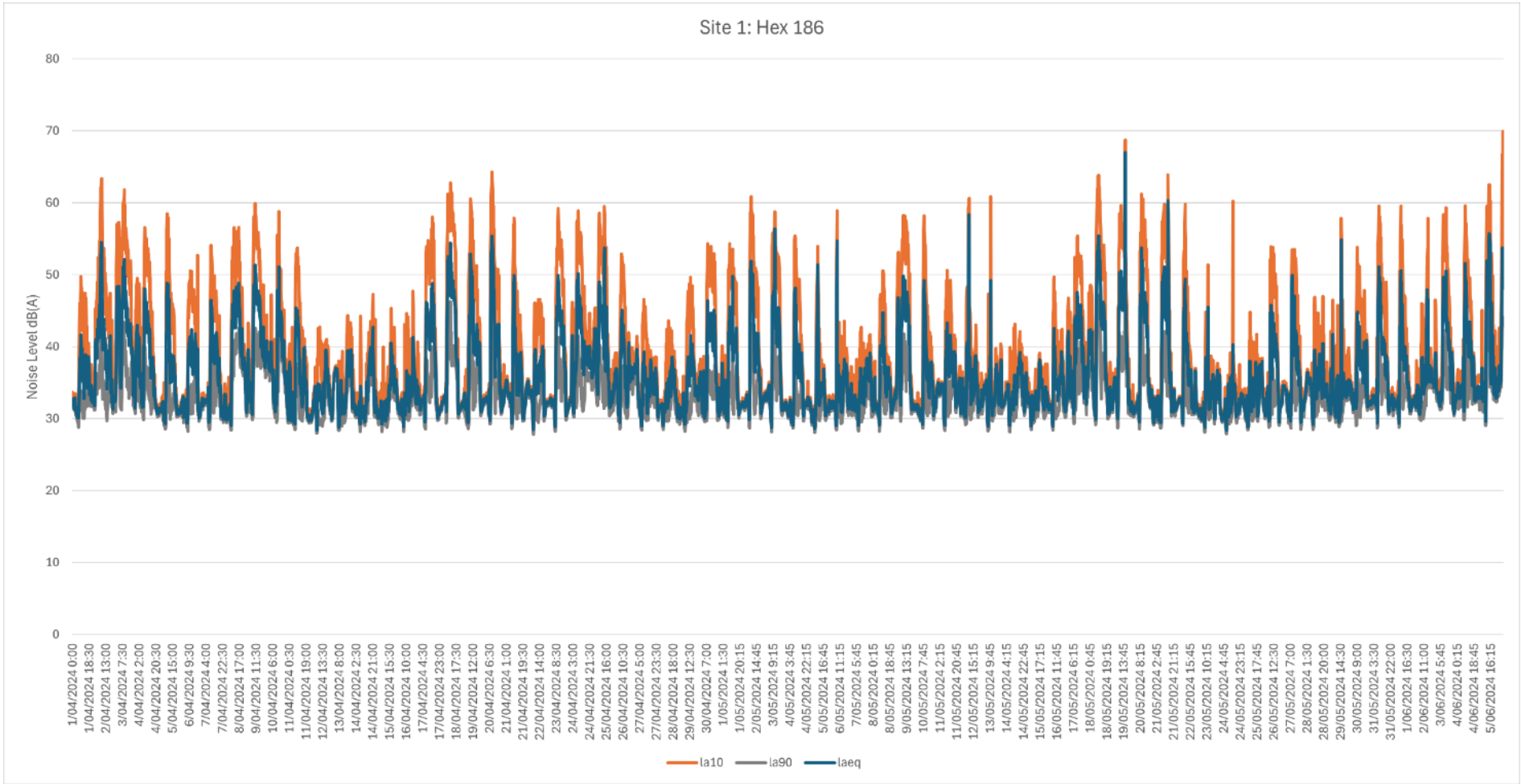
- Analysis, modelling and predictions of impacts from odour, dust and noise, including likely impacts during, worst, best and most likely case scenarios
- Characterisation of proximity to sensitive receptors
- Summary of proposed technologies, emission reduction equipment and management practices
- Description of proposed management and monitoring arrangements
- Analysis of cumulative impacts, including existing and reasonably foreseeable emission sources

APPENDIX B
Noise Source Sound Power Levels (SWLs)

Noise source	Octave Band Levels, dB(A)									O/A
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4KHz	8KHz	
Scraper	61.9	77.3	93.4	100.1	104.6	107.2	106.0	101.1	95.7	**111.8**
90t Excavator	70.4	85.1	101.9	108.2	110.7	110.9	109.5	104.7	99.4	**116.5**
30t Excavator	60.4	75.1	91.9	98.2	100.7	100.9	99.5	94.7	89.4	**106.5**
Service Truck	67.0	83.4	91.4	97.9	102.1	101.9	97.4	89.1	80.1	**106.6**
D10 Dozer	78.3	84.1	89.8	105.3	108.9	107.8	104.9	98.7	91.9	**113.4**
D6 Dozer (?)	78.3	84.1	89.8	105.3	108.9	107.8	104.9	98.7	91.9	**113.4**
Loader	65.9	81.2	99.1	101.2	105.5	107.2	106.5	102.6	98.1	**112.5**
Moxy Trucks	65.9	81.2	99.1	101.2	105.5	107.2	106.5	102.6	98.1	**112.5**
Water Carts	64.1	84.5	94.6	102.1	106.0	105.4	103.8	99.0	93.7	**111.1**
Grader	61.9	77.3	93.4	100.1	104.6	107.2	106.0	101.1	95.7	**111.8**
Roller	61.9	77.2	95.1	97.2	101.5	103.2	102.5	98.6	94.1	**108.5**
Diesel Welders	77.0	78.8	89.9	98.4	100.8	99.1	94.5	86.5	77.8	**105.0**
Air Compressors	65.2	77.5	86.3	91.4	96.7	97.1	96.1	92.1	87.5	**102.5**
Hand Tools	80.9	86.7	101.4	107.9	111.5	110.4	107.4	101.3	94.5	**116.0**
Generators	64.0	80.4	88.4	94.9	99.1	98.9	94.4	86.1	77.1	**103.6**
Sand Blasting and Painting	84.3	100.7	108.8	115.3	119.5	119.3	114.7	106.4	97.4	**124.0**
Tree & Vegetation Shredding Equipment	76.1	92.5	100.6	107.1	111.2	111.1	106.5	98.2	89.2	**115.8**
Concrete Pump	66.6	79.2	89.8	97.3	102.4	103.9	102.2	97.1	91.4	**108.5**
Articulated Dump Truck	71.8	88.8	104.6	104.5	104.4	101.5	101.8	96.2	84.0	**110.8**
Semi-Trailer	64.3	83.3	91.1	97.9	102.6	102.4	97.4	89.6	81.7	**107.0**
Mobile Crusher	86.9	100.9	111.0	114.8	117.6	118.3	115.8	108.4	99.5	**123.3**
Rockbreaker	65.6	89.2	93.7	95.6	103.4	101.7	99.8	91.6	82.0	**107.4**
Forklift	41.8	57.3	72.7	77.8	86.4	88.2	88.8	85.5	80.2	**93.8**

Noise source	Octave Band Levels, dB(A)									O/A
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4KHz	8KHz	
Concrete Truck	65.3	78.3	89.5	97.2	102.8	104.2	102.5	97.3	90.1	**108.8**
Pump	65.4	65.4	77.6	87.2	89.7	87.7	83.0	77.0	68.7	**93.7**
Concert Vibrator	68.5	84.3	95.7	102.0	10.9	107.2	105.4	100.2	92.8	**112.0**
Crane Large	62.8	81.8	89.6	96.4	101.1	100.9	95.9	88.1	80.2	**105.5**
Crane Small	61.3	80.3	88.1	94.9	99.6	99.4	94.4	86.6	78.7	**104.0**
Crane franna	61.3	80.3	88.1	94.9	99.6	99.4	94.4	86.6	78.7	**104.0**
Generator	71.4	71.4	83.6	93.2	95.7	93.7	89.0	83.0	74.7	**99.7**
EWP	53.3	67.6	86.6	93.1	97.7	100.7	99.3	90.2	81.1	**104.8**
Telehandler	53.3	67.6	86.6	93.1	97.7	100.7	99.3	90.2	81.1	**104.8**
Posytrac	53.3	67.6	86.6	93.1	97.7	100.7	99.3	90.2	81.1	**104.8**
Traxcavator	77.2	80.3	98.0	104.3	108.5	106.9	104.1	98.3	88.0	**112.7**
Compressor	63.9	76.9	86.5	90.9	97.3	97.1	96.5	88.0	78.3	**102.4**
Sleeper Laying Machine	65.3	78.3	89.5	97.2	102.8	104.2	102.5	97.3	90.1	**108.8**
Flashbutt Welder	80.3	96.7	104.8	111.3	115.5	115.3	110.7	102.4	93.4	**120.0**
Tamper	65.3	78.3	89.5	97.2	102.8	104.2	102.5	97.3	90.1	**108.8**
Drill Rig	67.3	85.0	99.8	109.1	111.4	110.5	106.8	99.7	90.9	**116.0**
Wind Turbine 5m/s	66	79.2	87.9	93.4	94	91.4	83.7	69.2	58.9	**98.5**
Wind Turbine 6m/s	69.9	83.1	91.8	97.3	97.9	95.3	87.6	73.1	59.8	**102.4**
Wind Turbine 7m/s	73.3	86.5	95.2	100.7	101.3	98.7	91	76.5	63.2	**105.8**
Wind Turbine 8m/s	75.7	88.9	97.6	103.1	103.7	101.1	93.4	78.9	65.6	**108.2**
Wind Turbine 9m/s	77.2	90.4	99.1	104.6	105.2	102.6	94.9	80.4	67.1	**109.7**
Wind Turbine 10m/s	78	91.2	99.9	105.4	106	103.4	95.7	81.2	67.9	**110.5**
Wind Turbine 11m/s	78	91.2	99.9	105.4	106	103.4	95.7	81.2	67.9	**110.3**
Wind Turbine 12m/s	78.2	91.4	100.1	105.6	106.2	103.6	95.9	81.4	68.1	**110.6**

APPENDIX C
Noise Logging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10
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4/04/2024 2:00
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6/04/2024 9:30
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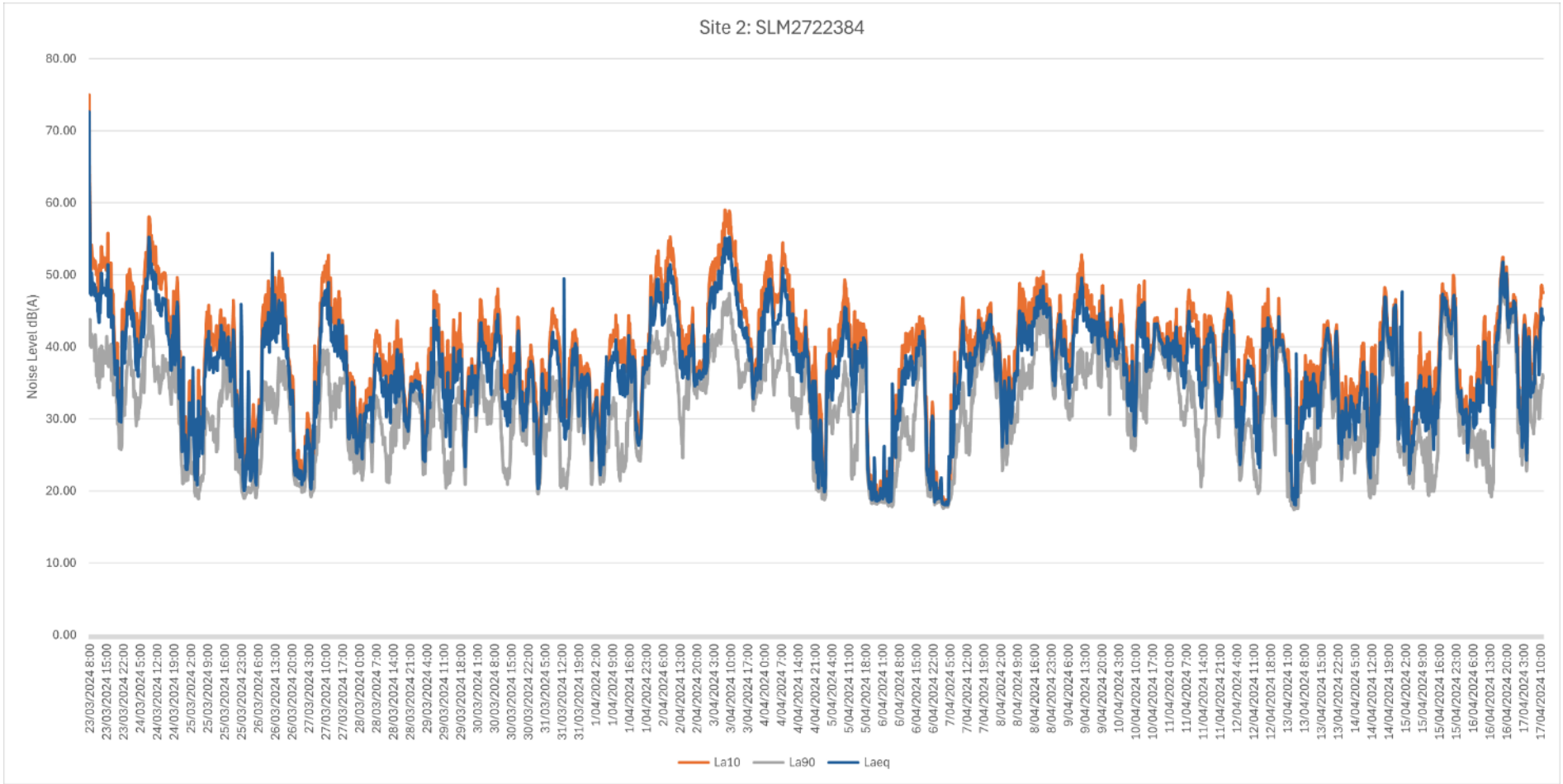
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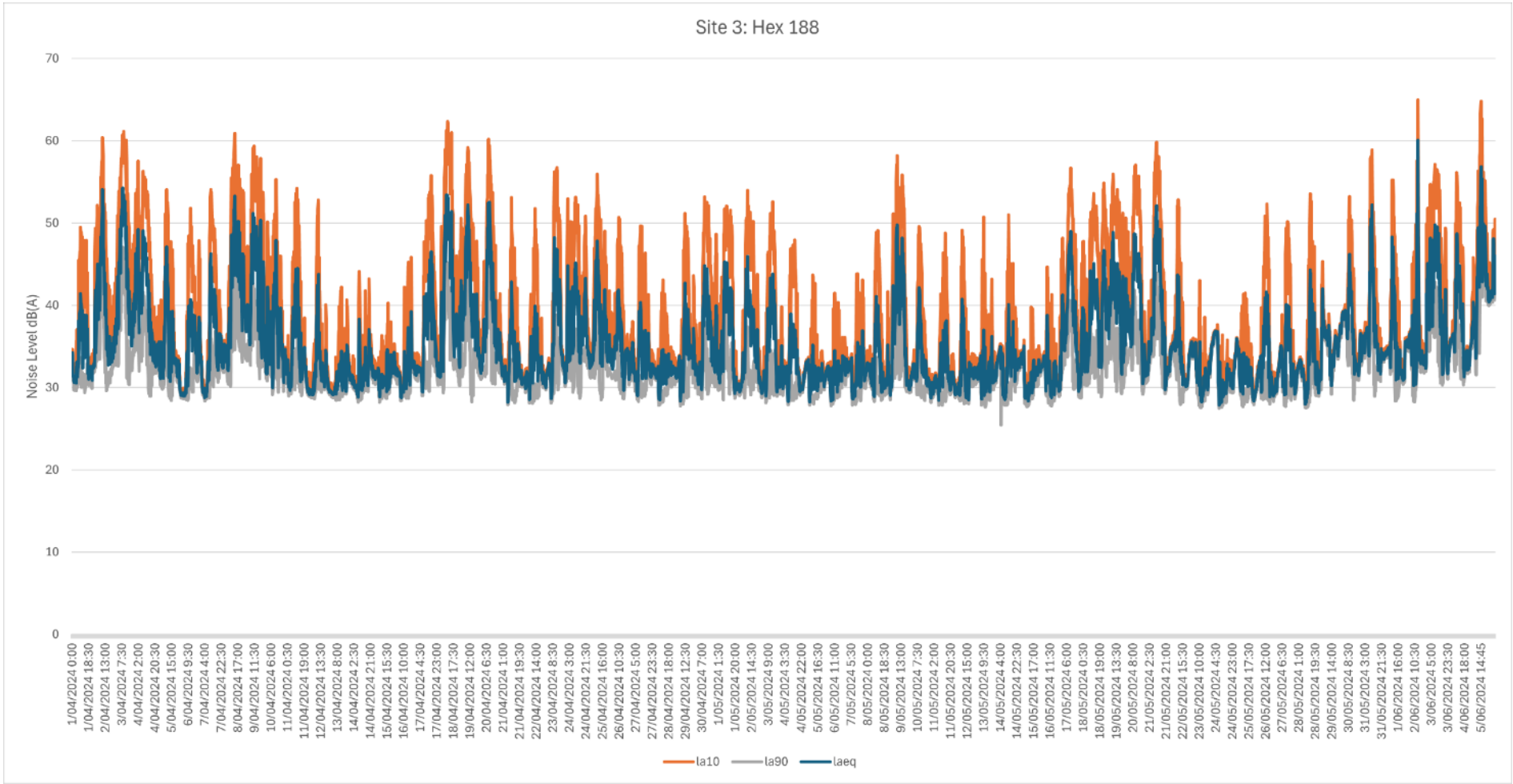
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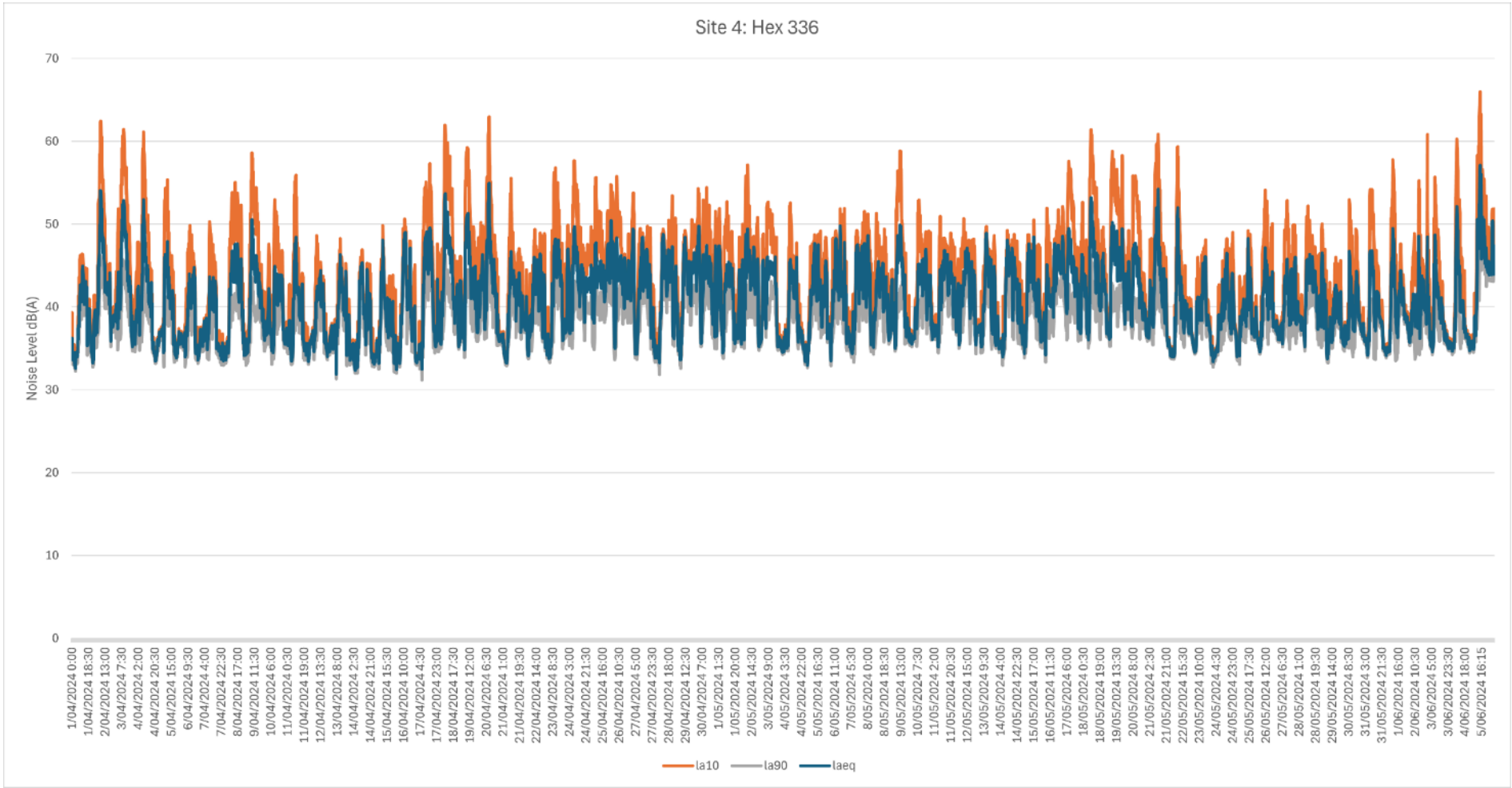
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60
50
40
30
20
10
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la10
la90
laeq

Assets | Engineering | Environment | Noise | Spatial | Waste

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