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Arnot South Environmental Authorisation and Water Use Licence, Mpumalanga Province

Environmental Noise Impact Assessment

Prepared for:
Exxaro Coal Mpumalanga (Pty) Ltd

Project Number:
UCD6802

August 2021

MP 30/5/1/2/3/2/1 (10292) MR

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Project Name:	Arnot South Environmental Authorisation and Water Use Licence, Mpumalanga Province
Project Code:	UCD6802

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DETAILS AND DECLARATION OF THE SPECIALIST

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I, Keenan Terry, declare that: –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
    - I declare that there are no circumstances that may compromise my objectivity in performing such work;
    - I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

11/08/2021

Signature of the Specialist *Date*

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EXECUTIVE SUMMARY

Exxaro Coal Mpumalanga (Pty) Ltd (Exxaro) was the holder of a Prospecting Right (PR), reference MP 30/5/1/1/2360 PR for the proposed Arnot South underground mine, situated in the Mpumalanga Province. The PR was authorised by the Department of Mineral Resources and Energy (DMRE) and included farm portions, Weltevreden 174 IS, Mooiplaats 165 IS, Vlakfontein 166 IS, as well as Schoonoord 164 IS. The PR was renewed in September 2017 and lapsed on 10 September 2020. However, a Mining Right Application (MRA) and Mine Works programme (MWP) were submitted by Exxaro to the DMRE before the lapsing of the PR. Exxaro was issued reference number MP 30/5/1/2/2/10292 MR.

The proposed development triggers Listed Activities in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R 982 of 4 December 2014 as amended by GN R326 of 7 April 2017) (EIA Regulations, 2014), as amended promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). Digby Wells Environmental (hereafter Digby Wells) is the appointed Environmental Assessment Practitioner (EAP) to undertake the environmental applications in support of the proposed Arnot South underground mine. The Environmental Authorisation (EA) process includes a suite of specialist studies including an Environmental Noise Impact Assessment (ENIA) in support of the EIA process.

The results from the field measurements show the LAeq recorded for both daytime and night-time. Based on the results, the LAeq daytime ambient noise levels at measurement locations; (N1 – 43dBA and N2 – 41dBA) were lower than the SANS 10103:2008 guidelines maximum limit rating of 45dBA for the daytime rural environment. The results for measurement location; (N3 – 46dBA) were higher than the SANS 10103:2008 guidelines maximum limit rating of 45dBA for the daytime rural environment. The noise sources impacting these measurement locations were natural (birds, dogs, cows and sheep) and anthropogenic (vehicular and agricultural activity). For night-time, the LAeq night-time ambient noise levels at measurement locations; (N1 – 26dBA and N2 – 29dBA) were lower than the SANS 10103:2008 guidelines maximum limit rating of 35dBA for night-time rural environment. The results for measurement location; (N3 – 38dBA) was higher than the SANS 10103:2008 guidelines maximum limit rating of 35dBA for night-time rural environment. The noise sources impacting these measurement locations were mainly natural (birds, dogs, cows and sheep).

In summary:

- The resulting overall ambient noise as determined by the noise monitoring survey complies with the acceptable standards for day and night-time noise in rural areas as recommended by SANS 10103:2008; and
- The noise contributions of vehicular and agricultural activity will to a large extent mask the daytime impact of the noise emissions caused by future mining operations at nearby sensitive receivers.

Noise dispersion modelling scenarios were conceptualized for the construction and operational phases, with the model predictions indicating a negligible impact on the ambient noise levels at sensitive receivers for daytime and significant impacts on the ambient noise levels at sensitive receivers for night-time from a SANS 10103:2008 perspective. In summary:

- No identified nearby sensitive receiver for the daytime construction and operational phases is predicted to experience noise impacts above the regulatory limits based on results from the cumulative evaluation;
- Sensitive receivers NR3 (also monitoring location N3), NR7 and NR9 for night-time operational phase are predicted to experience noise impacts above the regulatory limits based on results from the cumulative evaluation;
- Predicted future emissions from the daytime construction and operational phase of the project will not increase the ambient noise level by 7dBA or more;
- Predicted future emissions from the nighttime operational phase of the project will increase the ambient noise level by 7dBA or more at sensitive receivers NR7 and NR9; and
- In line with the community/group response (as per SANS 10103 guidelines) to noise generated from the different phases are categorized as “Little” (0-10dBA) resulting in “sporadic complaints” from the noise-sensitive receivers.

The findings from the model predictions and the impact assessment ranking methodology have indicated major impacts on the surrounding noise sensitive receivers. However, the implementation of mitigation measures during the different phases of the project is recommended. Once these mitigation measures are implemented, they will result in an emission reduction onsite and at the nearby receivers.

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LIST OF ACRONYMS, ABBREVIATIONS AND DEFINITION

Ambient Noise	Ambient noise is the noise from all sources combined − mining noise, traffic noise, birdsong, running water, etc.
A-weighting	The A-weighting filter covers the full audio range - 20 Hz to 20 kHz and the shape is similar to the response of the human ear at the lower levels
B&P	Bord and Pillar
CONCAWE	Conservation of Clean Air and Water in Europe
CM	Continuous Miner
dB(A)	Decibels, 'A' Weighted is the most commonly used standard frequency weighting designed to reflect the response of the human ear to noise.
Disturbing Noise	Disturbing noise refers to a noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7dBA or more.
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
ENIA	Environmental Noise Impact Assessment
IWULA	Integrated Water Use License Application
ktpa	kilotons per month
LA_{90}	The noise level exceeded for 90% of the measurement, calculated by statistical analysis.
LA_{eq}	A-frequency weighted, equivalent sound level value for a specific period measured using Impulse – time weighting.
LAmax	The maximum Sound Level with 'A' Frequency weighting and Fast Time weighting during the measurement period.
LAmin	The maximum Sound Level with 'A' Frequency weighting and Fast Time weighting during the measurement period.
LoM	Life of Mine
LReq,T	The equivalent continuous A-weighted sound pressure level, in decibels (dBA), determined over a specific time period.
MWP	Mine Works Programme

MRA	Mining Right Application
NCRs	Noise Control Regulations
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
Noise Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes, after such meter had been put into operation, and, if the alleged disturbing noise has a discernible pitch, to which 5 dBA has been added.
ROM	Run-off Mine
SABS	South African Bureau of Standards
SANS	South African National Standard
SLMs	Sound Level Meters
SPL	Sound Pressure Level
SPLs	Sound Power Levels
tpa	tonnes per annum

CONTENT OF THIS REPORT IN ACCORDANCE WITH THE REGULATION GNR982 OF 2014, APPENDIX 6 (AS AMENDED)

Legal Requirement		**Section in Report**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	iii to iv, 5
	(i) the specialist who prepared the report; and	iii to iv, 5
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	iii to iv, 5
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page iii to iv
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	3
cA	And indication of the quality and age of the base data used for the specialist report;	7.1
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	8.1

Legal Requirement		Section in Report
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	7.1.1.2
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	7
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	2
(g)	an identification of any areas to be avoided, including buffers;	N/A
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	2
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	4
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	8
(k)	any mitigation measures for inclusion in the EMPr;	11
(l)	any conditions/aspects for inclusion in the environmental authorisation;	N/A
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	12
(n)	a reasoned opinion (Environmental Impact Statement) -	N/A
	whether the proposed activity, activities or portions thereof should be authorised; and	N/A
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	11
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q)	any other information requested by the competent authority.	N/A

1. Introduction

Exxaro Coal Mpumalanga (Pty) Ltd (Exxaro) was the holder of a Prospecting Right (PR), reference MP 30/5/1/1/2360 PR for the proposed Arnot South underground mine, situated in the Mpumalanga Province. The PR was authorised by the Department of Mineral Resources and Energy (DMRE) and included farm portions, Weltevreden 174 IS, Mooiplaats 165 IS, Vlakfontein 166 IS, as well as Schoonoord 164 IS. The PR was renewed in September 2017 and lapsed on 10 September 2020. However, a Mining Right Application (MRA) and Mine Works programme (MWP) were submitted by Exxaro to the DMRE before the lapsing of the PR. Exxaro was issued reference number MP 30/5/1/2/2/10292 MR.

The proposed development triggers Listed Activities in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R 982 of 4 December 2014 as amended by GN R326 of 7 April 2017) (EIA Regulations, 2014), as amended, promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). Digby Wells Environmental (hereafter Digby Wells) is the appointed Environmental Assessment Practitioner (EAP) to undertake the environmental applications in support of the proposed Arnot South underground mine.

The process is being undertaken as per the requirements stipulated in the Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). Exxaro is initiating the required Integrated Environmental Authorisation (EA) and Water Use Licence Application (IWULA) processes to comply with the following requirements:

- NEMA;
- National Environmental Management: Waste Act, 2008 (Act No. 56 of 2008) (NEM: WA); and
- National Water Act, 1998 (Act No. 36 of 1998) (NWA).

The EA and IWULA applications require a suite of specialist studies in support of the Environmental Regulatory Process for the proposed Arnot South MRA, including an Environmental Noise Impact Assessment (ENIA).

2. Project Background and Description

The Arnot South Prospecting Area is approximately 10 km east of Hendrina, 25 km west of Carolina, and 50 km southeast of Middelburg. The Project is near two of Eskom's power stations, namely Hendrina and Arnot. There are five farm homesteads situated within the planned underground mining area and a small watercourse runs in a north-easterly direction across the northern half of the mining area. The land is currently mainly used for game farming. The target area for mining lies mainly on the farms Weltevreden 174 IS, Mooiplaats 165 IS, Vlakfontein 166 IS, and Schoonoord 164 IS.

As stated in the MWP provided, the No. 2 Seam is the only economically viable seam to mine. The depth of the Seam varies between 10 m to 100 m below the surface. Figure 2-1 below, extracted from the MWP, shows the depth distribution.

The initial underground mine has an estimated Life of Mine (LoM) of 17 years, producing 2.4 million Run of Mine (ROM) tonnes per annum (tpa). A potential future resource of approximately 32,912,300 tonnes has been identified to the South of the MRA, further drilling will be required to confirm the resources. It is anticipated (depending on the markets for the S2 and S4 coal) that the future resource will allow for an additional mining period of approximately 13 years. This mining right application is for 30 years.

2.1. Mining

The planned LoM for the proposed Arnot South underground mine, “the Project”, is estimated to be 17 years. A box cut, located in the southeast has been designed and shall allow access to the S2 underground workings. An eight degree (°) ramp, 8.0 m wide, shall give access into the box cut and to the underground entrance portals. The inclination of the ramp shall allow rubber-wheeled equipment to travel up and down the ramp unassisted. The basis of the selected position of the box cut is on the most practical underground mining layout with the least conveyor belt transfer points.

The mining of the initial reserve shall be by utilising underground Continuous Miner (CM) on the bord and pillar (B&P) layout method due to the reserves being deep. Mining shall commence in the south-eastern end of the block from where the underground mining shall develop northwest.

All the necessary mine infrastructure for the proposed Project shall be established on the MP 30/5/1/1/2/360 PR area and shall be placed on the farm Weltevreden 174 IS on the southern part of the mining layout area.

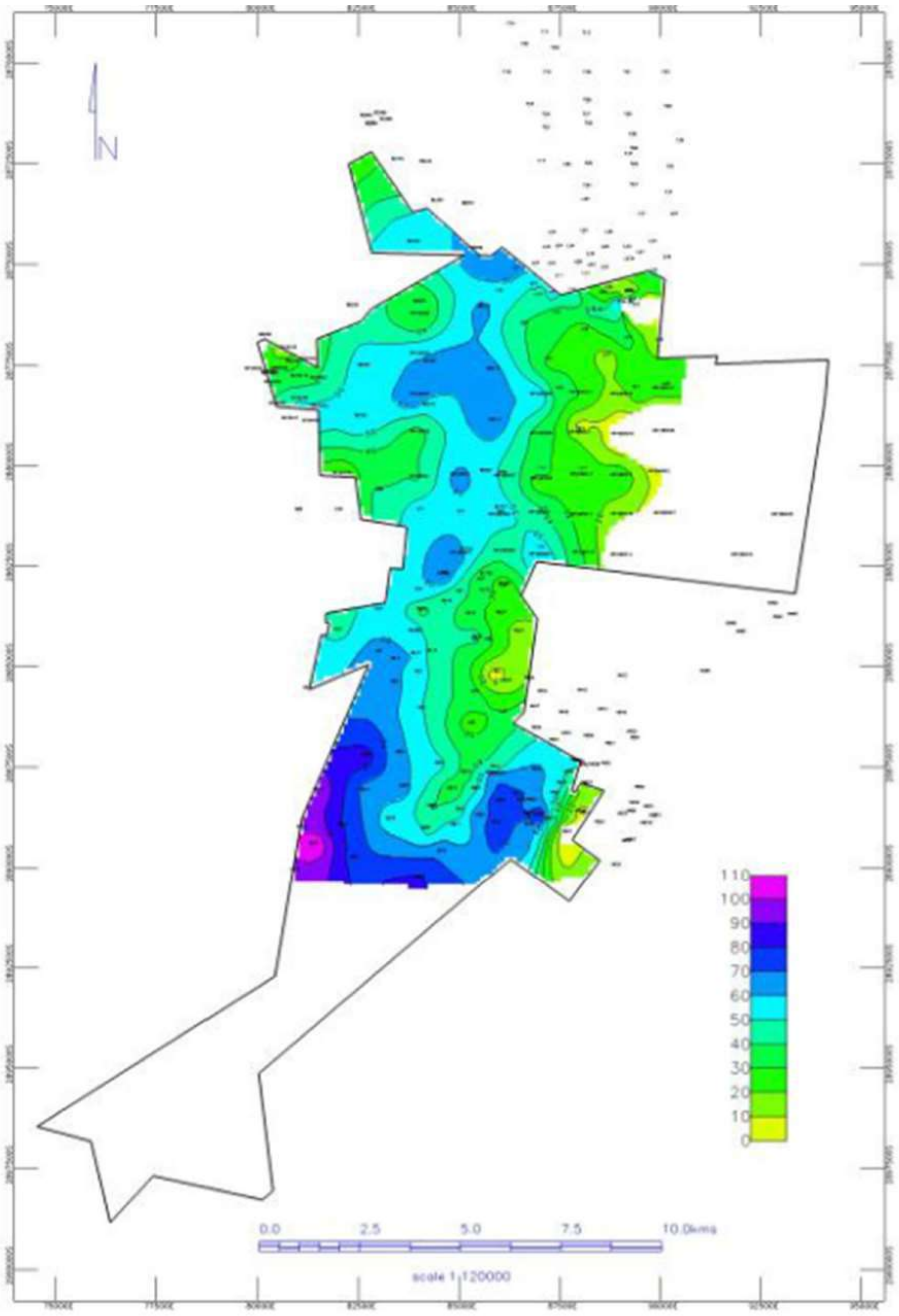

Figure 2-1: Seam Elevation

(Source: Arnot South Mining Works Programme, 2020)

2.2. Proposed Infrastructure

The proposed mining infrastructure for the Arnot South underground mine and their respective locations in relation to the proposed Arnot South Mining Right Boundary can be seen in Figure 2-2: The infrastructure footprint for this ENIA will be defined as the “Project Area”. The infrastructure footprint is the physical location where the different surface infrastructures will be placed.

The Project list of activities for the construction, operational, and decommissioning phases are depicted in Table 2-1 below. This detailed list of project activities will be used for impact assessment.

Table 2-1: Project Phases and Associated Activities

Project Phase	Project Activity
Construction Phase	Removal of vegetation/topsoil for the establishment of mining and linear infrastructure
	Establishing the box cut
	Construction of infrastructure, and ventilation Shafts.
	Construction of access road and haul roads
	Stockpiling of soils, rock dump and discard dump establishment.
Operational Phase	Ventilation fans and infrastructure area containing stockpile areas
	Underground blasting
	Maintenance of haul roads, pipelines, machinery, water, effluent, and stormwater management infrastructure and stockpile areas.
	Removal of rock(blasting)
	Concurrent rehabilitation as mining progresses
Decommissioning Phase	Demolition and removal of infrastructure
	Post-closure monitoring and rehabilitation
	Closure of the underground mine

2.3. Project Locality

The Arnot South Mining Right Boundary is situated in the Mpumalanga Province, within the Nkangala and Gert Sibande district municipalities as well as within the Steve Tshwete and Chief Albert Luthuli local municipalities. Refer to Figure 2-3 for the local setting map of the proposed Project.

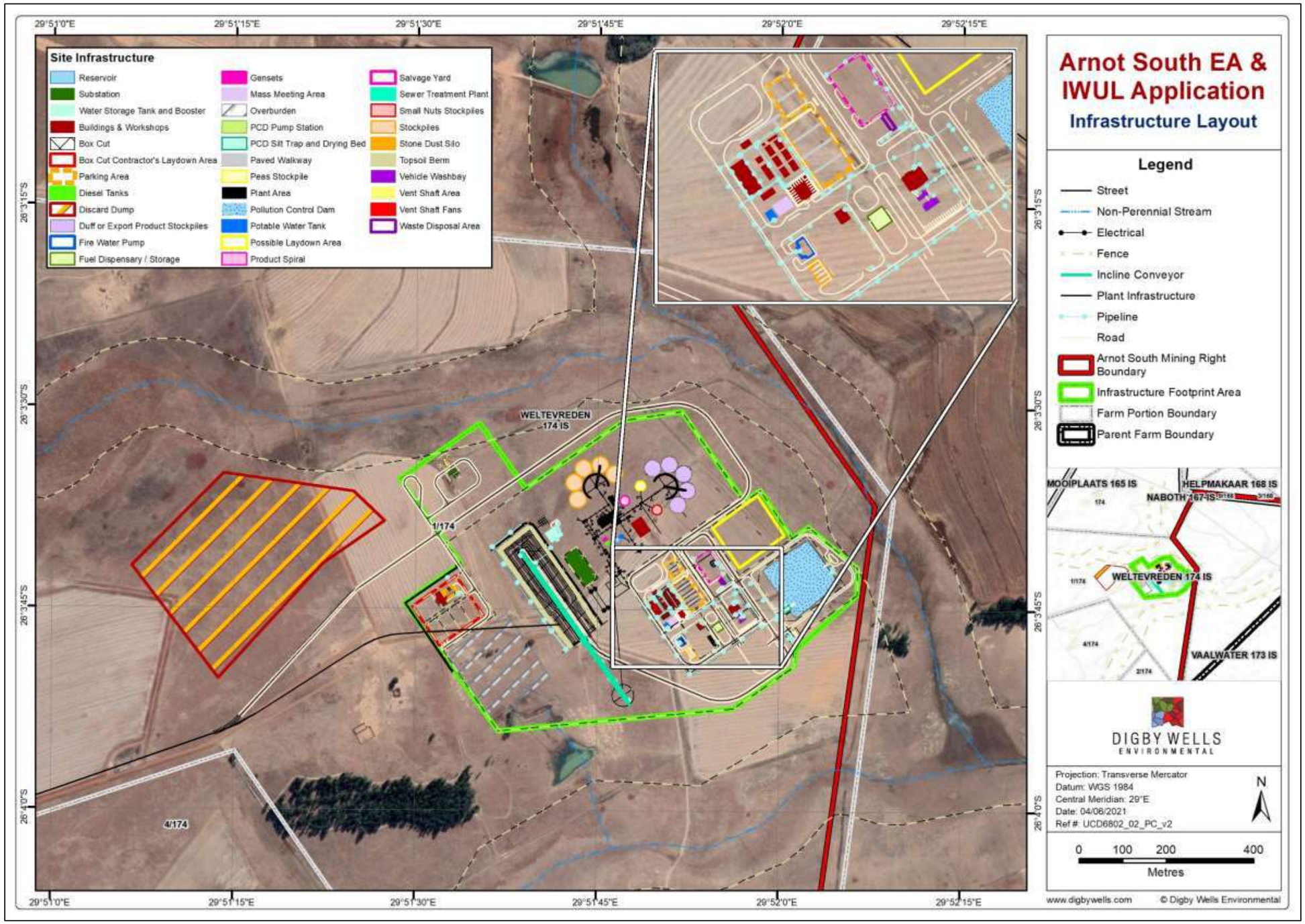

Figure 2-2: Infrastructure Layout

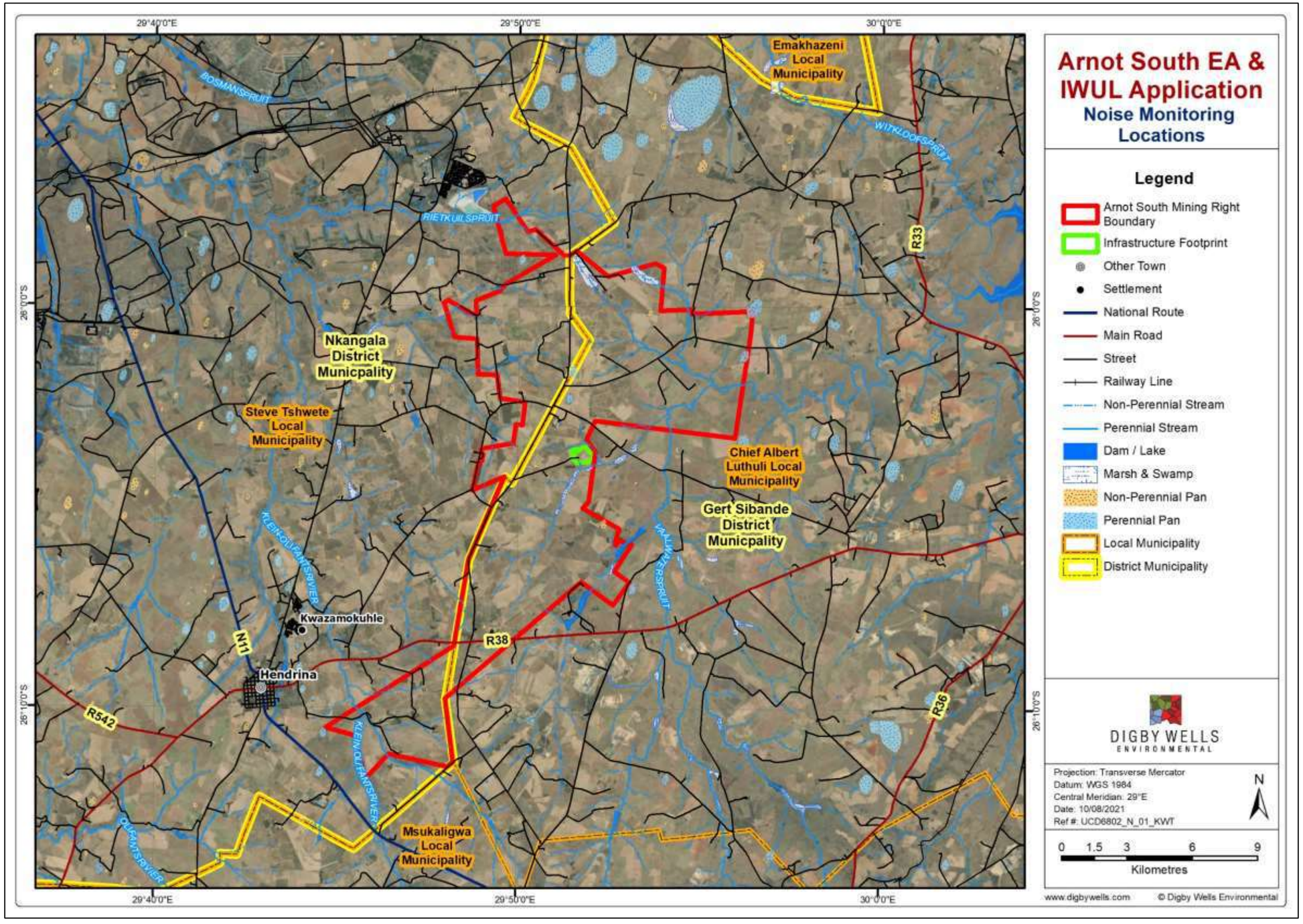

Figure 2-3: Local Setting

3. Scope of Work (SoW)

The ENIA aims to establish the current/existing soundscape of the receiving environment (Project area and immediate surroundings) and a noise dispersion modelling assessment to predict the future implications of mining on the ambient noise levels and exposure scenarios. The aforementioned applies to the nearby sensitive receivers as a result of the construction and operational phases of the proposed Project.

Based on the above, the noise scope of work encompasses the following:

- Environmental noise baseline monitoring surveys;
- Assessment of the future noise impacts and comparison against regulatory standards for compliance; and
- Recommendations of management measures, including mitigation and monitoring requirements.

4. Assumptions, Limitations and/or Exclusions

Assumptions, limitations and exclusions pertaining to this Project are discussed in Table 4-1 and are included as part of this assessment.

Table 4-1: Assumptions, Limitations and Exclusions

Assumption, Limitation, or Exclusion	Consequence
The construction phase is assumed to be carried out during daytime hours only (06:00-18:00).	Only a daytime scenario was modelled.
The modelling adopted a conservative worst-case scenario approach assuming that all activities for each phase are being carried out simultaneously.	This approach may lead to over prediction of the noise impact on-site and at the receiver.
A 1.8km segment of the main road was modelled for the impact of traffic noise. It was assumed that the remaining extent of the road would experience similar impacts.	None, standard approach to reduce large model calculation areas.
Noise measurements could not have been conducted at noise receivers NR7, NR10 and NR26 due to farm access issues.	Alternative locations further away from the infrastructure footprint had to be selected.
No audio recordings were recorded at noise monitoring location N2. It is assumed that noise sources documented (field notes) for daytime will be the same as night-time.	None, generally noise sources experienced during the day is similar to those at night.

5. Details of the Specialist(s)

Keenan Terry (Author) is the Noise Lead and Environmental GIS Specialist at Digby Wells & Associates (Pty) Ltd. He obtained a BSc. degree in Environmental Science as well as a BSc (Hons) degree in Environmental Science from the University of Kwa-Zulu Natal. He is a member of the South African Council for Natural Scientific Professions (SACNASP), the International Association for Impact Assessment South Africa (IAIAsa), and the South African Geomatics Council (SAGC).

6. Relevant Legislation, Standards and Guidelines

The legislation, regulation, and guidelines considered in this noise report are tabulated and discussed briefly in Table 6-1. The applicable standards in terms of compliance are discussed in Section 6.1 below.

Table 6-1: Applicable Legislation, Regulations, Guidelines, and By-Laws

Legislation, Regulation, Guideline, or By-Law	Applicability
National Noise Control Regulations, R.154 of 1992 (the Noise Regulations) promulgated in terms of Section 25 of the Environmental Conservation Act, 1989 (Act 73 of 1989) The National Noise-Control Regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) (NCRs) form part of the Environmental Conservation Act and these Regulations apply to external noise. The NCRs differentiates between Disturbing Noise levels (which is objective and scientifically measurable which are generally compared to existing ambient noise level) and Noise Nuisance (which is a subjective measure and is defined as noise that "*disturbs or impairs or may disturb or impair the convenience or peace of any person*"). Local Authorities use Controlled Areas to identify areas with high noise levels. Restrictions have been set out for development that occurs in these Controlled Areas. These regulations make provision for guidelines pertaining to noise control and measurements. The regulations make reference to the use of the South African National Standards 10103:2008 (SANS) guidelines for the Measurement and Rating of Environmental Noise with Respect to Land Use, Health, and Annoyance and to Speech Communication. As such, a Noise Impact Assessment in accordance with the NCRs must be undertaken for submission to determine the potential disturbing and nuisance noise levels associated with a particular development.	The purpose of these Regulations is to prescribe general measures for the control of noise.

Legislation, Regulation, Guideline, or By-Law	Applicability
South African National Standard (SANS) 10103:2008 Edition 6: The measurement and rating of environmental noise with respect to annoyance and to speech communication The standard covers methods and gives guidelines to assess working and living environments with respect to acoustic comfort, excellence, and with respect to possible annoyance by noise (i.e., whether complaints can be expected). It also gives a method to predict speech communication efficiency	The purpose of this standard is to provide a guideline for the measurement and rating of environmental noise.
South African National Standard (SANS) 10328:2008 Edition 2: Methods for environmental noise impact assessments The standard covers procedures for environmental noise impact investigations and assessments.	The purpose of this standard is to provide a guideline for environmental noise impact investigations and assessments. Therefore, this ENIA has been prepared in compliance with this standard

6.1. Applicable South African Standards

The NEMA,1998 (Act No. 107 of 1998) as amended provides a legislative framework for environmental management in South Africa. Principles from NEMA are relevant to noise pollution, Section 24(4) b(i) … "*the investigation and* assessment of the potential impacts of activities that require authorisation or permission.", and Section 24(7). The principles from NEMA (GN R320 of 20 March 2020) provides the criteria for the specialist assessment and minimum report content requirements for the impacts of noise on the environment for activities requiring environmental authorisation.

The NCR is the primary law on noise in the Republic of South Africa (GN R154 of 10 January 1992) and forms part of the Environmental Conservation Act (ECA), 1989 (Act 73 of 1989). The Regulations puts in place various measures for the prevention of noise pollution and national norms as well as standards for the regulation of noise in South Africa. Based on the NCRs, it is prohibited to make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device, or apparatus or any combination thereof. The NCRs describe a "disturbing noise" as a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7dBA or more. The zone sound level also referred to as the acceptable rating levels, sets the acceptable noise levels for ambient noise in various districts (Table 6-2).

In 1996, Schedule 5 of the Constitution devolved responsibility to the provinces to administer these regulations themselves. To date, only three have done so, these include the Western Cape (RN 627/PG 5309/19981120), Gauteng (GN 5479/PG 75/19990820), and Free State (GN 24/PG 35/19980424). Subsequently, the NCRs have been repealed in these provinces. Also, various municipalities have their By-Laws regarding noise control.

The South African Bureau of Standards (SABS) is the National Standards Body in the Republic of South Africa that is responsible for the development, maintenance, and promotion of South African National Standards (SANS) as mandated by the Standards Act No.8 of 2008. The SANS10103:2008 and SANS 10328:2008 have been identified in NEMA,1998 (Act No. 107 of 1998) (GN R320 of 20 March 2020) as the national standard for the assessment of noise impacts for residential and non-residential areas as defined in these standards. The acceptable rating levels according to SANS 10103:2008 for ambient noise in different districts (residential and non-residential) are presented in Table 6-2.

Table 6-2: Acceptable Rating Levels for Noise in Districts (SANS 10103, 2008)

Type of District	Equivalent continuous rating level ($L_{Reg.T}$) for noise (dBA)					
	Outdoors			Indoors, with open windows		
	Day-night	Day-time	Night-time	Day-night	Day-time	Night-time
	$L_{R,DNA}$	$L_{Req,d}$[b]	$L_{Req,n}$[b]	$L_{R,dn}$[a]	$L_{Req,d}$[b]	$L_{Req,n}$[b]
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON-RESIDENTIAL DISTRICTS						
d) Urban districts with some workshops, with business premises, and with main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50
NOTE 1 If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table might result.						
NOTE 2 If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken and specialist advice should be obtained. In this case the indoor sound levels might significantly differ from the values given in columns 5 to 7						
NOTE 3 In districts where outdoor $L_{R,dn}$ exceeds 55 dBA, residential buildings (e.g. dormitories, hotel accommodation and residences) should preferably be treated acoustically to obtain indoor $L_{Req,T}$ values in line with those given in table 1.						

Type of District	Equivalent continuous rating level ($L_{Reg.T}$) for noise (dBA)					
	Outdoors			Indoors, with open windows		
	Day-night	Day-time	Night-time	Day-night	Day-time	Night-time
	$L_{R,DNA}$	$L_{Req,d}$[b]	$L_{Req,n}$[b]	$L_{R,dn}$[a]	$L_{Req,d}$[b]	$L_{Req,n}$[b]
NOTE 4 For industrial districts, the $L_{R,dn}$ concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24 h day/night cycle, LReq,d = LReq,n =70 dBA can be considered as typical and normal.						
NOTE 5 The values given in columns 2 and 5 in this table are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.						
NOTE 6 The noise from individual noise sources produced, or caused to be produced, by humans within natural quiet spaces such as nature reserves, private game farms, national parks, wilderness areas and bird sanctuaries, should not exceed a maximum Weighted sound pressure level of 50 dBA at a distance of 15 m from each individual source.						
A - The values given in columns 2 and 5 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise and the time of day.						
B - The values given in columns 3, 4, 6 and 7 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness.						
C – $L_{Req,T}$ is the equivalent continuous A-weighted sound pressure level (LAeq,T) during a specified time interval, plus specified adjustments for tonal character, impulsiveness of the sound and the time of day.						
D – dBA 'A-weighted' is a standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.						

The SANS10103:2008 also provides guidelines for addressing the issues concerning environmental noise and for estimating communities' responses to increases in the general ambient noise levels as a result of an intruding noise. The probable community/group response to levels over the acceptable rating levels are presented in

Table 6-3, where LReq,T is the equivalent continuous A-weighted sound pressure level, in decibels (dBA), determined over a specific period. 'A-weighted' is a standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.

Table 6-3: Categories of Community/Group Response (SANS 10103, 2008)

Excess ($\Delta L_{Req,T}$)[a]dBA	Estimated community/group response	
	Category	Description
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 - 20	Strong	Threats of action

Excess ($\Delta L_{Req,T}$)[a]dBA	Estimated community/group response	
	Category	Description
>15	Very strong	Vigorous action
NOTE Overlapping ranges for the excess values are given because a spread in the community reaction might be anticipated.		
a ΔLReq,T should be calculated from the appropriate of the following:		
1) ΔLReq,T = LReq,T of ambient noise under investigation MINUS LReq,T of the residual noise (determined in the absence of the specific noise under investigation);		
2) ΔLReq,T = LReq,T of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1;		
3) ΔLReq,T = LReq,T of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from table 2; or		
4) ΔLReq,T = Expected increase in LReq,T of ambient noise in an area because of a proposed development under investigation.		

7. Methodology

The approach used in investigating the noise impacts of the proposed Project on the sensitive receivers is covered in the section below.

7.1. Environmental Noise Baseline Assessment

The baseline characterisation encompassed a description of the existing soundscape using measurement data at pre-selected noise receivers in the vicinity of the proposed Project area.

7.1.1. Existing Soundscape

The existing soundscape refers to the acoustic environment as perceived or experienced and/or understood by a person or people (Axelsson et al, 2019). The existing soundscape was determined based on the results of a noise monitoring survey that was conducted in June 2021 at three (3) pre-selected noise-sensitive receiver locations. Google Earth® Imagery was used to identify the nearby sensitive receivers in the vicinity of the Project area.

7.1.1.1. Sensitive Receivers

Sensitive receptors include, but are not limited to; industrial, educational and residential facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to noise pollution. The locations of the potential sensitive receivers are displayed in Figure 7-1.

7.1.1.2. Measurement of Ambient Noise Levels

The noise monitoring survey (site visit) was undertaken from 21st June – 25th June 2021 to determine ambient noise levels at sensitive receivers. The approach used was based on NEMA,1998 (Act No. 107 of 1998) as amended (GN R320 of 20 March 2020) and the SANS

10103:2008 standard. Noise is often classified into roughly three (3) categories; Continuous, Intermittent, and Impulsive noise. According to Bruel and Kjaer, 2001 these noise types are defined as follows:

- Continuous noise refers to noise that occurs without interruption such as noise produced by machinery i.e., pumps or processing equipment when in operation;
- Intermittent noise refers to noise that operates in cycles or events such as noise produced by a passing vehicle or aircraft; and
- Impulsive noise refers to noise from impacts or explosions, e.g., from a pile driver, punch press or gunshot

The noise monitoring locations were chosen to be as relevant as possible to the Project design and were designated as N1, N2 and N3. It is anticipated that these locations would remain the same for construction and operational phase monitoring. Table 7-1 and Figure 7-1 indicate the noise monitoring locations where noise measurements were conducted.

Table 7-1: Noise Measurement Locations

Site ID	Location	Category of receiver	GPS coordinates
N1	Farm Homestead	Rural districts	26° 2'9.15"S & 29°49'59.00"E
N2	Farm Homestead	Rural districts	26° 3'25.03"S & 29°49'26.89"E
N3	Farm Homestead	Rural districts	26° 4'9.75"S & 29°50'50.54"E

During the site visit, long-term continuous measurements of forty-eight (48) hours per monitoring location were recorded, with ambient noise levels collected every second for the duration of the measurement at each receiver. The measurements took into account both daytime as well as night-time noise characteristics. According to the SANS 10103:2008 standard ‘Day – 6 am to 22 pm’ and ‘Night – 22 pm to 6 am’.

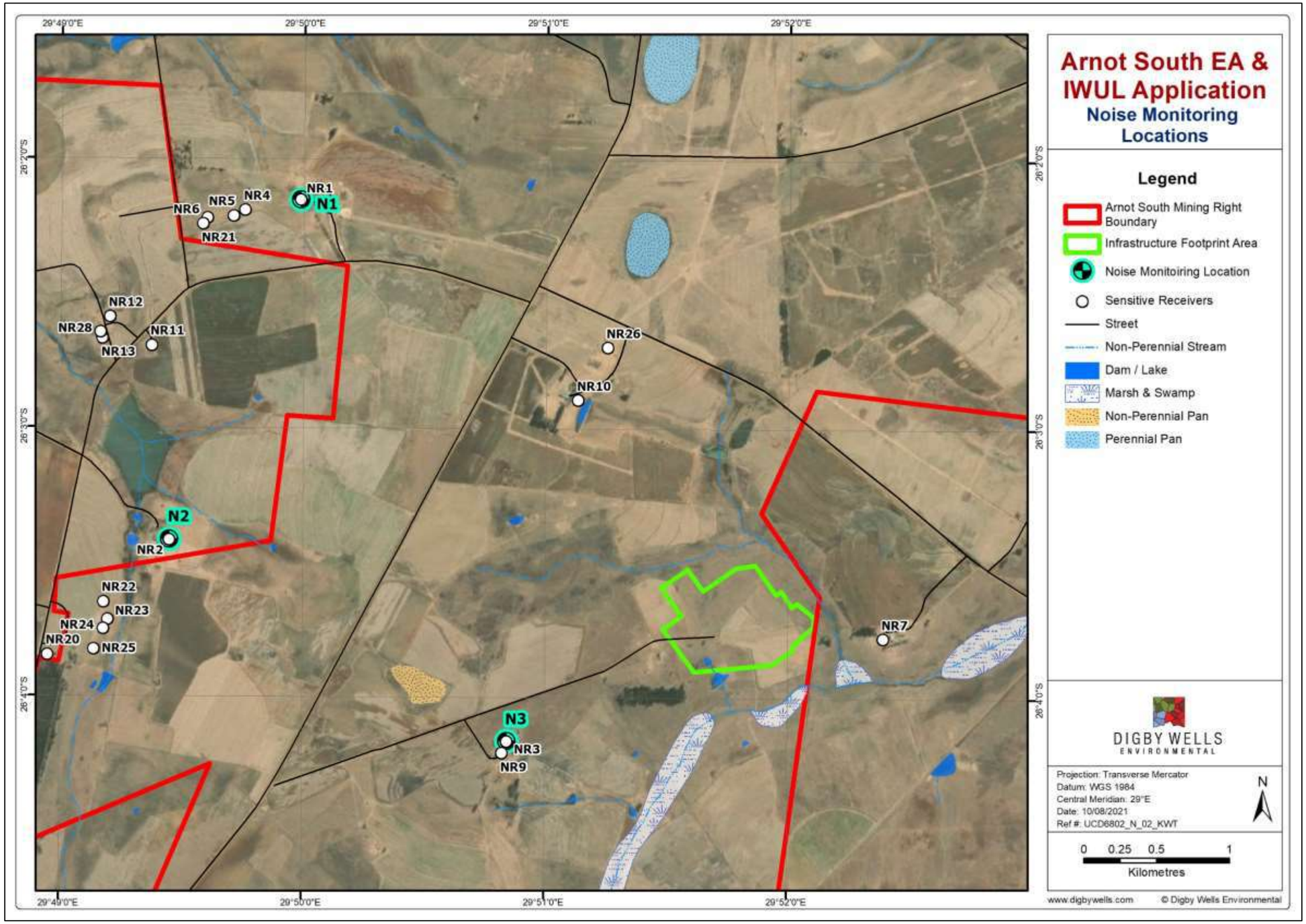

Figure 7-1: Noise Measurement and Sensitive Receivers Locations

A Cirrus, Optimus Green, ‘Class 1, precision grade’ Sound Level Meters (SLMs), compliant with International Standards IEC 61672-1 was used for the measurements. The instrument was field calibrated with a Cirrus, sound level calibrator and 1/3 octave band logging were employed. Measurements were taken at a measurement height of 1.5 m above ground level and no closer than 3m to any reflecting surface (e.g., wall) in accordance with the SANS 10103:2008 standard (see Figure 7-2 to Figure 7-4).

Figure 7-2: Noise Monitoring at Location N1

Figure 7-3: Noise Monitoring at Location N2

Figure 7-4: Noise Monitoring at Location N3

The parameter measured at each location included but was not limited to, the equivalent continuous sound pressure level (LAeq). It is a common practice to measure noise levels using the A-weighting setting built into all SLMs. The LAeq noise level data describes the average noise level for the measurement period taking into account all noise sources that were audible at the specific measurement location. The ambient noise measurements, including the A-weighted sound level parameters for minimum (LAmin), maximum (LAmax), 90th percentile (LA90) for the four measurement locations were also record and archived.

The meteorological conditions were also captured for the duration of the measuring period and are displayed in Table 7-2.

Table 7-2: Meteorological Conditions (World Weather Online, 21-25 June 2021)

	Air Pressure (mb)	Relative Humidity (%)	Temperature (°C)	Wind Speed (km/h)	Rain (mm)
Average	1023	43	13	8	0
Maximum	1029	74	19	19	0
Minimum	1017	25	8	2	0

7.2. Future Noise Sources and Sound Power Levels

This section describes various sources of noise associated with the construction and operational phases of the proposed Project that can result in noise emissions audible to the nearby sensitive receivers in the area. Namely, noise from industry, electricity generation and transportation.

7.2.1. Industry Noise (Mining Infrastructure – Equipment and Machinery)

The mechanized industry creates serious noise problems for sensitive receivers. This noise is due to the machinery of all kinds and often increases with the power of the machine. Sound generation mechanisms of machinery are reasonably well understood, and the noise may contain predominantly low or high frequencies, tonal components, be impulsive or have unpleasant and disruptive temporal sound patterns.

Noise from the construction and operation of fixed installations such as ventilation fans, workshop facilities, processing and treatment plants etc. often result in noise emissions. Mobile equipment/machinery such as dozers, cranes, excavators etc. also result in noise emissions and may affect nearby sensitive receivers. Noise emissions from the proposed noise generating mining infrastructure will be assessed in this noise study.

7.2.2. Electricity Generation (Substation, Transformers, and Transmission Lines)

Noise generated from electricity generation (substation, transformers, and transmission lines) does not create serious noise problems for sensitive receivers. Electrical service providers such as Eskom go to great lengths to minimise the noises associated with electricity generation and transmission. Transformer and substation noise is generated when the sheet steel used in the core of the transformer deforms when being magnetized, this is known as magnetostriction (De Jager,2018). Due to the transformer core being composed of many sheets of steel, the deformation in each sheet occurs erratically in comparison to its neighbour which results in the “low frequency hum sound” frequently associated with transformers. This noise is relatively easy to mitigate with the use of acoustic shielding and the placement of the transformer in relation to the sensitive receivers therefore will not be considered further in this study.

Corona noise is the most common noise associated with transmission lines and is heard as a crackling or hissing sound. Corona is the breakdown of air into charged particles caused by the electrical field at the surface of conductors. This type of noise varies with both weather and voltage of the line (70kV or higher) and most often occurs in conditions of heavy rain and high humidity (typically >80%). An electric field surrounds power lines and causes implosion of ionized water droplets in the air, which produces the sound. Since Corona noise is only a feature during fog or rain, transmission line noise will not be considered further in this study.

7.2.3. Transportation Noise (Haul and Access Road)

Transportation noise, including road traffic, rail traffic and air traffic noise creates serious noise problems for sensitive receivers. As a general rule, larger and heavier vehicles emit more noise than smaller and lighter vehicles. The noise of road vehicles is mainly generated from the engine and frictional contact between the vehicle and the ground and air. In general, road-contact noise exceeds engine noise at speeds higher than 60 km/h. The sound pressure level (SPL) from traffic can be predicted from the traffic flow rate, the speed of the vehicles, the proportion of heavy to light vehicles, and the nature of the road surface. Traffic noise

generated from the usage of the main (13km), access (3km) and haul roads will be assessed in this noise study.

Based on the aforementioned, an inventory of the noise generating equipment/machinery (point, line and area noise sources) including their octave band SPLs was developed for the proposed Project based on industry experience and information gathered from similar operations as well as Exxaro. The SPLs for noise generating equipment/machinery per project phase are presented in Table 7-3. The SPLs are given in the A-weighted scale, which is used to filter the sound levels according to the human ear's varying response to different frequencies.

Table 7-3: Sound Power Levels from Main Noise Generating Equipment / Machinery

Project Phase	Noise Source	Sound Power Level dBA
Construction Phase	Backhoe	97
	Bulldozer	103
	Concrete Truck	106
	Dump Truck	107
	General Noise	96.5
	Grader	114
	Raise Bore Machine (Vertical reamer)	113.0
	Skid Steer	109
	Truck-Mounted Crane	105
	Vibratory Soil Compactor & Smooth Drum Roller	100
	Water Truck	109
	Excavator	103
Operational Phase	Ventilation Fan	110.1
	Bulldozer	103
	General Noise	96.5
	Water Truck	109
	Coal Handling Preparation Plant (CHPP)	115
	Conveyor	79.5

The total number of the noise generating equipment/machinery (point, line and area noise sources) including their octave band SPLs were imported into the SoundPlan Essential modelling software for noise dispersion modelling.

7.3. Noise Dispersion Modelling

The future noise impacts of the proposed development were estimated using the **CON**servation of **C**lean **A**ir and **W**ater in **E**urope (CONCAWE) calculation method for noise dispersion modelling. Noise dispersion modelling simulates outdoor sound propagation and predicts the noise levels at the sensitive receivers. The SoundPlan Essential modelling software was used for carrying out the computational calculations of the noise dispersion model in accordance with the CONCAWE calculation method. The model is described in the sections below.

7.3.1. Model Description

The CONAWE method is a prescribed standard (SANS 10357:2004 'The calculation of sound propagation by the CONCAWE method') in South Africa for calculating the propagation of sound over distances of up to two kilometres, under a variety of meteorological and topographical conditions. In addition, the method accounts for:

- The attenuation of noise due to the geometrical spreading of the noise;
- The effect of the ground surface;
- Height of the source and receiver;
- Atmospheric attenuation/absorption; and
- The screening effect of the topography and other barriers (vegetation, walls, berms etc.).

The CONCAWE method calculates the octave band sound pressure levels at a receiver from the following information:

- The octave band power levels of the source;
- The pressure, temperature and the relative humidity of the air;
- The wind speed and the wind direction; and
- The nature of the ground surface between the source and the receiver.

The aforementioned information, including topography (elevation) data, is imported into the SoundPlan Essentials modelling software. The software generates corrections such as the correction for working hours of industrial noise sources etc. within the software using industry-accepted equations before calculating the predicted octave band sound pressure levels at a receiver. Traffic noise is also calculated within the software taking into account corrections for speed, the number of vehicles (light and heavy) gradient and the surface of the proposed road.

7.3.2. Predicted Future Noise Impact

The approach applied for determining the predicted future noise impacts associated with the proposed Project were drawn from the NCRs as well as the guidelines provided by SANS 10103:2008. The noise impacts were assessed by comparing the predicted propagating noise

levels derived from the output of the noise dispersion model with the current ambient noise levels established during the baseline assessment survey.

8. Findings and Discussion

A summary of the ENIA findings as they relate to the baseline environment and the future impacts associated with the construction and operational phases of the proposed Project is provided below.

8.1. Baseline Environment

The receiving environment (project area and its immediate surroundings) is predominantly characterised by scattered farm homesteads, low population density and can therefore be classified as a rural geographic area (Pateman, 2011). The identified land use of the receiving environment is agriculture (subsistence and commercial farming), transportation (main access roads) and residential (farm homesteads). The noise sources that were audible during the noise monitoring survey, contributing to the existing soundscape are depicted in Table 8-1. The noise sources in the area were predominantly natural with birds, dogs, cows and sheep contributing the most to the daytime and night-time ambient noise levels at the various measurement locations. The predominant anthropogenic noise sources significantly influencing both the daytime ambient noise levels at the various measurement locations were vehicular (light and heavy vehicles) activity along the access roads including driveways and agricultural equipment (machinery and vehicles i.e., tractors).

Table 8-1: Noise Sources Identified

Location ID	Day	Noise Type	Night	Noise Type
N1	Birds (birdsong/chirping)	Intermittent	Birds (birdsong/chirping)	Intermittent
	Domestic animals (dogs barking)	Intermittent	Domestic animals (dogs barking)	Intermittent
	Vehicular (light and heavy vehicles) activity along the driveway.	Intermittent	Vehicular (light and heavy vehicles) activity along the driveway.	Intermittent
	Communication (People talking)	Intermittent	Livestock (Cows)	Intermittent
	Agricultural Equipment (Machine Running)	Continuous		
N2 (No audio recordings captured. Noise sources identified during daytime survey)	Birds (birdsong/chirping)	Intermittent	Birds (birdsong/chirping)	Intermittent
	Vehicular (light) activity along the driveway.	Intermittent	Vehicular (light) activity along the driveway.	Intermittent
	Agricultural Equipment (Tractor)	Intermittent	Livestock (Cows and Sheep)	Intermittent
	Livestock (Cows and Sheep)	Intermittent		
N3	Livestock (Cows and Sheep)	Intermittent	Livestock (Cows and Sheep)	Intermittent
	Birds (birdsong/chirping)	Intermittent	Birds (birdsong/chirping)	Intermittent
	Communication (People talking)	Intermittent	Domestic animals (dogs barking)	Intermittent
	Metal scraping	Intermittent		
	Domestic animals (dogs barking)	Intermittent		
	Poultry (Chickens)	Intermittent		

Location ID	Day	Noise Type	Night	Noise Type
	Vehicular (heavy vehicles) activity along the driveway	Intermittent		
	Music Playing	Intermittent		

8.1.1. Sensitive receivers

Due to the low population density of the receiving environment, sensitive receivers are limited and are at a distance from the proposed Project area (refer to Figure 7-1). The only nearby sensitive receivers closer the operation was a farm homestead, within 5km of the proposed noise generating infrastructure locations.

8.1.2. Ambient Noise Levels

The results of the noise monitoring survey are presented in Table 8-2 and discussed in the sections below. The ambient noise levels recorded on-site, the rating limits according to the SANS 10103:2008 guidelines, are presented side by side. The SPL is given in the A-weighted scale, which is used to filter the sound levels according to the human ear's varying response to different frequencies.

The time history graph per noise measurement location is displayed in Figure 8-1 to Figure 8-3. The graph shows the noise profile data as recorded in-field by the Cirrus SLM instrument and is presented in the A-weighted scale.

Table 8-2: Baseline Noise Measurements

Sample ID	SANS 10103:2008 rating limit					
	Type of district	Period	Acceptable Rating Level dBA	$L_{Aeq,T}$ dBA (Field Measurement)	Maximum / Minimum dBA	Date
N1	Rural	Daytime	45	43	88 / 22	07/06/2021– 08/06/2021
		Night-time	35	26	71 / 24	
N2	Rural	Daytime	45	41	83 / 11	09/06/2021 – 11/06/2021
		Night-time	35	29	71 / 26	
N3	Rural	Daytime	45	46	82 / 28	04/06/2021 – 05/06/2021
		Night-time	35	38	65 / 27	
	Indicates current $L_{Aeq,T}$ levels above either the daytime rating limit or the night-time rating limit					

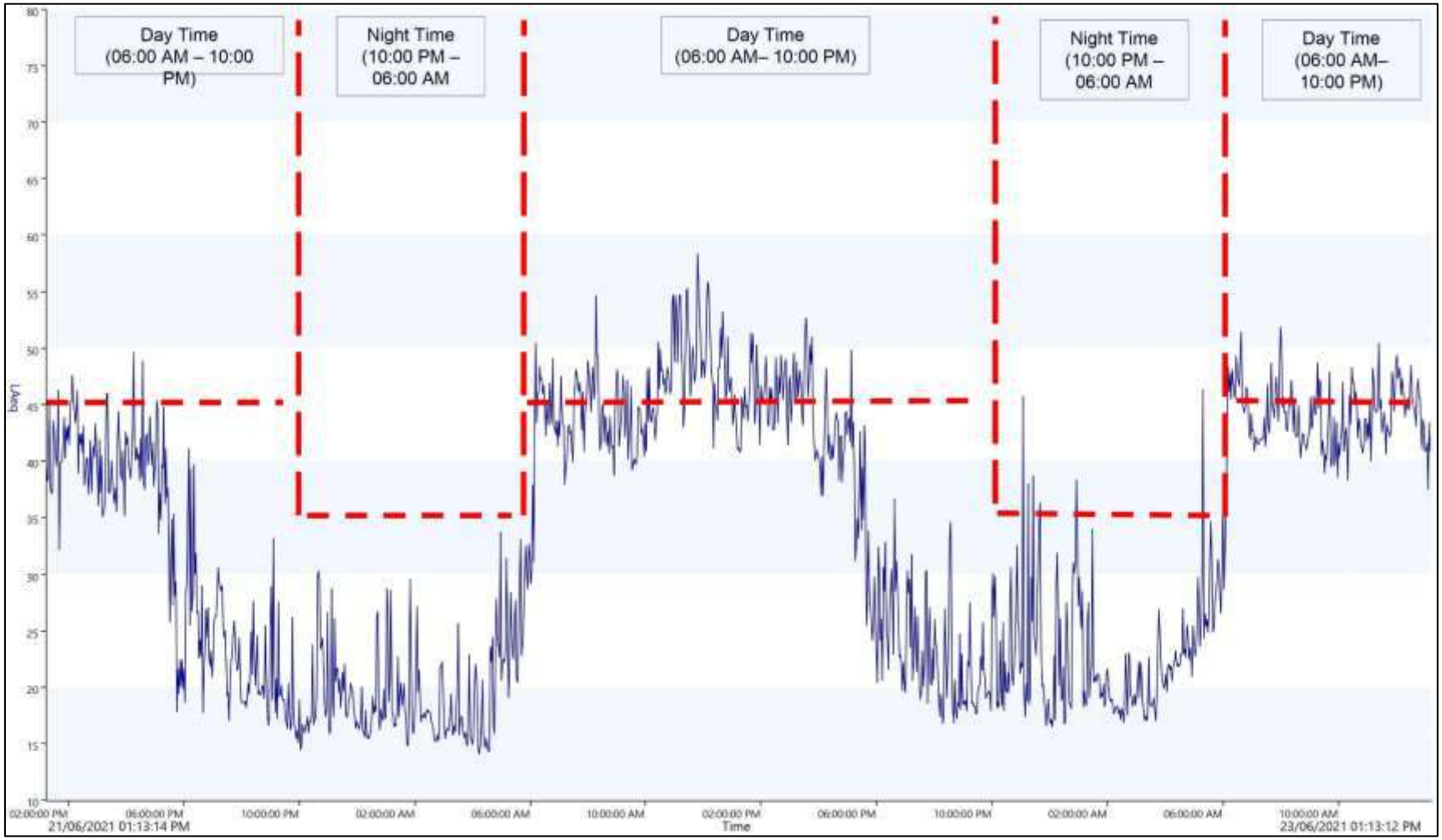

Figure 8-1: Noise Time Series Graph for N1

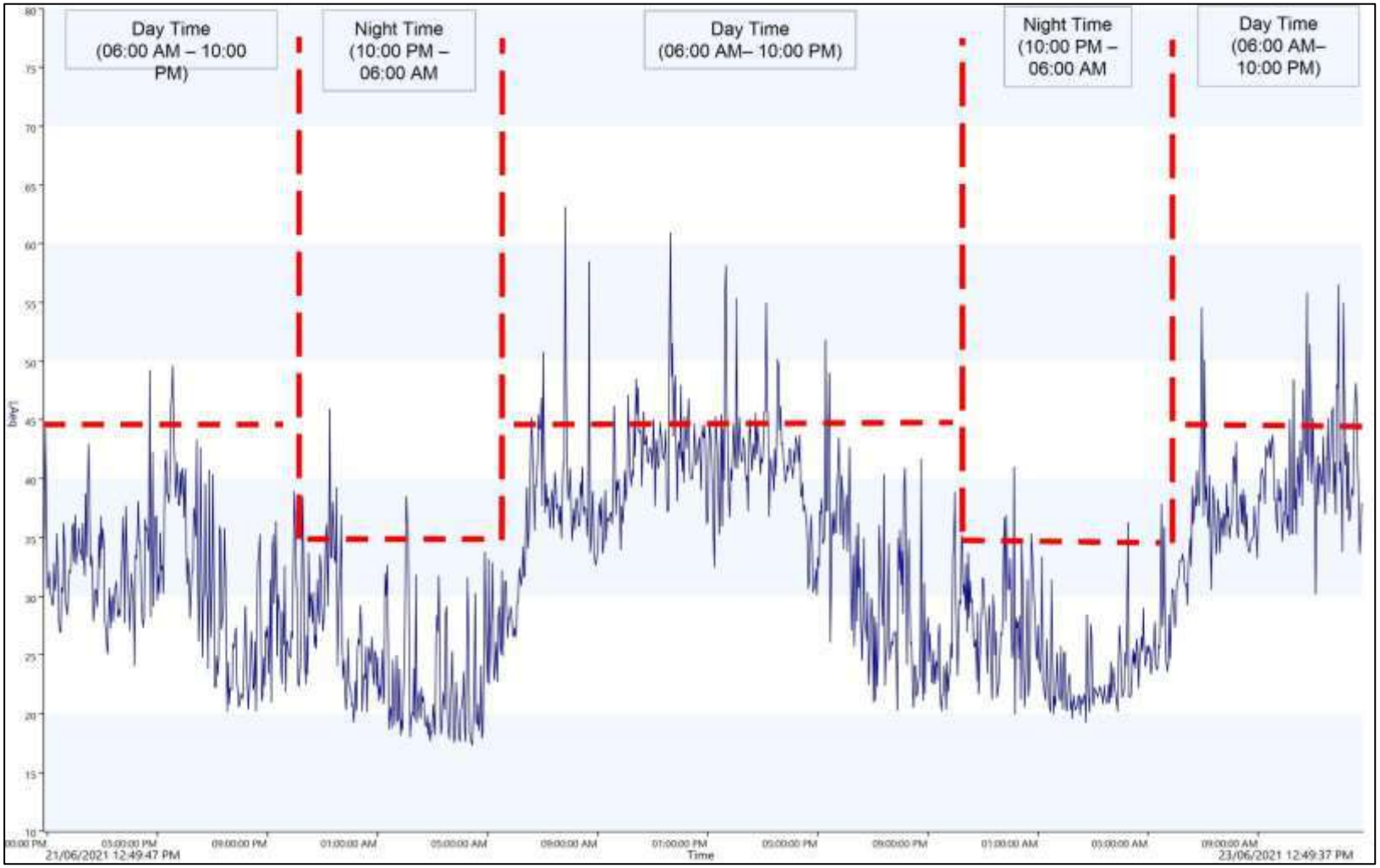

Figure 8-2: Noise Time Series Graph for N2

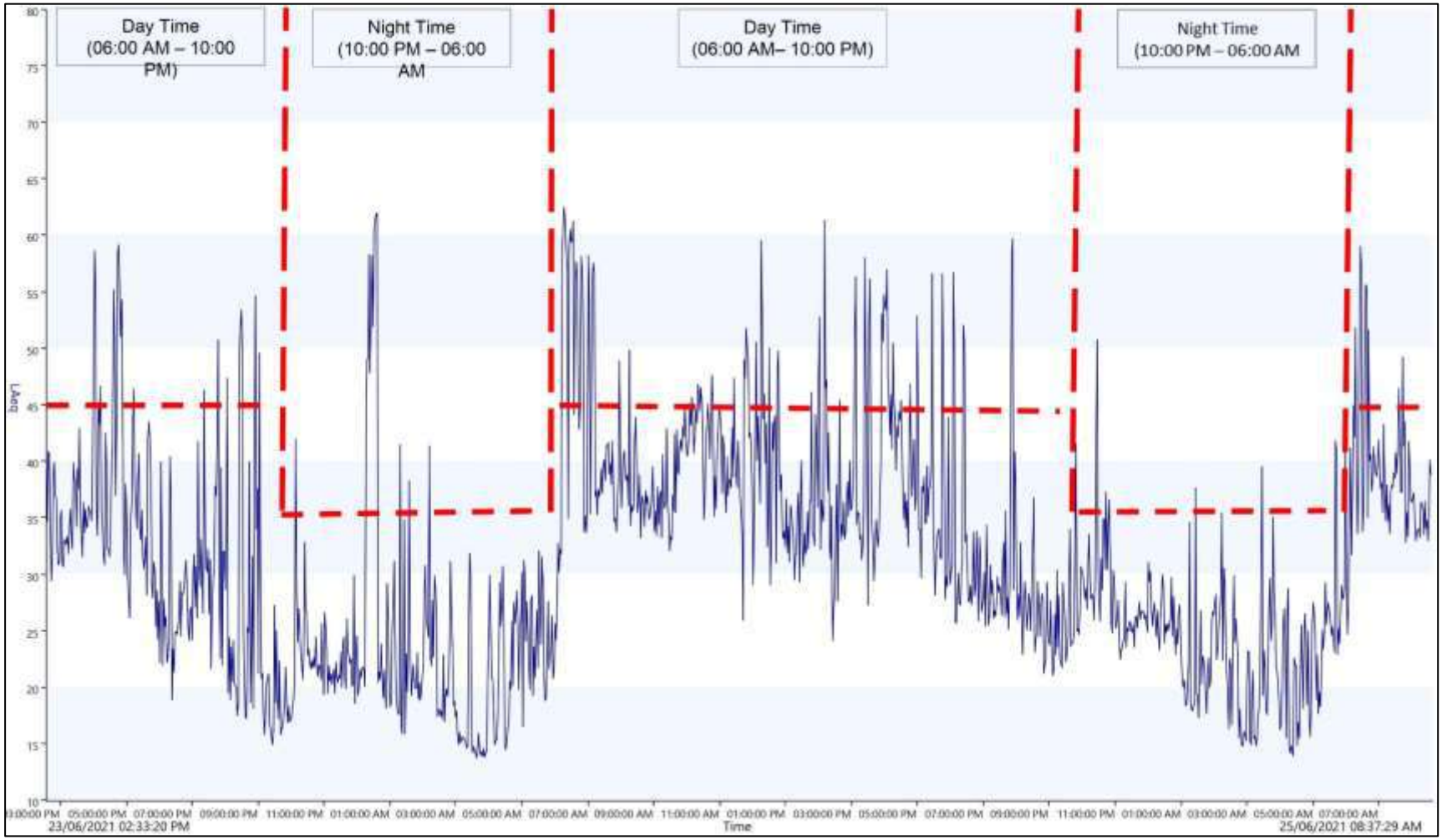

Figure 8-3: Noise Time Series Graph for N3

8.1.2.1. Day-Time Results

The LAeq for daytime ambient noise level measured throughout the measuring period for all monitoring locations was 43dBA which is below the SANS guidelines maximum limit rating of 45dBA allowable for outdoor daytime ambient noise in rural districts. The LAeq for daytime ambient noise level at measurement locations N1 and N2 were 43dBA and 41dBA respectively, these measurements were below the SANS 10103:2008 guidelines maximum limit rating of 45dBA. The LAeq for daytime ambient noise level at measurement location N3 was 46dBA, this measurement was the only measurement above the SANS guidelines maximum limit rating of 45 dBA.

The identified noise sources contributing to the daytime ambient noise levels at the various measurement locations are presented in Table 8-1.

The results from the measurements suggest that the overall ambient noise levels of the receiving environment comply with the acceptable standards for daytime noise in rural districts.

8.1.2.2. Night-Time Results

The LAeq night-time ambient noise level measured throughout the measuring period for all monitoring locations was 31dBA which is below the SANS 10103:2008 guidelines maximum limit rating of 35dBA allowable for outdoor night-time ambient noise in rural districts. The LAeq for night-time ambient noise level at measurement locations N1 and N2 were 26dBA and 29dBA respectively, these measurements were below the SANS guidelines maximum limit rating of 35dBA. The LAeq for night-time ambient noise level at measurement location N3 was 38dBA, this measurement was the only measurement above the SANS guidelines maximum limit rating of 35dBA .

The identified noise sources contributing to the night-time ambient noise levels at the various measurement locations are presented in Table 8-1.

The results from the measurements suggest that the overall ambient noise levels of the receiving environment comply with the acceptable standards for night-time noise in rural districts.

8.2. Noise Model Simulations

The Project-related isolines (lines of equal sound pressure levels) generated are reported and discussed for the construction phase (daytime only) and operational phase (daytime and night-time). Findings are presented in the sections below.

8.2.1. Construction Phase Model Results

The noise isolines or contour lines for the construction phase are depicted in Figure 8-4. The model results for the daytime construction phase presented in Figure 8-4 indicates that the areas where the daytime limit of 45dBA is predicted to be exceeded are mostly confined within 1.5km of the proposed noise generating sources (without mitigation measures). Therefore,

sensitive receivers greater than 1.5km from the proposed noise generating sources can expect limited noise disturbance during the construction phase. In addition, model results also indicate that during the daytime, no sensitive receivers will experience noise levels that exceed the SANS 10103 guidelines maximum daytime limit of 45dBA. As a result, the construction phase impacts on the receivers are considered negligible from a SANS 10103:2008 perspective.

8.2.2. Operational Phase Model Results

The noise contour maps are displayed in Figure 8-5 and Figure 8-6 showing the predicted noise levels for day and night-time during the operational phase.

The model results for the daytime operational phase presented in Figure 8-5, indicates that sound propagation is highest (exceeds the daytime limit of 45dBA) within a 1.5km radius of the proposed noise generating sources (without mitigation measures). Therefore, receivers at a distance greater than 1.5km from the proposed noise generating sources will experience limited noise disturbance during the operational phase of the Project. In addition, model results from a traffic noise perspective indicate that sound propagation is highest (exceeds the daytime limit of 45dBA) within a 100m distance from the main and access road. Therefore, receivers at a distance greater than 100m from the main and access road will experience limited noise disturbance during the operational day-time phase of the Project. It is predicted based on the model results that no sensitive receivers are within the areas where the noise level are predicted to exceed the limit value of 45dBA. As a result, the noise impact of the proposed Project on noise levels at these receivers during the daytime is negligible from a SANS 10103:2008 perspective.

The results for the night-time operational phase presented in Figure 8-6 indicate that sound propagation is highest (exceeds night-time limit of 35dBA) within a 2km radius of the proposed noise generating sources (without mitigation measures). Therefore, receivers at a distance greater than 2km from the noise generating sources will experience limited noise disturbance during the night-time. In addition, model results from a traffic noise perspective indicate that sound propagation is highest (exceeds the daytime limit of 35dBA) within a 500m distance from the main and access road. Therefore, receivers at a distance greater than 500m from the main and access road will experience limited noise disturbance during the operational night-time phase of the Project. It is predicted based on the model results that three (3) sensitive receivers (NR7, NR9 and NR3 – monitoring location N3) are within the areas where the noise level is predicted to exceed the limit value of 35dBA. As a result, the noise impact of the proposed Project on noise levels at these three receivers during the daytime is significant from a SANS 10103:2008 perspective.

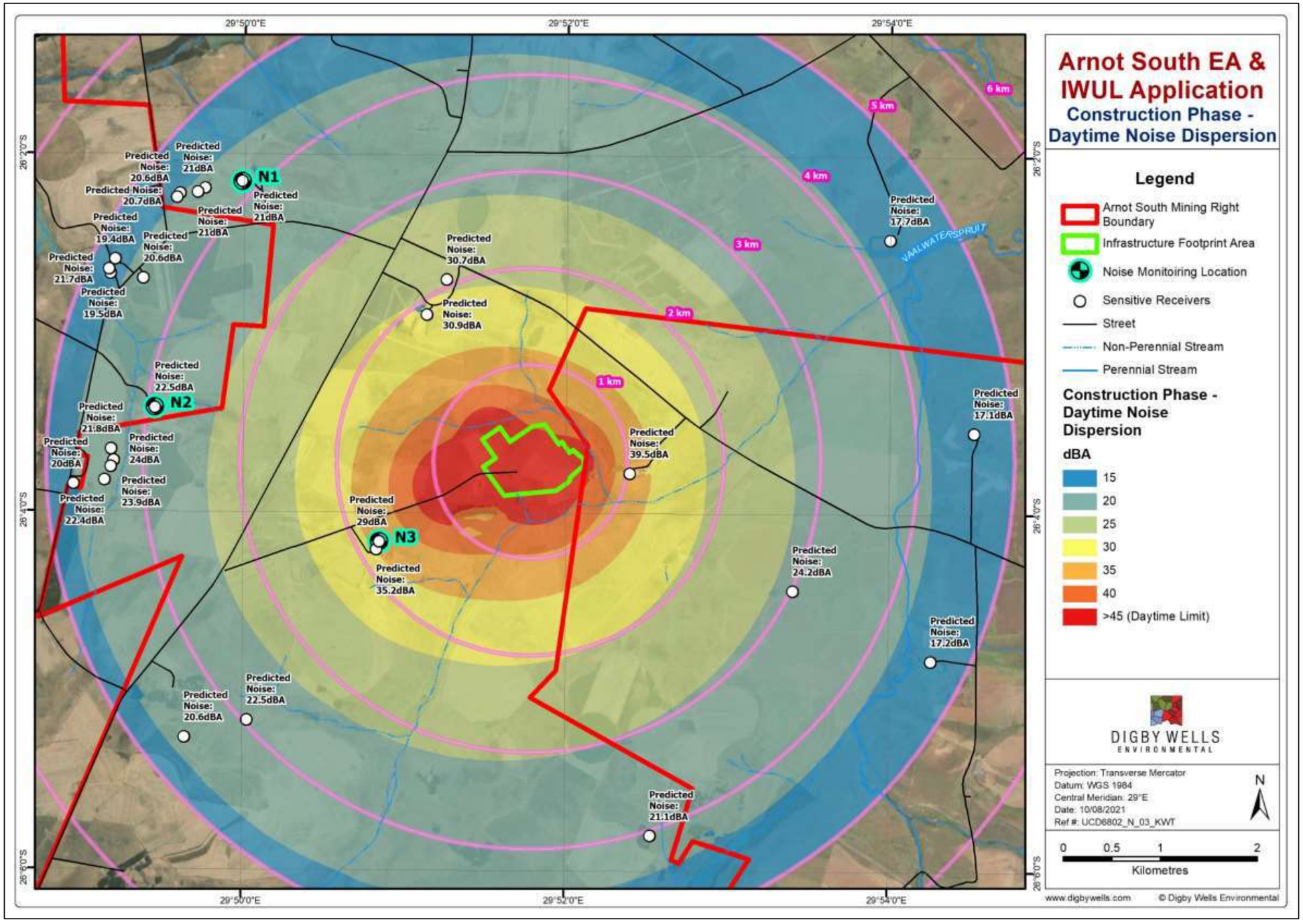

Figure 8-4: Predicted Noise at Selected Receivers for the Construction Phase (Daytime)

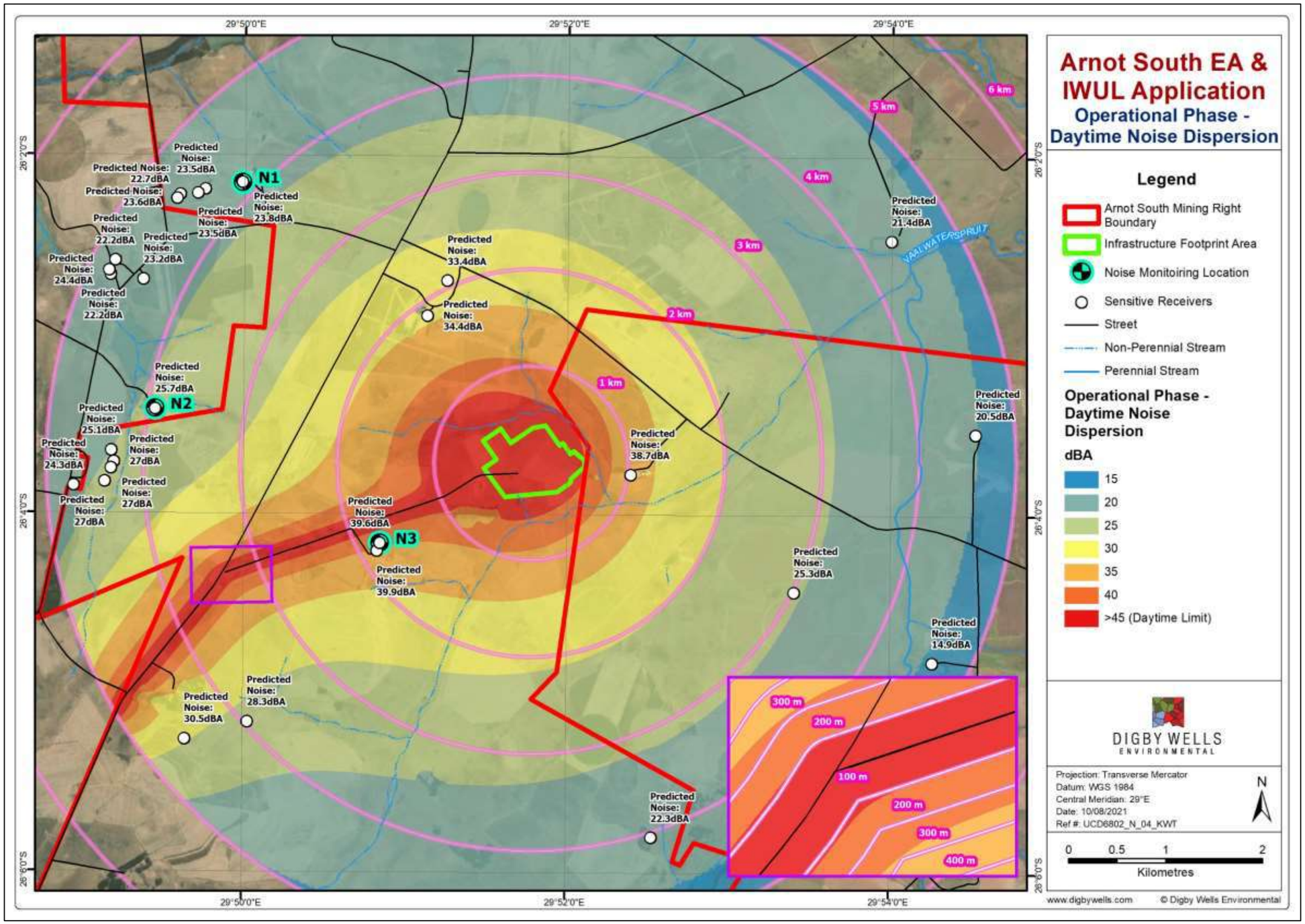

Figure 8-5: Predicted Noise at Selected Receivers for the Operational Phase (Daytime)

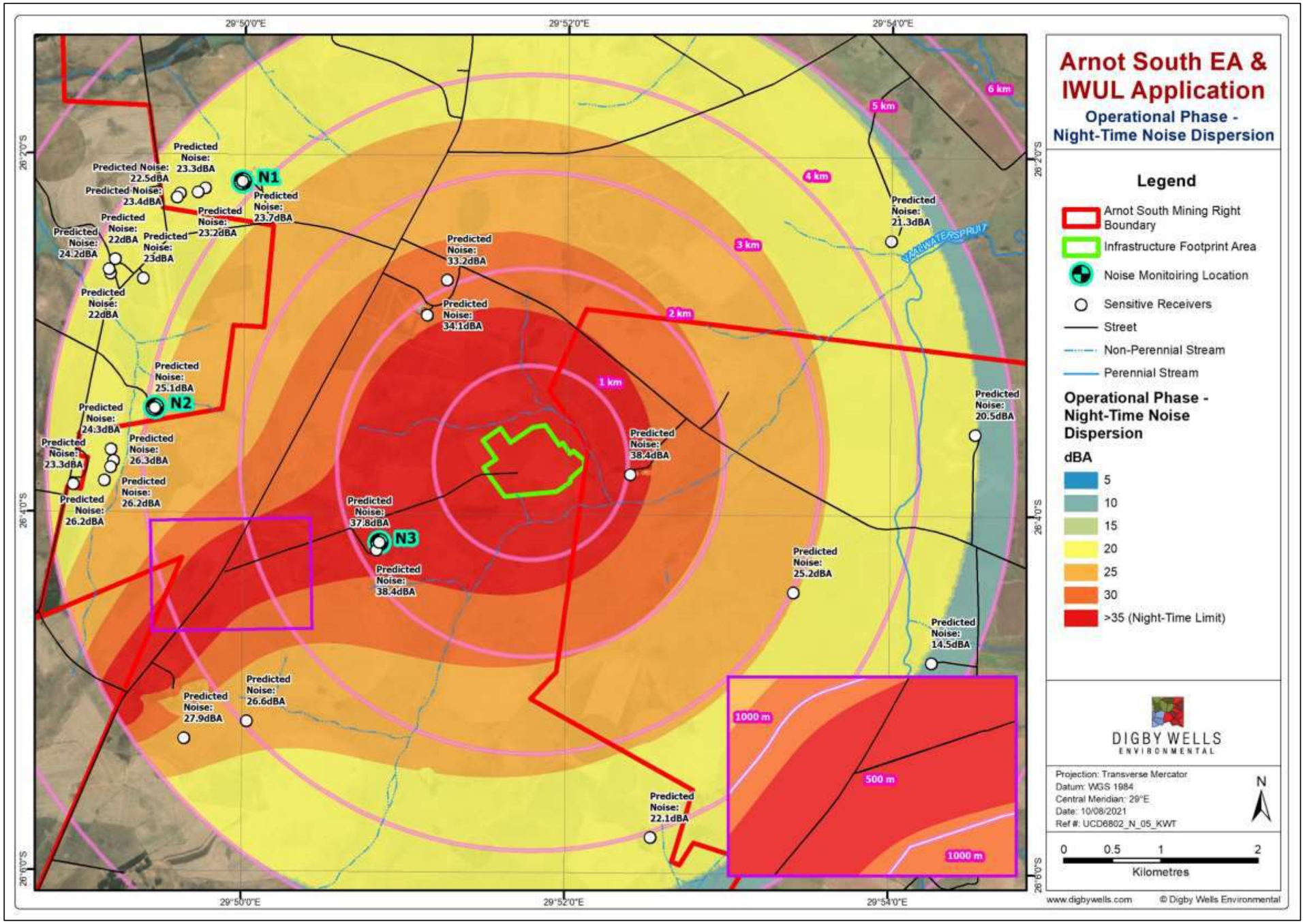

Figure 8-6: Predicted Noise at Selected Receivers for the Operational Phase (Night-Time)

8.2.3. Predicted Future Noise Impacts Results

8.2.3.1. Construction

The daytime results indicate that the noise emissions will not result in a noise disturbance in terms of the NCRs at any of the receivers (Table 8-3). The reason being that the construction activities will not increase the ambient noise level by 7dBA or more, above the daytime baseline. Also, the community/group response (as per SANS 10103 guidelines) to the noise emissions from the day-time construction phase activities is categorized as “Little” (0-10dBA), resulting in “Sporadic complaints” if any from the noise-sensitive receivers.

Table 8-3: Cumulative Future Impact for the Construction Phase (Daytime Only)

Receivers	Daytime ambient noise levels measured at the receivers (dBA)	Predicted (dispersion model) noise from construction activities (dBA)	Cumulative level (dBA)	Increase in ambient noise level dBA
Day Time				
N1	43	21	43	0
N2	41	22.5	41	0
N3	46	29	46	0
	Indicates predicted $L_{Aeq,T}$ levels above the daytime rating limit rating limit of 45dBA.			
	Indicates increase in the ambient noise level by 7dBA or more.			

8.2.3.2. Operational

The day-time results for the proposed operational phase activities indicate that the expected noise levels during the operational phase will not result in a noise disturbance in terms of the NCRs at any of the receivers (refer to Table 8-4). The reason being that the daytime noise emissions from the operational phase activities will not increase the ambient noise level by 7dBA or more above the baseline values. In addition, the community/group response (as per SANS 10103 guidelines) to noise emissions from the daytime operational phase can be categorized as “Little” (0-10 dBA), resulting in “Sporadic complaints” from the noise-sensitive receivers.

The night-time results for the proposed operational phase activities indicate that the expected noise levels during the operational phase will result in a noise disturbance in terms of the NCRs at receivers NR7 and NR9 (refer to Table 8-4). The reason being that the night-time noise emissions from the operational night-time phase activities is expected to increase the ambient noise level at receivers NR7 and NR9 by 7dBA or more above the baseline values. In addition, the community/group response (as per SANS 10103 guidelines) to noise

emissions from the night-time operational phase can be categorized as “Little” (0-10 dBA), resulting in “Sporadic complaints” from the noise-sensitive receivers.

Table 8-4: Cumulative Future Impact for the Operation Phase (Day and Night-time)

Receivers	Daytime ambient noise levels measured at the receivers (dBA)	Predicted (dispersion model) noise from construction activities (dBA	Cumulative level (dBA)	Increase in ambient noise level dBA
Daytime				
N1	43	23.8	43	0
N2	41	25.7	41	0
N3	46	39.6	47	1
Night-Time				
Receivers	**Night-time ambient noise levels measured at the receivers (dBA)**	**Predicted (dispersion model) noise from construction activities (dBA**	**Cumulative level (dBA)**	**Increase in ambient noise level dBA**
N1	26	23.7	28	2
N2	29	25.1	30	1
N3	38	37.8	41	3
NR7	31*	38.4	39	8
NR9	31*	38.4	39	8
	Indicates predicted $L_{Aeq,T}$ levels above either the daytime rating limit of 45dbA or the night-time rating limit of 35dBA.			
	Indicates increase in the ambient noise level by 7dBA or more.			

9. Environmental Noise Impact Assessment

The impact assessment ranking methodology in Appendix A was applied in rating the implications of the different phases of the Project on the ambient noise levels of the receiving environment. The impact assessment approach has been formalised to comply with Regulation 31(2)(l) of the NEMA.

* Overall night-time ambient noise level measured at the noise sensitive receivers.

9.1. Construction Phase

Activities during the Construction Phase that may have potential impacts on the ambient noise levels in the area are indicated in Table 9-1.

Table 9-1: Interactions and Impacts of Activity

Interaction	Impact
Removal of vegetation/topsoil for the establishment of mining and linear infrastructure	Noise emissions from equipment/machinery will increase the noise levels at sensitive receivers and may result in a noise disturbance.
Establishing the box cut	
Construction of infrastructure, and ventilation Shafts.	
Construction of access road and haul roads	
Stockpiling of soils, rock dump and discard dump establishment.	

9.1.1. Impact Description

The activities associated with the construction phase will lead to the emission of noise and an increase in noise levels at nearby sensitive receivers. The construction phase activities will occur during daylight hours only therefore the anticipated noise impacts associated with these activities will be limited to daylight hours. In addition, the construction phase will be short-term in nature therefore the anticipated noise impacts associated with this phase will also be short-term. The receivers are outside the 1.5km radius where the limit value is predicted to be exceeded. Hence, the significance of the anticipated noise impacts is considered negligible from a SANS 10103:2008 perspective.

9.1.1.1. Management Objectives

The noise management objective is to minimise noise emissions and to ensure that the noise exposure levels at the nearby sensitive receivers do not exceed the SANS 10103:2008 guidelines. Also, to ensure that mitigation measures are implemented so noise levels are below limit values and in compliance with the guidelines.

9.1.1.2. Management Actions

The following management measures are recommended as good practice guidelines:

- Construction activities should be restricted to daylight hours;
- Construction activities should be carried out in phases;
- Construction machinery and vehicles should be switched off when not in use;
- Construction vehicles should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type

reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound;

- Vehicles to be serviced as per their design requirements to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and
- Regulate vehicle speeds on the main, access and haul roads.

9.1.1.3. Impact Ratings

The noise impact during the construction phase of the Project has been assessed and the rating is provided in Table 9-2.

Table 9-2: Significance Ratings for Construction Phase

Activity and Interaction: Construction phase activities as per Table 9-1			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Noise will emanate from the machinery and vehicles operating during the construction activities.			
Prior to mitigation/ management			
Duration	Short term (2)	Noise will be generated for the duration of each activity in the construction phase	Negligible (negative) – 21
Extent	Local (3)	It is expected that the noise impact will be limited to 1.5km radius from Project related noise generating sources.	
Intensity	Minor (2)	The predicted noise levels based on the noise dispersion model indicate that the impacts will not result in a noise disturbance. Therefore, noise impacts will be negligible at the nearby receivers.	
Probability	Unlikely (3)	The predicted noise levels based on the noise dispersion model indicate that the impacts will not result in a noise disturbance. In addition, no receiver is predicted to experience noise levels that exceed the limit value for day and night-time in rural districts therefore the noise impact unlikely to occur.	
Nature	Negative		
Mitigation/ Management actions			
• Construction activities should be restricted to daylight hours; • Construction activities should be carried out in phases; • Construction machinery and vehicles should be switched off when not in use;			

Activity and Interaction: Construction phase activities as per Table 9-1			
Dimension	**Rating**	**Motivation**	**Significance**
• Construction vehicles should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound; • Vehicles to be serviced as per their design requirements to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and • Regulate vehicle speeds on the main, access and haul roads.			
Post- mitigation			
Duration	Short term (2)	Noise will be generated for the duration of each activity in the construction phase	Negligible (negative) – 15
Extent	Limited(2)	It is expected that the noise impact will be limited to the Project area and its immediate surroundings post-mitigation.	
Intensity	Minimal (1)	Minimal implications on the surrounding area are anticipated post-mitigation.	
Probability	Unlikely (3)	Noise impacts are unlikely to occur post-mitigation.	
Nature	Negative		

9.2. Operational Phase

Activities during the Operational Phase that may have potential impacts on the ambient noise levels in the area are indicated in Table 9-3.

Table 9-3: Interactions and Impacts of Activity

Interaction	Impact
Ventilation fans and infrastructure area containing stockpile areas	Noise emissions from equipment/machinery will increase the noise levels at sensitive receivers and may result in a noise disturbance
Underground blasting	Noise impacts are considered to be negligible therefore was not assessed further.
Maintenance of haul roads, pipelines, machinery, water, effluent, and stormwater management infrastructure and stockpile areas.	Noise emissions from equipment/machinery will increase the noise levels at sensitive receivers and may result in a noise disturbance
Removal of rock (blasting)	Noise impacts are considered to be negligible therefore was not assessed further.

Interaction	Impact
Concurrent rehabilitation as mining progresses	Noise emissions from equipment/machinery will increase the noise levels at sensitive receivers and may result in a noise disturbance

9.2.1. Impact Description

The activities associated with the operational phase will lead to the emission of noise and an increase in noise levels at nearby sensitive receivers. The operation phase activities will occur during both day and night-time and will be long-term in nature (throughout the LoM). Therefore, the noise impacts associated with this phase will also be long-term. The extent of the predicted noise impact as indicated in the model results, predict that the areas where the limit value is predicted to be exceeded will be limited to 1.5km (daytime) and 2km (night-time) radius from Project-related noise generating sources. From a traffic noise perspective, the areas where the limit value is predicted to be exceeded will be limited to 100m (daytime) and 500m (night-time) distance from the road. The significance of the anticipated noise impact as indicated in the results section above for both day and night-time will be negligible (daytime) to significant (night-time) from a SANS 10103:2008 perspective.

9.2.1.1. Management Objectives

The noise management objective is to minimise noise emissions and to ensure that the noise exposure levels at the nearby sensitive receivers do not exceed the SANS 10103:2008 guidelines. Also, to ensure that mitigation measures are implemented so noise levels are below limit values and in compliance with the guidelines.

9.2.1.2. Management Actions

The following management measures are recommended as good practice guidelines.

- Machinery and vehicles used for mining and maintenance work should be switched off when not in use;
- Vehicles used for mining and maintenance work should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound;
- A concrete wall should be used as the perimeter fence instead of a wire fence;
- Vehicles to be serviced as per their design requirements to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and
- Regulate vehicle speeds on the main, access and haul roads.

9.2.1.3. *Impact Ratings*

The noise impact during the Operational Phase of the Project has been assessed and is provided in Table 9-4.

Table 9-4: Significance Ratings for Operational Phase

Activity and Interaction: Operational phase activities as per Table 9-3			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Noise will emanate as a result of the operation of the mine.			
Prior to mitigation/ management			
Duration	Project Life (5)	Noise emissions will be generated for the LoM	Major (negative) – 77
Extent	Local (3)	It is expected that the noise impact will be limited to 1.5km (Daytime) and 2km (Night-time) radius from Project related noise generating sources.	
Intensity	On-going (3)	The predicted noise levels based on the noise dispersion model indicate that the impacts will result in a night-time noise disturbance.	
Probability	Definite (7)	The predicted noise levels based on the noise dispersion model indicate that a night-time noise disturbance is definitely going to occur at nearby receivers.	
Nature	Negative		
Mitigation/ Management actions			
• Machinery and vehicles used for mining and/ maintenance work should be switched off when not in use; • Vehicles used for mining and maintenance work should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound; • A concrete wall should be used as the perimeter fence instead of a wire fence; • Vehicles to be serviced as per their design requirements to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and • Regulate vehicle speeds on the main, access and haul roads.			
Post- mitigation			
Duration	Project Life (5)	Noise emissions will be generated for the LoM.	Minor

Activity and Interaction: Operational phase activities as per Table 9-3			
Dimension	**Rating**	**Motivation**	**Significance**
Extent	Limited (2)	It is expected that the noise impact will be limited to the project area and its immediate surroundings post-mitigation.	(negative) – 40
Intensity	Minimal (1)	Minimal implications on the surrounding area are anticipated post-mitigation.	
Probability	likely (5)	Noise impacts are likely to occur post-mitigation.	
Nature	Negative		

9.3. Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts on the ambient noise levels in the area are indicated in Table 9-5.

Table 9-5: Interactions and Impacts of Activity

Interaction	Impact
Demolition and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation.	Noise emissions from equipment/machinery will increase the noise levels at sensitive receivers and may result in a noise disturbance. However, the removal of noise generating sources will also lead to a reduction in the noise levels.
Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land, and re-vegetation.	Noise impacts are considered to be negligible therefore will not be assessed further.
Post-closure monitoring and rehabilitation.	

9.3.1. Impact Description

The demolition and removal of the mine infrastructure will involve the use of heavy machinery and vehicles similar to those used in the construction phase. This will lead to the emission of noise which may increase background noise levels onsite and at sensitive receivers. The decommissioning phase activities will occur during daylight hours only therefore the predicted noise impacts will be limited to daylight hours only. In addition, the decommissioning phase will be short-term in nature, therefore, the predicted impacts will also be short-term. The significance of the noise impact will be negligible due to the simultaneous reduction in cumulative noise onsite and at sensitive receivers.

9.3.1.1. Management Objectives

The noise management objective is to minimise noise emissions and to ensure that the noise exposure levels at the nearby sensitive receivers do not exceed the SANS 10103:2008 guidelines. Also, to ensure that mitigation measures are implemented so noise levels are below limit values and in compliance with the guidelines.

9.3.1.2. Management Actions

The following management measures are recommendations as good practice guidelines:

- Restrict decommissioning activities to daylight hours;
- Construction vehicles should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound;
- Regularly service machines and vehicles to ensure noise suppression mechanisms are effective e.g., installed exhaust mufflers;
- Regulate speed limits on access roads; and
- Switch off equipment when not in use.

9.3.1.3. Impact Ratings

The noise impact during the Decommissioning Phase of the Project has been assessed and is provided in Table 9-6.

Table 9-6: Significance Ratings for Decommissioning Phase

Activity and Interaction: Decommisioning phase activities as per Table 9-5			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Noise will emanate from the machinery and vehicles operating during the decommissioning phase activities.			
Prior to mitigation/ management			
Duration	Short term (2)	Noise will be generated for the duration of each activity in the decommissioning phase.	Negligible (negative) – 18
Extent	Limited (2)	It is expected that the noise impact will be limited to the Project area and its immediate surroundings	
Intensity	Minor (2)	Minor implications on the surrounding area are anticipated	
Probability	Unlikely (3)	Noise impacts at nearby receivers from decommissioning activities are unlikely	

Activity and Interaction: Decommisioning phase activities as per Table 9-5			
Dimension	**Rating**	**Motivation**	**Significance**
		to occur due to the simultaneous reduction in noise generating Project related sources.	
Nature	Negative		
Mitigation/ Management actions			
• Restrict decommissioning activities to daylight hours; • Construction vehicles should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound; • Regularly service machines and vehicles to ensure noise suppression mechanisms are effective e.g., installed exhaust mufflers; • Regulate speed limits on access roads; and • Switch off equipment when not in use.			
Post- mitigation			
Duration	Short term (2)	Noise will be generated for the duration of each activity in the decommissioning phase.	Negligible (negative) – 12
Extent	Site Specific (1)	Noise generated post-mitigation will be limited to specific isolated parts of the site.	
Intensity	Minimal (1)	Minimal implications on the surrounding area are anticipated post-mitigation	
Probability	Unlikely (3)	Noise impacts at nearby receivers from decommissioning activities are unlikely to occur due to the simultaneous reduction in noise generating Project related sources.	
Nature	Negative		

10. Cumulative Impacts

The findings of this noise survey show that the predicted noise emissions will have negligible daytime and significant night-time impacts from a SANS 10103:2008 perspective on the ambient noise levels in the area (refer to Section: 8.2.3). This is corroborated by the calculated cumulative noise impacts, which shows that the exceedance of the regulatory limit values for daytime will not occur. However, exceedance of the regulatory limit values will occur for night-time at sensitive receivers NR7 and NR9. Irrespective of the above mentioned, it is

recommended that quarterly noise monitoring be conducted to ensure the cumulative impact stay the same throughout the LoM.

11. Environmental Management Plan

Table 11-1 provides a summary of the proposed Project activities, environmental aspects and impacts on the receiving environment. Information on the mitigation measures, mitigation type and timing of implementation of the Environmental Management Plan (EMP) are specified.

Table 11-1: Environmental Management Plan

Activities	Potential Impacts	Aspects Affected	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
• Removal of vegetation/topsoil for the establishment of mining and linear infrastructure • Establishing the box cut • Construction of infrastructure, and ventilation Shafts. • Construction of access road and haul roads • Stockpiling of soils, rock dump and discard dump establishment.	Noise emission	Noise	Construction	• Construction activities should be restricted to daylight hours; • Construction activities should be carried out in phases; • Construction machinery and vehicles should be switched off when not in use; • Construction vehicles should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound; • Vehicles to be serviced as per their design requirements to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and • Regulate vehicle speeds on the main, access and haul roads.	Noise control measures; and Noise monitoring.	Upon commencement of the construction phase.
• Ventilation fans and infrastructure area containing stockpile areas • Underground blasting • Maintenance of haul roads, pipelines, machinery, water, effluent, and stormwater management infrastructure and stockpile areas. • Removal of rock(blasting) • Concurrent rehabilitation as mining progresses.	Noise emissions	Noise	Operational	• Machinery and vehicles used for mining and/ maintenance work should be switched off when not in use; • Vehicles used for mining and maintenance work should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound; • A concrete wall should be used as the perimeter fence instead of a wire fence; • Vehicles to be serviced as per their design requirements to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and • Regulate vehicle speeds on the main, access and haul roads.	Noise control measures; and Noise monitoring.	Upon commencement of the operational phase.
• Demolition and removal of infrastructure • Post-closure monitoring and rehabilitation • Closure of the underground mine.	Noise emission	Noise	Decommissioning	• Restrict decommissioning activities to daylight hours; • Construction vehicles should be equipped with a Brigade white noise reversing alarm (buzzer type reverse alarm) installed, rather than the conventional beeping type reverse alarms. The white noise reversing alarm produces a buzzer sound instead of the conventional beeping sound; • Regularly service machines and vehicles to ensure noise suppression mechanisms are effective e.g., installed exhaust mufflers; • Regulate speed limits on access roads; and • Switch off equipment when not in use.	Noise control measures; and Noise monitoring.	Upon commencement of the decommissioning phase.

12. Monitoring Programme

The noise emissions/impacts from the operational phase on the sensitive nearby noise receivers are high therefore, it is recommended that a monitoring plan be implemented to monitor future noise emissions (increases and/or decreases in noise levels) throughout the LoM. Components to be included in the proposed monitoring plan are discussed below:

- Noise monitoring is to be conducted throughout all phases (Construction, Operational and Decommissioning) of the Project's life; and
- Quarterly noise measurements must be conducted at the prescribed locations as per the baseline noise measurement locations of this report.

Table 12-1: Noise Monitoring Programme

Monitoring Element	Comment	Frequency	Responsibility
Noise Monitoring	Noise monitoring in line with the requirements of SANS 10103:2008 on-site, and at selected receivers	Quarterly Noise Monitoring	Mine Environmental Officer

13. Conclusion and Recommendations

The existing ambient noise levels have been established in the Project area and its immediate surroundings. The results from the noise monitoring survey indicate that the LAeq for both day and night-time for N1 and N2 were lower than the respective regulatory limit values. The LAeq for both day and night-time for N3 was higher than the regulatory limit value. The main noise sources that impacted these locations were:

- Natural (birds, dogs, cows and sheep); and
- Anthropogenic (agricultural and vehicular activity).

The following conclusions can be drawn for the ambient noise levels in the Project area and its immediate surroundings:

- The resulting overall ambient noise as determined by the noise monitoring survey complies with the acceptable standards for day and night-time noise in rural areas as recommended by SANS 10103:2008;
- The noise contributions of vehicular and agricultural activity will to a large extent mask the daytime impact of the noise emissions caused by future mining operations at nearby sensitive receivers.

Noise dispersion modelling scenarios were conceptualized for the construction and operational phases, with the model predictions indicating a negligible impact on the ambient

noise levels at sensitive receivers for daytime and significant impacts on the ambient noise levels at sensitive receivers for night-time from a SANS 10103:2008 perspective. In summary:

- No identified nearby sensitive receiver for the daytime construction and operational phases is predicted to experience noise impacts above the regulatory limits based on results from the cumulative evaluation (Table 8-3 and Table 8-4);
- Sensitive receivers NR3 (also monitoring location N3), NR7 and NR9 for night-time operational phase are predicted to experience noise impacts above the regulatory limits based on results from the cumulative evaluation (Table 8-3 and Table 8-4);
- Predicted future emissions from the daytime construction and operational phases of the project will not increase the ambient noise level by 7dBA or more for daytime;
- Predicted future emissions from the nighttime operational phase of the Project will increase the ambient noise level by 7dBA or more at sensitive receivers NR7 and NR9; and
- In line with the community/group response (as per SANS 10103 guidelines) to the noise generated from the different phases are categorized as “Little” (0-10 dBA) resulting in “Sporadic complaints” from the noise-sensitive receivers.

The findings from the impact assessment ranking methodology for the operational phase have indicated major impacts on the nearby sensitive receivers from Project related activities. However, the implementation of mitigation measures during the different phases of the Project is recommended and is predicted to result in minor – negligible impacts post-mitigation. The aforementioned will result in emission reduction and a further decrease in anticipated noise impacts onsite and at the receivers. The implementation of a monitoring plan would also be imperative in managing future noise sources and impacts throughout the Project’s life.

Based on the findings detailed in this report and the appropriate implementation of noise mitigation, management and monitoring measures, it is therefore recommended that the proposed Project be authorized from a noise impact perspective.

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Appendix A: Impact Assessment Ranking

The potential impacts from the proposed Project have been assessed based on the severity predicted on-site and at sensitive receptor(s). This culminates in a significance rating which identifies the most important impacts that require mitigation and/or management.

Based on international guidelines and South African legislation, the following criteria were considered when examining potentially significant impacts:

- Nature of impacts (direct / indirect, positive / negative);
- Duration (short / medium / long-term, permanent (irreversible) / temporary (reversible), frequent / seldom);
- Extent (geographical area, size of affected population / habitat / species);
- Intensity (minimal, severe, replaceable / irreplaceable);
- Probability (high / medium / low probability); and
- Possibility to mitigate, avoid or offset significant adverse impacts.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact / risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 14-1. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts. Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the Environmental Management Plan Report (EMPr).

The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 14-2, which is extracted from Table 14-1. The description of the significance ratings is discussed in Table 14-3.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 14-1: Impact Assessment Parameter Ratings

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	Positive impacts			
7	Irreplaceable damage to highly valued items of great natural or social significance or complete breakdown of natural and / or social order.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable damage to highly valued items of natural or social significance or breakdown of natural and / or social order.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Very serious widespread natural and / or social baseline changes. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	Positive impacts			
4	On-going serious natural and / or social issues. Significant changes to structures / items of natural or social significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	On-going natural and / or social issues. Discernible changes to natural or social baseline.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor natural and / or social impacts which are mostly replaceable. Very little change to the baseline.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	Minimal natural and / or social impacts, low-level replaceable damage with no change to the baseline.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 14-2: Probability/Consequence Matrix

Probability	Significance																																					
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 14-3: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Substantial (positive)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Major (positive)
36 to 72	An positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Major (negative)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Substantial (negative)