Nhlabathi Minerals (Pty) Ltd

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

for the

Proposed Rietkol Mining Operation near Eloff, Mpumalanga

Study done for:

JACANA environmentals cc

Prepared by:

EAR Enviro Acoustic Research

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EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Enviro-Acoustic Research CC was contracted by Jacana Environmentals cc (the EAP) to conduct an Environmental Noise Impact Assessment (ENIA) to determine the potential noise impact on the surrounding environment due to the development of the Rietkol Mining Operation north of Eloff, Mpumalanga.

This report describes ambient sound levels in the area, potential worst case noise rating levels and the potential noise impact that the operation may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations.

PROJECT DESCRIPTION

Nhlabathi applied for a Mining Right to mine silica in February 2018 and commenced with the Environmental Impact Assessment (EIA) process as contemplated in the National Environmental Management Act 107 of 1998 (NEMA) and Government Notice (GN) No. R. 982-986 of 4 December 2014: NEMA: Environmental Impact Assessment Regulations, as amended (2014 EIA Regulations), for the Rietkol Project.

The Rietkol application for Environmental Authorisation lapsed during 2020, and Nhlabathi has decided to re-apply for a mining right and environmental authorisation. Nhlabathi indicated that specialist reports must be updated to reflect possible changing circumstances in the area, confirming the baseline conditions and confirm the impact assessment as completed in 2018. The report will be reviewed and updated if required, and will be a complete separate updated report.

Silica is planned to be mined by means of conventional opencast methods to a depth of between 30 and 50 meters below surface (mbs). The estimated life of mine (LOM) for the proposed Rietkol Project is 20 years. Further exploration drilling will be conducted during the operational phase, which may increase the LOM and mining depth if the resource proves viable.

The proposed project includes the following mining and related infrastructure:

- Opencast pits;
- Processing plant (i.e. crushing, wash plant, screening, etc.);
- Product stockpiles;

- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc.);
- Production facilities (i.e. locker rooms, laboratory, workshops, stores, explosives magazine, ablution facilities, etc.);
- Access roads; and
- Clean and dirty water management infrastructure.

BASELINE ASSESSMENT

Though baseline ambient sound levels were measured during 2016 (Jansen, 2016), additional measurements were collected as the raw data was not available for this report. This original study defined the existing ambient sound to be typical of an urban noise district. The data collected during the original baseline study was used to identify a quieter long-term measurement location as the original baseline report located the monitoring points too close to significant noise sources, namely:

- Large eucalyptus trees close to two of the measurement locations,
- The one location was just south of the nursery that operated a substantial number of fans 24 / 7.

Additional unattended long-term ambient (background) sound levels were measured over a four-night-time period from 16 - 20 April 2018 at one location, with additional short-term measurements collected at three other locations.

The additional noise measurements (collected during April and July 2021) highlighted high ambient sound levels, yet, considering the developmental character of the area, the acceptable zone rating level would be typical of an **urban area** (45 dBA at night and 55 dBA during the day) as defined in SANS 10103:2008 (acceptable for residential use). Mining activities (calculated noise levels) should not change these proposed acceptable rating levels with more than 7 dBA (disturbing noise) and ideally with no more than 3 dBA.

NOISE IMPACT DETERMINATION AND FINDINGS

The potential noise rating levels were calculated using a sound propagation model. Conceptual scenarios were developed for the construction and operational phase with the output of the modelling exercise indicating that there is risk of a noise impact of high significance during these phases. Mitigation is available and if implemented would reduce the significance of the noise impact to a more acceptable medium.

NEED AND DESIRABILITY OF PROJECT

Due to economic advantages, mining does provide valuable employment, local taxes and foreign currency. It must be noted when mining projects are near to potential noise-sensitive receptors, consideration must be given to ensure a compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time mining need to reach an optimal scale in terms of layout and production.

The proposed mining activities however will raise the noise levels at a number of potential noise-sensitive developments. These noises can be disturbing and may impact on the quality of living for the receptors. Therefore, in terms of acoustics there is no benefit to the surrounding environment (closest receptors).

However, the project will greatly assist in the economic growth and development challenges South Africa is facing by means of assisting in providing employment and other business opportunities. Considering only noise[1], people in the area not directly affected by increased noise levels could have a positive perception of the project and could see the need and desirability of the project.

RECOMMENDATIONS (MANAGEMENT AND MITIGATION)

The proximity of potential noise-sensitive receptors necessitates the selection of appropriate mitigation measures and the following is recommended:

- That NSDs 1, 2, 3, 5 and 7 be relocated;
- The mine must discuss the potential noise impact on NSD06 with this receptor, highlighting the magnitude as well as feasible mitigation options available that will reduce the noise levels. There should be an agreement between the developer and the receptor in writing on the noise impact as well as the selected mitigation options to be implemented;
- Development of a noise barrier or similar between NSD06 and the mining area;
- Minimise night-time activities within 300 m from NSD06 if mitigation measures are not implemented. If unavoidable, that the quietest equipment be used when operating within 300 m of receptors at night;
- Ensure a good working relationship between mine management and all potentially noise-sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them (especially if work is to take place within 300 m from them at night). Information that should be provided to potentially sensitive receptor(s) includes:

[1] Considering only noise as other environmental factors may affect other people.

  - Proposed working dates, the duration that work will take place in an area and working times;
  - The reason why the activity is taking place;
  - The construction methods that will be used; and
  - Contact details of a responsible person where any complaints can be lodged should there be an issue of concern.
- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised;
- The operation should investigate the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads, within the mining area and at stockpile areas;
- The mine must implement a line of communication (such as a help line where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers, or alternative means to communicate issues. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated;
- All employees and contractors should receive induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment;
- The development and implementation of a noise measurement programme (at NSD04, NSD06, NSD15, NSD19 preferably, if safety and security allow, a measurement location at the informal community, NSD09 – 13 should be included); and
- The correct design of the exhaust stack to ensure that the design consider the minimization of noise from this source. An engineering company specialising in the design of exhaust stacks must be contracted;

It is concluded that, while this project will have a noise impact on a number of the closest noise-sensitive receptors, these impacts can be mitigated to reduce the significance. Working with these receptors, the mine could also improve on the negative perceptions and impacts. It is the opinion of the Author that, if the mine considers the recommendations in this report (incorporated in the Environmental Management Plan), that the increases in noise levels does not constitute a fatal flaw. It is therefore the recommendation that the project should be authorized (from a noise impact perspective).

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6 (as amended 2017)		Relevant Section in Specialist study
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	
	(i) the specialist who prepared the report; and	Section 1
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Section 1
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	*(separate document to this report)*
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 4.1
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 6.1
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.1 and 10.1
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.1
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4.6
(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;	Sections 6.1, 7.2, 7.3, 10.3 and 10.4
(g)	an identification of any areas to be avoided, including buffers;	No buffers required. Noise rating levels calculated and illustrated.
(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;	Sections 10.3 and 10.4
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 9
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Sections 10 and 11
(k)	any mitigation measures for inclusion in the EMPr;	Sections 12.1.2 and 12.2.2
(l)	any conditions for inclusion in the environmental authorisation;	Sections 12.1.2 and 12.2.2

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6 (as amended 2017)		Relevant Section in Specialist study
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 14.1
(n)	a reasoned opinion -	Section 15
	whether the proposed activity, activities or portions thereof should be authorised;	Section 15
	regarding the acceptability of the proposed activity or activities; and	Section 15
	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;	Sections 12.1.2 and 12.2.2
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	See Section 4.5
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	See Section 4.5
(q)	any other information requested by the competent authority.	None

This report should be sited as:

De Jager, M. (2021): "*Environmental Noise Impact Assessment for the Proposed Rietkol Mining Operation near Eloff, Mpumalanga*". Enviro-Acoustic Research CC, Pretoria

Client:

Jacana Environmentals cc
on behalf of
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Date:

August 2021

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GLOSSARY OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
AZSL	Acceptable Zone Sound Level (Rating Level)
EAP	Environmental Assessment Practitioner
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act (Act 78 of 1989)
EMP	Environmental Management Plan
FEL	Front End Loader
IFC	International Finance Corporation
km	kilometres
LHD	Load haul dumper
m	Meters (measurement of distance)

m^2	Square meter
m^3	Cubic meter
mamsl	Meters above mean sea level
MRA	Mining Right Application
Mtpa	Million tons per annum
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NCR	Noise Control Regulations (under Section 25 of the ECA)
ROM	Run of Mine
SANS	South African National Standards
TLB	Tip Load Bucket
UTM	Universal Transverse Mercator
WHO	World Health Organisation

1 THE AUTHOR

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining related courses (Rock Mechanics, Surveying, Sampling, Safety and Health [Ventilation, noise, illumination etc] and Metallurgy. He did work in both underground (Coal, Gold and Platinum) as well as opencast (Coal) for 4 years. He changed course from Mining Engineering to Chemical Engineering after his second year of his studies at the University of Pretoria.

After graduation he worked as a Water Pollution Control Officer at the Department of Water Affairs and Forestry for two years (first year seconded from Wates, Meiring and Barnard), where duties included the perusal (evaluation, commenting and recommendation) of various regulatory required documents (such as EMPR's, Water Licence Applications and EIA's), auditing of licence conditions as well as the compilation of Technical Documents.

Since leaving the Department of Water Affairs, Morné has been in private consulting for the last 15 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing these projects within budget and timeframe. During that period he gradually moved towards environmental acoustics, focusing on this field exclusively since 2007.

He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control as well as blasting impacts. Since 2007 he has completed more than 350 Environmental Noise Impact Assessments and Noise Monitoring Reports as well as various acoustic consulting services, including amongst others:

Wind Energy Facilities	*Full Environmental Noise Impact Assessments for - Bannf (Vidigenix), iNCa Gouda (Aurecon SA), Isivunguvungu (Aurecon), De Aar (Aurecon), Kokerboom 1 (Aurecon), Kokerboom 2 (Aurecon), Kokerboom 3 (Aurecon), Kangnas (Aurecon), Plateau East and West (Aurecon), Wolf (Aurecon), Outeniqwa (Aurecon), Umsinde Emoyeni (ARCUS) , Komsberg (ARCUS), Karee (ARCUS), Kolkies (ARCUS), San Kraal (ARCUS), Phezukomoya (ARCUS), Canyon Springs (Canyon Springs), Perdekraal (ERM), Scarlet Ibis (CESNET), Albany (CESNET), Sutherland (CSIR), Kap Vley (CSIR), Kuruman (CSIR), Rietrug (CSIR), Sutherland 2 (CSIR), Perdekraal (ERM), Teekloof (Mainstream), Eskom Aberdene (SE), Dorper (SE), Spreeukloof (SE), Loperberg (SE), Penhoek Pass (SE), Amakhala Emoyeni (SE), Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), Namas (SE), Zonnequa (SE), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Deep River (SE), Tsitsikamma (SE), AB (SE), West Coast One (SE), Hopefield II (SE), Namakwa Sands (SE), VentuSA Gouda (SE), Dorper (SE), Klipheuwel (SE), INCA Swellendam (SE), Cookhouse (SE), Iziduli (SE), Msenge (SE), Cookhouse II (SE), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Koningaas (SE), Spitskop (SE), Castle (SE), Khai Ma (SE), Poortjies (SE), Korana (SE), IE Moorreesburg (SE), Gunstfontein (SE), Boulders*

	(SE), Vredenburg (Terramanzi), Loeriesfontein (SiVEST), Rhenosterberg (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Dwarsrug (SiVEST), Graskoppies (SiVEST), Philco (SiVEST), Hartebeest Leegte (SiVEST), Ithemba (SiVEST), !Xha Boom (SiVEST), Spitskop West (Terramanzi), Haga Haga (Terramanzi), Vredenburg (Terramanzi), Msenge Emoyeni (Windlab)
Mining and Industry	*Full Environmental Noise Impact Assessments for – Delft Sand (AGES), BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream Environmental), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream Environmental), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream Environmental), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream Environmental), EastPlats (CleanStream Environmental), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Glencore Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali Environmental), Fumani Gold (AGES), Leiden Coal (EIMS), Colenso Coal and Power Station (SiVEST/EcoPartners), Klippoortjie Coal (Gudani), Rietspruit Crushers (MENCO), Assen Iron (Tshikovha), Transalloys (SE), ESKOM Ankerlig (SE), Nooitgedacht Titano Project (EcoPartners), Algoa Oil Well (EIMS), Spitskop Chrome (EMAssistance), Vlakfontein South (Gudani), Leandra Coal (Jacana), Grazvalley and Zoetveld (Prescali), Tjate Chrome (Prescali), Langpan Chromite (Prescali), Vereeniging Recycling (Pro Roof), Meyerton Recycling (Pro Roof), Hammanskraal Billeting Plant 1 and 2 (Unica), Development of Altona Furnace, Limpopo Province (Prescali Environmental), Haakdoorndrift Opencast at Amandelbult Platinum (Aurecon), Landau Dragline relocation (Aurecon), Stuart Coal Opencast (CleanStream Environmental), Tetra4 Gas Field Development (EIMS), Kao Diamonds – Tiping Village Relocation (EIMS), Kao Diamonds – West Valley Tailings Deposit (EIMS), Upington Special Economic Zone (EOH), Arcellor Mittal CCGT Project near Saldanha (ERM), Malawi Sugar Mill Project (ERM), Proposed Mooifontein Colliery (Geovicon Environmental), Goedehoop North Residue Deposit Expansion (Geovicon Environmental), Mutsho 600MW Coal-Fired Power Plant (Jacana Environmentals), Tshivhaso Coal-Fired Power Plant (Savannah Environmental), Doornhoek Fluorspar Project (Exigo), Royal Sheba Project (Cabanga Environmental), Rietkol Silica (Jacana), Gruisfontein Colliery (Jacana), Lehlabili Colliery (Jaco-K Consulting), Bloemendal Colliery (Enviro-Insight), Rondevly Colliery (REC), Welgedacht Colliery (REC), Kalabasfontein Extension (EIMS)*
Road and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane), Transnet Apies-river Bridge Upgrade (Transnet), Gautrain Due-diligence (SiVest), N2 Piet Retief (SANRAL), Atterbury Extension, CoT (Bokomoso Environmental), Riverfarm Development (Terramanzi)*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping (Aurecon)*
Noise monitoring and Audit Reports	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional (Xstrata), Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF Ambient Sound Level study (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Hopefield WEF Noise Analysis (Umoya), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon), Jeffries Bay Wind Farm (Globeleq), Sephaku Aganang (Exigo), Sephaku Delmas (Exigo), Beira Audit (BP/GPT), Nacala Audit (BP/GPT), NATREF (Nemai), Rappa Resources (Rayten), Measurement Report for Sephaku Delmas (Ages), Measurement Report for Sephaku Aganang (Ages), Bank of Botswana measurements (Linnspace), Skukuza Noise Measurements (Concor), Development noise measurement protocol for Mamba Cement (Exigo), Measurement Report for Mamba Cement (Exigo), Measurement Report for Nokeng Fluorspar (Exigo), Tsitsikamma Community Wind Farm Pre-operation sound measurements (Cennergi), Waainek WEF Operational Noise Measurements (Innowind), Sedibeng Brewery Noise Measurements (MENCO), Tsitsikamma Community Wind Farm Operational noise measurements (Cennergi), Noupoort Wind Farm Operational noise measurements (Mainstream), Twisdraai Colliery (Lefatshe Minerals), SASOL Prospecting (Lefatshe Minerals)*
Small Noise Impact Assessments	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment*

	(Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion 2 (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), RareCo (SE), Struisbaai WEF (SE), Perdekraal WEF (ERM), Kotula Tsatsi Energy (SE), Olievenhoutbosch Township (Nali), , HDMS Project (AECOM), Quarry extensions near Ermelo (Rietspruit Crushers), Proposed uMzimkhulu Landfill in KZN (nZingwe Consultancy), Linksfield Residential Development (Bokomoso Environmental), Rooihuiskraal Ext. Residential Development, CoT (Plandev Town Planners), Floating Power Plant and LNG Import Facility, Richards Bay (ERM), Floating Power Plant project, Saldanha (ERM), Vopak Growth 4 project (ERM), Elandspoort Ext 3 Residential Development (Gibb Engineering), Tiegerpoort Wedding Venue (Henwood Environmental)
Project reviews and amendment reports	*Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma Community Wind Farm Noise Simulation project (Cennergi), Amakhala Emoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (SE), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy), De Aar WEF (Holland), Quarterly Measurement Reports – Dangote Delmas (Exigo), Quarterly Measurement Reports – Dangote Lichtenburg (Exigo), Quarterly Measurement Reports – Mamba Cement (Exigo), Quarterly Measurement Reports – Dangote Delmas (Exigo) Quarterly Measurement Reports – Nokeng Fluorspar (Exigo), Proton Energy Limited Nigeria (ERM), Hartebeest WEF Update (Moorreesburg) (Savannah Environmental), Modderfontein WEF Opinion (Terramanzi), IPD Vredenburg WEF (IPD Power Vredenburg), etc.*

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2 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

- I act as the independent specialist in this application
- I will perform the work relating to this study 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 environmental noise impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2014, 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 will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- all the particulars furnished by me in this form are true and correct;
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act, and;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014.

Signature of the environmental practitioner:

Name of company:

Enviro-Acoustic Research cc

Date:

2021 – 08 –03

3 CHECKLIST: GG43110 MINIMUM REQUIREMENTS

3.1 Site Sensitivity Verification

Nhlabathi applied for a Mining Right to mine silica in February 2018 and commenced with the Environmental Impact Assessment (EIA) process as contemplated in the National Environmental Management Act 107 of 1998 (NEMA) and Government Notice (GN) No. R. 982-986 of 4 December 2014: NEMA: Environmental Impact Assessment Regulations, as amended (2014 EIA Regulations), for the Rietkol Project.

Several specialist studies were conducted within the Mining Right Application (MRA) area in support of the EIA process, and a comprehensive Public Participation process was initiated. The Final Scoping Report was submitted on 3 April 2018 and accepted by the Department of Mineral Resources and Energy (DMRE) on 26 April 2018. However, the MRA was rejected by the DMRE Mpumalanga Mine Economics Directorate on the basis that the MRA formed part of another right granted in terms of the MPRDA. This decision resulted in a delay in the EIA process, ultimately causing the application for Environmental Authorisation to lapse. Nhlabathi has recently re-initiated the MRA process and applied for a Mining Right over the same farm portions in early 2020. The MRA was accepted by the DMRE on 21 January 2021 and Nhlabathi has since re-initiated the EIA process with Jacana Environmentals cc (Jacana) appointed as the independent Environmental Assessment Practitioner (EAP).

Several additional requirements when applying for Environmental Authorisation (EA) have emerged since the 2018 EIA process, including but not limited to:

- Notice was given in Government Notice No. 960 (GN 960) dated 5 July 2019 of the requirement to submit a report generated by the National Web Based Environmental Screening Tool in terms of section 24(5)(h) of the NEMA and regulation 16(1)(b)(v) of the 2014 EIA Regulations. Such a Screening Report became compulsory when applying for an EA 90 days from publication of GN 960 (5 October 2019). The purpose of the Screening Report is to identify the list of specialist assessments that needs to be conducted in support of the EA application, based on the selected classification, and the environmental sensitivities of the proposed development footprint.
- Government Notice No. 320 (GN 320) dated 20 March 2020 prescribes general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring EA in terms of sections 24(5)(a), (h) and 44 of NEMA. These procedures and requirements came into effect 50 days after publication of GN 320 (15 May 2020). The purpose of the site sensitivity verification

is to verify (confirm or dispute) the current use of the land and the environmental sensitivity of the site under consideration as identified in the Screening Report. This will determine the level of assessment required for each environmental theme, i.e. Specialist Assessment or Compliance Statement.

As indicated above, several specialist studies were commissioned for the Rietkol Project during 2016-2018 in support of the previous application, including an Environmental Noise Impact Assessment.

Comprehensive specialist assessments were conducted for all the environmental and social themes listed above, irrespective of the sensitivity identified by the specialist assessment (2018) or the Screening Report. However, a site sensitivity verification was done for the noise report and attached in Appendix D.

3.2 REQUIREMENTS OF ONLINE SCREENING TOOL

The National Web based Environmental Screening Tool[2] was used to screen the proposed site for the noise environmental sensitivity as per the requirements of GNR320 (20 March 2020), considering the site location. The site report generated by the Screening Tool highlighted that a Noise Impact Assessment must be completed and appended to the Environmental Authorization (EA) documentation. The screening report was developed for both:

- *Mining => Mining Right*, and
- *Activity requiring permit or licence in terms of National or Provincial legislation governing the release or generation of emissions => Emissions*.

Potential noise sensitive areas are not included in these categories, but was obtained from the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the output indicating that the larger area are considering to have a "very high" noise sensitivity.

In terms of GNR320 (20 March 2020), a Noise Study must contain, as a minimum, the following information:

Clause	**Requirement**	**Comment / Reference**

[2] https://screening.environment.gov.za/screeningtool/#/pages/welcome

2.5.1	Contact details of the environmental assessment practitioner or noise specialist, their relevant qualifications and expertise in preparing the statement, and a curriculum vitae	Section 1
2.5.2	a signed statement of independence by the environmental assessment practitioner or noise specialist.	Section 2
2.5.3	The duration and date of the site inspection and the relevance of the season and weather condition to the outcome of the assessment	Section 6
2.5.4	A description of the methodology used to undertake the on-site assessment, inclusive of the equipment and models used, as relevant, together with the results of the noise assessment	Section 6.3
2.5.5	a map showing the proposed development footprint (including supporting infrastructure) overlaid on the noise sensitivity map generated by the screening tool	Larger area considered to be "very high" noise sensitive. Infrastructure depicted in Figure 10-2
2.5.6	confirmation that all reasonable measures have been taken through micro- siting to minimize disturbance to receptors	Site development limited to the location of the ore resource
2.5.7	a substantiated statement from the specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development	Section 15
2.5.8	any conditions to which this statement is subjected	Sections 12 and 15
2.5.9	the assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered	Site development limited to the location of the ore resource
2.5.10	A motivation must be provided if there were development footprints identified as per paragraph 2.5.9 above that	Site development limited to the

	were identified as having a "low" noise sensitivity and that were not considered appropriate	location of the ore resource
2.5.11	where required, proposed impact management outcomes, mitigation measures for noise emissions during the construction and commissioning phases that may be of relative short duration, or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr), and	Section 12 and 14
2.5.12	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations	Section 9

4 INTRODUCTION

4.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research (EARES) was contracted by Jacana Environmentals cc (the EAP) to determine the potential noise impact on the surrounding environment due to the proposed development of a silica mine by Nhlabathi Minerals (Pty) Ltd in 2018.

The Rietkol application for Environmental Authorisation lapsed during 2020, and Nhlabathi has decided to re-apply for a mining right and environmental authorisation. Nhlabathi indicated that specialist reports must be updated to reflect possible changing circumstances in the area, confirming the baseline conditions and confirm the impact assessment as completed in 2018. The report will be reviewed and updated if required, and will be a complete separate updated report.

This report describes ambient sound levels in the area, potential worst case noise rating levels and the potential noise impact that the operation may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations. This report did not investigate vibrations and only briefly considers blasting.

The Terms of Reference (ToR) for this study is in the guidelines provided by SANS 10103:2008, SANS 10328:2008, the procedures defined in Government Gazette 43110 of 20 March 2020 and the National Noise Control Regulations GN R154 of 1992. The study also considers the noise limits as proposed by the International Finance Corporation (IFC) which is based on studies completed by the World Health Organization (WHO).

4.2 BRIEF PROJECT DESCRIPTION

4.2.1 Overview of the Project

Nhlabathi Minerals (Pty) Ltd (the Applicant) submitted an application for a Mining Right to the Department of Mineral Resources (DMR) for the mining of Silica.

Silica is planned to be mined by means of conventional opencast methods to a depth of between 30 and 50 meters below surface (mbs). The estimated life of mine (LOM) for the proposed Rietkol Project is 20 years. Further exploration drilling will be conducted during the operational phase, which may increase the LOM and mining depth if the resource proves viable.

The proposed project includes the following mining and related infrastructure:

- Opencast pits;
- Processing plant (i.e. crushing, wash plant, screening, baghouse, etc.);
- Run of mine (ROM) and product stockpiles;
- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc.);
- Production facilities (i.e. locker rooms, laboratory, workshops, stores, explosives magazine, ablution facilities, etc.);
- Access roads; and
- Clean and dirty water management infrastructure.

4.3 STUDY AREA

The study area concerns a number of dwellings or potential noise-sensitive receptors in the vicinity of the proposed development. The study area is further described in terms of environmental components that may contribute or change the sound character in the area.

4.3.1 Topography

The Environmental Potential Atlas of South Africa (ENPAT) (Van Riet *et al*, 1998) describes the topography as *"Plains and Pans"*. The project is situated at approximately 1,600 (1,580 – 1,620) meters above sea level (mamsl). There are little natural features that could act as noise barriers considering practical distances at which sound propagates.

4.3.2 Surrounding Land Use

The area in the vicinity of the proposed development is agricultural and residential. Activities identified onsite includes crop cultivation, chicken coops, and a nursery (Unex Roses) with scattered dwellings featuring the bulk of the land use.

The site visit highlighted that the fans at the Unex Roses and chicken coops operate 24/7. The fans are quite audible and a significant source of noise at night.

4.3.3 Roads

The most important road (in terms of calculable acoustics near a receptor's dwelling) is the N12. Based on the 2003 data, the Average Annualized Daily Traffic (AADT) volume were approximately 6,500 vehicles[3]. With a 6.5% growth, this would equate to an AADT for

[3] Derived from https://www.arrivealive.co.za/2003-TRAFFIC-OFFENCE-SURVEY-Comprehensive-Report-on-Fatal-Crash-Statistics-and-Road-Traffic-Information-11

approximately 16,700 vehicles per day in 2018, or 955 vehicles/hour during the day and 335 vehicles/hour at night.

Traffic on tarred road D1550 (leading from the R50 to Eloff) is quite audible during passing, with around 140 vehicles/hour (traffic count Tuesday, 17 April 2018). Assuming an AADT of around 5,000 vehicles per day (RAMS), traffic volumes would be ± 300 and 100 vehicles/hour during the day and night-time periods (see **Figure 4-3**) respectively.

Traffic on the R50 is relatively high, but it is located further than 1,000 m from the project site, yet it may cumulatively contribute to noise levels in the area. Traffic volumes similar to the D1550 will be assumed (based on the RAMS database, see **Figure 4-3**).

Other roads in the area do not carry sufficient traffic to warrant considering their contribution to the ambient soundscape (even though these roads do contribute to single events / during passing).

4.3.4 Residential areas and potential noise-sensitive receptors

Residential areas and potential noise-sensitive developments/receptors were identified during the scoping phase by the EAP (Eksteen, 2018) and confirmed during previous site visits (16 and 20 April 2018; 17 – 21 February 2021). While there are a number of residential dwellings close to the proposed infrastructure, there are no formal residential/urban development's closer than 2,000m from the proposed mine infrastructure.

Generally, noises from mining and industrial activities:

- are limited to a distance of less than 500 m from active mining access roads, though this would normally be less than 200 m with low traffic volumes and speeds associated with such roads (night-time impacts). This can be increased to a distance of 1,000 m, normally associated with very busy roads (such as a busy national road where average speeds exceed 100 km/h);
- are generally significant within 500 m, with receptors staying within 500 m from active mining/industrial activities normally subject to noises at a sufficient level to be considered disturbing;
- are normally limited to a distance of approximately 1 000 m from the active mining activities. Ambient sound levels are increased due to noises from the activities, with the potential noise impact measurable. Noise levels from such activities are generally less than 45 dBA further than 1 000 m from these activities;
- are audible up to a distance of 2 000 m at night, though the noises may be audible up to 4 000 m during very quiet periods at night with certain meteorological

conditions. These noises are normally of a low concern at distances greater than 2 000 m from activities at night (though it may be audible up to 4 000 m during very quiet periods).

These buffer distances may not be valid with very large mining or industrial operations, or in areas with very low ambient sound levels.

4.3.5 Other industrial and commercial processes

There are a number of commercial and light industrial activities taking place on a number of the smallholdings in the vicinity of the proposed development. A number of these activities are located close to the tar road, although based on the audible impression, the noise generating activities would be limited to daytime activities from most of the businesses and premises. While impulsive noises were audible, it was not considered significant.

There is a nursery in the area with a large number of greenhouses. It appears that each greenhouse is fitted with a number of fans that generate a significant and constant noise that is clearly audible, especially at night. This will not be included in the baseline noise model, but will be considered during the noise impact assessment (probability that some NSD may be influenced by increased noises from the proposed Rietkol mine).

4.3.6 Ground conditions and vegetation

The area falls within the Grassland biome, with the vegetation type being moist cool Highveld grassland. The natural veldt has been impacted significantly due to anthropogenic activities; with significant trees planted close the dwellings in the area. Most of the surface area is well vegetated with grasses, shrubs, sedges and trees.

Taking into consideration available information it is the opinion of the author that the ground surface is sufficiently covered to assume 50% hard ground conditions for modelling purposes. It should be noted that this factor is only relevant for air-borne waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

4.3.7 Existing Ambient Sound Levels

Ambient sound measurements were conducted by Jansen (2016) during the compilation of a baseline report. Additional onsite measurements were collected 16 – 20 April 2018. The soundscape is discussed in more detail in **Section 3**.

4.4 POTENTIAL NOISE-SENSITIVE RECEPTORS (DEVELOPMENTS) AND NO-GO AREAS

Potentially sensitive receptors, also known as noise-sensitive developments (NSDs), located within or close to the proposed mining area was identified using Google Earth® by the EAP during the Scoping Phase.

The potential NSDs relevant to this study was reduced and defined for this study. All potential NSDs within approximately 2km from the closest proposed infrastructure are illustrated in **Figure 4-2**.

4.5 COMMENTS REGARDING NOISE RECEIVED DURING THIS PROJECT

The following comments have been received from Interested and Affected Parties during the EIA Phase[4].

Stakeholder	Question / Comment / Concern	Response
Van der Walt, Piet Plot 213	Comment on Noise Measurements	Comment
Rossouw, Adriaan Rossgro Pluimvee Rietkol 327	Concern that noise will impact on birds, stop them eating and potential heart attacks.	Noise rating levels defined in **section 10**, see also **section 8.1**
Johann Minnaar on behalf of Rossgro Group of Companies Rietkol 237 IR Ptn 2, RE/31, 71, RE/90, 103 and Geluk 234 IR Ptn 2 and 24 and others	Environmental degradation associated with silica mining such as air pollution, dust pollution, noise and water depletion are not conducive to the business of my client as explained above.	See **section 8.1**, no criteria defined for faunal species.
Johann Minnaar on behalf of Rossgro Group of Companies Rietkol 237 IR Ptn 2, RE/31, 71, RE/90, 103 and Geluk 234 IR Ptn 2 and 24 and others	Noise: The Environmental Specialist should investigate and evaluate the effect that noise emanating from the proposed mine may have on the business of my client. The cumulative effect, which planned and existing mines may have on the noise levels, should also be investigated. Noise associated with blasting should also be investigated.	Noise rating levels defined in **section 10**.
Cllr Mashilela Ward Councilor Ward 9 Victor Khanye Local Municipality Meeting 9-3-2018	In terms of your information, noise levels are already high.	Comment
Arthur Channon on behalf of Roy Robertson	Communities: Increased dust, noise impact, traffic etc.	Noise generating activities conceptualized with noise rating levels calculated and

[4] Proposed Rietkol Mining Operation – Comments and Responses Report. 15 March 2021.

Family Trust Plot 278,279,281		defined in **section 10**. Significance of noise impact determined in **section 11**.
Sarel Kritzinger Goudhoek SA Boerperd Stoet / Ovomart (Pty) Ltd / SJN Kritzinger cc Plot: 158, 160, 161, 162.	Noise: a. what about the effect on animals. b. Horses hearing: can hear sounds up to 4km away and with a range of 14 hertz – 35 kilo hertz (human typical 20 hertz – 20 kilohertz)	See **section 8.1**. Noise generating activities conceptualized with noise rating levels calculated and defined in **section 10**. Significance of noise impact determined in **section 11**.
Riaan Fisher Ptn 3 of Plot 282 Landowner within 1km MRA buffer Email 13-03-2018	My next big concern is that my plot is next to the main gravel road that will be used by the mine! The dust and the noise will be unbearable on a 1-hectare plot next to the road. Not to mention the health risks and issues.	Traffic noises calculated to be of low concern. See **Sections 10.3** and **10.4**.
Dirk & Luanne Smalle Landowner Plot 103, 104	Increase in noise and air pollution	Noise generating activities conceptualized with noise rating levels calculated and defined in **section 10**. Significance of noise impact determined in **section 11**.
Karin Badenhorst-Brooks	Property value will decrease after the mining start, due to the blasting noise, dust, and water usage.	
Karin Badenhorst-Brooks	What happens to our horses and animals when you blast? When an animal is in a situation where they know there will be loud noise, they can handle it. But like horses, if you blast, they will run and hurt themselves. Who will pay those costs, or must we change our land use activities. I have 11 horses with normal fencing, they will hurt themselves breaking through the fence.	Comment mainly concerned about blasting related noise. This is discussed in the Blasting Impact Assessment.

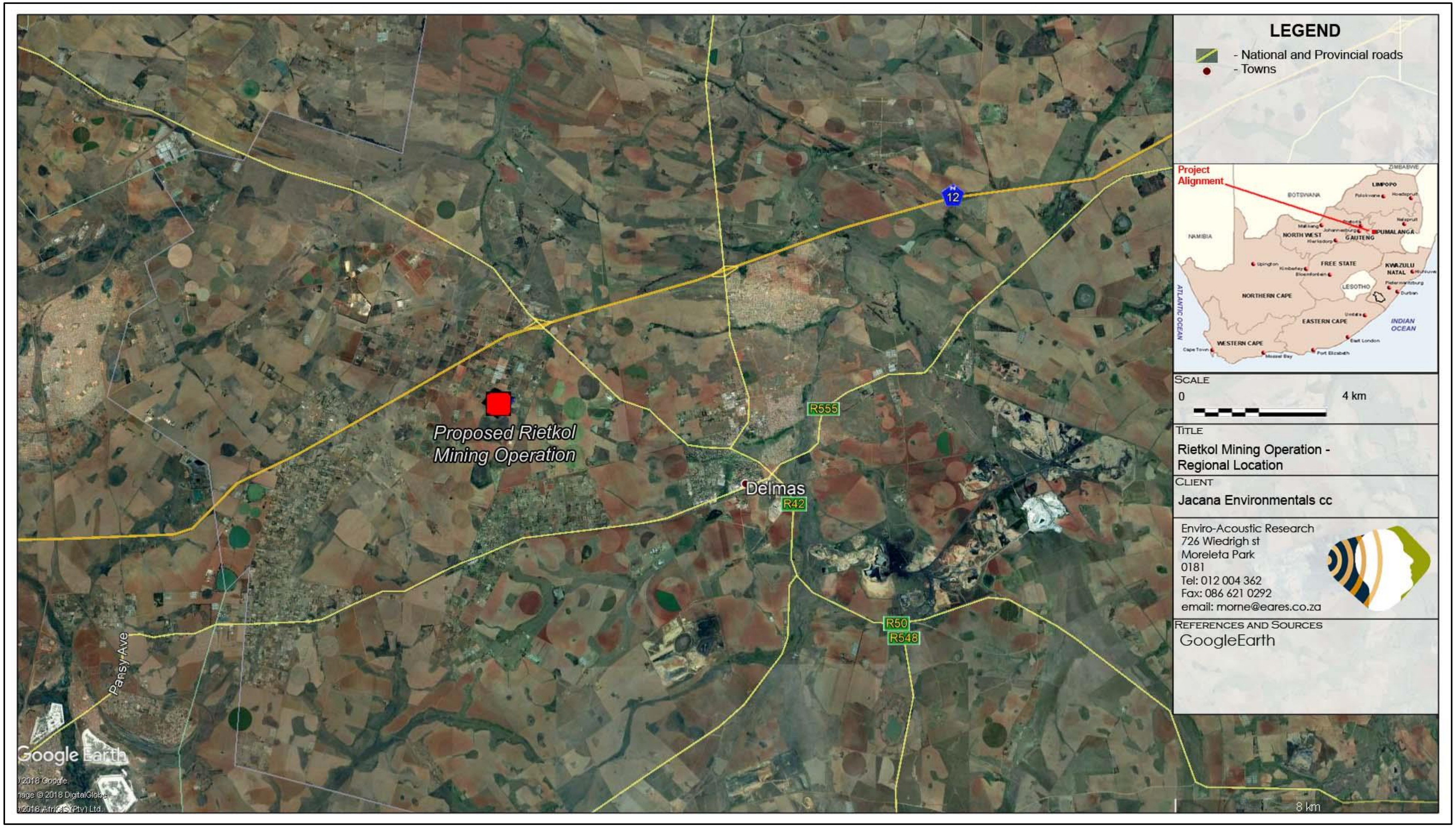

Figure 4-1: Locality map indicating the location of the proposed Rietkol Mining Operation

Figure 4-2: Aerial image indicating potentially noise-sensitive receptors close to mining area

Figure 4-3: Traffic volumes as reported by RAMS

4.6 TERMS OF REFERENCE

A noise impact assessment must be completed for the following reasons:

- It was identified as an environmental theme needing further investigation i.t.o. the National Screening Tool as per the procedures of Government Gazette 43110 of 20 March 2020;
- A change in land use as highlighted in SANS 10328:2008, section 5.3;
- if a proposed plant is to be developed on a site that is situated within 200 m of a noise-sensitive development (SANS 10328:2008 [5.4 (a)]) *or visa versa*;
- If a noise-sensitive development is to be established within 500 m (or, in the case of a busy throughway, 1 000 m) of a road or railway line (SANS 10328:2008 [5.4 (d)]) *or visa versa*;
- If a noise sensitive development is to be established within 1,000 m from an industry (SANS 10328:2008 [5.4 (g)]) *or visa versa*;
- If an industry is to be established within 1,000 m from a potential noise sensitive development (SANS 10328:2008 [5.4 (h)]) *or visa versa*;
- If a wind farm (wind turbines - SANS 10328:2008 [5.4 (i)]) or a source of low-frequency noise (such as cooling or ventilation fans - SANS 10328:2008 [5.4 (l)]) is to be established within 2,000 m from a potential noise sensitive development *or visa versa*;
- It is a controlled activity in terms of the NEMA regulations and an ENIA is required, because:
  - It may cause a disturbing noise that is prohibited in terms of section 18(1) of the Government Notice 579 of 2010;
  - It is a potential environmental theme to be further assessed as identified using the national environmental screening tool as required by GG No. 42451 of 10 May 2019 (proposed procedures);
- It is generally required by the local or district authority as part of the environmental authorization or planning approval in terms of Regulation 2(d) or GN R154 of 1992;

4.6.1 Requirements as per GG 43110

The Department of Environment, Forestry and Fisheries also promulgated Regulation 320, dated 20 March 2020 as published in Government Gazette No. 43110. The Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation would be applicable to this project.

This regulation defines the requirements for undertaking a site sensitivity verification, specialist assessment and the minimum report content requirements for environmental impact where a specialist assessment is required but no protocol has been prescribed. It requires that the current land use be considered using the national web based environmental screening tool to confirm the site sensitivity available at: https://screening.environment.gov.za.

If an applicant intending to undertake an activity identified in the scope of this protocol for which a specialist assessment has been identified on the screening tool on a site identified as being of:

- "very high" sensitivity for noise, must submit a Noise Specialist Assessment; or
- "low" sensitivity for noise, must submit a Noise Compliance Statement.

On a site where the information gathered from the site sensitivity verification differs from the designation of "very high" sensitivity on the screening tool and it is found to be of a "low" sensitivity, a Noise Compliance Statement must be submitted.

On a site where the information gathered from the initial site sensitivity verification differs from the designation of "low" sensitivity on the screening tool and it is found to be of a "very high" sensitivity, a Noise Specialist Assessment must be submitted.

If any part of the proposed development footprint falls within an area of "very high" sensitivity, the assessment and reporting requirements prescribed for the "very high" sensitivity apply to the entire footprint excluding linear activities for which noise impacts are associated with construction activities only and the noise levels return to the current levels after the completion of construction activities, in which case a compliance statement applies. In the context of this protocol, development footprint means the area on which the proposed development will take place and includes any area that will be disturbed.

The minimum requirements for a Noise Specialist Assessment are also covered in **Section 3** in the form of a checklist.

This assessment will be comprehensive and a Noise Specialist Assessment will be submitted because:

- There are a number of potential noise-sensitive receptors living within 1 000 m from the proposed mining activities; and,
- The larger area was identified to have a “very high” noise sensitivity.

4.6.2 Requirements as per South African National Standards

In South Africa the document that addresses the issues specifically concerning environmental noise is SANS 10103:2008. It has been thoroughly revised in 2008 and brought in line with the guidelines of the World Health Organisation (WHO). It provides the maximum average ambient noise levels during the day and night to which different types of developments indoors may be exposed.

In addition, SANS 10328:2008 (Edition 3) specifies the methodology to assess the potential noise impacts on the environment due to a proposed activity that might impact on the environment. This standard also stipulates the minimum requirements to be investigated for EIA purposes. These minimum requirements are:

a) the purpose of the investigation (see **section 4.1**);
b) a brief description of the planned development or the changes that are being considered (see **section 4.2**);
c) a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements (see **section 4.3 and 6**);
d) the identified noise sources together with their respective sound pressure levels or sound power levels (or both) and, where applicable, the operating cycles, the nature of sound emission, the spectral composition and the directional characteristics (see **sections 6.3 and 6.4.1**);
e) the identified noise sources that were not taken into account and the reasons as to why they were not investigated (see **sections 9 and 10**);
f) the identified noise-sensitive developments and the noise impact on them (see **sections 4.4, 10 and 11**);
g) where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics (see **section 9**);
h) an explanation, either by a brief description or by reference, of all measuring and calculation procedures that were followed, as well as any possible adjustments to existing measuring methods that had to be made, together with the results of calculations (see **sections 6, 9 and 10**);
i) an explanation, either by description or by reference, of all measuring or calculation methods (or both) that were used to determine existing and predicted rating levels, as well as other relevant information, including a statement of how the data were obtained and applied to determine the rating level for the area in question (see **section 6, 9 and 10**);

j) the location of measuring or calculating points in a sketch or on a map (see **sections 6.3 and 10**);
k) quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made (see **sections 6.4.1, 9, 10, 11 and 16**);
l) alternatives that were considered and the results of those that were investigated (see **section 11.5**);
m) a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation (see **section 4.5**);
n) a detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them (see **section 4.5**);
o) conclusions that were reached (see **section 15**);
p) proposed recommendations (see **section 15**);
q) if remedial measures will provide an acceptable solution which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority (see **sections 12 and 15**); and
r) any follow-up investigation which should be conducted at completion of the project as well as at regular intervals after the commissioning of the project so as to ensure that the recommendations of this report will be maintained in the future (see **section 15**).

5 LEGAL CONTEXT, POLICIES AND GUIDELINES

5.1 THE REPUBLIC OF SOUTH AFRICA CONSTITUTION ACT ("THE CONSTITUTION")

The environmental rights contained in section 24 of the Constitution provide that everyone is entitled to an environment that is not harmful to his or her well-being. In the context of noise, this requires a determination of what level of noise is harmful to well-being. The general approach of the common law is to define an acceptable level of noise as that which the reasonable person can be expected to tolerate under the particular circumstances. The subjectivity of this approach can be problematic, which has led to the development of noise standards (see **Section 5.5**).

"Noise pollution" is specifically included in Part B of Schedule 5 of the Constitution, which means that noise pollution control is a local authority competence, provided that the local authority concerned has the capacity to carry out this function.

5.2 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Environmental Affairs") to make regulations regarding noise, among other concerns. See also **section 5.2.1**.

5.2.1 Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the national Noise Control Regulations (NCRs) (GN R154 in *Government Gazette* No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Free State, Gauteng and Western Cape provinces but not in Mpumalanga and the National Regulations will be in effect.

The National Noise Control Regulations (GN R154 1992) defines:
"**controlled area**" as:
a piece of land designated by a local authority where, in the case of--
c) industrial noise in the vicinity of an industry-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or
ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period of 24 hours, exceeds 61 dBA.

"**disturbing noise**" as:
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 7 dBA or more.

"**zone sound level**" as:
a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. *This is the same as the Rating Level as defined in SANS 10103.*

In addition:
In terms of Regulation 2 -
"A local authority may –
(c): if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefor, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the lever of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles;
(d): before changes are made to existing facilities or existing uses of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests are conducted to the satisfaction of that local authority by the owner, developer, tenant or occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b); or (c), reports or certificates in relation to the noise impact to the satisfaction of that local authority are submitted by the owner, developer, tenant or occupant to the local authority on written demand".

In terms of Regulation 4 of the Noise Control Regulations:

"No person shall 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".

5.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 OF 1998)

The National Environmental Management Act (NEMA) defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating any facility to prevent noise pollution occurring. NEMA sets out measures which may be regarded as reasonable. They include the following measures:

1. to investigate, assess and evaluate the impact on the environment;
2. to inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment;
3. to cease, modify or control any act, activity or process causing the pollution or degradation;
4. to contain or prevent the movement of the pollution or degradation;
5. to eliminate any source of the pollution or degradation; and
6. to remedy the effects of the pollution or degradation.

In addition, Appendix 6 of GN 982 of December 2014 (Gov. Gaz. 38282), as amended in 2017, issued in terms of this Act, have general requirements for EAPs and specialists. It also defines minimum information requirements for specialist reports.

5.4 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT (ACT 39 OF 2004)

Section 34 of the National Environmental Management: Air Quality Act (Act 39 of2004) makes provision for:

(1) the Minister to prescribe essential national noise standards -

(a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or

(b) for determining –

(i) a definition of noise; and

(ii) the maximum levels of noise.

(2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.

This section of the Act has been promulgated, but no such standards have yet been issued. Draft regulations have however, been promulgated for adoption by Local Authorities.

An atmospheric emission licence issued in terms of Section 22 may contain conditions in terms of noise. This, however, is unlikely to be relevant to the mine as no atmospheric emissions are expected to take place.

5.4.1 Model Air Quality Management By-law for adoption and adaptation by Municipalities (GN 579 of 2010)

Model Air Quality Management By-Laws for adoption and adaptation by municipalities was published by the Department of Environmental Affairs in the Government Gazette of 2 July 2010 as Government Notice 579 of 2010.

The main aim of the model air quality management by-law is to assist municipalities in the development of their air quality management by-law within their jurisdictions. It is also the aim of the model by-law to ensure uniformity across the country when dealing with air quality management challenges. Therefore, the model by-law is developed to be generic in order to deal with most of the air quality management challenges. With Noise Control being covered under the Air Quality Act (Act 39 of 2004), noise is also managed in a separate section under this Government Notice.

- **IT IS NOT** the aim of the model by-law to have legal force and effect on municipalities when published in the Gazette; and
- **IT IS NOT** the aim of the model by-law to impose the by-law on municipalities.

Therefore, a municipality will have to follow the legal process as set out in the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000) when adopting and adapting the model by-law to its local jurisdictions.

5.5 NOISE STANDARDS

There are a few South African scientific standards (SABS) relevant to noise from mines, industry and roads. They are:

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication';
- SANS 10210:2004. 'Calculating and predicting road traffic noise';
- SANS 10328:2008. 'Methods for environmental noise impact assessments';
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method';

- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'; and
- SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful *per se.*

5.6 NATIONAL TRANSPORT POLICY (SEPTEMBER 1996)

The White Paper sets the vision for transport in South Africa that provides for *safe, reliable, effective, efficient and fully integrated transport operations and infrastructure which….. are environmentally and economically sustainable*. The White Paper further states that "*the provision of transportation infrastructure and the operation of the transportation system have the potential for causing damage to the physical and social environment, inter alia, through atmospheric and noise pollution, ecological damage and severance. … The Department of Transport is committed to an integrated environmental management approach in the provision of transport*". It is also stated that "*As part of the overall long-term vision for the South African transport system, transport infrastructure will, inter alia, be structured to ensure environmental sustainability and internationally accepted standards*". One of the strategic objectives for transport infrastructure to achieve this vision is to promote environmental protection and resource conservation.

5.7 INTERNATIONAL GUIDELINES

While a number of international guidelines and standards exist, those selected below are used by numerous countries for environmental noise management.

5.7.1 Guidelines for Community Noise (WHO, 1999)

The World Health Organization's (WHO) document on the *Guidelines for Community Noise* is the outcome of the WHO- expert task force meeting held in London, United Kingdom, in April 1999. It is based on the document entitled "Community Noise" that was prepared for the World Health Organization and published in 1995 by the Stockholm University and Karolinska Institute.

The scope of WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments.

Guidance on the health effects of noise exposure of the population has already been given in an early publication of the series of Environmental Health Criteria. The health risk to humans from exposure to environmental noise was evaluated and guidelines values derived. The issue of noise control and health protection was briefly addressed.

The document uses the L_{Aeq} and $L_{A,max}$ noise descriptors to define noise levels. It should be noted that a follow-up document focusing on Night-time Noise Guidelines for Europe (WHO, 2009).

5.7.2 Night Noise Guidelines for Europe (WHO, 2009)

Refining previous Community Noise Guidelines issued in 1999, and incorporating more recent research, the World Health Organization has released a comprehensive report on the health effects of night time noise, along with new (non-mandatory) guidelines for use in Europe. Rather than a maximum of 30dB inside at night (which equals 45-50dB max outside), the WHO now recommends a maximum year-round outside night-time noise average of 40dB to avoid sleep disturbance and its related health effects. The report notes that only below 30dB (outside annual average) are "*no significant biological effects observed*," and that between 30 and 40dB, several effects are observed, with the chronically ill and children being more susceptible; however, "*even in the worst cases the effects seem modest*." Elsewhere, the report states more definitively, "*There is no sufficient evidence that the biological effects observed at the level below 40 dB (night, outside) are harmful to health*." At levels over 40dB, "*Adverse health effects are observed*" and "*many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected*."

The 184-page report offers a comprehensive overview of research into the various effects of noise on sleep quality and health (including the health effects of non-waking sleep arousal), and is recommended reading for anyone working with noise issues. The use of an outdoor noise standard is in part designed to acknowledge that people do prefer to leave windows open when sleeping, though the year-long average may be difficult to obtain (it would require longer-term sound monitoring than is usually budgeted for by either industry or neighbourhood groups).

While recommending the use of the average level, the report notes that some instantaneous effects occur in relation to specific maximum noise levels, but that the health effects of these "cannot be easily established."

5.7.3 Equator Principles

The **Equator Principles** (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Equator Principles Financial Institutions (EPFIs) commit to not providing loans to projects where the borrower will not or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

The Equator Principles were developed by private sector banks and were launched in June 2003. The banks chose to model the Equator Principles on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). 67 financial institutions (October 2009) have adopted the Equator Principles, which have become the de facto standard for banks and investors on how to assess major development projects around the world. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the International Finance Corporation Environmental, Health and Safety (EHS) Guidelines.

5.7.4 IFC: General EHS Guidelines – Environmental Noise Management

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principle.

It states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source.

It goes as far as to propose methods for the prevention and control of noise emissions, including:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment causing radiating noise;
- Improving the acoustic performance of constructed buildings, apply sound insulation;

- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective;
- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas;
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Placement of permanent facilities away from community areas if possible;
- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

It sets noise level guidelines (see **Table 5-1**) as well as highlighting the certain monitoring requirements pre- and post-development. It adds another criterion in that the existing background ambient noise level should not rise by more than 3 dBA. This criterion will effectively sterilize large areas of any development. It is, therefore, the considered opinion that this criterion was introduced to address cases where the existing ambient noise level is already at, or in excess of the recommended limits.

Table 5-1: IFC Table 7.1-Noise Level Guidelines

Receptor type	**One hour L_{Aeq} (dBA)**	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The document uses the $L_{Aeq,1hr}$ noise descriptors to define noise levels. It does not determine the detection period, but refers to the IEC standards, which requires the fast detector setting on the Sound Level Meter during measurements for Europe.

6 CURRENT ENVIRONMENTAL SOUND CHARACTER

6.1 EFFECT OF SEASON ON SOUND LEVELS

Natural sounds are a part of the environmental noise surrounding humans. In rural areas the sounds from insects and birds would dominate the ambient sound character, with noises such as wind flowing through vegetation increasing as wind speed increase. Work by Fégeant (2002) stressed the importance of wind speed and turbulence causing variations in the level of vegetation generated noise. In addition, factors such as the season (e.g. dry or no leaves versus green leaves), the type of vegetation (e.g. grass, conifers, deciduous), the vegetation density and the total vegetation surface all determine both the sound level as well as spectral characteristics.

Ambient sound levels are significantly affected by the area where the sound measurement location is situated. When the sound measurement location is situated within an urban area, close to industrial plants or areas with a constant sound source (ocean, rivers, etc.), seasons and even increased wind speeds could have a significant impact on ambient sound levels.

Sound levels in undeveloped rural areas (away from occupied dwellings) however are impacted by changes in season for a number of complex reasons. The two main reasons are:

- Faunal communication during the warmer spring and summer months as various species communicate in an effort to find mates; and
- Seasonal changes in weather patterns, mainly wind (also see **section 6.1.1**).

For environmental noise, weather plays an important role; the greater the separation distance, the greater the influence of the weather conditions; so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible.

Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in the following sections.

6.1.1 Effect of wind speeds on vegetation and sound levels

Wind speed is a determining factor for sound levels at most rural locations. With no wind, there is little vegetation movement that could generate noises, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on the type of vegetation in a certain area. The impact of increased wind speeds on sound levels depends on the vegetation type (deciduous versus conifers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes the effect of faunal communication as vegetation may create suitable habitats and food sources for fauna, attracting more animals in number and species diversity as may be found in the natural veldt.

6.1.2 Effect of wind on sound propagation

Excluding wind-induced noises relating to increased wind speeds, wind alters sound propagation by the mechanism of refraction; that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the source. Waves bending downward means that a listener standing downwind of the source will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high.

Over short distances, wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e. less than 3 – 5 m/s.

6.1.3 Effect of temperature on sound propagation

On a typical sunny afternoon, air is warmest near the ground and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. In the evening, this temperature gradient will reverse, resulting in cooler temperatures near the ground. This condition, often referred to as a temperature inversion will cause sound to bend downward toward the ground and results in louder noise levels at the listener's position. Like wind gradients, temperature gradients can influence sound propagation over long distances and further complicate measurements.

Generally, sound propagate better at lower temperatures (down to 10°C), and with everything being equal, a decrease in temperature from 32°C to 10°C would increase the sound level at a listener 600 m away by ±2.5 dB (at 1,000 Hz).

6.1.4 Effect of humidity on sound propagation

The effect of humidity on sound propagation is quite complex, but effectively relates how increased humidity changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at high humidity. With everything being equal, an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz).

6.2 INFLUENCE OF WIND ON NOISE LIMITS

Current local regulations and standards do not consider changing ambient (background) sound levels due to natural events such as can be found near the coast or areas where wind-induced noises are prevalent. It is therefore important that the contribution of wind-induced noises be considered, especially if ambient sound level measurements were collected in an area known to experience significant winds.

While the total ambient sound levels are of importance, the spectral characteristics also determine the likelihood that someone will hear external noises that may or may not be similar in spectral characteristics to that of the vegetation that created the noise.

There are a number of factors that determine how ambient sound levels close to a dwelling might differ from the ambient sound levels further away (or even at another dwelling in the area), including:

- Type of activities taking place in the vicinity of the dwelling;
- Equipment being used near the dwelling, especially equipment such as water pumps, compressors and air conditioners;
- Whether there are any windmills (*"windpompe"*) close to the dwelling as well as their general maintenance condition;
- Types of trees around dwelling (conifers vs. broad-leaved trees, habitat that it provides to birds, food that it may provide to birds);
- The number, type and distance between the dwelling (measuring point) and trees. This is especially relevant when the trees are directly against the house (where the branches can touch the roof);
- Distance to large infrastructural developments, including roads, railroads and even large diameter pipelines (generation of low-frequency noises);
- Distances to other noise sources, whether anthropogenic or natural (such as the ocean or running water);
- The material used in the construction of the dwelling;
- The design of the building, including layout and number of openings (relating to the detection and secondary generation of low-frequency noises);
- How well the dwelling is maintained; and
- The type and how many farm animals are in the vicinity of the dwelling.

6.3 AMBIENT SOUND LEVEL AND CHARACTER MEASUREMENTS - 2018

Though baseline ambient sound levels were measured during 2016 (Jansen, 2016), additional measurements were collected during 2018 as the raw data was not available for this report. This original study defined the existing ambient sound to be typical of an urban noise district. The data collected during the original baseline study was used to identify a quieter long-term measurement location as the original baseline report located the monitoring points too close to significant noise sources, namely:

- Large eucalyptus trees close to two of the measurement locations,
- The one location was just south of the nursery that operated a substantial number of fans 24 / 7.

Unattended long-term ambient (background) sound levels were measured over a four-night-time period from 16 - 20 April 2018 at one location in accordance with the South African National Standard SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and
- weather conditions.

Attended short-term measurements were collected 20 April 2018 close to Unex Roses in an attempt to define the significance of this noise source. The sound measurement locations are illustrated in **Figure 6-1** as a blue square.

The sound level measuring equipment was referenced at 1,000 Hz directly before and after the measurements were taken. In all cases drift was less than 0.2 dBA. The sound level meters would measure "average" sound levels over 10-minute periods, save the data and start with a new 10-minute measurement till the instrument was stopped.

Figure 6-1: Localities of where ambient sound levels were measured in 2018

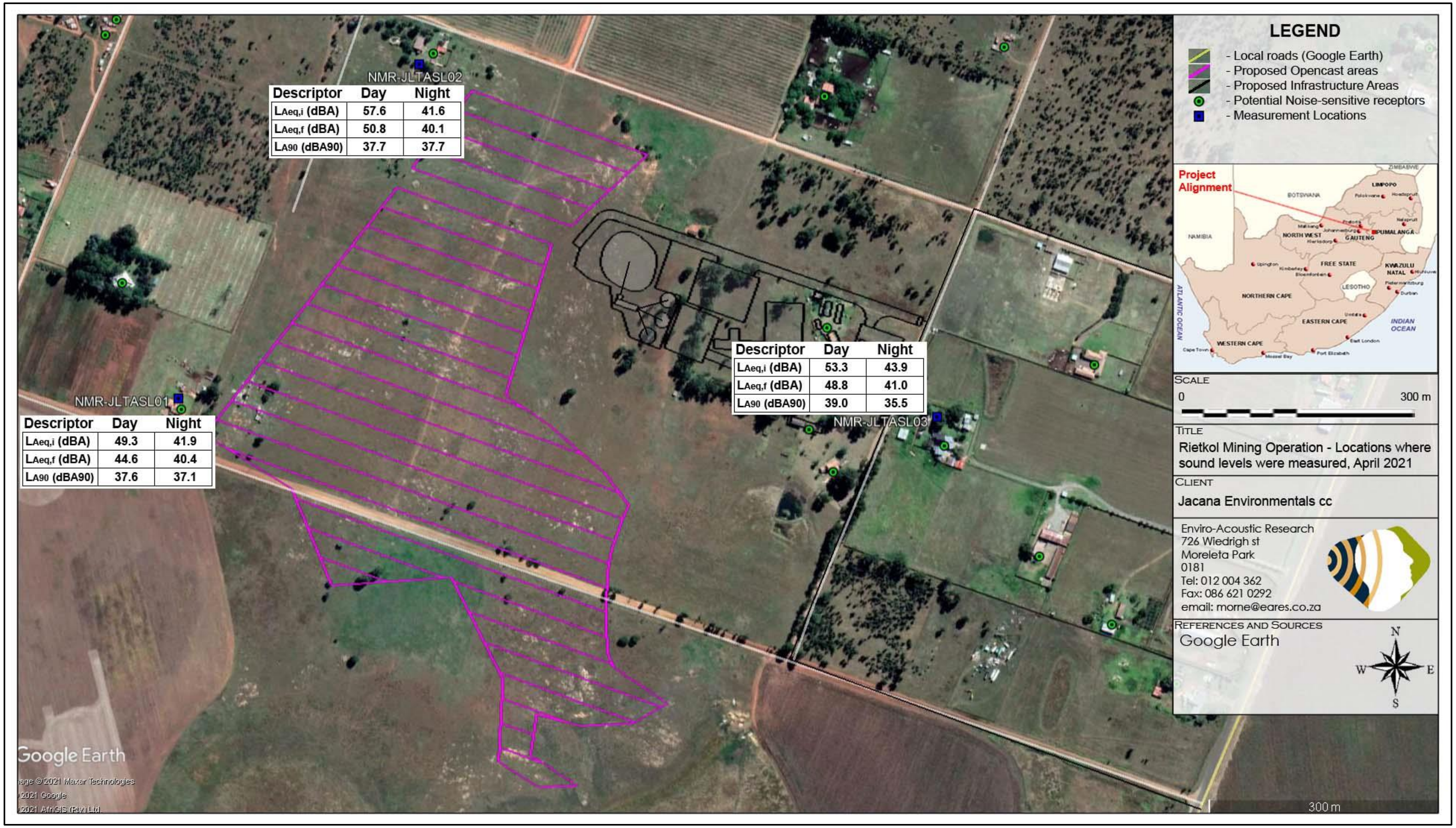

Figure 6-2: Localities of where ambient sound levels were measured in April 2021

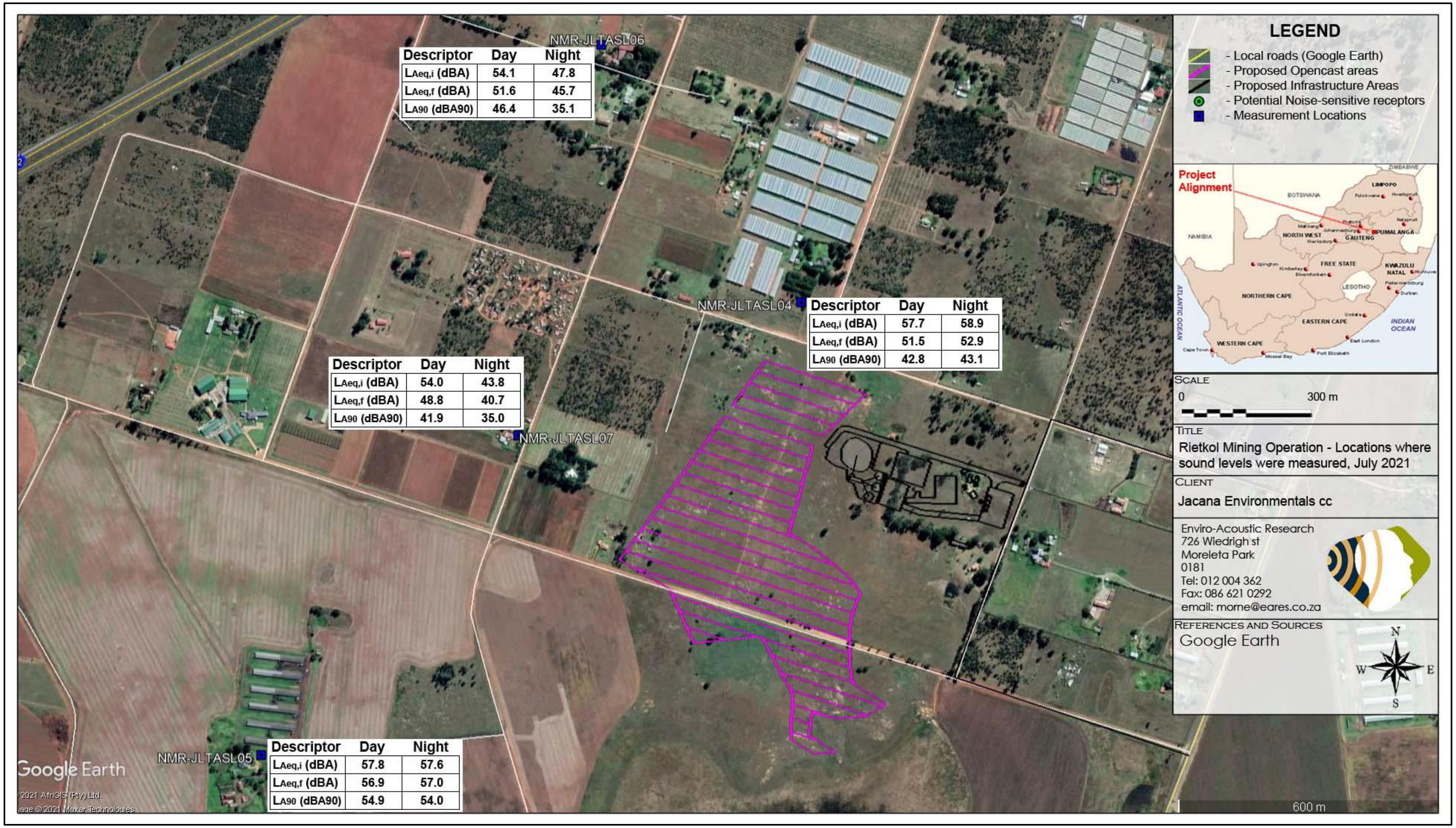

Figure 6-3: Localities of where ambient sound levels were measured in July 2021

6.3.1 Ambient Sound Measurements at NMR-JLTASL01

Measurements were collected in April 2018. The microphone was deployed at the back of the house, away from any identifiable potential noise sources. There were no large trees within 20m from the microphone apart from a small tree. Photos of the measurement location are presented in **Appendix B**. Sounds heard onsite are described in the following table.

Table 6-1: Noises/sounds heard during site visits at receptor NMR-JLTASL01

Ambient Sound Character – Sounds of significance heard onsite	
Magnitude Scale Code: Barely Audible / Audible / Dominating	**Faunal and Natural**
	Deployment: Bird sounds dominant. Chickens on the property but they were only occasionally audible. Insects at times. Collection: Bird sounds dominant.
	Residential and other Anthropogenic
	Deployment: Hammering from worker cleaning bricks. People working at the premises. Voices from house. Collection: Hammering and grinding in area. Voices from people working at the premises.
	Industries, Commercial and Road Traffic
	Deployment: - Collection: -

Table 6-2: Equipment used to gather data at NMR-JLTASL01

Equipment	Model	Serial no	Calibration
SLM	SVAN 977	34160	February 2017
Microphone	ACO Pacific 7052E	54645	February 2017
Calibrator	Quest CA-22	J 2080094	July 2017
Weather Station	WH3081PC	-	-

- Microphone fitted with the appropriate windshield.

Impulse equivalent sound levels (South African legislation): Figure 6-4 illustrates how the impulse-weighted 10-minute equivalent values changes over time with **Table 6-3** defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown on **Figure 6-4** with **Table 6-3** defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. **L_{A90}** is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time on **Figure 6-5** and **Table 6-3**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Figure 6-5** and **Table 6-3**.

Table 6-3: Sound levels considering various sound level descriptors at NMR-JLTASL01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	53	49	41	-	-
Night arithmetic average	-	44	41	34	-	-
Day minimum	-	33	30	-	22	-
Day maximum	117	97	84	-	-	-
Night minimum	-	30	28	-	24	-
Night maximum	78	64	59	-	-	-
Day 1 equivalent	-	56	49	-	-	Late afternoon and evening
Night 1 Equivalent	-	51	47	-	-	8 hour night equivalent average
Day 2 equivalent	-	62	55	-	-	16 hour day equivalent average
Night 2 Equivalent	-	50	45	-	-	8 hour night equivalent average
Day 3 equivalent	-	57	53	-	-	16 hour day equivalent average
Night 3 Equivalent	-	54	49	-	-	8 hour night equivalent average
Day 4 equivalent	-	59	54	-	-	16 hour day equivalent average
Night 4 Equivalent	-	50	45	-	-	8 hour night equivalent average
Day 5 equivalent	-	82	69	-	-	Morning and afternoon

The statistical data (**$L_{A90,f}$**) indicate a location with substantial elevated noise levels both day and night, even though **L_{Amin}** data indicate a location with a potential to become quiet. **L_{Amax}** levels frequently exceeded 65 dBA at night (more than 10 times each night) with the source unknown. When sound events occur at night (where the noise level exceeds 65 dBA) this may disturb the sleep of people. It should be noted that equivalent data show a location where ambient sound levels are higher than the level desired for residential use at night (higher than 45 dBA).

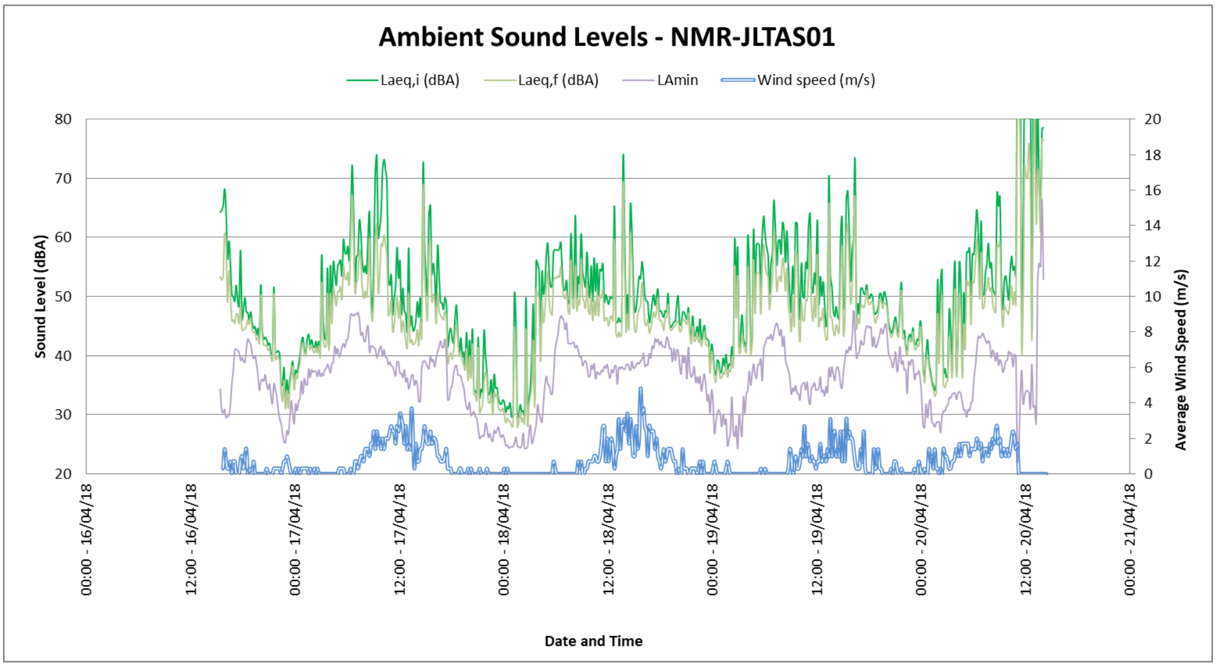

Figure 6-4: Ambient Sound Levels at NMR-JLTASL01

Figure 6-4 and **Figure 6-5** illustrate the cyclic nature of the sound levels in the area, where sound levels reduce at night, increasing early in the mornings, remaining higher during the day and decreasing again at night. The data however indicate a location with significant external noise sources that raised the ambient sound levels. This data confirms an area with elevated ambient sound levels as highlighted by the baseline report (Jansen, 2016).

Considering the character of the area, sounds heard as well as the average $\mathbf{L_{Aeq,i}}$ values, daytime ambient sound levels are typical of an **urban noise district** with night-time ambient sound levels typical of an **urban noise district** (SANS 10103:2008 – see **Table 8-1**).

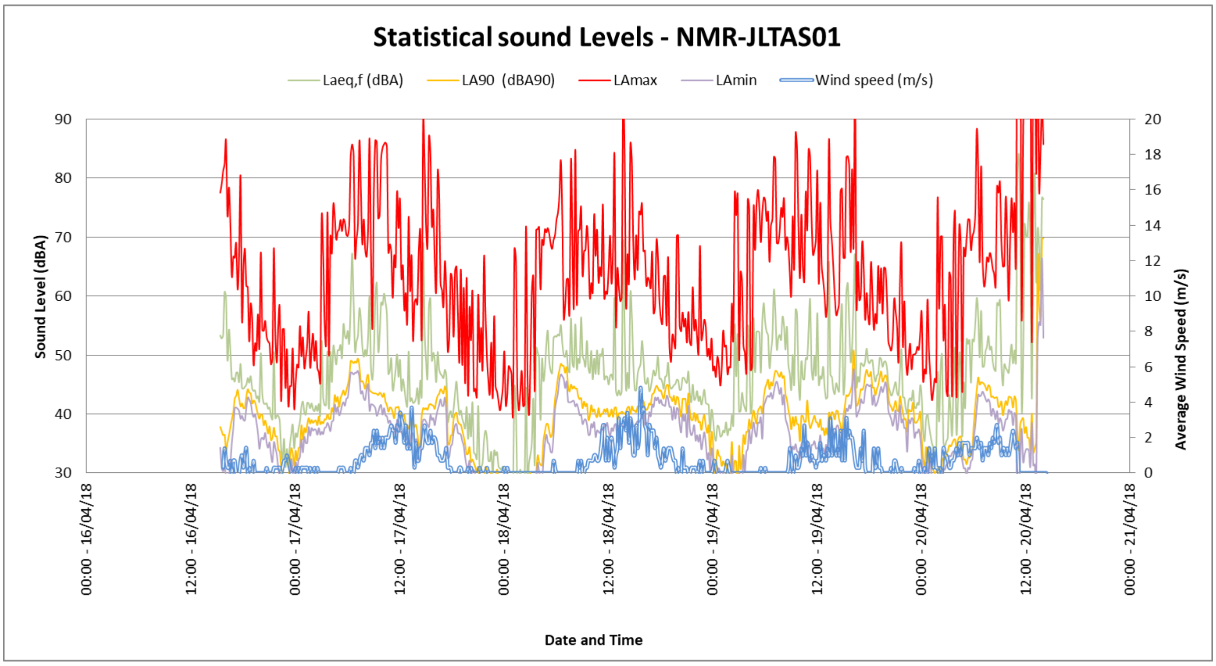

Figure 6-5: Maximum, minimum and statistical values at NMR-JLTASL01

Third octaves were measured and are displayed in the following figures. It should be noted that a loud noise started at this measurement location around 11 AM on the 20th and the spectral data was excluded in the calculation of the average acoustic energy. Each of the day and night-time graphs shows at least two different and quite distinct spectral signatures, namely:

- Daytime: Varied spectral character of typical daytime activities, a smoother number of curves associated with the late afternoon and evenings, and a similar number of curves (with a bump at 2,500 Hz) from morning measurements. The bump is likely due to birds (morning chorus) observable in the night-time measurements, where the dawn chorus starts at around 04:00.
- Night-time: A relative smoother curve associated with late night, quieter periods and a number of curves with peaks at 1,250 and 2,500 Hz, likely due to dawn chorus (starting at around 04:00), possibly one or more roosters crowing.

Lower frequency (20 – 250 Hz) – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relative smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies. People generally do not hear these frequencies unless very quiet due to the low response of the ear to these low frequencies. Sounds from wind-induced noises generally have significant acoustic energy in this frequency range (normally identified by a smooth curve).

Night-time data indicated a site with some acoustic energy in this frequency range (average of approximately 30 dBA). Most night-time measurements show a peak at 40 and 63 – 100 Hz due to an unknown noise source, although the fans from the nursery are suspected as a potential source of constant noise, cumulative with traffic noises from the N12. It should be noted, that, at 10 – 30 dBA, these frequencies would be difficult to detect for the average human ear.
Daytime data shows some acoustic energy in this frequency band with a character similar of the night-time spectral data (average of approximately 34 dBA).

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally peaking in 630 – 1,600 Hz range (depending on vehicular speed and road characteristics).

Night-time data indicated a site with significant acoustic energy in this frequency range (average of approximately 40 dBA). Most measurements show a clearly discernible peak at 400 – 800 Hz, with this peak ranging between 400 – 1,600 Hz after approximately 04:00.
Daytime data shows significant acoustic energy in this frequency band due to various different sources (average of approximately 47 dBA). Most measurements show a definite peak at the 400 – 1,600 Hz frequency range.

Higher frequency (2,000 Hz upwards) – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt etc.

Night-time data indicated a site with a bit of acoustic energy in this frequency range (average of approximately 27 dBA), with measurements associated with the early mornings showing a peak at 2,500 and 5,000 Hz (possibly a harmonic of 2,500 Hz). There are also peaks at 12,500 – 20,000 Hz, likely a combination of bats, cicada and other insects.
Daytime data shows some acoustic energy in this frequency band due to various different sources, likely birds and insects (average of approximately 37 dBA). Evening measurements indicate peaks at 12,500 and higher, likely bats and insects.

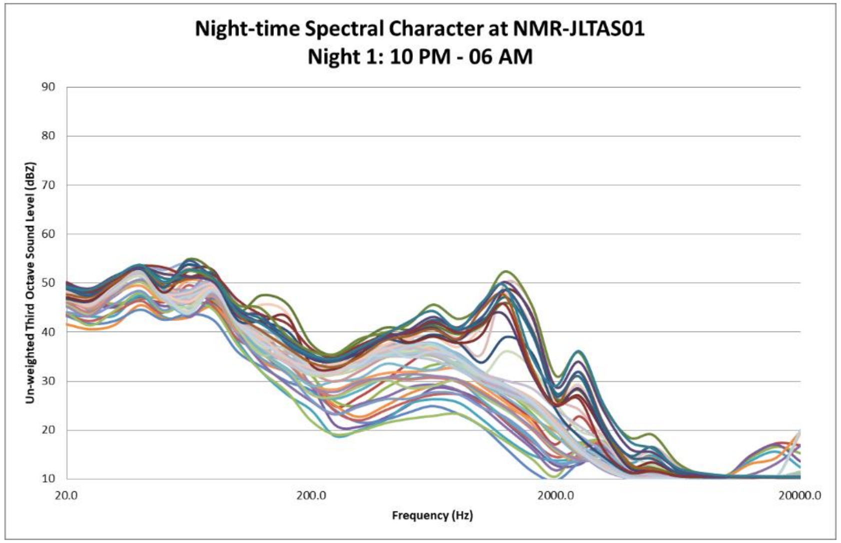

Figure 6-6: Spectral frequencies – NMR-JLTASL01, Night 1

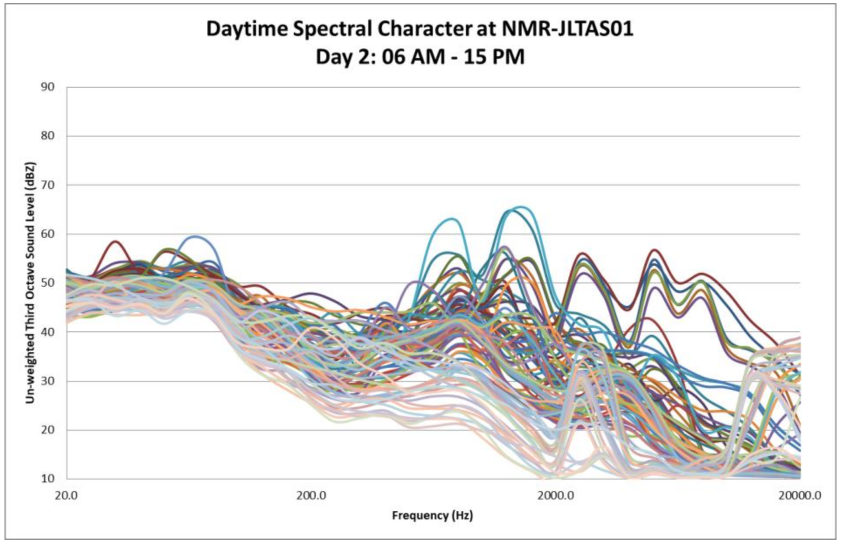

Figure 6-7: Spectral frequencies - NMR-JLTASL01, Day 2

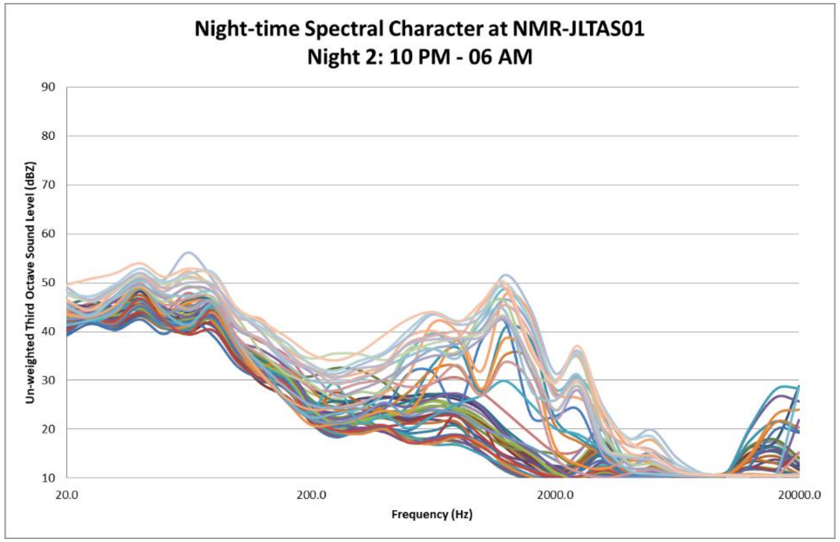

Figure 6-8: Spectral frequencies - NMR-JLTASL01, Night 2

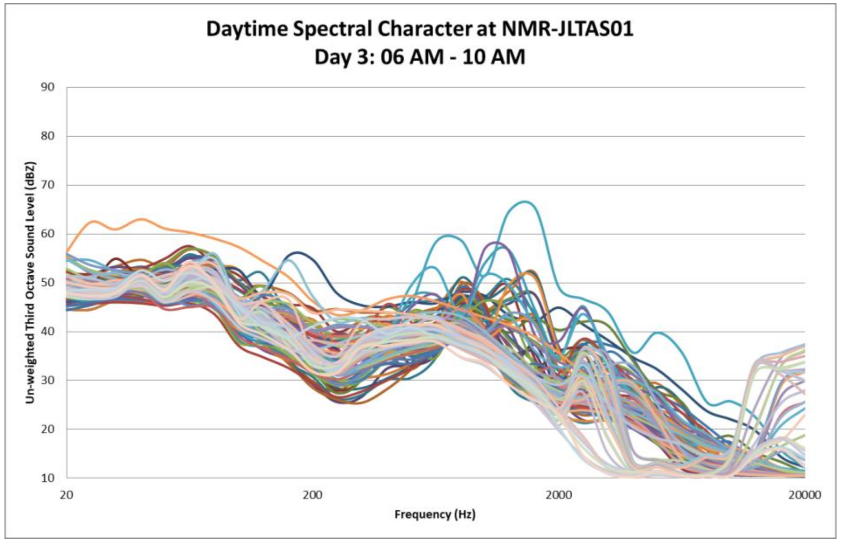

Figure 6-9: Spectral frequencies - NMR-JLTASL01, Day 3

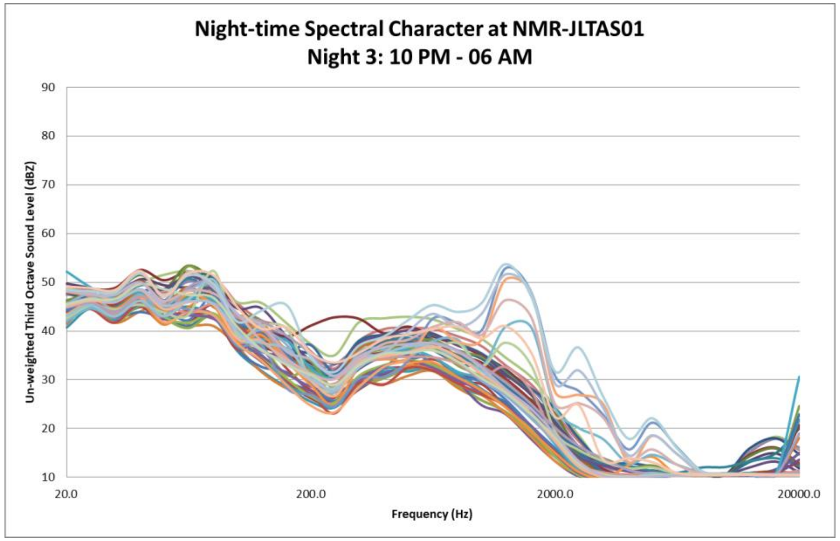

Figure 6-10: Spectral frequencies – NMR-JLTASL01, Night 3

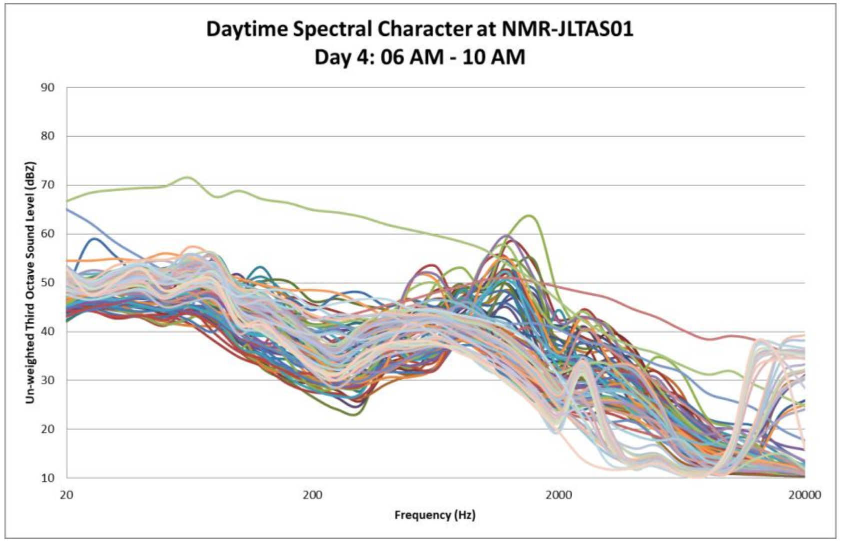

Figure 6-11: Spectral frequencies - NMR-JLTASL01, Day 4

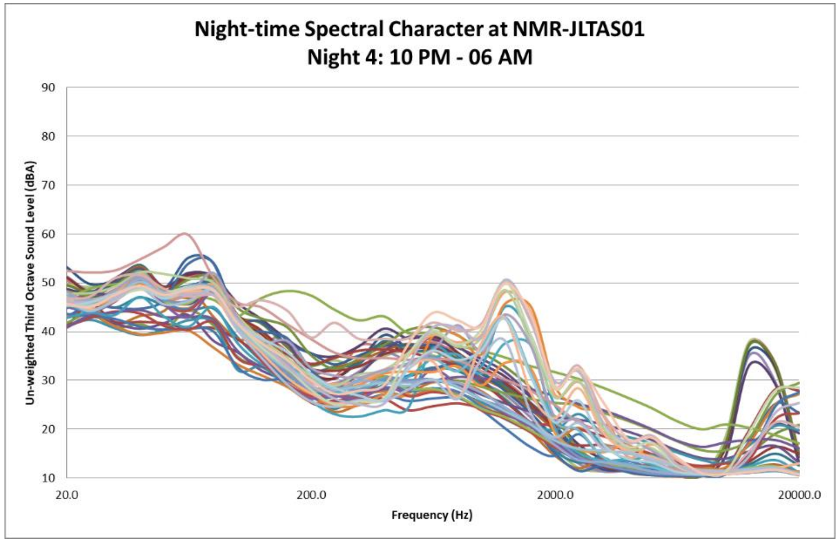

Figure 6-12: Spectral frequencies - NMR-JLTASL01, Night 4

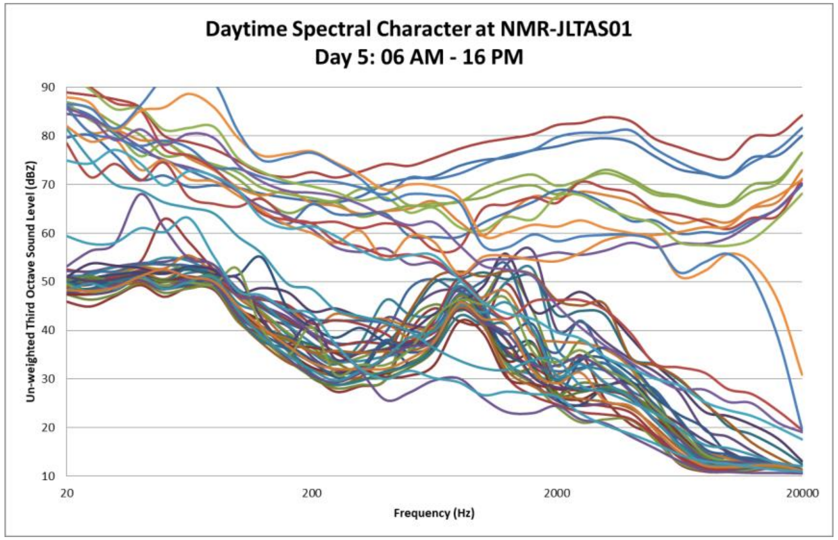

Figure 6-13: Spectral frequencies - NMR-JLTASL01, Day 5

6.3.2 Single Measurements – In vicinity of mining area

Measurements were collected in April 2018. A number of single measurements were collected to gauge the noise levels from the fans located at the greenhouses of the nursery (levels and spectral character). Equipment used at these locations is defined in the following table. Refer to **Appendix B** for a photo of this measurement location.

Table 6-4: Equipment used to do singular measurements around Hernic

Equipment	Model	Serial no	Calibration
SLM	RION NA-28	00901489	February 2017
Microphone	UC-59	02087	February 2017
Calibrator	Quest QC-20	QOC 020005	June 2017

Note: SLM fitted at all times with appropriate windshield

Note:

$L_{Aeq,i}$ - Equivalent A-weighted noise level, similar to an average noise level – Impulse-detector

$L_{Aeq,f}$ - Equivalent A-weighted noise level, similar to an average noise level – Fast-detector

L_{A90} - Noise level that is exceeded 90% or more of the time – Fast-detector

The data collected and information about the measurement locations are presented in the following tables.

6.4 Ambient Sound Level and Character Measurements - 2021

This original noise study (Jansen, 2016) defined the existing ambient sound to be typical of an urban noise district, confirmed by the measurements conducted in April 2021. Additional sound level measurements were collected in February 2021 to assess the sound character, and to confirm or refute previous sound level measurements.

Unattended long-term ambient (background) sound levels were measured over a two-night time period from 17 - 19 February 2021 at three locations in accordance with the South African National Standard SANS 10103:2008.

The sound level measuring equipment were referenced at 1,000 Hz directly before and after the measurements were taken. In all cases drift was less than 0.2 dBA. The sound level meters would measure "average" sound levels over 10-minute periods, save the data and start with a new 10-minute measurement till the instrument was stopped.

Table 6-5: Summary of singular noise measurements

Measurement location	$L_{Aeq,i}$ level (dBA)	$L_{Aeq,f}$ level (dBA)	L_{A90} Level (dBA90)	Spectral character	Comments
NMR-JSTASL02	50.6	49.5	47.0	**Figure 6-14**	Fans from the nursery significant and dominant sound. Birds and chickens audible at times, with some wind-induced noises. Agricultural equipment active in the area and clearly audible. Sounds of grinding and other workshop related activities audible at times. There were significant peaks at 40 and 80 Hz, with a detectable peak at 800 Hz. The 40 and 80 Hz peaks are likely from the nursery fans, with the peak at 800 Hz from an unknown source.
NMR-JSTASL03	50.9	48.6	46.7	**Figure 6-15**	Fans from the nursery significant and dominant sound. Wind-induced noises due to plastic sheeting (from tunnels) occasionally flapping in the wind. Workers travelling up and down the gravel road on foot, via bicycle, tractor and in LDV. Voices audible at times. Nearby workshop related activities are taking place including grinding, use of hammers and drills etc. Wind-induced noises due to the presence of trees. There were significant peaks at 40 and 80 Hz, with detectable peaks at 250 and 8000 Hz. The 40 and 80 Hz peaks are likely from the nursery fans, with the peaks at 250 and 8000 Hz from an unknown source.
NMR-JSTASL04	50.3	48.0	45.5	**Figure 6-16**	Fans from the nursery significant and dominant sound. Wind-induced noises due to plastic sheeting (from tunnels) occasionally flapping in the wind. Workers travelling up and down the gravel road on foot, via bicycle, tractor and in LDV. Voices audible at times. Nearby workshop related activities are taking place including grinding, use of hammers and drills etc. Wind-induced noises due to the presence of trees. Road traffic noise in distance, possibly the N12 traffic. There were detectable peaks at 40 and 80 Hz, with a clear peak at 800 Hz.

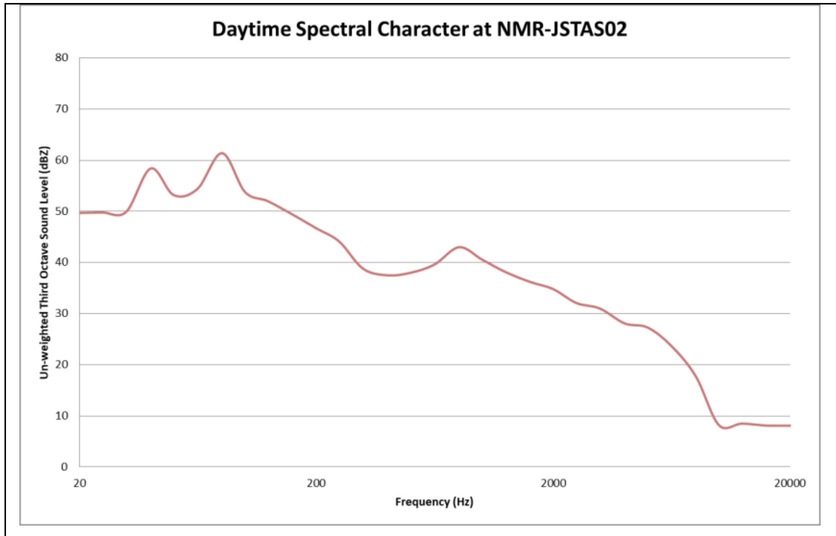

Figure 6-14: Spectral frequencies recorded at NMR-JSTASL02

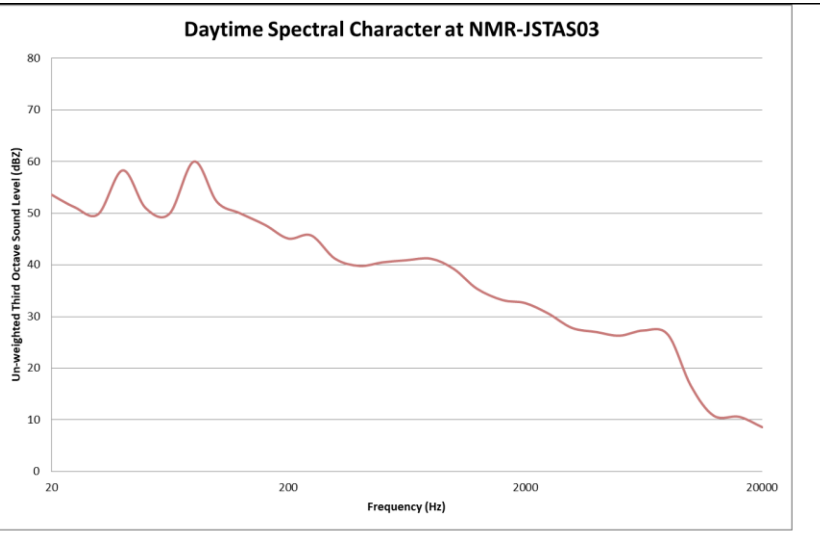

Figure 6-15: Spectral frequencies recorded at NMR-JSTASL03

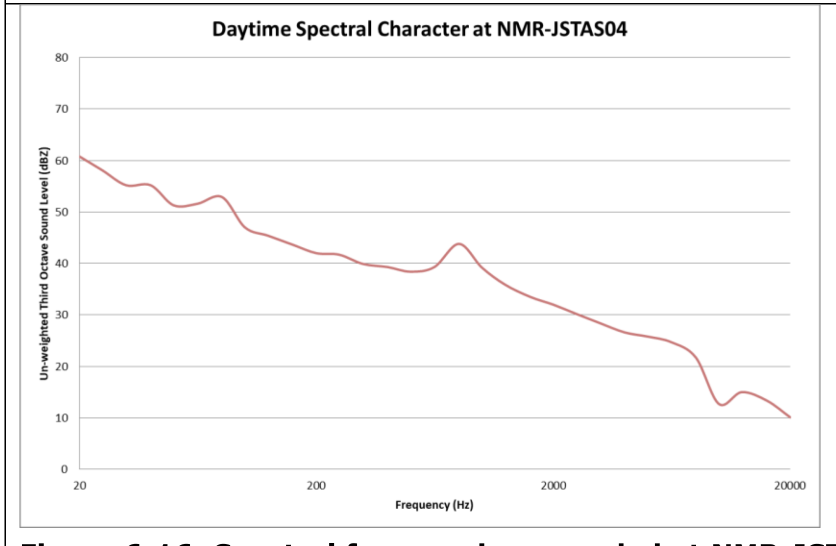

Figure 6-16: Spectral frequencies recorded at NMR-JSTASL04

6.4.1 Long-term Measurement Location - NMR-JLTASL01

The microphone was deployed at the back of the house, away from any identifiable potential noise sources at a similar location as per the 2018 measurement. There were no large trees within 20m from the microphone apart from a small tree, with a number of large eucalyptus trees within 60 m. Photos of the measurement location are presented in **Appendix B**. While not audible during the site visit, previous site visits detected a pump which may influence ambient sound levels.

The equipment defined in **Table 6-6** was used for gathering data, with **Table 6-7** highlighting sounds heard during equipment deployment and collection.

Table 6-6: Equipment used to gather data at NMR-JLTASL01

Equipment	Model	Serial no	Calibration Date
SLM	NL-32	01182945	October 2020
Microphone	NH-21	28879	October 2020
Calibrator	Quest CA-22	J 2080094	June 2020

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-7: Noises/sounds heard during site visits at NMR-JLTASL01

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • Barely Audible • Audible • Dominating	During equipment deployment	
	Faunal and Natural	Farm animals dominant sound, with chickens and chicks in close proximity to the microphone. Turkey audible, birds audible.
	Residential	-
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Farm animals dominant sound, with chickens and chicks in close proximity to the microphone. Turkey audible, birds audible.
	Residential	-
	Industrial & transportation	-

6.4.1.1 Summary of Ambient Sound levels measured

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-17** and summarized in **Table 6-8** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-18**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is elevated, indicating the presence of constant noises in the area that raises the noise levels.

Maximum noise level exceeded 65 dBA 3 times the first, and 5 times the second night. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[5].

Table 6-8: Sound levels considering various sound level descriptors at NMR-JLTASL01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	49.3	44.6	37.6	-
Night arithmetic average	-	41.9	40.4	37.1	-
Day Equivalent	-	52.4	47.5	-	-
Night Equivalent	-	46.7	43.2	-	-
Day minimum	-	39.4	35.9	-	26.7
Day maximum	84.9	68.2	59.9	-	-
Night minimum	-	34.3	33.1	-	27.2
Night maximum	74.3	57.5	52.9	-	-
Day 1 equivalent	-	54.7	47.0	-	-
Night 1 Equivalent	-	46.1	42.7	-	-
Day 2 equivalent	-	51.3	46.3	-	-
Night 2 Equivalent	-	47.3	43.7	-	-
Day 3 equivalent	-	46.0	41.1	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 6-19** (night) and **Figure 6-20** (day).

6.4.1.2 Spectral Frequencies

The Rion NL-32 instrument was not fitted with 3rd octave filters.

(5) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

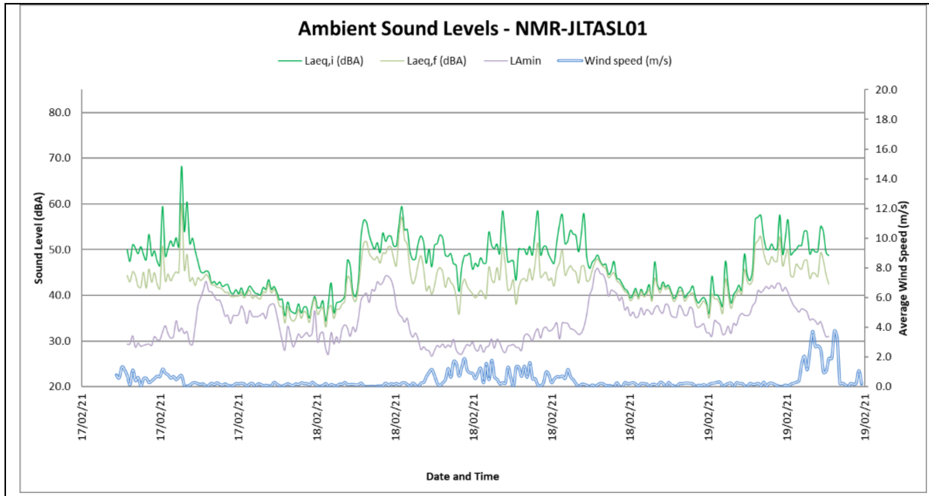

Figure 6-17: Ambient Sound Levels at NMR-JLTASL01

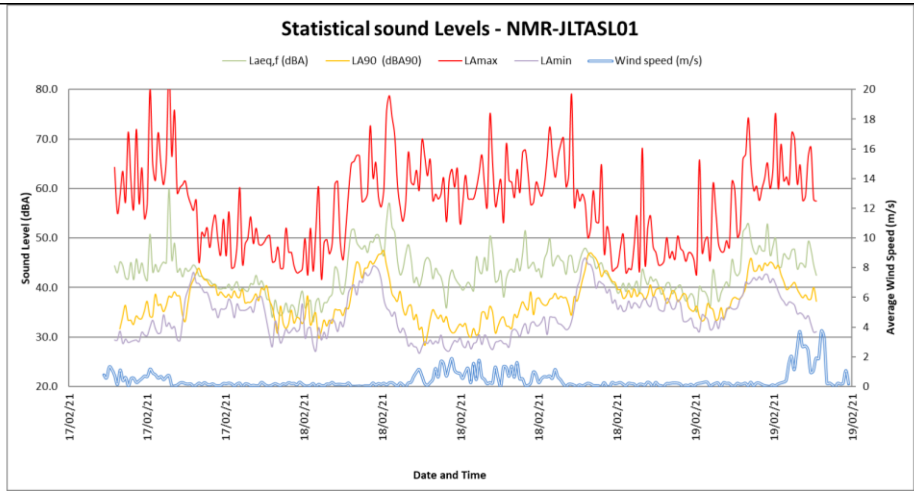

Figure 6-18: Maximum, minimum and Statistical sound levels at NMR-JLTASL01

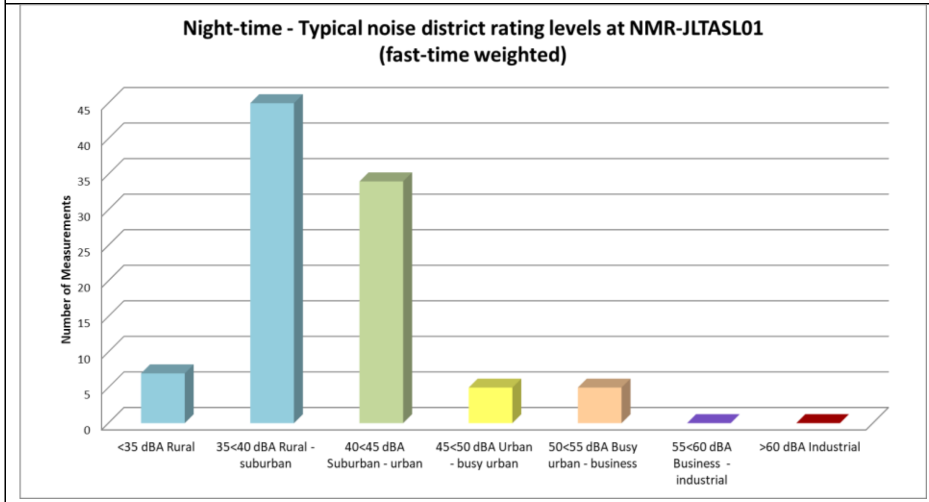

Figure 6-19: Classification of night-time measurements in typical noise districts at NMR-JLTASL01

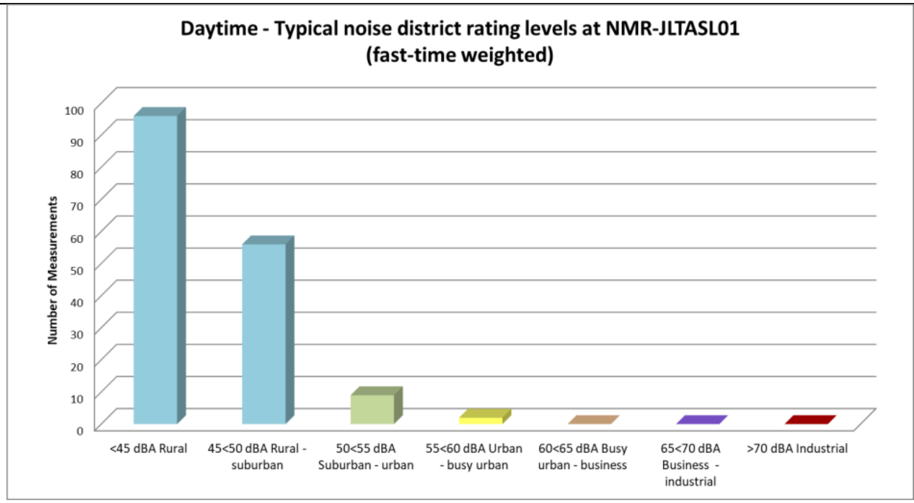

Figure 6-20: Classification of daytime measurements in typical noise districts at NMR-JLTASL01

6.4.2 Long-term Measurement Location - NMR-JLTASL02

The microphone was deployed at the back of the house, in a relative rocky area with a number of trees within 20 m. Photos of the measurement location are presented in **Appendix B**. The equipment defined in **Table 6-9** was used for gathering data with **Table 6-10** highlighting sounds heard during equipment deployment and collection. The instrument only measured sound levels for approximately 25 hours, with the instrument trampled by a cow.

Table 6-9: Equipment used to gather data at NMR-JLTASL02

Equipment	Model	Serial no	Calibration Date
SLM	Svan 977	34849	October 2020
Microphone and Pre-amplifier	ACO 7052E & SV 12L	33077	October 2020
Calibrator	Quest CA-22	J 2080094	June 2020

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-10: Noises/sounds heard during site visits at NMR-JLTASL02

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • Barely Audible • Audible • Dominating	During equipment deployment	
	Faunal and Natural	Birds dominant most of the time.
	Residential	-
	Industrial & transportation	Fans from Unex Roses audible and dominant when birds are quiet.
	During equipment collection	
	Faunal and Natural	Birds dominant most of the time.
	Residential	-
	Industrial & transportation	Fans from Unex Roses audible and dominant when birds are quiet.

6.4.2.1 *Summary of Ambient Sound levels measured*

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-21** and summarized in **Table 6-11** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-22**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is elevated, indicating the presence of constant noises in the area that raises the noise levels.

Maximum noise level exceeded 65 dBA a few times (only 3 times) the first night. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[6].

Table 6-11: Sound levels considering various sound level descriptors at NMR-JLTASL02

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	57.6	50.8	37.7	-
Night arithmetic average	-	41.6	40.1	37.7	-
Day Equivalent	-	55.7	46.3	-	-
Night Equivalent	-	49.1	43.3	-	-
Day minimum	-	41.4	40.4	-	30.1
Day maximum	109.4	86.1	77.0	-	-
Night minimum	-	37.3	36.3	-	32.5
Night maximum	78.7	62.6	54.6	-	-
Day 1 equivalent	-	73.6	65.7	-	-
Night 1 Equivalent	-	49.1	43.3	-	-
Day 2 equivalent	-	58.7	49.3	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 6-23** (night) and **Figure 6-24** (day).

6.4.2.2 Spectral Frequencies

The spectral character is illustrated in **Figure 6-25** to **Figure 6-28**. All measurements indicate clear peaks at 40 and 80 Hz, with a slight peak at 160 Hz. It is suspected to be from the nursery fans.

Night-time measurements show a peak between 10,000 – 20,000 Hz, likely from faunal sources.

Daytime measurements indicate various different noise sources, with faunal sources generally increasing acoustic energy in the 2,000 – 20,000 Hz frequency range.

(6) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

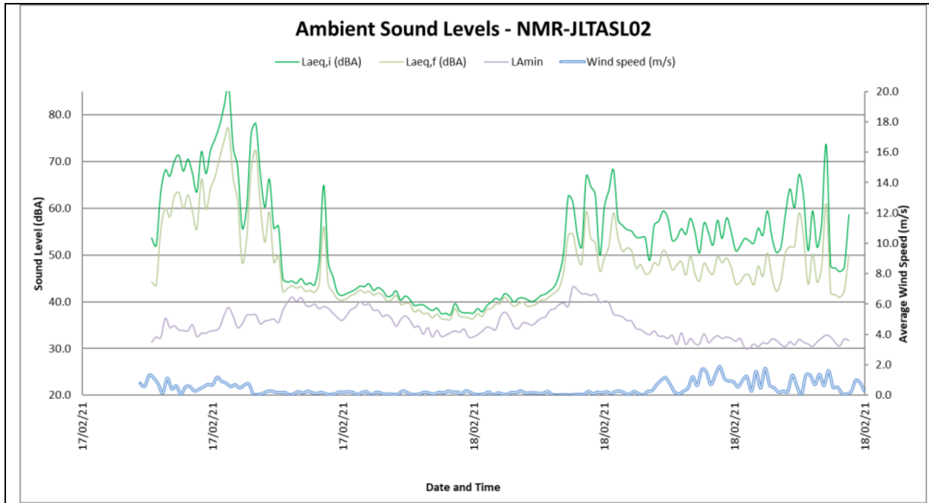

Figure 6-21: Ambient Sound Levels at NMR-JLTASL02

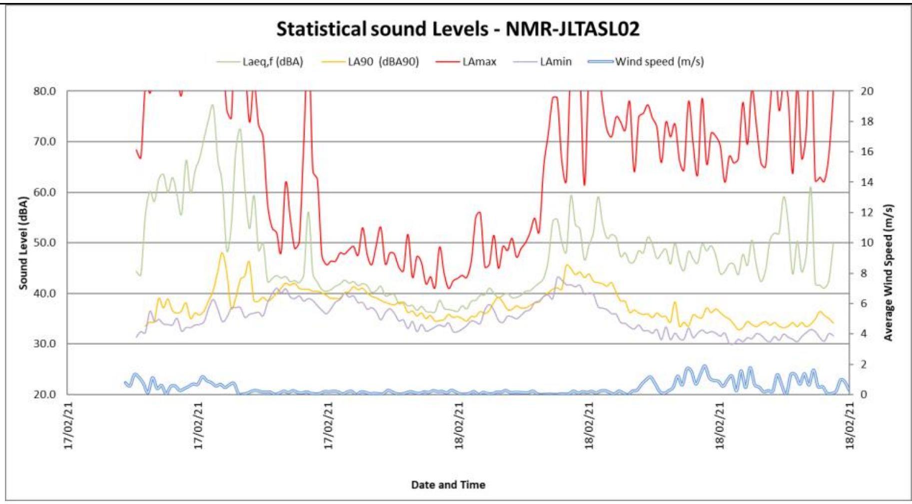

Figure 6-22: Maximum, minimum and Statistical sound levels at NMR-JLTASL02

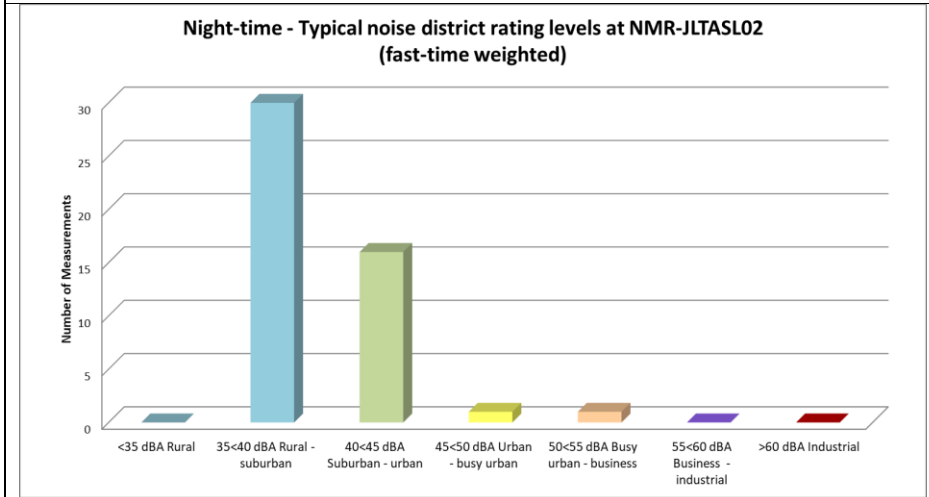

Figure 6-23: Classification of night-time measurements in typical noise districts at NMR-JLTASL02

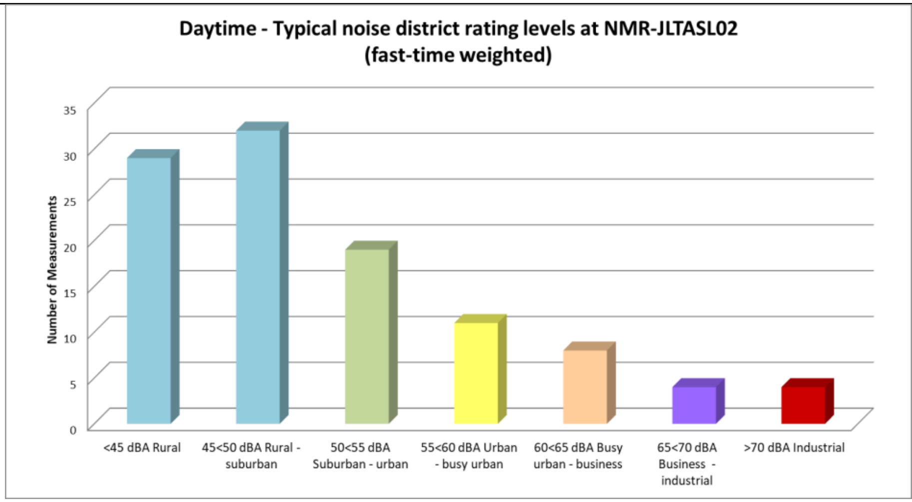

Figure 6-24: Classification of daytime measurements in typical noise districts at NMR-JLTASL02

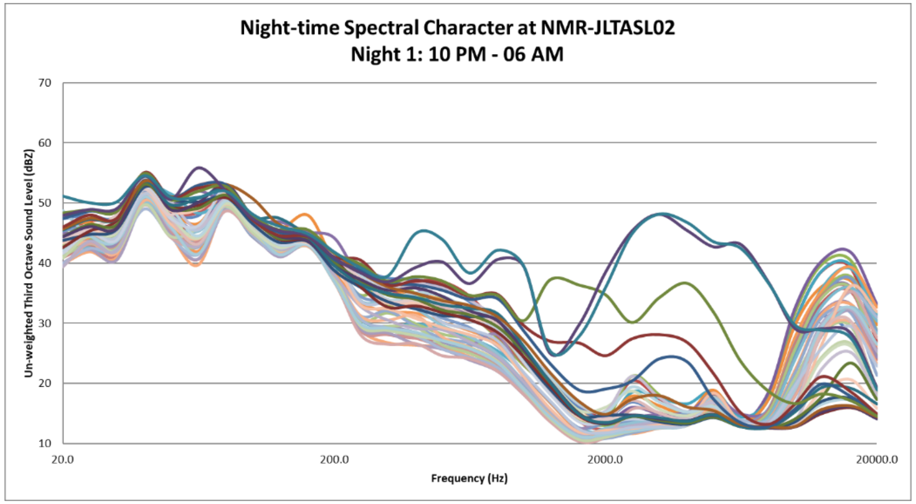

Figure 6-25: Spectral frequencies – NMR-JLTASL02, Night 1

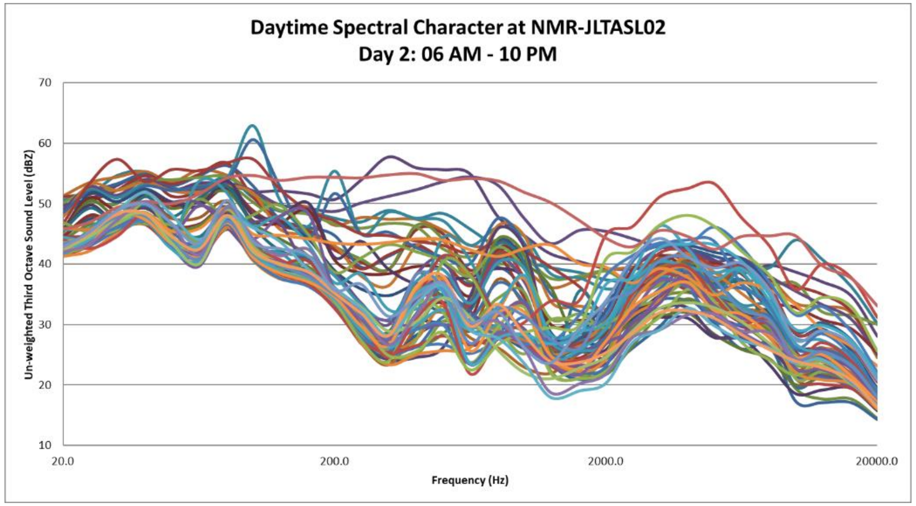

Figure 6-26: Spectral frequencies - NMR-JLTASL02, Day 2

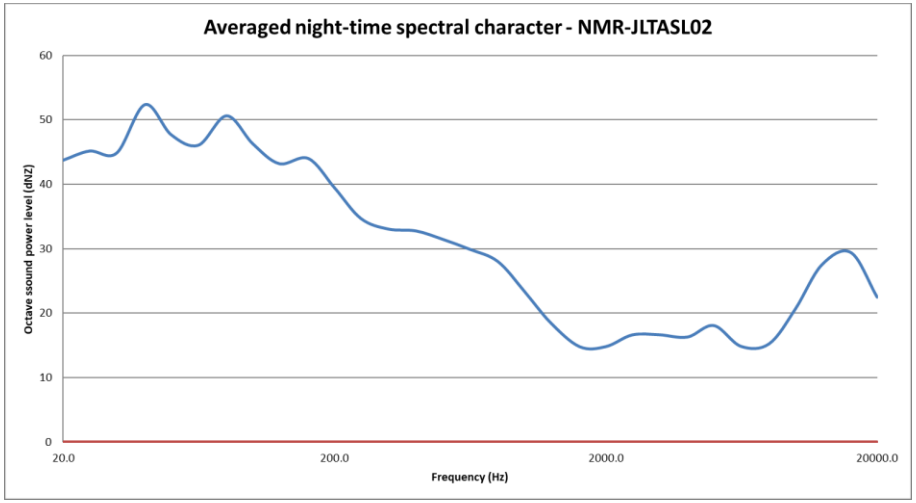

Figure 6-27: Average night-time frequencies - NMR-JLTASL02

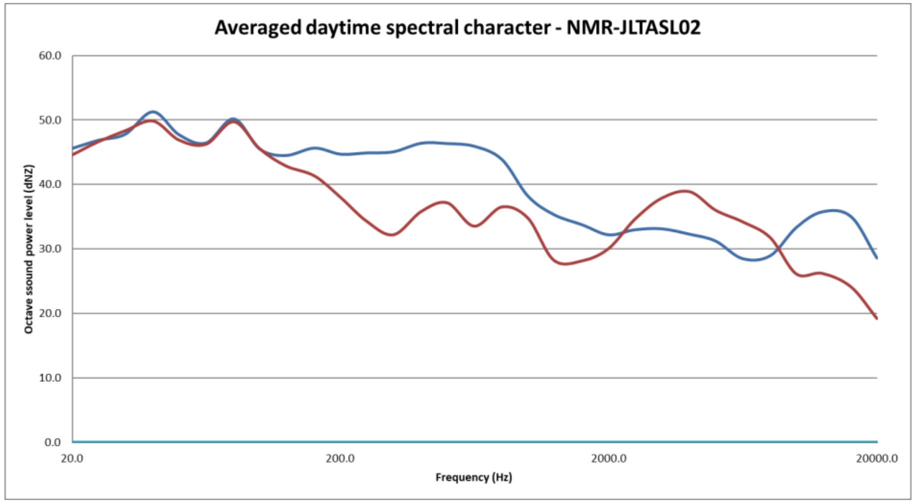

Figure 6-28: Average daytime frequencies - NMR-JLTASL02

6.4.3 Long-term Measurement Location - NMR-JLTASL03

The microphone was deployed in the garden of the house, with a number of large deciduous and palm trees within 10 m. This may increase faunal noises, as well as wind-induced noises during periods with increased winds. Photos of the measurement location are presented in **Appendix B**. The equipment defined in **Table 6-12** was used for gathering data with **Table 6-13** highlighting sounds heard during equipment deployment and collection.

Table 6-12: Equipment used to gather data at NMR-JLTASL03

Equipment	Model	Serial no	Calibration Date
SLM	SVAN 977	36176	January 2020
Microphone	ACO 7052E	49596	January 2020
Calibrator	Quest CA-22	J 2080094	Jun 2020

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-13: Noises/sounds heard during site visits at NMR-JLTASL03

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • Barely Audible • Audible • Dominating	**During equipment deployment**	
	Faunal and Natural	Birds audible and dominant. Some slight wind-induced noises.
	Residential	-
	Industrial & transportation	Cars passing on tar road audible in distance. Aircon units at offices.
	During equipment collection	
	Faunal and Natural	Birds audible and dominant.
	Residential	-
	Industrial & transportation	Cars passing on tar road audible in distance. Unidentified noise in far distance with low frequency content.

6.4.3.1 *Summary of Ambient Sound levels measured*

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-29** and summarized in **Table 6-14** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-30**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is elevated, indicating the presence of constant noises in the area that raises the noise levels.

Maximum noise level exceeded 65 dBA at least 5 and 4 times the first and second night respectively. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[7].

Table 6-14: Sound levels considering various sound level descriptors at NMR-JLTASL03

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	53.3	48.8	39.0	-
Night arithmetic average	-	43.9	41.0	35.5	-
Day Equivalent	-	57.8	54.6	-	-
Night Equivalent	-	50.1	45.9	-	-
Day minimum	-	38.9	36.1	-	29.3
Day maximum	84.4	67.7	66.9	-	-
Night minimum	-	35.4	34.5	-	30.4
Night maximum	79.0	61.2	56.8	-	-
Day 1 equivalent	-	53.8	47.9	-	-
Night 1 Equivalent	-	50.0	45.8	-	-
Day 2 equivalent	-	54.8	49.6	-	-
Night 2 Equivalent	-	50.1	46.0	-	-
Day 3 equivalent	-	54.7	52.9	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 6-31** (night) and **Figure 6-32** (day).

6.4.3.2 Spectral Frequencies

The spectral character is illustrated in **Figure 6-33** and **Figure 6-36**. Night-time indicate a acoustic energy at 40 Hz during quiet periods, with significant peaks at 6,300 and 16,000 Hz. There are some acoustic energy in the 400 – 1,000 Hz frequency range, possibly from road traffic noises.

Daytime data indicate acoustic energy in the 400 – 1,250 Hz frequency range, likely from road traffic noises, as well as in the 3,150 – 6,300 Hz frequency range (faunal noises).

(7) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

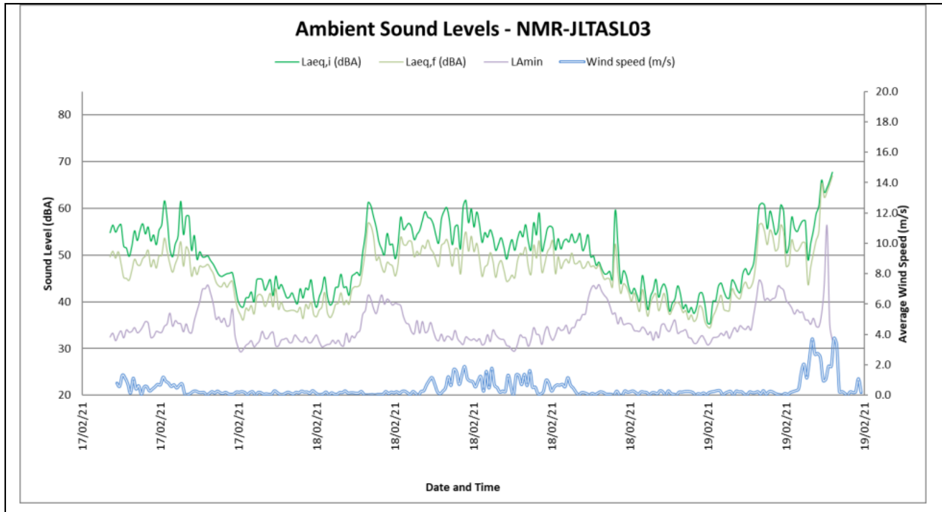

Figure 6-29: Ambient Sound Levels at NMR-JLTASL03

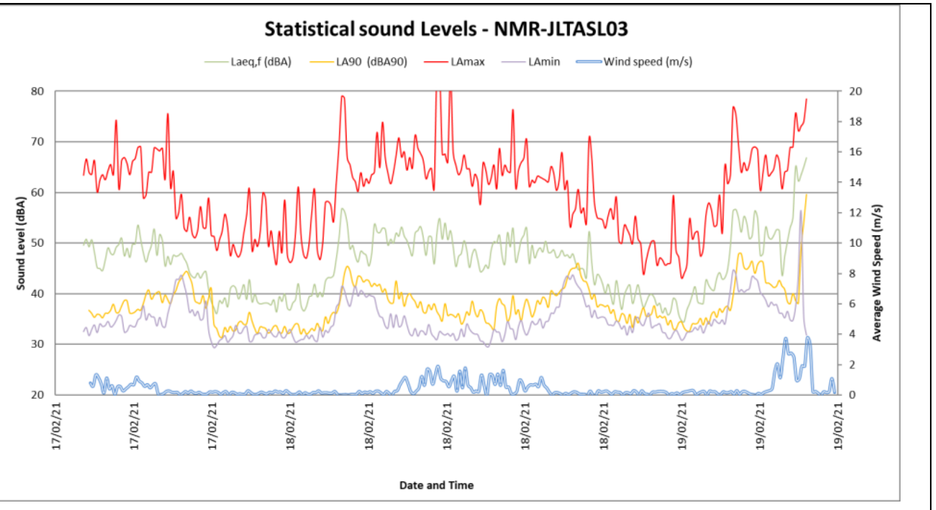

Figure 6-30: Maximum, minimum and Statistical sound levels at NMR-JLTASL03

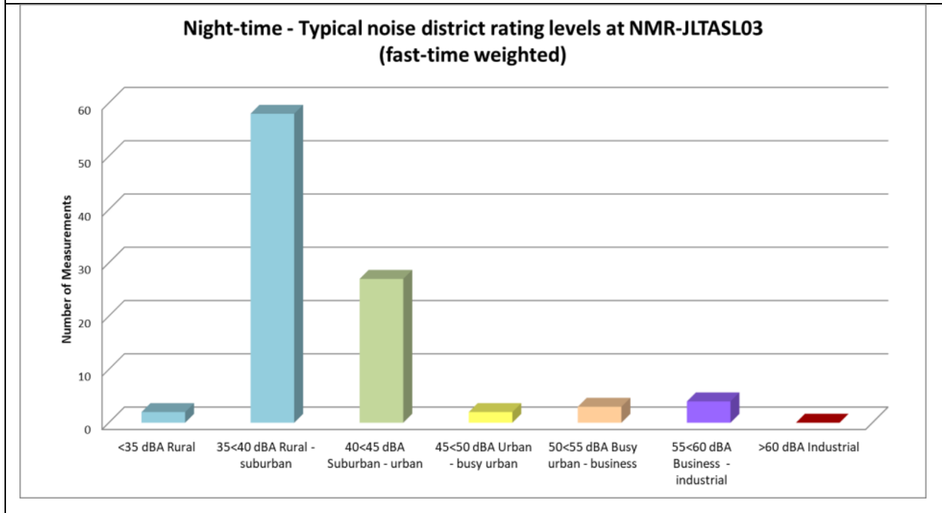

Figure 6-31: Classification of night-time measurements in typical noise districts at NMR-JLTASL03

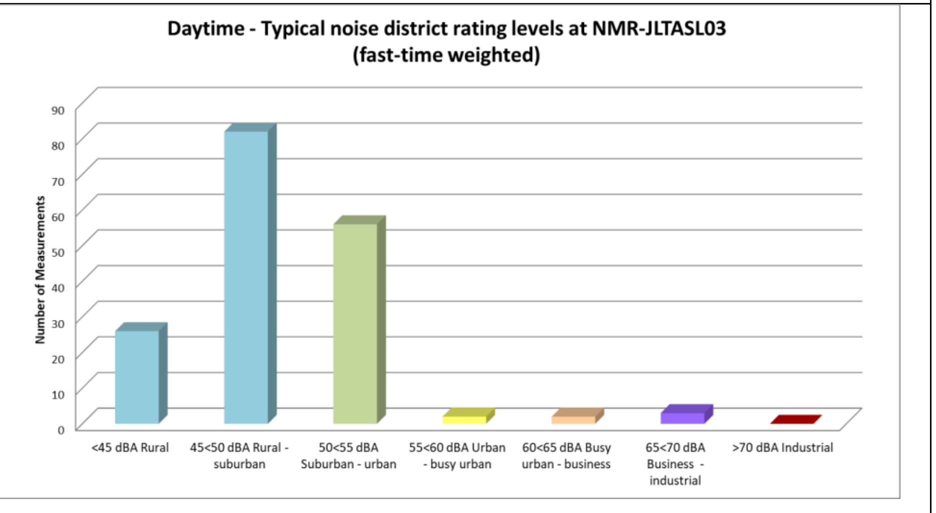

Figure 6-32: Classification of daytime measurements in typical noise districts at NMR-JLTASL03

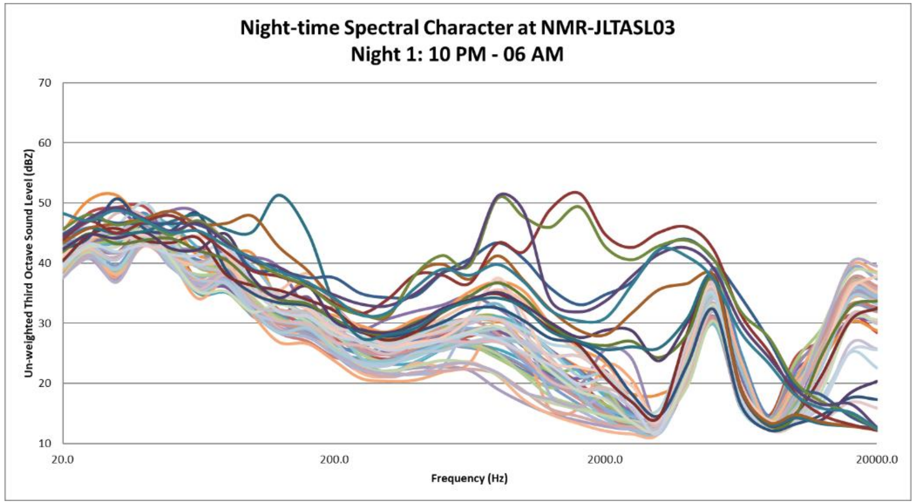

Figure 6-33: Spectral frequencies – NMR-JLTASL03, Night 1

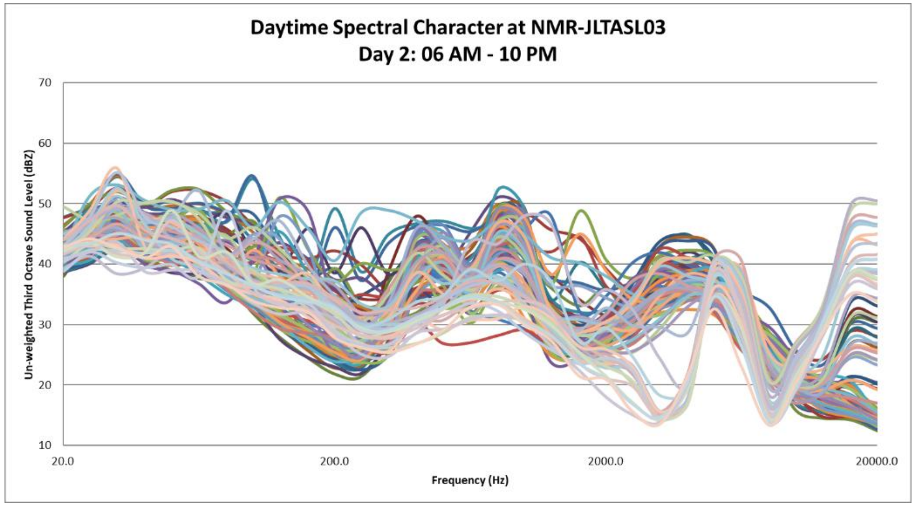

Figure 6-34: Spectral frequencies - NMR-JLTASL03, Day 2

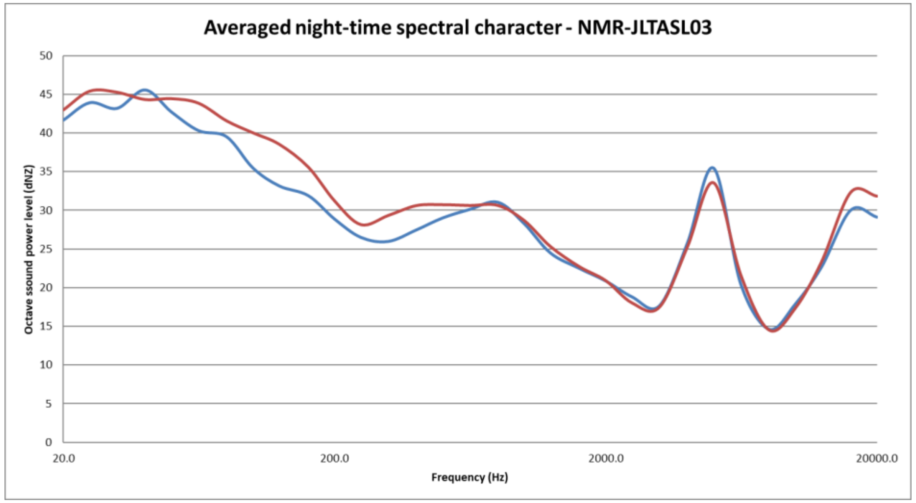

Figure 6-35: Average night-time frequencies - NMR-JLTASL03

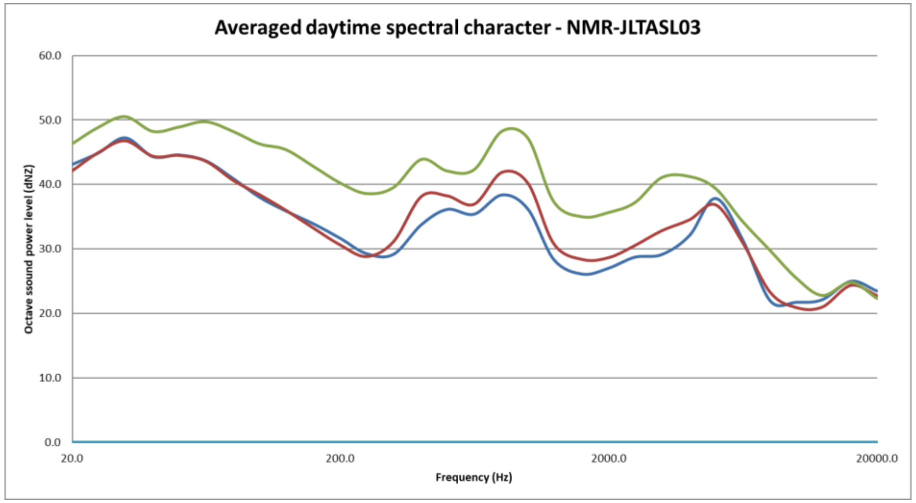

Figure 6-36: Average daytime frequencies - NMR-JLTASL03

6.4.4 Long-Term Measurement Location - NMR-JLTASL04

This measurement location was deployed at a dwelling just south of the Unex Roses greenhouses. The equipment defined in **Table 6-15** was used for gathering data with **Table 6-16** highlighting sounds heard during equipment deployment and collection. Photos of the measurement location is presented in **Appendix B**.

It should be noted that, while the average sound levels are similar to measurement location NMR-JLTASL05 (with a number of chicken houses), there were a number of impulsive noises that significantly influenced the equivalent sound levels (see also **Table 6-17**). Equivalent sound levels are very high and the data is questioned.

Spectral data also indicate a number of measurements with a broadband character similar to white noise. It is recommended that this measurement be repeated in the future and the new data compared with the July 2021 data. There is a low confidence in the data and the data will only be reported but not processed.

Table 6-15: Equipment used to gather data at NMR-JLTASL04

Equipment	Model	Serial no	Calibration
SLM	Svan 977	34160	March 2021
Microphone	ACO 7052E	54645	March 2021
Calibrator	Quest CA-22	J 2080094	July 2021

Table 6-16: Noises/sounds heard during site visits at NMR-JLTASL04

<table>
<tr><th colspan="3">Noises/sounds heard during onsite investigations</th></tr>
<tr><td rowspan="8">Magnitude – Colour Code Used
Barely Audible
Audible
Dominating</td><td colspan="2">During equipment deployment</td></tr>
<tr><td>Faunal and Natural</td><td>Birds dominant.</td></tr>
<tr><td>Residential</td><td>Dogs barking and dominant during barking event. Fires crackling.</td></tr>
<tr><td>Industrial & transportation</td><td>Fans clearly audible. Wood being chopped indistance.</td></tr>
<tr><td colspan="2">During equipment collection</td></tr>
<tr><td>Faunal and Natural</td><td>Wind-induced noise dominant. Birds clearly audible.</td></tr>
<tr><td>Residential</td><td>-</td></tr>
<tr><td>Industrial & transportation</td><td>-</td></tr>
</table>

6.4.4.1 Summary of Ambient Sound Levels measured

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-37** and summarized in **Table 6-17** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-38**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is elevated, indicating the presence of constant noises in the area that raises the noise levels.

The maximum noise level exceeded 65 dBA numerous times each night (more than 10 times each night). If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[8].

Table 6-17: Sound level descriptors as measured at NMR-JLTASL04

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	57.7	51.5	42.8	-
Night arithmetic average	-	58.9	52.9	43.1	-
Day equivalent	-	69.2	58.8	-	-
Night equivalent	-	72.7	62.4	-	-
Day minimum	-	41.3	39.9	-	30.6
Day maximum	101.4	84.2	76.3	-	-
Night minimum	-	39.6	38.5	-	34.5
Night maximum	103.0	85.0	74.6	-	-
Day 1 equivalent	-	66.7	55.4	-	-
Night 1 Equivalent	-	69.1	59.3	-	-
Day 2 equivalent	-	67.5	57.4	-	-
Night 2 Equivalent	-	71.3	60.8	-	-
Day 3 equivalent	-	72.2	61.8	-	-
Night 3 Equivalent	-	71.1	60.0	-	-
Day 4 equivalent	-	63.6	52.8	-	-
Night 4 Equivalent	-	75.4	65.4	-	-
Day 5 equivalent	-	69.6	58.9	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas (see **Table 8-1**) in **Figure 6-39** (night) and **Figure 6-40** (day).

(8) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

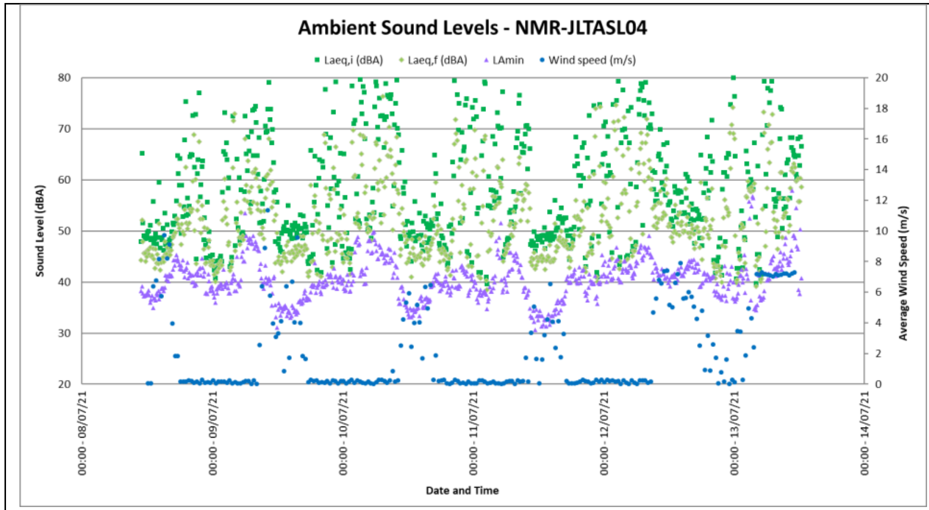

Figure 6-37: Ambient sound levels at NMR-JLTASL04

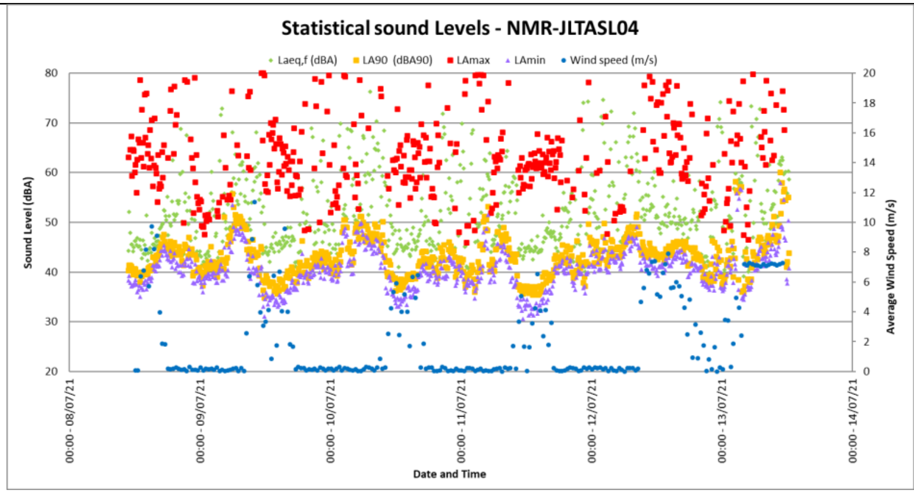

Figure 6-38: Maximum, minimum and statistical values at NMR-JLTASL04

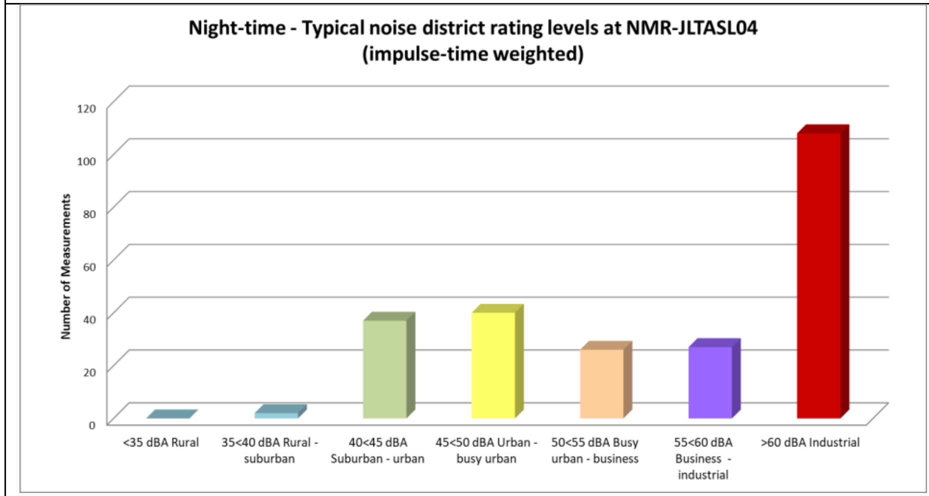

Figure 6-39: Classification of night-time measurements in typical noise districts at NMR-JLTASL04

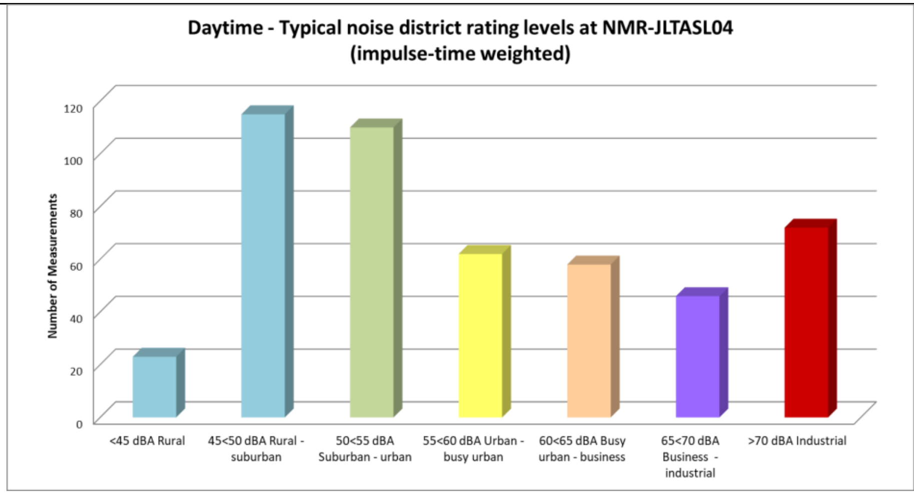

Figure 6-40: Classification of daytime measurements in typical noise districts at NMR-JLTASL04

6.4.5 Long-term Measurement Location - NMR-JLTASL05

This measurement location was added because the owner raised a concern about potential noise impacts (on their chickens) during the EIA process. The microphone was deployed between the residential dwelling and a chicken house (approximately 20 m). This measurement location would represent the typical sound levels at this dwelling. The equipment defined in **Table 6-6** was used for gathering data, with **Table 6-7** highlighting sounds heard during equipment deployment and collection. Photos of the measurement location is presented in **Appendix B**.

Table 6-18: Equipment used to gather data at NMR-JLTASL05

Equipment	Model	Serial no	Calibration Date
SLM	Svan 977	34849	October 2020
Microphone	ACO 7052E & SV 12L	33077	October 2020
Calibrator	Quest CA-22	J 2080094	July 2021

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-19: Noises/sounds heard during site visits at NMR-JLTASL05

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • Barely Audible • Audible • Dominating	**During equipment deployment**	
	Faunal and Natural	Bird communication dominant at times (together with the fans).
	Residential	-
	Industrial & transportation	Ventilation fans dominant and constant noise
	During equipment collection	
	Faunal and Natural	Bird communication dominant at times (together with the fans).
	Residential	-
	Industrial & transportation	Ventilation fans dominant and constant noise

6.4.5.1 *Summary of Ambient Sound levels measured*

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-17** and summarized in **Table 6-8** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-18**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is elevated, indicating the presence of constant noises in the area that raises the noise levels.

The maximum noise level did not exceed 65 dBA during any night. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[9].

Table 6-20: Sound levels considering various sound level descriptors at NMR-JLTASL05

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	57.8	56.9	54.9	-
Night arithmetic average	-	57.6	57.0	54.0	-
Day equivalent	-	58.4	57.3	-	-
Night equivalent	-	57.6	57.1	-	-
Day minimum	-	55.9	55.1	-	46.0
Day maximum	85.0	66.6	61.7	-	-
Night minimum	-	56.3	55.7	-	46.5
Night maximum	66.5	59.0	58.4	-	-
Day 1 equivalent	-	58.1	57.0	-	-
Night 1 Equivalent	-	57.3	56.7	-	-
Day 2 equivalent	-	58.0	56.9	-	-
Night 2 Equivalent	-	57.7	57.1	-	-
Day 3 equivalent	-	59.3	58.0	-	-
Night 3 Equivalent	-	57.9	57.3	-	-
Day 4 equivalent	-	57.8	56.9	-	-
Night 4 Equivalent	-	58.0	57.4	-	-
Day 5 equivalent	-	58.3	57.4	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas (see **Table 8-1**) in **Figure 6-19** (night) and **Figure 6-20** (day).

6.4.5.2 Spectral Frequencies

Both day and night indicate peaks at 25, 50 and 100 Hz, with significant acoustic energy between 315 to 1250 Hz. The spectral data is constant and relates to fan noises. The spectral frequencies are illustrated in **Figure 6-45** to **Figure 6-48**.

(9) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

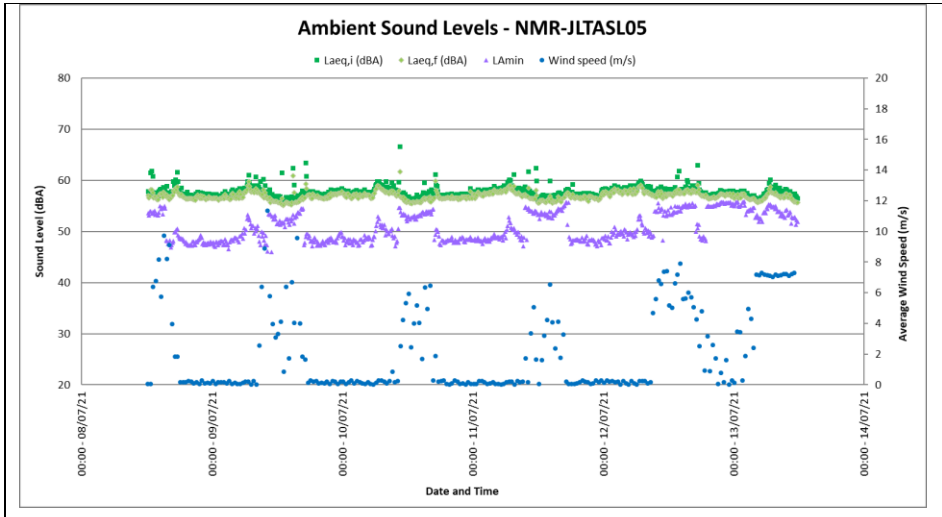

Figure 6-41: Ambient Sound Levels at NMR-JLTASL05

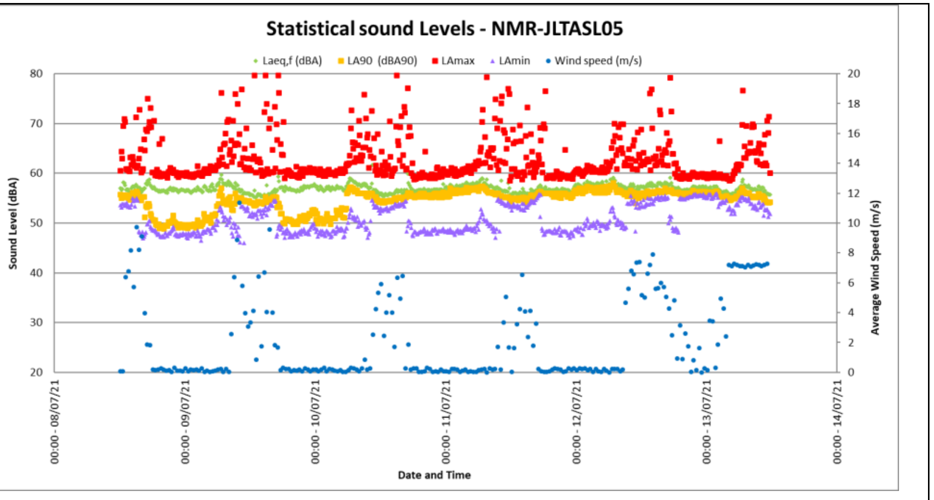

Figure 6-42: Maximum, minimum and Statistical sound levels at NMR-JLTASL05

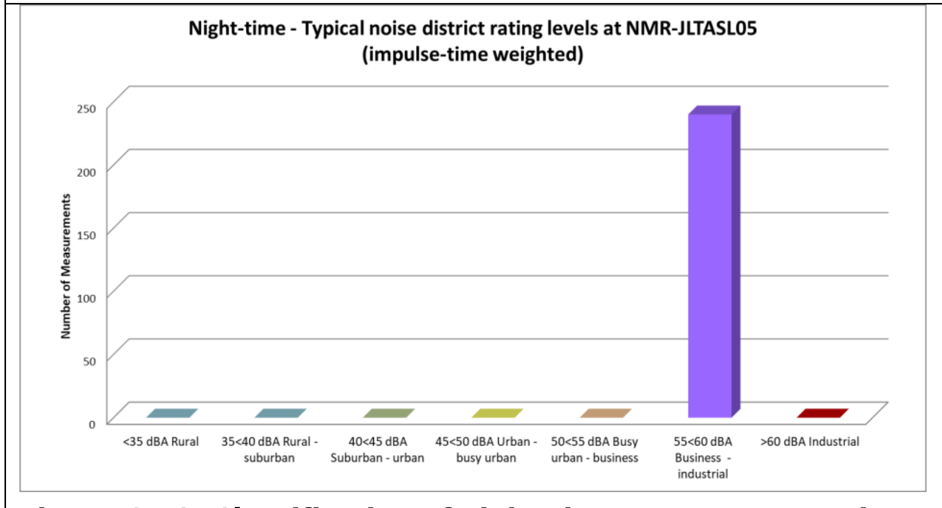

Figure 6-43: Classification of night-time measurements in typical noise districts at NMR-JLTASL05

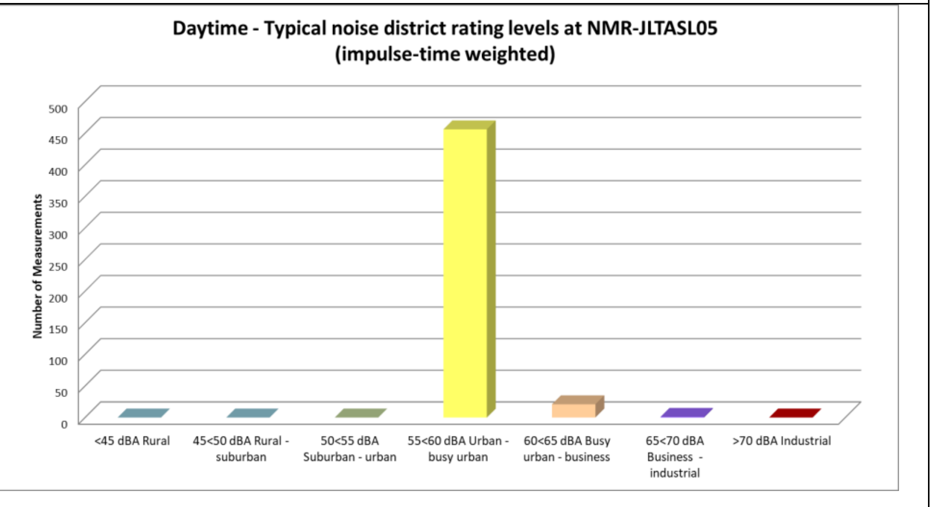

Figure 6-44: Classification of daytime measurements in typical noise districts at NMR-JLTASL05

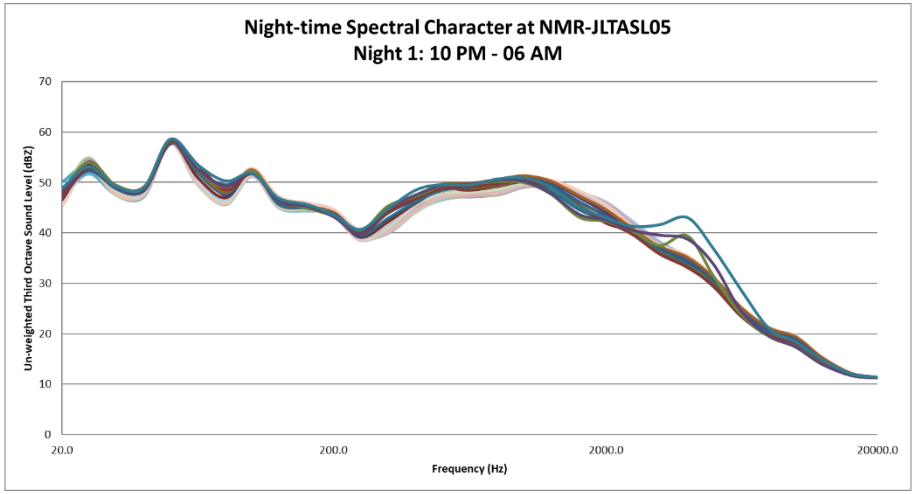

Figure 6-45: Spectral frequencies – NMR-JLTASL05, Night 1

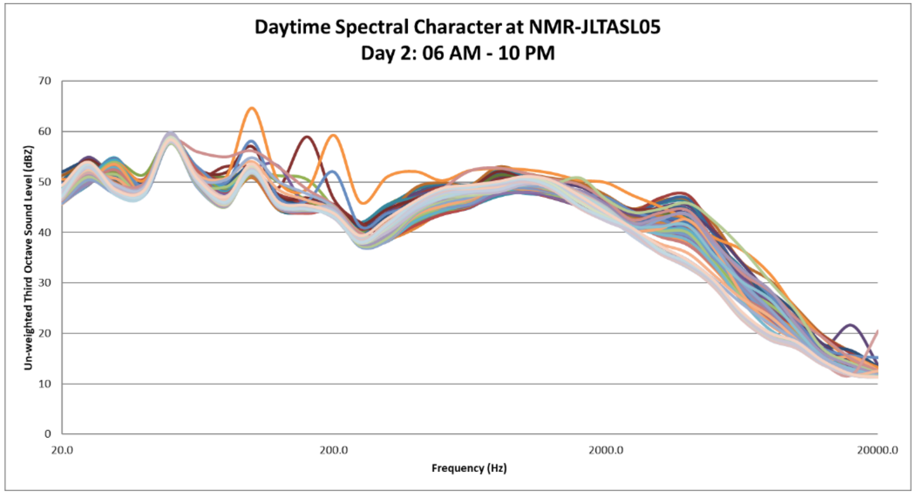

Figure 6-46: Spectral frequencies - NMR-JLTASL05, Day 2

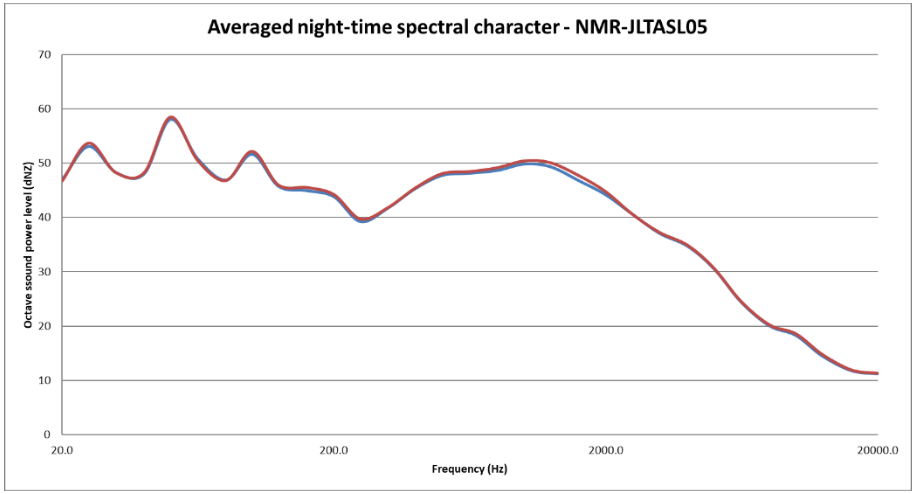

Figure 6-47: Average night-time frequencies - NMR-JLTASL05

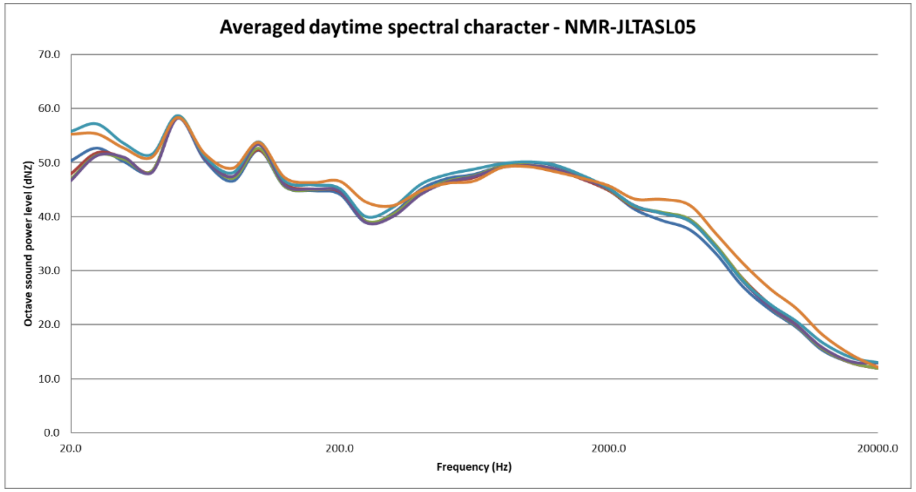

Figure 6-48: Average daytime frequencies - NMR-JLTASL05

6.4.6 Long-term Measurement Location - NMR-JLTASL06

This measurement location was added because the owner raised a concern about potential noise issues during the EIA process. The instrument was deployed away from the residential dwellings, close to the stables. The location was very close to a large eucalyptus tree and within 500 m from the N12 highway. The equipment defined in **Table 6-9** was used for gathering data with **Table 6-10** highlighting sounds heard during equipment deployment and collection. Photos of the measurement location is presented in **Appendix B**.

Table 6-21: Equipment used to gather data at NMR-JLTASL06

Equipment	Model	Serial no	Calibration Date
SLM	Svan 955	27637	October 2018
Microphone and Pre-amplifier	ACO 7052E & SV 12L	52437	October 2018
Calibrator	Quest CA-22	J 2080094	July 2021

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-22: Noises/sounds heard during site visits at NMR-JLTASL06

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • Barely Audible • Audible • Dominating	During equipment deployment	
	Faunal and Natural	Birds audible and dominant at times.
	Residential	Dogs barking.
	Industrial & transportation	Traffic on the N12 highway audible.
	During equipment collection	
	Faunal and Natural	Wind through trees audible and constant.
	Residential	-
	Industrial & transportation	-

6.4.6.1 *Summary of Ambient Sound levels measured*

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-21** and summarized in **Table 6-11** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-22**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is elevated, indicating the presence of constant noises in the area that raises the noise levels.

Maximum noise level exceeded 65 dBA a few times (less than 5 times) each night. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[10].

Table 6-23: Sound levels considering various sound level descriptors at NMR-JLTASL06

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	54.1	51.6	46.4	-
Night arithmetic average	-	47.8	45.7	35.1	-
Day equivalent	-	55.3	52.5	-	-
Night equivalent	-	49.3	47.6	-	-
Day minimum	-	43.1	41.4	-	24.9
Day maximum	87.9	63.9	60.8	-	-
Night minimum	-	36.4	34.2	-	20.9
Night maximum	73.2	57.2	55.8	-	-
Day 1 equivalent	-	56.2	54.4	-	-
Night 1 Equivalent	-	50.8	49.6	-	-
Day 2 equivalent	-	54.3	52.1	-	-
Night 2 Equivalent	-	50.7	49.4	-	-
Day 3 equivalent	-	56.4	53.4	-	-
Night 3 Equivalent	-	47.7	45.4	-	-
Day 4 equivalent	-	54.2	50.5	-	-
Night 4 Equivalent	-	48.1	45.9	-	-
Day 5 equivalent	-	56.0	53.3	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas (see **Table 8-1**) in **Figure 6-23** (night) and **Figure 6-24** (day).

6.4.6.2 Spectral Frequencies

The spectral character is typical of a measurement location near a busy road, with significant acoustic energy in the low frequencies (engine and transmission noises) as well as between 400 and 1250 Hz (due to road-tyre interaction). The spectral character is illustrated in **Figure 6-25** to **Figure 6-28**.

(10) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

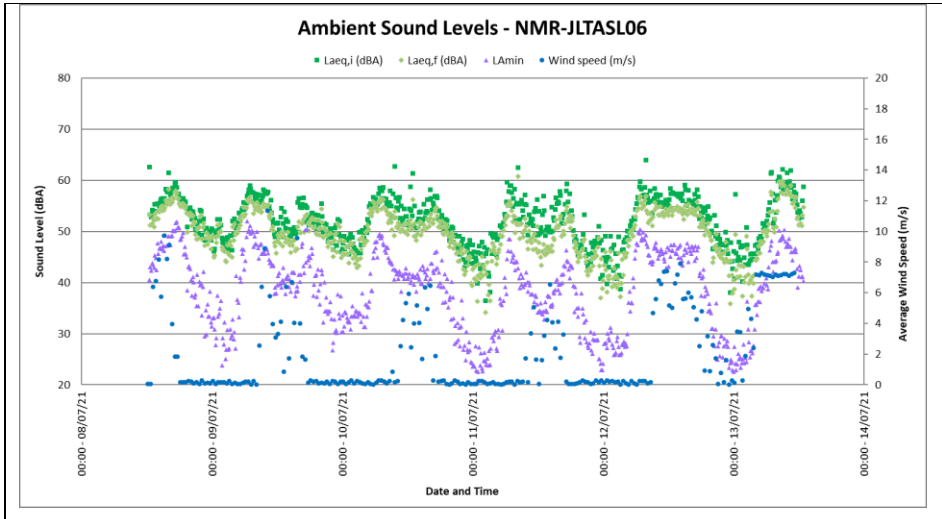

Figure 6-49: Ambient Sound Levels at NMR-JLTASL06

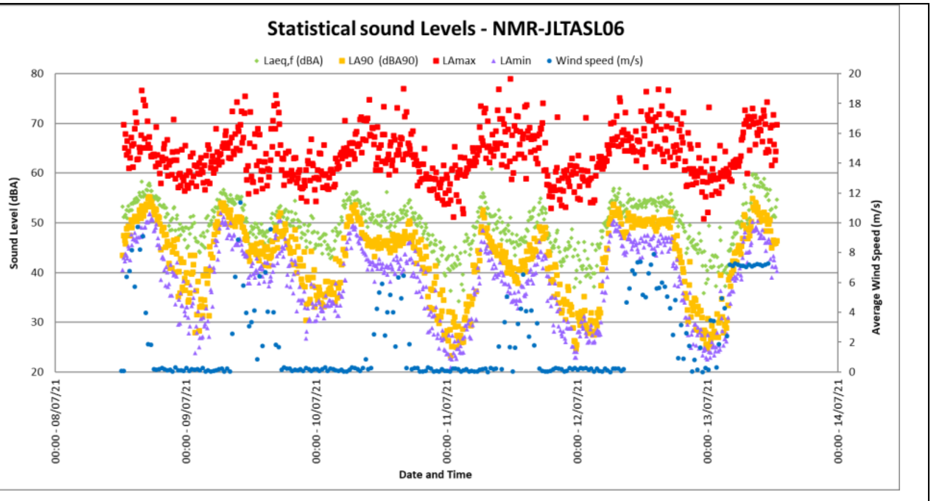

Figure 6-50: Maximum, minimum and Statistical sound levels at NMR-JLTASL06

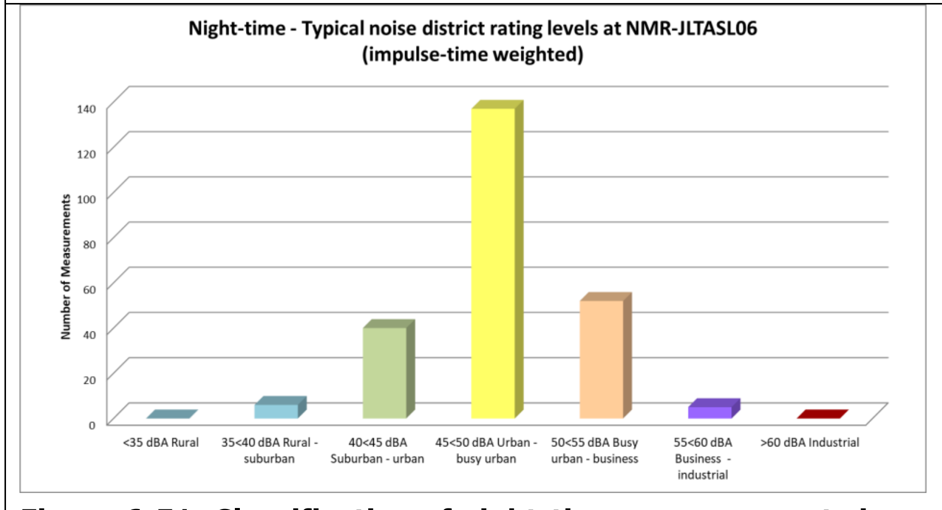

Figure 6-51: Classification of night-time measurements in typical noise districts at NMR-JLTASL06

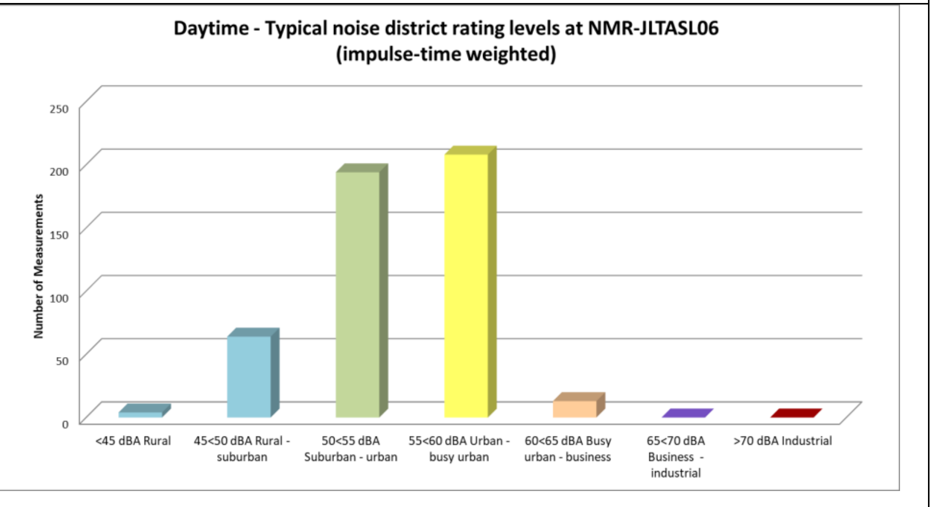

Figure 6-52: Classification of daytime measurements in typical noise districts at NMR-JLTASL06

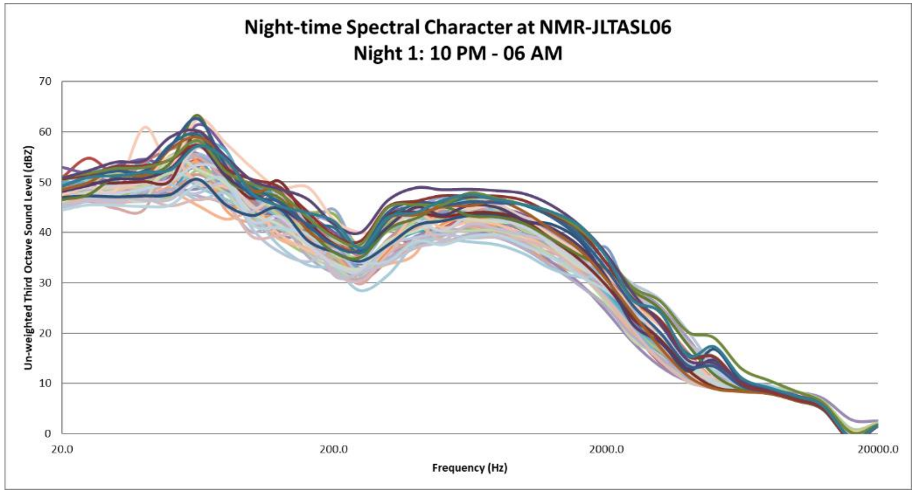

Figure 6-53: Spectral frequencies – NMR-JLTASL06, Night 1

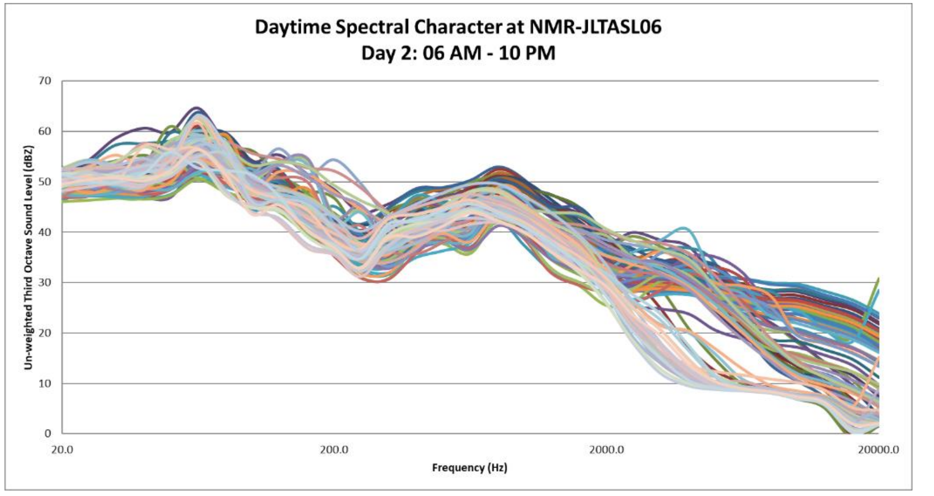

Figure 6-54: Spectral frequencies - NMR-JLTASL06, Day 2

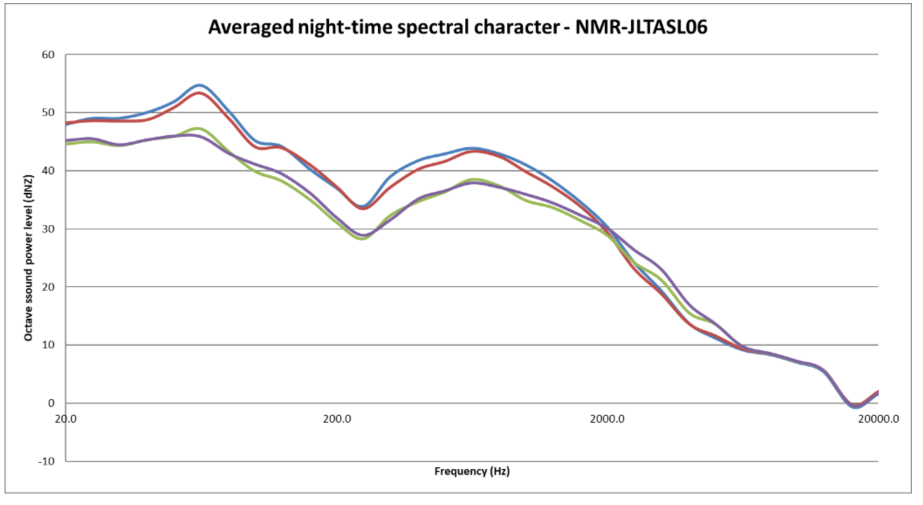

Figure 6-55: Average night-time frequencies - NMR-JLTASL06

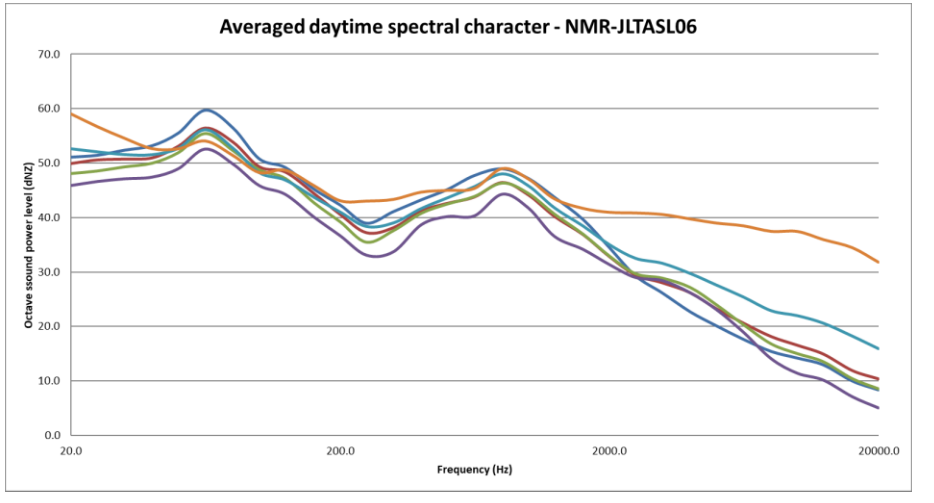

Figure 6-56: Average daytime frequencies - NMR-JLTASL06

6.4.7 Long-term Measurement Location - NMR-JLTASL07

The measurement location was near the proposed mining area (within 500m), close to the residential dwelling. The equipment defined in **Table 6-12** was used for gathering data with **Table 6-13** highlighting sounds heard during equipment deployment and collection. Photos of the measurement location is presented in **Appendix B**.

Table 6-24: Equipment used to gather data at NMR-JLTASL07

Equipment	Model	Serial no	Calibration Date
SLM	BSWA 308	589036	March 2020
Microphone and Pre-amplifier	MP231	570172	March 2020
Calibrator	Quest CA-22	J 2080094	July 2021

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 6-25: Noises/sounds heard during site visits at NMR-JLTASL07

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • Barely Audible • Audible • Dominating	During equipment deployment	
	Faunal and Natural	Birds audible and dominant. Slight Wind-induced noises.
	Residential	Rooster clearly audible at times. Grinding activities clearly audible at times. Television or Radio slightly audible in house.
	Industrial & transportation	Traffic on the N12 audible.
	During equipment collection	
	Faunal and Natural	Birds audible and dominant at times. Wind-induced noises in distance during quiet periods.
	Residential	Owner working on car, starting and revving engine (dominant during event). Voices from residents.
	Industrial & transportation	-

6.4.7.1 *Summary of Ambient Sound levels measured*

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-29** and summarized in **Table 6-14** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-30**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is slightly elevated, indicating the presence of constant noises in the area that raises the noise levels.

Maximum noise level exceeded 65 dBA at more than 10 times night 3 and 5. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[11].

Table 6-26: Sound levels considering various sound level descriptors at NMR-JLTASL07

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	54.0	48.8	41.9	-
Night arithmetic average	-	43.8	40.7	35.0	-
Day equivalent	-	58.4	51.5	-	-
Night equivalent	-	52.7	45.2	-	-
Day minimum	-	37.5	35.7	-	28.0
Day maximum	103.6	79.0	68.2	-	-
Night minimum	-	33.0	31.9	-	25.7
Night maximum	92.0	67.9	60.3	-	-
Day 1 equivalent	-	62.1	53.6	-	-
Night 1 Equivalent	-	53.8	47.3	-	-
Day 2 equivalent	-	60.0	52.3	-	-
Night 2 Equivalent	-	52.3	44.5	-	-
Day 3 equivalent	-	57.7	51.8	-	-
Night 3 Equivalent	-	55.8	47.3	-	-
Day 4 equivalent	-	57.7	51.2	-	-
Night 4 Equivalent	-	44.8	40.7	-	-
Day 5 equivalent	-	57.9	50.8	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 6-31** (night) and **Figure 6-32** (day).

(11) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

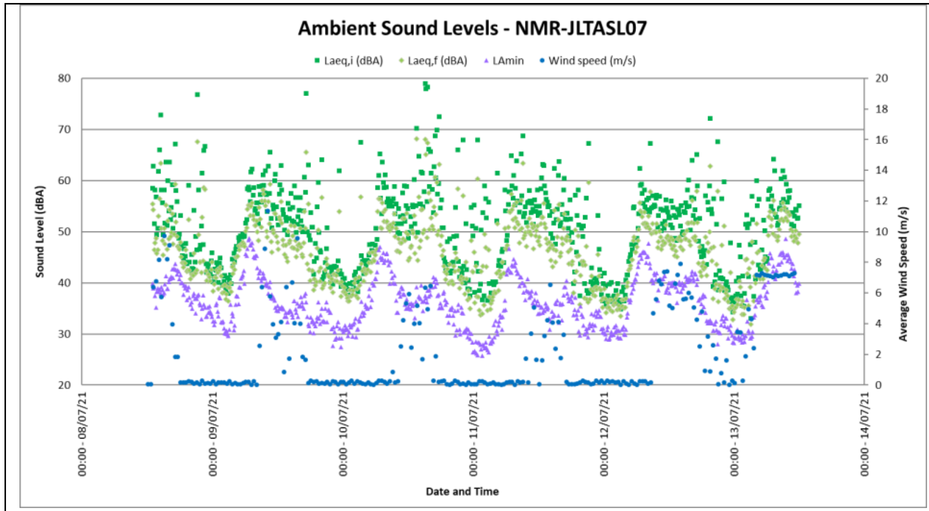

Figure 6-57: Ambient Sound Levels at NMR-JLTASL07

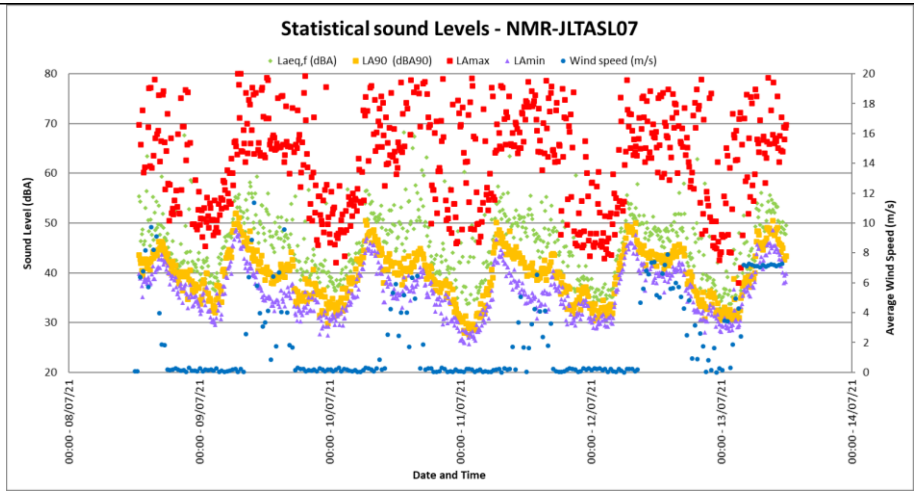

Figure 6-58: Maximum, minimum and Statistical sound levels at NMR-JLTASL07

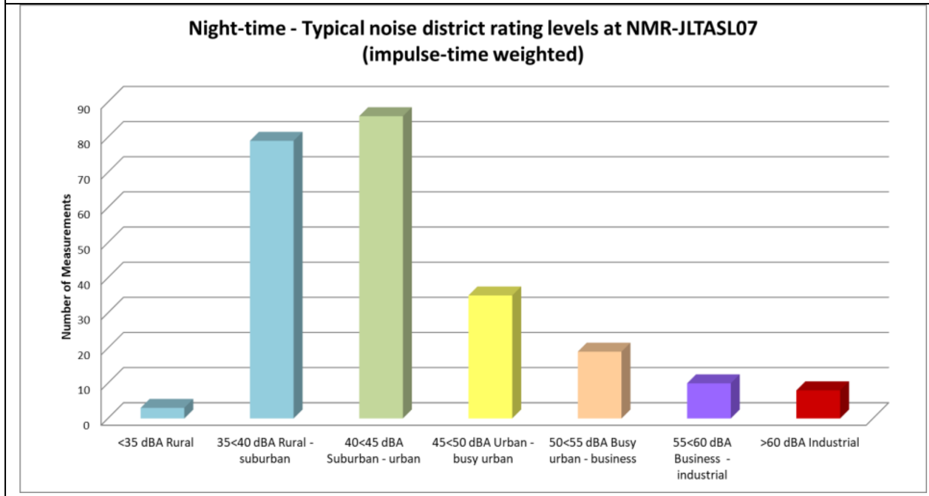

Figure 6-59: Classification of night-time measurements in typical noise districts at NMR-JLTASL07

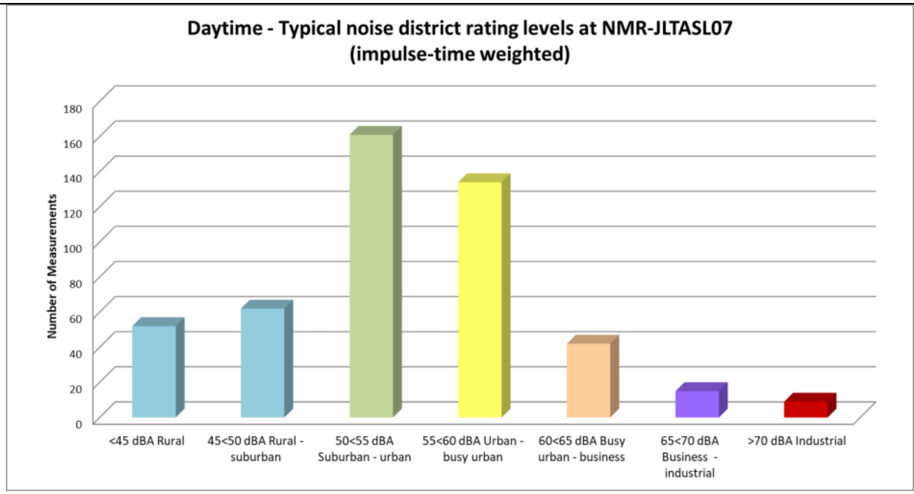

Figure 6-60: Classification of daytime measurements in typical noise districts at NMR-JLTASL07

6.5 SUMMARY OF AMBIENT SOUND LEVELS

As can be seen from the previous section (February 2021 measurements), ambient sound levels are elevated. Based on the sound level measurements:

- **Measurement Location NMR-JLTASL01**
  - The impulse-weighted sound level is generally used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the full 16-hour daytime period, the daytime $L_{Aeq,i}$ value is 52 dBA, with a rating level similar to a sub-urban to urban noise district;
    - based on the two 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 47 dBA, with a rating level similar to an urban to busy urban (with main roads, business and workshops) noise district;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the 16-hour daytime period, the $L_{Aeq,f}$ value is 48 dBA, with the arithmetic average being 45 dBA;
    - based on the two 8-hour night-time periods, the $L_{Aeq,f}$ value is 43 dBA, with the arithmetic average being 40 dBA;
  - The statistical L_{A90} levels are significantly elevated for both the day- (37.6 dBA90) and night-time (37.1 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is not clearly defined but may relate to the traffic noises as well as fans from the nursery.
- **Measurement Location NMR-JLTASL02**
  - The impulse-weighted sound level is generally used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the 18-hour daytime period data, the daytime $L_{Aeq,i}$ value is 56 dBA, with a rating level similar to an urban noise district;
    - based on the two 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 49 dBA, with a rating level similar to a busy urban (with main roads, business and workshops) noise district;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the 16-hour daytime period data, the $L_{Aeq,f}$ value is 46 dBA, with the arithmetic average being 51 dBA;
    - based on the two 8-hour night-time periods, the $L_{Aeq,f}$ value is 43 dBA, with the arithmetic average being 40 dBA;

  - The statistical L_{A90} levels are significantly elevated for both the day- (37.7 dBA90) and night-time (37.7 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is not clearly defined but may relate to the traffic noises as well as fans from the nursery.

- **Measurement Location NMR-JLTASL03**
  - The impulse-weighted sound level is generally used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the full 16-hour daytime period data, the daytime $L_{Aeq,i}$ value is 58 dBA, with a rating level similar to an urban to busy urban (with main roads, business and workshops) noise district;
    - based on the two 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 50 dBA, with a rating level similar to a busy urban (with main roads, business and workshops) noise district;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the 16-hour daytime period data, the $L_{Aeq,f}$ value is 55 dBA, with the arithmetic average being 49 dBA;
    - based on the two 8-hour night-time periods, the $L_{Aeq,f}$ value is 46 dBA, with the arithmetic average being 41 dBA;
  - The statistical L_{A90} levels are significantly elevated for both the day- (39.0 dBA90) and night-time (35.5 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is not clearly defined but may relate to the traffic noises as well as fans from the nursery.

- **Measurement Location NMR-JLTASL04**
  - The impulse-weighted sound level is generally used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the full 16-hour daytime period data, the daytime $L_{Aeq,i}$ value is 69 dBA, with a rating level similar to an industrial noise district;
    - based on the five 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 72 dBA, with a rating level similar to an industrial noise district;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the 16-hour daytime period data, the $L_{Aeq,f}$ value is 59 dBA, with the arithmetic average being 51 dBA;
    - based on the five 8-hour night-time periods, the $L_{Aeq,f}$ value is 62 dBA, with the arithmetic average being 53 dBA;

- The statistical L_{A90} levels are significantly elevated for both the day- (42.8 dBA90) and night-time (43.1 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is not clearly defined but may relate to fans from the nursery.

- **Measurement Location NMR-JLTASL05**
  - The impulse-weighted sound level is generally used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the full 16-hour daytime period data, the daytime $L_{Aeq,i}$ value is 58 dBA, with a rating level similar to an urban to busy urban (with main roads, business and workshops) noise district;
    - based on the two 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 58 dBA, with a rating level similar to an industrial noise district;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the 18-hour daytime period data, the $L_{Aeq,f}$ value is 57 dBA, with the arithmetic average being 57 dBA;
    - based on the five 8-hour night-time periods, the $L_{Aeq,f}$ value is 57 dBA, with the arithmetic average also being 57 dBA;
  - The statistical L_{A90} levels are significantly elevated for both the day- (54.9 dBA90) and night-time (54.0 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is suspected to related to fan noises from the chicken houses.

- **Measurement Location NMR-JLTASL06**
  - The impulse-weighted sound level is generally used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the full 16-hour daytime period data, the daytime $L_{Aeq,i}$ value is 55 dBA, with a rating level similar to an urban noise district;
    - based on the five 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 50 dBA, with a rating level similar to a busy urban (with main roads, business and workshops) noise district;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the 18-hour daytime period data, the $L_{Aeq,f}$ value is 53 dBA, with the arithmetic average being 52 dBA;
    - based on the five 8-hour night-time periods, the $L_{Aeq,f}$ value is 47 dBA, with the arithmetic average being 46 dBA;

  - The statistical L_{A90} levels are elevated for both the day- (46.4 dBA90) and night-time (35.1 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is likely from traffic noises in the area.
- **Measurement Location NMR-JLTASL07**
  - The impulse-weighted sound level is generally used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the full 16-hour daytime period data, the daytime $L_{Aeq,i}$ value is 58 dBA, with a rating level similar to an urban to busy urban (with main roads, business and workshops) noise district;
    - based on the five 8-hour night-time periods, the night-time $L_{Aeq,i}$ value is 53 dBA, with a rating level similar to a busy urban (with main roads, business and workshops) to central business noise district;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSRs. The equivalent:
    - based on the 16-hour daytime period data, the $L_{Aeq,f}$ value is 52 dBA, with the arithmetic average being 49 dBA;
    - based on the five 8-hour night-time periods, the $L_{Aeq,f}$ value is 45 dBA, with the arithmetic average being 41 dBA;
  - The statistical L_{A90} levels are significantly elevated for both the day- (41.9 dBA90) and night-time (35.0 dBA90) periods, indicating constant sounds that raised this statistical indicator. The source of this acoustic energy is not clearly defined.

Focussing on the night-time measurements at NMR-JLTASL01, NMR-JLTASL02 and NMR-JLTASL03, the average of the impulse-time weighted night-time equivalent rating levels (48.6 dBA) is typical of a busy urban (with main roads, business and workshops) noise district (with acceptable rating levels of 50 dBA during the night-time period respectively). The average of the fast-time weighted night-time equivalent rating levels (44.1 dBA) is typical of an urban noise district.

Data from measurement locations NMR-JLTASL04, NMR-JLTASL05, NMR-JLTASL06 and NMR-JLTASL07 are not considered because ambient sound levels are quite high at these locations, which will raise the rating levels (higher than the level acceptable for night-time residential use) significantly.

7 POTENTIAL NOISE SOURCES

Increased noise levels are directly linked with the various activities associated with the construction of the proposed mine and related infrastructure, as well as the operational phase of the activity.

7.1 POTENTIAL NOISE: PLANNING AND DESIGN

There are no noises associated with the planning and design phase of this project, excluding the noises associated with prospecting (site establishment and drilling). Noises associated with drilling however are generally of very short duration so that the noise pollution is of a low concern for the surrounding receptors.

7.2 CONSTRUCTION NOISES

Construction activities include:

- Site establishment;
- Construction of access roads;
- Vegetation removal;
- Topsoil removal and the development of stockpile footprints;
- The removal of soft (using excavator) and hard material (drill and blast to remove very hard material) during the development of the opencast/boxcut, and
- The establishment of infrastructure such as pollution control dam, offices/workshops, stockpile areas and plant (crushing/screen etc.) area.

Potential maximum noise levels generated by construction equipment, as well as the potential extent are presented in **Table 7-1**. The potential extent depends on a number of factors, including the prevailing ambient sound levels during the instance the maximum noise event occurred, as well as the spectral character of the noise and the ambient soundscape in the surroundings.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical sound power levels associated with various activities that may be found at a construction site is presented in **Table 7-2**.

The level and character of the construction noise will be highly variable as different activities with different equipment take place at different times, for different periods of time (operating cycles), in different combinations/sequences and on different parts of the construction site.

An additional source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include heavy (20 per hour) and light (20 per hour) vehicles transporting equipment, topsoil, overburden, as well as contractors to and from the site, entering the site from the north (using the road leading from the D1550). Construction traffic is expected to be generated throughout the entire construction period; however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period.

7.2.1 Blasting

A potential source of noise is blasting associated with construction when hard rock is reached. However, blasting will not be considered further for the following reasons:

- Blasting is highly regulated and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use minimum explosives and will occur in a controlled manner;
- Blasting is a highly specialised field, and various management options are available to the blasting specialist. Options available to minimise the risk to equipment, people and infrastructure includes
  - The use of different explosives that have a lower detonation speed, which reduces vibration, sound pressure levels as well as air blasts.
  - Blasting techniques such as blast direction and/or blast timings (both blasting intervals and sequence).
  - Reducing the total size of the blast.
  - Damping materials used to cover the explosives.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. This is normally associated with close proximity opencast mining/quarrying.
- Blasts will be an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relatively fast resulting in a higher acceptance of the noise.
- Blasting will be investigated in a separate Blasting Impact Assessment.

Table 7-1: Potential maximum noise levels generated by construction equipment

Equipment Description[12]	Impact Device?	Maximum Sound Power Levels (dBA)	Operational Noise Level at given distance considering potential **maximum** noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Backhoe	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Chain Saw	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Compactor (ground)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Drum Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Jackhammer	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Man Lift	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Mounted Impact Hammer	Yes	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Paver	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Pickup Truck	No	89.7	64.7	58.7	52.6	44.7	38.7	35.1	32.6	29.1	24.7	21.2	18.7	12.6
Pumps	No	111.7	86.7	80.7	74.6	66.7	60.7	57.1	54.6	51.1	46.7	43.2	40.7	34.6

[12] Equipment list and Sound Power Level source: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

Rivit Buster/Chipping Gun	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Rock Drill	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Roller	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Sand Blasting (single nozzle)	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Scraper	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Slurry Plant	No	112.7	87.7	81.7	75.6	67.7	61.7	58.1	55.6	52.1	47.7	44.2	41.7	35.6
Slurry Trenching Machine	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Soil Mix Drill Rig	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Tractor	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Vacuum Excavator (Vac-Truck)	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vacuum Street Sweeper	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Ventilation Fan	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibrating Hopper	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibratory Concrete Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Vibratory Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Warning Horn	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Welder/Torch	No	107.7	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7	30.6

Table 7-2: Potential equivalent noise levels generated by various equipment

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Bulldozer CAT D11	113.3	88.4	82.3	76.3	68.4	62.3	58.8	56.3	52.8	48.4	44.8	42.3	36.3
Bulldozer CAT D6	108.2	83.3	77.3	71.2	63.3	57.3	53.7	51.2	47.7	43.3	39.8	37.3	31.2
Bulldozer Komatsu 375	114.0	89.0	83.0	77.0	69.0	63.0	59.5	57.0	53.4	49.0	45.5	43.0	37.0
Crusher/Screen (MTC Mobile)	109.6	84.6	78.6	72.6	64.6	58.6	55.1	52.6	49.0	44.6	41.1	38.6	32.6
Crushing plant (50 tons/h)	114.5	89.5	83.5	77.5	69.5	63.5	60.0	57.5	54.0	49.5	46.0	43.5	37.5
Conveyor transfer	103.2	78.3	72.2	66.2	58.3	52.2	48.7	46.2	42.7	38.3	34.7	32.2	26.2
Drilling Machine	109.6	84.6	78.6	72.6	64.6	58.6	55.1	52.6	49.1	44.6	41.1	38.6	32.6
Dumper/Haul truck - CAT 700	115.9	91.0	85.0	78.9	71.0	65.0	61.4	58.9	55.4	51.0	47.5	45.0	38.9
Dumper/Haul truck - Terex 30 ton	112.2	87.2	81.2	75.2	67.2	61.2	57.7	55.2	51.7	47.2	43.7	41.2	35.2
Excavator - Hitachi EX1200	113.1	88.1	82.1	76.1	68.1	62.1	58.6	56.1	52.6	48.1	44.6	42.1	36.1
Excavator - Hitachi 870 (80 t)	108.1	83.1	77.1	71.1	63.1	57.1	53.6	51.1	47.5	43.1	39.6	37.1	31.1
FEL - Bell L1806C	102.7	77.7	71.7	65.7	57.7	51.7	48.2	45.7	42.1	37.7	34.2	31.7	25.7
FEL - CAT 950G	102.1	77.2	71.2	65.1	57.2	51.2	47.6	45.1	41.6	37.2	33.7	31.2	25.1
FEL - Komatsu WA380	100.7	75.7	69.7	63.7	55.7	49.7	46.2	43.7	40.1	35.7	32.2	29.7	23.7
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
Grader	110.9	85.9	79.9	73.9	65.9	59.9	56.4	53.9	50.3	45.9	42.4	39.9	33.9
Screening plant	105.5	80.6	74.6	68.5	60.6	54.6	51.0	48.5	45.0	40.6	37.0	34.6	28.5
Water Dozer, CAT	113.8	88.8	82.8	76.8	68.8	62.8	59.3	56.8	53.3	48.8	45.3	42.8	36.8

7.3 OPERATIONAL NOISES – GENERAL

7.3.1 Mining Activities

Silica will be mined through an opencast bench mining method. The benches will be mined at a width of 30 metres and a height of 10 metres. Final mining depth will be between 30 and 50 meters below surface (mbs). Mining will commence in the northern portion of the mining right application (MRA) area and will progress in a south-easterly direction.

The mining method will include:

- Vegetation and topsoil will be stripped ahead of mining. At least one cut (30m) should already be stripped and available for drilling between the active topsoil stripping operation and the open void;
- The topsoil will be loaded onto dump trucks by excavators and hauled to areas that require rehabilitation;
- Drilling operations will commence in the front of the advancing pit after the topsoil has been removed;
- The blasted Run of Mine (RoM) will be stockpiled with excavators; and
- Thereafter RoM will be transported to the crushing plant by means of haul trucks with a loading capacity of approximately 40 tons.

The level and character of the noise during this phase is more constant than with the construction phase, but can be significantly higher and more intrusive, especially if there is an impulsive[13] component involved and the noise generating activities takes place at night.

As with all noises (and with the construction phase), the audibility as well as the potential of a noise impact on receptors is determined by factors such as the sound character, spectral frequencies, number and magnitude of maximum noise events, the average noise levels etc. Potential maximum noise levels generated by various equipment and the potential extent of these sounds are presented in **Table 4-1**, with **Table 7-2** illustrating the equivalent (average) noise levels and potential extent.

7.3.2 Processing plant activities

The processing plant comprises of crushing, screening, washing and drying operations. These activities include:

- The crushing and screening of the ROM to various sizes. Material will be transported within the crushing and screening plant using conveyors. ROM will be tipped into the

[13] A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.

feed chute where it is screened, crushed (primary crushing), screened and again crushed (jaw crusher). The resource can be crushed again in a Gyro crusher with conveyor and the crushed product recycled for washing.

- Various products are produced in the wash plant using crusher feed stock. Depending on the category and quality requirement, additional crushing, screening and hydro-sizing equipment is employed.
- A vibratory feeder feeds the feedstock onto a conveyor which discharges the material onto a grizzly screen which cuts to the desired size. The material from the grizzly screen is wet screened on the main screen. The oversize from the first screen is discharged onto the dewatering screen containing a mixture of screening panels.
- Screening with hydro-sizing process where the feedstock is fed onto a conveyor with a vibratory feeder that combines with the recycled oversize material onto a single conveyor. This feeds the vertical side impactor (VSI) that crushes the -40mm feed to -5mm.
- Cyclones, thickeners and clarifiers to remove water for reuse.
- A drier plant that utilizes heated air to evaporate the moisture from the sand. Blowers will be used to deliver air into the system. The dried filter product is discharged from the drier onto conveyors and is stockpiled in the dry sand shed before being sized in the screening plant according to product specifications.

7.3.3 Traffic

A source of noise during the operational phase will be traffic to and from the site, traffic around the infrastructure facilities, ROM and product transport and activities associated with waste management. While trucks moving around on the site do have a clearly audible noise during passing, the average noise contribution during the day is relatively low compared to the other noise sources.

Estimated round trips are summarized in **Table 7-3**.

Table 7-3: Estimated transport at Rietkol (Eksteen, 2018)

Type of Vehicle	Estimated Daily Movements (round trips)
Light delivery vehicles (LDV)	16
Busses	12
Deliveries	Less than 1
Other	2
Product transport – 40 ton Tippers	54
Product transport – 33-ton tipper and flatbed	4

Product transport – Flatbed trucks	10
Product transport – Bulk tankers	4

This study will use 80 heavy vehicles over a 10 hour period, or 8 vehicles per hour travelling 60 km/h and 30 LDVs per day (3 per hour).

7.3.4 Blasting

Drilling and blasting of the rock face will be conducted on a predetermined schedule in accordance with projected volumes of production and will be undertaken by blast professionals and with the required safety procedures applied.

7.4 POTENTIAL NOISE SOURCES: FUTURE NOISE SCENARIO –DECOMMISSIONING

The Decommissioning Phase is considered the phase which begins after the last silica is removed from the mine area and ends when the mine receives a Closure certificate from the DMR.

As most of the material mined is processed and removed from site as product, backfilling of the pit to a free-draining state will not be possible for the Rietkol Project. Therefore, the final rehabilitation plan allows for the backfilling of all the remaining material and building rubble into the pit area, sloping of the high-wall areas and filling the pit with water. At the end of LOM all infrastructure and buildings will be demolished and building rubble will be placed in the pit. The cleared areas will be ripped and levelled before topsoil is placed and the area is re-vegetated. Inert reject material will be placed in the open pit area and the sides of the pit will be sloped and re-vegetated. Slimes will be pumped into the North Block and will form part of the rehabilitation process.

Activities that can take place include:

- Decommissioning and rehabilitation of the remaining infrastructure unless it is required for post mining impact management or for the final end land use. This includes the following:
    - Removal of all remaining redundant infrastructure (which includes the conveyors, the crusher, workshop, weighbridge, waste/salvage yard, haul roads, possibly the offices and other buildings, etc.).
    - Removal of any contaminated soil.
    - The rehabilitation of disturbed areas including the necessary ripping of compacted soils and the shaping of rehabilitated areas to ensure free drainage.

  - Placement of topsoil on rehabilitated surface areas followed by seeding (if necessary to re-establish vegetation).
  - Monitoring and maintenance of the rehabilitated areas.
  - Application for a Closure Certificate for the site.

However, while there are numerous activities that can take place during the decommissioning stage, the potential noise impact will only be discussed in general. This is because the noise impacts associated with the decommissioning phase is normally less than both the construction and operational phases for the following reasons:

- Final decommissioning normally takes place only during the day, a time period when existing ambient sound levels are higher, generally masking most external noises for surrounding receptors; and
- There is a lower urgency of completing this phase and less equipment remains onsite (and are used simultaneously) to affect the final decommissioning.

8 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

8.1 NOISE IMPACT ON ANIMALS[14]

A significant amount of research was undertaken during the 1960's and 70's on the effects of aircraft noise on animals. While aircraft noise has a specific characteristic that might not be comparable with industrial noise, the findings should be relevant to most noise sources. A general animal behavioural reaction to aircraft noise is the startle response with the strength and length of the startle response to be dependent on the following:

- which species is exposed;
- whether there is one animal or a group of animals, and
- whether there have been some previous exposures.

Overall, the research suggests that species differ in their response to noise depending on the duration, magnitude, characteristic and source of the noise, as well as how accustomed the animals are to the noise (previous exposure).

Extraneous noises impact on animals as it can increase stress levels and even impact on their hearing. Masking sounds may affect their ability to react to threats, compete and seek mates and reproduce, hunt and forage, communicate and generally to survive.

Unfortunately, there are numerous other factors in the faunal environment that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

The only animal species studied in detail are humans, and studies are still continuing in this regard. These studies also indicate that there is considerable variation between individuals, highlighting the loss of sensitivity to higher frequencies as human's age. Sensitivity also varies with frequency with humans. Considering the variation in the sensitivity to frequencies and between individuals, this is likely similar with all faunal species. Some of these studies are repeated on animals, with behavioural hearing tests being able to define the hearing threshold range for some animals as indicated on **Figure 8-1** below.

Only a few faunal (animal) species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject, with a few studies that discuss behavioural changes in other faunal species due to increased noises.

[14] Report to Congressional Requesters, 2005; USEPA, 1971; Autumn, 2007; Noise quest, 2010

Few studies indicate definitive levels where noises start to impact on animals, with most based on laboratory level research that subject animals to noise levels that are significantly higher than the noise levels these animals may experience in their environment (excluding the rare case where bats and avifauna fly extremely close to an anthropogenic noise, such as from a moving car or the blades of a wind turbine).

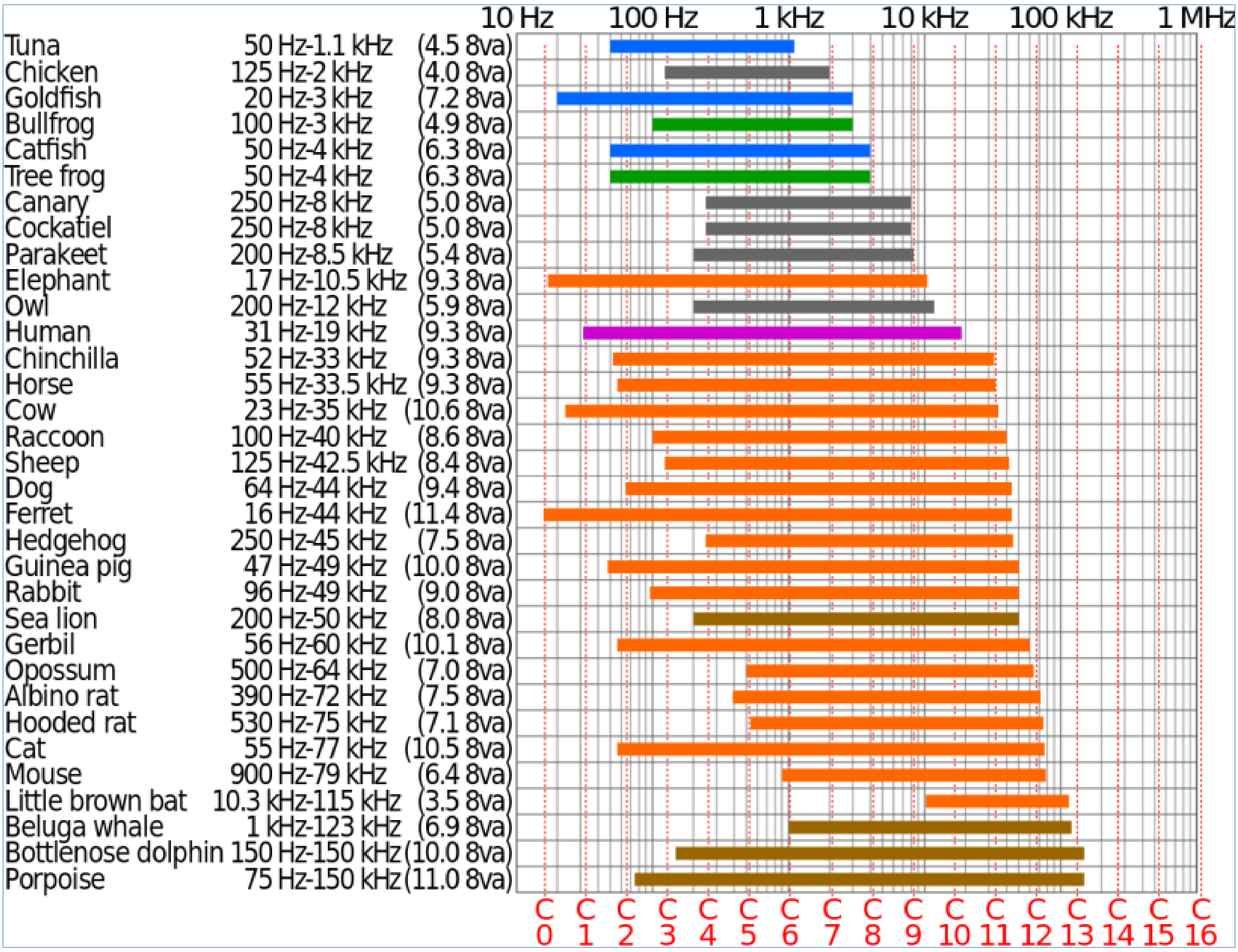

Figure 8-1: Logarithmic Chart of the Hearing Ranges of Some Animals[15]

From these and other studies the following can be concluded that:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate (Drooling, 2007).
- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2009).
- Animals of most species exhibit adaptation with noise (Broucek, 2014), including impulsive noises, by changing their behaviour.

[15] https://en.wikipedia.org/wiki/Hearing_range

More sensitive species would relocate to a quieter area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Drooling, 2007).

Noises associated with helicopters, motor- and quad bikes does significantly impact on animals. This is due to the sudden and significant increase in noise levels due to these activities.

To date there are, however, no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals.

8.1.1 Domestic Animals

It may be that domesticated animals are more accustomed to noise sources of an industrial, commercial or other anthropogenic nature, although exposure to high noise levels may affect domestic animals' well-being. Sound levels in animal shelters can exceed 100 dB, much more than what can be expected at a domestic dwelling from an industrial, commercial or transportation noise source (10-minute equivalent)[16&17].The high noise levels may see negative influences on animals' cardiovascular systems and behaviour, and may be damaging to the hearing of dogs in the kennel facility[18].

Domesticated animals may also respond differently to noises than animals in the wild. Domesticated dogs are pack animals and may respond excitedly or vocally to other noises, smells, visual and other stimulants, in contrast to wild animals that may flee due to any slight unfamiliar sounds or noises. Animals that are transported at least once in their life (such as pigs to an abattoir) would endure high noise levels for the duration of the delivery period. A change in the heart rate, renal blood flow and blood pressure of study subjects were noted in the above studies. How small changes (in environmental noise levels) may impact on domesticated animals have not been studied.

8.1.2 Wildlife

Many natural based acoustics themselves may be loud or impulsive. Examples include thunder, wind induced noises that could easily exceed 35 dBA ($L_{A90,fast}$) above wind speeds averaging 6 m/s, noise levels during early morning dawn chorus or loud cicada noises during late evening or early morning.

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[16]Crista L. Coppola. Noise in the Animal Shelter Environment: Building Design and the Effects of Daily Noise Exposure.
[17] David Key, Essential Kennel Designs.
[18]Wei, B. L. (1969). Physiological effects of audible sound. AAAS Symposium Science, 166(3904), 533-535.

Potential noise impacts on wildlife are very highly species dependent. Studies showed that most animals adapt to noises and would even return to a site after an initial disturbance, even if the noise continues. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area. Stress levels can increase in animals restricted to areas where the sound levels are impacting on them (due to the level, character or both).

There are a few specific studies discussing the potential impacts of noise on wildlife associated with construction, transportation and industrial facilities. Available information indicates that noises from transportation and industrial sources may mask the sound of a predator approaching; similarly predators depending on hearing would not be able to locate their prey.

8.1.3 Avifauna[19]

Noise impacts on birds include:

- It can cause hearing damage (very loud or loud impulsive sounds);
- It can increase stress levels (directly and indirectly);
- Masking (directly or indirectly) the sounds of their food, predators or mates;
- Their typical food sources may move;
- Relocation to less suitable habitats; and
- other behavioral reactions.

As with the impact on other wildlife, the impact of noise on avifauna depends on the character of the noise (including the impulsive character), the magnitude or intensity of the noise as well as the familiarity the birds have with the sound.

Similarly, different birds change their response to these sounds differently. Some may not be impacted while more sensitive species may relocate, some birds –

- may start to sing at different times;
- may change the frequency, pitch or character of their calls/singing/signals; or/and
- increase the volume of their calls/singing/signals.

As with other animals, there are no guidelines or even studies highlighting acceptable sound levels or other criteria before noise may start to impact on birds.

8.1.4 Laboratory Animal Studies

Although many laboratory animals have wild counterparts (rats, mice) the laboratory test subjects differ in many aspects (genetics, behaviour etc.). Also noise levels of studies are

[19] Ortega, 2012; Halfwerk, 2011; Francis, 2012; Francis, 2011; Parris, 2009, Brumm, 2004.

conducted at generally very high levels at over 100 dB, much more than what would be experienced in environmental settings around industrial, commercial or transportation activities.[20] Other dissimilarities to laboratory tests and a natural environment include the time exposure (duration of noise), the spectral and noise character (impulsive noise vs. constant noise) etc. Although there exist dissimilarities in tests conducted and noise levels around commercial and industrial environments, laboratory rodents exposed to high noise levels did indicated physiological, behavioural changes, hearing loss and other such effects[21].

8.1.5 Horses and Chickens

Though the author made an effort to source available data with regard to noise impacts on Horses and Chickens, there is no information, guidelines or studies covering the subject of noise impacts on these species.

However, audibility curves are available for some species as illustrated in (see **Figure 8-2** and **Figure 8-3** below) for various faunal species.

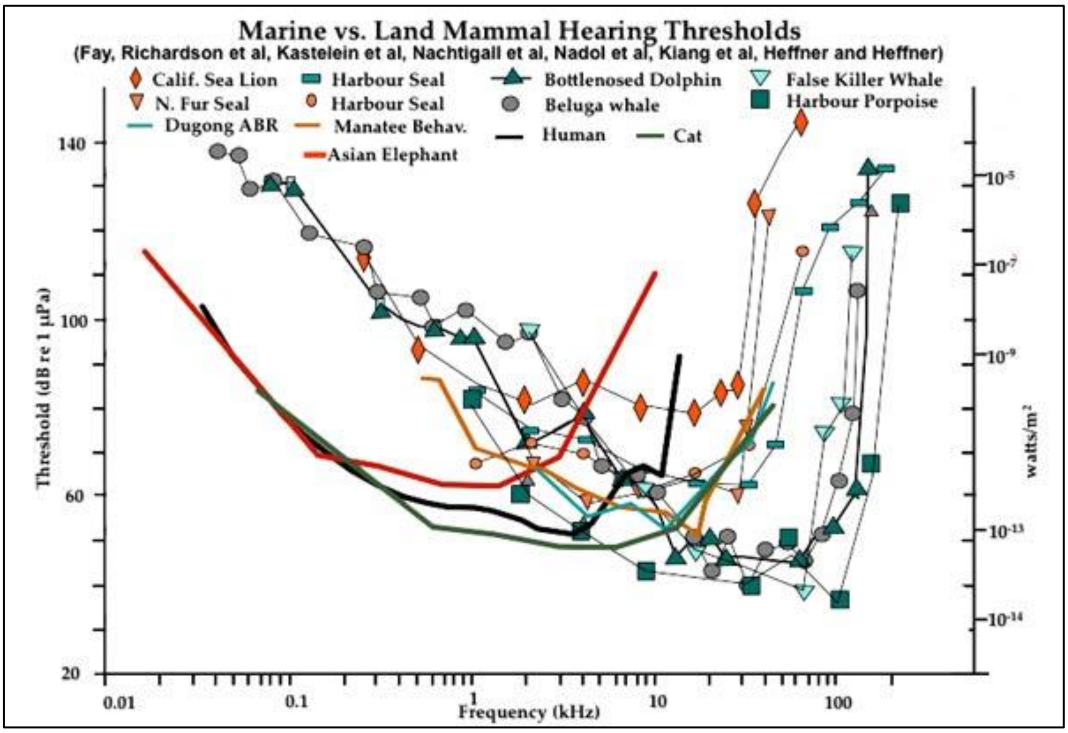

Figure 8-2: Audibility Threshold Curves for Humans and a few other species[22]

Considering the absolute audibility threshold for humans (from the Equal-loudness contours as defined by ISO 226:2003), it would be acceptable to conclude that the absolute audibility

[20]USEPA, 1971.
[21] Baldwin, 2007.
[22] Note: The Threshold reference pressure is dB re 1 µPa, different from the 20 µPa normally used

threshold of chickens would be less sensitive than that of humans (humans are more sensitive to sound than chickens). As no audibility curves were located for horses, no statement could be made about the sensitivity to sound for horses. This study will assume noise limits (as used for humans) as the noise limit for Chickens and Horses in the vicinity of the Project Area (night-time noise level exceeding 45 dBA, precautious principle).

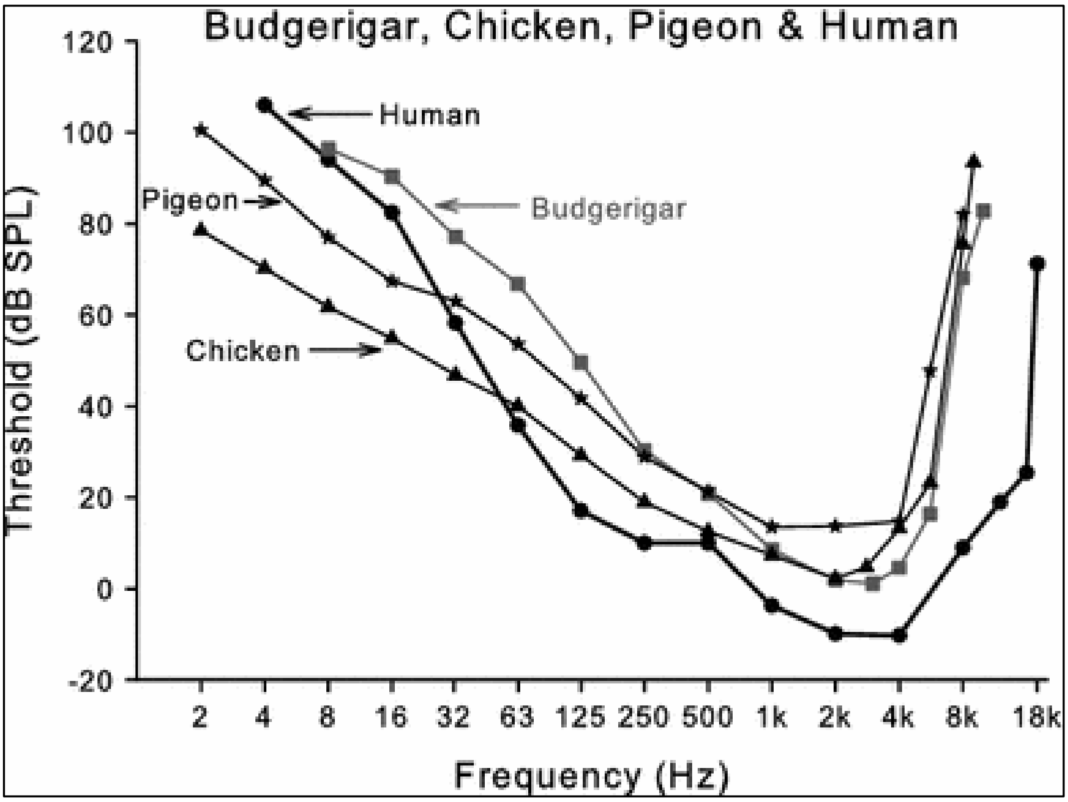

Figure 8-3: Audibility Threshold Curves for Humans and Chickens[23]

8.2 WHY NOISE CONCERNS COMMUNITIES[24]

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication;
- Impedes the thinking process;
- Interferes with concentration;
- Obstructs activities (work, leisure and sleeping); and
- Presents a health risk due to hearing damage.

[23] Note: The Threshold reference pressure is dB re 20 µPa
[24] World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered "disturbing". One can refer to a dripping tap in the quiet of the night, or the irritating "thump-thump" of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:

- Background sound levels, and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological state of the receptor; and
- The attitude of the receptor about the emitter (noise source).

8.3 IMPACT ASSESSMENT CRITERIA

8.3.1 Overview: The common characteristics

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity;
- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, intensity is the only one which is not subjective and can be quantified. Loudness is a subjective measure of the effect sound has on the human ear. As a quantity it is therefore complicated, but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

8.3.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts considering the latest EIA Regulations, SANS 10103:2008 as well as guidelines from the World Health Organization.

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 7 dBA is considered a disturbing noise. See also **Figure 8-4**.
- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also **Table 8-1**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

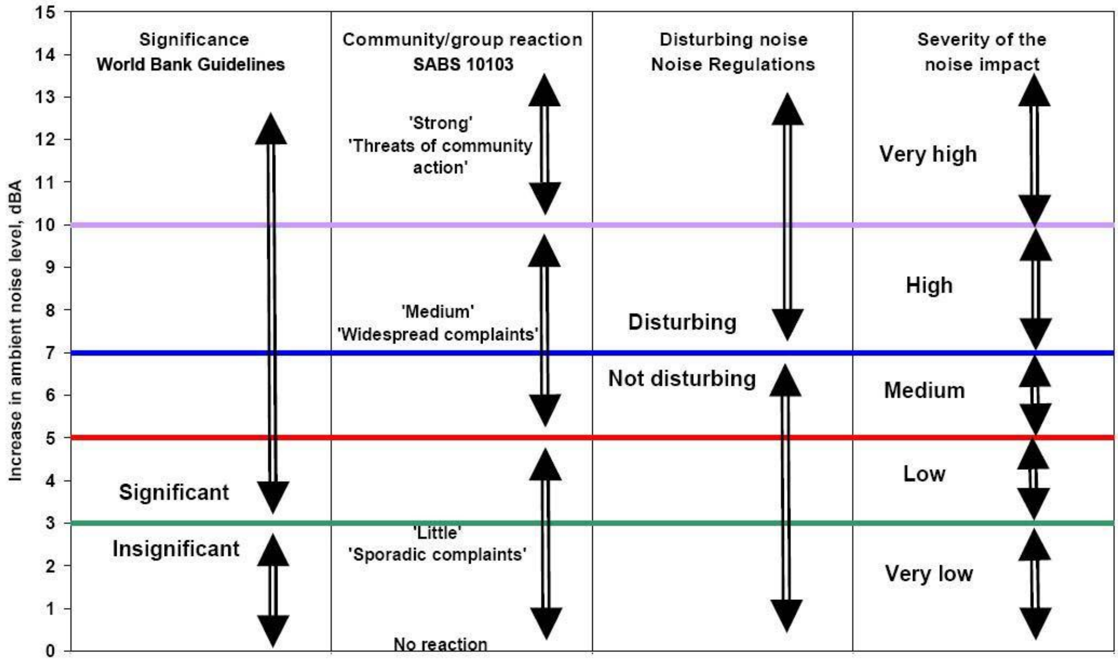

Figure 8-4: Criteria to assess the significance of impacts stemming from noise

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also **Table 8-1**). It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed.

Acoustical measurements indicated an area where the ambient sound levels are typically of an urban noise district, and the potential noise impact was evaluated in terms of (i.t.o.) the following proposed rating levels:

- "Urban District suitable for residential use" (55 and 45 dBA day/night-time Rating i.t.o. SANS 10103:2008).
- "Equator principles" (55 and 45 dBA day/night-time Rating i.t.o. IFC Noise Limits).

SANS 10103:2008 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in sound level, the following criteria are of relevance:

- **Δ ≤ 3 dBA:** An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- **3 < Δ ≤ 5 dBA:** An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- **5 < Δ ≤ 15 dBA:** An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National and Provincial Noise Control Regulations).

8.3.3 Other noise sources of significance

In addition, other noise sources that may be present should also be considered. During the day, people are generally bombarded with the sounds from numerous sources considered "normal", such as animal sounds, conversation, amenities and appliances (TV/Radio/CD playing in background, computer(s), freezers/fridges, etc.). This excludes activities that may generate additional noise associated with normal work.

At night, sounds that are present are natural sounds from animals, wind as well as other sounds we consider "normal", such as the hum from a variety of appliances (magnetostriction) drawing standby power, freezers and fridges.

Table 8-1: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	Equivalent continuous rating level ($L_{Req.T}$) for noise dBA					
	Outdoors			Indoors, with open windows		
	Day/night $L_{R,dn}$ [a]	Daytime $L_{Req,d}$ [b]	Night-time $L_{Req,n}$ [b]	Day/night $L_{R,dn}$ [a]	Daytime $L_{Req,d}$ [b]	Night-time $L_{Req,n}$ [b]
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
d) Urban districts with one or more of the following: workshops; business premises; and 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

8.3.4 Determining the Significance of the Noise Impact

Regulation 50(c), of the MPRDR (2004) under the MPRDA (2002) requires an assessment of the nature (status), extent, duration, probability and significance of the identified potential environmental impacts of the proposed mining operation.

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value as defined in the third column in the tables below.

The impact consequence is determined by summing the scores of Magnitude (**Table 8-2**), Duration (**Table 8-3**) and Spatial Extent (**Table 8-4**). The impact significance (see **Sections 8.3.5** and **Section 8.3.6**) is determined by multiplying the Consequence result with the Probability score (**Table 8-5**).

An explanation of the impact assessment criteria is defined in the following tables.

Table 8-2: Impact Assessment Criteria – Magnitude

This defines the impact as experienced by any receptor. In this report the receptor is defined as any resident in the area, but excludes faunal species.		
Rating	**Description**	**Score**
Low	Increase in average sound pressure levels between 0 and 3 dB from the expected ambient sound levels. Ambient sound levels are defined by the lower of the measured $L_{AIeq,8hr}$ or $L_{AIeq,16hr}$ during measurement dates. Total projected noise level is less than the Zone Sound Level and/or Equator Principle in wind-still conditions.	2
Low Medium	Increase in average sound pressure levels between 3 and 5 dB from the expected ambient sound levels. Total projected noise levels between 3 and 5 above the Zone Sound Level and/or Equator Principle (wind-less conditions).	4
Medium	Increase in average sound pressure levels between 5 and 7 dB from the ambient sound levels. Increase in sound pressure levels between 5 and 7 above the Zone Sound Level and/or Equator Principle (wind-less conditions). Sporadic complaints expected.	6
High	Increase in average sound pressure levels between 7 and 10 from the ambient sound level. Total projected noise levels between 7 and 10 dBA above the Zone Sound Level and/or Equator Principle (wind-less condition). Medium to widespread complaints expected.	8
Very High	Increase in average ambient sound pressure levels higher than 10 dBA. Total projected noise levels higher than 10 dB above the Zone Sound Level and/or Equator Principle (wind less-conditions). Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action. Any point where instantaneous noise levels exceed 65 dBA at any receptor.	10

Table 8-3: Impact Assessment Criteria - Duration

The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operational and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.		
Rating	**Description**	**Score**
Temporary	Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional.	1
Short term	Impacts that are predicted to last only for the duration of the construction period.	2
Long term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating.	4
Permanent	Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	5

Table 8-4: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact		
Rating	**Description**	**Score**
Site	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1

Local	The impact could affect the local area (within 1,000 m from site).	2
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns (further than 1,000 m from site).	3
National	The impact could have an effect that expands throughout the country (South Africa).	4
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.	5

Table 8-5: Impact Assessment Criteria - Probability

This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:		
Rating	**Description**	**Score**
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0%).	1
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined to be up to 25%.	2
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined to be between 25% and 50%.	3
Highly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined between 50% and 75%.	4
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined to be between 75% and 100%.	5

In order to assess each of these factors for each impact, the following ranking scales as contained in **Table 8-6** were used.

Table 8-6: Assessment Criteria: Ranking Scales

PROBABILITY		**MAGNITUDE**	
Description / Meaning	**Score**	**Description / Meaning**	**Score**
Definite/don't know	5	Very high/don't know	10
Highly likely	4	High	8
Likely	3	Medium	6
Possible	2	Low Medium	4
Improbable	1	Low	2
DURATION		**SPATIAL SCALE**	
Description / Meaning	**Score**	**Description / Meaning**	**Score**
		International	5
Permanent	5	National	4
Long Term	4	Regional	3
Short term	2	Local	2

Temporary	1	Footprint	1

8.3.5 Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a Significance Rating (SR) value for each impact (prior to the implementation of mitigation measures).

Significance without mitigation is rated on the following scale:

SR<30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30<**SR** <60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR>60	High (H)	Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

8.3.6 Identifying the Potential Impacts with Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it was necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale:

SR<30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30<**SR** <60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR>60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded of high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

9 ASSUMPTIONS AND LIMITATIONS

9.1 MEASUREMENTS OF AMBIENT SOUND LEVELS

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced a measurement using the reading result at the end of the measurement. Therefore, trying to define ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above (one of the reasons why long-term measurements were collected). The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement.
- It is assumed that the measurement locations represent other residential dwellings in the area (similar environment), yet, in practice this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including:
    - the distance to closest trees, number and type of trees as well as the height of trees;
    - available habitat and food for birds and other animals;
    - distance to residential dwelling, type of equipment used at dwelling (compressors, air-cons);
    - general maintenance condition of house (especially during windy conditions); and
    - number and type of animals kept in the vicinity of the measurement locations (typical land use taking place around the dwelling).
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation and external noise sources will influence measurements. It may determine whether one is measuring anthropogenic sounds from a receptors dwelling, or environmental ambient soundscape contributors of significance (faunal, road traffic, railway line movement etc.). At times there are extraneous noises that cannot be heard during deployment, or not operational, that can significantly impact on readings (such as water pumps, transformers, faunal communication, etc.).
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc.). Traffic however is highly dependent on the time of day

as well as general agricultural activities taking place during the site investigation. Traffic noise is one of the major components in urban areas and could be a significant source of noise during busy periods. Traffic[25] on the N12 is significant and traffic noises will have an impact on the ambient sound levels in an area up to about 1,000m either side of the N12, and depending on specific conditions, it may be more during other times. Traffic may be audible at distances up to 3,000 m during quiet periods (little faunal and other noises), especially if the wind blows from the road to the receptors.

- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. While the windshields used limits the effect of fluctuating pressure across the microphone diaphragm, the effect of wind-induced noises in the trees in the vicinity of the microphone did impact on the ambient sound levels. The site visit unfortunately coincided with a relatively windy period.
- Ambient sound levels are dependant not only on time of day and meteorological conditions, but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise. Many faunal species are more active during warmer periods than colder periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[26].
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement location. This generally is still considered naturally quiet and understood and accepted as features of the natural soundscape, and in various cases sought after and pleasing.
- Considering one or more sound descriptor or equivalent can improve an acoustical assessment. Parameters such as L_{AMin}, L_{AIeq}, L_{AFeq}, L_{Ceq}, L_{AMax}, L_{A10}, L_{A90} and spectral analysis forms part of the many variables that can be considered.
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

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25 [25] Derived from https://nraaudit.nra.ie/CurrentTrafficCounterData/html/N17-15.htm and https://www.arrivealive.co.za/2003-TRAFFIC-OFFENCE-SURVEY-Comprehensive-Report-on-Fatal-Crash-Statistics-and-Road-Traffic-Information-11
26 Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

9.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

The noise emissions into the environment from the various sources as defined were calculated for the operational phase in detail, using the sound propagation model described in ISO 9613-2.

The following was considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout; and
- Acoustical characteristics of the ground. 50% soft ground conditions were modelled, as the area where the mining activity would be taking place is well vegetated and sufficiently uneven to allow the consideration of relatively soft ground conditions. This is because the use of hard ground conditions could represent a too precautionary situation.

The noise emission into the environment due to additional traffic was calculated using the sound propagation model described in RLS-90 used in Germany. Corrections such as the following were considered:

- Distance of receptor from the road;
- Road construction material;
- Average speeds of travel;
- Types of vehicles used; and
- Ground acoustical conditions.

In this project it illustrates the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time. It is used to define potential issues of concern and not to predict a noise level at a potential noise-sensitive receptor. For this the selected model is internationally recognised and considered adequate.

9.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds are also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.

As previously mentioned, it is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor, but to calculate a noise rating level that is used to identify potential issues of concern.

9.4 UNCERTAINTIES ASSOCIATED WITH MITIGATION MEASURES

Any noise impact can be mitigated to have a low significance; however, the cost of mitigating this impact may be prohibitive, or the measure may not be socially acceptable (such as the relocation of an NSD). These mitigation measures may be engineered, technological or due to management commitment.

For the purpose of the determination of the significance of the noise impact mitigation measures were selected that is feasible, mainly focussing on management of noise impacts using rules, policy and require a management commitment. This however does not mean that noise levels cannot be reduced further, only that to reduce the noise levels further may require significant additional costs (whether engineered, technological or management).

It was assumed the mitigation measures proposed for the construction phase will be implemented and continued during the operational phase.

9.5 UNCERTAINTIES OF INFORMATION PROVIDED

While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is difficult to accurately model noise levels at a receptor from any operation. The projected noise levels are the output of a numerical model with the accuracy depending on the assumptions made during the setup of the model. The assumptions include the following:

- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment. The determination of octave sound power levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- Sound power emission levels from processes and equipment changes depending on the load the process and equipment is subject to. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to

a period that the process or equipment was subject to a certain load (work required from the engine or motor to perform action). Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worse-case scenario;

- As it is unknown which processes and equipment will be operational (when and for how long), modelling considers a scenario where processes and equipment are under full load for a set time period. Modelling assumptions complies with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would be likely over-estimated;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global DEM data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify, and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Fifty percent (50%) soft ground conditions will be modelled as the area where the construction activities are proposed is well vegetated and sufficiently uneven to allow the consideration of soft ground conditions.

10 PROJECTED NOISE RATING LEVELS

10.1 CHANGES IN PROJECT LAYOUT

The developer made some minor changes to the layout assessed in 2018, with the 2018 layout (as modelled and assessed in this report and illustrated in **Figure 10-1**) and the 2021 layout (depicted in **Figure 10-2**). The proposed change in infrastructure moved equipment and noise-generating activities approximately 50m to the north north-east. This change is insignificant and can be considered micro-siting. In addition, no new equipment or activities were added to the project.

The change will not change the mitigation measures, the findings or recommendations of this report. The change would not require remodelling the noise impact, as the noise rating levels and noise contours will be very similar.

10.2 CURRENT NOISE LEVELS (CONCEPTUAL)

Road traffic from the N12 is a significant noise source that should not be excluded in any noise impact assessment. Similarly, traffic on the R50 and D1550 is also sufficiently high to be included in the calculation of baseline noises from traffic. A conceptual ambient sound map was prepared using the following assumptions (see also **Figure 4-3**):

- N12[27]: 16,700 AADT with about 20% of this traffic being between the hours of 22:00 and 06:00 (night-time) travelling at 120 km/h. Heavy vehicles would constitute 10% of this traffic.
- D1550 and R50 (based on the lower values as reported by RAMS, **Figure 4-3**): 5,000 AADT with about 20% of this traffic being between the hours of 22:00 and 06:00 (night-time). Traffic travelling at 120 km/h with 10% of this traffic being heavy vehicles.

The projected Noise Levels due to the main roads in the area are illustrated in **Figure 10-3** and **Figure 10-4**, with the noise contours illustrated from 35 dBA upwards. This represents the potential area that people may hear road traffic during a quiet period.

10.3 PROPOSED CONSTRUCTION PHASE NOISE IMPACT

This section investigates the proposed construction activities as discussed in **section 7.2**. There may be a number of smaller equipment operating in the area, but the addition of a

[27] Derived from https://nraaudit.nra.ie/CurrentTrafficCounterData/html/N17-15.htm and https://www.arrivealive.co.za/2003-TRAFFIC-OFFENCE-SURVEY-Comprehensive-Report-on-Fatal-Crash-Statistics-and-Road-Traffic-Information-11

general noise source (at each location where activities can take place) covers most of these noise sources. The following input parameters are assumed:

- Drilling machine: Operating under full load both day and night;
- Excavator and truck: Operating under 75% load day and 25% load at night;
- Bulldozer: Operating under 100% load day and 25% load at night;
- Grader: Operating under 100% load day and 50% load at night; and
- General Noise: Operating under 100% load day and 50% load at night; and
- 20 heavy and light vehicles (each) per hour travelling to the site during the day at 60 km/h

These activities were conceptualised as illustrated in **Figure 10-5** with the octave sound power levels used in the model defined in **Table 10-1**. All noise sources generate the noises 2 m above the ground surface.

Table 10-1: Sound power emission levels used for operational phase modelling

Equipment	Sound power level, dB re1 pW, in octave band, Hz							SPL
Centre frequency	63	125	250	500	1000	2000	4000	(dBA)
Blower (flue gas stack)	121.1	119.9	122.9	117.6	110.1	108.2	104.9	119.0
Bulldozer CAT D5	107.4	105.9	104.8	104.5	104.4	97.5	90.2	107.4
Cement truck (with cement)	104.0	107.0	106.0	108.0	107.0	105.0	102.0	111.7
Diesel Generator (Large - mobile)	107.2	104.0	102.4	102.7	100.2	99.5	97.4	106.1
Drilling Machine	107.2	109.4	109.2	106.1	104.7	101.2	99.8	109.6
Dumper/Haul truck - Bell 25 ton	102.5	108.6	106.5	105.4	104.5	99.2	97.2	108.4
Excavator and truck	111.0	112.2	109.3	106.4	105.4	101.6	98.4	110.0
FEL - Bell L1806C	109.0	106.7	107.3	97.9	95.8	92.5	87.6	102.7
FEL and Truck	105.0	117.0	113.0	114.0	111.0	107.0	101.0	110.0
General noise	95.0	100.0	103.0	105.0	105.0	100.0	100.0	108.8
Grader	100.0	111.0	108.0	108.0	106.0	104.0	98.0	110.9
Road Transport Reversing/Idling	108.2	104.6	101.2	99.7	105.4	100.7	98.7	108.2
Road Truck average	90.0	101.0	102.0	105.0	105.0	104.0	99.0	109.6
Primary Crusher	121.1	122.3	120.1	120.0	117.3	112.5	106.3	121.7
Vibrating Screens - Hard rock	115.0	109.7	105.7	104.2	103.5	103.1	99.9	109.1

The potential extent of the noise from construction activities are presented in the figures as follows:

- **Figure 10-6**: Contours of equal noise rating levels as calculated for the conceptual daytime activities;
- **Figure 10-7**: Contours of equal changes in ambient sound levels, based on the projected existing daytime ambient sound levels (**Figure 10-3**) and the noise rating levels as calculated for the conceptual daytime activities (**Figure 10-6**);

- **Figure 10-8**: Contours of equal noise rating levels as calculated for the conceptual night-time activities; and
- **Figure 10-9**: Contours of equal changes in ambient sound levels, based on the projected existing night-time ambient sound levels (**Figure 10-4**) and the noise rating levels as calculated for the conceptual night-time activities (**Figure 10-8**).

Based on the noise modelling, the closest receptors may be subjected to noise levels as defined in **Table C. 1, Appendix C**.

10.4 OPERATIONAL PHASE NOISE IMPACT

This section investigates the proposed construction activities as discussed in **section 7.3**. The following input parameters were assumed:

- Drilling machine: Operating under full load both day and night;
- Excavator and truck (Ore): Operating under full load both day and night, with the excavation/loading activities taking place 10 m below the ground surface within the boxcut. The walls of the boxcut would act as a noise barrier;
- Excavator and truck (topsoil): Operating under 75% load in the day and 25% load at night on the ground surface;
- Bulldozer: Operating under 75% load in the day and 25% load at night;
- Front end loader and truck (working at ROM): Operating under 75% load in the day and 25% load at night on the ground surface;
- Primary crusher: Operating at 50% load both day and night;
- Crushing and screening plant: Operating at 100% load both day and night;
- Blower and exhaust stack: Operating under 100% load day and night;
- General Noise (workshop area): Operating under 75% load in the day and 25% load at night;
- Front end loader and truck (working at product loading): Operating under 100% load during the day only; and
- 10 heavy and light vehicles (each) per hour travelling to the site during the day at 60 km/h.

These activities were conceptualised as illustrated in **Figure 10-10** with the octave sound power levels used in the model defined in **Table 10-1**. All noise sources generate the noises 2 m above the ground surface with the exhaust stack located at 5 m above ground surface.

The potential extent of the noise from operational activities is presented in the figures as follows:

- **Figure 10-11**: Contours of equal noise rating levels as calculated for the conceptual daytime activities;
- **Figure 10-12**: Contours of equal changes in ambient sound levels, based on the projected existing daytime ambient sound levels (**Figure 10-3**) and the noise rating levels as calculated for the conceptual daytime activities (**Figure 10-11**);
- **Figure 10-13**: Contours of equal noise rating levels as calculated for the conceptual night-time activities; and
- **Figure 10-14**: Contours of equal changes in ambient sound levels, based on the projected existing night-time ambient sound levels (**Figure 10-4**) and the noise rating levels as calculated for the conceptual night-time activities (**Figure 10-13**).

Based on the noise modelling, the closest receptors may be subjected to noise levels as defined in **Table C. 2, Appendix C**.

10.5 Decommissioning and Closure Phase Noise Impact

The potential for a noise impact to occur during the decommissioning and closure phase is much lower than the construction and operational phases. The noise impact during this phase is generally significantly less than the operational phase, as there is a lower urgency to complete the phase. It was therefore not investigated further.

Figure 10-1: Layout assessed in 2018 (Report no: JA-NMR/ENIA/201806-Rev 1, Dated June 2018)

Figure 10-2: Latest Infrastructure Layout, moving infrastructure approximately 50m to the north north-east


Colour Scale
80 dBA
75 dBA
70 dBA
65 dBA
60 dBA
55 dBA
LEGEND
- National and Provincial roads
- Proposed Opencast areas
- Proposed Infrastructure areas
- Potential Noise-sensitive receptors
Project Alignment
SCALE
0
1,000 m
TITLE
Rietkol - Projected existing noise rating contours: Daytime
CLIENT
Jacana Environmentals cc
Enviro-Acoustic Research
726 Wiedrigh st
Moreleta Park
0181
Tel: 012 004 362
Fax: 086 621 0292
email: morne@eares.co.za
REFERENCES AND SOURCES
GoogleEarth
Google Earth
1 km

Figure 10-3: Projected conceptual ambient daytime noise levels due to roads

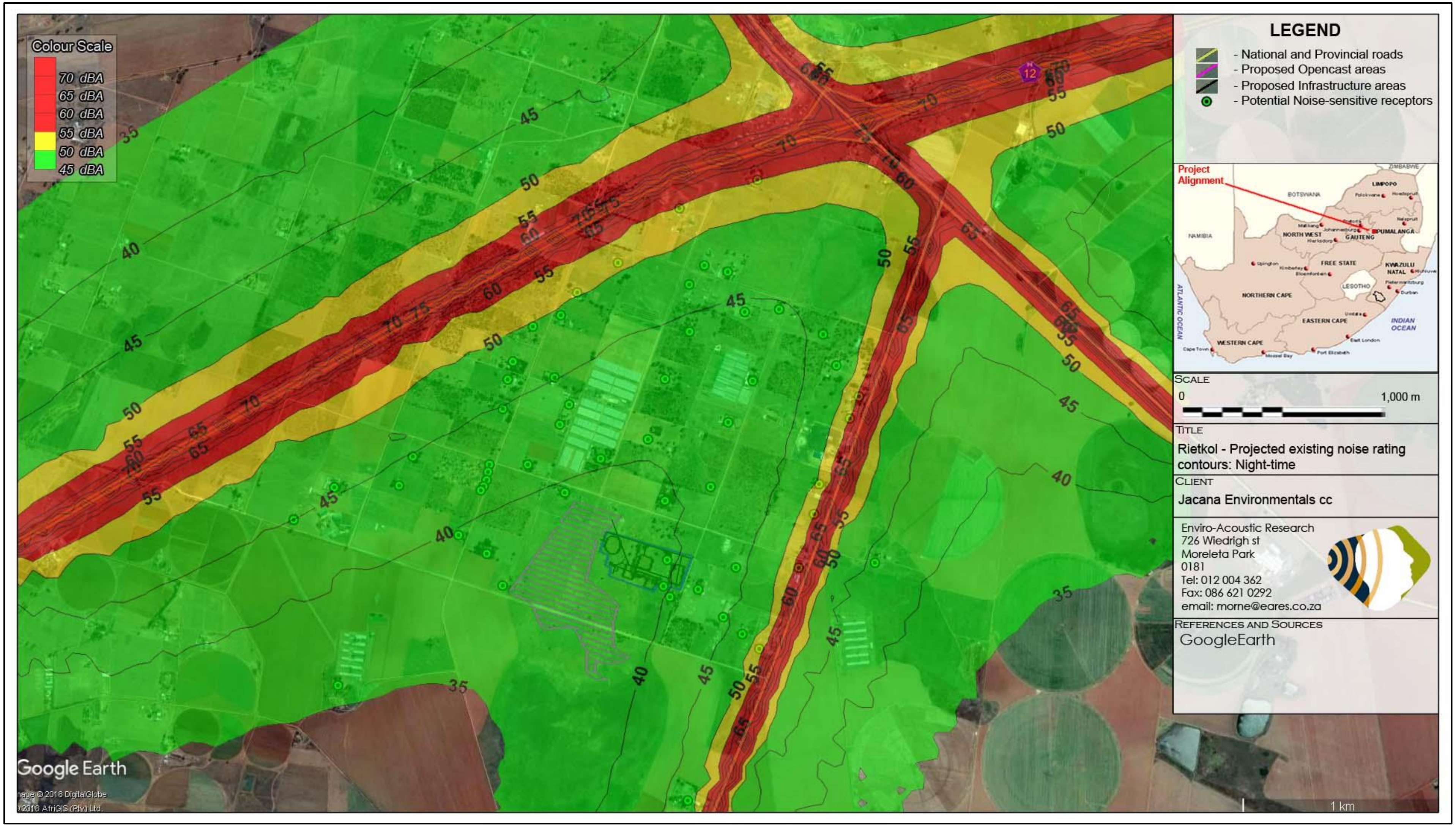

Figure 10-4: Projected conceptual ambient night-time noise levels due to roads

Figure 10-5: Conceptual construction noise sources

Figure 10-6: Projected conceptual daytime noise rating level contours due to construction activities

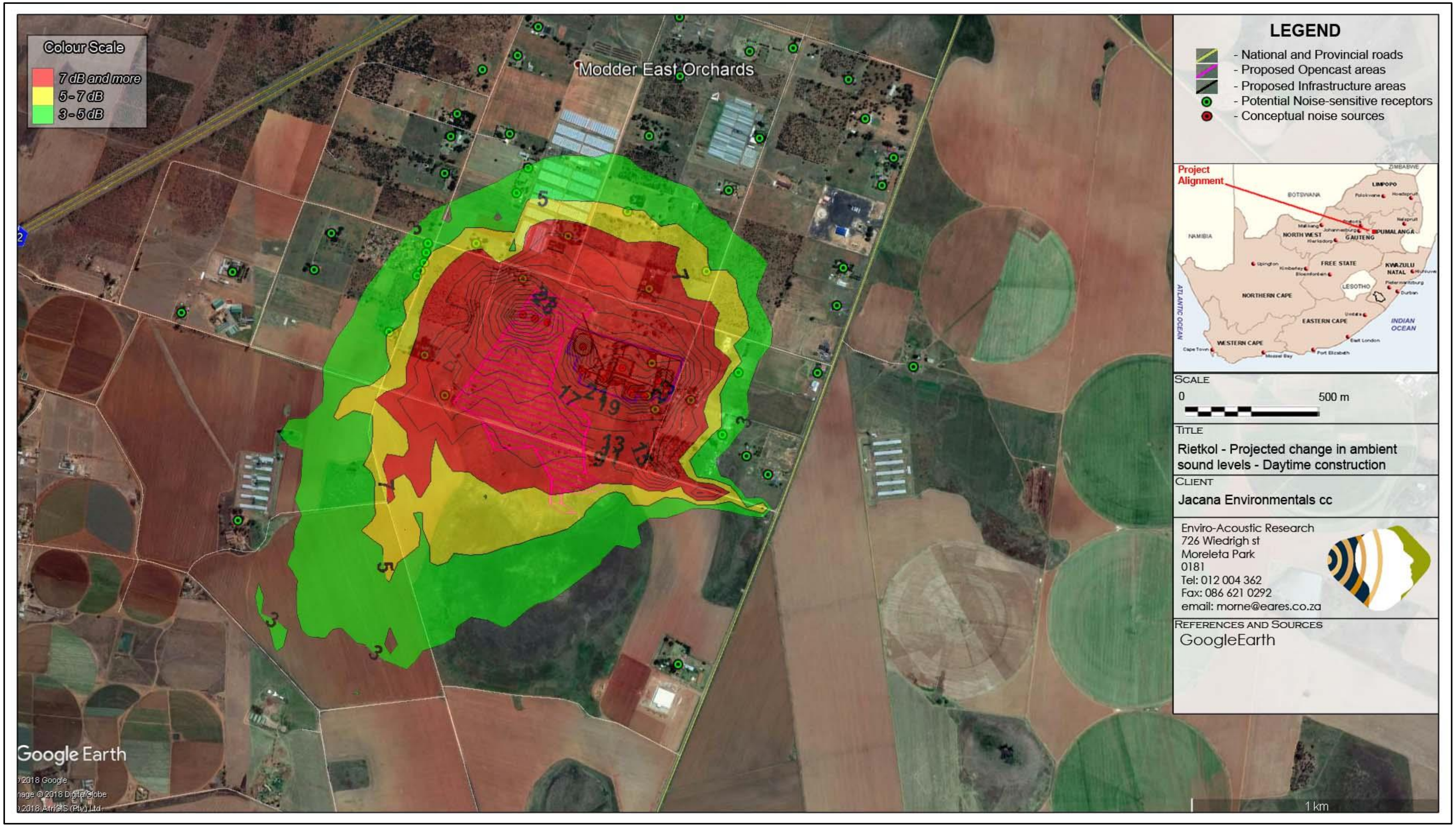

Figure 10-7: Projected change in ambient sound levels due to daytime construction activities

Figure 10-8: Projected conceptual night-time noise rating level contours due to construction activities

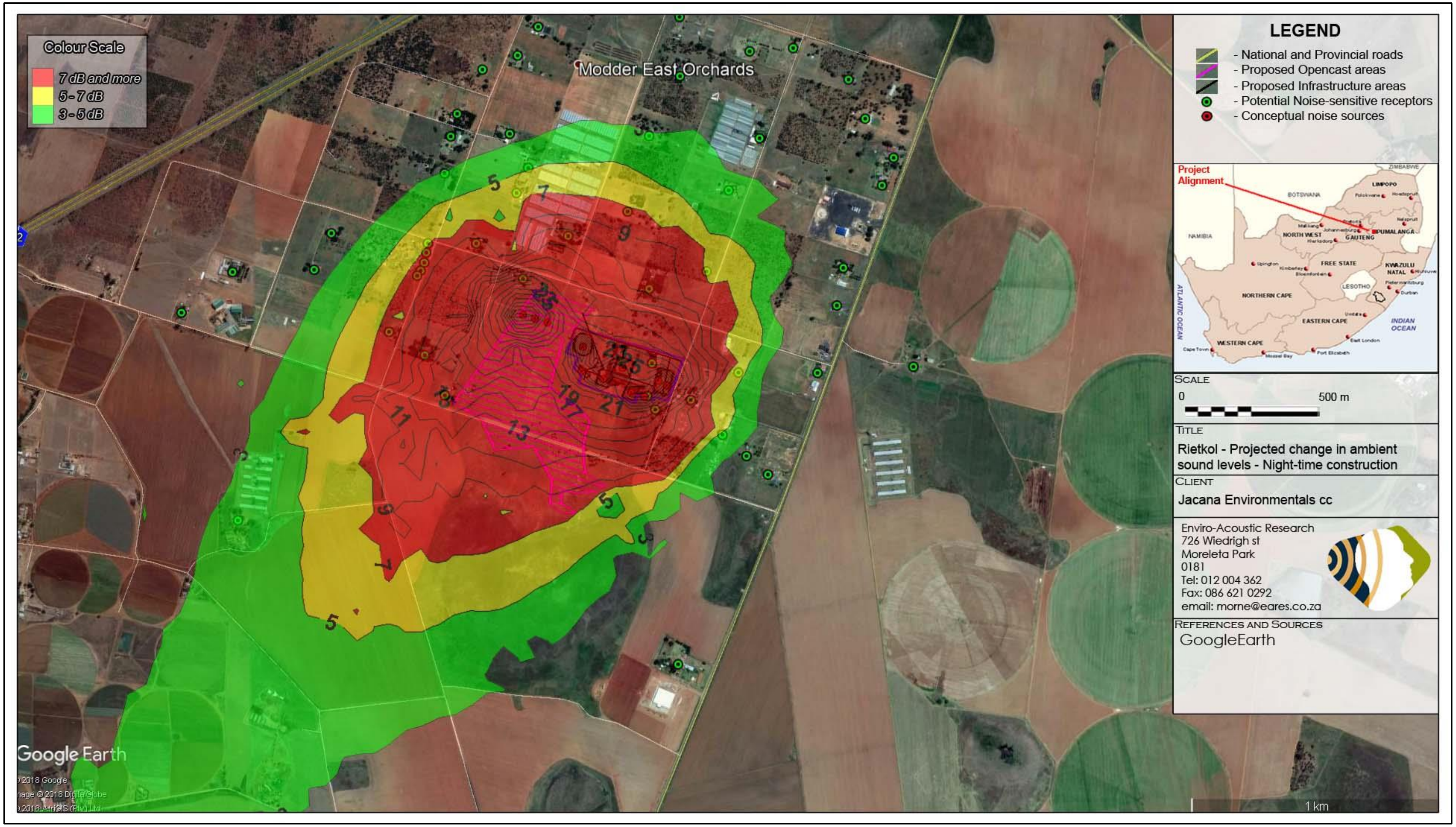

Figure 10-9: Projected change in ambient sound levels due to night-time construction activities

Figure 10-10: Conceptual Noise Generating Activities – Operational phase


Colour Scale
80 dBA
75 dBA
70 dBA
65 dBA
60 dBA
55 dBA
Modder East Orchards
LEGEND
- National and Provincial roads
- Proposed Opencast areas
- Proposed Infrastructure areas
- Potential Noise-sensitive receptors
- Conceptual noise sources
Project Alignment
SCALE
0
500 m
TITLE
Rietkol - Projected noise rating contours: Daytime operational activites
CLIENT
Jacana Environmentals cc
Enviro-Acoustic Research
726 Wiedrigh st
Moreleta Park
0181
Tel: 012 004 362
Fax: 086 621 0292
email: morne@eares.co.za
REFERENCES AND SOURCES
GoogleEarth
Google Earth
1 km

Figure 10-11: Projected conceptual daytime noise rating level contours due to operational activities

Figure 10-12: Projected change in ambient sound levels due to daytime operational activities

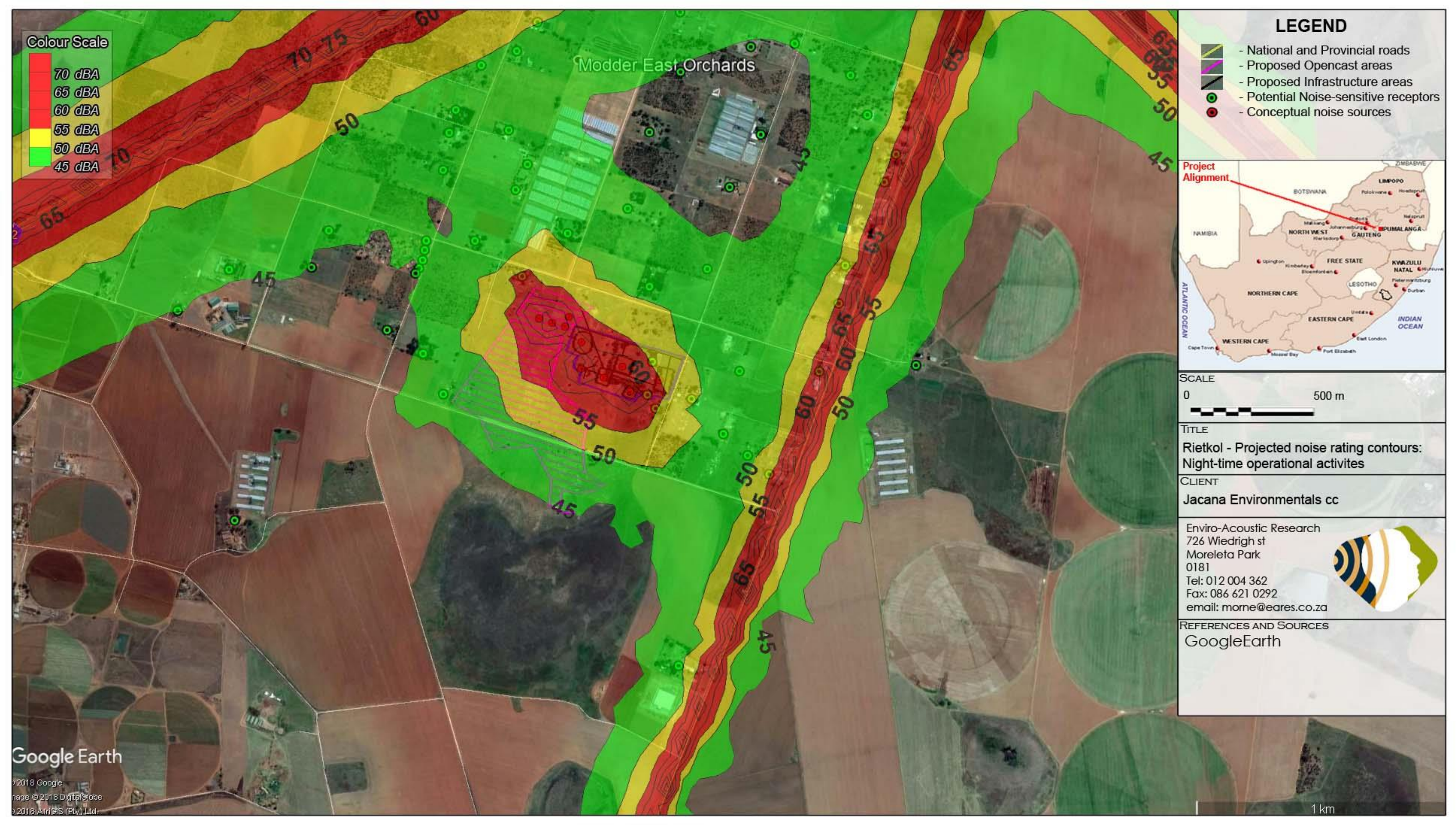

Figure 10-13: Projected conceptual night-time noise rating level contours due to operational activities

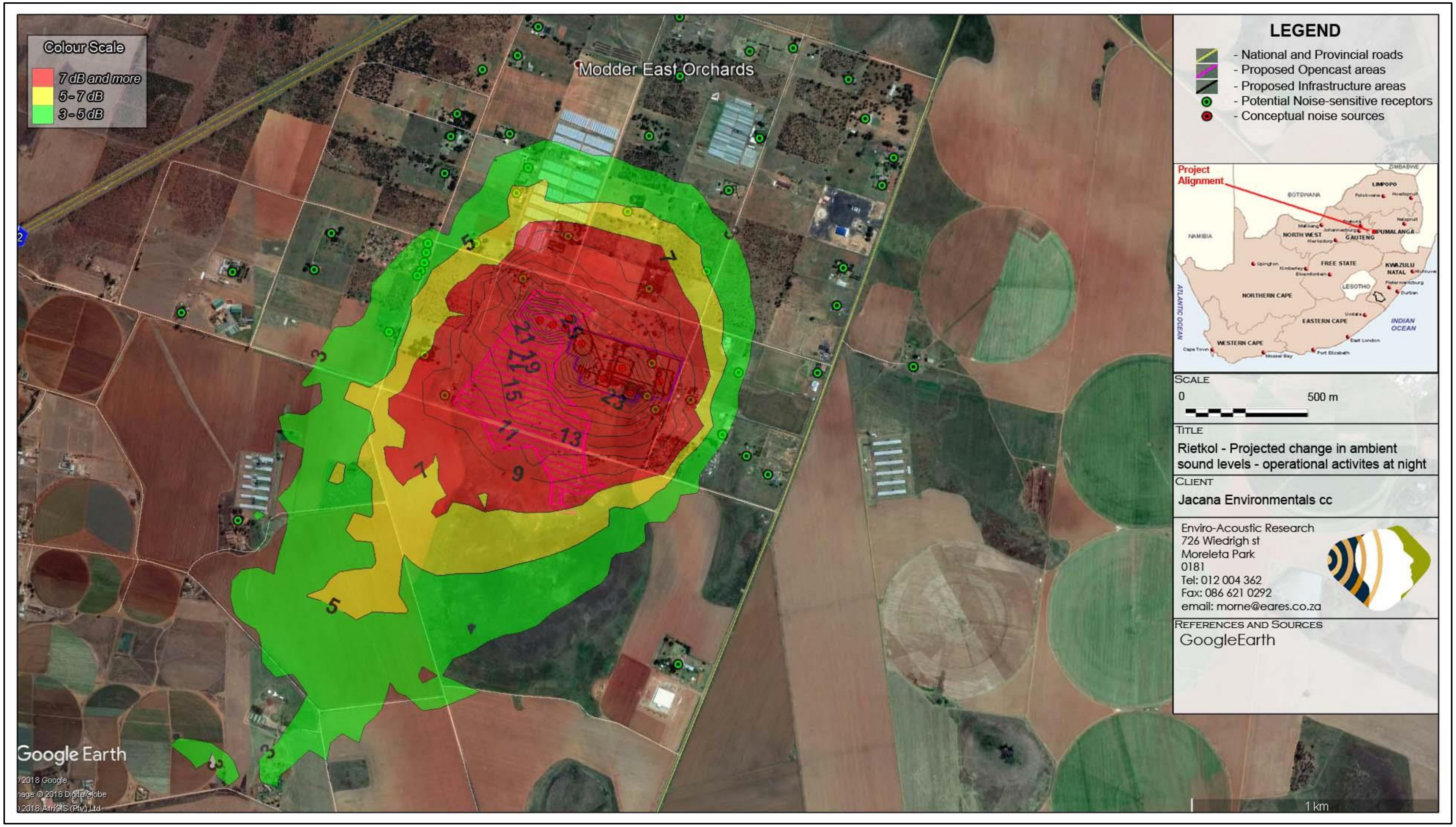

Figure 10-14: Projected change in ambient sound levels due to night-time operational activities

11 SIGNIFICANCE OF THE NOISE IMPACT

11.1 PLANNING PHASE NOISE IMPACT

Noises associated with the planning phase are generally of very short duration and located far from people. As such the magnitude of noise levels are low and the probability of a noise impact occurring is very low. The significance is very low and this will not be investigated in detail in this section.

Because of the projected high noise levels on receptors located within the footprint of the mine, it will be assumed that receptors such as NSD01, 02 and 03 will be relocated before construction starts. As mining progress, noise levels will increase at NSD05 and 07 and it is highly recommended that these receptors be relocated.

11.2 CONSTRUCTION PHASE NOISE IMPACT

The potential noise impacts for the various activities defined in **Section 7.2**, conceptualised and calculated in **section 10.3**. The noise rating levels are discussed in **Table 11-1** below with the significance for each receptor defined in **Table 11-2** and **Table 11-3** (day and night-time scenarios respectively). The potential significance of the noise impacts is summarized in **Table 11-4** and **Table 11-5** for the day and night-time scenarios respectively. Noise rating levels for all receptors are presented in **Table C. 1**, Appendix C.

Table 11-1: Construction noise impacts

NSD	Discussion of the noise impact
Daytime noise levels 1, 2, 3, 4, 5, 6, 7 and 19	Located within (or close to) the 60 dBA noise rating level contour due to daytime construction activities. Noises may increase annoyance with the mine.
Night-time noise levels 1, 2, 3, 4, 5, 6, 7, 14, 15, 18, 19 and 20	Located within (or close to) the 50 dBA noise rating level contour due to night-time construction activities. Maximum noises generated at the mine are likely to result in increased annoyance and potential complaints about noise.
Daytime change of ambient sound levels 1, 2, 3, 4, 5, 6, 7, 15 and 19	Receptors located in the area where the construction activities are likely to change the ambient sound levels (with more than 7 dB). They will clearly detect the change in ambient sound levels and may complain about the increase in noise levels in the area.
Night-time change of ambient sound levels 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 19	Receptors located in the area where the construction activities are likely to change the ambient sound levels (with more than 7 dB). They will clearly detect the change in ambient sound levels and are likely to complain about the increase in noise levels in the area.

Table 11-2: Daytime construction noise impacts (55 dBA noise limit)

NSD	Projected daytime noise rating levels with road traffic (dBA)	Projected change in ambient sound levels (dBA)	Magnitude (dBA)	Duration	Extent	Probability	Significance
1*	62.5	17.5	10	2	2	5	70
2*	65.5	20.9	10	2	2	5	70
3*	73.5	29.2	10	2	2	5	70
4**	52.9	8.6	6	2	2	2	20
5*	63.2	19.1	10	2	2	3	42
6**	52.2	9.2	6	2	2	2	20
7**	53.3	11.5	6	2	2	2	20
8	49	4.9	4	2	2	2	16
9	50.6	5	4	2	2	2	16
10	50.6	5.1	4	2	2	2	16
11	50.4	4.6	4	2	2	2	16
12	50.8	4.6	4	2	2	2	16
13	50.8	4.3	4	2	2	2	16
14**	52.6	6.9	6	2	2	2	20
15**	54	9.2	6	2	2	2	20
16	50.1	5.1	4	2	2	2	16
17	51.1	5.2	4	2	2	2	16
18	52.8	4.4	4	2	2	2	16
19	58.4	11.6	10	2	2	2	28
20	53	3.8	4	2	2	2	16

* Property bought by Consol
** Noise levels will increase as construction activities approach these receptors in the future, up to 66 dBA.

Table 11-3: Night-time construction noise impacts (45 dBA noise limit)

NSD	Projected daytime noise rating levels with road traffic (dBA)	Projected change in ambient sound levels (dBA)	Magnitude (dBA)	Duration	Extent	Probability	Significance
1*	58.9	18.6	10	2	2	5	70
2*	62.3	22.4	10	2	2	5	70
3*	70.5	30.9	10	2	2	5	70
4**	50.2	10.5	10	2	2	3	42
5*	62.6	23.1	10	2	2	5	70
6**	50.5	12.1	10	2	2	3	42
7**	52.5	15.2	10	2	2	3	42
8	47.2	7.6	8	2	2	3	36
9	48.9	7.9	8	2	2	3	36
10	49	8	8	2	2	3	36
11	48.6	7.4	8	2	2	3	36
12	49	7.4	8	2	2	3	36
13	48.9	6.9	8	2	2	3	36
14**	51.3	10.1	10	2	2	3	42
15**	52.2	12	10	2	2	3	42
16	47.7	7.3	8	2	2	2	24
17	48.1	6.8	6	2	2	3	30
18	49.3	5.5	6	2	2	3	30
19	55.2	13	10	2	2	4	56
20	49.3	4.8	4	2	2	3	24

* Property bought by Consol
** Noise levels will increase as construction activities approach these receptors in the future, up to 66 dBA.

Table 11-4: Impact Assessment: Construction Activities during the day

Nature:	***Numerous simultaneous construction activities (see also Table 11-1 and Table 11-2)***	
Acceptable Rating Level	Area has a sub-urban development character, but the proximity to busy roads raised the ambient sound levels. Ambient sound level measurements indicate a noise rating level more typical of an urban district. Use $L_{Req,D}$ of 55 dBA (urban).	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	NSDs 1, 2, 3 and 5 will experience noise levels well above the selected rating level for the area as well as experiencing a high change in ambient sound levels. Very High (NSDs 1, 2 and 3) Very High (NSDs 5, 6 and 7 as mining progress)	Relocation of NSDs 1, 2, 3, 5 and 7. Medium (NSD06)
Duration (Table 8-3)	Noises will continue for the construction phase. (Short – 2)	Noises will continue for the construction phase. (Short – 2)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Daytime construction activities will generate noise but it will mainly be limited to the project site and directly adjacent properties. (Local – 2)	Daytime construction activities will generate noise but it will mainly be limited to the project site and directly adjacent properties. (Local – 2)
Probability (Table 8-5)	NSDs 1, 2 and 3 are located within the footprint of the mining area and the impact on them will be definite (5). NSD 5, 6 and 7 are located very close to the proposed mining activities and taking the precautionary principle, it is definite that the receptor will experience a high noise impact (5) during a stage of the project. The probability is lower for the other NSDs.	Mitigation will reduce the magnitude of a noise impact and will also reduce the probability of the impact. Good relations with potential receptors will further reduce the perceived noise impact from the activities. The probability of an impact may reduce to highly likely (4) or less, depending on the mitigation selected for implementation.
Significance of Impact	High (NSDs 1, 2, 3, 5, 6 and 7)	Medium (NSD06)
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No loss of resources.	No loss of resources.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	Relocation of NSDs 1, 2, 3, 5 and 7 (before any construction activities need to start closer than 300m from these NSD). Feedback to the identified receptors on the potential noise impact on them and the mitigation measures identified to reduce the noise impact. Develop a noise barrier as soon as possible, as high as possible between NSD06 and the construction area. Use of smallest practical available equipment for construction purposes. Minimizing the number of construction equipment operating within 200m from NSD06 if no barrier or other mitigation measures were implemented. Establish complaints register with an open line to a relevant person that can act if there is a noise complaint.	

Cumulative impacts	There will be a slight cumulative effect from construction noise on the NSD (less than 1 dB, together with the noise due to road traffic).
Residual Impacts:	This impact will only disappear after mine decommissioning and closure is completed.

Table 11-5: Impact Assessment: Construction Activities at night

Nature:	***Numerous simultaneous construction activities (see also Table 11-1 and Table 11-3)***	
Acceptable Rating Level	Area has a sub-urban development character, but the proximity to busy roads raised the ambient sound levels. Ambient sound level measurements indicate a noise rating level more typical of an urban district. Use $L_{Req,N}$ of 45 dBA (urban).	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	NSDs 1, 2, 3 and 7 will experience noise levels well above the selected rating level for the area as well as experiencing a high change in ambient sound levels. Very High (NSDs 1, 2 and 3) Very High (NSDs 5, 6 and 7 as mining progress)	Relocation of NSDs 1, 2, 3, 5 and 7. Medium (NSD06)
Duration (Table 8-3)	Noise will continue for the construction phase. (Short – 2)	Noise will continue for the construction phase. (Short – 2)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Night-time construction activities will generate noise but it will mainly be limited to the project site and adjacent properties. (Local – 2)	Night-time construction activities will generate noise but it will mainly be limited to the project site and adjacent properties. (Local – 2)
Probability (Table 8-5)	NSDs 1, 2 and 3 are located within the footprint of the mining area and the impact on them will be definite (5). NSD 5, 6 and 7 are located very close to the proposed mining activities and taking the precautionary principle, it is definite that the receptor will experience a high noise impact (5) during a stage of the project. The probability is lower for the other NSDs.	Mitigation will reduce the magnitude of a noise impact and will also reduce the probability of the impact. Good relations with potential receptors will further reduce the perceived noise impact from the activities. The probability of an impact may reduce to highly likely (4) or less, depending on the mitigation selected for implementation.
Significance of Impact	High (NSD06)	Medium (NSD06)
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No loss of resources.	No loss of resources.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	Relocation of NSDs 1, 2, 3, 5 and 7 (before any construction activities need to start closer than 300m from these NSD). Feedback to the identified receptors on the potential noise impact on them and the mitigation measures identified to reduce the noise impact. Develop a noise barrier as soon as possible, as high as possible between NSD06 and the construction area. Use of smallest practical available equipment for construction purposes. Minimizing night-time construction activities within 300 m, and if not possible, minimizing the number of construction equipment operating within 300m from	

	NSD06 (or any other NSD) if no barrier or other mitigation measures were implemented. Establish complaints register with an open line to a relevant person that can act if there is a noise complaint.
Cumulative impacts	There will be a slight cumulative effect from construction noise on the NSD (less than 1 dB, together with the noise due to road traffic).
Residual Impacts:	This impact will only disappear after mine decommissioning and closure is completed.

11.3 Operational Phase Noise Impact

The impact assessment for the various activities defined in **section 7.3**, conceptualised and calculated in **section 10.4**. The noise rating levels are discussed in **Table 11-6** below with the significance for each receptor defined in **Table 11-7** and **Table 11-8** (day and night-time scenarios respectively). The potential significance of the noise impacts are summarized in **Table 11-9** and **Table 11-10** for the day and night-time scenarios respectively. Noise rating levels for all receptors are presented in **Table C. 2**, Appendix C.

Table 11-6: Operational noise impacts*

NSD	Discussion of the noise impact
Daytime noise levels 4, 5, 6, 7 and 19	Will be located within (or close to) the 60 dBA noise rating level contour due to daytime operational activities. Noise may increase annoyance with the mine.
Night-time noise levels 4, 5, 6, 7, 14, 15, 18, 19 and 20	Will be located within (or close to) the 50 dBA noise rating level contour due to night-time operational activities. Maximum noise generated at the mine is likely to result in increased annoyance and potential complaints about noise.
Daytime change of ambient sound levels 4, 5, 6, 7, 15 and 19	Receptors located in the area where the operational activities as likely to change the ambient sound levels (with more than 7 dB). They will clearly detect the change in ambient sound levels and may complain about the increase in noise level in the area.
Night-time change of ambient sound levels 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 19	Receptors located in the area where the operational activities as likely to change the ambient sound levels (with more than 7 dB). They will clearly detect the change in ambient sound levels and are likely to complain about the increase in noise level in the area.

- Assumed that NSD01, 02 and 03 were relocated.

Table 11-7: Daytime operational noise impacts (55 dBA noise limit) – Scenario evaluated

NSD	Projected daytime noise rating levels with road traffic (dBA)	Projected change in ambient sound levels (dBA)	Magnitude (dBA)	Duration	Extent	Probability	Significance
1*	*57*	*12*	*10*	*4*	*2*	*5*	***80***
2*	*57.9*	*13.3*	*10*	*4*	*2*	*5*	***80***
3*	*62.3*	*18*	*10*	*4*	*2*	*5*	***80***
4**	50.6	6.3	6	4	2	2	**24**
5*	55.5	11.4	10	4	2	3	**48**
6**	48.4	5.4	6	4	2	2	**24**
7**	48.5	6.7	6	4	2	2	**24**

8	46.2	2.1	2	4	2	2	16
9	47.4	1.8	2	4	2	2	16
10	47.4	1.9	2	4	2	2	16
11	47.5	1.7	2	4	2	2	16
12	48	1.8	2	4	2	2	16
13	48.2	1.7	2	4	2	2	16
14**	48.5	2.8	2	4	2	2	16
15**	50.5	5.7	2	4	2	2	16
16	47.9	2.9	2	4	2	2	16
17	48.8	2.9	2	4	2	2	16
18	50.5	2.1	2	4	2	2	16
19	53.1	6.3	6	4	2	2	24
20	51	1.8	2	4	2	2	16

* Property bought by Consol
** Noise levels will increase as operational activities approach these receptors in the future, higher than 60 dBA.

Table 11-8: Night-time operational noise impacts (45 dBA noise limit) – Scenario evaluated

NSD	Projected daytime noise rating levels with road traffic (dBA)	Projected change in ambient sound levels (dBA)	Magnitude (dBA)	Duration	Extent	Probability	Significance
1*	55.6	15.3	10	4	2	5	80
2*	54.1	14.2	10	4	2	5	80
3*	61.8	22.2	10	4	2	5	80
4**	48.7	9	10	4	2	3	48
5*	55.1	15.6	10	4	2	5	80
6**	47.3	8.9	10	4	2	3	48
7**	47.6	10.3	10	4	2	3	48
8	43.7	4.1	8	4	2	3	42
9	44.8	3.8	8	4	2	3	42
10	44.9	3.9	8	4	2	3	42
11	44.8	3.6	8	4	2	3	42
12	45.3	3.7	8	4	2	3	42
13	45.3	3.3	8	4	2	3	42
14**	46.4	5.2	10	4	2	3	48
15**	49	8.8	10	4	2	3	48
16	45.5	5.1	8	4	2	2	28
17	46.2	4.9	6	4	2	3	36
18	47.4	3.6	6	4	2	3	36
19	51	8.8	10	4	2	4	64
20	47.7	3.2	4	4	2	3	30

* Property bought by Consol
** Noise levels will increase as construction activities approach these receptors in the future, higher than 60dBA.

Table 11-9: Impact Assessment: Operational Activities during the day

Nature:	***Numerous simultaneous construction activities***	
Acceptable Rating Level	Area has a sub-urban development character, but the proximity to busy roads raised the ambient sound levels. Ambient sound level measurements indicate a noise rating level more typical of an urban district. Use $L_{Req,D}$ of 55 dBA (urban).	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	NSD06 expected to be subject to noise levels exceeding 45 dBA during the operational phase, well above the selected rating level for the area as	Medium (NSD06)

	well as experiencing a high change in ambient sound levels. Very High (NSD06 as mining approach the dwelling)	
Duration (Table 8-3)	Noise will continue for the operational phase. (Long – 4)	Noise will continue for the operational phase. (Long – 4)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Daytime operational activities will generate noise but it will mainly be limited to the project site and directly adjacent properties. (Local – 2)	Day-time operational activities will generate noise but it will mainly be limited to the project site and adjacent properties. (Local – 2)
Probability (Table 8-5)	NSD06 is located very close to the proposed mining activities and taking the precautionary principle, it is definite that the receptor will experience a high noise impact (5) during the operational phase of the project. The probability is lower for the other NSDs.	Mitigation will reduce the magnitude of a noise impact and will also reduce the probability of the impact. Good relations with potential receptors will further reduce the perceived noise impact from the activities. The probability of an impact may reduce to highly likely (4) or less, depending on the mitigation selected for implementation.
Significance of Impact	High (NSD06)	Medium (NSD06)
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No loss of resources.	No loss of resources.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	Feedback to the identified receptors on the potential noise impact on them and the mitigation measures identified to reduce the noise impact. Develop a noise barrier as soon as possible, as high as possible between NSD06 and the operational area. Use of smallest practical available equipment for construction purposes. Minimizing the number of construction equipment operating within 200m from NSD06 if no barrier or other mitigation measures were implemented. Establish complaints register with an open line to a relevant person that can act if there is a noise complaint.	
Cumulative impacts	There will be an insignificant cumulative effect from operational noises on NSD (together with the noise due to road traffic and fans).	
Residual Impacts:	This impact will only disappear after mine decommissioning and closure is completed.	

Table 11-10: Impact Assessment: Operational Activities at night

Nature:	***Numerous simultaneous construction activities***	
Acceptable Rating Level	Area has a sub-urban development character, but the proximity to busy roads raised the ambient sound levels. Ambient sound level measurements indicate a noise rating level more typical of an urban district. Use $L_{Req,N}$ of 45 dBA (urban)	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	NSD06 and 19 expected to be subject to noise levels exceeding 50 dBA during the operational phase, well above the selected rating level for the area as well as experiencing a high change in ambient sound levels.	Medium (NSD06 and 19)

	Very High (NSD06 and 19)	
Duration (Table 8-3)	Noise will continue for the operational phase. (Long – 4)	Noise will continue for the operational phase. (Long – 4)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Night-time operational activities will generate noises but it will mainly be limited to the project site and directly adjacent properties. (Local – 2)	Night-time operational activities will generate noises but it will mainly be limited to the project site and adjacent properties. (Local – 2)
Probability (Table 8-5)	NSD06 is located very close to the proposed mining activities and taking the precautionary principle, it is definite that the receptor will experience a high noise impact (5) during the operational phase of the project. The probability is lower for the other NSDs.	Mitigation will reduce the magnitude of a noise impact and will also reduce the probability of the impact. Good relations with potential receptors will further reduce the perceived noise impact from the activities. The probability of an impact may reduce to highly likely (4) or less, depending on the mitigation selected for implementation.
Significance of Impact	High (NSD06 and 19)	Medium (NSD06 and 19)
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No loss of resources.	No loss of resources.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	Feedback to the identified receptors on the potential noise impact on them and the mitigation measures identified to reduce the noise impact. Develop a noise barrier as soon as possible, as high as possible between NSD06 and the operational area. Use of smallest practical available equipment for operational purposes. Minimizing the number of operational equipment or activities taking place during night-time hours within 300m from NSD06 if no barrier or other mitigation measures were implemented. The design of the exhaust stack to minimise noise emissions (e.g. the installation of an industrial exhaust silencer, use of flow control vanes, use of sound insulation, use of diffuser or design of flue section, etc.), or not operating the drier exhaust stack at night. Establish complaints register with an open line to a relevant person that can act if there is a noise complaint.	
Cumulative impacts	There will be a slight cumulative effect from construction noise on the NSD (less than 1 dB, together with the noise due to road traffic).	
Residual Impacts:	This impact will only disappear after mine decommissioning and closure is completed.	

11.4 Decommissioning Phase Noise Impact

Final decommissioning activities will have a noise impact lower than either the construction or operational phases. This is because decommissioning and closure activities normally take place during the day using minimal equipment (due to the decreased urgency of the project). While there may be various activities, there is a very small risk for any additional noise impact.

11.5 EVALUATION OF ALTERNATIVES

11.5.1 Alternative 1: No-go option

The ambient sound levels will remain as is. The noise levels experienced by the surrounding receptors (from the activity) are typical of an urban noise district, with receptors staying closer to the N12 and D1550 roads being subjected to higher noise levels.

11.5.2 Alternative 2: Proposed mining activities

The proposed mining activities (worse-case evaluated) will raise the noise levels at a number of closest potential noise-sensitive developments. These noises can be disturbing and may impact on the quality of living for the receptors. Therefore, in terms of acoustics there is no real benefit to the surrounding environment (closest receptors). However, provided that the proposed mitigation measures are implemented, the impact will be reduced to a more acceptable medium significance.

However, the project will greatly assist in the economic growth and development challenges South Africa is facing by means of assisting in providing employment and other business opportunities. Considering only noise[28], people in the area not directly affected by increased noise levels may have a positive perception of the project and could see the need and desirability of the project.

[28] Considering only noise as other environmental factors may affect other people.

12 MITIGATION OPTIONS

12.1 CONSTRUCTION PHASE MITIGATION MEASURES

The study considers the potential noise impact on the surrounding environment due to construction activities during the daytime periods. It was determined that the potential noise impact would be of high significance, mainly due to the proximity of receptors to construction activities but mitigation measures will reduce the significance to medium.

The five NSDs that will experience the highest increases in noise levels are:

- NSDs 1, 2 and 3: Receptors staying within the footprint of the proposed development. They must be relocated for the project to continue;
- NSDs 5 and 7: Receptors staying very close to the proposed opencast mining area. It is recommended that that these houses not be used for residential purposes. While measures exist to reduce the noise levels, their proximity to the mining area will result in potential NSD experiencing very high noise levels at times during the construction and operational phases.

12.1.1 Mitigation options available to reduce Construction Noise Impact

Mitigation options included both management measures as well as technical changes. Options to reduce the noise impact during the construction phase include:

- NSDs 1, 2, 3, 5 and 7 not to be used for residential purposes;
- Development of a noise barrier or similar between the NSD06 and the mining area. This noise barrier should be as high as possible and as close as possible to the proposed opencast area;
- If night-time activities are required, do not operate closer than 300 m from any receptors unless the activity can take place behind a berm or mitigation measures was implemented to reduce the noise levels.
- Ensure a good working relationship between mine management and all potentially noise-sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them (especially if work is to take place within 300 m from them at night). Information that should be provided to potentially sensitive receptor(s) includes:
    - Proposed working dates, the duration that work will take place in an area and working times;
    - The reason why the activity is taking place;
    - The construction methods that will be used; and
    - Contact details of a responsible person where any complaints can be lodged should there be an issue of concern.

- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised.
- The operation should investigate the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads, within the mining area and at stockpile areas[29][30]. The advantages of white noise alarms above tonal alarms are:
    - It is as safe as a tonal alarm[31].
    - Highly audible close to the alarm (or revering truck)[32].
    - It generates a more uniform sound field behind a reversing vehicle[33].
    - Greater directional information, workers can locate the source faster.
    - Significantly less environmental noise and it creates significantly less annoyance far away.
    - When properly installed, white noise alarms of a similar sound power emission level are more likely to comply with the ISO 9533 standard.

The mine must know that community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon; as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. At all stages surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations. It is counterproductive to suggest that the activities (or facility) will be inaudible due to existing high ambient sound levels. The magnitude of the sound levels will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the activities, the spectral character and that of the surrounding soundscape (both level and spectral character).

12.1.2 Construction mitigation options that should be included in the EMP

- The mine must implement a line of communication (i.e. a helpline where complaints could be lodged). All potential sensitive receptors should be made aware of these

[29] White Noise Reverse Alarms: http://www.brigade-electronics.com/products.
[30] https://www.constructionnews.co.uk/home/white-noise-sounds-the-reversing-alarm/885410.article - White noise sounds the reversing alarm
[31] https://www.acoustics.asn.au/conference_proceedings/AAS2012/papers/p126.pdf - Which is Safer – Tonal or Broadband Reversing Alarms
[32] http://www.irsst.qc.ca/media/documents/PubIRSST/R-833.pdf - Safety of workers behind heavy vehicles
[33] https://www.vaultintel.com/blog/reversing-beeps-could-be-a-thing-of-the-past
https://brigade-electronics.com/white-sound-reversing-alarms-improving-safety-environment/

contact numbers, or alternative means to communicate issues. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated.

- The mine must discuss the potential noise impact on NSDs 5, 6 and 7 with these receptors, highlighting the magnitude as well as feasible mitigation options available that will reduce the noise levels. There should be an agreement between the developer and the receptor in writing on the noise impact as well as the selected mitigation options to be implemented.
- All employees and contractors should receive induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment.
- The development and implementation of a noise measurement programme (at NSD04, NSD06, NSD15, NSD19 preferably, if safety and security allow, a measurement location at the informal community, NSD09 - 13).

12.2 OPERATIONAL PHASE MITIGATION MEASURES

12.2.1 Mitigation options available to reduce Operational Noise Impact

The significance of the noise impact is high (during the operational phase) and additional mitigation measures are recommended to reduce the significance of the noise impact to medium. These measures will include:

- The discussion of the findings of this report with the receptors identified in this report (especially NSDs 5, 6, 7 and 19);
- Minimizing the number of operational equipment or activities taking place during night-time hours within 300m from NSD06 if no mitigation is implemented to reduce the noise level at this receptor;
- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures;
- Continuation of noise measurement programme;
- The mine should investigate the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads and at stockpile areas;
- The correct design of the exhaust stack to ensure that the design consider the minimization of noise from this source. An engineering company specialising in the design of exhaust stacks must be contracted;
- Compliance with the Noise conditions of the Environmental Management Plan that covers:

- Potential mitigation measures as defined in this report;
- Formal register where receptors can lodge any noise complaints;
- Noise measurement protocol to investigate any noise complaints; and
- The commitment from the mine to consider reasonable mitigation if the noise complaint investigation indicate the validity of a noise complaint. These measures could include steps ranging from process changes, development of barriers or enclosure of the noise source and even relocation (if no other feasible alternatives exist).

12.2.2 Operation mitigation options that should be included in the EMP

i. The mine must implement a line of communication (i.e. a helpline where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers, or alternative means to communicate issues. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated. Feedback must be provided to the affected stakeholder(s) with details of any steps taken to mitigate the impact (if valid complaint) or preventative steps to minimise this from happening again.

ii. All employees and contractors should receive induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment.

iii. The continuation of a noise measurement programme (at NSD04, NSD06, NSD15 and NSD19 preferably, if safety and security allow, a measurement location at the informal community, NSD09 - 13)).

13 ENVIRONMENTAL MANAGEMENT OBJECTIVES

The DMR guideline for EMP development requires the formulation of Objectives for Mine Closure as influenced by the Environmental Base Line description. This demonstrates the importance of considering the post closure land use, relative to the pre-mining land use, when formulating the closure objectives.

Environmental Management Objectives is difficult to be defined for noise because ambient sound levels would slowly increase as developmental pressures increase in the area. This is due to increased traffic and human habitation and is irrespective whether the mining activity starts. The moment the mine stops noise levels will drop similar to the pre-mining levels (typical of other areas with a similar developmental character).

However, as there are a number of potential noise-sensitive receptors in the area, Environmental Management Objectives will be proposed. These objectives are based on the sound levels criteria for Residential Use (International Best Practice) while considering the National Noise Control Regulations.

As such, the operation may not increase the existing ambient sound levels with more than **7 dB** (a disturbing noise and prohibited by the National Noise Control Regulations).

14 ENVIRONMENTAL MONITORING PLAN

Environmental Noise Monitoring can be divided into two distinct categories, namely:

- Passive monitoring – the registering of any complaints (reasonable and valid) regarding noise; and
- Active monitoring – the measurement of noise levels at identified locations.

Active environmental noise monitoring is recommended due to the medium (after the implementation of appropriate mitigation measures) significance for a noise impact to develop. In addition, should a valid complaint be registered, the mine must investigate this complaint as per the following sections. It is recommended that the noise investigation be done by an independent acoustic consultant.

While this section recommends a noise monitoring programme, it should be used as a guideline as site specific conditions may require that the monitoring locations, frequency or procedure be adapted.

14.1 MEASUREMENT LOCALITIES AND PROCEDURES

14.1.1 Measurement Localities

Quarterly noise measurements are recommended at NSD04, NSD06, NSD15 and NSD19 (if safety and security allow, a measurement location at the informal community, NSD09 – 13 should be included).

If any of these receptors are relocated the measurement locations should be replaced with a similar location. If there are no potential noise-sensitive receptors living within 1,000m (maximum distance where noise may be problematic, SANS 10328) from any noise sources (associated with the mine) no noise measurements is required.

In addition, noise measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint. The measurement location should consider the direct surroundings to ensure that other sound sources cannot influence the reading. A second instrument must be deployed at the mine infrastructure area (close to the source of noise) during the measurement.

14.1.2 Measurement Frequencies

Once-off ambient sound measurements are recommended before construction activities start at the measurement locations identified in **section 14.1.1** (or any additional measurement locations that can be motivated) using a defined measurement procedure (see **section 14.1.3**). This is to define the pre-mining ambient sound levels at these locations.

Once construction starts, noise measurements should be conducted on a quarterly basis at the measurement locations identified in **section 14.1.1** (or any additional measurement locations that can be motivated) using a defined measurement procedure (see **section 14.1.3**). Noise measurements should continue during the operational phase (quarterly) for the first two years of operation when the noise monitoring plan can be reviewed (measurements increased, continued, reduced or stopped). Compliance with the set Environmental Management Objectives (section 13) as well as the number of registered noise complaints should be considered.

14.1.3 Measurement Procedures

Ambient sound measurements should be collected as defined in SANS 10103:2008. Due to the variability that naturally occurs in sound levels at most locations, it is recommended that semi-continuous measurements are conducted over a period of at least 24 hours, covering at least a full day- (06:00 – 22:00) and night-time (22:00 – 06:00) period. Measurements should be collected in 10-minute bins defining the 10-minute descriptors such as $L_{Aeq,I}$ (National Noise Control Regulation requirement), $L_{A90,f}$ (background noise level as used internationally) and $L_{Aeq,f}$ (Noise level used to compare with IFC noise limit). Spectral frequencies should also be measured to define the potential origin of noise. When a noise complaint is being investigated, measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing noise event.

14.2 RELEVANT STANDARD FOR NOISE MEASUREMENTS

Noise measurements must be conducted as required by the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008. It should be noted that the SANS standard also refers to a number of other standards.

14.3 DATA CAPTURE PROTOCOLS

14.3.1 Measurement Technique

Noise measurements must be conducted as required by the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008.

14.3.2 Variables to be analysed

Measurements should be collected in 10-minute bins defining the 10-minute descriptors such as $L_{Aeq,I}$ (National Noise Control Regulation requirement), $L_{A90,f}$ (background noise level as used internationally) and $L_{Aeq,f}$ (Noise level used to compare with IFC noise limit). Spectral frequencies should also be measured to define the potential origin of noise.

14.3.3 Database Entry and Backup

Data must be stored unmodified in the electronic file saved from the instrument. This file can be opened to extract the data to a spread sheet system to allow the processing of the data and to illustrate the data graphically. Data and information should be safeguarded from accidental deletion or corruption.

14.3.4 Feedback to Receptor

A monitoring report must be compiled considering the requirements of the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008. The mine must provide feedback to the potential noise-sensitive receptors using the channels and forums established in the area to allow interaction with stakeholders, alternatively in a written report.

14.4 STANDARD OPERATING PROCEDURES FOR REGISTERING A COMPLAINT

When a noise complaint is registered, the following information must be obtained:

- Full details (names, contact numbers, location) of the complainant;
- Date and approximate time when this non-compliance occurred;
- Description of the noise or event; and
- Description of the conditions prevalent during the event (if possible).

15 RECOMMENDATIONS AND CONCLUSION

This ENIA covers the proposed development of a Silica Mine just north of Eloff, Mpumalanga. The potential noise rating levels were calculated using a sound propagation model. Conceptual scenarios were developed for the construction and operational phase with the output of the modelling exercise indicating that there is risk of a noise impact of high significance during these phases. Mitigation is available and if implemented would reduce the significance of the noise impact to a more acceptable medium.

The proximity of potential noise-sensitive receptors necessitates the selection of appropriate mitigation measures and the following is recommended:

- That the dwellings at NSDs 1, 2, 3, 5 and 7 not to be used for residential purposes;
- The mine must discuss the potential noise impact on NSD06 with this receptor, highlighting the magnitude as well as feasible mitigation options available that will reduce the noise levels. There should be an agreement between the developer and the receptor in writing on the noise impact as well as the selected mitigation options to be implemented;
- Development of a noise barrier or similar between NSD06 and the mining area;
- Minimise night-time activities within 300 m from NSD06 if mitigation measures are not implemented. If unavoidable, that the quietest equipment be used when operating within 300 m of receptors at night;
- Ensure a good working relationship between mine management and all potentially noise-sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them (especially if work is to take place within 300 m from them at night). Information that should be provided to potentially sensitive receptor(s) includes:
    - Proposed working dates, the duration that work will take place in an area and working times;
    - The reason why the activity is taking place;
    - The construction methods that will be used; and
    - Contact details of a responsible person where any complaints can be lodged should there be an issue of concern.
- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised;

- The operation should investigate the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads, within the mining area and at stockpile areas;
- The mine must implement a line of communication (i.e. a help line where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers, or alternative means to communicate issues. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated;
- All employees and contractors should receive induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment;
- The development and implementation of a noise measurement programme (at NSD04, NSD06, NSD15, NSD19 preferably, if safety and security allows, a measurement location at the informal community, NSD09 – 13 should be included); and
- The correct design of the exhaust stack to ensure that the design consider the minimization of noise from this source. An engineering company specialising in the design of exhaust stacks must be contracted;

It is concluded that, while this project will have a noise impact on a number of the closest noise-sensitive receptors, these impacts can be mitigated to reduce the significance. Working with these receptors, the mine could also improve on the negative perceptions and impacts. It is the opinion of the Author that, if the mine considers the recommendations in this report (incorporated in the Environmental Management Plan), that the increases in noise levels does not constitute a fatal flaw. It is therefore the recommendation that the project should be authorized (from a noise impact perspective).

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the center frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65dBA; or (ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2metres, but not more than 1,4 metres, above the ground for a period extending from06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a

	period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or (c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means 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 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.

Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kilo Hertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin}*and*L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.

Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1]second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and

	100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS10103:2008.

APPENDIX B

Site Investigation – Photos of monitoring locations

Photo B.1: Measurement location NMR-JLTASL01

Photo B.2: Measurement location NMR-JSTASL02

Photo B.3: Measurement location NMR-JSTASL03

Photo B.4: Measurement location NMR-JLTASL02

Photo B.5: Measurement location NMR-JLTASL03

Photo B.6: Measurement location NMR-JLTASL04

Photo B.7: Measurement location NMR- JLTASL05

Photo B.8: Measurement location NMR- JLTASL06

Photo B.9: Measurement location NMR- JLTASL07

APPENDIX C

Summary of projected noise rating levels

Table C. 1: Summary of projected noise rating levels due to construction activities

NSD	Roads only		Construction activities only		Construction activities with roads traffic		Change in ambient in ambient sound levels	
	LrD (dBA)	LrN (dBA)	LrD (dBA)	LrN (dBA)	LrD (dBA)	LrN (dBA)	ΔLr (dB)	ΔLrN (dB)
1	45	40.3	62.4	58.9	62.5	58.9	17.5	18.6
2	44.6	39.9	65.5	62.3	65.5	62.3	20.9	22.4
3	44.3	39.6	73.5	70.5	73.5	70.5	29.2	30.9
4	44.3	39.7	52.2	49.8	52.9	50.2	8.6	10.5
5	44.1	39.5	63.1	62.6	63.2	62.6	19.1	23.1
6	43	38.4	51.6	50.2	52.2	50.5	9.2	12.1
7	41.8	37.3	53	52.4	53.3	52.5	11.5	15.2
8	44.1	39.6	47.3	46.3	49	47.2	4.9	7.6
9	45.6	41	48.9	48.1	50.6	48.9	5	7.9
10	45.5	41	49	48.2	50.6	49	5.1	8
11	45.8	41.2	48.5	47.7	50.4	48.6	4.6	7.4
12	46.2	41.6	49	48.1	50.8	49	4.6	7.4
13	46.5	42	48.8	47.9	50.8	48.9	4.3	6.9
14	45.7	41.2	51.6	50.8	52.6	51.3	6.9	10.1
15	44.8	40.2	53.4	51.9	54	52.2	9.2	12
16	45	40.4	48.4	46.7	50.1	47.7	5.1	7.3
17	45.9	41.3	49.6	47.1	51.1	48.1	5.2	6.8
18	48.4	43.8	50.9	47.9	52.8	49.3	4.4	5.5
19	46.8	42.2	58.1	55	58.4	55.2	11.6	13
20	49.2	44.5	50.7	47.5	53	49.3	3.8	4.8
21	52	47.3	48.5	44.9	53.6	49.3	1.6	2
22	58.8	54.2	47.7	43.4	59.2	54.5	0.4	0.3
23	63.4	58.7	45.4	42.7	63.5	58.8	0.1	0.1
24	53.7	49	39.9	37.4	53.9	49.3	0.2	0.3
25	48.2	43.6	39.9	37.2	48.8	44.5	0.6	0.9
26	60.1	55.4	43.3	40.8	60.2	55.6	0.1	0.2
27	55.9	51.2	42.8	40.4	56.1	51.6	0.2	0.4
28	46.5	41.9	44.9	42.7	48.8	45.4	2.3	3.5
29	47.5	42.9	41.7	39.8	48.5	44.6	1	1.7
30	60.1	55.4	39.2	37.1	60.1	55.5	0	0.1
31	60.9	56.2	41.1	38.6	61	56.3	0.1	0.1
32	51.8	47.2	38.4	36.5	52	47.5	0.2	0.3
33	50.5	45.9	37.6	35.7	50.7	46.3	0.2	0.4
34	49.3	44.7	38.1	36.3	49.6	45.3	0.3	0.6
35	49	44.4	39.1	37.4	49.4	45.2	0.4	0.8
36	51	46.5	39.1	37.5	51.3	47	0.3	0.5
37	51.2	46.6	37.7	36.1	51.4	47	0.2	0.4
38	48.6	44.1	41.8	39.9	49.4	45.5	0.8	1.4

39	47	42.4	44.2	42.5	48.8	45.5	1.8	3.1
40	60.1	55.5	34.3	32.7	60.1	55.5	0	0
41	59.2	54.6	37.2	35.4	59.2	54.7	0	0.1
42	51.2	46.7	37.6	36	51.4	47	0.2	0.3
43	54.8	50.3	38.6	37.1	54.9	50.5	0.1	0.2
44	54.9	50.4	41.1	39.3	55.1	50.7	0.2	0.3
45	53.6	49	41.4	40	53.8	49.5	0.2	0.5
46	49.5	45	45.4	43.8	50.9	47.4	1.4	2.4
47	51.9	47.3	42.6	41.3	52.4	48.3	0.5	1
48	54.1	49.6	41.3	39.9	54.4	50	0.3	0.4
49	51	46.5	40.9	39.4	51.4	47.2	0.4	0.7
50	49.2	44.7	45.9	44.8	50.9	47.8	1.7	3.1
51	46.8	42.2	48.4	47.1	50.7	48.3	3.9	6.1
52	47.7	43.1	47.9	46.3	50.8	48	3.1	4.9
53	49.2	44.7	43.8	42.4	50.3	46.7	1.1	2
54	48	43.4	43.6	42.2	49.3	45.9	1.3	2.5
55	49.9	45.4	38.8	37.7	50.3	46.1	0.4	0.7
56	49.4	44.8	38	36.7	49.7	45.4	0.3	0.6
57	40.4	35.8	38.2	36.8	42.4	39.3	2	3.5

Table C. 2: Summary of projected noise rating levels due to operational activities

NSD	Roads only		Construction activities only		Construction activities with roads traffic		Change in ambient in ambient sound levels	
	LrD (dBA)	LrN (dBA)	LrD (dBA)	LrN (dBA)	LrD (dBA)	LrN (dBA)	ΔLr (dB)	ΔLrN (dB)
1	45	40.3	56.7	55.5	57	55.6	12	15.3
2	44.6	39.9	57.7	53.9	57.9	54.1	13.3	14.2
3	44.3	39.6	62.2	61.8	62.3	61.8	18	22.2
4	44.3	39.7	49.4	48.1	50.6	48.7	6.3	9
5	44.1	39.5	55.2	55	55.5	55.1	11.4	15.6
6	43	38.4	47	46.7	48.4	47.3	5.4	8.9
7	41.8	37.3	47.4	47.1	48.5	47.6	6.7	10.3
8	44.1	39.6	42	41.6	46.2	43.7	2.1	4.1
9	45.6	41	42.9	42.5	47.4	44.8	1.8	3.8
10	45.5	41	42.9	42.6	47.4	44.9	1.9	3.9
11	45.8	41.2	42.5	42.2	47.5	44.8	1.7	3.6
12	46.2	41.6	43.3	42.8	48	45.3	1.8	3.7
13	46.5	42	43.1	42.6	48.2	45.3	1.7	3.3
14	45.7	41.2	45.2	44.8	48.5	46.4	2.8	5.2
15	44.8	40.2	49.1	48.4	50.5	49	5.7	8.8
16	45	40.4	44.7	43.9	47.9	45.5	2.9	5.1
17	45.9	41.3	45.8	44.4	48.8	46.2	2.9	4.9
18	48.4	43.8	46.4	44.9	50.5	47.4	2.1	3.6

19	46.8	42.2	52	50.4	53.1	51	6.3	8.8
20	49.2	44.5	46.4	44.9	51	47.7	1.8	3.2
21	52	47.3	45.3	43.5	52.8	48.8	0.8	1.5
22	58.8	54.2	44.2	41.8	59	54.4	0.2	0.2
23	63.4	58.7	41.8	40.6	63.4	58.8	0	0.1
24	53.7	49	36.9	36	53.8	49.2	0.1	0.2
25	48.2	43.6	36.6	35.6	48.5	44.2	0.3	0.6
26	60.1	55.4	39.6	38.6	60.1	55.5	0	0.1
27	55.9	51.2	39.4	38.4	56	51.4	0.1	0.2
28	46.5	41.9	41.1	40.1	47.6	44.1	1.1	2.2
29	47.5	42.9	38.2	37.4	48	44	0.5	1.1
30	60.1	55.4	35.6	34.8	60.1	55.5	0	0.1
31	60.9	56.2	36.6	35.3	60.9	56.3	0	0.1
32	51.8	47.2	35	34.2	51.9	47.4	0.1	0.2
33	50.5	45.9	34.2	33.5	50.6	46.1	0.1	0.2
34	49.3	44.7	34.6	33.9	49.5	45.1	0.2	0.4
35	49	44.4	35.5	34.8	49.2	44.9	0.2	0.5
36	51	46.5	35.4	34.7	51.2	46.8	0.2	0.3
37	51.2	46.6	34.1	33.5	51.3	46.8	0.1	0.2
38	48.6	44.1	38	37.2	49	44.9	0.4	0.8
39	47	42.4	40.5	39.9	47.9	44.3	0.9	1.9
40	60.1	55.5	31.4	30.8	60.1	55.5	0	0
41	59.2	54.6	33.9	33.4	59.2	54.7	0	0.1
42	51.2	46.7	33.9	33.3	51.3	46.8	0.1	0.1
43	54.8	50.3	35.3	34.7	54.9	50.4	0.1	0.1
44	54.9	50.4	38.7	38.2	55	50.6	0.1	0.2
45	53.6	49	38.2	37.6	53.7	49.3	0.1	0.3
46	49.5	45	43.2	42.8	50.4	47	0.9	2
47	51.9	47.3	38.8	38.3	52.1	47.8	0.2	0.5
48	54.1	49.6	37.7	37.2	54.2	49.8	0.1	0.2
49	51	46.5	38.4	37.9	51.2	47	0.2	0.5
50	49.2	44.7	41.4	40.9	49.9	46.2	0.7	1.5
51	46.8	42.2	46.6	46.2	49.7	47.7	2.9	5.5
52	47.7	43.1	45.3	44.9	49.6	47.1	1.9	4
53	49.2	44.7	39.6	39.2	49.6	45.7	0.4	1
54	48	43.4	39.6	39.2	48.6	44.8	0.6	1.4
55	49.9	45.4	34.7	34.3	50.1	45.7	0.2	0.3
56	49.4	44.8	35.8	35.5	49.6	45.3	0.2	0.5
57	40.4	35.8	34.4	33.9	41.3	38	0.9	2.2

APPENDIX D

Site Sensitivity Verification

SITE SENSITIVITY VERIFICATION (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

Part A of the Assessment Protocols published in GN 320 on 20 March 2020 (i.e. Site sensitivity verification is required where a specialist assessment is required but no specific assessment protocol has been prescribed) is applicable where the Department of Environment, Forestry and Fisheries Screening Tool has the relevant themes to verify.

In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool). The details of the specialist that visited the site are noted below:

Date of Site Visit	16 and 20 April 2018 (M. de Jager) 17 and 19 February 2021 (F. de Vries)
Specialist Name	Morné de Jager Francois de Vries
Professional Registration Number (if applicable)	Not applicable, there is no registration body in South Africa that could allow professional registration for acoustic consultants.
Specialist Affiliation / Company	Enviro-Acoustic Research CC

Output from National Environmental Screening Tool

The site was initially assessed using the National Environmental Screening tool, available at, https://screening.environment.gov.za. The online screening tool did identify most of the area to have a "very high" noise sensitivity.

Description on how the site sensitivity verification was undertaken

The site sensitivity was verified using:

a) the experience gained during previous site visits;
b) potential noise sensitive areas identified using the online screening tool; and
c) all potential dwellings were identified using the latest available aerial images.

Outcome of the Site Sensitivity Verification

Based on the available information, the areas identified as "very high" noise sensitive are a number of residential activities. As such a noise specialist study would be required for this project.

Signature
Morné de Jager
2021 – 04 – 21

End of Report