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Kudumane Manganese Resources Expansion Project: EIA Noise and Vibration Opinion Statement	
For: Kudumane Manganese Resources (Pty) Ltd	



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Executive Summary

Acusolv was tasked to provide an opinion statement regarding the potential environmental noise and vibration implications of the proposed KMR Expansion Project. To this end, a high-level desktop assessment was carried out to estimate the spatial extent of the potentially significant noise impact footprint and to identify inhabited areas or specific locations sensitized by and likely to be impacted by KMR noise.

The area surrounding the KMR operations is scarcely populated. The nearest residential area is Hotazel Town at a distance of approximately 2,5 km from the nearest centre of KMR mining activities (Kipling). The next nearest residential areas are Magobing and Magonajeng, both of which are located at a distance of more than 12 km from the KMR operations. High-level estimations indicate that the audible reach of noise from KMR operations at night, is less than 2 km.

Machinery and earthwork vibrations are of no material consequence to people in the surroundings of KMR operations. The only source of potentially significant vibration in mining operations is blasting, which is the subject of assessment to be undertaken by the blast specialist.

Based on the findings of this high-level assessment, it is concluded that the proposed KMR operations are unlikely to have any significant noise or vibration impacts on Hotazel, or any other residential areas or communities in the area. Against this background, a detailed noise impact study is not required for the Project.

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1 Introduction

1.1 Project Background

Kudumane Manganese Resources (Pty) Ltd (KMR) is situated approximately 3 km south-west of Hotazel Town within the John Taolo Gaetsewe District Municipality in the Northern Cape. A location map is shown in Figure 1-1.



Figure 1-1 KMR Location Map

KMR currently holds two Mining Rights; Mining Right NC/30/5/1/2/2/0268 MR covering the farms York A 279 and Telele 312 and Mining Right NC/ 30/5/1/2/2/10053 MR over the farms Devon 277, Hotazel 280 and Kipling 271. The mine is therefore managed under two Environmental Management Programmes (EMPRs), a Water Use Licence (WUL) and a WUL Amendment.

1.2 Proposed Expansions

KMR intends to expand its existing operations and construct additional infrastructure in order to improve production capacity. Infrastructure and activities associated with the proposed KMR Expansion Project requires a new Environmental Authorisation, the amendment of the

mine's existing EMPRs, a Waste Management Licence (WML) and a Water Use Licence application (WULA) to authorise the following key infrastructure:

- A new opencast pit mine on Kipling;
- Expansion of the Hotazel and York opencast pits to allow for the mining of KMRs boundary pillar associated with each pit; and
- Two attenuation dams on the Ga-Mogara River, to allow for the expansion of the York and Hotazel pits.

The above key infrastructure will have secondary infrastructure and activities associated with them, which includes:

- Establishment of an additional water storage tank near the proposed Kipling opencast pit operation, including a pipeline for the transfer of water between the proposed Kipling water storage tank and the existing Hotazel and York water storage tanks;
- Development and expansion of waste rock dumps at the proposed Kipling operation and the existing Hotazel operation;
- Establishment and expansion of ore stockpile dumps at the proposed Kipling operation and the existing Hotazel and York operations;
- A new haul road between the proposed Kipling operation and the existing Hotazel operation and upgrading of the existing haul roads between the Hotazel and York operations;
- Development and expansion of sewerage treatment plants at Kipling (new), Hotazel and York (Expansion);
- Supporting infrastructure such as admin offices and ancillary infrastructure on the farm Kipling;
- Waste and fuel storage areas;
- Relocation and development of new pollution control dams at York and Kipling operations;
- Upgrading of the intersection along the R380 before the R31 –the intersection used by KMR as haul truck transport entrance;
- Establishment of a Contractor's camp; and
- Extension of existing mine powerlines.

The proposed KMR Expansion Project layout is shown in Figure 1-2.

SRK Consulting (South Africa) (Pty) Ltd (SRK) was appointed by Kudumane Manganese Resources Pty Ltd (KMR) to undertake an integrated environmental authorisation process for the proposed KMR expansion project in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) and National Water Act, 1998 (Act No. 36 of 1998) (NWA).

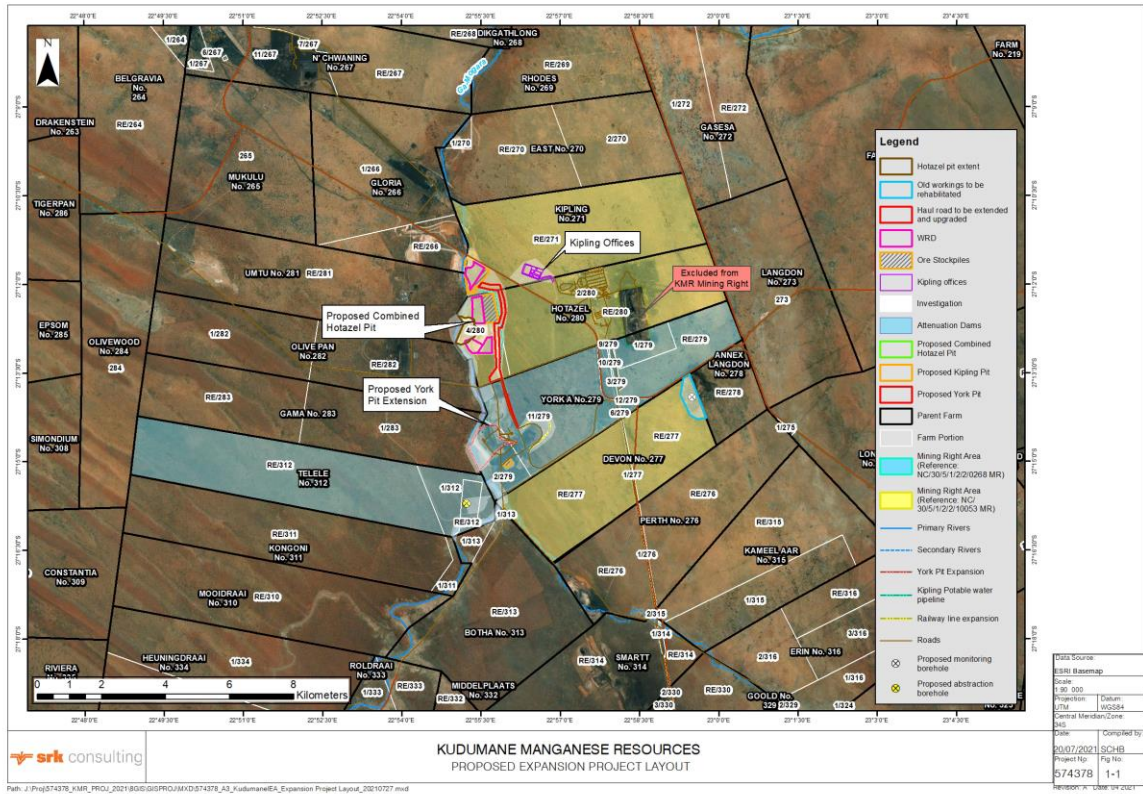


Figure 1-2 Proposed KMR Expansion Project layout

2 Noise and Vibration Assessment

2.1 Terms of Reference

Acusolv was appointed to provide an opinion statement regarding the potential environmental noise and vibration implications of the KMR Expansion Project. To this end, a high-level desktop assessment was carried out to estimate the spatial extent of the potentially significant noise impact footprint and to identify inhabited areas or specific locations sensitized by and likely to be impacted by KMR noise.

The brief is to investigate and assess the noise and vibration implications of the proposed project involving expansions of opencast operations at four pits, haulage and associated infrastructure.

2.2 Noise Specialist

2.2.1 Specialist Details

The KMR noise assessment was carried out, and this report compiled by Ben van Zyl, noise specialist in private practice based in Pretoria, South Africa. He holds masters and PhD degrees in acoustical engineering.

2.2.2 Experience

A fulltime career in acoustics since graduation afforded more than 40 years' experience in a wide range of acoustic disciplines. Experience in environmental acoustics stems from work while employed with the CSIR (Division of Applied Acoustics), Advena (SA Space Program) and SABS (Laboratory for Sound and Vibration). This was expanded in work as consulting engineer in private practice (Acusolv) since 1994. Throughout this career, experience accrued from basic and applied acoustics research work, development of new measurement techniques and instrumentation, participation in technical committees tasked with the development of national and international environmental noise standards, noise monitoring, noise modelling and assessment, as well as engineering design for noise control.

Acoustical engineering and other acoustical expertise are regularly applied in the development of hearing conservation programs, noise reduction strategies, noise problem solving and design for noise reduction. The latter involves design modification of existing equipment and design input in the development of new vehicles or equipment. Past projects involved a wide spectrum of vehicles and machinery including vibrating screens, overland conveyors, surface ventilation fans, dragline machine rooms, underground and surface mining equipment and locomotives. Examples of involvement in the development of low-noise locomotives are the new 15E Locomotive hauling freight on the Sishen-Saldanha iron ore line and the new 9E Locomotive hauling coal on the Ermelo-Richards Bay line.

Environmental noise assessments have been undertaken for a wide range of industrial and mining companies. In addition to South Africa, EIA noise studies have been undertaken for projects in countries such as Namibia, Zambia, the DRC, Madagascar and Sierra Leone.

2.3 Declaration of Independence

As a sole proprietor and independent noise specialist, Ben van Zyl has no commercial interest in KMR or the KMR Expansion Project, other than fair payment for specialist services rendered.

3 Methodology

3.1 Approach

To inform and prepare an opinion statement on the potential environmental noise and vibration implications of the KMR Expansion Project, a high-level desktop assessment based on map studies and explorative computations were carried out. No site visit was required and no detailed modelling was undertaken.

3.2 SANS 10328 Guidelines

South African Standard SANS 10328 [1] gives guidelines on procedures for conducting noise impact assessments. The process may entail one or more steps, not necessarily commencing at the lowest level. The purpose, scope, and levels¹ of assessment are defined below. In this context, the high-level KMR Project assessment and opinion statement in this report corresponds to Level 1.

Level 1 Screening Assessment (Applicable to the KMR Opinion Statement)

Carry out an administrative screening procedure and issue a report;

A screening assessment is a high-level, largely a desktop appraisal based on map studies to assess factors which may have an influence on the noise. The likelihood of significant impact implications is assessed by examining the relative positioning of sound sources and noise-sensitive areas. SANS 10328 lists situations which may require more detailed investigation. If there is a likelihood of significant impacts, a more detailed investigation is required, either in the form of a scoping assessment (Level 2), or a detailed noise impact study (Level 3).

Level 2 Scoping Assessment

Carry out a scoping assessment and issue a report;

A scoping assessment is also a high-level appraisal based on map studies and a site visit to identify sources of noise and noise-sensitive receptors and to assess topographical and other factors which may have an influence on the noise. Limited measurements may be taken at source and in the surroundings. Assessment is based on preliminary calculations to estimate approximate impacts. If there is a likelihood of significant impacts, a detailed noise impact study is required (Level 3).

The objective, procedure and the way forward would vary, depending on whether the assessment considers a future development, or implementation of a noise monitoring program at an existing operation.

Upon receipt of the scoping report, the relevant authority may in consultation with interested and affected parties, decide:

¹ The standard only numbers the levels of assessment without using any ranking term such as "Level" or "Stage".

(a) That the information is sufficient for consideration of the application without further investigation;

or

(b) That a more detailed scoping or exhaustive environmental noise impact investigation is needed to assess the impact of the activity involved.

Level 3 Detailed Noise Study (Applicable to future KMR full EIA)

Carry out an environmental noise impact assessment and issue a report;

This is a detailed noise study. In the case of new developments, it involves field surveys to measure existing noise levels, noise modeling and prediction of future noise levels and impacts.

In the case of existing operations, it would depend on the objectives defined for the study. It may in some cases involve the implementation of a noise monitoring program only, with monitoring locations and the scope of the monitoring program determined in the Level 2 scoping study.

3.3 Assessment Methodology

The methodology and steps followed in the high-level assessment were as follows:

- (a) Identify the main sources of noise created by KMR operations.
- (b) Use simplified exploratory computations and archived noise emission data for similar operations to derive an estimate of the extent of the potentially significant noise footprints of KMR operations with the proposed expansions implemented.
- (c) Identify areas or specific locations sensitized by noise from KMR operations. An area or location is sensitized if it is located within the estimated significant impact footprint determined in (b).
- (d) Create and use an audible noise footprint map to assess the likelihood of significant noise impacts and the implications for people living in the area.

4 Legal Framework

4.1 South African Noise Regulations

In assessing noise impact and setting design targets in in this project, the provisions of the National Noise Regulations [2] and the principles, guidelines, and criteria of SANS 10103 [3] were taken into consideration.

4.1.1 Prohibitions in terms of Noise Regulations

Prohibition of Disturbing Noise

In accordance with international and South African standard practice, noise impact assessments are made with respect to outdoor noise levels. Noise regulations prohibit any changes to existing facilities, or uses of land, or buildings or the erection of new buildings, if it houses activities that will cause a disturbing noise, unless precautionary measures to prevent disturbing noises have been taken to the satisfaction of the local authority. Noise is deemed to be disturbing if it exceeds certain limits. Depending on what data is available, SANS 10103 allows for different formulations of the excess.

If the actual residual ambient level is known: The excess is taken to be the difference between the noise under investigation and the residual noise measured in the absence of the specific noise under investigation. This definition, based on the *noise emergence criterion*, finds application in both predictive and noise monitoring assessments, if baseline noise data is available.

If the actual residual ambient level is unknown: Alternatively, the excess may also be defined as the difference between the ambient noise under investigation and the acceptable ambient rating for the type of district under consideration in accordance with SANS 10103. This definition, based on the *acceptable level criterion*, is employed in predictive noise studies and in noise monitoring assessments, if there is no baseline data available or if an existing source of intrusive noise cannot be switched off for purposes of measuring the residual background level.

In terms of National Noise Regulations, a disturbing noise means a noise that causes the ambient sound level to increase by 7 dB or more above the designated zone level, or if no zone level has been designated, the ambient sound level measured at the same point. Noise regulations also require that the measurement and assessment of ambient noise comply with the guidelines of SANS 10103.

It should be cautioned, however, that the legal limit of 7 dB should not be construed as the upper limit of acceptability. SANS 10103 (See Table 4-1 in this report) warns that an increase of 5 dB is already significant and that an increase of 7 dB can be expected to evoke widespread complaints from the community. Hence, although the mine would be within legal limits if the noise impact is prevented from exceeding 7 dB, that would not prevent the occurrence of noise disturbance and complaints about the noise. In the EIA phase, i.e., in the design and planning stage of a new development, it is advised that the target be set to limit the impact to 3 dB or less, with 5 dB considered to be a significant impact.

Prohibition of a Noise Nuisance

Noise regulations also prohibit the creation of a noise nuisance, defined as any sound which disturbs, or impairs the convenience or piece of any person. The intent of this clause is to make provision for the control of types of noise not satisfactorily covered by measurement and assessment criteria applicable to disturbing noises. These are noises which are either difficult to capture, or noises for which the readings registered on sound level meters do not correlate satisfactorily with the annoyance it causes, when assessed against standard criteria. Noise regulations list specific activities which are prohibited if exercised in a manner to cause a noise nuisance, such as:

- The playing of musical instruments and amplified music;
- Allowing an animal to cause a noise nuisance.
- Discharging fireworks;
- Discharge of explosive devices, firearms or similar devices which emit impulsive sound, except with the prior consent in writing of the local authority concerned and subject to conditions as the local authority may deem necessary;
- Load, unload, open, shut or in any other way handle a crate, box, container, building material, rubbish container or any other article, or allow it to be loaded, unloaded, opened, shut or handled, (if this may cause a noise nuisance).
- Drive a vehicle on a public road in such a manner that it may cause a noise nuisance.
- Use any power tool or power equipment used for construction work, drilling or demolition work in or near a residential area, (if this may cause a noise nuisance).
- Except in an emergency, emit a sound, or allow a sound to be emitted, by means of a bell, carillon, siren, hooter, static alarm, whistle, loudspeaker or similar device (if it may cause a noise nuisance).
- One or more of these activities may occur on industrial sites and in project activities. Potential sources of noise at the Klipkraal Shaft which may cause a noise nuisance, are the tonal component corresponding to fan blade passing frequency and motor hum.

The essential difference between a disturbing noise and a noise nuisance is as follows:

Noise Disturbance – Is quantifiable and its assessment is based on estimated or measured sound levels, expressed in decibel (dBA). Investigation and assessment of existing noise disturbance problems involve the measurement of ambient levels in the presence of a specific source under investigation and comparison of this level with either the level measured in the absence of the source, or a table value deemed to be an acceptable level for the type of district under consideration.

Noise Nuisance – Is difficult to quantify and is not confirmed or assessed by measurement. Judging whether a noise qualifies as a nuisance is based purely on its character and audibility, in conjunction with subjective considerations such as the perceived intent of the noise maker and connotations attributable to the source of noise. Where measurement is possible, measured data may serve as supplementary information.

4.1.2 SANS 10103

As mentioned before, noise regulations require that the measurement and assessment of noise comply with the guidelines of in SANS 10103. The concept of noise nuisance, however, only features in the regulations. SANS 10103 only deals with quantifiable noise (noise disturbance), without any guidelines for, or reference to noise nuisance.

It is normally expected of EIA noise studies as well as EMP surveys to make findings based on quantitative assessment of predicted or actual noise levels, i.e. based on noise disturbance considerations. But once an industrial site or mine starts operating, predictable as well as unexpected sources of noise nuisance may emerge. If present, they often constitute a major cause of complaints. It is therefore imperative that, in addition to quantitative predictions and measurements, noise studies and monitoring surveys also identify potential and actual sources of noise nuisance.

4.1.3 SANS 10103 - Acceptable Ambient Levels

Noise regulations require that the rating level of the ambient noise be compared with the rating level of the residual noise (where this can be measured), or alternatively (where the noise source cannot be switched off or interrupted), with the appropriate rating level given in Table 2 of SANS 10103. Neither the noise regulations, nor SANS 10103 define or refer to the term noise impact. It is however generally understood and defined for purposes of this assessment, as the amount in dB by which the total noise level exceeds the nominal or the measured ambient level rating, whichever is applicable, for the area under consideration.

Table 4-1 summarises SANS 10103 criteria for acceptable ambient levels in various districts. Note that ratings increase in steps of 5 dB from one to the next higher category and that, in general, regardless of the type of district, ambient noise levels tend to decline by typically 10 dB from daytime to night-time. It follows that, for the same level of intrusive noise, the noise impact would typically increase by 10 dB from daytime to night-time.

Table 4-1 Typical outdoor ambient noise levels in various districts (SANS 10103)

District		Daytime	Night-time
(a)	Rural	45	35
(b)	Suburban – With little road traffic	50	40
(c)	Urban	55	45
(d)	Urban - With workshops, business premises & main roads	60	50
(e)	Central business districts	65	55
(f)	Industrial districts	70	60

A 24-hour cycle is divided into the following periods:

Daytime (06:00 – 22:00)

Night-time (22:00 – 06:00)

SANS 10103 also gives guidelines in respect of expected community response to different levels of noise impact (increase in noise level), as summarized in Table 4-2.

Table 4-2 Expected community response to an increase in ambient noise level (SANS 10103)

Increase in Ambient Level [dB]	Expected Community Reaction
0 - 10	Sporadic complaints
5 - 15	Widespread complaints
10 - 20	Threats of community action
More than 15	Vigorous community action

5 Baseline Assessment

5.1 Noise Assessment Area

The focus in this high-level desktop assessment is the project area and surroundings shown on the map in Figure 6-1. This area includes the Project and noise receptors potentially located within estimated reach of audible Project activity noises.

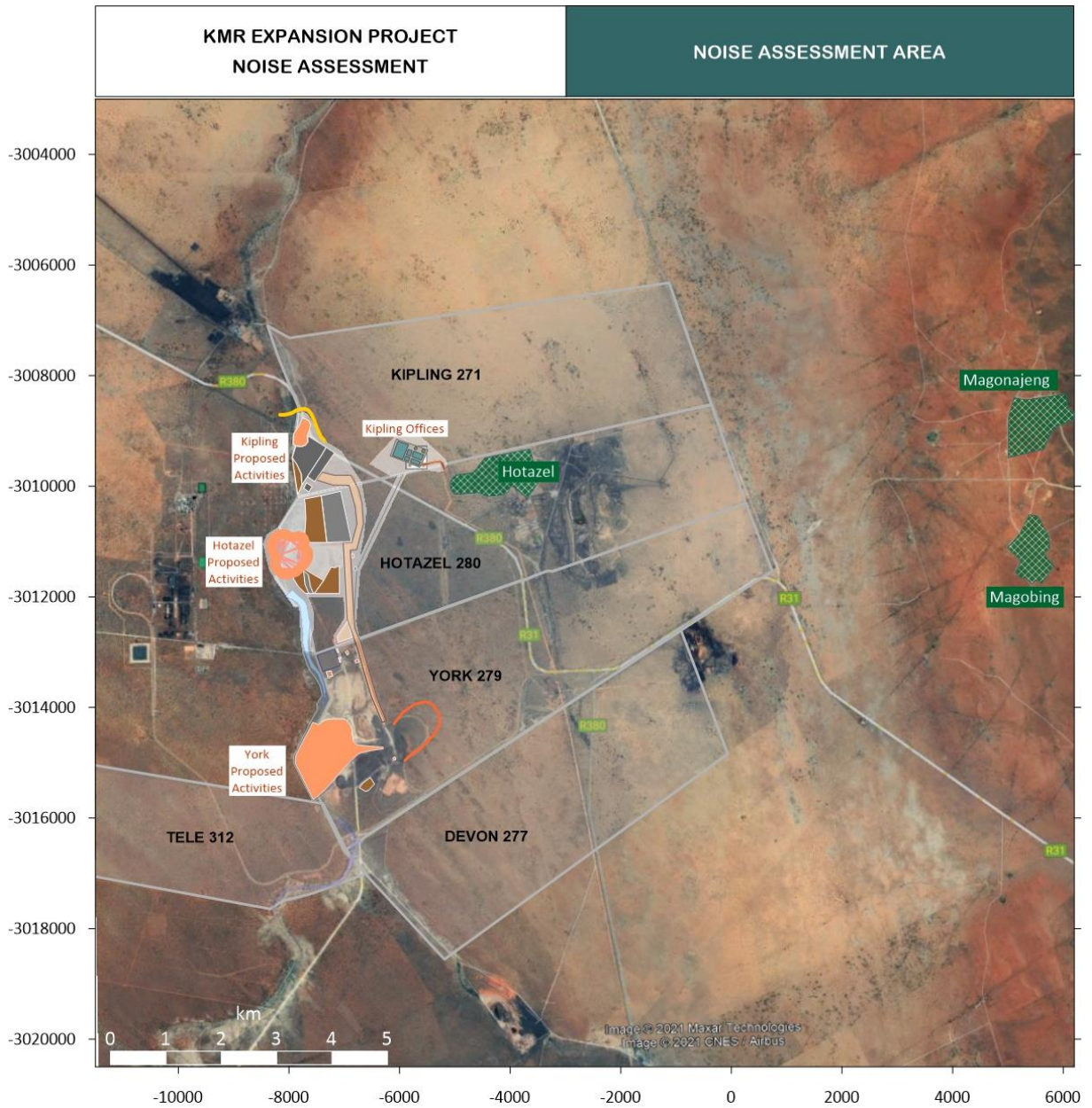


Figure 6-1 KMR Expansion Project noise assessment area

5.2 Character and Current Levels of Noise in the Area

5.2.1 Baseline Levels - High-level Assessment

SANS 10103 Guidelines

For purposes of high-level desktop assessment, a good indication of ambient noise levels to be expected in an area can be obtained by application of SANS 10103 guidelines and consideration of land-use, population density, road infrastructure and traffic volume profiles.

SANS 10103 provides guidelines (Table 4-1) for estimation of typical or expected ambient levels in various districts, ranging from rural to central business districts (CBD's). The table gives typical levels for ambient noise averaged over daytime (06:00 – 22:00) and night-time (022:00 - 06:00) periods. Ratings increase in steps of 5 dB from one to the next higher district category. In general, regardless of the type of district, ambient noise levels tend to drop by typically 10 dB from daytime to night-time.

Baseline Ratings for the KMR Assessment Area based on SANS 10103 Guidelines

The proposed KMR Expansion Project is located in a rural district interspersed with mining operations. Depending on the distance from the nearest main roads and mining operations, ambient noise in the assessment area vary. Hotazel, the nearest and only town potentially within audible range of KMR operations, is characteristically urban with little road traffic (Table 4-1). Elsewhere, most of the area has a rural to semi-rural character determined mainly by natural sounds with low background noise levels. According to SANS 10103 guidelines, typical daytime and night-time levels in the noise assessment area are as summarised in Table 5-1.

Table 5-1 Typical ambient noise levels in the noise assessment area

Noise Assessment Area	SANS 10103 Guideline		
	District	Typical Ambient Levels	
		Daytime	Night-time
Hotazel outlying areas	Rural to semi-rural	45 - 50	35 - 40
Hotazel Town	Suburban – With little road traffic	50	40

5.2.2 Information from Previous Assessments

Baseline Ratings derived by SRL in 2014

In an assessment by SLR in 2014 [4], ambient noise was measured and existing conditions investigated at three locations. One location was in Hotazel Town. A second location was at Langdon near a dormant mining area. This area, intersected by the R31 provincial road, is semi-rural in character. The third location was in the Devon/Tele area which is mostly rural. Baseline ratings derived by SRL from the field measurements and investigations, are

summarised in Table 5-2. These results are in agreement with the ratings derived in the current desktop assessment (Table 5-1).

Table 5-2 Baseline Ratings derived by SRL in 2014

Noise Assessment Area	SANS 10103 Guideline		
	District	Typical Ambient Levels	
		Daytime	Night-time
Hotazel	Suburban – With little road traffic	50	40
Langdon	Rural	45	35
Devon/Tele	Rural	45	35

6 High-Level Impact Assessment

6.1 Vibration

Machinery and earthwork vibrations are of no material consequence to people in the surroundings of KMR operations. Vibrations caused by machinery, excavation, dozing or by any other earth-moving equipment operations, are generally only significant on the equipment itself and in a localised area on the site or inside plant buildings (in the workplace). Vibration induced by such equipment into and propagated through the earth (ground-borne machine vibration), is rapidly attenuated to negligible levels even before it reaches the site boundaries. Compared to airborne noise, the vibration footprint of mining operations is entirely negligible. For all practical purposes, the scope of the noise and vibration assessment and the risk of vibration impacts are covered by the results and findings of the air-borne noise impact assessment concluded in this study.

The only source of potentially significant vibration in mining operations is blasting, which is the subject of assessment to be undertaken by the blast specialist.

6.2 Air-borne Noise

6.2.1 KMR Sources of Noise

As explained in Section 4-2, the noise sensitivity analysis in the KMR Expansion assessment was made by taking both the existing ambient levels and broad estimates of the expected noise footprints of KMR Expansion operations and activities into account. Centres of operation from which noise will emanate, are:

- Opencast in-pit and associated surface operations around the new pit on Kipling, and at the expanded Hotazel and York pits;
- Operations on the expanded waste rock dumps at the proposed Kipling operation and at the existing Hotazel operation;
- Operations on the expanded ore stockpile dumps at the proposed Kipling operation and at the existing Hotazel and York operations;
- Hauling operations on the new haul road between the proposed Kipling operation and the existing Hotazel operation and on the existing (to be upgraded) haul roads between the Hotazel and York operations.

The layout of operations and the locations of potentially significant noise-generating activities and infrastructure are shown on the map in Figure 6-1.

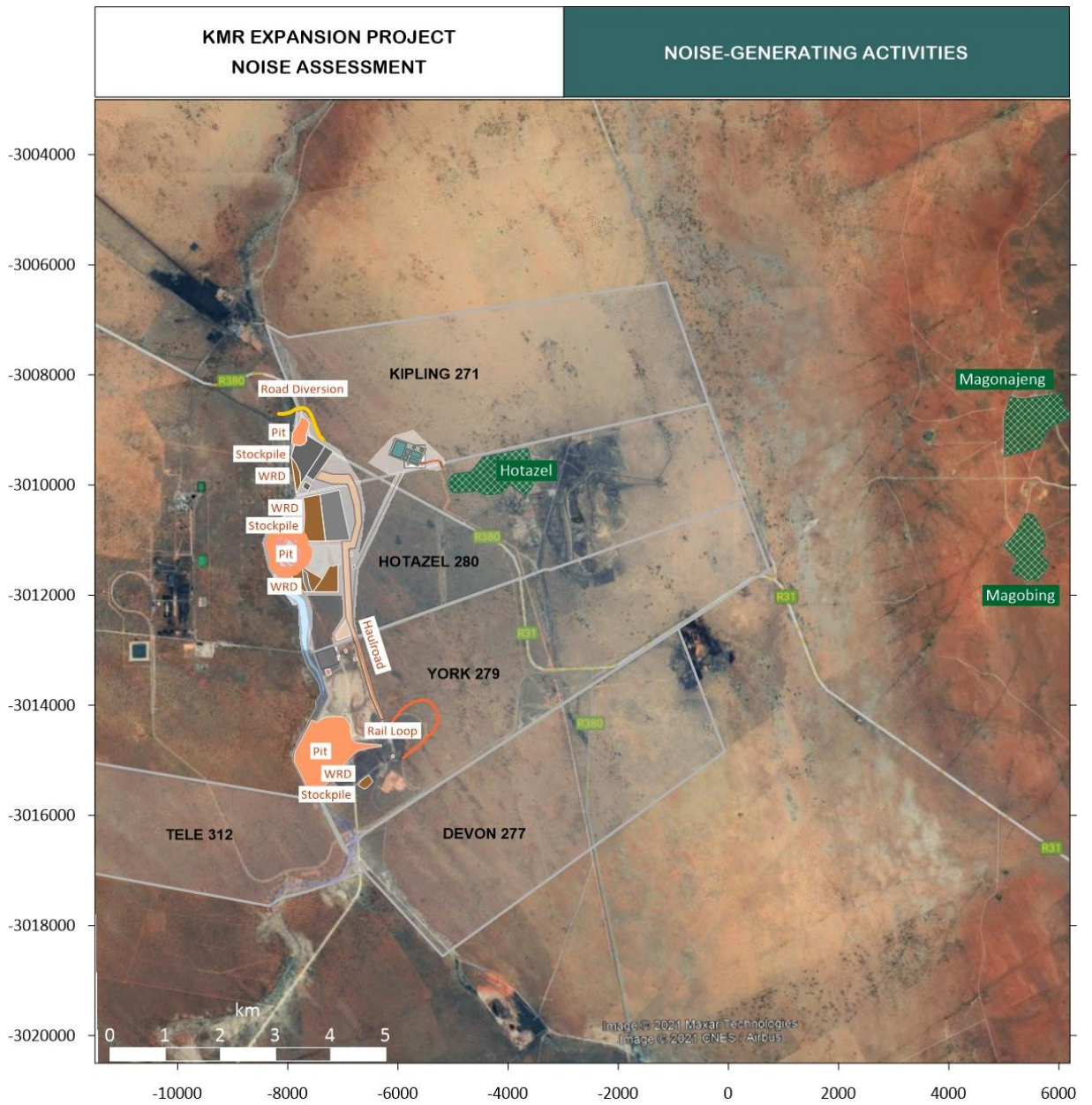


Figure 6-1 Noise-generating activities and infrastructure

6.2.2 KMR Noise Footprint

Ballpark estimates of Project noise footprints were derived by high-level computations, using archived noise emission data for the type of noise sources entailed by the proposed expanded KMR operations. Table 6-1 summarises typical audible reaches for these sources, estimated for neutral weather conditions at night in rural and semi-rural areas with little road traffic. These estimations are realistic and substantiated by knowledge gained from previous field surveys and modelling of similar operations.

Table 6-1 Typical ranges of influence. Distances over which noise from various noise-generating mining activities and associated infrastructure will be audible at night in rural and semi-rural areas.

Operation	Audible Range	
	Distance	Audible noises
Opencast – In-pit operations	500 m	Engine, drilling, excavation, dozing
Opencast – Surface operations	1500 m	Engine, dozing, truck movements
Waste Dump operations	1 900 m	Engine, dumping, dozing, truck movement
Stockpile operations	600 m	Piling, front-end loader, engine
Haul roads	1000 m	Engine, truck movements, bucket noises
Reverse alarms	1 500 m	Beeping (noise nuisance)

The most noise-sensitive time in any non-industrial urban or rural district is at night when the general ambient noise level characteristically drops to its lowest level. A 24-hour operation will therefore have maximum noise impact at night; not only because the noise output remains constant, but also because atmospheric sound propagation at night tends to diffract sound earthwards, rather than skywards as typically occurs during the day. This results in higher levels and higher impacts at night.

The estimated night-time audible noise footprint of all KMR mining operations collectively, is shown on the map in Figure 6-2. The contour delineates the distance beyond which noise from KMR operations is expected to drop to a level below 40 dBA, which is the typical night-time background ambient level in semi-rural districts. By implication, the audible footprint also signifies the potential significant impact range or footprint of KMR operations following implementation of the proposed expansions.

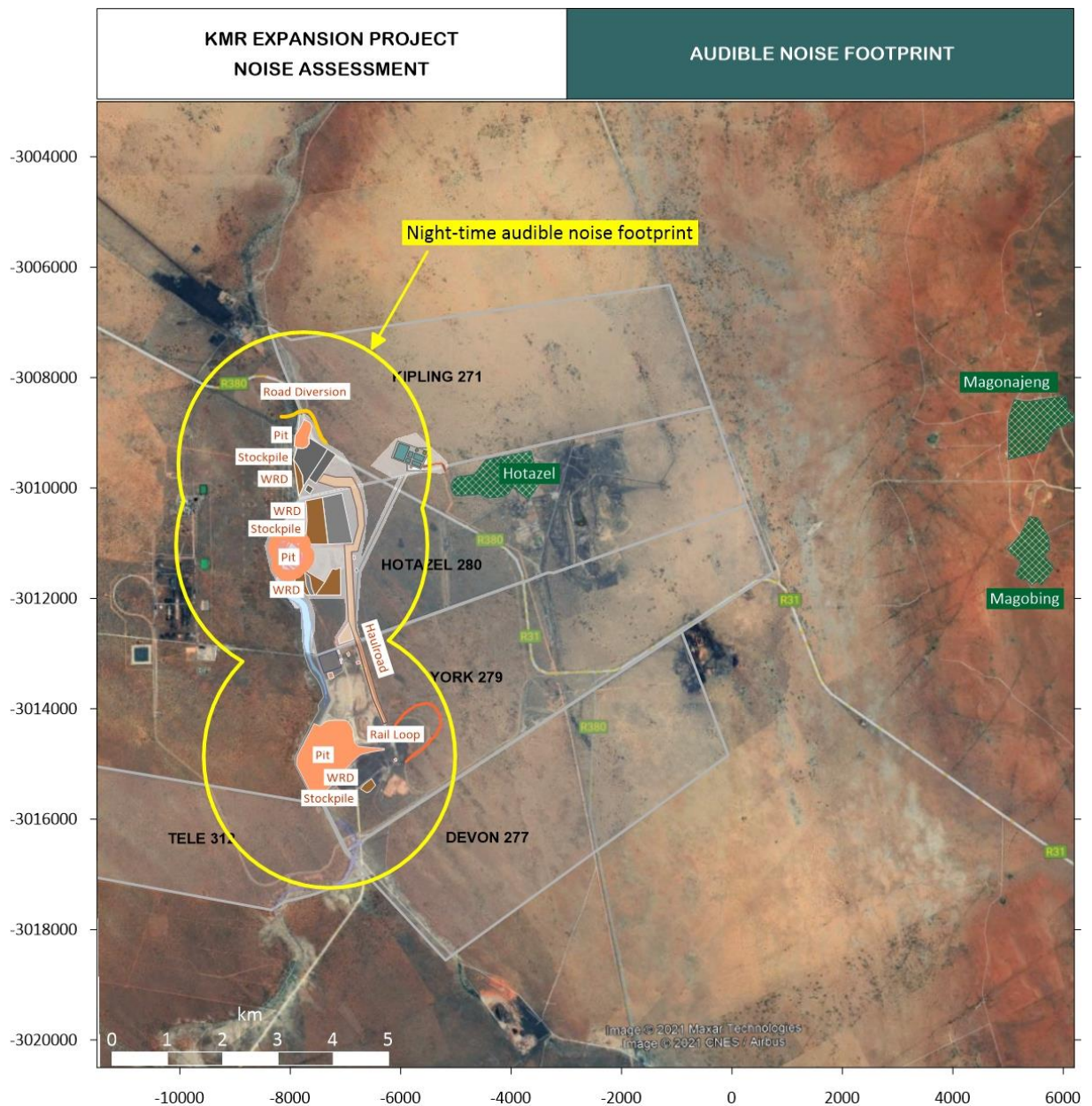


Figure 6-2 Estimated night-time audible noise footprint of KMR mining operations

6.3 Finding – Likelihood of Significant impacts

The areas surrounding the KMR operations are scarcely populated. The nearest residential area is Hotazel Town at a distance of approximately 2,5 km from the nearest centre of KMR mining activities (Kipling). The next nearest residential areas are Magobing and Magonajeng, both of which are located at a distance of more than 12 km from KMR operations. It is clear from examination of Figure 6-2 that none of these communities are within audible reach of KMR mining noise.

Based on the findings of this high-level assessment, it is concluded that the proposed KMR operations are unlikely to have any significant noise impacts, or vibration impacts (see Section 6.1) on Hotazel, or any other residential areas or communities in the area. Against this background, a detailed noise impact study is not required for the Project.

7 References

- [1] SANS 10328: Methods for environmental noise impact assessments.
- [2] Department of environment affairs: Noise control regulations under the environment conservation act, (Act No. 73 of 1989), Government Gazette No. 15423, 14 January 1994.
- [3] SANS 10103: The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication.
- [4] SLR: Kudumane Manganese Resources, Hotazel Operations, Hotazel, Noise Assessment & EMP for Noise, SRL Ref No 4ZA.03758.00013, August 2014.