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Turquoise Moon	Report G909-R1
Moonlight Iron Ore Project	
Noise Study for Environmental Impact Assessment	
For: Turquoise Moon Trading 157 (Pty) Ltd	Revised: 28-Jun-2011

Declaration of independence

I am a single proprietor, independent acoustic consulting engineer. I have no commercial interest in Turquoise Moon Trading 157 (Pty) Ltd (Turquoise Moon), or the above-mentioned project.

A personal curriculum vitae in support of my qualifications, expertise and experience to undertake studies of this nature, is attached in Appendix B of this report.

Executive Summary

This report presents the results of a specialist noise study that was carried in support of a comprehensive Environmental Impact Assessment of the proposed Turquoise Moon Project conducted by Metago Environmental Engineers (Pty) Ltd (Metago). The study finds that the mining operation will have a significant noise impact on surrounding farms up to distance of 5 km from the mine centre. The main sources of potentially disturbing noise are the plant, open cast operations, waste rock dump operations, road transport and blasting. Although also included in the calculation of noise contours, small sources of noise (such as the TMF pumps) will not be audible above plant noise. A potential cause of noise nuisance is the noise produced by reverse alarms and by truck hooters on waste dumps and transport routes.

The noise impact of the project can be reduced to a limited though significant extent. It is possible to mitigate the impact of plant noise to a degree by installation of custom designed noise screens on processing units. The mine is advised to instruct drivers and fleet owners of trucks to use hooters in a disciplined manner for purposes of safety only, not for signalling or any other purpose. The mine should be very strict in enforcing this rule and should verify compliance. Annoyance caused by reverse alarms can be mitigated by replacing standard fit conventional beeping type alarms with buzzer types. No mitigation of road noise is necessary if the pipeline transport option is implemented.

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1 Introduction

1.1 Location and description of the proposed activity

Turquoise Moon Trading 157 (Pty) Ltd (Turquoise Moon) has mining-related interests, near Lephalale (Ellisras), in the Limpopo Province. The iron ore prospect covers an area referred to as the Moonlight project area comprising the farms Moonlight 111LR, Gouda Fontein 76LR and Julietta 112LR. It is located along the N11 between Mokopane (Potgietersrus) and the Botswana border, near to the town of Marnitz, and approximately 60 km north and 145 km north-west of Lephalale (Ellisras) and Polokwane, respectively.

Turquoise Moon intends to develop an iron ore mine in the Moonlight area at the regional setting shown in Figure 1.1.

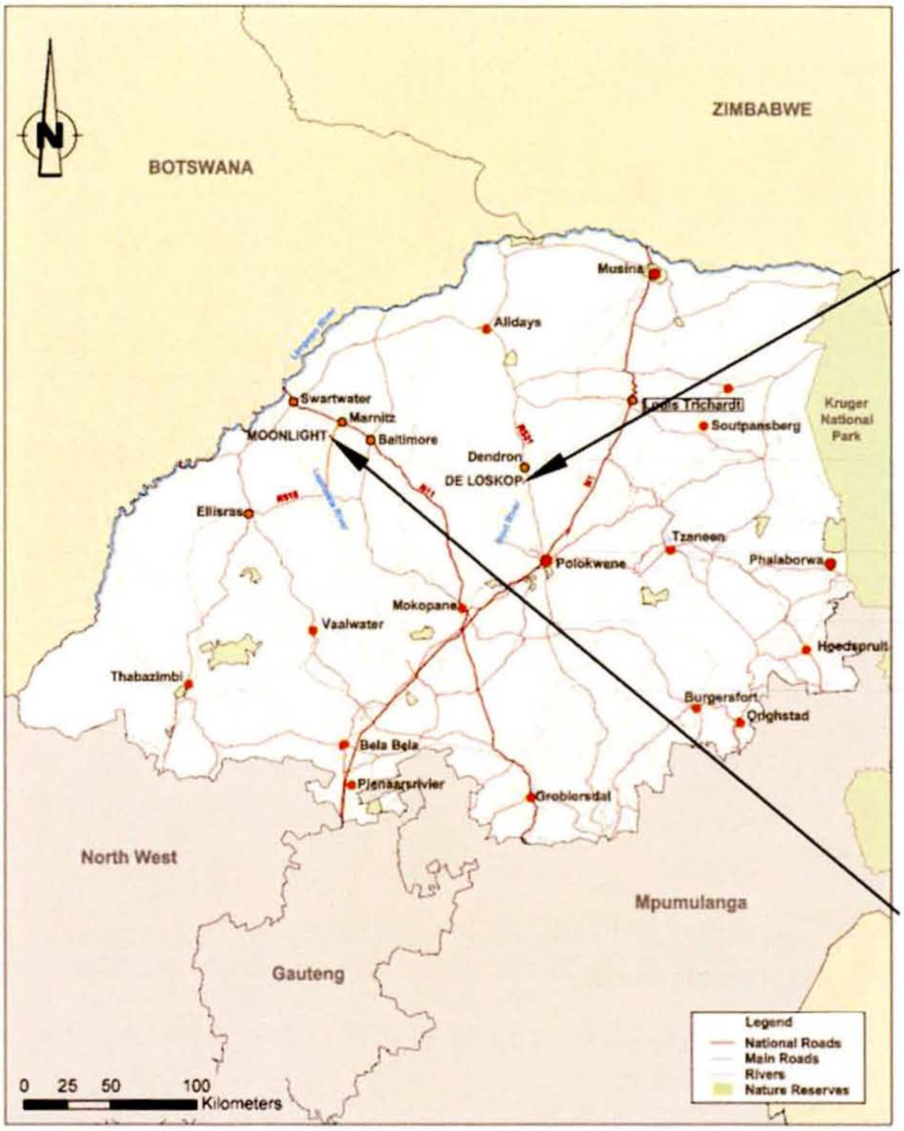


Figure 1.1

Regional Setting of the Moonlight Iron Ore Project

The project aims to establish an iron ore mine and processing plant at the Moonlight project site. This will entail the establishment of an open pit mining area and associated overburden/waste rock stockpiles, a beneficiation plant and associated tailings disposal facility, water management facilities and various support infrastructure and services. The design life of the project is 30 years.

1.2 Terms of reference and scope of work

Acusolv was appointed by Metago as an independent specialist to conduct a noise study with the aim to investigate the potential noise impact of the proposed Moonlight development on the surrounding area. Where applicable, the requirements and options for mitigation had to be considered. Figure 1.2 shows the local setting of the Moonlight project.

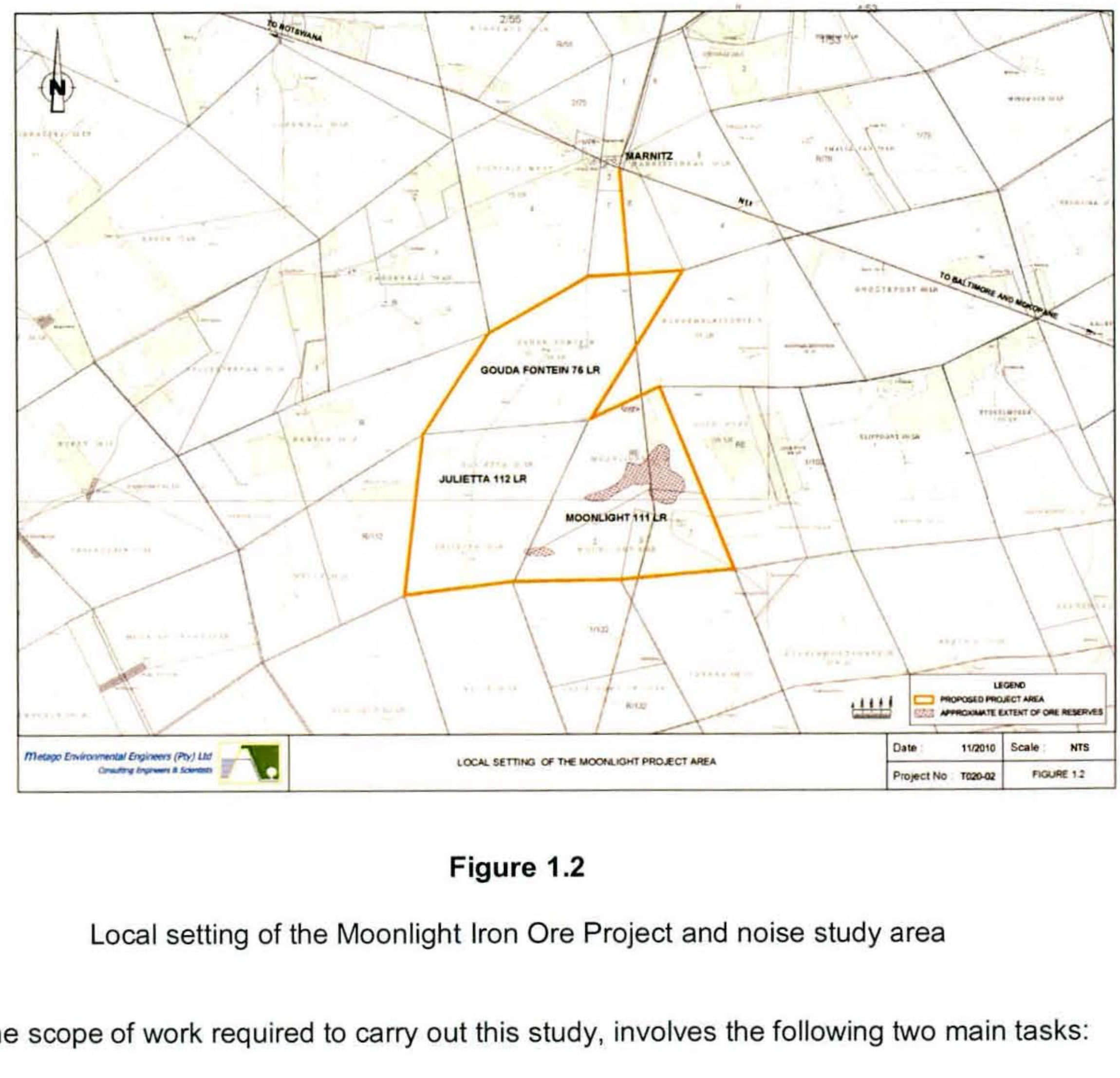


Figure 1.2

Local setting of the Moonlight Iron Ore Project and noise study area

The scope of work required to carry out this study, involves the following two main tasks:

Scoping and baseline study

Carry out a physical scoping and a measurement survey to assess the nature of the existing noise environment and to determine typical existing, i.e. predevelopment outdoor ambient sound levels in the area.

Predictive noise impact study

Carry out a study in which the expected impact of the development is quantified and assessed by means of computer modeling of the emission and atmospheric propagation of noise expected to be generated by mining-related surface operations.

This report presents the results of the baseline ambient survey and of the predictive noise study in support of the Environmental Impact Assessment (EIA) conducted by Metago.

2 Methodology

2.1 Guidelines

The Moonlight Project noise study was carried out in accordance with SANS 10328 [1], a South African Standard presenting guidelines on procedures for conducting noise assessments.

2.2 Baseline Study

2.2.1 Baseline survey – Methodology

Selection of noise monitoring locations

Criteria and practical considerations which influence the selection of suitable locations for noise monitoring, include the following:

- **Community concerns:** In selecting locations for noise monitoring, concerns raised by interested and affected parties should be taken into account.
- **Worst-case impact:** Focus on areas where maximum noise impact is expected.
- **Suitability for future surveys:** As far possible, select locations likely to be accessible in future surveys.
- **Avoid interference:** As far as practically possible, stay clear of and avoid interference by localised noise sources which may distort the data. Examples are power distribution boxes, barking dogs, speech interference by curious visitors and insects in close proximity of the microphone.
- **Equipment safety:** Measurement procedure, integration periods and sample size depend on the availability of facilities for safeguarding equipment. Long duration samples are only possible at locations where facilities are available to lock away recording equipment connected via a cable to a microphone positioned outdoors at a point clear of vertical reflecting surfaces and protected from the elements.

Meteorological considerations

Outdoor noise measurement is not permitted under certain weather conditions. Rain, drizzle or fog affects the conductivity of measurement microphones, resulting in faulty readings. It may also damage the microphone and measuring equipment. Secondly, although measurements often have to be performed in the presence of wind, care should be taken to verify that wind turbulence noise on the microphone capsule is negligible compared to the sound level under investigation. There is no fixed upper limit for permissible wind speed, it all depends on the level being measured. Another weather phenomenon which may cause interference and spoil measurement data, is thunder.

Meteorological conditions also affect the acoustic environment and the actual sound levels without causing interference or measurement error. Normal fluctuations in atmospheric conditions may cause large variations in noise level which cannot and should not be avoided in the planning and execution of noise monitoring surveys. These variations constitute the natural variance in both background and intrusive noise levels. Noise levels at a distance from large sources are highly dependent on meteorological conditions. In fact, the difference in characteristic day and night meteorological patterns is one reason why 24-hour mining or industrial operations always have much greater noise impacts at night[1].

It should be noted that, for the reasons explained above, the monitoring of meteorological conditions, such as temperature, wind and humidity on the ground can at best only serve to avoid errors and distortion of measurement data. Knowledge of cloud cover, temperature, humidity and wind which prevailed during the course of a noise survey has little if any value in the post-processing and interpretation of data.

Sampling considerations

To be of any use as an environmental management tool, noise monitoring has to produce accurate and relevant data. As a minimum requirement, measurement grade instrumentation should be used and tests performed with the necessary precision and accuracy, as laid down in SANS 10103 [2]. Just as important, no matter how accurate the measurements, the data is only as good as the sample. What complicates noise sampling, is that ambient noise is all but constant. As a rule, it is the net result of contributions from various constant, cyclic and randomly fluctuating sources.

To account for the intrinsic 24-hour cyclic variation, measurements should be taken within the relevant period of interest, e.g. daytime, night-time or a 24-hour cycle. Noise regulations require that the noise investigated must be measured (averaged) over a period of at least 10 minutes; i.e. 10 minutes or longer. Occasionally, in the investigation of noise complaints, a 10 minute sample may be sufficient to obtain the data needed to make a finding. For purposes of predictive noise studies and monitoring surveys, however, much longer averaging periods are required to determine baseline or operational noise levels. Noise levels have to be averaged over periods long enough to ensure that the sample is representative of the true average.

Where this is possible, in addition to measuring the average over the day or night-time period of interest, equipment may be programmed to simultaneously determine averages in a contiguous series of short sub-intervals of say 10-minute, 30-minute, or 1 hour duration, covering the main survey period. In this way, a picture can be obtained of the noise pattern over that period. For practical reasons, it is often not possible to attend measurements for the full duration of such long recordings.

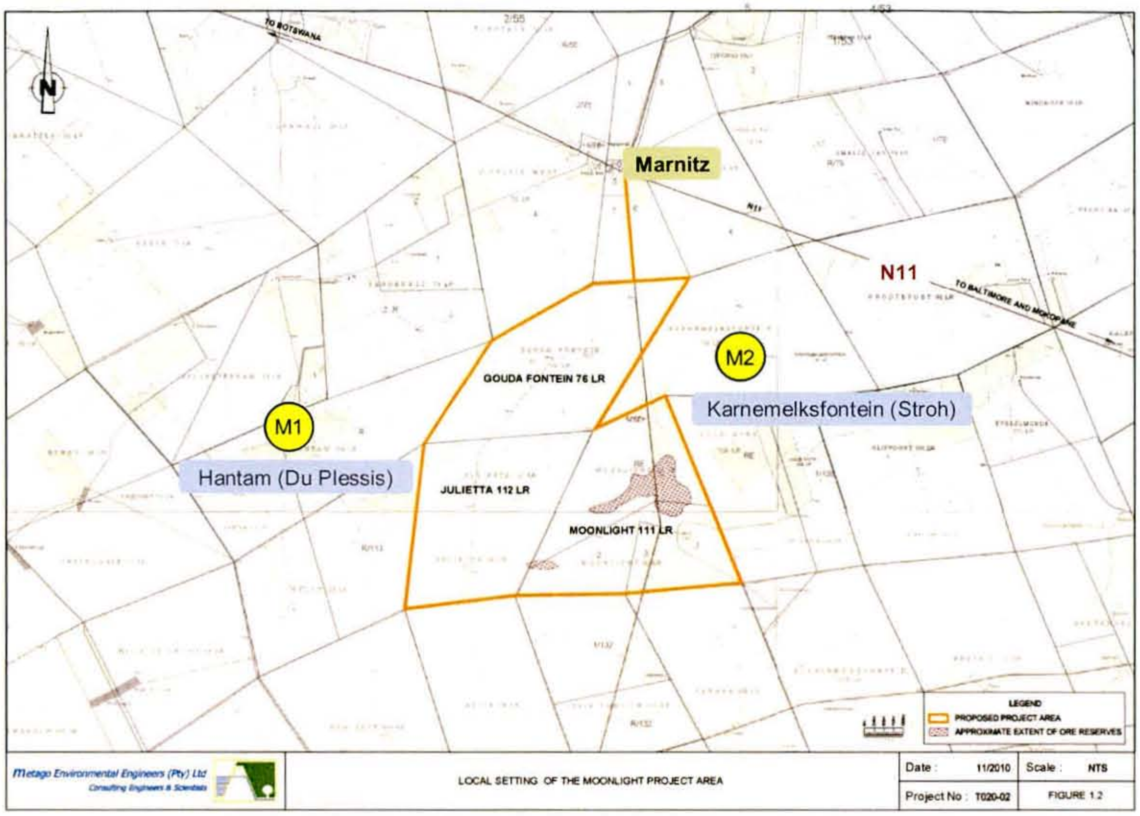
2.2.2 Baseline survey - The Moonlight study

Field surveys

Scoping investigations and measurement surveys were carried during the period 18-Apr-2011 to 19-Apr-2011. Calibrated equipment was set up to measure the outdoor ambient noise level at two locations selected on properties bordering the mining area. Figure 2.1 and the included table identify the locations selected for ambient noise monitoring.

Equipment was programmed to measure averages in sequences of 10-minute intervals covering several hours of daytime and a full 8-hour night-time period. A-weighted, equivalent continuous sound pressure levels L_{Aeq} (dBA) were measured, using an integrating sound analyser. At the same time, for purposes of identifying sources of noise, audio recordings synchronised with the data recordings were made at each monitoring point.

1 *Another contributing factor is increased community sensitivity at night due to a natural decline in road traffic and human activity noise.*



Monitoring Point	Position	Receptor / Area
M1	S23 13.602 E28 07.728	Farm house on farm Hantam (Du Plessis)
M2	S23 12.790 E28 14.665	Farm house on farm Karnemelksfontein (Stroh)

Figure 2.1

Noise monitoring locations

Assessment

Although measurements covered daytime periods as well, when considering noise impact, it is for all practical purposes only the night-time results that matter. Night-time, when people are normally sleeping, is when the environment is by far the most sensitive to intrusive noise and when maximum impact is experienced. Hence, in the assessment of noise, the focus is on night-time conditions.

Measurement data was processed to obtain a time history of ambient noise levels. Using the audio recordings, it was possible to listen to the actual noises which occurred at any time, to identify sources of noise and to correlate audible noise events with data.

2.2.3 Instrumentation

Noise level measurements

Field measurements were carried out using the following equipment:

(a) Brüel & Kjaer Type 2260 Modular Precision Sound Analyser (Ser no. 1875497)

(b) Brüel & Kjaer Type 2260 Modular Precision Sound Analyser (Ser no. 1823652)

(c) Brüel & Kjaer Type 4231 Sound Calibrator (Ser no. 2606011)

Equipment conformed to IEC 61672-1 Electro-Acoustics – Sound Level Meters – Part 1: Specifications.

Calibration:

- M& N Calibration Services Certificates No's 2010-1164 & 2010-1165
- National Metrology Institute of SA Certificate No AV/AS-4016-R
- National Metrology Institute of SA Certificate No AV/AS-4021-R

Audio recording equipment

(a) Olympus LS11 PCM Digital Recorder (Ser no. 200109647)

(b) Olympus LS11 PCM Digital Recorder (Ser no. 200114547)

2.3 Predictive noise impact study

2.3.1 Noise modelling

Estimates of future noise levels to be generated by the development in the study area were derived with the aid of a model simulating noise emission from all major noise-generating components and activities of the development. To this end, it was required to quantify the acoustic emission (sound power) levels, as well as the frequency and directional characteristics of individual or groups of sources. This data was available from measurement data obtained in previous noise studies and from in-house noise data archives.

Calculation of geometric dispersion and atmospheric propagation of noise is broadly based on the principles of the Concawe method SANS ARP 014 [3], extended to deal with more complex source configurations, as well as to simulate the effect of wind.

2.3.2 Project Infrastructure

The proposed mining layout is shown in Figure 2.2. The main infrastructural components of the project which may have a bearing on the noise footprint of the project, include the following:

- Construction borrow pits;
- Open pit mining;

- A processing plant comprising crushing, grinding, magnetic separation, agglomeration and support;
- Infrastructure;
- Mine residue disposal facilities;
- A temporary construction yard and offices.

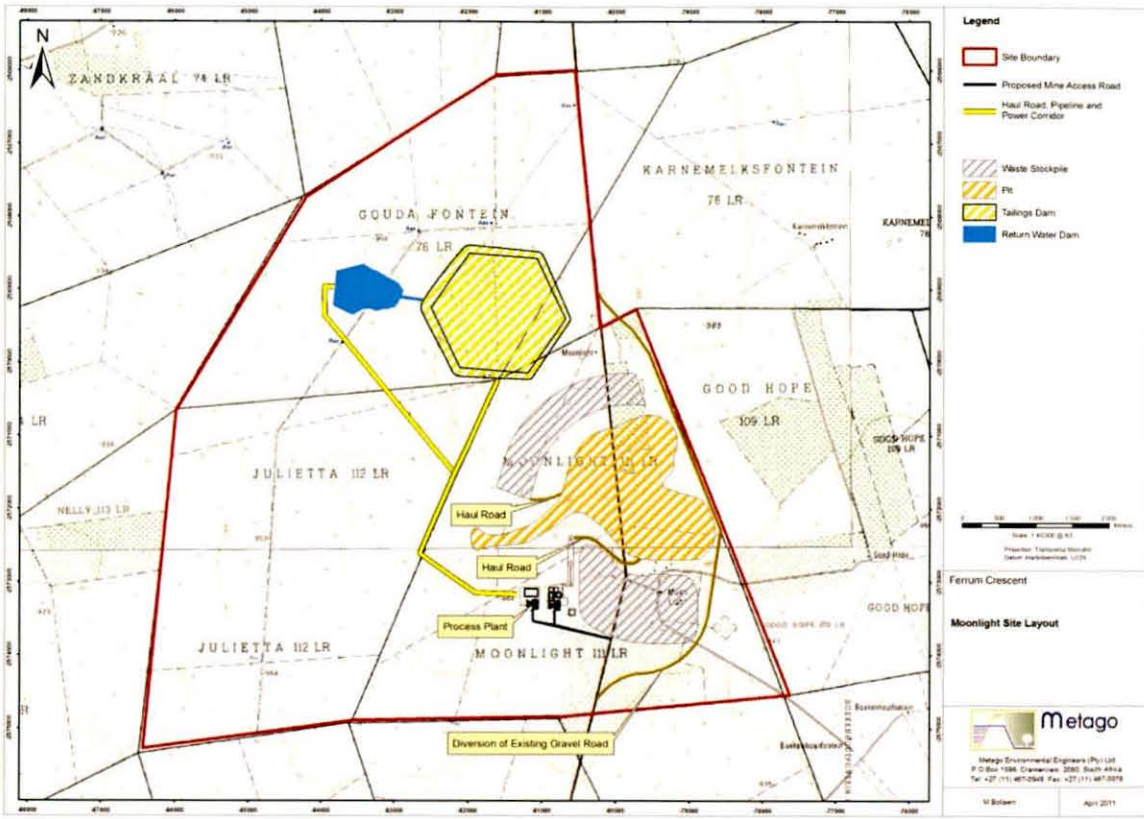


Figure 2.2

Local setting and proposed layout for the Moonlight Project

2.3.3 Sources of noise during the various phases

The following is an outline of project activities, equipment and operations expected to be potential sources of audible noise and the main contributors to overall project activity noise. The findings of the impact assessments for the various phases are presented in Section 3.

A Exploration and construction phase

Mining exploration comprising the drilling of boreholes is currently in progress and will most probably continue for the life of the operation to refine the position of the target ore body.

Potential noise-generating activities expected to take place during construction are as follows:

- Setting up a contractor's laydown area;
- Clearing of vegetation;
- Stripping and stockpiling of soil resources;
- Construction and work activities at borrow pits within the project area for sourcing building materials.
- Digging and/or blasting foundations and trenches;
- Construction of access and haul roads;
- Delivery of materials;
- Excavating activities in the construction of water dams;
- Preparation of residue disposal areas (if applicable);
- General building activities including the erection of structures.

Activities in the construction phase do not constitute a constant source of noise quantifiable in the same way as noise in the operational phase of the project. With changing activities and moving sources of noise, noise levels vary considerably in magnitude and over time. Hence, the assessment of noise in the construction phase is based on qualitative considerations. Construction noise, by and large, is expected to occur during daytime only. Activities and equipment which can be expected to contribute to construction noise are summarised in Table 2.1.

Table 2.1

Sources of noise in the construction phase

Construction Activity	**Sources of Noise**
• Power generation at construction site	Generator set – Diesel Engine
• Site preparation: Clearing, soil stripping	Bulldozer, loading, truck movement
• Blasting	Air blast noise
• Road construction	Bulldozer, grader, compactor, trucks
• Drilling	Drill rig engine and drilling
• Building construction	Cutting, sawing, grinding, hammering
• Delivery – Equipment and materials	Trucks & other vehicles on access road

B Operational Phase

Table 2.2 gives an overview of the mining and mineral processing operations likely to be used in the operational phase of the project.

Table 2.2

Summary of processes likely to be employed on the mine

Mining	Open pit mining	• It is envisaged that mining will use conventional open pit methods, i.e. drill and blast and load and haul to a ROM crusher. • Topsoil and overburden from the open pit will be used to rehabilitate mined out areas.
	Crushing & screening	• Crushing and screening will be done to achieve a desired material size. • Crushed ore stockpiled and fed to the plant. Secondary crushing at the plant.
Mineral processing	Materials handling	• Run-of-mine ore (ROM) stockpiling • Materials will be transported via conveyors and stored on stockpiles
	Concentrator plant	• The concentrator plant will comprise grinding and magnetic separation sections. • Grinding reduce the material size during the various stages of the process. • Magnetic separation will be used to remove the initial unwanted waste material and then to recover liberated magnetite. The slurry magnetite is then fed through a hydro-separator and filtration process. • Filtered product will be transported off-site.
	WRD	• Transport of waste material to Waste Rock Dump (WRD), off-loading and dozer operations
	TMF	• Pumping of residue from plant to TMF.
Transport	Product transport	• Options considered are road and pipeline transport. For the road option the proposed access route to the Moonlight site is the existing gravel road leading off the N11 near Marnitz south towards the project site.
	Personnel transport	• The gravel farm road leading from the project site south towards the R518 might be used by employees.
	Helicopter landing pad	• A helicopter landing pad will be located at the plant

The exact mining and processing technologies to be used in the Moonlight Project will only be finalised during the EIA process. Acoustic modelling of the mining operation for purposes of calculating noise contours in this project is based on typical configurations, equipment types and capacities employed in similar open cast mining operations. Operational data and potential sources of noise for a typical open cast operation are summarised in Table 2.3.

Table 2.3

Primary sources of noise in the operational phase
Based on data applicable to similar open pit iron ore operations
All sources operating 24 hours/day; 7 days/week

Operation		**Noise source**	**Qty**	**Type/Rating**
Mining	Pit operations	Excavator	2	90 t Tracked excavators
		Loading	2	80 t Wheel shovel loading dump trucks
		Trucks	10	170 ton dump trucks
		Earth movers	2	35 t Tracked Dozer
			2	35 t Wheel Dozer
	Pit services	Maintenance	1	Graders – Road maintenance
			1	Diesel browser
			3	1 Truck + 2 light vehicles
			2	Water trucks
	Blasting	Drilling blasting holes	4	Tracked mobile drilling machine
		Blasting	-	Once a day, weekdays only
	Stockpiling	Stockpiling	-	ROM stockpiling
	Disposal	Discard dump	-	Discard transport and dumping
Plant	Crushing	Primary Crusher	1	Jaw crusher
		Secondary Crusher	1	Cone type crusher
		Tipping at crusher bin		Trucks tipping into primary crusher
		Screening	4	Vibrating screens
		Conveyors		Conventional overland conveyor
		Stockpiles	2	Stockpile product discharge
		TMF	4	Motor-pump units operating at TMF
Roads	Haul roads	Trucks	60/h	170 t trucks on haul road
	Access roads	Personnel & visitors		Cars, minibuses, buses
		Delivery		Delivery trucks
Other	Landing pad	Helicopter	1/day	Helicopter approaching, landing and take-off

C Decommissioning and Closure Phase

During decommissioning buildings will be renovated for alternative use or be demolished. Work activity will be of low intensity and of relatively short duration.

2.4 Environmental noise assessment criteria

2.4.1 South African noise regulations

In 1994, with the devolution of regulatory power from governmental to provincial level, the authority to promulgate noise regulations was ceded to provinces. Each province could henceforth decide whether to develop their own regulations, or to adopt and adapt existing regulations. As yet, however, only three provinces (Gauteng, Free State and Western Cape) have promulgated such regulations. Elsewhere, including Limpopo Province, no provincial noise regulations have been put in place.

Consequently, in noise studies undertaken in provinces lacking official noise regulations, specialists usually consider the old national noise regulations [5] to apply by default. For further guidance, it is noted that noise criteria in all previous national and current provincial regulations, as well as current metropolitan noise policies, are all derived from SANS 10103. SANS 10103 defines the relevant acoustic parameters that should be measured, gives guidelines with respect to acceptable levels and assessment criteria and specifies test methods and equipment requirements. In this noise monitoring survey, the provisions of the old national noise regulations are taken into account, but noise assessment is based by and large on the principles, guidelines and criteria of SANS 10103.

2.4.2 Prohibitions

Prohibition of disturbing noise

Noise regulations prohibit any changes to existing facilities, or uses of land, or buildings or the erection of new buildings, if it will house 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 real 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 finds application in both predictive and noise monitoring assessments, if baseline noise data is available.
- **If the real 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 is employed in predictive noise studies and in noise monitoring assessments, if there is no baseline data available or if the noise source cannot be switched off for purposes of measuring the residual background level.

In terms of the old 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 2.4 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 applicant would be within legal limits if the noise impact is prevented from reaching or exceeding 7 dB, that would not prevent the community from being disturbed and to complain about the noise. In the EIA phase, i.e. in the design and planning stage of a new development, it is advised the target be set much lower at 3 dB. The 4 dB safety margin is required as a matter of good planning and to maintain good relations with neighbors. Once in operation, an appropriate limit in EMP noise monitoring of the actual levels would be an excess of 5 dB, which is still 2 dB below the legal limit.

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 peace 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[2], 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[3]:

- 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).

And:

- 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 mining operations. A common cause of noise nuisance are reverse hooters, the last item listed above.

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

2 *For example, barking dogs. Not only is the occurrence of the noise unpredictable and erratic, but the presence of a person investigating the problem with a noise meter is likely to attract attention and trigger incessant barking.*

3 *See Noise Regulations for the full list of prohibited activities.*

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 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.

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 whatsoever.

It is normally expected of an EIA noise study to make findings based on noise modelling and quantitative assessment of predicted noise levels, i.e. based on noise disturbance considerations. The same applies to noise monitoring conducted in terms of an EMP, where the report is expected to make findings based on measured data, assessed in terms of noise disturbance criteria as well. 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 also identify potential sources and monitoring surveys actual sources of noise nuisance.

2.4.3 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 defines or refers to the term noise impact. It is however generally understood and defined for purposes of this study, 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 2.4 in this report 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 2.4

Typical outdoor ambient noise levels in various districts (SANS 10103)

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

A 24 hour cycle is divided into the following periods:

Day-time (06:00 – 22:00)

Night-time (22:00 – 06:00)

Day-Night (24-hour day-night period)

The day-night level L_{dn} represents a 24-hour average of the ambient noise level, with a weighting of +10 dB applied to night-time levels, yielding numerically equal values for daytime and day-night levels.

SANS 10103 also gives guidelines in relation to expected community response to different levels of noise impact (increase in noise level), as summarized in Table 2.5.

Table 2.5

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

2.4.4 Assessment of blast noise

In the assessment of general industrial or community noise, the disturbing noise is measured and averaged over a period considered to be relevant for the source under assessment, which could be a limited period of an on-off operation, or, in the case of an on-going noise, such as road traffic, or mining noise, the relevant sub-interval of a 24-hour day, such as daytime, night-time or the day-night period.

The measurement and assessment of high-energy impulsive noise, as produced by blasting, is much more complicated. There are no regulatory limits and SANS 10103 does not provide any guidelines or criteria in this regard. It only states that advice from a specialist should be obtained. A suggestion in SANS 10103 that the procedures of SANS 10843 may be used, is of no help either, since the latter have been specifically developed for and only apply to the assessment of risk of hearing damage for persons exposed to gun shots or explosions involving peak levels above 140 dB. These methods and associated criteria have no bearing on, or relevance to noise disturbance assessment.

2.4.5 Note on animal response to noise

Assessment in any scientific noise study of the impact of noise on humans, is based on well defined scientific criteria. Based on decades of statistic data, international and national standards provide consistent guidelines with respect to noise disturbance and community reaction. If the measured or predicted elevation caused by an intrusive noise, such as mining noise, exceeds certain reference levels, the response of humans to such noise can be quantified. The noise contours calculated in this study define ranges of acceptable and significant impact noise as perceived by humans.

When it comes to animals, however, not only are human criteria not applicable at all, but there simply are no national or international standards pertaining to animal response to noise - Not in terms of audibility or disturbance, let alone the effect of noise on their well-being, health or production. It should be pointed out that not even in the case of humans, can the effect of noise on human health be quantified (except for hearing damage) and no standards or criteria exist in that regard.

It is completely understandable that farmers would be concerned about the effect of general mining or blasting noise on their livestock/game and it may very well be justifiable. But in the lack of standards or criteria, any statements made in the findings and recommendation of a noise study in that regard, would be speculative, unscientific and irresponsible. Hence in this report, we refrain to make any such unfounded statements either confirming or rejecting popular views on the matter.

3 Results and findings

3.1 Baseline study

3.1.1 Current state of the environment - Background ambient noise levels

General

The Moonlight study area is located in a district where, apart from a relatively small zone along the N11 main road, the initial rural ambient noise character is still largely intact. There are no mining or industrial activities within audible reach and local roads carry very little traffic.

Ambient levels at M1 (Farm Hantam; Mr A du Plessis)

The location of monitoring point M1 is representative of the region west of the proposed Moonlight Project. Average daytime and night-time ambient levels recorded during the course of this investigation, were 37 dBA (daytime) and 28 dBA (night-time), respectively. This is exceptionally quiet, considering that the corresponding typical levels for Rural Districts (SANS 10103) are 45 dBA (daytime) and 35 dBA night-time), respectively.

There is virtually no trace of traffic noise at this location. Only on rare occasions during daytime could passes of singular vehicles on farm or local roads be made out in the distance, but this had no effect on the average daytime ambient level. For all practical purposes, daytime ambient noise in this area consists purely of natural sounds, i.e. the sounds of birds, insects and the rustling of leaves in the wind. At night there was no sign of road noise and the ambient level was determined by natural sounds only, insects in particular.

What also contributed to the low ambient level is the fact that the residence at the measurement location was not occupied during the course of the survey.

Ambient levels at at M2 (Farm Karnemelksfontein; Mr E Stroh)

Average daytime and night-time ambient levels recorded at this location were 38 dBA (daytime) and 36 dBA (night-time), respectively. The daytime level is lower than and the night-time level well in line with the expected (typical) levels for Rural Districts in terms of SANS 10103.

The 8 dB difference in night-time level recorded at M1 and M2 can be ascribed to two factors (please also refer to comments in Section 3.1.2 (a)):

(a) Domestic activity: The house at M2 was occupied, the one at M1 not. Normal speech and domestic activity sounds, plus noises made by cattle and barking dog(s) on the premises contributed to a higher level at M2.

(b) Insect noise: Coincidental higher levels of insect noise have also contributed to the higher level recorded at M2.

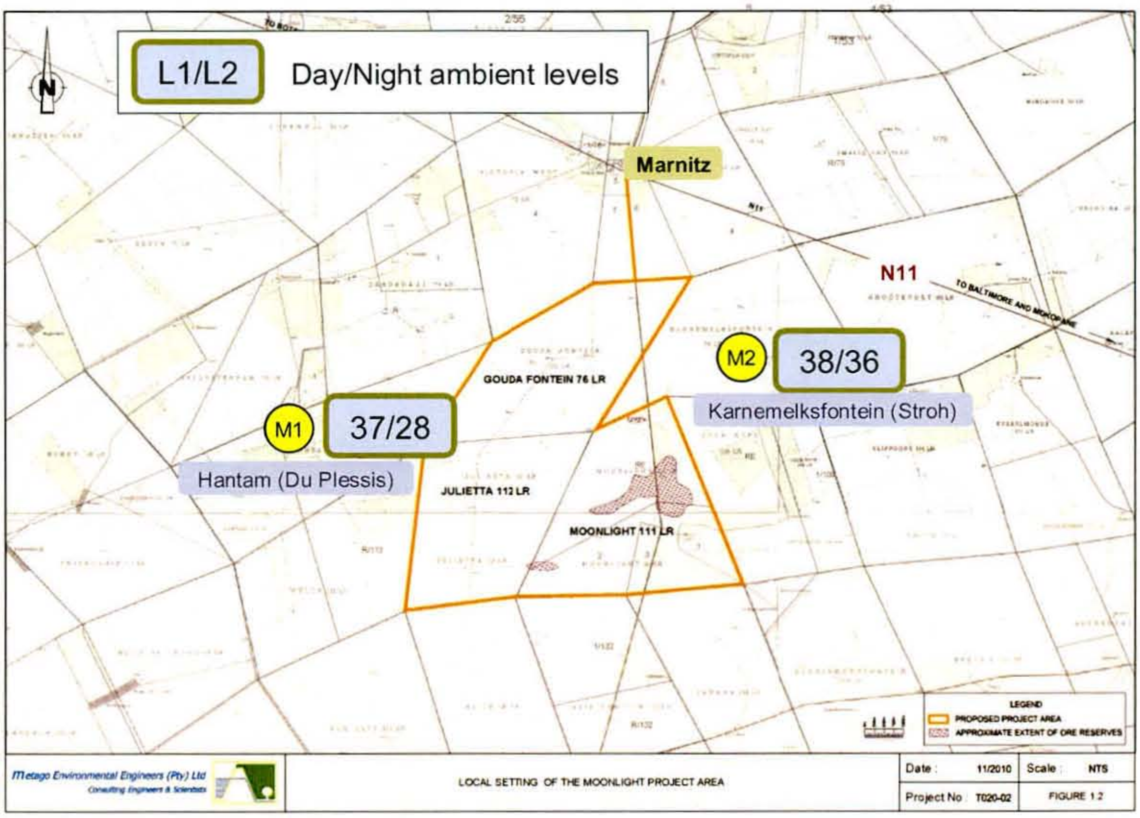
Ambient levels at Marnitz

Based on physical inspection in the scoping assessment, it was decided that a noise survey at Marnitz would not serve any purpose. With Marnitz located 8 to 9 km from the noise centre of the proposed open cast operation, it is highly unlikely that mining noise will be audible at all. Not only as a result of propagation losses over such a large distance, but also because ambient levels at Marnitz and other properties in the vicinity of the N11 main road are elevated by traffic noise on that road. This raises the characteristic baseline level by at least 5 dB above 35 dBA, the typical level in Rural Districts.

Summary

The results of the survey are summarised on the map in Figure 3.1. Daytime and night-time periods are as defined in SANS 10103 (See Section 2.4.2). Detailed results of the recordings made in 10-minute intervals at M1 and M2 are presented in Appendix A.

It should be noted that exploration drilling was restricted to daytime hours when (due to atmospheric dispersion) it has very limited audible impact. Night-time drilling would certainly have a significant effect on the ambient level within a 1 to 2 km zone around the drilling operation.



Monitoring Point	Position	Receptor / Area
M1	S23 13.602 E28 07.728	Farm house on farm Hantam (Du Plessis)
M2	S23 12.790 E28 14.665	Farm house on farm Karnemelksfontein (Stroh)

Figure 3.1

Results of baseline survey
Average daytime (06:00 to 22:00) and night-time (22:00 to 06:00) ambient levels

3.1.2 Baseline ratings

In assigning baseline ambient noise ratings, the following should be borne in mind:

(a) Ambient noise levels measured in any particular survey do not represent absolute values, but samples only of what in practice is a variable parameter. Even relatively long-duration averages of day and night ambient levels at any location will vary over time. This is in response to variances in noise source emission levels, as well as unpredictable day, night and seasonal fluctuations in atmospheric conditions.

In rural areas in particular, the level measured at any location also depends on the proximity of the recording microphone to the nearest singing birds or insects, something that cannot be controlled at all and which is bound to change from one survey to the next. Experience shows that with insects calling within 10 m distance of the microphone, night-time levels may easily rise to well above 55 dBA.

Hence, although the 8 dB difference in night-time level recorded at the two locations in the Moonlight survey is quite considerable, it should not be construed as an indication that one location is noisier than the other. The levels measured at M1 and M2 are two samples of the same property, i.e. the ambient level in the Moonlight Project area. The latter is characterised by sounds of nature, with no industrial or mining noise, outside reach of audible traffic noise on the N11 main road and with very low traffic volumes on local roads.

(b) For purposes of noise impact assessment, noise contours are calculated at nominal intervals best suited for evaluation of specific locations of concern, as well as for the global study area.

With these considerations in mind, the ratings assigned to the study area were determined by rounding the levels obtained in the survey to the nearest 5 dB day or night interval of typical levels for district categories in accordance with SANS 10103 guidelines (See Table 2.4). The result is presented in Table 3.1. Note that despite the higher level recorded at M2, the night-time rating for the area as whole is based on the lower reading obtained at M1 and is thus set at 30 dBA. This is 5 dB lower than the nominal rating for Rural Districts, the lowest noise category in SANS 10103. These are realistic best estimates of baseline ambient noise ratings for the area used to define limits in the noise impact assessment.

Table 3.1

Moonlight Iron Ore Project
Baseline outdoor ambient noise levels derived from field surveys
Rounded to the nearest nominal rating in 5 dB steps in accordance with SANS 10103 system

Area	Baseline ambient noise level L_{Aeq} (dBA)	
	Day-time L_d	**Night-time** L_n
Locations less than 750 m from N11 main road	50	40
Locations more than 750 m from N11 main road	40	30
Farms bordering on the mining area	40	30

3.1.3 Recommended limits

24-hour operation noise - Maximum impact occurs at night

Daytime intrusive noise levels created by distant industrial noise sources such as the Moonlight Project under consideration, are as a general rule substantially lower than the levels created by the same sources at night. The reason is that typical daytime meteorological conditions result in skyward refraction of sound propagation, in contrast with downward diffraction caused by typical night-time temperature profiles (vertical gradients). During the day, most of the noise emitted by a large source does not reach the ground, while at night, both direct sound and a portion of the energy radiated skywards are focussed back to earth. This contrast between day and night levels is further accentuated by a considerable drop at night in the residual ambient level due to a decline in road traffic and human activity noise. As a consequence, not only are the levels of intrusive noise from distance sources much higher at night, but the sensitivity of the environment increases sharply, as well.

It follows that for continuous noise from a 24-hour operation, such as open cast mining and truck movements, maximum impact will occur at night and that for all practical purposes, provided the night-time impact is contained to acceptable levels, the daytime impact would not be of any consequence or concern at all.

Significant impact criterion

With reference to the principles explained in Section 2.4, a significant impact on properties bordering the Moonlight Project area is deemed to occur if the specific level of an intrusive noise exceeds the existing ambient rating in Table 3.1 (deemed to be the acceptable level) by 5 dB or more. For the main study area, i.e. properties bordering on the Moonlight Project area, this implies that up to 30 dBA is still considered an acceptable level for specific noise generated by the Project, while 35 dBA is deemed to be a disturbing noise resulting in a significant impact.

3.2 Noise impact – Construction phase

Exploration drilling

Mining exploration comprising the drilling of boreholes is in progress and will most probably continue for the life of the operation to refine the position of the target ore body. As long as the current practice of drilling during daytime only is maintained, this activity is expected to have minimal noise impact and is not expected to cause any noise disturbance.

General construction noise

Noise generating activities in the construction phase will take place at and around the proposed open cast mining area. Most of the work will occur during the day when the environment is relatively insensitive to noise. Daytime noise levels produced by general construction activities and in the construction of access and haul roads will be relatively low and are not expected to be noticeable on bordering properties. On its own, it will be insignificant and of no consequence.

Blasting

Blasting will occur development of the open pit. The excavated materials will be used to construct berms and embankments around and within the Moonlight Project.

Any blasting required during construction will be clearly audible and occasionally cause a significant impact at residences on neighbouring farms.

3.3 Noise impact – Operational phase

3.3.1 Presentation of results

The operational noise footprint of the Moonlight Project is presented with the aid of noise contour maps. Noise contours delineate levels of specific project noise expected at night and were calculated for levels representing significant impacts (5 dB above the ambient level) for the main study area, for properties bordering on the mining area in particular. Specific noise means the noise produced by the project without the contribution of background ambient sound. To appreciate the significance of the various contour levels with respect to noise impact, it has to be noted first of all that if the specific level of mining noise at an observation point rises to the point where it equals the background level, the ambient level will rise by 3 dB above its initial level. This represents a noise impact of 3 dB, which is still acceptable in terms of noise regulations and SANS 10103 criteria. A significant impact is deemed to occur (See SANS 10103 criteria in Table 2.5) if the ambient level is exceeded by 5 dB or more.

Depending on the time of day or night and on meteorological conditions in particular, noise levels produced by industrial sources over long distances vary by a considerable margin. Noise contours were derived from calculations intended to investigate probable worst-case conditions (Night-time levels and Concawe model Meteorological Category 6). On average, typical levels are expected to be lower. "Probable worst-case" in the context of this study refers to levels that are higher than typical levels. Although less probable than typical levels, they are expected to occur from time to time during the course of the year, sometimes possibly for several days on end. Occurrence of worst-case conditions is not simplistically related to weather conditions and not limited to any particular season of the year.

Confidence in the predictions which are based on appropriately scaled data obtained in measurements at similar operational open cast mines, is high. It should nevertheless be cautioned that predicted noise levels and contours are not to be taken as absolute. Noise maps must be interpreted with caution. Although the confidence level in the acoustic model is high, predicted levels are valid for the assumptions made in respect of meteorological and other conditions. Since meteorological conditions in particular are highly variable, levels produced at a distance by a source at a constant acoustic output will vary considerably, even during the course of a single day-time or night-time period. Variance in noise level due to changes in atmospheric conditions increases with distance from the source. It should also be borne in mind that noise propagation is not only affected by distance and wind, but by temperature gradients in the atmosphere as well. The contours represent best estimates of continuous project activity noise levels averaged over a relatively long duration, in this case the nominal night-time period of 8 hours.

3.3.2 Findings - Unmitigated operational noise

The impact of general mining noise

Noise contours presented on the noise maps account for all mining operations, traffic and activities inside the mining area. It includes the contributions of plant and pit operations, haul road transport, dumping and truck movements on top of waste rock dumps, as well as power generation and tailing pumps and motors. Noise contours were calculated for the following conditions:

(a) It is assumed that Meteorological Category 6 atmospheric propagation conditions prevail at night, which results in maximum noise levels at large distances;

(b) Noise contours were calculated for conditions where pit operations, i.e. drilling, excavation, loading and truck movements are taking place near the surface. As the pit deepens, noise generated by these sources will gradually be attenuated by acoustic screening afforded by the pit walls.

The noise impact at any location depends on wind direction. In the Moonlight study area the predominant wind direction is expected to be from the north-east and east-north-east with moderate wind speeds (not exceeding 10 m/s). Noise contours in Noise Maps 3.1 and 3.2 were calculated for no wind and for a wind blowing from the north-east, respectively.

Noise Map 3.1 shows that for neutral wind conditions the significant noise impact footprint of the mine (delineated by the 35 dBA contour) extends to a distance of roughly 3 km around the virtual acoustic centre of the mine located between the pit and the plant. With the wind blowing from the north-east (the predominant direction), Noise Map 3.2 shows that the footprint is elongated, extending the radius by approximately 2 km in the downwind direction to about 5 km from the acoustic centre. This pattern of elongation in the downwind direction occurs for any wind direction as illustrated for example by the contours in Noise Map 3.3 which were calculated for the less probable condition where the wind is blowing from the south-west.

Further clarification

A simplified depiction of the net footprint for all possible wind directions is given in Noise Map 3.4 which shows the locus delineated by the maximum reach of the 35 dBA noise contour if wind direction rotates through a full circle of 360°. The result is a circle with a radius of 5 km. At or inside this circle at any location downwind from the mine, the level of general mining noise will be equal to or greater than 35 dBA, the level at which a significant impact is deemed to occur. Beyond a distance of 5 km, with the noise level declining with distance, the level drops to below 35 dBA and the impact becomes insignificant. Moving further and further away from the mine, the level will keep falling until it is equal to and eventually lower than the background ambient noise, thus becoming completely inaudible.

As a further aid to help understand the overall impact on land uses, the same method used to determine the noise footprint for all possible wind directions (Noise Map 3.4) was used to determine noise levels at a series of fixed distances. The result is summarised in Table 3.2.

As already explained, the mine is expected to have a significant noise impact up to a distance of 5 km. At 10 km the level will have dropped to 20 dBA. This is well below the ambient level and the mine is not expected to be audible at all. At 20 km the level will be even lower. The result is illustrated graphically for 5 and 10 km zones in Noise Map 3.5.

Table 3.2

Mining noise at a series of fixed distances from the mine
Allowing for all possible wind directions

Radius [km]	**Mining noise** Maximum level dBA	**Noise impact at specified distance**
5	35	Significant impact
6	30	Insignificant impact – Mining noise seldom exceeds ambient
8	25	No impact – Mining noise below ambient level
10	20	No impact – Mining noise below ambient level

It should be cautioned that Noise Maps 3.4 and 3.5 are intended as aids to visualize the potential range for all possible wind directions without taking probability into account. The most probable and likely scenarios are when there is either no wind, or if the wind blows from the predominant north-easterly direction, as depicted in Noise Maps 3.1 and 3.2.

The practical consequences of general mining noise may be summarised as follows:

- In the initial phase or as long as mining takes place at or near the surface, noise produced by drilling, bulldozing, excavation and loading of trucks will make out a significant portion of audible night-time mining noise at distances and locations within the significant impact range delineated by the 35 dBA noise contours.

- As the pit deepens, mining noise will be attenuated by acoustic screening afforded by the pit walls. This will reduce pit noise but will of course have no mitigating effect on the noise of other primary sources, i.e. the operation of the plant or surface activities, such as haul road transport, tipping into crushers and dumping on waste rock stockpiles.

- Plant noise will be a continuous contributor to audible noise. The main audible component will be crushing and tipping of truck loads into the primary crushers. Although included in the model, small sources such as TMF pumps will not be audible above plant noise.

- Truck movements on surface sections of haul roads can also be expected to contribute to audible night-time noise.

- Truck movements and dumping on top of waste rock dumps are likely to be one of the main contributors to audible noise at night. In addition, of particular significance and a common cause of noise complaints from residents near mines, is the annoyance caused by reverse alarms and hooters on such trucks. This type of noise does not necessarily manifest as an increase in the measured ambient level, but is particularly audible and annoying due to its pure tone characteristics.

Road traffic noise

Depending on the method used for transport of the mined product (road or pipeline), the mine may generate one or both of the following traffic components which could contribute to road noise impact:

(1) Basic commuting and services traffic such as administrative and management personnel (using own transport), mining shift workers (transported via 50-seater buses) and heavy vehicles delivering consumables. This component will be generated regardless of the method used for transport of the mined product.

(2) Only if the mined product is not transported by pipeline, traffic generated by transport of the mined product.

In terms of the current project plan, the product will be transported by pipeline, in which case the second road noise component will not be applicable. Notwithstanding, for purposes of reference and in case road transport is considered in the future, the noise implications of both road and pipeline options are considered in this report.

Transport Option 1: Mined product transported by pipeline

Transport of the mined product by pipeline is currently the preferred operational option. Considering that it will negate the road transport noise component, it is also the option preferred from a noise impact control point of view.

What remains to be considered, is noise from basic commuting and services traffic generated by the mine. Estimation of road noise footprints is based on road traffic data published by Siyazi Gauteng (Pty) Ltd in their Traffic Impact Assessment Report for the Moonlight Iron Ore Project [5].

Traffic data from the Siyazi report were used in calculations to obtain estimates of mining-generated traffic noise footprints without and with the proposed development. Road noise calculations are sufficiently accurate to obtain reliable estimates of the broad noise footprint. It is not intended as a detailed, comprehensive traffic noise study, which is beyond the scope of this study.

In considering the impact, it should be noted that unlike noise from 24-hour mining operations (pit, plant, and haul road activities), the noise of additional road traffic generated by the mine will for all practical purposes be restricted to daytime hours. Consequently, instead of night-time criteria applied in the assessment of mining noise (See Noise Maps 3.1 to 3.5), road traffic noise needs to be assessed in terms of daytime criteria with acceptable levels 10 dB higher than those applicable in night-time criteria. For the project study area the baseline (background) ambient levels in the quietest areas (See Table 3.1) are 30 dBA and 40 dBA for daytime and night-time periods, respectively. Clearly, the impact of daytime road traffic noise considered here and the impact of night-time mining noise shown in the noise maps cannot be combined and must be considered separately.

For road noise, a significant impact is deemed to occur if peak-hour road traffic noise exceeds 45 dBA (baseline daytime level + 5 dB). The results of road noise calculations using 2021 traffic data without and with project-generated noise are presented in Table 3.3.

It is clear that, for the pipeline transport option, the noise impact of 2021 project-generated road traffic noise will be small. In the worst case during peak-hour traffic it will increase the 45 dBA daytime noise footprint either side of the road from about 105 m to 125 m along the N11 and from 45 m to 140 m along the D1347 road. Compared to the night-time noise impact footprint of general mining noise (See Noise Map 3.4), this is entirely insignificant.

Transport Option 2: Mined product transported by road

The road traffic study report considers two options for road transport of the mined product:

Transport Route A: Along N11 East
Transport Route B: Along N11 West

Noise generated by trucks transporting the mined product on public roads is expected to have a significant impact. The noise footprint will be much greater than that of project-generated commuting and services traffic noise alone and will occur during daytime as well as night-time. Notwithstanding, the range will still be small compared to that of general mining noise as depicted on the noise maps. The noise footprint calculated for Transport Option 2 using traffic data from the road traffic study report is also shown in Table 3.3.

As a general guideline it can be expected that truck noise will be experienced as follows:

- ***In the quiet rural area around the mine:*** Part of the transport route is likely to follow local roads such as the D1347 which currently carry very little traffic. Unlike normal high speed traffic on public roads characterised by road-tire noise, what will be heard here is predominantly engine noise. This will be clearly audible and may be disturbing up to distances of typically 1 250 m either side of the road.

  It is found in practice that more than truck engine noise, the main cause of annoyance and complaints more than often is unnecessary casual use of truck hooters by drivers as a means of greeting or communication.

- ***Areas bordering the N11:*** Should the transport route follow the N11, the noise of mine trucks will add to and be integrated with existing main road traffic noise. The character of relatively high speed main road traffic is different from that described above in that it consists predominantly of road-tire noise. Because of higher existing ambient levels, the net impact of mine traffic on the N11 will be smaller than that caused by the same traffic on the D1347. It should be noted that for additional traffic to raise the noise level of existing traffic of the same mix by a discernable 3 dB, it has to double the traffic volume. For a 5 dB increase which is regarded as a significant impact, it has to increase the average traffic volume by a factor of 3.

Table 3.3

Moonlight Iron Ore Project
2021 Peak-hour road traffic noise footprint without and with project-generated traffic

Transport Option 1: Mined product transported by pipeline
Project-generated road traffic restricted to commuting and services traffic

Transport Option 2: Mined product transported by road
Project-generated road traffic comprises of commuting and services plus product transport traffic

Transport Route A: Along N11 East
Transport Route B: Along N11 West

Daytime criteria apply to commuting and services traffic
Night-time noise criteria apply to trucks transporting mined product

Road section	**Noise Footprint** N11 Main road 45 dBA D1347 Road 35 dBA			
	Distance either side of road [m]			
	Without mine	**With mine**		
		Product Transport		
		Pipeline	Road	
			Route A	Route B
N11 West of Marnitz	105	125	125	200
N11 East of Marnitz	110	115	175	115
Road D1347 section north of mine	45	140	1 250	1 250
Road D1347 section south of mine	45	120	120	120

Helicopter landing pad

Noise data required for purposes of estimating and assessing the potential impact of helicopter noise in this project was acquired from tests conducted in a previous study by the author to assess the noise impact of helipads. A series of measurements were performed during helicopter test flights at Wonderboom Airport. Tests were conducted on a Eurocopter 120 helicopter powered by a turbine engine, the noisiest of two types used in helicopters. Noise emission levels were determined from proximity measurements taken at a minimum safe distance of 15 m from a test landing point, as well as at various distances further away.

In respect of the Moonlight Iron Ore Project, the following characteristics of helicopter landings and take-offs and the operation of the proposed helipad are relevant:

- Helicopter noise is only expected to occur during daytime hours, assuming that Visual Flight Rules (daytime use only) apply.

- In terms of recordable noise level[4], the approximate durations of take-off and landing sequences are:

  Take-off (Start-up + warm-up + lift-off + fly-off): 2 minutes

  Landing (Approach + landing + shut-down): 1,5 minutes

- With the helicopter landing pad located at the plant, helicopter noise received at longer distances in the external surroundings will only be audible during the very brief fly-over periods of the approach and fly-off stages. Noise generated during start-up, warm-up and lift-off, as well as during approach, landing and shut-down at the helipad will not be audible above plant noise for most of this sequence. Only during lift-off, is it expected to momentarily rise above plant noise, a condition which will last for a brief period of less than 10 seconds.

- For a recipient located under the flight path, helicopter noise will be clearly audible during the brief periods of fly-over. However, considering the short duration and the fact that this will only occur during daytime, the contribution to and the elevation of the energy-averaged daytime level as determined in accordance with SANS 10103 will be negligible. What should be borne in mind is the fact that the very brief duration and noise exposure of singular fly-overs involved here, are very different to those of longer duration events, such as for example helicopters employed in police and military search flights, or in game counting exercises where the noise may continue for long periods at a time.

In view of these considerations it is not expected that helicopter noise will cause a significant impact in the area surrounding the mine.

Blast noise

Blasting is not included in the contours presented on the noise maps. Firstly, it involves single-event high-energy impulses which cannot be simplistically summed or combined with long-term averaged continuous machinery noise. Moreover, the inherent variability of the source rules out reliable prediction of blast noise levels. The noise output at source is highly variable, depending on pit depth, the depth of charge embedment and ore body properties. The level is also highly dependent on atmospheric and meteorological conditions. Consequently, blast levels at large distances (> 1 km) from the point of detonation are found to vary considerably for the same charge.

Because of these variances and uncertainties and because noise contour maps tend to be taken literally, no such maps were generated for blast noise.

Daily blasting will have a significant impact in the quiet surroundings of the Moonlight Project. A factor which has a strong influence on the level is the time of day (AM or PM) during which blasting takes place. Blasting during the afternoon will over large distances on average produce much lower noise levels.

Animal response to noise

There are no scientific criteria for the assessment of animal response to noise (see Section 2.4.5). The author is not qualified and it is unlikely that any authoritative source exists

4 *Noise level exceeding a residual ambient level of 40 dBA.*

to comment on or make statements about the absolute or relative impacts on animal behaviour caused by the following sources of noise:

- General mining noise versus the noise of low flying helicopters employed in game counting exercises;
- Blast noise versus gunshot noise to which animals are exposed in hunting.

In the absence of objective criteria, the best alternative that can be suggested for assessing the possible impact of general mining noise on animals is to use the noise contour maps presented in this report as a rough indication. Each map shows a contour of significant impact range based on human hearing and perception. The significant impact range is where mining noise will be clearly audible above the background noise. As for hunters and visitors on game farms, the contour maps serve as an appropriate measure of noise disturbance impact. Although animals may have more sensitive hearing, it is conceivable that noise will become audible above the background level at more or less the same threshold. Hence, as far as general mining noise is concerned, for a lack of any other guidelines, it is suggested that the findings with respect to significant impact ranges applicable to humans, be used as a rough indication for animals as well.

The assessment and rating of significant blast noise ranges is much more complex. Irrespective of the recipient (human or animal), the contours for general noise shown on the noise maps cannot be used as an indication at all of the audibility or impact of blast noise. Those graphs only have significance and are only meaningful for continuous noise.

A blast becomes clearly audible long before the peak level reaches the acceptability rating. Because of the short duration (only a fraction of a second), the energy spread out over a full daytime period is very small.

3.4 Noise impact – Decommissioning phase

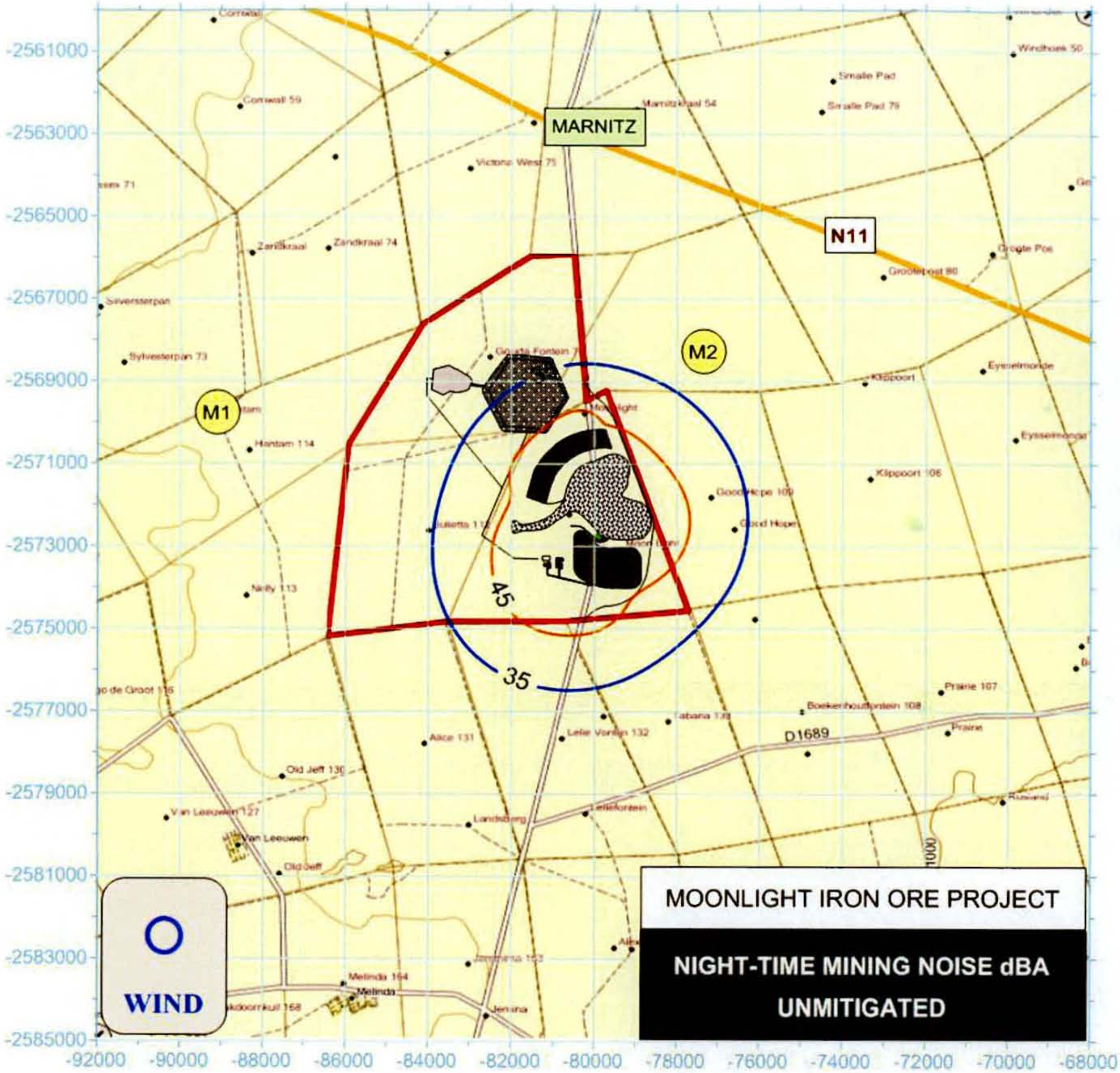
Noise in the decommissioning phase will be of a similar nature, but at a lower intensity and of shorter duration compared to noise in the construction phase. Decommissioning noise will be inaudible in noise-sensitive areas and the noise impact will be negligible.

3.5 Noise impact – Closure phase

No residual noise impacts will remain after decommissioning of the mine.

Noise Maps

Unmitigated Project Noise



Noise Map 3.1

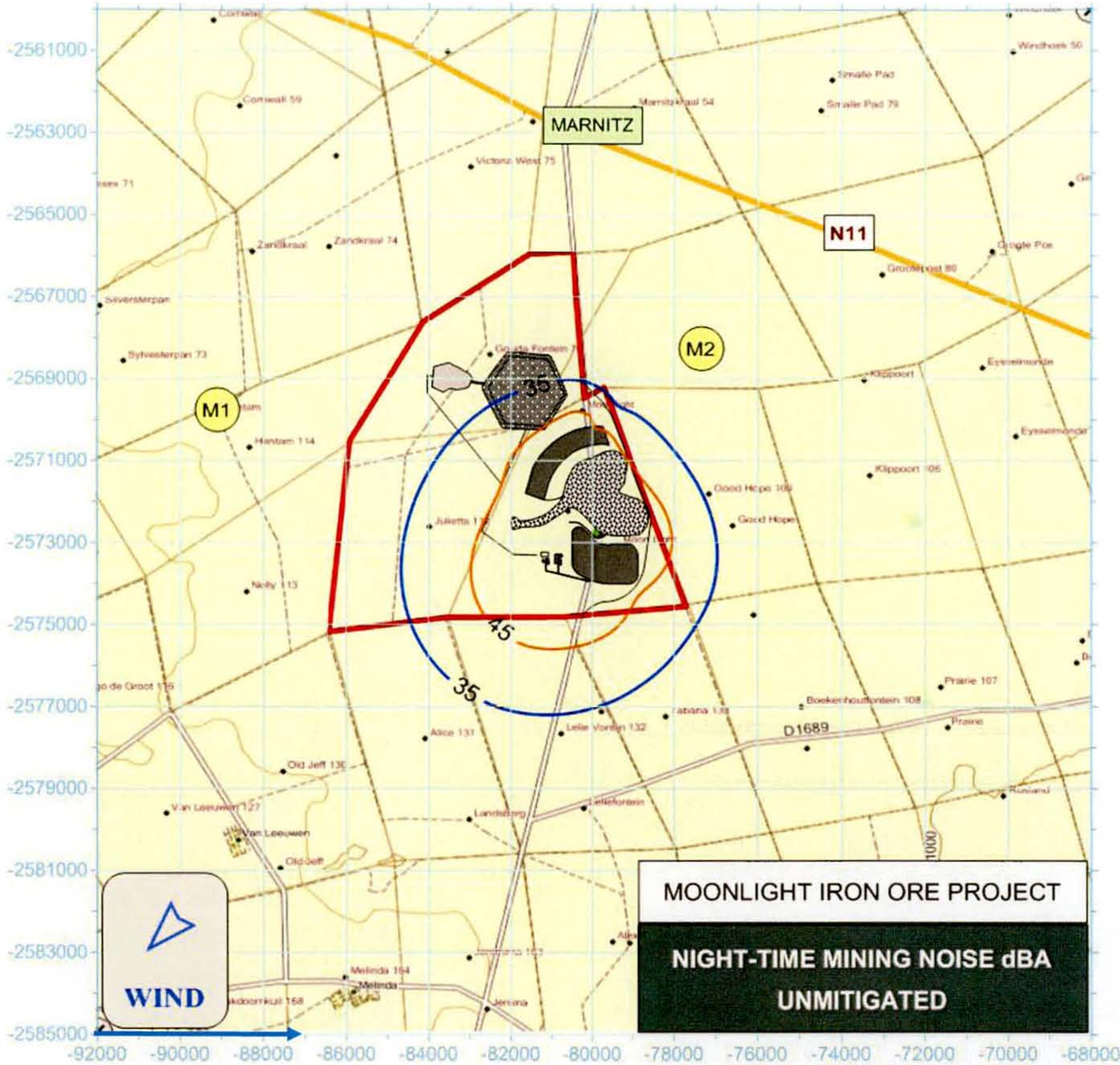
Moonlight Iron Ore Project

Unmitigated Project Noise

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise footprint

No wind

Significant impact occurs inside the 35 dBA contour



Noise Map 3.2

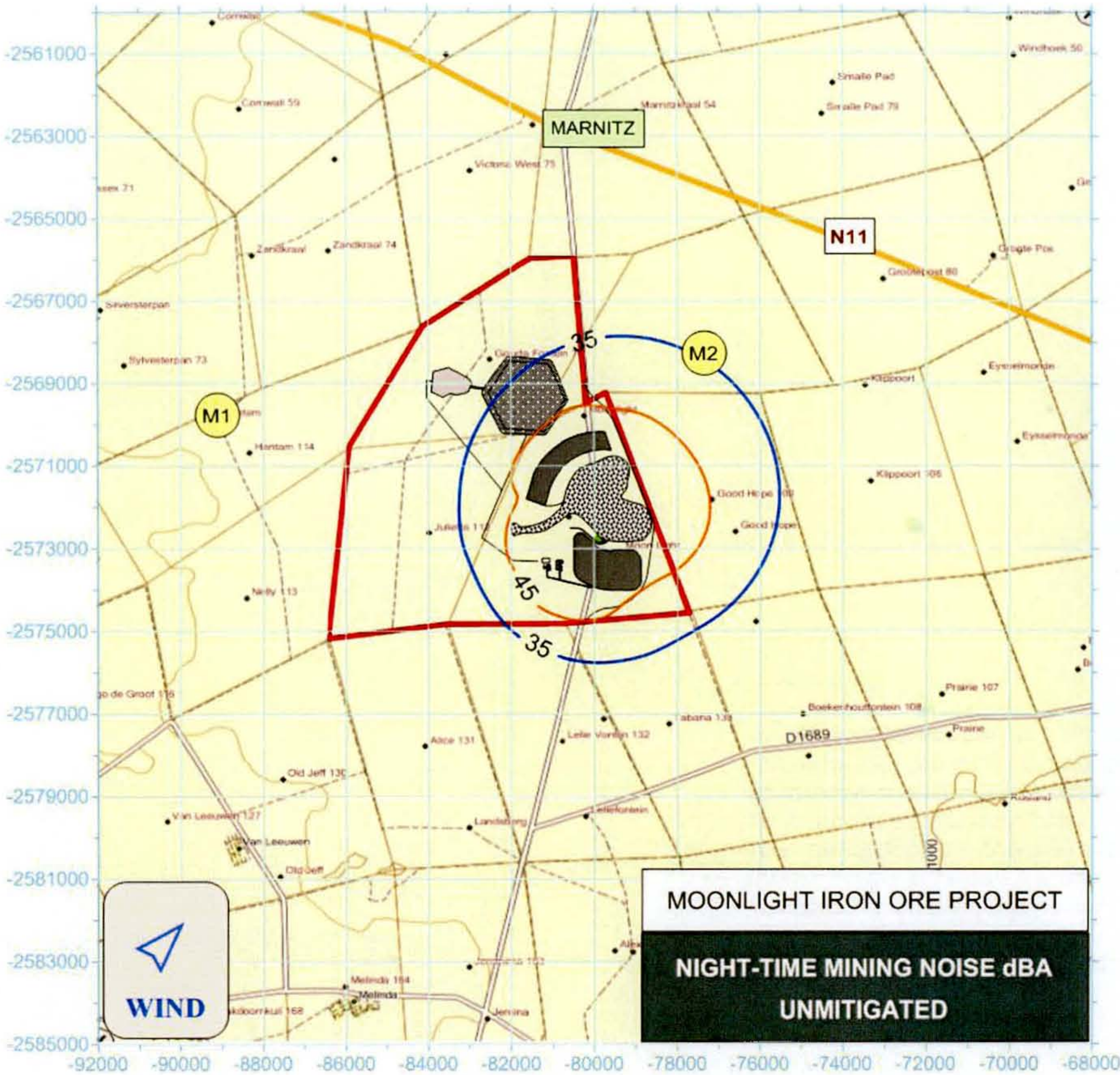
Moonlight Iron Ore Project

Unmitigated Project Noise

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise footprint

Wind blowing from predominating north-east direction

Significant impact occurs inside the 35 dBA contour



Noise Map 3.3

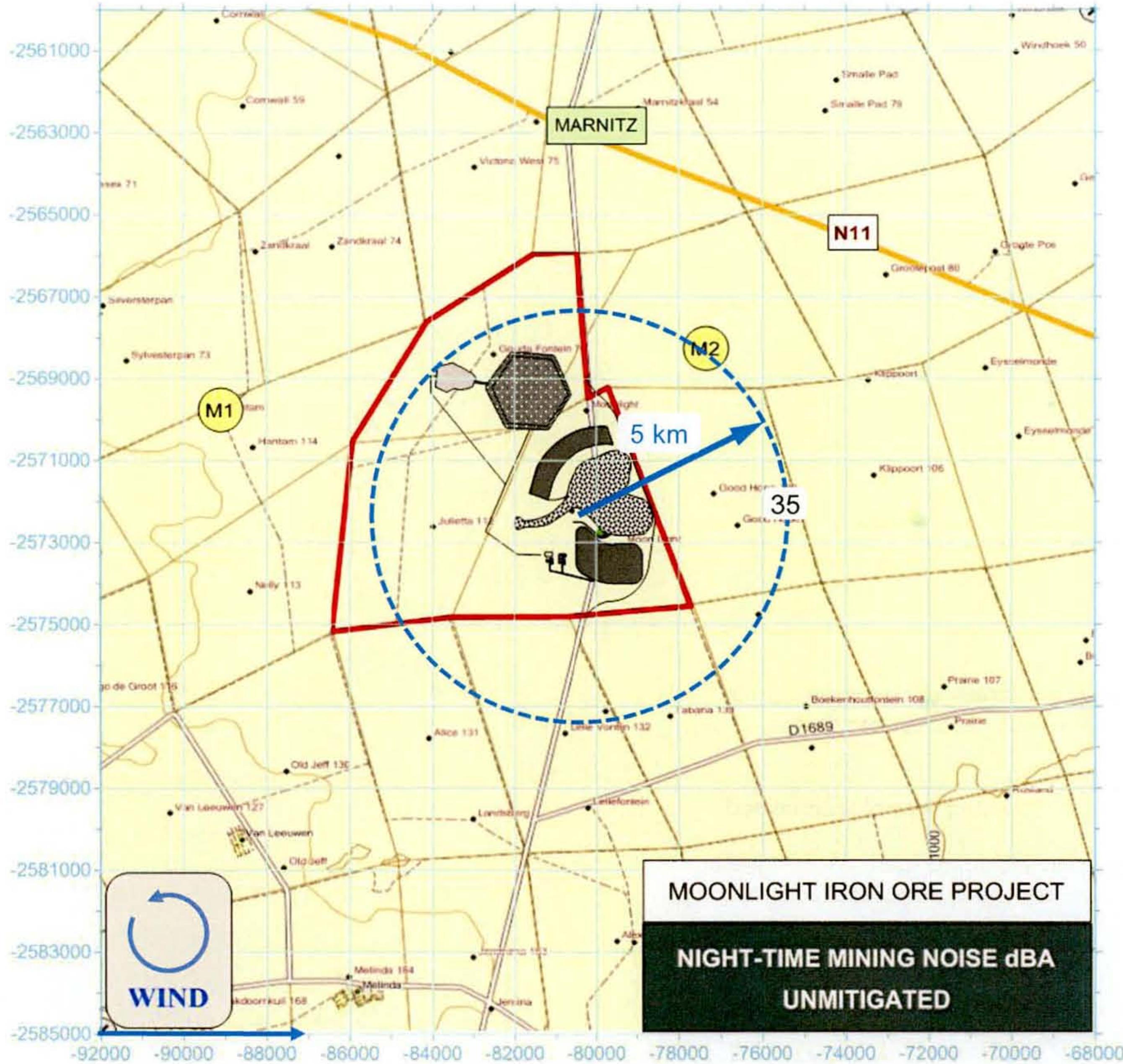
Moonlight Iron Ore Project

Unmitigated Project Noise

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise footprint

Wind blowing from less common south-west direction

Significant impact occurs inside the 35 dBA contour



Noise Map 3.4

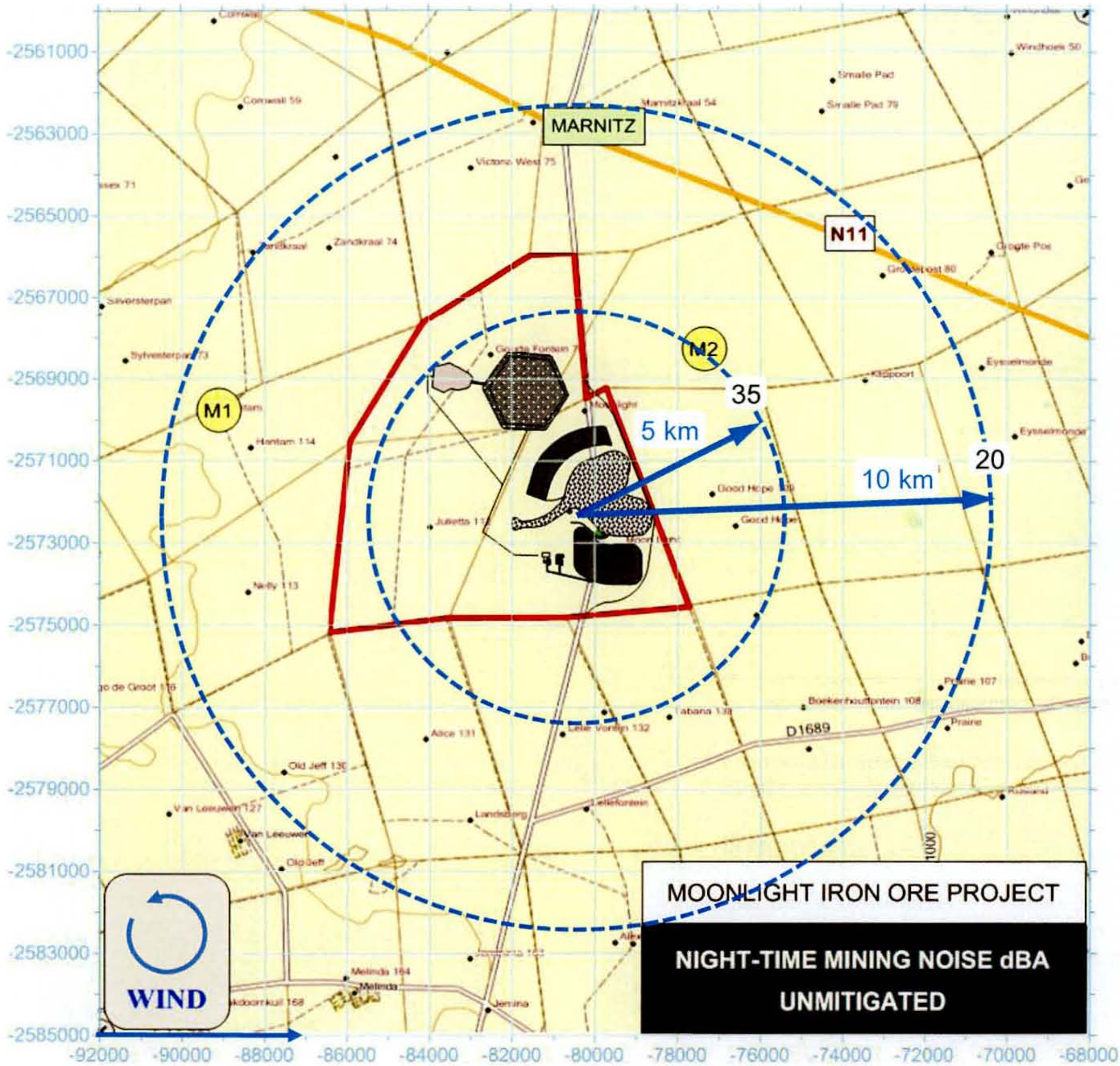
Moonlight Iron Ore Project

Unmitigated Project Noise

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise

Net footprint for all wind directions
Locus delineated by 35 dBA noise contour extreme edge if wind rotates through 360°

Significant impact occurs inside the 35 dBA locus



Noise Map 3.5

Moonlight Iron Ore Project

Mining noise at 5 and 10 km distances from the mine
Net footprint for all wind directions

Radius [km]	**Mining noise** Maximum level dBA	**Noise impact**
5	35	Significant impact
6	30	Insignificant impact – Mining noise seldom exceeds ambient
8	25	No impact – Mining noise below ambient level
10	20	No impact – Mining noise below ambient level

4 Mitigation

4.1 Mitigation - Construction noise

General construction noise

As explained in Section 3.2, noise produced by general construction activities is not expected to be noticeable at noise-sensitive locations during daytime hours. Potential noise disturbance at night can only be prevented if construction is restricted to daytime hours, i.e. by stopping all construction activities between 22:00 and 06:00.

Blast noise

Although blasting will be infrequent and of brief duration in the construction phase, it should nevertheless be treated with caution. To minimize the noise impact, it is recommended that blasting be scheduled to take place in the afternoon; under no circumstances during the morning hours of the day.

4.2 Mitigation - Operational noise

Plant noise

Plant noise should not be considered as fixed and unchangeable. It can be reduced by partial enclosure and acoustic screening of the particular unit under consideration. The concept of noise screening applied to a typical crusher is illustrated in the example shown below.

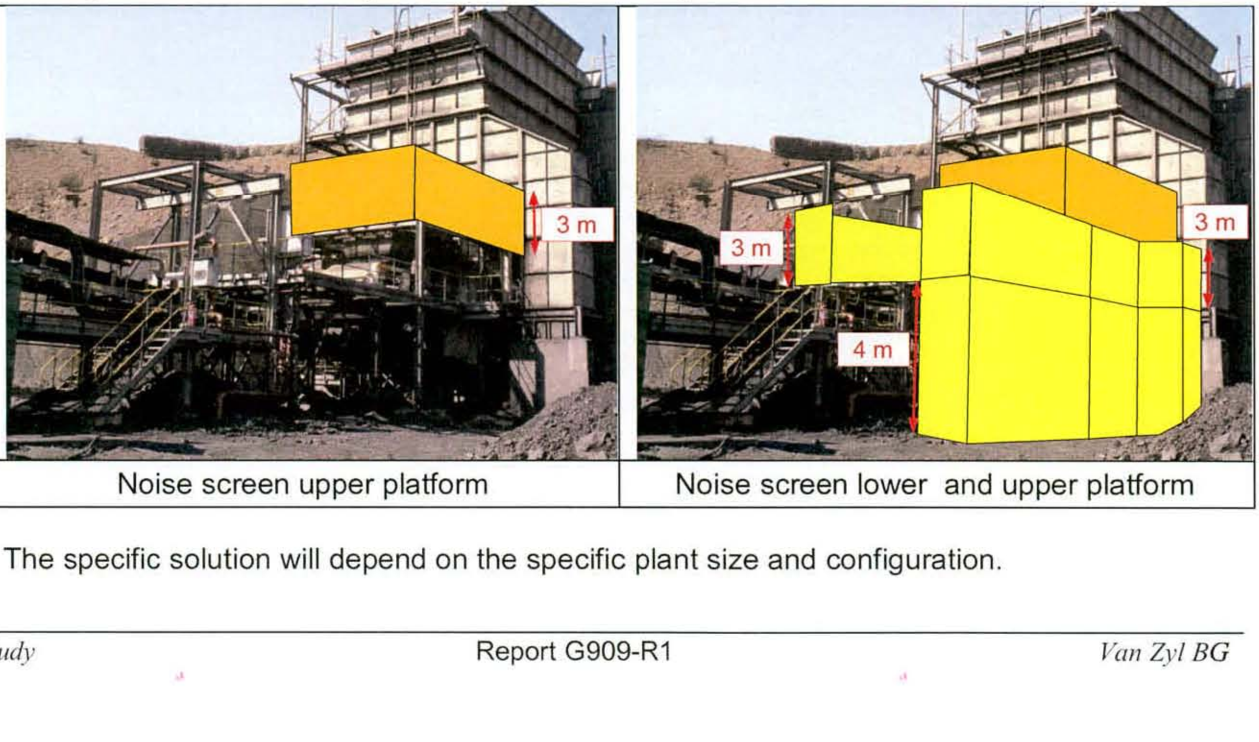
(a) Reduction of Primary Crusher noise can be achieved by construction of noise screens.

(b) The unit is screened off on the sides from ground level up to the top of equipment on the upper platform. At the front of the lower platforms (and if required on the upper platform as well) the screens are left open for operational access.

(c) No roof cover is required over the screened area.

(d) Noise screens comprise of removable acoustic panels mounted against a steel supporting framework which have to be designed for each particular case.

Primary Crusher: Example illustrating the concept of a noise reduction scheme



Noise screen upper platform	Noise screen lower and upper platform

The specific solution will depend on the specific plant size and configuration.

Reverse alarms and truck hooters

The noise study report cannot be prescriptive about specific measures to be implemented, considering that they may have operational and safety implications.

- The mine is advised to instruct drivers and fleet owners of trucks to use hooters in a disciplined manner for purposes of safety only, not for signalling or any other purpose. The mine should be very strict in enforcing this rule and should verify compliance.

- It should be considered to replace conventional beeping type reverse alarms (which produce a whistle) with buzzer types (which produce a hissing sound) on vehicles operating on the mine, waste rock dumps in particular. This measure will only be successful if implemented on all vehicles and if adherence by contractors is strictly enforced and monitored on a continual basis.

Noise screening by waste rock dumps and berms

Construction of berms and placement of waste rock dumps around the mining area can be a very effective measure to screen off noise from plants and surface activities. The problem, ironically, is that in performing the task of constructing such a noise barrier, the trucks are generating more noise than what emanates from the included pit and other sources for which the noise screening is intended. This is a common problem at opencast mines and lasts for as long as night-time construction of the berm, or dumping on top of the berm for that matter, takes place.

4.3 Mitigation – Decommissioning phase

No mitigation will be required during decommissioning.

4.4 Mitigation – Closure phase

No mitigation will be required after decommissioning.

5 Summary of noise impact implications

To the best of the information available and the accuracy of noise prediction methods, the noise impact implications of the Moonlight Project are as summarised in Table 5.1.

Validity of impact ratings and the findings of the study may be summarised as follows:

Adequacy of predictive methods and tools used	Adequacy of underlying assumptions	Uncertainties in information provided
Noise predictions are based on internationally accepted and proven Concave method Confidence in the predictions, assuming that the information supplied by the mine is valid, is high	Sufficient information was available for acoustic modelling of mining and plant noise, as well as for prediction of road traffic noise for the preferred pipeline product transport method	Uncertainties in information provided are relatively small and do not compromise the validity of the significance ratings of impacts or the main findings of the study

Table 5.1

Noise impact implications of the Moonlight Project

Receptor	Activity		Before Mitigation						After Mitigation					
			Severity	Duration	Spatial Scale	Consequence	Probability	Significance	Severity	Duration	Spatial Scale	Consequence	Probability	Significance
Construction phase														
Farms bordering the mine	Site and road construct		L	M	M	L	L	L	L	M	M	L	L	L
	Blasting		M	M	M	M	M	M	L	M	M	L	M	L
Operational Phase														
Within 5 km radius from mine centre	Plant & Pit operations + Blasting		M	M	M	M	H	M	L	M	M	L	L	L
Up to 1,5 km from road	Road noise Product transported by road		M	M	M	M	M	M	M	M	M	M	M	M
> 150 m	Road noise Product transported by pipeline		L	L	L	L	L	L	L	L	L	L	L	L
Decommissioning Phase														
Study Area	Dismantling		L	L	L	L	L	L	L	L	L	L	L	L
Closure Phase														
Study Area	No residual noise		L	L	L	L	L	L	L	L	L	L	L	L

6 Monitoring programme

Construction phase

Noise during the construction phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Operational phase

(a) A noise survey should be carried out immediately after commissioning.

(b) Follow up with annual surveys at the same locations.

(c) Measure noise levels at each of the reference points shown on the map in Figure 6.1.

(d) Measure the A-weighted equivalent continuous noise level in a sequence of 10-minute intervals covering a period of preferably 24 hours, but at least the night-time period from 22:00 to 06:00.

(e) Process the data and determine the increase in ambient level caused by plant or open cast noise.

(f) Assess the noise impact of the mine and present the findings in a report. If applicable, make recommendations for steps required to mitigate excessive noise.

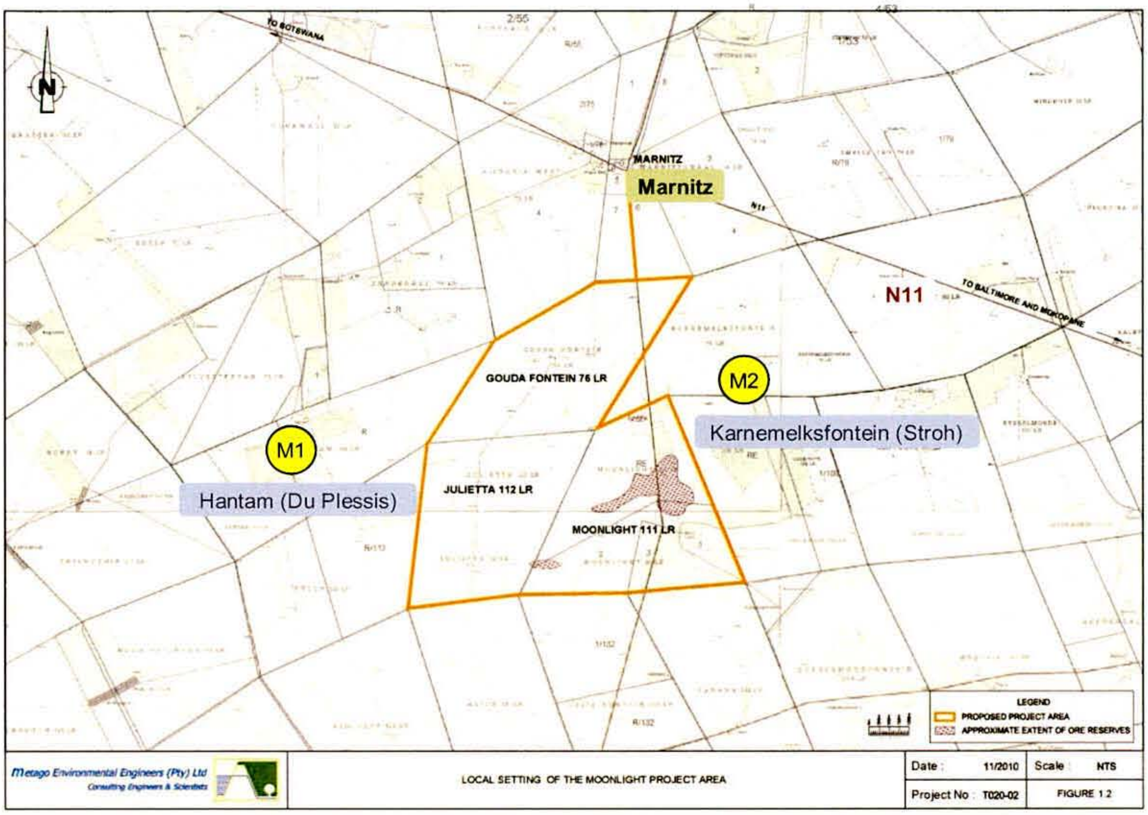
(g) Equipment, calibration and measurement procedures must comply with the requirements laid down in SANS 10103.

Decommissioning phase

Noise during the commissioning phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Closure phase

Noise during the closure phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.



Monitoring Point	Position	Receptor / Area
M1	S23 13.602 E28 07.728	Farm house on farm Hantam (Du Plessis)
M2	S23 12.790 E28 14.665	Farm house on farm Karnemelksfontein (Stroh)

Figure 6.1

Locations where noise should be monitored in annual surveys

7 References

[1] SANS 10328: *Methods for environmental noise impact assessments.*

[2] SANS 10103: *The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication.*

[3] SANS ARP 014 *The calculation of sound propagation by the Concawe method.*

[4] Department of environment affairs: *Noise control regulations under the environment conservation act*, (Act No. 73 of 1989), Government Gazette No. 15423, 14 January 1994.

[5] Siyazi Gauteng (Pty) Ltd, Traffic Impact Assessment Report; Proposed Moonlight Iron Ore Mine, May 2011.

Ben van Zyl MSc (Eng) PhD
Acoustical Engineer

Appendix A

Noise survey complete data sets

Figure A.1 Monitoring Point M1 Farm Hantam (Du Plessis) 18 to 19 Apr-2011

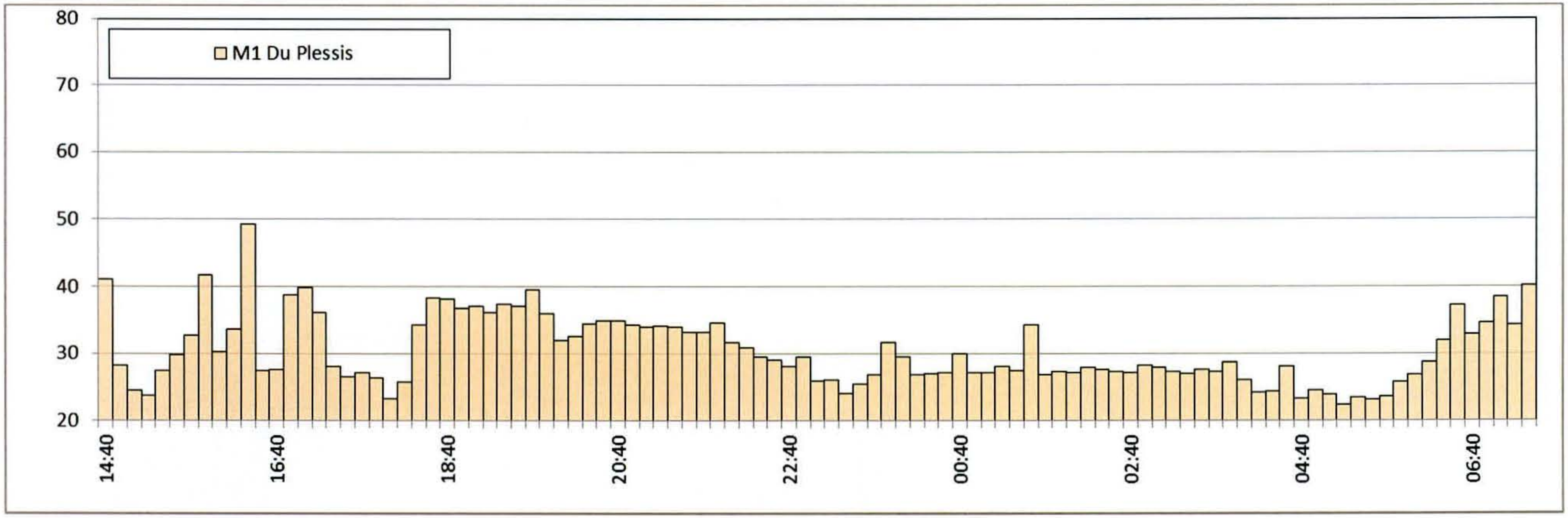
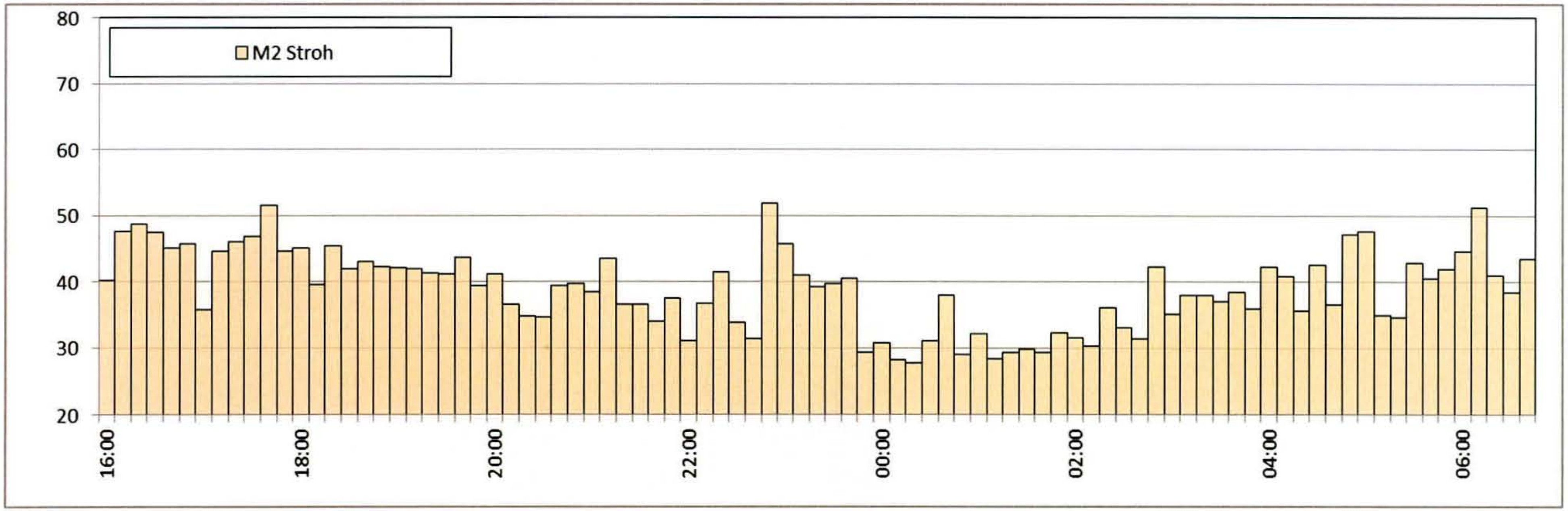


Figure A.2 Monitoring Point M2 Farm Karnemelksfontein (Stroh) 18 to 19 Apr-2011



Appendix B

Curriculum Vitae

Barend Gideon van Zyl - ID No 4605105089082
P O Box 70 596, Die Wilgers, 0041; 542 Verkenner Ave, Die Wilgers, Pretoria

Qualifications		Institution	Year Completed
(1)	BSc (Eng) Elec	University of Pretoria	1970
(2)	BSc (Eng) Hon Elec	University of Pretoria	1972
(3)	MSc (Eng) (Cum Laude)	University of Pretoria	1974
(4)	PhD	University of Natal	1986

MSc thesis: Sound intensity vector measurement
PhD thesis: Sound transmission analysis by measurement of sound intensity vector

Professional registration and membership

- Southern African Acoustics Institute Fellow (President 1994) Member since 1974

Career

CSIR 1971 – 1989	Join the Acoustics Division of the Council for Scientific and Industrial Research (CSIR) in 1971; Chief Specialist Research Engineer 1981 - 1989. • Undertake basic and applied acoustic research & development projects; • Pioneer technique and instrumentation for measurement of sound intensity vector, leading to sponsored research & consulting work in the Netherlands (TNO 1978) and Denmark (Brüel & Kjaer 1981). • Acoustic consulting engineering services rendered in the fields of building acoustics, industrial noise control, acoustic materials development & environmental acoustics.
Advena 1989 – 1990	• SA Space Programme: Manager Systems Integration & Environmental Test Laboratories; • Design and commissioning of ultra-high noise level simulation facilities for endurance testing of rocket launch vehicles, spacecraft, satellites, instrumentation and payload.
SABS 1991 – 1994	• Acoustic consulting engineering services rendered to industry • Building acoustics, industrial noise control and environmental acoustics.
Private Practice Since 1995	Private practice - Sole proprietor - Acoustic consulting engineering • Noise studies; Environmental noise surveys; Blast noise measurement & assessment • Design & problem solving: Building acoustics, Industrial & machinery noise reduction, Vehicle noise reduction (road, rail & air) • Specialised services: Theoretical analysis & design of multi-layered acoustic panels. • SABS Laboratory & field testing: Building systems and materials, Equipment & machinery noise

Papers and publications

- Several papers presented at international congresses and symposia.
- Several papers published in international acoustic journals, such as

Journal of the Acoustical Society of America; Applied Acoustics; Noise Control Engineering Journal.

- Several papers published in Southern African journals.

Other

- Part-time lecturer: Architectural acoustics, Department of Architecture, University of Pretoria;
- Associate of and specialist advisor to SABS Laboratory for Sound and Vibration

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Practice Profile

Sole Proprietor: Dr Ben van Zyl

Practicing since 1995.

An independent sole proprietor acoustic consulting engineering practice with in-house expertise and experience in various acoustic disciplines, including building acoustics, noise impact studies, industrial noise control, test and evaluation and acoustic materials development. Based in Pretoria South Africa, specialist services have been rendered throughout the RSA, as well as in the United Kingdom, Taiwan, Pakistan, Madagascar, Mauritius and Botswana.

Equipped with state-of-the-art acoustic measuring instruments employed in noise monitoring surveys, measurement of blast noise, laboratory and field testing of systems and materials and as an aid in the investigation and solving of noise problems.

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Examples of projects

Acoustic Field: Noise studies

Project	For	Aspects
• Gauteng Waste Plant	S E Solutions	Impact study: New waste plant
• Swartland	Centurus	Residential and commercial development - traffic
• Mapoch II	Marlin Granite	Quarry Impact study: Blasting, open cast mining
• Delmas Extension: mining dev	Ingwe Coal Corp	Noise study – Plant, conveyors, trains, roads
• Twistdraai new access roads	Sasol Coal	Noise study – Roads, conveyors
• Bosjesspruit shaft ventilation fans	Sasol Coal	Noise study; shaft & ventilation fan noise rural area
• Hillendale new mining development	Iscor Heavy Minerals	Noise study – Plant, road transport
• Empangeni Central Processing Plant	Iscor Heavy Minerals	Noise study – Large processing plant
• Rooiwater mining development	Iscor Mining	Noise study – Plants, road & rail transport
• Sigma overland conveyor	Sasol Mining	Conveyors: Analyse sources of conveyor noise
• Sigma overland conveyor	Sasol Mining	Noise study – Conveyors measurement survey
• Maputo steel project	Gibb Africa	Noise study peer review: trains, slurry pipe
• Pump station noise	Transvaal Suiker Bpk	Noise study & Design for noise reduction
• GPMC Environmental Resources Plan	GPMC	Noise policy & resources plan
• Damelin College Randburg	Titan Construction	Assess impact of traffic noise on college + design
• Atterbury Value Mart	Parkdev	Land use planning - City Council requirements noise
• Holmes Place HAC London	V Z de Villiers	Land use planning - City Council requirements noise
• Elmar College Pretoria	Iscor Pension Fund	Assess impact of traffic noise on college + design
• Sanae 4 Base Antarctica	Dept Public Works	Noise impact design for control - Plant rooms
• New truck fuel & service station	Bulktrans	Noise study & Design for noise control
• Country Lane	Country Lane Dev	Land use planning – Road traffic noise impact
• Randburg Water Front	Randburg City	Advisor & specialist court witness
• Syferfontein overland conveyor	Sasol Coal	Noise impact as function of idler properties
• Twistdraai East mining noise	Sasol Coal	Mitigation of noise impact on neighbouring farm
• Little Loftus – The Rest Nelspruit	TAP de Beer	Sports bar - Impact study
• Blast noise	Somchem	Blast noise impact assess & design noise control
• Syferfontein overland conveyor	Sasol Coal	Noise impact as function of conveyor design
• Leeuwpan Mine Delmas district	Iscor/Ticor	Noise study – Plant noise, loading
• Fairbreeze open cast mine KwaZulu	Iscor/Ticor	Noise study – Open cast mining; plant, transport
• Brandspruit mine	Sasol	Noise study - Ventilation fan noise rural area
• Irene Ext 47	Irene Land Dev Corp	Noise study - Mixed development; road traffic noise
• Irene Ext 55	Irene Land Dev Corp	Noise study - Residential; road traffic noise
• Lynnwood filling station & car wash	Town Planning Hub	Noise study: Filling station & car wash in residential
• Lyttleton 190	Ferero	Noise study: Residential next to N1 highway
• Twistdraai N-East Mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Wesput open cast mine	Petmin	Noise study: Blasting, excavation & transport
• Gedex open cast mine	Petmin	Noise study: Open cast excavation & transport
• Kensington college	Centurus	Noise study: Sport grounds, roads
• Spandow mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Twistdraai Central Mine Shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Addington Hospital	Delen Oudkerk	Equipment outdoor noise impact & mitigation
• Fourways Gardens Country Club	Fourways Gardens	Music noise impact assess & design for mitigation
• Irene Ext 29	Irene Land Dev Corp	Noise study: New township & highway noise
• Pick 'n Pay Warehouse Meadowbrook	Pick 'n Pay	Truck movement & loading: Assessment
• Irene Sports Academy	Centurus	Impact assessment: Sports grounds & road traffic
• Jameson substation transformer	EThekwini Municipal	Transformer noise: Assess & design mitigation
• Eugene Marais Hospital	Eugene Marais Hosp	Plantroom & outdoor equipment impact & mitigate
• Klipspruit mine wash plant	Billiton & DRA	Coal wash plant infra-sound: design for mitigation
• Eagle Quarry	Mapochs Action	Quarry new application: peer review
• Blast Test Facility Somchem	Denel	Blast noise impact: assess & design for mitigation
• Virgin Active Sandton Gym	Virgin Active	Aerobics, squash & equipment: assess & mitigate
• Conveyor noise study	Bateman	Overland conveyor noise: Causes & parameters
• Zuid Afrikaans Hospital	Z A Hospital	Chiller outdoor noise: design for mitigation
• K54 Road	Tshwane	Noise Study: Future road through residential
• PWV6 Road	Gautrans	Noise Study: Future highway noise contours
• Zandfontein mine shaft	Sasol Mining	Noise Study: Mine shaft & fan noise outdoor impact
• Pierre van Ryneveld Ext 24	Van Vuuren Dev	Noise study: New township & highway noise
• PFG Glass new float plant	PFG Glass	Noise study: Future plant noise in residential area
• Sterkfontein residential development	M&T	Noise study: Road noise impact mitigation
• Sasol future Irenedale mine	Sasol	Noise study: Prediction of shaft & conveyor noise
• Ammunition demolition	SA Army	Noise study: Long distance noise impact assess
• Rietvlei Ridge residential development	M&T	Noise study: Road noise impact mitigation
• Mooiplaats / Hoekplaats	Chieftain	Noise study: Road noise impact mitigation
• Sasol Syferfontein conveyor	Bateman	Noise study: Noise complaints from farmers
• Madagascar Toliara Sands	Exxaro	Noise study: Future mining, plant, transport
• Rooipoort Mine	Sasol Mining	Noise study: Mining and conveyor noise
• Vlakplaats	Quantum	Noise study: Residential development
• Polokwane 2010 Soccer stadium	Africon	Noise study: Stadium noise in residential area
• New Clydesdale colliery	Exxaro	Noise study: Open cast mining, blasting and plant
• Grootfontein ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Cicada Pycna mating call study	Anglo Platinum	Cicada mating call – Mining noise interference
• Weltevreden ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Leandra North new colliery	Ingwe	Noise study: Mining development
• PTM new platinum mine	PTM Platinum	Noise study: Mining development
• Lyttleton X191	Pro-Direct	Noise study, new residential development
• Barking noise nuisance	Vd Merwe	Barking noise measurements, specialist report

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Vanggatfontein	Exxaro/Metago	Noise study: Open-cast mine
• Forfar clay mining extension	Forfar/Zimbiwe	Noise study: Open-cast clay mining operations
• Luhfereng Doringkop development	Bigen	Noise study: Mixed development, train noise
• K113 Road noise study	Heartland/Bokamoso	Noise study: Road, mixed development
• Eland Mine	Exstrata/Metago	Noise study: New access road for product transport
• Sheraton Hotel	Pan Pacific Property	Noise study: Hotel impact on residential area
• Sishen Infrastructure Relocation	Kumba/Synergistics	Noise study: Railway route options evaluation
• Tharisa Mine noise monitoring	Tharisa/Metago	Baseline noise monitoring surveys
• Sishen Mine baseline monitoring	Kumba/Synergistics	Baseline noise monitoring surveys
• Sishen Mine Protea discard dump	Kumba/Synergistics	Discard dump location - Noise screening assess
• Eastplats	Barplats/Metago	Noise study: New vertical shaft
• Inyanda Mine noise disturbance	Exxaro	Noise surveys: Noise complaints investigation
• Irenedale Mine commissioning	Sasol Mining	Noise Monitoring: New shaft operational phase
• Honey Ridge indoor shooting range	Insul-Coustic	Design for noise reduction
• Sishen Mine expansion project 2	Kumba/Synergistics	Noise study: New processing plant Sishen mine
• Sishen Mine noise monitoring	Kumba Iron Ore	Peer review: Baseline survey
• Sishen Mine new 10 MTon plant	Kumba/AGES	Noise study: New 10 MTon processing plant
• Khameni Kalkfontein/Tamboti Mine	Khameni/Metago	Noise study: New opencast mine and plant
• Exxaro Kalbasfontein rail load-out	Exxaro	Noise survey: Assess impact of railway loud-out
• Sishen Mine Lylyveld development	Kumba/EGES	Noise study: New opencast mine & transport
• Haasfontein new opencast mine	Exxaro/Synergistics	Noise study: New underground mine + conveyor
• Westlake mixed development	Heartland/SEF	Noise study: New urban mixed development
• Marlboro road M60	Heartland/SEF	Noise study: New road traffic noise modelling
• Driefontein Mine	Goldfields	Noise scoping assessment and recommendations
• Bokfontein Chrome Mine	Hernic/Metago	Noise study: New furnaces and beneficiation plant
• Eland opencast mine extensions	Exstrata/Metago	Noise study: Opencast mine extensions
• Tharisa Mine EMP noise monitoring	Tharisa/Metago	EMP noise monitoring survey 1
• Dragline noise reduction Kriel	Anglo Coal	Dragline noise – Design for noise reduction
• Ivory Coast noise studies	Metago	Peer review
• Eskom Grootvlei Power Station	Insul-Coustic	Design for noise reduction - internal
• Inyanda Mine	Exxaro	Design for plant noise reduction - enviromental

APPENDIX N: VISUAL STUDY

Specialist report prepared by Newton Landscape Architects, June 2011

VIA Report

Visual Impact Assessment for the Proposed Moonlight Iron Ore Project, Limpopo Province

Yonanda Martin (Pri Sci Nat)
Newtown Landscape Architects

PROPOSED MOONLIGHT IRON ORE PROJECT

MARNITZ

LIMPOPO PROVINCE

Submitted to:

Metago Environmental Engineers (Pty) Ltd

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Prepared by:

Newtown Landscape Architects cc

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NLA Project No:	1293/E10L
Report Revision No:	VIA Report (Rev 01)
Date Issued:	June 2011
Prepared By:	Yonanda Martin (Pri. Sci. Nat.)
Reference:	Moonlight Iron Ore Project

EXPERTISE OF SPECIALISTS

Name:	Yonanda Martin
Qualification:	MSc. (Env.)
Professional Registration:	Pri. Sci. Nat.
Experience in Years:	4 years
Experience	Yonanda Martin has been doing visual impact assessments for Newtown Landscape Architects since 2006. She has experience in a wide range of visual impact assessments which include visual impacts for game lodges, transmission lines, roads, mines and telecommunication masts. Projects that she worked on include: • **Eskom Ngwedi Substation** (PBAI), North West Province • **NBC Belfast Project** (Exxaro), Mpumalanga • **Tamboti Platinum Mine** (Metago), Limpopo • **De Wittekrans** (GCS), Mpumalanga • **Dorsfontein West Expansion** (GCS (Pty) Ltd), Kriel • **Ferreira Coal Mining** (GCS (Pty) Ltd), Ermelo • **Eskom Honingklip** (Kv3 Engineers), Muldersdrift • **SANRAL PWV3** (Jeffares & Green), Hartbeespoort

Name:	Graham A Young
Qualification:	Pr LArch
Professional Registration:	South African Council for the Landscape Architectural Profession (SACLAP) Institute of Landscape Architects of South Africa (ILASA)
Experience in Years:	30 years
Experience	Graham is a landscape architect with thirty years' experience. He has worked in Southern Africa and Canada and has valuable expertise in the practice of landscape architecture, urban design and environmental

	planning. He is also a senior lecturer, teaching urban design and landscape architecture at post and under graduate levels at the University of Pretoria. He specializes in Visual Impact Assessments and has won an Institute of Landscape Architects Merit Award for his VIA work.

Please refer to Appendix F for the Declaration of Independence and to Appendix G for the CV's of the specialists.

ABBREVIATIONS

CSIR	Council for Scientific and Industrial Research
EIA	Environmental Impact Assessment
IFC	International Finance Corporation
SACLAP	South African Council for the Landscape Architectural Profession
TSF	Tailings Storage Facility
VIA	Visual Impact Assessment
WRD	Waste Rock Dump

GLOSSARY OF TERMS

Aesthetic Value

Aesthetic value is the emotional response derived from the experience of the environment with its particular natural and cultural attributes. The response can be either to visual or non-visual elements and can embrace sound, smell and any other factor having a strong impact on human thoughts, feelings and attitudes (Ramsay, 1993). Thus aesthetic value encompasses more than the seen view, visual quality or scenery, and includes atmosphere, landscape character and sense of place (Schapper, 1993).

Aesthetically significant place

A formally designated place visited by recreationists and others for the express purpose of enjoying its beauty. For example, tens of thousands of people visit Table Mountain on an annual basis. They come from around the country and even from around the world. By these measurements, one can make the case that Table Mountain (a designated National Park) is an aesthetic resource of national significance. Similarly, a resource that is visited by large numbers who come from across the region probably has regional significance. A place visited primarily by people whose place of origin is local is generally of local significance. Unvisited places either have no significance or are "no trespass" places. (after New York, Department of Environment 2000).

Aesthetic impact

Aesthetic impact occurs when there is a detrimental effect on the perceived beauty of a place or structure. Mere visibility, even startling visibility of a project proposal, should not be a threshold for decision making. Instead a project, by virtue of its visibility, must clearly interfere with or reduce (i.e. visual impact) the public's enjoyment and/or appreciation of the appearance of a valued resource e.g. cooling tower blocks a view from a National Park overlook (after New York, Department of Environment 2000).

Cumulative Effects

The summation of effects that result from changes caused by a development in conjunction with the other past, present or reasonably foreseeable actions.

Landscape Character

The individual elements that make up the landscape, including prominent or eye-catching features such as hills, valleys, woods, trees, water bodies, buildings and roads. They are generally quantifiable and can be easily described.

Landscape Impact

Landscape effects derive from changes in the physical landscape, which may give rise to changes in its character and how this is experienced (Institute of Environmental Assessment & The Landscape Institute, 1996).

Study area

For the purposes of this report the Moonlight Iron Ore Study area refers to the proposed project footprint / project site as well as the 'zone of potential influence' (the area defined as the radius about the centre point of the project beyond which the visual impact of the most visible features will be insignificant) which is a 10km radius surrounding the proposed project footprint / site.

Project Footprint / Site

For the purposes of this report the Moonlight Iron Ore Project *site / footprint* refers to the actual layout of the mine.

Sense of Place *(genius loci)*

Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. *Genius loci* literally means 'spirit of the place'.

Sensitive Receptors

Sensitivity of visual receptors (viewers) to a proposed development.

Viewshed analysis

The two dimensional spatial pattern created by an analysis that defines areas, which contain all possible observation sites from which an object would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1,8m above ground level.

Visibility

The area from which project components would potentially be visible. Visibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance.

Visual Exposure

Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion and visual acuity, which is also influenced by weather and light conditions.

Visual Impact

Visual effects relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity.

Visual Intrusion

The nature of intrusion of an object on the visual quality of the environment resulting in its compatibility (absorbed into the landscape elements) or discord (contrasts with the landscape elements) with the landscape and surrounding land uses.

Worst-case Scenario

Principle applied where the environmental effects may vary, for example, seasonally to ensure the most severe potential effect is assessed.

Zone of Potential Visual Influence

By determining the zone of potential visual influence it is possible to identify the extent of potential visibility and views which could be affected by the proposed development. Its maximum extent is the radius around an object beyond which the visual impact of its most visible features will be insignificant primarily due to distance.

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1 EXECUTIVE SUMMARY

1.1 Introduction

Newtown Landscape Architects was appointed by Metago Environmental Engineers (Pty) Ltd to undertake a Visual Impact Assessment to assess and evaluate the *significance* of potential visual impacts of the proposed Moonlight Iron Ore Project. This specialist report forms part of the *Environmental Impact Assessment* for the proposed project. The Moonlight Iron Ore Project consists of an open pit mine, mineral processing facilities, mine residue disposal facilities and various support infrastructure and services.

The proposed Moonlight Iron Ore project area is located along the N11 between Mokopane and the Botswana border and is approximately 60km north of Lephalale (Ellisras).

Landscape character, landscape quality and "sense of place" determined that the visual resource (scenic beauty of the study area) is of *high* quality for the proposed study area. The visibility of the project was established and then qualified in terms of its visual intrusion and exposure. Photographic panoramas were taken from representative viewpoints and altered through a computer simulation technique to characterize the nature of the visual intrusion of the proposed project components on the landscape. The *significance* of impacts was then predicted using intensity, extent, duration, and probability criteria.

1.2 Aim and Objectives

The main aim of the study is to ensure that the visual consequences of the proposed Moonlight Iron Ore Project are understood and adequately considered in the environmental impact assessment process. The main objectives of the study are to:

- Describe the baseline environment;
- To define the visual resource and sense of place of the study area;
- To identify the sensitive receptors / lines of site;
- To determine the visual intrusion by simulating the proposed components;
- To determine the visibility and visual exposure;
- Consider the visual impacts and;
- To recommend possible mitigation measures.

1.3 Visual Resource

The overriding sense of place of the study area can be described as being tranquil / serene. The study area is characterized by the woodlands, koppies and the Lephalale River located to the east and south of the site. The land use within the study area varies from game farms and grazing activities to agricultural fields, farmsteads and villages.

1.4 Sensitive Viewers

Sensitive viewing locations within the study area include views from the local roads, the Hunters Dream, Moonlight & Good Hope Lodges, Tabana, Boekenhoutfontein as well as farmsteads. Other viewers are the small villages within the area. These villages are located outside of the 'zone of potential influence' and the proposed Project will not be visible from the villages.

1.5 Predicted Impact

It is predicted that negative visual impacts would result from the construction, operational and decommissioning phases of the proposed Project. During closure phase the site will be rehabilitated but the waste rock dump and the tailings storage facility will remain and will therefore contribute to the long term negative visual impact of the Project.

The significance of the visual impact is rated as ***high***. The proposed TSF will remain on site after closure and even though it will be mitigated the impact will remain ***high***. The existing vegetation and undulating plains form a natural screen and block most of the views from sensitive viewers.

2 INTRODUCTION

2.1 Project Overview

Newtown Landscape Architects (NLA) were commissioned by Metago Environmental Engineers (Pty) Ltd to carry out a Visual Impact Assessment (VIA) for the proposed Moonlight Iron Ore Project, Limpopo Province ("**the Project**"). The proposed Project will consist of an open pit mine, mineral processing facilities, mine residue disposal facilities and various support infrastructure and services.

2.2 Proposed Study area

The Project is located on the farms Moonlight 111 LR, Gouda Fontein 886 (previously Gouda Fontein 76 LR) and Julietta 112 LR. The Project site is located along the N11 between Mokopane and the Botswana border and is located approximately 60km north of Lephalale (Ellisras).

2.3 Terms and Reference

A specialist study is required to assess the visual impacts arising from the proposed Project. Based on the general requirements for a comprehensive VIA, the following terms of reference were established:

- Define the visual resource and sense of place of the area;
- Identify the sensitive viewers;
- Determine the visual impact using recognized international criteria and by simulating the key components of the project;
- Assess the visual impact;
- Recommend visual mitigation measures;
- Comply with the IFC (International Finance Corporation) Standards.

2.4 Assumption, Uncertainties and Limitations

In determining the significance of the visual impact of the proposed Project, with mitigation, it is assumed that mitigation measures proposed in the report are effectively implemented and managed throughout the life of the project.

3 APPROACH AND METHODOLOGY

The World Bank's IFC Standards: Environmental, Health and Safety Guidelines for Mining refers to Visual Impact Assessments by stating that:

"Mining operations, and in particular surface mining activities, may result in negative visual impacts to resources associated with other landscape uses such as recreation or tourism. Potential contributors to visual impacts include high walls, erosion, discolored water, haul roads, waste dumps, slurry ponds, abandoned mining equipment and structures, garbage and refuse dumps, open pits, and deforestation. Mining operations should prevent and minimize negative visual impacts through consultation with local communities about potential post-closure land use, incorporating visual impact assessment into the mine reclamation process. Reclaimed lands should, to the extent feasible, conform to the visual aspects of the surrounding landscape. The reclamation design and procedures should take into consideration the proximity to public viewpoints and the visual impact within the context of the viewing distance. Mitigation measures may include strategic placement of screening materials including trees and use of appropriate plant species in the reclamation phase as well as modification in the placement of ancillary facilities and access roads."

These standards were also considered in the report.

3.1 Approach

The assessment of likely effects on a landscape resource and on visual amenity is complex, since it is determined through a combination of quantitative and qualitative evaluations. (The Landscape Institute with the Institute of Environmental Management and Assessment, 2002). When assessing visual impact the worst-case scenario is taken into account. Landscape and visual assessments are separate, although linked, procedures.

The landscape, its analysis and the assessment of impacts on the landscape all contribute to the baseline for visual impact assessment studies. The assessment of the potential impact on the landscape is carried out as an impact on an environmental resource, i.e. the physical landscape. Visual impacts, on the other hand, are assessed as one of the interrelated effects on people (i.e. the viewers and the impact of an introduced object into a particular view or scene).

3.1.1 The Visual Resource

Landscape character, landscape quality (Warnock, S. & Brown, N., 1998) and "sense of place" (Lynch, K., 1992) are used to evaluate the visual resource i.e. the receiving environment. A qualitative evaluation of the landscape is essentially a subjective matter. In this study the aesthetic evaluation of the study area is determined by the professional opinion of the author based on site observations and the results of contemporary research in perceptual psychology.

Aesthetic value is the emotional response derived from the experience of the environment with its particular natural and cultural attributes. The response is usually to both visual and non-visual elements and can embrace sound, smell and any other factor having a strong impact on human thoughts, feelings and attitudes (Ramsay, 1993). Thus aesthetic value is more than the combined factors of the seen view, visual quality or scenery. It includes atmosphere, landscape character and sense of place (Schapper, 1993). Refer also to Appendix B for further elaboration.

Studies for perceptual psychology have shown human preference for landscapes with higher visual complexity, for instance scenes with water or topographic interest. On the basis of contemporary research, landscape quality increases where:

- Topographic ruggedness and relative relief increase;
- Water forms are present;
- Diverse patterns of grassland and trees occur;
- Natural landscape increases and man-made landscape decreases;
- Where land use compatibility increases (Crawford, 1994).

Aesthetic appeal (value) is therefore considered **high** when the following are present (Ramsay, 1993):

- Abstract qualities: such as the presence of vivid, distinguished, uncommon or rare features or abstract attributes;
- Evocative responses: the ability of the landscape to evoke particularly strong responses in community members or visitors;
- Meanings: the existence of a long-standing special meaning to a particular group of people or the ability of the landscape to convey special meanings to viewers in general;
- Landmark quality: a particular feature that stands out and is recognized by the broader community.

And conversely, it would be **low** where:

- Limited patterns of grasslands and trees occur;
- Natural landscape decreases and man-made landscape increases;
- And where land use compatibility decreases (after Crawford, 1994).

In determining the quality of the visual resource, both the objective and the subjective or aesthetic factors associated with the landscape are considered. Many landscapes can be said to have a strong sense of place, regardless of whether they are considered to be scenically beautiful but where landscape quality, aesthetic value and a strong sense of place coincide - the visual resource or perceived value of the landscape is considered to be very high. The criteria given in Appendix B are used to assess landscape quality, sense of place and ultimately to determine the aesthetic value of the study area.

3.1.2 Sensitivity of Visual Resource

The sensitivity of a landscape or visual resource is the degree to which a particular landscape type or area can accommodate change arising from a particular development, without detrimental effects on its character. Its determination is based upon an evaluation of each key element or characteristic of the landscape likely to be affected. The evaluation will reflect such factors such as its quality, value, contribution to landscape character, and the degree to which the particular element or characteristic can be replaced or substituted (Institute of Environmental Assessment & The Landscape Institute, 1996:87).

3.1.3 Sense of Place

Central to the concept of sense of place is that the landscape requires uniqueness and distinctiveness. The primary informant of these qualities is the spatial form and character of the natural landscape taken together with the cultural transformations and traditions associated with the historic use and habitation of the area. According to Lynch (1992), sense of place "is the extent to which a person can recognize or recall a place as being distinct from other places – as having a vivid, unique, or at least particular, character of its own". Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. In some cases these values allocated to the place are similar for a wide spectrum of users or viewers, giving the place a universally recognized and therefore, strong sense of place.

Because the sense of place of the study area is derived from the emotional, aesthetic and visual response to the environment, it cannot be experienced in isolation. The landscape context must be considered. With this in mind, the combination of the natural landscape (mountains, streams and the vegetation) together with the manmade structures (residential areas, roads, mining activities and power lines) contribute to the sense of place for the study area. It is these land-uses, which define the area and establish its identity.

3.1.4 Sensitive Viewer Locations

The sensitivity of visual receptors and views are dependent on the location and context of the viewpoint, the expectations and occupation or activity of the receptor or the importance of the view. This may be determined with respect to its popularity or numbers of people affected, its appearance in guidebooks, on tourist maps, and in the facilities provided for its enjoyment and references to it in literature or art.

The most sensitive receptors may include:

- Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape;
- Communities where development results in changes in the landscape setting or valued views enjoyed by the community;
- Occupiers of residential properties with views affected by the development.

Other receptors include:

- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value);
- People traveling through or past the affected landscape in cars or other transport modes;
- People at their place of work.

Views from residences and tourist facilities / routes are typically more sensitive, since views from these are considered to be frequent and of long duration.

3.1.5 Landscape Impact

The landscape impact of a proposed development is measured as the change to the fabric, character and quality of the landscape caused by the physical presence of the proposed development Identifying and describing the nature and intensity (severity) of change in the landscape brought about by the proposed new mine is based on the professional opinion of the author supported by photographic simulations. It is imperative to depict the change to the landscape in as realistic a manner as possible (Van Dortmont in Lange, 1994). In order to do this, photographic panoramas were taken from key viewpoints and altered using computer simulation techniques to illustrate the physical nature of the proposed project in its final form within the context of the landscape setting. The resultant change to the landscape is then observable and an assessment of the anticipated visual intrusion can be made.

3.1.6 Visual Impact

Visual impacts are a subset of landscape impacts. Visual impacts relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effect with respect to visual amenity. Visual impact is therefore measured as the change to the existing visual environment (i.e. views) caused by the intervention and the extent to which that change compromises (negative impact) or enhances (positive impact) or maintains the visual quality of the scene as perceived by people visiting, working or living in the area. This approach reflects the layman's concerns, which normally are:

- Will I be able to see the new development?
- What will it look like?
- Will the development affect views in the area and if so how?

Landscape and visual impacts do not necessarily coincide. Landscape impacts can occur with the absence of visual impacts, for instance where a development is wholly screened from available public views, but nonetheless results in a loss of landscape elements and landscape character within a localized area (the site and its immediate surrounds).

3.1.7 Severity of Visual Impact

The severity of visual impact is determined using visual intrusion, visibility and visual exposure criteria (Hull, R.B. and Bishop, I.E., 1988), qualified by the sensitivity of viewers (visual receptors) towards the proposed development. The severity of visual impact is therefore concerned with:

- The overall impact on the visual amenity, which can range from degradation through to enhancement;
- The direct impacts of the mine upon views of the landscape through intrusion or obstruction;
- The reactions of viewers who may be affected.

For a detailed description of the methodology used in this study, refer to Appendix B, C and D. Image 1 below, graphically illustrates the visual impact process:

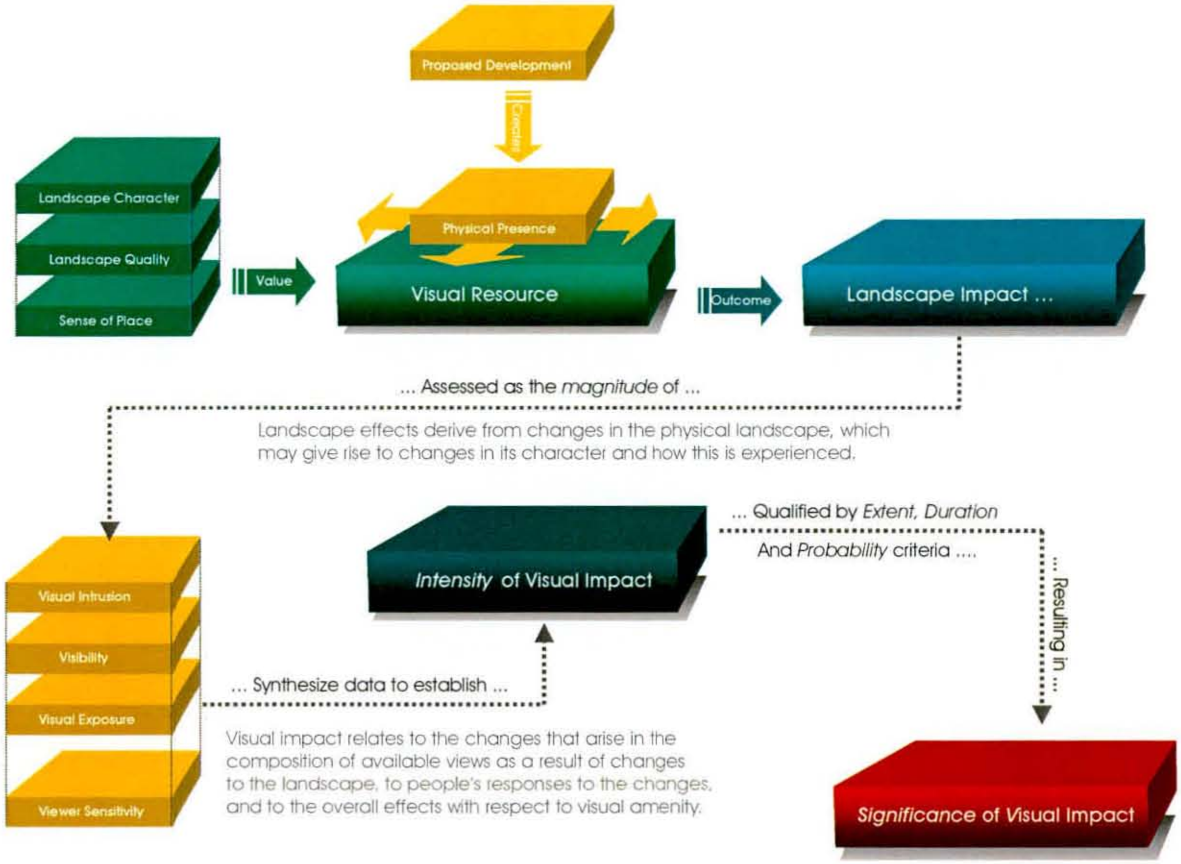

Image 1: Visual Impact Process

3.1.8 Significance of Visual Impact

The significance of impact was determined based on the Hacking method of determination of the significance of impacts. This method was provided by Metago Environmental Engineers.

Significance = consequence x probability

Consequence is a function of severity, spatial extent and duration

Severity, based on

- Intensity of impact (will the impact be of High, Moderate or Low intensity?) and

Scale/ spatial extent of impact

- Will the impact affect the national, regional or local environment, or only that of the site?

Occurrence duration, based on

- Duration of occurrence (how long may it last).

A detailed description of the significance rating criteria is included as Appendix D.

3.2 Methodology

The following method was used:

- Site visit: A field survey was undertaken and the study area scrutinized to the extent that the receiving environment could be documented and adequately described;
- Project components: The physical characteristics of the project components were described and illustrated;
- General landscape characterization: The visual resource (i.e. receiving environment) was mapped using field survey and GIS mapping technology. The description of the landscape focused on the nature of the land rather than the response of a viewer (refer to Appendix B);
- The **landscape character** of the study area was described. The description of the landscape focussed on the nature and character of the landscape rather than the response of a viewer;
- The **quality of the landscape** was described. Aesthetic appeal was described using recognized contemporary research in perceptual psychology as the basis;
- The **sense of place** of the study area was described as to the uniqueness and distinctiveness of the landscape. The primary informant of these qualities was the spatial form and character of the natural landscape together with the cultural transformations associated with the historic / current use of the land;
- Illustrations, in very basic **simulations**, of the proposed project were overlaid onto panoramas of the landscape, as seen from nearby sensitive viewing points to give the reviewer an idea of the scale and location of the proposed project within their landscape context;
- **Visual intrusion** (contrast) of the proposed project was determined by simulating its physical appearance from sensitive viewing areas;
- The **visibility** of the proposed project was determined;
- The **impact** on the visual environment and sense of place of the proposed project was rated based on a professional opinion and the method described below; and
- Measures that could mitigate the negative impacts of the proposed project were recommended.

4 DESCRIPTION OF THE PROJECT

The proposed Project will include the establishment of an iron ore mine and processing plant at the Moonlight Iron Ore project site. The proposed mine will include an open pit mining area and associated overburden / waste rock dump, beneficiation plant and associated tailings disposal facility, water management facilities and various support infrastructure and services. The design life of the project is 30 years.

During closure the tailings storage facility (TSF) and waste rock dump (WRD) will be left on site. The TSF will be rehabilitated with a combination of waste rock, topsoil and re-vegetation.

The following heights were used for the purpose of the visual impact assessment:

Mining Structures	Approximate Heights
Waste Rock Dump	15m
Concentrator Plant	15m
Other Associated Infrastructure	12m
Process Water and Fresh Water Ponds	3m
Tailings Storage Facility	38m

5 THE ENVIRONMENTAL SETTING

5.1 The Study Area

The Project site is situated along the N11 between Mokopane (Potgietersrus) and the Botswana Border. The study area as well as surrounding areas is mainly used for grazing, game farms and hunting. There are properties that are used for agricultural purposes but these fields are mostly associated with the smaller villages within the area. Refer to Figure 1: Locality and Views as well as Figure 2: Visual Resource for the location of the proposed project as well as the surrounding land use.

5.2 Surrounding Land Use

5.2.1 Residential

The closest residential area is the small town of Marnitz which is located approximately 3km to the north of the Project site. Other towns and residential areas along the N11 is Baltimore, which is approximately 25km south-east and Makopane which is 135km south of the site. Polokwane is located approximately 145km south-east and Lephalale (Ellisras) approximately 60km south-west of the site. To the west and the south of the site are smaller villages that are scattered out with more densely grouped villages towards the Lephalale River. The closest village to the Project site is Van Leeuwen which is located approximately 10km to the south-west of the site. Other residential uses include the farm houses and game farms (Hunters Dream and Moonlight & Good Hope Lodge) within the area.

5.2.2 Tourism

The proposed Project area as well as surrounding areas, especially towards Lephalale, is well known for hunting and therefore there are quite a few lodges and game farms in the area. There is four tourist accommodation facilities located within the 'zone of influence'; these include the Hunters Dream, Moonlight & Good Hope Lodge, Tabana and Boekenhoutfontein. These farms are mainly used for hunting and accommodation.

5.2.3 Infrastructure and mining

The only infrastructure within the study area is the N11, the local gravel farm roads, telephone and power lines. There is currently no other mining activities located within the vicinity of the proposed Project. The closest mining operations are Grootgeluk Coal Mine, approximately 80km to the south-west and Potties Platinum Mine which is located approximately 110km to the south-east of the site.

5.2.4 Transportation systems

The main access route to the proposed Project site is the N11 which is also one of the main routes to Botswana. Other roads are the local farm roads which are mainly gravel roads.

5.3 Landscape Character

Landscape character types are landscape units refined from the regional physiographic and cultural data derived from 1:50 000 topographical maps, aerial photographs and information gathered on the site visit. Dominant landform and land use features (e.g., hills, rolling plains, valleys and urban areas) of similar physiographic and visual characteristics, typically define landscape character types. Refer to the views in Figures 3 – 12, which illustrate the nature and character of the study area. The viewpoint locations are indicated in Figure 1: Location and Views.

The study area has a slightly rolling to flat topography with rocky outcrops, koppies and the Lephalale River towards the west and south of the site (refer to View 11 Figure 6, View 18 Figure 9 and View 22 Figure 10). The existing vegetation, as described by Mucina and Rutherford (2006), is a combination of Roodeberg Bushveld and Limpopo Sweet Bushveld. The Roodeberg Bushveld is characterised by slightly undulating plains with short closed woodland to tall open woodland and a poorly developed grass layer. The Limpopo Sweet Bushveld is described as being an area with undulating plains, which is traversed by tributaries of the Limpopo River and short open woodland. The proposed study area is a combination of the above mentioned characteristics. There are areas with dense, low to medium height trees as well as areas where the trees are less dense with more grassland. There are however areas, especially along the road between Marnitz and Melinda (south of the project site), where there are pockets of taller trees.

The farms within the study area are used for game, grazing and agricultural purposes.

Man-made structures within the area included the roads, power lines, villages and the farmsteads.

Figure 2: Visual Resource, illustrates the spatial distribution of the various landscape character types and the section below will rate the relative value of these types.

6 VISUAL RESOURCE

6.1 Visual Resource Value / Scenic Quality

The spatial distribution of the landscape types discussed in 5.3 is illustrated in Figure 2: Visual Resource. The figure also rates the relative scenic quality of each type and its landscape sensitivity.

Scenic quality ratings (using the scenic quality rating criteria described in Appendix C) were assigned to each of the landscape types defined in Figure 2: Visual Resource. The *highest* value is assigned to the Lephalale River which is located to the east and south of the project area. The koppies and woodland areas are also regarded as having a high visual resource value. The agricultural activities, grazing fields, villages and farmsteads are rated as being *moderate*.

The landscape type with the *lowest* scenic quality rating is assigned to the infrastructure which includes the local roads and power lines.

The overall study area can be regarded as having a ***high*** visual resource value with sections, such as the agricultural fields and villages that display a moderate visual resource value. Due to the overall high visual resource value of the study area and no other mining or industrial activities within the area, the study area is regarded to be sensitive to change to the landscape.

A summary of the visual resource values is tabulated in Table 1 below.

Table 1: Value of the Visual Resource
(After The Landscape Institute with the Institute of Environmental Management and Assessment (2002))

High	Moderate	Low
Lephalale River, Koppies and Woodland	Villages, Farmsteads, Agricultural Activities and Lodges	Transport infrastructure and power lines.
This landscape type is considered to have a *high* value because it is a:	This landscape type is considered to have a *moderate* value because it is a:	This landscape type is considered to have a *low* value because it is a:
Distinct landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve and which has a	**Common landscape that exhibits some positive character but which has evidence of alteration /degradation/erosion of features resulting in areas of more mixed character.**	**Minimal landscape generally negative in character with few, if any, valued features.**

strong sense of place.		
Sensitivity:	Sensitivity:	
It is sensitive to change in general and will be detrimentally affected if change is inappropriately dealt with.	**It is potentially sensitive to change in general and change may be detrimental if inappropriately dealt with**	

Sections that are placed in bold are applicable to the study area.

6.2 Sense of Place

The sense of place for the proposed study area derives from the combination of all landscape types and their impact on the senses. The natural environment with the outstretched woodland, koppies and the Lephalale River gives the area a serene sense of place while the combination of agricultural activities and villages gives the area a more rural or farming sense of place. The Game Lodges and hunting activities evoke a sense of excitement and anticipation which is in contrast to the serene, quiet and rural sense of place. The area is however dominated by a natural landscape that evokes and overall sense of tranquillity.

7 VISUAL RECEPTORS

7.1 Views

Typical views will be from the local roads, especially roads that will run along, or close to, the proposed Project site, views from farmsteads as well as views from the game farms, lodges and villages.

7.1.1 Sensitive Viewer Locations

The overall area is known for its hunting activities and game lodges. Visitors that stay or travel along the local roads within the study area as well as visitors travelling within the game farms adjacent to the project site will be exposed to the mining activities. Other sensitive viewers will include the local residents that stay or travel through the area.

Table 2: Potential Sensitivity of Visual Receptors – the Project

High	Moderate	Low
Visitors of Game Farms / Lodges and travelling along local routes, whose intention or interest may be focused on the landscape; **Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;** **Occupiers of residential properties with views affected by the development.**	People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value); People travelling through or past the affected landscape in cars, on trains or other transport routes.	Visitors and people working in mining / prospecting activities and travelling along local mining roads whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

Highlighted sections are applicable to the study area.

8 LANDSCAPE and VISUAL IMPACT

8.1 Landscape Impact

The *landscape impact* (i.e. the change to the fabric and character of the landscape caused by the physical presence of a development) of the proposed project will be ***high*** as the physical impact of the construction, operation, decommissioning and closure of the mining activities will disturb a great percentage of the proposed study site. The main disturbance would be during the construction, operational and decommissioning phase of the project.

However, as stated in the approach, the physical change to the landscape should be understood in visibility and aesthetic terms within the context of the study area. The following sections discuss the effect that the proposed project activities will have on the visual and aesthetic environment.

8.2 Severity of Visual Impact

The severity of visual impact is determined using visibility, visual intrusion, visual exposure and viewer sensitivity criteria. When the severity of impact is qualified with spatial, duration and probability criteria the significance of the impact can be predicted (refer to Appendix C).

8.2.1 Visual Intrusion

Visual intrusion deals with the notion of contextualism i.e. how well does a project component fit into the cultural aesthetic of the landscape as a whole? As discussed in Section 5.3, the study area is characterised by a flat to slightly rolling topography with koppies and the Lephalale River towards the east and south of the study area. Vegetation within this study area is a combination of dense woodland and more open woodland with grassland. There are also patches of agricultural fields.

The visual intrusion of the proposed Project will be ***high*** as mining activities are introduced into a natural environment. During construction most of the vegetation will be removed and the project will become visible as new structures are being built. Dust will also contribute to the visual intrusion of the construction phase. The visual intrusion for this phase will therefore be ***high***.

During the operational phase of the Project the visual intrusion will remain ***high*** as the plant will be standing. The TSF and WRD will become more intrusive as the Project evolves and reaches completion.

At decommissioning and closure of the mining structures, visual intrusion will still be ***high*** in the unmitigated scenario due to the unrehabilitated TSF and WRD and decommissioning activities will cause dust. Even though the TSF is rehabilitated by covering it with waste rock dump and surrounding it with vegetation the proposed TSF will still be intrusive to the study area. The main reason for this is the fact that there are no other similar structures located within the area.

The visual intrusion of the proposed Project after sunset will be ***high***. Currently the proposed study area is only exposed to lights from the farmsteads, game lodges and the villages. The proposed Project will light up the area and will be visible over a longer distance.

Table 3 rates and summarises visual intrusion of the project components when the *worst case scenario (no mitigation)* is taken into account.

Table 3: Visual Intrusion – the Project

High	**Moderate**	**Low**	**Positive**
Construction, Decommissioning, Operational Phase Closure phase – if not rehabilitated successfully			
Because the proposed project: **- Has a substantial negative effect on the visual quality of the landscape;** **- Contrasts dramatically with the patterns or elements that define the structure of the immediate landscape;** **- Contrasts with land use, settlement or enclosure patterns of the immediate environment;**	Because the proposed project: - Has a moderate negative effect on the visual quality of the landscape; - Contrasts with the patterns or elements that define the structure of the landscape; - Is partially compatible with land use (utilities) patterns of the general area.	Because the proposed project: - Contrasts minimally with the patterns or elements that define the structure of the landscape; - is mostly compatible with land use, (utility) patterns.	The proposed project: - Has a beneficial effect on the visual quality of the landscape; - Enhances the patterns or elements that define the structure of the landscape; - Is compatible with land use, settlement or enclosure patterns.

- Cannot be 'absorbed' into the landscape from key viewing areas	- Is partially 'absorbed' into the landscape from key viewing areas	- is 'absorbed' into the landscape from key viewing areas	
***Result*:** **Notable change in landscape characteristics over an extensive area and/or intensive change over a localized area resulting in major changes to key views**	*Result:* Moderate change in landscape characteristics over localized area, resulting in a moderate change to key views	*Result* Moderate change in landscape characteristics over localized area resulting in a minor change to a few key views.	*Result* Positive change in key views.

Sections that are placed in bold are applicable to the proposed Moonlight Iron Ore Project.

8.2.2 Visibility and Visual Exposure

In determining the visibility of the project the 'zone of potential influence' was established and is regarded to be 10km. Over 10km the impact of the proposed activities would have diminished due to the diminishing effect of distance (the project recedes into the background) and atmospheric conditions (haze) on visibility. Also, at this distance the features would appear in the background of a view and thus begin to be 'absorbed' into the landscape setting.

Visual exposure of the project is determined by the proximity of the viewer to the proposed new project component. The impact of an object in the foreground (0 – 0.8km) is greater than the impact of that same object in the middle ground (0.8km – 3km) which, in turn is greater than the impact of the object in the background (greater than 3km) of a particular scene. Therefore the visibility and visual exposure for viewers within 0.8km of the proposed project will be high, for viewers between 0.8km and 3km it will be moderate and beyond 3km it will be low.

8.2.2.1 Day Time

The proposed Project will be visible from approximately 70% of the 'zone of potential influence'. It is clear from the viewshed analysis that the proposed site has a slightly rolling topography which assists in screening the view from areas within the 'zone of potential influence'. The proposed Project is screened from views along the N11 which is located towards the north and the north-east of the

Project site. The site is also screened from areas located to the west and south-west of the proposed Project site.

The proposed Project falls within the foreground view for viewers that will travel on the local road between Marnitz and Melinda and will therefore have a ***high*** visibility. The proposed Project will however be partially obstructed for viewers travelling along this road as the vegetation along the road forms a dense vegetation screen and will therefore result in a ***moderate*** visibility. The Project will become highly visible once you are travelling next to the site or approach the entrance of the mine. The only farmstead within this zone is the farmstead located on the Farm Moonlight, which is assumed will not be used as a residential unit as it falls within the footprint of the proposed Project.

The proposed Project falls within the middle-ground view for viewers from the Moonlight & Good Hope Lodge, which is located to the east of the proposed site. Views towards the Project will however be mostly obstructed or totally screened due to the dense vegetation cover and will therefore have a ***low*** visibility.

The proposed Project will fall in the background view for viewers from the Hunters Dream Lodge, Tabana, Boekenhoutfontein and farmsteads located to the west and north-west of the proposed site. The visibility will therefore be ***low*** and could even become insignificant. It should however be noted that if the viewers from the lodge / game farm or farmstead is below the tree canopy the view will be obstructed or totally screened by the tree / vegetation layer. This will however change once the viewer is elevated above the tree canopy / vegetation layer and the topography of the area doesn't screen views towards the mining activities. The visibility could become moderate for these viewers but might not be high due to the distance of the viewer towards the mining activities.

The proposed Project will not be visible for viewers from Marnitz as views will be screened by the natural topography and dense vegetation screen. The Project will also not be visible for viewers from the villages located towards the west, south-west and south of the site as these villages are located 10km and beyond and the vegetation of the area forms a vegetation screen.

Due to the dense vegetation cover and the slightly rolling topography the proposed Project is screened from most of the viewers travelling on the local roads within the study site as well as in the surrounding area.

During closure the proposed Project will remain visible as the proposed TSF and WRD will remain on site. If the TSF and the WRD remain on site and are not rehabilitated successfully the visibility will remain high especially for people travelling on the local roads. The visibility can however be reduced if successfully rehabilitated as per the mitigation measures given in Section 9.

8.2.2.2 Night Time

The proposed Project will have a significant impact after sunset. The study area is currently exposed to the impact of lights from the farmsteads, game lodges and the small villages. The lights from the mining activities will light up the area after sunset and will be more visible over a longer distance; it will therefore have a visual impact beyond the 'zone of potential influence'.

Tables 4 below are based on the *worst-case scenario (no mitigation)*.

Table 4: Visibility of the proposed Project

High	Moderate	Low
Visual Receptors	***Visual Receptors***	***Visual Receptors***
If the project is visible from over half the zone of potential influence, and/or views are mostly unobstructed and / or the majority of viewers are affected.	**If the project is visible from less than half the zone of potential influence, and / or views are partially obstructed and or many viewers are affected**	**If the project is visible from less than a quarter of the zone of potential influence, and / or views are mostly obstructed and or few viewers are affected.**

Sections that are placed in bold are applicable to the proposed Moonlight Iron Ore Project.

The proposed Project will result in a ***high*** exposure for people travelling between Marnitz and Melinda. The exposure will be ***moderate*** for people living on the farmsteads and people visiting the lodges as these are located further than 0.8km from the proposed Project. The exposure will be ***low to insignificant*** for residents from the villages.

Table 5: Visual Exposure of the proposed Project

	High Exposure (significant contribution to visual impact)	**Moderate Exposure (moderate contribution to visual impact)**	**Low Exposure (minimal influence on visual impact)**	**Insignificant Exposure (negligible influence on visual impact)**
Local roads	**0 – 0.8 km**	**0.8 – 3.0 km**	**3.0 – 10.0 km**	**Over 10.0 km**
Farmsteads	0 – 0.8 km	**0.8 – 3.0 km**	**3.0 – 10.0 km**	**Over 10.0 km**

Game Lodges	0 – 0.8 km	**0.8 – 3.0 km**	**3.0 – 10.0 km**	**Over 10.0 km**
Villages	0 – 0.8 km	0.8 – 3.0 km	3.0 – 10.0 km	**Over 10.0 km**

Sections that are placed in bold are applicable to the proposed Moonlight Iron Ore Project.

8.2.3 Sensitivity of Visual Receptors

When visual intrusion, visibility and visual exposure are incorporated, and qualified by sensitivity (visual receptors) criteria the intensity of the visual impact of the proposed project can be determined.

The sensitivity of the visual receptors will be ***high*** for the proposed Moonlight Iron Ore Project as the proposed Project will bring change to the landscape character and views from sensitive viewing areas such as residences, lodges and local roads.

Table 6: Sensitivity of Receptors for the proposed Project

High	Moderate	Low
Moonlight & Good Hope Lodge, Hunters Dream Lodge, Tabana, Boekenhoutfontein, Farmsteads and Villages	Motorist (residents & tourists) travelling between Marnitz and Melinda	
Users of all outdoor recreational facilities including public rights of way (tourist routes), whose intention or interest may be focused on the landscape;	People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value);	The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view (i.e. office and industrial areas).
Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;	**People travelling through or past the affected landscape in cars,** on trains or other transport routes;	Roads going through urban and industrial areas
Occupiers of residential properties with views affected by the development.		

Sections that are placed in bold are applicable to the proposed Moonlight Iron Ore Project.

8.2.4 Severity of Visual Impact

In qualifying the criteria used to establish the severity of visual impact, a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgement (Institute of

Environmental Assessment & The Landscape Institute, 1996). These results are based on *worst-case scenarios* when the impact of all aspects is taken together and when viewed from the various sensitive viewing points as indicated in Table 7 below.

According to the results tabulated in Table 7 below the *severity* of visual impact will be ***high*** as a new project will be introduced into a natural environment. The visual intrusion will also be high as this project is the only one of its sort in the area and will therefore be intrusive to the area. Although the proposed Project will result in the loss or alteration of the baseline characteristics of the area the proposed Project will be partially screened / obstructed from sensitive viewers as a result of the vegetation and the topography. The visibility of the Project is rated as being moderate for most of the sensitive viewers and falls either within the middle-ground or background view of the viewer. The visibility is only high for viewers travelling along the local road between Marnitz and Melinda.

Table 7: Severity of Impact of the proposed Project

High	Moderate	Low	Negligible
Motorist (residents & tourists) travelling between Marnitz and Melinda	Moonlight & Good Hope Lodge, Hunters Dream Lodge, Tabana, Boekenhoutfontein Farmsteads	Villages	
Total loss of or major alteration to key elements / features / characteristics of the baseline.	**Partial loss of or alteration to key elements / features / characteristics of the baseline.**	**Minor loss of or alteration to key elements / features / characteristics of the baseline.**	Very minor loss or alteration to key elements/features/characteristics of the baseline.
i.e. Pre-development landscape or view and / or introduction of elements considered to be totally uncharacteristic when set within the attributes of the receiving landscape.	i.e. Pre-development landscape or view and / or introduction of elements that may be prominent but may not necessarily be considered to be substantially uncharacteristic when set within the attributes of the receiving landscape.	i.e. Pre-development landscape or view and / or introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape.	i.e. Pre-development landscape or view and / or introduction of elements that is not uncharacteristic with the surrounding landscape – approximating the 'no change' situation.
High scenic quality impacts would result.	**Moderate scenic quality impacts would result**	**Low scenic quality impacts would result.**	Negligible scenic quality impacts would result.

9 MITIGATING MEASURES

In considering mitigating measures there are three rules that were considered - the measures should be feasible (economically), effective (how long will it take to implement and what provision is made for management / maintenance) and acceptable (within the framework of the existing landscape and land use policies for the area). To address these, the following principles have been considered:

- Mitigation measures should be designed to suit the existing landscape character and needs of the locality. They should respect and build upon landscape distinctiveness.
- It should be recognized that many mitigation measures, especially the establishment of planted screens and rehabilitation, are not immediately effective.

The following mitigation measures are suggested. It should however be kept in mind that even though the TSF will be rehabilitated the structure will still be intrusive and visible and therefore the impact after mitigation will remain ***high***.

9.1 Project Area Development

- It is proposed that as little vegetation as possible be removed for the construction of the proposed Project.
- The dense vegetation forms a good visual screen and if too much vegetation is removed it could create openings from where the activities will be seen.
- Ensure, wherever possible, all existing natural vegetation is retained and incorporated into the mine site rehabilitation.

9.2 Earthworks

- Dust suppression techniques should be in place at all times during the construction, operational, the decommissioning and closure phases.
- Only the footprint and a small 'construction buffer zone' around the proposed Project should be exposed. In all other areas, the natural vegetation should be retained.

9.3 Landscaping

- If at all possible the WRD should be shaped in such a way that it blends with the contours of the surrounding landscape.
- It is suggested that the WRD be lower in height in order to reduce the visibility and intrusiveness of the WRD. It should be kept in mind that as soon as the mining structures (WRD, TSF or Plant) exceed the level of the tree canopy it becomes more visible and intrusive to the viewer.

- The side slopes should be designed in such a way that they are articulated to form natural shaded areas.
- Another alternative that could be considered is to use a chemical, such as Permeon, that ages the rock and gives it a more natural feeling or texture. The cost implications should however be considered.
- Vegetation screens (combination of indigenous trees and shrubs) can be planted along the boundaries of sensitive viewing areas. Please note that when planting a vegetation screen the screen should be as close as possible to the sensitive viewer. It is therefore suggested that the screen be planted along the boundary of the site in order to screen the view from motorist. The vegetation screen will only partially screen views towards the mining activities.
- It is however suggested that as little vegetation as possible should be removed during site clearance and a vegetation buffer should be allowed for between the Project and sensitive viewers.
- A registered Professional Landscape Architect should assist with the final design of the WRD.
- A registered Professional Landscape Architect should be appointed to assist with the rehabilitation plan for the TSF.
- Only vegetation indigenous to the area should be used for rehabilitation / landscaping purposes during the closure phase.

9.4 Access Roads

During construction, operation, decommissioning and closure of the Project, access roads will require an effective dust suppression management programme, such as the use of non-polluting chemicals that will retain moisture in the road surface.

9.5 Lighting

Light pollution should be seriously and carefully considered and kept to a minimum wherever possible as light at night travels great distances. If security lighting is used it should only be used where absolutely necessary and carefully directed.

The negative impact of night lighting, glare and spotlight effects, can be mitigated using the following methods:

- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the substation.
- Avoid high pole top security lighting along the periphery of the substation site and use only lights that are activated on movement at illegal entry to the site.

- Use security lighting at the periphery of the site that is activated by movement and are not permanently switched on.

10 SIGNIFICANCE OF VISUAL IMPACT

The Hacking Method was used to determine the significance of the impact, refer to Annexure D for the detailed criteria table.

Table 8 below summarises the results of the criteria (refer to Appendix D for description of criteria) used to determine the significance of the visual impact. The ratings for impact with mitigation assume that the mitigation measures are implemented as described in Section 9.

According to the ratings as tabulated in Table 8 below the significance of the visual impact for the proposed Project will be ***high***. The proposed TSF will remain on site and therefore even though mitigation measures, as discussed in Section 9, are implemented successfully the significance of the visual impact will remain ***high***.

Table 8: Summary of Visual Impacts and Mitigation Measures of the Proposed Project

Environmental Impacts	Severity (see Table 7)	Extent	Duration	Probability	*Significance* without Mitigation / *Significance* with Mitigation	Mitigation Measures	Mitigation Potential
MOONLIGHT IRON ORE PROJECT							
Motorist (residents & tourists) travelling between Marnitz and Melinda							
Construction Phase							
- The proposed project is located in a landscape of high value - The operational activities are visible from more than half the zone of potential influence, - Construction activities (start up) will cause a major change in landscape characteristics over a localized area resulting in a high change in key views and have a high negative effect on the visual quality of the area. - Construction activities will add to the cumulative negative effect on the visual quality of the landscape.	High	Medium	High	High	**High**	• Dust suppression techniques should be in place at all times during the construction and operational phases. • As mush vegetation as possible should be kept during site clearance. The trees form a vegetation screen and will block views to sensitive viewers. • Where a paved road surface is required, paving materials with 'earthy' tones that complement the natural red / brown colours and textures of the soils in the area should be used. • Rehabilitate / restore exposed areas as soon as possible after construction activities are complete. • Paint buildings and	Although mitigation measures will be implemented motorist will travel directly next to the site and will therefore be able to see the mining activities. Mitigation will only partially obstruct views

Environmental Impacts	Severity (see Table 7)	Extent	Duration	Probability	*Significance* without Mitigation / *Significance* with Mitigation	Mitigation Measures	Mitigation Potential
					High	structures with colours that reflect and complement the natural browns of the surrounding landscape. Avoid pure light colours and pure blacks. • To reduce the potential of glare external surfaces of buildings and structures should be articulated or textured to create interplay of light and shade. • Avoid high pole top security lighting along the periphery of the project area and use only lights that are activated on illegal entry to the project area. • Light public movement areas (pathways and roads) with low level 'bollard' type lights and avoid post top lighting.	
Operational Phase							
- The proposed project is located in a landscape of high value - The operational activities are visible from more than half the zone of potential influence, - The operation will cause intensive change over a fairly widespread area resulting in major changes in key views from nearby sensitive viewing areas. - Operational activities will add to the cumulative negative effect (adding to prospecting and mining within the study area) on the visual quality of the landscape.	High	Medium	High	High	High / High	• Dust suppression techniques should be in place at all times during the construction and operational phases. • Avoid high pole top security lighting along the periphery of the project area and use only lights that are activated on illegal entry to the project area. • Light public movement areas (pathways and roads) with low level 'bollard' type lights and avoid post top lighting. • Employ a Professional Landscape Architect / Environmental Engineer to assist with the ongoing rehabilitation as well as the design (contouring) of the WRD. • Include a tree buffer area around the proposed site. • Vegetation should be kept where possible and excessive removal of vegetation avoided.	Although mitigation measures will be implemented motorist will travel directly next to the site and will therefore be able to see the mining activities. Mitigation will only partially obstruct views.
Decommissioning							

Environmental Impacts	Severity (see Table 7)	Extent	Duration	Probability	*Significance* without Mitigation / *Significance* with Mitigation	Mitigation Measures	Mitigation Potential
- The proposed project is located in a landscape of high value - The project is visible from more than half the zone of potential influence, - During decommissioning the structures will be removed and the area of their footprint rehabilitated. - The TSF and WRD will however remain on site and will have permanent visual impact.	High	Medium	High	High	**High** **High**	• Dust suppression techniques should be in place at all times during the decommissioning and closure phases. • Employ a Professional Landscape Architect to assist with the rehabilitation as well as the final design (contouring) of the WRD	Although mitigation measures will be implemented motorist will travel directly next to the site and will therefore be able to see the mining activities. Mitigation will only partially obstruct views.
Closure Phase							
- The proposed project is located in a landscape of high value - The project is visible from more than half the zone of potential influence, - During decommissioning the structures will be removed and the area of their footprint rehabilitated. - The TSF and WRD will however remain on site and will have permanent visual impact.	High	Medium	High	High	**High** **High**	• Dust suppression techniques should be in place at all times during the decommissioning and closure phases. • Employ a Professional Landscape Architect to assist with the rehabilitation as well as the final design (contouring) of the WRD	Although mitigation measures will be implemented motorist will travel directly next to remaining TSF. Mitigation will only partially obstruct views.

Environmental Impacts	Severity (see Table 7)	Extent	Duration	Probability	*Significance* without Mitigation / *Significance* with Mitigation	Mitigation Measures	Mitigation Potential
MOONLIGHT IRON ORE PROJECT Moonlight & Good Hope Lodge, Hunters Dream Lodge, Tabana, Boekenhoutfontein and Farmsteads							
Construction Phase							
- The proposed project is located in a landscape of high value - The operational activities are visible from more than half the zone of potential influence, - Construction activities (start up) will cause a major change in landscape characteristics over a localized area resulting in a high change in key views and have a high negative effect on the visual quality of the area. - Construction activities will add to the cumulative negative effect on the visual quality of the landscape.	Medium	Medium	High	High	**High** / **High**	• Dust suppression techniques should be in place at all times during the construction and operational phases. • As mush vegetation as possible should be kept during site clearance. The trees form a vegetation screen and will block views to sensitive viewers. • Where a paved road surface is required, paving materials with 'earthy' tones that complement the natural red / brown colours and textures of the soils in the area should be used. • Rehabilitate / restore exposed areas as soon as possible after construction activities are complete. • Paint buildings and structures with colours that reflect and complement the natural browns of the surrounding landscape. Avoid pure light colours and pure blacks. • To reduce the potential of glare external surfaces of buildings and structures should be articulated or textured to create interplay of light and shade. • Avoid high pole top security lighting along the periphery of the project area and use only lights that are activated on illegal entry to the project area. • Light public movement areas (pathways and roads) with low level 'bollard' type lights and avoid post top lighting.	The proposed mining activities will be intrusive to the area and will be visible above the tree canopy even though mitigation measures are implemented.
Operational Phase							

Environmental Impacts	Severity (see Table 7)	Extent	Duration	Probability	*Significance* without Mitigation / *Significance* with Mitigation	Mitigation Measures	Mitigation Potential
- The proposed project is located in a landscape of high value - The operational activities are visible from more than half the zone of potential influence, - The operation will cause intensive change over a fairly widespread area resulting in major changes in key views from nearby sensitive viewing areas. - Operational activities will add to the cumulative negative effect (adding to prospecting and mining within the study area) on the visual quality of the landscape.	Medium	Medium	High	High	**High** **High**	• Dust suppression techniques should be in place at all times during the construction and operational phases. • Avoid high pole top security lighting along the periphery of the project area and use only lights that are activated on illegal entry to the project area. • Light public movement areas (pathways and roads) with low level 'bollard' type lights and avoid post top lighting. • Employ a Professional Landscape Architect / Environmental Engineer to assist with the ongoing rehabilitation as well as the design (contouring) of the WRD. • Include a tree buffer area around the proposed site. • Vegetation should be kept where possible and excessive removal of vegetation avoided.	The proposed mining activities will be intrusive to the area and will be visible above the tree canopy even though mitigation measures are implemented.
Decommissioning							
- The proposed project is located in a landscape of high value - The project is visible from more than half the zone of potential influence, - During decommissioning the structures will be removed and the area of their footprint rehabilitated. - The TSF and WRD will however remain on site and will have permanent visual impact.	Medium	Medium	High	High	**High** **High**	• Dust suppression techniques should be in place at all times during the decommissioning and closure phases. • Employ a Professional Landscape Architect to assist with the rehabilitation as well as the final design (contouring) of the WRD	The proposed TSF will remain on site and even though mitigation measures will be implemented the structure will still be intrusive to the area as it will be visible above the tree canopy.
Closure Phase							

Environmental Impacts	Severity (see Table 7)	Extent	Duration	Probability	*Significance* without Mitigation / *Significance* with Mitigation	Mitigation Measures	Mitigation Potential
- The proposed project is located in a landscape of high value - The project is visible from more than half the zone of potential influence, - During decommissioning the structures will be removed and the area of their footprint rehabilitated. - The TSF and WRD will however remain on site and will have permanent visual impact.	Medium	Medium	High	High	**High** / **High**	• Dust suppression techniques should be in place at all times during the decommissioning and closure phases. • Employ a Professional Landscape Architect to assist with the rehabilitation as well as the final design (contouring) of the WRD	The proposed TSF will remain on site and even though mitigation measures will be implemented the structure will still be intrusive to the area as it will be visible above the tree canopy.