Appendix 5:

Specialist Studies Report

Agriculture Impact Assessment

NHLOSO
LAND RESOURCES

Conserving Natural Resources Through Sustainable Land Use

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AGRICULTURAL LAND CAPABILITY IMPACT ASSESSMENT FOR THE PROPOSED MINING RIGHT APPLICATION FOR COAL ON REMAINING EXTENT OF PORTION 1 AND REMAINING EXTENT OF THE FARM SCHURFDE POORT 1147 GS;THE FARM SHAWS NO.11317 GS; PORTION 1 AND THE REMAINING EXTENT OF THE FARM GANNA HOEK 1317 GS; PORTION 1 AND THE REMAINING EXTENT OF THE FARM KLIP BERG 2158 GT;THE FARM BRAKFONTEIN 1316 GS;PORTIONS 1, 2 AND THE REMAINING EXTENT OF THE FARM RAMAK 13696 GT, LOCATED WITHIN THE MAGISTERIAL DISTRICT OF UTHUKELA/ESTCOURT KWAZULU-NATAL PROVINCE.

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EXECUTIVE SUMMARY

Nhloso Land Resources (Pty) Ltd. was appointed by Vahlengwe Mining Advisory & Consulting (Pty) Ltd to conduct an Agricultural Land Capability Impact Assessment for the proposed Coal Mining activity approximately 18 km South-east of Ladysmith (uMnambithi), within the Magisterial District of uThukela/Estcourt Kwazulu-Natal Province, hereafter referred to as the Mining Right Area (MRA). The proposed mining activity will be conducted using highwall mining techniques for the first 12-15 years, which will be there-after be followed by conventional underground mining techniques. This involves the establishment of a 50m wide contour bench at the elevation of the coal upon which the highwall mining machine will be placed. The mined coal will be transported to the clean chemicals & fuel plant using a conveyor belt system, and subsequently sold directly to the power plant without beneficiation. Concurrent rehabilitation will be implemented where the coal has been mined as the highwall mining machine moves forward.

The Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental Screening Tool identified some areas with high agricultural sensitivity within the proposed MRA, which necessitated a site sensitivity verification assessment in order to evaluate the anticipated impacts of the proposed mining activity on the land capability and agricultural potential as required by the 2014 Environmental Impact Assessment (EIA) regulations. A soil survey was subsequently conducted on 28th – 31st of May 2025 to inform the land capability and agricultural potential of the identified soil forms within the MRA.

The MRA is dominated by wilderness, comprising of natural grasslands and woodlands. The observed agricultural activities included commercial livestock grazing camps within the Schurfde Poort Farm, while subsistence grazing and wildlife browsing were also observed across the remainder of the MRA. The majority of the MRA is dominated by the relatively shallow Mayo / Milkwood / Arcadia (My / Mw / Ar) soil forms, which constitute approximately 83.29% (5 325.64 ha) of the MRA. The remainder of the MRA comprised of moderately deep Mayo / Arcadia (My / Ar) and Avalon / Bainsvlei (Av / Bv) soil forms, which constitute approximately 13.94% (891.16 ha) and 2.77% (177.2 ha) of the MRA, respectively. The Avalon / Bainsvlei and Mayo / Arcadia soil forms are considered to have medium agricultural sensitivity to the proposed development in respect of their marginal agricultural potential for arable agriculture, while the Mayo / Milkwood / Arcadia soil forms are considered to have low agricultural sensitivity, attributed to their inherently poor agricultural potential and association with steep terrain.

The proposed mining activity is anticipated to have a negligible impact on the land capability and agricultural potential as the proposed highwall and underground mining techniques will not interfere with surface land use. However, the associated mining infrastructure i.e. the Clean Chemical & Fuel Plant, conveyer belt, workshop, offices, laydown areas, mine stores etc., is anticipated to have a significant impact on the land capability and agricultural potential given the long-term duration of the proposed mining operation. The identified cumulative impacts include land withdrawal from ongoing livestock grazing land use, and long-term inaccessibility of potentially arable land in the vicinity of the proposed surface infrastructure.

The mining infrastructure (Clean Chemical & Fuel Plant) will inevitably result in cessation of ongoing livestock grazing from approximately 175 ha within the Schurfde Poort Farm, which may increase the grazing intensity beyond the carrying capacity on the remaining (undisturbed areas) and potentially induce land degradation given the long-term duration of the proposed mining operation. It is therefore highly recommended that the viability of communal livestock grazing from surrounding landowners be considered and implemented to mitigate the residual impact on the land carrying capacity, and the proposed mitigation measures be appropriately implemented throughout the mining operation.

The inaccessibility of potentially arable land impact due to mining infrastructure will be negligible for the shallow Mayo / Milkwood / Arcadia soil forms due to their inherently poor agricultural potential; however, this is anticipated to have a moderately-high significance for both Avalon / Bainsvlei and Mayo / Arcadia soil forms, which is largely attributed to the long-term nature of mining operations. However, the impact can be effectively mitigated by relocating the proposed surface infrastructure within the delineated Mayo / Milkwood / Arcadia soil forms to mitigate the inaccessibility of potentially arable land impact for the Avalon / Bainsvlei and Mayo / Arcadia soil forms where feasible. The residual impacts from soil erosion, compaction and potential contamination will be localised and restricted to the vicinity of the proposed surface infrastructure. The soil erosion impact is considered to be moderately high for all identified soil forms due to inevitable exposure to wind and runoff erosion once the protective vegetation cover is removed. The soil compaction impact is anticipated to be moderately-high for all the identified soil forms; while the contamination risk would be largely dependent on the nature, volume and/or concentration of the contaminant(s) of concern. The proposed mitigation measures are anticipated to effectively alleviate all the identified residual impacts to a low significance for all the identified soil forms.

It is the Specialist's opinion that the identified impacts can be effectively mitigated to reinstate the ongoing livestock grazing and wildlife browsing from the land use and land capability perspective. Therefore, the proposed mining development can be considered in a positive manner provided that the recommended mitigation measures are implemented accordingly and the proponent is duly committed to ensure the land is adequately rehabilitated after decommissioning & closure.

Declaration

This report has been prepared according to the requirements as set out in Appendix 6 of the Environmental Impact Assessments EIA Regulations, 2017 (GNR. 326). I (the undersigned) declare the findings of this report free from influence or prejudice.

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DOCUMENT GUIDE

NEMA Regulations (2014) - Appendix 6	Relevant section in report
Details of the specialist(s) who prepared the report	Appendix A
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
A declaration that the person is independent in a form as may be specified by the competent authority	Appendix A
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.3
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2.1 to 2.6
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 3.5
An identification of any areas to be avoided, including buffers	N/A
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3.1 – 3.5
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.1
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 3 and 4
Any mitigation measures for inclusion in the EMPr	Section 5
Any conditions for inclusion in the environmental authorisation	Section 4 - 6
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 4 - 6
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 4 - 6
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	None

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ACRONYMS

AGIS	Agricultural Geo-Referenced Information Systems
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
IUSS	International Union of Soil Sciences
KZN	KwaZulu Natal
MRA	Mining Right Area
NLR	Nhloso Land Resources (Pty) Ltd.
ROM	Run-of-Mine
SACNASP	South African Council for Natural Scientific Professions
SOTER	Soil and Terrain

GLOSSARY OF TERMS

Apedal	Weakly structured soil morphology
Anthrosol	Man-made soil deposit with no recognisable diagnostic soil horizons, including soil materials which have not undergone pedogenesis (soil formation) to an extent that would qualify them for inclusion in another diagnostic horizon.
Haplic	Having a typical expression of certain features (typical in the sense that there is no further or meaningful characterization) and only used if none of the preceding qualifiers applies (adopted from Greek *haplous*, simple).
In-situ	Taking place "locally", or "on site", or "on the premises"
Soil Map Unit	The soil composition of a land, identified by a symbol and a boundary on a map.
Truncated	A genetic soil that has lost part of its upper horizon(s), typically through erosion.
Waste:	Any substance that is surplus, unwanted, rejected, discarded, abandoned or disposed of which the generator has no further use of for the purposes of production that must be treated or disposed of. Alternatively defined as "an inorganic or organic element or compound that, may exercise detrimental acute or chronic impacts on human health and the environment due to its toxicological, physical, chemical or persistency properties".

1. INTRODUCTION

Nhloso Land Resources (Pty) Ltd. was appointed by Vahlengwe Mining Advisory & Consulting (Pty) Ltd to conduct an Agricultural Land Capability Impact Assessment for the proposed Coal Mining activity approximately 18 km South-east of Ladysmith (uMnambithi), within the Magisterial District of uThukela/Estcourt Kwazulu-Natal Province. The Mining Right Area (MRA) comprises of the remaining extent of Portion 1 and remaining extent of the Farm Schurfde Poort 1147 GS; the Farm Shaws NO.11317 GS; Portion 1 and the remaining extent of the Farm Ganna Hoek 1317 GS; Portion 1 and the remaining extent of the Farm Klip Berg 2158 GT; the Farm Brakfontein 1316 GS; Portions 1, 2 and the remaining extent of the Farm Ramak 13696 GT, located within the Magisterial District Of uThukela/Estcourt Kwazulu-Natal Province, as depicted on the locality map in **Figure 1** below.

Dunrose Investment 174 (Pty) Ltd hereafter referred as "the applicant" holds the prospecting right in respect of the above-mentioned portions and farms (KZN30/5/1/1/2/10662 PR) renewed under (KZN30//5/1/1/2/11124 PR) for a period of three years commencing 10 November 2024 ending on 09 November 2025. The applicant commenced exploration on the property with an initial surface program in 2007 to ground truth existing surface maps and positions of coal outcrops and historic boreholes. The proposed mining activity will be conducted using the highwall mining techniques for the first 12-15 years, which will be there-after be followed by conventional underground mining techniques. This involves the establishment of a 50m wide contour bench at the elevation of the coal upon which the highwall mining machine will be placed. The mined coal will be transported to the clean chemicals & fuel plant using a conveyor belt system, and subsequently sold directly to the power plant without beneficiation. Concurrent rehabilitation will be implemented where the coal has been mined as the highwall mining machine moves forward. The required support infrastructure for the proposed coal mine includes administration buildings i.e. offices, workshop, laydown area, mine stores, change house and ablution facilities.

The Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental Screening Tool identified some areas with high agricultural sensitivity within the proposed MRA, which necessitated a site sensitivity verification assessment in order to evaluate the anticipated impacts of the proposed mining activity on the land capability and agricultural potential as required by the 2014 Environmental Impact Assessment (EIA) regulations. A soil survey was subsequently conducted on 28th – 31st of May 2025 to inform the land capability and agricultural potential of the identified soil forms within the MRA.

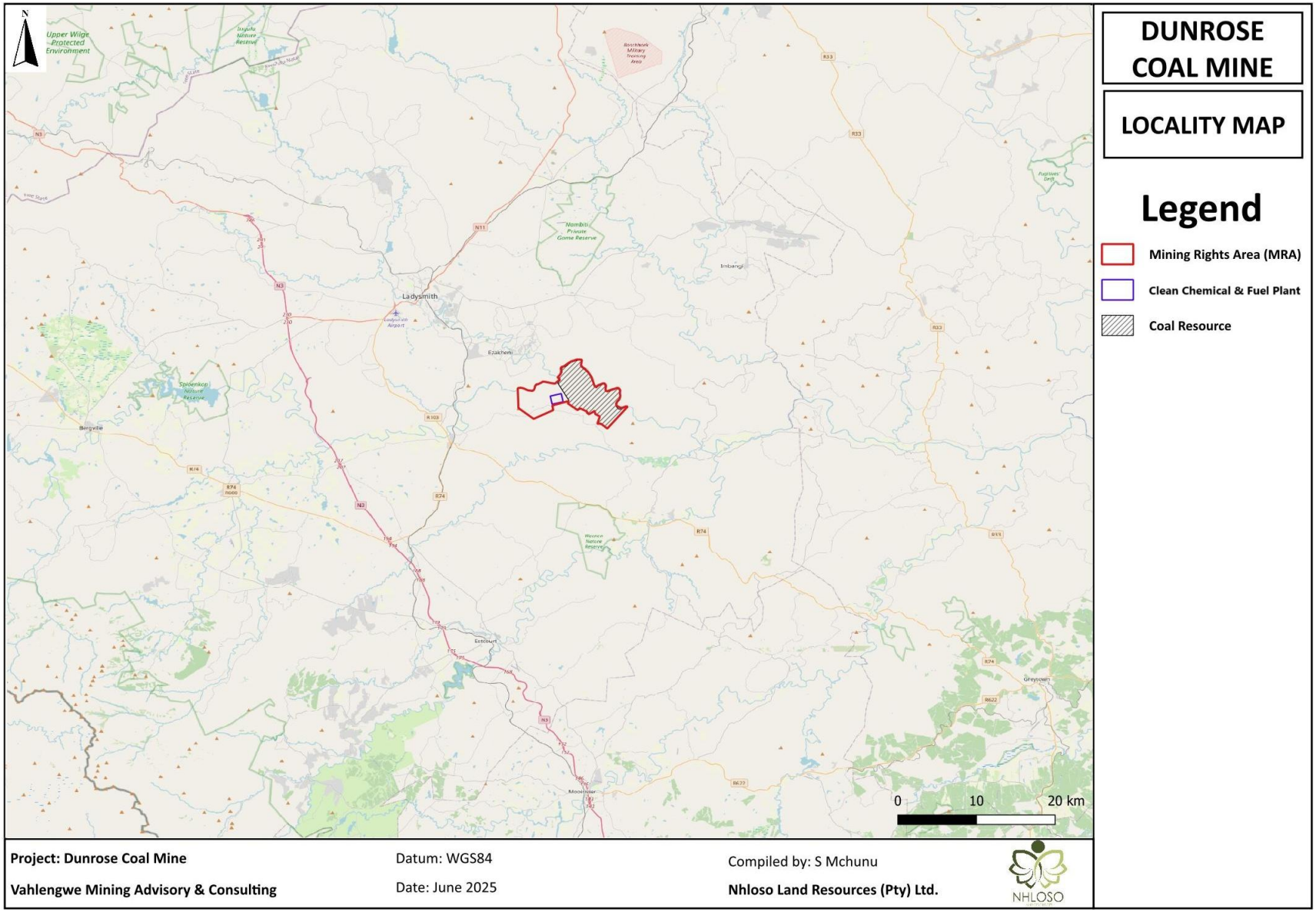


Figure 1: Locality map depicting the location of the MRA and surrounding areas.

1.1 TERMS OF REFERENCE

This investigative assessment was guided by the following terms of reference:

Phase I: Site Assessment

- Review historic and current land uses as well as existing land capability impacts in the vicinity of the investigated area(s);
- Subsurface soil observations to classify dominant soil type(s) according to the South African Soil Classification System (Soil Classification Working Group, 2018);
- Record survey points on a Global Positioning System (GPS); and include a description of physical soil properties including the following parameters:
  - Terrain morphological units (landscape position);
  - Diagnostic soil horizons and their respective sequence;
  - Depth of the identified soil horizons;
  - Soil form classification name; and
  - Depth to saturation (water table), where encountered.

Phase II: Reporting (Mapping and Impact Assessment):

- Group uniform soil types into soil map units, according to observed limitations;
- Evaluate the agricultural land capability of the demarcated soil map units;
- Assess the significance of the anticipated impacts of the proposed development on the land capability of the identified soils; and
- Present the assessment findings in a form of an electronic report including:
  - A Soil Type Map, indicating the delineated soil types within the MRA;
  - Photos of current environmental conditions and adjacent land uses in the vicinity of the MRA;
  - A Land Capability Map, illustrating the agricultural land capability and suitability of the identified soil forms to alternative land uses including arable agriculture, forestry, grazing etc.;
  - A discussion of the identified impacts and their respective significance on the identified soils and agricultural land capability; and
  - An integrated mitigation approach and management practices to be implemented in order to alleviate the identified agricultural impacts.

2. METHOD OF ASSESSMENT

The scope of this investigation included both a desktop and *in-situ* assessment, as briefly described below:

- Desktop screening of prevailing soil types, land use, and agricultural sensitivity within the MRA footprint.
- *In-situ* verification assessment of prevailing soil forms and land use within the MRA footprint according to the provided Terms of Reference (ToR).
- Assess the significance of potential impacts of the proposed mining activities on the land use and Agricultural Land Capability within the MRA footprint.
- Compile an Agricultural Land Capability Impact Assessment report (this document) and recommend key mitigation and management measures to alleviate the identified impacts on the agricultural resources and land capability.

2.1 ASSUMPTIONS AND LIMITATIONS

Access was significantly restricted by steep terrain conditions, which hindered *in-situ* verification to some of the identified points of interest (POIs). It is also acknowledged that sampling by definition means that not all areas were physically assessed, and therefore some aspects of soil and land capability may have been overlooked on the scale that the assessment was conducted. However, it is the opinion of the specialist that this assessment was carried out with adequate sampling and sufficient analytical detail to enable informed data extrapolation from accessible observation points and POIs in a manner that enables the applicant, the Environmental Assessment Practitioner (EAP), and the regulating authorities to make informed decisions regarding the proposed development.

It is further acknowledged that it is virtually impossible to achieve 100% purity in soil mapping due to restricted visibility beneath the ground surface; therefore, the delineated soil map units could include other soil type(s), and the boundaries between the delineated soils map units are not absolute but rather form a continuum and gradually change from one type to another. As such, the presented data, maps, and the findings of this assessment were extrapolated from individual observation points, and the boundaries are considered the best estimate of the different soil forms from which the Land Capability and Agricultural Potential was inferred. The Land Capability and Agricultural Potential were subsequently classified according to current soil physical limitations, with respect to prevailing local climatic conditions. The soil fertility status was not considered on this assessment as inherent nutrient deficiencies and/or toxicities can be rectified by appropriate liming and/or fertilization prior to cultivation.

No alternative layout was provided to enable micro-siting to minimize fragmentation and disturbance of agricultural activities due to the fixed nature of the coal resource within the MRA, and the sitting of the proposed Clean Chemical & Fuel Plant was intuitively placed to avoid intersecting the wetland areas and drainage lines which intuitively have a higher sensitivity to the proposed development activities compared to the agricultural resources. Furthermore, the purpose and scope of this investigation does not include a geotechnical assessment; therefore, the geotechnical stability of the soils will require detailed assessment and verification by a geotechnical expert.

2.2 DESKTOP ASSESSMENT

Prior to the commencement of the field assessment, a background analysis, including a desktop analysis and review was conducted to collect the existing baseline soil and land capability data in the vicinity of the MRA. Various data sources including, but not limited to, the Agricultural Geo-Referenced Information System (AGIS), Soil Terrain (SOTER), DFFE Screening Tool, and other sources as listed under references (section 7) were used for this assessment.

2.3 FIELD INVESTIGATION

A soil survey was conducted on 28th – 31st of May 2025, where the identified soils within the MRA were classified into soil forms according to the Natural and Anthropogenic Soil Classification System for South Africa (2018). Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, and this entailed evaluating physical soil properties and prevailing limitations to various land uses.

2.4 SOIL MAPPING

Relatively similar soil forms identified within uniform terrain units were grouped into map units, with respect to observed limitations. Soils with relatively equivalent potential (i.e. soils with relatively similar limitations) were then assigned into predetermined land capability classes.

2.5 LAND CAPABILITY CLASSIFICATION

High potential agricultural land is defined as having the soil and terrain quality, growing season and adequate available moisture supply needed to produce sustained economically high crop yields when treated and managed according to best possible farming practices (Scotney et al., 1987). Agricultural land capability is measured on a scale from I to VIII, as presented in Table 1 below. Classes I to III are classified as prime agricultural land that is well suitable for cultivated crops. Class IV soils may be

cultivated under certain circumstances and management practices, whereas Classes V to VIII are not typically suitable for cultivation, but may be suitable for grazing and other recreational purposes, and/or ecological conservation (wilderness). In addition, the climate capability is also measured on a scale from 1 to 8, as illustrated in Table 2 below. Therefore, the land capability rating is adjusted, depending on the prevailing climatic conditions as indicated by the respective climate capability ratings.

Table 1: Land Capability Classification (Scotney et al., 1987)

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

W - Wildlife F - Forestry LG - Light grazing
MG – Moderate grazing IG - Intensive grazing LC - Light cultivation
MC - Moderate cultivation IC - Intensive cultivation. VIC – Very intensive cultivation

Table 2: Climate Capability Classification (Scotney et al., 1987)

Climate Capability Class	Limitation Rating	Description
C1	None to slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk, and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

2.6 IMPACT ASSESSMENT METHODOLOGY

An impact assessment was performed in order to assess the significance of the potential impacts of the proposed development on the land capability of the identified soil forms as an agricultural resource. The identified impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of sensitive receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change.

The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructures that are possessed by an organisation.
- **Impact** (environmental) refers to the consequences of the proposed development activities on environmental resources and/or receptors.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as soils, wetlands, and water features where applicable.
- **Resources** include components of the biophysical environment.
- **Sensitivity** refers to the susceptibility of the receptor or resource to the anticipated impact caused by the development activities.
- **Intensity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.
- The **significance** of the impact is then assessed by rating each variable numerically according to the defined criteria, as illustrated under **Table 3** to **Table 6** below.

The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The probability of the impact and the sensitivity of the receptor(s) together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. Whereas the extent, intensity, and duration of the impact together comprise the consequence of the impact, also adding up to a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix (Table 3) to determine the significance of the impact and necessary mitigation requirements. The impact significance is calculated using the following formula:

Significance = (Probability + Resource/Receptor Sensitivity)
X
(Extent + Intensity + Duration)

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table 3: Impact assessment criteria and description

	Descriptor	Description	Rating
Probability	Unlikely	Impact is unlikely to occur for the proposed activity	1
	Possible	Impact may occur	2
	Likely	The nature of the activity commonly triggers the impact	3
	Highly likely	The activity will almost certainly trigger the impact	4
	Inevitable	The impact will most definitely occur	5
Resource/ Receptor Sensitivity	Negligible	Receptor(s) not sensitive to the impact	1
	Low	Receptor(s) significantly resistant against impact	2
	Moderate	Receptor(s) moderately sensitive to impact	3
	Moderately High	Receptor(s) vulnerable to impact	4
	Very High	Receptor(s) highly susceptible to impact	5
Extent	Local/Site	Impact limited within the vicinity of the development area (≤ 5km from site)	1
	Regional	Includes the surrounding area, within 100km and/or ≤ 250 ha	2
	National	Extends >100km and/or ≥250 ha	3

	Descriptor	Description	Rating
Intensity	Low	Natural processes or functions are not affected.	1
	Moderate	Affected environment is altered but function and process continue in a modified manner	2
	High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases	3
Duration	Temporary (short term)	Dissipation of impact through active or natural mitigation in a time span shorter than 5 years	1
	Medium term	Will most likely last for 5–10 years, and can be effectively mitigated thereafter.	2
	Long term	The impact will last for the entire operational life of the operation, but can be mitigated thereafter	3
	Permanent	Non-transitory.	4

Table 4: Significance Rating Matrix

LIKELIHOOD (Likelihood + Sensitivity)	CONSEQUENCE (Extent + Intensity + Duration)									
	1	2	3	4	5	6	7	8	9	10
	2	4	6	8	10	12	14	16	18	20
	3	6	9	12	15	18	21	24	27	30
	4	8	12	16	20	24	28	32	36	40
	5	10	15	20	25	30	35	40	45	50
	6	12	18	24	30	36	42	48	54	60
	7	14	21	28	35	42	49	56	63	70
	8	16	24	32	40	48	56	64	72	80
	9	18	27	36	45	54	63	72	81	90
	10	20	30	40	50	60	70	80	90	100

Table 5: Criteria for assessing the significance of impacts.

Significance	Low	Site specific, low intensity	1 - 25
	Moderately	Site specific, moderate intensity	26 - 50
	Moderately High	Site specific, high intensity	51 - 75
	Very High	Regional, high intensity	75 - 100

Table 6: Mitigation Requirements.

Significance Level	Significance Rating	Negative Impact Management Recommendation
Very High	76 - 100	Critically consider the viability of proposed projects Improve current management of existing projects significantly and immediately.
Moderately High	51 - 75	Comprehensively consider the viability of proposed projects Improve current management of existing projects significantly and seek mechanisms to minimise impacts.
Medium	26 - 50	Maintain current project layout and methodology, with recommended management practices to alleviate the identified impacts.
Low	1 - 25	Maintain current project layout and methodology, with recommended management practices to alleviate the impacts.

3. ASSESSMENT RESULTS

3.1 DESKTOP ANALYSIS

The DFFE screening tool report identified some areas with high agricultural sensitivity within the proposed MRA (see Figure 2 below), which necessitated the assessment of anticipated impacts of the proposed mining activity on the Agricultural Land Capability as required by the 2014 Environmental Impact Assessment (EIA) regulations. The desktop assessment results were obtained from various data sources including, but not limited to, the Agricultural Geo-referenced Information System (AGIS) and other sources as listed under references. The available Soil Terrain (SOTER) and geological data indicate that the MRA comprises of Haplic Luvisols (LVh), Eutric Regosols (RGe), and Lithic Leptosols (LPq) soil types, as illustrated in Figure 3 below.

- Luvisols soil types are characterised as fertile soils and suitable for a wide range of agricultural uses and are characterised by pedogenetic clay differentiation (especially clay migration) between the topsoil and the underlying argic subsoil horizon with a distinctly higher clay content and a high base status (IUSS, 2014).
- Regosols are characterised by incipient soil formation of weakly developed soils from unconsolidated materials, with minimal profile development and no diagnostic horizons as a consequence of young age and/or slow soil formation, particularly common in mountain regions and arid areas (including the dry tropics). The name is adopted from Greek *rhegos*, blanket.
- Leptosols comprise of very thin soils over continuous rock and soils that are extremely rich in coarse fragments, particularly common in mountainous regions (adopted from Greek *leptos*, thin). These soils typically have a continuous rock at or very close to the surface or are extremely gravelly and commonly occur at high or medium altitudes with strongly dissected topography across all climatic zones.

According to the AGIS Land Capability Atlas, the majority of the MRA comprises of high potential arable land of Class III land capability, as well as moderate potential grazing land of Class IV land capability, and Wilderness (Class VIII) land of low agricultural potential, as presented in Figure 4 below. The AGIS database indicates that the grazing capacity ranges from 4 to 10 ha per Large Stock Unit (LSU), as depicted in Figure 5 below. The grazing capacity values indicate the amount of hectares required to sustain production of an Large Stock Unit, defined as an animal with a mass of 450 kg and which gains 0,5 kg per day on forage with a digestible energy of 55%.in accordance with the Conservation of Agricultural Resources Act (CARA), Act 43 of 1983 Regulation 10.

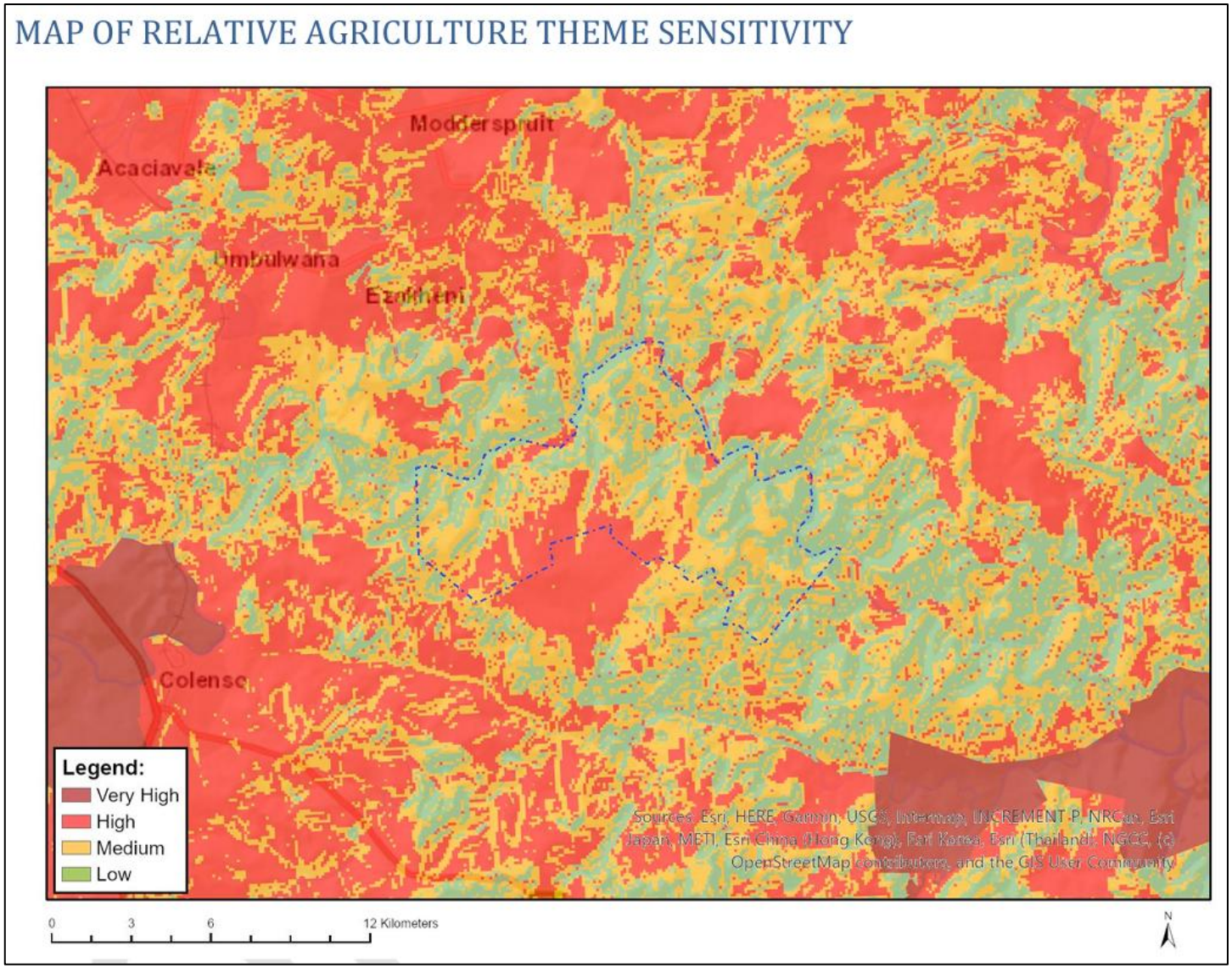


Figure 2: DFFE Agricultural Sensitivity Map.

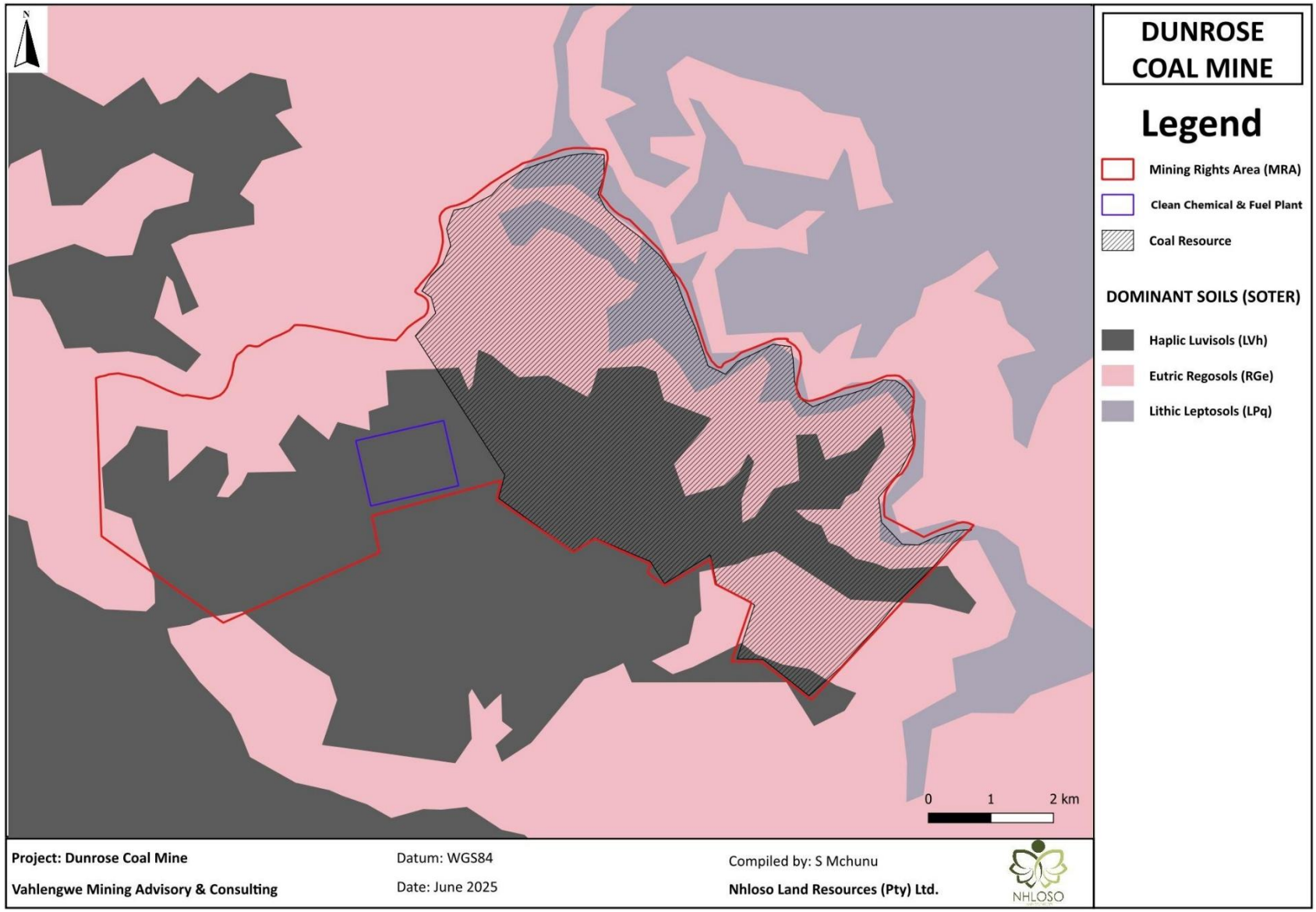


Figure 3: WRB soil map depicting dominant soil types within the MRA, according to the SOTER database.

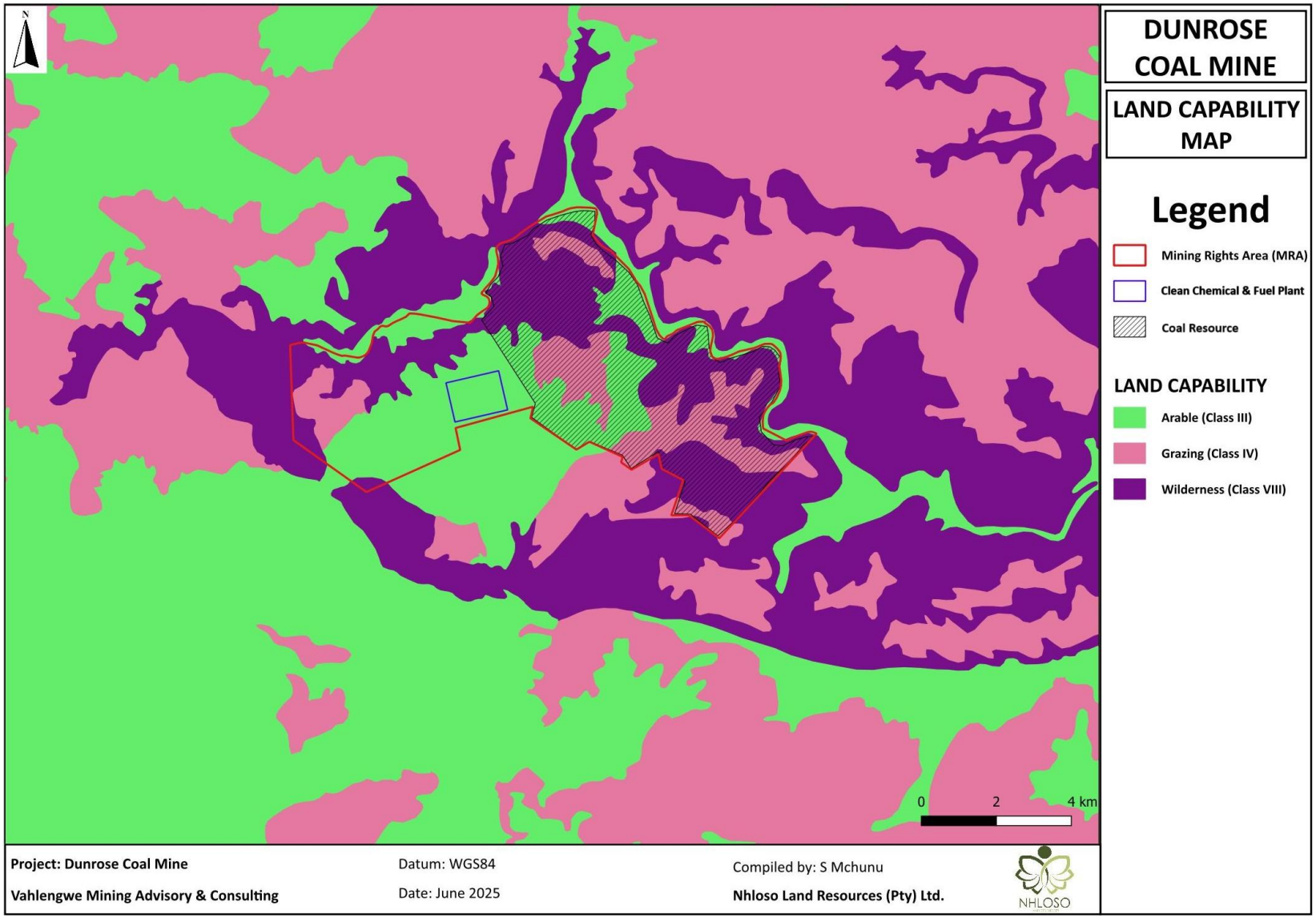


Figure 4: Land capability classification in the vicinity of the MRA.

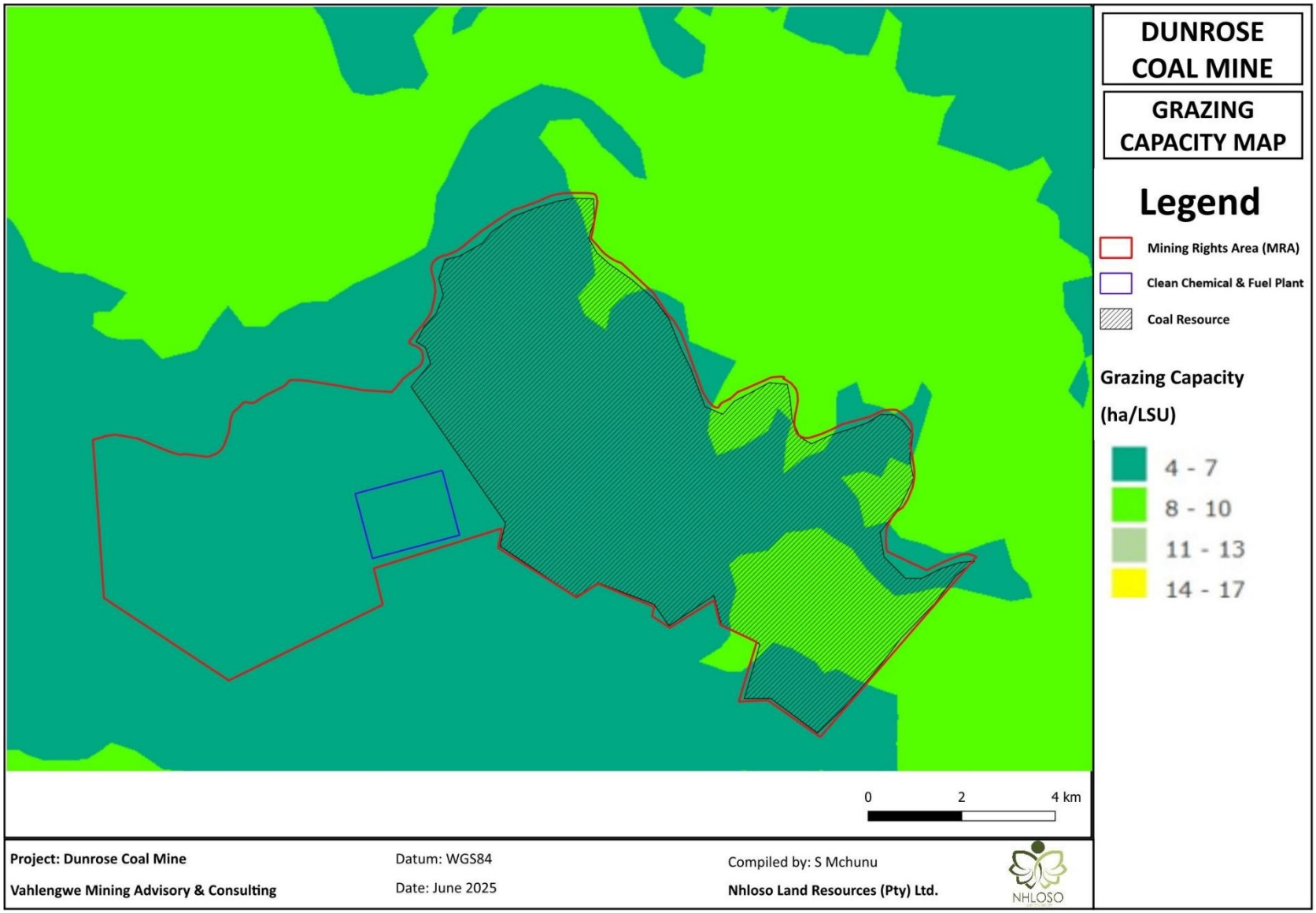


Figure 5: Grazing Capacity in the vicinity of the MRA.

3.2 HISTORIC AND CURRENT LAND USE

The MRA is dominated by wilderness, comprising of natural grasslands and woodlands. The observed agricultural activities included commercial livestock grazing camps within the Schurfde Poort Farm, while subsistence grazing and wildlife browsing were also observed across the remainder of the MRA, as depicted in **Figure 6** below. Emaweni Game Ranch and Hunting Lodge, operated by Thukela Wildlife CC, is located on the remaining extent of the farm Klip Berg 2158, while rural settlements and several livestock watering dams were also observed within the MRA.

The current landowner (Mr. Ngxongo) indicated that he has not cultivated any crops during his tenure for the past 14 years; while the historic satellite imageries (year 2010) indicates that some of the soils within the Schurfde Poort Farm were historically ploughed, presumably for subsistence farming and local consumption given the limited extent of these areas.

Figure 6: Prevailing land uses within the MRA.

3.3 DOMINANT SOIL TYPES

The majority of the MRA comprised of the relatively shallow Mayo / Milkwood / Arcadia (My / Mw / Ar) soil forms, which constitute approximately 83.29% (5 325.64 ha) of the MRA, as illustrated in a soil map in **Figure 7**, and further detailed in **Table 7** and **Table 8** below. A distinction was made within the Mayo / Arcadia soil forms according to profile depth characteristics, where moderately deep Mayo / Arcadia (My / Ar) soil forms were identified contrary to their shallower counterparts, as presented in **Table 9** below. The moderately deep My / Ar soil forms comprised of 891.16 ha which amounted to 13.94% of the MRA, while the remainder 2.77% (177.2 ha) of the MRA comprised of Avalon / Bainsvlei (Av / Bv) soil forms, as presented in **Table 10** below.

Table 7: Soil form distribution within the MRA

Soil Forms	Soil Families	Area (ha)	% Spatial Extent
Mayo / Milkwood / Arcadia (My / Mw / Ar)	My 1200 Mw 1100 & 1200 Ar 1120 & 2120	5 325.64	83.29%
Mayo / Arcadia (My / Ar)	Ar 1120 & 2120	891.16	13.94%
Avalon / Bainsvlei (Av / Bv)	Dr 1000 / Gs 1110	177.20	2.77%
Total Area		**6 394 ha**	**100%**

3.4 LAND CAPABILITY CLASSIFICATION

In South Africa, agricultural land capability is generally restricted by climatic conditions, particularly water availability. However, even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics.

For the purposes of this assessment, land capability was inferred from both physical soil properties and prevailing local climatic conditions. The surveyed area is considered to fall within Climate Capability Class 5, with a Moderately restricted growing season due to low temperatures, frost and/or moisture stress. The identified soils were classified into two land capability classes; The identified moderately deep My / Ar and Av / Bv soil forms are considered to have moderate arable agricultural potential of Class IV land capability, while the relatively shallow My / Mw / Ar soil forms were classified to be of low agricultural potential with Class VIII land capability, as presented in **Figure 8** below. The identified agricultural potential and land capability limitations of the identified soil forms are discussed in comprehensive summary tables presented in **Table 8** to **Table 10** below, with representative photos and spatial extents of each soil form.

3.5 AGRICULTURAL SENSITIVITY

The Avalon / Bainsvlei and Mayo / Arcadia soil forms are considered to have medium agricultural sensitivity to the proposed development in respect of their marginal agricultural potential for arable agriculture; whereas the Mayo / Milkwood / Arcadia soil forms are considered to have low agricultural sensitivity, which is attributed to their inherently poor agricultural potential and steep terrain restrictions, as depicted in Figure 9 below.

The agricultural sensitivity of the proposed mining activity is primarily related to the prolonged preclusion of agricultural activities within the proposed surface infrastructure footprint, which is anticipated to increase the grazing intensity beyond the carrying capacity of the remaining (undisturbed areas), and might enforce reduction of ongoing livestock farming. It is therefore recommended to initiate communal grazing land negotiations and obtain relevant agreements to mitigate the residual impact on the land carrying capacity for the duration of the proposed mining activities until the land is adequately rehabilitated. It is further recommended to relocate the proposed surface infrastructure to fall within delineated low sensitivity areas, which coincides with the Mayo / Milkwood / Arcadia soil forms to mitigate the inaccessibility of potentially arable land impact for the Avalon / Bainsvlei and Mayo / Arcadia soil forms where feasible.

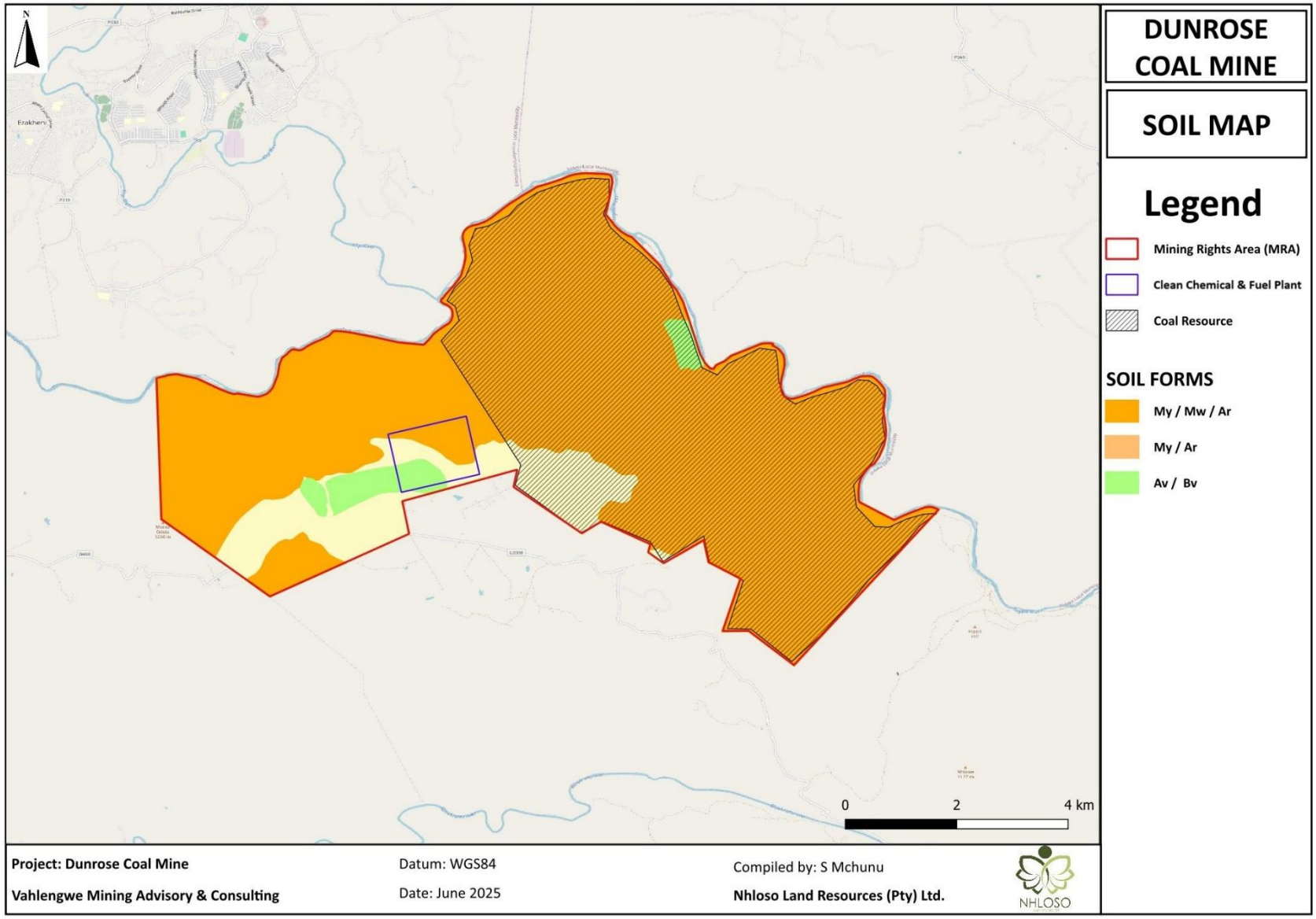


Figure 7: Soil map depicting the spatial distribution of the identified soil forms within the MRA

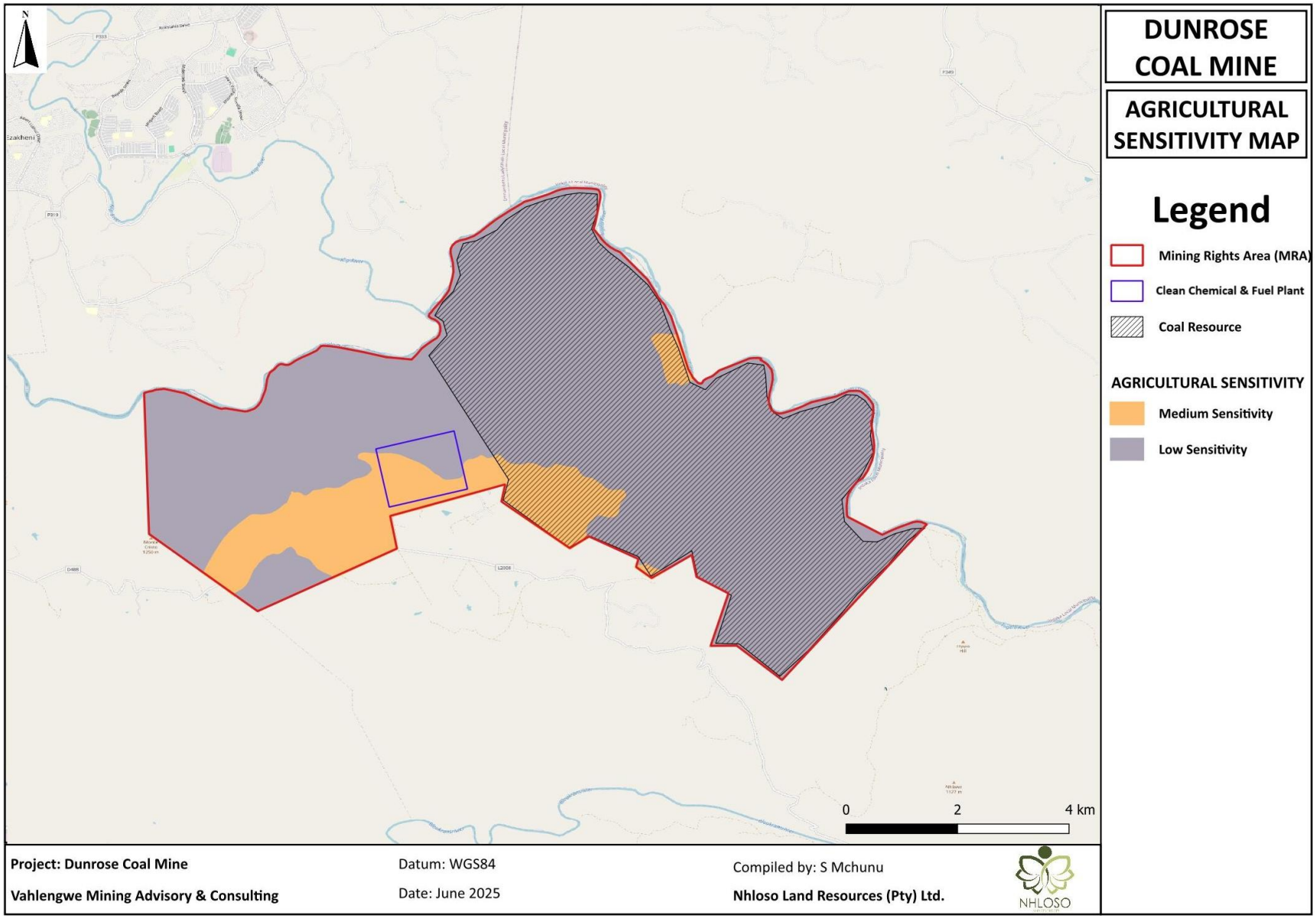
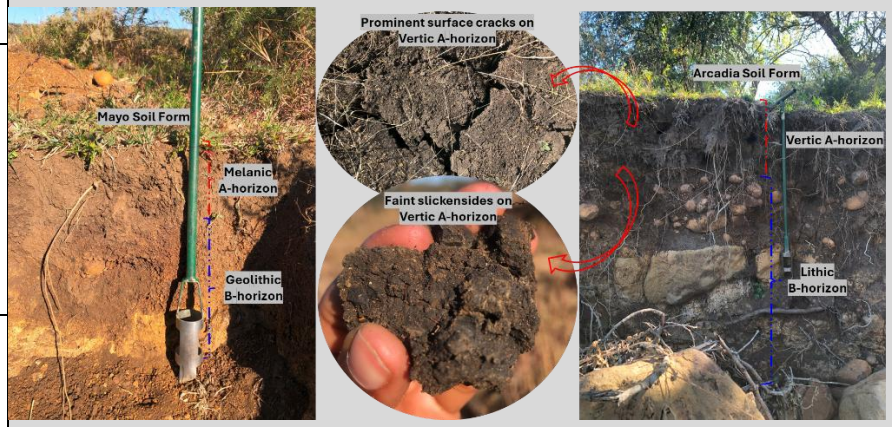


Figure 8: Land capability map depicting land capability classification of the identified soils within the MRA.

Table 8: Summary discussion of the Mayo / Milkwood / Arcadia soil forms and their agricultural land capability

Soil Form(s)	Mayo / Milkwood / Arcadia (My / Mw / Ar)
Land Capability	Arable – Class VIII
Areal Extent	Approximately 5 325.6 ha; which constitutes ≈ 83.3% of the MRA
Terrain Morphological Unit (TMU)	Gently sloping landscape of 2% up to > 20% slope gradient
Soil Family & Diagnostic Horizon Sequence	<u>Mayo (My 1200)</u>: 0 ≈ 27 cm: Melanic A-horizon ≥ 27 cm: Geolithic B-horizon <u>Milkwood (Mw 1100 & 1200)</u>: 0 ≈ 6 cm: Melanic A-horizon ≥ 6 cm: Hard Rock <u>Arcadia (Ar 1120 & 2120)</u>: 0 ≈ 23 cm: Vertic A-horizon ≥ 23 cm: Geolithic B-horizon
Soil Texture	▪ Melanic A-horizon: Sandy clay loam ▪ Vertic A-horizon: Sandy clay loam ▪ Geolithic B-horizon: > 50% coarse gravel intermixed with sandy clay loam
Physical Limitations	Shallow effective rooting depth is the primary limitation of the land capability of the identified Mayo / Milkwood / Arcadia soil forms, which is attributed to the occurrence of the moderately weathered Lithic (hard plinthite) B-horizon or hard rock at shallow depth i.e. within 18 cm from the soil surface. These soil forms also include rock outcrop areas where the topsoil has been truncated and the bedrock was observed to be exposed at the surface, likely due to a combination of rill and sheet erosion.
Agricultural Potential	The agricultural potential is largely excluded by steep terrain of up to > 20% for the majority of these soil forms. These soils were therefore classified to be of poor (class VIII) land capability, which is considered to be unsuitable to arable agriculture, although commonly used for light grazing. On the contrary, these soils are best suited to wilderness and typically provide unique habitats for various fauna and flora species of ecological concern.

Observed diagnostic features of the identified Milkwood soil forms.



Observed diagnostic features of the identified Mayo & Arcadia soil forms.

Table 9: Summary discussion of the Mayo / Arcadia soil forms and their agricultural land capability

Soil Form(s)	Mayo / Arcadia (My / Ar)
Land Capability	Arable – Class IV
Areal Extent	Approximately 891.2 ha; which constitutes ≈ 13.9% of the MRA
Terrain Morphological Unit (TMU)	Gently sloping landscape of 0.5 - 5% slope gradient
Soil Family & Diagnostic Horizon Sequence	<u>Mayo (My 1200)</u>: 0 ≈ 48 cm: Melanic A-horizon ≥ 48 cm: Geolithic B-horizon <u>Arcadia (Ar 1120 & 2120)</u>: 0 ≈ 38 cm: Vertic A-horizon ≥ 38 cm: Geolithic B-horizon
Soil Texture	▪ Melanic A-horizon: Sandy clay loam ▪ Vertic A-horizon: Sandy clay loam ▪ Geolithic B-horizon: > 50% coarse gravel intermixed with sandy clay loam
Physical Limitations	Although considerably weathered, the Lithic (hard plinthite) B-horizon restricts root development to a moderately deep effective rooting depth to approximately 48 cm for these soil forms. The rooting depth was likely improved by colluvial soil deposition from hillslopes. However, historic satellite imageries and the observed diagnostic criteria indicates that these soils were historically ploughed, and the hard plinthite layer would have most likely been ripped to improve rooting depth, which would suggest that these soils most likely resembled their identified shallow variants prior to cultivation.
Agricultural Potential	These soils were classified to be of moderate (class IV) land capability, which is considered to be marginally suitable to arable agriculture. However, the inherently high natural fertility of these soils is considered to be of significant value and these soils are often ploughed for subsistence farming for shallow rooted crops like vegetables under resource-poor circumstances.

Observed diagnostic features of the identified dark variants of moderately deep Mayo & Arcadia soil forms.

Observed diagnostic features of the identified lighter (reddish-brown) variants of moderately deep Mayo soil form.

Table 10: Summary discussion of the Avalon / Bainsvlei soil forms and their agricultural land capability

Soil Type(s)	Avalon / Bainsvlei
Land Capability	Arable – Class IV
Areal Extent	Approximately 177.2 ha; which constitutes ≈ 2.8% of the MRA
Terrain Morphological Unit (TMU)	Gently sloping landscape of 0.5 – 1.5% slope gradient
Soil Family & Diagnostic Horizon Sequence	Avalon (Av 3220): 0 - 24 cm: Orthic A-horizon 24 - 43 cm: Yellow-brown apedal B-horizon ≥ 43 cm: Soft Plinthic B-horizon Bainsvlei (Gc 1220): 0 - 21 cm: Orthic A-horizon 21 – 48 cm: Red apedal B-horizon ≥ 48 cm: Hard Plinthite B-horizon
Texture	▪ Orthic A-horizon: Fine loamy sand ▪ Yellow-brown apedal B-horizon: Loamy sand ▪ Red apedal B-horizon: Sandy loam ▪ Soft Plinthic B-horizon: Sandy clay loam ▪ Hard Plinthite B-horizon: > 50% coarse gravel intermixed with sandy clay loam
Physical Limitations	The primary limitation of the Avalon and Bainsvlei soil forms is attributed to the seasonal wetness in soft-plinthic horizon and the relatively impermeable hard plinthite layer, respectively. The prolonged wetness in the soft-plinthic horizon is prone to induce anoxic conditions which would hamper root development, while the hard plinthite layer physically hinder root penetration for most arable crops. The diagnostic properties of the soil horizons of these soil forms appears to have been significantly altered by historic ploughing, and it is considered likely that the original soil properties resembled the identified moderately deep Mayo / Arcadia soil form prior to cultivation.
Agricultural Potential	Although seasonal fluctuations of the relatively shallow water table through the soft-plinthic horizon is likely to cause anoxic (oxygen deficiency) and root decay, maize is commonly cultivated on similar soils by some farmers to exploit the subsoil moisture availability from the soft-plinthic horizon which is considered beneficial under dryland cultivation systems. The effective depth of the Bainsvlei soil forms can potentially be improved ripping the hard plinthite layer.

Diagnostic features of the identified Avalon soil forms.

Diagnostic features of the identified Bainsvlei soil forms.

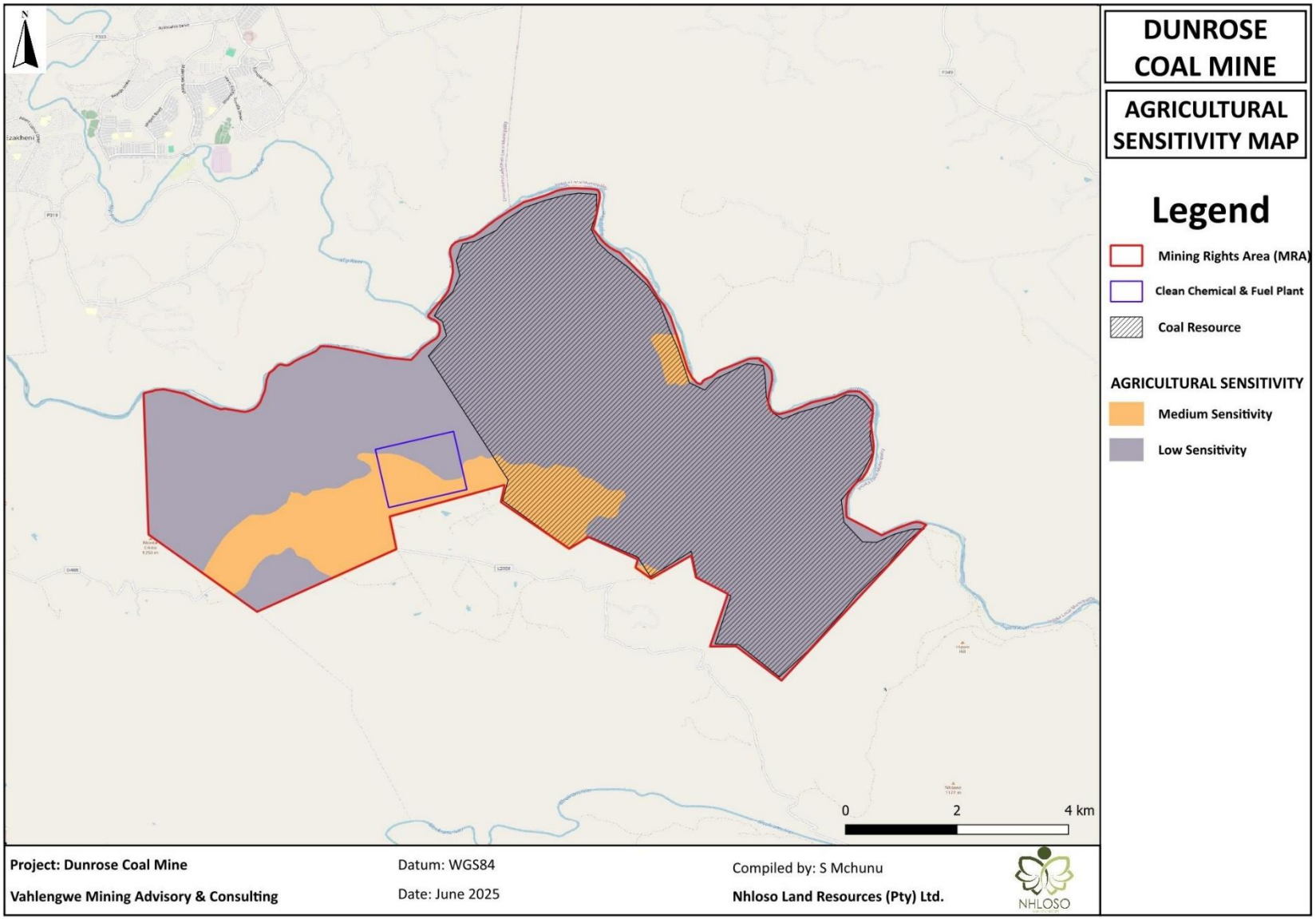


Figure 9: Agricultural Sensitivity Map for the proposed mining development.

4. IMPACT ASSESSMENT RESULTS

The significance of the anticipated impacts on the agricultural potential of the identified soil forms were holistically evaluated based on the proposed site layout and associated activities for the proposed mining activity. The proposed mining activity is anticipated to have a negligible impact on the land capability and agricultural potential as the proposed highwall and underground mining techniques will not interfere with surface land use. However, the associated mining infrastructure (i.e. the Clean Chemical & Fuel Plant, workshop, offices, laydown areas, mine stores etc.) is anticipated to have a significant impact on the land capability and agricultural potential given the long-term duration of the proposed mining operation.

4.1 CUMULATIVE IMPACTS

The following cumulative impacts are likely to occur in the surrounding area, should the proposed mining development be approved within the MRA:

- Land withdrawal from livestock grazing land use; and
- Inaccessibility of potentially arable land.

4.1.1 Land withdrawal from grazing

The proposed mining activity is anticipated to have a negligible impact on livestock grazing as the proposed highwall and underground mining techniques will not interfere with ongoing livestock grazing on the surface. However, the associated mining infrastructure i.e. the Clean Chemical & Fuel Plant in particular, will inevitably result in cessation of ongoing livestock grazing from approximately 175 ha within the Schurfde Poort Farm. Land withdrawal from livestock grazing within the Schurfde Poort Farm will likely increase the grazing intensity beyond the carrying capacity on the remaining (undisturbed areas), which can potentially induce land degradation given the long-term duration of the proposed mining operation. This impact is anticipated to be particularly significant as this is the primary source of income for the surrounding community, and the impact is anticipated to persist for the duration of the mining operation without appropriate mitigation.

However, this impact is considered to be only applicable to the proposed Clean Chemical & Fuel Plant footprint which intersects with ongoing livestock grazing activities, and can be effectively mitigated to a low significance through communal grazing land negotiations and agreements for the duration of the proposed mining activities, as summarised in Table 11 below.

Table 11: Impact assessment for land withdrawal from livestock grazing on the Schurfde Poort Farm

Impact Descriptors	Avalon / Bainsvlei (Class IV) Soil Forms		Mayo / Arcadia (Class IV) Soil Forms		Mayo / Milkwood / Arcadia (Class VIII) Soil Forms	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
Probability	Inevitable (5)	Unlikely (1)	Inevitable (5)	Unlikely (1)	Inevitable (5)	Unlikely (1)
Sensitivity	Moderately high (4)	Low (2)	Moderately high (4)	Low (2)	Moderate (3)	Low (2)
Extent	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)
Intensity	High (3)	Moderate (2)	High (3)	Moderate (2)	High (3)	Moderate (2)
Duration	Life of operation (3)	Temporary (1)	Life of operation (3)	Temporary (1)	Life of operation (3)	Temporary (1)
Significance	**Moderately High (63)**	**Low (12)**	**Moderately High (63)**	**Low (12)**	**Moderately High (56)**	**Low (12)**

4.1.2 Inaccessibility of potentially arable land

The proposed mining activities are anticipated to have a negligible fragmentation and land inaccessibility impact as the proposed highwall and underground mining techniques will not interfere with surface land use. However, the associated surface infrastructure will preclude potential cultivation for subsistence farming for the duration of the mining operation. This impact is anticipated to be negligible for the majority of the MRA which primarily constitute of shallow Mayo / Milkwood / Arcadia soil forms with inherently poor agricultural potential. however, this impact will have a moderate significance for both Avalon / Bainsvlei and Mayo / Arcadia soil forms, which is largely attributed to the long-term nature of the proposed development and low reversibility of the anticipated impacts, as summarised in Table 12 below.

Table 12: Impact assessment for the fragmentation and exclusion of identified soils from potential cultivation

Impact Descriptors	Avalon / Bainsvlei (Class IV) Soil Forms		Mayo / Arcadia (Class IV) Soil Forms		Mayo / Milkwood / Arcadia (Class VIII) Soil Forms	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
Probability	Inevitable (5)	Possible (2)	Inevitable (5)	Possible (2)	possible (2)	possible (2)
Sensitivity	Moderate (3)	Low (2)	Moderate (3)	Moderate (3)	Negligible (1)	Negligible (1)
Extent	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)
Intensity	Moderate (2)	Moderate (2)	Moderate (2)	Moderate (2)	Moderate (2)	Moderate (2)
Duration	Life of operation (3)	Temporary (1)	Life of operation (3)	Temporary (1)	Life of operation (3)	Medium-Term (2)
Significance	**Moderate (48)**	**Low (16)**	**Moderate (48)**	**Low (20)**	**Low (18)**	**Low (15)**

4.2 RESIDUAL LAND CAPABILITY IMPACTS

The proposed mining development will directly hinder grazing within the proposed mining infrastructure footprint as this will result in a significant loss of forage and expose the soils to erosion, compaction, and potential contamination in the event of an accidental spillage and/or leakage of hazardous substances. The significance of the aforementioned residual impacts is discussed below.

4.2.1 Soil Erosion

The anticipated soil erosion impacts are fundamentally based on field observations including the terrain morphology (landscape) and the observed soil morphology and physical properties. In general, soils with a high clay content have a high water-holding capacity and are less prone to erosion compared to sandy textured soils, which are more susceptible to erosion due to poor soil particle cohesion (aggregation). However, soils located in close proximity to the drainage lines and/or river streams tend to be more vulnerable to erosion regardless of their structural properties or landscape morphology at which they occur. Although the majority of the identified soils seemingly display moderate susceptibility to erosion under current conditions, their susceptibility to erosion will be largely increased once the protective vegetation cover is removed, and the soils become exposed to wind and stormwater. The majority of the MRA comprises of undulating steep terrain which will increase soil vulnerability to erosion risk once the vegetation is cleared. The physical soil properties become a dominant criteria for assessing the erosion hazard for the gently sloping areas.

The soil erosion impact is considered to be moderately high for all identified soil forms due to inevitable exposure to wind and runoff erosion once the protective vegetation cover is removed; however this can be effectively mitigated to a low significance by implementing the proposed mitigation measures, as summarised in Table 13 below.

Table 13: Soil erosion impact assessment for the identified soils

Impact Descriptors	Avalon / Bainsvlei (Class IV) Soil Forms		Mayo / Arcadia (Class IV) Soil Forms		Mayo / Milkwood / Arcadia (Class VIII) Soil Forms	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
Probability	Highly Likely (4)	Likely (3)	Highly Likely (4)	Likely (3)	Highly Likely (4)	Likely (3)
Sensitivity	Moderately High (4)	Moderate (3)	Moderately High (4)	Moderate (3)	Very High (5)	Moderate (3)
Extent	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)
Intensity	High (3)	Moderate (2)	High (3)	Moderate (2)	High (3)	Moderate (2)
Duration	Life of operation (3)	Temporary (1)	Life of operation (3)	Temporary (1)	Life of operation (3)	Temporary (1)
Significance	**Moderately High (56)**	**Low (24)**	**Moderately High (56)**	**Low (24)**	**Moderately High (63)**	**Low (24)**

4.2.2 Soil Compaction

The common use of heavy mechanical implements during the construction of the proposed mining infrastructure is anticipated to induce localised soil compaction in the vicinity of the proposed surface infrastructure. The Mayo / Arcadia soil forms will be the most vulnerable to compaction due to their inherently high clay content, although the impact is anticipated to be moderately-high for all the identified soil forms, as summarised in Table 14 below. However, the proposed mitigation measures

are anticipated to effectively alleviate soil compaction to a low significance for all the identified soil forms (see Table 14 below).

Table 14: Soil compaction impact assessment for the identified soils

Impact Descriptors	Avalon / Bainsvlei (Class IV) Soil Forms		Mayo / Arcadia (Class IV) Soil Forms		Mayo / Milkwood / Arcadia (Class VIII) Soil Forms	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
Probability	Inevitable (5)	Possible (2)	Inevitable (5)	Possible (2)	Inevitable (5)	Possible (2)
Sensitivity	Moderate (3)	Low (2)	Moderately High (4)	Moderate (3)	Moderate (3)	Low (2)
Extent	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)
Intensity	Moderate (2)	Low (1)	High (3)	Moderate (2)	Moderate (2)	Low (1)
Duration	Permanent (4)	Temporary (1)	Permanent (4)	Temporary (1)	Permanent (4)	Temporary (1)
Significance	**Moderately High (56)**	**Low (12)**	**Moderately High (72)**	**Low (20)**	**Moderately High (56)**	**Low (12)**

4.2.3 Soil Contamination

The soils are generally considered to be equally predisposed to contamination as contamination sources are generally unpredictable and anticipated to likely occur as a result of accidental spillage or leakage of hazardous substances typically from mechanical equipment during the construction and operational phases, and/or wastewater seepage or overflow from pollution control infrastructure during the operational phase. This impact is therefore largely dependent on the nature, volume and/or concentration of the contaminant(s) of concern. The contamination risk is anticipated to be moderately high for all the identified soil forms, as summarised in Table 15 below. However, the proposed mitigation measures are anticipated to effectively mitigate the contamination risk to a low significance for all the identified soil forms (see Table 15) below.

Table 15: Soil contamination impact assessment for the identified soils

Impact Descriptors	Avalon / Bainsvlei (Class IV) Soil Forms		Mayo / Arcadia (Class IV) Soil Forms		Mayo / Milkwood / Arcadia (Class VIII) Soil Forms	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
Probability	Highly Likely (4)	Possible (2)	Highly Likely (4)	Possible (2)	Highly Likely (4)	Possible (2)
Sensitivity	Moderate (3)	Low (2)	Moderate (3)	Low (2)	Moderately High (4)	Moderate (3)
Extent	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)	Local/Site (1)
Intensity	High (3)	Moderate (2)	High (3)	Moderate (2)	High (3)	Moderate (2)
Duration	Permanent (4)	Medium-Term (2)	Permanent (4)	Medium-Term (2)	Permanent (4)	Medium-Term (2)
Significance	**Moderately High (56)**	**Low (20)**	**Moderately High (56)**	**Low (20)**	**Moderately High (64)**	**Low (25)**

5. MITIGATION STRATEGY

The Mining and Biodiversity Guideline document (DEA *et al.*, 2013) provides a range of "best practice" guidelines and mitigation hierarchy, which were adapted for this assessment. The following mitigation measures were compiled in line with the aforementioned mitigation hierarchy, which constitutes avoidance of adverse impacts on environmental resources as a first option (the "no-go alternative") prior to any other development alternative; and in circumstances where avoidance is not feasible, the potential impacts should be mitigated accordingly following the mitigation hierarchy.

5.1 THE NO-GO ALTERNATIVE

The "no-go" alternative implies that the proposed development would not be implemented within the MRA as an avoidance of the identified impacts in order to maintain the *status quo*. However, maintaining the *status quo* is not likely to improve nor decline the agricultural productivity in the near future, as this would essentially imply that the land would remain under current management practices. However, agricultural productivity is anticipated to potentially decline from an economic viability perspective due to irregular rainfall and seasonal variations induced by climate change under *status quo*.

5.2 INTEGRATED MITIGATION MEASURES

The identified soil and agricultural land capability impacts can be effectively mitigated and rehabilitated to reinstate the current livestock grazing and wildlife browsing under judicious management practices; however, this will largely depend on strategic environmental management and effective implementation of the proposed mitigation measures throughout the mining operation from construction to closure.

The following integrated mitigation measures are recommended to alleviate the severity of the identified soil and land capability impacts in the event that the relevant authorization(s) are granted by the Competent Authority for the proposed mining development within the MRA:

- It is recommended to relocate the proposed surface infrastructure to align with the delineated Mayo / Milkwood / Arcadia soil forms to mitigate the inaccessibility of potentially arable land impact for the Avalon / Bainsvlei and Mayo / Arcadia soil forms where feasible.
- Initiate communal grazing land negotiations and obtain relevant agreements to mitigate the residual impact on the land carrying capacity for the duration of the proposed mining activities until the land is adequately rehabilitated.

- Schedule construction works and any ground disturbance activities to coincide with the dry (low rainfall) season when chances of runoff and water erosion are minimal to avoid excessive soil erosion through stormwater runoff, and avoid unprecedented delays, such that the soil exposure duration is reduced to absolute minimum.
- Strictly limit vegetation clearance and earthworks to the immediate vicinity of the surface infrastructure construction areas as far as practically possible, such that the soils and the protective vegetation cover remain intact above the underground mining areas to allow livestock grazing to resume as soon as possible with minimal requirement for rehabilitation works.
- Implement a robust access control and safety measures to prevent livestock and wildlife entry into active mining areas to avoid negative impacts on livestock and wildlife populations.
- It is recommended that the MRA be sequentially subdivided into subsections of ≤ 250 ha (preferrably within the delineated soil boundaries where feasible) and concurrently rehabilitate the mined sections as the mining activity progresses.
- The concurrent rehabilitation progress must be routinely monitored and continuously improved to the satisfaction of the regulating authority to ensure successful rehabilitation post closure.
- It is further recommended to install the associated surface infrastructure from and upgradient portion and gradually progress towards a downgradient direction such that the undisturbed downgradient portion can progressively serve as a stormwater attenuation mechanism to alleviate soil erosion.
- Maintain an intact vegetated strip as a buffer between the active mining and/or construction areas and the Tugela River as well as the associated tributaries to attenuate soil erosion and/or sedimentation from upgradient active mining and construction areas.
- Avoid soil stripping and stockpiling to mitigate soil loss and/or degradation from prolonged soil exposure during stockpiling where feasible; or the upper 300 mm topsoil must be stripped along with the grass cover to preserve the seedbank and subsequently covered for re-use during rehabilitation, where stripping cannot be avoided.
- Bare soils and temporary stockpiles must be regularly dampened with water or commercial dust suppressants to mitigate windborne soil losses especially where strong wind conditions are expected, and/or adequately covered with a durable protective cover for protection against heavy rainfall where predicted according to the local weather forecast.

- Spread at least a 200 mm layer of the stockpiled topsoil over disturbed surface areas and lightly re-vegetate the layered soils with indigenous grass species to improve re-vegetation success as an additional erosion control mechanism during rehabilitation.
- Detailed site-specific contamination prevention measures, spill prevention and emergency spill response plans should be compiled to adequately address preventative and remedial measures to mitigate ingress of contaminants into the soils and potential leaching of contaminants into groundwater in the event of a spill and/or a leak of potentially hazardous substances into the receiving environment.
- Stormwater run-off must be diverted away from the active mining areas to separate the clean and dirty water circuits, and mitigate potentially contaminated stormwater runoff and/or subsurface seepage into the surrounding soils.
- The pollution control infrastructure e.g. pollution control dams must be adequately lined with an impermeable barrier and equipped with leak detection sensors and/or resistance testing devices to prevent wastewater from seeping into the underlying soils and groundwater system.
- All vehicle and machinery servicing and maintenance shall be confined to the paved designated areas specifically demarcated for this purpose, and any spillage of fuel, oil, transmission or hydraulic fluids etc. shall be cleaned up immediately and appropriately disposed offsite.
- The prescribed waste management protocols and all applicable legislative requirements should be adhered to throughout the design, construction, operational, and closure phases of the proposed mining operation.
- Efforts should be made to decommission all the associated facilities and infrastructure as soon as they are no longer in use, and subsequently rehabilitate the land to resume pre-mining livestock grazing and wildlife browsing.
- Soil compaction must be alleviated by ripping the soils to at least 300 mm below ground surface using appropriate tillage implements to physically loosen the soil prior to rehabilitation, after all the surface infrastructure has been decommissioned .
- It is recommended that the soil contamination monitoring, as well as surface water and groundwater quality monitoring programme be implemented and reviewed by the regulating authorities throughout the duration of the proposed mining activities, and continued on an annual basis to the satisfaction of the regulating authorities post-closure.
- Furthermore, the rehabilitation and mine closure design should be evaluated and approved by an experienced geotechnical expert to assess potential risk of subsidence from the underground mining areas and ensure the integrity of the final landscape design post-closure.

6. CONCLUSIONS AND RECOMMENDATIONS

The majority of the MRA is dominated by the relatively shallow Mayo / Milkwood / Arcadia (My / Mw / Ar) soil forms, which constitute approximately 83.29% (5 325.64 ha) of the MRA. The remainder of the MRA comprised of moderately deep Mayo / Arcadia (My / Ar) and Avalon / Bainsvlei (Av / Bv) soil forms, which constitute approximately 13.94% (891.16 ha) and 2.77% (177.2 ha) of the MRA, respectively. The Avalon / Bainsvlei and Mayo / Arcadia soil forms are considered to have medium agricultural sensitivity to the proposed development in respect of their marginal agricultural potential for arable agriculture, while the Mayo / Milkwood / Arcadia soil forms are considered to have low agricultural sensitivity, attributed to their inherently poor agricultural potential and association with steep terrain.

Wilderness is the dominant land use within the MRA, while the observed agricultural activities were limited to livestock grazing primarily within the Schurfde Poort Farm. The proposed mining activity is anticipated to have a negligible impact on the prevailing soils and land capability as the proposed highwall and underground mining techniques will not interfere with ongoing land uses on the surface. However, the associated surface infrastructure (Clean Chemical & Fuel Plant, conveyer belt, workshop, offices, laydown areas, mine stores etc.) is anticipated to have a significant impact on the land capability and agricultural potential if left unmitigated, due to the long-term duration of the proposed mining operation.

Land withdrawal from livestock grazing is anticipated to increase the grazing intensity beyond the carrying capacity on the remaining (undisturbed) areas within the Schurfde Poort Farm, which can potentially induce localized land degradation given the long-term duration of the proposed mining operation. However, this impact can be effectively mitigated to a low significance through communal grazing land negotiations and agreements for the duration of the proposed mining activities. The inaccessibility of potentially arable land impact will be negligible for the shallow Mayo / Milkwood / Arcadia soil forms due to their inherently poor agricultural potential; however, this is anticipated to have a moderately-high significance for both Avalon / Bainsvlei and Mayo / Arcadia soil forms, which is largely attributed to the long-term duration of the proposed mining operations. It is therefore recommended to relocate and place the proposed surface infrastructure within the delineated Mayo / Milkwood / Arcadia soil forms to mitigate the inaccessibility of potentially arable land impact for the Avalon / Bainsvlei and Mayo / Arcadia soil forms where feasible.

The residual impacts from soil erosion, compaction and potential contamination will be localised and restricted to the vicinity of the proposed surface infrastructure. The proposed mitigation measures are anticipated to effectively alleviate all the identified residual impacts to a low significance for all the identified soil forms. Although the identified soil and land capability impacts can be effectively mitigated and rehabilitated to reinstate livestock grazing under judicious management practices, this will largely depend on strategic environmental management and effective implementation of the proposed mitigation measures throughout the mining operation.

In light of the above findings, it is the Specialist's opinion that the identified impacts can be effectively mitigated to reinstate the ongoing livestock grazing and wildlife browsing from the land use and land capability perspective. Therefore, the proposed mining development can be considered in a positive manner provided that the recommended communal livestock grazing is negotiated successfully with surrounding landowners to manage the residual impact on the carrying capacity during the mining operation, and the proponent is duly committed to ensure the land is adequately rehabilitated after decommissioning & closure, in accordance with the recommended mitigation measures derived from this assessment.

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APPENDICES

APPENDIX A:

DETAILS, EXPERTISE AND CURRICULUM VITAE OF THE SPECIALIST

1.(a)(i) Details of the specialist who prepared the report

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SACNASP: 008755
M.Sc. Soil Science (US)
BSc. Hons (Soil Science) (US)

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1.(a).(ii) The expertise of the specialist who compile a specialist report including a curriculum vitae

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- 2009: BSc. Agric. Viticulture and Soil science, University of Stellenbosch

Postgraduate Biometry (Statistics) course

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- South African Council for Natural Scientific Professions (SACNASP): Reg. No.: 008755
- Land Rehabilitation Society of Southern Africa (LaRSSA)
- Soil Science Society of South Africa (SSSSA)
- South African Soil Surveyors Organization (SASSO)

WORK EXPERIENCE

- Founder of Nhloso Land Resources (Pty) Ltd. (Current)
- Senior Environmental Consultant (Project Manager) at Scientific Aquatic Services
- Contaminated Site Consultant (Project Manager) at Environmental Resources Management (ERM) South Africa
- Soil Specialist at Strategic Environmental Focus (Pty) Ltd. (2012 – 2013)
- Soil Analytical Researcher at Stellenbosch University (2009 –2010)

SELECTED PROJECT EXAMPLES

- Soil Impact Assessment Investigations
- Soil and Land Capability Assessment for the expansion of the Royal Bafokeng Styldrift Mine near Brits, North West province, South Africa;
- Soil and Land Capability Impact Assessment for the proposed Xstrata Coal Mine in Paardekop, Mpumalanga Province, South Africa;
- Soil and Land Capability Impact Assessment for the proposed Xstrata Coal Mine in Amersfoort, Mpumalanga Province, South Africa;
- Agricultural Impact Assessment for a proposed 30 megaWatts (MW) Photo Voltaic (PV) Solar Facility in Mareetsane, North West Province, South Africa;
- Soil and Land Capability Impact Assessment for the proposed BioGas Plant facility in Malmesbury, Western Cape Province, South Africa; and
- Soil and Agricultural Potential Assessment for the proposed Hulett Milling Plant at the Owen Sithole College of Agriculture (OSCA) in Empangeni, KwaZulu Natal Province, South Africa.

Contaminated Site Investigations

- Soil and Groundwater contamination assessments prior to installation and decommissioning of underground fuel storage tanks at multiple petroleum filling stations within the Gauteng, Limpopo, Free State, Northern Cape, and North West Provinces;
- Soil contamination assessment at ELCA Engineering Turbo Manufacturing and Fabrication to inform the due diligence process;
- Bi-annual soil contamination assessment at BHP Billiton Klipspruit Coal Mine for Water Use Licence compliance;
- Soil Contamination and Waste Classification Assessment at Petra Diamonds Mine in Lime Acres, Kimberly, Northern Cape Province, South Africa;
- Soil and Groundwater contamination assessments at multiple Mining and Distribution operations with private fuel storage facilities; and
- Sediment and water quality assessment for the Bokoni Platinum Mine.

Environmental Risk Assessments

- Environmental Risk and Liability Assessment prior to decommissioning and mine closure for the BECSA TNC Colliery in the Mpumalanga Province, South Africa;
- Environmental Risk Assessment for the abandonment of the former Rand Uranium Gold Mine, prior to land use change to a mixed residential and commercial development at Bhongweni and Toekomsrus in Randfontein, Gauteng Province, South Africa;

Wetland Delineations and Impact Assessments

- Characterisation of the wetland recharge mechanism(s) through the vadose zone, as part of the impact assessment of the proposed coal mining activities within the catchment in Kwagga North, Mpumalanga Province, South Africa;
- Investigating wetland offset alternatives and appropriate rehabilitation measures for the proposed coal mining activities at Phalanndwa Colliery in Delmas, Mpumalanga Province, South Africa;
- Wetland Rehabilitation Plan and ecological assessment of an artificial watercourse "abandoned quarry" in Olifantsfontein, Gauteng Province, South Africa;

1.(b) A declaration that the specialist is independent in a form as may be specified by the competent authority

I, Sinethemba Mchunu, declare that -

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

---

Signature of the Specialist

VISUAL IMPACT ASSESSMENT

KMG
Environmental
Solutions Services

VISUAL AND LANDSCAPE IMPACT ASSESSMENT FOR A MINING RIGHT APPLICATION OF COAL

DMRE Ref No: KZN30/5/1/2/2/10137 MR

PREPARED FOR:

DUNROSE INVESTMENT 174 (PTY) LTD

DATE OF SUBMISSION:
June 2025

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Document Reference Number	KMG/DI174 24-05-25/4		
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INDEMNITY

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study. Therefore, the author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although the author exercises due care and diligence in rendering services and preparing documents, he accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

EXECUTIVE SUMMARY

This Visual and Landscape Impact Assessment (VLIA) has been undertaken by KMG Environmental Solutions Services (Pty) Ltd on behalf of Dunrose Investment 174 (Pty) Ltd, for a proposed coal mining right application (DMRE Ref No: KZN30/5/1/2/2/10137 MR) near Colenso in the KwaZulu-Natal Province. The project site spans approximately 6,333 hectares within a visually sensitive rural landscape, containing key natural, cultural, residential, and tourism-related features.

The assessment was conducted using a comprehensive methodology that included desktop studies, field surveys, visual sensitivity mapping, GIS analysis, photographic documentation from Key Observation Points (KOPs), and the development of visual simulations. The goal was to identify, evaluate, and quantify the potential visual impacts that may result from the implementation of highwall mining activities, as well as to recommend appropriate mitigation and monitoring measures.

The VLIA identified a variety of sensitive visual receptors in proximity to the proposed mining area, including:

- Residential settlements such as Colenso and scattered rural homesteads,
- Scenic tourism facilities and accommodations,
- Cultural heritage sites and sacred landscapes,
- Major transport corridors including the R74 and R103,
- Local wetlands, rivers, and natural high points.

Visual impacts were rated based on magnitude, extent, duration, probability, and sensitivity of receptors. Findings indicate that, without mitigation, the proposed mining operations would result in moderate to major visual impacts. These include visible changes to the natural landform, vegetation clearance, dust generation, lighting glow at night, and scenic disruption near key receptors.

However, a suite of detailed mitigation measures has been proposed to minimize these impacts. These include:

- Indigenous vegetative screening and buffer zones,
- Low-profile, earth-toned infrastructure designs,

- Strategic alignment of internal access roads,
- Controlled lighting practices using night-sky compliant fixtures,
- Progressive rehabilitation of disturbed areas,
- Ongoing stakeholder engagement and visual performance audits.

Monitoring will be conducted through repeat photography, vegetation audits, lighting compliance checks, and the use of community feedback mechanisms. These steps will ensure that mitigation measures remain effective and responsive throughout all project phases: construction, operation, and closure.

In conclusion, the VLIA confirms that the proposed coal mining project, while visually transformative in nature, can be effectively managed through the recommended mitigation strategies. With strict adherence to these measures and proactive environmental stewardship, the project is considered visually feasible and compliant with regional planning frameworks, provided the recommendations are fully implemented and maintained. The project can be considered visually manageable and environmentally feasible within the context of current land use planning and regional visual sensitivity, provided that all recommendations are strictly implemented

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Full Description
DEA	Department of Environmental Affairs
DMRE	Department of Mineral Resources and Energy
DFFE	Department of Forestry, Fisheries and the Environment
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GIS	Geographic Information System
GPS	Global Positioning System
KMG	KMG Environmental Solutions Services (Pty) Ltd
KOP	Key Observation Point
KZN	KwaZulu-Natal
LED	Light Emitting Diode
MR	Mining Right
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
NWA	National Water Act (Act No. 36 of 1998)
SACNASP	South African Council for Natural Scientific Professions
SDF	Spatial Development Framework
SPLUMA	Spatial Planning and Land Use Management Act (Act No. 16 of 2013)
VLIA	Visual and Landscape Impact Assessment
WISA	Water Institute of Southern Africa
IIAV	Institute of Impact Assessment of South Africa
R	Regional Route (South African Road Classification)
WGS 1984	World Geodetic System 1984 (Coordinate Reference System)

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1. INTRODUCTION

1.1 Background and Purpose of the Study

The Visual and Landscape Impact Assessment (VLIA) has been commissioned by Dunrose Investment 174 (Pty) Ltd as part of the environmental assessment process for a proposed mining right application for coal. This assessment is being conducted by KMG Environmental Solutions Services (Pty) Ltd appointed by by Dunrose Investment 174 (Pty) Ltd the primary applicant for the mining right. The project site is located within a region characterized by diverse landscape features, including natural and modified environments, which necessitate a thorough evaluation of potential visual and landscape impacts associated with the proposed mining operations.

KMG Environmental Solutions Services (Pty) Ltd is an experienced and accredited environmental consulting firm specializing in various environmental assessments, including Visual and Landscape Impact Assessments. The company is committed to providing high-quality, compliant, and objective environmental consulting services, ensuring that the assessment is conducted in line with regulatory requirements and industry best practices.

The primary purpose of this study is to systematically identify, assess, and evaluate the potential visual and landscape impacts that may arise due to the development and operation of the proposed coal mining project. The VLIA is a critical component of the environmental authorization process, providing stakeholders, including regulatory authorities, local communities, and interested and affected parties (IAPs), with a clear understanding of how the proposed project may alter the visual character of the area.

Specifically, **the objectives of the VLIA are as follows**:

- Establish Baseline Conditions: To document and describe the existing visual and landscape characteristics of the project area, including key visual receptors and sensitive viewpoints.
- Assess Visual Sensitivity: To identify and categorize areas of high, moderate, and low visual sensitivity within the project area based on their scenic quality, viewer sensitivity, and landscape integrity.
- Evaluate Potential Impacts: To assess the magnitude and significance of potential visual and landscape impacts resulting from various phases of the project, including site preparation, mining operations, and post-closure rehabilitation.

- Visual Impact Mitigation Measures: To develop and recommend appropriate mitigation measures aimed at minimizing or avoiding adverse visual impacts, thereby enhancing visual integration of the project into the surrounding environment.
- Stakeholder Engagement: To ensure that the concerns and expectations of stakeholders, including the local community, are adequately considered in the visual impact assessment process.
- Compliance with Regulatory Requirements: To ensure that the VLIA is conducted in accordance with South African environmental legislation, including the National Environmental Management Act (NEMA) and other relevant guidelines for visual and landscape impact assessment.
- Technical Excellence: To maintain high technical standards throughout the assessment, leveraging KMG Environmental Solutions Services' expertise in conducting visual and landscape impact studies.

By achieving these objectives, the VLIA aims to support the decision-making process for the proposed mining right application, ensuring that potential visual and landscape impacts are identified, understood, and effectively managed. This report is prepared in accordance with industry best practices and aligns with KMG Environmental Solutions Services' commitment to environmental sustainability and regulatory compliance.

Limitations and Assumptions

This Visual and Landscape Impact Assessment (VLIA) conducted by KMG Environmental Solutions Services (Pty) Ltd for the proposed coal mining project of Dunrose Investment (Pty) Ltd is based on a systematic approach designed to ensure accuracy and reliability. However, like any environmental study, it is subject to certain limitations and assumptions, which are outlined below:

1.1.1 Limitations

Availability of Baseline Data: The accuracy of the visual and landscape assessment is dependent on the availability and quality of baseline data, including topographical maps, satellite imagery, and site-specific observations. Limited or outdated data may affect the precision of the assessment.

- Access Restrictions: Field surveys and on-site visual observations were conducted within accessible areas of the project site. Access to certain areas may have been restricted due to

land ownership, safety concerns, or physical barriers, which could affect the completeness of the visual characterization.

- Weather and Seasonal Conditions: The assessment of visual and landscape characteristics is influenced by seasonal variations (e.g., vegetation cover, atmospheric visibility). Field observations may have been conducted during specific seasons, which may not fully represent year-round conditions.
- Stakeholder Input: While stakeholder engagement is an integral part of the assessment process, the study may not have captured the views of all potentially affected parties, especially those who did not participate in the engagement process.
- Visual Simulation Accuracy: Visual simulations and photomontages provided in this report are intended to represent the potential visual impact of the project. However, they are subject to certain limitations in terms of scale, perspective, and image quality, which may differ slightly from actual visual experiences.
- Assumptions in Impact Predictions: The significance of visual impacts has been assessed based on the current project design and information provided by Dunrose Investment (Pty) Ltd. Any changes to the project design, layout, or operational activities may alter the visual impact outcomes.

1.1.2 Assumptions

Project Design Consistency: It is assumed that the final design, layout, and operational practices of the proposed coal mining project will be consistent with the project description and plans provided to KMG Environmental Solutions Services (Pty) Ltd at the time of this assessment.

- Effective Implementation of Mitigation Measures: The assessment assumes that recommended visual impact mitigation measures will be effectively implemented by the project proponent (Dunrose Investment (Pty) Ltd) throughout the project lifecycle.
- Regulatory Compliance: It is assumed that the proposed coal mining project will comply with all relevant South African environmental regulations and permitting requirements, including those related to visual and landscape impacts.
- Standard Observation Conditions: The visual and landscape assessment has been conducted under standard daylight and weather conditions, which are assumed to be representative of typical conditions in the project area.

- Objective Visual Sensitivity Analysis: The categorization of visual sensitivity and the assessment of visual impacts have been based on objective criteria, including scenic quality, viewer sensitivity, and landscape integrity, as per industry best practices.
- Stakeholder Feedback Consideration: It is assumed that the feedback provided by stakeholders during the engagement process is accurate, reliable, and represents their genuine concerns regarding visual and landscape impacts.

This section is essential to ensure transparency in the assessment process, acknowledging the factors that may influence the accuracy of the study results while maintaining confidence in the overall findings and recommendations provided by KMG Environmental Solutions Services (Pty) Ltd.

2. PROJECT DESCRIPTION

2.1 Project Location

The project is situated within the designated area specified in Mining Right Application No. KZN 30/5/1/2/2/10137MR for coal, submitted by Dunrose Investments 174 (Pty) Ltd. The mining right area is located in the KwaZulu-Natal Province, approximately 12 km east of the town of Colenso, within the jurisdiction of the uThukela District Municipality, and specifically the Okhahlamba Local Municipality.

Geographical Context

- The project area lies between the towns of Colenso, Ladysmith, and Estcourt.
- It falls within the Klip River Coalfield, a region with a long-established coal mining history.
- Accessibility is provided via the N3 national route, and R74 and R103 regional routes, with internal access via an all-weather dirt road from Colenso.

Geographical Coordinates:

- Latitude: -27.7950
- Longitude: 29.9387

Property Description:

The mining right area covers a total surface area of approximately 6,333 hectares, including portions of the following registered farms within the Estcourt Magisterial District:

- Schurfde Poort No. 1147 GS – Remaining Extent of Portion 1
- Shaws No. 11317 GS – All Portions
- Ganna Hoek No. 1317 GS – Portion 1 and Remaining Extent
- Klip Berg No. 2158 GT – Portion 1 and Remaining Extent
- Brakfontein No. 8033 GS – All Portions
- Ramak No. 13696 GT – Portions 1, 2, and Remaining Extent

Surrounding Land Use:

- The area is a semi-rural setting dominated by natural grasslands, scattered bushland, and agricultural fields.
- There is limited built infrastructure, with nearby rural settlements and lodges.
- The land is largely undeveloped, with a mix of natural ecological habitats and historically cultivated areas.

Accessibility:

- The project site is accessible via the R74 and R103 regional roads, with a local gravel access road extending from the town of Colenso to the project area.
- The nearest major urban centres are: Colenso, located approximately 5 km west of the project boundary and Ladysmith, approximately 25 km northwest of the project area, offering regional services, transport infrastructure, and workforce access.
- The N3 national highway lies further east and provides regional connectivity between Durban and Johannesburg via Estcourt and Ladysmith.

Visual Context:

- The landscape is defined by rolling hills, gently sloping ridges, and panoramic views across the Tugela River Valley.
- Sensitive visual receptors in the surrounding area include local rural communities, lodges, and tourism routes, particularly near Colenso.
- The area's low-density development and high visual quality make it sensitive to any visible alterations, particularly along elevated KOPs.

This location information is critical for understanding the visual and landscape context of the proposed mining project, ensuring that the Visual and Landscape Impact Assessment (VLIA)

accurately evaluates potential impacts on surrounding communities, scenic routes, and sensitive visual receptors.

2.2 Project Components

The proposed coal mining project will employ the **Highwall Mining Method**, a specialized form of surface mining that allows for the extraction of coal from exposed seams along a highwall. This method combines the advantages of surface and underground mining techniques, making it a highly efficient and safe option for coal extraction in the project area.

Highwall mining involves the use of a highwall mining machine, which is remotely operated from the surface. This machine extracts coal by advancing into the exposed seam, using a continuous miner that cuts and transports the coal to the surface without the need for underground personnel. The extracted coal is then processed on-site, ensuring that it meets the required quality specifications.

2.2.1 Mining Activities

The primary mining activities will include:

- **Highwall Mining Operations:** The highwall mining machine will be used to access and extract coal from the exposed seams along the highwall of a previously mined area. The machine operates remotely, maintaining a high level of safety.
- **Coal Extraction and Transport:** Extracted coal will be transported to a designated stockpile area using conveyor belts or shuttle cars. The stockpiled coal will be processed to improve its quality.
- **Rehabilitation:** Progressive rehabilitation will be carried out alongside mining operations. This will involve regrading and stabilizing the highwall, re-vegetation of disturbed areas, and soil stabilization to restore the visual and ecological quality of the site.

2.2.2 Support Infrastructure

To support the highwall mining operations, the project will establish the following infrastructure:

- **Access Roads:** A network of access roads will be developed for the movement of mining equipment, personnel, and coal transportation. These roads will be designed to minimize dust generation, with regular maintenance to ensure safety.

- **Site Offices and Facilities:** Administrative offices will be set up for project management, employee accommodation, and equipment storage. Safety facilities, including a first-aid center and emergency response station, will also be provided.
- **Security Measures:** The project site will be secured with perimeter fencing and access control points. 24-hour security will be maintained to safeguard assets and ensure operational safety.

2.2.3 Utilities

The project will require reliable utility services to maintain efficient and sustainable operations:

- **Electricity Supply:** The site will be connected to the local electricity grid, providing power for mining equipment, site offices, and processing facilities. Backup generators will be available to maintain essential operations during power outages.
- **Water Supply:** Water will be sourced from a combination of boreholes, surface water, and recycled water from the coal processing area. Efficient water conservation measures will be implemented to minimize water use.
- **Waste Management:** A comprehensive waste management plan will be implemented
- **Environmental Monitoring:** Regular monitoring of air quality, water quality, noise levels, and dust fallout will be conducted to ensure compliance with environmental management standards.

2.2.4 Project Phases

The project will be implemented in three main phases, each designed to ensure efficient and environmentally responsible operations:

Phase 1: Site Preparation

- Land clearing, vegetation removal, and initial grading.
- Installation of access roads and support infrastructure.
- Establishment of site offices, utilities, and the highwall mining area.
- Initial highwall preparation to expose the coal seam.

Phase 2: Highwall Mining Operations

- Continuous operation of the highwall mining machine, extracting coal from the exposed seams.
- Transportation of extracted coal to the processing area.
- Regular maintenance of highwall mining equipment.
- Ongoing environmental monitoring and progressive rehabilitation.

Phase 3: Site Closure and Rehabilitation

- Cessation of highwall mining operations and removal of equipment.
- Comprehensive site rehabilitation
- Post-closure monitoring to ensure environmental stability and compliance.

2.3 Project Layout Map

The Project Layout Map below clearly defines the proposed mining site, marked with red and green boundaries, and is accessible via a network of primary, secondary and tertiary (yellow) roads, along with a railway network. It highlights key water features, including perennial and non-perennial rivers, ensuring that water resources are adequately considered in the assessment. Nearby towns such as Colenso, Ezakheni, and KwaNobamba provide spatial context, while educational institutions and tourism sites, including Nambiti Hills Lodge and Lions Valley Lodge, emphasize the social and economic sensitivity of the region.

The map also provides a detailed view of the region's topography, showcasing mountains, valleys, and open plains, which are essential for understanding the area's visual character. Prepared using the WGS 1984 coordinate system, it ensures accurate spatial representation and distance estimation. Developed by R Matosse of KMG Environmental Solutions Services, the map maintains professional standards, serving as a critical reference for the Visual and Landscape Impact Assessment (VLIA).

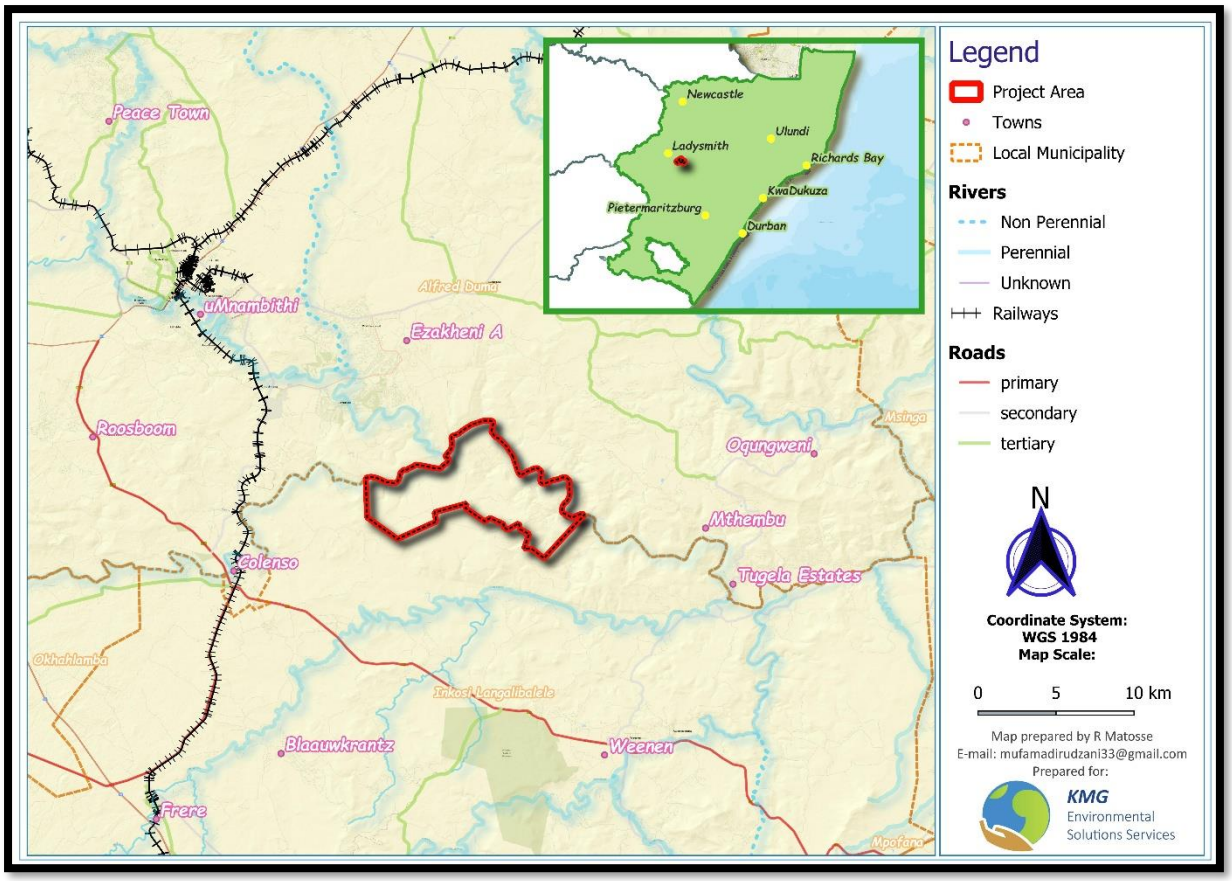


Figure 1: Regional Map

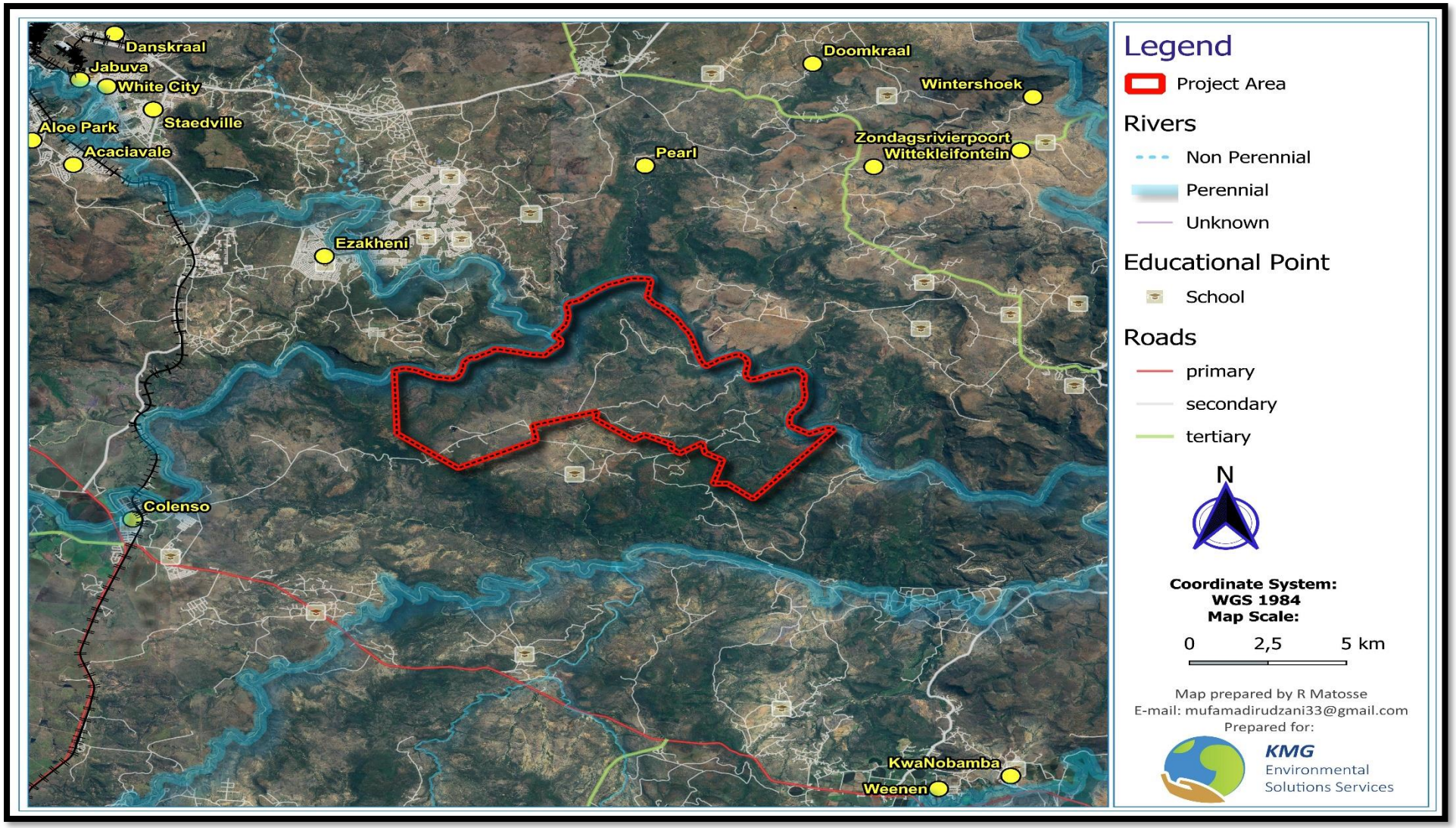


Figure 2: Locality Map

3. APPLICABLE LEGISLATIONS

The Visual and Landscape Impact Assessment (VLIA) for the proposed coal mining project by Dunrose Investment 174 (Pty) Ltd, conducted by KMG Environmental Solutions Services (Pty) Ltd, has been structured to comply with relevant national, provincial (KwaZulu-Natal), and local legislation, as well as applicable guidelines and international best practices. The table below summarizes the key legislations and guidelines relevant to the project area, which is located within the KwaZulu-Natal (KZN) Province, South Africa.

Table 1: Applicable Legislations

Legislation/Guideline	Purpose	Relevance to VLIA	Specific to KwaZulu-Natal (KZN) Region
National Environmental Management Act (NEMA), Act No. 107 of 1998	Establishes a framework for sustainable development and integrated environmental management.	Ensures that visual and landscape impacts are assessed as part of the EIA process.	KZN's diverse landscapes, including coastal areas, mountains, and agricultural regions, require careful assessment of visual changes caused by mining activities.
Environmental Impact Assessment Regulations (2014, as amended)	Provides procedural requirements for conducting EIAs in South Africa.	Ensures public participation, impact assessment, and the compilation of a detailed assessment report.	KZN is home to sensitive ecosystems (e.g., Drakensberg, coastal regions) requiring strict compliance with these regulations to manage visual impacts.
National Environmental Management: Air Quality Act (NEM:AQA), Act No. 39 of 2004	Regulates air quality management and pollution control.	Addresses potential dust and particulate emissions that may affect atmospheric	In KZN, industrial activities, including mining, can generate dust, affecting air

		visibility and landscape aesthetics.	quality and the visual character of surrounding natural landscapes.
National Heritage Resources Act (NHRA), Act No. 25 of 1999	Protects cultural and natural heritage resources, including scenic and cultural landscapes.	Ensures that the mining project does not negatively impact culturally significant landscapes or heritage sites.	KZN has several cultural heritage sites (e.g., Zulu Kingdom sites, Drakensberg World Heritage Site), which must be preserved during mining operations.
Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes (DEA, 2005)	Guides the assessment of visual and aesthetic impacts within the EIA process.	Provides a standardized methodology for visual impact assessments, including classification of visual sensitivity and visual simulation.	Due to KZN's scenic beauty (coastlines, valleys, and mountain ranges), visual impact assessments must carefully consider aesthetic value and viewer sensitivity.
Spatial Planning and Land Use Management Act (SPLUMA), Act No. 16 of 2013	Regulates spatial planning and land use management across South Africa.	Ensures that the proposed mining project aligns with existing and future land use plans.	The project must comply with KZN's municipal planning frameworks, including Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs).
KwaZulu-Natal Nature Conservation Management Act, Act No. 9 of 1997	Provides for the conservation of nature and management of	Ensures that mining activities do not compromise the visual integrity of	The region includes protected areas (e.g., iSimangaliso Wetland Park, uKhahlamba

	protected areas in KZN.	conservation areas or ecological landscapes.	Drakensberg Park), where visual impacts must be carefully managed.
KwaZulu-Natal Heritage Act, Act No. 4 of 2008	Protects the cultural and natural heritage of KZN, including landscapes of cultural significance.	Ensures that visual impacts do not negatively affect heritage landscapes, sacred sites, or historical landmarks.	The assessment must consider the impact on traditional Zulu heritage sites, battlefields, and historical landmarks throughout the province.
Municipal Bylaws and Spatial Development Frameworks (SDFs)	Establish local planning and land use management policies.	Aligns project activities with municipal planning requirements, ensuring no conflict with local visual and landscape management objectives.	The local municipalities in KZN may have specific zoning and development guidelines that must be adhered to in the visual impact assessment.
KwaZulu-Natal Tourism Act, Act No. 11 of 2000	Promotes tourism and sustainable use of natural resources in KZN.	Ensures that visual impacts do not negatively affect the tourism appeal of the area, especially scenic routes and tourist attractions.	KZN's tourism hotspots (e.g., Durban coastline, Midlands Meander) must maintain their scenic value, and the project must mitigate any negative visual impacts.

4. METHODOLOGY

4.1 Overview of Visual Impact Assessment Methodology

The Visual and Landscape Impact Assessment (VLIA) was conducted using a systematic and structured approach, which includes the following key steps:

Project Understanding and Baseline Study:

- Review of the project description, layout, and design as provided by Dunrose Investment (Pty) Ltd.
- Collection of baseline data, including topographical maps, satellite imagery, and existing landscape characteristics.

Field Survey and Desktop Study:

- On-site field surveys were conducted to document and photograph the existing visual and landscape characteristics of the project area.
- A desktop study was carried out to supplement field observations with geographic information system (GIS) data, maps, and satellite images.

Identification of Visual Receptors:

- Sensitive visual receptors (e.g., residential areas, tourist destinations, cultural sites) were identified and categorized based on their sensitivity to visual changes.

Visual Sensitivity Analysis:

- The visual sensitivity of the project area was classified into high, medium, and low sensitivity zones, based on scenic quality, viewer sensitivity, and landscape integrity.

Visual Impact Assessment:

- Potential visual impacts were identified, and their magnitude, extent, duration, and significance were evaluated using a standardized rating system.

Visual Simulation and Photomontages:

- Visual simulations were prepared using photomontages to illustrate the potential visual impacts of the project from selected viewpoints.

Development of Mitigation Measures:

- Appropriate mitigation measures were recommended to minimize adverse visual impacts.

Stakeholder Engagement:

- Engagement with stakeholders, including local communities, regulatory authorities, and interested and affected parties (IAPs), to obtain feedback on visual concerns.

4.2 Field Survey and Desktop Study Procedures

4.2.1 Field Survey Procedures

A site visit and field survey were conducted on the 8th of May 2025 by a team of environmental specialists from KMG Environmental Solutions Services (Pty) Ltd.

The survey included:

- Systematic observation and documentation of the site's topography, vegetation, land use, and existing infrastructure.
- Photography of the site from key observation points (KOPs) to capture the existing visual character.
- GPS coordinates were recorded for all KOPs, ensuring accurate location tracking.
- Site sketches were prepared to highlight significant landscape features and sensitive visual receptors.
- Weather conditions during the survey were clear, with good visibility, providing optimal conditions for visual observations.

4.2.2 Desktop Study Procedures

- Geographic Information System (GIS) tools were used to analyze the spatial characteristics of the project area.
- Topographical maps, satellite images, and aerial photographs were reviewed to supplement field observations.
- Visual sensitivity mapping was carried out using GIS to identify high, medium, and low sensitivity zones.
- Relevant legislation, guidelines, and best practices for visual impact assessment were reviewed, ensuring compliance with national and provincial regulations (specific to the region of KwaZulu-Natal).

4.3 Identification of Visual Receptors

Visual receptors are individuals, communities, or areas that may be affected by visual changes resulting from the proposed coal mining project. The identification and classification of visual receptors were based on the following categories:

Table 2: Visual Receptors

Category	Description	Examples in the Project Area
Residential Areas	Communities and households within the visual influence zone of the project.	Rural settlements, villages, and farmsteads located near the project site.
Scenic Routes	Roads or pathways that offer scenic views and are frequently used for tourism or commuting.	Major roads, scenic drive routes in KZN, and tourism trails.
Cultural and Heritage Sites	Areas of cultural, historical, or heritage significance that may be visually impacted.	Historical landmarks, traditional Zulu heritage sites, and protected cultural landscapes.
Recreational Areas	Parks, reserves, or public spaces used for outdoor recreation and leisure.	Local nature reserves, picnic sites, and public viewpoints.
Tourist Attractions	Popular destinations for visitors and tourists that may be visually affected by the project.	Scenic lookouts, eco-tourism sites, and resorts in the region.
Workplace Receptors	Industrial or commercial facilities where employees may have views of the project site.	Local businesses, agricultural farms, and nearby industrial facilities.
Transport Routes	Main roads, highways, and railway lines from which the project may be visible.	National and provincial roads that pass through the project area.

Map below illustrates the visual influence zone of the proposed mining right area in relation to nearby sensitive receptors, including local villages, scenic homesteads, and tourism establishments, thereby highlighting the area's most likely to experience visual impacts."

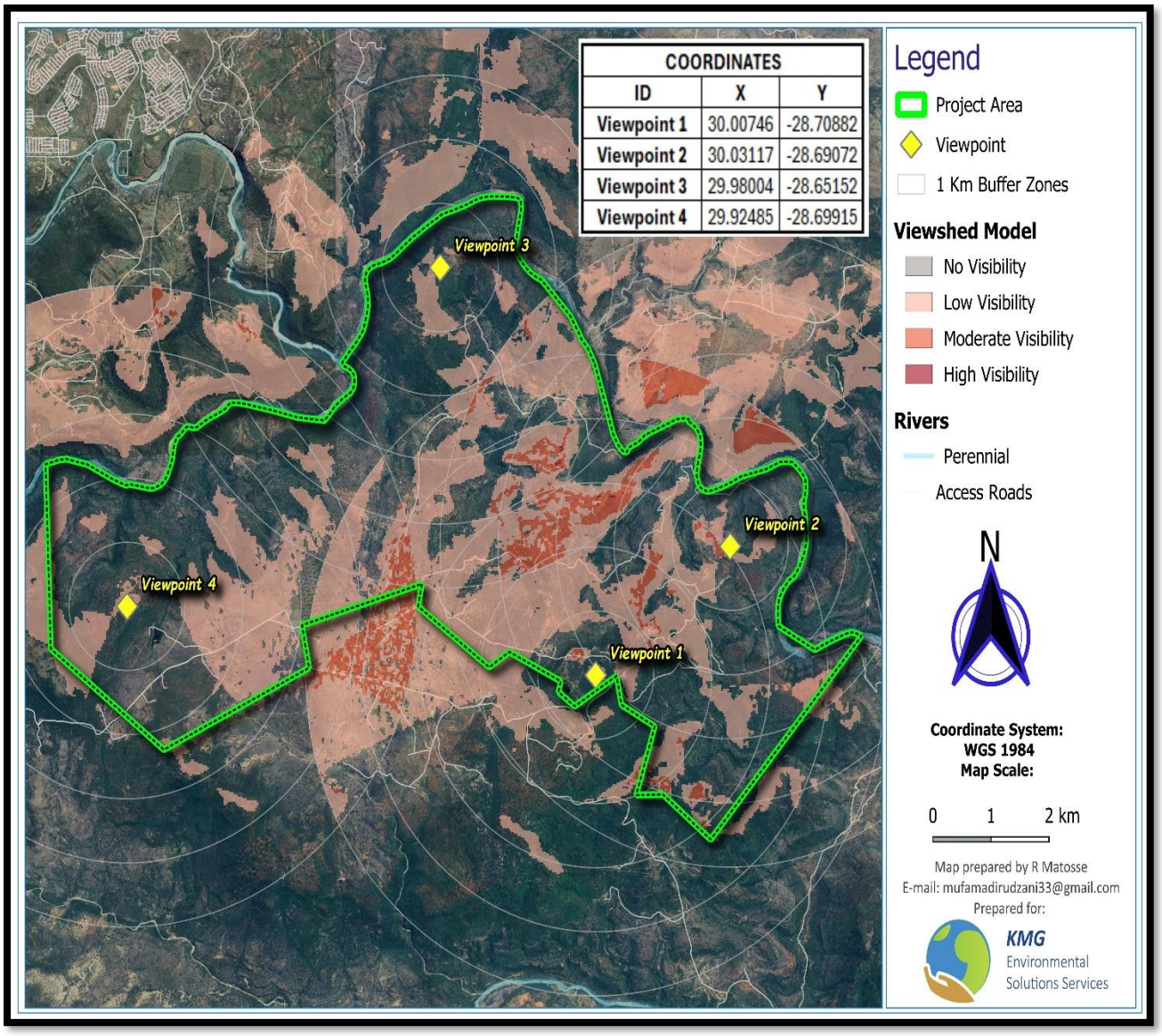


Figure 3:Visual Impact Zone Map

4.4 Visual Impact Rating Criteria

The visual impact of the proposed coal mining project was assessed using a standardized impact rating system. The following criteria were used to evaluate the significance of each identified visual impact:

Table 3: Visual Impact Rating Criteria

Criteria	Description	Rating Scale
Nature of Impact	Indicates whether the impact is positive, negative, or neutral.	Positive, Negative, Neutral

Extent	Geographical area affected by the visual impact.	Local, Regional, National, International
Duration	Period over which the impact will occur.	Short-term, Medium-term, Long-term, Permanent
Intensity	The degree to which the visual change is noticeable or severe.	Low, Medium, High
Probability	Likelihood of the visual impact occurring.	Unlikely, Possible, Probable, Definite
Significance	Overall importance of the visual impact, considering all criteria.	Negligible, Minor, Moderate, Major
Sensitivity of Receptor	The level of sensitivity of the visual receptor to the visual change.	Low, Medium, High
Reversibility	The potential for the visual impact to be reversed or mitigated.	Reversible, Partially Reversible, Irreversible

Visual Impact Significance Calculation:

Significance = (Extent + Duration + Intensity + Probability) x Sensitivity of Receptor

The result is categorized as follows:

- Negligible Impact (0 - 4): No significant visual change.
- Minor Impact (5 - 10): Low-intensity impact that is easily mitigated.
- Moderate Impact (11 - 15): Noticeable impact that may require mitigation.
- Major Impact (16 - 20): Significant impact requiring strong mitigation measures.

This methodology ensures that the Visual and Landscape Impact Assessment (VLIA) is comprehensive, transparent, and aligned with industry best practices and regional regulations.

5. DESCRIPTION OF THE AFFECTED AREA

5.1 Land Cover

The study area is characterized by a diverse landscape predominantly covered by forested land, which occupies a significant portion of the region. These forested areas consist of dense natural vegetation, including indigenous tree species that contribute to local biodiversity and provide essential ecosystem services such as carbon sequestration, soil stabilization, and habitat for wildlife.

Surrounding the forested regions are expansive grasslands, which support a variety of herbaceous plants and grasses, providing grazing areas for livestock and habitat for grassland species. Shrubland areas, scattered across the landscape, further enhance the ecological diversity of the study area, offering habitat for smaller fauna and contributing to the region's visual character.

In the southern sections of the study area, cultivated land is evident, reflecting agricultural activities where crops are grown for local consumption and commercial purposes. These cultivated fields are interspersed with patches of natural vegetation, maintaining a balance between agricultural use and ecological integrity.

The study area is traversed by several watercourses, including rivers and streams that flow through the landscape, creating a network of wetlands and waterbodies that support aquatic life and provide critical ecosystem services such as water purification and flood control. These wetlands are particularly important for maintaining biodiversity and supporting seasonal wildlife migrations.

The region also contains limited built-up areas, reflecting sparse human settlement, primarily in rural communities. These settlements are characterized by small clusters of houses, community facilities, and basic infrastructure. The relatively low level of urbanization enhances the area's natural character, making it a predominantly rural landscape.

Overall, the study area is defined by its rich natural environment, marked by forested hills, open grasslands, and a network of watercourses, providing a scenic and ecologically valuable landscape. Below is the land cover map of the study area.

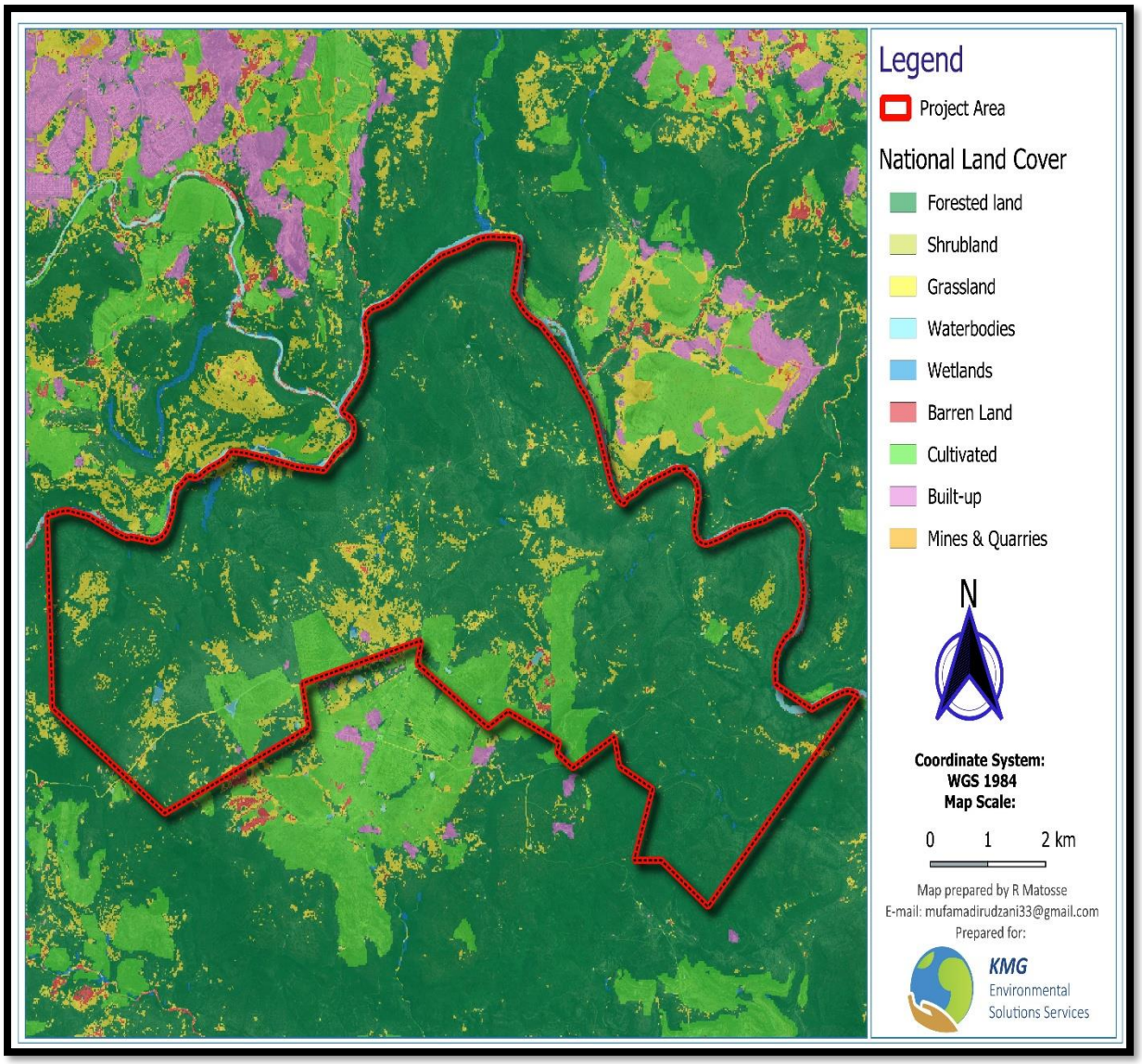


Figure 4: Land Use

In terms of vegetation cover, the study area is primarily defined by two dominant vegetation types: Thukela Thornveld and Thukela Valley Bushveld Thukela Thornveld is characterized by open savannah grasslands interspersed with thorny shrubs, providing habitat for a variety of herbivores and smaller wildlife. Thukela Valley Bushveld, on the other hand, is a dense, woody vegetation type typical of valley regions, offering critical habitat for bird species, mammals, and reptiles. These vegetation types are essential for maintaining the region's ecological balance and must be carefully managed during project implementation. Below is the land cover map and vegetation cover map of the study area.

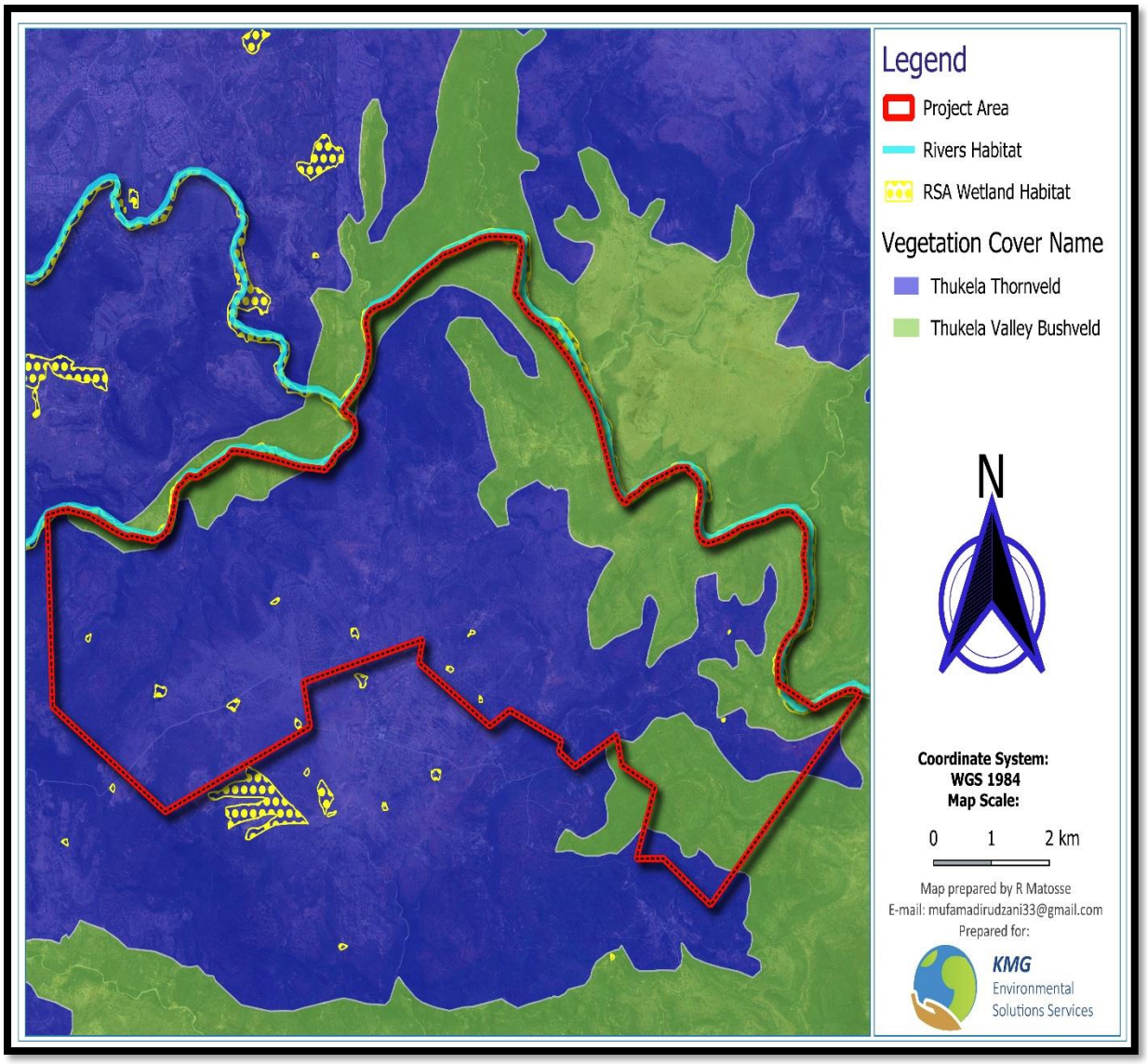


Table 4: Land Cover

5.2 Sensitive Visual Receptors

Sensitive visual receptors are individuals, communities, or land uses that may be significantly affected by changes to the visual landscape resulting from the proposed coal mining project. These receptors are identified based on their proximity to the project area, the nature of their current views, and their sensitivity to alterations in the visual environment. Based on the scoping report and field context, the following key receptor groups have been identified.

Residential Areas:

- Colenso Community: The town of Colenso is the closest significant settlement to the project area, located approximately 5 km to the west. It contains residential zones with potential partial or direct views toward the mining area from higher elevations.
- Rural Homesteads and Settlements: Scattered traditional dwellings and farmsteads are located within and adjacent to the mining right boundary. These homesteads may experience close-range visual exposure to mining infrastructure and activities.

Tourist Attractions and Lodges:

- Local Game Lodges and Guesthouses: While large-scale lodges such as those near Nambiti are outside the immediate visual catchment, there are several small hospitality facilities and game farms within the uThukela region whose appeal relies on landscape aesthetics and rural tranquility.
- Tourism Routes: Scenic portions of the R74 and R103 routes serve as regional tourism corridors. Views from these roads, particularly where they pass elevated terrain, may expose travellers to mining infrastructure.

Educational and Community Facilities:

- Local Schools and Churches: Community-based institutions in and around Colenso and nearby rural areas may be affected, particularly where they serve populations that walk or travel along visual corridors adjacent to the project.
- Community Centres and Gathering Spaces: Visual quality in these spaces contributes to local amenity and may be degraded if mining features are visually dominant or incongruent with the current setting.

Recreational Areas:

- Tugela River Corridor: The river system adjacent to or intersecting parts of the project site holds ecological and aesthetic value. Its visual integrity is considered sensitive, particularly in areas used for informal recreation or conservation.
- Local Grasslands and Wetlands: Open natural areas within the mining right area and nearby properties are valued for their biodiversity, ecological function, and visual openness.

Heritage and Cultural Sites:

- Cultural Landscapes and Sacred Sites: The surrounding area is historically significant, forming part of KwaZulu-Natal's broader heritage landscape. Any traditional sites or burial grounds within the mining footprint or visual catchment would be considered highly sensitive.
- Battlefields and Historical Features: While the main battlefields are not immediately adjacent, the broader Ladysmith–Colenso–Estcourt corridor includes sites of historical military and cultural relevance.

Transport Routes:

- R74 and R103 Regional Roads: These primary routes provide both local commuter and tourism access and traverse topographies that may afford clear views toward mining activities, especially from elevated curves or cuttings.
- Rail Infrastructure: The rail line east of Colenso and nearby crossings may offer direct views depending on embankment elevations and direction of travel.

Agricultural Areas**:**

- Farmland and Grazing Lands: The area includes operational farms and grazing lands whose owners and workers may be impacted by visual changes, particularly where long, unobstructed views currently exist.
- Scenic Farmsteads: Some isolated properties are located on elevated terrain or hill slopes, where views across the landscape form a defining characteristic of their rural identity.

These sensitive visual receptors have been identified to ensure that the Visual and Landscape Impact Assessment (VLIA) adequately considers the potential impacts of the proposed mining project on the visual experience of affected individuals and communities.

5.3 Topography

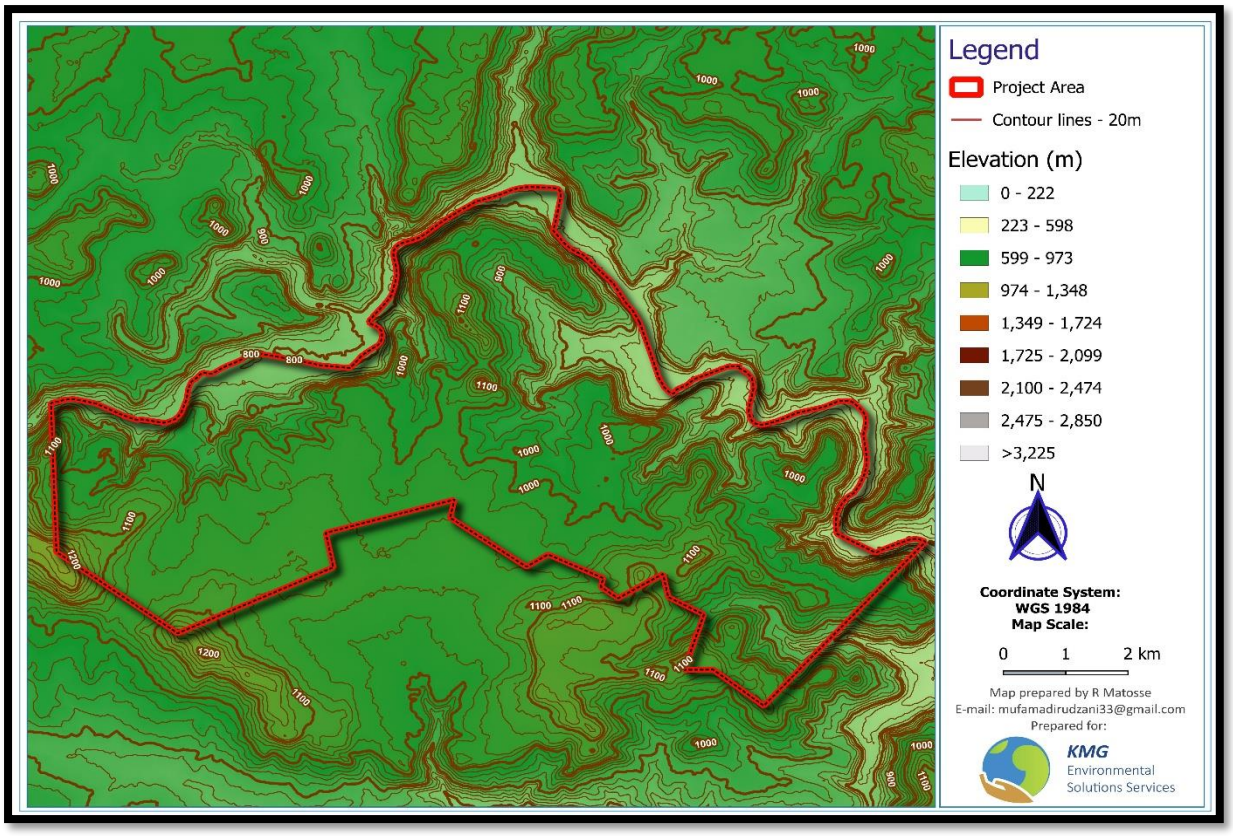
The study area is characterized by a diverse and undulating topography, dominated by a series of rolling hills, steep slopes, and elevated ridges. The topographical variation is evident from the contour lines on the map, which are spaced at 20-meter intervals, providing a detailed representation of the terrain.

The highest elevations in the study area exceed 1,100 meters above sea level, primarily in the south eastern and south-western sections. These elevated ridges offer panoramic views of the surrounding landscape, making them critical viewpoints for visual impact assessment. The lowest areas are

located along the river valleys, where the terrain is relatively flat, providing natural corridors for water flow.

The terrain is further defined by several deep valleys and watercourses, including the main river system that flows along the northeaster boundary of the project area. These valleys are not only important for water drainage but also contribute to the scenic value of the landscape, making them visually sensitive areas.

The steep slopes and rugged terrain in certain sections of the study area present both challenges and opportunities for the proposed mining project. The challenging terrain may restrict certain mining activities, but it also provides natural visual screening, reducing the visibility of mining infrastructure from surrounding areas. Careful planning will be required to ensure that mining activities are conducted in a manner that minimizes visual intrusion, especially in areas visible from scenic viewpoints and residential areas. Below is the topographical map of the study area.



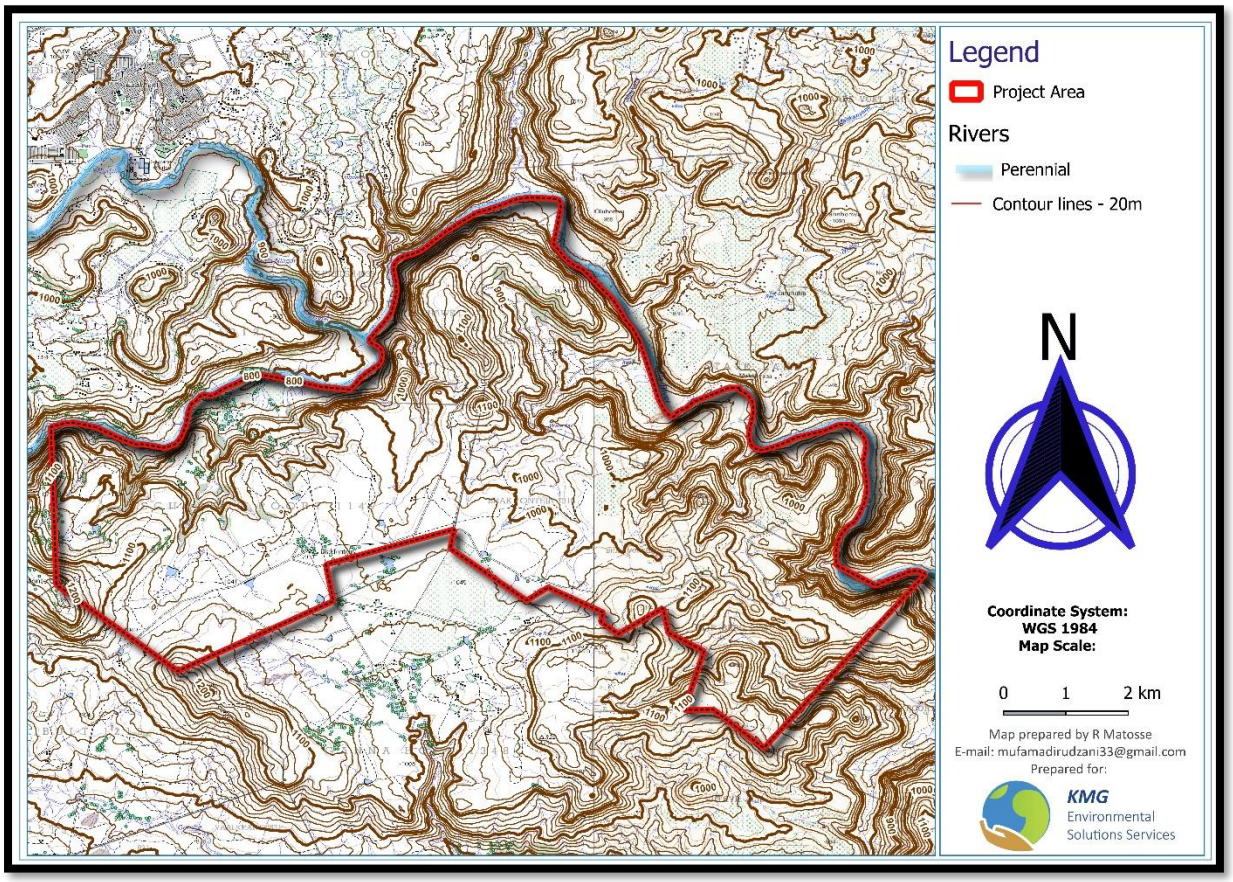


Figure 5: Topography Map

5.4 Sense of Place

The study area possesses a distinct and captivating sense of place, defined by its natural beauty, ecological diversity, cultural heritage, and rural character. This sense of place is shaped by a harmonious blend of natural and cultural elements that give the area its unique identity and visual appeal.

- Natural Landscape Character

  The region is predominantly characterized by rolling hills, rugged mountain ridges, and expansive grasslands, creating a picturesque and tranquil rural setting. The dense forested areas, interspersed with open grasslands and shrublands, provide a lush green backdrop, while the winding river valleys and wetlands introduce dynamic natural features that enhance the area's scenic value. The topographical variation, with elevated ridges offering panoramic views, further accentuates the area's visual character.

  The river systems that meander through the landscape are not only ecologically significant but also visually striking, adding a sense of natural serenity to the region. These watercourses, along with the surrounding vegetation, support a wide variety of wildlife, contributing to the area's ecological richness.

- Cultural and Heritage Significance

  The sense of place is further enriched by the cultural heritage of the region, which is deeply rooted in the traditional practices of local communities. Traditional Zulu heritage sites, rural homesteads, and cultural landmarks scattered across the landscape add a layer of cultural identity that is integral to the area's character. The presence of historical sites, including battlefields and cultural landscapes, reflects the region's historical significance and attracts visitors interested in cultural tourism

- Rural and Agricultural Identity

  The region's predominantly rural character is reflected in the scattered rural settlements, agricultural fields, and grazing lands. Small villages and farmsteads are interspersed among the natural landscape, creating a sense of peaceful rural living. Agriculture is an essential

part of the local economy, and the visual presence of cultivated fields, grazing livestock, and rural homesteads contributes to the area's sense of place.

- Tourism and Scenic Value

The area's scenic beauty is further highlighted by its status as a popular destination for nature-based tourism. Lodges such as Nambiti Hills Lodge, Lions Valley Lodge, and Umzolozolo Lodge offer visitors an opportunity to experience the region's natural beauty, while scenic routes and nature trails allow for immersive outdoor experiences. Notably, Zingela Safari and River Company, located on Farm Krompoort 2155 GT and immediately adjacent to the mining application area, provides a unique wilderness retreat that combines eco-tourism, adventure activities, and river-based recreation. As one of the closest tourism establishments to the site, Zingela plays a significant role in shaping the local tourism character and contributes meaningfully to the region's sense of place. The region's overall tourism appeal is thus strengthened by the presence of these diverse establishments, where visitors are drawn to the picturesque landscapes, cultural experiences, and rich natural heritage.

- Visual Harmony and Tranquillity

Overall, the study area is defined by a sense of visual harmony, where natural, cultural, and rural elements coexist, creating a tranquil and visually appealing environment. This sense of place is an essential aspect of the region's identity and must be carefully considered in the Visual and Landscape Impact Assessment (VLIA) to ensure that the proposed mining project does not compromise the area's natural beauty, cultural heritage, and visual integrity.

6. BASELINE VISUAL CHARACTERISTICS

6.1 Landscape Character (Natural and Built Environment)

The landscape character of the study area is predominantly rural and natural, defined by a mosaic of natural vegetation, gently undulating topography, and limited built development. The natural environment features a combination of forested areas, open grasslands, shrubland, and riparian corridors, all of which contribute to a tranquil and scenic rural atmosphere. The vegetation cover, including Thukela Thornveld and Thukela Valley Bushveld, adds ecological richness and visual texture

to the landscape, while the presence of seasonal wetlands and rivers enhances both biodiversity and visual interest.

In contrast, the built environment is minimal, consisting of dispersed rural settlements, farmsteads, access roads, and limited infrastructure related to agricultural activity. The absence of large-scale industrial or urban development reinforces the region's sense of openness and natural integrity. This combination of scenic natural features and sparsely populated built elements gives the area a distinctive rural cultural landscape, which is highly sensitive to transformation and visual intrusion.

6.2 Existing Visual Quality

The existing visual quality of the study area is high, largely due to its natural vegetation cover, topographical variation, and scenic views across valleys and ridgelines. The absence of significant human-made disturbances or intrusive infrastructure allows for uninterrupted sightlines and expansive vistas that are typical of KwaZulu-Natal's rural interior. Elevated areas provide panoramic views over grasslands, river systems, and distant hills, making the visual experience rich and aesthetically pleasing.

The area's visual quality is further enhanced by the presence of tourism-related infrastructure—such as lodges and scenic routes—indicating a reliance on landscape aesthetics for economic activity. The sense of place and visual harmony found here contributes significantly to its recreational and ecological value. Any visual disturbances from future development must therefore be carefully managed to preserve this high-quality visual environment.

6.3 Photographic Record (Before Development)

A photographic survey was conducted during the site visit on 8 May 2025 to document the baseline visual conditions of the project area. Photographs were taken from several Key Observation Points (KOPs), selected based on visibility, elevation, proximity to sensitive visual receptors, and potential future viewpoints of the mining operation.

The photographic record includes:

- Panoramic views from elevated ridgelines and hills.
- Ground-level views from nearby settlements and roads.
- Visual perspectives from within grassland and bushveld habitats.
- Views towards the project area from existing lodges and scenic routes.

These images provide a reference point for assessing visual change and serve as critical inputs into the visual simulation and impact assessment phases. The photos also support mitigation planning by identifying locations where screening, vegetation buffers, or terrain features may reduce visual exposure

Below is a photographic record illustrating the current visual character of the site prior to any development.Photographic Record of the Study Area (Pre-Development Conditions)

Table 5: Photographic Record

Photo ID	Location / KOP	GPS Coordinates	View Direction	Description
Photo 1	KOP 1 –Entrance to the entire Property Main access road	28,73460°"S 29,84802°"E	North East	The photo depicts a quiet rural dirt road with two cows near the roadside, surrounded by dry grassland, sparse trees, and fencing, indicating a typical agricultural setting.

Photo 2 	KOP 2 – Access Road /Bridge – Watercourse and Wetland	28,73460°"S 29,84802°"E	North	The image shows a gravel road beside a calm waterbody with surrounding vegetation and hills, capturing a peaceful rural countryside scene.

	KOP 3 – Next to the Local School	28°41'58.40"S 29°57'9.52"E	North East	The image captures an open savannah landscape with scattered acacia trees, dry grass, and distant hills under a clear sky, reflecting a natural, undisturbed environment
Photo 4	KOP 4 – Access Road to proposed mining area	28°41'31.48"S 29°58'21.94"E	North	The image captures a narrow dirt track winding through a natural savannah landscape with scattered trees and a distant hill

				under a clear blue sky.
Photo 5	KOP 5 – – Kopas Dippernar Gate	-28.7371°, 29.7558°	Northwest	The image shows a weathered entrance gate with a rusted sign reading "Kobus Dippenaar en

				Seuns – Gannahoek Landgoed – Tel. 2849," set against a backdrop of dense green vegetation and gently sloping hills under a clear blue sky. The scene reflects a rural farm or private property in a natural, undisturbed landscape.
Photo 6	KOP 6 – View from high point	28°40'20.98"S 29°58'52.98"E		The image shows a cluster of rural homesteads with

				metal roofs partially hidden among tall grass and dense trees at the base of a forested hillside. The scene reflects a traditional settlement in a natural, wooded landscape, suggesting a quiet and remote village setting.
Photo 7	KOP 7 – View from lower point	28°40'25.69"S 29°58'44.95"E	Northeast	The image shows a natural landscape featuring a grassy path or clearing leading

				into dense vegetation, with a tree-covered hillside rising in the background. The clear blue sky above enhances the sense of openness and isolation, reflecting a remote, undeveloped area typical of rural or wilderness terrain.
Photo 8	KOP 8 – From Higher Point - House Stand	28°40'20.98"S 29°58'52.98"E	Southeast	The image shows a grassy landscape with scattered shrubs

				and tall aloes in the foreground, leading up to a densely vegetated hill under a clear blue sky. The terrain reflects a typical savannah or bushveld environment, with minimal human disturbance and strong visual natural character.
Photo 9	KOP 9 – From Higher Point – low House Stand	28°40'21.76"S 29°58'43.59"E		The image shows a rural homestead at the edge of a forested hillside.

				In the foreground, there are stone and wooden structures, scattered building materials, and basic fencing, suggesting subsistence living or small-scale farming. The densely vegetated hill in the background rises under a bright, clear sky, emphasizing the natural and

				undeveloped surroundings.
Photo 10 	KOP 10 Next to the Local School	28°41'58.40"S 29°57'9.52"E	South	The image shows an open grassland with tall, golden grasses and scattered low trees beneath a clear, vibrant blue sky. A simple wire fence runs across the scene, indicating land boundaries within a natural rural setting. The landscape

				appears undisturbed, showcasing a typical savannah environment.

7. IMPACT ASSESSMENT AND SIGNIFICANCE RATING

7.1 Identification of Potential Visual Impacts

The proposed coal mining project, including highwall mining operations and associated infrastructure, has the potential to introduce noticeable visual changes within the landscape. These changes may affect the area's visual quality, landscape character, and the experience of viewers situated within the visual catchment. The key potential visual impacts identified include:

- Alteration of Natural Landform and Vegetation Cover: Vegetation clearance and the excavation of highwall may disrupt the natural flow and visual continuity of the landscape, especially on ridgelines and slopes.
- Introduction of Industrial Elements into a Rural Landscape: Structures such as site offices, conveyor belts for transportation of coal, machinery, and stockpiles will contrast with the existing rural and natural environment.
- Increased Visual Exposure from Key Viewpoints: Elevated terrain surrounding the project site creates vantage points (Key Observation Points) from which mining operations may become visually prominent.
- Dust Plumes and Surface Disturbance: Dust generated from coal handling, and exposed surfaces may cause transient visual impacts and reduce visual clarity in the surrounding areas.
- Night-Time Light Pollution: Artificial lighting for operational and security purposes may introduce night-time glow, affecting dark rural skies and nearby receptors such as lodges and homesteads.
- Reduction in Scenic and Tourism Value: Visual intrusion on tourist-facing assets (e.g., lodges, scenic routes) may degrade the area’s visual appeal, with potential implications for eco-tourism and heritage tourism.

7.2 Impact Rating Criteria (Nature, Magnitude, Duration, Extent, Probability)

Visual impacts were assessed using a standardized rating system based on the following five criteria:

Table 6:Impact Rating Criteria

Criteria	Description

Nature	Indicates whether the impact is positive, negative, or neutral.
Magnitude	Describes the scale or intensity of the visual change (e.g., low, medium, high).
Duration	Refers to how long the impact will last (e.g., short-term, medium-term, long-term, permanent).
Extent	Describes the spatial reach of the impact (e.g., site, local, regional, national).
Probability	Assesses the likelihood of the impact occurring (e.g., unlikely, possible, probable, definite).

7.3 Visual Impact Rating Matrix

Below is the visual impact rating matrix used to assess the significance of each identified impact:

Visual Impact Rating Scale

Table 7:Visual Impact Rating Scale

Rating Level	Score Range	Interpretation
Negligible	0–4	Little to no visible change
Minor	5–10	Low-intensity, localized impact
Moderate	11–15	Noticeable but manageable impact
Major	16–20	High visibility, requiring significant mitigation

Rating Matrix

Table 8:Rating Matrix

Impact	Nature	Magnitude	Duration	Extent	Probability	Sensitivity	Significance
Visual intrusion from highwall face	Negative	High (4)	Long-term (4)	Local (2)	Probable (3)	High (3)	(4+4+2+3)×3 = **39 (Major)**
Night-time glow from site lighting	Negative	Medium (3)	Long-term (4)	Local (2)	Definite (4)	Medium (2)	(3+4+2+4)×2 = **26 (Moderate)**

View obstruction from access road traffic	Negative	Low (2)	Short-term (2)	Site (1)	Possible (2)	Low (1)	(2+2+1+2)×1 = **7 (Minor)**

Note: Sensitivity multiplier is based on the sensitivity of the receptor (Low=1, Medium=2, High=3).

8. MITIGATION MEASURES

8.1 Design Mitigation (Architectural and Landscape Design)

To minimise the visual intrusion of the proposed coal mining project on the surrounding landscape, a range of **design-focused mitigation measures** have been proposed. These measures aim to integrate the mining infrastructure as harmoniously as possible into the existing landscape character, preserving the area's high scenic and cultural value.

Architectural Design Measures

- Low-Profile Infrastructure: Design site structures (offices, storage units, control rooms) to have minimal vertical impact. Use single-storey, compact designs where possible to reduce visibility from surrounding viewpoints.
- Non-Reflective Finishes: Use matte, non-reflective materials for all buildings and infrastructure to avoid glare and visual distraction.
- Natural Colour Palette: Apply colours that match the surrounding natural environment (e.g., earth tones, muted greens and browns) to external finishes, ensuring structures blend into the background.
- Screening and Cladding: Use visually permeable screens or wooden cladding around mechanical and utility structures to soften their appearance and reduce industrial visual cues.

Landscape Design Measures

- Vegetative Screening: Establish buffer zones of indigenous vegetation around the perimeter of the site and along access roads, especially near sensitive visual receptors such as

residential areas and lodges. Fast-growing native trees and shrubs should be prioritised to provide effective screening within the shortest time.

- Landform Utilisation: Make use of natural ridgelines and topographical depressions to shield high-impact areas such as highwall faces, stockpiles, and haul roads from public view.
- Progressive Rehabilitation: Rehabilitate mined areas in phases rather than waiting until the end of operations. Early re-vegetation helps to quickly restore visual continuity and reduce the long-term visual footprint.
- Contoured Shaping of Stockpiles and Highwall: Avoid steep, angular cuts and mounds. Instead, shape disturbed surfaces into more natural, undulating forms that mimic the surrounding landscape.

Access Road Design

- Road Alignment: Align internal access roads to follow natural contours where possible, avoiding straight lines that may be visually jarring in an otherwise organic landscape.
- Dust Suppression Measures: Implement regular dust control strategies to reduce visibility impacts caused by dust plumes, particularly along roads and active mining areas.

These design mitigation strategies **will play a vital role in reducing the visual impact of the mining project, maintaining the scenic quality of the broader landscape, and supporting a balanced relationship between development and environmental integrity**.

8.2 Vegetation Screening

Vegetation screening is a primary visual mitigation strategy aimed at softening the appearance of mining infrastructure and reducing direct visibility from sensitive receptors. The following measures are proposed:

- Establishment of Visual Buffer Zones: Indigenous trees and shrubs will be planted along the perimeter of the mining area, especially near access roads, community boundaries, tourism lodges, and elevated viewpoints.
- Use of Fast-Growing Indigenous Species: Species native to the KwaZulu-Natal region, such as Acacia, Cussonia, and Diospyros species, will be selected for their ecological compatibility, growth rate, and screening potential.

- Layered Planting Techniques: A combination of tall trees, medium-height shrubs, and groundcovers will be used to create dense, multi-tiered vegetation screens for maximum coverage.
- Topsoil Preservation: Stripped topsoil will be stockpiled and reused during screening and rehabilitation efforts to ensure soil fertility and successful re-establishment of vegetation.
- Progressive Rehabilitation: As mining progresses, disturbed areas will be rehabilitated and re-vegetated in phases to gradually restore the natural appearance of the landscape.

8.3 Lighting Control Measures

To minimise night-time visual impacts and light pollution, especially in rural areas with limited existing artificial lighting, the following lighting control measures will be implemented:

- Directional Lighting: All external lighting will be downward-facing and shielded to prevent light spillage into the night sky and surrounding areas.
- Low-Intensity LED Fixtures: Energy-efficient, low-lumen LED lighting will be used to provide functional lighting while reducing glare and brightness.
- Motion-Activated Security Lights: Where appropriate, motion sensors will be installed to ensure lights are only active when needed, reducing continuous illumination.
- Avoidance of Over-Lighting: Lighting will be limited to operational zones and safety-critical areas only, with no unnecessary decorative or floodlighting.
- Night Sky Compliance: Lighting design will comply with the principles of dark-sky friendly development to preserve the natural nocturnal character of the area.

8.4 Monitoring and Maintenance

Effective implementation of visual mitigation measures requires ongoing monitoring and maintenance to ensure their success throughout the life of the project.

- Routine Visual Inspections: Monthly inspections will be carried out from key observation points to assess the effectiveness of screening, lighting, and general visual integration.
- Vegetation Monitoring: Planted vegetation buffers will be monitored seasonally for growth performance, health, and density. Replanting will be undertaken in areas of poor establishment or die-off.

- Erosion and Landform Stability Checks: Areas shaped for visual screening, such as berms or stockpile contours, will be regularly assessed for erosion and structural integrity.
- Lighting Audits: Annual audits of site lighting will be conducted to identify non-compliant fixtures, excessive brightness, or light trespass beyond the site boundary.
- Community Feedback Mechanism: A stakeholder feedback system will be maintained, allowing local residents and tourism operators to report visual concerns, which can be addressed through responsive management actions.

Together, these mitigation strategies will help ensure that the mining operation maintains visual compatibility with the surrounding landscape and respects the region's rural and ecological character.

9. VISUAL SIMULATIONS AND PHOTOMONTAGES

9.1 Visual Simulations from Key Viewpoints

To assess the potential visual impact of the proposed coal mining project, a series of visual simulations were developed using geo-referenced photography and 3D modelling. Simulations were created from selected Key Observation Points (KOPs) identified during the field survey on 8 May 2025. These viewpoints represent locations of high visual sensitivity and public visibility, such as nearby settlements, scenic routes, and tourism establishments.

Each simulation presents a "before and after" comparison, illustrating the visual change that would occur once the mining infrastructure is in place. The simulations include key elements such as the highwall face, access roads, support infrastructure, and stockpile areas.

Terrain screening, vegetation cover, and elevation were taken into account to ensure realistic visibility assessments.

The following KOPs were simulated:

KOP 1: Main access road from the village.

Baseline Picture 28°41'31.48"S 29°58'21.94"E

Visual Simulation

The image depicts a tarred access road winding through a natural savannah landscape toward a central hill, showcasing minimal ecological disturbance and a visually integrated route for mining-related transport.

KOP 2: Rural homestead adjacent to the project

Baseline Picture 28°40'20.98"S 29°58'52.98"E

Visual Simulation

The simulation shows a newly constructed tarred access road within a rural savannah landscape. It features clean markings, graded slopes, and minimal surrounding disturbance, representing planned mining infrastructure with low visual and ecological impact.

KOP 3: Ground-level perspective of operations

Baseline Picture 28°40'25.69"S 29°58'44.95"E

Visual Simulation

The simulated image illustrates the proposed highwall mining operation incorporating key infrastructure as outlined in the Mining Work Programme. It depicts a terraced highwall face with an active continuous miner, a surface conveyor transporting coal toward a ROM stockpile, and a haul road connecting the mine to surrounding infrastructure. The contrast between the developed mining area and the adjacent natural

landscape highlights the visual transformation resulting from road and infrastructure development, as assessed in the Visual and Landscape Impact Assessment.

KOP 4 High point View of Integrated Highwall Mining

Baseline Picture : 28°40'21.76"S 29°58'43.59"E

Visual Simulation

The simulation represents a view from an elevated Key Observation Point overlooking the proposed highwall mining area situated within a densely vegetated valley. The mining activity is discreetly positioned along the hillside, incorporating a narrow highwall bench carved into the slope. A low-impact conveyor system extends from the highwall face, transporting coal across the vegetation-covered terrain with minimal visual intrusion. The use of gravel access roads instead of paved infrastructure reinforces the project's low-impact footprint. The overall visual character of the landscape remains largely intact, with the mining elements integrated into the topography and screened by natural vegetation, ensuring reduced visibility from distant viewpoints

9.2 Comparison of Baseline and Project Scenarios

A comparative analysis between baseline (pre-development) conditions and the project scenario (post-development) was conducted using the visual simulations. The baseline scenario represents the current natural and rural landscape, characterized by undisturbed vegetation, minimal built features, and high visual quality.

In contrast, the project scenario introduces industrial elements associated with highwall mining, including:

- Cleared vegetation and exposed rock faces.
- Highwall mining equipment and supporting infrastructure.
- Stockpiles and internal access roads.
- Altered landforms and reduced vegetation continuity.

The key findings of the comparison include:

- Visibility: Mining infrastructure will be partially visible from elevated points and some low-lying areas, depending on slope and distance.
- Contrast: High visual contrast is expected between natural vegetation and exposed mining surfaces, particularly during initial clearing and active mining.
- Duration: Visual impacts will persist throughout the operational phase but may reduce during post-closure rehabilitation.
- Sensitivity: Views from tourism lodges and homesteads are the most affected due to their reliance on scenic quality.

This comparison highlights the need for strategic mitigation to preserve the visual integrity of the area and reduce negative perception, especially among local communities and tourism stakeholders.

10. MONITORING PLAN

10.1 Monitoring Objectives

The purpose of visual and landscape monitoring is to ensure that the mitigation measures implemented during the development and operation of the proposed coal mining project are functioning effectively and that unforeseen visual impacts are promptly identified and addressed. The key objectives are:

- To verify the effectiveness of vegetation screening, lighting control, and landform rehabilitation measures in reducing visual intrusion.
- To detect and document any adverse visual changes in the landscape over time, particularly from key observation points (KOPs) and sensitive visual receptors.
- To assess the progress and success of rehabilitation and re-vegetation efforts, especially in areas designated for progressive rehabilitation.
- To ensure compliance with visual impact mitigation commitments outlined in the Environmental Management Programme (EMPr) and this Visual and Landscape Impact Assessment (VLIA).
- To incorporate stakeholder feedback and observations into the ongoing visual management strategy.

10.2 Monitoring Frequency

Visual impact monitoring will be conducted in alignment with the various phases of the project and according to the following recommended frequencies:

Table 9:Monitoring Frequency

Phase	Monitoring Frequency
Pre-construction (Baseline)	Once-off (prior to site clearance)
Construction Phase	Monthly
Operational Phase (Years 1–10)	Quarterly (4 times per year)
Rehabilitation Phase	Quarterly during active rehabilitation

Post-Closure Monitoring	Bi-annually (for 3–5 years post-closure)
Ad-hoc Monitoring	As required following complaints or incidents

10.3 Monitoring Methods

A combination of qualitative and quantitative monitoring methods will be used to ensure a comprehensive assessment of visual impact and mitigation performance:

Photographic Monitoring

- Repeat photography from fixed Key Observation Points (KOPs) to visually track landscape changes and vegetation growth over time.
- All photographs will be date-stamped and georeferenced for comparison with earlier visual records.

Vegetation Assessment

- Site visits to assess the survival rate, health, and coverage of vegetation screens.
- Vegetation growth will be evaluated against predefined success criteria (e.g., 80% survival rate within two years).

Lighting Audits

- Night-time site inspections using lux meters to measure lighting intensity and spill over beyond the site boundaries.
- Verification of compliance with lighting design standards (e.g., shielded, downward-facing lights).

Visual Intrusion Checklists

- Use of standardised checklists to rate visibility, contrast, movement, and lighting from sensitive receptors.
- Checklist ratings will be used to inform corrective actions and adaptive management.

Stakeholder Input

- Collection of community and stakeholder feedback regarding visual concerns or disturbances.
- Complaints or comments logged and investigated as part of the site's environmental grievance mechanism.
- These monitoring activities will be documented in periodic visual monitoring reports and reviewed during environmental performance audits to ensure that the project's visual impacts remain within acceptable thresholds.

11. CONCLUSION AND RECOMMENDATIONS

The Visual and Landscape Impact Assessment (VLIA) undertaken for the proposed coal mining right application (DMRE Ref No: KZN30/5/1/2/2/10137 MR) has comprehensively evaluated the potential visual impacts associated with the development and operation of the project within a rural and environmentally sensitive landscape in the KwaZulu-Natal Province.

The assessment identified numerous sensitive visual receptors, including rural communities, tourism lodges, scenic routes, cultural landscapes, and natural viewpoints. Using a structured methodology that incorporated baseline field surveys, GIS analysis, visual simulations, and impact rating matrices, the study found that the project is likely to result in moderate to major visual impacts if unmanaged—particularly from high wall faces, stockpiles, and night-time lighting.

However, through the implementation of targeted mitigation measures, such as indigenous vegetative screening, low-profile infrastructure design, strategic road alignment, and lighting control, these impacts can be significantly reduced. The use of topographical features to shield sensitive viewpoints, combined with phased rehabilitation and effective stakeholder engagement, will further support the visual integration of the project.

Monitoring mechanisms, including photographic documentation and vegetation audits from Key Observation Points (KOPs), have also been proposed to ensure ongoing compliance and to facilitate adaptive management throughout the life of the project.

In conclusion, the proposed coal mining project can be visually accommodated within the existing landscape provided that all recommended mitigation measures are fully implemented and maintained. With adherence to best practices and proactive environmental management, the project is not expected to result in unacceptable or irreversible visual impacts, and is therefore considered to be environmentally and visually feasible in terms of the current land use and regional planning context

Recommendations

To maintain visual integrity and mitigate the project's landscape impacts, the following recommendations are made:

- Implement Vegetation Screening Early: Establish indigenous vegetation buffers before major site clearance to provide early visual screening, especially near roads, lodges, and community areas.
- Use Earth-Tone Colours and Low-Profile Infrastructure: All buildings and equipment should use non-reflective, neutral tones that blend into the surrounding landscape. Infrastructure should be single-storey or shielded by topography where possible.

- Apply Night-Sky Friendly Lighting Principles: Use downward-facing, shielded LED lights with motion sensors to minimize light pollution and protect the natural night-time landscape character.
- Progressive Rehabilitation Strategy: Rehabilitate mined and disturbed areas progressively throughout the project to restore visual continuity and reduce long-term landscape fragmentation.
- Conduct Regular Monitoring and Stakeholder Engagement: Perform quarterly photographic assessments from Key Observation Points (KOPs) and engage nearby stakeholders—particularly residents and tourism operators—to identify any emerging visual concerns.
- Preserve Natural Landforms and Topographical Features: Avoid excessive landform modification. Utilize natural ridges and depressions to screen infrastructure and maintain the site's topographic character.
- Maintain a Visual Grievance Mechanism: Establish a clear process for community members to raise concerns about visual impacts. These should be documented and addressed promptly as part of the project's environmental management programme (EMPr).
- Review Visual Mitigation Performance Annually: Conduct formal visual performance audits to ensure all mitigation measures remain effective and are being properly maintained.

By adopting these recommendations, Dunrose Investment 174 (Pty) Ltd will demonstrate proactive visual stewardship and support environmental sustainability in line with best practice and regulatory expectations.

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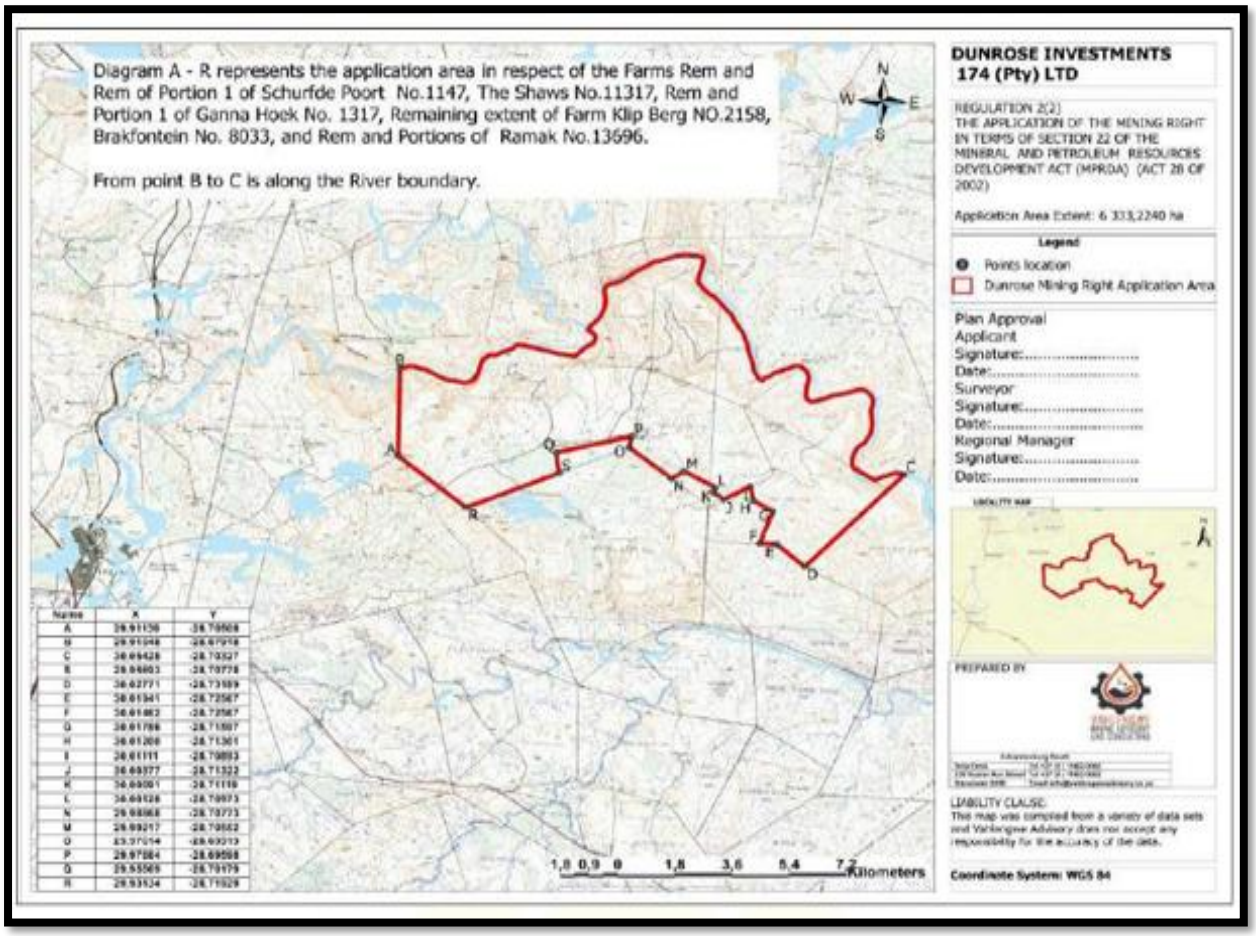
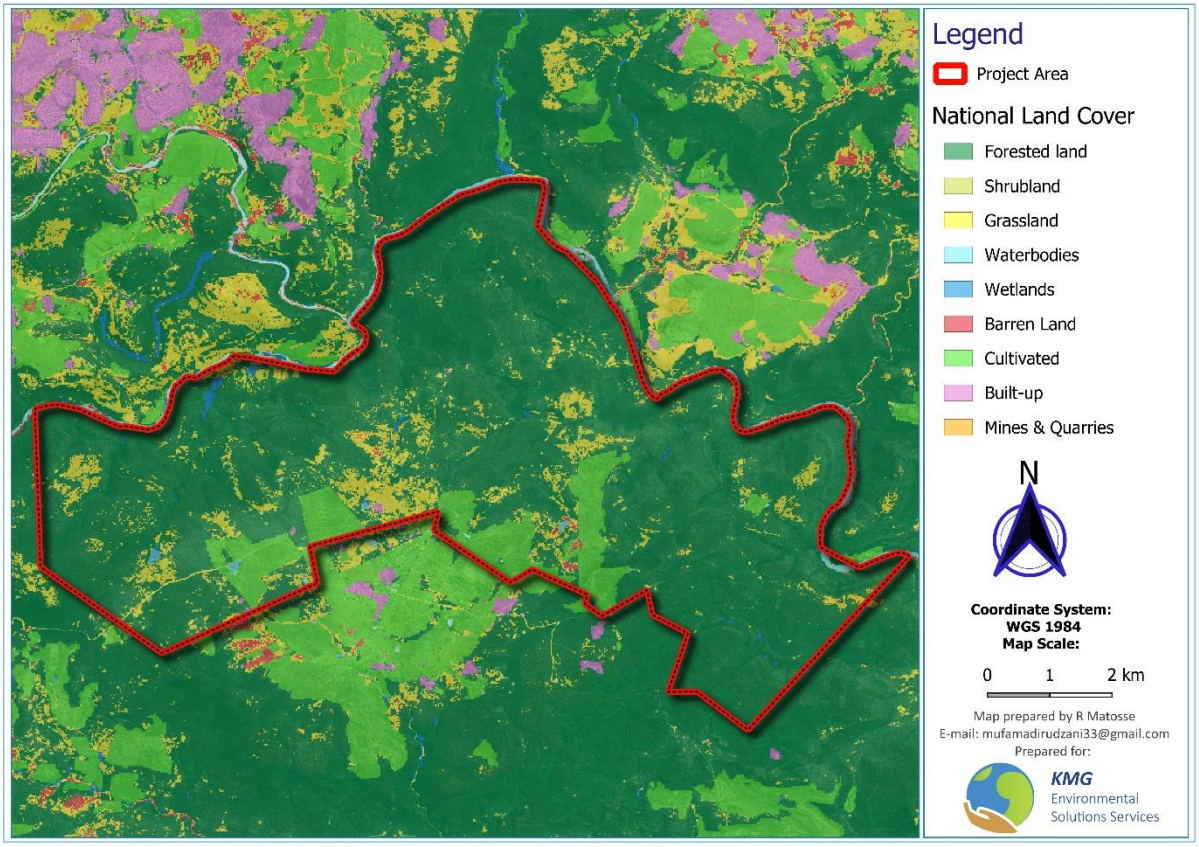
13. APPENDICES

Appendix A: Site Map / Mining Application Area

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Project Area
National Land Cover
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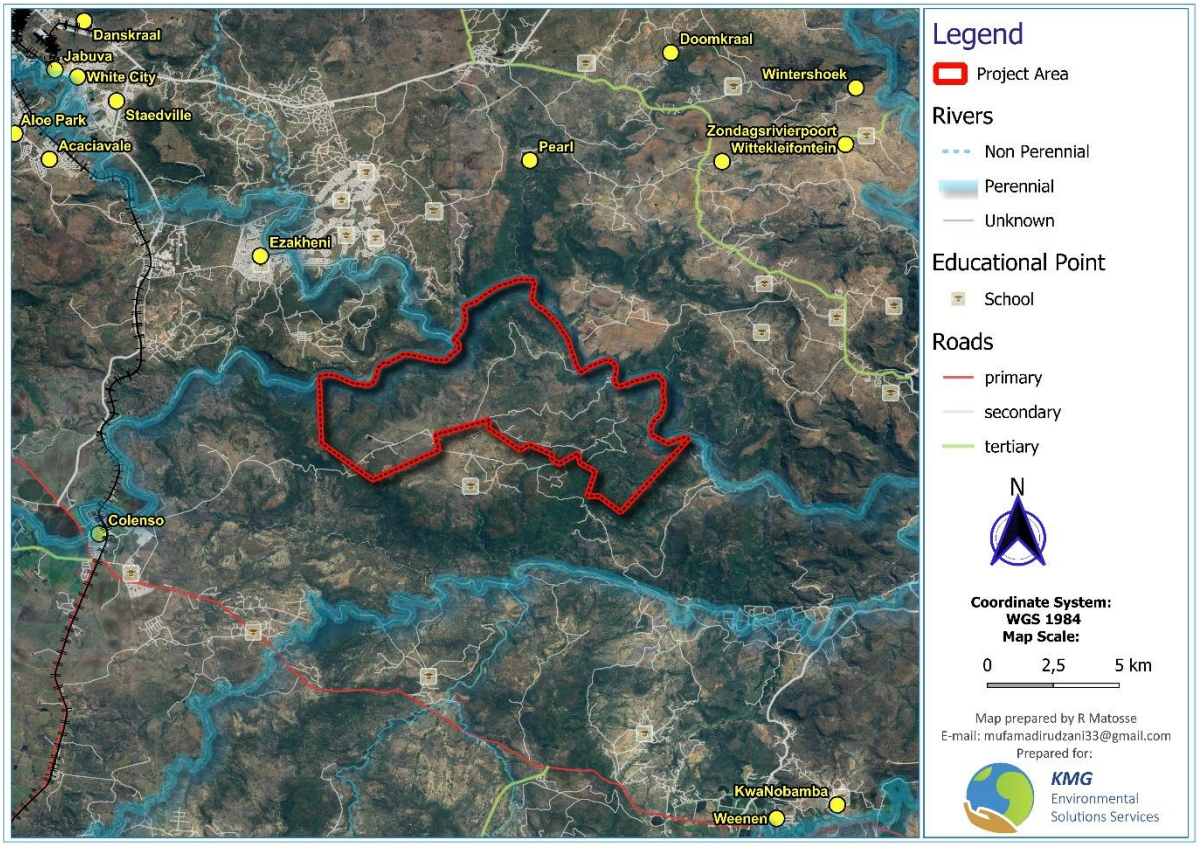
Shrubland
Grassland
Waterbodies
Wetlands
Barren Land
Cultivated
Built-up
Mines & Quarries
N
Coordinate System:
WGS 1984
Map Scale:
0 1 2 km
Map prepared by R Matosse
E-mail: mufamadirudzani33@gmail.com
Prepared for:
KMG
Environmental
Solutions Services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Pearl
Ezakheni
Colenso
KwaNobamba
Weenen
Legend
Project Area
Rivers
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Perennial
Unknown
Educational Point
School
Roads
primary
secondary
tertiary
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Coordinate System:
WGS 1984
Map Scale:
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Map prepared by R Matosse
E-mail: mufamadirudzani33@gmail.com
Prepared for:
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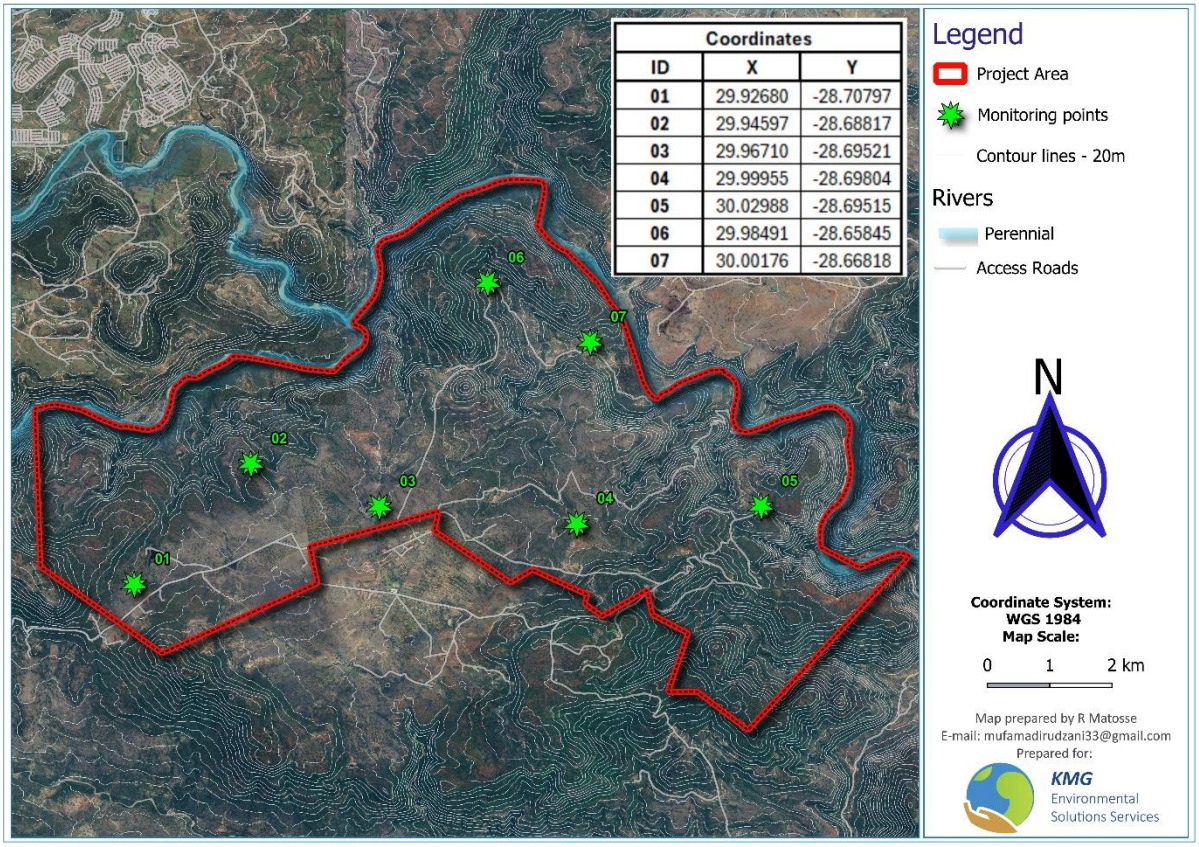
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Legend
Project Area
Monitoring points
Contour lines - 20m
Rivers
Perennial
Access Roads
N
Coordinate System:
WGS 1984
Map Scale:
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Map prepared by R Matosse
E-mail: mufamadirudzani33@gmail.com
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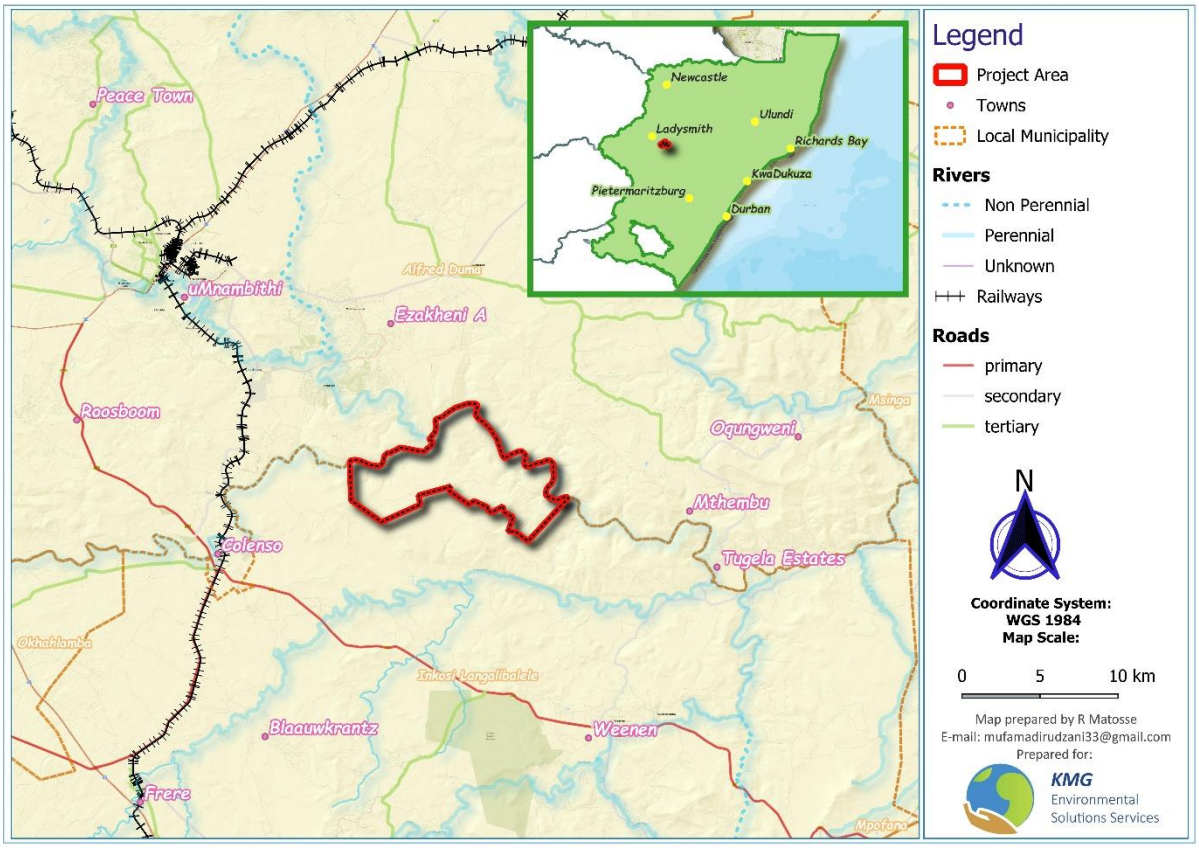
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Ezakheni A
Alfred Dumi
Roosboom
Colenso
Okhahlamba
Ogungweni
Msinga
Mchembu
Tugela Estates
Inkosi Langalibalele
Blaauwkrantz
Weenen
Frere
Mpofana
Newcastle
Ladysmith
Ulundi
Richards Bay
KwaDukuza
Pietermaritzburg
Durban
Legend
Project Area
Towns
Local Municipality
Rivers
Non Perennial
Perennial
Unknown
Railways
Roads
primary
secondary
tertiary
N
Coordinate System:
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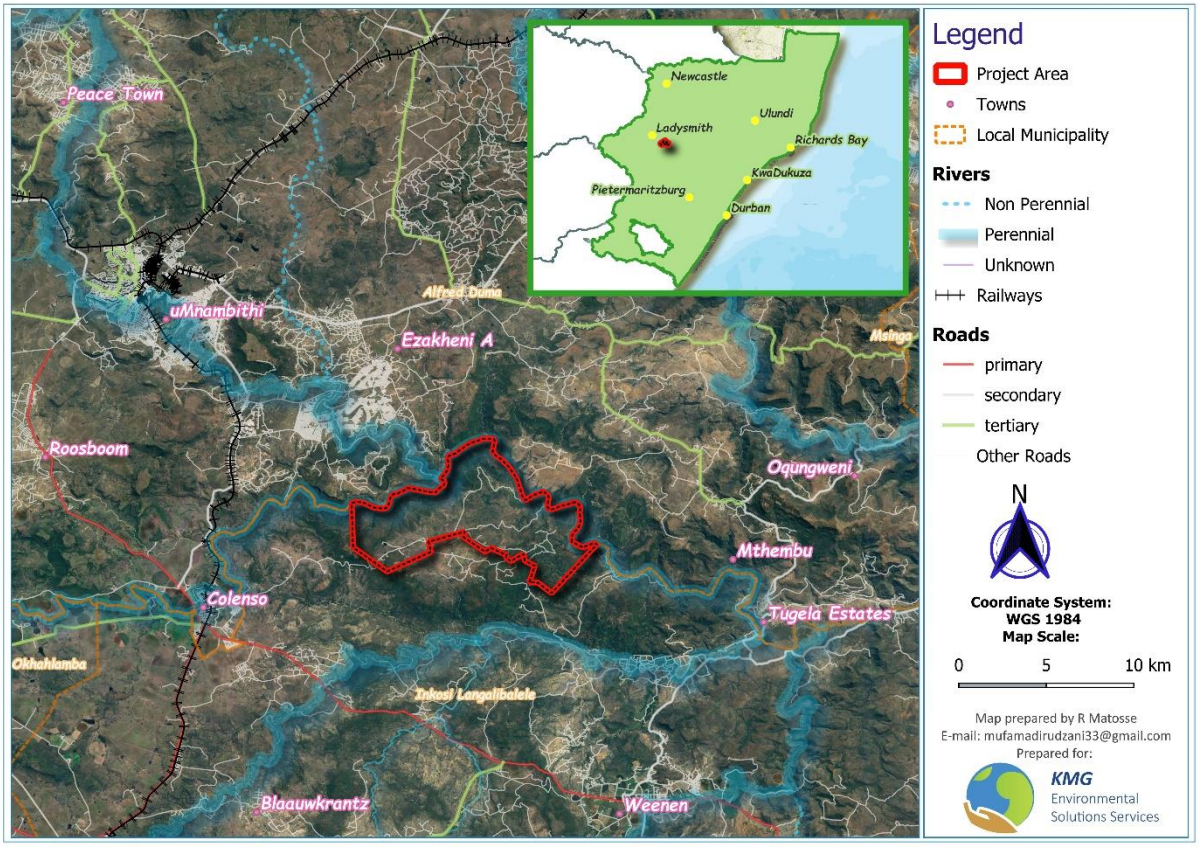
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Blaauwkrantz
Weenen
Newcastle
Ladysmith
Ulundi
Richards Bay
KwaDukuza
Pietermaritzburg
Durban
Legend
Project Area
Towns
Local Municipality
Rivers
Non Perennial
Perennial
Unknown
Railways
Roads
primary
secondary
tertiary
Other Roads
N
Coordinate System:
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Map prepared by R Matosse
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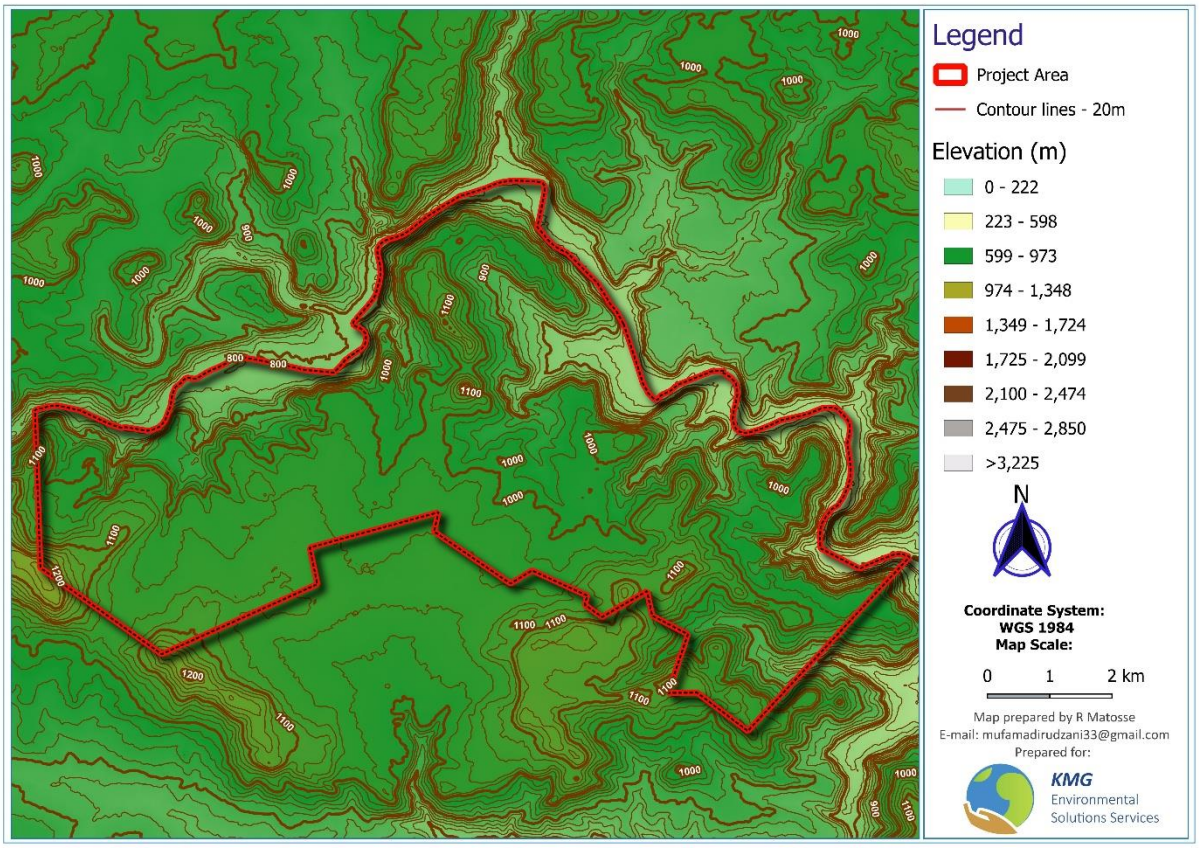
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Coordinate System:
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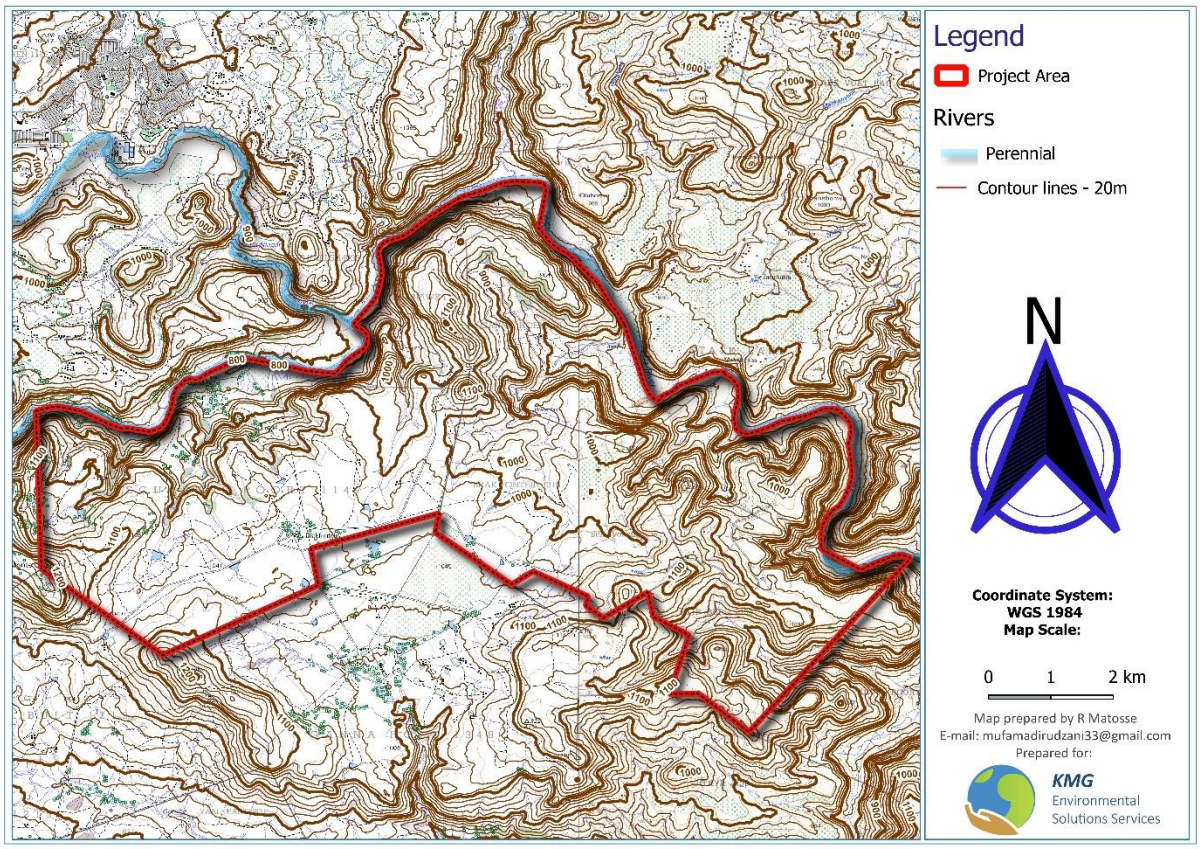
Map Scale:
0 1 2 km
Map prepared by R Matosse
E-mail: mufamadirudzani33@gmail.com
Prepared for:
KMG
Environmental
Solutions Services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Rivers
Perennial
Contour lines - 20m
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Coordinate System:
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Map Scale:
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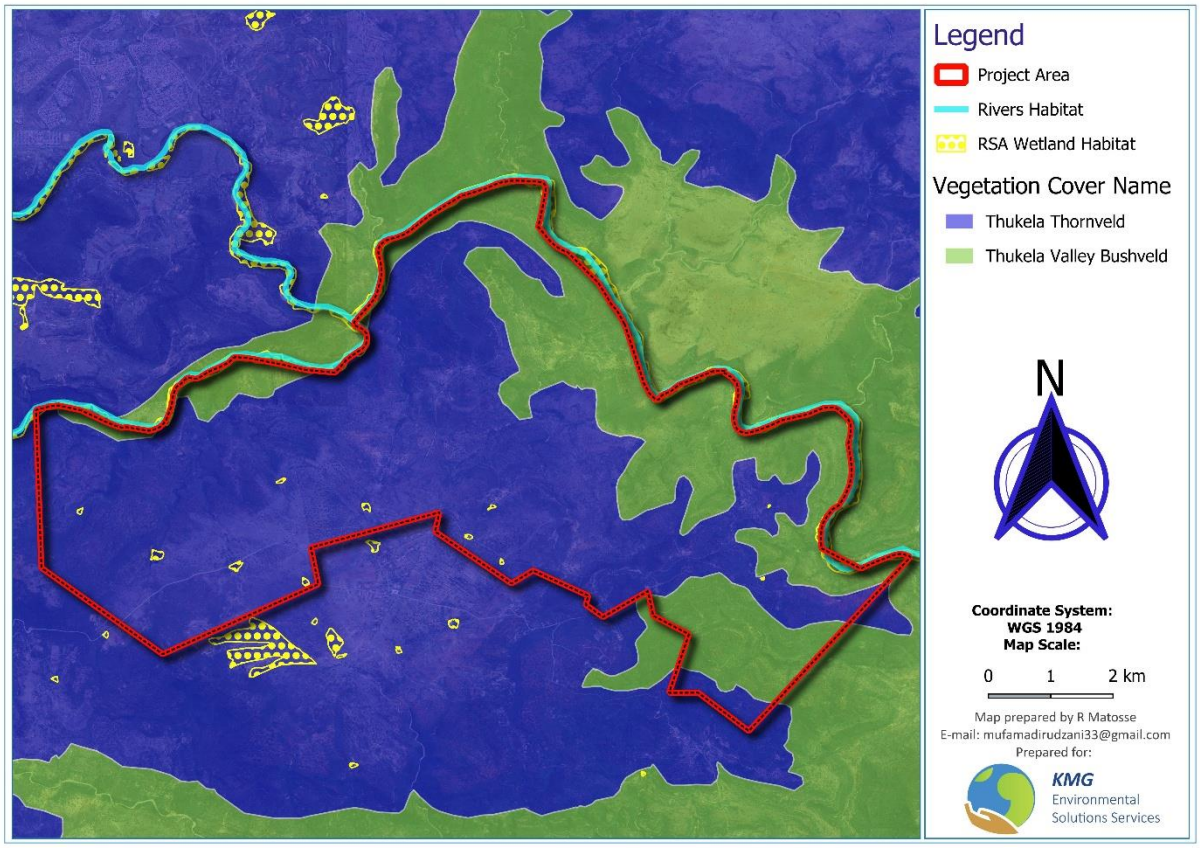
Map prepared by R Matosse
E-mail: mufamadirudzani33@gmail.com
Prepared for:
KMG
Environmental
Solutions Services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Map prepared by R Matosse
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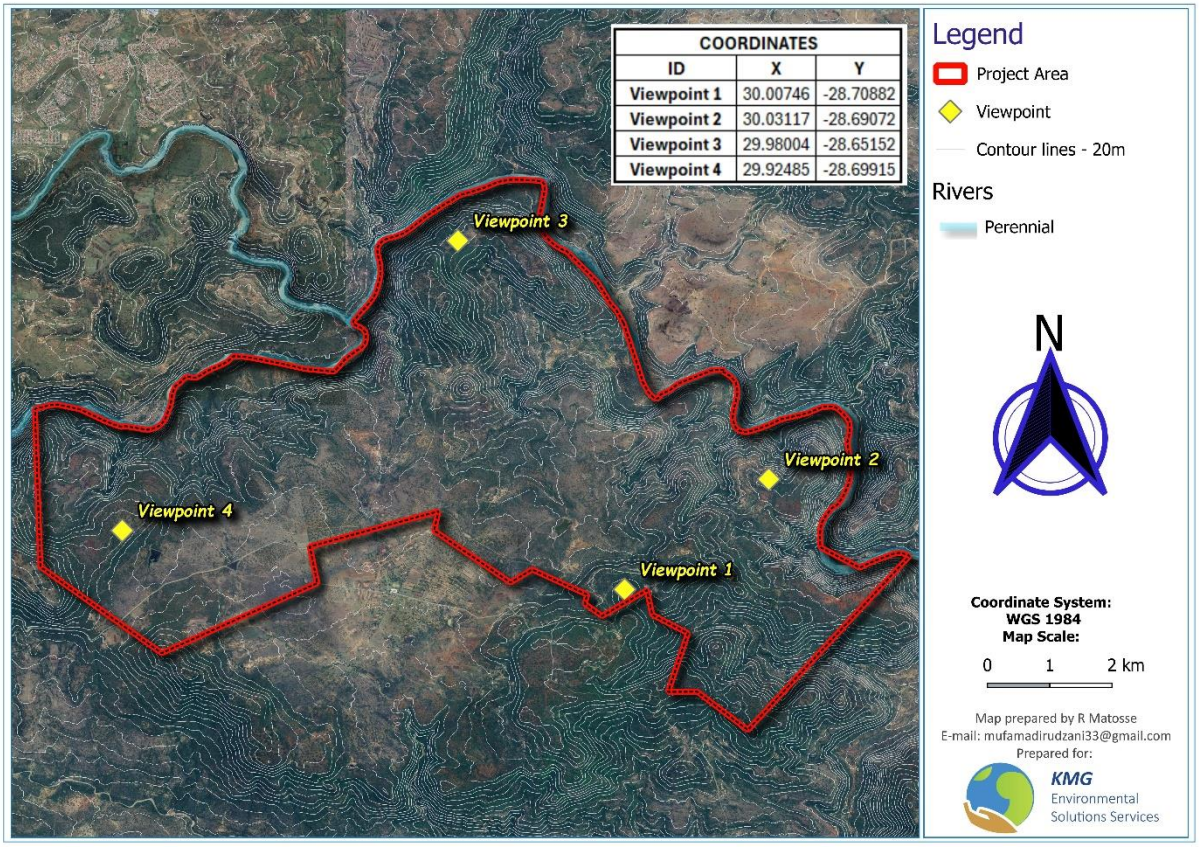
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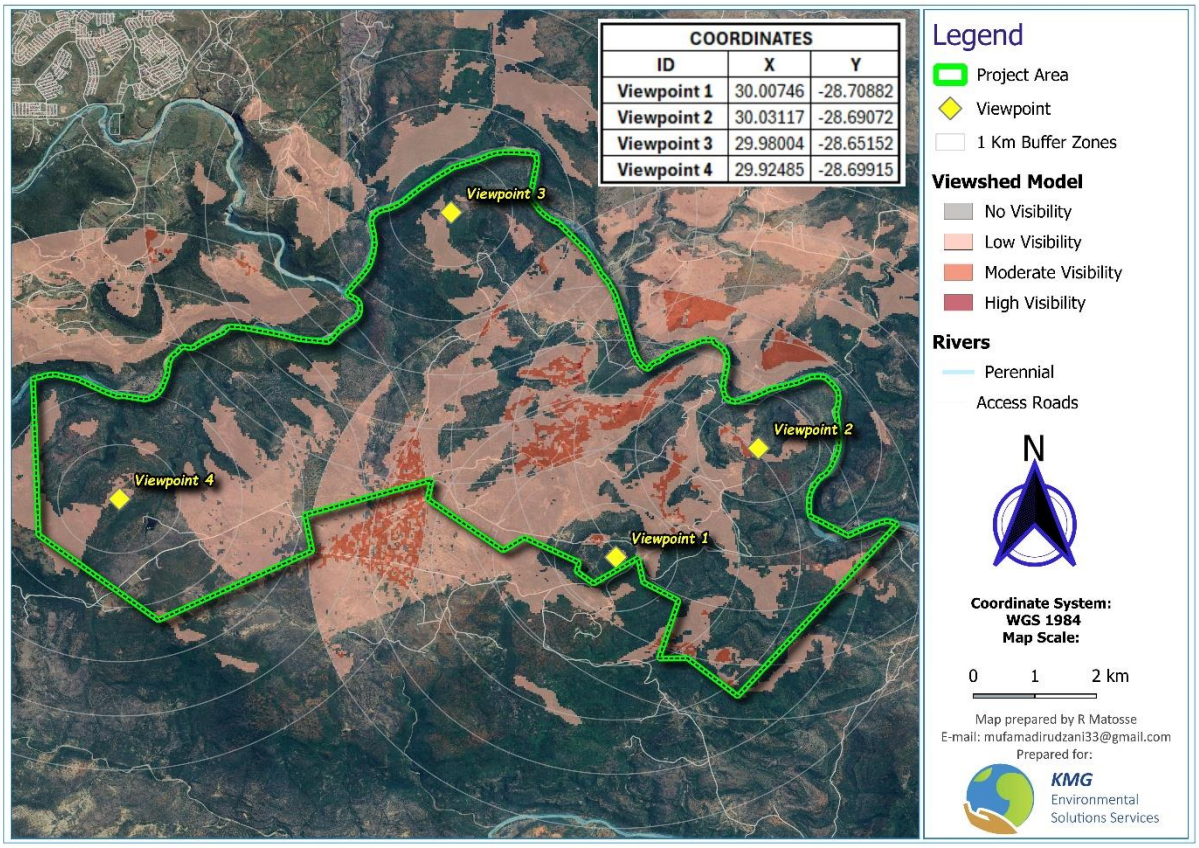
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Moderate Visibility
High Visibility
Rivers
Perennial
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Coordinate System:
WGS 1984
Map Scale:
0 1 2 km
Map prepared by R Matosse
E-mail: mufamadirudzani33@gmail.com
Prepared for:
KMG
Environmental
Solutions Services

Appendix B: Specialist Declaration and Team Curriculum Vitae(s)

I, Khumbelo Given Marabe, declare that I:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority.
- all the particulars furnished by me in this form are true and correct; and
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).
- I realize that a false declaration is an offence in terms of Regulation 71 of NEMA and is punishable in terms of section 24F of the Act.

Signature

Khumbelo Given Marabe

SACNASP NO: 132731

WISA REG NO :39885

IAIAsa : Membership no: 7837

IIAV Member No. 3163

Mr Khumbelo Given Marabe

Principal Environmental Consultant | **Director – KMG Environmental Solutions Services (Pty) Ltd**

SACNASP Registered– Reg. No. **132731**

WISA Professional Process Controller – Reg. No. **39885**

Summary of Expertise:

Mr. Marabe is an experienced environmental specialist with over a decade of expertise in:

- Visual ,Social, Wetland and Terrestrial Impact assessments
- Agricultural and soil capability impact assessments
- Noise, air quality, water, and dust monitoring
- Environmental awareness training
- Environmental audits and licensing applications
- NEMA and NWA compliance
- Environmental management and monitoring across sectors including mining, manufacturing, and renewable energy

Education & Certifications:

- BSc Environmental Sciences – University of Venda
- NEBOSH Environmental Management Certificate (2024)
- ISO 45001 & ISO 14001 Implementation & Internal Auditor – NOSA
- Health and Safety Regulations – HASLAC
- Certificates in Management Development (GIBS – AECI Programmes)
- Honours in Environmental Monitoring & Modelling (ongoing – UNISA)

Ms. Rudzani Matosse

Environmental GIS and Mapping Technician

Affiliation: KMG Environmental Solutions Services (Pty) Ltd

🔎 *Specialist in Environmental GIS, Wetland Mapping & Spatial Sensitivity Analysis*

Professional Overview:

Mr. Rudzani Matosse is a technically skilled Environmental Mapping and GIS Technician with a background in field-based wetland delineation and spatial data analysis. He provides vital support in environmental assessments by producing geospatial products and performing site-level data validation for use in Environmental Impact Assessments (EIAs), Basic Assessments (BAs), Wetland Impact Assessments, and Water Use Licence Applications (WULAs).

With hands-on experience in both **desktop and field applications**, Rudzani brings a valuable blend of practical and digital expertise to complex projects that require environmental sensitivity mapping, buffer zone compliance checks, and spatial integration of biodiversity datasets.

Core Competencies:

- GIS Mapping & Spatial Analysis (ArcGIS, QGIS)
- GPS-based Field Surveying and Data Collection
- Wetland and Riparian Zone Delineation Support
- Regulatory Sensitivity Mapping (NFEPA, CBAs, 500 m buffer zones)
- Desktop Hydrological and Terrain Analysis (DEM interpretation)
- Satellite Imagery Interpretation and Overlay Mapping
- Figure Development for Reporting (PDF & Word-embedded visuals)

Key Project Contributions:

◆ **Wetland Mapping and Sensitivity Overlay Support**

- Developed comprehensive map series for **prospecting right applications** in the North West and Limpopo provinces, including:
  - ✓ **Wetland Classification Maps** (HGM units: seep, valley-bottom, flat wetlands)
  - ✓ **30 m Riparian Buffer Sensitivity Maps**
  - ✓ **500 m Regulated Area Compliance Maps**
  - ✓ **Field-Verified Wetland Delineation Maps**

◆ **GIS Support for Impact Assessments**

- Integrated **soil, rainfall, vegetation, and biodiversity** datasets with national layers (e.g., NFEPA, Aquatic CBAs, ESA zones) to support:
  - ✓ Wetland Impact Assessments
  - ✓ Agricultural Impact Assessments (AIA)
  - ✓ Biodiversity screening and risk mapping

◆ **Field Data Management & GPS Verification**

- Accompanied environmental specialists on site visits to:
  - ✓ Capture **wetland and watercourse coordinates**
  - ✓ Assist with **transect layout and data recording**
  - ✓ Cross-check digital boundary outputs against **ground conditions**

◆ **Reporting and Compliance Visuals**

- Prepared high-resolution map figures used in:
  - ✓ **Basic Assessment Reports (BARs)**
  - ✓ **Environmental Management Programmes (EMPrs)**
  - ✓ **Water Use Licence Applications (WULAs)**
- Ensured maps met **legislative and formatting standards** for submission to DMRE, DWS, and DFFE.

Professional Strengths:

- Detail-oriented and deadline-driven
- Strong spatial logic and environmental understanding
- Collaborative work ethic with specialists and field teams
- Effective communication of spatial data to technical and non-technical audiences

Summary Value to Projects:

Mr. Matosse's GIS and mapping expertise plays an essential role in ensuring that environmental reports are **visually informative, spatially accurate, and legally aligned**. His ability to translate field

data into structured spatial products enhances the defensibility and scientific integrity of environmental applications, especially those involving **wetland delineation, regulated activity compliance**, and **site sensitivity verification**.

HEALTH IMPACT ASSESSMENT

CONSULTING OCCUPATIONAL HYGIENIST cc.

Reg. No: 2004/091989/23

TITLE:

DESKTOP HEALTH IMPACT ASSESSMENT – DUNROSE INVESTMENT PROPOSED COAL MINE

Compiled for Rayten Engineering Solutions (Pty) LTD

(SCI-INE-253984)

REPORT No – COH-25-17994-HIA

	OCCUPATIONAL HYGIENE REPORT	REFERENCE COH-25-17994-HIA
	DESKTOP HEALTH IMPACT ASSESSMENT – DUNROSE INVESTMENT PROPOSED COAL MINE	Issue DATE 2 JULY 2025

AUTHORISATION	
J.C Roets CEO / Technical Signatory Consulting Occupational Hygienist CC. Approved Inspection Authority 2025.07.23 13:55:52 +02'00' J.C ROETS OCCUPATIONAL HYGIENIST	Number of pages: 40

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STATEMENT

Consulting Occupational Hygienist is an Approved Inspection Authority with the Department of Employment and Labour and all its inspectors are registered with the Southern African Institute for Occupational Hygiene (SAIOH), and Accredited by SANAS in terms of SANS 17020:2012 for Hazardous Chemical Agents, Lead and Asbestos, Noise and Control measures. (Certificate No. OH0026-CI 018 OH).

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8. Any external pressures placed on COH inspectors will be reported to the CEO, and dealt with according to severity.

9. “Results marked “Not SANAS Accredited” in this report are not included in the SANAS Schedule of Accreditation for this inspection body

DESKTOP HEALTH IMPACT ASSESSMENT – DUNROSE INVESTMENT PROPOSED COAL MINE.

EXECUTIVE SUMMARY

Consulting Occupational Hygienist was requested to do a "Desktop Health Impact Assessment for DUNROSE INVESTMENTS 174 (PTY) LTD – PROPOSED HIGHWALL SURFACE COAL MINING located north-east of Colenso, within the Umtshezi Local Municipality of the Uthukela District Municipality, Kwa-Zulu Natal Province.

The Assessment was requested by Rayten Engineering Solutions. Data for the desktop study was provided by Rayten, whom conducted an Air Quality Impact Assessment for the proposed mine.

As part of the Rayten AQIA, a baseline air quality assessment was undertaken to determine the following:

- the prevailing meteorological conditions at the site;
- establish baseline concentrations of key air pollutants of concern;
- identify existing sources of emissions; and
- identify key sensitive receptors surrounding the project site.

The larger area surrounding the project site is classified as rural in nature. Existing key sources of air pollutant emissions surrounding the project site have been identified as follows:

- Vehicle dust entrainment on unpaved roads (surrounding areas);
- Wind erosion from exposed areas (bare surfaces and fallow land);
- Villages and domestic fuel combustion (surrounding areas); and
- Commercial agricultural activities (cultivated lands) and potential biomass burning (south-east, west and north-west of project site

Meteorological data used for the modelling was obtained between 01 January 2022 – 31 December 2024. From this data, downwind receptors towards the west, west-northwest and east-southeast may mostly be affected. Future mining activates and stockpiling may also impact on down-wind exposure, but the model can only be updated if mining operations stabilize.

A predicted discrete/ sensitive receptor boundary of 20km is used for the modelling.

The Health Impact Assessment is done to predict potential health risks at receptors downwind from the proposed high wall coal mine. Airborne contaminants of concern at this early stage are dust fall $PM_{2.5}$ and PM_{10} and was selected for the Health Impact Assessment to model the potential long term health effects at receptors within a 20km radius.

From the Desktop Health Impact Assessment, the following outcomes are predicted.

The calculated and predicted Health Impacts Risk Rating for all sensitive receptors living within 20km downwind for the proposed Dunrose Investment Coal Mining is low. (Using predicted PM_{10} and $PM_{2.5}$ concentration). None of the sensitive receptors showed any significant **Excess Lifetime Cancer Risk** (ELCR) to contract Chronic or adverse health effects as a result of air pollutants potential generated by the proposed high wall coal mining operation.

1.0 INTRODUCTION

Consulting Occupational Hygienist was requested to do a desktop Health Impact Assessment based on information provided from a Rayten Engineering Air Quality Impact Assessment done for DUNROSE INVESTMENTS 174 (PTY) LTD – PROPOSED HIGHWALL SURFACE COAL MINING PROJECT (SCI-INE-253940 dated 20 June 2025)

The mining site is located 9 – 17km north-east of Colenso, within the Umtshezi Local Municipality of the Uthukela District Municipality, Kwa-Zulu Natal Province. As part of the Mining Right application process a Health Impact Assessment is required. Because no actual emission data is available models are used to predict airborne pollutants and their potential health impacts on downwind sensitive receptors.

The proposed mine will be established on several farms consisting of coal resources, namely the Shaws, Gannahoek, Schurfdepoort, Klipberg, Brakfontein and Ramak farm portions. Approximately 1 million tonnes of coal are anticipated to be mined per annum over a period of 20 to 30 years.
Coal mine includes the highwall surface mining method. The coal seam outcropping will run along the 865m and 845m contours with minimal overburden removal required to access the coal seam. The highwall mining approach will start on the western side of the property and will progress along the contours towards the south-eastern boundary of the property. This method will allow for targeted extraction of the coal seam.

The mined coal will be stored at a temporary stockpile prior to removal from site.
The focus of this study is to quantify emissions of dustfall, PM10 and PM2.5 associated with operational activities at the proposed mine, which include:

- Highwall mining (drilling into coal seam);
- Bulldozing;
- Materials handling operations (transfer, loading/offloading operations);
- Wind erosion from exposed areas: temporary coal stockpile; and
- x4 FELs (servicing the needs of the highwall miners, cleaning up coal spillages, and establishing the highwall and performing rehabilitation).

The land use immediately surrounding the project site within a 20km radius consists mostly of forests, grasslands and formal residences, interspersed with cultivated land, subsistence crops, bare lands, fallow land, wetlands and waterbodies. Informal residences, industrial areas and mining areas – though present, occupy much smaller land footprints. Apart from the dirt roads and farming activities, a minimum pollution contribution to the mining activity is expected. No other mining or industrial activities were identified.

The Health Impact Assessment is only based on prediction modelling and theoretical airborne contaminant concentrations, wind roses and predicted mining activities and do not consider changes and expansions on the mining activities and for example the footprint of coal storage sizes.

Normally, environmental contaminants are emitted in a mixture and some chemical agents can have an additive effect on the receptor's target organs. Other factors which can contribute to the uncertainty of the exposure predictions include: age, gender, different ethnic groups, previous sensitization and/or previous chronic exposure to similar chemical agents. Once such a person has already been sensitized to chemical agents, even low concentration of a contaminant could result in acute exposure reactions some of which may be fatal. Adding to this uncertainty, personal susceptibility, frail senior citizens, hospitalized individuals and children who have not built-up the required immune system, will be included in the sample population.

2.0 Abbreviations

AIA	Approved Inspection Authority
DoEL	Department of Employment and Labour
SANAS	South African National Accreditation System
AP-HRA	Air Pollution Health Risk Assessment
AF	Attributable fraction.
CI	Confidence Interval
DALYs	Disability-adjusted life years
EBD	Environmental Burden of Disease
GBD	Global burden of disease
IF	Impact fraction
OAP	Outdoor air pollution
PM	Particulate matter
PM_{10}	Particulate matter less than 10 µm in diameter
$PM_{2.5}$	Particulate matter less than 2.5 µm in diameter
RR	Relative risk
TSP	Total suspended particles, or PM of any size
YLL	Years of life lost
RR	Relative Risk
LADD	Lifetime Average Daily Dose
SF	Slope Factor
ELCR	Excess Lifetime Cancer Risk
MRL	Minimum Risk Level
HQ	Hazard Quotient

3.0 DEFINITIONS:

- **MRL -** A Minimum Risk Level is **an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure**.

- **HQ** – Hazard Quotient represent the target ratio of predicted chemical exposure relative to its health-based benchmarks.

- **A sensitive receptor is defined as a person or place where involuntary exposure to air pollutants released by the site's activities could occur.**

4.0 Background

Air pollution is an important determinant of health. Numerous epidemiological studies have found an association between air pollution and a wide range of adverse health effects in the general population; the effects have ranged from subtle subclinical effects to premature death.

Some groups – for example older adults, children, pregnant women and people with an underlying disease, such as asthma – may be more at risk, and may develop more severe health effects more quickly when exposed to air pollution. In addition, certain groups may be exposed to higher levels of outdoor air pollution, e.g. people living nearer to the source of contaminant / pollutant.

Some indications of fugitive emission exposure in a population may include but is not limited to premature deaths, increased hospital admission rates, emergency room visit with specific respiratory symptoms and increased asthmatic diagnosis that was not hereditary.

Pollution in ambient air is generally a complex mixture. Consequently, the adverse health impacts observed in epidemiological studies and attributed to an individual air pollutant may actually be partly due to other pollutants in the mixture or a combination and even a reaction between various contaminants before it reaches the receptor down-wind. Air pollutants used for the health impact assessment is PM2.5 and PM10.

5.0 Health Effects

Even healthy people can experience health impacts from polluted air including respiratory irritation or breathing difficulties during exercise or outdoor activities. Your actual risk of adverse effects depends on your current health status, the pollutant type and concentration, and the length of your exposure to the polluted air.

High air pollution levels can cause immediate health problems including:
- Aggravated cardiovascular and respiratory illness.
- Added stress to heart and lungs, which must work harder to supply the body with oxygen.
- Damaged cells in the respiratory system.

Long-term exposure to polluted air can have permanent health effects such as:
- Accelerated aging of the lungs.
- Loss of lung capacity and decreased lung function.
- Development of diseases such as asthma, bronchitis, emphysema, and possibly cancer.
- Shortened life span.

Those most susceptible to severe health problems from air pollution are:
- Individuals with heart disease, coronary artery disease or congestive heart failure
- Individuals with lung diseases such as asthma, emphysema or chronic obstructive pulmonary disease (COPD)
- Pregnant women
- Outdoor workers
- Older adults and the elderly
- Children under age 14
- Athletes who exercise vigorously outdoors

People in these groups may experience health impacts at lower air pollution exposure levels, or their health effects may be of greater intensity.

Health Effects from Specific Pollutants PM2.5 and PM10 in Coal mining

Coal mining presents numerous health risks to workers, including respiratory diseases like black lung (pneumoconiosis) and chronic obstructive pulmonary disease (COPD)

Respiratory Diseases:
- Coal Workers' Pneumoconiosis (CWP) or Black Lung is a debilitating lung disease caused by inhaling coal dust, leading to scarring and impaired breathing.
- Chronic Obstructive Pulmonary Disease (COPD): Exposure to coal dust also increases the risk of COPD, which includes conditions like emphysema and chronic bronchitis.
- Silicosis: Miners can be exposed to crystalline silica dust, which can cause silicosis, another severe lung disease.

- Other Lung Diseases: Coal mine dust can cause a range of lung diseases, collectively known as coal mine dust lung diseases.
- Lung Cancer: There's evidence suggesting an increased risk of lung cancer among coal miners due to dust exposure and other factors. **(https://blogs.cdc.gov/niosh-science-blog/2023/02/27/mining-lungdisease/#:~:text=Recent%20scientific%20and%20media%20attention,all%20of%20these%20serious%20diseases).**

6. REGULATORY ASPECTS

To comply with the Occupational Health and Safety Act requirements (Act 85 of 1993) the work environment in which employees are, or are likely to be exposed to various risk factors must be assessed and a comprehensive risk assessment report must be drafted and updated biennially. If the status of any risk factors changes or the process changes the risk assessment need to be updated. The risk assessment document is thus a working living document which should be consulted continuously. It is not only the risk to the health and well-being of employees which needs to be assessed, but if there is a potential health risk to the public due to the emissions from an industrial operation, it too should be assessed and if a significant health risk is identified, mitigation should be forthcoming.

Other Regulatory requirements:

There are various Acts and regulations that regulate environmental management in South Africa, as well as different by-laws that regulate industrial activity.
The following are the key Acts against which this specialist study is evaluated:

- The National Environmental Management Act (NEMA), (Act 107 of 1998)
- This Act forms the overarching framework for environmental management in South Africa and incorporates, amongst others, the principles embodied in the White Paper on Integrated Pollution and Waste Management for South Africa (Jan. 2000), and the National Waste Management Strategy documents (Oct. 1999). The key principles include moving away from the “end- of- pipe” treatment approach towards the prevention of pollution and waste and avoiding environmental degradation. The Environmental Conservation Act, (Act 73 of 1989) Sections 21, 22 and 26 of this Act were promulgated in 1997, and make Environmental Impact Assessments a statutory requirement for specified new developments. Section 20 of this Act indicates that waste can only be disposed of at a waste disposal facility that has a permit issued by the Minister of Water Affairs and Forestry. Such a waste disposal facility must be in accordance with the Department’s Waste Management Series, “Minimum Requirements” documents [3].
- The Air Pollution Prevention Act, (Act 45 of 1965)
- This Act is concerned with emissions at stacks and specifies acceptable levels of pollutants in the air. Scheduled processes are identified in the Act and the allowable emissions and ambient air quality guidelines are provided.
- The Occupational Health and Safety Act, (Act 85 of 1993).
- Hazardous Chemical Agent Regulation of 2021.

What is a health risk assessment?

A health hazard can be defined as a source of risk to human health or wellbeing (Department of Health, 2006). A health risk assessment is the scientific evaluation of potential adverse health effects resulting from human exposure to a particular health hazard. In the context of this publication, the health hazard of interest is air pollution. An AP-HRA aims to estimate the risks of past, current or future exposure to air pollution and of changes in exposure that may result from planned policies or other modifications of air quality (Department of Health, 2006; HIP, 2014). An AP-HRA may be quantitative or qualitative; it generally assesses (i) the amount of air pollution present, i.e. pollutant concentrations, (ii) the amount of contact (exposure) of the targeted population, and (iii) how harmful the concentration is for human health, i.e. the resulting health risks to the exposed population (WHO, 2010). The estimates provided by an AP-HRA are intended to inform the decisions of policy-makers or other stakeholders. The required input data for an

APHRA (e.g. air pollution, baseline health statistics, CRFs of air pollutants) are not always available, and many risk assessments have to be based on estimates or judgements of some of the data inputs or characterizations. As a result, HRA outcomes generally have associated uncertainties, which should be characterized as far as possible (WHO 2010). It should also be noted that APHRAs generally include only the subset of health impacts that can be quantified, and do not deal with other health effects for which no CRF is available. Ideally, to protect public health, an AP-HRA should be as inclusive as possible; however, in most cases, it is likely that the HRA will underestimate the actual risk. As an analytical tool, an AP-HRA can be used as part of a comprehensive assessment of the health impacts of policies, programs, and projects that affect environmental conditions – a health impact assessment (HIA). APHRA and HIA are different concepts, although the two terms are sometimes used interchangeably. An HIA may be defined as follows (WHO Regional Office for Europe, 1999): "a combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population." An HIA identifies appropriate actions to manage those effects (Quigley et al., 2006). While an HRA tends to look into particular hazards and their effects on human health, an HIA takes a broader perspective. For example, when planning the construction of a new industrial site in or near a city, an HIA would look into not only the specific risks associated with possible air pollutants, but also issues such as noise and soil and water pollution, as well as the potential impact on the population of the city through, for example, the influx of construction workers, employment opportunities for inhabitants of the city, and the possible accumulation of hazards with already existing hazards in the area. The focus of this report is on APHRA considering the definitions provided above. An overview of the steps involved in an AP-HRA is given in methodology.

There should be a target group for the risk assessment and in this desktop study the assessment was focused on sensitive receptors within a 20km area downwind from the proposed mining operation.

Predicted sensitive receptors identified by Rayten Engineering Solutions in their Air Quality Impact Assessment report.

A sensitive receptor is defined as a person or place where involuntary exposure to air pollutants released by the site's activities could occur. Identified sensitive receptors which are located within a 20km radius of the proposed mine are given in Figure 1. For modelling purposes, the identified sensitive receptors are restricted to those located within the same Universal Transverse Mercator (UTM) zone as that of the project area (i.e. 35S). Additionally, it is noted that most of the receptors located near to the proposed mine fall within this UTM Zone

The discrete receptors given in Table 1 below, were used for modelling purposes. Maximum predicted incremental concentrations are provided for the identified discrete receptors. These points are located at the centre of residentials areas, or near schools, hospitals, old age homes, dwellings or buildings to determine the maximum concentrations that could be expected near sensitive receptors. Discrete points are not plotted for each individual sensitive receptor but are used to represent a group of sensitive receptors located near to each other (e.g. several schools, dwellings or buildings).

Baseline Air Quality Concentrations

The existing air quality is usually evaluated using available monitoring data from permanent ambient air quality monitoring stations. Due to a lack of scientific air quality data in and around the proposed mining area, the PM10 and PM2.5 concentrations for the health impact assessment is based on modelling values provided in the Air Quality Impact Assessment as provided by Rayten Engineering Solutions.

It is noted that the proposed mine is in an isolated/remote area, which is mostly rural, and surrounded by a few background pollution sources. Therefore, background air quality in the area is not expected to be poor.

Surrounding Sources of Air Pollution

Existing key sources of air pollution surrounding the project site were identified during a desktop exercise and include:

- Vehicle dust entrainment on unpaved roads (surrounding areas);
- Wind erosion from exposed areas (bare surfaces and fallow land);
- Villages and domestic fuel combustion (surrounding areas); and

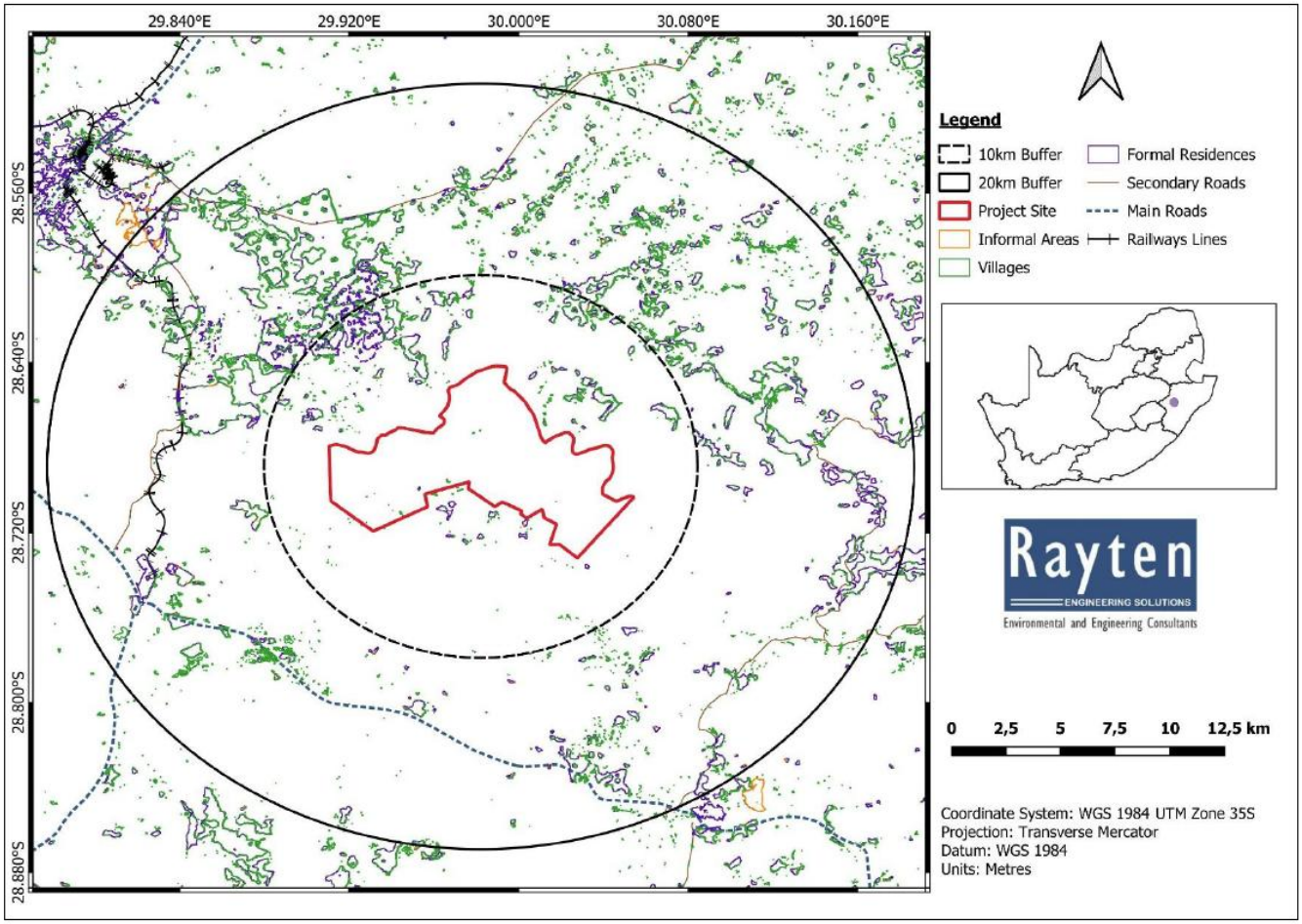
Commercial agricultural activities (cultivated lands) and potential biomass burning (south-east, west and north-west of project site).

Notes:
*DR = discrete receptor
*<10 hospitals/healthcare/clinic facilities within 20km of site (located in surrounding areas).
*>10 school/training/educational facilities within 20km of site (located in surrounding areas).
*No old age home facilities identified within 20km of the project site. *Numerous dwellings/residential areas in surrounding areas

Table 1 – Possible Sensitive Receptors within 20km from the Dunrose Investment Proposed Coal Mine.

Discrete Receptor ID	Name Edu = educational/school/training facilities HC = healthcare/clinic/hospital facilities Old = old age home Residential = Dwellings/ farm houses	UTM Co-ordinates (35S)	
		X(m)	Y (m)
DR1	Dwellings/Edu (Phoweni Secondary School)	783593.43	6825731.85
DR2	Dwellings/Edu (Umndeni Woxolo Primary School)	779482.58	6825347.41
DR3	Dwellings/Edu (Ncinjane Secondary School)	778355.45	6825780.23
DR4	Res (Ezakheni E)/Edu (Sakhelwe High School & Mnambithi College -E Campus)/HC (Ezakheni E Clinic)	782559.66	6829402.74
DR5	Res (Ezakheni C)/Edu (Isiqophamithi School)/ (Ezakheni Health Centre)	785387.63	6830383.47
DR6	Res (Ezakheni C)/Edu (Endakane High School)	784319.47	6829380.59
DR7	Edu (Qophindela Secondary School)	785790.97	6829793.12
DR8	Edu (Ekuphumuleni Primary School)	784853.75	6830372.91
DR9	Edu (Falethu Primary School)	785656.50	6830142.39
DR10	Res (Ezakheni D)/Edu (Ingceboyesizwe Primary School)	786578.07	6829824.71
DR11	Res (Dwellings)	788620.07	6827806.84
DR12	Res (Dwellings)	787944.85	6829235.24
DR13	Edu (Bhekintuthuko Secondary School)	788984.10	6831087.95
DR14	Res (Ezakheni B)/Edu (Ekukhuleni High School)	785533.62	6831867.83
DR15	Res (Ezakheni B)/Edu (Mcitsheni Primary School)	785990.51	6831915.30
DR16	Res (Ezakheni A)/Edu (Idamu School & Sir Manyathi Learning Institute)	786437.18	6832280.65
DR17	Res (Ezakheni A)/Edu (Ezakheni High School)	786165.40	6832778.21
DR18	Edu (Gqama Primary School)	786512.53	6832911.17
DR19	Ezakheni IA (Light Industrial Area)	778832.92	6829281.50
DR20	Edu (Ezakheni FET College)	786219.77	6833493.20
DR21	Edu (Amancakazana Primary School)	784941.56	6833872.08
DR22	Res (Dwellings)/Edu (St Chads High School)	782143.80	6834918.39
DR23	Res (St Chads)	784769.30	6835138.40
DR24	Res (Dwellings)/Edu (Mabhomane H.P. School)	784530.25	6836387.06
DR25	Church (Mhkuku Kunene Umthandazi)	781819.70	6819617.37
DR26	Res (Inkanyezi)/Edu (Colenso Combined School)/HC (Tholusizo Clinic)	777184.28	6817860.49
DR27	Res (Colenso)/Edu (Colenso Primary School)/Midlands Orphanage & Care Centre	775884.55	6817303.49
DR28	Res (Dwellings)/Edu (ML Sultan Colenso Primary School)	777090.77	6815781.16
DR29	Res (Dwellings)/(Edu (Indulwana Primary School)	778006.41	6813570.49
DR30	Edu (Morning Star Primary School)	781654.46	6813123.54
DR31	Umsuluzi Game Park	780070.25	6810755.95
DR32	Weenen Nature Reserve	792576.37	6806583.65
DR33	Tugela Private Game Reserve	772711.33	6820884.68
DR34	HC (Unjani Clinic Ezakheni)	786435.35	6831319.77

Fig 1. Sensitive receptors surrounding proposed mining area.



(Mapping compliments - Rayten Engineering Consultants)

8.0 LOCAL WIND FIELD

Figure 2 below provides the period wind rose plot for the project site for the period January 2022 to December 2024. The predominant wind directions for the period are observed from the east, east-southeast (~17.3% of the time) and west-northwest (~13.8% of the time). Wind speeds for the three-year period were generally moderate to fast, with an average wind speed of 3.13 m/s recorded for the period. Calm conditions, defined as wind speeds less than 0.5 m/s, were observed for 9.65% of the time (Figure 2).

The morning (AM) and evening (PM) period wind rose plots for the period January 2022 to December 2024 are given in Figure 2 and show diurnal variation in the wind field data. During the morning (AM) period, high frequency winds are observed from the west-northwest, but with additional low-frequency winds originating from the east-southeast and north-west. In the evening (PM) period, there is a shift in prevailing winds, as easterly and east-southeasterly winds become prominent (Figure 2).

Based on the prevailing wind fields for the period January 2022 to December 2024, emissions from activities at the proposed mine will likely be transported towards the west, west-northwest and east-southeast, depending on the season and time of day. Moderate to fast winds observed during all the time periods may result in effective dispersion and dilution of emissions from the proposed mining operations; however, higher winds speeds can also facilitate fugitive dust emissions from open exposed areas such as temporary coal stockpiles, material handling operations and other mining activities.

Prevailing wind direction.

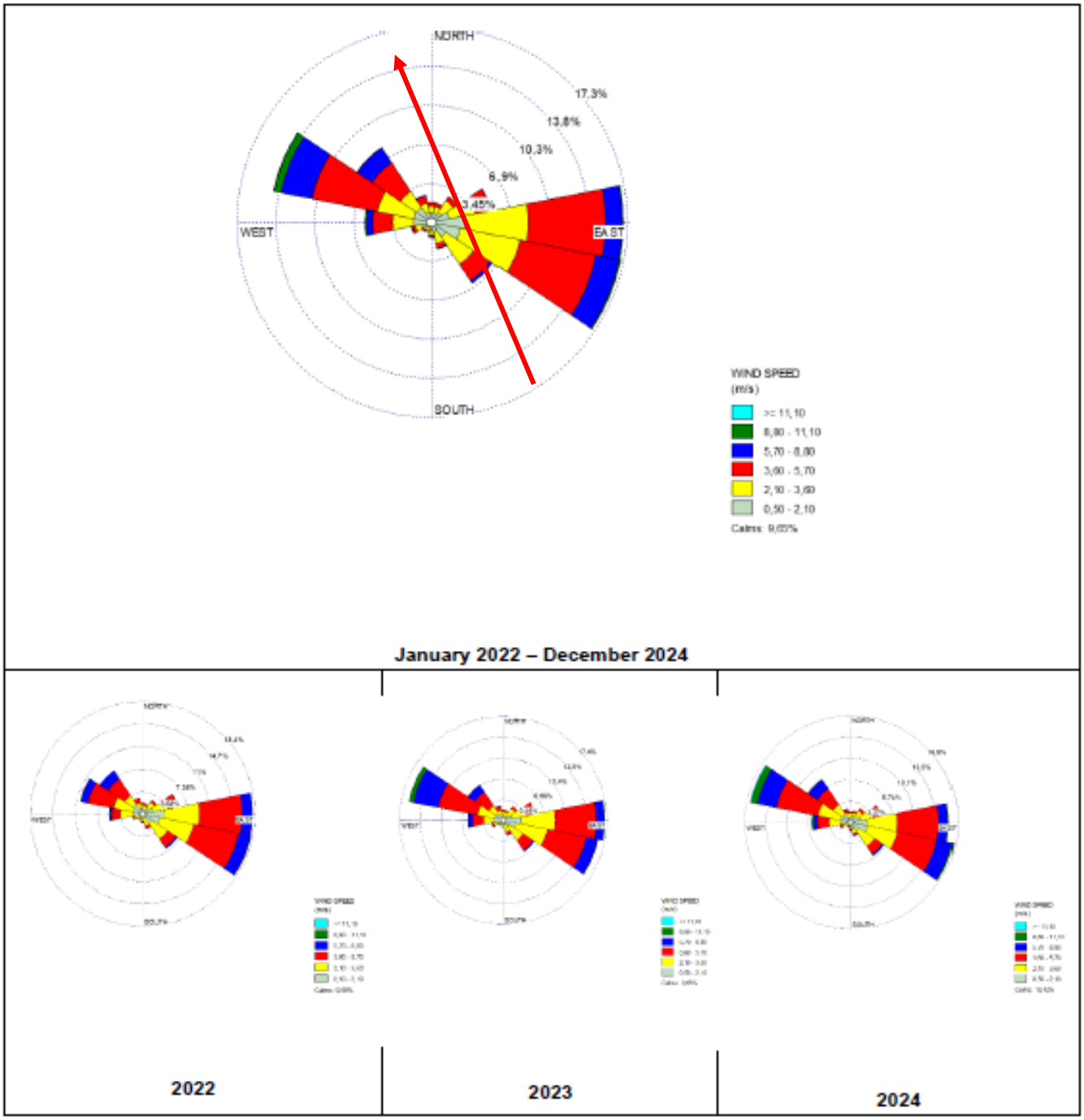


Figure 2 - Period Wind Rose Plots for the project site for the period January 2022 - December 2024.

9.0 RATIONAL

Dustfall, PM10 and PM2.5 are key pollutants of concern associated with operations at the proposed mine and are emitted from the following key sources:
Dustfall and Particulate Emissions:

- Highwall mining (drilling into coal seam);
- Bulldozing;
- Materials handling operations (transfer, loading/offloading operations);
- Wind erosion from exposed areas: temporary coal stockpile; and
- x4 FELs (servicing the needs of the highwall miners, cleaning up coal spillages, and establishing the highwall and performing rehabilitation).

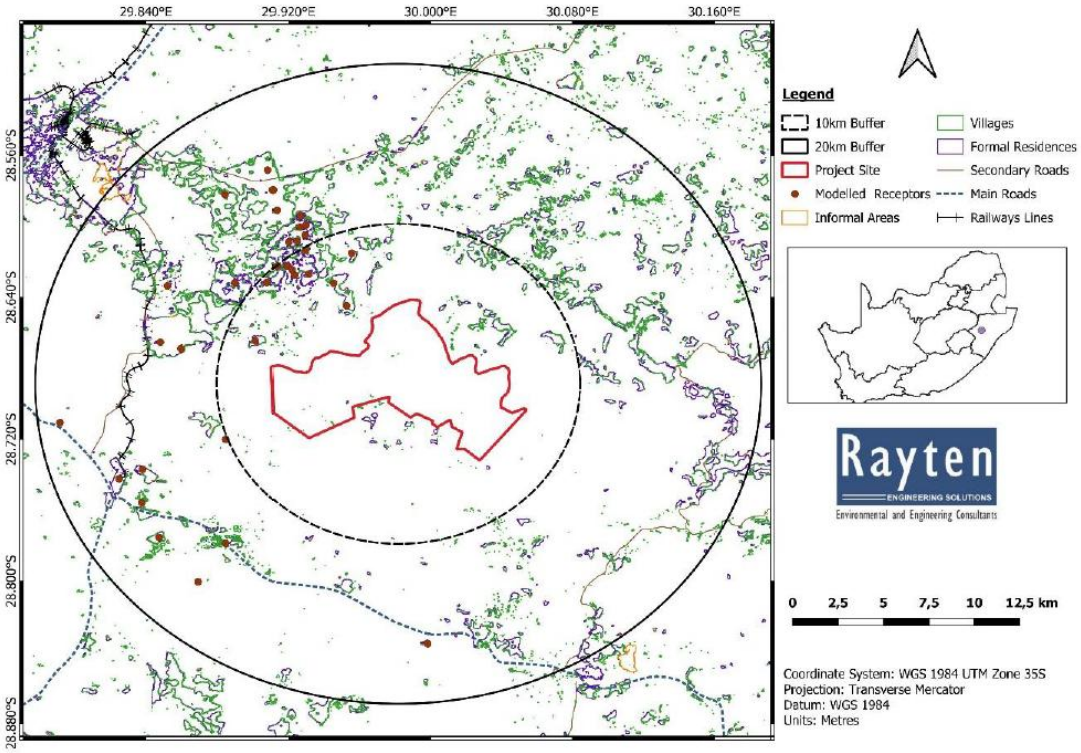
This Health Impact Assessment will focus on dust emissions as this is a key pollutant emitted associated with operational activities at the proposed mine.
(**All Health Impact outcomes are based on the Rayten Environmental data based on *Dispersion Model Output Plots for Dustfall, PM10 and PM2.5).***

Maximum Predicted Incremental Concentrations

Maximum predicted incremental concentrations at nearby sensitive receptors (represented as discrete receptors) located within a 20km radius from the centre of the proposed mine operations are given in the below section, and they are very low.

The discrete receptor points are located at the centre of residentials areas, or near schools, hospitals old age homes, building and dwellings, to determine the maximum concentrations that could be expected near sensitive receptors.

Figure 3 - Spatial representation of discrete receptors included in dispersion model (<20km from the proposed mine).



10.0 ASSESSMENT METHODOLOGY

Based on Ostro B. *Outdoor air pollution: Assessing the environmental burden of disease at national and local levels*. Geneva, World Health Organization, 2004 (WHO Environmental Burden of Disease Series, No. 5).
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ISSN 1728-1652

The ability to measure the environmental health effects of pollution has improved over the last several decades, owing to advances in pollution monitoring and in statistical techniques and modelling. Current methods often measure the effects of air pollution in terms of particulate matter (PM), and increases in both mortality and morbidity have been detected at existing ambient PM concentrations. The largest source of PM is often fuel combustion from both mobile and stationary sources, but other sources such as road dust, biomass burning, manufacturing processes and primary pollutants from diesel engines also contribute.

Epidemiological studies have provided evidence of associations between concentrations of PM and several adverse health outcomes including: mortality, hospital admissions for cardiovascular and respiratory disease, urgent care visits, asthma attacks, acute bronchitis, respiratory symptoms, and restrictions in activity.

Therefore, the Global Burden of Disease (**GBD**) and our proposed methods for estimating the Environmental Burden of Disease (**EBD**) use both PM_{10} and $PM_{2.5}$ as indicators of exposure to outdoor air pollution.

To estimate the EBD, we used a methodology similar to that used to estimate the GBD, with similar caveats and uncertainties. As with the GBD study, EBD estimates are provided for several health outcomes including: adult cardiovascular mortality and lung cancer associated with long-term exposure to $PM_{2.5}$, all-cause mortality for all ages associated with short-term exposure to PM_{10}, and infant and childhood mortality from respiratory diseases associated with PM_{10} exposure. Quantification of these estimates on a national

or city-specific level, especially if local studies were utilized, will help to determine priorities for air pollution control.

For the quantitative assessment of the health impact of outdoor air pollution, using PM_{10} or $PM_{2.5}$ measurements, is based on four components:

1. An assessment of the ambient exposure of the population to PM (either PM_{10} or $PM_{2.5}$), based either on existing fixed-site monitors or on model-based estimates. In addition, a background or "target" concentration is needed as a comparison, to determine the attributable disease or potential benefits of reducing the risk factor by a specified amount.
2. A determination of the size of the population groups exposed to PM_{10} and $PM_{2.5}$, and the type of health effect of interest.
3. The incidence of the health effect being estimated (e.g. the underlying mortality rate in the population, in deaths per thousand people).
4. Concentration–response functions from the epidemiological literature that relate ambient concentrations of PM_{10} or $PM_{2.5}$ to selected health effects, and provide the attributable fractions (AFs) that are then used to estimate the following:
   - the number of cases of premature mortality and DALYs (cardiopulmonary and lung cancer) attributed to long-term exposure to $PM_{2.5}$, for people >30 years old.
   - the number of cases of premature mortality and DALYs from respiratory diseases attributed to the short-term exposure to PM_{10}, for children younger than five years old.
   - the number of cases of premature mortality from all causes from short-term exposure to PM_{10} (Note that this estimate should not be added to those above since this would involve double-counting. However, calculation of this number may provide useful information and is based on a separate set of studies)

The outcomes, exposure metrics, and relative risk functions are summarized in Table 2.

TABLE 2 Recommended health outcomes and risk functions used to calculate the EBD

Outcome and exposure metric	Source	Relative risk function[a]	Suggested ß coefficient (95% CI)	Subgroup
All-cause mortality and short-term exposure to PM10[b]	Meta-analysis and expert judgment (see text)	RR = exp[ß (X -Xo)]	0.0008 (0.0006 - 0.0010)[c]	All ages
Respiratory mortality and short-term exposure to PM10 (all-cause mortality for upper bound where applicable)	Meta-analysis (Table 2)	RR = exp[ß (X-Xo)]	0.00166 (0.00034, 0.0030)	Age <5 years
Cardiopulmonary mortality and long-term exposure to PM2.5	Pope et al. (2002); R Burnett[d]	RR = [(X+1)/(Xo+1)] ^{ß}	0.15515 (0.0562, 0.2541)	Age >30 years
Lung cancer and long-term exposure to PM2.5	Pope et al. (2002); R Burnett[d]	RR = [(X+1)/(Xo+1)] ^{ß}	0.23218 (0.08563, 0.37873)	Age >30 years

[a] X = current pollutant concentration ($\mu g/m^3$) and Xo = target or threshold concentration of pollutant ($\mu g/m^3$).
[b] Not used in DALY calculations and should not be added to the other mortality estimates.
[c] Presentation of a range rather than a point estimate is preferred.
[d] Personal communication.

With increasing statistical sophistication, these studies have shown that either one-day or multi-day PM average concentrations are associated with both total mortality and cardiopulmonary mortality.
Consistent associations were reported between daily mortality and daily exposures to both PM_{10} and $PM_{2.5}$, with a 0.8% (95% confidence interval (CI) = 0.5–1.1) increase in daily total mortality per 10 µg/m^3 of PM_{10}.

In addition, the methodology found that measurement error would likely underestimate the effect of PM (Zeger et al., 2000), and that co-pollutants such as ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide did not significantly affect or confound the estimated effect of PM (Samet et al., 2000a).

Recommended relationships for quantifying disease

It is important to note that estimation of the effects of short-term exposure would, to a certain extent, double-count those cases estimated to result from long-term exposure, and the burden specifically estimated for children under age 5. The details for quantification, therefore, are provided so analysts can generate additional information based on the timeseries studies. These estimates, however, should not be added to those generated from the studies of long-term exposure, described below. The latter are preferred since they can be used to determine life years lost and DALYs. In contrast, no evidence is currently available regarding the amount of life shortening involved with each fatality associated with short-term exposure. Therefore, these calculations are used only to provide an estimate of the number of premature deaths per year, not years of life lost (YLL) or DALYs.

Based on available evidence, a reasonable estimate of the Environmental Burden of Disease (EBD) for mortality due to short-term exposure is generally a 0.6% to 1% increase per 10 µg/m^3 PM (possibly more, depending on local conditions and mortality structure). This range reflects the evidence from a variety of cities and averaging times (including single and multi-day lags). If a central estimate is needed, **0.8% may be most appropriate** and local studies may provide more specific results.

For quantifying this effect, the **relative risk (RR)** can be specified as follows (Figure 1):

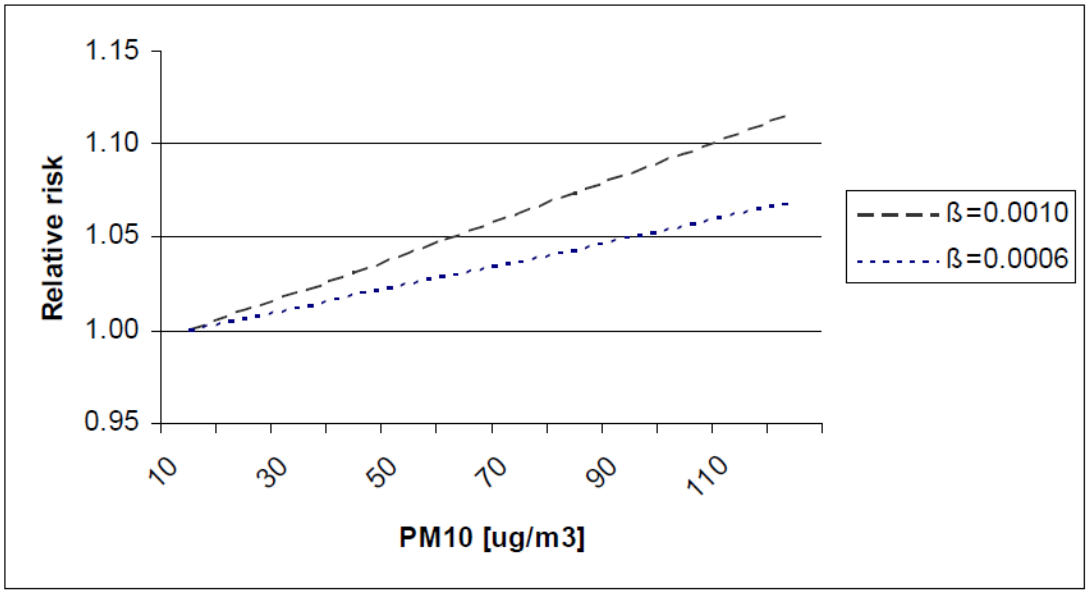
$$RR = \exp[ß(X - Xo)] \qquad \textit{(Equation 1)}$$

where:
ß = range 0.0006 – 0.0010; (proposed best estimate = 0.0008)……0.8%
X = current annual mean concentration of PM_{10} (µg/m^3).
Xo = baseline concentration of PM_{10} (µg/m^3).

Comparing current and background concentrations is one step in calculating the attributable burden (i.e. the total health impact of the risk factor). The current concentration will be determined from **existing monitoring data, model estimates, or best judgement**. The baseline concentration is assumed to be the baseline concentration based on the model predicted results and an international baseline of approximately 10 µg/m^3 PM_{10} without any man-made pollution.

The relative risk estimate (Figure 3) can be applied to the entire sample group (i.e. all ages) and over the full range of PM_{10} concentrations, since the relationship appears to be almost linear up to relatively high PM_{10} concentrations, typically 125 to 150 µg/m^3.

Figure 3 Relative risks for short-term mortality and OAP for all ages
Based on a background concentration of 10 µg/m3 PM10



CONSIDERATION OF UNCERTAINTY.

An inherent uncertainty is associated with the risk assessment predictions. The magnitudes of the uncertainties are in large part a function of the quality, quantity, and variability of available data. When information is uncertain, it is standard practice in a risk assessment to make assumptions that are biased towards safety rather over estimate than under estimate exposure and the potential for adverse health effects.

Uncertainty in such estimates could arise from a number of causes. In this context, upper and lower estimates could be obtained by applying the upper and lower coefficients of the confidence intervals for estimating the relative risks. This would however only cover statistical uncertainty related to the risk estimates, while further uncertainty is added due to potential errors in measuring population exposure, differences in pollution mixtures and baseline health status, and in extrapolating existing results to very high concentrations only found in developing countries for example For the latter case, it is likely that linear extrapolations of our estimates will overestimate the effect of PM on mortality where the PM_{10} is higher than 125 µg/m^3.

Short-term exposure and mortality: children

While the elderly may dominate the potential population at risk, several recent cross-sectional, cohort and time-series studies have reported associations between ambient PM and neonatal or infant mortality, low birth weight or higher rates of prematurity.

However, daily time-series studies in several cities have also demonstrated associations between PM and mortality for those under five years old (or in one case, under one year old), and these studies provide a basis for our estimates of the effects of PM_{10} on infant mortality.

Recommended relationships for quantifying disease

Combining the estimates reviewed above, using a fixed-effects model that weights each estimate by the inverse of its standard error, we estimate that a 10 µg/m^3 increase in ambient PM_{10} concentration results

in a 1.66% (95% CI = 0.34–3.0) mean increase in daily mortality from acute respiratory infections in children 0−5 years of age.

Thus, the linear exposure model (Equation 1) should be used to quantify the relative risks for the endpoint of respiratory diseases with **ß = 0.00166 (95% CI of 0.00034−0.0030),** and where applicable for all causes for the upper bound. As in the case for all-cause mortality for all ages reported above, analysts should cap the maximum risk estimates to those found when PM_{10} is approximately 125 µg/m^3.

Table 3 Child and infant mortality related to PM10 exposure

Source	City	Country	Age group (years)	PM measure	Diagnosis	Change per 10 µg/m^3 increase (%)	95% CI
Conceição et al. (2001)	Sao Paulo	Brazil	0–4	PM10	All respiratory	1.61	-14.82, 21.22
Loomis et al. (1999)	Mexico City	Mexico	0–1	PM2.5[a]	All cause	6.87	2.48, 11.45
Saldiva & Bohm (1995)	Sao Paulo	Brazil	<5	PM10	All respiratory	-1.98	-6.54, 2.57
Gouveia & Fletcher (2000)	Sao Paulo	Brazil	<5	PM10	All respiratory	-0.09	-3.23, 3.14
Ostro et al. (1998)	Bangkok	Thailand	<6	PM10	All cause	1.80	0.23, 3.37
Overall			<5	PM10	All respiratory (All cause for upper bound)	1.66	0.34, 3.00

[a] Converted to PM10 assuming PM2.5 = 0.5 x PM10 (Ostro et al., 1998).

PM as an index.

A related issue is whether there is independent evidence for an effect of PM, or whether confounding by co-pollutants makes it impossible to implicate PM as a pollutant of concern. In many of the time-series mortality studies, including additional pollutants into the regression model did not alter the estimated impact of PM, suggesting the co-pollutants were not confounding factors.

Studies found that there were minimal changes in the estimated PM_{10} coefficient after gaseous pollutants (ozone, nitrogen dioxide, sulphur dioxide, and carbon monoxide) were sequentially added to the regression model. Katsouyanni et al. (2001) also found no effect modification or confounding associated with either ozone or sulphur dioxide.

Given that fuel combustion will generate multiple pollutants that are often correlated over time, PM still may be serving as a general proxy for the overall mixture. Thus, for the purposes of calculating the overall EBD, PM is useful as a proxy for combustion sources.

Disease-specific effects.

Pre-existing cardiovascular and respiratory diseases are clearly risk factors for PM-related mortality, and many time-series studies have reported statistically significant associations between PM and cardiovascular-specific and respiratory-specific mortality (e.g. Schwartz, 1993; Fairley, 1999; Ostro et al., 1999a; Samet et al., 2000a). When compared with all-cause mortality, these disease-specific mortality analyses typically generate larger and more precise effect estimates for PM. In calculating the AF, however, the higher relative risk estimates will be offset by a lower baseline incidence level. Therefore, the total effect of using disease-specific estimates may be fairly similar to that obtained by using all-cause mortality. As

data collection improves, analysts could use disease-specific relative risks and baseline mortality rates to generate estimates of attributable risk.

Life shortening.

Although time-series studies to date have been unable to determine the amount of life shortening that is related to PM, there is indirect evidence that it is significant. Recent studies have reported associations between ambient PM and increased heart rate, decreased heart rate variability, and the incidence of arrhythmias (Liao et al., 1999; Pope et al., 1999; Gold et al., 2000; Peters et al., 2001). These outcomes are considered reliable predictors of the risk of death from heart disease (e.g. Nolan et al., 1998). More direct evidence for a nontrivial reduction in life expectancy has been provided by studies that statistically control for mortality displacement, where the time of death might be delayed by only a few days. If all pollution-related deaths were associated with such mortality displacement, the total life shortening would likely be very small. However, using both frequency-domain and time-domain methods, it has been shown that most air pollution-associated mortality is not due to such displacement (Zeger, Domenici & Samet, 1999; Schwartz, 2000c). For cardiovascular deaths, mortality displacement does not appear to be a major factor, as the average life shortening appears to be greater than two or three months. In contrast, deaths from chronic obstructive pulmonary disease (COPD, which consists mainly of emphysema and chronic bronchitis) appeared to be more consistent with a mortality displacement hypothesis (Schwartz, 2000c, 2001).

The studies indicated that infants and children, possibly those with pre-existing respiratory illness, may be especially sensitive to the effects of ambient PM pollution.

Thresholds.

For short-term exposure to PM, two general methods are available to address the issue of a threshold (i.e. an ambient PM level below which there would be no risk of a significant adverse health outcome). The first method is indirect and uses data sets with very low mean ambient concentrations to examine whether there is a threshold. The second method is direct and uses statistical tests that carefully model the shape of the concentration−response function. Both approaches indicate there is no observable population threshold.

Mortality related to long-term exposure

Recommended relationships for quantifying disease.

Given the studies that are available to date, we recommend that the following log−linear exposure formula for relative risk be used when measuring cardiopulmonary mortality (Pope et al., 2002):

$$RR = \exp(\alpha + ß\ln(X + 1)) / \exp(\alpha + ß\ln(Xo + 1)) \quad \text{.....(Equation 2)}$$

where:
ß = 0.1551 (95% CI = 0.05624 - 0.2541).
X refers to the annual mean concentration of $PM_{2.5}$. A value of 1 was added to the X terms in the formula to ensure that the log function is defined at X = 0.
The value of Xo is usually assumed to be either: the background concentration 3 µg/m^3 of $PM_{2.5}$ in the city or country (e.g. 3 µg/m^3) or the lowest observed concentration in the original study (7.5 µg/m^3 in the Pope et al. (1995) study)4. This formula can be simplified as the ratio of the relative concentrations (of the current -versus the target) raised to the power of ß (which equals 0.1551 for cardiopulmonary mortality):

$$RR = [(X + 1) / (Xo + 1)]^{ß} \quad \text{.....(Equation 3)}$$

For lung cancer-related mortality, the **ß coefficient would be 0.232179** (standard error = 0.07477; 95% CI = 0.08563−0.37873) (Pope et al., 2002). The ß-coefficient can then be substituted into Equation 3.
As the exposure-response relationships are expressed as $PM_{2.5}$, but the mean air quality is generally measured as PM_{10}, we need a $PM_{2.5}$:PM_{10} ratio to apply these relationships. Where available, it is preferred that such a ratio is measured locally. Alternatively, values of 0.65 could be used for developed countries (0.73 in Europe), and 0.5 for developing countries.

The relative risks are graphically represented for a range of mean annual PM_{10} levels, and for a background level of $PM_{2.5}$ = 5 µg/m^3, for developed and developing countries, applying different $PM_{2.5}$:PM_{10} ratios.

Information can when be used to calculate Relative Risks for Cardiopulmonary mortality in adults above 30 years at various ratios. (Fig 4 &5 below).

Figure 4 Recommended relative risks for cardiopulmonary mortality and OAP in adults >30 years, with a PM2.5:PM10 ratio of 0.5 (default for developing countries)
Based on a background concentration of 5µg/m^3 PM2.5

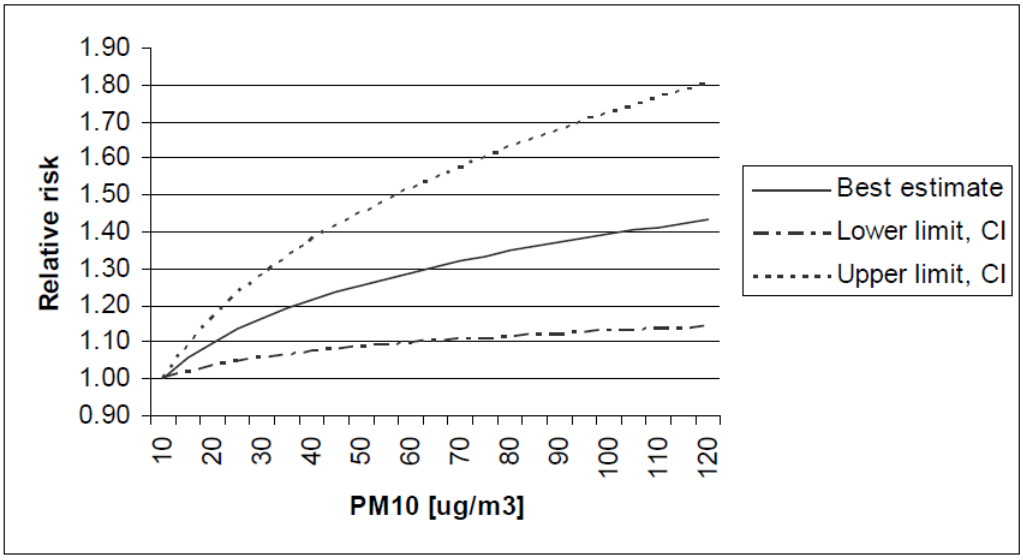


Figure 5 Recommended relative risks for cardiopulmonary mortality and OAP in adults >30 years, with a PM2.5:PM10 ratio of 0.65 (default for developed countries)
Based on a background concentration of 5 $\mu g/m^3$ PM2.5

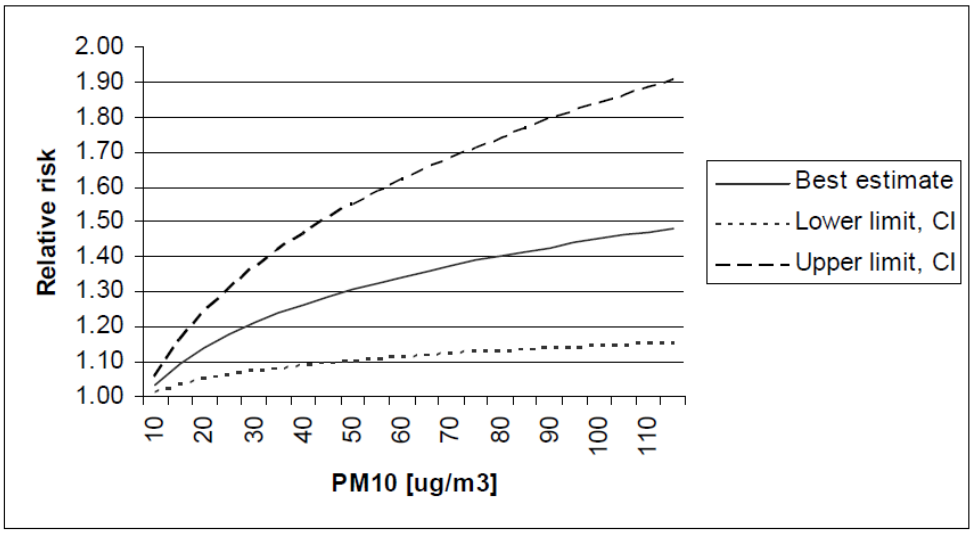
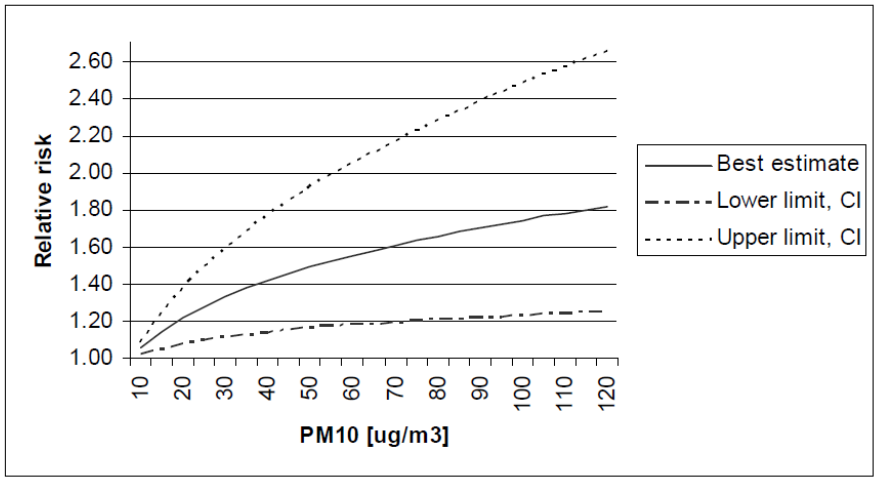


Figure 6 Recommended relative risks for lung cancer related mortality and OAP in adults >30 years, with a PM2.5:PM10 ratio of 0.65 (default for developed countries)
Based on a background concentration of 5 $\mu g/m^3$ PM2.5



Morbidity

Several dozen epidemiological studies have reported associations between various measures of PM and a range of morbidity outcomes, including:
- hospitalization for cardiovascular or respiratory disease
- emergency room and urgent care visits
- asthma exacerbation
- acute and chronic bronchitis
- restrictions in activity

− work loss
− school absenteeism
− respiratory symptoms
− decreased lung function.

Most of these studies have been conducted in cities in North America, with a few conducted in Europe and very few outsides of these two areas. Therefore, compared to the mortality findings, there is a greater degree of uncertainty when morbidity findings are extrapolated to developing countries like South Africa, since estimation requires both a concentration−response function and a baseline incidence rate. As additional evidence is compiled on these effects, one can become more confident about applying these estimates to other economically developing regions. Below, a brief review of some of the effects, focusing on those that have been reported in developing countries. The studies support the idea that PM exposure affects mortality, and that the data can be extrapolated to other regions of the world.
Typically, these studies have used one of two analytical methods. The first method, timeseries analysis of daily count data, is similar to that used to determine mortality related to short-term PM exposure. Specifically, daily counts of an endpoint, such as hospitalization for cardiovascular disease, are examined in response to single-day and multi-day average concentrations of PM. As in the case of mortality, these models also control for potential confounders, such as season, meteorology, day of week, and time trends.

The second approach involves the use of panel data, in which a cohort of subjects (e.g. asthmatic children) is followed prospectively over a period of several months or years, while daily health outcomes and pollution measures are recorded and compared. Below, we review some representative studies for some of these health endpoints.

Estimating the health risk

The risk of air pollution to health in a population is usually represented by a concentration–response function, which is typically based on Relative Risk (RR) estimates derived from epidemiological studies. The RR estimate describes the likelihood of an adverse health outcome (e.g. premature death, heart attack, asthma attack, emergency room visit, hospital admission) occurring in a population exposed to a higher level of air pollution relative to that in a population with a lower exposure level. Typically, RR is expressed as the proportional increase in the assessed health outcome associated with a given increase in pollutant concentrations in µg per m^3 or parts per billion (ppb) (Katsouyanni, 2003). It is important to note that the RR estimate cannot be assigned to a specific person; it describes risk in a defined population, not individual risk.

In order to provide useful advice aimed at answering a specific question, the AP-HRA assesses a specific health endpoint or set of health endpoints in a specific population. The analysis does not cover the full range of possible adverse health effects in all possible groups of the population.

All these factors mean that, in certain assessment contexts, the absence of direct epidemiological evidence about the health risk of exposure to air pollution is an important limitation.

When generating and communicating AP-HRA results for a specific health endpoint, it should be kept in mind that the effects of long-term exposure are much greater than those observed for short-term exposure.

Quantifying the health impact

Results of AP-HRAs are often reported in terms of number of the attributable deaths or cases of disease, years of life lost (YLL), disability-adjusted life years (DALYs), or change in life expectancy attributable to total exposure to air pollution or a change in exposure. These metrics aggregate different types of health impact and can be used to highlight different aspects of the health status of a population (Murray & Lopez, 2013). It is important to note that these metrics provide expected values for a whole population and cannot be applied to individuals in that population.

Number of attributable deaths or cases of disease. This is calculated as the difference in number of deaths or cases of diseases between the incidence/rate at the exposure measured over a specific period and that at baseline exposure, e.g. difference between current disease incidence and historical incidence or projected future incidence, or total health risk (in relation to zero exposure or to some assumed threshold value.)

Years of life lost.

YLL is a measure of the years of life lost as a result of premature death. In simplified terms, the calculated number of deaths attributable to changes in exposure to air pollution is multiplied by the standard life expectancy at the age at which death occurs. In some cases, social value weights are also applied (WHO, 2014). Social value weights include disability weights (used in the calculation of YLD (see below)), time discounting and age weights, which assign different values to the time lived at different ages, to reflect varying societal roles and changing levels of dependence with age (Murray, 1994; WHO, 2014). Discounting takes into account whether a year of healthy life gained now is worth more to society than one gained sometime in the future, while age weighting reflects the fact that lost years of healthy life are valued more at some ages than others (Murray & Acharya, 1997; SA Health, 2003). An example of a study that applied social value weights is the Global Burden of Disease Study.

Years lost due to disability.

YLD measures years lost due to disability. It is estimated by multiplying the number of incident cases of a particular health outcome in a particular period by the average duration of the case until remission or death (years) and a disability weight factor that reflects the severity of the disease on a scale from 0 (perfect health) to 1 (dead) (WHO, 2014). The GBD 2010 study used an updated life expectancy standard for the calculation of YLL and based the YLD calculation on prevalence rather than incidence (WHO 2014). The Prevalence YLD were estimated by multiplying the number of prevalent cases by the disability weight factor.

Disability-adjusted life years.

One DALY is one lost year of healthy life. The sum of DALYs across a population – the burden of disease – can be thought of as a measurement of the gap between actual health status and an ideal situation in which the entire population lives to an advanced age, free of disease and disability. Total DALYs for a particular disease or health condition in a population are calculated as the sum of YLL and YLD (WHO, 2014; Murray & Lopez, 2013). These estimates of impacts can be used for further estimation of the monetary costs and benefits in a health benefits analysis. Some AP-HRA tools incorporate this economic valuation step or it is conducted in a separate step after the AP-HRA. This health benefits analysis yields the economic value of the change in health impacts. If it is a positive change, then it is considered a benefit. If it is negative, it could be considered a cost. This economic valuation is not considering the implementation costs of the policy.

Uncertainty in AP-HRA

The uncertainty of an assessment is related to a lack of knowledge about one or more components of the assessment (US EPA, 2011). Uncertainty analysis is an instrumental part of any scientific analysis, and is usually limited to components that are already identified as uncertain (“known unknowns”). It is a challenging yet important task to find a balance between the complexity of information and tools used and the need to produce understandable results for policy-makers and others who do not necessarily have a technical background or expertise in the field (WHO Regional Office for Europe, 2014). The key sources of uncertainty in an APHRA are listed below (WHO Regional Office for Europe, 2014).

1. Air pollutants exist as a complex mixture. Despite great improvements in the science underlying AP-HRAs, it is still not possible to know with complete certainty the effects of air pollution on health (WHO Regional Office for Europe, 2014). There is a considerable body of evidence from epidemiological studies in various parts of the world documenting a wide range of adverse health effects associated with ambient air pollution. However, the observed adverse effects attributed to an individual air pollutant may actually be (partly) attributable to other pollutants in the mixture which are correlated with the assessed pollutant (WHO Regional Office for Europe, 2013). The resulting uncertainty in the outcome of the APHRA may be considered “unknown unknowns” and is not included in this document.

2. Baseline disease burden: the number of deaths or cases of disease may be uncertain for a variety of reasons, especially when data from a number of countries are combined. In addition, uncertainty arises when projections are made of population size and deaths in the future.

3. Pollution exposure level: Because there is no full geographical coverage of ground monitors, most APHRAs rely to some extent on modelling to estimate exposure. Modelling is also needed for estimates of future exposure based on predicted changes in air pollution as a result of new policies or technological improvements. Since air quality models are based on a set of assumptions, it is not possible to be certain that the estimated exposure coincides with the actual ambient concentrations in a given location. Even if there could be full coverage by ground monitors, all AP-HRAs assume that either measurements made at a specific location or model estimates of average exposure over a particular area are representative of the exposure of the targeted population. Even if population exposure is well estimated, individual exposures can vary substantially, as a result of differences in concentrations at different places as well as individuals’ own activity patterns. Personal monitoring is generally necessary to assess individual-level risks.

4. The concentration–response function (CRFs) is derived from epidemiological studies, in which assumptions made during the analysis inevitably introduce some uncertainty into the results. In addition, epidemiological evidence on air pollution is scarce or absent in some parts of the world. Most epidemiological studies have been conducted in developed countries, and the range of exposures studied does not necessarily represent what is observed around the world.

5. For many public health and policy decisions, the mortality attributable to ambient air pollution has to be considered in the context of mortality due to other factors. A comparative risk assessment (CRA) is a type of AP-HRA that provides comparable estimates for the various risk factors; it requires that consistent approaches are used to estimate the various risks (WHO Regional Office for Europe, 2014). The GBD 2010 project, coordinated by the Institute for Health Metrics and Evaluation (IHME), carried out a CRA to compare the burden of disease from various risk factors, including air pollution (Lim et al., 2013). The project developed integrated exposure–response (IER) functions that combined evidence from studies of ambient air pollution, second-hand smoke, household air pollution and active smoking to estimate risk from ambient air pollution over the entire range of exposure (Lim et al., 2013; WHO Regional Office for Europe, 2014).

6. The counterfactual level of air pollution the counterfactual level of air pollution is a baseline or reference exposure against which the health impacts of air pollution are calculated (WHO, 2014b). This level of air pollution may be defined differently in different AP-HRAs, depending on the policy question to be answered. It may, for example, be defined as the national air quality standard, the WHO air quality guideline (AQG) level, the natural level (i.e. without anthropogenic influence) or the lowest level observed in epidemiological studies (WHO Regional Office for Europe, 2014). Uncertainty in the counterfactual level may be due to imperfect knowledge about the exact effect of some previous policy change or a theoretical minimum level of pollution (WHO Regional Office for Europe, 2014). It should be noted that choosing a counterfactual level of air pollution is not an uncertainty in the same sense as those previously discussed. The results of the AP-HRA are sensitive to this choice, but they are not themselves made uncertain by it.

7. Deliberate simplifications of the model: Practical considerations may require the use of a simplified model, which can lead to increased uncertainty (WHO, 2005). It is important that these various sources of uncertainty are acknowledged and described as fully as possible, to give a sense of the precision of the estimates. Uncertainties arise mainly from the current understanding of CRFs and from exposure estimates. In addition, there are probably components of uncertainty that are not recognized. Despite these uncertainties, an AP-HRA can provide useful and valid results. Therefore, while it is important to communicate uncertainties, the message should be balanced to ensure that decision-makers take the results of the AP-HRA seriously. The multiple sources of uncertainty may be quantified by Monte Carlo simulations or probabilistic simulations, as was done in the GBD 2010 study (Lim et al., 2013).

8. Confidence in AP-HRA estimates the results of the uncertainty analysis are usually presented as ranges, with the focus being on confidence intervals around the mean (WHO Regional Office for Europe, 2014). Conventionally, 95% confidence intervals are used to provide an estimate of the precision of the results. This interval is the range of values within which there is a 95% probability that the true value lies (Scott, 2008; US EPA, 2015). For example, as outlined in Annex 3, the uncertainty in the estimates in the GBD 2010 study (Lim et al., 2013) was presented as numerical ranges, i.e. confidence intervals around the mean.

(Curtesy Rayten Engineering Solutions dust fall prediction model)

Table 4 - Maximum predicted incremental PM10, PM2.5 concentrations and Dustfall rates at nearby sensitive receptors, located within a 20km radius of the proposed mine

Discrete Receptor ID	Name Edu = educational/school/training facilities HC = healthcare/clinic/hospital facilities Old = old age home Residential = Dwellings/ farm houses	PM10 (24H) (µg/m^3)	PM2.5 (24H) (µg/m^3)	UTM Co-ordinates (35S)	
				X(m)	Y (m)
DR1	Dwellings/Edu (Phoweni Secondary School)	0.16	0.02	783593.43	6825731.85
DR2	Dwellings/Edu (Umndeni Woxolo Primary School)	0.10	0.01	779482.58	6825347.41
DR3	Dwellings/Edu (Ncinjane Secondary School)	0.07	0.01	778355.45	6825780.23
DR4	Res (Ezakheni E)/Edu (Sakhelwe High School & Mnambithi College -E Campus)/HC (Ezakheni E Clinic)	0.22	0.02	782559.66	6829402.74
DR5	Res (Ezakheni C)/Edu (Isiqophamithi School)/ (Ezakheni Health Centre)	0.17	0.02	785387.63	6830383.47
DR6	Res (Ezakheni C)/Edu (Endakane High School)	0.19	0.02	784319.47	6829380.59
DR7	Edu (Qophindela Secondary School)	0.16	0.02	785790.97	6829793.12
DR8	Edu (Ekuphumuleni Primary School)	0.10	0.01	784853.75	6830372.91
DR9	Edu (Falethu Primary School)	0.17	0.02	785656.50	6830142.39
DR10	Res (Ezakheni D)/Edu (Ingceboyesizwe Primary School)	0.18	0.02	786578.07	6829824.71
DR11	Res (Dwellings)	0.49	0.05	788620.07	6827806.84
DR12	Res (Dwellings)	0.31	0.04	787944.85	6829235.24
DR13	Edu (Bhekintuthuko Secondary School)	0.18	0.02	788984.10	6831087.95
DR14	Res (Ezakheni B)/Edu (Ekukhuleni High School)	0.13	0.01	785533.62	6831867.83
DR15	Res (Ezakheni B)/Edu (Mcitsheni Primary School)	0.12	0.01	785990.51	6831915.30
DR16	Res (Ezakheni A)/Edu (Idamu School & Sir Manyathi Learning Institute)	0.10	0.01	786437.18	6832280.65
DR17	Res (Ezakheni A)/Edu (Ezakheni High School)	0.09	0.01	786165.40	6832778.21
DR18	Edu (Gqama Primary School)	0.09	0.01	786512.53	6832911.17
DR19	Ezakheni IA (Light Industrial Area)	0.11	0.01	778832.92	6829281.50
DR20	Edu (Ezakheni FET College)	0.05	0.01	786219.77	6833493.20
DR21	Edu (Amancakazana Primary School)	0.08	0.01	784941.56	6833872.08
DR22	Res (Dwellings)/Edu (St Chads High School)	0.06	0.01	782143.80	6834918.39
DR23	Res (St Chads)	0.06	0.01	784769.30	6835138.40
DR24	Res (Dwellings)/Edu (Mabhomane H.P. School)	0.06	0.01	784530.25	6836387.06
DR25	Church (Mhkuku Kunene Umthandazi)	0.17	0.02	781819.70	6819617.37
DR26	Res (Inkanyezi)/Edu (Colenso Combined School)/HC (Tholusizo Clinic)	0.09	0.01	777184.28	6817860.49
DR27	Res (Colenso)/Edu (Colenso Primary School)/Midlands Orphanage & Care Centre	0.09	0.01	775884.55	6817303.49
DR28	Res (Dwellings)/Edu (ML Sultan Colenso Primary School)	0.08	0.01	777090.77	6815781.16
DR29	Res (Dwellings)/(Edu (Indulwana Primary School)	0.06	0.01	778006.41	6813570.49
DR30	Edu (Morning Star Primary School)	0.19	0.02	781654.46	6813123.54
DR31	Umsuluzi Game Park	0.14	0.02	780070.25	6810755.95
DR32	Weenen Nature Reserve	0.22	0.02	792576.37	6806583.65
DR33	Tugela Private Game Reserve	0.06	0.02	772711.33	6820884.68
DR34	HC (Unjani Clinic Ezakheni)	0.13	0.01	786435.35	6831319.77

12.0 ANALYSIS AND PERDICTIONS FOR THE HEALTH IMPACT RISK ASSESSMEN BASED ON PERDICTED ENVIRONMENTAL IFORMATION PRESENTED BY RAYTEN ENGINEERING SOLUTIONS (Pty) Ltd, (Dunrose Investment Proposed Coal Mine – KZN).

Courtesy from Rayten's Air Quality Impact Assessment Report for Dunrose Investment Proposed Coal Mine - KZN the existing air quality stations was not working and a prediction model was used to predict PM_{10}, $PM_{2.5}$ dust fall, which is the major air contaminant in high wall coal mining.
MM5 meteoritical data capture period is 1 January 2022 to 31 December 2024.

- PM_{10}, $PM_{2.5}$ for the various Sensitive Receptors were predicted as **Insignificant Risk**.
- Because of the various measurement intervals all data was related to a 24-hour exposure because the sensitive receptors may be exposed to the air pollutants continuously throughout the day and not only the 8-hour work day.

For the Health Impact Prediction Model, various parameters are used to calculate the "Probability of Health Risk". These are World Standards (Table 3) derived from various international studies and publications.

Table 5: Parameters used for Calculation of Probability of Health Risk – World Standards.

Parameter Name	Parameter Value used in predictions	Source of Standard Parameter
Co-efficient of risk function (cardiopulmonary mortality) β	**0.15515**	Ostro (2004)
Co-efficient of risk function (lung cancer mortality) β	**0.23218**	Ostro (2004)
Co-efficient of risk function (for all-cause mortality) β	**0.0008**	Ostro (2004)
Base line concentration PM_{10} $X_{o\,(}ug/m^3)$	**10**	Ostro (2004)
Base line concentration $PM_{2.5}$ $X_{o\,(}ug/m^3)$	**3**	Ostro (2004)
Inhalation rate M^3/day	**14.25**	Hyungkeun et al.(2018)
Exposure duration Hours	**24**	Hyungkeun et al.(2018)
Body weight kg	**62.8**	Hyungkeun et al.(2018)
Unit risk $PM_{2.5}$ ug/m^3	**0.008**	Greene and Morris (2006)
Exposure frequency	**0.85**	EPA (1997)
Average time years	**70**	US EPA (2009)

The data from the maximum predicted incremental PM_{10}, $PM_{2.5}$ concentrations and Dustfall rates at nearby sensitive receptors, located within a 20km radius of the proposed mine was used for the Health Impact Assessment model.

Table 6 – Dust fall perdition at mining boundary – Dunrose Investment Proposed Coal Mine (All results reflect 24Hr exposure because sensitive receptor will be exposed during the entire day)

Location	Averaging time	Dustfall ($mg/m^2/day$	PM_{10} $\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
Predicted Maximum Modelled Incremental Concentrations at the boundary of the project site	24hr	1.08	0.49	0.05
Compliance Air Quality Standard ($\mu g/m^3$)	-	1200	75	40

Using the Parameters for Calculation of Probability of Health Risk, with the measured **PM_{10}** air pollution concentrations, the Relative Risk Rating (RR) and Attributable Fraction (AF) for cardiopulmonary, lung cancer and all-cause mortality risks is calculated.

cardiopulmonary		cardiopulmonary	
ATTRIBUTABLE FRACTIONS **(AF) PM10** ***AF = (RR-1) / RR***		Relative Risk **(RR) PM10 ((x+1)/(Xo+1))expβ**	
RR	0.158188305	X=0.16	0.49
ER = RR-1	**-0.841811695**	Xo=10	10
AF	**-5.321579848**	co-eff=0.15515	0.15515
			0.135455
		RR	**0.158188**
Lung cancer		Lung cancer	
ATTRIBUTABLE FRACTIONS **(AF) PM10** ***AF = (RR-1) / RR***		Relative Risk **(RR) PM10 ((x+1)/(Xo+1))expβ**	
RR	0.170855151	X=30.16	0.49
ER = RR-1	-0.829144849	Xo=10	10
AF	**-4.85291105**	co-eff=0.23218	0.23218
			0.135455
		RR	**0.170855**
All cause mortality		All cause mortality	
ATTRIBUTABLE FRACTIONS **(AF) PM10** ***AF = (RR-1) / RR***		Relative Risk **(RR) PM10 exp(β(x-Xo))**	
RR	0.992420868	X=0.16	0.49
ER = RR-1	-0.007579132	Xo=10	10
AF	**-0.007637014**	co-eff=0.0008	0.0008
			-0.00761
		RR	**0.992421**

Using the measured $PM_{2.5}$ concentrations measured during the period 2025 the same fractions is calculated for Cardiopulmonary, Lung cancer and all-cause mortality proportions.

Dunrose Proposed Coal Mine 2025

cardiopulmonary		cardiopulmonary	
ATTRIBUTABLE FRACTIONS **(AF) PM2.5** ***AF = (RR-1) / RR***		Relative Risk **(RR) PM2.5** **((x+1)/(Xo+1))expβ**	
RR	0.306556195	X=0.02	0.05
ER = RR-1	**-0.693443805**	Xo=3	3
AF	**-2.262044666**	co-eff=0.15515	0.15515
			0.2625
		RR	**0.306556**

Lung cancer		Lung cancer	
ATTRIBUTABLE FRACTIONS **(AF) PM2.5** ***AF = (RR-1) / RR***		Relative Risk **(RR) PM2.5** **((x+1)/(Xo+1))expβ**	
RR	0.331103522	X=0.02	0.05
ER = RR-1	**-0.668896478**	Xo=3	3
AF	**-2.020203451**	co-eff=0.23218	0.23218
			0.2625
		RR	**0.331104**

All cause mortality		All cause mortality	
ATTRIBUTABLE FRACTIONS **(AF) PM2.5** ***AF = (RR-1) / RR***		Relative Risk **(RR) PM2.5** **exp(β(x-Xo))**	
RR	0.997642783	X=0.02	0.05
ER = RR-1	**-0.002357217**	Xo=3	3
AF	**-0.002362787**	co-eff=0.0008	0.0008
			-0.00236
		RR	**0.997643**

To calculate the **LADD and ELCR** for the Predicted sensitive receptors Air Pollution concentrations the Probability of Health Risk Parameters is again required.

- **LADD** – Lifetime Average Daily Dose
- **ELCR** – Excess Lifetime Cancer Risk

From table 3 " Parameters used for Calculation of Probability of Health Risk – World Standards".

Inhalation rate M^3/day (IR)	**14.25**	Hyungkeun et al.(2018)
Exposure duration Hours (ED)	**24**	Hyungkeun et al.(2018)
Body weight kg (BW)	**62.8**	Hyungkeun et al.(2018)
unit risk $PM_{2.5}$ ug/m^3(UR)	**0.008**	Greene and Morris (2006)
Exposure frequency (EF)	**0.85**	EPA (1997)
Average time years (AT)	**70**	US EPA (2009)

The Predicted Airborne Pollutant concentration for $PM_{2.5}$ in the Dunrose Investment Proposed Coal Mine sample station was **0.05µg/m³.**

Using the equation LADD = (C*IR*EF*ED) / (BW*AT)

A LADD of **0.003306415** is calculated for 2025.

To calculate the **ELCR**, the Slope Factor (SF) is required and calculated by SF=UR/(BW*IR) which again use WHO parameters set in Table 1 and equates to an SF of **0.000008940**.

The ELCR is calculated by multiplying the calculated SF and LADD values:

ELCR $PM_{2.5}$:

= 0.000008940 x 0.003306415
= 0,000009429
= 2.9X10^{-8}

Table 7: Criteria used to Assess Magnitude of Potential Risk for Human Health.

Parameter	Levels of Magnitude of Potential Health Risk			
	Negligible	Low	Moderate	High
Human Health Risk Assessment				
Non-Carcinogenic Substances	No Change from Base Case, below applicable guidelines or the HQ<1	1 < HQ ≤ 10	5 < HQ ≤ 10	HQ > 10
Carcinogenic Substances	No Change from Base Case, below applicable guidelines or the ELCR≤1 X 10^{-5}.	1 x10^{-5} < ELCR ≤ 5 x10^{-4}	5 x10^{-5} < ELCR ≤ 1 x10^{-4}	1 x10^{-5} < ELCR ≤ 5 x10^{-4}

HQ – Hazard Quotient (Represent the target ratio of predicted chemical exposure relative to its health-based benchmarks)
ELCR – Excess Lifetime Cancer Risk (additional or extra risk of developing cancer due to exposure to a chemical incurred over the lifetime of an individual.
(Reference: Human and Wildlife Health Risk Assessment Report for the Jay Project. Dominion Diamond Ekati Corporation February 2015.)

Similar reference is made for the Health Risk Matrix with ELCRs used by
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Calculated and predicted ELCR Value	Rating
ELCR ≥ 1.0 x 10^{-4}	**Very High**
ELCR ≥ 1.0 x 10^{-5}	**High**
ELCR between 1.0 x 10^{-5} and 1.0 x 10^{-6}	**Moderate**
ELCR < 1.0 x 10^{-6}	**Low**

Based on the predicted Fugitive Emission concentration for $PM_{2.5}$ and PM_{10} the final Health Risk rating at the boundary of the Dunrose Investment Proposed Coal Mine is:

Year of measurement	Calculated ELCR for Proposed Dunrone Coal Mine Sample site	Final Risk Rating Matrix
2025	$2.9X10^{-8}$	LOW

In the same manner as the $PM_{2.5}$ the other pollutants can also be evaluated and is expressed in terms of the **Hazard Quotient (HQ**) value which when calculated should not exceed 1,0.

In **Summary for 2025** used as the baseline Health Risk Assessment at the Air Pollution Sample point the following parameter conclusion can be made.

- The ELCR using the $PM_{2.5}$ as Health Risk marker, was $2.9X10^{-8}$. This equates to a Low Health Risk and can be interpreted that 2.9 chance in a 100 million, of suffering a moderate chance increased health risk as a result of the Air Pollution levels measured at the sampling point which is located 20km around the Proposed Durose Coal Mine.

13.0 $PM_{2.5}$ modelling and prediction Air Pollution Concentrations at Sensitive Receptor points downwind from the proposed Dunrose Investment Coal Mine - KZN.

The predicted airborne pollutants concentrations measured at the Air Quality sample point on the Dunrose Investment Proposed Coal Mine was used in as inputs into prediction models to predict the airborne pollutant concentrations within a 20 kilometer range from the mining operation occupied by various sensitive receptors using current legislative requirements and to predict possible health risks at these receptors. The Model Air Pollution prediction was calculated for the maximum predicted incremental air pollution concentrations at nearby <20km of Proposed Dunrose Coal Mine Operation

Table 8: Maximum Predicted incremental pollutant concentrations at nearby sensitive receptors, located within 20km of Proposed Dunrose Coal Mine Operation.

Discrete Receptor	Dustfall ($Mg/m^2/day$)	PM_{10} 24-Hr	$PM_{2.5}$ 24-Hr
DR1	16.21	0.16	0.02
DR2	40.40	0.10	0.01
DR3	41.25	0.07	0.01
DR4	34.55	0.22	0.02
DR5	27.97	0.17	0.02
DR6	27.74	0.19	0.02
DR7	35.33	0.16	0.02
DR8	36.82	0.10	0.01
DR9	38.74	0.17	0.02
DR10	51.73	0.18	0.02
DR11	55.15	0.49	0.05
DR12	47.26	0.31	0.04
DR13	50.88	0.18	0.02
DR14	69.50	0.13	0.01
DR15	51.23	0.12	0.01
DR16	46.90	0.10	0.01
DR17	42.79	0.09	0.01
DR18	40.50	0.09	0.01
DR19	44.18	0.11	0.01
DR20	46.16	0.05	0.01
DR21	40.85	0.08	0.01
DR22	49.13	0.06	0.01
DR23	57.04	0.06	0.01
DR24	53.91	0.06	0.01
DR25	77.75	0.17	0.02
DR26	60.96	0.09	0.01
DR27	64.55	0.09	0.01
DR28	25.86	0.08	0.01
DR29	27.68	0.06	0.01
DR30	113.76	0.19	0.02
DR31	177.17	0.14	0.02
DR32	87.06	0.22	0.02
DR33	47.30	0.06	0.02
DR34	51.25	0.13	0.01

Based on the data set obtained from the Rayten Engineering Solutions' Air Pollution prediction model 20km away from the Dunrose Proposed Coal Mine, the predicted $PM_{2.5}$ (24-hr) model Air Pollutant concentrations was used to calculate a Risk Rating (RR) and Attributable Fraction (AF) for Ccardiopulmonary, Lung Cancer and All-Cause Mortality.

A) The data was also used to calculate the **Lifetime Average Daily Dose (**LADD) and **Excess Lifetime Cancer Risk (**ELCR). The ELCR was then used as an indicator for the Calculated Health Risk for occupants who live within 20km from the proposed Dunrose Coal Mine. (Results in table 9 & 10 below).

The Calculated Health Risks was categorized in Low, Medium or High Risks. (Table 9 &10)

Table 9 – Calculated Health Risk Ratings for Sensitive Receptors living within 20km down-wind from Proposed Dunrose Coal Mine - PM10

Discrete Receptor	RR	AF	RR	AF	RR	AF	LADD	ELCR	Final Health Risk Rating Evaluation.
	Cardiopulmonary		Lung Cancer		All-Cause Mortality				
DR1	1.173	0.147	1.187	0.158	1.000	0.000	0.011	$9.45x10^{-8}$	Low
DR2	1.112	0.101	1.126	0.112	1.000	0.000	0.007	$5.91 x10^{-8}$	Low
DR3	1.082	0.076	1.095	0.087	1.000	0.000	0.005	$4.148 x10^{-8}$	Low
DR4	1.233	0.189	1.249	0.199	1.000	0.000	0.015	$1.30 x10^{-7}$	Low
DR5	1.183	0.155	1.198	0.165	1.000	0.000	0.011	$1.01 x10^{-7}$	Low
DR6	1.203	0.169	1.218	0.179	1.000	0.000	0.013	$1.12 x10^{-8}$	Low
DR7	1.173	0.147	1.187	0.158	1.000	0.000	0.011	$9.46 x10^{-8}$	Low
DR8	1.112	0.101	1.126	0.112	1.000	0.000	0.007	$5.91 x10^{-8}$	Low
DR9	1.183	0.155	1.198	0.165	1.000	0.000	0.011	$1.01 x10^{-7}$	Low
DR10	1.193	0.162	1.208	0.172	1.000	0.000	0.012	$1.06 x10^{-7}$	Low
DR11	1.506	0.336	1.525	0.344	1.000	0.000	0.032	$2.9 x10^{-7}$	Low
DR12	1.324	0.245	1.341	0.254	1.000	0.000	0.020	$1.83 x10^{-7}$	Low
DR13	1.193	0.162	1.208	0.172	1.000	0.000	0.012	$1.06 x10^{-7}$	Low
DR14	1.142	0.125	1.157	0.136	1.000	0.000	0.009	$7.70 x10^{-8}$	Low
DR15	1.132	0.117	1.147	0.128	1.000	0.000	0.008	$7.09 x10^{-8}$	Low
DR16	1.112	0.101	1.126	0.112	1.000	0.000	0.007	$5.91 x10^{-8}$	Low
DR17	1.102	0.093	1.116	0.104	1.000	0.000	0.006	$5.32 x10^{-8}$	Low
DR18	1.102	0.093	1.116	0.104	1.000	0.000	0.006	$5.32 x10^{-8}$	Low
DR19	1.122	0.109	1.136	0.120	1.000	0.000	0.007	$6.50 x10^{-8}$	Low
DR20	1.062	0.058	1.075	0.070	1.000	0.000	0.003	$2.96 x10^{-8}$	Low
DR21	1.092	0.084	1.106	0.095	1.000	0.000	0.005	$4.73 x10^{-8}$	Low
DR22	1.072	0.067	1.085	0.078	1.000	0.000	0.004	$3.55 x10^{-8}$	Low
DR23	1.072	0.067	1.085	0.078	1.000	0.000	0.004	$3.55 x10^{-8}$	Low
DR24	1.072	0.067	1.085	0.078	1.000	0.000	0.004	$3.55 x10^{-8}$	Low
DR25	1.183	0.155	1.198	0.165	1.000	0.000	0.011	$1.01 x10^{-7}$	Low
DR26	1.102	0.093	1.116	0.104	1.000	0.000	0.006	$5.32 x10^{-8}$	Low
DR27	1.102	0.093	1.116	0.104	1.000	0.000	0.006	$5.32 x10^{-8}$	Low
DR28	1.092	0.084	1.106	0.095	1.000	0.000	0.005	$4.73 x10^{-8}$	Low
DR29	1.072	0.067	1.085	0.078	1.000	0.000	0.004	$3.55 x10^{-8}$	Low
DR30	1.203	0.169	1.218	0.179	1.000	0.000	0.013	$1.12 x10^{-7}$	Low
DR31	1.153	0.132	1.167	0.143	1.000	0.000	0.009	$8.28 x10^{-8}$	Low
DR32	1.233	0.189	1.249	0.199	1.000	0.000	0.015	$1.30 x10^{-7}$	Low
DR33	1.072	0.067	1.085	0.078	1.000	0.000	0.004	$3.55 x10^{-8}$	Low
DR34	1.142	0.125	1.157	0.136	1.000	0.000	0.009	$7.69 x10^{-8}$	Low

Table 10 – Calculated Health Risk Ratings for Sensitive Receptors living within 20km down-wind from Proposed Dunrose Coal Mine – $PM_{2.5}$

Discrete Receptor	RR	AF	RR	AF	RR	AF	LADD	ELCR	Final Health Risk Rating Evaluation.
	Cardiopulmonary		Lung Cancer		All-Cause Mortality				
DR1	1.031	0.030	1.044	0.042	1.000	$1.54x10^{-6}$	$1.32x10^{-3}$	$1.18 x10^{-8}$	Low
DR2	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR3	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR4	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR5	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR6	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR7	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR8	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR9	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR10	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR11	1.062	0.058	1.075	0.070	1.000	$3.94 x10^{-5}$	$3.31 x10^{-3}$	$2.96 x10^{-8}$	Low
DR12	1.051	0.049	1.065	0.061	1.000	$3.14 x10^{-5}$	$2.65 x10^{-3}$	$2.36 x10^{-8}$	Low
DR13	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR14	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-3}$	$5.91 x10^{-9}$	Low
DR15	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR16	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR17	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR18	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR19	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR20	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR21	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR22	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR23	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR24	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR25	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-9}$	Low
DR26	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR27	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR28	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR29	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR30	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR31	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR32	1.031	0.030	1.044	0.042	1.000	$1.54 x10^{-5}$	$1.32 x10^{-3}$	$1.18 x10^{-8}$	Low
DR33	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low
DR34	1.021	0.021	1.034	0.033	1.000	$7.36 x10^{-6}$	$6.61 x10^{-4}$	$5.91 x10^{-9}$	Low

16.0 Model and Prediction Assumptions.

- Data/information provided by the client (Rayten Engineering Solutions) and used as input into the model for the Desktop Study;
- The study is limited by the amount of detailed information that could be provided at the time of the Desktop Health Impact Assessment. No site visits were conducted and information provided are only from Air Pollution Models.
- Activities that are not associated with the proposed Coal Mining Activities and occur outside the scope of Proposed Mining Operation were not included in the assessment. These may include any potential background emission sources. Background sources are excluded as detailed information for these is required for input into the model and is not readily available.

17.0 Conclusion:

From the Desktop Health Impact Assessment, the following outcomes are recorded.

The Calculated and predicted Health Impacts Risk Rating for all sensitive receptors living within 20km downwind for the proposed Dunrose Investment Coal Mining is low. (Using predicted PM_{10} and $PM_{2.5}$ concentration). None of the sensitive receptors showed any significant **Excess Lifetime Cancer Risk** (ELCR) to contract Chronic or adverse health effects as a result of air pollutants potential generated by the proposed high wall coal mining operation.

18.0 ANALYST AND CLIENT DETAILS

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TARGETED ASSESSMENT SITE USED IN THE DESKTOP STUDY.

DUNROSE INVESTMENTS 174 (PTY) LTD – PROPOSED HIGHWALL SURFACE COAL MINING
North-east of Colenso,
Umtshezi Local Municipality
Uthukela District Municipality,
Kwa-Zulu Natal Province

19.0 REFERENCES

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International Journal of Environmental Research and Public Health
(Int. J.Environ. Res. Public Health 2021, 2819 (page 6 of 20)
https://www.mdpi.com/1660-4601/18/6/2819/pdf

Human and Wildlife Health Risk Assessment
Jay Project Section 1, Introduction - February 2015

1. APPENDICES Approved Inspection Authority Certificate.

employment & labour

Department:
Employment and Labour
REPUBLIC OF SOUTH AFRICA

National Department of Employment and Labour
Republic of South Africa

APPROVED INSPECTION AUTHORITY

Registered in accordance with the provisions of the Occupational Health and Safety Act, Act 85 of 1993, as amended.

This is to certify that:

CONSULTING OCCUPATIONAL HYGIENIST CC

has been approved by the Department of Employment & Labour as a Type A, Approved Inspection Authority: Occupational Health and Hygiene under the following regulations:

- Asbestos Abatement Regulations 4(2), 5(7), 13, 15(2)(c), 16 & 22
- Hazardous Chemical Agents Regulations 6 & 12.
- Lead Regulations 7 & 14.
- Noise Induced Hearing Loss Regulation 7

CHIEF INSPECTOR

Valid from: **30 September 2022**
Expires: **29 September 2026**
Certificate Number: **OH0026 – CI 018**

Traffic Impact Assessment

TRAFFIC IMPACT ASSESSMENT (TIA)

Proposed Coal Mine on Remainder of Portion 1 & Remainder of The Farm Schurfde Poort 1147 GS; The Farm Shaws No.11317 GS; Portion 1 & Remainder of The Farm Ganna Hoek 1317 GS; Portion 1 & Remainder of The Farm Klip Berg 2158 GT; The Farm Brakfontein 1316 GS; Portions 1, 2 & Remainder of The Farm Ramak 13696 GT

Report No.: J035
Report Date.: May 2025

PREPARED BY:

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TT TRAFFIC ENGINEERS
(PTY) LTD "on the dot!"
Reg No: 2024/608044/07

Inkosi Langalibalele
LOCAL MUNICIPALITY · UMKHANDLU WENDAWO

TRAFFIC IMPACT ASSESSMENT INFORMATION & CONTROL SHEET

Local municipal area	:	Inkosi Langalibalele Local Municipality
Property description	:	Rem. of Ptn. 1 & Rem. of The Farm Schurfde Poort 1147 GS; The Farm Shaws No.11317 GS; Ptn. 1 & Rem. of The Farm Ganna Hoek 1317 GS; Ptn. 1 & Rem. of The Farm Klip Berg 2158 GT; The Farm Brakfontein 1316 GS; Ptn. 1, 2 & Rem. of The Farm Ramak 13696 GT
Application type	:	Coal Mining Rights

Author of the Report:

TT TRAFFIC ENGINEERS
(PTY) LTD "on the dot!"
Reg No: 2024/608044/07

Compiled / Reviewed	*Jonas Makala (Pr. Techni Eng.)*
Qualifications	*B. Tech. Transportation Engineering*
ECSA Registration	*No.: 201330047*
SAICE Registration	*No.: 204411*
Certification	*It is herewith certified that this Traffic Impact Assessment has been prepared according to requirements of the TMH 16 South African Traffic Impact and Site Traffic Assessment Manual.*
Signed	

Remainder of Portion 1 & Remainder of The Farm Schurfde Poort 1147 GS; The Farm Shaws No.11317 GS; Portion 1 & Remainder of The Farm Ganna Hoek 1317 GS; Portion 1 & Remainder of The Farm Klip Berg 2158 GT; The Farm Brakfontein 1316 GS; Portions 1, 2 & Remainder of The Farm Ramak 13696 GT,

TRAFFIC IMPACT ASSESSMENT (TIA)

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1 INTRODUCTION

1.1 Background

TT Traffic Engineers (Pty) Ltd were appointed to undertake a Traffic Impact Assessment (TIA) in support of the mining rights application for the proposed coal mine to be situated on various farm portions near the town of Colenso, KwaZulu-Natal; namely,

- ✓ Remainder of Portion 1 & Remainder of The Farm Schurfde Poort 1147 GS
- ✓ The Farm Shaws No.11317 GS
- ✓ Portion 1 & Remainder of The Farm Ganna Hoek 1317 GS
- ✓ Portion 1 & Remainder of The Farm Klip Berg 2158 GT
- ✓ The Farm Brakfontein 1316 GS
- ✓ Portions 1, 2 & Remainder of The Farm Ramak 13696 GT

The proposed mining area measures approximately 6 333, 2240 hectares in extent.

The purpose of this study is to investigate the site accessibility, transportation infrastructure provision requirements, traffic flow conditions at the key intersection/s within the study area, development trip generation estimates and determine any road and/or intersections improvements required to mitigate the anticipated development traffic impact.

Comments are also made in respect of the non-motorised and public transport in this TIA.

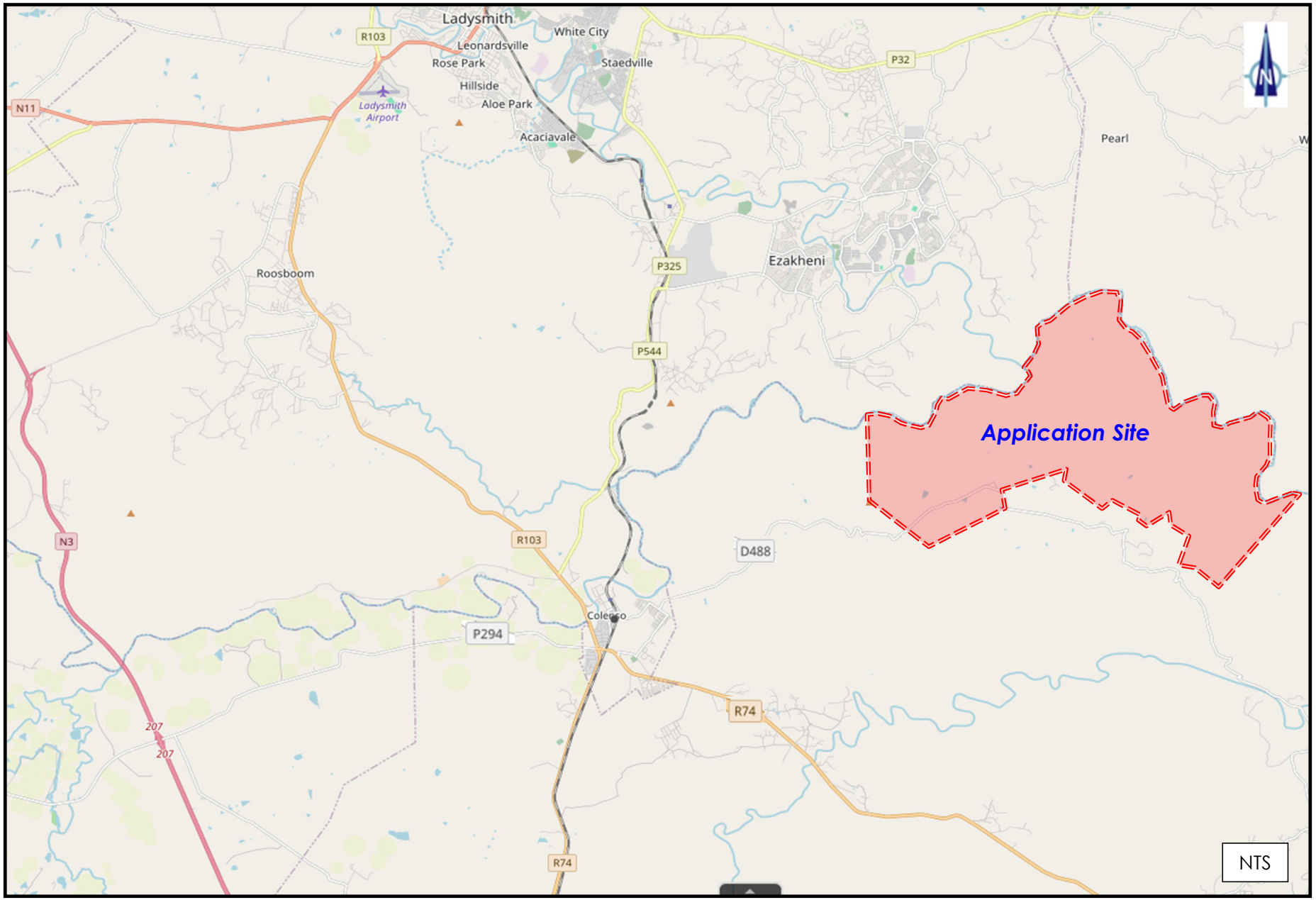
The study has been undertaken considering the requirements and guidelines as set out in the *TMH 16 Volume 1 (South African Traffic Impact and Site Traffic Assessment Manual), COTO Committee Draft 2.1, dated April 2021*.

1.2 Location

The application site is located some 10km to the north-east of the town of Colenso, within the jurisdiction of uThukela District Municipality in the KwaZulu Natal Province.

The application site will generally be bordered by Tugela River to the north.

Figures 1.1 and ***1.2*** depict the site location from regional and local contexts respectively, relative to the surrounding road network.



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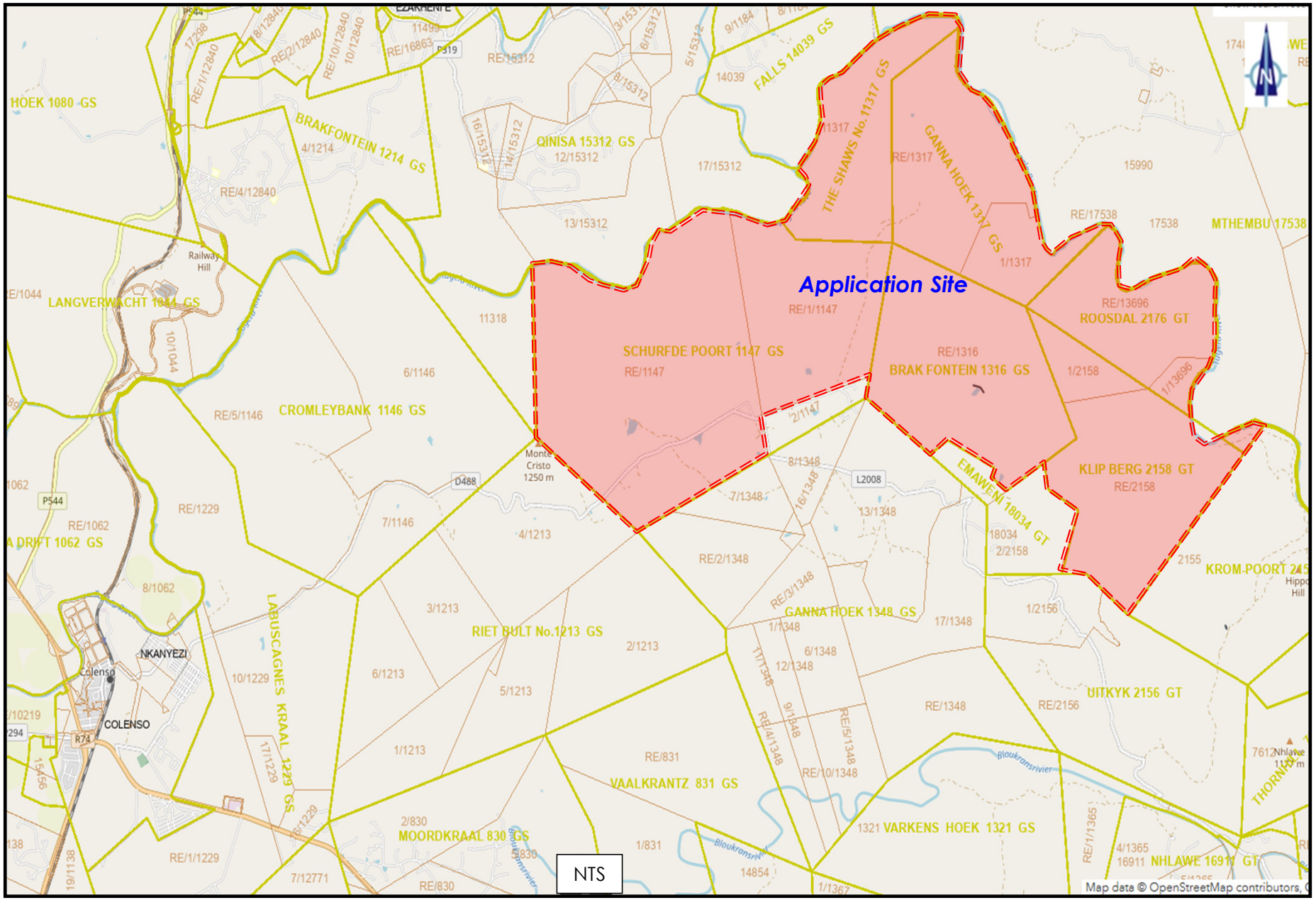
Colenso Coal Mining Development
Application Site Locality Plan – Regional Context

Figure 1.1



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Colenso Coal Mining Development
Application Site Locality Plan – Local Context

Figure 1.2

1.3 Methodology

Methodology of this TIA includes the following:

- ✓ Site visit for visual inspection and obtain road geometry.
- ✓ Liaison with road authorities to obtain the necessary information relevant to the TIA.
- ✓ Consider relevant road authority road network planning (if any).
- ✓ Traffic surveys / counts at relevant intersection/s.
- ✓ Development trip generation estimate calculations.
- ✓ Capacity analyses for the relevant peak periods (as appropriate).
- ✓ Preparation of conceptual access intersection layout plan.
- ✓ Assess development traffic impact on the receiving environment.
- ✓ Non-motorised and public transport assessment as necessary.
- ✓ Report on the findings, conclusions and recommendations.

2 DATA COLLECTION

2.1 Study Area & Traffic Surveys

Traffic surveys were conducted at an intersection considered to be *key* for the purpose of this study, along the R74 (P12-3) during a typical weekday, on the 8th of May 2025.

The location of a key intersection referred to above is shown in **Figure 2.1**.

From the traffic counts undertaken, the peak / busiest hours were found to be as follows;

- Weekday AM peak hour 06:45 – 07:45
- Weekday PM peak hour 16:45 – 17:45

The existing 2025 weekday AM and PM peak hour traffic volumes at the counted intersection are summarised in **Figure 2.2.**

Annexure A contains detailed traffic surveys data.

2.2 Latent Right Development

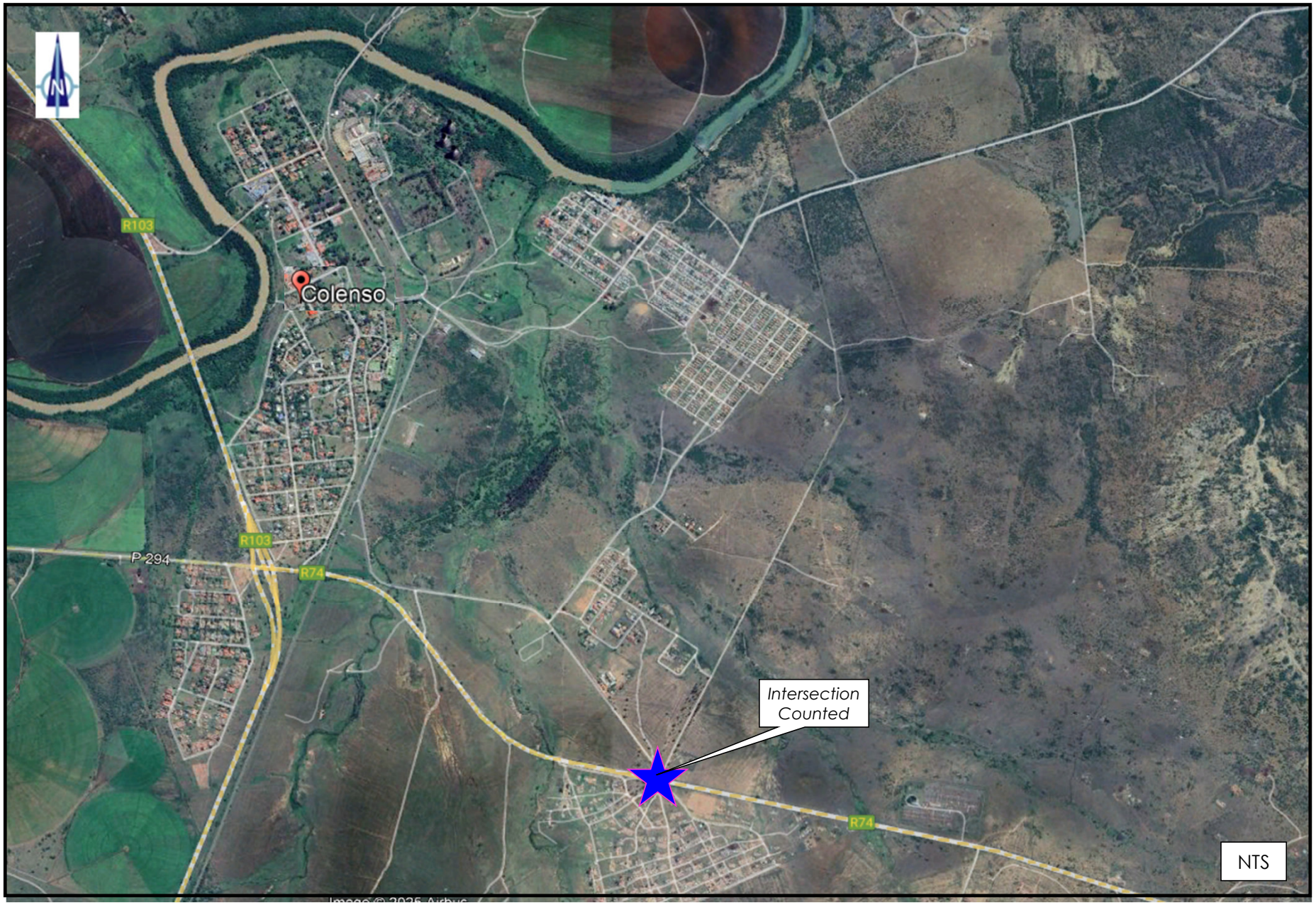
The latent right development considered in this study is the proposed power station to be situated on Portion 1 of the Farm Schurfdepoort 1147, within the immediate vicinity of the application site.

The proposed coal mine development being dealt with in this study is aimed at fulfilling the coal supply requirements of the proposed power station.

A traffic impact assessment [5] carried out in support of the proposed power station on Portion 1 of the Farm Schurfdepoort 1147 was carried out by Sturgeon Consulting in the year 2015.

2.3 Intersections Geometry

The status quo intersection geometric configuration obtained from the field has been used for the capacity analysis's purpose.



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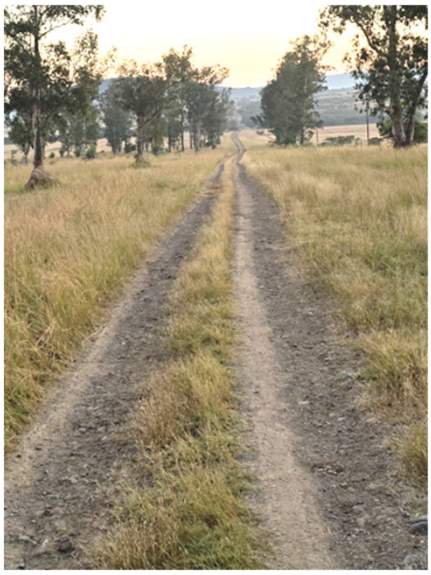
Colenso Coal Mining Development
Traffic Count Station

Figure 2.1



Informal Gravel Road

Forbes Road Extension

R74 (P12-3)

(1) 2
(46) 40
(5) 5

(1) 8
(1) 6
(1) 3

0 (2)
7 (1)
3 (7)

11 (2)
25 (41)
0 (1)

Traffic Volume Legend:
52 → AM Peak Hour (06:45 – 07:45)
(52) → PM Peak Hour (16:45 – 17:45)

NTS

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Colenso Coal Mining Development

Existing 2025 Peak Hour Traffic Demand

Figure 2.2

3 TRANSPORTATION SYSTEM NETWORK

3.1 General

The proposed mining development is fairly surrounded by several transportation infrastructure network as can be seen in ***Figure 1.1.*** The key transportation infrastructure considered applicable to the application site fall within various jurisdictions, as briefly described in the subsections to follow.

3.2 National Roads

The roads forming part of the South African National Roads Agency Limited (SANRAL) in the surrounding area include the following,

- ✓ *N3: →* This national road is a principal arterial road in the area located some 25km to the south-west of the application site. It is a dual carriageway road comprising two traffic lanes per direction in the vicinity of the application site. The road connects to the R74 (P12-3) and P294 which then link to the town of Colenso.

- ✓ *P544: →* Further to the north towards Ezakheni Township and Ladysmith, this 2-lane surfaced road becomes the P325. The road connects to the R103 (P1-10) near Colenso, and it runs in a north-to-south direction, some 10km to the west of the application site. This road may be classified as a typical Class 3 minor arterial road.

3.3 Provincial Roads

The key roads falling with the jurisdiction of KwaZulu Natal Provincial Road Network include the following in the surrounding area; namely,

- ✓ *P294: →* To the west of R103 (P1-10), the R74 (P12-3) is known as P294. This is a single carriageway road comprising one surfaced traffic lane per direction in the immediate vicinity of Colenso, then remained unsurfaced further towards the N3, which is located some 15km to the west of Colenso. This road may be classified as a typical Class 3 minor arterial road in the province.

- ✓ *R103 (P1-10): →* This road runs almost parallel to the N3 and it is located some 11km away from the application site. It is also a single carriageway road comprising one surfaced traffic lane per direction past Colenso. The road forms a diamond access interchange with the R74 (P12-3) and P294 in the immediate vicinity of Colenso.

The R103 (P1-10) in the vicinity of Colenso, functions as a Class 2 major arterial road linking to the N3; a Class 1 principal arterial road located some 20km to the south of Colenso.

- ✓ *R74 (P12-3): →* To the east of R103 (P1-10), the P294 is known as the R74 (P12-3); a single carriageway road comprising one surfaced traffic lane per direction past the town of Colenso. This road is located some 10km to the south of the application site and it connects to the R103 (P1-10) in the form of an access diamond interchange. The road falls within jurisdiction of the province and it functions as a Class 3 minor arterial road in the vicinity of Colenso. The road currently carries relatively low traffic volumes of between 75 and 105 vehicles (total both directions) per hour during the critical weekday morning (AM) and afternoon (PM) peak hours in the vicinity of ML Sultan Colenso Primary School.

3.4 Municipal Roads

The following are considered the key municipal roads infrastructure in the surrounding area; namely,

- ✓ *D488: →* This is an unsurfaced road connecting the application site to Inkanyezi Residential Area and the town of Colenso. The road falls within the jurisdiction of uThukela District Municipality. It is an important road that will be serving the application site from accessibility point of view.

- ✓ *Forbes Road Extension: →* This is an informal unsurfaced road forming the southern boundary of ML Sultan Colenso Primary School. The road stretches from a point where Forbes Road interests with Peacock Road and connects informally with the R74 (P12-3), a provincial road described above, at a point 28°45'33.52 S 29°50'21.81 E.

  As part of providing accessibility to the application site, it will be required to formalise connection of this road to the R74 (P12-3) as shown conceptually in ***Annexure B***.

  This road falls within the jurisdiction of Inkosi Langalibalele Local Municipality.

3.5 Transnet Infrastructure

A railway line infrastructure forming the eastern boundary of Colenso Town exists, and it is located some 10km to the west of the application site. This line comprises a supplementary train station in the immediate vicinity of Eskom Colenso Warehouse and the CBD.

4 PROPOSED DEVELOPMENT & ACCESSIBILITY

4.1 Proposed Development

The proposed development is a coal mining type of development, and it will be situated on various farm portions to the northeast of Colenso, KwaZulu Natal; namely,

- ✓ Remainder of Portion 1 & Remainder of The Farm Schurfde Poort 1147 GS
- ✓ The Farm Shaws No.11317 GS
- ✓ Portion 1 & Remainder of The Farm Ganna Hoek 1317 GS
- ✓ Portion 1 & Remainder of The Farm Klip Berg 2158 GT
- ✓ The Farm Brakfontein 1316 GS
- ✓ Portions 1, 2 & Remainder of The Farm Ramak 13696 GT

The proposed mining area measures approximately 6 333, 2240 hectares in extent.

The envisaged annual coal production is estimated at 1 200 000 tonnages, with a monthly target of approximately 100 000 tonnages.

The proposed coal mining development is aimed at supplying all the coal mined, solely to Colenso 1050 MW Coal Fired Power Station, planned within the application site, on Portion 1 of the Farm Schurfdepoort 1147. Considering location of the proposed mining site relative to the envisaged coal destination, all the coal mined will be transported to the power station by means of conveyer belts. It is therefore concluded that the mining operations would not contribute coal haulage truck trips on the external transportation system.

The proposed coal mining development will consist of two key phases; namely, the *construction phase* as well as the *operational phase* as briefly described in the next subsections.

4.2 Construction Phase

The following activity assumptions are made in respect of the construction phase of the proposed coal mine development.

- ✓ Total number of construction workers is no more than 300, inclusive of labour workforce and staff personnel.
- ✓ Up to 80% of construction workers would commute using public transport or transport provided by the employer (staff transport), which is assumed to have a vehicle occupancy of 14 passenger seats per vehicle.
- ✓ The latter 20% would commute using personal private transport which is assumed to have an average vehicle occupancy of 1.5 occupants per vehicle.
- ✓ The peak hour development traffic directional split percentage as follows,

- Inbound / outbound in the morning (AM) = 80% / 20%.
- Inbound / outbound in the afternoon (PM) = 20% / 80%.

✓ Construction and delivery vehicles will travel to and from the application site in daily basis throughout the day as and when required.

✓ The construction phase duration is estimated at only 12 months.

4.3 Operational Phase

The following activity assumptions are made in respect of the operational phase of the proposed coal mining development.

✓ A total number of workers entailing both the labour workforce and the staff personnel is estimated at only 67.

✓ Annual coal production is aimed at approximately 1 200 000 tonnages.

✓ Monthly coal production is aimed at approximately 100 000 tonnages.

✓ All the coal mined will be transported via conveyor belts to its destination (power station in the immediate vicinity).

✓ Up to 70% of the labour workforce would commute using public transport or transport provided by the employer (staff transport), which is assumed to have a vehicle occupancy of 14 passenger seats per vehicle.

✓ The latter 30% would commute using personal private transport which is assumed to have an average vehicle occupancy of 1.2 occupants per vehicle.

✓ The peak hour development traffic directional split percentage as follows,

- Inbound / outbound in the morning (AM) = 80% / 20%.
- Inbound / outbound in the afternoon (PM) = 20% / 80%.

✓ Delivery vehicles will travel to and from the site in daily basis throughout the day as and when required.

✓ The operational phase life span of the proposed mining development is estimated at 30 years plus.

4.4 Site Accessibility Investigations

4.4.1 General

Considering location of the proposed development relative to the existing transportation infrastructure network, various accessibility options have been investigated in this study.

The application site is bounded by Tugela River to the north, and there are no existing roads connecting the site area to areas to the north of Tugela River.

Accessibility to the application site will be via D488. A point was identified along D488 (viz: 28°44'7.26"S 29°50'43.62"E); namely, *Point B*, from which accessibility to the surrounding area will be investigated as described in the subsubsections to follow,

4.4.2 Alternative 1 Accessibility

The first accessibility option is shown in ***Figure 4.1,*** a route stretching between the R103 (P1-10) to Point B on D488, via a surfaced road crossing over a narrow steel bridge allowing one directional movement at a time: namely, Bulwer Bridge and links to Sir Geroge Street in Colenso.

The route then runs through Colenso CBD as can be seen in ***Figure 4.1***, then into and through Inkanyezi Township via surfaced and unsurfaced streets.

4.4.3 Alternative 2 Accessibility

This option is shown in ***Figure 4.2,*** a route stretching between the R74 (P12-3) to Point B on D488, via residential streets through Colenso residential area. The route travels further in the north-east direction as can be seen in ***Figure 4.2***, then into and through Inkanyezi Township via surfaced and unsurfaced streets.

4.4.4 Alternative 3a Accessibility

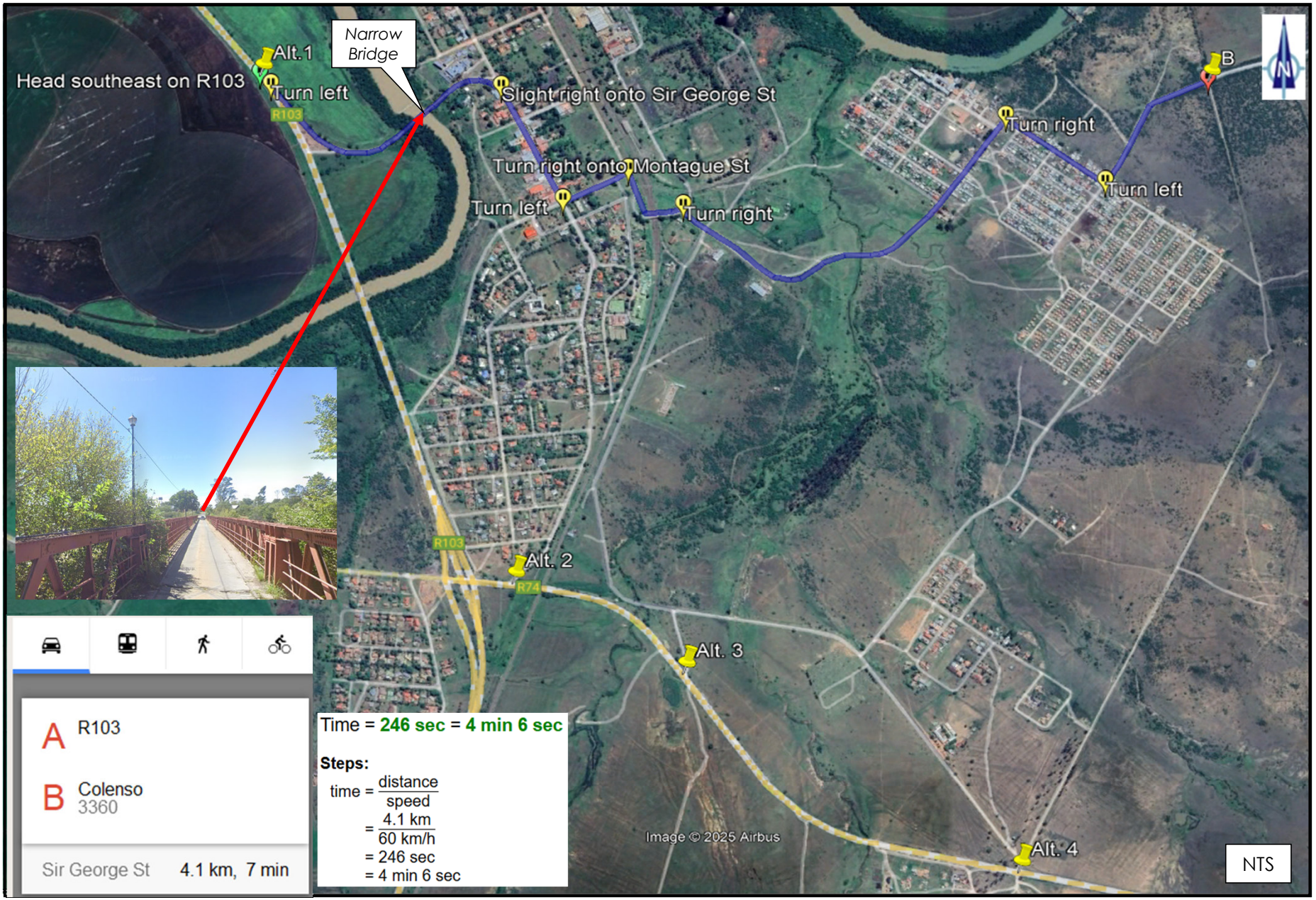
This alternative is shown in ***Figure 4.3a*** and it entails connection of the R74 (P12-3) to Forbes Road, then via a gravel road running in the north-to-south direction, parallel to and to the east of a railway line. The route then leads to Inkanyezi Township via surfaced and unsurfaced residential streets before reaching Point B on D488.

4.4.5 Alternative 3b Accessibility

Figure 4.3b depicts an accessibility alternative showing another route stretching also from the R74 (P12-3) to Point B on D488. The route entails connection of the R74 (P12-3) via Forbes Road, running in the north-to-south direction to the east of Colenso CBD, through Inkanyezi Township via surfaced and unsurfaced residential streets.

4.4.6 Alternative 4 Accessibility

The fourth accessibility alternative has also been identified as can be seen in ***Figure 4.4***. This alternative entails construction of a new and direct Class 4 access road linking the R74 (P12-3) to Point B on D488. The proposed Class 4 access road will formally intersect with the R74 (P12-3) to the south and D488 to the north as shown conceptually on a drawing appended in ***Annexure A*** of this study.



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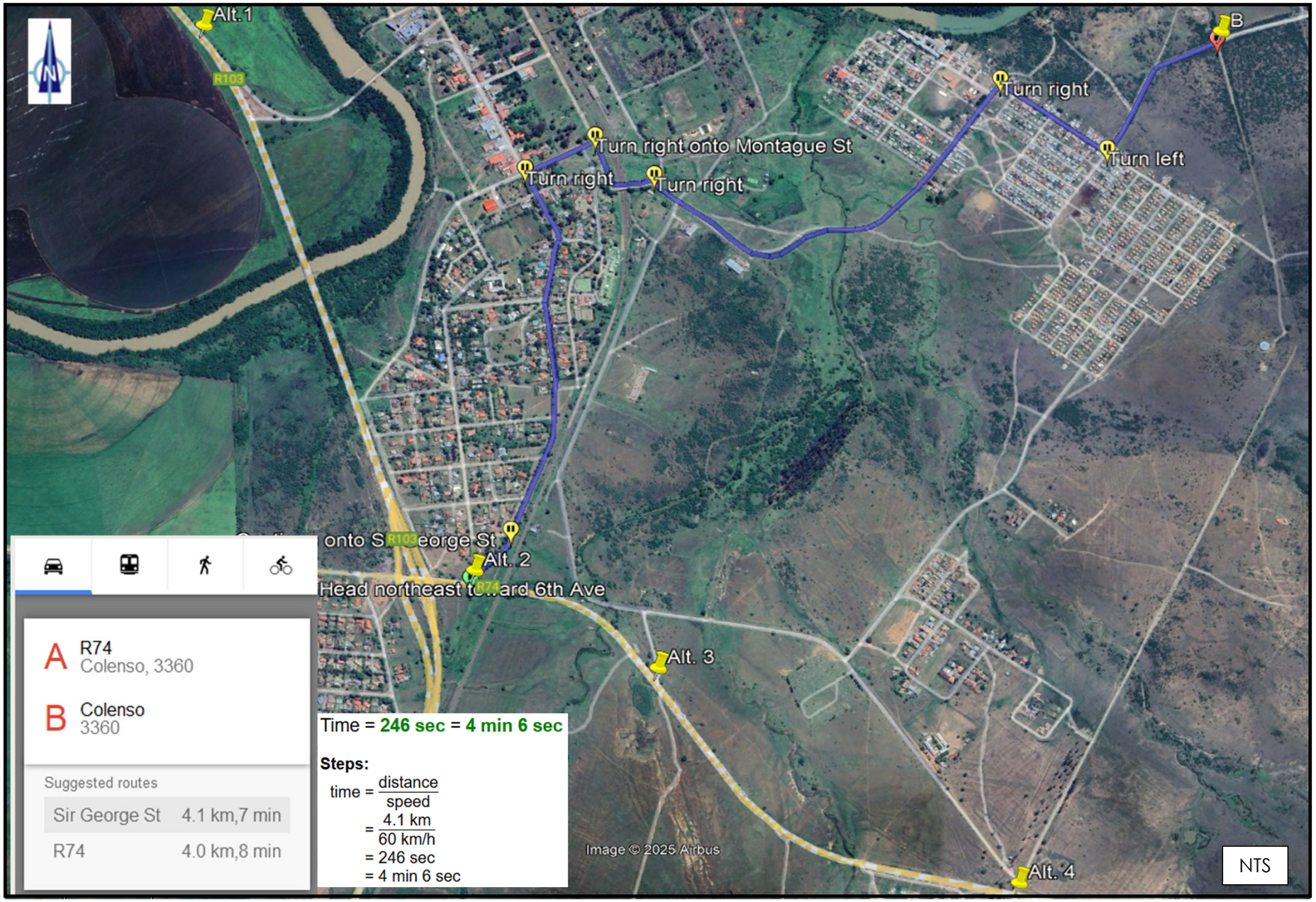
Colenso Coal Mining Development

Alternative 1 Route Alignment & Travel Time

Figure 4.1



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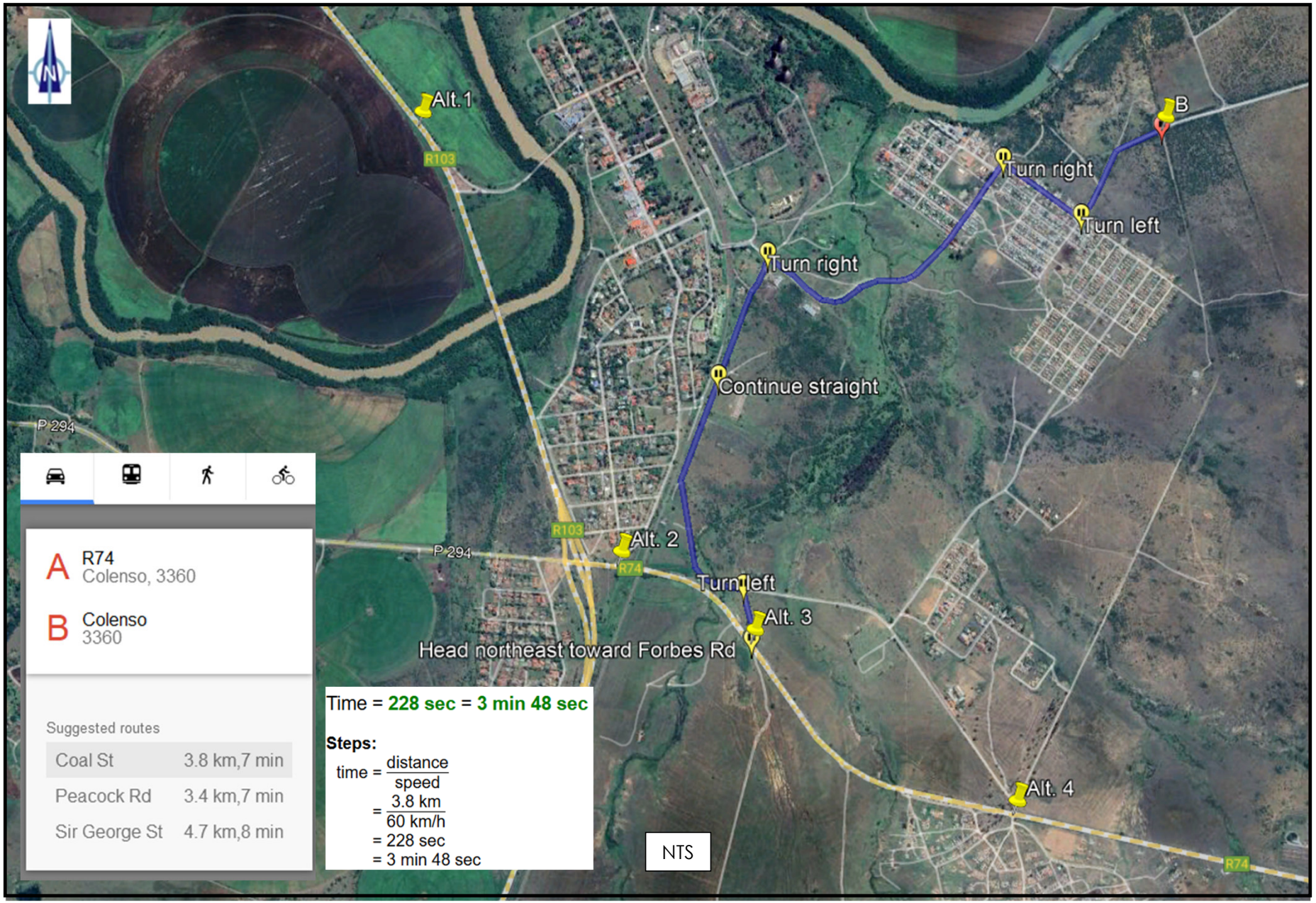
Alternative 2 Route Alignment & Travel Time

Figure 4.2



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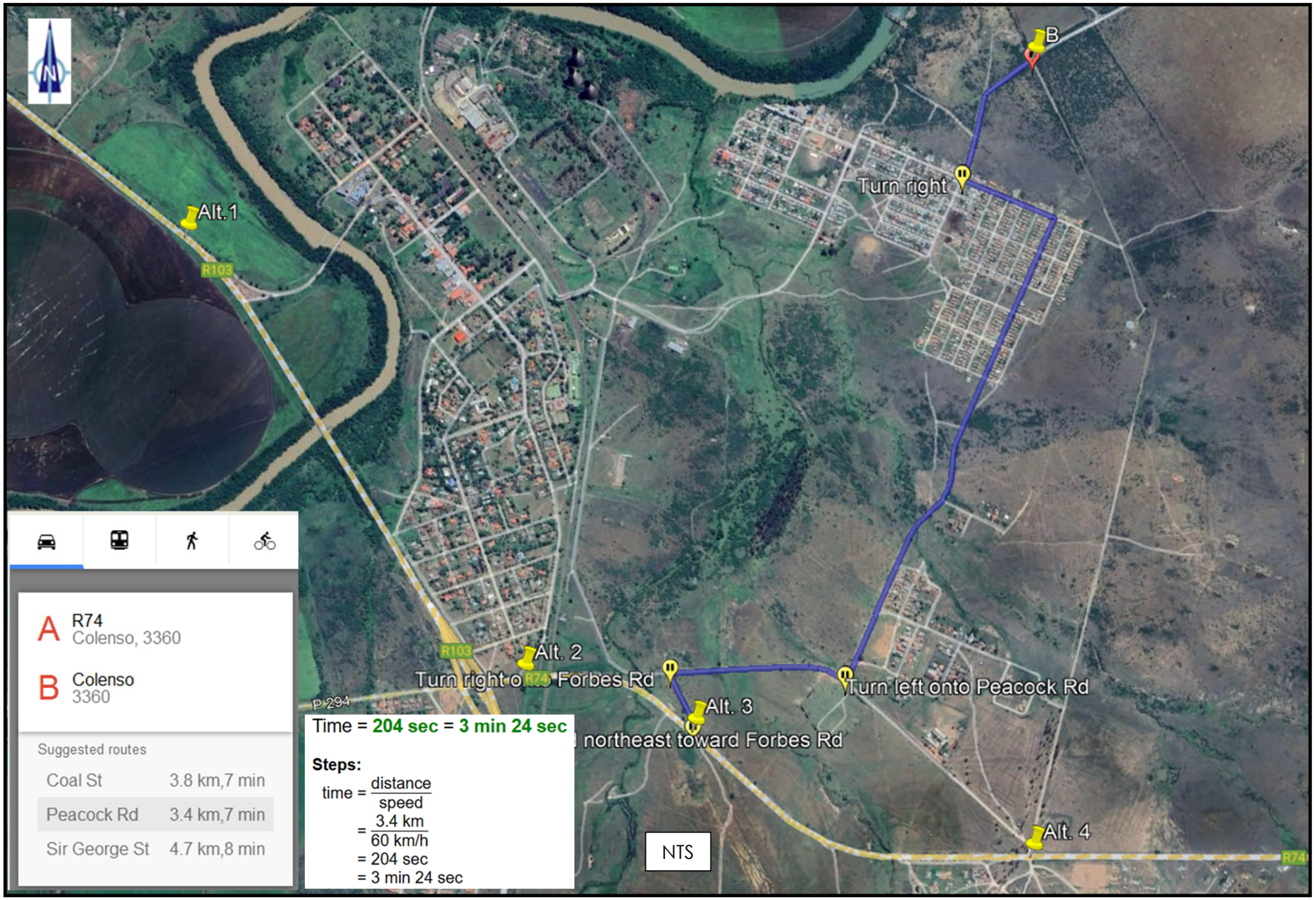
Colenso Coal Mining Development

Alternative 3a Route Alignment & Travel Time

Figure 4.3a



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Alternative 3b Route Alignment & Travel Time

Figure 4.3b

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Alternative 4 Route Alignment & Travel Time

Figure 4.4

4.5 Preferred Site Accessibility Alternative

4.5.1 Assessment Of Alternatives Identified

Accessibility alternatives via ***existing*** transportation system through Colenso (i.e. Alternatives 1 to 3) have various pros and cons including and not necessarily limited to the following; namely,

- ✓ Pros
  - The use of readily available transportation infrastructure network.
- ✓ Cons
  - Longer travel time and travel distances from main roads such as the R103 (P1-10) and R74 (P12-3) which in turn result in the increased average delays.
  - Additional traffic load to the existing transportation infrastructure network within and around Colenso.
  - Unwanted rat running throughout Colenso CBD, residential areas and Inkanyezi Township.
  - Increased deterioration of the existing transportation infrastructure system resulting from additional traffic load resulting from the discouraged rat running.
  - Unwanted through traffic with no origin or destination within or near the streets in Colenso, and thus impact negatively to the receiving environment.
  - Unwanted mix of residential and heavy vehicles traffic in the built-up areas.
  - Unwanted heavy vehicles (deliveries, abnormal and construction) traffic through the built-up areas.
  - Indirect accessibility coupled to the general negative impact to the receiving environment.

Accessibility alternative via the ***newly proposed*** transportation system also has various pros and cons including and not necessarily limited to the following; namely,

- ✓ Pros
  - Shorter travel time and travel distances from main roads such as the R103 (P1-10) and R74 (P12-3), which yield the best possible minimum average delays.
  - No additional unnecessary traffic loading on the existing transportation infrastructure network in and around Colenso.
  - No contribution towards unwanted rat running throughout Colenso CBD, residential areas and Inkanyezi Township.

- No through traffic originating or ending within or near Colenso streets and thus no negative impact to the environment.
- No contribution towards increased deterioration of the existing transportation infrastructure system in and around Colenso.
- No contribution towards unwanted rat running throughout Colenso CBD, residential areas and Inkanyezi Township.
- The newly proposed road link promotes separation of residential traffic from heavy vehicles (deliveries, abnormal and construction) traffic in and through the built-up areas.
- A more direct site accessibility coupled to the minimal negative impact onto the receiving environment.

✓ Cons

- Initial costs resulting from construction of the required Class 4 road link.

4.5.2 Conclusion

It is concluded that Alternative 4; namely, construction of a newly proposed Class 4 road link has *more advantages* than other alternatives and it is thus considered a *preferred alternative*.

5 DEVELOPMENT TRIP GENERATION ESTIMATES

5.1 Construction Phase Trip Generation Estimates

The *South African Trip Data Manual (TMH 17 – Committee Draft 2.3 Dated May 2021)* has been used as a guideline to determine the estimated peak hour development trip generation.

The following parameters as detailed in Sub-section 4.2 have been used in the trip generation calculations;

- ✓ Total number of construction workers = 300
- ✓ Labour workforce commuting by public / staff transport = 80%
- ✓ Staff personnel commuting by own / private transport = 20%
- ✓ Public / staff transport vehicle occupancy = 14-seater
- ✓ Own / private transport vehicle occupancy = 1.5 person
- ✓ Development trip directional split percentage = 80% / 20%

It estimated that the construction phase could generate up to 57 per hour trips during the critical weekday morning and afternoon peak periods, as summarised in ***Table 5.1***.

Table 5.1: Summary of Construction Phase Trip Generation

Total Number of Employees = 300	Vehicle Occupancy	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Public / Staff Transport (80% = 240)	14-seater	14	3	17	3	14	17
Staff Personnel (20% = 60)	1.5 person	32	8	40	8	32	40
Total Trips Generated		***46***	***11***	***57***	***11***	***46***	***57***

5.2 Operational Phase Trip Generation Estimates

The following parameters as detailed in Sub-section 4.3 have been used in the trip generation calculations;

- ✓ Total number of construction workers = 67
- ✓ Labour workforce commuting by public / staff transport = 70%
- ✓ Staff personnel commuting by own / private transport = 30%
- ✓ Public / staff transport vehicle occupancy = 14-seater
- ✓ Own / private transport vehicle occupancy = 1.2 person
- ✓ Development trip directional split percentage = 80% / 20%

It estimated that the operational phase could generate up to 23 per hour trips during the critical weekday morning and afternoon peak periods, as summarised in ***Table 5.2***.

Table 5.2: Summary of Operational Phase Trip Generation

Total Number of Employees = 76	Vehicle Occupancy	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Public / Staff Transport (70% = 53)	14-seater	3	1	4	1	3	4
Staff Personnel (30% = 23)	1.2 person	15	4	19	4	15	19
Total Trips Generated		***18***	***5***	***23***	***5***	***18***	***23***

5.3 Latent Rights Trip Generation Estimates

The information pertaining to trip generation estimation by the proposed power station as contained in the traffic impact assessment [5] conducted by Sturgeon Consulting in August 2015 has been considered.

The study referred to above concluded that a total of up to 154 vehicle trips *per day* could be generated by the proposed power station. As a worst-case scenario, this could translate to a total of 77 peak hour trips when split into two peak hours of a day – see ***Table 5.3***. This is considered the *most conservative* trip generation estimate scenario for the purpose of this study. A directional split percentage of 25% / 75% is deemed appropriate.

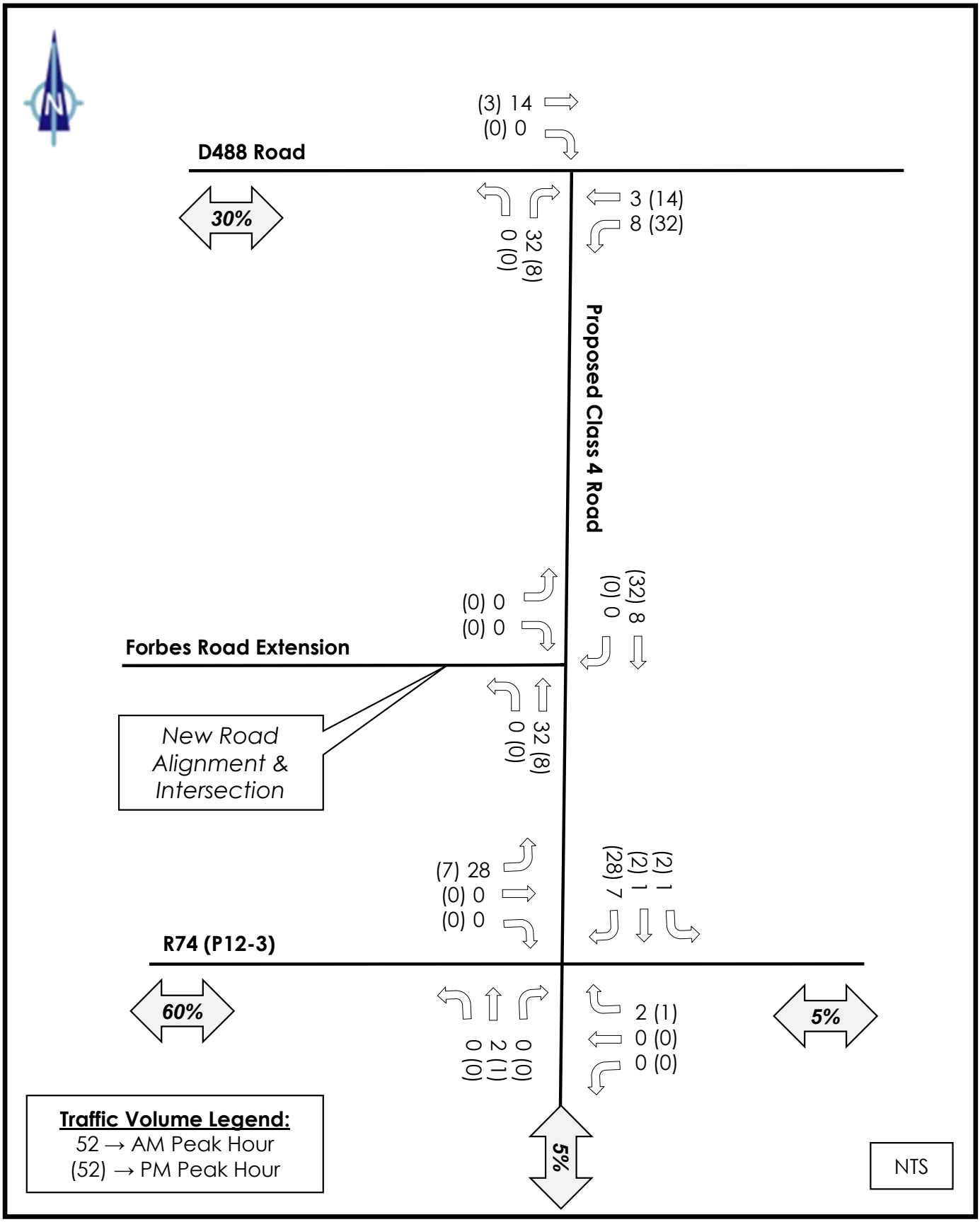
Table 5.3: Summary of Latent Rights Trip Generation

Power Station Trip Estimates	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Total Trips Generated	***58***	***19***	***77***	***19***	***58***	***77***

5.4 Development Trip Distribution & Assignment

Assumptions on the expected trip distribution and assignment were based on the type of development proposed, anticipated origins and destinations of the trips relative to the site accessibility and location, in respect of the surrounding road network, as well as the background traffic volumes and patterns in the surrounding area.

Figure 5.1 depicts summary of the trip distribution and assignment estimates for both the application site (viz; construction phase, a worst-case scenario) and the latent right development (viz; the proposed power station).



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Development Trip Distribution & Assignment Estimates

Figure 5.1

6 FUTURE TRAFFIC DEMAND

6.1 Traffic Growth

The background traffic growth rate has been estimated in accordance with the guidelines of the following documents;

- ✓ *TMH 16 Volume 2 (South African Traffic Impact and Site Impact Assessment Standards and Requirements Manual), COTO, Version 1 dated August 2012*
- ✓ *TMH 17 (South African Trip Data Manual), COTO, Draft 2.3 dated May 2021*

The growth in the background traffic may be expected to be less than 3% per annum.

As a worst-case scenario for the purpose of this study, a 3% traffic growth rate has been used to cater for other unforeseen background traffic growth due to potential other latent rights developments in the area.

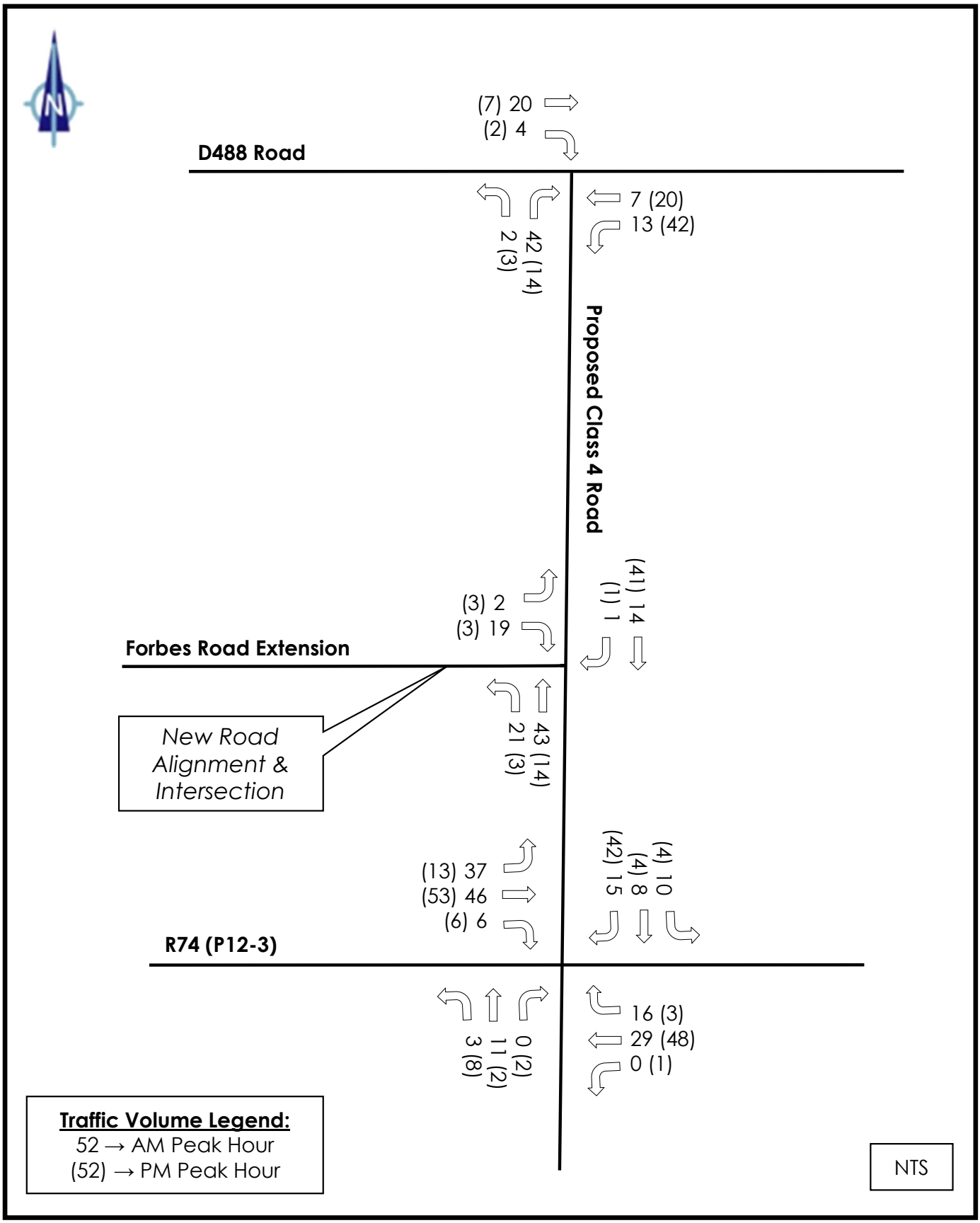
6.2 Traffic Attraction

It is expected that the newly proposed Class 4 access road facility has potential to attract and draw some of the traffic in the vicinity, that is currently using other roads to join the R74 (P12-3).

Figure 6.1 depicts the estimated total future 2030 background peak hour traffic demand, which comprises growth in the background traffic, latent trips as well as the potential trips to be attracted.

6.3 Total Future Traffic Demand

Figure 6.2 depicts the estimated total future 2030 peak hour traffic demand which comprises the total background traffic flows as per ***Figure 6.1*** plus the anticipated application site trip generation.



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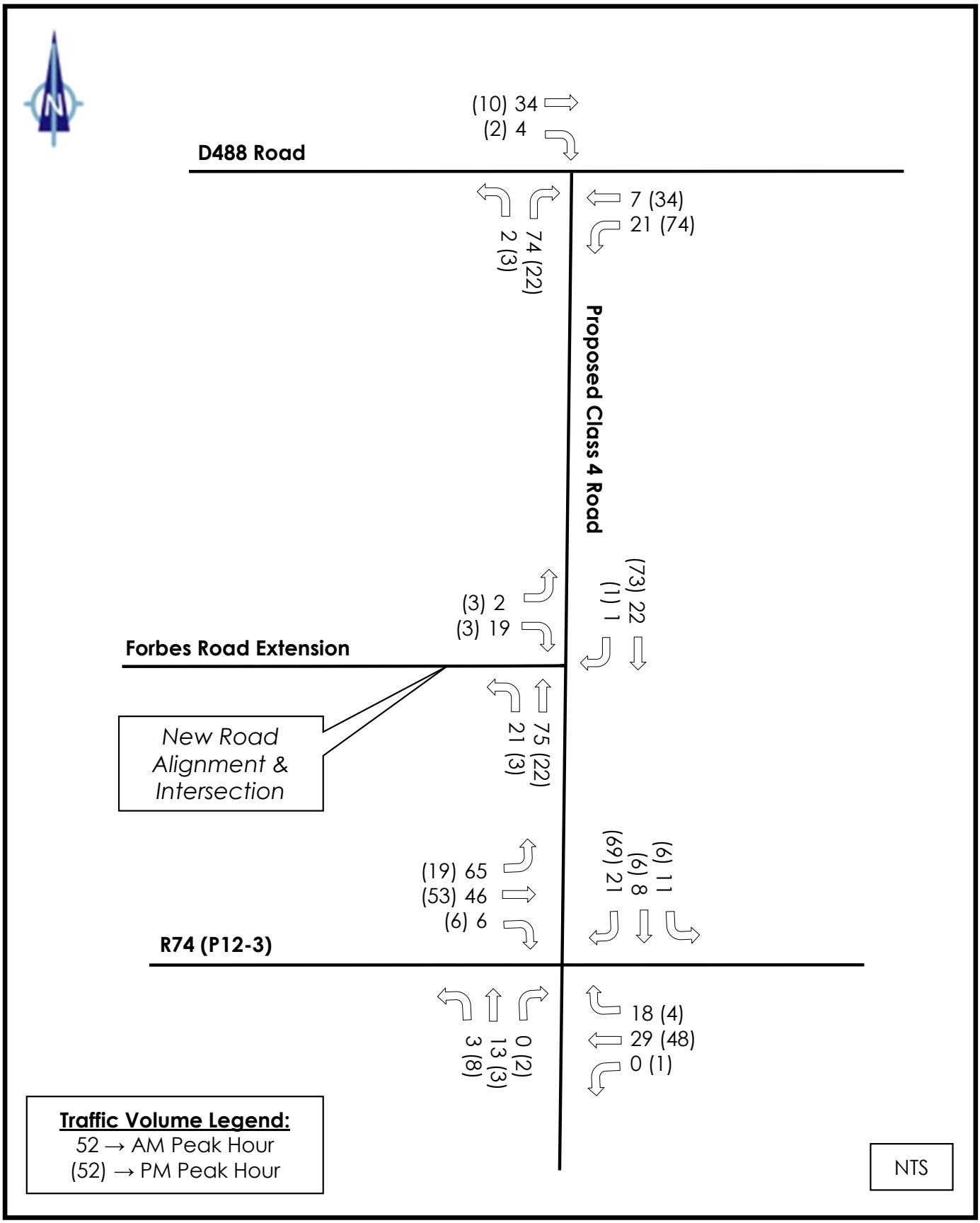
Colenso Coal Mining Development

Estimated Future 2030 Background Peak Hour Traffic Demand (Incl. Latent Rights)

Figure 6.1



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Colenso Coal Mining Development

Estimated Total Future 2030 Peak Hour Traffic Demand

Figure 6.2

7 DEFINITIONS RELEVANT TO CAPACITY ANALYSIS

The following definitions from the 2000 Highway Capacity Manual are used in this report. A revised LOS method for vehicles were introduced in HCM 2010 (TRB 2010). It offers an important variation on the Delay (HCM 2000) method in using both the average control delay and the v/c (demand volume / capacity) ratio, or degree of saturation for LOS determination.

Capacity → The maximum hourly rate at which vehicles can reasonably be expected to traverse a lane or roadway during a given period under prevailing traffic and control conditions.

Volume → The hourly rate of vehicle arrivals at an intersection.

Volume to capacity ratio (v/c) → Is the ratio of volume to capacity.

Level of service (LOS) → Level of service is defined in terms of delay. Delay is a measure of driver discomfort, frustration, fuel consumption and lost travel time. The levels of service for signalised and un-signalised intersections as defined in the Highway Capacity Manual are tabulated in **Table 7.1** below.

Table 7.1: Delay & v/c (HCM 2010) definitions for LOS Based on delay and v/c ratio

Level of Service for **v/c≤1.0**	Rating	Average delay per vehicle in seconds (d)			Level of Service for for **v/c>1.0**
		Signals	"SIDRA Roundabout LOS" option	Priority Control *(HCM2010 default for roundabouts)*	All Intersection Types
A	Excellent	d ≤ 10	d ≤ 10	d ≤ 10	**F**
B	Very Good	10 < d ≤ 20	10 < d ≤ 20	10 < d ≤ 15	**F**
C	Good	20 < d ≤ 35	20 < d ≤ 35	15 < d ≤ 25	**F**
D	Acceptable	35 < d ≤ **55**	35 < d ≤ **50**	25 < d ≤ **35**	**F**
E	Poor	**55** < d ≤ 80	**50** < d ≤ 70	**35** < d ≤ 50	**F**
F	Very Poor	80 < d	70 < d	50 < d	**F**

Note: v/c (demand volume / capacity) ratio, or degree of saturation: v/c > 1.0 represents oversaturated conditions.

An intersection is deemed to be operating acceptably at levels of service A to D. If an intersection operates at a level of service E or F or has a volume to capacity ratio higher than 0.95 the intersection is considered to be operating at capacity.

8 TRAFFIC IMPACT & CAPACITY ANALYSES

8.1 General

In order to determine the expected traffic impact of the proposed development at the key intersections within the study area, the capacity analyses were carried out using ***Automated Junction Traffic Analysis (AutoJ)*** software program developed by Dr John Sampson**.** The following key intersections were analysed:

- ✓ R74 (P12-3) / Proposed Class 4 Access Road
- ✓ Proposed Class 4 Road / D488 Road
- ✓ Proposed Class 4 Road / Forbes Road Extension

The most critical traffic scenario was analysed; namely, estimated total future 2030 peak hour traffic demand - as per ***Figure 6.2***.

8.2 Intersections` Capacity Analyses Results Interpretation

AutoJ Capacity Analyses Results provide the intersection individual movement approach v/c, average delay, average queue length (vehicles), auxiliary lane length requirements as well as the traffic signal phasing summary where applicable.

Tables 8.1 to ***8.3*** interpret the capacity analyses results of all the intersections analysed, with the detailed AutoJ capacity analyses results appended in ***Annexure C.***

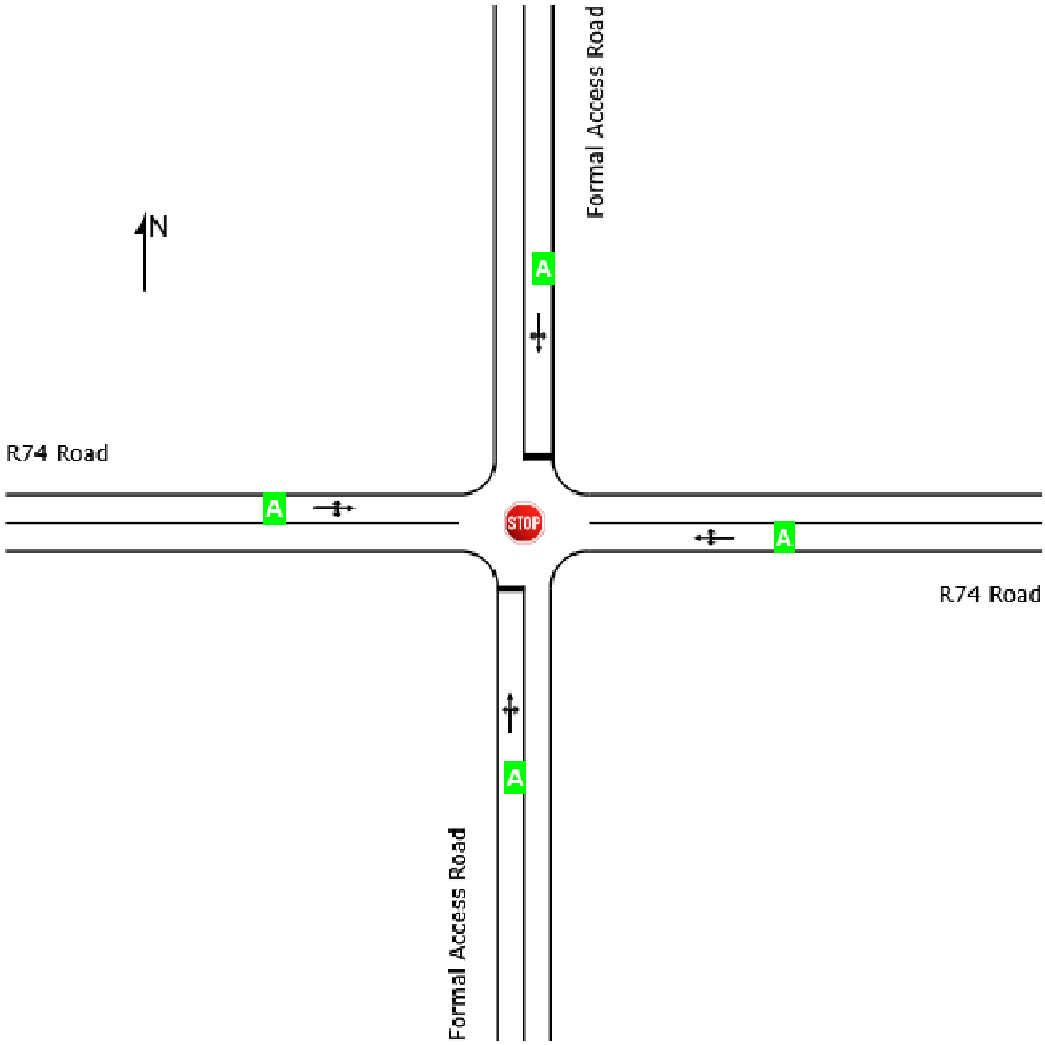
8.3 Bulk Services Contributions

It is recommended that any bulk services contributions payable in respect of this application (if applicable), be offset against provision of additional transportation infrastructure and/or non-motorised and public transport facilities requirements.

Table 8.1: Performance – R74 (P12-3) / Proposed Class 4 Access Road Intersection

Scenario Analysed	Peak Hour	Overall Traffic Operations		
		LOS	v/c	Delay
Total Future 2030 Peak Hour Traffic Demand	AM	A	0.05	2.00
	PM	A	0.06	4.00

Proposed Intersection Geometric Layout



Concluding Remarks

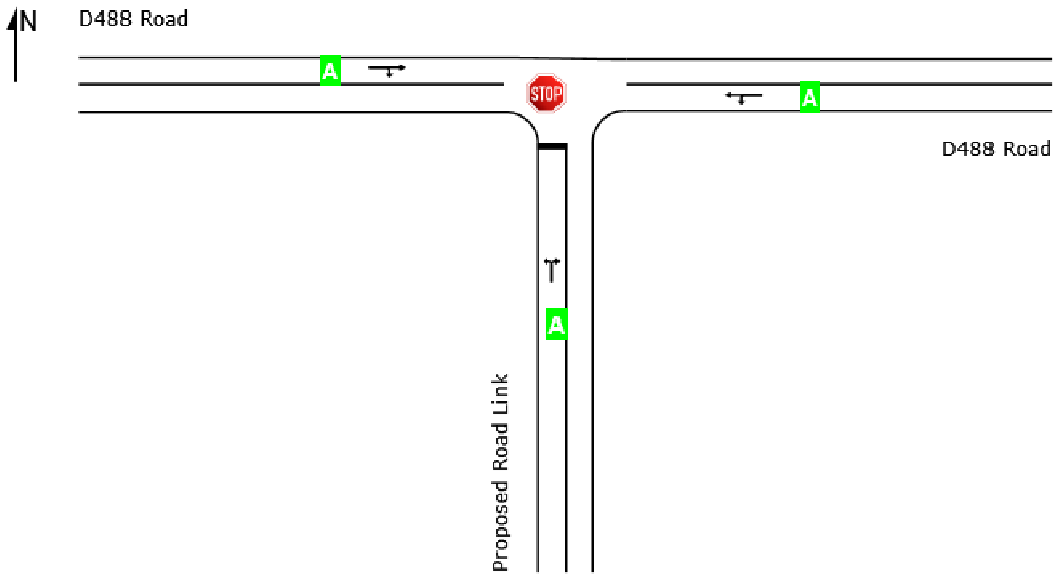
The AutoJ capacity analyses results appended in ***Annexure C1*** indicate that the proposed intersection geometric configuration will operate excellently at overall LOS A with the total future traffic demand.

It must be noted that the current and anticipated total future traffic demand does not warrant provision of exclusive turning lanes at this intersection.

Table 8.2: Performance – Proposed Class 4 Road / D488 Road Intersection

Scenario Analysed	Peak Hour	Overall Traffic Operations		
		LOS	v/c	Delay
Total Future 2030 Peak Hour Traffic Demand	AM	A	0.05	5.00
	PM	A	0.05	2.00

Proposed Intersection Geometric Layout



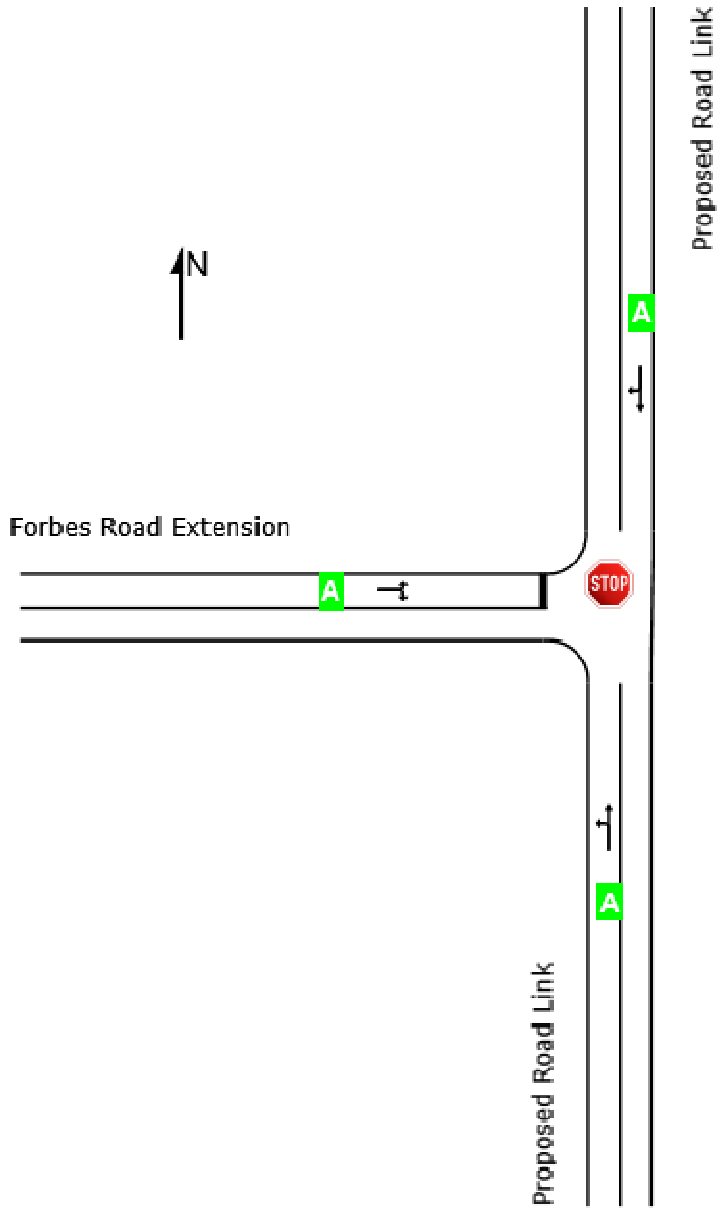
Concluding Remarks

The AutoJ capacity analyses results appended in ***Annexure C2*** indicate that the proposed intersection geometric configuration will operate excellently at overall LOS A with the total future traffic demand.

Table 8.3: Performance – Proposed Class 4 Road / Forbes Road Extension Intersection

Scenario Analysed	Peak Hour	Overall Traffic Operations		
		LOS	v/c	Delay
Total Future 2030 Peak Hour Traffic Demand	AM	A	0.04	1.00
	PM	A	0.03	0.00

Proposed Intersection Geometric Layout



Concluding Remarks

The AutoJ capacity analyses results appended in ***Annexure C3*** indicate that the proposed intersection geometric configuration will operate excellently at overall LOS A with the total future traffic demand.

8.4 Transportation Infrastructure Upgrading & Provision Summary

Annexure B of this study depicts the concept layout plan showing the transportation infrastructure requirements deemed applicable to this application, and can be summarised as follows;

- ✓ Road construction: → Construct a new ±2,9km long Class 4 access road (see also ***Figure 4.4)*** to entail,
    - A surfaced 2-lane Class 4 road is recommended.
    - Adhere to the appropriate road authority design standards.
    - A servitude to be registered as necessary.
    - The road to be included in the municipal road network or planning.
    - The southern end of a surfaced road to terminate with a concrete edge beam.
- ✓ Intersection upgrade → Upgrade the informal intersection on R74 (P12-3) to comprise the following (see also ***Figure 8.1****),*
    - Formalisation of the existing informal intersection at co-ordinates 28°45'33.52 S 29°50'21.81 E.
    - Resurface a section of R74 (P12-3) within the traffic calming area, east and west of the intersection (see ***Figure 8.1***).
    - Repair or reconstruct the existing speed humps and rumble strips (see ***Figure 8.2***).
    - Provide a pair of public transport lay-byes along and on the downstream sides of the R74 (P12-3).
    - Upgrade existing level pedestrian crossing blocks on the R74 (P12-3) approaches to raised pedestrian crossings (see ***Figure 8.3***).
    - Repaint all the road markings as necessary to ensure the intersection safety.
    - Sight distances to conform to the appropriate intersection geometric design standards.
- ✓ New Intersection: → Construct a formal intersection of Forbes Road Extension with the newly proposed Class 4 access road (see also ***Figure 8.4***) as part of site accessibility,
    - Priority controlled intersection at no less than 100m from R74 (P12-3).
    - Forbes Road Extension realigned.
    - First surfaced section of Forbes Road Extension to terminate with a concrete edge beam.
    - Sight distances to conform to the appropriate intersection geometric design standards.

Figure 8.1: A Photograph Showing Current R74 (P12-3) Conditions at the Informal Intersection Co-ordinates 28°45'33.52 S 29°50'21.81 E

Figure 8.2a: A Photograph Showing Current Speed Humps Conditions Along R74 (P12-3) Within Traffic Calming Area

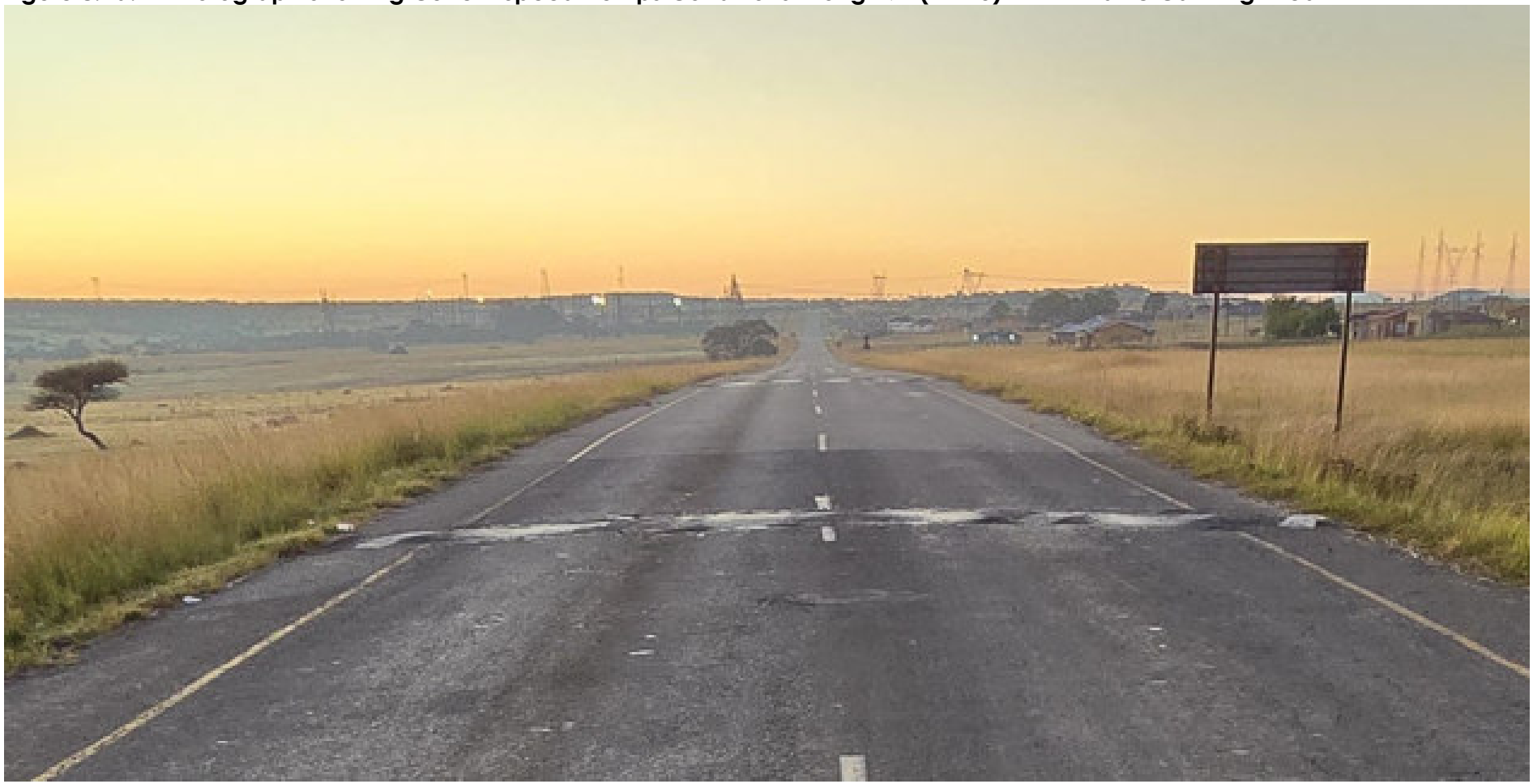
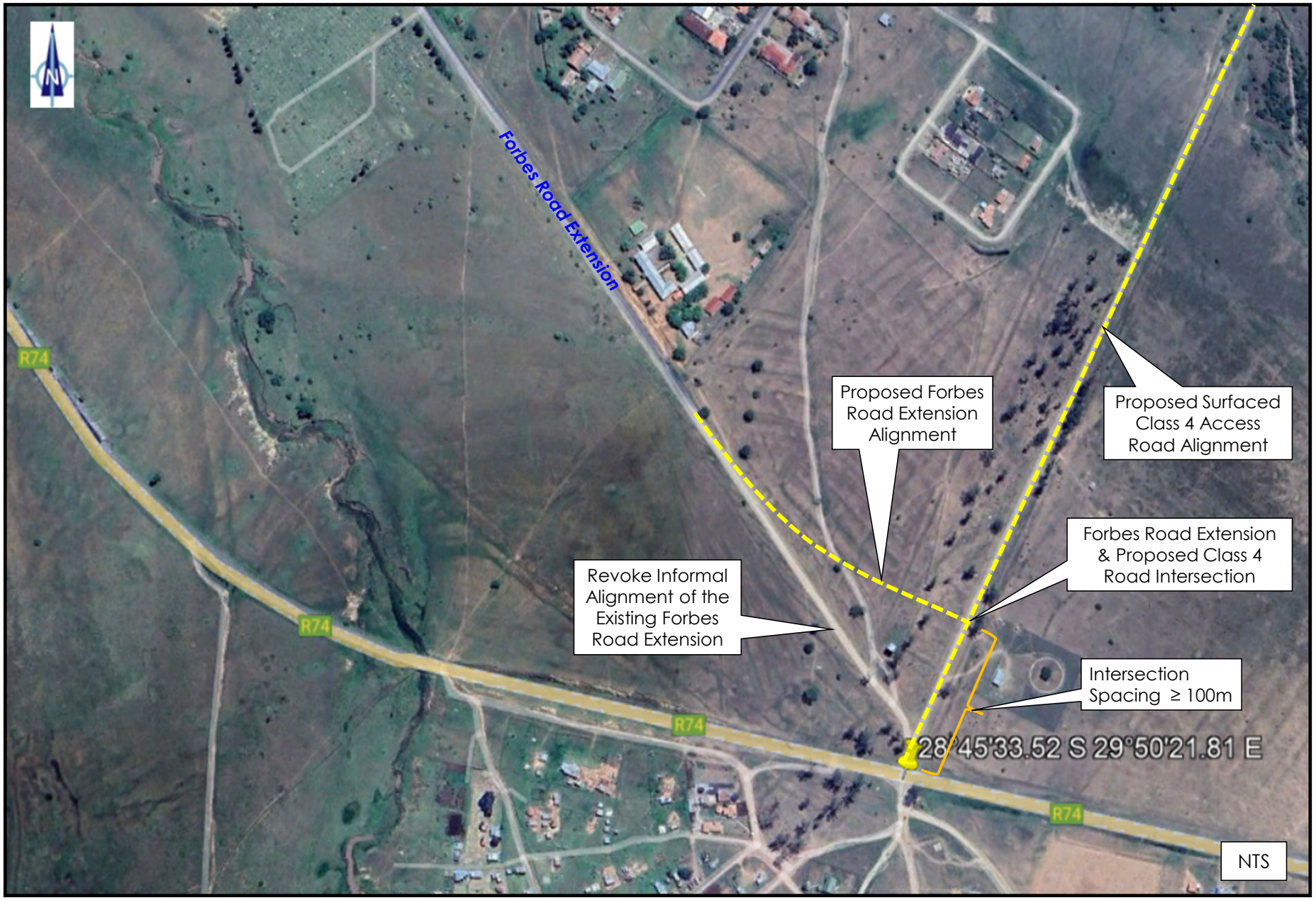


Figure 8.2b: A Photograph Showing Current Rumble Strips Conditions Along R74 (P12-3) Within Traffic Calming Area

Figure 8.3: A Photograph Showing Current Level Pedestrian Crossing Blocks Conditions Along R74 (P12-3) Within Traffic Calming Area



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Colenso Coal Mining Development
Proposed Forbes Road Extension & Class 4 Road Alignment

Figure 8.4

- ✓ New Intersection: → Construct a new intersection of D488 with the newly proposed Class 4 road (see also ***Table 8.3***) to comprise.
  - Priority controlled intersection at co-ordinates 28°44'7.26"S 29°50'43.62"E
  - First surfaced section of D488 to terminate with concrete edge beams if D488 does not get surfaced (see ***Figures 8.5*** to ***8.7***).
  - Sight distances to confirm to the appropriate intersection geometric design standards.
- ✓ Road Upgrading: → Upgrade D488 if necessary (see ***Annexure B)***
  - D488 will provide direct accessibility to the application site and may therefore be either surfaced or left unsurfaced if it gets maintained regularly as required.

Figure 8.5: A Photo Showing Current Conditions of D488 Looking East at the Proposed Intersection Point (28°44'7.26"S 29°50'43.62"E)

Figure 8.6: A Photograph Showing Current Conditions of D488 Looking West at the Proposed Intersection Point (28°44'7.26"S 29°50'43.62"E)

Figure 8.7: A Photo Showing Proposed Road Link from D488 Looking South at the Proposed Intersection Point (28°44'7.26"S 29°50'43.62"E)

9 ENVIRONMENTAL IMPACT IMPLICATIONS

9.1 Nature of Impact

Based on both the construction and operational phases traffic characteristics stated in Sub-sections 5.1 and 5.2 and considering ***Table 9.1*** below, nature of the traffic impact expected is considered "*low-medium*" and thus scores *Rating 2*.

Table 9.1: Nature of The Impact, Description and Rating

Impact Nature	Description	Rating
Low	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are not affected.	1
Low-Medium	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are affected insignificantly.	2
Medium	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are altered.	3
Medium-High	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are severely altered.	4
High	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes will temporarily or permanently cease.	5

9.2 Extent of Impact

Although some of the traffic generated during the construction or operational phases will be destined regionally or even nationally, the impact (as determined by the defined study area) will be concentrated locally.

The traffic influence outside the boundaries of the study area is expected to be insignificant. In terms of ***Table 9.2*** below, extent of the traffic impact expected is considered "*Site*" and thus scores *Rating 2*.

Table 9.2: Extent of The Impact, Description and Rating

Impact Extent	Description	Rating
Local	The impacted area will only extend as far as the activity being conducted, e.g., the activity footprint.	1
Site	Impact occurs within a 20km radius of the site.	2
Regional	Impact occurs within a 100km radius of the site.	3
National	Impact occurs within South Africa.	4

9.3 Duration of Impact

The traffic impact due to the construction phase will only last for the duration of the activity, which is estimated to be 12 months, whilst that of the operational phase will last for the entire operational life span of the project. The life of mine (LOM) is expected to be 30 years plus.

In terms of ***Table 9.3***, duration of the traffic impact expected may be assigned as follow,

- ✓ Construction phase → *"Medium-term"* and thus scores *Rating 2.*
- ✓ Operational phase → *"Long-term"* and thus scores *Rating 3.*

Table 9.3: Duration of The Impact, Description and Rating

Impact Duration	Description	Rating
Short-term	The impact will either disappear with mitigation or will be mitigated through the natural processes in shorter time span.	1
Medium-term	The impact will last up to the end of the project phases, where after it will be negated. The impact will cease within 5 years if the activity is stopped.	2
Long-term	The impact will last for the entire operational phase and after the operational life of the operation but will be mitigated by direct human action or by natural processes thereafter.	3
Permanent	Intervention will not occur in such a way or in such a time span that the impact can be considered transient.	4

9.4 Frequency of the Occurrence of The Impact

Traffic will be generated in daily basis during both the construction and operational phases.

In terms of ***Table 9.4*** below, frequency of the occurrence of the traffic impact expected is considered *"Daily"* and thus scores *Rating 5* for both the construction and operational phases.

Table 9.4: Frequency of the Occurrence of The Impact, Description and Rating

Impact Frequency	Description	Rating
Annually or less	Impact occurs at least once in a year or less frequently.	1
6 monthly	Impact occurs at least once in 6 months.	2
Monthly	Impact occurs at least once a month.	3
Weekly	Impact occurs at least once a week.	4
Daily	Impact occurs daily.	5

9.5 Probability of the Occurrence of The Impact

In accordance with ***Table 9.5*** below, probability of the occurrence of the traffic impact expected is considered "*highly probable*" and thus scores *Rating 3* for both the construction and operational phases.

Table 9.5: Probability of the Occurrence of The Impact, Description and Rating

Impact Probability	Description	Rating
Improbable	The possibility of the impact materializing is very low either because of design or historic experience.	1
Probable	The possibility of the impact materializing will occur to the extent that provision must be made thereof.	2
Highly Probable	It is most.	3
Definite	The impact will occur regardless of any prevention measures.	4

9.6 Magnitude of The Impact

In accordance with ***Table 9.6*** below, magnitude of the traffic impact expected is considered "*Low*" and thus scores *Rating 2* for both the construction and operational phases.

Table 9.6: Magnitude of The Impact, Description and Rating

Impact Magnitude	Description	Rating
Low	The impact alters the affected environment in such a way that the natural processes are not affected.	2
Medium	The affected environment is altered; however, the functions and processes continue in a modified way.	4
High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.	6

9.7 Significance of The Impact

A significance rating can be allocated to the expected traffic impact, based on the following equation and the descriptions provided in ***Table 9.7***.

Significance = (Duration + Extent + Magnitude) x Probability

Table 9.7: Significance of The Impact, Description and Rating

Impact Significance	Description	Rating
Negligible	The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.	<20
Low	The impact is limited in extent, with low to medium intensity and whatever the probability of the occurrence may be, the impact will not have a material effect on the decision and is likely to require the management intervention with increased costs.	<40
Moderate	The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.	<60
High	The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.	>60

9.8 Aspect & Impact

Table 9.8 provides summary of the anticipated impact as a result of the proposed coal mining development in respect of the traffic and transportation aspect.

Table 9.8: Traffic Aspect and Impact

Aspect	Traffic and transportation system.
Impact	The proposed coal mining activities will result in additional trips to the transportation system. However, no coal hauling trucks will be generated as the conveyor belts will be used for coal transportation to the nearby power station.
Nature	Low-Medium
Extent	Site
Duration	Construction Phase = Medium-term Operational Phase = Long-term
Frequency	Daily
Magnitude	Low
Probability	Highly Probable
Significance	Construction Phase = (2 + 2 + 2) X 3 = 18 (i.e. <20) Operational Phase = (3 + 2 + 2) X 3 = 21 (i.e. 20 < 21 < 40)
Reversibility	Reversible
Replaceability	Replaceable

9.9 Impact Mitigation Measures

In terms of ***Table 9.9*** below, likelihood and severity of the anticipated traffic impact on the receiving environment is considered "*Possible*" and thus scores *Rating 3.*

Table 9.9: Likelihood Rating System

Rating	Definitions	Likelihood
5	The event is expected to occur in most circumstances (The event is likely to occur once per year).	Almost certain
4	The event will probably occur in most circumstances (The event is likely to occur once every 1 – 2 years).	Likely
3	The event might occur at some time (The event is likely to occur once every 2 – 5 years)	Possible
2	The event could occur at some time (The event is likely to occur once every 5 – 10 years)	Unlikely
1	The event may occur only in exceptional circumstances (The event is unlikely to occur in any 10-year period)	Rare

9.10 Risk Analysis Matrix

A significance rating can be allocated to the expected traffic impact based on the significance assessment matrix provided in ***Table 9.10*** below.

Table 9.10: Significance Assessment Matrix

		Severity of Consequence				
Likelihood of Consequence		**Critical (5)**	**Major (4)**	**Significant (3)**	**Moderate (2)**	**Minor (1)**
	Almost Certain (5)	Extreme	Extreme	High	High	Medium
	Likely (4)	Extreme	High	High	Medium	Medium
	Possible (3)	Extreme	High	Medium	Medium	Low
	Unlikely (3)	High	Medium	Medium	Low	Very Low
	Rare (1)	Medium	Medium	Low	Low	Very Low

The anticipated traffic impact consequence severity may therefore be classified as being "*Medium*".

The significant ratings for the proposed coal mining development project phases are provided in ***Table 9.12***.

Table 9.11: Positive & Negative Impacts of The Proposed Project

Impact	Rating Pre-Mitigation	Construction Phase	Operational Phase	Decommissioning Phase	Rating Post Mitigation
Positive (+)	Medium	✓ Employment opportunities ✓ Support to local businesses and SMME's ✓ Income generation for accommodation business sector ✓ Contributing to the national's economy	✓ Employment opportunities ✓ Support to local businesses and SMME's ✓ Income generation for accommodation business sector ✓ Contributing to the national's economy	✓ Employment opportunities ✓ Land and soils capability restoration ✓ Re-vegetation and regeneration of the indigenous vegetation	Low
Negative (-)	Moderate	✓ Visual nuisance ✓ Health and Safety impacts ✓ Surface and groundwater contamination ✓ Impacts on traffic ✓ Unsustainable job security ✓ Disturbance on the landscape ✓ Waste generation ✓ Alien vegetation species invasion ✓ Noise disturbances	✓ Visual nuisance ✓ Health and Safety impacts ✓ Surface and groundwater contamination ✓ Impacts on traffic ✓ Unsustainable job security ✓ Disturbance on the landscape ✓ Waste generation ✓ Alien vegetation species invasion ✓ Noise disturbances	✓ Visual nuisance ✓ Health and Safety impacts ✓ Surface and groundwater ✓ contamination ✓ Impacts on traffic ✓ Job losses	Low
Negative (-)	High	✓ Habitat disturbance ✓ Vegetation disturbances ✓ Loss of biodiversity ✓ Soil erosion ✓ Impacts on groundwater quality ✓ Soils contamination ✓ Visual nuisance to moving equipment and vehicles	✓ Habitat disturbance ✓ Vegetation disturbances ✓ Loss of biodiversity ✓ Soil erosion ✓ Impacts on groundwater quality ✓ Soils contamination ✓ Visual nuisance to moving equipment and vehicles	✓ Habitat disturbance ✓ Vegetation disturbances due to vegetation clearance ✓ Alien vegetation species invasion ✓ Soil erosion ✓ Impacts on groundwater quality ✓ Waste generation ✓ Visual nuisance to moving equipment and vehicles	Medium

9.11 Positive & Negative Traffic Impact Assessment

Reference is made to ***Table 9.11*** above, the assessment criteria for positive and negative impacts that the proposed coal mining development may have on the receiving environment.

Based on the significance scores contained in ***Table 9.12*** below, the proposed coal mining development project *can be authorised* in terms of the impact rating criteria, without the need to implement any other mitigation measures, *except for upgrading and provision of the transportation infrastructure requirements identified as contained in Sub-section 8.4 of this study.*

Table 9.12: Impact Assessment for the Project Phases Considered

Project Phase	Mitigation Stage & Rating	Nature	Impact Rating Criteria				Significance
			Extent	Duration	Magnitude	Probability	
Construction Phase	Pre-Mitigation → Medium Post-Mitigation → Low	+	2	2	2	3	<20
Operational Phase	Pre-Mitigation → Medium Post-Mitigation → Low	+	2	3	2	3	<40

9.12 Legal Requirements & Other Considerations

The following comments may be made, regarding the legal requirements and other considerations during the proposed project:

- ✓ All legal authorisations and permits must be obtained for the transportation of abnormal loads and hazardous materials on public roads.
- ✓ Measures should be taken to ensure that all health and safety requirements regarding transportation activities are complied with.
- ✓ It is proposed that flagmen and temporary warning signs be placed at the access point where heavy vehicles will access to public roads during any of the project phase.
- ✓ Controls should be put in place to ensure that vehicles exiting the site are not overloaded.

10 NON-MOTORISED & PUBLIC TRANSPORT

In terms of Section 35 of the National Land Transport Act (NLTA) (Act No 5 of 2009), it is a requirement to include assessment of non-motorised and public transport in the traffic impact assessments.

The following comments are relevant in respect of the public transport availability and provision in support of the proposed coal mining development.

Due to the remote location of the application site relative to the existing transportation infrastructure and likely places of residence, it is assumed that the employer would provide transport to the employees in need of such a service.

Alternatively, like in any other businesses whereby public transport services are not available, workers usually arrange a staff transport for themselves, for and at their own convenience.

Considering the above discussions, the proposed mining development is supported from the non-motorised & public transport point of view.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

- ✓ This Traffic Impact Assessment (TIA) has been undertaken in support of the mining rights application for the proposed coal mine to be situated on various farm portions near the town of Colenso, KwaZulu-Natal; namely,
    - Remainder of Portion 1 & Remainder of The Farm Schurfde Poort 1147 GS
    - The Farm Shaws No.11317 GS
    - Portion 1 & Remainder of The Farm Ganna Hoek 1317 GS
    - Portion 1 & Remainder of The Farm Klip Berg 2158 GT
    - The Farm Brakfontein 1316 GS
    - Portions 1, 2 & Remainder of The Farm Ramak 13696 GT
- ✓ The proposed mining area measures approximately 6 333, 2240 hectares in extent.
- ✓ The application site is located some 10km to the north-east of town of Colenso, within the jurisdiction of uThukela District Municipality in the KwaZulu Natal Province.
- ✓ The study has been undertaken considering the requirements and guidelines as set out in the *TMH 16 Volume 1 (South African Traffic Impact and Site Traffic Assessment Manual), COTO Committee Draft 2.1, dated April 2021.*
- ✓ This study investigates the site accessibility, transportation infrastructure provision requirements, traffic flow conditions at the key intersection/s within the study area, development trip generation estimates and determine any road and/or intersections improvements required to mitigate the anticipated development traffic impact.
- ✓ Traffic surveys were conducted at an intersection considered *key* for the purpose of this study, along the R74 (P12-3) during a typical weekday, on the 8th of May 2025.
- ✓ The latent right development considered in this study is the proposed power station to be situated on Portion 1 of the Farm Schurfdepoort 1147, within the immediate vicinity of the application site.
- ✓ The proposed mining development is surrounded by several transportation infrastructure network as can be seen in ***Figure 1.1.***
- ✓ The envisaged annual coal production is estimated at 1 200 000 tonnages, with a monthly target of approximately 100 000 tonnages.
- ✓ The following activity assumptions are made in respect of the *construction phase* of the proposed coal mine development.
    - Total number of construction workers is no more than 300, inclusive of labour workforce and staff personnel.

- Up to 80% of construction workers would commute using public transport or transport provided by the employer (staff transport), which is assumed to have a vehicle occupancy of 14 passenger seats per vehicle.
- The latter 20% would commute using personal private transport which is assumed to have an average vehicle occupancy of 1.5 occupants per vehicle.
- The peak hour development traffic directional split percentage as follows,
  - Inbound / outbound in the morning (AM) = 80% / 20%.
  - Inbound / outbound in the afternoon (PM) = 20% / 80%.
- Construction and delivery vehicles will travel to and from the application site in daily basis throughout the day as and when required.
- The construction phase duration is estimated at only 12 months.

✓ The following activity assumptions are made in respect of the operational phase of the proposed coal mining development.

- A total number of workers entailing both the labour workforce and the staff personnel is estimated at only 67.
- Annual coal production is aimed at approximately 1 200 000 tonnages.
- Monthly coal production is aimed at approximately 100 000 tonnages.
- All the coal mined will be transported via conveyor belts to its destination (power station in the immediate vicinity).
- Up to 70% of the labour workforce would commute using public transport or transport provided by the employer (staff transport), which is assumed to have a vehicle occupancy of 14 passenger seats per vehicle.
- The latter 30% would commute using personal private transport which is assumed to have an average vehicle occupancy of 1.2 occupants per vehicle.
- The peak hour development traffic directional split percentage as follows,
  - Inbound / outbound in the morning (AM) = 80% / 20%.
  - Inbound / outbound in the afternoon (PM) = 20% / 80%.
- Delivery vehicles will travel to and from the site in daily basis throughout the day as and when required.
- The operational phase life span of the proposed mining development is estimated at 30 years plus.

✓ In terms of site accessibility, Alternative 4 depicted in ***Figure 4.4***; namely, construction of a newly proposed Class 4 road has *more advantages* than other alternatives investigated, and it is thus considered a *preferred alternative*.

✓ Development trip generation estimates are as follows;

- Construction phase → 57 per hour trips
- Operational phase → 23 per hour trips
- Latent development rights → 77 per hour trips

- ✓ The growth in the background traffic may be expected to be less than 3% per annum.
- ✓ The newly proposed access road facility has potential to attract and draw some of the traffic in the vicinity, that is currently using other roads to join the R74 (P12-3).
- ✓ The AutoJ capacity analyses results indicated that geometric configuration of all the three intersections analysed will operate excellently at overall LOS A with the total future traffic demand.
- ✓ The transportation infrastructure requirements in support of this application are shown conceptually in ***Annexure B*** and can be summarised as follows;
    - Road construction: → Construct a new ±2,9km long Class 4 access road (see also ***Figure 4.4)*** to entail,
        - A surfaced 2-lane Class 4 road is recommended.
        - Adhere to the appropriate road authority design standards.
        - A servitude to be registered as necessary.
        - The road to be included in the municipal road network or planning.
        - The southern end of a surfaced road to terminate with a concrete edge beam.
    - Intersection upgrade → Upgrade the informal intersection on R74 (P12-3) to comprise the following (see also ***Figure 8.1****),*
        - Formalisation of the existing informal intersection at co-ordinates 28°45'33.52 S 29°50'21.81 E.
        - Resurface a section of R74 (P12-3) within the traffic calming area, east and west of the intersection (see ***Figure 8.1***).
        - Repair or reconstruct the existing speed humps and rumble strips (see ***Figure 8.2***).
        - Provide a pair of public transport lay-byes along and on the downstream sides of the R74 (P12-3).
        - Upgrade existing level pedestrian crossing blocks on the R74 (P12-3) approaches to raised pedestrian crossings (see ***Figure 8.3***).
        - Repaint all the road markings as necessary to ensure the intersection safety.
        - Sight distances to conform to the appropriate intersection geometric design standards.
    - New Intersection: → Construct a formal intersection of Forbes Road Extension with the newly proposed Class 4 access road (see also ***Figure 8.4***) as part of site accessibility,
        - Priority controlled intersection at no less than 100m from R74 (P12-3).
        - Forbes Road Extension realigned.
        - First surfaced section of Forbes Road Extension to terminate with a concrete edge beam.

- Sight distances to conform to the appropriate intersection geometric design standards.

- New Intersection: → Construct a new intersection of D488 with the newly proposed Class 4 road (see also ***Table 8.3***) to comprise.
  - Priority controlled intersection at co-ordinates 28°44'7.26"S 29°50'43.62"E
  - First surfaced section of D488 to terminate with concrete edge beams if D488 does not get surfaced (see ***Figures 8.5*** to ***8.7***).
  - Sight distances to confirm to the appropriate intersection geometric design standards.
- Road Upgrading: → Upgrade D488 if necessary (see ***Annexure B)***
  - D488 will provide direct accessibility to the application site and may therefore be either surfaced or left unsurfaced if it gets maintained regularly as required.

✓ From the environmental impact point, the proposed coal mining development project *can be authorised* in terms of the impact rating criteria, without the need to implement any other mitigation measures, *except for upgrading and provision of the transportation infrastructure requirements identified as contained in Sub-section 8.4 of this study.*

✓ The following comments may be made regarding the legal requirements and other considerations during the proposed project:

- All legal authorisations and permits must be obtained for the transportation of abnormal loads and hazardous materials on public roads.
- Measures should be taken to ensure that all health and safety requirements regarding transportation activities are complied with.
- It is proposed that flagmen and temporary warning signs be placed at the access point where heavy vehicles will access to public roads during any of the project phase.
- Controls should be put in place to ensure that vehicles exiting the site are not overloaded.

✓ The proposed mining development is supported from non-motorised & public transport point of view considering the following;

- It is assumed that the employer would provide transport to the employees in need of such a service.
- Alternatively, like in any other businesses whereby public transport services are not available, workers usually arrange staff transport for themselves, for their own convenience.

11.2 Recommendations

- ✓ Any bulk services contributions payable in respect of this application (if applicable), be offset against provision of additional transportation infrastructure and/or non-motorised and public transport facilities requirements.
- ✓ This application is supported from traffic and transportation engineering viewpoints and be therefore approved by the road authorities.

12 REFERENCES

1. *Committee of Transport Officials (COTO) - TMH 16 Volume 1 (South African Traffic Impact and Site Traffic Assessment Manual), COTO Committee Draft 2.1,* April 2021.
2. Committee of Transport Officials (COTO) - *TMH16 Vol. 2 South African Traffic Impact and Site Impact Assessment Standards and Requirements Manual*, August 2012
3. Committee of Transport Officials (COTO) - *TMH17 South Africa Trip Data Manual, Committee Draft 2.3,* May 2021
4. Committee of Transport Officials (COTO) – *TRH26 South Africa Road Classification and Access Management Manual*, August 2012
5. Proposed Power Station Colenso - *Traffic Impact Study*, Sturgeon Consulting, 04 August 2015
6. Dunrose Investments 174 (Pty) Ltd - *Scoping Report*, Vahlengwe Mining Advisory and Consulting, January 2025

ANNEXURE A

Detailed Traffic Surveys Data

DATE: THURSDAY, 8 MAY 2025

CLIENT: JONAS MAKALA

SITE: R74 & UNNAMED ROAD, COLENSO

APPROACH FROM	NORTH															
NAME	UNNAMED ROAD															TOTAL ALL MOVEMENTS
MOVEMENT	LEFT TURN					STRAIGHT					RIGHT TURN					
TIME/ CLASS	C	T	H	B	TOTAL	C	T	H	B	TOTAL	C	T	H	B	TOTAL	
06:00 - 06:15	0	0	0	0	0	1	1	0	0	2	1	0	0	0	1	3
06:15 - 06:30	1	0	0	0	1	0	1	0	0	1	1	0	0	0	1	3
06:30 - 06:45	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
06:45 - 07:00	2	0	0	0	2	2	1	0	0	3	0	0	0	0	0	5
07:00 - 07:15	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	2
07:15 - 07:30	1	2	0	0	3	1	0	0	0	1	1	0	0	0	1	5
07:30 - 07:45	3	0	0	0	3	1	0	0	0	1	1	0	0	0	1	5
07:45 - 08:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 - 08:15	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
08:15 - 08:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 - 08:45	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
08:45 - 09:00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
09:00 - 09:15	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
09:15 - 09:30	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	2
09:30 - 09:45	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
09:45 - 10:00	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
10:00 - 10:15	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
10:15 - 10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30 - 10:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:45 - 11:00	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	2
11:00 - 11:15	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	2
11:15 - 11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 - 11:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45 - 12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 - 12:15	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	2
12:15 - 12:30	1	1	0	0	2	1	0	0	0	1	0	0	0	0	0	3
12:30 - 12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 - 13:00	1	0	0	0	1	0	0	0	0	0	2	0	0	0	2	3
13:00 - 13:15	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
13:15 - 13:30	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
13:30 - 13:45	1	0	0	0	1	0	0	0	0	0	1	1	0	0	2	3
13:45 - 14:00	0	0	0	0	0	1	1	1	0	3	0	0	0	0	0	3
14:00 - 14:15	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
14:15 - 14:30	4	0	0	0	4	2	1	0	0	3	2	1	0	0	3	10
14:30 - 14:45	1	1	0	0	2	0	2	0	0	2	1	0	0	0	1	5
14:45 - 15:00	0	1	0	0	1	1	1	0	0	2	0	0	0	0	0	3
15:00 - 15:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:15 - 15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:30 - 15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45 - 16:00	0	0	2	0	2	0	0	0	0	0	1	0	0	0	1	3
16:00 - 16:15	0	1	0	0	1	2	0	0	0	2	0	0	0	0	0	3
16:15 - 16:30	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
16:30 - 16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45 - 17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00 - 17:15	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
17:15 - 17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30 - 17:45	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	2
17:45 - 18:00	1	0	0	0	1	0	0	0	0	0	0	1	0	0	1	2
TOTAL	**24**	**7**	**2**	**0**	**33**	**18**	**10**	**3**	**0**	**31**	**16**	**4**	**0**	**0**	**20**	**84**
AM Peak Hour	*6*	*2*	*0*	*0*	***8***	*4*	*2*	*0*	*0*	***6***	*2*	*1*	*0*	*0*	***3***	
AM Peak Hour	*1*	*0*	*0*	*0*	***1***	*1*	*0*	*0*	*0*	***1***	*1*	*0*	*0*	*0*	***1***	

5

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DATE: THURSDAY, 8 MAY 2025

CLIENT: JONAS MAKALA

SITE: R74 & UNNAMED ROAD, COLENSO

APPROACH FROM	SOUTH															
NAME	UNNAMED ROAD															TOTAL ALL MOVEMENTS
MOVEMENT	LEFT TURN					STRAIGHT					RIGHT TURN					
TIME/ CLASS	C	T	H	B	TOTAL	C	T	H	B	TOTAL	C	T	H	B	TOTAL	
06:00 - 06:15	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
06:15 - 06:30	1	1	0	0	2	1	0	0	0	1	0	0	0	0	0	3
06:30 - 06:45	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
06:45 - 07:00	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	2
07:00 - 07:15	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
07:15 - 07:30	1	0	0	0	1	1	2	0	0	3	0	0	0	0	0	4
07:30 - 07:45	1	0	0	0	1	1	1	0	0	2	0	0	0	0	0	3
07:45 - 08:00	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	2
08:00 - 08:15	2	0	0	0	2	1	0	0	0	1	0	0	0	0	0	3
08:15 - 08:30	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
08:30 - 08:45	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	2
08:45 - 09:00	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
09:00 - 09:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:15 - 09:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:30 - 09:45	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
09:45 - 10:00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
10:00 - 10:15	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
10:15 - 10:30	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
10:30 - 10:45	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
10:45 - 11:00	1	1	0	0	2	1	0	0	0	1	0	0	0	0	0	3
11:00 - 11:15	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1
11:15 - 11:30	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
11:30 - 11:45	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
11:45 - 12:00	2	0	0	0	2	0	0	1	0	1	0	0	0	0	0	3
12:00 - 12:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 - 12:30	2	0	0	0	2	0	0	1	0	1	0	0	0	0	0	3
12:30 - 12:45	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
12:45 - 13:00	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
13:00 - 13:15	2	0	0	0	2	0	0	1	0	1	0	0	0	0	0	3
13:15 - 13:30	3	1	0	0	4	1	1	0	0	2	0	0	0	0	0	6
13:30 - 13:45	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
13:45 - 14:00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
14:00 - 14:15	1]	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
14:15 - 14:30	1	0	0	0	1	1	1	0	0	2	0	0	0	0	0	3
14:30 - 14:45	2	0	0	0	2	1	0	0	0	1	0	0	0	0	0	3
14:45 - 15:00	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	2
15:00 - 15:15	1	1	0	0	2	1	0	0	0	1	0	0	0	0	0	3
15:15 - 15:30	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
15:30 - 15:45	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
15:45 - 16:00	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	2
16:00 - 16:15	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
16:15 - 16:30	1	1	0	0	2	1	0	0	0	1	0	0	0	0	0	3
16:30 - 16:45	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
16:45 - 17:00	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
17:00 - 17:15	3	1	0	0	4	1	0	0	0	1	1	0	0	0	1	6
17:15 - 17:30	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
17:30 - 17:45	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
17:45 - 18:00	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
TOTAL	**52**	**7**	**0**	**0**	**59**	**15**	**8**	**5**	**0**	**28**	**5**	**0**	**0**	**0**	**5**	**92**
AM Peak Hour	*3*	*0*	*0*	*0*	***3***	*2*	*5*	*0*	*0*	***7***	*0*	*0*	*0*	*0*	***0***	
AM Peak Hour	*6*	*1*	*0*	*0*	***7***	*1*	*0*	*0*	*0*	***1***	*2*	*0*	*0*	*0*	***2***	

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DATE: THURSDAY, 8 MAY 2025

CLIENT: JONAS MAKALA

SITE: R74 & UNNAMED ROAD, COLENSO

APPROACH FROM	EAST															
NAME	R 74															TOTAL ALL MOVEMENTS
MOVEMENT	LEFT TURN					STRAIGHT					RIGHT TURN					
TIME/ CLASS	C	T	H	B	TOTAL	C	T	H	B	TOTAL	C	T	H	B	TOTAL	
06:00 - 06:15	0	0	0	0	0	2	0	1	0	3	0	0	0	0	0	3
06:15 - 06:30	0	0	0	0	0	2	4	0	0	6	0	0	0	0	0	6
06:30 - 06:45	0	0	0	0	0	6	3	1	0	10	2	0	0	0	2	12
06:45 - 07:00	0	0	0	0	0	5	2	0	0	7	0	0	0	0	0	7
07:00 - 07:15	0	0	0	0	0	5	1	0	0	6	1	1	0	0	2	8
07:15 - 07:30	0	0	0	0	0	3	1	0	0	4	5	2	1	0	8	12
07:30 - 07:45	0	0	0	0	0	6	2	0	0	8	1	0	0	0	1	9
07:45 - 08:00	0	0	0	0	0	4	1	0	0	5	2	0	0	0	2	7
08:00 - 08:15	0	0	0	0	0	4	1	0	0	5	0	0	0	0	0	5
08:15 - 08:30	0	0	0	0	0	8	1	0	0	9	0	0	0	0	0	9
08:30 - 08:45	0	0	0	0	0	5	3	0	0	8	1	0	0	0	1	9
08:45 - 09:00	1	0	0	0	1	4	1	0	0	5	0	0	0	0	0	6
09:00 - 09:15	0	0	0	0	0	6	1	1	0	8	1	0	0	0	1	9
09:15 - 09:30	0	0	0	0	0	6	2	1	0	9	1	0	0	0	1	10
09:30 - 09:45	0	0	0	0	0	7	0	0	0	7	0	0	0	0	0	7
09:45 - 10:00	0	0	0	0	0	10	2	0	0	12	0	0	0	0	0	12
10:00 - 10:15	0	0	0	0	0	8	1	1	0	10	1	0	0	0	1	11
10:15 - 10:30	0	0	0	0	0	8	0	0	0	8	0	0	0	0	0	8
10:30 - 10:45	0	0	0	0	0	7	0	0	0	7	0	0	0	0	0	7
10:45 - 11:00	0	0	0	0	0	5	1	0	0	6	0	0	0	0	0	6
11:00 - 11:15	0	0	0	0	0	6	1	0	0	7	0	0	0	0	0	7
11:15 - 11:30	0	0	0	0	0	9	1	2	0	12	0	0	0	0	0	12
11:30 - 11:45	0	0	0	0	0	2	1	0	0	3	1	0	0	0	1	4
11:45 - 12:00	0	0	0	0	0	6	1	0	0	7	0	0	0	0	0	7
12:00 - 12:15	0	0	0	0	0	5	1	0	0	6	2	0	0	0	2	8
12:15 - 12:30	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
12:30 - 12:45	0	0	0	0	0	8	2	1	0	11	2	0	0	0	2	13
12:45 - 13:00	0	0	0	0	0	5	4	0	0	9	0	0	0	0	0	9
13:00 - 13:15	0	0	0	0	0	5	1	0	0	6	0	0	0	0	0	6
13:15 - 13:30	0	0	0	0	0	5	3	0	0	8	1	0	0	0	1	9
13:30 - 13:45	0	0	0	0	0	11	0	0	0	11	0	0	0	0	0	11
13:45 - 14:00	0	0	0	0	0	7	1	0	0	8	0	0	0	0	0	8
14:00 - 14:15	0	0	0	0	0	5	1	2	0	8	0	1	0	0	1	9
14:15 - 14:30	1	0	0	0	1	6	1	0	0	7	1	0	0	0	1	9
14:30 - 14:45	0	0	0	0	0	4	2	0	0	6	0	0	0	0	0	6
14:45 - 15:00	0	0	0	0	0	8	3	0	0	11	0	0	0	0	0	11
15:00 - 15:15	0	0	0	0	0	12	3	2	0	17	2	0	0	0	2	19
15:15 - 15:30	0	0	0	0	0	7	3	2	0	12	0	0	0	0	0	12
15:30 - 15:45	0	0	0	0	0	6	2	0	0	8	3	0	0	0	3	11
15:45 - 16:00	0	0	0	0	0	11	2	0	0	13	0	0	0	0	0	13
16:00 - 16:15	1	0	0	0	1	6	2	1	0	9	0	0	0	0	0	10
16:15 - 16:30	0	0	0	0	0	5	1	0	0	6	0	1	1	0	2	8
16:30 - 16:45	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	3
16:45 - 17:00	0	0	0	0	0	7	2	1	0	10	1	0	0	0	1	11
17:00 - 17:15	0	0	0	0	0	8	1	0	0	9	0	0	0	0	0	9
17:15 - 17:30	1	0	0	0	1	8	1	0	0	9	1	0	0	0	1	11
17:30 - 17:45	0	0	0	0	0	12	1	0	0	13	0	0	0	0	0	13
17:45 - 18:00	1	0	0	0	1	9	0	0	0	9	1	0	0	0	1	11
TOTAL	**5**	**0**	**0**	**0**	**5**	**297**	**69**	**16**	**0**	**382**	**30**	**5**	**2**	**0**	**37**	**424**
AM Peak Hour	*0*	*0*	*0*	*0*	***0***	*19*	*6*	*0*	*0*	***25***	*7*	*3*	*1*	*0*	***11***	
AM Peak Hour	*1*	*0*	*0*	*0*	***1***	*35*	*5*	*1*	*0*	***41***	*2*	*0*	*0*	*0*	***2***	

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DATE: THURSDAY, 8 MAY 2025

CLIENT: JONAS MAKALA

SITE: R74 & UNNAMED ROAD, COLENSO

APPROACH FROM	WEST															
NAME	R 74															TOTAL ALL MOVEMENTS
MOVEMENT	LEFT TURN					STRAIGHT					RIGHT TURN					
TIME/ CLASS	C	T	H	B	TOTAL	C	T	H	B	TOTAL	C	T	H	B	TOTAL	
06:00 - 06:15	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1
06:15 - 06:30	0	0	0	0	0	3	2	1	0	6	0	0	0	0	0	6
06:30 - 06:45	1	0	0	0	1	4	4	1	0	9	1	0	0	0	1	11
06:45 - 07:00	0	0	0	0	0	6	0	0	0	6	0	1	1	0	2	8
07:00 - 07:15	1	0	0	0	1	2	1	0	0	3	1	0	0	0	1	5
07:15 - 07:30	1	0	0	0	1	7	2	1	0	10	1	0	0	0	1	12
07:30 - 07:45	0	0	0	0	0	16	1	4	0	21	1	0	0	0	1	22
07:45 - 08:00	1	0	0	0	1	14	2	0	0	16	0	1	0	0	1	18
08:00 - 08:15	0	0	1	0	1	13	0	1	0	14	1	1	0	0	2	17
08:15 - 08:30	0	0	0	0	0	7	1	0	0	8	0	0	0	0	0	8
08:30 - 08:45	0	0	0	0	0	6	1	1	0	8	0	0	0	0	0	8
08:45 - 09:00	0	0	0	0	0	7	1	0	0	8	1	0	0	0	1	9
09:00 - 09:15	0	0	0	0	0	7	1	0	0	8	0	0	0	0	0	8
09:15 - 09:30	0	0	0	0	0	5	0	0	0	5	1	1	0	0	2	7
09:30 - 09:45	0	0	0	0	0	4	1	2	0	7	1	0	0	0	1	8
09:45 - 10:00	1	0	0	0	1	4	1	1	0	6	0	0	0	0	0	7
10:00 - 10:15	0	0	0	0	0	3	2	0	0	5	1	0	0	0	1	6
10:15 - 10:30	0	0	0	0	0	5	1	0	0	6	2	0	0	0	2	8
10:30 - 10:45	0	2	0	0	2	5	0	0	0	5	2	0	0	0	2	9
10:45 - 11:00	0	0	0	0	0	3	0	2	0	5	1	0	0	0	1	6
11:00 - 11:15	0	0	0	0	0	2	1	1	0	4	2	0	0	0	2	6
11:15 - 11:30	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	4
11:30 - 11:45	0	0	0	0	0	9	1	1	0	11	2	0	0	0	2	13
11:45 - 12:00	0	0	0	0	0	8	0	0	0	8	2	0	0	0	2	10
12:00 - 12:15	1	0	0	0	1	7	1	1	0	9	0	0	0	0	0	10
12:15 - 12:30	1	0	0	0	1	7	1	0	0	8	1	0	1	0	2	11
12:30 - 12:45	0	0	0	0	0	4	1	2	0	7	1	0	0	0	1	8
12:45 - 13:00	0	0	0	0	0	12	1	1	0	14	2	0	0	0	2	16
13:00 - 13:15	0	0	0	0	0	4	0	1	0	5	1	0	0	0	1	6
13:15 - 13:30	1	0	0	0	1	4	1	1	0	6	0	0	0	0	0	7
13:30 - 13:45	0	0	0	0	0	8	2	0	0	10	1	0	0	0	1	11
13:45 - 14:00	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	2
14:00 - 14:15	2	1	0	0	3	3	1	0	0	4	0	0	0	0	0	7
14:15 - 14:30	1	0	0	0	1	7	0	0	0	7	0	0	0	0	0	8
14:30 - 14:45	1	0	0	0	1	8	6	0	0	14	2	0	0	0	2	17
14:45 - 15:00	0	0	0	0	0	6	2	0	0	8	1	0	0	0	1	9
15:00 - 15:15	1	0	0	0	1	4	1	0	0	5	2	0	0	0	2	8
15:15 - 15:30	1	0	0	0	1	6	2	1	0	9	1	1	0	0	2	12
15:30 - 15:45	1	0	0	0	1	7	4	0	0	11	3	1	0	0	4	16
15:45 - 16:00	0	0	0	0	0	7	2	0	0	9	0	1	0	0	1	10
16:00 - 16:15	1	0	0	0	1	8	2	0	0	10	2	0	0	0	2	13
16:15 - 16:30	0	0	0	0	0	8	3	0	0	11	1	0	0	0	1	12
16:30 - 16:45	0	0	0	0	0	14	1	0	0	15	1	1	0	0	2	17
16:45 - 17:00	0	0	0	0	0	8	1	0	0	9	1	1	0	0	2	11
17:00 - 17:15	0	0	0	0	0	4	1	2	0	7	1	0	0	0	1	8
17:15 - 17:30	0	0	0	0	0	8	3	2	0	13	0	0	0	0	0	13
17:30 - 17:45	1	0	0	0	1	16	1	0	0	17	2	0	0	0	2	20
17:45 - 18:00	0	0	0	0	0	11	1	1	0	13	2	0	0	0	2	15
TOTAL	**17**	**3**	**1**	**0**	**21**	**316**	**62**	**29**	**0**	**407**	**45**	**9**	**2**	**0**	**56**	**484**
AM Peak Hour	*2*	*0*	*0*	*0*	***2***	*31*	*4*	*5*	*0*	***40***	*3*	*1*	*1*	*0*	***5***	
AM Peak Hour	*1*	*0*	*0*	*0*	***1***	*36*	*6*	*4*	*0*	***46***	*4*	*1*	*0*	*0*	***5***	

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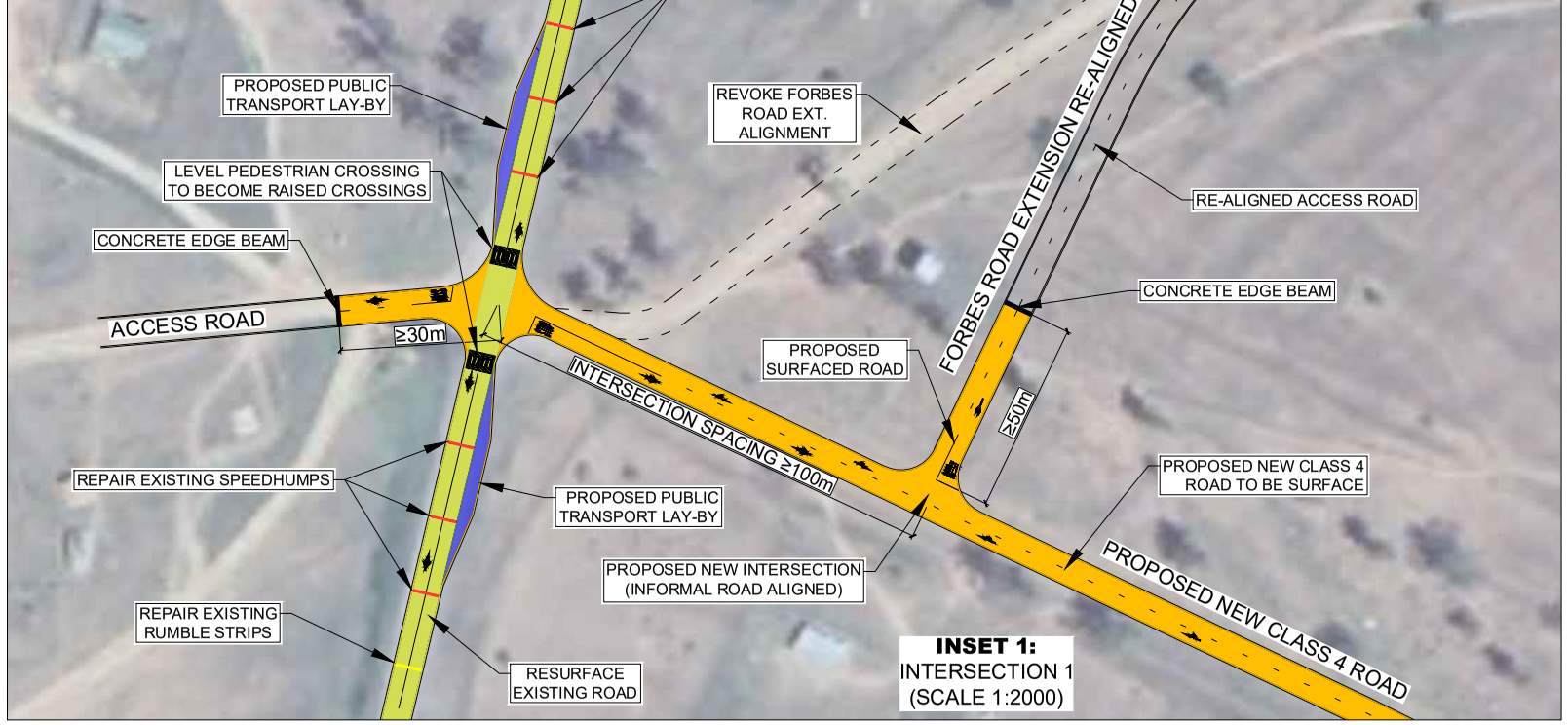
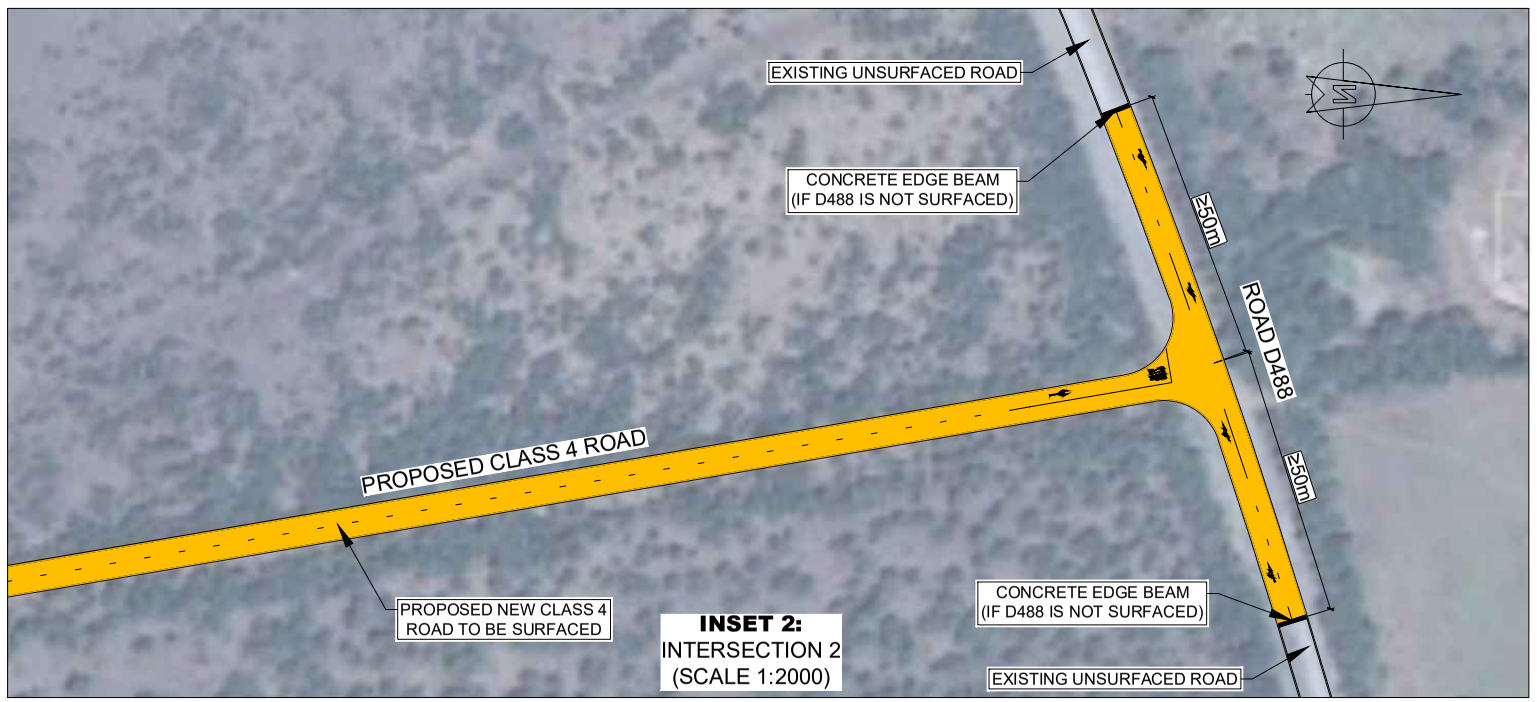
ANNEXURE B

Proposed General Layout Plan





REV	DATE	BY	DESCRIPTION	CHK	APD
A	22/05/25	JM	INITIAL ISSUE	-	-

CLIENT:

BRODSKY TRADING
266 (PTY) LTD

TT TRAFFIC ENGINEERS
(PTY) LTD "on the dot!"
Reg No: 2024/608044/07
Cell: 082 090 7541
Email: jonas@tttrafficeng.com

PROJECT:

COLENSO COAL MINE

TITLE:

GENERAL LAYOUT PLAN

SCALE :	CHECKED:	APPROVED:
AS SHOWN	JN	.
		PR No.: ---
DESIGN:	DRAWN:	DATE:
J MAKALA	D MOKANSI	2025/05/22
PROJECT No:	DRAWING No:	REV:
J035	J035_GL001	-

ANNEXURE C

Detailed AutoJ Intersection Capacity Analyses Results

Annexure C1 → R74 (P12-3) / Proposed Class 4 Road Intersection

Annexure C2 → Proposed Class 4 Road / D488 Road Intersection

Annexure C3 → Proposed Class 4 Road / Forbes Road Extension Intersection

ANNEXURE C1

R74 (P12-3) / Proposed Class 4 Road Intersection

AutoJ

Formal Access Road & R74 Road

Colenso, KwaZulu Natal

&AutoJ 1910 makala

Xns | **Stop street on north and south approaches**

Scenario 2: Total Future 2030 Peak Hour Traffic Demand

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM		11	9	23	**43**		3	14	1	**18**		70	46	6	**122**		1	29	18	**48**		**231**
off		5	4	24	**33**		3	4	1	**8**		23	25	3	**50**		1	19	6	**25**		**116**
PM		7	7	74	**88**		8	3	2	**13**		20	53	6	**79**		1	48	4	**53**		**233**

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3

Control

	from North				from South				from West				from East			
	peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
	stop	stop	stop	stop	*stop*	stop	stop	stop								

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		0,05	0,05	0,05	**0,05**		0,02	0,02	0,02	**0,02**		0,06	0,06	0,06	**0,06**		0,03	0,03	0,03	**0,03**	0,06	0,05
off		0,04	0,04	0,04	**0,04**		0,01	0,01	0,01	**0,01**		0,03	0,03	0,03	**0,03**		0,01	0,01	0,01	**0,01**	0,04	0,03
PM		0,11	0,11	0,11	**0,11**		0,02	0,02	0,02	**0,02**		0,04	0,04	0,04	**0,04**		0,03	0,03	0,03	**0,03**	0,11	0,06

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		8	9	9	**9**		8	9	9	**9**		0	0	0	**0**		0	0	0	**0**	9	**2**
off		8	9	9	**9**		8	9	9	**9**		0	0	0	**0**		0	0	0	**0**	9	**3**
PM		9	9	9	**9**		8	9	9	**9**		0	0	0	**0**		0	0	0	**0**	9	**4**

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM		0,0	0,0	0,1	**0,1**		0,0	0,0	0,0	**0,0**		0,0	0,0	0,0	**0,0**		0,0	0,0	0,0	**0,0**	0,1	**0,2**
off		0,0	0,0	0,1	**0,1**		0,0	0,0	0,0	**0,0**		0,0	0,0	0,0	**0,0**		0,0	0,0	0,0	**0,0**	0,1	**0,1**
PM		0,0	0,0	0,2	**0,2**		0,0	0,0	0,0	**0,0**		0,0	0,0	0,0	**0,0**		0,0	0,0	0,0	**0,0**	0,2	**0,3**

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ANNEXURE C2

Proposed Class 4 Road / D488 Road Intersection

AutoJ

Proposed Road Link & D488 Road

Colenso, KwaZulu Natal

&AutoJ 1910 makala

Xns | **Stop street on north and south approaches**

Scenario 2: Total Future 2030 Peak Hour Traffic Demand

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM							1		78	79			34	1	35		22	10		32		146
off							1		25	26			11	1	12		25	11		36		73
PM							1		22	23			10	1	11		78	34		112		146

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes						0,3	0,4	0,3			0,5	0,5		0,5	0,5	

Control

	from North				from South				from West				from East			
	peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
						stop		stop								

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM							0,08		0,08	**0,08**			0,02	0,02	**0,02**		0,02	0,02		**0,02**	0,08	0,05
off							0,03		0,03	**0,03**			0,01	0,01	**0,01**		0,02	0,02		**0,02**	0,03	0,02
PM							0,02		0,02	**0,02**			0,01	0,01	**0,01**		0,06	0,06		**0,06**	0,06	0,05

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM							9		9	**9**			0	0	**0**		0	0		**0**	9	**5**
off							8		9	**9**			0	0	**0**		0	0		**0**	9	**3**
PM							8		9	**9**			0	0	**0**		0	0		**0**	9	**2**

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM							0,0		0,2	**0,2**			0,0	0,0	**0,0**		0,0	0,0		**0,0**	0,2	**0,2**
off							0,0		0,1	**0,1**			0,0	0,0	**0,0**		0,0	0,0		**0,0**	0,1	**0,1**
PM							0,0		0,1	**0,1**			0,0	0,0	**0,0**		0,0	0,0		**0,0**	0,1	**0,1**

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ANNEXURE C3

Proposed Class 4 Road / Forbes Road Extension Intersection

AutoJ

Proposed Road Link & Forbes Road Extension

Colenso, KwaZulu Natal

&AutoJ 1910 makala

Xwe | **Stop street on west and east approaches**

Scenario 2: Total Future 2030 Peak Hour Traffic Demand

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM			24	1	25		21	81		102		1		19	20							147
off			26	1	26		6	26		32		1		6	6							64
PM			78	1	79		3	24		27		1		3	4							110

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes			0,5	0,5		0,5	0,5			0,3	0,4	0,3				

Control

	from North				from South				from West				from East			
	peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
										stop		stop				

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM			0,01	0,01	**0,01**		0,05	0,05		**0,05**		0,02		0,02	**0,02**						0,05	0,04
off			0,01	0,01	**0,01**		0,02	0,02		**0,02**		0,01		0,01	**0,01**						0,02	0,01
PM			0,04	0,04	**0,04**		0,01	0,01		**0,01**		0,00		0,00	**0,00**						0,04	0,03

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM			0	0	**0**		0	0		**0**		8		9	**9**						9	**1**
off			0	0	**0**		0	0		**0**		8		9	**9**						9	**1**
PM			0	0	**0**		0	0		**0**		8		9	**8**						9	**0**

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM			0,0	0,0	**0,0**		0,0	0,0		**0,0**		0,0		0,0	**0,0**						0,0	**0,1**
off			0,0	0,0	**0,0**		0,0	0,0		**0,0**		0,0		0,0	**0,0**						0,0	**0,0**
PM			0,0	0,0	**0,0**		0,0	0,0		**0,0**		0,0		0,0	**0,0**						0,0	**0,0**

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Palaeontology Impact Assessment

The Proposed Mining Right Application for Coal situated in the Magisterial District of Uthukela/Estcourt KwaZulu-Natal Province

Alfred Duma Local Municipality, uThukela District Municipality, KwaZulu-Natal Province

Farm: Remaining Extent of Portion 1 and Remaining Extent Schurfde Poort 1147-GS; Shaws 11317-GS, Portion 1 and Remaining Extent Ganna Hoek 1317-GS; Portion 1 and Remaining Extent Klip Berg 2158-GT; Brakfontein 1316-GT, Portions 1, 2 and Remaining Extent of Ramak 13596-GT

Fourie, H. Dr

Palaeontological Impact Assessment: Desktop Study

Facilitated by: Nyamoki Consulting (Pty) Ltd

1850 Berg Avenue, Doreg AH,

Akasia, 0182

Tel: 076 327 1827

2025/05/12

Ref: KZN30/5/1/1/2/11124 MR KZN 30/5/1/2/2/10137 MR

B. Executive summary

Outline of the development project: Nyamoki Consulting (Pty) Ltd appointed Dr H. Fourie, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Desktop Study The Proposed Mining Right Application for Coal situated in the Magisterial District of Uthukela/Estcourt KwaZulu-Natal Province in the Alfred Duma Local Municipality, uThukela District Municipality, KwaZulu-Natal Province on Farm: Remaining Extent of Portion 1 and Remaining Extent Schurfde Poort 1147-GS; Shaws 11317-GS, Portion 1 and Remaining Extent Ganna Hoek 1317-GS; Portion 1 and Remaining Extent Klip Berg 2158-GT; Brakfontein 1316-GT, Portions 1, 2 and Remaining Extent of Ramak 13596-GT. 13696- GT

The applicant, Dunrose Investments 174 (Pty) Ltd is applying for a mining right for coal over several farms.

The Project includes one locality Option (see Figure 2):
Option 1: A mining area indicated in red situated 12 km west of Colenso, with Ladysmith and Estcourt as the largest towns nearby. The N11 National Road is south and the Tugela River is the northern border. The project is approximately 6 333,2240 ha in size.

Legal requirements:

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

"palaeontological" means any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or traces.

For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

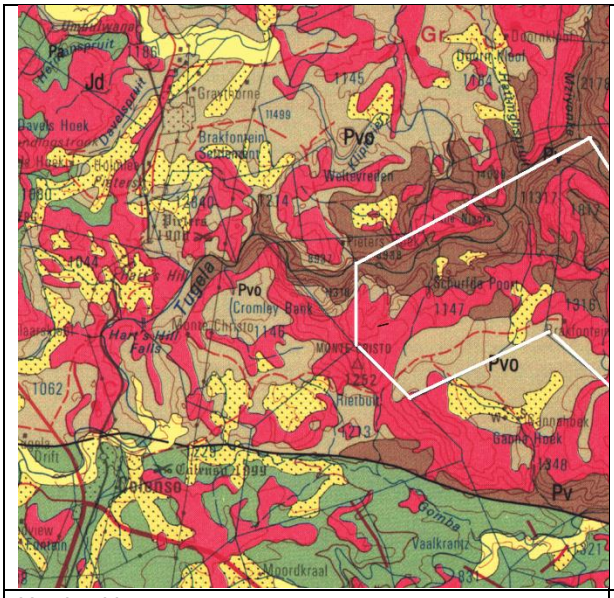
A Palaeontological Impact Assessment is generally warranted where rock units of **LOW** to **VERY HIGH** palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):

(i) (i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.
This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999). Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m² (1 ha) in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report (**1c)** aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigation or conservation measures are necessary.

Outline of the geology and the palaeontology:
The geology was obtained from map 1:100 000, Geology of the Republic of South Africa (Visser 1984) and 2828 Harrismith (Johnson and Verster 1994) and 2830 Dundee (Linstrőm 1987), 1:250 000 geological maps.



Harrismith	Dundee

Figure: The geology of the development area.
Legend to Map and short explanation.
Partly consolidated fine-grained sediments with silcrete nodules (::). Masotcheni Formation. Quaternary.
Jd – Karoo Dolerite Suite (pink). Jurassic.
Pa – Grey and brownish-red mudstone; dark-grey shale (carbonaceous in places), siltstone, sandstone (green). Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Permian.
Pvo – Blue-grey to dark-grey shale (light brown). Volksrust Formation, Ecca Group, Karoo Supergroup. Permian.
Pv – Medium- to coarse-grained sandstone, grey micaceous shale; coal (brown). Vryheid Formation, Ecca Group, Karoo Supergroup. Permian.
…… – (black) Lineament (Possible dyke).
-----f - Fault.
------ - Concealed geological boundary.
⊥2° - Strike and dip.

□ - Proposed development (blocked in white on Figure).

Kent (1980) described the Volksrust Formation as the 150-270 m of shale which overlies the Vryheid Formation. The deposition of this formation coincides with that of the Fort Brown and Waterford Formations in the south (Snyman 1996). It occurs from the south of Kwazulu-Natal into the Free State and is concordant (Visser 1989). Very little is written on the Volksrust Formation. It rests conformably on the Vryheid Formation. Fossils consist of fish scales and wood. This formation reaches thicknesses of 170-270 m (Visser 1989).

The Vryheid Formation is named after the type area of Vryheid-Volksrust. In the north-eastern part of the Karoo basin the Vryheid Formation thins and eventually wedges out towards the south, southwest and west with increasing distance from its source area to the east and northeast (Johnson 2009). The Vryheid Formation consists essentially of sandstone, shale, and subordinate coal beds, and has a maximum total thickness of 500 m. It forms part of the Middle Ecca (Kent 1980). This formation has the largest coal reserves in South Africa. The pro-delta sediments are characterised by trace and plants fossils (Snyman 1996).

Palaeontology – Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of strata the palaeontological sensitivity can generally be **VERY LOW** to **VERY HIGH**, and here locally **VERY HIGH** for the Vryheid Formation and **MODERATE** for the Volksrust Formation (SG 2.2 SAHRA APMHOB, 2012).

The Volksrust Formation consists of a monotonous sequence of grey shale and fossils are significant, but very rarely recorded. Fossils include rare temnospondyl amphibian remains, invertebrates, minor coals with plant remains, fish scales, petrified wood, and low-diversity marine to non-marine trace fossil assemblages (Groenewald and Groenewald 2014). The bivalve *Megodesmus* is described from this formation (Groenewald 2012).

The Ecca Group, Vryheid Formation may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005). Sediments of the Group contain significant reserves of coal and the interbedded shale is an important source of clay for brick making (Groenewald and Groenewald 2014).

Summary of findings (**1d**): The Desktop Study was undertaken in May 2025 in the autumn in mild and dry conditions. As this is a desktop study the season (vegetation) and time (shadows) have no influence on the outcome, and the following is reported:

The Project includes one locality Option (see Figure) with **VERY HIGH** sensitivity present to the west of Colenso. Other locality options will not be feasible as the coal is already present and all options may be situated on the Ecca Group sediments. The quaternary age sediments will not be disturbed and a buffer area will be created.

Recommendation:
Concerns/threats **(1g)** to be added to EMPr:

1. Threats to the National Heritage are earth moving equipment/machinery (for example haul trucks, front end loaders, excavators, graders, dozers) during construction/mining, the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic, clearing, and human disturbance.

2. Special care must be taken during the clearing, digging, drilling, (blasting) and excavating of foundations, trenches, channels and footings and removal of overburden not to intrude fossiliferous layers.

The recommendations are (**1ni,1niA,1nii)**:

1. The potential impact of the development on fossil heritage is **VERY HIGH** sensitivity and therefore a Phase 1: Field Survey will be necessary for this development (according to SAHRA protocol), if a chance fossil is found during mining a Phase 2 Palaeontological Impact Assessment and Mitigation or conservation will be necessary.
2. Mitigation may be needed if fossils are found during the development. Overburden and interburden must be surveyed for fossils.
3. No consultation with parties was necessary. The Environmental Control Officer must familiarise him- or herself with the formation present and its fossils and follow protocol.
4. The development may go ahead with caution. The ECO if appointed must survey for fossils before and or after clearing, ground breaking, or excavating and keep a photographic record.
5. The EMPr will cover the conservation of heritage and palaeontological material that may be exposed during mining activities. For a chance find, the protocol is to immediately cease all mining activities, construct a 30 m no-go barrier, and contact AMAFA for further investigation. It is recommended that the EMPr be updated to include the involvement of a palaeontologist where necessary.

Stakeholders: Developer/Applicant – Dunrose Investments 174 (Pty) Ltd. P.O. Box 1364, Rayton, 1001. Tel: 011 784 6201.
Environmental – Nyamoki Consulting (Pty) Ltd. 1850 Berg Avenue, Doreg AH, Akasia, 0182. Tel: 076 327 1827.
Landowner – Dunrose Investments 174 (Pty) Ltd. P.O. Box 1364, Rayton, 1001. Tel: 011 784 6201.

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D. Background information on the project

Report

This report is part of the environmental impact assessment process under the National Environmental Management Act, as amended (Act No. 107 of 1998) (NEMA) and includes Appendix 6 (May 2019) of the Environmental Impact Assessment Regulations (see Appendix 2). It also is in compliance with The Minimum Standards for Palaeontological Components of Heritage Impact Assessment Reports, SAHRA, APMHOB, Guidelines 2012, Pp 1-15 (**2**).

Outline of development (**1f)**

This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction phase it may necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA / PHRA) if fossils are present.

The applicant, Dunrose Investments 174 (Pty) Ltd is applying for a mining right for coal over several farms. The prospecting phase started in 2007 with bore holes drilled, sampling, logging, and mapping. It was found that the Dundas seam is well developed. Hybrid surface and underground mining will be employed in the proposed mining area. The proposed mining area is located within the Klip River Coalfield. Mining operations will create job opportunities, social development of the community and economical growth in the area.

Related Infrastructure:

1. Opencast workings
2. R.O.M coal stockpile
3. Crushing and screening plant
4. Topsoil dump
5. Softs and hards overburden stockpile
6. Road network
7. Waste management
8. Fuel storage facilities
9. Workshop
10. Weighbridge
11. Offices and contractors' yard, and
12. Clean and dirty water management.

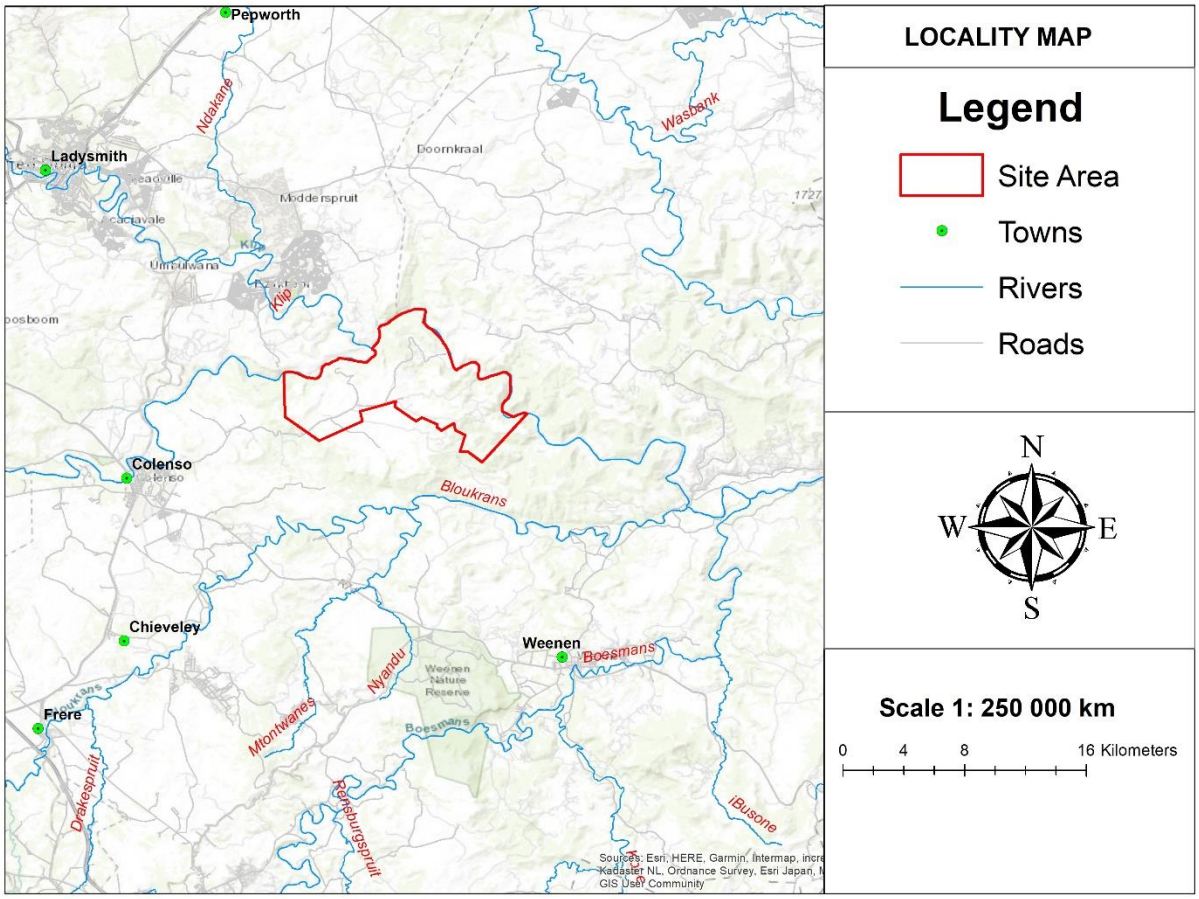

Figure 1: Figure showing topographic position (Nyamoki)

The Project includes one locality Option (see Figure 2) at Colenso:
Option 1: A mining area indicated in red situated 12 km west of Colenso, with Ladysmith and Estcourt as the largest towns nearby. The N11 National Road is south and the Tugela River is the northern border. The project is approximately 6 333,2240 ha in size.

Rezoning/ and or subdivision of land: Mining.
Name of Developer and Consultant: Dunrose Investments 174 (Pty) Ltd and Nyamoki Consulting (Pty) Ltd.
Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a palaeontological impact assessment: field study to ascertain if any palaeontological sensitive material is present in the development area. This study will advise on the impact on fossil heritage mitigation or conservation necessary, if any.
Short *Curriculum vitae:(**1ai, 1aii**)* Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research (now ESI), University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. At present she is curator of a large fossil invertebrate, Therapsid, dinosaur, amphibia, fish, reptile, and plant collections at Ditsong: National Museum of Natural History. For the past 18 years she carried out field work in the North West, Western Cape, Northern Cape, Eastern Cape, Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal, and Free State Provinces and has done more than 200 PIA's since 2012. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 30 years.
Legislative requirements: South African Heritage Resources Agency (SAHRA) for issue of permits if necessary. National Heritage Resources Act (Act No. 25 of 1999). An electronic copy of this report must be supplied to SAHRA (**2**).

E. Description of property or affected environment

Location and depth:

The Proposed Mining Right Application for Coal will be situated in the Magisterial District of Uthukela/Estcourt KwaZulu-Natal Province in the Alfred Duma Local Municipality, uThukela District Municipality, KwaZulu-Natal Province on Farm: Remaining Extent of Portion 1 and Remaining Extent Schurfde Poort 1147-GS; Shaws 11317-GS, Portion 1 and Remaining Extent Ganna Hoek 1317-GS; Portion 1 and Remaining Extent Klip Berg 2158-GT; Brakfontein 1316-GT, Portions 1, 2 and Remaining Extent of Ramak 13596-GT. RAMAK 13696-GT -GS

The depth is determined by the infrastructure to be developed and the thickness of the formation in the development area, in this instance the related infrastructure. Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to determine due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot. Geological maps do not provide depth or superficial cover, it only provides mappable surface outcrops (Figure 3).

The Project includes one locality Option over several farms (see Figure 2) below:

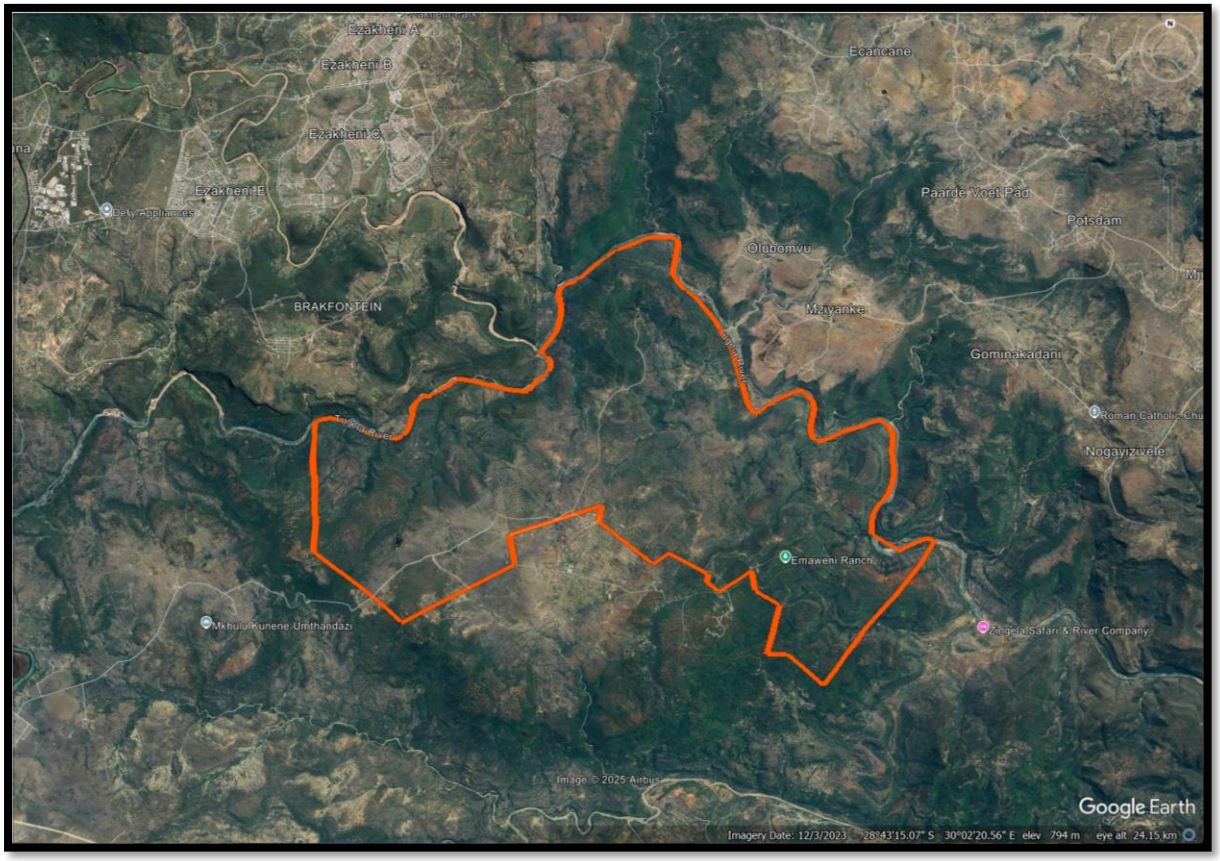

Figure 2: Google earth image showing location (Nyamoki).

The bulk of the site is underlain by the Karoo Supergroup Formations covered by vegetation, grass, trees, roads, and buildings.

F. Description of the Geological Setting

Description of the rock units:

Large areas of the southern African continent are covered by the Karoo Supergroup (Figure 3). It covers older geological formations with an almost horizontal blanket. Several basins are present with the main Karoo basin in the central part of south Africa and several smaller basins towards Lebombo, Springbok Flats and Soutpansberg.

An estimated age is 150 – 180 Ma. And a maximum thickness of 7000 m is reached in the south. Three formations overlie the Beaufort Group, they are the Molteno, Elliot and Clarens Formations. The Elliot Formation is also known as the Red Beds and the old Cave Sandstone is known as the Clarens Formation. At the top is the Drakensberg Basalt Formation with its pillow lavas, pyroclasts, etc. (Kent 1980, Snyman 1996).

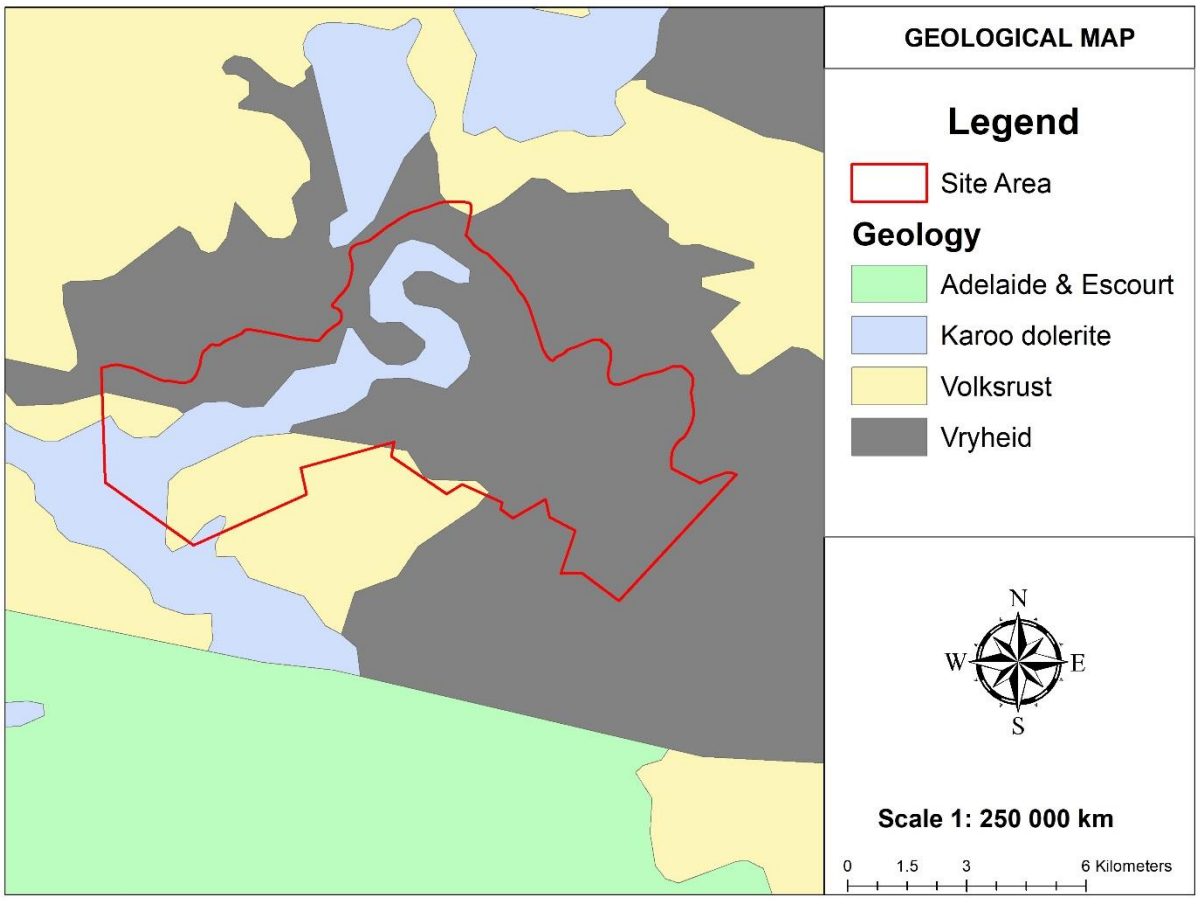

Figure 3: Geology of the development area (Nyamoki) (**1h)**.

Legend to Map and short explanation.

Partly consolidated fine-grained sediments with silcrete nodules (::). Masotcheni Formation. Quaternary.Jd – Karoo Dolerite Suite (pink). Jurassic.

Pa – Grey and brownish-red mudstone; dark-grey shale (carbonaceous in places), siltstone, sandstone (green). Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Permian.

Pvo – Blue-grey to dark-grey shale (light brown). Volksrust Formation, Ecca Group, Karoo Supergroup. Permian.

Pv – Medium- to coarse-grained sandstone, grey micaceous shale; coal (brown). Vryheid Formation, Ecca Group, Karoo Supergroup. Permian.

…… – (black) Lineament (Possible dyke).

--f— Fault.

----- - Concealed geological boundary.

⊥2° - Strike and dip.

□ – Approximate position of development (blocked in red).

Mining Activities on Figure above:

Gr – Graphite.

Mining past and present has no influence on the development.

Dolerite dykes (Jd) occur throughout the Karoo Supergroup. Structural geological features such as dykes and faults can have a measurable influence on ground water flow and mass transport. Permian sediments are extensively intruded and thermally metamorphosed (baked) by sub-horizontal sills and steeply inclined dykes of the Karoo Dolerite Suite (Jd). These early Jurassic (183 Ma) basic intrusions baked the adjacent mudrocks and sandstones to form splintery hornfels and quartzites respectively. Thermal metamorphism by dolerite intrusions tends to reduce the palaeontological heritage potential of the adjacent sediments.

The rocks of the Beaufort Group were deposited by large, northward-flowing, meandering rivers in which sand accumulated, flanked by extensive floodplains where periodic floods deposited mud. Following the end-Permian mass extinction, the meandering rivers were replaced by multi-channelled, braided river systems that deposited sand rather than the silts and muds of the earlier meandering rivers (McCarthy and Rubidge 2005). Two Subgroups are present in the Beaufort Group, namely the upper Tarkastad Subgroup and the lower Adelaide Subgroup.

The Adelaide Subgroup consists of up to three formations (Koonap, Middleton, Balfour in the east). Mudrock predominates with subordinate sandstone and is Upper Permian in age. It overlies the Ecca Group conformably and is overlain by the Katberg Formation of the Tarkastad Subgroup. Siltstone beds are common (Cole *et al.* 2004). The Koonap Formation is the lowermost unit of the Beaufort Group and reaches a thickness of 1 300 m. (Kent 1980). The Balfour Formation is distinguished from the Middleton Formation by the lack of 'red' mudstone and is ±2 150 m. thick, whereas the Middleton Formation is ±1 600 m. thick (sheet info, Kent 1980). The Abrahamskraal and Teekloof Formations form part of the Adelaide Subgroup in the west (Snyman 1996) with the Member Poortjie at the top of the Teekloof Formation. Chert is present in the Abrahamskraal Formation. The Adelaide Subgroup has a maximum thickness of 1 750 m. in the south (Visser 1989).

Ecca rocks are stable and lend themselves well to developments. It is only unstable in or directly above mining activities (Snyman 1996). The site itself is partly situated on the flat-lying Vryheid Formation, Ecca Group, Karoo Supergroup. Dolerite dykes occur throughout the Karoo Supergroup. Structural geological features such as dykes and faults can have a measurable influence on ground water flow and mass transport. The Vryheid Formation sediments may attain a thickness of 120 – 140 m. A typical profile includes soil and clay, sandstone and siltstone, shale, 2 upper seam, shale, 2 seam, sandstone, no 1 seam, shale and dolomite at the bottom. The typical colours for the Vryheid Formation are grey and yellow for the sediments and black for the coal seam. The thickness of the grey shale can vary and this is interlayered with the also variable yellow sandstone and coal seams.

Kent (1980) described the Volksrust Formation as the 150-270 m of shale which overlies the Vryheid Formation. The deposition of this formation coincides with that of the Fort Brown and Waterford Formations in the south (Snyman 1996). It occurs from the south of Kwazulu-Natal into the Free State and is concordant (Visser 1989). Very little is written on the Volksrust Formation. It rests conformably on the Vryheid Formation. Fossils consist of fish scales and wood. This formation reaches thicknesses of 170-270 m (Visser 1989). A monotonous sequence of grey shale is present and fossils are significant, but very rarely recorded. Fossils include rare temnospondyl amphibian remains, invertebrates, minor coals with plant remains, petrified wood, and low-diversity marine to non-marine trace fossil assemblages (Groenewald and Groenewald 2014).

The Vryheid Formation is named after the type area of Vryheid-Volksrust. In the north-eastern part of the basin the Vryheid Formation thins and eventually wedges out towards the south, southwest and west with increasing distance from its source area to the east and northeast (Johnson 2009). The Vryheid Formation consists essentially of sandstone, shale, and subordinate coal beds, and has a maximum total thickness of 500 m. It forms part of the Middle Ecca (Kent 1980). This formation has the largest coal reserves in South Africa. The pro-delta sediments are characterised by trace and plants fossils (Snyman 1996).

Coal has always been the main energy source in industrial South Africa. It is in Mpumalanga, south of the N4, that most of the coal-fired power stations are found. Eskom is by far the biggest electricity generator in Africa. Thick layers of coal just below the surface are suited to open-cast mining and where the overlying sediments are too thick, shallow underground mining. In 2003, coal was South Africa's third most valuable mineral commodity and is also used by Sasol for fuel- and chemicals-from-coal (Norman and Whitfield 2006). Grodner and Cairncross (2003) proposed a 3-D model of the Witbank Coalfield to allow easy evaluation of the sedimentary rocks, both through space and time. Through this, one can interpret the environmental conditions present at the time of deposition of the sediments. This can improve mine planning and mining techniques. The Vryheid Formation is underlain by the Dwyka Group and is gradually overlain by mudstones (and shale) and sandstones of the Volksrust Formation. The typical colours for the Vryheid Formation are grey and yellow for the sediments and black for the coal seam. The thickness of the grey shale can vary and this is interlayered with the also variable yellow sandstone and coal seams.

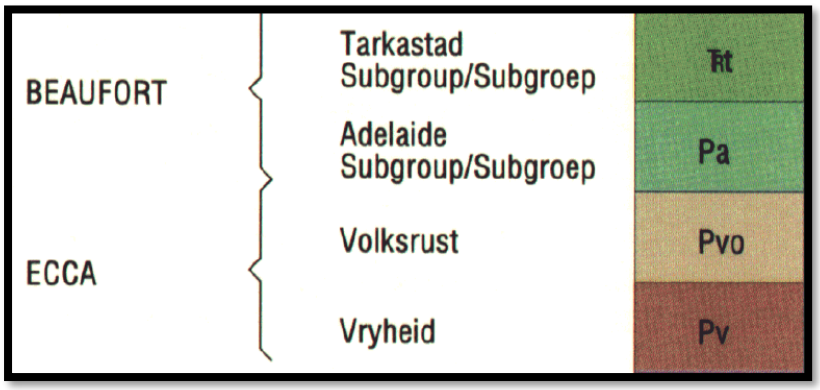

Figure 4: Lithostratigraphic column of the Karoo Supergroup in development area (Johnson and Verster 1994).

G. Background to Palaeontology of the area

Summary: When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, a desk top and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB, 2012).

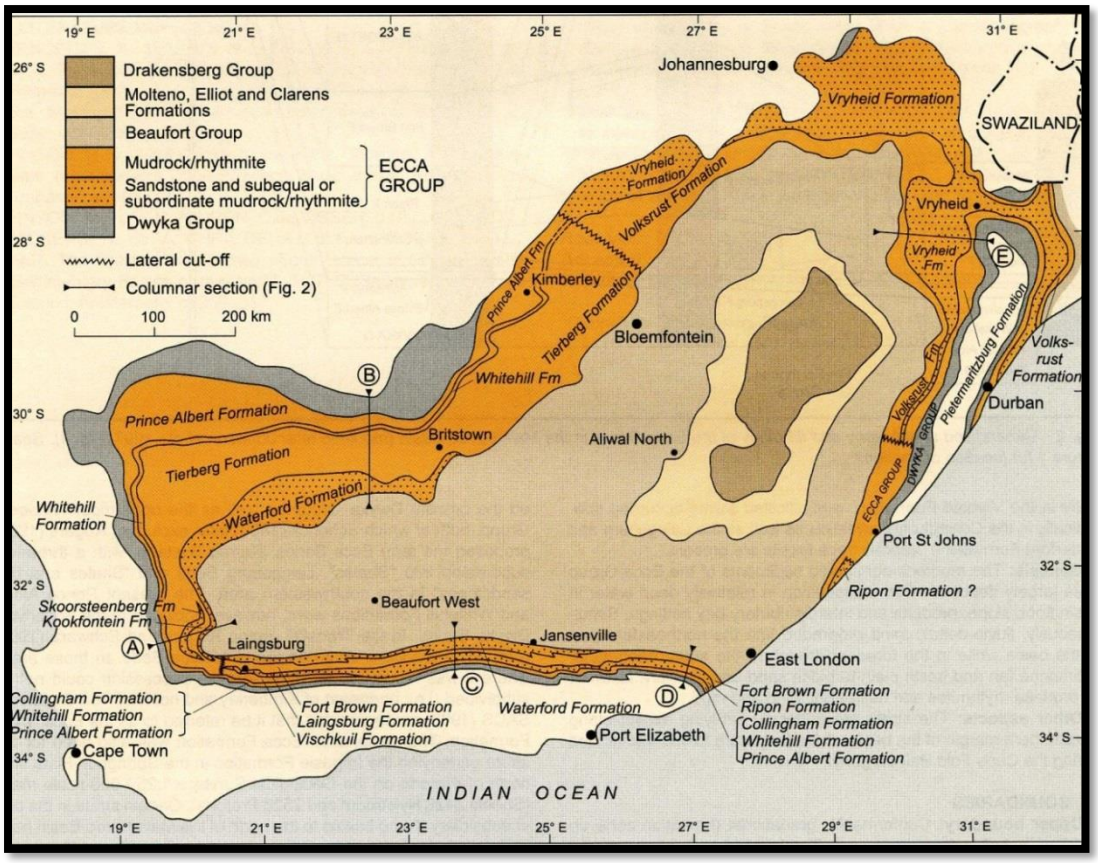

Figure 5: Extent of the Ecca Group (Johnson 2009).

The rocks of the Karoo Supergroup are internationally acclaimed for their richness and diversity of fossils. The rocks of the Beaufort Group of South Africa cover approximately one-third of the land surface and have yielded an abundance of well-preserved therapsids and other tetrapods which have been used to subdivide this Group into nine faunal Assemblage Zones.

Further to the lithostratigraphy, the Beaufort Group is divided into biostratigraphic units. Zones present in the study area are the *Daptocephalus* Assemblage Zone including the upper part of the Teekloof Formation (west of 24°), Adelaide Subgroup, Balfour Formation (between 24 and 25° east), and Normandien Formation (east of 25° east) and the *Lystrosaurus* Assemblage Zone. It is characterised by the abundance of *Dicynodon* in association with *Emydops, Pristerodon, Lystrosaurus maccaigi, Dinanomodon; Palemydops Aulacephalodon* and *Oudenodon; Diictodon,* and several Therocephalia such as *Theriognathus microps* and the Cynodont *Cynosaurus* amongst others (Rubidge 1995). Plant fossils such as *Glossopteris* and silicified wood are also present. In this area the biozone boundaries are uncertain. The *Daptocephalus* Assemblage Zone overlies the *Cistecephalus* Assemblage zone (Viglietti 2020).

Well preserved fossils of therapsids occur in mudrock horizons, and are usually found as dispersed, isolated specimens associated with an abundance of calcareous nodules. An abundant and varied therapsid fauna as well as amphibian and fish fossils have been recovered from the lower half of the stratigraphic levels assigned to the *Daptocephalus* Assemblage Zone in the main Karoo basin. However, in the upper levels the fauna shows a marked decrease in diversity (Rubidge 1995).

The Ecca Group, Vryheid Formation may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009).

Glossopteris trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005). Sediments of the Group contain significant reserves of coal and the interbedded shale is an important source of clay for brick making (Groenewald and Groenewald 2014).

The Volksrust Formation consists of a monotonous sequence of grey shale and fossils are significant, but very rarely recorded. Fossils include rare temnospondyl amphibian remains, invertebrates, minor coals with plant remains, fish scales, petrified wood, and low-diversity marine to non-marine trace fossil assemblages (Groenewald and Groenewald 2014). The bivalve *Megodesmus* is described from this formation (Groenewald 2012).

The Glossopteris flora is thought to have been the major contributor to the coal beds of the Ecca. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Rocks of Permian age in South Africa are particularly rich in fossil plants (Rayner and Coventry 1985). The fossils are present in the grey shale interlayered with the coal seams. The fossils are not very rare and occur also in other parts of the Karoo stratigraphy. It is often difficult to spot the greyish fossils as they are the same colour as the grey shale in which they are present as these coalified compressions have been weathered to leave surface replicas on the enclosing shale matrix. The pollen of the Greenside Colliery near Witbank also on the Vryheid Formation was the focus of a Ph.D study. A locality close to Ermelo, also Vryheid Formation, has yielded *Scutum, Glossopteris* leaves, *Neoggerathiopsis* leaves, the lycopod *Cyclodendron leslii,* and various seeds and scale leaves (Prevec 2011).

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of strata the palaeontological sensitivity is generally **VERY LOW** to **VERY HIGH**, but here locally as below:

Table 1: Taken from Palaeotechnical Report (Groenewald 2012) (**1cA)**.

Adelaide (Pa / Pne)		Deltaic and fluvial sequences of sandstone and green-grey mudstone	*Dicynodon* and *Lystrosaurus* assemblage zones. Fish, amphibians, reptiles, therapsids and vertebrate burrows
Normandien (Pn)	Harrismith	Lacustrine environment. Fine-grained brightly coloured siltstone	*Lystrosaurus* Assemblage zone. Fish, amphibians, reptiles, therapsids and vertebrate burrows
	Schoondraai	Meandering river channel sandstone	*Dicynodon* Assemblage Zone
	Rooinek	Meandering river channel sandstone	*Glossopteris* tree fossils and insect wings
Estcourt (Pe / Pes) / Emakwazini (Pem)		Deltaic Coarse-grained sandstone and shale	Trace Fossils, including areas in the Estcourt Area, plant fossils of *Glossopteris*
Volksrust (Pvo)		Dark Grey Shale	Trace Fossils
Vryheid (Pv)		Light grey coarse- to fine-grained sandstone and siltstone. Dark coloured siltstone due to presence of carbon enrichment and coal beds	Abundant plant fossils of *Glossopteris* and other plants. Trace fossils. The reptile *Mesosaurus* has been found in the southern part of the Karoo Basin

Table 2: Criteria used (Fossil Heritage Layer Browser/SAHRA) (**1cB)**:

Rock Unit	Significance/vulnerability	Recommended Action
Jurassic Dolerite	Very Low	No action required
Adelaide Subgroup	Very High	Desktop Study and Phase 1: Field Assessment required
Volksrust Formation	Moderate	Desktop Study required
Vryheid Formation	Very High	Desktop Study and Phase 1: Field Assessment required

Databases and collections: Ditsong: National Museum of Natural History. Evolutionary Studies Institute, University of the Witwatersrand (ESI).
Impact: **VERY HIGH** for the Vryheid Formation and **MODERATE** for the Volksrust Formation, Karoo Supergroup. There are significant fossil resources that may be impacted by the development (mudstone, shale) and if destroyed are no longer available for scientific research or other public good (Almond, *et al.* 2009).

The Project includes one locality Option with a **VERY HIGH** palaeontological sensitivity (see Figure 2) (**1j)**:
Option 1: A mining area indicated in red situated 12 km west of Colenso, with Ladysmith and Estcourt as the largest towns nearby. The N11 National Road is south and the Tugela River is the northern border. The project is approximately 6 333,2240 ha in size.

H. Description of the Methodology (1e)
The palaeontological impact assessment study was undertaken in May 2025. A Phase 1: Field Study includes a survey of the affected portion with photographs taken (in 7.1 mega pixels) of the site with a digital camera (Canon PowerShot A470). Additionally, a Global Positioning System (GPS) (Garmin eTrex 10) is used to record fossiliferous finds and outcrops (bedrock) when the area is not covered with topsoil, subsoil, overburden, vegetation, grassland, trees or waste. The survey did identify the Karoo Supergroup. A literature survey is included and the study relied heavily on geological maps.

SAHRA document 7/6/9/2/1 requires track records/logs from archaeologists not palaeontologists as palaeontologists concentrate on outcrops which may be recorded with a GPS. Isolated occurrences of rocks usually do not constitute an outcrop. Fossils can occur in dongas, as nodules, in fresh rock exposures, and in

riverbeds. Finding fossils require the experience and technical knowledge of the professional palaeontologist, but that does not mean that an amateur can't find fossils. The geology of the region is used to predict what type of fossil and zone will be found in any particular region. Archaeozoologists concentrate on more recent fossils in the quaternary and tertiary deposits.

Assumptions and Limitations (**1i)**:-
The accuracy and reliability of the report **may be** limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. Inaccessibility of site –no site visit was conducted.
7. Insufficient data from developer and exact lay-out plan for all structures - sufficient.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes.

Act No. 25 of 1999. National Heritage Resources Act, 1999.
National Estate: 3 (2) (f) archaeological and palaeontological sites,
(i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,
Heritage assessment criteria and grading: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;
(b) Grade 2: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 3: Other heritage resources worthy of conservation.
SAHRA is responsible for the identification and management of Grade 1 heritage resources.
Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 2 heritage resources.
Local authorities identify and manage Grade 3 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.
Archaeology, palaeontology and meteorites: Section 35.
(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources

authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

I. Description of significant fossil occurrences

All Karoo Supergroup geological formations are ranked as **VERY LOW** to **VERY HIGH**, and here the impact is potentially **VERY HIGH** for the Beaufort Group.

The Jurassic Dolerite does not contain fossils.

The Ecca Group may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005). Sediments of the Group contain significant reserves of coal and the interbedded shale is an important source of clay for brick making (Groenewald and Groenewald 2014).

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Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to be determined due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot.

The threats are:-

- Earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during mining,
- The sealing-in or destruction of fossils by development, vehicle traffic, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation (1o,1p,1q)

a. There is no objection (see Recommendation B) to the development, it will be necessary to request a Phase 1 Palaeontological Impact Assessment: Field Study to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity is **VERY HIGH.** If chance fossils are found during construction a Phase 2 Palaeontological Assessment: Mitigation is recommended. Protocol is attached (Appendix 2).
b. Preferred choice: Only one locality Option is presented and possible.
c. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, or drilling AMAFA must be notified. All mining activities must be stopped, a 30 m no-go barrier constructed, and a palaeontologist should be called in to determine proper mitigation measures.
d. This report must be submitted to AMAFA together with the Heritage Impact Assessment.

Sampling and collecting **(6m,6k)**:
Wherefore a permit is needed from the South African Heritage Resources Agency (SAHRA / PHRA).

a. Objections: Cautious. See heritage value and recommendation.
b. Conditions of development: See Recommendation.
c. Areas that may need a permit: Yes, if a fossil is found.
d. Permits for mitigation: If fossils are found, Needed from SAHRA/AMAFA prior to Mitigation.

K. Conclusions

a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
b. All information needed for the Palaeontological Impact Assessment was provided by the Consultant. All technical information was provided by Nyamoki Consulting (Pty) Ltd.

c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
d. No consultation with parties was necessary.
e. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, drilling or blasting, AMAFA must be notified. All mining activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures.
f. This project may benefit the economy, the life expectancy of the community, the growth of the community and social development in general.
g. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment (fossils/dongas) and adjacent areas as well as for safety and security reasons.

L. Bibliography

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Declaration (1b)

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological assessment. There are no circumstances that compromise the objectivity of me performing such work.

I accept no liability, and the client, by receiving this document, indemnifies me against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

It may be possible that the Palaeontological Impact Assessment may have missed palaeontological resources in the project area as outcrops are not always present or visible while others may lie below the overburden of earth and may only be present once development commences.

This report may not be altered in any way and any parts drawn from this report must make reference to this report.

POPI Act 2013 Statement

It provides that everyone has the right to privacy and includes a right to protection against the unlawful collection, retention dissemination and use of personal information contained in this document and pertains to the phone and contact details, signature and contents.

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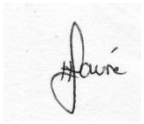

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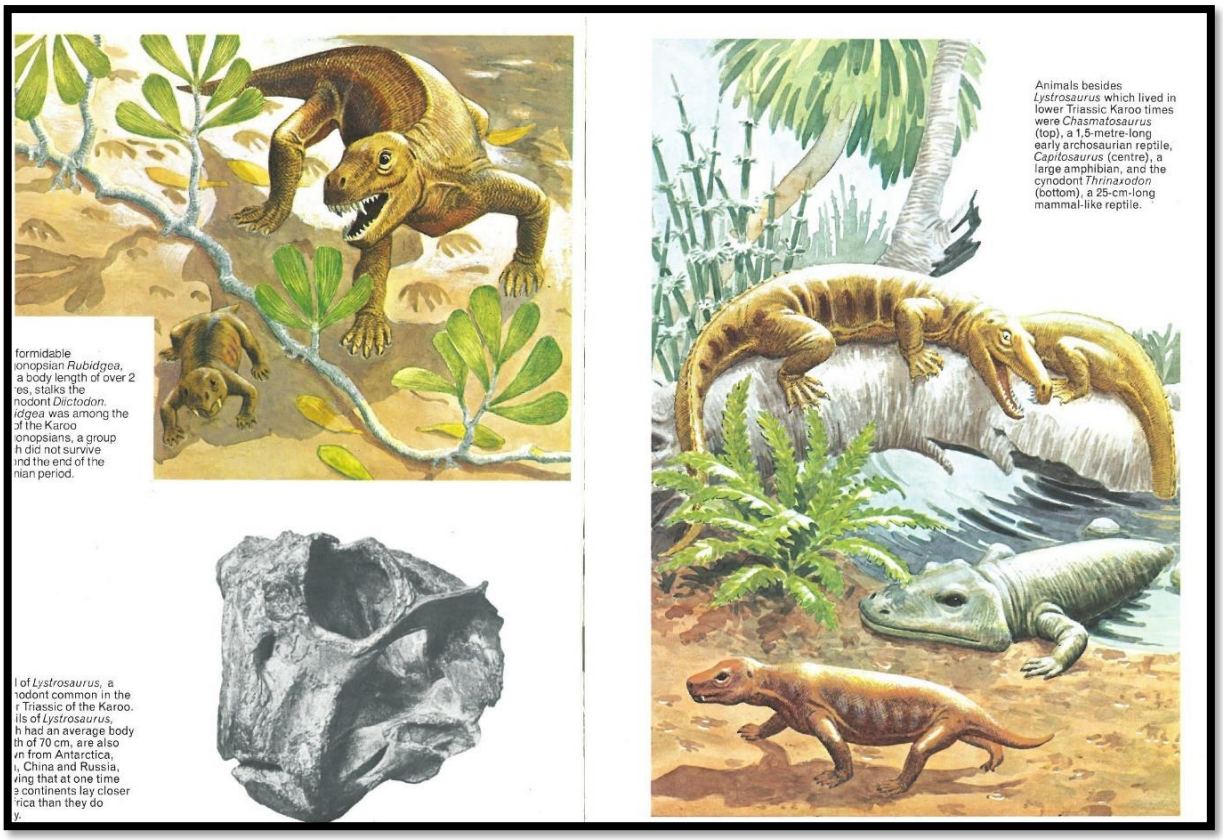
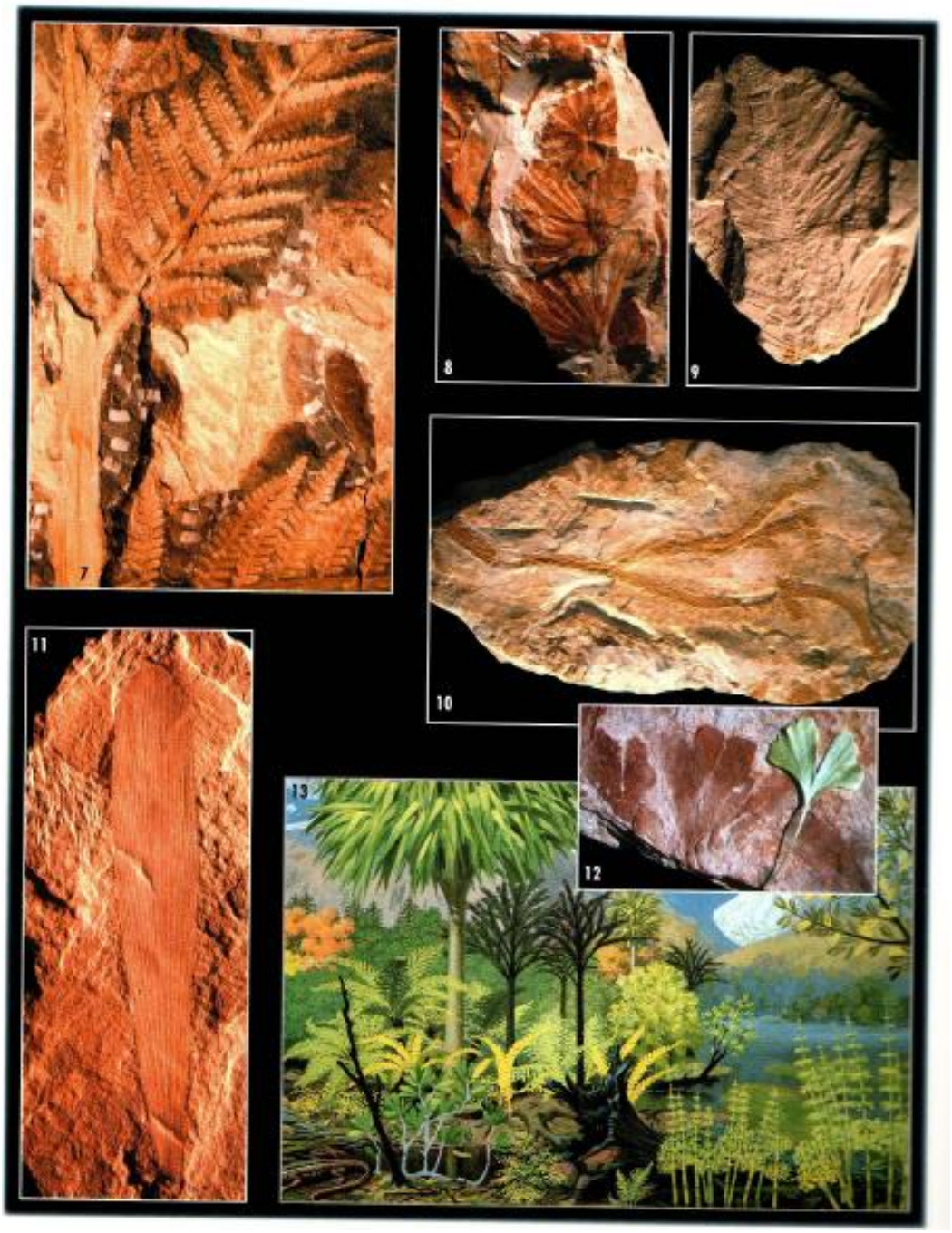
Heidi Fourie
2025/05/12

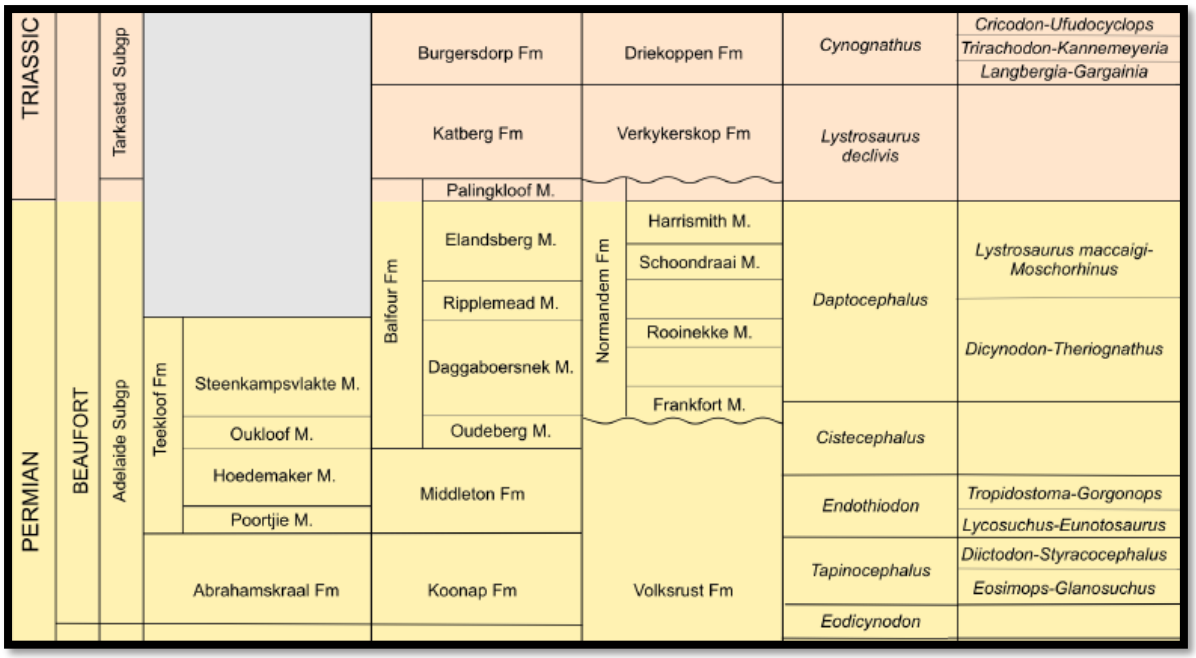


Karoo scene (Cluver 1978)

Appendix 1: Examples of Ecca Group fossils (Cluver 1978).



Appendix 2: Biozonation range of the Beaufort Group (EC 4th column from right) (Smith *et al.* 2020).



Appendix 3: Protocol for Chance Finds and Management Plan (also include Section B) **(1k,1l,1m)**
This section covers the recommended protocol for a Phase 2 Mitigation process as well as for reports where the Palaeontological Sensitivity is **LOW**; this process guides the palaeontologist / palaeobotanist on site and should not be attempted by the layman / developer.

- As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction/prospecting/mining activities in line with the legally binding Environmental Management Programme (EMPr) so that when a fossil is unearthed, they can notify the relevant department and specialist to further investigate.
- The ECO should familiarise him- or herself with the applicable formations and its fossils.
- The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities.
- It is recommended that the EMPr be updated to include the involvement of a palaeontologist for pre-construction training of the ECO or during the digging and excavation phase of the development.
- The ECO must visit the site after clearing, drilling, excavations and blasting and keep a photographic record.
- The developer may be required to survey the areas affected by the development and indicate on plan where the construction / development / mining will take place. Trenches may have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give an indication of the depth of the topsoil, subsoil, and overburden, if need be, trenches should be dug deeper to expose the interburden.
- For a chance find, the protocol is to immediately cease all construction activities, construct a 30 m no-go barrier, and contact SAHRA for further investigation. Construction workers must be informed that this is a no-go area.
- A representative sample must be put aside for inspection. This sample can be sent to a recognised palaeontological repository for curation and safe keeping after the permit was obtained.
- The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity. A Phase 2 study is very

often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during mining or excavations. In order for this to happen, in case of coal mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good plant localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.
10. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied

that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining/ construction/ development operations and dig representative trenches and if possible supply geological borehole data. When the route is better defined, it is recommended that a specialist undertake a 'walk through' of the entire road as well as construction areas, including camps and access roads, prior to the start of any construction activities, this may be done in sections.
2. When clearing vegetation, topsoil, subsoil or overburden, hard rock (outcrop) is found, the contractor needs to stop all work.
3. A Palaeobotanist / palaeontologist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
4. If the palaeontologist / palaeobotanist is satisfied that no fossils will be destroyed or have removed the fossils, development and removing of the topsoil can continue.
5. After this process the same palaeontologist / palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.
6. When permission for the development is granted, the next layer can be removed, if this is part of a fossiliferous layer, then with the removal of each layer of sediment, the palaeontologist / palaeobotanist must do an investigation (a minimum of once every week).
7. At this stage the palaeontologist / palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the palaeontologist / palaeobotanist.

The South African Heritage Resources Agency has the following documents in place:
Guidelines to Palaeontological Permitting policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.
Palaeotechnical Reports (Eastern Cape, North West, Northern Cape, Mpumalanga, Gauteng, Western Cape, Free State, KwaZulu Natal, and Limpopo)

Appendix 4: Table 2: Listing points in Appendix 6 of the Act and position in Report (bold in text).

Section in Report	Point in Act	Requirement
B	1(c)	Scope and purpose of report
B	1(d)	Duration, date and season
B	1(g)	Areas to be avoided
D	1(ai)	Specialist who prepared report
D	1(aii)	Expertise of the specialist
F Figure 3	1(h)	Map

F	1(ni)	Authorisation
F	1(nii)	Avoidance, management, mitigation and closure plan
G Table 1	1(cA)	Quality and age of base data
G Table 2	1(cB)	Existing and cumulative impacts
G	1(f)	Details or activities of assessment
G	1(j)	Description of findings
H	1(e)	Description of methodology
H	1(i)	Assumptions
J	1(o)	Consultation
J	1(p)	Copies of comments during consultation
J	1(q)	Information requested by authority
Declaration	1(b)	Independent declaration
Appendix 3	1(k)	Mitigation included in EMPr
Appendix 3	1(l)	Conditions included in EMPr
Appendix 3	1(m)	Monitoring included in EMPr
D	2	Protocol or minimum standard

Appendix 5: Impact Statement

The development footprint is situated on the Ecca Group of the Karoo Supergroup with a Very High palaeontological sensitivity. The **nature of the impact is the destruction of Fossil Heritage.** Loss of fossil heritage will have a negative impact. The extent of the impact only extends in the region of the development activity footprint and may include transport routes. The expected duration of the impact is assessed as potentially permanent. The intensity/magnitude of the impact is high as it is destructive. The probability of the impact occurring will be definite and will occur regardless of preventative measures.

In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be irreversible. With Mitigation the impact will be moderate as replacing the disturbed strata through backfilling will ensure that the significance of the impact is minimised. The cumulative impact is low unless other developments are present in the area. Impacts on palaeontological heritage during the construction/mining and preconstruction/pre-mining phase could potentially occur and is regarded as having a high possibility. The significance of the impact occurring will be as below: S= (E+D+M) P

S= (2+5+8)5

75 High (>60).

Mitigation measures:

1. For a chance find, the protocol is to immediately cease all mining activities, construct a 30 m no-go barrier, and contact AMAFA for further investigation. Mining workers must be informed that this is a no-go area.
2. A representative sample must be put aside for inspection. This sample can be sent to a recognised palaeontological repository for curation and safe keeping after the permit was obtained.

All phases of the development will have the same impact.

Terrestrial Biodiversity Study Impact Assessment

PROPOSED MINING RIGHT APPLICATION

ON SELECTED FARMS SITUATED IN THE MAGISTERIAL DISTRICT OF UTHUKELA/ESTCOURT KWAZULU-NATAL PROVINCE.

2025

DOCUMENT CONTROL

Project title	TERRESTRIAL BIODIVERSITY STUDY: PROPOSED MINING RIGHT APPLICATION FOR COAL ON REMAINING EXTENT OF PORTION 1 AND REMAINING EXTENT OF THE FARM SCHURFDE POORT 1147 GS;THE FARM SHAWS NO.11317 GS; PORTION 1 AND THE REMAINING EXTENT OF THE FARM GANNA HOEK 1317 GS; PORTION 1 AND THE REMAINING EXTENT OF THE FARM KLIP BERG 2158 GT;THE FARM BRAKFONTEIN 1316 GS;PORTIONS 1, 2 AND THE REMAINING EXTENT OF THE FARM RAMAK 13696 GT, SITUATED IN THE MAGISTERIAL DISTRICT OF UTHUKELA/ESTCOURT KWAZULU-NATAL PROVINCE
Report reference	DUN/TBIA25
Document prepared for	DUNROSE INVESTMENTS 174 (PTY) LTD
Document prepared by	MORA Ecological Services (Pty) Ltd
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EXECUTIVE SUMMARY

MORA Ecological Services (Pty) Ltd was appointed to undertake a terrestrial biodiversity assessment in support of the proposed **Dunrose Investments 174 (Pty) Ltd mining right application** within the uThukela / Estcourt Magisterial District, KwaZulu-Natal Province. A combination of desktop review and field surveys was undertaken to evaluate the ecological value and sensitivity of the site, identify Species of Conservation Concern (SCC) and biodiversity driver species, assess vegetation condition and habitat integrity, and determine the potential impacts of the proposed mining activities on terrestrial flora, fauna, and ecological processes.

The assessment aimed to determine the ecological importance of the receiving environment, its role within the broader landscape, and the implications of the proposed mining activities for provincial and national biodiversity planning frameworks.

Results and Conclusions

The project area occurs within a **landscape of high ecological importance**, characterised by **largely pristine and intact Thukela Thornveld and Thukela Valley Bushveld vegetation** within the Savanna Biome. The site overlaps **with Critical Biodiversity Areas (CBA Irreplaceable and Optimal), forms part of the Tugela–Bushmans Thornveld Key Biodiversity Area, and includes land identified as a priority area for the National Protected Area Expansion Strategy (NPAES)**. These biodiversity planning layers collectively indicate a landscape critical to maintaining biodiversity patterns, ecological processes, and landscape-scale connectivity.

The study area supports a **high diversity of indigenous flora**, including protected and endemic plant species, and provides suitable habitat for a range of **faunal taxa**, including mammals, avifauna, reptiles, amphibians, and invertebrates. Several **Species of Conservation Concern** were confirmed or have a high likelihood of occurrence within the mining rights area. The intact vegetation matrix, together with drainage features, rocky outcrops, and habitat heterogeneity, contributes to faunal movement, dispersal, and persistence at both local and regional scales.

Although the vegetation types present are classified as **Least Concern at a national level**, their largely untransformed condition within the study area elevates their conservation importance. Disturbance within this intact landscape is likely to result in **disproportionate ecological impacts**, including habitat loss, fragmentation, disruption of ecological connectivity, and

increased susceptibility to **the establishment of Alien and Invasive Plant (AIP) species** along disturbed edges and access routes.

Without mitigation, the impacts associated with the proposed mining activities-particularly vegetation clearance, habitat fragmentation, disturbance to fauna, loss of biodiversity priority land, and secondary invasion by alien plant species- are assessed as **moderate to high**. With the strict implementation of mitigation measures, including avoidance of sensitive areas, footprint minimisation, buffering, effective AIP management, and progressive rehabilitation, most impacts can be reduced to **low to moderate significance**. However, **residual impacts associated with the loss of CBAs, KBA habitat, and NPAES priority land are likely to remain moderate**, even after mitigation.

Recommendations

Given the high ecological sensitivity of the site, the following measures are considered essential:

- All mining-related activities must be confined strictly to the **approved mining footprint**, with **no-go areas** designated for:
    - Critical Biodiversity Areas (Irreplaceable and Optimal),
    - Key Biodiversity Area trigger habitats,
    - NPAES priority areas,
    - Drainage lines, riparian zones, and other sensitive habitats.
- Sensitive ecological features must be **clearly mapped, demarcated, and buffered** prior to the commencement of any site activities.
- **Avoidance of high-sensitivity areas** must be prioritised in final layout planning. Where avoidance is not feasible, impacts must be minimised through footprint reduction and site-specific mitigation.
- All **Species of Conservation Concern**, including protected plant species, must be identified, mapped, and avoided where possible. Relocation may only occur as a last resort, under specialist supervision and subject to the relevant permits.
- **Existing access roads** must be used wherever possible. No new informal tracks may be created, and off-road driving must be strictly prohibited.

- **Alien and Invasive Plant species** must be managed under a formal Alien Plant Control Plan in accordance with NEM:BA requirements, with ongoing monitoring and control throughout the life of the project.
- Progressive rehabilitation must be implemented using **locally indigenous plant species**, with rehabilitation aimed at restoring ecological function, stabilising soils, and limiting secondary invasion by alien species.
- A **Biodiversity Offset** is recommended as a last resort to address residual impacts on CBAs, KBA features, and NPAES priority land that cannot be mitigated to low significance.
- Prior to disturbance, a **pre-clearance ecological walk-down** must be undertaken to identify and manage SCC and sensitive habitats within areas proposed for development.

All mitigation and management measures outlined in this assessment and associated specialist inputs must be fully incorporated into the Environmental Management Programme and implemented from the outset of the project.

Specialist Opinion

Based on the findings of this assessment, desktop evidence, field observations, and specialist judgement, the proposed Dunrose mining right may be considered **conditionally acceptable from a terrestrial biodiversity perspective**, provided that all recommended mitigation, avoidance measures, and offset requirements are strictly implemented, ecological sensitivities are respected, and compliance is maintained throughout the project life cycle. Failure to do so may result in unacceptable impacts on terrestrial biodiversity and long-term ecological degradation.

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DECLARATION BY THE SPECIALIST

I, Mokgatla Jerry Molepo declare that:

• I act as the independent specialist in this application.

• I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.

• I declare that there are no circumstances that may compromise my objectivity in performing such work.

• I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.

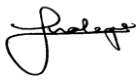
• I will comply with the Act, Regulations, and all other applicable legislation.

• I have no, and will not engage in, conflicting interests in the undertaking of the activity.

• I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority.

• all the particulars furnished by me in this form are true and correct; and

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



Signature of the Specialist

MORA Ecological Services (Pty) Ltd

Name of Company

25/06/2025

Date

I, Musa Baloyi declare that:

• I act as the independent specialist in this application.

• I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.

• I declare that there are no circumstances that may compromise my objectivity in performing such work.

• I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.

• I will comply with the Act, Regulations, and all other applicable legislation.

• I have no, and will not engage in, conflicting interests in the undertaking of the activity.

• I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority.

• all the particulars furnished by me in this form are true and correct; and

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

Signature of the Specialist

MORA Ecological Services (Pty) Ltd

Name of Company

25/06/2025

ABBREVIATION LIST

Abbreviation	Description
AIP	Alien and Invasive Plant
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CBA-I	Critical Biodiversity Area – Irreplaceable
CBA-O	Critical Biodiversity Area – Optimal
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
ESA	Ecological Support Area
ESA-C	Ecological Support Area – Corridor
EKZNW	Ezemvelo KZN Wildlife

INTRODUCTION

MORA Ecological Services (Pty) Ltd was appointed by Dunrose Investments 174 (PTY) LTD, to conduct an ecological specialist study towards their pursuit of obtaining the mining right application for coal on remaining extent of portion 1 and remaining extent of the Farm Schurfde Poort 1147, the Farm shaws no.11317 GS; portion 1 and the remaining extent of the Farm Ganna Hoek 1317 GS; portion 1 and the remaining extent of the Farm Klipberg 2158 GT the Farm Brakfontein 1316 GS portions 1, 2 and the remaining extent of the Farm Ramak 13696 GT, situated in the Magisterial District of uThukela Kwazulu-Natal Province.

Biodiversity plays a pivotal role in South Africa's development, encompassing economic, socio-economic, and sustainable livelihood dimensions. The preservation of species, ecosystems, and ecological processes is imperative for the long-term sustainable utilization of the country's ecological resources. Effective governance in the biodiversity sector is essential to ensure these resources remain available for future generations.

Mining activities can cause multiple ecological disruptions, affecting terrestrial ecosystems through various mechanisms. The mining process often requires clearing large tracts of vegetation, resulting in habitat destruction and fragmentation. This not only displaces the resident flora and fauna but also alters the natural landscape and soil structure, making it inhospitable for many species.

Moreover, excavation and extraction processes cause significant soil erosion and compaction, which can adversely affect plant root systems and water infiltration rates. Removing topsoil, rich in organic matter and nutrients, can further degrade the land's capacity to support vegetation, reducing biodiversity and increasing the risk of invasive species.

In addition to physical disturbances, mining activities can introduce pollutants, such as heavy metals and other toxic substances, into the surrounding environment. These contaminants can leach into soil and water systems, causing adverse effects on plant and animal life. Changes to watercourses can also disrupt the area's hydrology, affecting the availability and quality of water for ecological processes.

Although mining is essential to the economy, the cumulative impact of these factors degrades terrestrial ecosystems, necessitating comprehensive environmental management strategies to mitigate the adverse effects of mining.

Project Locality

The proposed project site is located at (28°41'1.39"S and 29°58'59.54"E), approximately 10 km northwest of Colesto township (R103), in the Uthukela District Municipality and Inkosi Langalibelele Municipality, KwaZulu-Natal (Figure 1).

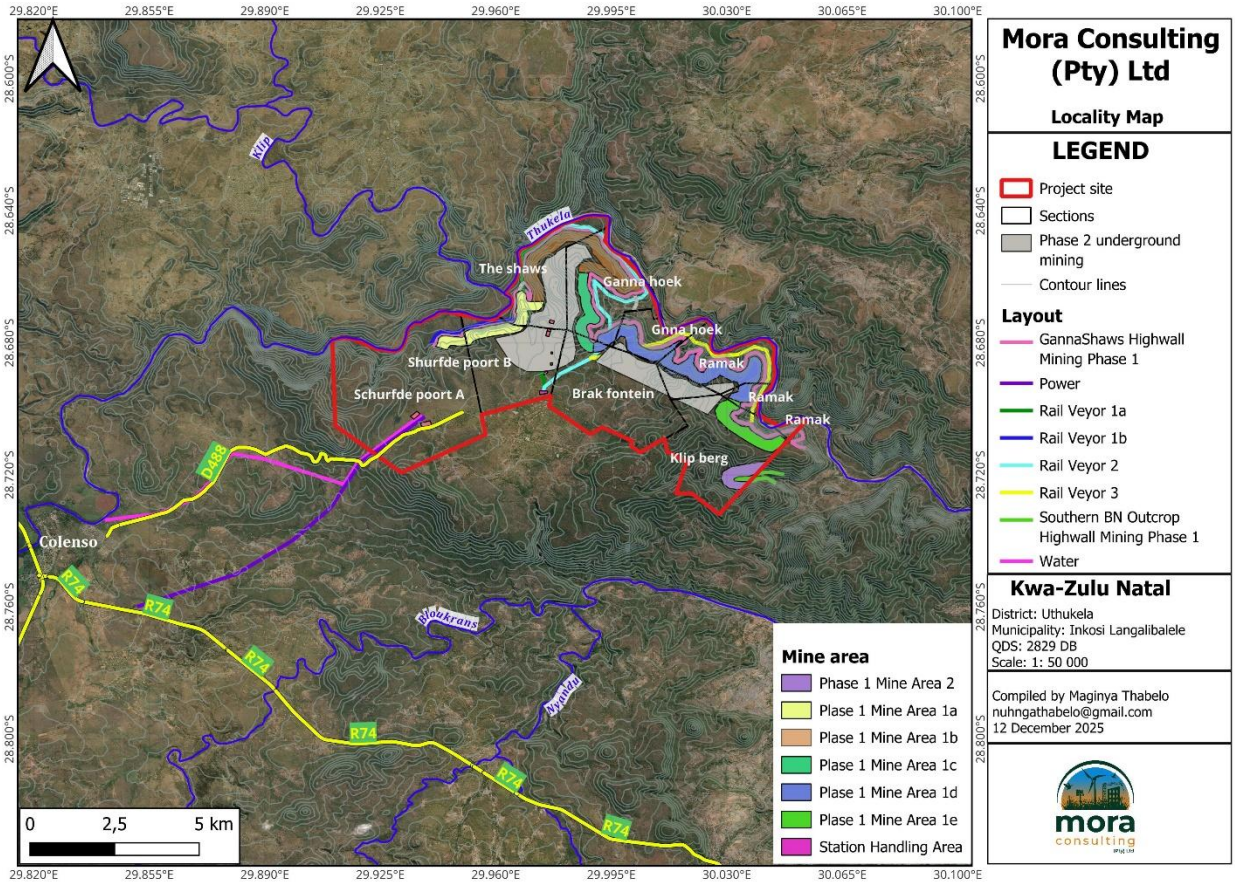


Figure 1: Locality Map of the proposed mining rights.

Land uses on site

The proposed mining rights area land uses are depicted in Figure 2 below. The project area falls within a largely pristine ecosystem. Ground-truthing further supported the area's status as pristine and largely in its natural state.

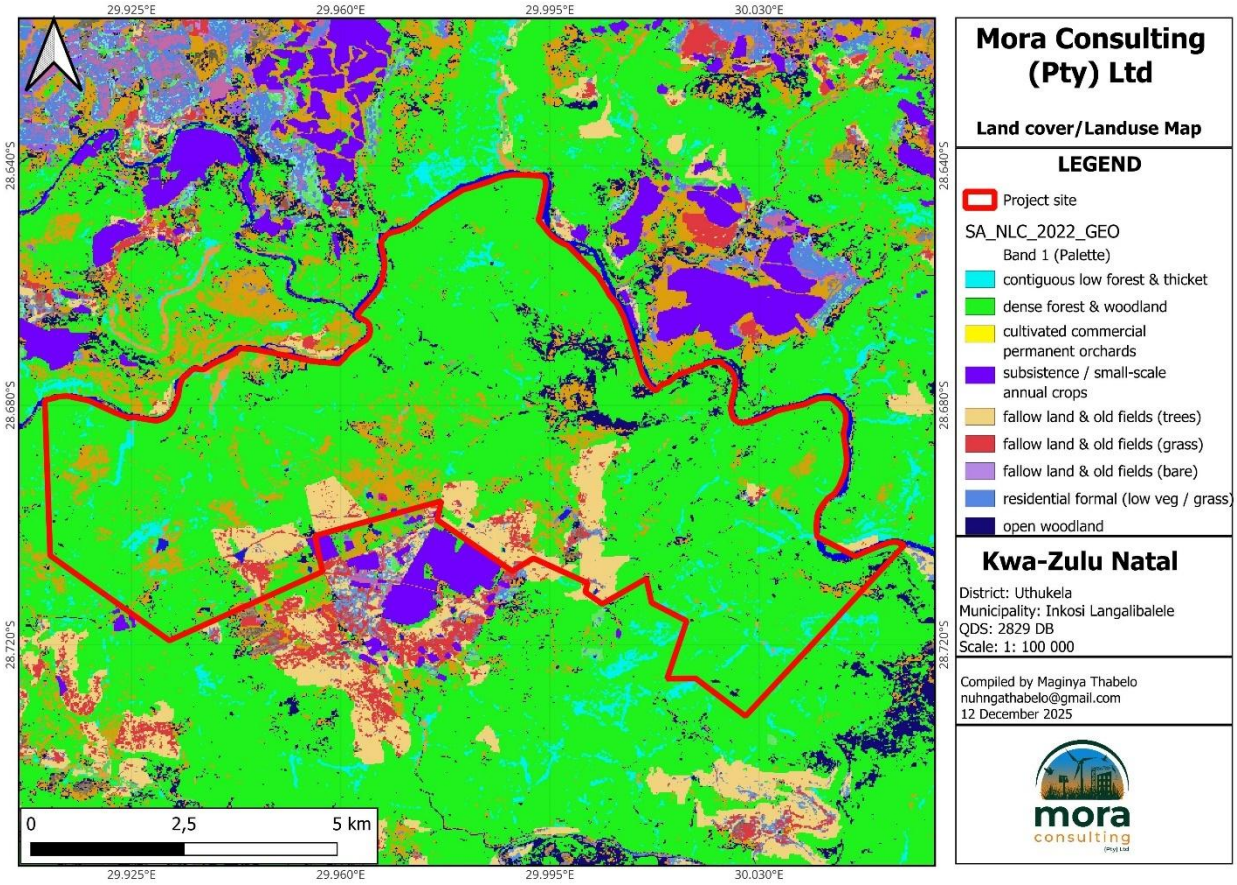
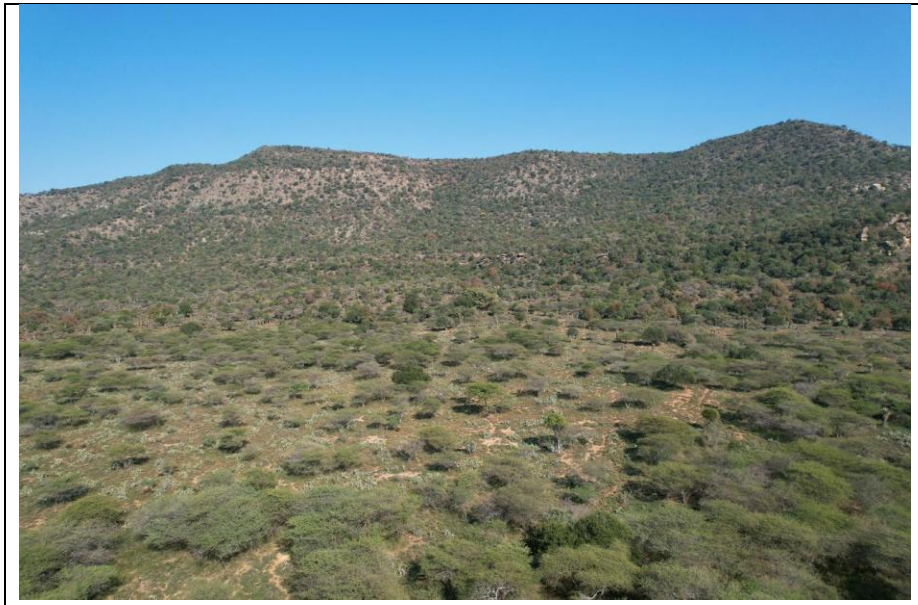


Figure 2: Land use and Cover of the proposed mining rights.

Landscape photographs of the proposed site.



TERMS OF REFERENCE

The primary objective of this specialist study is to assess the site's biodiversity sensitivity based on desktop and field assessments and mapping using the national vegetation classification system. The main objective of the assessment was to include in the species list every species with even the slightest chance of occurring within the site. The following tasks were undertaken by MORA Ecological Services (Pty) Ltd to achieve the assessment objective:

- A visual inspection of the study area was done before surveys were conducted.
- The site was surveyed on foot and by vehicle to determine the floristic composition.
- A plotless, random sampling method was used to record floral species.
- Species identification was done following reputable checklists and field guides.
- Where necessary, plant material was collected and/or photographs taken of specimens for identification purposes.

ASSUMPTIONS, LIMITATIONS, UNCERTAINTIES AND GAP ANALYSIS

- The observations, findings, conclusions, and recommendations provided in this report are based on the results of this survey, the available information regarding the potential impacts of the proposed mining activities and the author’s best scientific and professional knowledge.
- Access to all areas of the property was limited.
- The assessment of impacts was based on the current state of the primary environment.
- MORA Ecological Services (Pty) Ltd relied on the client to supply correct information on the site locality and extent, as well as project details which were assumed to be correct.
- It was assumed that the information contained in existing databases, reports and publications is correct.

MORA reserves the right to amend this report, recommendations and/or conclusions at any stage should any additional or otherwise significant information come to light.

LEGAL FRAMEWORK RELATING TO FLORA SPECIES AND PROPOSED DEVELOPMENT

International Law and Conventions

The importance of sustainable development and the protection of environmental resources have globally become a driving factor in the construction of new legislation governing industrial practices and their impact on the environment. South Africa has signed and ratified several global treaties, protocols, and conventions, agreeing to implement the policies, which endorse sustainable development and promote a positive environmental legacy for future generations. A considerable international convention to which South Africa agrees to signatory is namely the Convention on Biological Diversity (CBD). The CBD is notably the key international convention for sustainable development. The CBD has three main objectives which lead and encourage a sustainable future. These are:

- The conservation of biological diversity.
- The sustainable use of its components; and
- The fair and equitable sharing of the benefits from the use of genetic resources.

The convention covers all possible domains that are directly or indirectly related to biodiversity and its role in development, ranging from science, politics and education to agriculture, business, and culture.

South African Constitution

The foundation of South Africans Environmental law is set in the Constitution of the Republic of South Africa (1996), specifically “Chapter 2- The Bill of Rights: section 24”. This has allowed for the rapid development of environmentally based legislations which guard, enforce, and guide all parties to maintain the human rights granted in the Constitution. These rights include:

- The right to an environment that is not harmful to their health or well-being; and

- To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

National Environmental Management Act (NEMA)

The National Environmental Management Act (NEMA), Act 107 of 1998 is the fundamental environmental legislation which aims to strengthen the rights granted in the South African Constitution. The NEMA Act is the foundation of environmental law in South Africa and has set the framework for additional legislation to build on. The Act establishes principles for decision-making on environmental matters, as well as providing motive for institutions which promote cooperative governance, and which can coordinate environmental action plans. Section 2(4) specifies that sustainable development requires the consideration of all relevant factors. In the regard to biodiversity and South Africa's ecological integrity, development should not result in the disturbance of ecosystems and loss of biological diversity, if not possible, these effects must be minimised and remedied. A low-risk, cautious approach should always be applied, considering limits of current knowledge concerning consequences and actions. Always anticipate possible negative impacts on the environment and people's environmental rights, identified impacts should be prevented and where they cannot be altogether prevented, are minimised, and mitigated. Outlined NEMA principles about biodiversity are to:

- Prevent pollution and ecological degradation.
- Promote conservation; and
- Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

National Environmental Management of Biodiversity Act (NEMBA)

The National Environmental Management of Biodiversity Act (NEMBA) Act 10 of 2004 was designed to provide a management and conservation outline for biological diversity, as drafted under the NEMA. NEMBA focuses on the management and conservation of biodiversity, with its

relevant components, which includes the use of indigenous biological resources in a sustainable manner, the fair and equitable sharing of benefits arising from bio-prospecting, cooperative governance in biodiversity management and conservation within the structures of NEMA. The Act, in protecting biodiversity, deals with the protection of threatened ecosystems and species, the control of alien invasive species, genetically modified organisms and regulates bio-prospecting. As with NEMA, NEMBA incorporates and gives effect to international agreements relating to biodiversity. The Act gives the Minister of Environmental Affairs, Forestry and Fisheries the power to categorise any process or activity in a listed ecosystem, as a threatening process, thereafter, be regarded as an activity contemplated in Section 24(2) (b) of NEMA which states that: Specified activities may not be commenced without prior authorisation from the Minister or MEC and specify such activities. NEMBA is the most prominent statute containing provisions directly aimed at the conservation of b with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). The NEMBA Regulations on Threatened or Protected Species (TOPS, 2007) lists all the species that are threatened with extinction and therefore, nationally protected under an approach to sustainable use and development. Periodically, Red Data books are published, and the data used to update these lists of protected species.

Additionally, NEMBA regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. The purpose of Chapter 5 is:

- To prevent the unauthorized introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur.
- To manage and control alien species and invasive species to prevent or minimize harm to the environment and to biodiversity.
- To eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

According to Section 65 of the Act, "Restricted activities involving alien species":

- A person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7.

Restricted activities include the following:

- Importing into the Republic, including introducing from the sea, any specimen of a listed invasive species.
- Having in possession or exercising physical control over any specimen of a listed invasive species.
- Growing, breeding or in any other way propagating any specimen of a listed invasive species or causing it to multiply.
- Conveying, moving, or otherwise translocating any specimen of a listed invasive species.
- Selling or otherwise trading in, buying, receiving, giving, donating, or accepting as a gift, or in any other way acquiring or disposing of any specimen of a listed invasive species.
- Spreading or allowing the spread of any specimen of a listed invasive species.
- Releasing any specimen of a listed invasive species.

National Environmental Management: Protected Areas Act (Act 57 of 2003) (NEMPAA)

NEMPAA provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The Act also supports the establishment of a national register of all national; provincial, and local protected areas for the management of those areas per national norms and standards, for intergovernmental cooperation and public consultation in matters concerning protected areas, for continued existence, governance and functions of South African National Parks, and for matters concerning protected areas.

Section 50(5) of NEMPAA states that "no development, construction or farming may be permitted in a nature reserve or world heritage site without the prior written approval of the management authority."

Conservation of Agricultural Resources Act (Act No. 43 of 1983)

In terms of the amendments to the regulations under this Act, landowners are legally responsible for the control of invasive alien plants on their properties. The schedules provide a list of declared weeds and invaders, which have been divided into three categories, as follows:

- Category 1 plants are prohibited and must be controlled.
- Category 2 plants (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants (ornamentally used plants) may no longer be planted; existing plants may remain, if all reasonable steps are taken to prevent the spreading there of, except within the flood line of watercourses and wetlands.

BIOME AND BIOREGION

Savanna Biome

The site is located in the Savanna Biome (Figure 3). The Savanna vegetation of South Africa and Swaziland constitutes the southernmost extension of the most widespread biome in Africa. It represents 32.8% of South Africa (399 600 km^2) and 74.2% of Swaziland (12 900 km^2). It extends beyond the tropics to meet the Nama-Karoo Biome on the central plateau, the Grassland Biome at higher altitudes towards the east, and down the eastern seaboard interior and valleys, where it grades into Albany Thicket in the Eastern Cape.

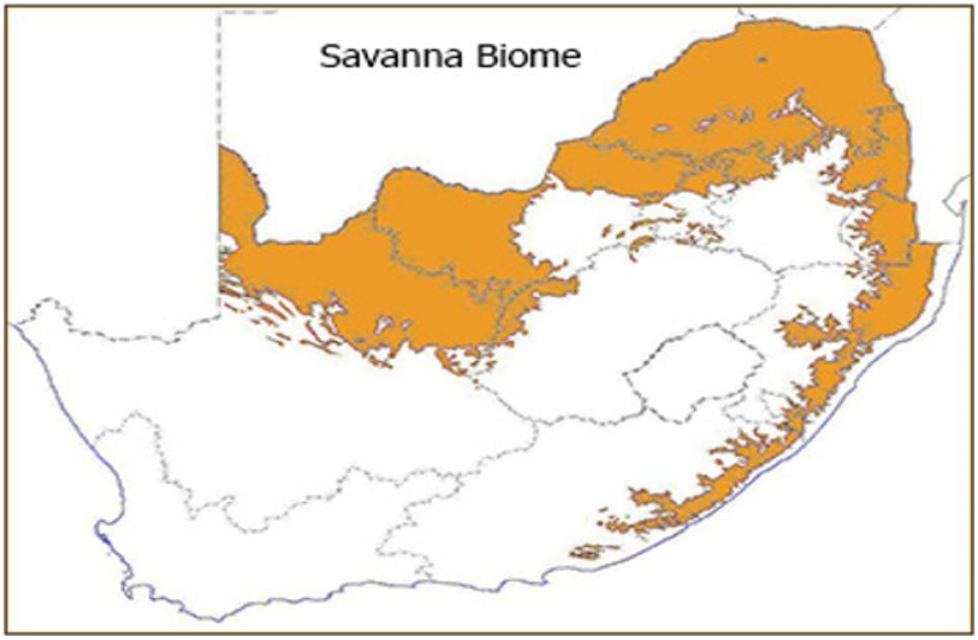


Figure 3: Location map of the Savanna Biome within South Africa (Low & Rebelo, 1996).

Vegetation types and biophysical descriptions

Vegetation units are broadly classed and may include several distinct vegetation communities within a unit (Mucina and Rutherford, 2006). The vegetation types found on the study site are Thukela Thornveld and Thukela Valley Bushveld (Figure 4)

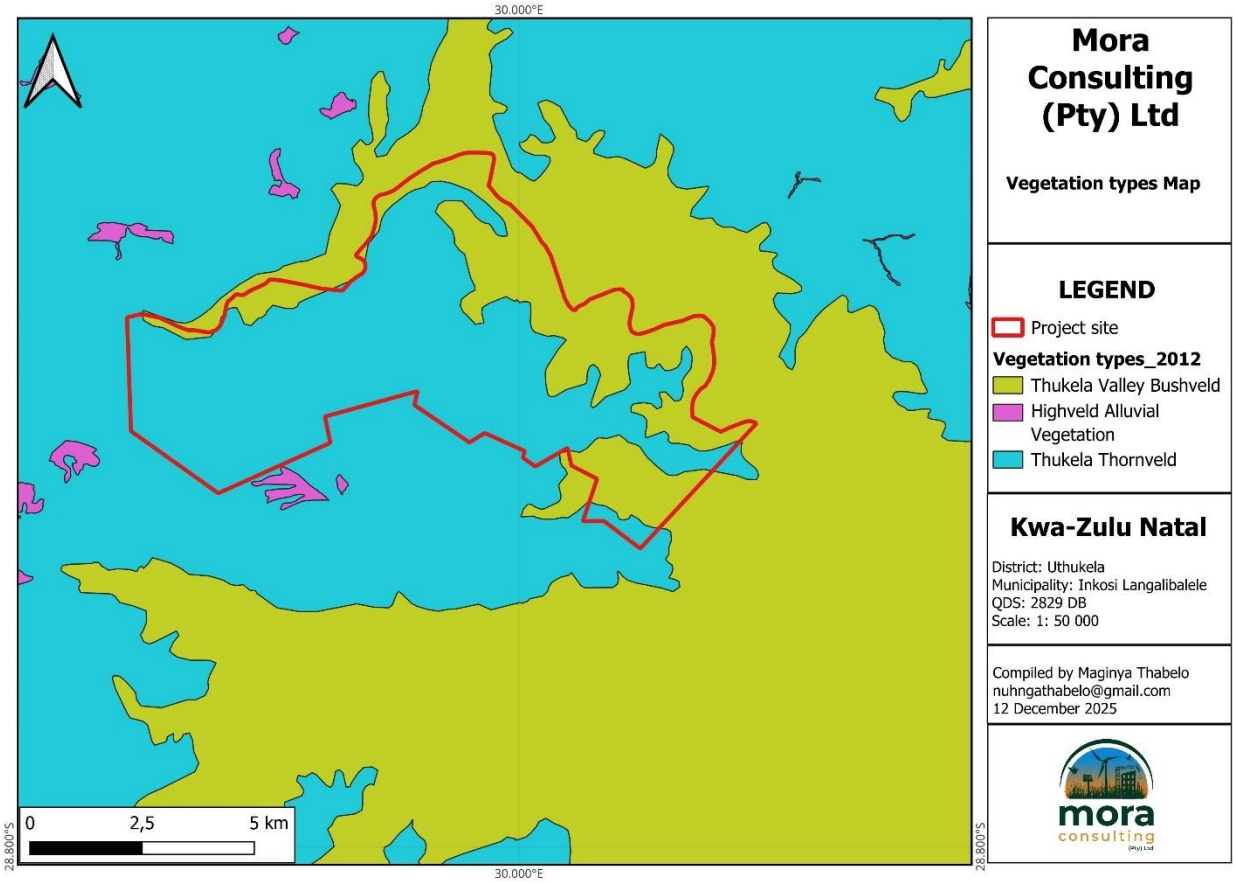
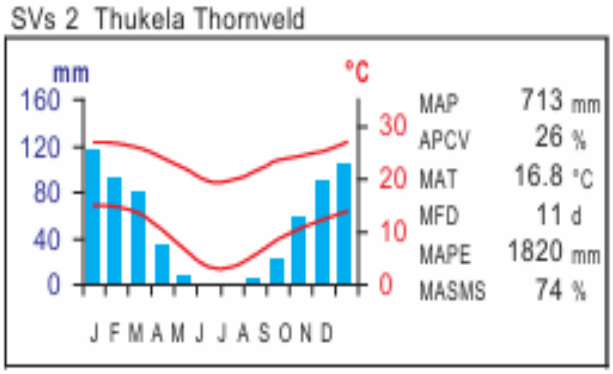


Figure 4: Vegetation Map of the proposed mining rights.

I. Thukela Thornveld

Distribution; KwaZulu-Natal Province: Upper Thukela River basin fringing the SVs 1 Thukela Valley Bushveld on its upper border in a series of discontinuous patches. Largest area east of Estcourt–Colenso and including Ladysmith. Also, some outliers on slopes south of Dundee. Altitude 900–1 300 m.

Climate; Summer rainfall with dry summers. MAP about 550–850 mm. Frost fairly infrequent, occurring mainly on the f lats. Mean monthly maximum and minimum temperatures for Ladysmith 36.1°C and –3.6°C for January and July, respectively.



Conservation; Least threatened. Target 25%. Statutorily conserved (less than 1 500 ha) in Weenen Game Reserve and Isandlwana Nature Reserve. About 5% already transformed, mainly by cultivation. Erosion somewhat less than in SVs1 Thukela Valley Bushveld.

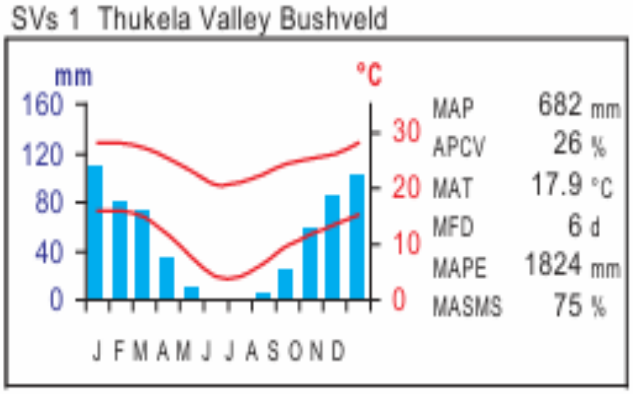
Vegetation and Landscape Features; The dominant landscape features are valley slopes to undulating hills. Vegetation is Vachellia-Senegalia (Acacia) dominated bushveld of variable density (ranging from wooded grassland to dense thickets) with dense grassy undergrowth.

Geology and soils; Broad variety of soils ranging from vertisols and solodised solonetzic soils to transitional fersiallitic soils (Edwards 1967) developing over Karoo Supergroup sediments of the Beaufort and Ecca Groups). Heavy soils are developed over Jurassic dolerite intrusions forming koppies and sills. Land types of Fb, Fa, Db, Ea, Fc and Dc.

II. Thukela Valley Bushveld

Distribution; KwaZulu-Natal Province: Central Thukela River basin upstream of Jameson's Drift, past Tugela Ferry to about 20 km southeast of Ladysmith. Also, in valleys of several major tributaries, such as the lower Mooi, Bushmans, Buffels and Sundays Rivers. Altitude about 350–1 000 m.

Climate; Summer rainfall with dry winters. MAP about 500–850 mm. Frost fairly infrequent and usually on valley bottoms. Mean monthly maximum and minimum temperatures for Muden 36.7°C and 0.2°C and for Weenen 38.1°C and –4.4°C both for December and June, respectively.



Conservation; Least threatened. Target 25%. Statutorily con served (less than 200 ha) in the Weenen Game Reserve. This vegetation unit has undergone considerable degradation over almost its entire area. In the many eroded areas, prolonged continuous overgrazing has led to the complete destruction of the grass cover. Often the only ground cover is found under *Vachellia tortilis* trees where their root systems retain soil, the trees act as nutrient pumps and provide shade (Camp 1999e). Erosion very variable, ranging from very low to very high. Alien plants include the widely scattered Opuntia imbricata

Vegetation and Landscape Features; Often rocky rugged slopes and terraces mainly with deciduous trees of short to medium height (and many large shrubs) including *Vachellia tortilis V. nilotica and V. natalitia* and prominent evergreen species such as *Olea europaea* subsp. *africana*, *Boscia albitrunca* and *Euclea crispa* in places. Succulent plants, mainly species of Euphorbia and Aloe occur on shallow and eroded soils. Relatively limited areas are dominated by succulents such as *E. tirucalli* (some hill sides south of the Thukela) and *E. ingens* on steep slopes, but also commonly on the valley floor.

Geology and soils; Shallow soils of Mispah and Glenrosa forms on the slopes, while in valley bottoms, pockets of deep alluvial soils as well as calcareous, duplex soils are found. The major

geological formations are sediments of Ecca Group (Karoo Supergroup) and in the eastern part also Archaean granites. Land types mainly Fc and Fb, with some Ae and E.

Kwa-Zulu Natal Biodiversity Sector Plan (2015)

This section of the assessment aims to describe the biodiversity plans and spatial priorities relevant to the project area, particularly the KZN Biodiversity Sector Plans (BSP) (2015).

The aim of the KZN BSP is to:

- Identify and map Critical Biodiversity Areas (CBAs) in the KZN DMs, in this case, the Zululand DM.
- Provide associated management guidelines that aim to maintain the integrity of these biodiversity features.

The objectives of the BSP are to:

- Ensure aquatic and terrestrial biodiversity targets are met at the district level.
- Conserve representative samples of biodiversity patterns.
- Conserve the ecological and evolutionary processes that allow biodiversity to persist over time; and
- Serve as a first step towards the development of a Bioregional Plan.

The main purpose of this BSP is to "assist and guide land use planners and managers within various district and local municipalities, to account for biodiversity conservation priorities in all land use planning and management decisions, thereby promoting sustainable development and the protection of biodiversity, and in turn the protection of ecological infrastructure and associated ecosystem services" (KZN BSP, 2014).

The KZN BSP also provides a spatial representation of land and coastal marine areas required to ensure the persistence and conservation of biodiversity and biodiversity targets within KZN, as reflected in Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). A CBA is considered a significant, ecologically sensitive area and should be maintained in a pristine or near-natural state to ensure the continued functioning of ecosystems. A CBA is the best way to

achieve biodiversity targets. ESAs are not essential to achieving targets, but they play a vital role in sustaining ecosystem function. The two main layers, CBAs and ESAs, are divided into further subcategories as set out in a table below:

Critical Biodiversity Area: Natural or near-natural features, habitats or landscapes that include terrestrial, aquatic and marine areas that are considered critical for (i) meeting national and provincial biodiversity targets and thresholds (ii) safeguarding areas required to ensure the persistence and functioning of species and ecosystems, including the delivery of ecosystem services; and/or (iii) conserving important locations for biodiversity features or rare species. Conservation of these areas is crucial because, if they are not maintained in a natural or near-natural state, biodiversity conservation targets cannot be met.	
Critical Biodiversity Areas: Irreplaceable	Areas considered critical for meeting biodiversity targets and thresholds, and required to ensure the persistence of viable populations of species and the functioning of ecosystems.
Critical Biodiversity Areas: Optimal	Areas that represent an optimised solution to meet the required biodiversity conservation targets while avoiding areas where the risk of biodiversity loss is high. The category is driven primarily by process, but is also informed by expert input.
Ecological Support Area: Functional, but not necessarily entirely natural, areas that are required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the Critical Biodiversity Areas.	
Ecological Support Area: Corridors	Corridors made up of Landscape and Local Corridors
Ecological Support Area: Species Specific	Areas required for the persistence of specific species. Although these areas are frequently modified, a change in current land use to anything other than rehabilitated land would most likely result in the loss of that feature.

The Conservation Terms for the EKZNW Spatial Planning Products Document (2016) provides a map of important biodiversity areas within the KwaZulu-Natal Province to guide sustainable

development and to focus conservation efforts within the province. The aim of the Document is to provide stakeholders with a simplified guide to SCA and the development of the KwaZulu-Natal Biodiversity Plan (KZN BP). The KZN BP consists of two primary spatial layers, namely Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), but also includes the legislated Protected Areas, modified areas, and Natural Biodiversity Areas.

According to the KZN Biodiversity Sector Plans (BSP) (2015), parts of the project sites are classified as Critical Biodiversity Areas (optional and irreplaceable) and as Ecological Support Areas (Figure 5).

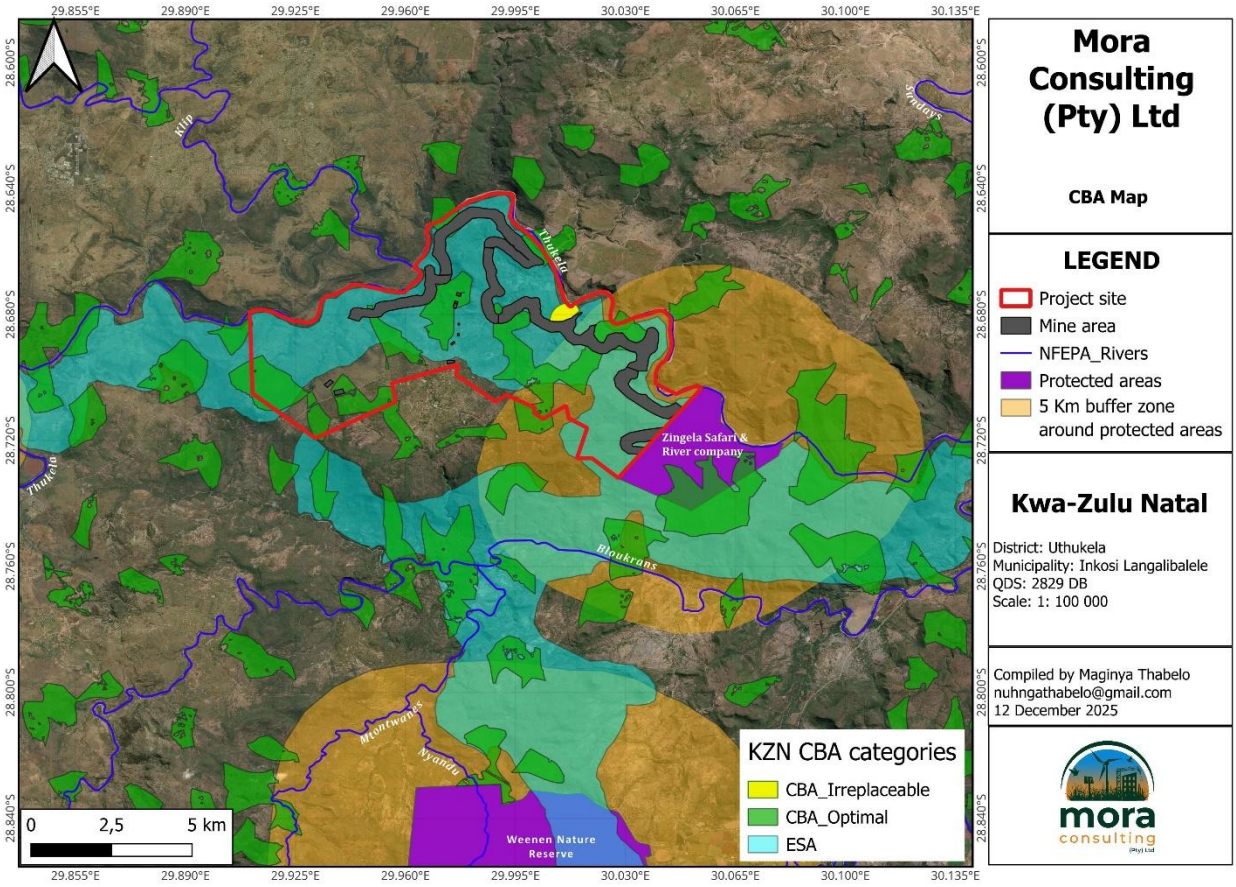


Figure 5: Conservation Map of the proposed mining rights.

Key Biodiversity Areas

Site-based management efforts are among the most effective means to reduce global biodiversity loss. Therefore, it is crucial to identify sites with globally significant biodiversity, so that we can prioritise where and how to act most effectively. Key Biodiversity Areas are the most important places in the world for species and their habitats. Through the Key Biodiversity Area (KBA) programme in South Africa, we identify, map, monitor, and conserve these high-priority areas to help safeguard the most critical sites for nature.

SANBI and BirdLife South Africa lead this important initiative in South Africa in collaboration with several other partners.

What are Key Biodiversity Areas, and why are they important?

Key Biodiversity Areas (KBAs) are 'sites that contribute significantly to the global persistence of biodiversity', which means they are the most important places in the world for species and their habitats – whether these be in terrestrial, freshwater, estuarine, or marine ecosystems. The aim is to help prevent the rapid loss of biodiversity by supporting nationally led efforts to identify places worldwide that are critical for the survival of unique plants and animals and the ecological communities they comprise. KBAs provide a global currency for identifying the most biologically significant sites, thereby focusing our collective efforts on conserving the places that matter most.

Sites qualify as global KBAs if they meet the specific standardised criteria and quantitative thresholds focused on one or more of the five trigger aspects:

Threatened biodiversity	Sites that support significant populations of species or ecosystems at risk of extinction.
Geographically restricted biodiversity	Sites that hold species or ecosystems with limited global ranges or extent.
Ecological integrity	Sites with intact ecological communities that maintain natural processes and have low human impact.

Biological processes	Locations critical for key life-cycle events such as breeding aggregations, refuges, or recruitment sources.
Irreplaceability	Sites essential for achieving conservation goals, where loss would significantly reduce options for biodiversity protection.

According to the South African KBAs (2024), the project area falls within the Tugela-Bushmans Thornveld KBA (Figure 6).

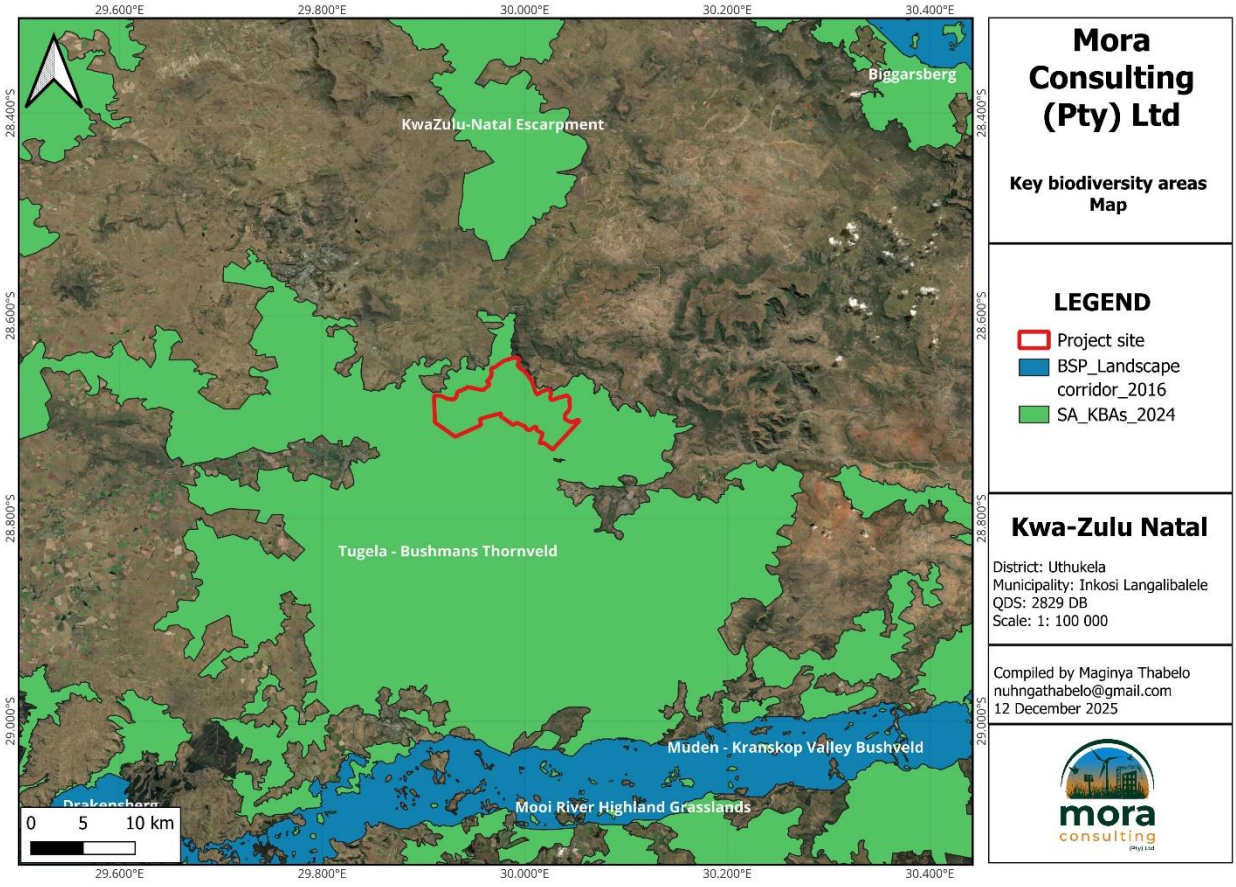


Figure 6: Key Biodiversity Area of the proposed mining rights.

Site description: Tugela - Bushmans Thornveld is a large terrestrial site with limited protection, located in KwaZulu-Natal, South Africa. To the west, the site comprises hilly, undulating landscapes and broad valleys supporting tall tussock grassland, usually dominated by *Hyparrhenia hirta*, with occasional savannoid woodlands containing scattered Vachellia sieberiana var. woodii and, in small pockets, *V. karroo* and *A. nilotica*. On rocky, rugged slopes and terraces mainly with deciduous trees of short to medium height (and many large shrubs), including V. tortilis, V. nilotica, and V. karroo, and prominent evergreen species such as *Olea europaea* subsp. *africana*, *Boscia albitrunca* and *Euclea crispa* in places. To the east lie valley slopes and undulating hills, where the vegetation is *Vachellia*-dominated bushveld and thornveld of variable density (ranging from wooded grassland to dense thickets) with dense grassy undergrowth.

Rationale for Qualifying as a Key Biodiversity Area (KBA)

The project area is located within the Tugela–Bushmans Thornveld Key Biodiversity Area, a site identified in the SANBI 2024 South African Key Biodiversity Areas Database as making a significant contribution to the global and national persistence of biodiversity. The identification of this KBA follows the application of the IUCN Global Standard for the Identification of Key Biodiversity Areas, using the best available species, habitat, and spatial planning data (SANBI, 2024).

The KBA is triggered by the confirmed and inferred presence of biodiversity elements of global and national conservation significance, including threatened and geographically restricted species across multiple taxonomic groups, notably plants, birds, mammals, and freshwater-associated taxa. In accordance with SANBI guidance, the site meets Criterion A1 (Threatened Biodiversity) **because it contributes to the persistence of threatened species, with the area supporting a suitable habitat of** sufficient extent and condition to be of conservation importance.

The KBA also meets Criterion B1 (Geographically Restricted Biodiversity) **by supporting** species with limited global or regional distributions that are closely associated with the Tugela–Bushmans Thornveld vegetation mosaic. These species rely on the continued availability of intact habitat within this landscape to maintain viable populations. In addition, portions of the KBA contribute to

Criterion E (Irreplaceability), as spatial analyses indicate that the loss of these areas would significantly reduce the ability to achieve biodiversity conservation targets, with few or no suitable alternative sites available.

Although the vegetation types within the project area are classified as Least Concern at a national scale, SANBI guidance emphasises that KBA status is assigned based on the presence of trigger biodiversity elements, rather than ecosystem threat status alone. As such, the **site's conservation importance is enhanced** by its role in supporting species persistence, maintaining ecological processes, and contributing to landscape-scale connectivity.

In line with SANBI's 2024 KBA management principles, **KBA areas should be managed to prevent** irreversible loss or degradation of the biodiversity features for which the site was identified. Any development within the KBA is therefore considered sensitive and requires strict application of the mitigation hierarchy, with avoidance of key habitats and trigger features as the preferred option, followed by buffering, minimisation, and management of residual impacts where avoidance is not feasible.

METHODOLOGY AND ASSESSMENT APPROACH

Desktop

A desktop assessment was undertaken using freely available geographic information and mapping tools, including QGIS (v. 3.44.0) and Google Earth Pro (v. 7.3.6). These tools are reliable, accurate, and effective for detecting and analysing present and historical imagery across most of the world, including Limpopo Province. The desktop study consulted available spatial and ecological datasets for the project site and surrounding areas to obtain the most recent and reliable information on the ecosystem.

The following activities were undertaken:

- The project footprint was mapped in QGIS and the BGIS to obtain all relevant shapefiles.
- The National Biodiversity Assessment (NBA) datasets on rivers, wetlands, South African vegetation types, Important Biodiversity Areas (IBAs), and Protected areas were overlaid to determine their occurrence within or near the project site.

Additional SANBI datasets consulted included:

- **Red List of South African Plants** (Threatened Species Programme) to identify any red-listed plants in the area (http://redlist.sanbi.org/index.php.

- **Plants of South Africa (POSA)** database to identify provincially protected and endemic plant species (https://posa.sanbi.org/sanbi/Explore.

A literature review was conducted on publications relevant to the KZN Province and to the vegetation type of the study area. This ensured a robust understanding of the ecological context and the most appropriate biodiversity assessment guidelines, processes, and protocols to apply. Key references included:

- **Guidelines for Incorporating Biodiversity into Environmental Impact Assessment** (Brownlie et al., 2009).
- **Guidelines for Working in Freshwater Ecosystem Priority Areas** (Driver et al., 2011).
- **National Biodiversity Assessment: Synthesis Report 2018** and **Provincial Summaries 2017**.
- National Terrestrial Threat Status and Protection Level (2018).

A complete list of all materials and datasets consulted during this assessment is provided in the References section of this report.

Field Assessment

The specialists conducted a three-day on-site survey from 14-16 April 2025 and a two-day follow-up survey from 30-31 May 2025. A reconnaissance ‘walkabout’ and point survey were undertaken to determine the general habitat types found throughout the study area. are marked “Trap 1 to 10, (figure 8). The focus was on identifying species of conservation concern (SCC), Threatened or Protected Species (TOPS), or Red Data Listed (RDL) Species. Our survey primarily targeted ridges, rocky areas, water streams and drainage lines, less disturbed sites, and servitudes.

Flora

The focus was on an ecological assessment of habitat types and the identification of any Red Data species within the known distribution of the proposed mining right area. The South African National Biodiversity Institute (SANBI) provides an electronic database, the Botanical Database of Southern Africa (BODATSA), for accessing distribution records of southern African plants. This new database replaces the Plants of Southern Africa (POSA) database. We also consulted iNaturalist to obtain possible species occurring within the project area.

Fauna

For all animal species, it is acknowledged that some may have been missed due to the assessment period, the season, and the limitations of this type of assessment. It should be noted that some species, particularly reptiles, birds, and mammals such as porcupines, are secretive and/or nocturnal. Therefore, the POC prediction model will also apply. Significant consideration was given to microhabitat types and their potential occurrence, as well as to available databases obtained from various sources. The specialists made a great effort to assess this aspect.

Mammals

Potential mammal species for the study area were identified through desktop analysis using:

- iNaturalist South Africa (https://www.inaturalist.org/places/south-africa)
- The Mammals of the Southern African Subregion (Skinner & Chimimba, 2005), The Red Data Book of the Mammals of South Africa: A Conservation Assessment [Friedmann and Daly (editors), 2004]

Avifauna

Several threatened bird species have been recorded in the KZN Province to date. Bird species at the site were identified and recorded using a notebook, the Bird Lasser Version 1.0.8 Build 8 (http://www.birdlasser.com), binoculars 10x42, and the iNaturalist app (http://www.iNaturalist.org) during walking transects. At least 4-5 hours were spent on site, and all bird species heard and seen flying and perching within a 20-30m radius (Macchi & Grau, 2012) were recorded. Additionally, remains such as feathers, droppings, and nests were used to identify potential species. Flying birds were recorded only when they flew against the observers. A list of the species potentially to occur in the area was downloaded from the SABAP2 online source,

SABAP2 Coverage: 2840_2955 and 2840_3000, and a complete list is attached in the appendix section of this report.

Herpetology (Reptiles & Amphibians)

A desktop assessment of the herpetofauna in the area was conducted, with particular attention to the SCCs. Sources used included the IUCN (2026). Herpetofauna distributional data were obtained from the following information sources:

- iNaturalist (http://www.iNaturalist.org)
- A Guide to the Reptiles of Southern Africa (Alexander & Marais, 2007);
- Atlas and Red list of Reptiles of South Africa, Lesotho and Swaziland (Bates et al.,2014).
- Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland (Mintner et al., 2004).
- Ensuring a future for South Africa's frogs (Measey, 2011).
- African Snakebite Institute Snakes Application (ASI Snakes)

Red Data Listed Species

A desktop assessment was also conducted to screen key, threatened, or species of concern within the study area. The aim was to obtain and provide a list of potentially threatened species that may occur, as highlighted, and to verify the site assessment (see Appendix I).

The primary resources used during the desktop assessment include the National Red List of Threatened Plants of South Africa, Lesotho & Swaziland (SANBI), the POSA of SANBI, the SABAP2 dataset, the African Snakebite Institute Snakes Application (ASI Snakes), and iNaturalist.

The presence of species of concern, rare or protected species, or suitable habitat was sought and recorded during the field assessment. The definitions of status and category for the Red Data Listed Species are provided in Table 1.

Table 1: Red List Data Status and definitions as per SANBI (2010) guidelines.

P- Protected Species **M- Medicinal species**		
EX	**Extinct**	A taxon is Extinct when there is no reasonable doubt that the last individual has died. Taxa should be listed as extinct only once exhaustive surveys throughout the historic range have failed to record an individual.
EW	**Extinct in the Wild**	A taxon is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
CR PE	**Critically Endangered (Possibly Extinct**	Critically Endangered (Possibly Extinct) taxa are those that are, on the balance of evidence, likely to be extinct, but for which there is a small chance that they may be extant. Hence, they should not be listed as Extinct until adequate surveys have failed to record the taxon.
CR	**Critically Endangered**	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the five IUCN criteria for Critically Endangered and is therefore facing an extremely high risk of extinction in the wild.

EN	**Endangered**	A taxon is Endangered when the best available evidence indicates that it meets any of the five IUCN criteria for Endangered and is therefore facing a very high risk of extinction in the wild.
VU	**Vulnerable**	A taxon is Vulnerable when the best available evidence indicates that it meets any of the five IUCN criteria for Vulnerable and is therefore facing a high risk of extinction in the wild.
NT	**Near Threatened**	A taxon is Near Threatened when available evidence indicates that it nearly meets any of the five IUCN criteria for Vulnerable and is therefore likely to qualify for a threatened category in the near future.
CRITICALLY RARE		A taxon is Critically Rare when it is known to occur only at a single site but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to the five IUCN criteria.
RARE		A taxon is Rare when it meets any of the four South African criteria for rarity but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to the five IUCN criteria.
DECLINING		A taxon is Declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

DDD	**Data Deficient—Insufficient Information**	A taxon is DDD when there is inadequate information to make an assessment of its risk of extinction, but the taxon is well defined. Data Deficient is not a category of threat. However, listing of taxa in this category indicates that more information is required, and that future research could show that a threatened classification is appropriate.
LC	**Least Concern**	A taxon is Least Concern when it has been evaluated against the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, and it is not rare, and the population is not declining.

DATA ANALYSIS

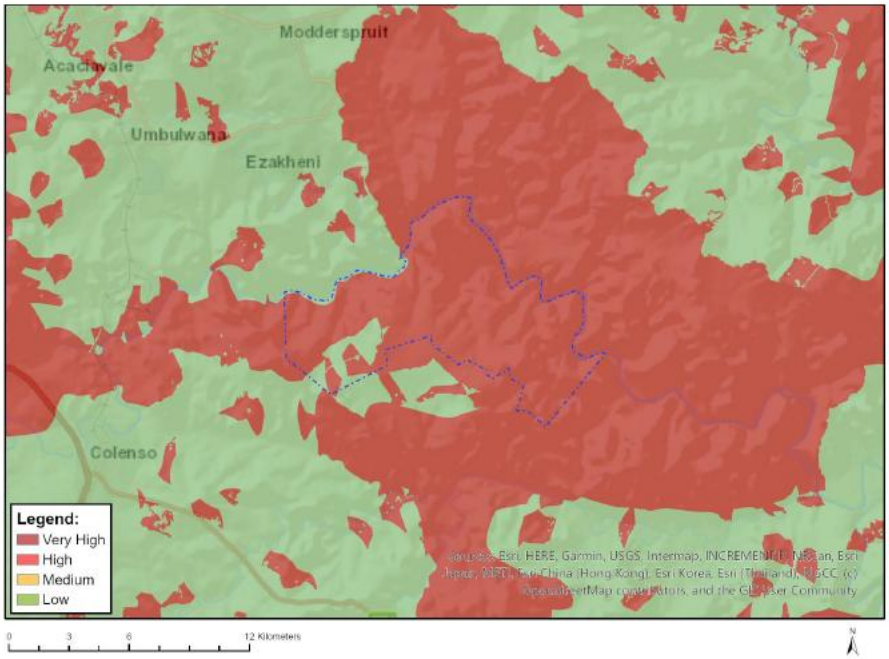
Any large-scale development within a natural system inevitably exerts pressure on the environment, often with negative ecological consequences if not carefully managed. It is therefore critical, during the planning and environmental authorisation phases, to identify potential impacts and to design effective mitigation measures. Best practice requires that such developments be located in already modified or fragmented areas wherever possible (Edwards et al., 2018).

BIODIVERSITY AND ENVIRONMENTAL PLANNING AND POLICIES

The DFFE screening tool for the “Terrestrial Biodiversity Theme Sensitivity” identified several biodiversity conservation planning tools that classify the area as very sensitive (see the figure below). The plans, which are discussed in detail below, include:

- Critical Biodiversity and Ecological Support Areas mapped in the KZN Biodiversity Sector Plan
- National Protected Area Expansion Strategy (NPAES).

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	CBA 1
Very High	CBA 2
Very High	ESA
Very High	FEPA Subcatchment
Very High	SWSA (sw)_Northern Drakensberg
Very High	National Protected Area Expansion Strategy (NPAES)

It is probable that these biodiversity features were key drivers for CBA selection in the project area. Future threats to habitats are expected to occur across a wider area if the project progresses to the mining phase, thereby considerably increasing the risk of cumulative negative impacts. Table 2 outlines the key biodiversity features in the project area and the potential impacts of the proposed mining project.

Table 2: key biodiversity features in the project area and the potential impacts of the proposed mining project.

Taxonomic group/Species	Type of impact	Significance of impact/Mitigation
Condition of the vegetation. The vegetation of the Thukela thornveld is on valley slopes to undulating hills, while the Thukela Valley Bushveld is often on rocky, rugged slopes and terraces. Both vegetation types are classified as least concern, with a 25% target. Thukela Thornveld has a with about 5% transformed.	Loss of vegetation communities as a result of clearance activities.	Significant impacts on vegetation communities, including species composition, vegetation, and basal cover. However, this can be mitigated by confining all mining activities to approved areas and avoiding clearance in areas not intended for disturbance.
Ecosystem function. The remaining natural vegetation provides nesting areas for avifauna and occasional shelter for terrestrial fauna. Niche habitats for fauna provide sheltered burrows and nesting sites. A microclimate is created by shrubs and trees that shelter species sensitive to direct sunlight or frost.	Ecosystem fragmentation and loss of habitat.	Significant impacts on ecosystem functioning. However, this can be mitigated/reduced by confining all mining activities to approved areas and avoiding clearance in areas not intended to be disturbed.
Protected, Threatened, and Endemic species expected. There are several protected species under the NFA and the KZN Nature Conservation Management Amendment Act that are expected to occur in the area, as well as threatened and endemic species. The area is categorized as high for strategic environmental assessment priority species.	Ecosystem fragmentation, Loss of habitat, and Death of faunal species	In the context of the threatened plant and animal species supported by the ecosystems and habitats across the large project area, the impact is relatively low and should not compromise the CBA's objective. Impacts can be mitigated. Where impact is high, this can be mitigated by confining all mining activities to approved areas and avoiding clearance in areas not intended for disturbance.

Fauna. The majority of the proposed project area is primarily characterised by the savanna biome, which supports a diverse array of fauna. There are a large number of SCC that could be affected by the proposed project.	Ecosystem fragmentation, Loss of habitat, Death of faunal species, Loss of SCC	In the context of the threatened plant and animal species supported by the ecosystems and habitats across the large project area, the impact is relatively low and should not compromise the CBA's objective. Impacts can be mitigated. It is highly likely that the proposed mining right will have a significant impact on amphibian species, given the presence of watercourses.
A**vifauna.** Numerous SCC were flagged by the DFFE screening report as HIGH sensitivity. The project's developmental footprint falls within any listed KBA. This may be one reason the area was classified as a CBA.	Death of bird species. Loss of important habitats	Significant impact, particularly on birds; however, with appropriate mitigation measures, the impact may be low to moderate.
Threatened Ecosystems. The project is not located within any threatened ecosystem. Twelve exists at least 20km around the area. Any further disturbance may not result in negative impacts on the biodiversity driving features of these ecosystems.	Loss of terrestrial habitats	No significant impacts on threatened ecosystems.
Ecosystem function. The mining rights area is pristine, and largely intact natural vegetation provides nesting areas for avifauna and shelter for terrestrial fauna. Niche habitats for fauna provide sheltered burrows and nesting sites. A microclimate is created by shrubs and trees that shelter species sensitive to direct sunlight or frost.	Ecosystem fragmentation, Loss of habitat	Significant impacts on ecosystem functioning. However, this can be mitigated by confining all mining rights activities to approved areas and avoiding the clearance of areas not intended for disturbance.

National Protected Area Expansion Strategy (NPAES). Portions of the proposed mining right overlap with areas identified in the National Protected Area Expansion Strategy as priority areas for future conservation expansion and ecological connectivity. It was further flagged by the DFFE screening report as VERY HIGH sensitivity. These areas contribute to meeting national biodiversity targets and maintaining landscape-scale ecological processes.	Loss and fragmentation of priority conservation land; reduced future conservation potential.	The proposed mining rights activities will result in substantial land loss and fragmentation within the area identified for protected area expansion, potentially reducing the feasibility of achieving NPAES targets in the region. While the direct impact is limited to the approved mining footprint, any transformation within NPAES priority areas is considered significant at the strategic level. Impacts can be mitigated by strictly confining mining activities to approved areas, avoiding disturbance of high-priority expansion zones where possible, maintaining ecological corridors, and implementing progressive rehabilitation to restore post-mining conservation potential.
Key Biodiversity Area (KBA). The project area lies within the Tugela–Bushman's Thornveld KBA, recognized for supporting biodiversity of global and national significance, including species of conservation concern and intact savanna ecosystems.	Loss of KBA habitat; ecosystem fragmentation; disturbance to biodiversity features underpinning KBA status.	Vegetation clearance and associated disturbances within the KBA may affect habitats that contribute to the site's biodiversity value. Although the vegetation type is classified as Least Concern nationally, its occurrence within a KBA increases sensitivity. The impact is considered moderate and localized and is unlikely to compromise the KBA's overall objectives if mitigation is effectively implemented. Mitigation includes minimizing the disturbance footprint, avoiding sensitive habitats and

		watercourses, and applying rehabilitation and biodiversity management measures.

National Protected Area Expansion Strategy (NPAES)

The National Protected Areas Expansion Strategy (NPAES, 2010) was developed to “achieve cost-effective protected area expansion for ecological sustainability and increased resilience to climate change.” The NPAES originated as the government recognised the importance of protected areas in maintaining biodiversity and ecosystem functions. The NPAES sets targets for expanding South Africa’s protected area network, with emphasis on the least-protected ecosystems.

Protected areas are areas designated under national or provincial legislation. The project area is not situated within the NPAES (Figure 7).

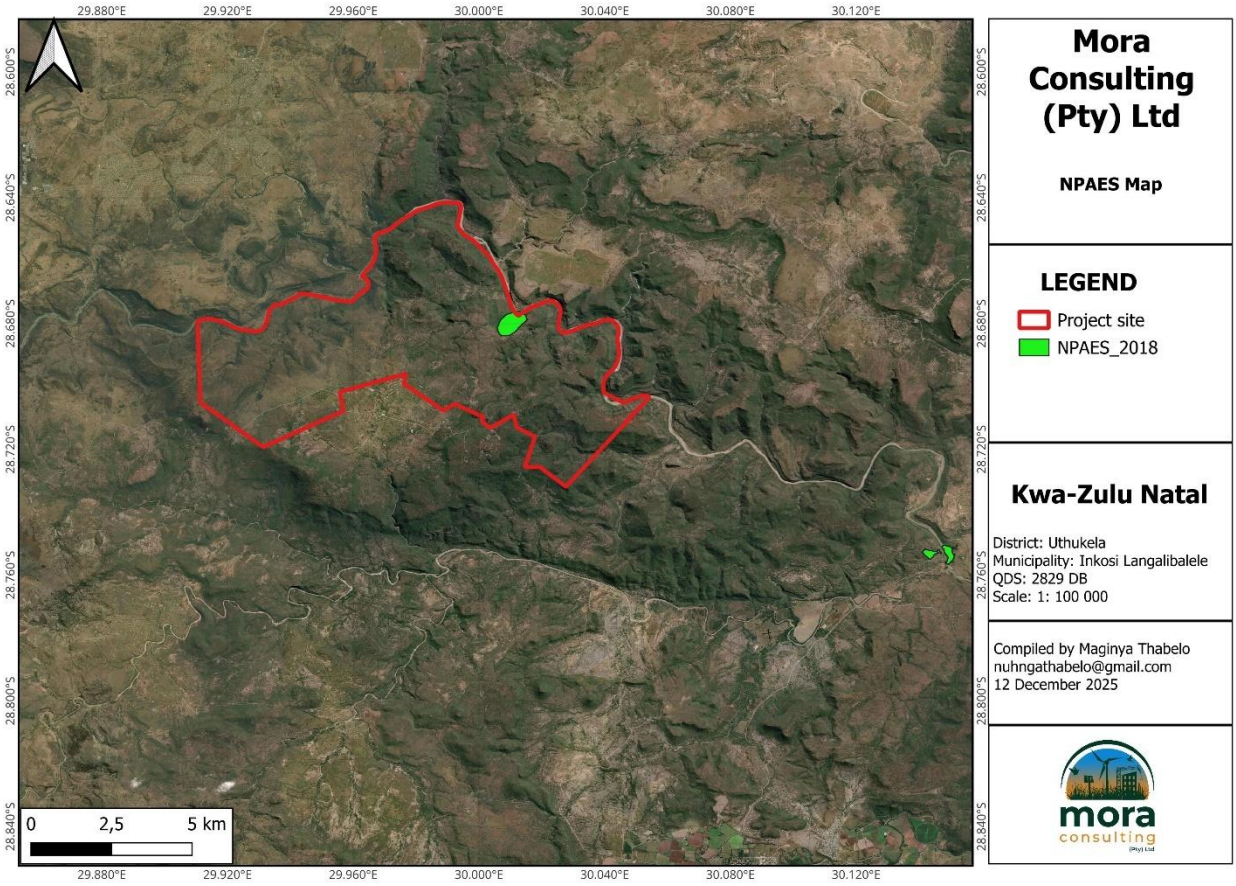


Figure 7: National Protected Area Expansion Strategy found in the study area.

Ecosystem Threat Status

The NBA primarily focuses on evaluating biodiversity at the ecosystem and species levels in the four realms (terrestrial, inland aquatic, estuarine, and marine), as well as in two cross-realm areas (the coast and South Africa's sub-Antarctic territory), which are subject to the two headline indicators of threat status and protection level (Driver et al., 2011).

Ecosystem Threat Status and Protection Level

The National Environmental Management: Biodiversity Act (Act 10 of 2004) provides for listing threatened or protected ecosystems in one of four categories, namely Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT). The main purpose of listing Threatened Ecosystems is to reduce the rate of ecosystem and species extinctions and to prevent further degradation and loss of structure, function, and composition of threatened ecosystems (Nel and Driver, 2014). Ecosystem threat status outlines the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function, and composition, on which their ability to provide ecosystem services ultimately depends (Driver et al., 2011 of each ecosystem type that remains in good ecological condition (Driver et al., 2011).

The level of ecological protection indicates whether or not ecosystems are sufficiently protected. Based on the percentage of each ecosystem type within a protected area recognized under the Protected Areas Act, ecosystem types are categorized as not protected, poorly protected, moderately protected, or well protected (Driver et al., 2012).

The National Environmental Management: Biodiversity Act, (Act No. 10 OF 2004) (NEM:BA) provides a National List of Ecosystems that are threatened and in need of protection – GN 1002 of 2011. According to the NEM:BA List of threatened ecosystems (2011), the mining rights project is not located within any threatened ecosystems (See Figure 8). The closest are located approximately 20km away.

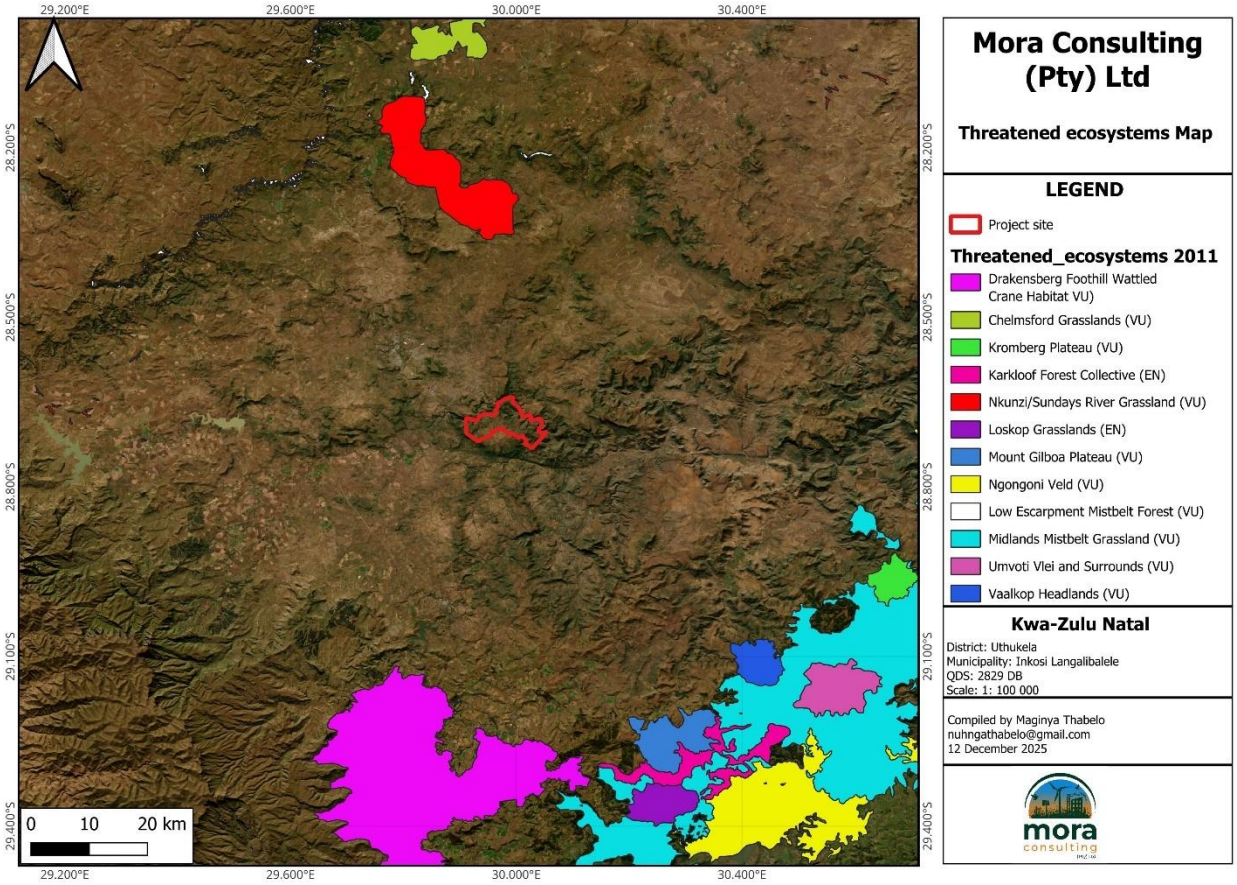


Figure 8: Threatened Ecosystem Map.

Landscape and Local Corridors

For certain movement-related ecological processes to occur, such as species migration, seasonal and altitudinal dispersal, and range displacement in response to climate change, connections must be maintained. Therefore, these corridors primarily aim to maintain regional connectivity to support ecological processes rather than to meet specific biodiversity targets (Ezemvelo KZN Wildlife, 2015). It should be noted that none of the development components fall within a Landscape Corridor (EKZNW Landscape Corridors, 2016) (Figure 6). The closest are located approximately 35km away South.

ENVIRONMENTAL IMPACT ASSESSMENT

Any activities associated with a natural system, whether historical or current, will affect the surrounding environment, typically negatively. The purpose of this phase of the study was to identify and assess the potential impacts and their significance, and to describe the mitigation required to limit perceived impacts on the natural environment. In determining the impacts of the activities, due consideration was given to prior factors affecting the freshwater ecosystem within the study area. The major issues and potential impacts related to terrestrial biodiversity within the project site and immediate surroundings were established using existing information, specialist input and site investigations.

Mitigation hierarchy

A **no-net-loss approach** will be adopted to manage project-related impacts.

- **Avoidance** – impacts are to be avoided where practicable e.g., through the implementation of alternatives.
- **Mitigation** – should it not be possible to avoid all impacts; the remaining impacts are to be mitigated to acceptable levels.
- **Offset** – As the last option, should it not be possible to avoid and mitigate all impacts to acceptable levels it will be necessary to offset the remaining impacts. Suitable offset programmes will need to be identified that will meet legal and Zee Minerals requirements.

The impacts have been ranked before and after the implementation of the mitigation measures. Where mitigation is not sufficient to reduce the impact to acceptable levels offsets will need to be identified.

Predictions on future changes on ecosystems and populations once a development has happened are seldom straightforward, except in cases such as the total loss of a habitat to development. Whilst a possible mechanism for an impact to occur can usually be identified, the actual likelihood of occurrence and its severity are much harder to describe (Hill & Arnold, 2012).

A closely related issue is that of the effectiveness of ecological mitigation which stems from ecological assessments (including freshwater ecological assessments), as well as in response to legal and planning policy requirements for development. Many recommendations may be incorporated into planning conditions or become conditions of protected species licences, but these recommendations are implemented to varying degrees, with most compliance being for the

latter category (i.e., protected species) because there is a regulatory framework for implementation. What is often missing is the follow-up monitoring and assessment of the mitigation with sufficient scientific rigour or duration to determine whether the mitigation, compensation or enhancement measure has actually worked in the way intended (Hill and Arnold, 2012).

Many of the above impacts are not only a result of the direct impact on a particular species, but rather due to what is known as the 'Edge Effect', which can be explained as follows: Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type, and abundance of species they contain. At the periphery of natural patches, influences of neighbouring environments become apparent; this then is the 'Edge Effect'. Patch edges may be subjected to degradation due factors such as increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other negative agents. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat to survive in the long term. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman and Milder, 2004).

Risk Evaluation

The impacts were further quantified in terms of severity, and values were assigned to the criteria ratings. This will allow us to understand the degree of impact it has on the environment. Therefore, the significance scoring assesses and predicts environmental impacts by evaluating the following factors.

- probability of the impact,
- duration of the impact,
- extent of the impact, and
- magnitude of the impact.

The significance of those environmental impacts is then assessed by considering the proposed mitigation measures. The importance of the impact "**without mitigation**" is the prime determinant of the nature and degree of mitigation required. Each of the above impact factors has been used to assess potential impacts using ranking scales, as detailed in Table 3.

Table 3: Criteria for Assessment of Impacts.

Severity (Magnitude) The severity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as:	
Insignificant	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
Moderate	The affected environment is altered, but functions and processes continue, albeit in a modified way.
Very High	The function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Duration The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
Temporary	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
Short term	The impact will be relevant through to the end of a construction phase (1.5–2 years).
Medium term	The impact will last up to the end of the development phases, where after it will be entirely negated.
Long term	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
Permanent	This is the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.
Spatial scale Classification of the physical and spatial scale of the impact	
Footprint	The impacted area extends only as far as the activity, such as the footprint occurring within the total site area.

Site	The impact could affect the whole, or a significant portion of, the site.
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
National	The impact could have an effect that expands throughout the country (South Africa).
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
Probability This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chance of this impact occurring is defined as 25%.
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chance of this impact occurring is defined as 50%.
Highly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chance of this impact occurring is defined as 75%.
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

The following formula was used to calculate impact significance:

Impact Significance = (Magnitude + Duration + Extent) x Probability)

The formula gives a maximum value of 100 points which are translated into 1 of 3 impact significance categories; Low, Moderate and High as per Table 3 below.

Table 4: Impact significance ratings.

SIGNIFICANCE POINTS	SIGNIFICANCE RATING
0 - 30 points	Low environmental significance
31 - 59 points	Moderate environmental significance
60 -100 points	High environmental significance

Determination of Significance – With Mitigation

Determination of significance refers to the foreseeable impact after the successful implementation of the necessary mitigation measures. The Significance Rating (SR) is determined as follows:

Significance Rating (SR) = (Extent + Intensity + Duration) x Probability

Identifying the Potential Impacts without Mitigation Measures (WOM)

After assigning the necessary weights to the respective aspects, the criteria are summed and multiplied by their assigned probabilities, yielding a value for each impact (before the implementation of mitigation measures). Significance without mitigation is rated on the following scale (Table 4):

Table 5: Significance Rating Scales without Mitigation.

SR < 30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30 < SR < 60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.

SR > 60	High (H)	The impact is significant, mitigation is critical reducing impact or risk. The resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

Identifying the Potential Impacts with Mitigation Measures (WM)

To gain a comprehensive understanding of the overall significance of the impact after the implementation of the mitigation measures, it will be necessary to re-evaluate the impact. The significance of mitigation thereafter is rated on the following scale, Table 5:

Table 6: Significance Rating Scales with Mitigation.

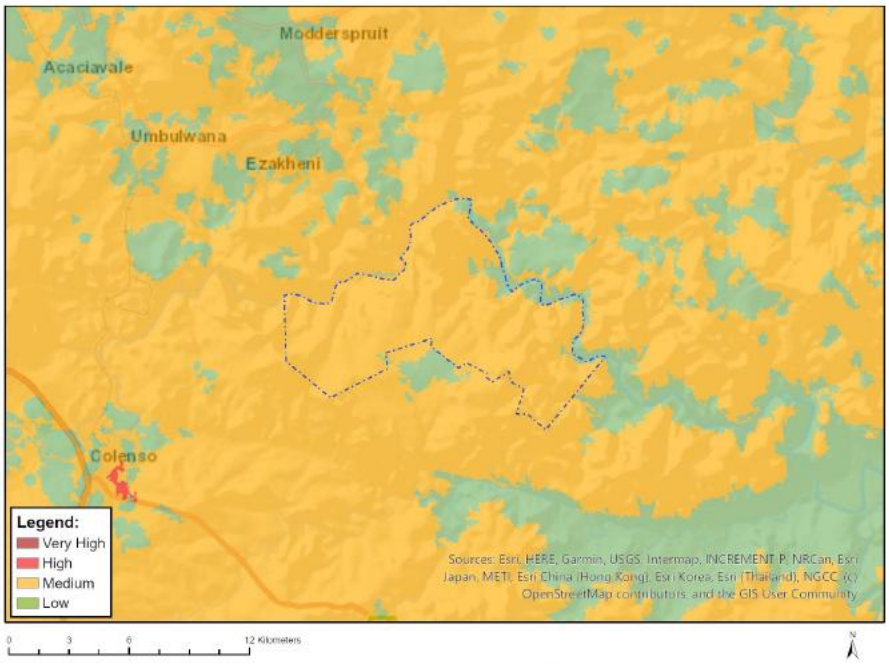
SR < 30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30 < SR < 60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures to reduce the negative impacts to acceptable levels, the negative impact will remain significant. However, taken within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

RESULTS

Floral Species

The Mining Rights project is situated within the Thukela Thornveld and Thukela Valley Bushveld. The developmental footprint was assessed at a desktop level using the National Web-based Environmental Screening Tool and a field-based survey. According to the DFFE Screening Tool Report for Plant Theme Sensitivity, the project area has been classified as Medium. The tool also indicated that the majority of the project area is rated as 'medium sensitivity' in terms of the plant species on account of the potential occurrence of floral species such as Sensitive species 1252 (*Discorea sylvatica*), Sensitive species 596 (*Aloe prinslooi*), Sensitive species 1181 (*Orbea woodii*), *Vitellariopsis dispar*, and *Thunbergia venosa*.

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Sensitive species 596
Medium	Sensitive species 1181
Medium	Vitellariopsis dispar
Medium	Thunbergia venosa

The species list attached as **Appendix 1** has been compiled using records obtained from the National Screening Report, the list of species recorded for each vegetation type (Mucina et al., 2006-2018), as well as the list of Red Data Plant Species known to occur, or likely to occur, within the development footprint.

The species recorded during the survey are listed in Tables 7 and 8 below.

Table 7: List of recorded plant species.

*= provincially protected

Family	Common name	Species	Growth form	IUCN Redlist
Euphorbiaceae	Pencil tree	*Euphorbia tirucalli*	Shrub or small to medium-sized succulent tree	LC
Euphorbiaceae	Tamboti	*Spirostachys africana*	Medium-sized deciduous tree	LC
Ochnaceae	Small-leaved plane	*Ochna serrulata*	Densely branched shrub or small tree	LC
Fabaceae	Paperbark thorn	*Vachellia sieberiana*	Medium to large tree	LC
Sapindaceae	*Sand olive*	*Dodonea viscosa var. angustifolia*	Shrub or small tree	LC
Combretaceae	Russet bushwillow	*Combretum herorense*	Deciduous or semi-deciduous shrub or small tree	LC
Combretaceae	Velvet bushwillow	*Combretum molle*	Small to medium-sized tree	LC
Fabaceae	Sweet thorn	*Vachellia karoo*	Shrub or small to medium-sized tree	LC
Capparaceae	Stink shepherds' tree	*Boscia foetida subsp. Foetida*	Shrub or small tree	LC
Araliaceae	Cabbage tree	*Cussonia spicata*	Small to medium-sized tree	LC
Fabaceae	Sickle bush	*Dichrostachys cinerea*	Shrub or small tree	LC

Asphodelaceae	*Mountain aloe	*Aloe marlothii*	Single-stemmed, unbranched leaf succulent	LC
Fabaceae	Flame thorn	*Senegalia ataxacantha*	Spiny scanded shrub or medium-sized tree	LC
Ebenaceae	Blue guarri	*Euclea crispa*	Evergreen shrub or small tree	LC
Fabaceae	Common hook-thorn	*Senegalia caffra*	Shrub to medium-sized deciduous tree	LC
Cannabaceae	White stinkwood	*Celtis africana*	Medium to large deciduous tree	LC
Boraginaceae	Puzzle bush	*Ehretia rigida*	Deciduous shrub or small tree	LC
Asparagaceae	Asparagus	*Asparagus sp.*	Hardy evergreen shrub	LC
Celastraceae	*Gymnosporia senegalensis*	*Gymnosporia senegalensis*	Multistemmed shrub or small tree	LC
Rhamnaceae	Buffalo thorn	*Ziziphus mucronata*	Shrub or small to medium-sized tree	LC
Celastraceae	Common spike thorn	*Gymnosporia buxifolia*	Very variable shrub or small tree	LC
Anacardiaceae		*Searsia sp.*		LC
Euphorbiaceae	Common tree euphorbia	*Euphorbia ingens*	Spiny, Succulent tree	LC
Fabaceae	Umbrella thorn	*Vachellia tortilis*	Small to medium-sized tree	LC

Fabaceae	Scented thorn	*Vachellia nilotica*	Small to medium-sized tree	LC
Lamiaceae	Lions ear plant	*Leonotis leonurus*	Fast growing perennial shrub	LC
Sterculiaceae	Common wild pear	*Dombeya rotundufolia*	Small deciduous tree	LC
Oleaceae	Wild olive	*Olea europaea subsp. africana*	Small to medium-sized evergreen tree	LC
Flacourtiaceae	Wild apricot	*Dovyalis zyheri*	Small to medium-sized tree	LC
Asphodelaceae	Greathead's aloe	*Aloe greatheadii*	evergreen succulent plant	LC
Plantaginaceae	Ribwort plantain	*Plantago lanceolata*	Perennial herb	LC

Table 8: List of recorded Poeceae.

Family	Common name	Species	IUCN Redlist
Poaceae	Spiderweb grass	*Chloris pycnothrix*	LC
Poaceae	Gum grass	*Eragrostis gummiflua*	LC
Poaceae	Herringbone	*Pogonathria squarrosa*	LC
Poaceae	Saw tooth love grass	*Eragrostis superba*	LC
Poaceae	Common reeds	*Phragmites australis*	LC
Poaceae	Guinea grass	*Panicum maximum*	LC
Poaceae	Rats tail grass	*Sporobolus africanus*	LC

Poaceae	Rhodes grass	*Chloris virgata*	LC
Poaceae	Natal red top	*Melinis repens*	LC
Poaceae	Red grass	*Themeda triandra*	LC
Poaceae	Spreading three-awn grass	*Aristida congesta subsp. Barbicollis*	LC
Poaceae	Common turpentine grass	*Cymbopogon caesius*	LC
Poaceae	Shade love grass	*Eragrostis biflora*	LC
Poaceae	Weeping love grass	*Eragrostis cavular*	LC
Poaceae	Tassel three-awn	*Aristida congesta subsp. Congesta*	LC

Significant and/or Red data species

The Red List of South African Plants provides up-to-date information on the national conservation status of South Africa's indigenous plants. A list of plants of conservation concern was compiled using information from the South African National Biodiversity Institute's (SANBI) checklist on the Plants of Southern Africa Website (POSA, SANBI, 2009), iNaturalist, and literature pertaining to the area. At least 14 red data species could be expected within the proposed project area.

Table 9: SCC expected within the project area.

No.	Scientific Name	Common Name	SANBI RED LIST
1	*Aloe prinslooi*	Prinsloo's Spotted Aloe	Endemic
2	*Blepharis inermis*		Vulnerable
3	*Blepharis natalensis*		Endemic
4	*Boscia foetida longipedicellata*	Tugela Stink Shepherdstree	Endemic
5	*Dicliptera cernua*	False buckweed	Endemic
6	*Dioscorea sylvatica*		Vulnerable

7	*Elaeodendron transvaalense*	anthill saffron	Near threatened
8	*Gymnosporia macrocarpa*	Tugela Spikethorn	Endemic
9	*Kalanchoe daigremontiana*	Mother of Thousands	Endangered
10	*Kalanchoe longiflora*		Endemic
11	*Mesembryanthemum cordifolium*	Heartleaf Sunfig	Endemic
12	*Orbea woodii*		Vulnerable
13	*Thunbergia venosa*		Rare
14	*Vitellariopsis dispar*		Rare

Protected species in terms of the NFA

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species (GN 71 6 of 7 September 2012). A number of trees indigenous to South Africa are nationally protected under the National Forests Act, 1998 (Act No 84 of 1998). The removal or pruning of these protected trees will require a permit from the Department of Agriculture Forestry and Fisheries. Two protected species expected to occur:

Table 10: Protected Species in terms of NFA.

No.	Scientific Name	Common Name	SANBI RED LIST
1	*Boscia albitrunca*	Shepherds tree	Least concern
2	*Elaedendron transvaalense*	Bushveld Saffron	Near threatened

Species protected under the KZN Nature Conservation Management Amendment Act, 1999, Act No 5 of 1999.

The mandate of this act is to direct the management of nature conservation within the Province, including protected areas (PAs). This includes the development and promotion of ecotourism facilities within the PAs. No protected species expected to occur.

Alien Invasive Plant (AIP)

Alien Invasive Plant (AIP) species are plants that occur outside their natural geographic range and have been introduced by human activities, either intentionally or accidentally. While not all alien species are invasive, and not all invasive species are alien, specific taxa can establish and spread aggressively, leading to ecological disruption. These species often displace native vegetation, alter ecosystem processes, and reduce habitat quality for indigenous flora and fauna.

In terms of the National Environmental Management: Biodiversity Act (NEM:BA, Act No. 10 of 2004), an Invasive Alien Plant Species is defined as any taxon whose establishment and spread outside its natural distribution range:

a) threatens ecosystems, habitats, or other species, or has the potential to do so; and
b) may result in economic, ecological, or human health impacts.

Alien plant species were also noted from the database of in which some are naturalised alien species. This alien and invasive species has been recorded in the broader project area; all species are alien, but they vary in their invasive potential. They occur in clumps, scattered distributions, or as single individuals. Nine AIP species were expected in Table 10; the present study refined this list, recording 12 AIPs occurring at the site (Table 11).

Table 11: Expected Alien Invasive Species (AIS).

No.	Scientific Name	Common Name	NEMBA Category
1	*Argemone ochroleuca*	Mexican Poppy	1b
2	*Catharanthus roseus*	Madagascar Periwinkle	1b
3	*Cirsium vulgare*	Bull Thistle	1b
4	*Datura ferox*	White Stinkweed	1b
5	*Lantana camara*	Lantana	1b
6	*Opuntia ficus-indica*	Prickly Pear Cactus	1b
7	*Salvia tiliifolia*	Lindenleaf Sage	1b
8	*Sesbania punicea*	Scarlet Sesbane	1b
9	*Solanum sisymbriifolium*	Red Buffalo-bur	1b

Table 12: Alien and Invasive Plants (AIPs) recorded on site.

No.	Family	Scientific Name	Common Name	NEMBA category
1	Asteraceae	*Tagetes minuta*	Wild marigold	1b
2	Cactaceae	*Cereus jamacaru*	Queen of the night	1b
3	Verbenaceae	*Lantana camara*	Lantana	1b
4	Solanaceae	*Solanum mauritianum*	Bugweed	1b
5	Oleaceae	*Ligustrum sinense*	Chinese privet	1b
6	Asteraceae	*Biden pilosa*	Black jack	3
7	Amaranthaceae	*Amaranthus retroflexus*	Redroot pigweed	1a
8	Meliaceae	*Melia azedarach*	Syringa	1b
9	Asparagaceae	*Yucca glauca*	Yucca	NOT LISTED
10	Verbenaceae	*Verbena bonariensis*	Purpletop vervain	1b
11	Euphorbiaceae	*Ricinus communis*	Castor oil plant	1b
12	Cactaceae	*Ficus opuntia-indica*	Sweet-prickly pear	1b

In respect of Categories 1a, 1b, 2 and 3 Listed Invasive Species, certain Restricted Activities are—

(a) Prohibited in terms of section 71A(1); (b) exempted in terms of section 71(3); or (c) require a Permit in terms of Chapter 7, and must be read with the lists in Notice 3

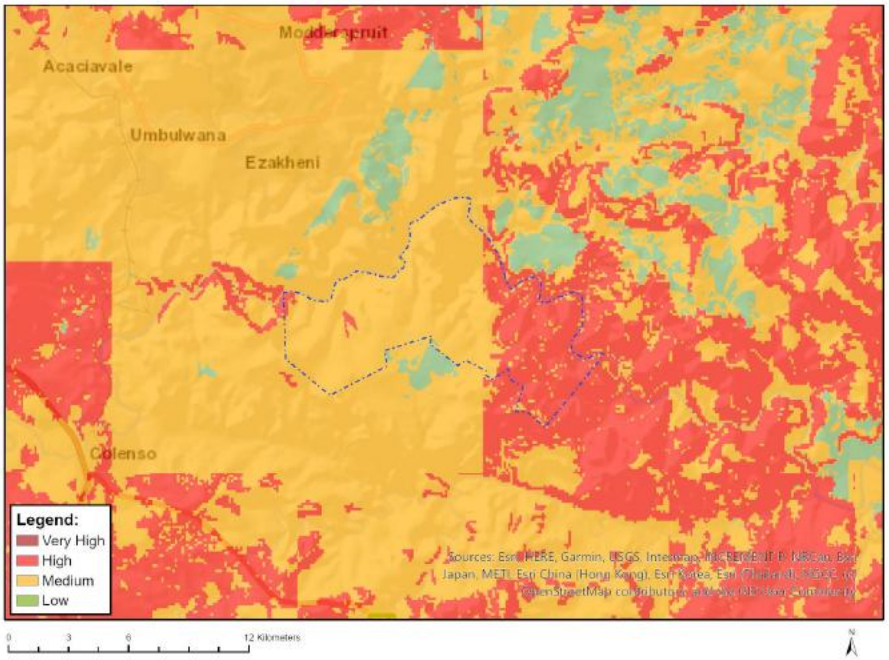
Faunal Species

The study area is primarily characterised by the Savanna biome which supports a diverse array of fauna. This section provides a brief description of the herpetofauna and mammals, which may occur within the study area. Macro- and micro-habitat scales are utilized by faunal species within a given area, with ecological and behavioural factors (such as food availability, niche habitat, and reduced predation risk) determining their persistence. Given the presence of KBA, it is essential to recognize that faunal habitats and their associated functions within the research region must be examined within the landscape matrix rather than in isolation.

According to the DFFE online National Web-based Environmental Screening report, the Animal Species Theme Sensitivity was classified as High for the project area, and a high probability of occurrence of the following faunal species: Avian (*Geronticus calvus, Falco biarmicus, Aquila*

rapax, Sagittarius serpentarius, Podica senegalensis, and *Hydroprogne caspia*), Mammalia [*Loxodonta africana, Ourebia ourebi ourebi*, sensitive species 5 (*Acinonyx jubatus*), and sensitive species 8 (*Philantomba monticola*)], and Reptilia (*Kinixys natalensis*).Previously recorded animal data surveys indicated that additional animal species may be present in the project area and may not be flagged by the environmental screening tool.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Mammals

A full, detailed list of expected mammal species is attached as part of **Appendix 2** of this report. Approximately 12 mammal species of conservation concern are expected. During the survey, only one species of conservation concern was recorded (Table 13).

Table 13: Mammals recorded during the survey.

Family	Common name	Species	IUCN Redlist
Hyaenidae	Brown hyena	*Hyaena brunnea*	NT
Veverridae	Spotted genet	*Genetta genetta*	LC
Bovidae	Kudu	*Tragelaphus strepsiceros*	LC
Hystricidae	Cape Porcupine	*Hystrix africaeaustralis*	LC
Bovidae	Springbok	*Antidorcas marsupialis*	LC
Bovidae	Impala	*Aepyceros melampus*	LC
Giraffidae	Giraffe	*Giraffa camelopardalis*	LC
Bovidae	Nyala	*Tragelaphus angasii*	LC
Suidae	Warthog	*Phacochoerus africanus*	LC

Herpetofauna

A full detailed list of expected herpetofauna species is attached as part of Appendix 2 of this report. A total of three species are classified as of conservation concern. It is important to note that amphibians in Zululand are among the most threatened vertebrate groups, with wetland-associated anurans in particular experiencing high levels of habitat loss. No species of conservation concern has been recorded during the survey.

Avifauna

A full, detailed list of expected bird species is attached as part of **Appendix 3** of this report. The project area is dominated by woody species within the savanna biome, which provide significant feeding areas for many bird species. The online database of the Southern African Bird Atlas Project (SABAP2) was queried to obtain a list of bird species confirmed to occur within the relevant pentads (2840_2955 & 2840_3000). Bird species of conservation concern may be expected within the project area. The table below lists red data bird species that are expected.

Table 14: List of expected SCC List Bird species.

No.	Common_group	Common_species	Genus	Species	IUCN Status	National/Regional Status
1	Buzzard	Common	*Buteo*	*buteo*	LC	Fifth Schedule
2	Bustard	White-bellied	*Eupodotis*	*senegalensis*	LC	CITES II & Fifth Schedule
3	Buzzard	European Honey	*Pernis*	*apivorus*	LC	Fifth Schedule
4	Buzzard	Jackal	*Buteo*	*rufofuscus*	LC	Fifth Schedule
5	Eagle	Booted	*Hieraaetus*	*pennatus*	LC	Fifth Schedule
6	Eagle	Tawny	*Aquila*	*rapax*	VU	Fifth Schedule
7	Eagle	Tawny	*Aquila*	*rapax*	VU	CITES II & Fifth Schedule
8	Eagle	Wahlberg's	*Hieraaetus*	*wahlbergi*	LC	Fifth Schedule
9	Eagle-Owl	Spotted	*Bubo*	*africanus*	LC	Fifth Schedule
10	Falcon	Lanner	*Falco*	*biarmicus*	LC	CITES II
11	Finfoot	African	*Podica*	*senegalensis*	LC	Fifth Schedule
12	Fish Eagle	African	*Haliaeetus*	*vocifer*	LC	Fifth Schedule
13	Goshawk	African	*Accipiter*	*tachiro*	LC	Fifth Schedule
14	Harrier-Hawk	African	*Polyboroides*	*typus*	LC	Fifth Schedule
15	Heron	Black-headed	*Ardea*	*melanocephala*	LC	Fifth Schedule
16	Heron	Goliath	*Ardea*	*goliath*	LC	Fifth Schedule
17	Heron	Grey	*Ardea*	*cinerea*	LC	Fifth Schedule
18	Ibis	Hadada	*Bostrychia*	*hagedash*	LC	Fifth Schedule
19	Ibis	Southern Bald	*Geronticus*	*calvus*	NT	Fourth Schedule
20	Kite	Black-winged	*Elanus*	*caeruleus*	LC	Fifth Schedule

21	Kite	Yellow-billed	*Milvus*	*aegyptius*	LC	Fifth Schedule
22	Snake Eagle	Brown	*Circaetus*	*cinereus*	LC	Fifth Schedule
23	Sparrowhawk	Little	*Accipiter*	*minullus*	LC	Fifth Schedule
24	Tern	Caspian	*Hydroprogne*	*caspia*	LC	Fifth Schedule
25		Hamerkop	*Scopus*	*umbretta*	LC	Fifth Schedule
26		Secretarybird	*Sagittarius*	*serpentarius*	EN	CITES II

Conservation and Sensitive Areas

The proposed mining rights area is situated within the Thukela Thornveld and Thukela Valley Bushveld, both classified as Least Threatened vegetation types at the national scale, but occurring largely in pristine or near-natural condition within the study area. Despite their national status, these vegetation units are ecologically important locally due to their intact structure, connectivity, and ability to support species of conservation concern (SCC). The site overlaps with Critical Biodiversity Areas (CBAs) classified as irreplaceable and optimal in the KwaZulu-Natal Biodiversity Sector Plan and falls entirely within a Key Biodiversity Area (KBA), namely the Tugela–Bushmans Thornveld KBA. These biodiversity planning layers represent priority areas required to meet provincial and national biodiversity targets and should be maintained in a natural or near-natural state.

At a broader landscape scale, the mining rights area and its immediate surroundings remain predominantly natural, with continuous tracts of indigenous vegetation providing important ecological functions, including habitat provision, soil stabilisation, hydrological regulation, and movement corridors for fauna. The presence of multiple SCC flora and fauna within the project footprint further underscores the area's ecological value and sensitivity. Although some species recorded on site are relatively common or disturbance-tolerant, the confirmed and potential occurrences of endemic, threatened, and protected species increase the site's conservation significance.

Based on the integration of desktop and field assessment outcomes, the study area is considered highly significant for conservation and should be managed accordingly, particularly given its overlap with CBAs, the KBA, and areas identified under the National Protected Area Expansion Strategy (NPAES).

Sensitive Areas

For the purposes of this assessment, sensitive areas are defined as Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Key Biodiversity Areas (KBAs), NPAES priority areas, and habitats supporting Species of Conservation Concern (SCC). Within the proposed mining rights area, the following sensitive features are present:

- **Critical Biodiversity Areas (CBAs):**
  Portions of the mining rights area fall within terrestrial CBAs classified as irreplaceable and optimal. These areas are required to meet biodiversity targets and maintain ecological processes and should, where possible, be protected from irreversible transformation.
- **Key Biodiversity Area (KBA): Tugela–Bushmans Thornveld:**
  The entire project area lies within a globally significant KBA that supports threatened, endemic, and geographically restricted species, as well as intact savanna ecosystems. Disturbance in this area may affect biodiversity features that underpin the site's KBA status.
- **National Protected Area Expansion Strategy (NPAES):**
  The full extent of the NPAES priority area identified within the study area falls inside the proposed mining rights footprint. These areas are strategically important for future protected-area expansion and ecological connectivity and are considered highly sensitive at the planning level.
- **Species of Conservation Concern (SCC):**
  Several SCC flora and fauna, including endemic, threatened, and protected species, were confirmed or are likely to occur within the study area. These species trigger specific legislative and management requirements.
- **Ecological Connectivity and Corridors:**
  The largely intact Thukela Thornveld and Thukela Valley Bushveld vegetation forms part of a broader ecological network that supports faunal movement and landscape-scale ecological processes within the uThukela District.

The site can therefore be regarded as "high" ecologically sensitive, primarily due to its location within CBAs, KBA, NPAES, confirmed presence of SCC, and ecological connectivity.

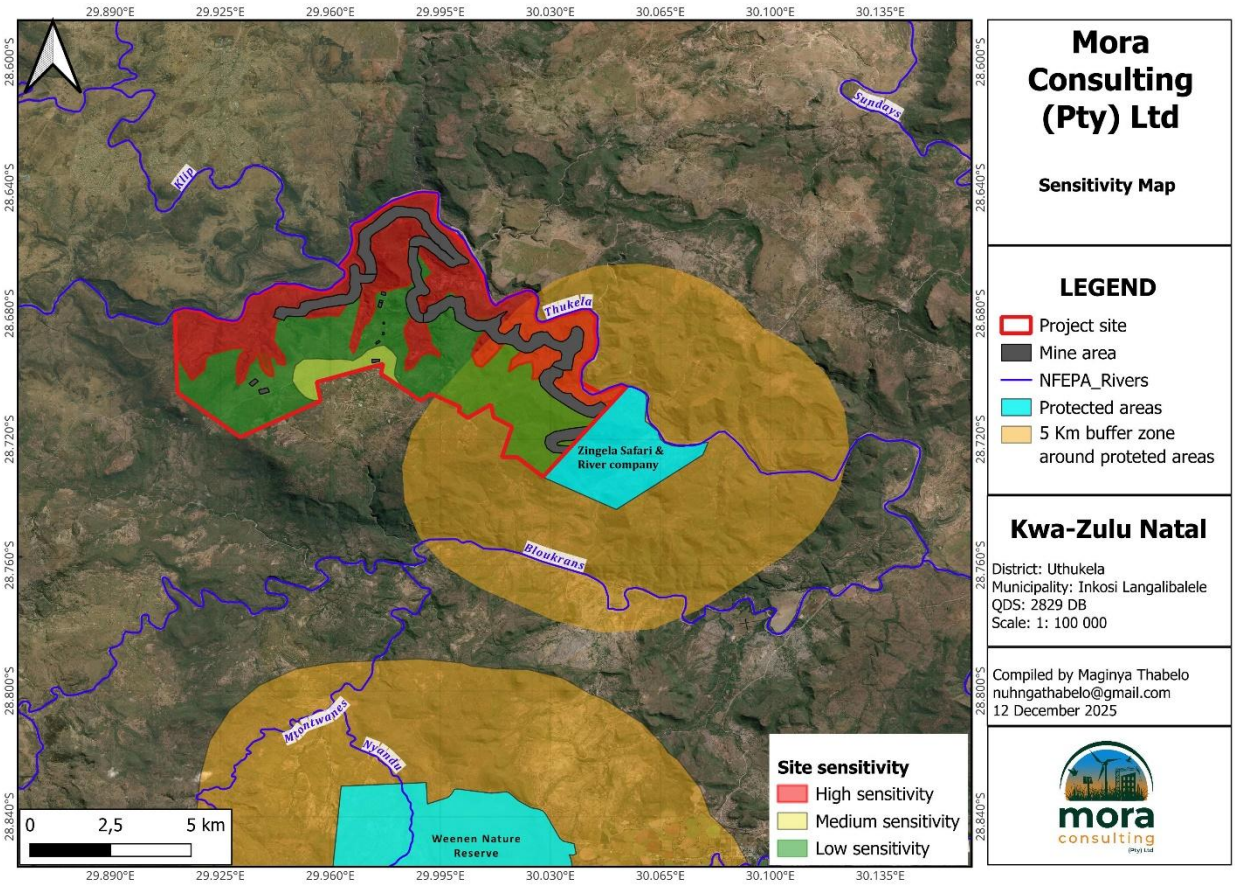


Figure 9: Sensitivity Map of the proposed mining rights.

Ecological Function

Ecological function refers to the degree of connectivity and interaction between ecosystems within the landscape. Highly connected systems are generally more sensitive to disturbances and play a key role in maintaining ecosystem services, including habitat provision, climate regulation, and biodiversity persistence. The study area supports high ecological function due to its intact vegetation, presence of watercourses and drainage features, and role as a movement corridor for fauna. The area's conservation importance is further enhanced by the presence of SCC and its inclusion in formal biodiversity planning frameworks.

Description of the Sensitivity scale

- **No Go Areas:** Areas that have irreplaceable biodiversity or important ecosystem function values which may be lost permanently if these ecosystems are transformed, with a high potential of also affecting adjacent and/or downstream ecosystems negatively.
- **High ecological function:** Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors, or highly dynamic systems considered to be stable and important for the maintenance of ecosystem integrity, for example, pristine grasslands, pristine wetlands, and pristine ridges.
- **Medium ecological function:** Relatively important ecosystems at gradients of intermediate disturbances. An area may be considered of medium ecological function if it is directly adjacent to a sensitive/pristine ecosystem.
- **Low ecological function:** Degraded and highly disturbed systems with little or no ecological function.

Conservation status of the vegetation

- **High conservation importance:** Ecosystems with high species richness which usually provide suitable habitats for several threatened species. Traditionally termed 'no-go' areas and unsuitable for development and should be conserved.
- **Medium conservation importance:** Ecosystems with intermediate levels of species diversity without any threatened species. Low-density development may be accommodated, provided the current species diversity is conserved.
- **Low conservation importance:** Areas with little or no conservation potential and usually species-poor (most species are generally exotic).

Conservation Importance, PES, and EIS Summary

The project area supports high plant and animal diversity, including endemic and threatened taxa, and functions as an important ecological corridor within the broader landscape. Despite some historical disturbance and the presence of alien invasive plant species, the vegetation remains largely natural and pristine. This confers **High** Conservation Importance.

The Present Ecological Status (PES) of the site is assessed as **high**, while the Ecological Importance and Sensitivity (EIS) is rated as **high**, reflecting both the ecological value of the site and its low resilience to disturbance. Consequently, the proposed mining activities could cause significant ecological impacts if not carefully managed and mitigated in accordance with the mitigation hierarchy.

Scoping Report

The Scoping report is in line with the EIA Regulations of 2014, as amended on 07 April 2017. In line with this requirement, the scoping phase provides an initial, defensible overview of the receiving environment and the key ecological issues that may be associated with the proposed development. A summary of the identified impacts is provided in Table 15 below.

Table 15: A summary of the identified impacts.

Impact	Issue	Nature of Impact	Extent of Impact	No-Go Areas
Potential loss of faunal species	Habitat clearance and fragmentation	**Direct impacts:** Loss of natural habitat leading to displacement or mortality of fauna. **Indirect impacts:** Increased edge effects, disturbance, and reduced habitat connectivity beyond the footprint.	Regional	None formally declared; however, CBAs, KBA, riparian zones, and NPAES priority areas are functionally no-go areas
Potential loss of Species of Conservation Concern (SCC)	Presence of SCC fauna and flora within footprint	**Direct impacts:** Destruction of habitat supporting SCC. **Indirect impacts:** disturbance, population isolation, and disruption of ecological processes.	National	SCC habitats, CBAs (irreplaceable and optimal), KBA, NPAES priority areas

Description of Expected Significance of Impact: The proposed mining rights area is largely pristine and retains intact Thukela Thornveld and Thukela Valley Bushveld vegetation. Unlike previously transformed urban or industrial sites, the project area supports high ecological integrity, ecological connectivity, and multiple species of conservation concern. The presence of CBAs, the Tugela–Bushmans Thornveld KBA, and full overlap with an NPAES priority area elevates the sensitivity of the receiving environment. As a result, habitat loss and fragmentation associated with mining activities are expected to have moderate to high ecological impacts, particularly on SCC and ecosystem functioning. Without mitigation, impacts may be significant and long-lasting; however, with appropriate avoidance, buffering, and offset measures, impacts can be reduced, though not fully eliminated.
Gaps in Knowledge and Recommendations for Further Study: • Detailed mapping of all confirmed and potential SCC within the mining rights footprint; • Mapping of breeding, foraging, roosting, sheltering, and dispersal habitats; • Habitat condition assessment and sensitivity mapping at a fine spatial scale; • Targeted seasonal surveys for cryptic, nocturnal, and seasonal fauna; • Assessment of offset feasibility for impacts on NPAES and KBA areas.

Impact Assessment

Nature of Impacts Identified

This section describes the potential impacts that the proposed mining right and its associated activities may have on the terrestrial biodiversity of the study area. The assessment considers impacts across the **pre-construction and construction**, **operational**, and **closure/decommissioning** phases of the project, as mining-related activities will involve vegetation clearance, earthworks, infrastructure development, and ongoing operational disturbance.

Based on the proposed mining layout and associated infrastructure, the following potential impacts on terrestrial biodiversity have been identified:

- The **primary impacts on vegetation and flora** are expected to occur during the pre-construction and construction phases, when vegetation clearance and topsoil disturbance take place. This will result in the loss of intact plant communities and associated faunal habitat within the mining footprint.
- **Operational activities** are expected to result in ongoing disturbance to the natural environment through increased vehicle traffic, movement of personnel, noise, dust, and lighting. The use of heavy machinery and vehicles may lead to soil compaction, disruption of soil structure, and further degradation of vegetation in disturbed areas.
- The proposed mining activities may **affect sensitive habitats and ecological features**, including drainage lines, riparian zones, rocky outcrops, ridges, and specialised niche habitats that support fauna and flora of conservation importance.
- Vegetation clearance and soil disturbance may result in **habitat fragmentation and edge effects**, increasing the vulnerability of disturbed areas to invasion by alien and invasive plant species. The establishment of invasive species may outcompete indigenous vegetation, leading to changes in species composition and further degradation of habitat quality.

- The **presence of endemic, threatened, or Species of Conservation Concern (SCC)** within the mining footprint or adjacent areas may result in direct loss or disturbance of individuals and habitats if not adequately avoided, buffered, or managed through appropriate mitigation measures.
- Increased **anthropogenic disturbance** associated with mining personnel, contractors, and supporting infrastructure may result in trampling of vegetation, disturbance to fauna, and degradation of adjacent natural areas beyond the approved footprint if access is not strictly controlled.
- Human activity associated with the mining operation, including noise, vibration, waste generation, lighting, and increased human presence, may **negatively affect faunal communities**, leading to avoidance behaviour, displacement, disruption of breeding and foraging activities, and potential declines in local populations, particularly for sensitive and wide-ranging species.

Overall, due to the **pristine and largely untransformed condition of the receiving environment**, these impacts are considered potentially significant and require strict application of the mitigation hierarchy, with emphasis on avoidance, buffering, and footprint minimisation, to reduce long-term effects on terrestrial biodiversity.

The Table below summarises the significant impacts.

Impact Assessment

The Table below summarises the significant impacts.

Impact Phase: Pre-construction and Construction
Nature of Impact: Direct and indirect loss and disturbance of natural vegetation, terrestrial habitat, fauna, and Species of Conservation Concern (SCC) within CBAs, KBA, and NPAES priority areas due to vegetation clearance, earthworks, access roads, and associated mining infrastructure.

	Without mitigation	With mitigation
Extent	3	2
Duration	4	4
Magnitude	8	6
Probability	4	3
Significance	**60 (High)**	**42 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Partially	Partially

Mitigation:

- Avoidance of CBAs (irreplaceable and optimal), SCC habitats, and NPAES priority areas where feasible
- Application of a minimum 100 m buffer around NPAES areas, SCC habitats, drainage lines, and riparian features
- Restrict clearing strictly to the approved mining footprint
- Pre-construction ecological walk-throughs and demarcation of no-go areas
- Progressive rehabilitation of disturbed areas

Cumulative impacts:

Contribution to regional habitat loss and fragmentation when combined with existing and proposed mining and agricultural activities in the landscape.

Residual Risks:

Residual loss of future conservation potential within NPAES areas and reduced habitat connectivity despite mitigation.

Impact Phase: OPERATIONAL		
Nature: Ongoing disturbance to fauna and ecological processes due to noise, lighting, vehicle movement, dust, and continued habitat fragmentation within a sensitive biodiversity landscape.		
	Without mitigation	**With mitigation**
Extent	3	2
Duration	4	4
Magnitude	6	4
Probability	3	2
Significance	**39 (Medium)**	**20 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: • Control of vehicle access and prohibition of off-road driving • Management of lighting to reduce disturbance to nocturnal fauna • Dust suppression and noise control measures • Continued rehabilitation and invasive alien plant control		
Cumulative impacts: Incremental degradation of habitat quality and increased faunal avoidance behaviour at a landscape scale.		
Residual Risks: Low-level, long-term disturbance to fauna and reduced ecological functionality near operational infrastructure.		

Impact Phase: Decommissioning		
Nature: Temporary disturbance of vegetation, habitat, and fauna during infrastructure removal, earthworks, and rehabilitation activities.		
	Without mitigation	**With mitigation**
Extent	2	1
Duration	3	2
Magnitude	4	2
Probability	2	1
Significance	**18 (Low)**	**6 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: • Controlled and phased decommissioning • Removal of all infrastructure and waste • Active re-vegetation using indigenous species • Erosion control and long-term rehabilitation monitoring		
Cumulative impacts: Negligible if rehabilitation objectives are achieved.		
Residual Risks: Short-term disturbance only, with low residual ecological risk.		

Assessment of Cumulative Impacts

"Cumulative Impact", in relation to an activity, means the past, current, and reasonably foreseeable future impact of an activity, considered together with the impact of activities

associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

Cumulative impact table:

Nature: Progressive loss of natural habitat, reduction in ecological connectivity, and cumulative pressure on biodiversity features due to mining and other land-use activities within the region.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	2	3
Duration	4	4
Magnitude	6	8
Probability	3	4
Significance	**42 (Medium)**	**60 (High)**
Status (positive/negative)	Negative	Negative
Reversibility	Low	Low
Loss of resources?	Yes	Yes
Can impacts be mitigated?	Partially	Partially
Confidence in findings: High. Supported by field observations, desktop datasets, and the disturbed condition of the receiving environment.		
Mitigation: • Footprint minimisation across all project phases • Avoidance and buffering of biodiversity priority areas • Implementation of biodiversity offsets for residual impacts on NPAES and KBA areas • Compliance with the EMPr and long-term ecological monitoring		

The cumulative impact assessment indicates that the proposed mining right, when considered with existing and reasonably foreseeable developments in the surrounding area, has the potential to result in cumulative impacts of concern, primarily because the receiving environment is pristine, mainly intact, and currently untransformed. The absence of historical agricultural or mining pressures increases the ecological sensitivity of the landscape, as any new disturbance represents a net loss of natural habitat, ecological function, and future conservation potential.

Cumulative impacts are therefore expected to arise predominantly from the proposed mining activities themselves rather than from additive effects with existing land uses. Potential cumulative effects include the incremental loss of intact habitat, increased fragmentation of savanna ecosystems, disruption of ecological connectivity, and disturbance to fauna, including wide-ranging and sensitive species. Given the overlap with Critical Biodiversity Areas, a Key Biodiversity Area, and a National Protected Area Expansion Strategy priority area, cumulative impacts on biodiversity patterns and processes may extend beyond the immediate footprint and persist at the local-to-regional scale.

In the absence of strict mitigation, such cumulative impacts could result in moderate to high residual impacts, including irreversible loss of land identified for strategic conservation planning. Even with mitigation, residual impacts are anticipated to remain moderate, reflecting the limited resilience of pristine ecosystems to transformation. As such, mitigation must prioritise avoidance as the primary response, supported by clearly defined and mapped buffers informed by Ezemvelo KZN Wildlife spatial datasets and guidelines, maintenance of ecological corridors, and minimisation of the disturbance footprint.

Where avoidance and minimisation cannot adequately address residual impacts, particularly in relation to the loss of NPAES and KBA features, biodiversity offsets must be considered in line with the mitigation hierarchy to address residual cumulative loss. Progressive rehabilitation alone will not fully compensate for the loss of intact habitat and conservation expansion potential.

Provided that the above measures are fully incorporated into the project design, supported by additional seasonal field surveys, clearly mapped sensitivity areas and buffers, and an offset strategy acceptable to the competent authority and Ezemvelo KZN Wildlife, the cumulative impacts are not expected to result in unacceptable risk or complete whole-scale changes to the

environment or sense of place. However, in the absence of these measures, the risk of unacceptable cumulative impacts cannot be excluded.

Ongoing monitoring, adaptive management, and consultation with relevant conservation authorities will be essential to verify the effectiveness of mitigation measures and to ensure that residual cumulative impacts remain within acceptable limits throughout the project's life.

Mitigation and Management Measures

- All mitigation measures prescribed in this report and the approved Environmental Management Programme (EMPr) must be **implemented in full** throughout all phases of the project to prevent, minimise, and manage impacts on terrestrial biodiversity.
- All **mining-related activities** must be strictly confined to the **approved mining footprint and layout**. No activities may occur outside demarcated areas without prior authorisation.
- Prior to any vegetation clearance or earthworks, **no-go areas, buffers, and sensitive habitats** must be clearly demarcated on the ground by a suitably qualified environmental control officer (ECO) and remain in place for the duration of activities.
- **Vegetation clearance must be minimised and controlled**, limited strictly to areas required for mining infrastructure and access. Selective clearing should be applied where feasible to reduce habitat loss.
- **Existing access roads and tracks must be used** wherever possible. No new access routes may be created without prior approval, and all roads must be clearly demarcated and maintained to prevent unnecessary fragmentation and soil compaction.
- **Alien and Invasive Plant (AIP) control measures** must be implemented in all disturbed areas in accordance with applicable legislation. Disturbed areas must be regularly monitored and treated to prevent the establishment and spread of invasive species.
- All staff, contractors, and visitors must undergo **environmental awareness induction training** prior to accessing the site, with specific emphasis on the protection of fauna, flora, sensitive habitats, and legal consequences of non-compliance.

- If **endemic, threatened, protected, or Species of Conservation Concern (SCC)** are identified within or adjacent to the mining footprint, these areas must be avoided where feasible. Where avoidance is not possible, a suitably qualified specialist must be consulted to determine appropriate management actions. Any relocation or disturbance of such species must be undertaken **in accordance with the relevant permits and** specialist recommendations.
- **Sensitive ecological areas**, including drainage lines, riparian zones, rocky outcrops, and areas identified as CBAs, KBA features, or NPAES priority areas, must be avoided and buffered as per specialist recommendations. No mining activities may occur within these areas unless specifically authorised.
- Human activity must be **strictly controlled** to prevent trampling, off-road movement, and disturbance to fauna. Waste must be managed appropriately, and no hunting, trapping, or harassment of wildlife is permitted.
- All excavations, trenches, and temporary disturbance areas must be **backfilled and stabilised** as soon as practicable. Rehabilitation must use locally sourced indigenous plant species appropriate to the vegetation type.
- All exploration or monitoring boreholes must be **appropriately sealed and rehabilitated** once no longer required, and disturbed areas must be re-vegetated to reduce erosion and visual impacts.
- Progressive rehabilitation must be implemented throughout the life of the project, with disturbed areas rehabilitated as soon as they become available, and rehabilitation success must be monitored and reported.

Table 16: Terrestrial Biodiversity Mitigation and Management Measures.

Impact / Risk	Mitigation / Management Measure	Responsibility	Phase	Monitoring / Performance Indicator
Uncontrolled habitat loss	Confine all activities strictly to the approved mining footprint and layout. No work outside demarcated areas without written approval.	Mine Manager / ECO	All phases	No disturbance observed outside the approved footprint
Disturbance to sensitive habitats (CBAs, KBA, NPAES areas, riparian zones)	Demarcate all no-go areas and buffers prior to site establishment using visible fencing or markers.	ECO	Pre-construction	No-go areas are clearly demarcated and intact
Excessive vegetation clearance	Limit vegetation clearance to areas strictly required. Apply selective clearing where feasible.	Contractor / ECO	Pre-construction & construction	Clearance footprint matches approved layout
Soil compaction and erosion	Use existing roads and tracks only. Prohibit off-road driving.	Contractor	All phases	No new informal tracks observed
Alien and invasive plant establishment	Implement an Alien and Invasive Plant (AIP) control programme in disturbed areas.	ECO / Contractor	Construction, operation, closure	No increase in listed AIP species
Disturbance to fauna	Prohibit hunting, trapping, harassment, or feeding of wildlife.	Mine Manager	All phases	Zero wildlife-related incidents

Disturbance from human activity	Conduct mandatory environmental awareness training for all staff and contractors.	ECO	Pre-construction & ongoing	Training attendance registers
Impact on SCC, endemic or protected species	Avoid SCC habitats where feasible. If encountered, stop work and consult a specialist. Obtain permits prior to any relocation.	ECO / Specialist	All phases	Specialist report and permit compliance
Fragmentation of habitat	Keep roads, laydown areas, and infrastructure to a minimum and within approved areas.	Mine Manager	All phases	No additional fragmentation observed
Waste-related impacts	Implement strict waste management; remove waste regularly.	Contractor	All phases	No litter or illegal dumping
Open excavations and trenches	Backfill and stabilise excavations as soon as practicable.	Contractor	Construction & operation	No open, unsafe excavations
Borehole impacts	Seal and rehabilitate all boreholes once decommissioned.	Contractor	Closure	Boreholes sealed and rehabilitated
Failure of rehabilitation	Implement progressive rehabilitation using locally indigenous species.	Mine Manager / ECO	All phases	Rehabilitation success is assessed annually

CONCLUSION

The DFFE Screening Report identified the **Terrestrial Biodiversity theme for the proposed Dunrose mining right as HIGH to VERY HIGH sensitivity**. This is supported by the findings of the Terrestrial Biodiversity Assessment, which confirm that the project area is **pristine, mainly ecologically intact, and of high conservation importance**, with the confirmed presence and/or high likelihood of occurrence of **Species of Conservation Concern**. The overlap with **Critical Biodiversity Areas (irreplaceable and optimal)**, a **Key Biodiversity Area (Tugela–Bushmans Thornveld)**, and a **National Protected Area Expansion Strategy (NPAES) priority area** further increases the site's ecological sensitivity.

The proposed mining activities are expected to result in **direct and localised loss of indigenous terrestrial vegetation**, specifically **Thukela Thornveld and Thukela Valley Bushveld**, which, although classified as Least Concern at a national level, remain largely untransformed within the study area and are therefore of high local conservation value. The clearance and fragmentation of these vegetation types will result in the loss of habitat for indigenous flora and fauna, including endemic, protected, and threatened species. Aquatic features and associated riparian vegetation occur within and adjacent to the project area and are addressed in the aquatic specialist study; therefore, they are not assessed further in this report.

Areas of **high ecological sensitivity**, including CBAs, KBA features, NPAES priority areas, riparian zones, and specialised habitats such as rocky outcrops and drainage lines, must be **avoided wherever feasible**. Where avoidance is not possible, **appropriate and site-specific mitigation measures**, including clearly defined buffers and strict footprint control, must be implemented. Although the landscape comprises a mosaic of savanna habitats, these areas function collectively as an **ecologically connected system** that supports faunal movement, dispersal, and key ecological processes. Further fragmentation resulting from mining activities may disrupt these processes, particularly for wide-ranging and disturbance-sensitive species. As a result, **certain portions of the mining right area must be regarded as no-go areas from a biodiversity perspective**.

In this context, the loss and/or fragmentation of indigenous vegetation within key vegetation units may contribute to the **cumulative degradation of ecological structure and function** within

CBAs and the NPAES priority area. It is therefore critical, from a terrestrial biodiversity perspective, that the final mining layout and development footprint explicitly account for these biodiversity constraints in order to maintain ecosystem functioning and landscape connectivity.

Overall, the impacts on terrestrial biodiversity associated with the proposed mining rights have been identified and assessed. **Prior to mitigation, several impacts are rated High, while others are rated Moderate**. With the implementation of the whole mitigation hierarchy, including avoidance, buffering, footprint minimisation, and rehabilitation, most impacts can be reduced to **Moderate or Low significance**. However, in instances where impacts associated with the **loss of CBAs, KBA features, or NPAES priority land cannot be reduced to Low**, a **biodiversity offset must be considered** in accordance with national and provincial biodiversity planning frameworks and in consultation with the competent authority and Ezemvelo KZN Wildlife.

Terrestrial Biodiversity Statement and Opinion of the Specialist

Based on the findings presented in this assessment, the proposed Dunrose mining activities are expected to have a **moderate negative impact on terrestrial biodiversity**, even after mitigation measures are implemented. Impacts are anticipated to arise primarily from the **loss and fragmentation of indigenous vegetation**, disturbance to fauna, and the transformation of areas identified as **Critical Biodiversity Areas (CBAs), Key Biodiversity Area (KBA) features, and National Protected Area Expansion Strategy (NPAES) priority land**.

The project area is pristine mainly **and in a natural state**, supporting intact Thukela Thornveld and Thukela Valley Bushveld vegetation and providing habitat for a range of indigenous flora and fauna, including **Species of Conservation Concern**. In such intact systems, **disturbance creates a high risk of secondary impacts**, particularly the **introduction and spread of Alien and Invasive Plant (AIP) species** along disturbed edges, access routes, and rehabilitated areas.

Areas of **high ecological sensitivity**, including CBAs (irreplaceable and optimal), KBA features, NPAES priority areas, riparian zones, and specialised habitats, should be designated as no-go areas for development wherever feasible and protected by clearly defined, enforceable buffer zones. Disturbance within or adjacent to these areas would not only result in direct habitat loss

but would also increase susceptibility to **AIP establishment**, further degrading ecological integrity and ecosystem functioning.

To minimise the direct and cumulative loss of sensitive ecosystems, mining activities should be **restricted to the smallest practicable footprint** and directed away from sensitive habitats. All disturbed areas must be subject to **active control of alien and invasive plants**, implemented in accordance with relevant legislation and integrated into the Environmental Management Programme. Failure to effectively manage AIPs may result in long-term degradation that exceeds the direct footprint of mining activities.

Based on the assessment findings and the current condition of the associated vegetation units, the specialist **concurs with the high-sensitivity classification assigned to the site in** the National Web-based Environmental Screening Tool for terrestrial biodiversity. This classification reflects the intact nature of the receiving environment, the presence and potential occurrence of Species of Conservation Concern, and the area's vulnerability to invasion by alien plant species following disturbance.

It is the reasoned opinion of the specialist that the proposed development may be considered **conditionally acceptable**, provided that all recommended mitigation measures—including **strict footprint control, avoidance of sensitive habitats, effective AIP management, buffering, and progressive rehabilitation**- are implemented **from the outset of project activities** and enforced throughout the life of the project. When impacts on CBAs, KBA features, or NPAES priority areas cannot be reduced to a low level, biodiversity offsets should be considered in accordance with the mitigation hierarchy and in consultation with the competent authority and Ezemvelo KZN Wildlife.

Where active rehabilitation or restoration is required, this should be undertaken using **locally indigenous plant species**, preferably those native to the project area. Rehabilitation should aim to restore natural vegetation structure and species composition while **preventing the establishment and spread of AIPs**, thereby supporting long-term ecological functioning and reducing cumulative impacts beyond the mining footprint.

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APPENDICES

Appendix 1: List of expected flora

No.	Scientific name	Common name	SANBI Red List	National Protection	Regional Protection	Protected Tree
1	*Abutilon austroafricanum*		Least concern			
2	*Achyranthes aspera*	Devil's Horsewhip	Exotic			
3	*Adiantum incisum*	Torn Maidenhair Fern	Least concern			
4	*Alectra sessiliflora*	Yellow Paintflower	Least concern			
5	*Aloe marlothii*	mountain aloe	Least concern			
6	*Aloe prinslooi*	Prinsloo's Spotted Aloe	Endemic			
7	*Ammocharis coranica*	Ground lily	Least concern			
8	*Argemone ochroleuca*	Mexican Poppy	1b			
9	*Aristida congesta congesta*	Cat's-Tail Three-Awned Grass	Least concern			
10	*Asparagus suaveolens*	Catthorn Asparagus	Least concern			
11	*Barleria lancifolia*	Butterfly Bushviolet	Least concern			
12	*Barleria obtusa*	Blue Bushviolet	Least concern			
13	*Blepharis inermis*		Vulnerable			
14	*Blepharis natalensis*		Endemic			
15	*Boscia albitrunca*	Shepherds tree	Least concern			Protected
16	*Boscia foetida longipedicellata*	Tugela Stink Shepherdstree	Endemic			
17	*Callisia repens*	Turtle Vine	Exotic			
18	*Catharanthus roseus*	Madagascar Periwinkle	1b			
19	*Ceratotheca triloba*	South African foxglove	Least concern			
20	*Cheilanthes viridis*	Green Cliff Brake	Least concern			
21	*Chloris pycnothrix*	Spider Web Chloris	Least concern			

22	*Chloris virgata*	feather finger grass	Least concern			
23	*Cirsium vulgare*	Bull Thistle	1b			
24	*Clematis brachiata*	Travellers Joy	Least concern			
25	*Coddia rudis*	Coddia	Least concern			
26	*Coleus cylindraceus*	Camphor Spurflower	Least concern			
27	*Coleus livingstonei*	Large Hedgehog-Flower	Least concern			
28	*Combretum erythrophyllum*	umDubu	Least concern			
29	*Commelina africana*	Yellow Dayflower	Least concern			
30	*Commelina erecta*	Coastal Blue Dayflower	Least concern			
31	*Commicarpus plumbagineus*	White Wartclub	Least concern			
32	*Commiphora neglecta*	Green Corkwood	Least concern			
33	*Corbichonia decumbens*		Least concern			
34	*Corchorus asplenifolius*	Spleenwort Gusha	Least concern			
35	*Cotyledon orbiculata*	varkoor	Least concern			
36	*Crassula expansa fragilis*	Fragile Stonecrop	Least concern			
37	*Crassula nudicaulis*	Karoo Stonecrop	Least concern			
38	*Crotalaria lanceolata*	lanceleaf rattlepod	Least concern			
39	*Croton gratissimus*	Lavender Feverberry	Least concern			
40	*Cucumis metuliferus*	Jelly Melon / Rooikomkommer	Least concern			
41	*Cymbopogon caesius*	Broad-leaved Turpentine Grass	Least concern			
42	*Cyperus difformis*	Variable Flatsedge	Least concern			
43	*Cyperus dives*	Fig Sedge	Least concern			
44	*Cyperus rubicundus*		Least concern			
45	*Cyphocarpa angustifolia*	Silky Burweed	Least concern			
46	*Cyphostemma cirrhosum cirrhosum*		Least concern			
47	*Cyrtanthus galpinii*	Galpins Firelily	Least concern			
48	*Dalbergia obovata*	Climbing Flatbean	Least concern			

49	*Datura ferox*	White Stinkweed	1b			
50	*Delosperma tradescantioides*	Wandering Sheepfig	Least concern			
51	*Dichrostachys cinerea*	sicklebush	Least concern			
52	*Dichrostachys cinerea*	Small-leaf Sicklebush	Least concern			
53	*Dicliptera cernua*	False buckweed	Endemic			
54	*Digitaria eriantha*	Digitgrass	Least concern			
55	*Dioscorea sylvatica*		Vulnerable			
56	*Diospyros lycioides*	Quilted Bluebush	Least concern			
57	*Dombeya cymosa*	Hairless Dombeya	Least concern			
58	*Drimia zambesiaca*	African Squill	Least concern			
59	*Duvalia polita*		Least concern			
60	*Ehretia amoena*	sandpaper stamperwood	Least concern			
61	*Ehretia rigida*	Puzzle Bush	Least concern			
62	*Elaeodendron transvaalense*	anthill saffron	Near threatened			Protected
63	*Eragrostis superba*	Heartseed Lovegrass	Least concern			
64	*Euclea crispa*	Blue Guarri	Least concern			
65	*Eulophia petersii*	Garden Harlequin	Least concern			
66	*Eulophia streptopetala*	Twisted Harlequin	Least concern			
67	*Euphorbia grandidens*	Valley Naboom	Least concern			
68	*Euphorbia ingens*	Common Naboom	Least concern			
69	*Euphorbia tirucalli*	Rubber Milkbush	Least concern			
70	*Euphorbia triangularis*	River Naboom	Least concern			
71	*Ficus abutilifolia*	Large-leaved rock fig	Least concern			
72	*Ficus ingens*	red-leaved fig	Least concern			
73	*Fingerhuthia africana*	Thimble Grass	Least concern			
74	*Glandularia aristigera*	Moss Verbena	Least concern			
75	*Gomphocarpus fruticosus*	Narrow-leaf Cotton Bush	Least concern			

76	*Gomphocarpus fruticosus fruticosus*	Wild Cotton	Least concern			
77	*Gomphostigma virgatum*	Common Otterbush	Least concern			
78	*Grewia flava*	Velvet Raisin	Least concern			
79	*Gymnosporia buxifolia*	Common Spikethorn	Least concern			
80	*Gymnosporia macrocarpa*	Tugela Spikethorn	Endemic			
81	*Hibiscus calyphyllus*	Large Yellow Wild Hibiscus	Least concern			
82	*Hibiscus trionum*	flower-of-an-hour	Least concern			
83	*Ipomoea obscura*	Obscure Morning Glory	Least concern			
84	*Justicia odora*	Justicea	Least concern			
85	*Justicia protracta*		Least concern			
86	*Kalanchoe daigremontiana*	Mother of Thousands	Endangered			
87	*Kalanchoe delagoensis*	Mother-of-Millions	Exotic			
88	*Kalanchoe longiflora*		Endemic			
89	*Kalanchoe rotundifolia*	Nentakalanchoe	Least concern			
90	*Kedrostis foetidissima*	Stinky Haap	Least concern			
91	*Lantana camara*	Lantana	1b			
92	*Lantana rugosa*	Small Lantana	Least concern			
93	*Ledebouria asperifolia*	rough-leaved African hyacinth	Least concern			
94	*Ledebouria luteola*	highveld African hyacinth	Least concern			
95	*Leonotis nepetifolia nepetifolia*	Orange Lionears	Least concern			
96	*Leucas martinicensis*	White Tumbleweed	Least concern			
97	*Lysimachia arvensis*	scarlet pimpernel	Least concern			
98	*Maerua rosmarinoides*	Needle-Leaved Spider Bush	Least concern			
99	*Megathyrsus maximus*	Guinea Grass	Least concern			
100	*Melilotus albus*	White Sweetclover	Exotic			
101	*Melinis repens*	Natal Grass	Least concern			
102	*Mesembryanthemum cordifolium*	Heartleaf Sunfig	Endemic			

103	*Momordica balsamina*	Balsam Apple	Least concern			
104	*Mystacidium capense*	Summer Tree Orchid	Least concern			
105	*Obetia tenax*	Rock Tree Nettle	Least concern			
106	*Ocimum labiatum*	Large Shellbush	Least concern			
107	*Oenothera rosea*	rose evening primrose	Exotic			
108	*Opuntia ficus-indica*	Prickly Pear Cactus	1b			
109	*Orbea woodii*		Vulnerable			
110	*Pellaea calomelanos*	Hard Fern	Least concern			
111	*Persicaria decipiens*	slender knotweed	Least concern			
112	*Persicaria madagascariensis*	Bristly Snakeroot	Least concern			
113	*Phyllanthus tenellus*	Mascarene Island leaf-flower	Least concern			
114	*Plectranthus verticillatus*	Whorled plectranthus	Least concern			
115	*Plumbago auriculata*	blue plumbago	Least concern			
116	*Polypogon monspeliensis*	rabbitfoot grass	Exotic			
117	*Pontederia crassipes*	common water hyacinth	Least concern			
118	*Portulaca oleracea*	Common Purslane	Exotic			
119	*Portulacaria afra*	Common Spekboom	Least concern			
120	*Ptaeroxylon obliquum*	Sneezewood	Least concern			
121	*Rhynchosia caribaea*	Common Snoutbean	Least concern			
122	*Rhynchosia totta*	Carpet Snoutbean	Least concern			
123	*Ruellia patula*	White Veld Violet	Least concern			
124	*Salix mucronata woodii*	Flute Cape Willow	Least concern			
125	*Salvia tiliifolia*	Lindenleaf Sage	1b			
126	*Sansevieria hyacinthoides*	mother-in-law's tongue	Least concern			
127	*Scadoxus puniceus*	Paintbrush lily	Least concern			
128	*Schotia brachypetala*	Weeping Boerbean	Least concern			
129	*Searsia pentheri*	Common Crowberry	Least concern			

130	*Senegalia ataxacantha*	Flame Thorn Acacia	Least concern			
131	*Senna corymbosa*	Argentine Senna	Exotic			
132	*Senna italica*	Eland's Senna / Eland's Pea	Least concern			
133	*Sesbania punicea*	Scarlet Sesbane	1b			
134	*Solanum americanum*	American black nightshade	Exotic			
135	*Solanum catombelense*		Least concern			
136	*Solanum sisymbriifolium*	Red Buffalo-bur	1b			
137	*Solanum viarum*	tropical soda-apple	Exotic			
138	*Spirostachys africana*	tamboti	Least concern			
139	*Sporobolus africanus*	Parramatta Grass	Least concern			
140	*Striga bilabiata*	Small Pink Witchweed	Least concern			
141	*Stylochaeton natalense*	Bushveld Arum	Least concern			
142	*Tecomaria capensis*	Cape Honeysuckle	Least concern			
143	*Themeda triandra*	Red Grass	Least concern			
145	*Thunbergia venosa*		Rare			
146	*Tragus berteronianus*	African bur-grass	Least concern			
147	*Vachellia nilotica*	Egyptian acacia	Least concern			
148	*Vachellia nilotica kraussiana*	Sweet-scented Pod	Least concern			
149	*Vachellia robusta*	moOka	Least concern			
150	*Vachellia tortilis*	umbrella thorn	Least concern			
151	*Vepris lanceolata*	white-ironwood	Least concern			
152	*Vitellariopsis dispar*		Rare			
153	*Volkameria glabra*	Cat's-whiskers	Least concern			
154	*Zinnia peruviana*	Peruvian zinnia	Exotic			
155	*Ziziphus mucronata*	buffalo-thorn	Least concern			

Appendix 2: List of expected fauna.

No.	scientific_name	common_name	IUCN Status	National/Regional
Mammals				
1	*Alcelaphus buselaphus caama*	*Red Hartebeest*	LC	Fifth Schedule
2	*Ceratotherium simum simum*	*Southern White Rhinoceros*	NT	NEMBA
3	*Giraffa giraffa*	*Southern Giraffe*	VU	Fifth Schedule
4	*Kobus ellipsiprymnus ellipsiprymnus*	*Common Waterbuck*	LC	Fifth Schedule
5	*Mellivora capensis capensis*	*Cape Ratel*	LC	Fourth Schedule
6	*Orycteropus afer*	*Aardvark*	LC	NEMBA
7	*Panthera pardus pardus*	*African Leopard*	VU	NEMBA
8	*Steatomys pratensis*	*Common Fat Mouse*	LC	Fifth Schedule
9	*Loxodonta africana*	*African Savanna Elephant*	EN	NEMBA
10	*Ourebia ourebi ourebi*	*Oribi*	LC	Fourth Schedule
11	*Philantomba monticola*	*Blue Duiker*	LC	Fifth Schedule
12	*Acinonyx jubatus*	*Cheetar*	VU	Fifth Schedule
Herpetofauna (Amphibians and Reptiles				
13	*Acanthocercus atricollis*	Southern Tree Agama	LC	
14	*Acontias plumbeus*	Giant Legless Skink	LC	
15	*Agama aculeata*	Ground Agama	LC	
16	*Agama atra*	Southern Rock Agama	LC	
17	*Amietia delalandii*	Common River Frog	LC	
18	*Atractaspis bibronii*	Bibron se Sypikskang	LC	
19	*Bitis arietans arietans*	Puffadder	LC	

20	*Boaedon capensis*	Cape House Snake	LC	
21	*Breviceps adspersus*	Bushveld Rain Frog	LC	
22	*Chamaeleo dilepis*	Flap-necked Chameleon	LC	
23	*Crotaphopeltis hotamboeia*	Red-lipped Herald	LC	
24	*Dendroaspis polylepis*	Swartmamba	LC	
25	*Hemidactylus mabouia*	Tropical House Gecko	LC	
26	*Homopholis wahlbergii*	Wahlberg's Velvet Gecko	LC	
27	*Kinixys natalensis*	Natal Hinge Tortoise	VU	Fifth Schedule
28	*Leptotyphlops scutifrons*	Peter's Thread Snake	LC	
29	*Lygodactylus capensis*	Common Dwarf Gecko	LC	
30	*Naja mossambica*	Mozambique Spitting Cobra	LC	
31	*Nucras ornata*	Ornate Scrub Lizard	LC	
32	*Pachydactylus maculatus*	Spotted Thick-toed Gecko	LC	
33	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	LC	
34	*Pelomedusa galeata*	Cape Terrapin	LC	
35	*Philothamnus occidentalis*	Western Natal Green Snake	LC	
36	*Philothamnus semivariegatus*	Spotted Bush Snake	LC	
37	*Psammophis brevirostris*	Short-snouted Whip Snake	LC	
38	*Pseudocordylus subviridis*	Drakensberg Crag Lizard	Endemic	
39	*Ptychadena anchietae*	Anchieta's Ridged Frog	LC	
40	*Python natalensis*	Southern African Python	LC	NEMBA
41	*Schismaderma carens*	Red Toad	LC	
42	*Sclerophrys capensis*	Ixoxo eliklabalasayo	LC	
43	*Sclerophrys gutturalis*	Guttural Toad	LC	
44	*Stigmochelys pardalis*	Leopard Tortoise	LC	
45	*Tomopterna adiastola*	Confused Sand frog	LC	

46	*Tomopterna natalensis*	Natal sand frog	LC	
47	*Trachylepis punctatissima*	Speckled Rock Skink	LC	
48	*Trachylepis varia*	Variable Skink	LC	
49	*Varanus albigularis albigularis*	Southern Rock Monitor	LC	
50	*Varanus niloticus*	Nile Monitor	LC	

Appendix 3: List of expected Avifauna.

No.	Common_group	Common_species	Genus	Species	IUCN Status	National/Regional Status
1		Bokmakierie	*Telophorus*	*zeylonus*	LC	
2		Brubru	*Nilaus*	*afer*	LC	
3		Hamerkop	*Scopus*	*umbretta*	LC	Fifth Schedule
4		Neddicky	*Cisticola*	*fulvicapilla*	LC	
5	Apalis	Bar-throated	*Apalis*	*thoracica*	LC	
6	Babbler	Arrow-marked	*Turdoides*	*jardineii*	LC	
7	Barbet	Acacia Pied	*Tricholaema*	*leucomelas*	LC	
8	Barbet	Black-collared	*Lybius*	*torquatus*	LC	
9	Barbet	Crested	*Trachyphonus*	*vaillantii*	LC	
10	Batis	Chinspot	*Batis*	*molitor*	LC	
11	Bee-eater	Little	*Merops*	*pusillus*	LC	
12	Bee-eater	White-fronted	*Merops*	*bullockoides*	LC	
13	Boubou	Southern	*Laniarius*	*ferrugineus*	LC	
14	Bulbul	Dark-capped [x]	*Pycnonotus*	*tricolor*	LC	
15	Bunting	Cinnamon-breasted	*Emberiza*	*tahapisi*	LC	
16	Bunting	Golden-breasted	*Emberiza*	*flaviventris*	LC	
17	Bushshrike	Gorgeous	*Telophorus*	*viridis*	LC	
18	Bushshrike	Grey-headed	*Malaconotus*	*blanchoti*	LC	
19	Bushshrike	Olive	*Chlorophoneus*	*olivaceus*	LC	
20	Bushshrike	Orange-breasted	*Chlorophoneus*	*sulfureopectus*	LC	
21	Buzzard	Common	*Buteo*	*buteo*	LC	Fifth Schedule
22	Buzzard	European Honey	*Pernis*	*apivorus*	LC	Fifth Schedule
23	Buzzard	Jackal	*Buteo*	*rufofuscus*	LC	Fifth Schedule

24	Camaroptera	Green-backed	*Camaroptera*	*brachyura brachyura*	LC	
25	Canary	Brimstone	*Crithagra*	*sulphurata*	LC	
26	Canary	Yellow-fronted	*Crithagra*	*mozambica*	LC	
27	Chat	Familiar	*Oenanthe*	*familiaris*	LC	
28	Chat	Mocking Cliff	*Thamnolaea*	*cinnamomeiventris*	LC	
29	Cisticola	Lazy	*Cisticola*	*aberrans*	LC	
30	Cisticola	Levaillant's	*Cisticola*	*tinniens*	LC	
31	Cisticola	Rattling	*Cisticola*	*chiniana*	LC	
32	Cisticola	Wing-snapping	*Cisticola*	*ayresii*	LC	
33	Cisticola	Zitting	*Cisticola*	*juncidis*	LC	
34	Coot	Red-knobbed	*Fulica*	*cristata*	LC	
35	Cormorant	Reed	*Microcarbo*	*africanus*	LC	
36	Cormorant	White-breasted	*Phalacrocorax*	*lucidus*	LC	
37	Coucal	Burchell's	*Centropus*	*burchellii*	LC	
38	Crombec	Long-billed	*Sylvietta*	*rufescens*	LC	
39	Crow	Cape	*Corvus*	*capensis*	LC	
40	Crow	Pied	*Corvus*	*albus*	LC	
41	Cuckoo	Black	*Cuculus*	*clamosus*	LC	
42	Cuckoo	Diederik	*Chrysococcyx*	*caprius*	LC	
43	Cuckoo	Klaas's	*Chrysococcyx*	*klaas*	LC	
44	Cuckoo	Levaillant's	*Clamator*	*levaillantii*	LC	
45	Cuckoo	Red-chested	*Cuculus*	*solitarius*	LC	
46	Cuckooshrike	Black	*Campephaga*	*flava*	LC	
47	Dove	Laughing	*Spilopelia*	*senegalensis*	LC	
48	Dove	Red-eyed	*Streptopelia*	*semitorquata*	LC	
49	Dove	Ring-necked	*Streptopelia*	*capicola*	LC	

50	Dove	Tambourine	*Turtur*	*tympanistria*	LC	
51	Drongo	Fork-tailed	*Dicrurus*	*adsimilis*	LC	
52	Duck	African Black	*Anas*	*sparsa*	LC	
53	Duck	White-faced Whistling	*Dendrocygna*	*viduata*	LC	
54	Duck	Yellow-billed	*Anas*	*undulata*	LC	
55	Eagle	Booted	*Hieraaetus*	*pennatus*	LC	Fifth Schedule
56	Eagle	Tawny	*Aquila*	*rapax*	VU	Fifth Schedule
57	Eagle	Wahlberg's	*Hieraaetus*	*wahlbergi*	LC	Fifth Schedule
58	Eagle-Owl	Spotted	*Bubo*	*africanus*	LC	Fifth Schedule
59	Firefinch	African	*Lagonosticta*	*rubricata*	LC	
60	Firefinch	Red-billed	*Lagonosticta*	*senegala*	LC	
61	Fiscal	Southern	*Lanius*	*collaris*	LC	
62	Fish Eagle	African	*Haliaeetus*	*vocifer*	LC	Fifth Schedule
63	Flycatcher	African Dusky	*Muscicapa*	*adusta*	LC	
64	Flycatcher	African Paradise	*Terpsiphone*	*viridis*	LC	
65	Flycatcher	Fiscal	*Melaenornis*	*silens*	LC	
66	Flycatcher	Pale	*Melaenornis*	*pallidus*	LC	
67	Flycatcher	Southern Black	*Melaenornis*	*pammelaina*	LC	
68	Flycatcher	Spotted	*Muscicapa*	*striata*	LC	
69	Goose	Egyptian	*Alopochen*	*aegyptiaca*	LC	
70	Goshawk	African	*Accipiter*	*tachiro*	LC	Fifth Schedule
71	Grebe	Little	*Tachybaptus*	*ruficollis*	LC	
72	Greenbul	Sombre	*Andropadus*	*importunus*	LC	
73	Guineafowl	Helmeted	*Numida*	*meleagris*	LC	
74	Harrier-Hawk	African	*Polyboroides*	*typus*	LC	Fifth Schedule
75	Heron	Black-headed	*Ardea*	*melanocephala*	LC	Fifth Schedule
76	Heron	Goliath	*Ardea*	*goliath*	LC	Fifth Schedule

77	Heron	Grey	*Ardea*	*cinerea*	LC	Fifth Schedule
78	Honeybird	Brown-backed	*Prodotiscus*	*regulus*	LC	
79	Honeyguide	Greater	*Indicator*	*indicator*	LC	
80	Hoopoe	African	*Upupa*	*africana*	LC	
81	Hornbill	Crowned	*Lophoceros*	*alboterminatus*	LC	
82	Hornbill	Trumpeter	*Bycanistes*	*bucinator*	LC	
83	House Martin	Common	*Delichon*	*urbicum*	LC	
84	Ibis	Hadada	*Bostrychia*	*hagedash*	LC	Fifth Schedule
85	Ibis	Southern Bald	*Geronticus*	*calvus*	NT	Fourth Schedule
86	Kingfisher	Brown-hooded	*Halcyon*	*albiventris*	LC	
87	Kingfisher	Giant	*Megaceryle*	*maxima*	LC	
88	Kingfisher	Malachite	*Corythornis*	*cristatus*	LC	
89	Kingfisher	Pied	*Ceryle*	*rudis*	LC	
90	Kite	Black-winged	*Elanus*	*caeruleus*	LC	Fifth Schedule
91	Kite	Yellow-billed	*Milvus*	*aegyptius*	LC	Fifth Schedule
92	Lapwing	Blacksmith	*Vanellus*	*armatus*	LC	
93	Lark	Rufous-naped	*Mirafra*	*africana*	LC	
94	Lark	Sabota	*Calendulauda*	*sabota*	LC	
95	Mannikin	Bronze	*Lonchura*	*cucullata*	LC	
96	Martin	Banded	*Neophedina*	*cincta*	LC	
97	Martin	Brown-throated	*Riparia*	*paludicola*	LC	
98	Martin	Rock	*Ptyonoprogne*	*fuligula*	LC	
99	Mousebird	Red-faced	*Urocolius*	*indicus*	LC	
100	Mousebird	Speckled	*Colius*	*striatus*	LC	
101	Nightjar	Fiery-necked	*Caprimulgus*	*pectoralis*	LC	
102	Oriole	Black-headed	*Oriolus*	*larvatus*	LC	
103	Ostrich	Common	*Struthio*	*camelus*	LC	

104	Pigeon	African Olive	*Columba*	*arquatrix*	LC	
105	Pigeon	Speckled	*Columba*	*guinea*	LC	
106	Pipit	African	*Anthus*	*cinnamomeus*	LC	
107	Plover	Three-banded	*Charadrius*	*tricollaris*	LC	
108	Prinia	Tawny-flanked	*Prinia*	*subflava*	LC	
109	Puffback	Black-backed	*Dryoscopus*	*cubla*	LC	
110	Pygmy Kingfisher	African	*Ispidina*	*picta*	LC	
111	Pytilia	Green-winged	*Pytilia*	*melba*	LC	
112	Quelea	Red-billed	*Quelea*	*quelea*	LC	
113	Raven	White-necked	*Corvus*	*albicollis*	LC	
114	Red Bishop	Southern	*Euplectes*	*orix*	LC	
115	Robin-Chat	Cape	*Cossypha*	*caffra*	LC	
116	Robin-Chat	White-throated	*Cossypha*	*humeralis*	LC	
117	Rock-Thrush	Cape	*Monticola*	*rupestris*	LC	
118	Scimitarbill	Common	*Rhinopomastus*	*cyanomelas*	LC	
119	Scrub Robin	White-browed	*Cercotrichas*	*leucophrys*	LC	
120	Seedeater	Streaky-headed	*Crithagra*	*gularis*	LC	
121	Shrike	Red-backed	*Lanius*	*collurio*	LC	
122	Snake Eagle	Brown	*Circaetus*	*cinereus*	LC	Fifth Schedule
123	Sparrow	Cape	*Passer*	*melanurus*	LC	
124	Sparrow	Southern Grey-headed	*Passer*	*diffusus*	LC	
125	Sparrow	Yellow-throated Bush	*Gymnoris*	*superciliaris*	LC	
126	Sparrowhawk	Little	*Accipiter*	*minullus*	LC	Fifth Schedule
127	Spurfowl	Natal	*Pternistis*	*natalensis*	LC	
128	Spurfowl	Swainson's	*Pternistis*	*swainsonii*	LC	
129	Starling	Cape	*Lamprotornis*	*nitens*	LC	

130	Starling	Red-winged	*Onychognathus*	*morio*	LC	
131	Starling	Violet-backed	*Cinnyricinclus*	*leucogaster*	LC	
132	Stonechat	African	*Saxicola*	*torquatus*	LC	
133	Sunbird	Amethyst	*Chalcomitra*	*amethystina*	LC	
134	Sunbird	Greater Double-collared	*Cinnyris*	*afer*	LC	
135	Sunbird	White-bellied	*Cinnyris*	*talatala*	LC	
136	Swallow	Barn	*Hirundo*	*rustica*	LC	
137	Swallow	Greater Striped	*Cecropis*	*cucullata*	LC	
138	Swallow	Lesser Striped	*Cecropis*	*abyssinica*	LC	
139	Swallow	South African Cliff	*Petrochelidon*	*spilodera*	LC	
140	Swallow	White-throated	*Hirundo*	*albigularis*	LC	
141	Swallow	Wire-tailed	*Hirundo*	*smithii*	LC	
142	Swift	African Black	*Apus*	*barbatus*	LC	
143	Swift	Common	*Apus*	*apus*	LC	
144	Swift	Horus	*Apus*	*horus*	LC	
145	Tchagra	Black-crowned	*Tchagra*	*senegalus*	LC	
146	Tchagra	Brown-crowned	*Tchagra*	*australis*	LC	
147	Tchagra	Southern	*Tchagra*	*tchagra*	LC	
148	Thick-knee	Spotted	*Burhinus*	*capensis*	LC	
149	Thick-knee	Water	*Burhinus*	*vermiculatus*	LC	
150	Thrush	Kurrichane	*Turdus*	*libonyana*	LC	
151	Thrush	Olive	*Turdus*	*olivaceus*	LC	
152	Tinkerbird	Red-fronted	*Pogoniulus*	*pusillus*	LC	
153	Tit	Southern Black	*Melaniparus*	*niger*	LC	
154	Wagtail	African Pied	*Motacilla*	*aguimp*	LC	
155	Wagtail	Cape	*Motacilla*	*capensis*	LC	

156	Warbler	Chestnut-vented	*Curruca*	*subcoerulea*	LC	
157	Warbler	Common Reed	*Acrocephalus*	*scirpaceus*	LC	
158	Warbler	Little Rush	*Bradypterus*	*baboecala*	LC	
159	Warbler	Willow	*Phylloscopus*	*trochilus*	LC	
160	Waxbill	Blue	*Uraeginthus*	*angolensis*	LC	
161	Waxbill	Common	*Estrilda*	*astrild*	LC	
162	Weaver	Lesser Masked	*Ploceus*	*intermedius*	LC	
163	Weaver	Southern Masked	*Ploceus*	*velatus*	LC	
164	Weaver	Spectacled	*Ploceus*	*ocularis*	LC	
165	Weaver	Thick-billed	*Amblyospiza*	*albifrons*	LC	
166	Weaver	Village	*Ploceus*	*cucullatus*	LC	
167	White-eye	Cape	*Zosterops*	*virens*	LC	
168	Whydah	Long-tailed Paradise	*Vidua*	*paradisaea*	LC	
169	Whydah	Pin-tailed	*Vidua*	*macroura*	LC	
170	Widowbird	Fan-tailed	*Euplectes*	*axillaris*	LC	
171	Widowbird	White-winged	*Euplectes*	*albonotatus*	LC	
172	Wood Hoopoe	Green	*Phoeniculus*	*purpureus*	LC	
173	Wood-Dove	Emerald-spotted	*Turtur*	*chalcospilos*	LC	
174	Woodpecker	Bearded	*Chloropicus*	*namaquus*	LC	
175	Woodpecker	Cardinal	*Dendropicos*	*fuscescens*	LC	
176	Woodpecker	Golden-tailed	*Campethera*	*abingoni*	LC	
177	Wryneck	Red-throated	*Jynx*	*ruficollis*	LC	
178	Falcon	Lanner	*Falco*	*biarmicus*	LC	CITES II
179	Eagle	Tawny	*Aquila*	*rapax*	VU	CITES II & Fifth Schedule
180		Secretarybird	*Sagittarius*	*serpentarius*	EN	CITES II
181	Finfoot	African	*Podica*	*senegalensis*	LC	Fifth Schedule

182	Tern	Caspian	*Hydroprogne*	*caspia*	LC	Fifth Schedule
183	Bustard	White-bellied	*Eupodotis*	*senegalensis*	LC	CITES II & Fifth Schedule

Geotechnical Assessment

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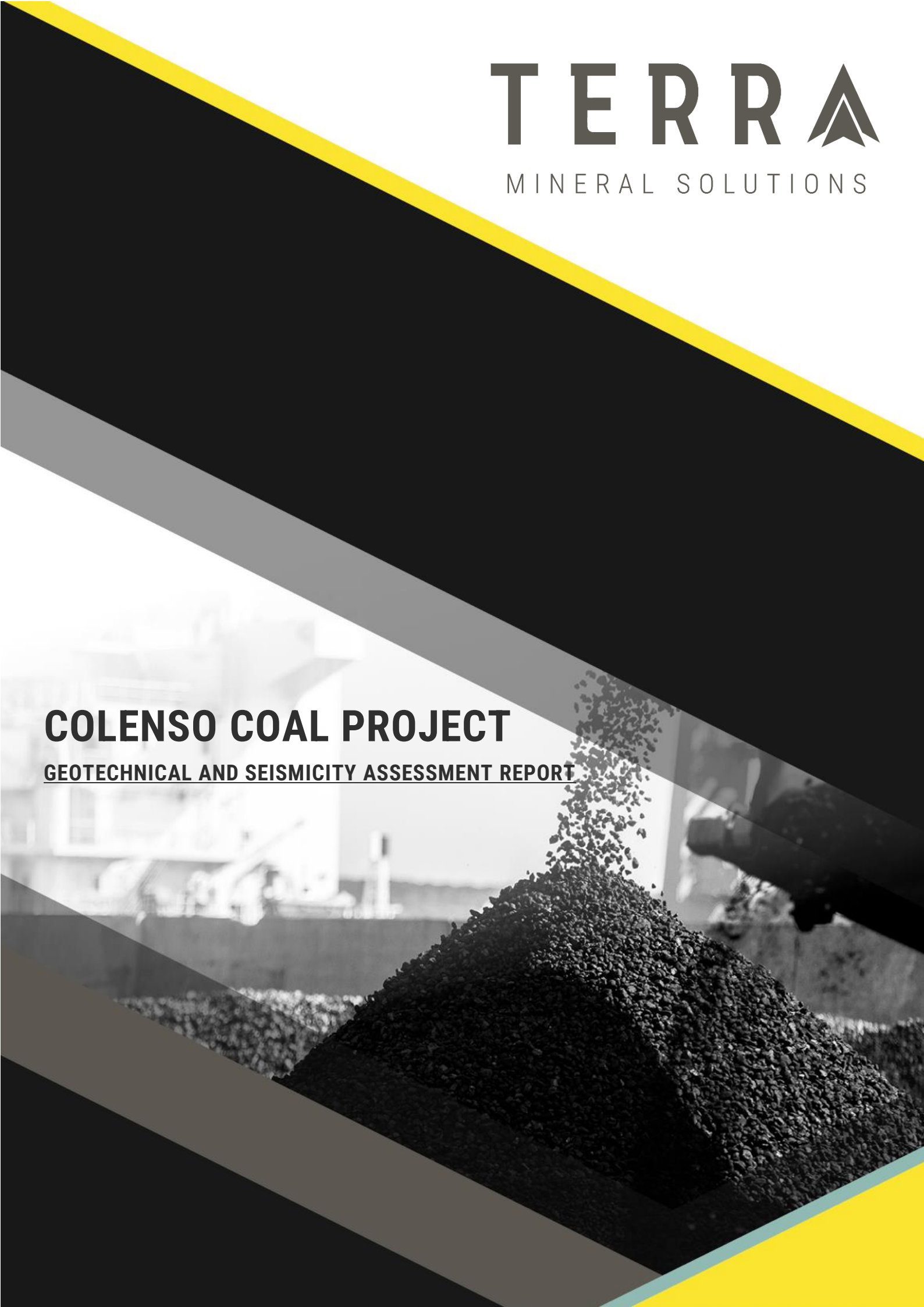
GEOTECHNICAL AND SEISMICITY ASSESSMENT REPORT



Geotechnical and Seismicity Assessment Report

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EXECUTIVE SUMMARY

This Geotechnical and Seismicity Assessment Report has been meticulously compiled for Dunrose Investments 174 (Pty) Ltd concerning the proposed Colenso Coal Project. As a crucial component of the Environmental Impact Assessment (EIA) for Mining Right Application No. KZN 30/5/1/2/2/10137MR, this study provides an in-depth analysis of the geological, geotechnical and seismic conditions influencing the project. The Colenso Coal Project, situated approximately 12 km east of Colenso in KwaZulu-Natal, involves an initial highwall mining phase (Phase 1-3) followed by a transition to conventional underground mining over a 15-year period.

The assessment critically evaluates site characterization, potential impacts, mitigation measures, and provides robust design recommendations to ensure environmental soundness and sustainability. Key geotechnical considerations for both highwall stability and underground excavation stability, including appropriate ground support, are detailed. Special attention has been given to the definition and assessment of competent highwall slopes for highwall mining operations and the application of rock mass classification systems for underground design.

The report also addresses the project's broader significance, noting the recent news about its potential to bring significant investment and job creation to KwaZulu-Natal. Furthermore, a comprehensive review of regional seismicity, drawing upon data from authoritative sources, is included to inform design and operational planning.

Based on extensive experience and thorough evaluation, it is the professional opinion of the undersigned Geotechnical Engineer that, provided all minimum prescribed geotechnical requirements, design specifications, and monitoring protocols as outlined in this report are rigorously met and adhered to, there is no inherent geotechnical and seismic activity concerns as to why the Colenso Coal Project should not be implemented.

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
AMD	Acid Mine Drainage
CGS	Council for Geoscience
DMRE	Department of Mineral Resources and Energy
EIA	Environmental Impact Assessment
FoS	Factor of Safety
GMP	Geotechnical Management Plan
GPS	Global Positioning System
GSI	Geological Strength Index
KZN	KwaZulu-Natal
RMR	Rock Mass Rating
RQD	Rock Quality Designation
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
UCS	Uniaxial Compressive Strength
Wits	University of the Witwatersrand
g	Peak Ground Acceleration

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1. INTRODUCTION

1.1 INTRO AND REGIONAL LOCATION

A geotechnical and seismic study constitutes an indispensable element within the Environmental Impact Assessment (EIA) framework in South Africa, particularly for mining right applications. Its fundamental role is to comprehensively assess the geological, geotechnical including the seismic activity conditions inherent to a proposed project site. This assessment is critical for identifying potential environmental impacts, formulating effective mitigation strategies, and guiding the design and implementation of mining operations. By providing invaluable insights into soil and rock properties, groundwater regimes, and other pertinent geotechnical hazards, these studies ensure that proposed developments are not only economically viable but also environmentally responsible and sustainable over their entire project lifecycle.

This report serves as the comprehensive geotechnical and seismic assessment for the Colenso Coal Project, commissioned by Dunrose Investments 174 (Pty) Ltd. The project seeks a Mining Right under Application No. KZN 30/5/1/2/2/10137MR, for coal extraction. The primary purpose of this study is to provide detailed geotechnical information and recommendations to support the mining right application, ensuring compliance with regulatory requirements and the long-term stability and safety of the mining operations. It aims to identify potential geotechnical and seismic risks and propose robust measures for their management throughout the project's lifecycle.

1.1.1 Limitations

This Geotechnical and Seismic Assessment Report is subject to the following limitations:

- **Data Availability:** The assessment is based on available geological borehole data, published literature, and general industry knowledge. While efforts have been made to simulate comprehensive site-specific understanding, direct, detailed, geophysical surveys, and laboratory test results were not available for direct input into this report. Future detailed design phases will require such specific data.
- **Assumed Conditions:** The report relies on typical geological, geotechnical and seismic conditions characteristic of the Klip River Coalfield and Karoo Basin. Localized anomalies, unforeseen geological structures, or variations in rock mass quality may exist and could influence actual ground conditions.
- **Scope of Work:** The scope of this report is limited to a geotechnical and seismic assessment for EIA purposes. It does not constitute detailed engineering design for specific mine components but provides the overarching geotechnical and seismic framework and recommendations.
- **Information from External Documents:** While referencing concepts from referenced information (e.g., "Addcar Highwall Mining System"), the actual content of these documents accessible from its referenced sources. The discussion reflects general industry knowledge and best practices associated with such mining methods.
- **Dynamic Nature of Mining:** Ground conditions in mining environments are dynamic and can evolve. The recommendations provided herein are based on current understanding and must be continually re-evaluated and adapted through ongoing monitoring and observational methods during mining operations.

1.1.2 Assumptions

The following assumptions have been made in the preparation of this report:

- **Geological Continuity:** It is assumed that the regional geological understanding of the Vryheid Formation and associated strata is broadly representative of the conditions at the Colenso Coal Project site.
- **Typical Coalfield Characteristics:** The coal seams and interburden lithologies encountered are assumed to exhibit geotechnical properties generally consistent with other operating mines in the Klip River Coalfield.
- **Mining Method Implementation:** It is assumed that, for example, Addcar Highwall Mining System or similar will be safely operated to extract coal according to manufacturer's guidelines and industry best practices by a competent appointed local contractor.

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- **Regulatory Compliance:** It is assumed that all regulatory permits and approvals will be obtained and that the project will adhere to all applicable South African mining, environmental, and safety legislation.
- **Competent Personnel:** It is assumed that all design, construction, operation, monitoring, and management activities will be carried out by suitably qualified and experienced geotechnical engineers, geologists, and operational personnel.
- **Availability of Resources:** It is assumed that adequate resources (financial, human and technological) will be allocated for the implementation of all recommended geotechnical investigations, design measures, mitigation strategies, and monitoring programs to ensure the efficient execution of the recommendations contained herein.

2. PROJECT DESCRIPTION

The Colenso Coal Project represents a significant mining development at Colenso area within the KwaZulu-Natal Province, aiming to extract coal resources using a phased approach of highwall and underground mining methods (Figure 1).

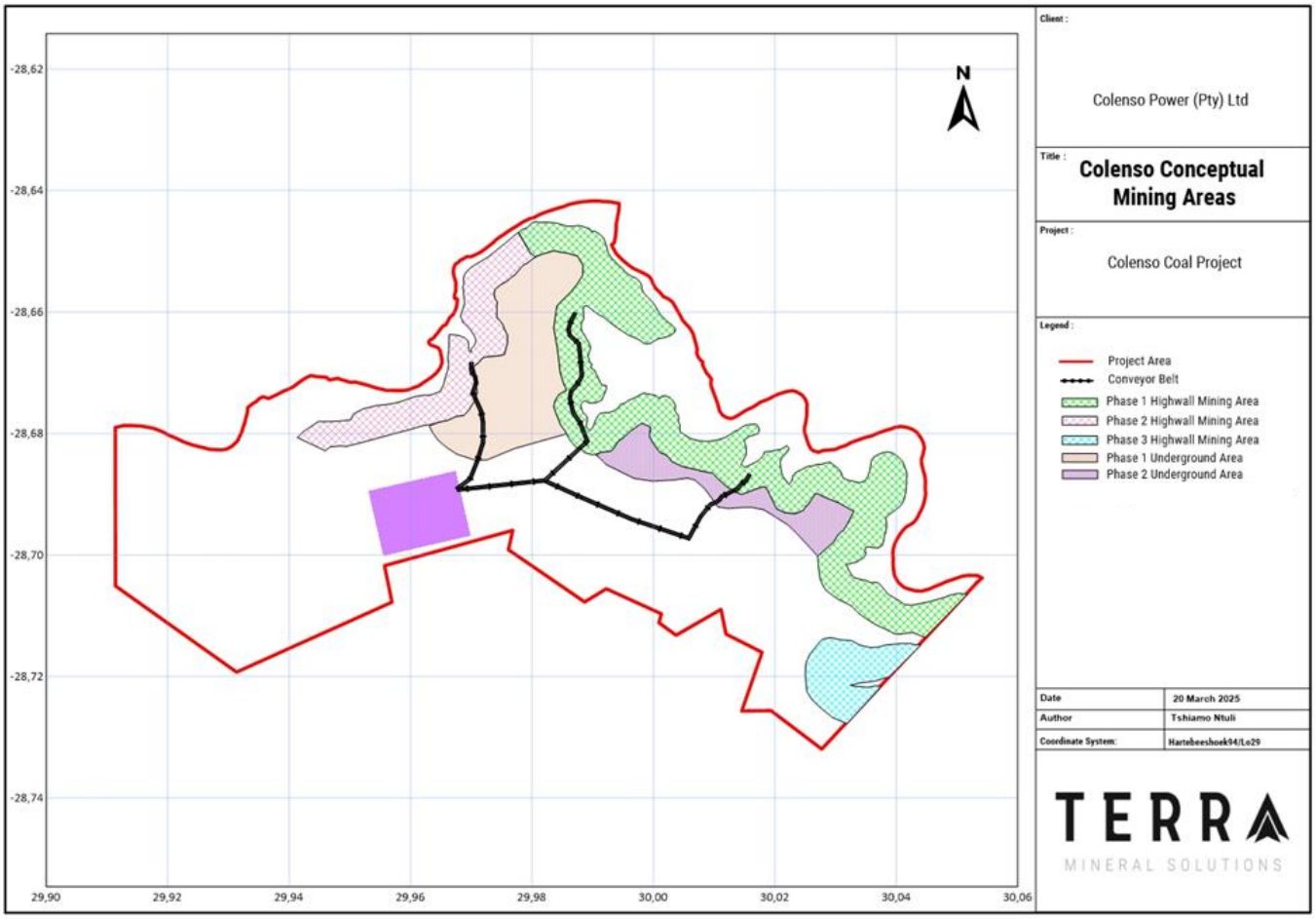

Figure 1: Colenso coal project description and conceptual mining areas

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2.1 PROJECT LOCATION

The Colenso Coal Project is strategically located within the KwaZulu-Natal Province, approximately 12 km east of the town of Colenso (Figure 2). Geographically, it falls within the administrative jurisdiction of the uThukela District Municipality and, more specifically, the Okhahlamba Local Municipality. The precise coordinates for the project area are Latitude: -27.7950 and Longitude: 29.9387. The mining right area is specifically designated in Mining Right Application No. KZN 30/5/1/2/2/10137MR. The site is characterized by an undulating topography typical of the Karoo Basin, with varying overburden depths to the targeted coal seams. Regional access is via a network of provincial and district roads connecting to the town of Colenso.

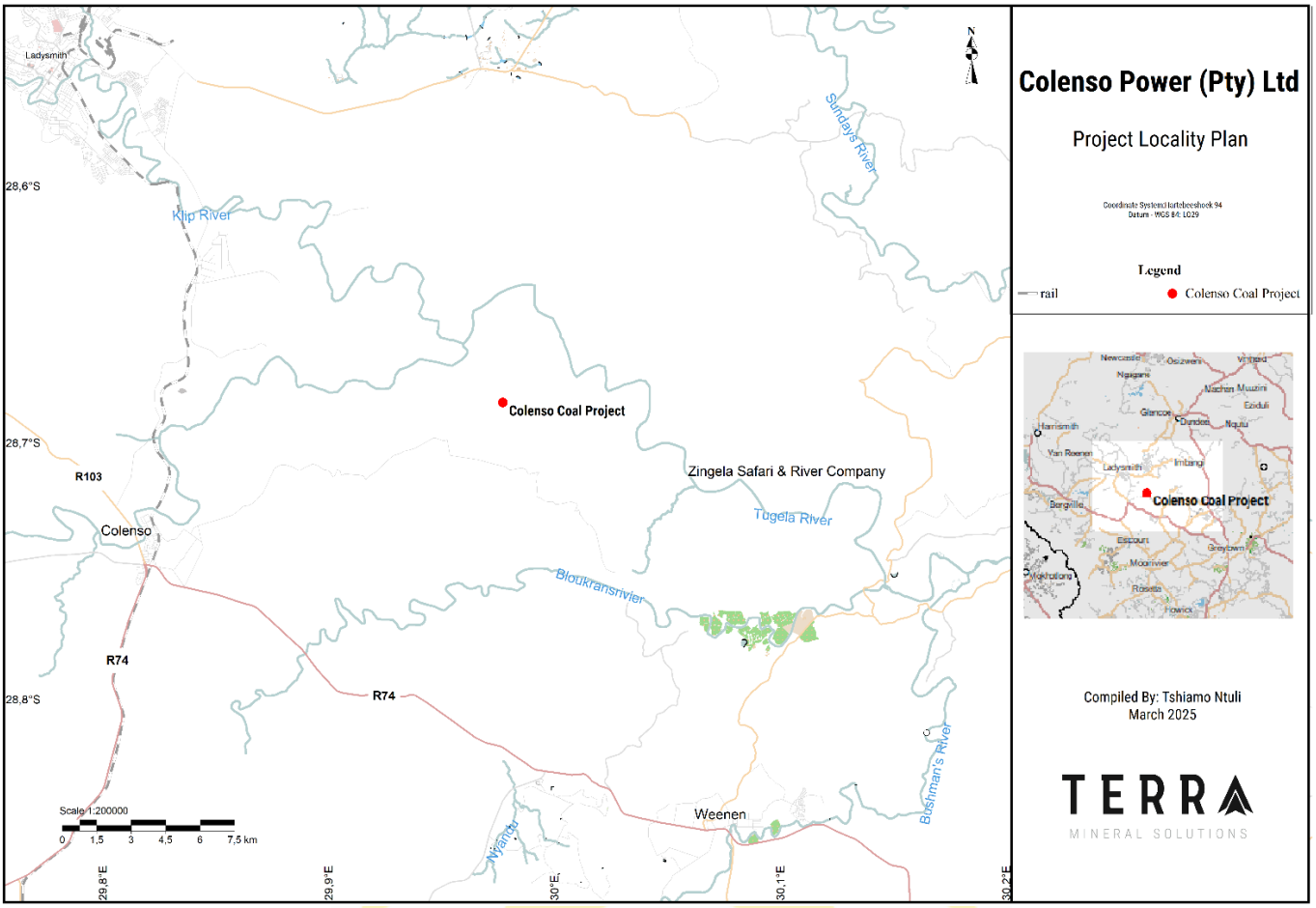

Figure 2: Colenso coal project regional location

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2.2 PROJECT COMPONENTS

The Colenso Coal Project will comprise various interconnected components to facilitate the extraction, processing, and transportation of coal, alongside essential support infrastructure.

2.2.1 Mining Activities

- **Highwall Mining Phase 1-3:** This initial phase will involve the establishment of geotechnically stable highwalls from which the likes of Addcar Highwall Mining System or similar will remotely extract coal. This system will bore multiple, parallel entries into the coal seam, with extracted coal conveyed to the surface.
- **Underground Mining Phase 1-2 (Subsequent 15 years):** Following the highwall phase, conventional underground mining methods, likely bord-and-pillar, will be employed to access deeper coal reserves. This will involve the excavation of main and secondary roadways, the development of working panels, and the construction of ventilation shafts and other access points.

2.2.2 Project Phases

The project development will proceed in distinct phases:

- **Pre-Mining Phase:** Baseline studies (including this geotechnical assessment), EIA processes, obtaining mining rights and associated permits, detailed design, and establishment of initial surface infrastructure.
- **Highwall Mining Phase 1-3:** Mobilization of highwall mining equipment, development of highwall benches, and extraction of coal using a highwall mining method. This phase is anticipated to last for a specific initial period before deeper reserves become primary reserves.
- **Transition Phase:** Overlapping with the latter part of highwall mining, this phase involves the development of underground access (e.g., adits or shafts) and initial underground roadways.
- **Underground Mining Phase 1-2 (Subsequent 15 years):** Full-scale underground coal extraction, continuous development of new panels, and ongoing maintenance of underground infrastructure.
- **Decommissioning and Closure Phase:** Following the cessation of mining, this phase will involve rehabilitation of disturbed areas, dismantling of surface infrastructure, and long-term environmental monitoring and management, including closure of underground voids.

2.3 PROJECT LAYOUT MAP

A comprehensive project layout map (Figure 3), typically illustrates:

- The designated Mining Right Application area boundaries (Project Area).
- The precise location of planned highwall and underground phases.

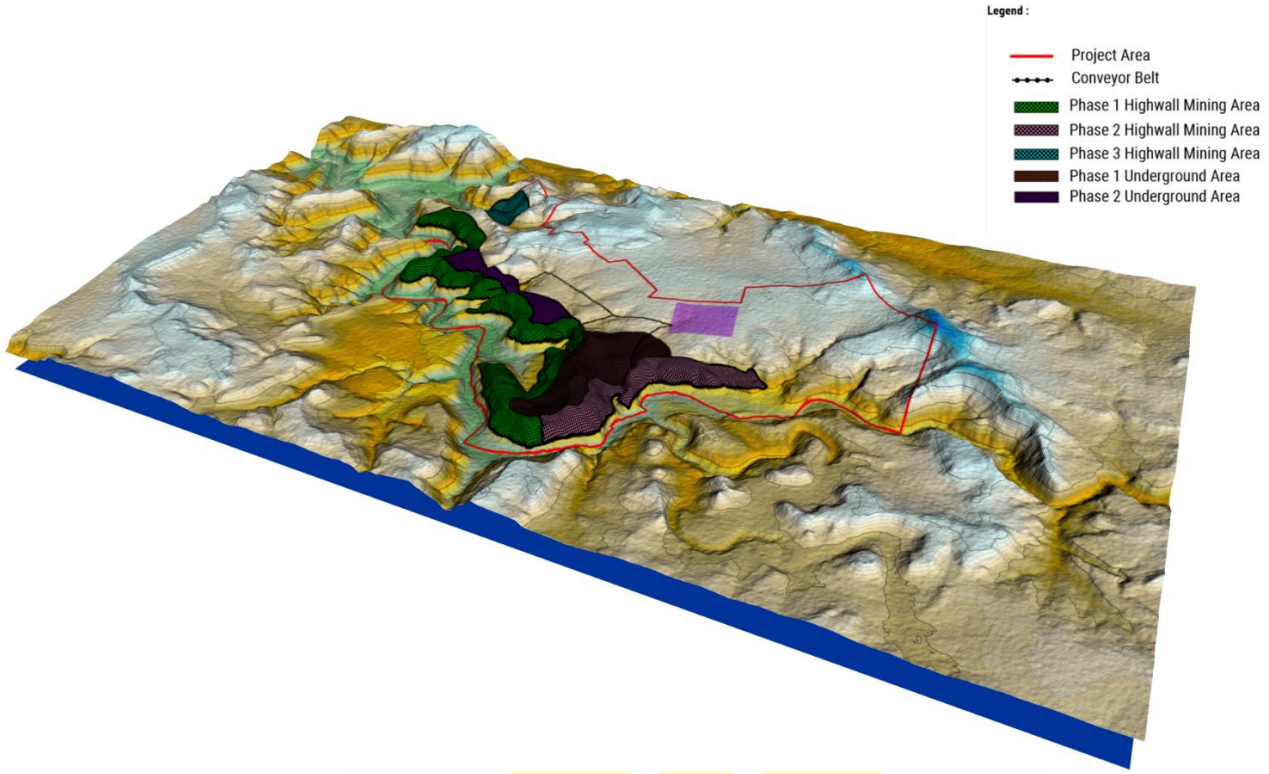

Figure 3: Colenso coal project layout map

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3. METHODOLOGY

The geotechnical and seismic assessment for the Colenso Coal Project was conducted using a comprehensive methodology, combining borehole analysis, desktop studies with considerations for future detailed field investigations and further analytical techniques. The approach focuses on identifying geotechnical and potential seismic activity risks, evaluating potential impacts, and formulating practical mitigation and design recommendations.

3.1 Overview of Geotechnical Assessment Methodology

The methodology for this geotechnical and seismic assessment is structured to address the key aspects required for an EIA, as per guidelines. It involves a multi-faceted approach:

i. **Site Assessment:** Understanding the geological and hydrogeological setting, identifying existing ground conditions, and characterizing the physical properties of the rock and soil materials.

ii. **Impact Identification:** Pinpointing potential geotechnical and seismic hazards associated with highwall and underground mining, including land instability, subsidence, and water-rock interaction.

iii. **Mitigation Measures:** Developing and recommending practical engineering solutions and management strategies to minimize or avoid adverse geotechnical and seismic activity impacts.

iv. **Design Recommendations:** Providing geotechnical and seismic activity input for the conceptual and detailed design of mining excavations and surface infrastructure.

v. **Monitoring and Management:** Proposing programs for continuous monitoring of geotechnical and seismic conditions and implementing adaptive management strategies.

3.2 Field and Desktop Study Procedures

3.2.1 Field Survey Procedures (Future Detailed Phase)

- While this report is a geotechnical and seismic assessment, future detailed geotechnical and seismic risk investigations will require comprehensive field survey procedures to gather site-specific data. These would typically include:
    - **Geotechnical Drilling:** Execution of boreholes across the project area, targeting coal seams, interburden, and overburden. This includes:
    - **Oriented Core Drilling:** To obtain intact rock samples for laboratory testing and to determine the orientation of discontinuities (joints, bedding planes, faults).
    - **Standard Penetration Tests (SPTs) / Cone Penetration Tests (CPTs):** For characterizing soil and weathered rock properties in the overburden.
- **Geological Mapping:** Detailed mapping of surface geology, including outcrops, structural features (faults, folds, joint sets), and rock mass conditions within exposed highwalls or existing excavations.
- **Hydrogeological Investigations:**
    - **Piezometer Installation:** Installation of standpipe and vibrating wire piezometers in boreholes to monitor groundwater levels and pore pressures at various depths.
    - **Pump Tests/Slug Tests:** To determine hydraulic conductivity and aquifer characteristics.
- **Geophysical Surveys:**
    - **Downhole Geophysics:** Acoustic televiewer and optical televiewer logging to provide continuous images of borehole walls, allowing for detailed mapping of fractures and rock mass quality.
    - **Surface Geophysics:** Seismic refraction, electrical resistivity tomography (ERT), or ground-penetrating radar (GPR) to delineate geological structures, depth to bedrock, or areas of highly fractured rock.

- **In-Situ Testing:** Where feasible and necessary, conducting in-situ tests such as plate load tests or rock mass classification using face mapping.

3.2.2 Desktop Study Procedures

The preparation of this report has relied heavily on desktop study, physical site assessment and borehole analysis procedures, which involve the assimilation and analysis of existing information from independent sources:

- **Review of Existing Geological Information:** Examination of regional geological maps (e.g., from the Council for Geoscience), geological survey reports, and academic literature pertaining to the Karoo Basin and Klip River Coalfield.
- **Review of Previous Reports:** Consultation of any available existing geotechnical and seismic reports, feasibility studies, or mining work programmes for the Colenso Coal Project.
- **Satellite Imagery and Aerial Photography Analysis:** Interpretation of high-resolution satellite images and aerial photographs to identify surface features, structural lineaments, drainage patterns, and areas of potential instability.
- **Literature Review:** Researching industry best practices, academic papers, and technical guidelines relevant to highwall mining (such as the Addcar highwall mining equipment), underground coal mining (bord-and-pillar), ground control, and seismicity in the Colenso mining area.
- **Climatic Data Review:** Analysis of rainfall patterns, temperature, and other climatic data to understand their influence on weathering, erosion, and hydrogeology.

3.3 Geotechnical and Seismic Data Acquisition and Analysis

Following data acquisition and analytical approach is undertaken:

- **Site assessment:** Conducting physical site assessment of the exposed highwall outcrops at the project site to understand any potential geotechnical risks that might be a hazard to the planned mining operation
- **Geological Borehole Analysis:** Analysing the existing drilled geological boreholes to identify any potential geotechnically high risk structures such as faulting, jointing and weathering.
- **Regional Geotechnical and Seismic Literature Review:** Using existing geotechnical and seismic database such the Council for Geosciences (CGS) to understand seismic activity risks in and around the project area.

3.4 Geotechnical Risk Assessment Criteria

The assessment of geotechnical risk involves evaluating the likelihood and consequence of potential geotechnical hazards. This informs the prioritization of mitigation measures and design recommendations. While specific detailed criteria vary, the general principles for rating geotechnical risks include:

- **Likelihood:** The probability of a geotechnical event occurring (e.g., very low, low, medium, high, very high), based on geological conditions, mining methods, and historical data.
- **Consequence:** The severity of the outcome if the event occurs, considering:
    - **Safety:** Potential for injury, fatalities, or operational disruption.
    - **Environmental:** Scale of contamination, erosion, or ecosystem degradation.
    - **Economic:** Cost of repairs, production losses, or legal liabilities.
    - **Reputational:** Damage to company image.
- **Risk Level:** A combination of likelihood and consequence (e.g., low, medium, high, extreme risk), often presented in a risk matrix. This allows for clear prioritization and management of geotechnical hazards.

4. DESCRIPTION OF THE AFFECTED AREA

4.1 LAND COVER

The land cover within the Colenso Coal Project area is typical of agricultural and rural landscapes in KwaZulu-Natal, interspersed with remnants of natural vegetation and historical mining disturbances. Expected land cover types include:

- **Cultivated Land:** Areas under active agriculture, primarily crop farming or pastures. This land will be directly impacted by surface infrastructure and highwall mining.
- **Grasslands/Pastures:** Natural or semi-natural grasslands used for grazing, forming a significant portion of the vegetated areas.
- **Bushveld/Thicket:** Scattered pockets of woody vegetation, particularly along drainage lines or on steeper slopes where agriculture is less feasible.
- **Degraded/Disturbed Land:** Areas previously disturbed by historical or existing mining activities (e.g., old adits, small-scale quarries, degraded access tracks), or by informal settlements.
- **Residential Areas:** Scattered rural homesteads or small communities within or adjacent to the mining right area.
- **Water Bodies:** Rivers, streams, farm dams, and wetlands forming part of the local drainage network.

Understanding the pre-mining land cover is critical for planning effective progressive rehabilitation, soil management, and minimizing erosion, as well as for assessing potential changes to land use and ecology.

4.2 SENSITIVE RECEPTORS

Sensitive receptors within the project area are elements that are particularly vulnerable to geotechnical and seismic impacts and require special consideration in planning and mitigation. These include:

- **Human Settlements:** Rural homesteads, small communities, and farmsteads. These are sensitive to ground vibration (from blasting), dust, and crucially, potential subsidence from underground mining or highwall failures.
- **Infrastructure:** Roads, power lines, pipelines (water, possibly gas), communication lines, and railway lines (if present). These are vulnerable to ground movement, subsidence, or direct physical impact.
- **Water Resources:** Rivers, streams, wetlands, natural springs, and groundwater aquifers. These are highly sensitive to changes in water quality (e.g., AMD, increased TDS, sedimentation) and quantity (e.g., groundwater drawdown) resulting from mining activities.
- **Agricultural Land:** Productive farmlands are sensitive to soil degradation, erosion, and changes in water availability or quality, which can impact livelihoods.
- **Ecological Habitats:** Identified sensitive ecological areas, including protected flora and fauna, wetlands, and riparian zones, which can be impacted by land disturbance, altered hydrology, or contamination.
- **Cultural and Heritage Sites:** Any sites of archaeological, historical, or cultural significance identified within the project area, which require protection from physical disturbance or visual impact (though latter is less of a geotechnical concern).

4.3 TOPOGRAPHY

The topography of the Colenso Coal Project area, typical of the Klip River Coalfield, is generally undulating to moderately hilly. The landscape is characterized by:

- **Rolling Hills and Valleys:** A succession of rounded hills and relatively shallow valleys incised by ephemeral and perennial drainage lines. This undulating terrain influences surface water runoff patterns and the potential for erosion.
- **Varying Overburden Depths:** The undulating topography will result in variable depths to the target coal seams. In areas where overburden is thicker and the coal seam is deeper, highwall mining will be more feasible, while deeper sections where the highwall mining method cannot reach will necessitate underground operations.
- **Highwall Locations:** Highwall mining will typically occur where the coal seams daylight, forming prominent, steep slopes. The natural topography at these locations will dictate the initial approach to highwall development.

- **Drainage Networks:** The topography defines the surface water catchment areas and drainage patterns. Rivers and streams flow generally down-gradient, and their presence impacts mining plans, mine layout and water management.
- **Slope Stability:** Naturally occurring slopes, as well as constructed slopes (e.g., waste dumps), will be influenced by topography. Steeper natural slopes may already exhibit signs of instability or be prone to erosion, requiring careful consideration during planning.

Understanding the topography is essential for mine planning, optimizing infrastructure placement, managing surface water, and assessing the visual impact of the operation (though the latter is outside the direct scope of this geotechnical report).

4.4 HYDROGEOLOGY AND GROUNDWATER CONDITIONS

The hydrogeological regime at the Colenso Coal Project site is intrinsically linked to the underlying geology of the Karoo Basin. Groundwater typically occurs within fractured rock aquifers and intergranular aquifers within superficial deposits.

- **Aquifer Systems:**
    - **Fractured Rock Aquifers:** The dominant aquifer type in the Vryheid Formation is typically found within secondary porosity (fractures, joints, faults) in the sandstone, siltstone, and even coal layers. The presence and connectivity of these fractures significantly influence groundwater flow and storage. Dolerite intrusions, while sometimes forming barriers, can also create highly fractured zones acting as preferential flow paths.
    - **Intergranular Aquifers:** Shallow, unconfined aquifers may exist within the weathered overburden, superficial soils, and alluvial deposits along drainage lines. These are typically smaller in extent but are important for local water supply (e.g., shallow boreholes, springs).
- **Groundwater Levels:** The depth to groundwater will vary across the site, influenced by topography, seasonal rainfall, and the presence of impermeable layers. Perched water tables can occur above less permeable strata.
- **Groundwater Flow:** Groundwater generally flows down-gradient, mimicking surface topography, but can also be influenced by geological structures such as faults or dolerite dykes acting as conduits or barriers.
- **Groundwater Quality:** Baseline groundwater quality is a critical parameter. Typical constituents may include varying levels of dissolved solids, ions, and, in some cases, naturally occurring heavy metals or sulphates, which can be exacerbated by mining activities which can result to acid mine drainage.
- **Interaction with Surface Water:** Groundwater and surface water systems are often interconnected. Wetlands and perennial streams may be groundwater-fed, making them particularly sensitive to changes in groundwater levels or quality.
- **Pore Pressure:** The pressure exerted by groundwater within the rock mass is a crucial geotechnical parameter. Increased pore pressure reduces the effective stress acting on rock joints and fractures, leading to a decrease in the shear strength of the rock mass and increasing the risk of instability in highwalls and underground excavations.

Comprehensive hydrogeological investigations are imperative to accurately define the baseline conditions, predict potential impacts of dewatering and contamination, and design effective water management and mitigation strategies.

4.4.1 Geotechnical Site Assessment

The Colenso site assessment provided significant insights into the topographical features and geological conditions that will directly influence the highwall mining operations and associated stability challenges. These considerations are critical for effective planning and risk mitigation.

- **Naturally Benched Areas:**
    - Some areas designated for highwall mining are naturally benched, varying from 8-15m high with relatively gentle slopes. These existing benches create natural catchment areas that can serve to collect material rolling from the upper slopes of the highwall. This natural configuration offers an initial advantage by reducing the direct impact of minor rockfalls on the working benches.
- **Relatively Steep Sloped Areas:**
    - Other areas of planned highwall mining exhibit relatively steep slopes, not necessarily vertical, but inclined sufficiently for material to easily roll down to the working benches where the highwall mining machine will be deployed. In such instances, rockfalls and other rolling debris pose a significant hazard to mining equipment and operator safety.
    - **Mitigation:** It is strongly recommended that these areas are secured with robust steel wire mesh fences (catch fences) that are specifically designed and installed to intercept and contain any debris that may fall downslope. The effectiveness of such barriers in preventing rockfall hazards is well-documented in mining safety guidelines (American Mine Services, "Highwall Safety").
- **Vertical Steep Slopes:**
    - A portion of the planned highwall mining areas consists of naturally vertical steep slopes with exposed highwalls. Such steepness could be attributed to deep erosion or tectonic forces, such as faulting, where a weaker plane of the strata sheared off downslope under gravity over geological time, leaving an exposed vertical face.
    - **Mitigation:** When mining in the vicinity of such vertical slopes, a wire mesh draping system should be extensively used to secure the highwall. This system, often combined with rock bolts, helps to contain loose rock fragments and prevent large-scale spalling (American Mine Services, "Highwall Safety"). Crucially, a highwall movement monitoring radar (such as the highwall radar from GroundProbe) must be deployed to continuously monitor the highwall for any deformation in real-time, providing early warnings for potential instability. This real-time monitoring is a critical component of a proactive geotechnical risk management strategy.
- **Slope Geometry and Stability:**
    - It is a fundamental principle of geotechnical engineering that a reduced slope angle and height generally increases the Factor of Safety (FoS), which is a direct measure of slope stability. The rate of increase in FoS can vary significantly based on the specific rock and soil type, as well as the overall slope geometry.
    - Research indicates that the failed material volume in slope failures increases with increasing fall height (McQuillan & Bar, 2024). This reinforces the need for meticulous planning and control of highwall height where possible, even in naturally benched areas.
    - **Operational Planning:** It is imperative to always consider and plan the deployment of the highwall mining machine at a suitable (calculated) distance from the highwall toe. This stand-off distance should be relative to the slope height and the anticipated trajectory and runout of potential failed material, ensuring the safety of personnel and equipment.
    -

- **Vegetation Cover and Rock Mass Exposure:**
    - The Colenso project site is largely covered in thick natural vegetation, including trees and grass. Such natural features significantly contribute to slope stability by increasing soil cohesion through root reinforcement and by reducing erosion, which limits the exposure of natural soil and rock to weathering elements. Maintaining this natural vegetation cover, where undisturbed by mining, will contribute to the overall stability of natural slopes.
    - However, any rock masses exposed to weathering, particularly in the highwall coal face toe (especially observable on the shales above the coal seam as shown in Figure 4, will inevitably result in weathering and weakening of the rock mass. Shales are particularly susceptible to rapid degradation and loss of strength upon exposure to air and moisture.

Figure 4: Exposed highly weathered highwall toe on the exposed Shales on a 10m high bench

- **Recommendation:** To preserve the strength and durability of the shales and sandstones in the highwall toe planned for mining, it is strongly recommended that highwall toe exposure is not conducted for elongated periods in advance (i.e., not more than 24 months in advance of mining). Limiting exposure time reduces the opportunity for weathering processes to significantly degrade the rock mass, thereby maintaining its integrity for safer and more efficient highwall mining operations.

4.4.2 Rock Mass Characterization

Accurate characterization of the rock mass is fundamental for the safe and efficient design most importantly for the future underground operations. This involves assessing the quality and strength of the rock surrounding the coal seams and within potential pillar locations.

The geotechnical assessment for the Colenso Coal Project has utilized available data, primarily from borehole logs, to infer initial rock mass characteristics. As indicated in the attached report, a total of 39 (Table 1) geological boreholes were drilled and logged for input data for highwall mining phase 1 with 20 boreholes analysed, and while phase 2 has only 3 boreholes and no boreholes available for phase 3. However, additional boreholes are planned for drilling in the future. For the underground mining, there are 16 boreholes for phase 1 and no boreholes for phase 2, and similarly, additional boreholes are planned in the future.

These borehole logs serve as the primary source for initial rock mass characterization, noting that no laboratory sample tests were done for the geotechnical assessment, and data is inferred from laboratory testing on similar rock types (sandstone, siltstone, mudstone/shales, and dolerite). A few boreholes (GK14, GK10, GK07, GK11 SW13 and SW05) were randomly selected and presented on this report to highlight the observed common geotechnical aspects identified within the project area.

Table 1: Colenso coal project input data of the drilled and analysed boreholes

COLENSO COAL PROJECT BOREHOLES INPUT DATA				
HW Mining Ph. 1	**HW Mining Ph. 2**	**HW Mining Ph. 3**	**Underground Mining Ph.1**	**Underground Mining Ph.2**
BN04	SW13	No Boreholes	ST05	No Boreholes
GK18	SW09		SW02	
GK17	SW12		T03	
BN02			SW01	
GK07			GK06	
T02			SW11	
GK05			SW07	
GK08			AAA_S1-66	
GK09R			SW08	
GK09			SW06	
T01			ACC_G167	
GK10			SW05	
W-BH01			GK12	
W-BH02			GK11	
GK15			GK13	
GK04			GK02	
GK16				
GK14				
GK03				
SW03				
20	**3**	**0**	**16**	**0**

Based on these borehole logs and lithology published estimates (Bieniawski, et al.,1972), the following inferences are drawn:

- **Dolerite:** Generally strong, but descriptions of fracturing and weathering indicate potentially reduced in-situ strength.
- **Sandstone:** Strength varies with grain size and cementation. Massive white to greyish sandstone is likely stronger than laminated and dark carbonaceous sandstone.
- **Shale:** Generally weaker and more susceptible to weathering and slaking than sandstone or dolerite, especially carbonaceous shales.
- **Coal:** Strength is highly variable and is influenced by the presence of partings, cleat density, and any form of thermal alteration.

Without laboratory testing data, inferences about rock strengths are based on the lithology published estimates. Uniaxial Compressive Strength (UCS) values for sandstone, siltstone, and mudstone/shales are recorded to range from approximately 5 MPa to over 80 MPa, with a general trend of increasing strength with depth. Mohr-Coulomb strength cohesion parameters values range from 4.6 MPa to 14.3 MPa. The friction angle values range from 27° to 50.92° and the Hoek-Brown *mi* parameters values ranging from 0.27 to 22.21.

The Hoek-Brown criterion provides input for the design of underground excavations in rock. The criterion incorporates both intact rock and discontinuities, such as joints, characterized by the geological strength index (GSI), into a system designed to estimate the mechanical behaviour of typical rock masses encountered in tunnels and slopes. Where it is noted that the strength and deformation properties of intact rock based and derived from laboratory tests, are reduced based on the properties of discontinuities in the rock mass (Hoek and Brown, 2018).

The Hoek-Brown failure criterion is a widely used empirical strength criterion for rock masses, particularly valuable when dealing with fractured or jointed rock where traditional Mohr-Coulomb parameters (cohesion and friction angle) can be difficult to define for the rock mass. It is expressed as:

The parameter '*mi*' is the material constant for the intact rock. It is one of the foundational parameters within the Hoek-Brown system.

Significance of mi:

The *mi* parameter is a fundamental property of the intact rock (i.e., unfractured, unweathered rock sample) and represents a measure of the rock's intrinsic frictional characteristics and the shape of its failure envelope when plotted in principal stress space. It specifically relates to:

- **Non-linearity of Strength:** It defines the degree of curvature of the intact rock's strength envelope. For many rocks, the strength gain with increasing confining pressure is non-linear, and mi captures this curvature.
- **Frictional Behaviour:** It is indicative of the internal friction of the intact rock material. Higher mi values correspond to more frictional materials.
- **Rock Type Characterization:** Different rock types have characteristic ranges for mi. For example, fine-grained igneous rocks tend to have higher mi values than coarse-grained sedimentary rocks or highly altered rocks. It reflects the fundamental geological characteristics of the rock material itself.

A higher *mi* value generally indicates a more brittle rock and a steeper failure envelope, implying a greater sensitivity of its strength to confining pressure. This means that a rock with a high mi will exhibit a much larger increase in strength when subjected to increasing confining pressure compared to a rock with a lower mi. Conversely, a lower *mi* suggests a less brittle, more ductile, or weaker intact rock.

In summary, *mi* represents the fundamental strength characteristic of the intact rock component within the rock mass, serving as a critical input for accurately applying the generalized Hoek-Brown criterion to predict the behaviour and design appropriate support for underground excavations in a fractured rock environment.

It should be noted that these parameters are highly variable and present significant uncertainty in the mine design without specific laboratory tests. Therefore, laboratory tests will be crucial to ensure the integrity of the geotechnical aspect of the mine design in future detailed phases.

Rock Mass Rating (RMR) System (Bieniawski, 1989): This widely used system classifies rock masses based on six primary parameters, each assigned a rating:

1. **Uniaxial Compressive Strength (UCS) of Intact Rock:** The strength of the solid rock material.
2. **Rock Quality Designation (RQD): A** measure of the degree of fracturing in a rock mass, derived from borehole core.
3. **Spacing of Discontinuities:** The average distance between fractures.
4. **Condition of Discontinuities:** Assesses roughness, infilling, weathering, and continuity of joint surfaces.

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5. **Groundwater Conditions:** Evaluates the presence and flow of water, and its impact on rock mass strength.

6. **Orientation of Discontinuities:** A rating adjustment based on how favourably or unfavourably discontinuities are oriented relative to the excavation axis. The sum of these ratings gives the overall RMR value, which correlates with rock mass quality (e.g., Very Poor, Poor, Fair, Good, Very Good) and provides empirical guidelines for ground support design for various excavation sizes and shapes.

Q-System (Barton, Lien, & Lunde, 1974): The Q-System is another prominent empirical classification method, specifically developed for tunnel and cavern support. It uses six parameters grouped into three ratios:

7. **RQD / Jn (Joint Set Number):** Represents the block size.

8. **Jr (Joint Roughness Number) / Ja (Joint Alteration Number):** Represents the inter-block shear strength.

9. **Jw (Joint Water Reduction Factor) / SRF (Stress Reduction Factor):** Represents active stress and water pressure.

The product of these ratios gives the Q-value, which ranges from 0.001 (exceptionally poor) to 1000 (exceptionally good). The Q-value, along with the 'Equivalent Dimension' of the excavation, informs the required support pressure and bolt length.

Geological Strength Index (GSI) (Hoek, Kaiser, & Bawden, 1995): While not a direct support design tool, the GSI is crucial for estimating rock mass properties (e.g., deformation modulus, shear strength, cohesion, friction angle) for numerical modelling. It is estimated qualitatively based on two primary visual observations of the rock mass:

10. **Rock Mass Structure:** How blocky or intact the rock mass appears (e.g., intact, blocky, very blocky, disintegrated).

11. **Surface Condition of Discontinuities:** The quality of the joint surfaces (e.g., very good, good, fair, poor, very poor).

The GSI chart allows for the visual estimation of the rock mass quality, which is then used as input into the generalized Hoek-Brown failure criterion to derive mechanical properties for rock mass strength and deformation analysis.

The application of these systems, derived from detailed core logging, geological mapping in pilot excavations, and laboratory testing (which will be crucial in future phases), will enable the engineering team to predict rock mass behaviour, assess stability, and design appropriate excavation geometries and ground support systems for the various underground components (e.g., development roadways, production panels, shafts, intersections).

4.4.3 Borehole Analysis

To further understand the site-specific geological and geotechnical conditions influencing highwall stability, detailed analysis of selected boreholes, namely GK14, GK10, GK07, GK11 SW13 and SW05, was conducted. These boreholes demonstrate key observable features that have a direct impact on slope and ground stabilities from a geotechnical perspective.

Boreholes GK07 and GK14:

Observations in both boreholes (Figure 5 and Figure 6) have an observable interlamination of carbonaceous shales into the visually competent medium-grained grey-to-whitish Sandstone. This interlamination, if extensive, can create a plane of weakness where the entire rock body can easily disjoin and deform if any unidirectional strain were to be applied.

It is important to note that these interlaminations are generally horizontal in orientation (based on drilled core observation). This orientation poses a very low risk of slope failures compared to inclined interlaminations, as the shear forces acting along horizontal planes due to gravity are minimal in a vertical highwall.

Furthermore, in borehole GK14, visually competent shale is observed directly under the sandstone, just before the transition into the coal seam. The overburden in this specific area is primarily comprised of the observed competent sandstone, which generally provides good structural integrity.

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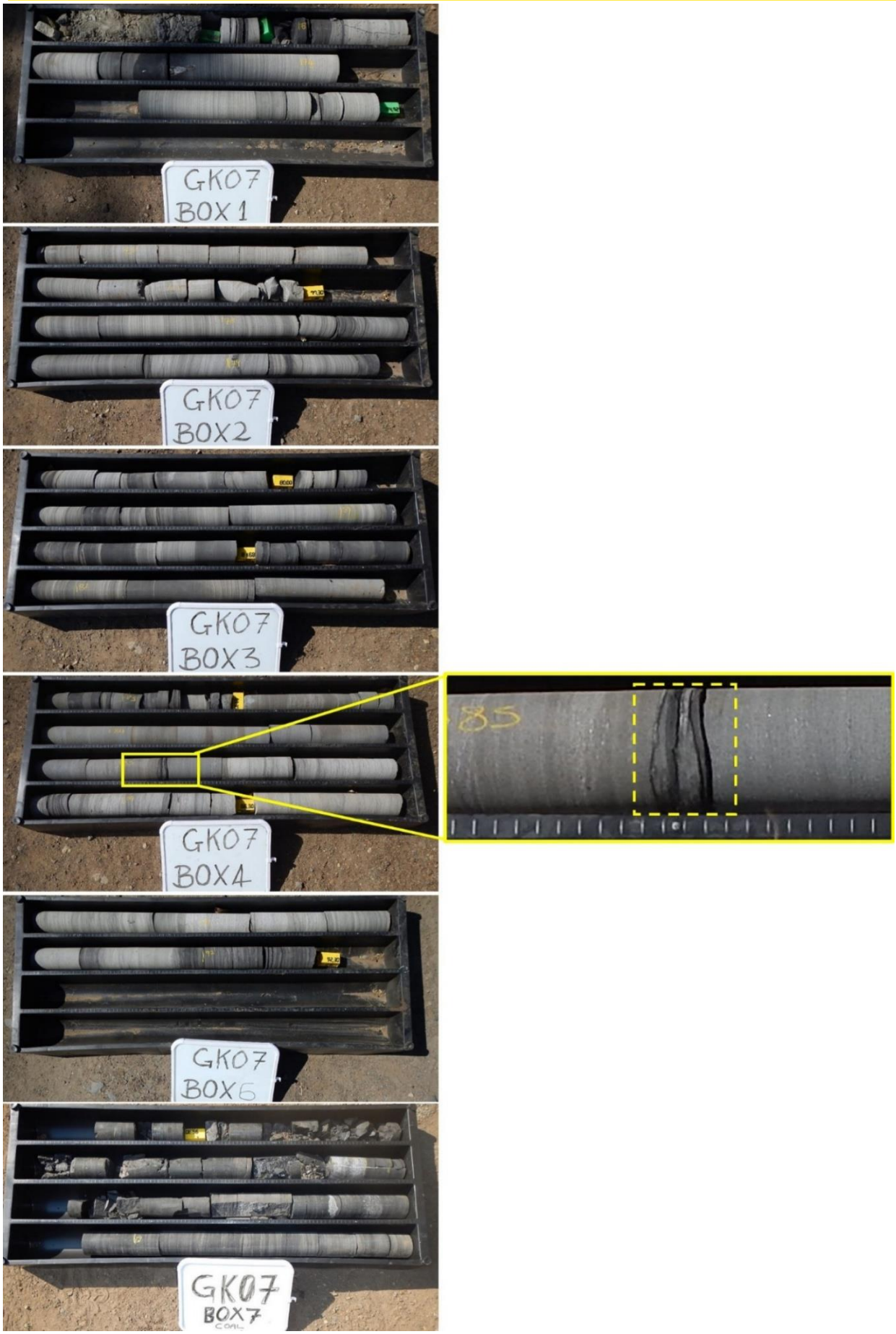

Figure 5: Borehole GK07 showing interlamination in the Sandstone

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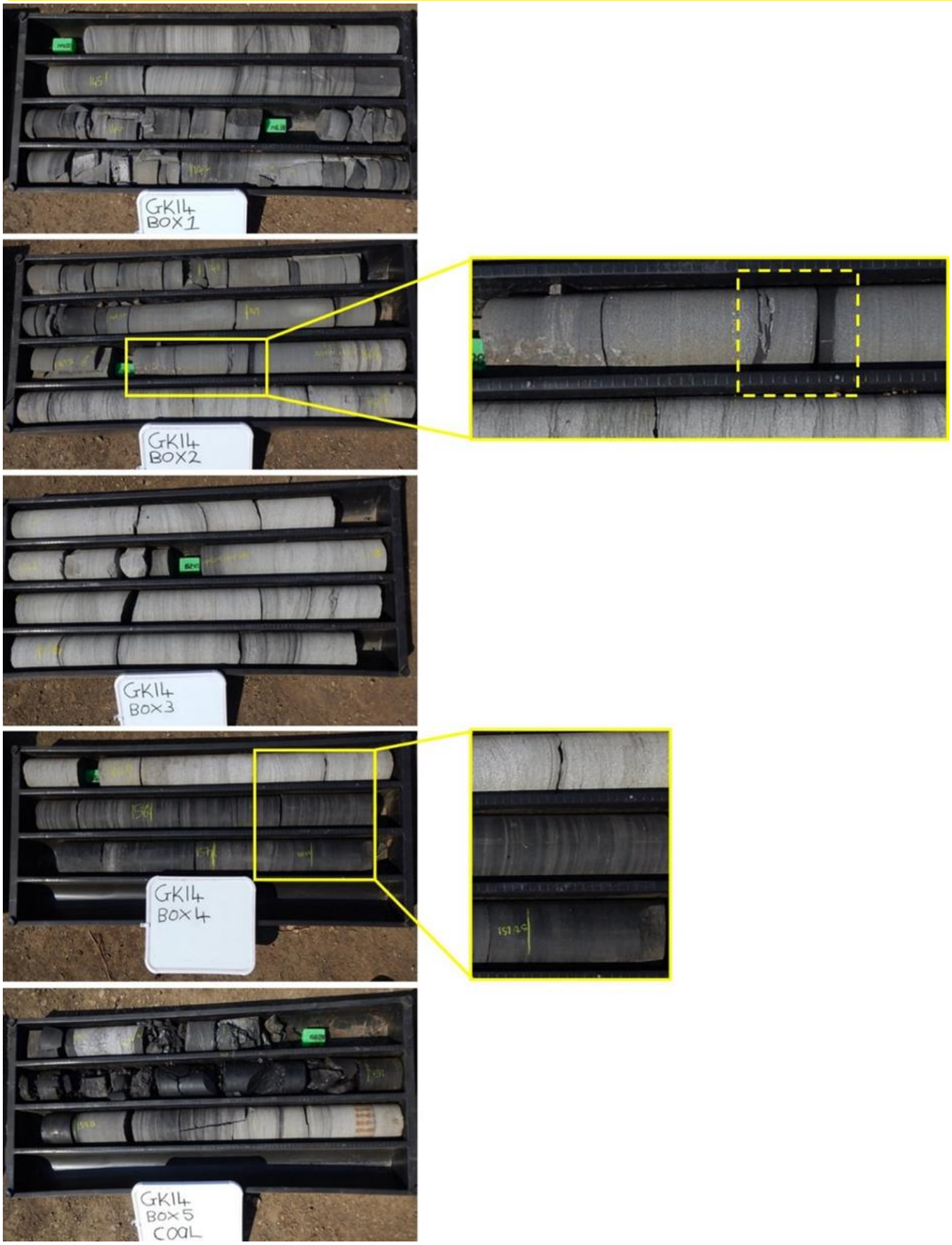

Figure 6: Borehole GK14 showing interlamination in Sandstones, and competent sandstone and shales

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Borehole GK10:

The observation of borehole GK10 (Figure 7) shows some level of weathering at a depth of 27.6m. This weathering can be attributed to water ingress through joints within the sandstone rock mass strata.

The brown-reddish colour observed in this zone signifies a level of oxidation (rust) due to the prolonged presence of water. Such weathered and oxidized features can create a zone of deformation and potential slope failures if disturbed through stresses induced by the removal of underlying support rock masses during mining.

Moreover, this observation signifies that the rock mass in this area allows for water seepage, which normally reduces the friction coefficient of the rock mass and subsequently increases the potential for slope failures. This highlights the importance of effective dewatering and managing water ingress in this zone.

Figure 7: Borehole GK10 showing some weathering within the Sandstone

Borehole SW13:

In borehole SW13 (Figure 8), there is an observable micro-faulting with a 1cm displacement. This locally observed faulting signifies that there were potential local deformation stresses in this specific geological area.

Such deformations create a distinct plane of weakness (a deformation plane). When mining in the vicinity of such features, it is crucial to understand the strike, dip, and spatial extent of the fault. This understanding is paramount to ensuring that safe measures are put in place to prevent slope failures along and around the fault, as faults can act as preferential planes for rock mass movement under induced stresses.

These borehole analyses provide critical site-specific insights that will inform detailed geotechnical design, ground support selection, and ongoing monitoring strategies for the highwall mining operations to ensure overall stability and safety.

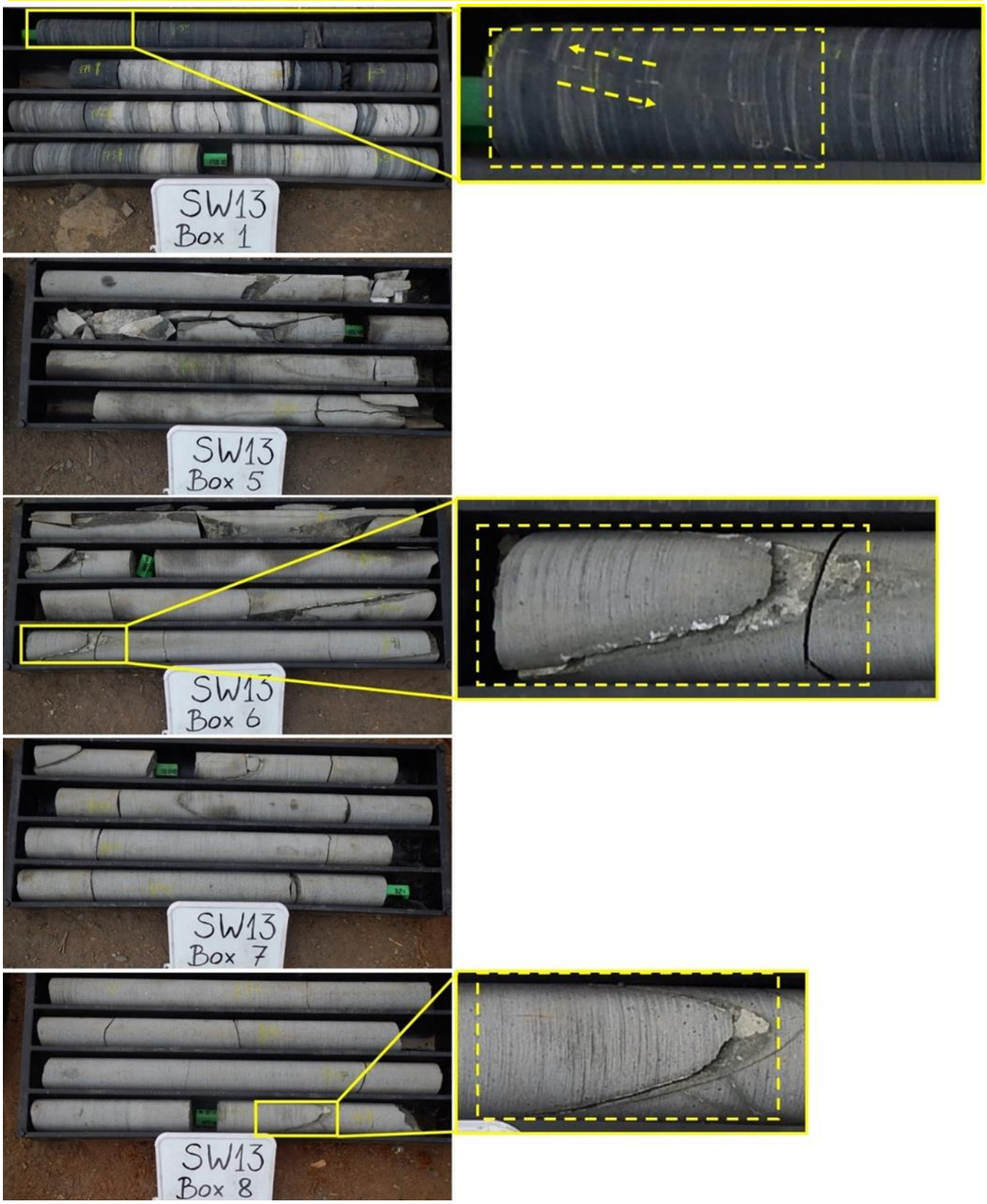

Figure 8: Borehole SW13 showing a micro fault in the carbonaceous Shales and joints in the Sandstone

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Borehole GK11:

In borehole GK11 (Figure 9), multiple joints are visible throughout the core. Vein infill is observed in several of the joints, possibly suggesting fluid movement after joint formation. The joints run typically sub-vertical to inclined in orientation, based on the intersection angle of the core. Joint spacing appears moderate to closely spaced, which can make the ground more prone to failure due to reduced rock mass strength.

Figure 9: Borehole GK11 showing filled joints in the Sandstone

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Borehole SW05:

Close joint spacing is observed in borehole SW05 (Figure 10), with no visible mineral infill. Some of the joints have resulted in blocky fragmentations. Two intersection joint sets are observable orientated vertically, which implies that the rock masses can detach vertically under gravity in the event of removal of the underlying and supporting rock mass.

Figure 10: Borehole SW05 showing closed joints in the Dolerite and Sandstone

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5. GEOTECHNICAL ASPECTS OF MINING OPERATIONS

5.1 PHASE 1-3: HIGHWALL MINING METHOD

5.1.1 Introduction to Highwall Mining

Highwall mining is a surface-based coal extraction method designed to recover coal seams that are uneconomical to mine by traditional open-pit methods due to increasing overburden thickness, or structurally complex for conventional underground mining in the initial stages of the project. The process typically involves creating a stable access bench at the base of an exposed coal seam (the highwall). A remotely operated, continuous mining machine, such as Addcar Highwall Mining System, or similar, is then launched from this bench to bore multiple, parallel entries into the coal seam, extracting coal without requiring personnel to enter the underground workings. The extracted coal is typically conveyed back to the surface.

Mining equipment such as Addcar Highwall Mining System, or similar, is a robust and efficient machine designed for this specific application. Its operational principles include a cutter module that excavates the coal, a series of push beams that advance the machine into the seam, and a continuous conveying system to bring coal to the surface. The system is designed for high productivity and, critically, enhanced safety by removing personnel from the direct underground environment. The geotechnical integrity of the highwall is paramount for the safe and efficient operation of this system.

5.1.2 Geotechnical Requirements for Highwall Mining

The successful and safe operation of highwall mining equipment, particularly with a sophisticated system like The Cat® HW300, or similar, is profoundly dependent on a rigorous understanding and management of geotechnical conditions.

5.1.3 Highwall Stability

The paramount geotechnical consideration in highwall mining is the stability of the highwall face and slope themselves. A failure of the highwall can lead to catastrophic consequences, including equipment damage, loss of production, and, most importantly, safety hazards to personnel on the bench. Potential failure mechanisms in highwalls include:

- **Planar Failures:** Occur along a single, well-defined discontinuity (e.g., bedding plane, fault, joint) that dips out of the highwall face at an angle less than the friction angle of the discontinuity, and steeper than the highwall face angle. These are typically analysed using kinematic methods (stereonet) and limit equilibrium calculations.
- **Wedge Failures:** Result from the intersection of two discontinuities that daylight in the highwall face, forming a wedge that can slide out. Similar to planar failures, these are identified through kinematic analysis.
- **Toppling Failures:** Involve columns or blocks of rock detaching and rotating forward, often due to steeply dipping discontinuities or the presence of tension cracks behind the highwall. This mechanism is common in fractured rock masses with adverse joint orientations.
- **Circular Failures:** More common in soil or heavily weathered rock masses, where the failure surface is curved. This is less typical for competent rock highwalls but can occur in the overlying weathered overburden, particularly if moisture content increases significantly.
- **Slab/Block Failures:** Smaller, localized failures involving individual rock blocks detaching from the face due to discontinuity intersections or weathering.

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Figure 11: Local vertical joints on the exposed highwall bench shales

The geological structures influencing stability are critical. The orientation, persistence, spacing, roughness, and infilling of bedding planes, joints, and faults must be meticulously mapped and analysed. Structural mapping should identify 'unfavourable' orientations – those that dip towards the excavation at angles conducive to failure. Comprehensive geotechnical assessments should be conducted to evaluate rock strength, fault presence, and potential instability risks, as outlined in good mining practice guidelines.

5.1.4 Highwall Support and Rockfall Prevention

To prevent rockfalls and ensure the safety of equipment and personnel operating on the highwall bench/face, various ground support systems and rockfall prevention measures are essential. The selection of appropriate measures depends on the assessed stability and potential for localized failures. Common measures include:

- **Highwall Wire-Mesh Draping:** This involves covering the highwall face with high-tensile steel mesh, which is then secured with rock bolts or cable anchors. Its primary function is to contain loose or spalling rock, preventing small-scale rockfalls from reaching the bench or damaging equipment. It is particularly effective in fractured or highly weathered rock faces where surface unravelling is a concern. The mesh also provides a visual barrier against personnel approaching unstable zones.
- **Rock Bolting:** Steel bolts (e.g., mechanical, resin-grouted, or fully encapsulated friction bolts) are installed into the rock mass, providing reinforcement and increasing the shear strength across discontinuities. They can be passive (grouted) or active (tensioned) and are designed to tie unstable blocks or layers back into the more stable rock mass behind the highwall face. Bolt length, diameter, and pattern are determined by the depth of potential failure planes and the required reinforcement loads.
- **Shotcreting:** A layer of concrete (often fibre-reinforced) sprayed onto the rock face, providing immediate surface support, preventing ravelling, and protecting the rock from weathering. It can be used in conjunction with mesh and bolts, especially in areas of poor rock mass quality or localized instability.
- **Scaling:** Regular, systematic removal of loose rock fragments from the highwall face using mechanical excavators or specialized scaling tools. This is a proactive measure to address immediate hazards and improve the overall stability of the highwall by removing potential rockfall sources. This should be performed from a safe distance or from a secure platform.
- **Berms and Catch Fences:** Physical barriers constructed at the base of the highwall (on the access bench) to catch any falling debris. Berms (earthen structures) or purpose-built catch fences (e.g., wire rope barriers) can significantly reduce the risk of rockfalls reaching operating equipment or personnel. Their size and location are determined by the potential rockfall trajectory and energy.

The integration of these measures will be critical, especially in areas identified as potentially unstable due to geological structures, excessive fracturing, or weathering, and in zones where the highwall mining machine is operating closest to the face.

5.1.5 Competent Highwall Slopes

The concept of "competent highwall slopes" refers to the ability of the exposed rock mass to remain stable under the influence of gravity, mining operations, and environmental factors, without excessive deformation or catastrophic failure. The assessment of competence involves:

- **Rock Mass Characterization:** Detailed characterization of the rock mass forming the highwall is foundational. This includes assessing the intact rock strength, presence and characteristics of discontinuities (orientation, spacing, persistence, roughness, infilling), groundwater conditions, and degree of weathering.
- **Rock Mass Classification Systems:** Tools like the Rock Mass Rating (RMR) system by Bieniawski or the Q-System by Barton et al. are invaluable. These systems assign numerical values to various geotechnical parameters (e.g., RQD, joint spacing, joint condition, groundwater, discontinuity orientation) to quantify the overall quality and stability of the rock mass. A higher RMR or Q-value generally indicates a more competent rock mass requiring less support for a given slope angle. For example, a competent coarse sandstone with RQD >75% and few joints may yield RMR in the “good” range (≥60), while weathered shale or fractured basalt may be lower. Higher RMR/Q allows steeper slopes; for example, RMR ~80 would permit near-vertical stable benches. In practice, slope angles will likely be set conservatively (e.g. 60–70°) in this locale, with berms between 10–15 m lifts to catch rockfall.
- **Geotechnical Design Parameters:** Based on the rock mass classification and detailed structural analysis, appropriate highwall slope angles and overall highwall geometry (e.g., inter-ramp angles, bench heights, bench widths) are determined. These angles are critical for maintaining long-term stability and ensuring safe operational widths for the highwall mining

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equipment. The designed highwall angle must be shallower than the critical angle for any potential failure mechanisms identified.

- **Factor of Safety Analysis:** Numerical modelling (e.g., using finite element or finite difference software) and limit equilibrium analysis (e.g., using SLOPE/W, SWEDGE) are employed to calculate the factor of safety (FoS) for various potential failure modes (planar, wedge, circular, toppling). A factor of safety (FoS) greater than 1.0 (typically 1.3 to 1.5 for long-term stability in surface excavations, and higher for critical slopes or short-term stability during operations) indicates a stable slope under given conditions. Designs aim for FoS values that provide an acceptable level of risk.
- **Observational Method:** The observational method, while not a design tool in itself, complements the design process by allowing for adaptive management. Based on continuous monitoring, the design can be refined and support measures adjusted as actual ground conditions are encountered.

Figure 12: Exposed highwall bench to access the coal seam using the highwall mining system

5.1.6 Influence of Weathering and Hydrogeology

Weathering and water are critical to slope stability. Near-surface weathering of sandstone and shale is evident at Colenso and dolerite sills oxidize rapidly. As the DMRE slope guideline notes, degree of rock weathering "significantly affects" engineering properties, with weathered rock often soft and unstable. Weathered shale can soften (swelling or slaking) when wet, further undermining slope strength. Seasonal rainfall infiltrates the highwall; water in joints raises pore pressure and reduces effective shear strength. If the water table is high or perched zones exist in sandstone, groundwater may flow into pit faces, causing piping or undercutting at the toe. All slope designs must assume a design rainstorm (e.g. 1-in-100 year) and ensure adequate surface drainage (e.g. ditches, berms). Based on the DMRE guidance, a groundwater and hydrogeological evaluation will be performed during drilling (Section 2.3) to identify aquifers and flow path. If needed, targeted dewatering (borehole sumps or pumps) should be planned for long-term stability.

- **Weathering Profiles:** The degree of weathering in the overburden and upper rock strata significantly impacts geotechnical properties. Highly weathered rock can behave more like soil, exhibiting lower strength, higher compressibility, and increased susceptibility to erosion. The depth and extent of the weathering front must be accurately delineated through drilling and geological mapping, as it often dictates the stable angle of the upper portion of the highwall. Differential weathering (where different rock types weather at different rates) can also create unstable overhangs or ledges.

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- **Groundwater Conditions:** Groundwater within the highwall and surrounding strata is a major destabilizing factor. Increased pore pressure within discontinuities (joints, fractures, bedding planes) reduces the effective normal stress across these features, thereby decreasing the shear strength of the rock mass. This reduction in strength can significantly lower the factor of safety against slope failure. Seepage from the highwall face can also lead to ravelling and erosion of weaker materials, exacerbating instability. Effective dewatering strategies, such as horizontal drains (weep holes), sumps on the bench with continuous pumping, or vertical dewatering wells, may be required to maintain stability by reducing pore pressures and managing surface water runoff from the highwall face. Seasonal variations in rainfall and groundwater levels must be considered in the design.

5.2 FUTURE UNDERGROUND MINING OPERATIONS

This section addresses the geotechnical considerations for the planned transition to conventional underground mining methods, based on established principles for coal mining in South Africa.

5.2.1 General Geotechnical Setting for Underground Mining

The anticipated geotechnical environment for underground mining at the Colenso Coal Project, given its location within the Klip River Coalfield and general Karoo Basin geology, will be characterized by:

- **Rock Types:** The primary strata encountered will be the target coal seams, interbedded shales, siltstones, and sandstones of the Vryheid Formation. The mechanical properties of these lithologies (e.g., Uniaxial Compressive Strength, deformation modulus) will vary significantly, influencing excavation stability. Fine-grained sedimentary rocks (shales, siltstones) are often weak and prone to weathering and slaking upon exposure to air and moisture, requiring careful consideration for roof and sidewall stability.
- **Geological Structures:** In addition to bedding planes, the underground environment will be profoundly affected by natural discontinuities such as joints (systematic and non-systematic), faults (normal and reverse, with varying displacements), and potentially minor folds or rolls. The orientation, density (spacing), persistence (length), roughness, and infilling of these structures will govern the rock mass behaviour, particularly for roof stability in roadways and overall stability of pillars and longwall panels (if applicable). Fault zones are particularly critical as they often consist of highly fractured or weak rock and can be conduits for groundwater.
- **Seam Characteristics:** The thickness, dip (angle of inclination), and quality variations of the coal seams themselves will directly influence the choice of mining method, design of excavations, and ground control requirements. Thin seams may require mining of adjacent waste rock (cut-and-fill) leading to different ground conditions, while steeply dipping seams introduce additional gravitational stresses.
- **Overburden Thickness and Stress Regime:** As mining progresses deeper, the increasing overburden thickness will result in higher virgin stresses. Understanding the magnitude and orientation of the in-situ stress field (vertical and horizontal stresses) is crucial, as high stress concentrations around excavations can lead to stress-induced failures (e.g., pillar spalling, floor heave, roof bursts). Geological structures can also perturb the stress field.

5.2.2 Ground Support Design for Underground Mining

Effective ground support is paramount to ensure the stability of underground excavations and the safety of personnel. The selection and design of ground support must account for the rock mass quality, anticipated stress conditions, excavation dimensions, and the expected lifespan of the openings. Common ground support methods applicable to coal mining include:

- **Roof Bolts:** The most common form of active support in coal mines. Steel bolts (e.g., mechanical anchor, resin-grouted rebar, fully encapsulated friction bolts, or combination bolts) are installed into the roof strata to reinforce the rock mass, prevent bedding plane separation, and enhance the overall stability of the roof. Bolt length, diameter, pattern (e.g., square, staggered), and tension are determined by the depth of potential failure planes, the required reinforcement loads, and specific rock mass conditions. The aim is to create a "beam" or "arch" within the roof strata.
- **Timber Props and Cribs:** Used for temporary or localized support, particularly in conjunction with roof bolts or for areas requiring additional bearing capacity. Timber props provide axial support, while timber cribs (stacked timber blocks) can

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provide significant passive support for heavier loads, ground squeeze, or as emergency support in unstable areas. They are also used at intersections and for temporary support during equipment moves.

- **Yielding Supports:** In areas subjected to high stress or significant ground movement (e.g., destressed zones, pillar squeezes, areas near large fault zones, or deep mining), yielding supports such as steel arches (e.g., arch sets, yielding arches) or hydraulic props may be necessary. These supports are designed to deform under load, absorbing energy without failing catastrophically, thereby maintaining ground control in areas of active closure.
- **Shotcrete and Mesh:** As with highwall mining, shotcrete (often fibre-reinforced for enhanced tensile strength) can be applied to the roof and sidewalls of underground excavations to provide immediate surface support, prevent unravelling or spalling of fractured rock, and protect the rock from weathering. Mesh (e.g., welded wire mesh, high-tensile steel mesh) is often used in conjunction with bolts and shotcrete to contain smaller rock fragments and enhance surface stability.
- **Cable Bolts:** Longer and higher-capacity than conventional roof bolts, cable bolts (often multi-strand steel cables) are used for reinforcing larger rock masses or where deeper reinforcement is required, particularly in large intersections, main roadways, areas of significant geological disturbance, or zones of high stress. They can extend significantly into the roof and sidewalls to tie back large rock blocks.
- **Pillar Design:** The most fundamental form of ground support in bord-and-pillar mining. Pillars must be designed to safely carry the overburden load with an adequate factor of safety. Design considers coal seam strength, pillar dimensions (width-to-height ratio), and expected stress conditions. The stability of individual pillars and the overall panel stability (regional stability) are critical.

Ground support design for the Colenso Coal Project will be an iterative and dynamic process, informed by initial geotechnical investigations and refined through ongoing monitoring, observational methods during mining, and periodic review of support standards.

5.2.3 Groundwater Management in Underground Operations

Groundwater is a significant factor influencing geotechnical stability and operational efficiency in underground coal mining. Its effective management is critical.

- **Potential Inflows:** Inflows can occur from overlying aquifers, geological discontinuities (faults, joints, dolerite dykes) acting as preferential flow paths, or permeable strata directly connected to surface water bodies. Excessive water ingress can:
    - **Reduce Rock Mass Strength:** Increased pore water pressure within discontinuities reduces the effective stresses, leading to a decrease in the shear strength of the rock mass. This can contribute to roof falls, sidewall instability, floor heave, or even pillar instability, especially in weaker strata.
    - **Operational Interference: Excessive** water can impede mining equipment movement, cause slippery conditions, corrode equipment, and require significant pumping infrastructure and capacity, increasing operational costs and potentially reducing productivity.
    - **Environmental Impact:** Large volumes of mine water, if not managed and treated properly, can lead to flooding and contamination of surface and groundwater resources upon discharge.
- **Dewatering Strategies:** Effective dewatering is crucial for maintaining safe and stable underground conditions. Strategies will include:
    - **Pre-Dewatering:** Involves pumping from boreholes drilled from the surface into identified aquifers above the coal seam before mining commences. This lowers the regional water table, reduces the hydraulic head, and minimizes anticipated inflows into the mine workings.
    - **In-Mine Pumping:** Continuous pumping from sumps (collection points) within the underground workings to manage water inflows encountered during mining development and production. Sumps are strategically located in low points, and pumping systems are sized to handle peak flow events.
    - **Drainage Boreholes:** Drilling short boreholes into water-bearing structures (e.g., water-filled faults, jointed zones) from within the mine to drain water to sumps for collection and pumping.

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- **Grouting/Sealing:** In areas of high-water ingress through discrete features, grouting (injecting cementitious or chemical grouts) can be used to seal off water-bearing fractures and reduce inflow.

- **Impact on Geotechnical Stability:** A detailed hydrogeological model will be necessary to predict groundwater behaviour and design effective dewatering strategies. The interaction between groundwater and rock mass must be carefully considered in all stability analyses. This includes:

  - The effect of pore pressure on effective stresses and shear strength.
  - The potential for liquefaction in certain saturated, granular strata (e.g., highly weathered sandstone, interburden lenses) under dynamic loading conditions.
  - The impact of dewatering on the strength of clay-rich interburden layers (e.g., potential for swelling or softening upon water contact and subsequent drying/wetting cycles).
  - The potential for progressive deterioration of rock mass due to prolonged water exposure.

Proper design and ongoing management of the hydrogeological regime are fundamental to ensuring the long-term geotechnical stability and economic viability of the underground mining operations at Colenso.

6. IMPACT ASSESSMENT AND SIGNIFICANCE RATING

The proposed Colenso Coal Project, encompassing both highwall and underground mining, has the potential for various geotechnical impacts. A thorough impact assessment is crucial for developing effective mitigation strategies.

6.1 IDENTIFICATION OF POTENTIAL GEOTECHNICAL IMPACTS

6.1.1 Land Instability

- **Highwall Mining:** The creation of exposed highwalls inherently introduces the risk of slope instability. Potential failure mechanisms include planar, wedge, toppling, and circular failures, particularly in zones of unfavourable structural geology (e.g., joints dipping out of the highwall face) or highly weathered rock. Failures can impact the mining bench, equipment, and personnel operating at the toe of the highwall.
- **Underground Mining:**
    - **Subsidence:** Extraction of coal seams through underground methods (e.g., bord-and-pillar, or potential future total extraction) can lead to surface subsidence, which is the lowering of the ground surface. The extent and magnitude of subsidence depend on factors such as mining method (e.g., pillar extraction ratio), depth of mining, thickness of extracted seams, overburden characteristics (stiffness, thickness of strong layers), and the presence of geological structures. Potential impacts include damage to surface structures, infrastructure (roads, pipelines, power lines), changes in surface drainage patterns, disruption to agricultural land, and alteration of natural habitats, including wetlands.
    - **Pillar Instability:** In bord-and-pillar mining, inadequate pillar design, unforeseen geological weaknesses (e.g., joint sets, faulting, soft bands within coal), or changes in groundwater conditions can lead to pillar failure. This can result in localized or widespread roof collapse, known as bord or panel collapse, which in turn can propagate to the surface as subsidence.
    - **Roof and Sidewall Instability:** Uncontrolled roof falls or sidewall spalling in underground roadways, intersections, and working areas pose significant safety risks to personnel and can lead to operational disruptions and economic losses. This is particularly prevalent in areas of poor rock mass quality, high stress concentrations, or adverse structural orientations.
- **Waste Dump Stability:** The stability of waste rock dumps and discard facilities is critical. Potential impacts include rotational failures, foundation failures, and liquefaction (in discards or saturated fine-grained waste), leading to mass movement, release of contaminated materials, and safety hazards.

6.1.2 Soil Erosion

- **Surface Disturbances:** Land clearing, topsoil removal, and the creation of access roads, construction areas, and stockpiles expose underlying soils to erosive forces (wind and water). This can lead to significant soil loss, especially on steeper slopes, during heavy rainfall events, or in areas with strong winds.
- **Highwall Mining:** The formation of highwalls and benches creates large exposed surfaces that are highly susceptible to erosion, contributing to increased sediment runoff into drainage systems.
- **Spoil Dumps/Waste Rock Dumps:** Unstable, improperly contoured, or poorly vegetated spoil dumps and discard facilities are major sources of erosion and sediment generation. Sedimentation can impact downstream water quality, alter river morphology, and reduce the capacity of dams and water features.

6.1.3 Groundwater Contamination and Hydrogeological Impacts

- **Acid Mine Drainage (AMD):** Exposure of sulphide-bearing minerals (e.g., pyrite, marcasite) commonly found in coal seams and associated carbonaceous shales to oxygen and water during mining operations can lead to the formation of acidic leachate (AMD). If uncontrolled, AMD can contaminate surface and groundwater resources, leading to low pH, high concentrations of sulphates and heavy metals. This can severely impact aquatic ecosystems, render water unfit for human consumption or agricultural use, and require long-term treatment.

- **Altered Groundwater Levels:** Mine dewatering (both highwall dewatering and underground pumping) can lower the regional water table, creating a cone of depression. This can potentially impact groundwater-dependent ecosystems (e.g., wetlands, phreatophytes), reduce yields of existing boreholes used by local communities or farmers, and alter natural groundwater flow regimes.
- **Inter-aquifer Leakage:** Mining activities (e.g., shafts, underground workings) can create new pathways for groundwater to move between previously separated aquifers, potentially facilitating the migration of contaminants or altering natural hydrological gradients.
- **Increased Total Dissolved Solids (TDS):** Even without AMD, contact of water with exposed rock surfaces within the mine can lead to an increase in TDS, salinity, and other dissolved constituents, affecting water quality for downstream users.

6.1.4 Impact on Surface Water Drainage

- **Diversion of Flow Paths:** Construction of roads, dumps, processing facilities, and mining excavations can physically alter natural surface water drainage patterns, potentially leading to localized flooding, increased erosion in new flow paths, or disruption of natural stream dynamics.
- **Sedimentation:** Runoff from disturbed areas carries suspended solids (silt, clay, sand) into natural watercourses, increasing turbidity and sediment load. This can negatively impact aquatic life by smothering habitats, reducing light penetration, and reducing the aesthetic quality of water bodies. Sedimentation can also reduce the capacity of dams and culverts.
- **Water Quality Alteration:** Beyond AMD, surface water quality can be impacted by hydrocarbons (from equipment), nutrient enrichment (from topsoil runoff), or other pollutants.

6.1.5 Air Quality Impacts (Indirect Geotechnical Link)

- **Dust Generation:** While primarily an air quality issue, dust generation is fundamentally linked to disturbed ground. Mining activities, including drilling, blasting, hauling (on unpaved roads), crushing, screening, and wind erosion from exposed stockpiles and waste dumps, generate significant amounts of particulate matter. This impacts local air quality, human health (respiratory issues), and can cause nuisance to nearby communities. Proper geotechnical planning for stable surfaces and progressive rehabilitation directly reduces dust sources.

6.2 Impact Rating Criteria

The significance of identified impacts is typically assessed using a standardized rating methodology that considers various factors. While specific numerical criteria would be defined in a detailed EIA, the general parameters include:

- **Nature:** A description of the impact (e.g., physical, chemical, biological, socio-economic).
- **Magnitude (Severity):** The intensity or extent of the impact (e.g., minor, moderate, major).
- **Duration:** The temporal scale of the impact (e.g., short-term, medium-term, long-term, permanent).
- **Extent (Spatial Scale):** The geographical area over which the impact is experienced (e.g., site-specific, local, regional).
- **Probability (Likelihood):** The chance of the impact occurring (e.g., improbable, low, medium, high, definite).

These criteria are then combined to determine the overall significance of the impact (e.g., negligible, low, medium, high, very high), both before and after the implementation of mitigation measures.

6.3 GEOTECHNICAL RISK MATRIX

A Geotechnical Risk Matrix is a tool used to systematically assess and visualize the level of risk associated with various geotechnical hazards (Table 2, Table 3 and Table 4). It typically plots the "Likelihood" of an event against the "Consequence" of that event. Each intersection of likelihood and consequence yields a risk rating (e.g., Low, Medium, High, Extreme).

Table 2: Geotechnical Risk Assessment Matrix

Likelihood \ Consequence	**Minor (1)**		**Moderate (2)**	**Major (3)**	**Catastrophic (4)**
Remote (1)	Low		Low	Medium	Medium
Unlikely (2)	Low		Medium	Medium	High
Possible (3)	Medium		Medium	High	Extreme
Likely (4)	Medium		High	High	Extreme
Certain (5)	High		High	Extreme	Extreme

Table 3: Colenso Coal Project Inferred Geotechnical Risk Assessment Matrix

GEOTECHNICAL RISK	HAZARD DESCRIPTION	LIKELIHOOD	CONSEQUENCE				SCORE/20
			MINOR (1)	MODERATE (2)	MAJOR (3)	CATASTROPHIC (4)	
1. Planar Failure	**Description:** Occurs mainly in sandstone and shales where bedding planes or joints dip unfavorably. Often controlled by rainfall and weathering. Risk moderate where persistent discontinuities exist but mitigated with support.	Unlikely (4)		Medium			**8**
2. Wedge Failure	**Description:** Potential in zones with intersecting joints/faults. Especially relevant for highwall mining benches. Low overall likelihood except in fault zones.	Unlikely (4)	Low				**4**
3. Toppling Failure	**Description:** Mostly possible in steeply dipping sandstone columns or thinly bedded shales. Less common than planar or wedge failures but possible in exposed vertical slopes.	Remote (1)		Medium			**2**
4. Rotational (Circular) Failure	**Description:** More likely in weathered zones, soil, or weak rock masses (e.g. highly weathered shales or weathered sandstone). Generally low likelihood in competent rock but significant consequence if triggered.	Likely (4)			Medium		**12**

Note: This is a generic example. The Colenso coal project-specific matrix would define detailed criteria for each likelihood and consequence level relative to the project context.

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Table 4: Colenso Coal Project General Geotechnical Risk Assessment Matrix

GEOTECHNICAL HAZARD DESCRIPTION	LIKELIHOOD	RISK LEVEL	CONSEQUENCE
1. Localized rockfalls from highwall faces	Medium	Medium	Medium
2. Large-scale highwall collapse	Low	Medium	High
3. Slope instability due to water ingress/weathering	Medium	Medium	Medium
4. Soil erosion on disturbed surfaces	Medium	Low-Medium	Low
5. Fault reactivation affecting slope or underground	Low	Medium	High
6. Groundwater inflows into highwall benches	Low	Low-Medium	Medium
7. Subsidence from underground mining	Low	Low-Medium	Medium
8. Ground settlement affecting surface infrastructure	Low	Low-Medium	Medium

This matrix guides decision-making, allowing the project team to prioritize risks requiring immediate attention, allocate resources for mitigation, and develop appropriate response plans.

7. MITIGATION MEASURES

Effective mitigation measures are crucial for minimizing the identified geotechnical and associated environmental impacts throughout all phases of the Colenso Coal Project, from planning and design to operation and closure.

7.1 GROUND AND SLOPE INSTABILITY MITIGATION

- **Highwall Stability:**
    - **Optimized Slope Design:** Geotechnical engineers will design highwall angles, inter-ramp angles, and bench configurations based on detailed rock mass characterization, structural analysis (kinematic), and advanced numerical stability modelling (e.g., using finite element or finite difference methods). Designs will target an adequate factor of safety under both static and pseudo-static (seismic) conditions.
    - **Ground Support Implementation:** Implement appropriate ground support measures as detailed in Section 5.2.3. (Wire-mesh draping, rock bolting, shotcreting) in unstable or potentially unstable highwall sections, and proactively in areas identified with adverse geological structures. Support systems will be designed to integrate with Addcar highwall mining operation.
    - **Regular Monitoring and Inspection:** Implement a robust geotechnical monitoring program (Section 10.1) with regular visual inspections, mapping of any new discontinuities or movements, and instrumented monitoring (e.g., prisms, radar) to detect early signs of instability and trigger corrective actions. This includes the utilization of advanced highwall radar scanning technologies, such as the highwall radar from GroundProbe (Figure 13), which are widely used in open pit mining to continuously monitor highwall movements, detect subtle deformations, and provide real-time alerts for potential failures.

Figure 13: An example of a Highwall monitoring radar equipment

- **Underground Stability and Subsidence:**
    - **Conservative Pillar Design:** For bord-and-pillar mining, design coal pillars with a conservative factor of safety against failure, considering anticipated rock mass strength, overburden stresses, and potential for time-dependent degradation (e.g., weathering of exposed coal). Design methods should consider empirical (Salamon & Munro, TSM) and numerical analyses.
    - **Optimized Mining Layout:** Design mining layouts to minimize adverse interactions between adjacent panels and avoid creating excessive stress concentrations at critical points (e.g., intersections, panel corners). Consideration of barrier pillars and destressing techniques in highly stressed ground.

- **Active Ground Support:** Implement appropriate roof and sidewall support systems (roof bolts, cable bolts, shotcrete, mesh, timber props) in all underground excavations based on rock mass quality and anticipated ground conditions. Support standards will be developed for different rock mass classes and mining sections.
- **Subsidence Management Plan:** Develop and implement a comprehensive subsidence management plan that includes:
  - Detailed prediction of subsidence magnitudes and extents using validated numerical models (e.g., influence function methods, calibrated numerical models).
  - Identification and mapping of critical surface infrastructure (roads, pipelines, power lines, buildings) and sensitive receptors (wetlands, agricultural land, homesteads) that may be impacted by subsidence.
  - Implementation of targeted mitigation measures for affected structures (e.g., flexible connections for pipelines, reinforcement of buildings, relocation, if necessary, where impacts are unavoidable and severe).
  - Extensive surface monitoring network to track actual subsidence and ground movements, validating predictions and informing adaptive management.

- **Waste Dump Stability (where applicable):**
  - **Engineered Design:** Design waste rock dumps and discard facilities as stable geo-structures, considering shear strength of materials, foundation conditions, and seismic loading. Designs will specify appropriate batter angles, internal drainage systems, and phased construction.
  - **Material Placement:** Control material placement to achieve adequate compaction and avoid segregation that could lead to instability.
  - **Internal Drainage:** Incorporate internal drainage layers or systems within dumps to prevent waterlogging and reduce pore pressures, which can destabilize slopes.
  - **Progressive Rehabilitation:** Implement progressive shaping, topsoiling, and revegetation of completed sections of dumps to ensure long-term stability and erosion control.

7.2 SOIL EROSION MITIGATION

- **Progressive Rehabilitation:** Implement progressive rehabilitation as mining progresses. This involves shaping, topsoiling, and revegetating disturbed areas (e.g., completed highwall sections, rehabilitated waste dumps, decommissioned roads) as soon as they become available. This minimizes the exposed area at any given time, thereby reducing the window for erosion.
- **Erosion Control Structures:** Install appropriate temporary and permanent erosion control structures. These include:
  - **Berms and Diversion Drains:** To divert clean stormwater away from disturbed areas and channel dirty water to pollution control dams.
  - **Gabion Baskets and Reno Mattresses:** For stabilizing steep slopes or drainage channels.
  - **Silt Fences and Sediment Traps:** To capture suspended solids in runoff before it enters natural watercourses.
  - **Contouring and Terracing:** Shaping disturbed land to reduce slope lengths and gradients, thereby decreasing runoff velocity and erosive power.
  - **Compaction and Revegetation of Dumps:** Compact and revegetate spoil dumps and waste rock facilities with appropriate indigenous vegetation and a suitable topsoil layer to stabilize surfaces, promote infiltration, and prevent erosion. Hydroseeding and mulching can assist in rapid establishment of vegetation cover.
  - **Dust Suppression:** Implement effective dust suppression measures on haul roads (e.g., water bowsers, chemical dust suppressants), stockpiles (e.g., covers, water sprays), and other disturbed areas to prevent wind erosion of fine soil particles.

7.3 Groundwater Contamination and Hydrogeological Impacts Mitigation

- **AMD Prevention and Management:**
    - **Geochemical Characterization:** Conduct detailed geochemical testing of coal and overburden materials (including waste rock and discard) to identify their acid-generating potential (e.g., Acid-Base Accounting, Net Acid Generation tests).
    - **Waste Segregation and Encapsulation:** Segregate potentially acid-generating materials (e.g., pyritic shales, discard coal) from non-acid-generating materials. Encapsulate reactive materials within engineered waste rock dumps or dedicated discard facilities using impermeable liners (e.g., compacted clay, geomembrane liners) and cover systems to minimize their exposure to oxygen and water.
    - **Water Management:** Implement comprehensive water management plans to minimize water ingress into the mine workings and prevent contact of water with acid-generating materials. This includes diversion of clean stormwater away from dirty areas and rapid collection and removal of contaminated water.
    - **Passive/Active Treatment:** Design, install, and operate water treatment plants (passive systems like constructed wetlands or active chemical treatment) to treat any AMD-impacted water or other contaminated mine water to acceptable discharge standards before release into the environment, in compliance with National Water Act requirements.
- **Groundwater Level Management:**
    - **Controlled Dewatering:** Implement controlled dewatering strategies (Section 6.2.4) to manage groundwater inflows, minimizing the extent of groundwater drawdown to avoid significant impacts on surrounding aquifers and groundwater-dependent ecosystems.
    - **Monitoring Boreholes:** Establish and regularly monitor a robust network of groundwater monitoring boreholes to track water levels and quality in surrounding aquifers.
    - **Water Use Replenishment/Compensation:** Where significant groundwater drawdown impacts existing legitimate water users (e.g., boreholes for domestic or agricultural use), investigate and implement appropriate compensation or alternative water supply measures as part of the Water Use License application.
- **Lining of Contaminated Sumps/Ponds:** Line all sumps, settling ponds, pollution control dams, and discard facilities with impermeable liners (e.g., compacted clay, HDPE geomembranes) to prevent seepage of contaminated water into the underlying ground.

7.4 Geotechnical-Specific Design Mitigation Measures

- **Integrated Mine Planning:** Ensure geotechnical considerations are integrated from the earliest stages of mine planning, influencing the selection of mining methods, layout of pits and underground workings, and sequencing of operations to optimize stability.
- **Foundation Design:** For all surface infrastructure (CHPP, offices, workshops), foundations will be designed based on thorough geotechnical investigations of the underlying soil and rock, ensuring adequate bearing capacity and minimizing differential settlement.
- **Tunnel and Adit Design:** Design of underground access points (adits, shafts) will consider the specific geotechnical conditions of the near-surface strata, including weathering profiles, unstable geological structures, and groundwater inflows, requiring robust support systems.
- **Progressive Rehabilitation:** Integrate progressive rehabilitation into the mine plan to ensure that disturbed areas are reshaped, topsoiled, and revegetated concurrently with mining operations, minimizing the extent of exposed and potentially unstable ground at any given time. This includes contouring of final highwalls and dumps to achieve stable, aesthetically pleasing profiles.

8. DESIGN RECOMMENDATIONS

Based on the detailed geotechnical assessment, the following design recommendations are put forth to guide the Colenso Coal Project's development, ensuring appropriate siting, construction, and operation to minimize geotechnical risks and comply with regulatory requirements.

8.1 General Geotechnical Design Principles

- **Data-Driven Design:** All detailed engineering designs for highwalls, underground excavations, and surface infrastructure must be founded on comprehensive, site-specific geotechnical investigations. This includes sufficient borehole drilling, core logging, laboratory testing, and in-situ measurements to characterize rock and soil properties accurately.
- **Risk-Based Approach:** Adopt a formal risk-based design philosophy, where potential geotechnical hazards are systematically identified, assessed, and managed through appropriate design choices and mitigation measures.
- **Factor of Safety (FoS) Compliance:** All designs (e.g., slopes, pillars, foundations) must achieve and maintain acceptable Factors of Safety as per relevant South African and international standards and codes of practice, considering both static and dynamic (seismic) loading conditions.
- **Adaptive Design:** The design should incorporate flexibility to adapt to actual ground conditions encountered during excavation, allowing for adjustments to support systems, excavation methods, and layouts based on ongoing monitoring and geological mapping.
- **Long-Term Stability:** Designs must consider the long-term stability of excavations and engineered structures (e.g., waste dumps, rehabilitated highwalls) well beyond the operational life of the mine, particularly regarding weathering, erosion, and post-closure hydrogeology.

8.2 Highwall Mining Specific Designs

- **Optimized Highwall Geometry:**
    - Design highwall angles (face angle, inter-ramp angle, overall slope angle) based on detailed kinematic analysis of discontinuity orientations and numerical stability modelling, aiming for a stable configuration with a robust FoS.
    - Specify appropriate bench heights and widths to ensure stability, facilitate safe operation of Addcar Highwall mining system, and provide a sufficient catchment for minor rockfalls.
    - Consider geological structures (faults, major joint sets, lithological contacts) in positioning and orienting highwall sections.
- **Ground Support Specifications:** Develop detailed ground support standards for highwall sections, specifying:
    - Type, length, diameter, and pattern of rock bolts.
    - Type and coverage of wire-mesh draping (e.g., high-tensile galvanized steel mesh).
    - Shotcrete thickness and reinforcement (e.g., fibre-reinforced shotcrete).
    - Grout type and application procedures.
- **Surface Water Management:** Design effective surface water diversion systems on the highwall crest and benches to prevent uncontrolled runoff from impacting the highwall face, reducing erosion and pore pressure.
- **Dewatering Systems:** Design internal highwall drainage systems (e.g., horizontal drain holes, sumps on benches) to control groundwater seepage and reduce pore pressures behind the highwall face.

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8.3 UNDERGROUND MINING SPECIFIC DESIGNS

- **Mine Layout Optimization:**
    - Design main and secondary roadways (gate roads, access drifts) to align favourably with the principal stress directions where possible, minimizing stress concentrations and improving stability.
    - Optimize pillar dimensions (width-to-height ratio) and spacing in bord-and-pillar layouts to ensure long-term stability and regional stability, using a combination of empirical formulas (e.g., Salamon & Munro, SPSA) and numerical stress analysis.
    - Incorporate appropriate barrier pillars (inter-panel, boundary) to provide regional stability and compartmentalize groundwater or gas.
- **Ground Support Design Standards:** Establish clear, prescriptive ground support standards for all underground excavations, categorizing them by rock mass quality (e.g., based on RMR or Q-System) and excavation type (e.g., development headings, panel sections, intersections, shafts). Standards should specify:
    - Types and lengths of roof bolts, cable bolts.
    - Bolt patterns (e.g., square, staggered, diagonal).
    - Auxiliary support requirements (e.g., mesh, straps, timber sets, shotcrete, yielding supports).
    - Installation procedures and quality control measures.
- **Ventilation and Access Design:** Ensure that the design of ventilation shafts and primary access ways (e.g., adits, vertical shafts) accounts for specific geotechnical challenges related to depth, stress environment, geological structures, and groundwater inflows, requiring robust support systems.
- **Water Management Infrastructure:** Design and implement a robust underground dewatering system including adequately sized sumps, pumps, and pipelines with sufficient capacity to manage anticipated water inflows during both development and production phases. Include provision for water treatment before discharge.
- **Mine Closure Design:** Integrate mine closure planning into the initial design. This includes planning for long-term stability of underground voids (e.g., ensuring pillar stability or controlled subsidence), designing for the management of post-closure groundwater rebound and potential AMD, and planning for the sealing of shafts and adits.

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9. MONITORING PLAN

A comprehensive monitoring and management plan is essential to ensure the ongoing geotechnical stability and environmental performance of the Colenso Coal Project throughout its lifespan, enabling adaptive management and proactive risk mitigation.

9.1 MONITORING OBJECTIVES

The primary objectives of the geotechnical and hydrogeological monitoring program are to:

- **Validate Design Assumptions:** Verify that actual ground conditions and rock mass behaviour align with design assumptions and predictions.
- **Detect Instability:** Identify early signs of instability in highwalls, underground excavations, and waste dumps, allowing for timely intervention.
- **Assess Impact Magnitude:** Quantify the extent and magnitude of ground movements (e.g., highwall deformation, surface subsidence, pillar convergence).
- **Track Environmental Performance:** Monitor changes in groundwater levels and quality, and assess the effectiveness of mitigation measures (e.g., AMD control, erosion prevention).
- **Ensure Safety:** Provide real-time data to support safe mining operations and inform emergency response plans.
- **Inform Adaptive Management:** Provide data necessary to refine geotechnical designs and operational procedures as conditions evolve.
- **Comply with Regulations:** Meet all statutory monitoring requirements as stipulated by the DMRE and other regulatory bodies.

9.2 MONITORING FREQUENCY AND PARAMETERS

The monitoring frequency will vary depending on the criticality of the area, the observed stability, and the phase of mining.

- **Daily/Shiftly:** Visual inspections of active highwall faces, development headings, and production panels.
- **Weekly/Fortnightly:** Geotechnical mapping updates, instrument readings (e.g., extensometers, convergence meters) in active mining areas.
- **Monthly/Quarterly:** Surveys of surface subsidence monitoring points, hydrogeological monitoring boreholes, and detailed inspections of major infrastructure.
- **Annually/Bi-annually:** Comprehensive geotechnical reviews, re-evaluation of stability models, and reporting.
- **Event-Driven:** Immediate monitoring response following significant seismic events, major rainfall events, or observed signs of instability.

Parameters to be monitored include:

- **Ground Movement:** Displacements (e.g., highwall crest movement, surface subsidence, roof sag, pillar closure).
- **Stress:** Where applicable, in-situ stress changes or stress concentrations.
- **Groundwater:** Levels, flow rates, and chemical quality.
- **Weather:** Rainfall, temperature (influencing weathering, erosion).
- **Operational Data:** Excavation dimensions, support installed.

9.3 MONITORING METHODS

A combination of monitoring methods will be employed:

- **Highwall Monitoring (Continuous/Periodic):**
    - **Visual Inspections:** Routine observations by trained personnel to identify new cracks, spalling, bulges, or water seepage.
    - **Prism/GPS Monitoring:** Installation of prisms or GPS receivers on the highwall face and crest, surveyed regularly by total station or high-precision GPS to detect and quantify movements.

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- **Slope Stability Radar:** Deployment of continuous radar monitoring systems for critical highwall sections, such as the highwall radar from GroundProbe, which are widely used in open pit mining to continuously monitor highwall movements, detect subtle deformations, and provide real-time alerts for potential failures.
- **Extensometers/Inclinometers:** Installation in key boreholes within the highwall to measure sub-surface deformation and identify the depth of potential failure planes.

- **Underground Monitoring (Ongoing):**
  - **Routine Visual Examinations:** Daily inspections of roof and sidewalls in all active and accessed underground workings by supervisors and rock engineers, documenting observed ground conditions and any signs of instability.
  - **Convergence Monitoring:** Installation of convergence meters (e.g., tape extensometers, wire extensometers) to measure changes in excavation dimensions (roof-to-floor, sidewall-to-sidewall) in roadways and intersections.
  - **Roof Sag and Bolt Load Monitoring:** Use of specialized instruments (e.g., sag stations, bolt load cells) to monitor sag in the roof strata and measure the load on installed roof bolts, providing insight into support effectiveness.
  - **Pillar Deformation Monitoring:** Regular measurements of pillar compression where significant pillar loading is anticipated, using prisms or strain gauges.
- **Surface Subsidence Monitoring:**
  - **Survey Monuments:** Establishment of a dense grid of stable survey monuments (benchmarks) across the project area and beyond the expected subsidence limits to precisely measure surface elevation changes over time using precision surveying techniques.
  - **Lidar/Satellite Interferometry (InSAR):** Utilizing advanced remote sensing techniques for broader area subsidence monitoring, providing high-resolution data on ground deformation over time. This is particularly useful for large-scale, long-term monitoring.
- **Hydrogeological Monitoring:**
  - **Groundwater Level Monitoring:** Manual or automated (transducer) measurements of groundwater levels in dedicated monitoring boreholes (piezometers) within all relevant aquifers.
  - **Groundwater Quality Monitoring:** Regular sampling and laboratory analysis of groundwater from monitoring boreholes and production boreholes (if any) to assess potential contamination indicators (e.g., pH, EC, TDS, heavy metals, sulphates, alkalinity).
  - **Surface Water Quality and Flow Monitoring:** Regular sampling and analysis of surface water bodies (streams, rivers, dams) upstream and downstream of the project area to detect any impacts from mine water discharge or runoff. Flow meters will monitor water inflows and outflows.

9.4 MANAGEMENT SYSTEMS AND ACTION PLANS

- **Geotechnical Management Plan (GMP):** Develop a comprehensive GMP outlining roles, responsibilities, procedures for data collection, analysis, reporting, and decision-making related to geotechnical stability for both highwall and underground operations. This plan will be integrated into the overall Mine Health and Safety Management System.
- **Trigger Action Response Plans (TARPs):** Establish clear TARPs for all critical geotechnical and hydrogeological parameters (e.g., highwall movement rates, roof sag rates, groundwater level changes, water quality exceedances). These plans define specific trigger levels (Action, Alarm, Crisis) and corresponding prescribed actions to be taken, ensuring timely and effective intervention.
- **Regular Review and Adaptation:** The monitoring and management plans should be regularly reviewed and adapted based on monitoring data, observed ground conditions, changes in mining practices, and technological advancements. Feedback loops is essential for continuous improvement.
- **Competent Personnel:** Ensure that all geotechnical and hydrogeological monitoring and management activities are carried out by suitably qualified and experienced personnel (e.g., Rock Engineers, Geohydrologists, Surveyors). Training and competency assessment are crucial.

10. SEISMICITY ASSESSMENT

Understanding the seismicity of the project area is vital for the design and long-term stability of both surface infrastructure and underground mining operations, particularly in regions prone to natural or induced seismic activity. This assessment draws upon available published information from authoritative sources, integrating it into the project's overall geotechnical risk profile.

10.1 REGIONAL SEISMICITY PROFILE

South Africa, including the KwaZulu-Natal province, is generally considered a region of moderate to low natural seismicity when compared to active plate boundaries. However, the country does experience intraplate seismic activity. The Council for Geoscience (CGS) is the primary custodian of seismic data in South Africa, operating a national seismograph network that continuously monitors seismic events. Their extensive historical records and real-time data provide crucial insights into earthquake activity across the country.

Reports from the CGS indicate that while significant natural seismic events (e.g., magnitudes above 4.0) are relatively rare in the uThukela District and Okhahlamba Local Municipality, minor tremors and low-magnitude events (e.g., below 3.0) can occur. These natural events are typically associated with the reactivation of ancient fault lines or zones of crustal weakness under contemporary regional stress fields. While the Colenso area is not located in a historically highly active natural seismic zone, the regional background seismicity must still be considered for long-term design and infrastructure resilience. According to the South African seismic hazard map in Figure 14, the Colenso coal project is located in a region with an expected peak acceleration (g) of 0.06-0.07 which indicates a very low seismic activity compared to, for example, Ottosdal in the North West province (Van Der Merwe, 2021). This data confirms that the Colenso coal project area is not susceptible to natural and active seismic activities.

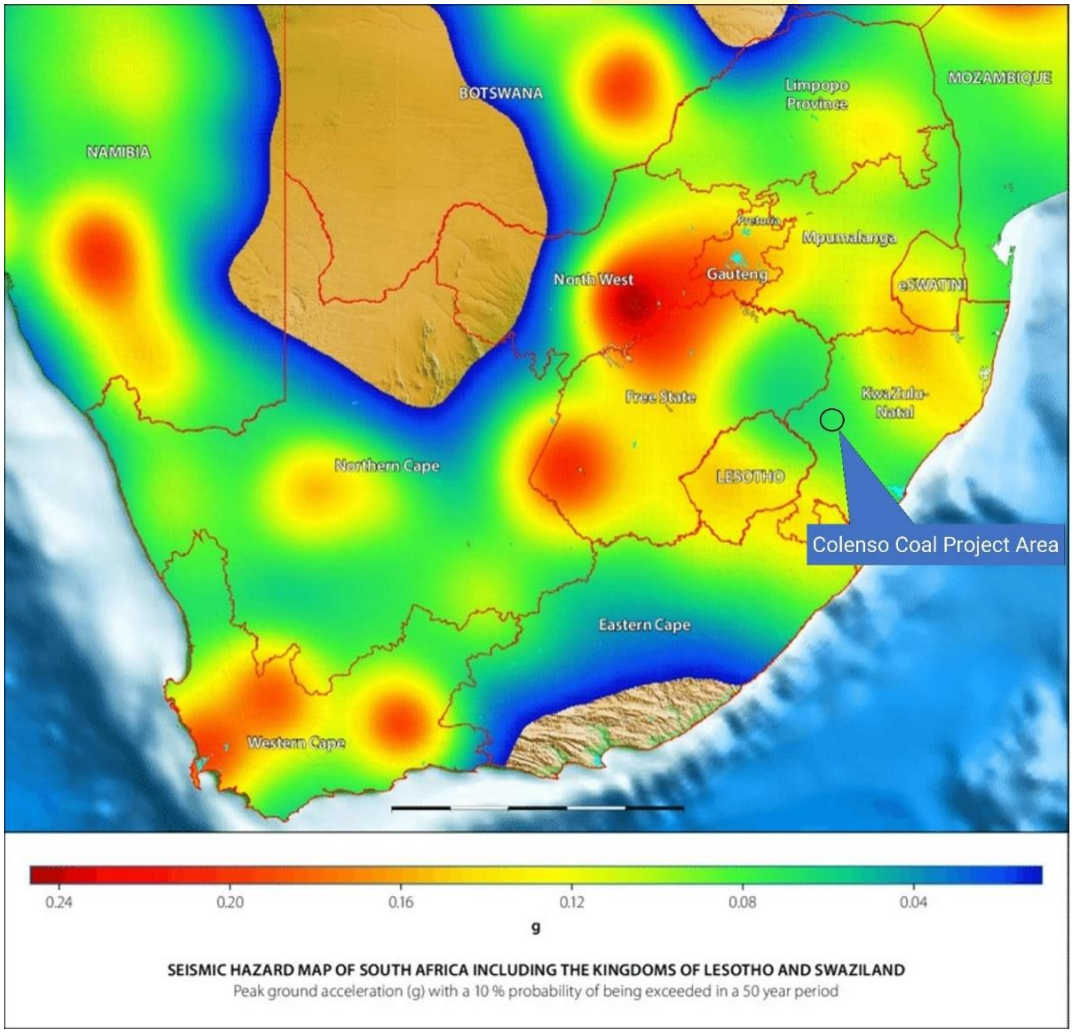

Figure 14: South African Seismic Hazard Map for the Colenso Coal Project (Van Der Merwe, 2021).

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10.2 Induced Seismicity Considerations

A more pertinent concern for mining operations, particularly underground mining in coalfields, is the potential for induced seismicity. This refers to seismic events triggered or influenced by human activities, rather than purely natural tectonic forces. In the context of coal mining, induced seismicity can arise from several mechanisms:

- **Mining-Induced Stress Changes:** The excavation of coal creates voids and significantly alters the virgin stress regime in the surrounding rock mass. This redistribution of stress can lead to the brittle failure of highly stressed intact rock or the movement along pre-existing geological discontinuities (faults, joints), resulting in the sudden release of stored elastic energy as seismic events. This phenomenon is particularly relevant in deep underground mines but can also occur in shallower operations if geological conditions (e.g., strong, brittle strata) are conducive.
- **Pillar Failure and Panel Collapse:** In bord-and-pillar mining, the progressive failure of individual coal pillars or the large-scale collapse of entire mined-out panels can release substantial amounts of energy, generating measurable seismic events that can propagate to the surface.
- **Water Injection/Withdrawal:** Changes in pore pressure due to extensive dewatering (reducing pore pressure and increasing effective stress) or, less commonly in coal mining, fluid injection (increasing pore pressure and reducing effective stress) can also trigger seismic events by altering the frictional resistance along existing fractures.
- **Blasting (where applicable):** While generally localized and of short duration, large production blasts can generate seismic waves and may also trigger small-scale seismic events in critically stressed ground.

The magnitude of induced seismic events in coal mining typically ranges from very low (micro-seismic) to moderate (e.g., up to Magnitude 3.0-4.0), depending on the energy released. While usually smaller than significant natural earthquakes, these events can still cause ground vibration and impact local mine infrastructure and surface structures.

10.3 Regional Seismic Research Data

Academic and research institutions in South Africa play a vital role in advancing the understanding of seismicity. The University of the Witwatersrand (Wits University) Seismicity Study Centre is a leading institution conducting extensive research on both natural and mining-induced seismicity in South Africa. Their ongoing studies often involve:

- **Detailed Micro-Seismic Monitoring and Analysis:** Research into specific mining areas utilizing dense micro-seismic networks to accurately locate and characterize mining-induced seismic events, providing insights into the mechanisms of rock mass failure.
- **Seismic Source Mechanisms:** Studies on the fundamental processes of energy release in response to mining, helping to distinguish between different types of ground response.
- **Attenuation Relationships:** Development of empirical relationships that describe how seismic wave energy diminishes with distance in various geological settings. This is critical for predicting ground motion at surface infrastructure from both natural and induced events.
- **Risk Assessment Methodologies:** Development and refinement of methodologies for assessing and managing seismic risk in complex mining environments, including probabilistic seismic hazard assessments.
- **Publicly Available Data and Publications:** While highly localized project-specific studies may not be publicly available, Wits and other research bodies regularly publish findings on regional seismicity, including data relevant to coalfields, which contribute to the general understanding of seismic hazards in South Africa.

For the Colenso Coal Project, incorporating this knowledge base helps in contextualizing potential seismic risks, designing appropriate monitoring programs, and ensuring that mine infrastructure and practices are robust enough to withstand anticipated seismic loads, thus safeguarding operations and surrounding communities.

10.4 SEISMICITY MONITORING AND MANAGEMENT

For the Colenso Coal Project, particularly with the transition to underground mining, a dedicated seismicity monitoring and management strategy will be implemented as part of the overall monitoring plan. This involves:

- **Establishing a Local Micro-Seismic Monitoring Network:** Deployment of an array of sensitive seismometers (geophones or accelerometers) within and around the underground mining area. This network aims to:
    - **Detect and Locate Events:** Accurately detect and locate small-scale seismic events (micro-seismic events) that may be induced by mining operations.
    - **Characterize Events:** Determine seismic parameters such as magnitude, energy release, source mechanism, and focal depth.
    - **Real-time Monitoring:** Provide real-time data to identify trends in seismic activity and correlate events with mining operations (e.g., blasting, face advance, pillar loading).
- **Data Analysis and Interpretation:** Analysis of micro-seismic data to:
    - Identify zones of high stress or instability.
    - Assess the effectiveness of destressing measures.
    - Provide early warning of potentially larger events.
    - Refine geomechanical models of the rock mass.
- **Integration with Mine Planning:** Seismic data will be regularly reviewed by the rock engineering team and integrated into mine planning processes to:
    - Adjust mining sequences or rates in areas of high seismic activity.
    - Implement additional ground support where required.
    - Optimize pillar design to reduce stress concentrations.
    - Application of a comprehensive seismic hazard and risk assessment such as shown in Table 5
- **Trigger Action Response Plan (TARP) for Seismicity:** Develop specific TARPs for seismic events, defining:
    - Threshold magnitudes or event rates that trigger specific responses.
    - Actions to be taken, such as temporary cessation of mining in affected areas, inspection of workings, reinforcement of ground support, or evacuation.
    - Communication protocols for internal and external stakeholders.

Table 5: Colenso Coal Project Seismic Risk Assessment Matrix

SEISMIC HAZARD DESCRIPTION	LIKELIHOOD	RISK LEVEL	CONSEQUENCE
1. Minor regional tremors causing ground vibration	Low	Low	Low
2. Induced seismicity affecting underground workings	Medium	Medium	Medium
3. Rockfalls triggered in highwalls by vibrations	Low	Low-Medium	Medium
4. Significant regional earthquake >0.1g PGA	Very Low	Medium	High

This proactive approach to seismicity monitoring and management ensures that mining operations are conducted safely, minimizing risks associated with natural and induced seismic activity.

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11. CONCLUSION AND DECLARATIONS

This Geotechnical and Seismic Assessment Report for the Colenso Coal Project has provided a detailed analysis of the geological and geotechnical conditions relevant to both the initial highwall mining phase and the subsequent transition to conventional underground mining. Comprehensive geotechnical site characterization has been discussed, alongside potential impacts, robust mitigation measures, and precise design and monitoring recommendations.

The report has specifically addressed the unique geotechnical requirements for highwall mining using Addcar Highwall Mining System, emphasizing highwall stability, essential ground support measures (such as wire-mesh draping), and the critical assessment of competent highwall slopes. For the underground phase, key aspects such as rock mass characterization using industry-standard systems (RMR, Q-System, GSI), the intricacies of ground support design, and the vital role of groundwater management have been detailed. A thorough explanation of the Hoek-Brown mi parameter has been provided, highlighting its fundamental role in rock mass strength determination and its influence on the overall rock mass behaviour. Furthermore, the comprehensive assessment of seismicity around the project area, drawing upon data and research from authoritative sources like the Council for Geoscience and Wits University, underscores the project's commitment to robust risk management in a dynamic geological environment.

Based on the comprehensive geotechnical and seismic activity assessment, analyses, and the detailed recommendations outlined in this report, and contingent upon the strict and rigorous adherence to all minimum prescribed geotechnical and seismic requirements, robust design specifications, and vigilant monitoring protocols, there is no inherent geotechnical and seismic factor why the Colenso Coal Project should not be implemented as this will further support the strategic social economic importance of the Colenso Coal Project, as evidenced by its significant investment and job creation potential for KwaZulu-Natal as highlighted in the IOL Mercury article: https://iol.co.za/mercury/2025-06-09-colenso-power-project-almost-r10-billion-investment-to-create-thousands-of-jobs-in-kzn/ . The project is poised to contribute meaningfully to regional socio-economic development, provided its inherent geotechnical risks are proactively and meticulously managed.

The successful, safe, and sustainable implementation of this project hinges critically on the diligent application of the principles and measures presented herein, ensuring ongoing safety, environmental protection, and operational integrity throughout its entire lifespan, from initial highwall mining to the long-term underground operations and ultimate closure.

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End of Report

Heritage Impact Assessment

APELSER ARCHAEOLOGICAL CONSULTING

Comprehensive and Professional Solutions for all Heritage Related Matters

CK 2006/014630/23 **VAT NO.: 4360226270**

A Phase 1 Archaeological & Cultural Heritage Impact Assessment for a Mining Right Application on various farms and farm portions situated in the Magisterial District of uThukela/Estcourt, KwaZulu Natal Province

DMRE Ref No: KZN30/5/1/2/2/10137 MR

For:

Dunrose Investment 174 (Pty) Ltd

REPORT: **APAC025/74**

by:

A.J. Pelser
Accredited member of ASAPA
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May 2025

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Although all efforts are made to identify all sites of cultural heritage (archaeological and historical) significance during an assessment of study areas, the nature of archaeological and historical sites are as such that it is always possible that hidden or subterranean sites, features or objects could be overlooked during the study. APELSER Archaeological Consulting can't be held liable for such oversights or for costs incurred as a result thereof.

Clients & Developers should not continue with any development actions until SAHRA or one of its subsidiary bodies has provided final comments on this report. Submitting the report to SAHRA is the responsibility of the Client unless required of the Heritage Specialist as part of their appointment and Terms of Reference

SPECIALIST DECLARATION

I, Anton Pelser, in my capacity as a specialist consultant, hereby declare that I -

- **Act as an independent environmental specialist and will perform the study in an objective manner free of influence and prejudice, even if the resultant findings are unfavourable to the applicant;**
- **Have the relevant expertise in conducting the report relevant to this application;**
- **Will comply with all regulations, acts and other applicable guidelines that are applicable to the activity;**
- **Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended; as well as the National Heritage Resources Act (Act 25 of 1999)**
- **Do not have any conflicting interests in the preparation of this report;**
- **Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision taken with respect to the application by the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended; The National Heritage Resources Act (Act 25 of 1999)**
- **Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement. This report has been prepared according to the requirements of Appendix 6 of the Environmental Impact Assessments Regulations, 2014 as amended in April 2017 (GNR 326).**

Heritage Specialist

SUMMARY

APelser Archaeological Consulting (APAC) was appointed by Dunrose Investment 174 (Pty) Ltd, in conjunction with Vahlengwe Mining Advisory & Consulting, to undertake a Phase 1 Archaeological and Cultural Heritage Impact Assessment for the for a Mining Right Application (MRA) for coal on various portions of various farms, situated in the Magisterial District of uThukela/Estcourt in the KwaZulu Natal Province. The mining area is situated 12km west of Colenso. This May 2025 report is an amendment of an earlier 2015 Phase 1 HIA Report by the same Heritage Specialist for the Colenso Power Project (**See Report APAC015/26**), which included a proposed Power Plant & Mining Area. The study and proposed MRA area is the same as the one fairly extensively assessed in 2015.

The literature review indicates that there are some cultural heritage (archaeological & historical) sites and features in the larger geographical area within which the study area falls. Earlier Basic Assessments in the MRA area indicated the presence of a range of historical (mainly Anglo-Boer War 1899-1902) sites in and around the area, while the desktop research for the assessment indicated that there are a range of archaeological and historical resources known in the larger geographical area as well. The physical assessment conducted during May 2015 identified and recorded a large number of sites, features and objects of varying significance within the study area, dating to the Stone Age, Iron Age and Historical time periods. This document discusses the results of this assessment, and provides recommendations regarding required mitigation measures at the end. A number of the sites are of High Significance, and should future mining-related activities resulting from a successful Mining Rights Application impact negatively on these sites required mitigation measures will have to be implemented prior to these activities commencing.

From an Archaeological & Cultural Heritage point of view, it can be concluded that the Mining Rights Application should be allowed to continue provided that the recommendations made in the report are implemented.

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1. INTRODUCTION

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The focus of the Heritage Impact Assessment was within the location and boundaries of the study & development area as indicated by the client.

2. TERMS OF REFERENCE

The Terms of Reference for the study was to:

1. Identify all objects, sites, occurrences and structures of an archaeological or historical nature (cultural heritage sites) located on the portion of land that will be impacted upon by the proposed development;

2. Assess the significance of the cultural resources in terms of their archaeological, historical, scientific, social, religious, aesthetic and tourism value;

3. Describe the possible impact of the proposed development on these cultural remains, according to a standard set of conventions;

4. Propose suitable mitigation measures to minimize possible negative impacts on the cultural resources;

5. Review applicable legislative requirements;

For this Report a Physical Field-based Assessment was not undertaken, as the 2015 assessment covered the Mining Rights Application area extensively. The results of that assessment and

report were utilised for the drafting and submission of the current May 2025 Phase 1 Archaeological and Cultural Heritage Impact Assessment Report.

3. LEGISLATIVE REQUIREMENTS

Aspects concerning the conservation of cultural resources are dealt with mainly in two Acts. The National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) are the two main legislations concerning the conservation of cultural resources, used as guidelines when conducting the Heritage Impact Assessment. Should the development be in KwaZulu Natal, Section 41(1) of the KwaZulu-Natal Amafa and Research Institute Act, 2018 (Act No. 5 of 2018), must be adhered to.

3.1. The National Heritage Resources Act (Act 25 of 1999)

According to the National Heritage Resources Act (Act 25 of 1999) (NHRA), the following is protected as cultural heritage resources:

a. Archaeological artifacts, structures, and sites older than 100 years
b. Ethnographic art objects (e.g., prehistoric rock art) and ethnography
c. Objects of decorative and visual arts
d. Military objects, structures, and sites older than 75 years
e. Historical objects, structures, and sites older than 60 years
f. Proclaimed heritage sites
g. Grave yards and graves older than 60 years
h. Meteorites and fossils
i. Objects, structures and sites of scientific or technological value.

The National Estate includes the following:

a. Places, buildings, structures, and equipment of cultural significance
b. Places to which oral traditions are attached or which are associated with living heritage
c. Historical settlements and townscapes
d. Landscapes and features of cultural significance
e. Geological sites of scientific or cultural importance
f. Sites of Archaeological and paleontological importance
g. Graves and burial grounds
h. Sites of significance relating to the history of slavery
i. Movable objects (e.g., archaeological, paleontological, meteorites, geological specimens, military, ethnographic, books etc.)

The Heritage Impact Assessment (HIA) process is done to determine whether there is any heritage resources located within the area to be developed as well as to determine the possible impacts of the proposed development. An Archaeological Impact Assessment (AIA) only looks at archaeological resources, such as material remains of human life or activities which are at least 100 years of age, and which are of archaeological interest. A HIA must be done under the following circumstances:

a. The construction of a linear development (road, wall, power line, canal etc.) exceeding 300m in length
b. The construction of a bridge or similar structure exceeding 50m in length
c. Any development or other activity that will change the character of a site and exceed 5 000m^2 or involve three or more existing erven or subdivisions thereof
d. Re-zoning of a site exceeding 10 000m^2
e. Any other category provided for in the regulations of SAHRA or a provincial heritage authority

Structures

Section 34(1) of the Act state that no person may demolish any structure or part thereof that is older than 60 years without a permit issued by the relevant provincial heritage resources authority.

A structure refers to any building, works, device or other facility made by people, and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith.

To alter means any action taken that affects the structure, appearance or physical properties of a place or object, whether by way of structural or other works, by painting, plastering or the decoration or any other means.

Archaeology, palaeontology, and Meteorites

Section 35(4) of the Act deals with archaeology, palaeontology, and meteorites. The Act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial)

a. destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or paleontological site or any meteorite;
b. destroy, damage, excavate, remove from its original position, collect or own any archaeological or paleontological material or object or any meteorite;
c. trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or paleontological material or object, or any meteorite; or
d. bring onto or use at an archaeological or paleontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and paleontological material or objects, or use such equipment for the recovery of meteorites.
e. alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned may only be disturbed or moved by an archaeologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Human remains

Graves and burial grounds are divided into the following:

a. ancestral graves
b. royal graves and graves of traditional leaders
c. graves of victims of conflict
d. graves designated by the Minister
e. historical graves and cemeteries
f. human remains

In terms of Section 36(3) of the National Heritage Resources Act, no person may, without a permit issued by the relevant heritage resources authority:

i. destroy, damage, alter, exhume or remove from its original position of otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

ii. destroy, damage, alter, exhume, or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

iii. bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation, or any equipment which assists in the detection or recovery of metals.

Human remains that are less than 60 years old are subject to provisions of the Human Tissue Act (Act 65 of 1983) and to local regulations. Exhumation of graves must conform to the standards set out in the **Ordinance on Excavations** (**Ordinance no. 12 of 1980**) (replacing the old Transvaal Ordinance no. 7 of 1925).

Permission must also be gained from the descendants (where known), the National Department of Health, Provincial Department of Health, Premier of the Province, and local police. Furthermore, permission must also be gained from the various landowners (i.e., where the graves are located and where they are to be relocated to) before exhumation can take place.

Human remains can only be handled by a registered undertaker, or an institution declared under the **Human Tissues Act** (**Act 65 of 1983 as amended**).

3.2. The National Environmental Management Act (No. 107 of 1998)

This Act states that a survey and evaluation of cultural resources must be done in areas where development projects, that will change the face of the environment, will be undertaken. The impact of the development on these resources should be determined and proposals for the mitigation thereof are made.
Environmental management should also take the cultural and social needs of people into account. Any disturbance of landscapes and sites that constitute the nation's cultural heritage should be avoided as far as possible and where this is not possible the disturbance should be minimized and remedied.

The specific requirements that specialist studies and reports must adhere to are contained in Appendix 6 of the EIA Regulations.

4. METHODOLOGY

4.1. Review of literature

A review of available literature was undertaken in order to place the development area in an archaeological and historical context. The sources utilized in this regard are indicated in the bibliography. These include Bergh (1999), Huffman (2007) & Lombard et.al (2012).

4.2. Field survey

The field assessment component of any study is normally conducted according to generally accepted HIA practices and aimed at locating all possible objects, sites, and features of heritage significance in the area of the proposed development. The location/position of all sites, features and objects is determined by means of a Global Positioning System (GPS) where possible, while detail photographs are also taken where needed.

The current assessment did not include a field-based study, with the results of the extensive assessment of May 2015 used for and referred to in this document.

4.3. Documentation

All sites, objects, features, and structures identified are documented according to a general Global Positioning System (GPS). The information is added to the description in order to facilitate the identification of each locality.

4.4. Limitations

Very dense vegetation hampered access to and physical movement in the study area in certain sections, while it limited archaeological visibility on the ground in these areas.

5. DESCRIPTION OF THE AREA & PROJECT

Dunrose Investment 174 (Pty) Ltd hereafter referred as 'the applicant' is applying for a mining right for coal on Remaining extent of Portion 1 and Remaining Extent of the Farm Schurfde Poort 1147 GS; The Farm Shaws No.11317 GS; Portion 1 and the Remaining extent of the Farm Ganna Hoek 1317 GS; Portion 1 and the Remaining extent of the Farm Klip Berg 2158 GT; The Farm Brakfontein 1316 GS; Portions 1, 2 and the Remaining Extent of the Farm Ramak 13696 GT, situated in the Magisterial District of uThukela/Estcourt KwaZulu Natal Province, covering an extent of 6 333, 2240 ha. The mining area is situated 12km west of Colenso. Ladysmith and Estcourt are the largest towns nearby in the uThukela District in KwaZulu Natal Province. The project is accessible via the N11 toll route located south of the project area or via the regional R74 and 103 routes in South Africa. Dunrose holds the prospecting right in respect of the above-mentioned portions and farms (KZN30/5/1/1/2/10662 PR) renewed under (KZN30//5/1/1/2/11124 PR).

Dunrose has appointed Vahlengwe Mining Advisory and Consulting as the independent Environmental Assessment Practitioner (EAP) to conduct the environmental authorisation process. The proposed mining area can be optimally mined using the hybrid surface and underground mining method. This mining method will be utilising the sequential lateral rollover mining technique. A reputable mining contractor will conduct the mining. The coal to be mined will be transported by tipper trucks from the mining areas to the R.O.M. coal stockpile area. After the processing (crushing and screening) of the R.O.M coal, the product coal will be hauled by haulage trucks via the road networks to destined clients.

All necessary surface infrastructures required to undertake the proposed mining operation will be constructed at the proposed Colenso Project. Proposed surface infrastructure and facilities associated with the proposed Dunrose Mining Right application area will include the following i.e.: access roads and haul roads; opencast workings, R.O.M and product stockpiling areas; crushing and screening plant; topsoil, softs and hards overburden stockpiling facilities (mineral residue deposits and stockpiles); clean and dirty water management facilities, waste management facilities, fuel storage facilities; workshops, weighbridge, offices and contractors' yard.

In view of the above, Dunrose Investments (Pty) Ltd has lodged a mining right application (Ref No: KZN/30/5/1/2/2/10137 MR) with the Department of Mineral Resources and Energy in accordance with the relevant guidelines and regulations under the Mineral and Petroleum Resources Development Act ,2002 as amended. The Mining Right Application was accepted with a DMRE reference number KZN/30/5/1/2/2/10137 MR on the 25th of November 2024.

"The study area is underlain by sedimentary rocks of the Permian aged Vryheid and Volksrust Formations of the Ecca Group and Permian aged Adelaide Subgroup of the Beaufort Group, Karoo Supergroup as well as a prominent Jurassic aged dolerite sill and Quaternary aged surface deposits of the Masotcheni Formation and alluvium.

The topography is characterized by a mix of relatively flat plains, hilly terrain and incised valleys (Figure 3). The terrain consists of slopes of around 2-12%, and lies at an altitude of between 900 and 1 200 m above sea level. The Tugela River forms the northern boundary of the study & application area. In the south-western parts of the area the terrain is relatively flat to gently undulating with topographical variations in the form of localized hills (such as Colenso Koppie). The northeastern part is characterized by higher lying terrain that slopes down sharply toward the Tugela River. Overall, the topography slopes down gradually in a southern direction, with the residential community of Ezakheni in the northern parts being located on higher ground. As such, lower lying terrain with incised valleys in the vicinity of the Bloukrans River dominates in the southern part or the area. The study area falls within the Savanna and Grassland Biomes. Within a biome, smaller groupings referred to as bioregions can be found which provide more specific but general details as to the biophysical characteristics of smaller areas.

The project areas can be found within the Sub-Escarpment Savanna and Sub-Escarpment Grassland bioregions. Going into even finer detail, vegetation units are classified which contain a set of general but more local biophysical characteristics as opposed to the entire bioregion. The proposed development is found within the Thukela Thornveld, the Thukela Valley Bushveld and the KwaZulu-Natal Highland Thornveld vegetation units. The land use in the area is characterized

by natural or undeveloped areas which have been partially transformed and degraded as a result of urban transformation, rural settlement, and agricultural activities in the form of livestock grazing, subsistence and commercial farming. The broad study area is bounded to the west by the R103 secondary road and the R74 bisects the south-western part of the broad study area. The dominant built-up areas within the study area include the town of Colenso, located directly east of the R103, and the residential community and industrial area of Ezakheni in the northern reaches of the area. The land use classification of the area is currently "Cultivated temporary – commercial dryland", "unimproved grassland" and Urban/built-up land: residential. There are a number of game ranches in the area. The R103 road is a rural principal arterial (provincial) main road and is extensively used to transport goods from the larger industrialized towns such as Estcourt and Ladysmith. Smaller single carriage paved roads exists in the preliminary study area but is not expected to carry much traffic. A Transnet/Spoornet railway route borders the Colenso community and traverses the preliminary study area. There are many transmission lines crossing over the western part of the area feeding into the Bloukrans Substation.

*Visibility during the assessment was fairly good in sections, although some very dense vegetation cover made visibility difficult in other areas. Although some residential (homesteads and related structures) development, as well as agricultural activities, have impacted on the area in the historical and recent past, the land parcels are fairly undeveloped. Both archaeological and historical remains were identified in the area, although some will not be directly and negatively impacted by the proposed development actions" (**From Pelser 2015: 10-11**).*

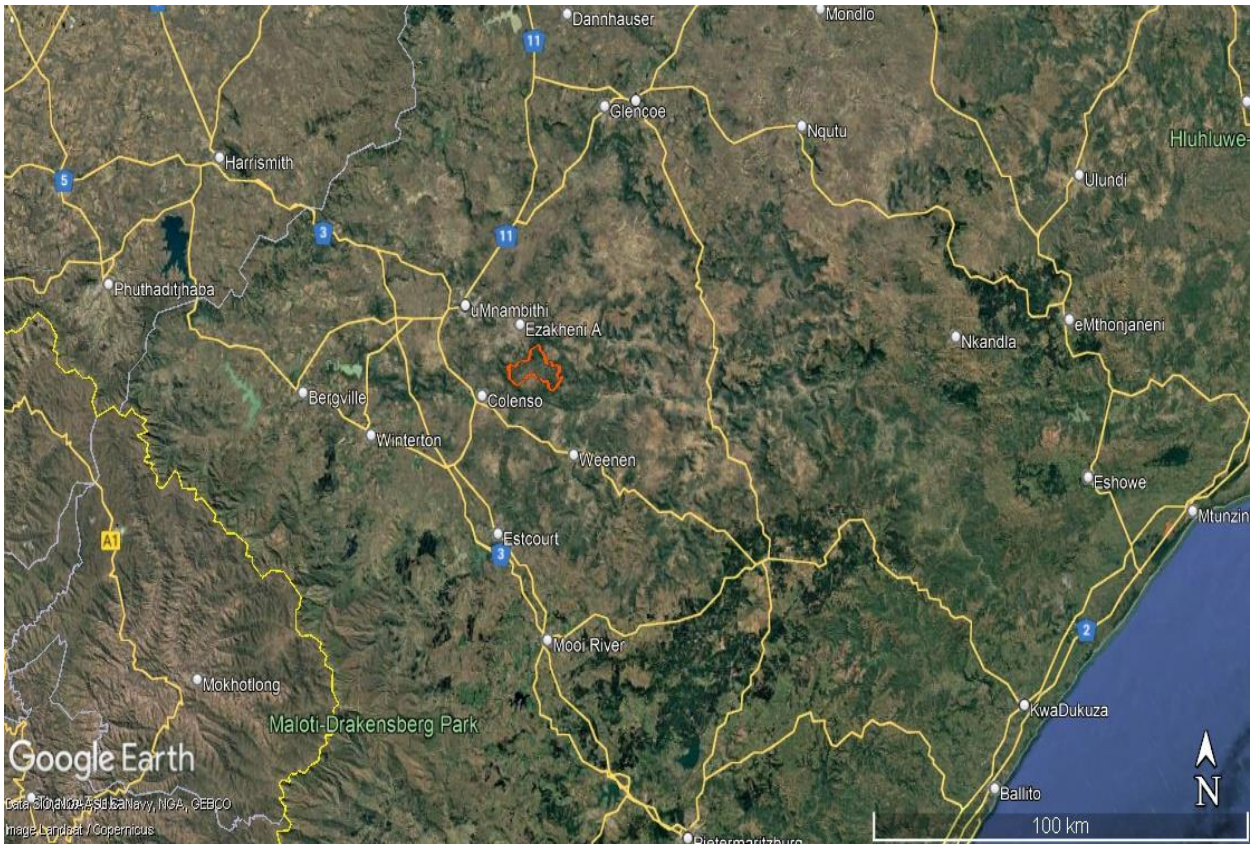


Figure 1: The general location of the study & application area in the orange polygon (Google Earth 2025).

Figure 2: Closer view of the study and application area footprint (Google Earth 2025).

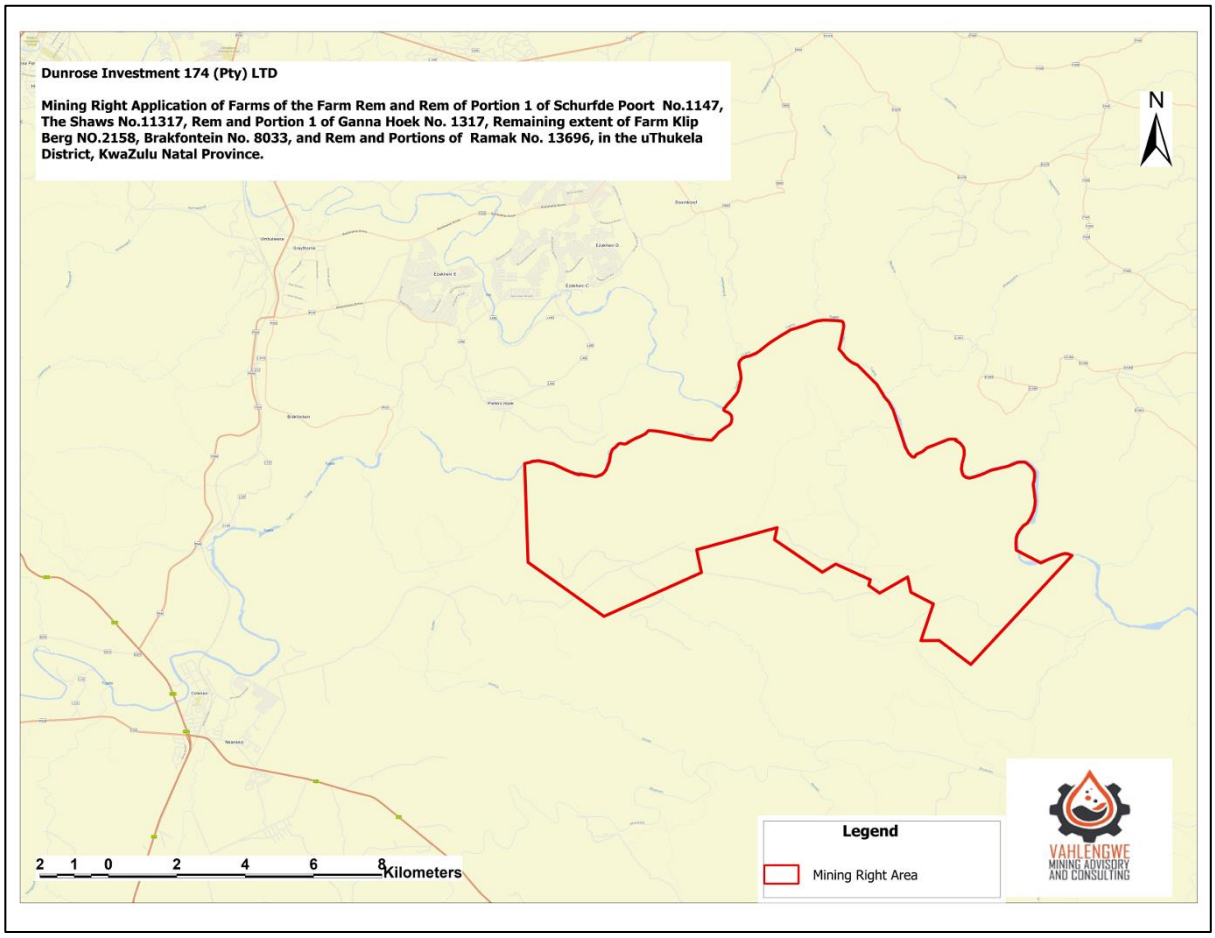
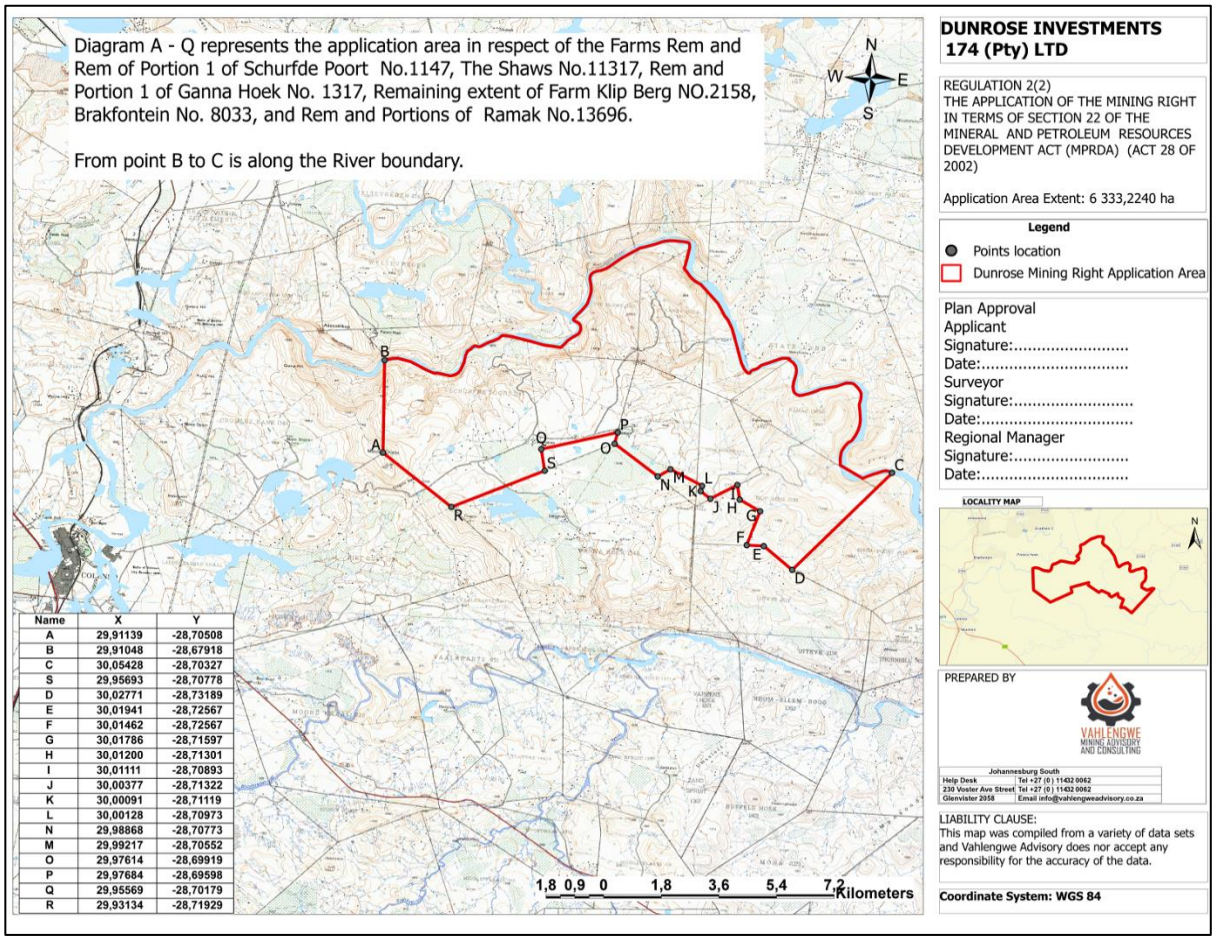


Figure 3: Project Locality Map (courtesy Vahlengwe Mining Advisory & Consulting).



Name	X	Y
A	29,91139	-28,70508
B	29,91048	-28,67918
C	30,05428	-28,70327
S	29,95693	-28,70778
D	30,02771	-28,73189
E	30,01941	-28,72567
F	30,01462	-28,72567
G	30,01786	-28,71597
H	30,01200	-28,71301
I	30,01111	-28,70893
J	30,00377	-28,71322
K	30,00091	-28,71119
L	30,00128	-28,70973
N	29,98868	-28,70773
M	29,99217	-28,70552
O	29,97614	-28,69919
P	29,97684	-28,69598
Q	29,95569	-28,70179
R	29,93134	-28,71929

Figure 4: Topographical Locality (courtesy Vahlengwe Mining Advisory & Consulting).

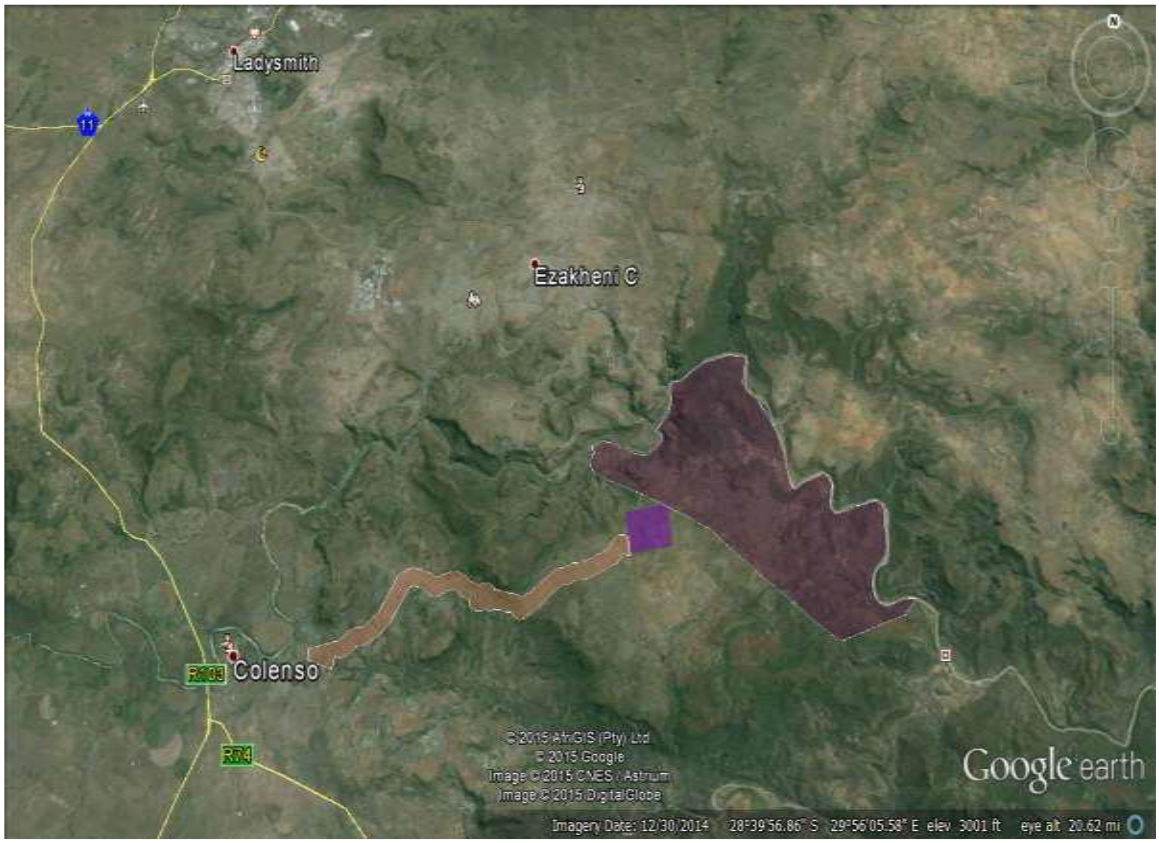


Figure 5: The area assessed in 2015 (Google Earth 2015 – from Pelser 2015: 14).

Figure 6: Some sections of the study area is fairly open and flat (from Pelser 2015).

Figure 7: Another view of part of the study & application area (Pelser 2015).

Figure 8: Some parts are more mountainous, with rocky ridges and outcrops present, while the vegetation is also denser (Pelser 2015).

Figure 9: View of a prominent hill in the area (Pelser 2015).

Figure 10: General view of part of the area that shows the mountainous nature of the landscape in some sections, forming valleys and steep ridges and slopes. The vegetation of the area is also evident here (Pelser 2015).

Figure 11: Another section of the study area that is very open and flat (Pelser 2015).

6. DISCUSSION

The first part of this discussion is a summary of the results of a Heritage Scoping Report for the Colenso Project, conducted in 2014 by PGS Heritage, that provided a background to the known archaeological and historical heritage of the study area prior to the 2015 Field Assessment.

The Heritage Scoping Report indicated that for the Earlier Stone Age (2.5 million to 250 000 years ago); Middle Stone Age (250 000 to 40 000 years ago); the Later Stone Age (40 000 years ago to the historic past), as well as for the Early Iron Age (AD200 - 900) and Middle Iron Age (AD900 – 1300), no information on recorded sites in the immediate study area was located during the desktop study by PGS (2014: p.17).

No mention is made of the Later Iron Age (AD1300 onwards). Both Stone Age and Iron Age sites, features and material were identified and recorded during the 2015 field assessment, as were discussed in the 2015 report. The 2014 PGS Report deals mainly with the so-called Colonial/Historical Period, with a fairly large number of sites known in the immediate study and larger geographical area.

The Great Trek that started in 1838 resulted in the conflict between the Zulu, under Dingane, and the Voortrekkers under their leader Piet Retief. The resultant massacre of Retief and his party by Dingane on 6 February 1838 lead to numerous battles and skirmishes over the next year. These include, Ithaleni, Blood River, Saailager, Rensburg Koppie, Veglaer and Bloukrans. After the massacre of Retief, Dingane dispatched his impi to kill all remaining Boer parties. On the night of

16 February 1838, the laager at Bloukrans was surrounded and attacked on the morning of 17 February 1838, with approximately 282 Voortrekkers and 250 servants killed during the Battle of Bloukrans.

Colenso was established as a wagon stop in 1855 at Commando Drift, a crossing on the Tugela River. This crossing was on the main road between the then Colony of Natal and the Republic of the Orange Free State and the South African Republic. The Bulwer Bridge was constructed in 1879 along with a toll house to cross the Tugela and in 1886 the railway bridge was opened to the east of the Bulwer bridge. Colenso and the crossings of the Thukela River played a major part in the first part of the South African War (1899-1902). Between December 1899 and February 1900, a number of battles and skirmishes took place on the Natal front around Colenso (PGS 2014: 17 – 19).

The known historical heritage resources (PGS 2014: 43) include the site of the Battle of Bloukrans (1838) 6.5km to the south of the study area, to sites in and straddling the study area with their associated monuments, graves and cemeteries:

1. Battle of Colenso (16 December 1899);
2. Battle of Thukela Heights that comprised of the battles and skirmishes at:
3. Hlangwane Hill – 19 February 1900
4. Monte Cristo – 18 February 1900
5. Cingolo Hill – 17 February 1900
6. Horshoe Hill – 21 February 1900
7. Wynne's Hill – 21 February 1900
8. Hart's Hill – 23 February 1900
9. Pieters Hill – 27 February 1900

Another recent historical site is the Colenso Power Station that was constructed by the South African Railway Administration for the electrification of the Natal main line between the Glencoe Junction and Pietermaritzburg. The implementation of the line and power station took place in June 1926. The construction commenced in November 1922 and by 1925 construction was completed. During the same time the barrage in the Tugela River was completed by 1926. In January 1927 the power station was taken over by Eskom, with a number of buildings and other additions done over the years up to its decommissioning in 1985 (PGS 2014: 21-22). The 2014 field work by PGS (p.30) also identified a Muslim cemetery situated inside one of the coal staging and water treatment alternatives, this alternative also contained the remains of the historical Colenso Power Station of which some of the buildings were still in use.

The Heritage Scoping Report indicated that the Colenso Power project area did have numerous heritage resources of national value situated inside the study area. These resources provide a significant interaction with the natural environment to produce a cultural landscape of high cultural heritage significance (PGS 2014: 42). The 2014 report also recommended that a detailed HIA of the area had to be undertaken once the final footprint for the development actions had been determined. This was subsequently adhered to and the 2015 Assessment was the result of these recommendations. The results of the fieldwork conducted during 2015 are discussed below.

The 2015 search in the Chief Surveyor General's database (www.csg.dla.gov.za) also provided evidence on the dates for the granting and surveying of the farms and farm portions in the study area (the mid to late 1800's and early to mid-20th centuries), but provided no evidence on the existence of any historically significant sites or features on these land parcels.

The Stone Age is the period in human history when lithic (stone) material was mainly used to produce tools. In South Africa the Stone Age can be divided into three periods as listed below. It is important to note that dates are relative and only provide a broad framework for interpretation. A basic sequence for the South African Stone Age (Lombard et.al 2012) is as follows:

- Earlier Stone Age (ESA) up to 2 million – more than 200 000 years ago
- Middle Stone Age (MSA) less than 300 000 – 20 000 years ago
- Later Stone Age (LSA) 40 000 years ago – 2000 years ago

It should also be noted that these dates are not a neat fit because of variability and overlapping ages between sites (Lombard et.al 2012: 125).

A number of Stone Age sites have been found in the larger geographical area, including EAS, MSA and LSA ones. The Earlier Stone Age sites were mostly found in dongas and out of context. The Middle Stone Age sites were found in open-air environments and were therefore also found out of context. The Later Stone Age sites were more dispersed with some of them being in open-air environments and some at caves and shelters. The nature reserves in the area also contain 11 instances of rare Zululand rock art (Prins 2021: 3). A number of open-air Stone Age sites are also known to occur in the Emakhosini Opathe Reserve to the north-east of the Colenso application area (Pelser 2013).

A number of Stone Age sites and material were identified in the study & application area during the May 2025 field assessment. These are mostly represented by scatters of stone stools of varying density found in open-air contexts in the area.

The Iron Age is the name given to the period of human history when metal was mainly used to produce metal artifacts. In South Africa it can be divided in two separate phases (Bergh1999: 96-98), namely:

- Early Iron Age (EIA) 200 – 1000 A.D
- Late Iron Age (LIA) 1000 – 1850 A.D.

Huffman (2007: xiii) however indicates that a Middle Iron Age should be included. His dates, which now seem to be widely accepted in archaeological circles, are:

- Early Iron Age (EIA) 250 – 900 A.D.
- Middle Iron Age (MIA) 900 – 1300 A.D.
- Late Iron Age (LIA) 1300 – 1840 A.D.

Around 1 700 years ago Early Iron Age people started to settle in the area. They were early agro-pastoralists and they produced a characteristic pottery style known as Matola (Prins 2021:3). Around 1 500 years ago new Iron Age migrants settled in the Tugela River Basin area (Huffman 2007).

A number of Iron Age stone-walled settlement, as well metal working and smelting sites and features were identified and recorded in the area during the May 2015 fieldwork.

"Archaeological evidence from KwaZulu-Natal shows that, similar to elsewhere in southern Africa, the region was occupied exclusively by Stone Age hunter-gatherers until the early centuries of the first millennium AD. The Later Stone Age (LSA) is associated with KhoeSan people. In KwaZulu-Natal the earliest evidence of agriculturist communities appears in the early centuries of the first millennium AD. Calibrated dates of c. 400 AD identify Mzonjani as the earliest known farming settlement in KwaZulu-Natal. Although evidence from the first phase of the Iron Age in KwaZulu-Natal is still relatively sparse, it is already apparent from southern Africa in general that the significant aspects of what has been called the Early Iron Age 'package' - including crop cultivation, livestock herding, iron production, settled village life and distinctive styles of ceramics - were already established. In KwaZulu-Natal the first, or Mzonjani, phase appears to be restricted to coastal areas, extending from the Mozambique border to the area south of Durban. People chose living sites in positions favorable for a range of economic activities, including slash-and-burn agriculture, small stock herding and iron smelting, while shellfish collecting seems to have contributed a significant part of the diet.

In the second half of the first millennium AD, Iron Age settlement extended further south along the coast, as well as inland up the valleys of major rivers such as the Thukela system, reaching altitudes of around 1000 m but remaining in wooded, savanna environments. The first interactions between hunter-gatherers and agriculturists in KwaZulu-Natal took place in coastal or near-coastal settings, but became more widespread during the latter part of the first millennium AD. On Iron Age settlements many shell disc beads, a large proportion of ostrich-egg shell, which must have been introduced from grassland regions, well inland of the area settled by Iron Age people at that time, have been found. Later Stone Age-style bone arrowpoints and link-shafts, and on some sites, LSA stone artefacts, have also been found, possible evidence for hunter-gatherer presence at some of these sites. Likewise, in LSA deposits in rock shelters, pottery fragments of typical Early Iron Age style occur, sometimes far inland of Early Iron Age settlement.

Early in the second millennium AD, Late Iron Age settlement had extended into some grasslands of the KwaZulu-Natal interior. Some of these sites are in naturally defensible positions and have surrounding walls, while the associated material culture no longer includes LSA elements. This may reflect a period of greater competition or conflict. Later in the second millennium, Iron Age settlements become quite dense in these lower-altitude grassland areas, yet even with the arrival of white colonists in the nineteenth century, KhoeSan groups still living a hunter-gatherer lifestyle survived in the interior at higher altitude, where the environment was unfavorable for Iron Age farming.

During the second millennium AD we begin to see archaeological evidence for the material culture associated with ethnic/linguistic groups known today as Nguni-speaking people in

KwaZulu-Natal. These patterns can be traced back to the beginning of the second millennium AD. The evidence becomes compelling in the second half of the millennium when ceramics, settlement pattern and historical sources confirm continuity into recent times"

The above section comes from Ribot et.al., 2010:90-91.

"Most of the Stone Age sites in the near vicinity of the study area occur in shelters and in open air contexts as exposed by donga and sheet erosion. Some Middle Stone Age flakes, probably dating back to ca. 40 000 – 200 000 years ago, occur in disturbed context in dongas and road cuttings. The majority of Later Stone Age sites as well as rock art sites occur further west in the foothills of the Drakensberg.

The available evidence, as captured in the KwaZulu-Natal Museum heritage site inventories, indicates that the general geographical area in which the study area falls contains a wide range of archaeological sites covering different time-periods and cultural traditions. These include Early Stone Age site, Middle Stone Age, Later Stone Age sites, Later Iron Age sites and numerous historical sites dating back to the colonial period. Some of the farms in the area contain graves and structures relating to early Voortrekker settlement. However, the majority of older buildings on farmsteads were erected by British colonists after 1850 who occupied farms previously inhabited by Voortrekker pioneers.

The San were the owners of the land for almost 30 000 years but the local demography started to change soon after 2000 years ago when the first Bantu-speaking farmers crossed the Limpopo River and arrived in South Africa. European settlement of the area started soon after 1838 when the first Voortrekker settlers marked out large farms in the area. However, most of these farms were abandoned in the 1840's when Natal became a British colony only to be reoccupied again by British immigrants".

The above section taken from Prins 2013: 6-9.

The historical period usually starts with the moving into an area of people that were able to read and write and record histories such as early European travellers and/or missionaries.

Some recent historical sites, such as farmsteads/homesteads and grave sites, were identified in the study & application area during the previous May 2015 assessment.

Results of the May 2015 Field Assessment

A fairly large number of sites and individual finds were recorded during the May 2015 assessment (for the original Power Plant Alternative and Mining Area assessment). This included Stone Age scatters (open-air sites), Iron Age and more recent sites. As a result of the large area, dense vegetation in some sections at the time and the hilly terrain characteristic of some portions, sites might have been missed during the physical assessment. However, aerial views of the study area did reveal more sites that were indicated on the original Site Distribution Map.

Site 1 - Farmstead

This site contains a farmstead and related outbuildings, of which some were built of sandstone. Although the original farm house could be older than 60 years of age, it has been altered to a large degree over the years and is therefore of very little heritage significance. The age of the associated buildings is not known but is likely less than 60 years of age and not of any heritage significance. Some rondavels are present, and the farmstead and related structures probably formed part of the Tugela Game Ranch located here.

GPS Location: S28.69939 E29.95283
Cultural Significance: Low
Heritage Significance: N/A
Field Ratings: General protection C (IV C): Phase 1 is seen as sufficient recording and it may be demolished (low significance.
Mitigation: From a Heritage point of view none required. Could be utilized as part of development

Figure 12: Site 1 (from Pelser 2015).

Figure 13: Outbuilding related to Site 1 (from Pelser 2015).

Figure 14: Another view of homestead (from Pelser 2015).

Figure 15: Back view of homestead at Site 1 (from Pelser 2015).

Sites 2 & 3 – Possible Graves

Both these features are stone packed, without any headstones though, and are the size and shape typical of graves. One of the stone cairns (Site No.3) has a ploughshare on it, an object sometimes associated with graves. Social consultation should be undertaken to determine if these are indeed graves and if there are any further low, stone-packed or unmarked graves in the study area.

GPS Location: S28.70072 E29.95582 (Site 2) & S28.70007 E29.95563 (Site 3)
Cultural Significance: High – Graves always carry a High Cultural Significance
Heritage Significance: Grade III: Other heritage resources of local importance and therefore worthy of conservation
Field Ratings: Local Grade IIIB: S hould be included in the heritage register and may be mitigated (high/ medium significance)
Mitigation: Fence-off and manage/protect. If required then the graves could be exhumed and relocated after the necessary permissions have been provided and detailed social consultation has been undertaken.

Site 12 – Possible Grave

This is another stone cairn, similar to those ones at Sites 2 & 3 that could be a possible grave. It is however difficult to determine this without a doubt, and although possibly a grave it is also likely that this feature could be associated with the stone walled sites found in the study area and could represent a stone platform such as a granary stand.

GPS Location: S28.68155 E29.97141
Cultural Significance: High – Graves always carry a High Cultural Significance
Heritage Significance: Grade III: Other heritage resources of local importance and therefore

worthy of conservation

Field Ratings: Local Grade IIIB: Should be included in the heritage register and may be mitigated (high/ medium significance)

Mitigation: Fence-off and manage/protect. If required then the possible grave could be exhumed and relocated after the necessary permissions have been provided and detailed social consultation has been undertaken.

Figure 16: Possible Grave at Site 2 (from Pelser 2015).

Figure 16: Possible Grave at Site 3 (from Pelser 2015).

Figure 17: Possible grave Site 12 (from Pelser 2015).

Graves & Grave Sites always carry a High Significance Rating from a Cultural Heritage perspective. As such, due care should be taken to not impact on them in any way through development actions. If possible, these sites should be avoided and protected in situ.

There are two Options (mitigation measures) available in mitigating the possible impacts on a Grave Site by any development. These are as follows:

Option 1

The 1st and preferred option, is always be to leave the site and graves on it intact. This will entail demarcating the site with a proper boundary fence and providing an entrance gate for potential visitors (descendants/family members of the deceased). The site would also have to be clearly sign-posted as a Grave Site and will have to be cleaned and each grave marked, numbered and included in a Graves Register. A Graves Management Plan will have to be drafted and implemented as part of the Development. A 30m buffer zone (from the outside boundary fence of the site) will also have to be adhered to, with no development allowed in this exclusion zone.

Option 2

The 2nd Option available is the exhumation and relocation of the graves from the site. This entails the following:

a. Detailed social consultation/public participation in the form of Newspaper Advertisements and the erection of site notices. This is in order to try and trace any possible descendants of the deceased buried here and to obtain their consent for the exhumation and relocation work. These advertisements and notices need to be run for 60 days before permit applications to various government and local authorities can be undertaken. This includes SAHRA, Department of Health, COGTA, local Municipality/ies and the SAP.

b. Only once the permits have been issued, and all permissions (e.g., family consent) have been obtained, can the physical work be undertaken. A registered undertaker also needs to be contracted to be part of the process.

It needs to be noted that the costs involved with Option 2 can be high and that the time-delays can be quite long. However, with Option 1 the commitment to preserving the sites and the graves on them is ongoing and could lead to conflict with family members in terms of site visits/access and possible security issues.

Sites 4; 5 & 8 – Single piece of pottery (4), broken lower grinding stone (5) & broken upper grinder (8)

All three finds are out of context (not associated with an identified settlement in the area), but probably related to Later Iron Age habitation and activities. The pottery piece is very small and undecorated and cannot be used to determine the relative age of the material finds and the

cultural identity of the occupants of the area. Because these objects are out of context their archaeological significance is low.

GPS Location: S28.69622 E29.95812 (Site 4); S28.69732 E29.95633 (Site 5) & S28.69723 E29.96360 (8)
Cultural Significance: Low
Heritage Significance: N/A
Field Ratings: General protection C (IV C): Phase 1 is seen as sufficient recording and it may be demolished (low significance.
Mitigation: None required.

Figure 17: Undecorated piece of pottery at Site 4 (from Pelser 2015).

Figure 18: Broken lower grinding stone at Site 5 (from Pelser 2015).

Figure 19: Broken upper grinder at Site 8 (from Pelser 2015).

Site 6 – Stone platform

This could be a granary stand or a small enclosure of which the wall had collapsed. An upper grinding stone was found in close proximity of this feature. No other stone walling was recorded in the immediate area.

GPS Location: S28.69529 E29.95559
Cultural Significance: Low
Heritage Significance: N/A
Field Ratings: General protection C (IV C): Phase 1 is seen as sufficient recording and it may be demolished (low significance)
Mitigation: None required

Figure 20: Site 6 – Stone packed feature (from Pelser 2015).

Site 7 – Stone Age tool scatter

This site consists of a low-density scatter of individual MSA/LSA stone tools and flakes located in and around an erosion donga in the area. These dongas are caused by overgrazing and by livestock tracks cutting through the area.

GPS Location: S28.69648 E29.96249 & S28.69659 E29.96265
Cultural Significance: Low
Heritage Significance: N/A
Field Ratings: General protection C (IV C): Phase 1 is seen as sufficient recording and it may be demolished (low significance)
Mitigation: None required

Figure 21: Two stone tools found on Site 7 (from Pelser 2015).

The largest number of sites were identified and recorded in the original proposed Mining Area. Most of these dated to the Iron Age. The topography of this area was also more elevated than the Alternative Power Plant area that had to be assessed in 2015, and the vegetation was also much denser. Because of the hilly terrain certain sections were also inaccessible and it is possible that more sites could be located in the area. However, it was not envisaged that these sections will be impacted by future mining actions either because of the topography.

Site 9 – Stone walling/Iron Age settlement

This site contains stone walling (livestock enclosures; stone cairns; possible terracing) and other features such as a large kraal and midden deposit. Pottery, upper and lower grinding stones are also found on the site. This site, as is many of the others found in the area, is fairly extensive and most likely date to the Later Iron Age period (AD1300-AD1800's).

GPS Location: S28.68259 E29.97607; S28.68271 E29.97582; S28.68271 E29.97509 & S28.68358 E29.97450
Cultural Significance: Medium to High
Heritage Significance: Grade III: Other heritage resources of local importance and therefore worthy of conservation
Field Ratings: Local Grade IIIB: Should be included in the heritage register and may be mitigated (high/ medium significance)
Mitigation: Fence-off and manage/protect. Detailed Mapping. Include in Cultural Resources Management Plan.

Figure 22: Stone feature on Site 9 (from Pelser 2015).

Figure 23: Midden/kraal area on Site 9 (from Pelser 2015).

Sites 10 & 22 – Stone Age tool scatters (Open-air sites)

Both these sites are located in erosion dongas in the area, and contain MSA/LSA tools such as scrapers, flake-tools, cores and smaller chips and flakes. Iron Age pottery is found in some cases as well here, but these are related to stone walling and other Iron Age features recorded as separate sites in the vicinity. The stone tools density is fairly low. It is however possible that more tools might be found during development actions, and it is recommended that surface sampling be undertaken prior to development taking place.

GPS Location: S28.68356 E29.97451 (10); S28.66957 E29.99821; S28.66954 E29.99787; S28.66954 E29.99754 (22)
Cultural Significance: Medium to High
Heritage Significance: Grade III: Other heritage resources of local importance and therefore worthy of conservation
Field Ratings: General protection A (IV A): Site should be mitigated before destruction (high/medium significance)
Mitigation: Sampling of material for representative collection before destruction

Figure 24: Some of the MSA/LSA flakes from Site 10 (from Pelser 2015).

Figure 25: Some of the stone tools from Site 22 (from Pelser 2015).

Sites 11, 13- 19 – Stone walling/Iron Age settlement

These sites contain stone walling (livestock enclosures/kraals; stone platforms/granary stands & other features), large kraals/midden deposits and possible agricultural terracing. Some of these settlement sites are relatively extensive and are all probably related to a larger Iron Age Settlement Complex in the area. Site 16 is two features that could possibly be ***isivivanes*** – cairns of stones placed in areas by visitors to important settlements. Pottery, bone fragments (faunal remains) as well as upper and lower grinding stones are found commonly all over

these sites. It is possible that many more similar sites are located in the study area, but due to dense vegetation might have been missed during the assessment.

It is recommended that should the proposed mining operations impact negatively on these sites that detailed archaeological mitigation be undertaken on them. This will include mapping and drawing, excavations and sampling of material. If possible, the sites should be avoided and protected by proper fencing-in, sign-posting and Management through an implemented Heritage Management Plan.

GPS Location: S28.68386 E29.97451 (11); S28.68237 E29.97649 (13); S28.67953 E29.97637 (14); S28.67824 E29.97673 (15); S28.67764 E29.97679 (16 – isivivanes); S28.67740 E29.97725 (17); S28.67740 E29.97812 (18); S28.67790 E29.97774 (19)
Cultural Significance: Medium to High
Heritage Significance: Grade III: Other heritage resources of local importance and therefore worthy of conservation
Field Ratings: General protection A (IV A): site should be mitigated before destruction (high/medium significance)
Mitigation: If impacted detailed archaeological mitigation. Otherwise fence-in, protect and Manage.

Figure 26: Stone platform on one of the sites (from Pelser 2015).

Figure 27: A large broken lower grinding stone (from Pelser 2015).

Figure 28: Stone walling (from Pelser 2015).

Figure 29: A large kraal & midden area on one of the sites (from Pelser 2015).

Figure 30: One of the isivivanes on Site 16 (from Pelser 2015).

Figure 31: Foundations of a small stone circle (from Pelser 2015).

Figure 32: Pottery on one of the sites (from Pelser 2015).

Figure 33: More stone walling in the area (from Pelser 2015).

Figure 34: Another large kraal area on one of the sites. Many of the settlement sites are located in the saddles between hills in the study area (from Pelser 2015).

Figure 35: Stone walling on top of a ridge (from Pelser 2015).

Site 20 – Terracing and recent homestead remains

This site contains some well-built terrace walling and the foundations of a number of rondavels/huts on the terrace walls. It is similar to an existing and occupied homestead close by. One of the residents indicated that according to him the site dates to the late 1950's. It is recommended that the site be recorded and mapped in detail should it be impacted by the development, and that the history of the site be researched.

GPS Location: S28.67304 E29.98121
Cultural Significance: Low to Medium
Heritage Significance: None
Field Ratings: General protection B (IV B): Site should be recorded before destruction (medium significance)
Mitigation: Mapping & Research

Figure 36: A view of Site 20 terracing (from Pelser 2015).

Figure 37: Another view of the terrace walling (from Pelser 2015).

Figure 38: One of the rondavel/hut foundations on Site 20 (from Pelser 2015).

Figure 39: A view from Site 20 towards an existing homestead in the distance with a similar layout (from Pelser 2015).

Figure 40: Another terrace wall on Site 20 (from Pelser 2015).

Site 21 – Recent farming remains

This site is located next to the main dirt road through the mining area and overlooks the river valley (Tugela) below. It contains some stone walled remains of a possible homestead, a wire-fenced livestock enclosure, cement feature (water reservoir/dam?) and possible stone- packed graves. The age of the site is unknown, but most likely date to the 1950's/1960's or even later.

GPS Location: S28.66132 E29.98528
Cultural Significance: Low (Stone walling and others) High (possible graves).

Heritage Significance: If the stone packed features represent graves then they would carry a High Cultural Significance rating
Field Ratings: Local Grade IIIB: should be included in the heritage register and may be mitigated (high/ medium significance) – for the possible graves
General protection C (IV C): Phase 1 is seen as sufficient recording and it may be demolished (low significance)
Mitigation: For the possible graves detailed social consultation and if impacted then could be exhumed and relocated. Otherwise fence-in and protect/manage

Figure 41: Stone walling on Site 21 (from Pelser 2015).

Figure 42: Foundations of possible homestead on Site 21 (from Pelser 2015).

Figure 43: Cement water reservoir/dam on Site 21 (from Pelser 2015).

Figure 44: Possible grave on Site 21 (from Pelser 2015).

Site 23 – Iron Age Metal Working/Smelting Site

This is arguably the most important site found during the 2015 assessment, and is fairly extensive. It might also not be the only one of this nature in the area, as will be shown later on. It is located fairly close to the Tugela River and in an area heavily eroded. Similar areas (erosion dongas) exist here. The site is situated within the Mining Area, and some impact by road works associated with mining prospecting/drilling in the area is visible already. This aspect will have to be addressed.

The site contains at least 13 metal smelting/forging furnaces, found in 6 different locations spread across the area, while large numbers of anvils, hammer stones (in some areas concentrations of these close to the smelting furnaces) and smaller stone tools associated with metal working were also found. Slag heaps area also located on the site, with anvils and hammer stones also located in close proximity to these heaps. At least one hut floor was also recorded, as well scatters of pottery, metal artifacts, glass beads and animal bones. The site seems to have been an extensive metal working complex, with the possibility of more sites such as these existing in the area. Sites such as these are scarce, especially in terms of its size, while the fairly good preservation of the metal/iron smelting ovens on the site enhances the Archaeological Significance of the site even further.

Only a few of these sites have been archaeologically researched in much detail in the past, making the Colenso Project site even more significant. One such site is the one at Mabhija, excavated by Tim Maggs in the 1980's. The site is located around 20km down the Tugela River from Colenso. He found evidence of mining for iron ore, as well as numerous smelting sites marked by scatters of slag, furnace fragments and other cultural material. He excavated some of these furnaces and commented that this area would not have been suitable for herding of cattle and crop growing and would not have supported a dense population. He advocates that these sites would have functioned as a trading center from where iron goods were bartered for with sheep and sorghum. Mabhija dates to the second millennium AD, and therefore from AD1000 onwards (Hall 1987: 68-69).

The site in the Colenso Power Project study area, and indeed the possible others not recorded as yet, will therefore play a major part in our understanding of not only metal working at the time, but also the way of life of the people who utilized and occupied these sites and the region. The site should therefore be preserved and researched in detail at all costs, and the impact from the proposed Mining development should be minimized and negated through fencing-in, the halting of the destructive erosion now exposing these sites, detailed archaeological research and Long-term Management through an Implemented Cultural Heritage Resources Management Plan. The developer, in conjunction with specialists, Amafa and other related Departments, should take hands in this matter and ensure that this and other possible sites situated in the Mining Area close to the Tugela River are properly researched and preserved for future generations.

GPS Location: S28.66946 E29.99701 (3 furnaces); S28.66937 E29.99624 (Hut floor, beads, metal objects); S28.66938 E29.99645 (spear head); S28.66941 E29.99640 (1 furnace); S28.67008 E29.99628 (slag concentration, anvils, hammer stones); S28.67121 E29.99547 (2 furnaces); S28.67003 E29.99627 (Large slag heap, anvils); S28.66972 E29.99637 (slag, metal objects, anvils, hammer stone); S28.66974 E29.99637 (Anvils); S28.67087 E29.99500 (4 furnaces); S28.67050 E29.99544 (small stone enclosure); S28.67059 E29.99574 (2 furnaces, tuyeres, anvils); S28.67056 E29.99563 (1 furnace, anvils and hammer stones); S28.67185 E29.99542 (Worked stone, tuyere fragments); S28.67182 E29.99520 (earthworks close to site with anvils, tuyeres and hammer stones close to and around damaged area) **Cultural Significance**: High
Heritage Significance: Grade II: Heritage resources with qualities giving it provincial or regional importance although it may form part of the national estate
Field Ratings: Local Grade IIIB: should be included in the heritage register and may be mitigated (high/ medium significance)

Mitigation: Protect/Preserve. Detailed archaeological research (mapping, excavation, reporting & publication). Include in Cultural Heritage Resources Management Plan

Figure 44: A view of the location of Site 23 (from Pelser 2015).

Figure 45: Three of the furnaces next to each other (from Pelser 2015).

Figure 46: Close-up of one of the furnaces (from Pelser 2015).

Figure 47: The hut floor on the site (from Pelser 2015).

Figure 48: Another furnace close-up (from Pelser 2015).

Figure 49: Anvil and hammer stone close to a number of Furnaces (from Pelser 2015).

Figure 50: Large slag heap on the site (from Pelser 2015).

Figure 51: Tuyere (clay blowpipe) fragments & slag pieces (from Pelser 2015).

Figure 52: Another furnace on the site (from Pelser 2015).

Figure 53: Small stone wall section (from Pelser 2015).

Figure 54: Metal wire found close to one of the furnaces (from Pelser 2015).

Figure 55: Glass bead and possible copper slag from the site (from Pelser 2015).

Figure 55: Concentration of anvils close to area with furnaces (from Pelser 2015).

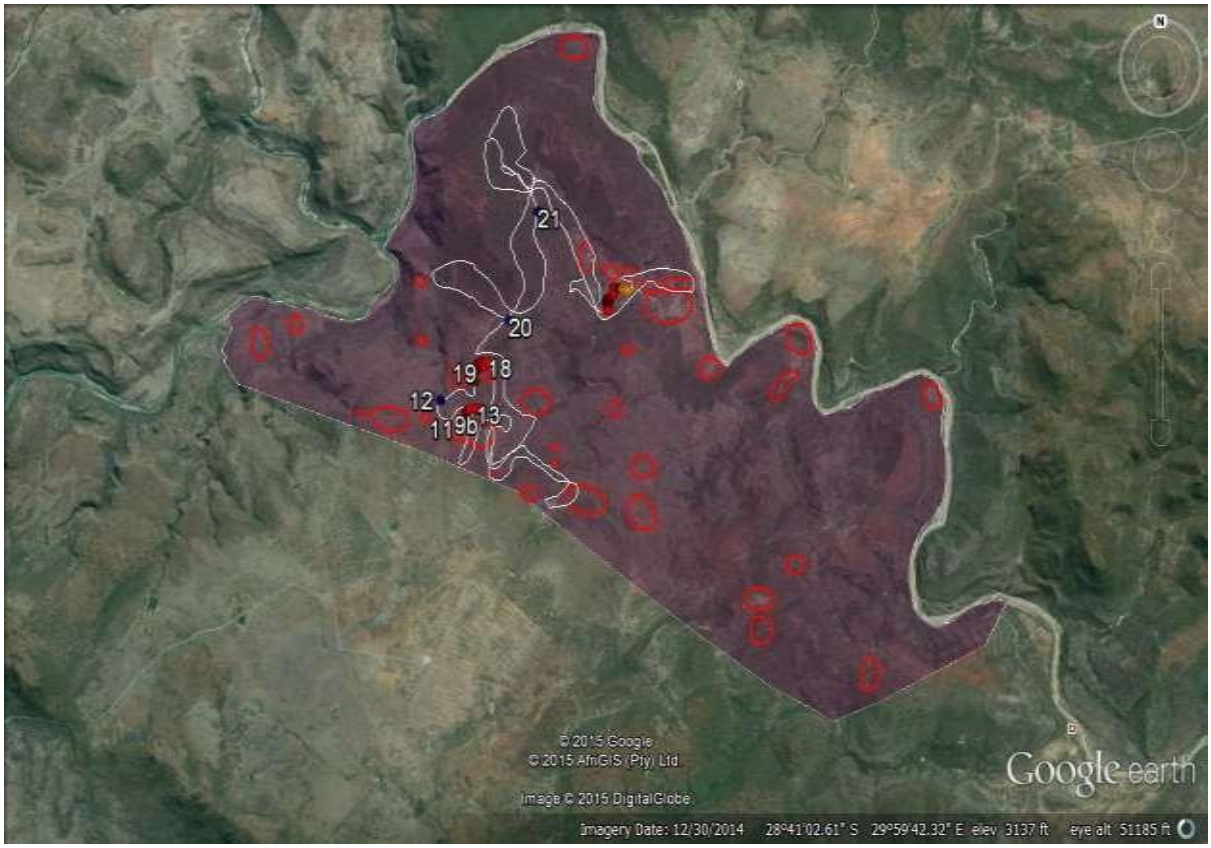


Figure 56: Map from 2015 showing sites recorded as well as other potential sites identified on Google Earth (red polygons). These polygons indicate stone circles (Iron Age stone walled settlements), erosion dongas (with the potential of Stone Age scatters and other sites similar to Site 23 (the metal working site). The white lines show the tracks followed (accessible dirt roads and footpaths). Large sections were inaccessible as a result of the steep, hilly terrain characterizing the area (from Pelser 2015).

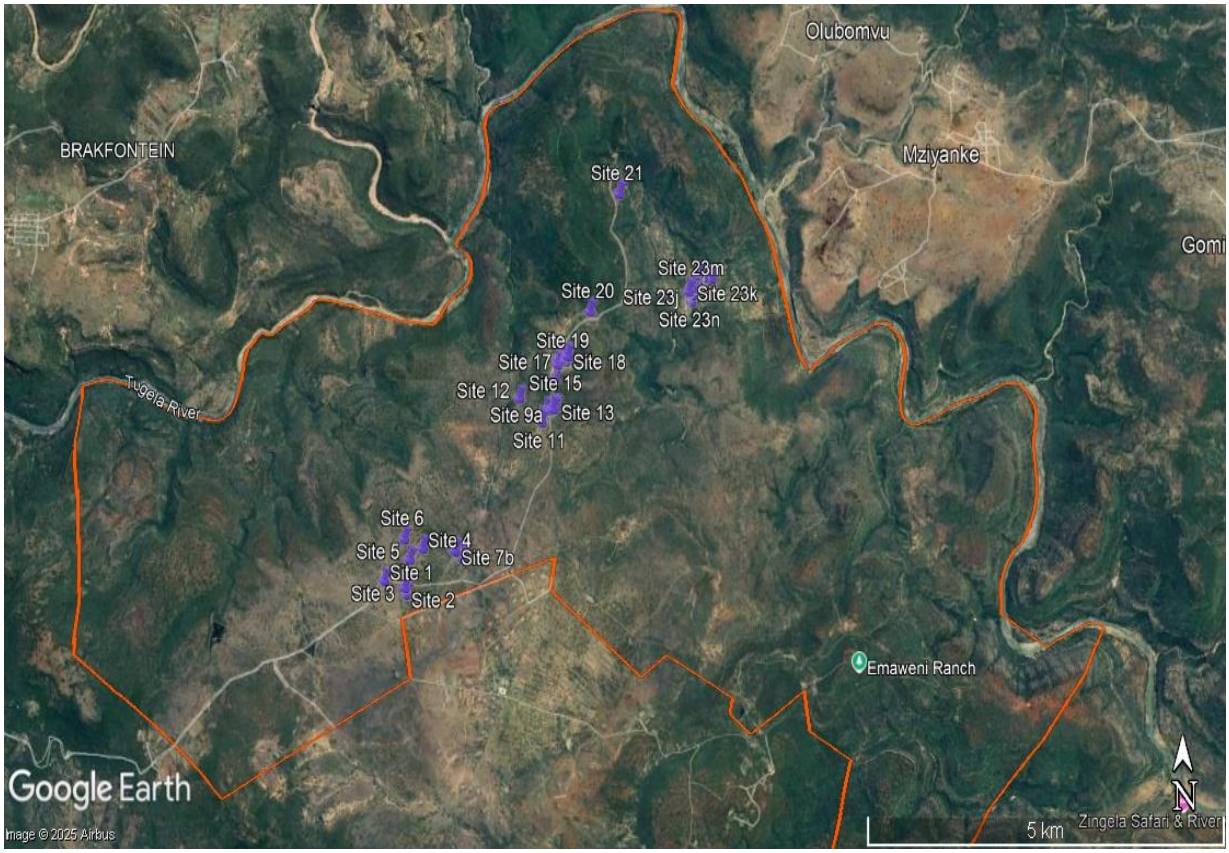


Figure 57: Map showing the location and distribution of the sites recorded during the 2015 assessment in the Mining Rights Application area (Google Earth 2025).

Impact Assessment and Mitigation Measures

The significance of impacts is determined using the following criteria:

Probability: describes the likelihood of the impact actually occurring

- **Improbable:** the possibility of the impact occurring is very low, due to the circumstances, design or experience.
- **Probable:** there is a probability that the impact will occur to the extent that provision must be made therefore.
- **Highly probable:** it is most likely that the impact will occur at some stage of the development.
- **Definite:** the impact will take place regardless of any prevention plans and there can only be relied on mitigation measures or contingency plans to contain the effect.

Duration: the lifetime of the impact

- **Short Term**: the impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- **Medium Term:** the impact will last up to the end of the phases, where after it will be negated.

- **Long Term:** the impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- **Permanent:** the impact is non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale: the physical and spatial size of the impact

- **Local:** the impacted area extends only as far as the activity, e.g. footprint
- **Site:** the impact could affect the whole or measurable portion of the abovementioned property.
- **Regional:** the impact could affect the area including the neighboring residential areas.

Magnitude/Severity: Does the impact destroy the environment, or alter its function

- **Low:** the impact alters the affected environment in such a way that natural processes are not affected.
- **Medium:** the affected environment is altered, but functions and processes continue in a modified way.
- **High:** function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance: This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

- **Negligible:** the impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- **Low:** the impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- **Moderate:** the impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
- **High:** The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The significance is calculated by combining the criteria in the following formula:

Sum (Duration, Scale, Magnitude) x Probability
S = Significance weighting; Sc = Scale; D = Duration; M = Magnitude; P = Probability

With a fairly large number of cultural heritage (archaeological and/or historical) sites, features and material recorded in the application area (and with potentially many more unknown ones) the future mining operations that will result from the granting of a Mining

Rights Application will more than likely have an impact. However, should the recommended mitigation measures be implemented these impacts will be minimized or negated.

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	**4**
	Definite	5
Duration	Short Term	1
	Medium Term	3
	Long Term	**4**
	Permanent	5
Scale	Local	1
	Site	2
	Regional	**3**
Magnitude/Severity	Low	2
	Medium	6
	High	**8**
Significance	**Sum (Duration, Scale, Magnitude)**	**x Probability**
	Negligible	≤20
	Low	>20≤40
	Moderate	>40≤60
	High	**>60**

Results: 4+3+8×4 = 60 i.e. High >60

The impact of the proposed development on cultural heritage sites in the area is deemed as High based on the Impact Assessment criteria used. However, there is always a possibility of sites, features and material being missed as a result of various factors such as vegetation cover hampering visibility on the ground, as well as the often-subterranean nature of cultural heritage resources (including low stone-packed or unmarked graves). These factors need to be taken into consideration and it is therefore recommended that a Chance Finds Protocol (CFP) also be drafted and implemented for any future mining-related activities that will result from the granting of the Mining Rights Application to the Applicants. A generic CFP is provided below:

Chance Find Protocol

A CFP will ensure that should any previously unknown sites, features or significant cultural material deposits are uncovered that these are reported to and investigated by a Heritage Specialist who will then provide recommendations on the way forward in terms of mitigation.

This Protocol applies to permanent employees, its subsidiaries, contractors and subcontractors, and service providers. The aim of this Protocol is to establish monitoring and reporting procedures to ensure compliance with this Protocol and its associated procedures. Construction crews must be properly inducted to ensure they are fully aware of the procedures regarding chance finds relating to heritage resources.

The term 'heritage resource' includes structures, archaeology, paleontology, meteors, and public monuments as per the South African National Heritage Resources Act (Act No. 25 of 1999) (NHRA) Sections 34, 35, and 37.

Procedures specific to burial grounds and graves as defined under NHRA Section 36 will be discussed separately as these require the implementation of separate criteria for Chance Find procedures.

The following procedural guidelines must be considered in the event that previously unknown heritage resources or burial grounds and graves are exposed or found during the life of the project.

Initial Identification and/or Exposure (Chance Find)

If during the construction, operations, or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, find any artefact of cultural significance, this person must cease work at the site of the find. They must report this find to their immediate supervisor, and through their supervisor to the senior on-site manager.

The initial procedure when such sites are found aim to avoid any further damage. If during the construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance the following steps and reporting structure must be observed in both instances:

- The person or group (identifier) who identified or exposed the heritage resource or burial ground must cease all activity in the immediate vicinity of the site;

- The identifier must immediately inform the senior on-site Manager of the discovery;

- The senior on-site Manager must make an initial assessment of the extent of the find, and confirm the extent of the work stoppage in that area and ensure that the site is secured and control access;

- The senior on-site Manager will inform the ECO and Health and Safety (HS) officer of the chance find and its immediate impact on operations. The ECO will then contact the project archaeologist.

- **Chance Find Protocol: Heritage Resources**

In the event that previously unidentified heritage resources are identified and/or exposed during construction or operation of the project, the following steps must be implemented subsequent to those outlined above:

- The project archaeologist must be notified of the discovery;

- The project archaeologist will visit the site for a field-based assessment of the finds and appropriate mitigation measures will then be presented to the developer;

- Should the specialist conclude that the find is a heritage resource protected in terms of the NHRA (1999) Sections 34, 35, 37 and NHRA (1999) Regulations (Regulation 38, 39, 40), the project archaeologist will notify the South African Heritage Resources Agency (SAHRA) and/or the Provincial Heritage Resources Agency Gauteng (PHRA-G) on behalf of the developer; and

- Based on the comments received from SAHRA and/or PHRA-G, the project archaeologist will provide the developer with a Terms of References Report and relevant associated costs if necessary.

Chance Find Protocol: Burials and Graves

In the event that previously unidentified burial grounds and graves are identified and/or exposed during construction or operation of the project, the following steps must be implemented subsequent to those outlined above:

- The project archaeologist must immediately be notified of the discovery in order to take the required further steps:

- The local South African Police Service (SAPS) will be notified on behalf of the developer;

- The project archaeologist will inspect the exposed burial and determine in consultation with the SAPS if any additional graves may exist in the vicinity as well as the temporal context of the remains, i.e.:

    - Forensic

- Authentic burial/grave (informal or older than 60 years, NHRA (1999) Section 36); or
- Archaeological (older than 100 years, NHRA (1999) Section 38);

- Should the specialist conclude that the find is a heritage resource protected in terms of the NHRA (1999) Section 36 and NHRA (1999) Regulations (Regulation 38, 39, 40), the project archaeologist will notify SAHRA and/or LIHRA on behalf of the developer;

- SAHRA's Burial Grounds & Graves Unit (BBG Unit) may require that an identification of interested parties, consultation and /or grave relocation take place;

Consultation must take place in terms of NHRA (1999) Regulations 39, 40, 42; and 5. Grave relocation must take place in terms of NHRA (1999) Regulations 34.

7. CONCLUSIONS AND RECOMMENDATIONS

APelser Archaeological Consulting (APAC) was appointed by Dunrose Investment 174 (Pty) Ltd, in conjunction with Vahlengwe Mining Advisory & Consulting, to undertake a Phase 1 Archaeological and Cultural Heritage Impact Assessment for the for a Mining Right Application (MRA) for coal on various portions of various farms, situated in the Magisterial District of uThukela/Estcourt in the KwaZulu Natal Province. The mining area is situated 12km west of Colenso. This May 2025 report is an amendment of an earlier 2015 Phase 1 HIA Report by the same Heritage Specialist for the Colenso Power Project, which included a proposed Power Plant & Mining Area. The study and proposed MRA area is the same as the one fairly extensively assessed in 2015.

The literature review indicates that there are some cultural heritage (archaeological & historical) sites and features in the larger geographical area within which the study area falls. Earlier Basic Assessments in the MRA area indicated the presence of a range of historical (mainly Anglo-Boer War 1899-1902) sites in and around the area, while the desktop research for the assessment indicated that there are a range of archaeological and historical resources known in the larger geographical area as well. The physical assessment conducted during May 2015 identified and recorded a large number of sites, features and objects of varying significance within the study area, dating to the Stone Age, Iron Age and Historical time periods.

The sites recorded in May 2015 included Stone Age surface scatters, Iron Age stone-walled settlement sites, a significant Iron Age smelting/forging site, recent historical farming sites and Grave Sites. With some sections of the study & application area that could not be assessed due to various factors including dense vegetation cover and inaccessibility due to location (mountainous terrain) it is possible that many more similar sites will be located in the area. It is recommended that once future mining-related infrastructure, the location of open-cast pits etc have been determined that details assessments at these locations be undertaken prior to mining commencing to determine the impacts on potential cultural heritage sites.

The following recommendations are also made in terms of the known and already recorded sites in the application area:

- Grave Sites: Graves & Grave Sites always carry a High Significance Rating from a Cultural Heritage perspective. As such, due care should be taken to not impact on them in any way through development actions. If possible, these sites should be avoided and protected in situ. If this is not possible the graves can be exhumed and relocated once detailed social consultation had been undertaken and the required permissions had been obtained

- Surface sampling of Stone Age scatters to recover a representative collection before destruction. For this a Permit from SAHRA/Amafa will have to be obtained

- Stone Walled Sites (Iron Age Settlements): If impacted detailed archaeological mitigation needs to be conducted. This will entail mapping and Phase 2 archaeological excavations. Otherwise fence-in, protect and Manage.

- Recent historical site (Site 20): Mapping & Research

- Iron Age Metal Working Site (Site 23): Protect/Preserve. Detailed archaeological research (mapping, excavation, reporting & publication). Include in a Cultural Heritage Resources Management Plan

The impact of the proposed development on cultural heritage sites in the area is deemed as High based on the Impact Assessment criteria used. However, there is always a possibility of sites, features and material being missed as a result of various factors such as vegetation cover hampering visibility on the ground, as well as the often-subterranean nature of cultural heritage resources (including low stone-packed or unmarked graves). These factors need to be taken into consideration and it is therefore recommended that a Chance Finds Protocol (CFP) also be drafted and implemented for any future mining-related activities that will result from the granting of the Mining Rights Application to the Applicants. A generic CFP is provided in the report.

Finally, from an Archaeological & Cultural Heritage point of view, it can be concluded that the Mining Rights Application should be allowed to continue provided that the recommendations made in the report are implemented.

The often-subterranean nature of cultural heritage resources (including low stone-packed or unmarked graves) should also be taken into consideration. Should any previously unknown or buried sites, features or material be uncovered during any development actions then an Archaeological expert should be contacted to investigate and provide recommendations on the way forward.

8. REFERENCES

General and Closer views of study & Application area location & footprint and

sites recorded: Google Earth 2015 & 2025.

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APPENDIX A: DEFINITION OF TERMS:

Site: A large place with extensive structures and related cultural objects. It can also be a large assemblage of cultural artifacts, found on a single location.

Structure: A permanent building found in isolation or which forms a site in conjunction with other structures.

Feature: A coincidental find of movable cultural objects.

Object: Artifact (cultural object).

(Also see Knudson 1978: 20).

APPENDIX B: DEFINITION/ STATEMENT OF HERITAGE SIGNIFICANCE

Historic value: Important in the community or pattern of history or has an association with the life or work of a person, group or organization of importance in history.

Aesthetic value: Important in exhibiting particular aesthetic characteristics valued by a community or cultural group.

Scientific value: Potential to yield information that will contribute to an understanding of natural or cultural history or is important in demonstrating a high degree of creative or technical achievement of a particular period

Social value: Have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

Rarity: Does it possess uncommon, rare or endangered aspects of natural or cultural heritage.

Representivity: Important in demonstrating the principal characteristics of a particular class of natural or cultural places or object or a range of landscapes or environments characteristic of its class or of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province region or locality.

APPENDIX C: SIGNIFICANCE AND FIELD RATING:

Cultural significance:

- Low: A cultural object being found out of context, not being part of a site or without any related feature/structure in its surroundings.

- Medium: Any site, structure or feature being regarded less important due to a number of factors, such as date and frequency. Also, any important object found out of context.

- High: Any site, structure or feature regarded as important because of its age or uniqueness. Graves are always categorized as of a high importance. Also, any important object found within a specific context.

Heritage significance:

- Grade I: Heritage resources with exceptional qualities to the extent that they are of national significance

- Grade II: Heritage resources with qualities giving it provincial or regional importance although it may form part of the national estate

- Grade III: Other heritage resources of local importance and therefore worthy of conservation

Field ratings:

i. National Grade I significance: should be managed as part of the national estate

ii. Provincial Grade II significance: should be managed as part of the provincial estate

iii. Local Grade IIIA: should be included in the heritage register and not be mitigated (high significance)

iv. Local Grade IIIB: should be included in the heritage register and may be mitigated (high/ medium significance)

v. General protection A (IV A): site should be mitigated before destruction (high/medium significance)

vi. General protection B (IV B): site should be recorded before destruction (medium significance)

vii. General protection C (IV C): phase 1 is seen as sufficient recording and it may be demolished (low significance)

APPENDIX D: PROTECTION OF HERITAGE RESOURCES:

Formal protection:

National heritage sites and Provincial heritage sites – Grade I and II
Protected areas - An area surrounding a heritage site
Provisional protection – For a maximum period of two years
Heritage registers – Listing Grades II and III
Heritage areas – Areas with more than one heritage site included
Heritage objects – e.g. Archaeological, paleontological, meteorites, geological specimens, visual art, military, numismatic, books, etc.

General protection:

Objects protected by the laws of foreign states
Structures – Older than 60 years
Archaeology, paleontology and meteorites
Burial grounds and graves
Public monuments and memorials

APPENDIX E: HERITAGE IMPACT ASSESSMENT PHASES

1. Pre-assessment or Scoping Phase – Establishment of the scope of the project and terms of reference.

2. Baseline Assessment – Establishment of a broad framework of the potential heritage of an area.

3. Phase I Impact Assessment – Identifying sites, assess their significance, make comments on the impact of the development and makes recommendations for mitigation or conservation.

4. Letter of recommendation for exemption – If there is no likelihood that any sites will be impacted.

5. Phase II Mitigation or Rescue – Planning for the protection of significant sites or sampling through excavation or collection (after receiving a permit) of sites that may be lost.

6. Phase III Management Plan – For rare cases where sites are so important that development cannot be allowed.

Air Quality Impact Assessment

Rayten
ENGINEERING SOLUTIONS
Environmental and Engineering Consultants

DUNROSE INVESTMENTS 174 (PTY) LTD

AIR QUALITY IMPACT ASSESSMENT REPORT – PROPOSED HIGHWALL SURFACE COAL MINING PROJECT

June 2025

Rayten Project Number: SCI-INE-253940

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REVISION AND APPROVAL PAGE

Revision Number	**1.0**		
Rayten Project Number	**SCI-INE-253940**		
Report Title	**DUNROSE INVESTMENTS 174 (PTY) LTD AIR QUALITY IMPACT ASSESSMENT REPORT – PROPOSED HIGHWALL SURFACE COAL MINING PROJECT**		
	Name	**Signature**	**Date**
Author	*Gertrude Mafusire (Pr. Sci. Nat)* *Snr Associate*		20 June 2025
Document Reviewer	*Clive Wray (Pr. Eng)* *Engineering Manager*		20 June 2025
Document Authorisation	Claire Wray *(Pri. Sci. Nat)* *Atmospheric Scientist*		20 June 2025

Draft Report Submission Summary		
Report Revision Number	1.0	Date Submitted: 20 June 2025
Report Revision Number		

DISCLAIMER

Information contained in this report was based on the last information received from the client in May 2025. Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Rayten Engineering Solutions (Pty) Ltd for incomplete or inaccurate data supplied by others. We are aware of the fact that there might have been changes since this report was submitted, however this report and its findings is based on the last information received from the client in May 2025. To the best of our knowledge the assumptions and findings are correct at the time of submission of the specialist report. Should any of the assumptions or findings prove to be incorrect subsequent to submission of the report, we as the specialist cannot be held accountable. Note that although every effort has been made by Rayten Engineering Solutions (Pty) Ltd to obtain the correct information and to carry out an appropriate, independent, impartial and competent study, Rayten Engineering Solutions (Pty) Ltd cannot be held liable for any incident which directly or indirectly relates to the work in this document, and which may have an effect on the client or on any other third party.

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DECLARATION OF PRACTITIONER

PROJECT TITLE

Dunrose Investments 174 (Pty) Ltd - Proposed Highwall Coal Mining Project – Air Quality Impact Assessment Report

Specialist:	Rayten Engineering Solutions (Pty) Ltd		
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Name of Practitioner: Rayten Engineering Solutions (Pty) Ltd
Name of Registration Body: South African Council for Natural Scientific Professions
Professional Registration No: 400171/15

Declaration of accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the National Environmental Management Air Quality Act (NEM:AQA) (No. 39 of 2004):

I Gertrude Mafusire, declare that – General declaration

I am independent of the applicant;
I have the necessary expertise to conduct the assessments required for the report; and
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer.
The information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1)(g) of the NEM:AQA (No.39 of 2004).

Signature of the specialist:

Rayten Engineering Solutions (Pty) Ltd

Name of company (if applicable):

20 June 2025

Date:

EXECUTIVE SUMMARY

Rayten Engineering Solutions was appointed by Brodsky Trading 266 (Pty) Ltd to compile an Air Quality Impact Assessment report (AQIAr) for the proposed Dunrose Investments 174 (Pty) Ltd's highwall coal mining project (hereafter referred to as the "proposed mine", located approximately 9 – 17km north-east of Colenso, within the Umtshezi Local Municipality of the Uthukela District Municipality, Kwa-Zulu Natal Province.

Dunrose Investments 174 (Pty) Ltd are currently in the process of applying for a Mining Right for the proposed mining operations. This AQIAr has been compiled as a supporting document for the Mining Right application. The main objective of the AQIA is to determine the potential impact of emissions from the operational activities associated with the proposed mine on ambient air quality in terms of dustfall, PM_{10} and $PM_{2.5}$.

As part of the AQIA, a baseline air quality assessment was undertaken to determine the following:

- the prevailing meteorological conditions at the site;
- establish baseline concentrations of key air pollutants of concern;
- identify existing sources of emissions; and
- identify key sensitive receptors surrounding the project site.

The main conclusions for the Baseline Assessment can be summarised as follows:

The land use surrounding the project site within a 20 km radius consists mostly of forests, grasslands and formal residences, interspersed with cultivated land, subsistence crops, bare lands, fallow land, wetlands and waterbodies. Informal residences, industrial areas and mining areas – though present, occupy much smaller land footprints. The larger area surrounding the project site is classified as rural in nature. Existing key sources of air pollutant emissions surrounding the project site have been identified as follows:

- Vehicle dust entrainment on unpaved roads (surrounding areas);
- Wind erosion from exposed areas (bare surfaces and fallow land);
- Villages and domestic fuel combustion (surrounding areas); and
- Commercial agricultural activities (cultivated lands) and potential biomass burning (south-east, west and north-west of project site).

MM5 meteorological data for the project area for the period 01 January 2022 – 31 December 2024 was used as input into the model and to determine prevailing meteorological conditions for the project site. Based on the prevailing wind fields for the period January 2022 to December 2024, emissions from activities at the proposed mine will likely be transported towards the west, west-northwest and east-southeast, depending on the season and time of day. Moderate to fast winds observed during all the time periods may result in effective dispersion and dilution of emissions from the proposed mining operations; however, higher winds speeds can also facilitate fugitive dust emissions from open exposed areas such as temporary coal stockpiles, material handling operations and other mining activities.

The existing air quality situation is usually evaluated using available monitoring data from permanent ambient air quality monitoring stations and dustfall networks operated near the project site. There was no air quality monitoring data from the South African Air Quality Information System (SAAQIS) (that could be determined) to present background concentrations for PM_{10} and $PM_{2.5}$ concentrations at the project site. The nearest AQMS to the project site is located at the Escourt station (-29.000526°S, 29.873569°E), located ~35km south of the proposed mine. However, there was no ambient air quality monitoring data available from the station as it appears to be malfunctioning, with no data recorded over the past several years. Furthermore, there is no ambient air quality monitoring undertaken at the project site. In addition, dustfall data could not be provided in this AQIAr as there are no available dustfall networks operated near the project site, that could be determined. Baseline air quality monitoring for dustfall, PM_{10} and $PM_{2.5}$ is therefore recommended, prior to commencement of the proposed mining operations, to determine baseline concentrations of key criteria air pollutants.

The main conclusions of the AQIA for the project can be summarised as follows:

Dustfall, PM_{10} and $PM_{2.5}$ are key pollutants of concern associated with operations at the proposed mine and are emitted from the following key sources:

Dustfall and Particulate Emissions:

- Highwall mining (drilling into coal seam);
- Bulldozing;
- Materials handling operations (transfer, loading/offloading operations);
- Wind erosion from exposed areas: temporary coal stockpile; and
- x4 FELs (servicing the needs of the highwall miners, cleaning up coal spillages, and establishing the highwall and performing rehabilitation).

Based on the dispersion modelling output plots, the following conclusions can be made:

- Incremental 99th percentile daily dustfall rates are predicted to comply with the residential area standard of 600 mg/m^2/day and non-residential area standard of 1200 mg/m^2/day over the entire project area, with no exceedances of the standards projected.
- 99th percentile daily, and annual average incremental PM_{10} concentrations, are mostly predicted to be low and fall well below the applicable daily and annual NAAQS of 75 µg/m^3 and 40 µg/m^3, respectively. Although exceedances of the daily and annual standards are predicted inside the boundary, they are restricted to a very small area in proximity to the proposed mining activities, with exceedances of the annual PM_{10} standard being barely noticeable.
- Predicted incremental 99th percentile daily, and annual average $PM_{2.5}$ concentrations, are significantly low and in compliance with the applicable standards of 40 µg/m^3 and 20 µg/m^3, respectively, over the entire project area.
- Based on the above, the proposed mine will not be a significant source of incremental dustfall and particulate matter (PM_{10} and $PM_{2.5}$) concentrations.
- All identified nearby surrounding sensitive receptors (represented as discrete receptors) are shown to experience low to negligible incremental dustfall rates, PM_{10} concentrations and $PM_{2.5}$ concentrations, over both the short and long term.

In conclusion, Rayten is of the opinion that operations at the proposed mine can be authorised. The inherent risk (in terms of air quality) associated with operation of the proposed mine can be considered

as low, while the likelihood of the impact occurring can be considered as highly unlikely. This results in a **low negative impact significance rating (i.e. low residual risk)** in terms of air quality, for the proposed mine operations. This is evident in that while pollutants associated with operational activities at the proposed mine will be dispersed from the operational area to nearby sensitive receptors, predicted concentrations at all the identified receptors are projected to be very low to negligible.

Despite the low negative impact significance rating predicted, it is recommended that a dust management plan is developed for the proposed mine, which includes the implementation of suggested dust suppression measures (Section 6) and an air quality programme. It is also recommended that ambient air quality monitoring of PM_{10} and $PM_{2.5}$ and dustfall monitoring be conducted before commencement of mining operations to determine baseline concentrations of these key pollutants. The monitoring programmes must continue throughout the operational phase of the mine.

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LIST OF ABBREVIATIONS

AEL	Atmospheric Emissions License
AQIA	Air Quality Impact Assessment
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
$CO_{2\text{-eq}}$	Carbon dioxide equivalent
DEA	Department of Environmental Affairs
DR	Discrete Receptor
EMP	Environmental Management Plan
EET	Emission Estimate Technique
FEL	Front-end-loader
GHG	Greenhouse gas
GMT	Greenwich Meridian Time
HFC	Hydrofluorocarbons
KZN	Kwa-Zulu Natal
MR	Mining Right
NAAQS	National Ambient Air Quality Standards
NAEIS	National Atmospheric Emissions Inventory System
NEMA	National Environmental Management Act
NEM:AQA	National Environmental Management Air Quality Act
NPI	National Pollutant Inventory
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
N_2O	Nitrous Oxide
Mtpa	Million tonnes per annum
O_3	Ozone
PBL	Planetary Boundary Layer
PFC	Perfluorocarbons
PM_{10}	Particulate Matter, aerodynamic diameter equal to or size less than 10µm
$PM_{2.5}$	Particulate Matter, aerodynamic diameter size equal to or less than 2.5µm
PRIME	Plume Rise Model Enhancements
SAAQIS	South African Air Quality Information System
SAGERS	South African Greenhouse Gas Emissions Reporting System
S21	Section 21
SF_6	Sulphur hexafluoride
SO_2	Sulphur Dioxide
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator

1. INTRODUCTION

Rayten Engineering Solutions was appointed by Brodsky Trading 266 (Pty) Ltd to compile an Air Quality Impact Assessment report (AQIAr) for the proposed Dunrose Investments 174 (Pty) Ltd's highwall coal mining project (hereafter referred to as the "proposed mine", located approximately 9 – 17km north-east of Colenso, within the Umtshezi Local Municipality of the Uthukela District Municipality, Kwa-Zulu Natal Province.

Dunrose Investments 174 (Pty) Ltd are currently in the process of applying for a Mining Right for the proposed mining operations. This AQIAr has been compiled as a supporting document for the Mining Right application. The main objective of the AQIA is to determine the potential impact of emissions from the operational activities associated with the proposed mine on ambient air quality in terms of dustfall, PM_{10} and $PM_{2.5}$.

As part of the AQIA, a baseline air quality assessment was undertaken through a review of meteorological monitoring data, available air quality monitoring data, air quality legislation and the identification of nearby sensitive receptors and existing emissions sources surrounding the project site. The potential impact of emissions from the mining activities associated with the proposed mine on air quality is evaluated through the compilation of an emissions inventory and subsequent dispersion modelling simulations using AERMOD. Comparison of predicted concentrations for dustfall, PM_{10} and $PM_{2.5}$ is made with the South African National Ambient Air Quality Standards and the South African National Dust Control Regulations, 2013 where applicable.

Regulations that have been considered during the compilation of this AQIAr include the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment Regulations, 2014 (as amended) (EIA Regs) - Requirements for Specialist Reports (Appendix 6), where applicable, the Dispersion Modelling Regulations (Government Gazette No. 37804 of 11 July 2014) and the regulations prescribing the format of an Atmospheric Impact Report (Government Gazette No. 36904 of 11 October), as amended (General Notice 284 in Government Notice 38633 of 02 April 2015).

1.1. Project Details

Applicant:	Dunrose Investments 174 (Pty) Ltd
Mine:	Dunrose Investments 174 (Pty) Ltd – Coal Mining Operations
Co-ordinates:	28.682161°S 29.989261°E
Municipality and Province:	Umtshezi Local Municipality of the Uthukela District Municipality, KZN Province.
AEL number:	No AEL required (based on proposed mining activities)
Mining Right:	In the process of applying for one
Designated Air Quality Priority Area:	N/A
Modelling contractor:	Rayten Engineering Solutions (Pty) Ltd *Gertrude Mafusire (MPhil.) Pr. Sci. Nat* *Senior Associate*

	8 years working experience *0117920880* *info@rayten.co.za*

1.2. Brief Project Description

The proposed mine will be established on several farms consisting of coal resources, namely the Shaws, Gannahoek, Schurfdepoort, Klipberg, Brakfontein and Ramak farm portions. Approximately 1 million tonnes of coal are anticipated to be mined per annum over a period of 20 to 30 years. The coal from these sources is anthracitic, with an energy content of 22 – 26 MJ/kg (Rayten, 2015 AQIAr).

The coal mining methods proposed for Dunrose Investments 174 (Pty) Ltd's coal mine include the highwall surface mining method (Figure 1-2). The coal seam outcropping will run along the 865m and 845m contours with minimal overburden removal required to access the coal seam. The highwall mining approach will start on the western side of the property and will progress along the contours towards the south-eastern boundary of the property. This method will allow for targeted extraction of the coal seam. Standard bord and pillar underground mining of the top seam shall commence after the seams along the contours have been mined out. The mined-out areas will be rehabilitated using overburden replacement, contouring and grassing resulting in a rehabilitated work face that will resemble the natural landscape as far as possible (Rayten, 2015 AQIAr).

The mined coal will be stored at a temporary stockpile prior to removal from site.

The focus of this study is to quantify emissions of dustfall, PM_{10} and $PM_{2.5}$ associated with operational activities at the proposed mine, which include:

- Highwall mining (drilling into coal seam);
- Bulldozing;
- Materials handling operations (transfer, loading/offloading operations);
- Wind erosion from exposed areas: temporary coal stockpile; and
- x4 FELs (servicing the needs of the highwall miners, cleaning up coal spillages, and establishing the highwall and performing rehabilitation).

A preliminary site layout diagram for the proposed mine is given in Figure 1-1. This layout was used for modelling purposes.

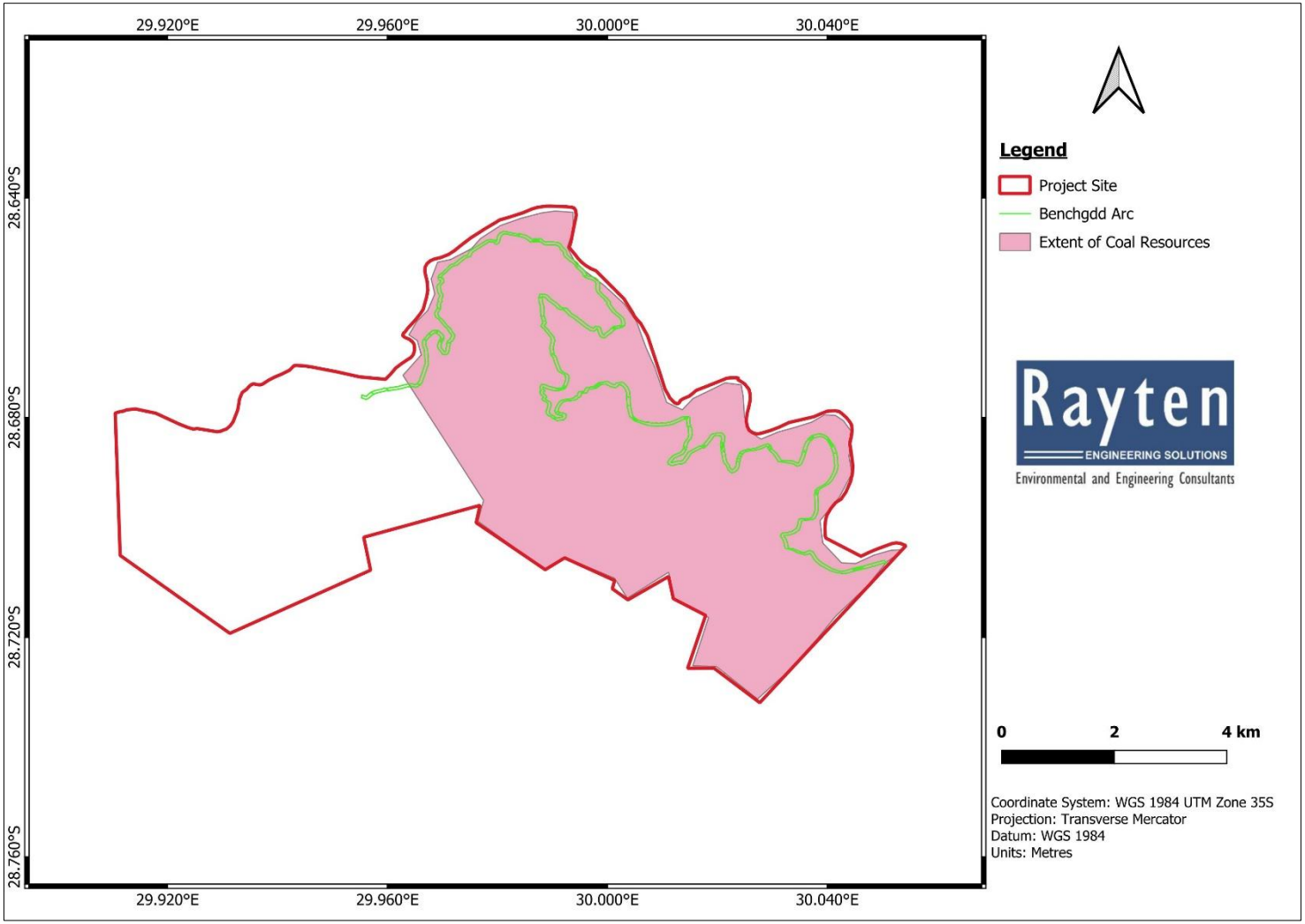

Figure 1-1: Site Layout Diagram for the proposed mine.

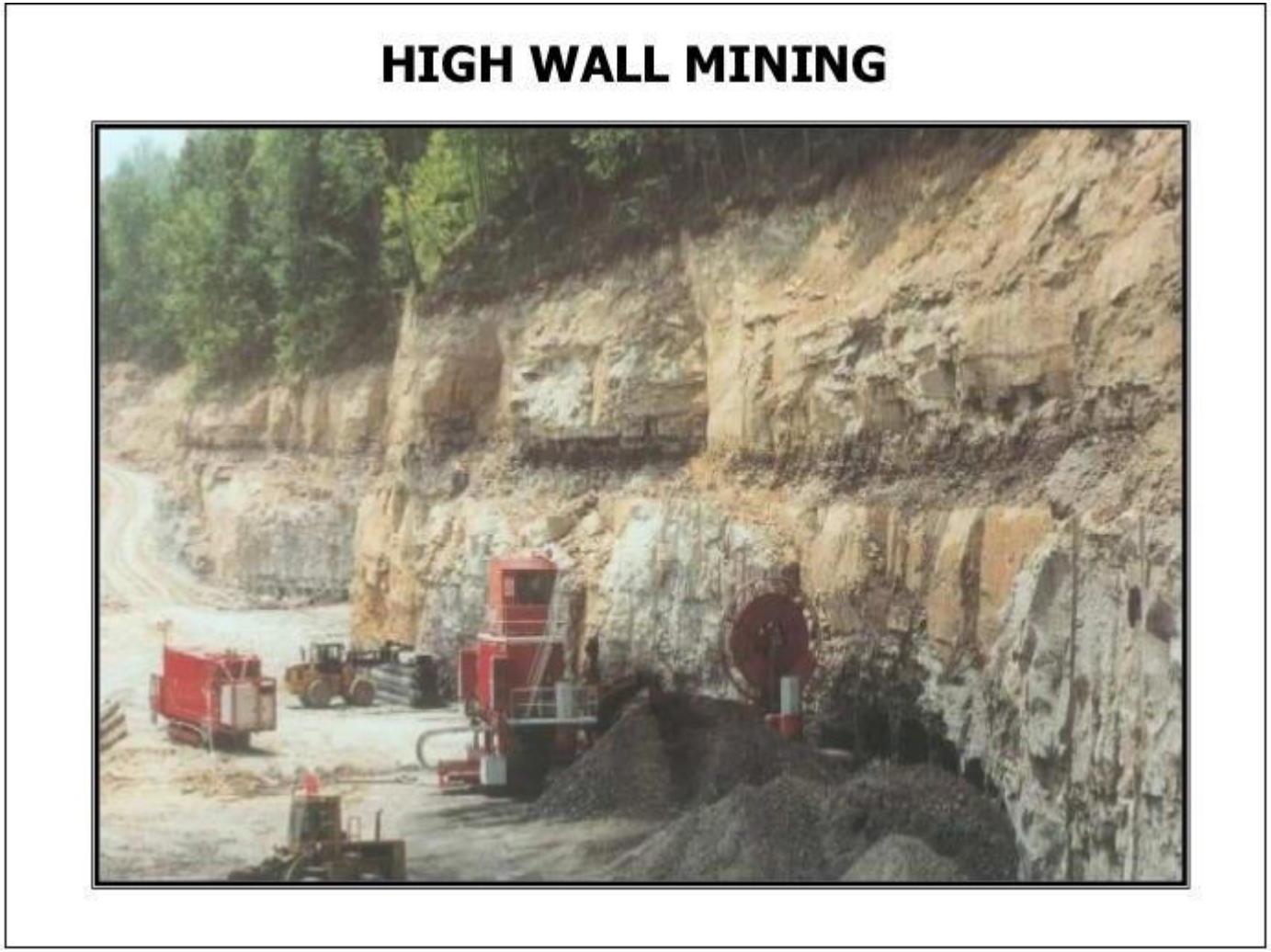

Figure 1-2: Photographic Representation of Highwall Mining Methods.

1.3. Terms of Reference

The scope of work for the AQIA is as follows:

- A review of the study site and activities;
- An overview of the prevailing meteorological conditions in the area which influence the dilution and dispersion of pollutants in the atmosphere;
- The identification of proposed sources of emissions;
- The identification of key air pollutants of concern that may be emitted from proposed mining activities (criteria air pollutants);
- Characterisation of the ambient air quality within the area using available air quality monitoring data;
- A review of the current South African legislative and regulatory requirements for air quality;
- The identification of sensitive receptors, such as local communities, surrounding the study area;
- The compilation of an emission inventory for key sources of emissions;
- Dispersion modelling simulations of ground level particulate emissions for incremental impacts; and
- Provision of general recommendations for the mitigation and management of identified potential impacts.

1.4. Outline of Report

An overview of the site location including surrounding receptors is given in **Section 2**. National Ambient Air Quality Standards, dust control regulations and associated health impacts for the relevant criteria pollutants are discussed in **Section 3**. The local meteorological conditions and baseline air pollutants concentrations are provided in **Section 4**. Potential emissions and their impact on air quality associated with the proposed operations are outlined in **Section 5**. Mitigation measures, recommendations and a summary report are detailed in **Section 6**.

2. SITE CHARACTERISTICS

2.1. Site Location

The proposed mine is located approximately 9 – 17km north-east of Colenso, within the Umtshezi Local Municipality of the Uthukela District Municipality, KZN Province (-28.682161°S; 29.989261°E) (Figure 2-1). The project area does not fall within a Nationally Declared Air Quality Priority Area.

2.2. Surrounding Land Use

The land use immediately surrounding the project site within a 20km radius consists mostly of forests, grasslands and formal residences, interspersed with cultivated land, subsistence crops, bare lands, fallow land, wetlands and waterbodies. Informal residences, industrial areas and mining areas – though present, occupy much smaller land footprints (Figure 2-2).

2.3. Topography

The topography surrounding the proposed mine is shown in Figure 2-3. Surrounding elevations range from 229 – 3176 m above sea level. The project site is situated approximately at 750 – 1080 m above sea level, with a mixture of both low-lying areas (valleys) and mountainous areas in nearby surroundings (Figure 2-3).

2.4. Sensitive Receptors

A sensitive receptor is defined as a person or place where involuntary exposure to air pollutants released by the site's activities could occur. Identified sensitive receptors which are located within a 20km radius of the proposed mine are given in Figure 2-4. For modelling purposes, the identified sensitive receptors are restricted to those located within the same Universal Transverse Mercator (UTM) zone as that of the project area (i.e. 35S). Additionally, it is noted that most of the receptors located near to the proposed mine fall within this UTM Zone.

The discrete receptors given in Table 2-1 below, were used for modelling purposes. Maximum predicted incremental concentrations are provided for the identified discrete receptors. These points are located at the centre of residentials areas, or near schools, hospitals, old age homes, dwellings or buildings to determine the maximum concentrations that could be expected near sensitive receptors. Discrete points are not plotted for each individual sensitive receptor but are used to represent a group of sensitive receptors located near to each other (e.g. several schools, dwellings or buildings).

Table 2-1: Discrete receptors within a 20km radius of the proposed mine. Receptors were identified through a desktop study.

Discrete Receptor ID	Name Edu = educational/school/training facilities HC = healthcare/clinic/hospital facilities Old = old age home Residential = Dwellings/ farmhouses	UTM Co-ordinates (35S)		Elevation (m)
		X (m)	Y (m)	
DR1	Dwellings/Edu (Phoweni Secondary School)	783593.43	6825731.85	1015.47
DR2	Dwellings/Edu (Umndeni Woxolo Primary School)	779482.58	6825347.41	1017.70
DR3	Dwellings/Edu (Ncinjane Secondary School)	778355.45	6825780.23	1015.41
DR4	Res (Ezakheni E)/Edu (Sakhelwe High School & Mnambithi College -E Campus)/HC (Ezakheni E Clinic)	782559.66	6829402.74	967.61
DR5	Res (Ezakheni C)/Edu (Isiqophamithi Primary School)/ HC (Ezakheni C Health Centre)	785387.63	6830383.47	1001.02
DR6	Res (Ezakheni C)/Edu (Endakane High School)	784319.47	6829380.59	979.12
DR7	Edu (Qophindela Secondary School)	785790.97	6829793.12	984.77
DR8	Edu (Ekuphumuleni Primary School)	784853.75	6830372.91	1022.92
DR9	Edu (Falethu Primary School)	785656.50	6830142.39	996.17
DR10	Res (Ezakheni D)/Edu (Ingceboyesizwe Primary School)	786578.07	6829824.71	984.71
DR11	Res (Dwellings)	788620.07	6827806.84	973.94
DR12	Res (Dwellings)	787944.85	6829235.24	977.87
DR13	Edu (Bhekintuthuko Secondary School)	788984.10	6831087.95	955.15
DR14	Res (Ezakheni B)/Edu (Ekukhuleni High School)	785533.62	6831867.83	1010.31
DR15	Res (Ezakheni B)/Edu (Mcitsheni Primary School)	785990.51	6831915.30	1011.28
DR16	Res (Ezakheni A)/Edu (Idamu Primary School & Sir Manyathi Learning Institute)	786437.18	6832280.65	1036.60
DR17	Res (Ezakheni A)/Edu (Ezakheni High School)	786165.40	6832778.21	1044.42
DR18	Edu (Gqama Primary School)	786512.53	6832911.17	1044.64
DR19	Ezakheni IA (Light Industrial Area)	778832.92	6829281.50	1010.30
DR20	Edu (Ezakheni FET College)	786219.77	6833493.20	1067.56
DR21	Edu (Amancakazana Primary School)	784941.56	6833872.08	1033.11
DR22	Res (Dwellings)/Edu (St Chads High School)	782143.80	6834918.39	1016.24
DR23	Res (St Chads)	784769.30	6835138.40	1047.07
DR24	Res (Dwellings)/Edu (Mabhomane H.P. School)	784530.25	6836387.06	1042.12
DR25	Church (Mhkuku Kunene Umthandazi)	781819.70	6819617.37	994.67
DR26	Res (Inkanyezi)/Edu (Colenso Combined School)/HC (Tholusizo Clinic)	777184.28	6817860.49	959.23
DR27	Res (Colenso)/Edu (Colenso Primary School)/Midlands Orphanage & Care Centre	775884.55	6817303.49	976.06
DR28	Res (Dwellings)/Edu (ML Sultan Colenso Primary School)	777090.77	6815781.16	980.19
DR29	Res (Dwellings)/(Edu (Indulwana Primary School)	778006.41	6813570.49	1020.01

DR30	Edu (Morning Star Primary School)	781654.46	6813123.54	949.72
DR31	Umsuluzi Game Park	780070.25	6810755.95	931.00
DR32	Weenen Nature Reserve	792576.37	6806583.65	993.89
DR33	Tugela Private Game Reserve	772711.33	6820884.68	1027.05
DR34	HC (Unjani Clinic Ezakheni)	786435.35	6831319.77	1005.66

Notes:
*DR = discrete receptor
*<10 hospitals/healthcare/clinic facilities within 20km of site (located in surrounding areas).
*>10 school/training/educational facilities within 20km of site (located in surrounding areas).
*No old age home facilities identified within 20km of the project site.
*Numerous dwellings/residential areas in surrounding areas

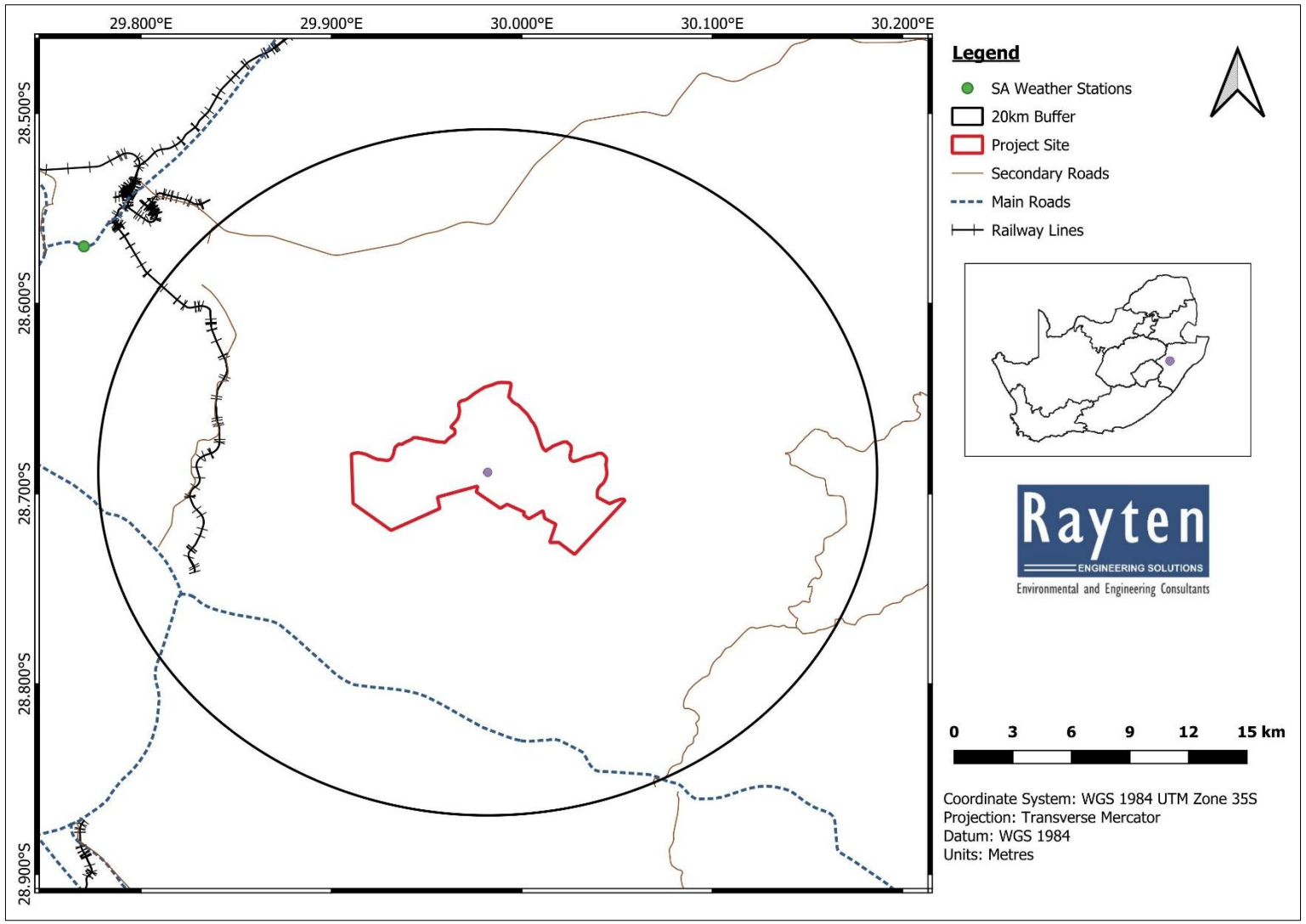

Figure 2-1: Site locality for the proposed mine.

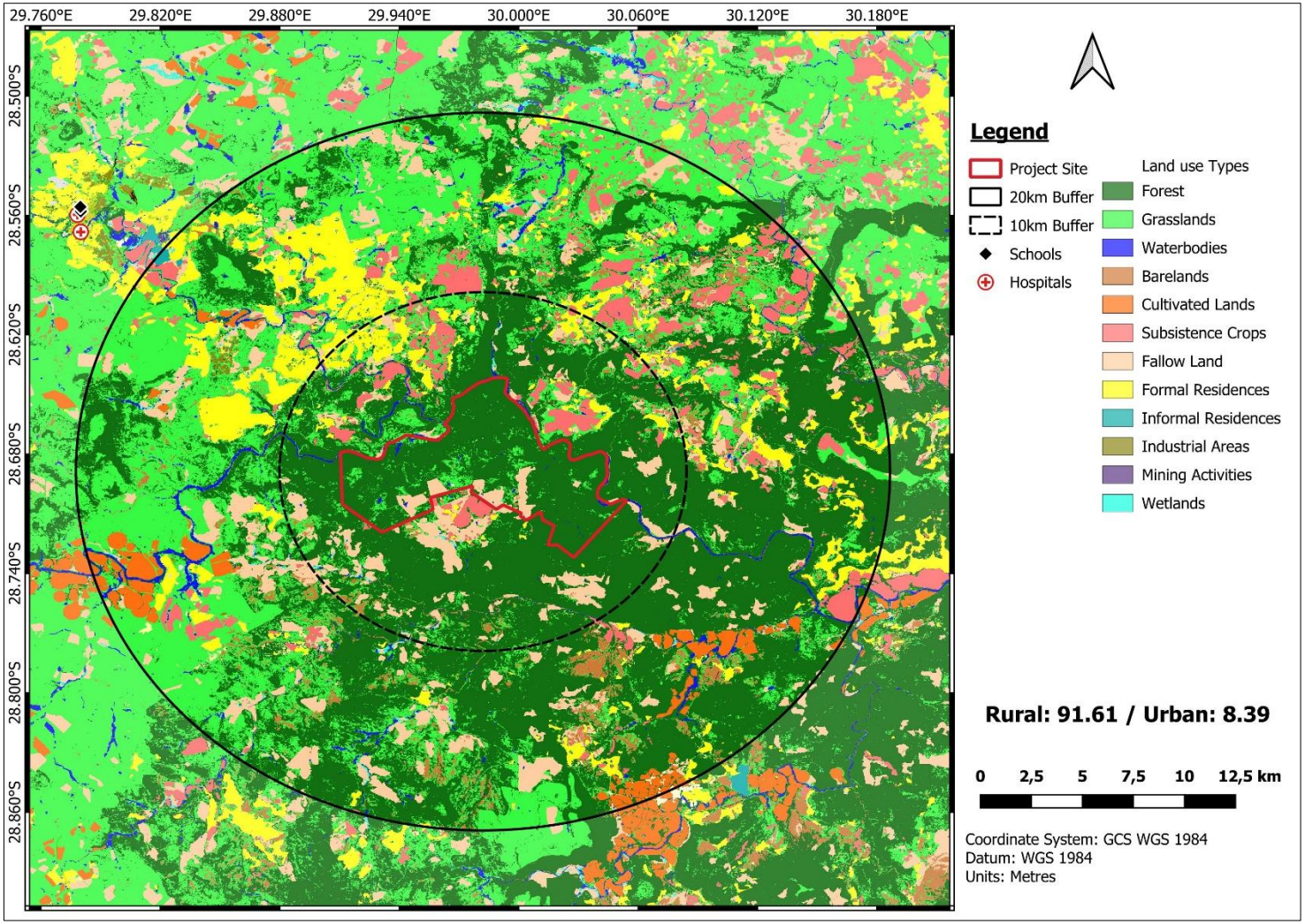

Figure 2-2: Land use surrounding the proposed mine.

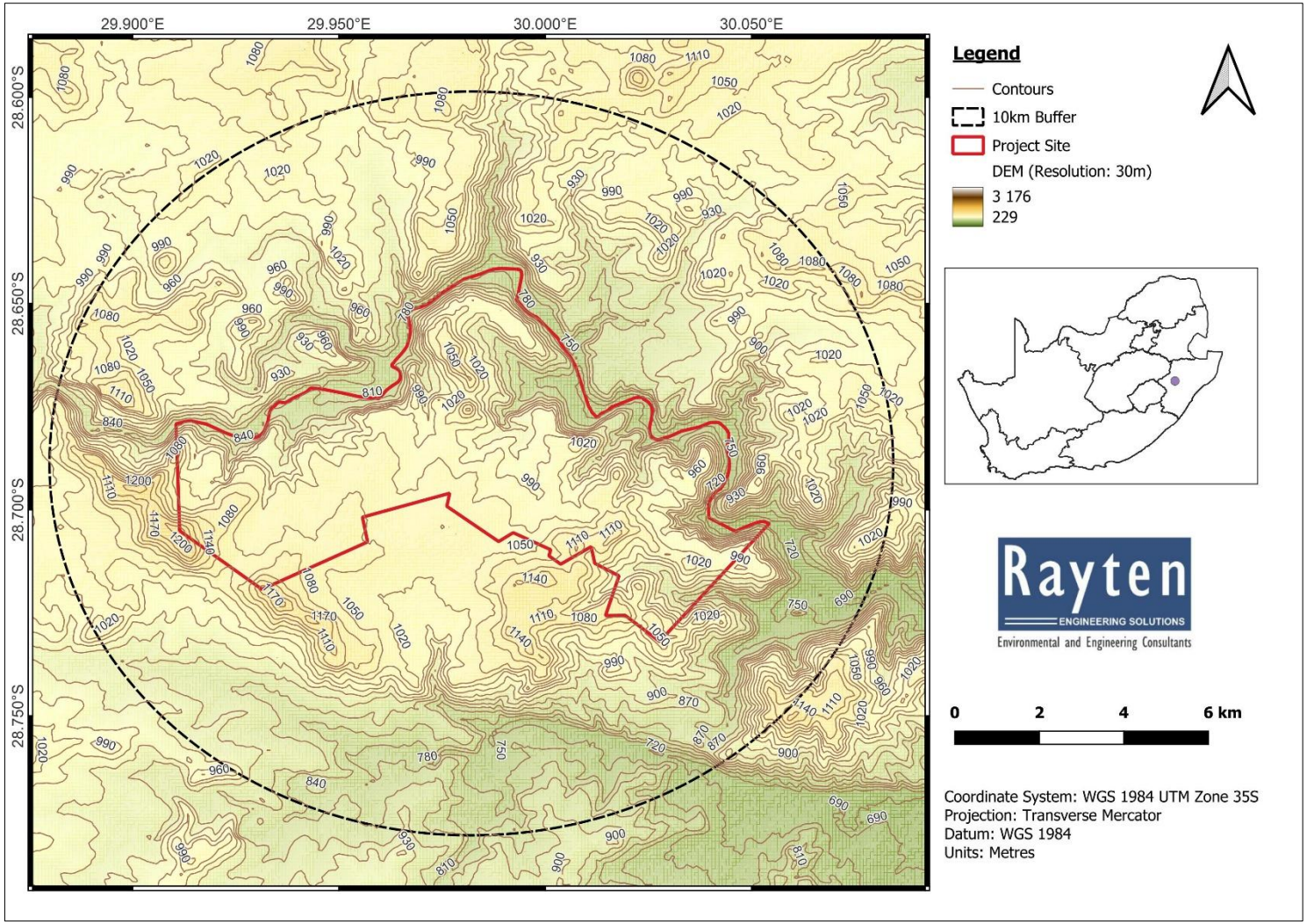

Figure 2-3: Digital elevation surrounding the proposed mine.

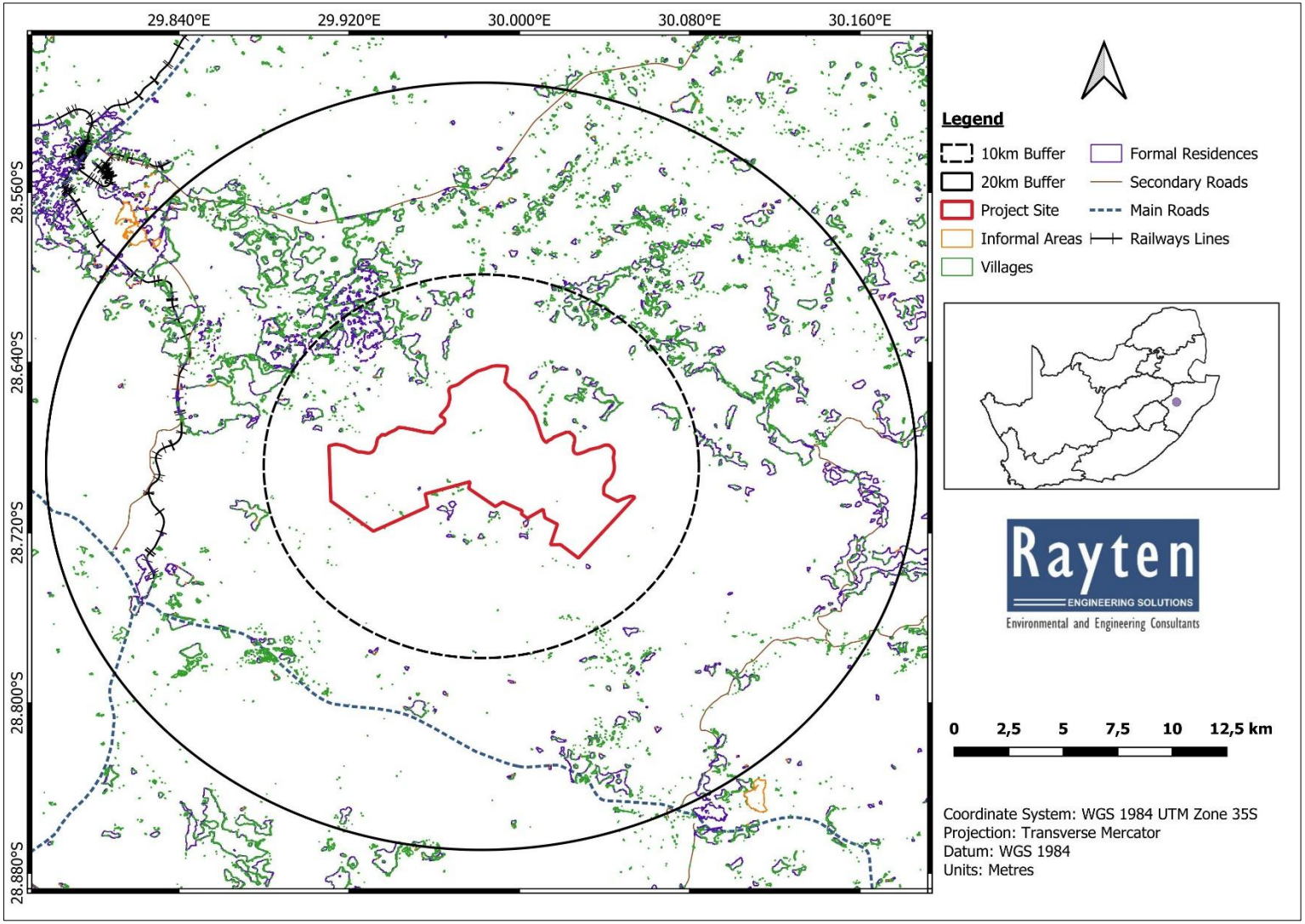

Figure 2-4: Sensitive receptors surrounding the proposed mine.

3. LEGISLATION

3.1. National Environmental Management: Air Quality Act (No 39 of 2004) (NEM: AQA), as amended

The NEM: AQA, has shifted the approach of air quality management from source-based control to receptor-based control. The main objectives of the Act are to;

- protect the environment by providing reasonable measures for—
  - i. the protection and enhancement of the quality of air in the Republic;
  - ii. the prevention of air pollution and ecological degradation; and
  - iii. securing ecologically sustainable development while promoting justifiable economic and social development; and
- generally, to give effect to section 24(b) of the Constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and wellbeing of people.

The Act makes provisions for the setting and formulation of National Ambient Air Quality Standards for “substances or mixtures of substances which present a threat to health, well-being or the environment”. More stringent standards can be established at the provincial and local levels.

The control and management of emissions in the NEM: AQA relates to the listing of activities that are sources of emissions and the issuing of Atmospheric Emission Licences (AEL). Listed activities are defined as activities which “result in atmospheric emissions and are regarded as having a significant detrimental effect on the environment, including human health”. Listed activities have been identified by the Minister of the Department of Environmental Affairs (DEA) (now known as the Department of Forestry, Fisheries and the Environment (DFFE)) and atmospheric emission standards have been established for each of these activities. These listed activities now require an AEL to operate. The issuing of AELs for listed activities is the responsibility of the Metropolitan and District Municipalities, with the exception of those associated within mining.

In addition, the Minister may declare any substance contributing to air pollution as a priority pollutant. Any industries or industrial sectors that emit these priority pollutants will be required to implement a Pollution Prevention Plan. Municipalities are required to “designate an air quality officer to be responsible for co-ordinating matters pertaining to air quality management in the Municipality”. The appointed Air Quality Officer is responsible for the issuing of AELs.

3.2. Listed Activities and Minimum Emission Standards

The NEM: AQA requires all persons undertaking listed activities in terms of Section 21 (S21) of the Act to obtain an AEL. The listed activities and associated minimum emission standards were issued by the DEA on 31 March 2010 (Government Gazette No. 33064 of 31 March 2010) and were amended in:

- 2013 (Government Gazette No. 37054 of 22 November 2013);
- 2015 (Government Gazette No. 38863 of 12 June 2015);
- 2018 (Government Gazette No.41650 of 25 May 2018; Government Gazette No.42013 of 31 October 2018);
- 2019 (Government Gazette No.42472 of 22 May 2019); and

- 2020 (Government Gazette No. 43174 of 27 March 2020).

The proposed mine will not trigger any of the S21 listed activities based on their proposed operations.

South Africa launched an online National reporting system, referred to as the National Atmospheric Emissions Inventory System (NAEIS). The NEM: AQA requires all emission source groups identified in terms of the National Atmospheric Emission Reporting Regulations (Government Gazette No. 38633 of 02 April 2015), to register and report emissions on the NAEIS. Mines are classified as Group C emitters and are thus required to report annually and comply with the National Atmospheric Emission Reporting Regulations.

Once operational, the proposed mine must register on the NAEIS and report on their fugitive dust emissions annually. The online NAEIS system is currently offline (as of 05 February 2024), and emissions reporting should be done manually by 30 June each year, until further notice (as per Government Notice 4493 in Government Gazette No. 50284 of 08 March 2024).

3.3. Ambient Air Quality Standards

National Ambient Air Quality Standards, including permitted frequencies of exceedance and compliance timeframes, were issued by the Minister of Water and Environmental Affairs on 24 December 2009 (Table 3-1). National standards for $PM_{2.5}$ were established by the Minister of Water and Environmental Affairs on 29 June 2012.

Table 3-1: National Ambient Air Quality Standards for Criteria Pollutants.

POLLUTANT	AVERAGING PERIOD	CONCENTRATION (µg/m^3)	FREQUENCY OF EXCEEDANCE [3]
Sulphur dioxide (SO_2)	10 minutes	500 (191)	526
	1 hour	350 (134)	88
	24 hours	125 (48)	4
	1 year	50 (19)	0
Nitrogen dioxide (NO_2)	1 hour	200 (106)	88
	1 year	40 (21)	0
Particulate Matter (PM_{10})	24 hours	75	4
	1 year	40	0
Particulate Matter ($PM_{2.5}$)	24 hours	40[1] 25[2]	0
	1 year	20[1] 15[2]	0
Ozone (O_3)	8 hours (running)	120 (61)	11
Benzene (C_6H_6)	1 year	5 (1.6)	0
Lead (Pb)	1 year	0.5	0
Carbon monoxide (CO)	1 hour	30 000 (26 000)	88
	8 hours (calculated on 1 hourly averages)	10 000 (8 700)	11

Notes:
*Values indicated in blue are expressed in part per billion (ppb)
(1) Compliance required by 1 January 2016 – 31 December 2029.
(2) Compliance required by 1 January 2030.
(3) Frequency of exceedance refers to the number of times an exceedance is allowed within a calendar year.

3.4. Dust Deposition Standards

The DEA (now known as the DFFE) issued National Dust Control Regulations (NDCR) promulgated in Government Gazette No. 36974 of 2013, which came into effect on 01 November 2013 (Table 3-2), and subsequently the Draft NDCR in Government Gazette No. 50272 of 08 March 2024. The purpose of the regulations is to prescribe general measures for the control of dust in all areas. The regulations prohibit activities which give rise to dust in such quantities and concentrations that the dustfall at the boundary or beyond the boundary of the premises where it originates exceeds:

a) 600 mg/m^2/day averaged over 30 days in residential areas measured using reference method ASTM D1739.
b) 1 200 mg/m^2/day averaged over 30 days in non-residential areas measured using reference method ASTM D1739.

Table 3-2: South African National Dust Control Regulations.

RESTRICTION AREAS	DUST FALL RATE (D) (1)	REQUENCY OF EXCEEDANCE
Residential Areas	D < 600 mg/m^2/day	Two within a year, no two sequential months (2)
Non-residential areas	600 < D < 1200 mg/m^2/day	Two within a year, no two sequential months (2)

Notes:
(1) Averaged over 1 month (30±2-day average) (mg/m^2/day)
(2) Per dust-fall monitoring site.

A person may be asked to implement a dustfall monitoring programme at their site should the person conduct an activity that gives rise to dustfall in rates greater than the dustfall standards. A dustfall monitoring report should be submitted to the air quality officer within a given timeframe, once a dustfall monitoring programme has been implemented. The report should include relevant information about the dustfall monitoring method used, potential identified sensitive receptor locations, locations of sampling sites, a classification of the study area, meteorological data for the sampling area and any other relevant information. If the report indicates non-compliance with the dustfall standards the person may be further required to conduct particulate matter (PM_{10}) monitoring on site.

As per the NDCR, any person who has exceeded the dustfall standard must, within three months after submission of a dustfall monitoring report, develop and submit a dust management plan to the air quality officer for approval. The dust management plan must:

a) Identify all possible sources of dust within the affected site;
b) Detail the best practicable measures to be undertaken to mitigate dust emissions;
c) Develop an implementation schedule;
d) Identify the line management responsible for implementation;
e) Incorporate the dustfall monitoring plan;
f) Establish a register for recording all complaints received by the person regarding dustfall, and for recording follow up actions and responses to the complainants.

The dust management plan must be implemented within a month of the date of approval. An implementation progress report must be submitted to the air quality officer at agreed time intervals.

3.5. Greenhouse Gas (GHG) Emissions

On 14 March 2014, the DEA (now known as the DFFE) (Government Gazette No. 37421 of 14 March 2014) declared the following six GHGs as priority air pollutants in South Africa:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)

National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), as amended (General Notice 994 in Government Notice 43712 of 11 September 2020), were published by the DEA (now known as the DFFE). A person identified as a Category A data provider in terms of Annexure 1 of these regulations, must register their facilities using the online South African Greenhouse Gas Emissions Reporting System (SAGERS) and must submit a GHG emissions inventory, activity data and report in the required format given under Annexure 3 of these regulations on an annual basis. All data must be provided annually, by the 31 March of the following year. Due to planned system upgrades, SAGERS is unavailable for the 2023/2024 and 2024/2025 reporting cycles and registration of data providers as well as reporting of GHG emissions is required to be done manually, as per Government Notice 4248 in Government Gazette 49984 of 11 January 2024. The NEM: AQA and the National GHG Emission Reporting Regulations, establish the legislative framework for the national GHG reporting system in South Africa.

National Pollution Prevention Plan Regulations (Gazette No. 40996) were published on 21 July 2017 by the DEA. A Pollution Prevention Plan will be required should the development do the following:

a) Undertake any of the following activities identified in Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), as amended (General Notice 994 in Government Notice 43712 of 11 September 2020), which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_{2\text{-eq}}$); or
b) Undertake any of the following activities identified in Annexure A of the National Pollution Prevention Plan Regulations (Gazette No. 40996 of 21 July 2017) as a primary activity, which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_{2\text{-eq}}$);

Annexure A activities in terms of the National Pollution Prevention Plan Regulations include:

- Coal mining
- Production and /or refining of crude oil
- Production and/or processing of natural gas
- Production of liquid fuels from coal or gas
- Cement production
- Glass production
- Ammonia production
- Carbon black production
- Iron & steel production
- Ferro-alloys production
- Aluminium production
- Polymers production
- Pulp and paper production
- Electricity production
- Nitric acid production

Coal mining falls under category 1A2i (i.e. Mining and Quarrying) in terms of Annexure 1 of the National GHG emission reporting regulations (Government Gazette No. 40762 of 3 April 2017), as amended (General Notice 994 in Government Notice 43712 of 11 September 2020). All facilities conducting this activity (i.e. Mining and Quarrying) are required to register and report on their GHG emissions by the 31 March of every year, should they have combustion installations that have a cumulative installed design capacity equal to or greater than 10MW.

3.6. Carbon Tax Act

The Carbon Tax Act No. 15 of 2019 was promulgated on the 23 May 2019 and is implemented using a phased approach, allowing emitters time to transition to cleaner and more efficient technologies resulting in lower GHG emissions. Phase One is effective from 1 June 2019 to 31 December 2022 (extended to 31 December 2025) and focuses on Scope 1 (direct) emissions, while phase 2, running from 31 December 2022 (extended to 2025) to 31 December 2030, will include Scope 2 (indirect) emissions.

Any person, company or entity who undertakes an activity (above a certain threshold) and is responsible for the release of GHG emissions is required to report on their emissions to the DFFE by the 31 March each year and pay tax on those emissions by July each year.

The base tax rate when the Act was published was R120 per tonne of $CO_{2\text{-eq}}$ (carbon dioxide equivalent) emitted by the generation facility or entity for the relevant reporting period, but it is now at R144 per tonne of $CO_{2\text{-eq}}$. The carbon tax rate will increase annually at a rate determined by the minister. However, there are tax-free allowances that apply, which can make the overall effective tax rate much lower, but are however capped at 95% and include:

- A basic tax-free allowance of 60% during Phase One (until 31 January 2022 [extended to 31 December 2025]).
- An additional tax-free allowance of 10% for process emissions.
- An additional tax-free allowance of 10% for fugitive emissions.
- An additional tax-free allowance of up to a maximum of 10% for trade exposed sectors.
- An additional tax-free performance allowance of 5% based on performance against intensity benchmarks.

- An additional tax-free allowance of 5% for companies who participate in the carbon budget system.
- An additional tax-free carbon offset allowance of 5% or 10%.

3.7. National Environmental Management Act (NEMA) (Act 107 of 1998), as amended

The National Environmental Management Act (Act no.107 of 1998), referred to as NEMA, provides South Africa's framework for environmental legislation. Although NEMA was initially promulgated in 1998, it has since been amended on several occasions.
The act intends to provide for:

- co-operative environmental governance by establishing principles for decision-making on matters affecting the environment;
- institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state;
- the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment; and
- matters connected therewith.

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities, which may not commence without Environmental Authorisation (EA). The result being that NEMA now governs the Environmental Impact Assessment (EIA) process with the said promulgation of the EIA Regulations in December 2014 (as amended on 07 April 2017). The EIA process for the proposed mine is being undertaken by Vahlengwe Mining Advisory & Consulting in accordance with the NEMA EIA Regulations. The EIA Regulations, 2014, as amended, specify requirements for specialist reports in Appendix 6 of GNR 982, in Government Gazette 38282. Therefore, this report complies with these requirements where applicable, as summarised in Table 3-3 below.

Table 3-3: Compliance of this AQIA with Appendix 6 of the NEMA EIA Regulations.

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	Section 1.1 Specialist CVs are attached as Appendix E
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page (ii)
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.3 Terms of Reference provided
(cA) an indication of the quality and age of base data used for the specialist report;	Section 4.1 and 4.2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4.3 and 5.3.3
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**N/A** No site investigation required or conducted for AQIA) AQIA is based on information provided by Vahlengwe Mining.

(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5.2 AERMOD Model Overview provided
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.2 (However, please note that site sensitivity and desktop verification are not applicable for AQIAs as these have not been developed for the South African screening tool).
(g) an identification of any areas to be avoided, including buffers;	**N/A** However, the report does comment on the impact of proposed activities on air quality at potential sensitive areas surrounding the project site in Section 5.3.2
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 1.2
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5.4
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 5.3
(k) any mitigation measures for inclusion in the EMPr;	Section 6.1
l) any conditions for inclusion in the environmental authorisation;	**N/A**
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6.2
(n) a reasoned opinion— i. whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	Section 5.3.5 and Section 6.1
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**N/A**
(p) any other information requested by the competent authority	**N/A**
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	General Notice No. 747 Government Gazette No. 36904 has been used in the compilation of this report. Report checklist provided in Appendix A

3.8. Human Health Effects

3.8.1. Dustfall

Dustfall are particles with an aerodynamic diameter greater than 20 µm that have been entrained into the air by a physical process such as wind, movement of vehicles, stack emissions or from fugitive dust. These particles are generally too heavy to remain in suspension in the air for any period and fall out of the air over a relatively short distance depending on a combination of various factors such as particle size, density, temperature (of the air and particle), emission velocity or method, ambient wind speed and humidity. These particles are therefore commonly known as “dust-fall”. Particulates in this range are generally classified as a nuisance dust and can cause physical damage to property and physical irritation to plants, animals and humans.

3.8.2. Particulate Matter (PM_{10} and $PM_{2.5}$)

Particles can be classified by their aerodynamic properties into coarse particles, PM_{10} (particulate matter with an aerodynamic diameter equal to or less than 10 µm) and fine particles, $PM_{2.5}$ (particulate matter with an aerodynamic diameter equal to or less than 2.5 µm). The fine particles mostly contain secondary formed aerosols such as sulphates and nitrates, combustion particles and re-condensed organic and metal vapours. The coarse particles mostly contain earth crust materials and fugitive dust from roads and industries (Harrison and van Grieken, 1998) (Fenger, 2002).

In terms of health impacts, particulate air pollution is associated with effects on the respiratory system (WHO, 2000 and 2021). When looking at human health particle size is an important factor to consider because it controls where in the respiratory system a given particle will be deposited. Fine particles are thought to be more damaging to human health than coarse particles as larger particles do not penetrate deep into the lungs compared to smaller particles. Larger particles are deposited into the extra thoracic part of the respiratory tract while smaller particles are deposited into smaller airways that lead to the respiratory bronchioles (WHO, 2000 and 2021).

Previous studies suggest that short-term exposure to particulate matter leads to adverse health effects, even at low concentrations of exposure (below 100 µg/m^3). Morbidity effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function. Long-term exposure to low concentrations (~10 µg/m^3) of particulates is associated with mortality and other chronic effects such as increased rates of bronchitis and reduced lung function (WHO, 2000 and 2021). Those most at risk include the elderly, individuals with pre-existing heart or lung disease, asthmatics and children.

4. BASELINE ASSESSMENT

4.1. Meteorological Overview

Meteorological processes will determine the dispersion and dilution potential of pollutants emitted into the atmosphere. The vertical dispersion of pollution is governed by the stability of the atmosphere as well as the depth of the surface mixing layer. Horizontal dispersion of pollution is defined by dominant wind fields. Therefore, meteorological parameters including temperature, precipitation, wind speed and wind direction are of significance as they will influence the degree to which pollution will accumulate or disperse in the atmosphere.

As per the Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (DEA, 2014), representativeness of the meteorological data is influenced by the following four factors:

- Proximity of the meteorological site to the area being modelled;
- Complexity of the terrain;
- Exposure of the meteorological measurement site; and
- Period of data collection.

MM5 modelled meteorological data was used for the project area. MM5 meteorological data was obtained from Lakes Environmental for the period January 2022 to December 2024. MM5 is a PSU/NCAR meso-scale model used to predict meso-scale and regional-scale atmospheric circulation. The model provides integrated model meteorological data, which can be used in a wide range of applications. This model is often used to create weather forecasts and climate projections. Details of the meteorological data obtained is summarised in Table 4-1 below.

The South African dispersion modelling regulations requires a minimum of 3-years of meteorological data for input into the dispersion model. The meteorological overview given below is with reference to the data used for input into the model. The meteorological data is representative of recent prevailing weather conditions that will likely be experienced at the project site.

Table 4-1: Meteorological Data Details.

Meteorological Data Details	
Met Data Information	**Description**
Met data type	MM5 AERMET-Ready (Surface & Upper Air Data)
Datum	WGS 84
Closest Town	Ladysmith - South Africa
Time zone	UTC +2 hours
Period of record	January 2022 - December 2024
Met Station Parameters	**Description**
Anemometer height	14 m
Station base elevation	921 m
Upper air adjustment	-2 hours
Grid Cell Information	
Co-ordinates of centre met grid	28.682161°S, 29.989261°E
UTM zone	-35
Cell dimension	12km x 12km
Surface Met Data	**Description**
File format	SAMSON file
Output interval	Hourly
Upper Air Data	**Description**
Format	TD-6201- Fixed Length
Reported in	GMT
Output interval	00Z and 12Z
Models used to process met data	
Model used to process data for wind roses	WR Plot

Model used to process data for AERMOD	AERMET

4.1.1. Local Wind Field

Figure 4-1 below provides the period wind rose plot for the project site for the period January 2022 to December 2024. The predominant wind directions for the period are observed from the east, east-southeast (~17.3% of the time) and west-northwest (~13.8% of the time). Wind speeds for the three-year period were generally moderate to fast, with an average wind speed of 3.13 m/s recorded for the period. Calm conditions, defined as wind speeds less than 0.5 m/s, were observed for 9.65% of the time (Figure 4-1).

The morning (AM) and evening (PM) period wind rose plots for the period January 2022 to December 2024 are given in Figure 4-2 and show diurnal variation in the wind field data. During the morning (AM) period, high frequency winds are observed from the west-northwest, but with additional low-frequency winds originating from the east-southeast and north-west. In the evening (PM) period, there is a shift in prevailing winds, as easterly and east-southeasterly winds become prominent (Figure 4-2).

Seasonal variation in winds at the project site is shown in Figure 4-3 below, which depicts a gradual shift in prevailing winds from season to season. In the summer season, east-southeasterly winds and easterly winds are dominant. Similar wind fields prevail during the autumn and spring seasons, however, an additional west-northwesterly wind component is established. In the winter season, stronger west-northwesterly winds prevail. On average, stronger winds are observed during the winter and spring seasons (i.e. mean wind speeds of 3.39m/s and 3.35 m/s, respectively). Winds weaken slightly in summer and autumn, with average wind speeds of 3.10 m/s and 2.69 m/s recorded, respectively.

Based on the prevailing wind fields for the period January 2022 to December 2024, emissions from activities at the proposed mine will likely be transported towards the west, west-northwest and east-southeast, depending on the season and time of day. Moderate to fast winds observed during all the time periods may result in effective dispersion and dilution of emissions from the proposed mining operations; however, higher winds speeds can also facilitate fugitive dust emissions from open exposed areas such as temporary coal stockpiles, material handling operations and other mining activities.

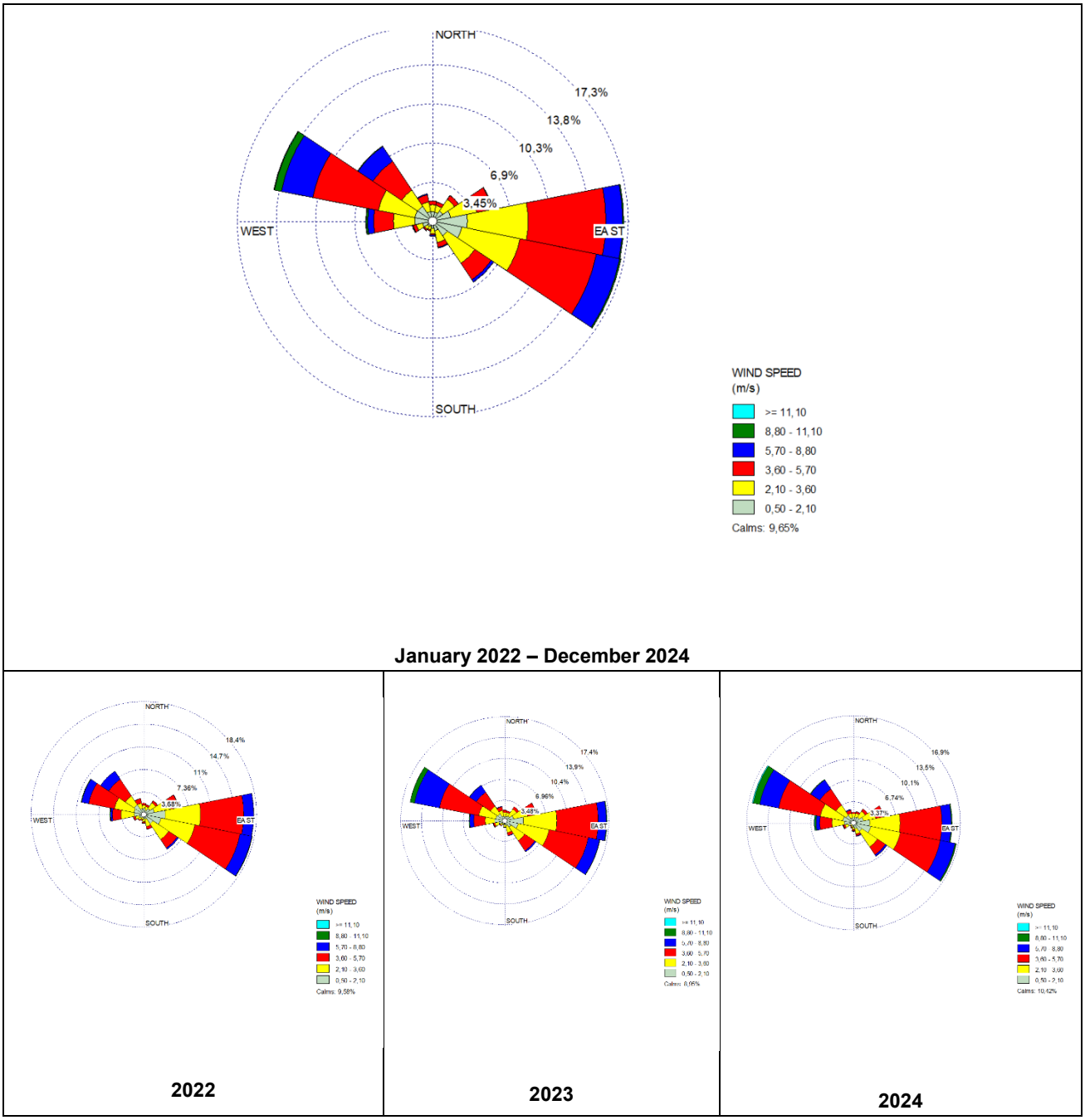

Figure 4-1: Period Wind Rose Plots for the project site for the period January 2022 - December 2024.

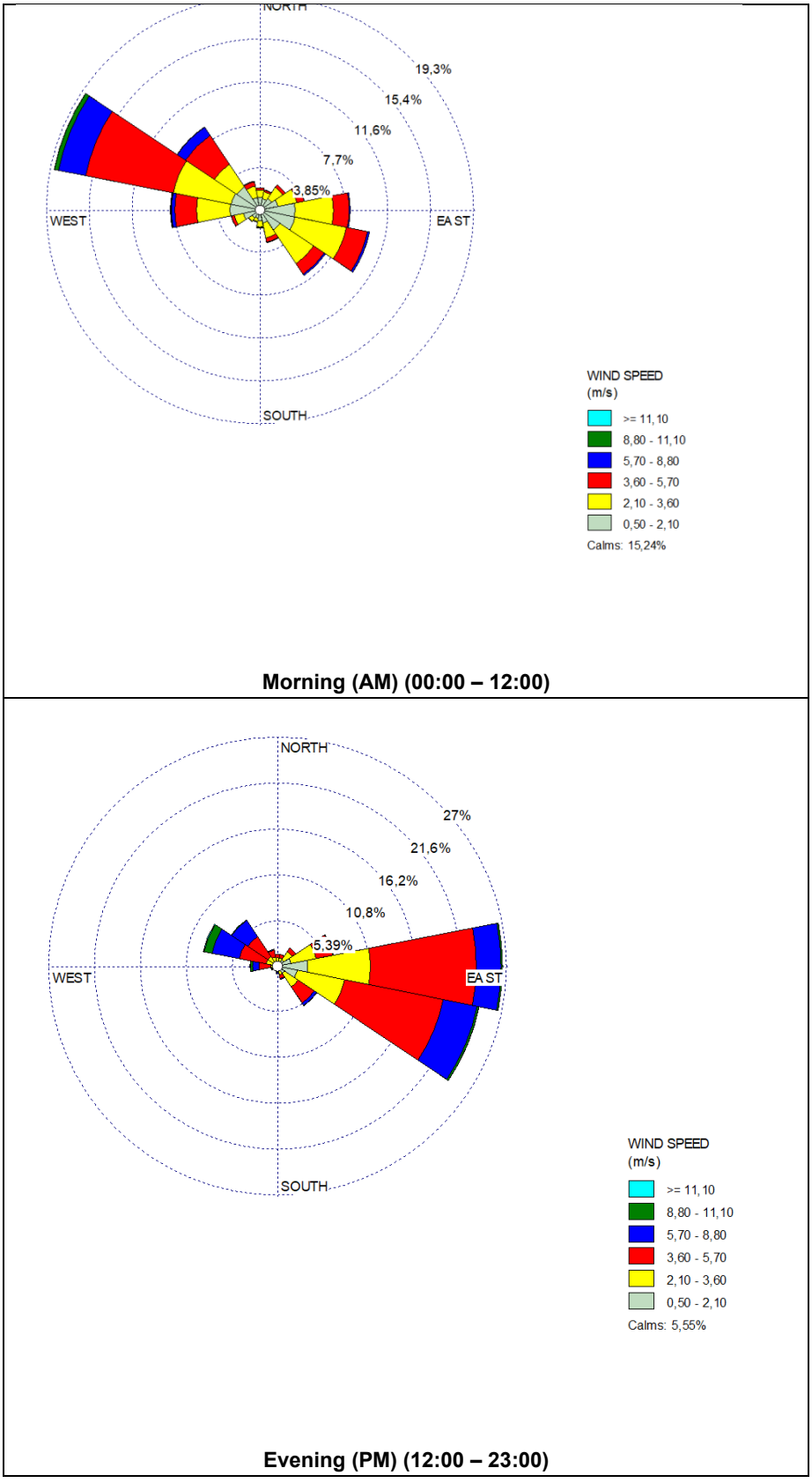

Figure 4-2: Morning (AM) (00:00 - 12:00) and Evening (PM) (12:00 - 23:00) Period Wind Rose Plots for the project site for the Period January 2022 - December 2024.

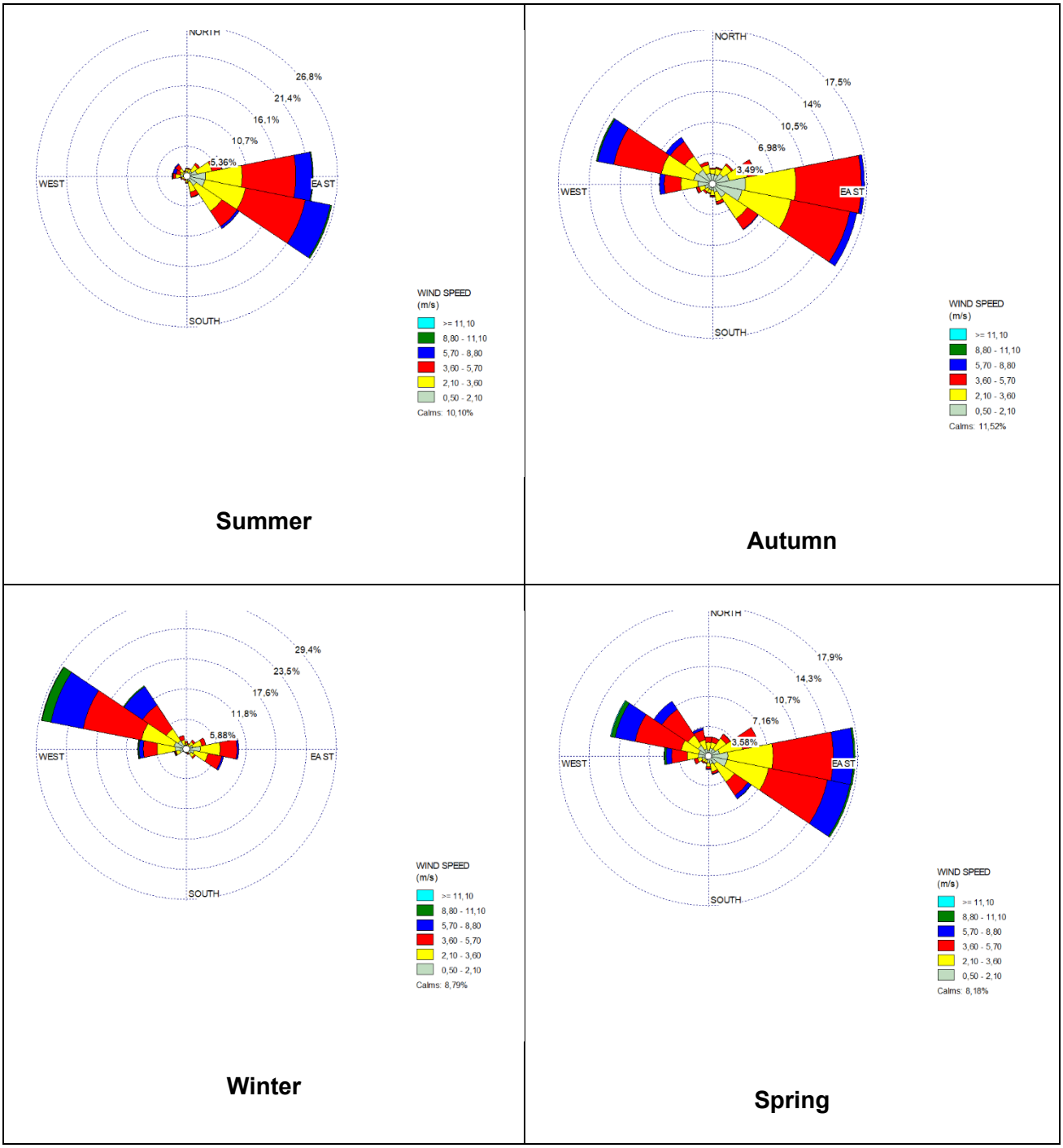

Figure 4-3: Seasonal Variation of Winds for the project site for the Period January 2022 - December 2024.

4.1.2. Temperature and Relative Humidity

Temperature affects the formation, action and interactions of pollutants in various ways. Temperature provides an indication of the rate of development and dissipation of the mixing layer, which is largely controlled by surface inversions. Surface temperature inversions play a major role in air quality, especially during the winter months when these inversions are the strongest. Higher ambient temperatures will facilitate the dispersion of air pollutants which can result in lower ambient concentrations.

Chemical reaction rates also tend to increase with temperature and the warmer the air, the more water it can hold and therefore the higher the humidity. When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles. This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids.

The KwaZulu-Natal region generally experiences hot summers with high humidity, while winters are dry and mild. Monthly average temperatures and relative humidity profiles at the project site for the period January 2022 to December 2024 are presented in Figure 4-4 below. Average monthly temperatures range from 12.6 – 23.0 ºC (Table 4-2). Higher temperatures are observed during the spring to mid-autumn months (September – April), while lower temperatures are observed during the late-autumn to winter months (May – August). The relative humidity profile for the project site is like the temperature profile – higher in the warmer months and lower in the colder and much cooler months.

Table 4-2: Monthly Minimum, Maximum and Average Temperatures for January 2022 - December 2024.

MONTHLY MINIMUM, MAXIMUM AND AVERAGE TEMPERATURES (ºC) 2022 – 2024												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Minimum	9.40	12.10	11.60	6.10	3.80	1.60	1.50	1.40	2.00	3.90	6.60	10.00
Maximum	36.90	37.60	34.10	32.10	30.40	25.50	26.60	29.60	33.20	35.90	36.90	37.60
Average	22.56	22.84	21.41	18.21	16.34	12.55	12.72	14.96	18.45	19.86	22.07	22.95

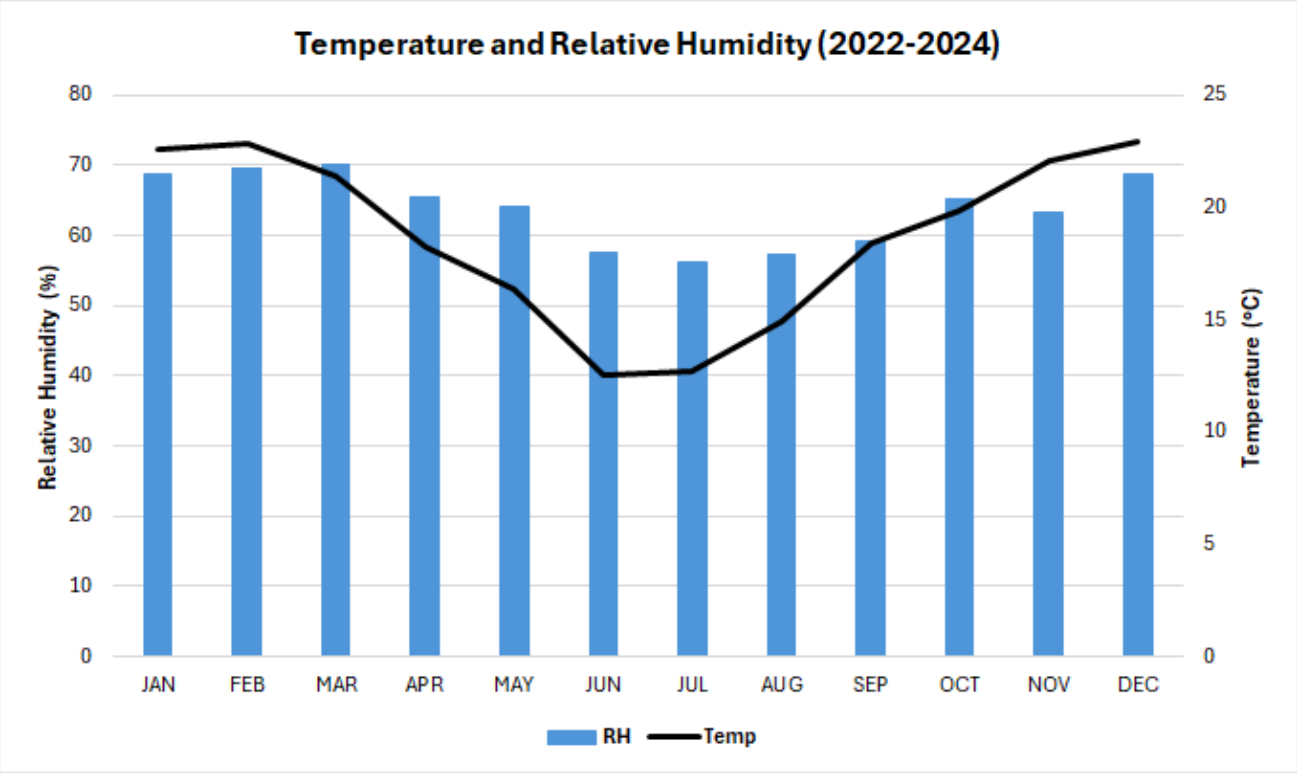

Figure 4-4: Monthly Average Temperature and Relative Humidity profiles for the project site for January 2022 - December 2024.

4.1.3. Precipitation

Precipitation has an overall dilution effect and cleanses the air by washing out particles suspended in the atmosphere. Monthly total rainfall at the project site for the period January 2022 to December 2024 is presented in Figure 4-5. The area receives most of its rainfall during late-spring to autumn seasons during the months October - March. Little to no rainfall is observed during the winter season from June to August (Table 4-3). Removal of particulates via wet depositional processes would be evident during the warmer (wet) seasons, thus lower ambient concentrations of dust could be expected during these seasons. Over the remainder of the year higher ambient concentrations of particulates could be expected.

Table 4-3: Total Monthly Rainfall for January 2022 - December 2024.

TOTAL MONTHLY RAINFALL (mm) 2020 - 2022													
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTAL**
2022	342	134	196	113	39	1	4	7	40	161	201	300	1537
2023	102	321	63	17	30	2	0	3	19	130	87	298	1070
2024	140	29	23	108	1	52	0	3	41	64	160	166	787

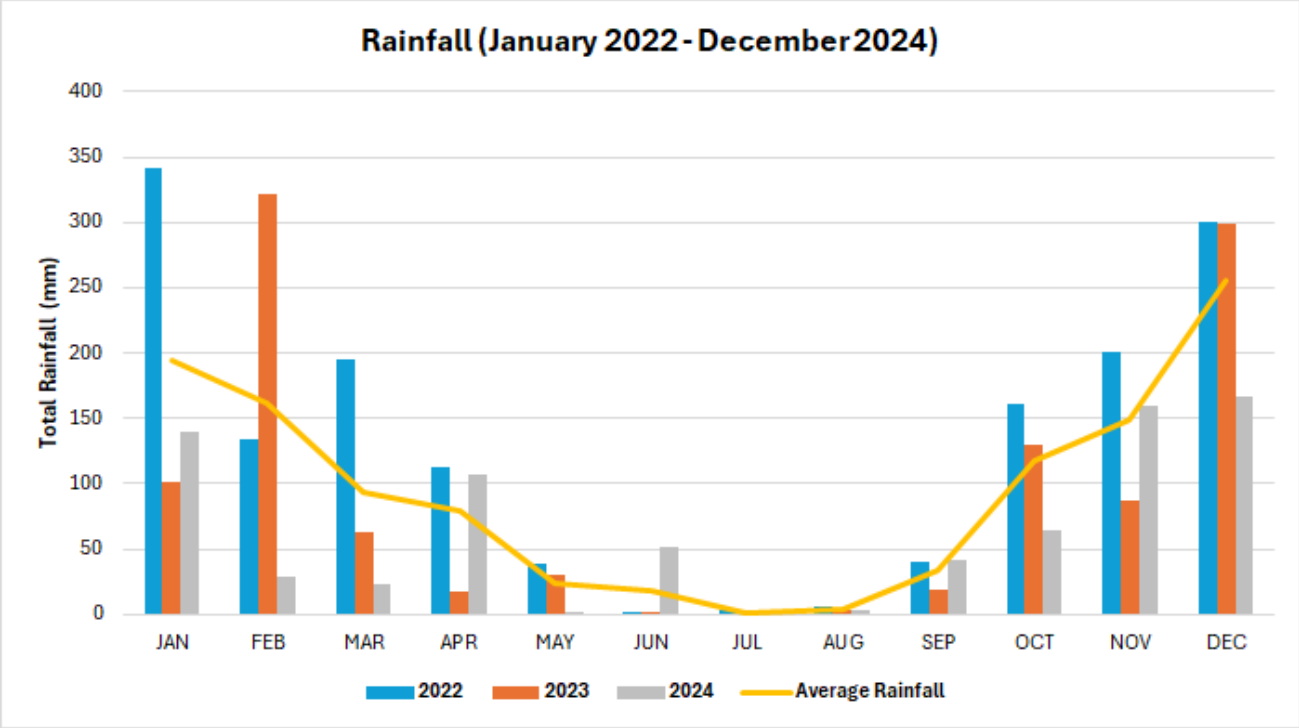

Figure 4-5: Total Monthly Rainfall (mm) for the project site for the period January 2022 - December 2024.

4.2. Baseline Air Quality Concentrations

The existing air quality situation is usually evaluated using available monitoring data from permanent ambient air quality monitoring stations and dustfall networks operated near the project site. There was no air quality monitoring data from the South African Air Quality Information System (SAAQIS) (that could be determined) to present background concentrations for PM_{10} and $PM_{2.5}$ concentrations at the project site. The nearest AQMS to the project site is located at the Escourt station (-29.000526°S, 29.873569°E), located ~35km south of the proposed mine. However, there was no ambient air quality monitoring data available from the station as it appears to be malfunctioning, with no data recorded over the past several years. Furthermore, there is no ambient air quality monitoring undertaken at the project site. In addition, dustfall data could not be provided in this AQIAr as there are no available dustfall networks operated near the project site, that could be determined.

It is noted that the proposed mine is in an isolated/remote area, which is mostly rural, and surrounded by a few background pollution sources (as seen in Section 4.3). Therefore, background air quality in the area is not expected to be poor. However, this can only be confirmed by undertaking baseline air quality monitoring for dustfall, PM_{10} and $PM_{2.5}$ before commencement of operations at the proposed mine, if possible.

4.3. Surrounding Sources of Air Pollution

Existing key sources of air pollution surrounding the project site were identified during a desktop exercise and include (Figure 4-6):

- Vehicle dust entrainment on unpaved roads (surrounding areas);
- Wind erosion from exposed areas (bare surfaces and fallow land);
- Villages and domestic fuel combustion (surrounding areas); and

- Commercial agricultural activities (cultivated lands) and potential biomass burning (south-east, west and north-west of project site).

Mining activities, informal settlements/townships and industrial activities are additional sources of air pollution, but to a minor extent. These activities are indicated to occur over much smaller areas when compared to the key pollution sources (Figure 4-6).

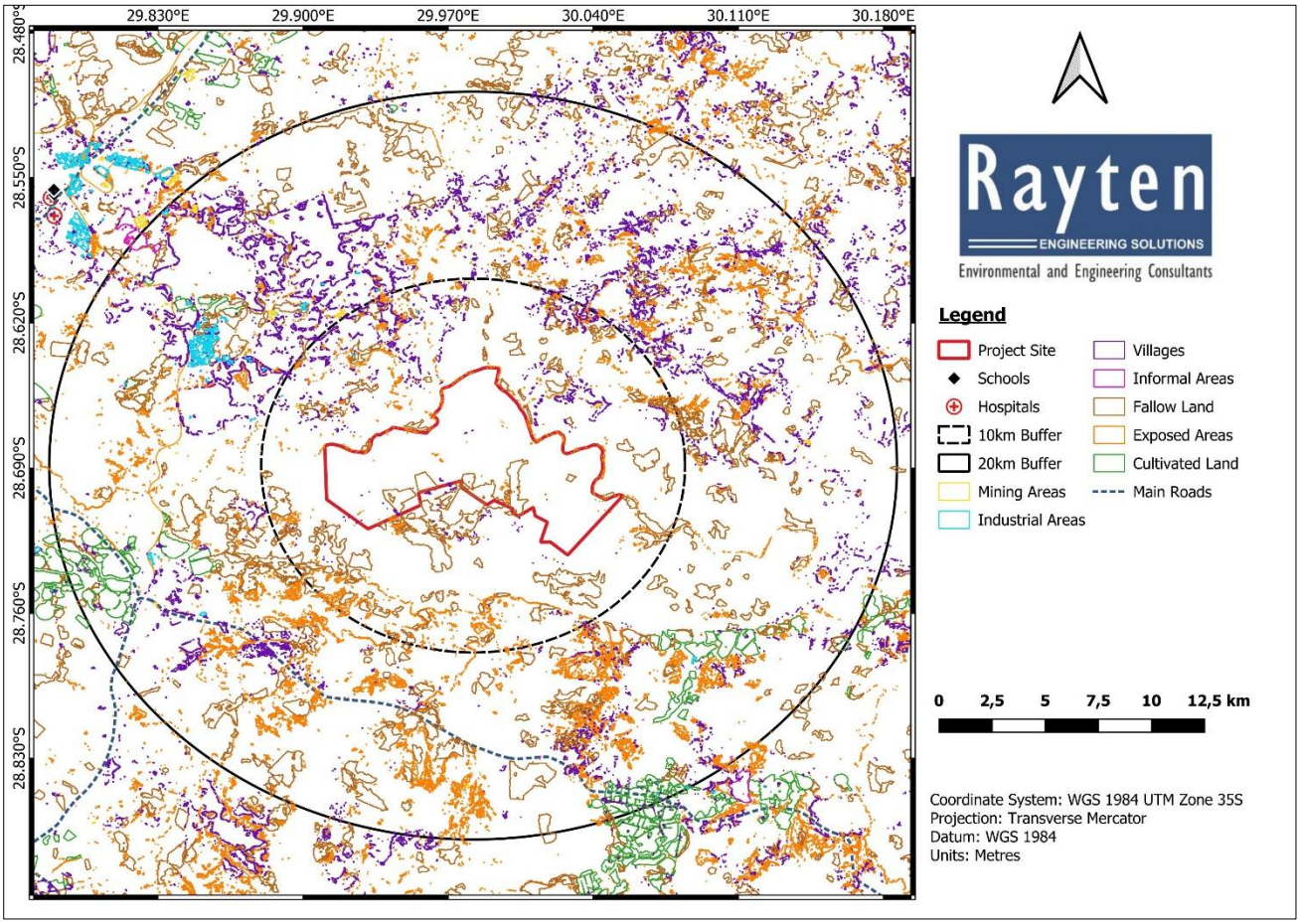

Figure 4-6: Identified surrounding emission sources within 20km of the proposed mine.

4.3.1. Vehicle Dust Entrainment on Unpaved Roads

The project area is largely rural and therefore surrounded by many unpaved dirt roads within a 20km radius. Vehicle-entrained dust emissions from the surrounding unpaved roads in the area potentially represent a key source of fugitive dust. When a vehicle or truck travels on an unpaved road, the force of the wheels on the road surface causes the pulverisation of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed.

4.3.2. Wind Erosion from Exposed Areas

There are open exposed areas such as bare lands and fallow lands surrounding the project site, which represent a source of dust in the area. Dust emissions due to the erosion of exposed areas occur when the threshold wind speed is exceeded. The threshold wind speed is dependent on the erosion

potential of the exposed surface, which is expressed in terms of the availability of erodible material per unit area (mass/area). Any factor which binds the erodible material or otherwise reduces the availability of erodible material on the surface thus, decreases the erosion potential of the surface. Studies have shown that when the threshold wind speeds are exceeded, particulate emission rates tend to decay rapidly due to the reduced availability of erodible material.

4.3.3. Villages and Potential Domestic Fuel Combustion

South Africa is characterised as a developing country, where many middle- to low-income settlements, such as villages and informal settlements are located. Due to increased levels of poverty and the rising cost of electricity in South Africa, many residents from middle- to low-income settlements make use of solid fuel (coal) combustion as a primary energy source for cooking and heating in winter (Language *et al.,* 2017). The household burning of coal emits large quantities of pollutants such as SO_2, CO, polycyclic aromatic hydrocarbons (PAHs) and respirable particulates (DEA, 2009). Some villages are located near the proposed mine in surrounding areas.

4.3.4. Agricultural Activities (cultivated lands) and Potential Biomass Burning

There are commercial agricultural areas surrounding the project site which include permanent and temporary crops. These areas are located south-east, west and north-west of the project site, within a 10 – 20km radius. Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions. Expected emissions resulting from agricultural activities include particulates associated with wind erosion and burning of crop residue, chemicals associated with crop spraying and odiferous emissions resulting from manure, fertilizer and crop residue. Dust associated with agricultural practices may contain seeds, pollen and plant tissue, as well as agrochemicals, such as pesticides. The application of pesticides during temperature inversions increases the drift of the spray and the area of impact.

Dust entrainment from farming vehicles travelling on gravel roads may also cause increased particulates in an area. Dust from traffic on gravel roads increases with higher vehicle speeds, more vehicles and lower moisture conditions. The seasonal burning of the veld from July to September for field clearing in preparation for planting is also a source of smoke (potential biomass burning). The nature of the activity has a potential impact on air quality in the area.

5. AIR QUALITY IMPACT ASSESSMENT

Dustfall, PM_{10} and $PM_{2.5}$ are key pollutants of concern associated with operations at the proposed mine and are emitted from the following key sources:

Dustfall and Particulate Emissions:

- Highwall mining (drilling into coal seam);
- Bulldozing;
- Materials handling operations (transfer, loading/offloading operations);
- Wind erosion from exposed areas: temporary coal stockpile; and
- x4 FELs (servicing the needs of the highwall miners, cleaning up coal spillages, and establishing the highwall and performing rehabilitation).

The above-mentioned sources were identified for the proposed mine based on the information provided by the client. A detailed questionnaire was given to the client prior to modelling to obtain

specific details needed for input into the model and for calculation of emission rates. The conservative scenario was assumed where information was not known for input into the model. Please refer to Section 5.4 for more details about the assumptions made in this study.

To investigate the potential impact of operations associated with the proposed highwall mining project on local ambient air quality, the following air pollutants were chosen to be quantified and modelled:

- Dustfall
- Particulate matter (PM_{10} and $PM_{2.5}$)

This project focused on dust emissions as this is a key pollutant emitted associated with operational activities at the proposed mine.

In the quantification of emissions, use was made of published predictive emission factor equations given in the United States Environmental Protection Agency (USEPA) AP-42 documents and the Australian National Pollutant Inventory (NPI) Emission Estimate Technique (EET) Manual. The South African Regulations regarding Air Dispersion Modelling recommends the use of published emission factors for national consistency, such as the USEPA AP-42 and NPI emissions factors.

An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors are always expressed as a function of the weight, volume, distance or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where:

E = emission rate
A = activity rate
EF = emission factor
ER = overall emission reduction efficiency (%)

The emission factors and equations used in the assessment for the proposed mine are described in section 5.1 below. Material throughputs are based on the information provided by the client and include:

- Maximum hourly production rate of 220 tonnes of coal produced from the proposed highwall mining operations (based on 16-hour working day).
- 220 tonnes of coal transferred from the mining area to the temporary stockpile area, per hour (based on 16-hour working day).

A summary of the activities modelled in this study is given below in Table 5-1. The fugitive emission source locations, descriptions and dimensions that were used for input into the model are given in Appendix C.

The margins of uncertainty/accuracy associated with the emission factors used are given in Section 5.1. NPI Emission factor symbols and ratings can be summarised as follows (NPI, 2015):

- A – Excellent;

- B – Above average;
- C – Average;
- D – Below Average;
- E – Poor; and
- U – Unrated.

An A or B rating indicates a higher degree of certainty, whereas a D or E rating indicates a lower degree of certainty. A rating of U indicates that the emission factor uncertainty has not been rated (e.g. for emission factors generated by modelling rather than actual test results) (NPI, 2015).

Table 5-1: Modelled sources of emissions associated with the proposed mine.

POLLUTANT	SOURCES OF EMISSIONS INCLUDED IN DISPERSION MODEL
	OPERATIONAL PHASE
Dustfall and Particulate emissions (PM_{10} & $PM_{2.5}$)	**Area and volume sources:** • Highwall mining (drilling into coal seam); • Bulldozing; • Materials handling operations (transfer, loading/offloading operations); • Wind erosion from exposed areas: temporary coal stockpile; and • x4 FELs (servicing the needs of the highwall miners, cleaning up coal spillages, and establishing the highwall and performing rehabilitation).

5.1. Proposed Highwall Mining Operations - Emission Rates.

5.1.1. Wind Erosion from Exposed Surfaces (i.e. Stockpiles.)

Wind erosion from exposed surfaces such as dumps and stockpiles, are a significant source of dust emissions. Physical properties namely the shape, size, height, the surface area coverage, moisture content and the surface compaction of the stockpiles together with prevailing meteorological conditions will influence the rate at which dust is emitted. Significant amounts of dust will be eroded from the stockpiles under wind speeds greater than 5.4 m/s (i.e. threshold friction velocity of 0.26 m/s). Fugitive dust generation resulting from wind erosion under high winds (i.e. > 5.4 m/s) is directly proportional to the wind speed.

There will be one coal stockpile at the proposed mine, for temporary storage of coal prior to the coal's removal from site. Wind erosion will, therefore, mainly occur at this one stockpile.

In the estimation of fugitive dust emissions from the coal stockpile at the proposed mine, emissions were calculated by use of the emission factors for wind erosion given in the NPI, EET manual for mining (NPI, 2012). The emission factors for TSP, PM_{10} and $PM_{2.5}$ used are given below.

Wind erosion (NPI Mining, Table 2):

$$E_{TSP} = 0.4\ \text{kg/Ha/hr}$$

$$\text{E}_{\text{PM10}} = 0.2\ \text{kg/Ha/hr}$$

$$E_{PM2.5} = 5\%\ of\ TSP$$

Where:
E = Emission rate (Kg/Hectare/hour)
Emission factor rating symbol = U

The emission rates for TSP, PM_{10} and $PM_{2.5}$ and input parameters for the coal stockpile are given in Table 5-2.

Table 5-2: Input parameters for stockpiles and exposed areas.

SOURCE [2]	EMISSION RATE (g/s)			MAX HEIGHT (m)[1,]	MAX LENGTH (m)[1]	MAX WIDTH (m)[1]
	TSP	PM_{10}	$PM_{2.5}$			
Coal stockpile	0.000044	0.000022	0.000002	5	2	2
Notes: 1. Max height and source dimensions were based on the information provided by client. Locality of source was assumed. 2. Emission duration assumed to be 16 hours for 7 days a week.						

5.1.2. Front-End-Loaders (FELs) and/or Excavators

FELs will be used for servicing the needs of the two proposed highwall miners, cleaning up coal spillages, establishing the highwall, performing rehabilitation, etc. There will be a total of four FELs, with two FELs assigned to each highwall miner. The USEPA does not have an emission factor or equation specific for calculating emissions from excavators, FELs or shovels. The Australian NPI, however, provides the same equation as for tipping to be applied to excavators, shovels and FELs.

Emissions of dust, PM_{10} and $PM_{2.5}$ due to FEL activities at the proposed mine were quantified using the NPI emission factors provided in the EET for Mining for:

Excavators/shovels & FELs – Coal (NPI Mining, Table 2):

$$\text{E}_{\text{TSP}} = 0.029\ \text{kg/ton}$$

$$\text{E}_{\text{PM10}} = 0.014\ \text{kg/ton}$$

$$\text{E}_{\text{PM2.5}} = 5\%\ \text{of TSP}$$

The emission rates for TSP, PM_{10} and $PM_{2.5}$ for FEL activity at the proposed mine are given in Table 5-3.

Table 5-3: Input parameters for front-end loader and excavator activity.

SOURCE [1, 2, 3, 5]	EMISSION RATE (g/s)			THROUGHPUT (TONNES/HOUR) [4]
	TSP	PM_{10}	$PM_{2.5}$	
x2 FELs at highwall miner 1 (assumed to be cleaning spillages)	0.0008	0.0004	0.00004	0.10 (per FEL)
x2 FELs at highwall miner 2 (assumed to be cleaning spillages)	0.0008	0.0004	0.00004	0.10 (per FEL)
Notes: 1. FEL = Front-end-loader 2. No emission control efficiency was considered for material handling. 3. The dimensions of source were based on the specifications given by Richie Specs for similar equipment. 4. Hourly throughputs were assumed for modelling purposes. 5. Operations assumed to occur 16 hours a day, 7 days a week.				

5.1.3. Bulldozing

Bulldozing activities will occur at the temporary coal stockpile, to shape the stockpile. One bulldozer was assumed to be used at any given time. Emissions of TSP, PM_{10} and $PM_{2.5}$ due to bulldozing activity at the proposed mine were quantified using the USEPA AP-42's emission equations for bulldozing at western surface coal mines:

Bulldozing material –coal (USEPA AP-42, Chapter 11.9, Table 11.9-2):

$$E_{TSP} = \frac{35.6 \times (s)^{1.2}}{(M)^{1.3}}$$

$$E_{PM10} = 0.75 \times [\frac{8.44 \times (s)^{1.5}}{(M)^{1.4}}]$$

$$E_{PM2.5} = [\frac{35.6 \times (s)^{1.2}}{(M)^{1.3}}] \text{x } 0.022$$

Where:
E = Emission rate (kg/hour/vehicle)
Emission factor rating symbol = C
M = material moisture content (%) (assumed to be 4.5%)
s = material silt content (%) (assumed to be 2.2%)

The emission rates for TSP, PM_{10} and $PM_{2.5}$ due to bulldozing activities at the proposed mine are given Table 5-4.

Table 5-4: Input parameters for bulldozing activities.

SOURCE [1, 2]	EMISSION RATE (g/s)			Material
	TSP	PM_{10}	$PM_{2.5}$	
x1 Bulldozer (shaping stockpile)	3.60	0.70	0.079	Coal

Notes:
1. The dimensions (length and width) for the source were assumed based on dimensions of the coal stockpile (i.e. 2m x 2m).
2. Assumed to be used for 16 hours a day for 7 days a week, based on information provided by the client.

5.1.4. Highwall Mining – Drilling at Proposed Mine

Highwall mining is similar to drilling in that the machine drills horizontally into the hard strata or hard overburden to extract the coal. It was confirmed that two highwall mining machines will be used at any given time. The USEPA does not have an equation specific for high wall mining therefore the USEPA emission factor for drilling into coal was used instead. Emissions from highwall mining activities were calculated using the following emission factor, obtained from the USEPA AP-42's emission factors for drilling at western surface coal mines:

Drilling at coal mines (USEPA AP-42, Chapter 11.9, Table 11.9-4):

$$E_{TSP} = 0.1 \text{ kg/hole/day}$$

$$E_{PM10} = \text{assumed to be } 50\% \text{ of TSP}$$

$$E_{PM2.5} = \text{assumed to be } 5\% \text{ of TSP}$$

Where:
E = Emission rate (kg/hole)
Emission factor rating symbol = E

The emission rates for TSP, PM_{10} and $PM_{2.5}$ due to highwall mining operations at the proposed mine are given Table 5-5.

Table 5-5: Input parameters for highwall mining activities.

SOURCE [1]	EMISSION RATE (g/s)			Dimensions of drill hole	
	TSP	PM_{10}	$PM_{2.5}$	Length/Width (m) [2]	Height (m) [2]
Highwall miner 1 (drilling into coal)	0.0017	0.0009	0.00009	3.5	1.2
Highwall miner 1 (drilling into coal)	0.0017	0.0009	0.00009	3.5	1.2

Notes:
1. Highwall mining (drilling) occurs for 16 hours a day for 7 days a week based on information provided by client.
2. Dimensions of source (width) and height were estimated based on information provided by client.

5.1.5. Materials Handling (Miscellaneous /Conveyer Transfer Points

Material handling operations, including the transfer of material by means of conveying, and/or miscellaneous transfer at the proposed mine, are predicted to result in fugitive dust emissions.

Emissions of dustfall, PM_{10} and $PM_{2.5}$ due to miscellaneous transfer points are quantified using the NPI emission factors provided in the NPI EET manual for mining (NPI, 2012) for:

Miscellaneous transfer points – coal mines (including conveying) (NPI, Mining, Table 2):

$$E_{TSP} = 0.00032 \text{ kg/ton}$$

$$E_{PM10} = 0.00015 \text{ kg/ton}$$

$$E_{PM2.5} = 5\% \text{ of TSP}$$

Where:
E = Emission rate (kg/tonne/transfer point)
Emission factor rating symbol = U

Emission rates for TSP, PM_{10} and $PM_{2.5}$ from conveyor/miscellaneous material transfer activities at the proposed mine are given in Table 5-6.

Table 5-6: Input parameter for miscellaneous/conveyor transfer activities.

SOURCE	Material Type	THROUGHPUT TONNES/HOUR (4)	EMISSION RATE (g/s)		
			TSP	PM_{10}	$PM_{2.5}$
x1 transfer point (load conveyor from highwall miner 1 (1,2)	Coal	110	0.01	0.0046	0.00049
x1 transfer point (load coal stockpile from conveyor 1)	Coal	110	0.01	0.0046	0.00049
x1 transfer point (load conveyor from highwall miner 2 (1,2)	Coal	110	0.01	0.0046	0.00049
x1 transfer point (load coal stockpile from conveyor 2)	Coal	110	0.01	0.0046	0.00049

Notes:
1. Operations assumed to occur 16 hrs for 7 days per week, based on information provided by the client
2. Hourly throughput was confirmed by the client (i.e. total of 220 tonnes/hour, based on a 16 hour working day).

5.2. Model Overview

5.2.1. AERMOD View

AERMOD, a state-of-the-art Planetary Boundary Layer (PBL) air dispersion model, was developed by the American Meteorological Society and USEPA Regulatory Model Improvement Committee (AERMIC). AERMOD utilizes a similar input and output structure to ISCST3 and shares many of the same features, as well as offering additional features. AERMOD fully incorporates the PRIME building downwash algorithms, advanced depositional parameters, local terrain effects, and advanced meteorological turbulence calculations.

The AERMOD atmospheric dispersion modelling system is an integrated system that includes three modules:

- A steady-state dispersion model designed for short-range (up to 50 km) dispersion of air pollutant emissions from stationary industrial sources.
- A meteorological data pre-processor (AERMET) for surface meteorological data, upper air soundings, and optionally, data from on-site instrument towers. It then calculates atmospheric parameters needed by the dispersion model, such as atmospheric turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux.
- A terrain pre-processor (AERMAP) which provides a physical relationship between terrain features and the behaviour of air pollution plumes. It generates location and height data for each receptor location. It also provides information that allows the dispersion model to simulate the effects of air flowing over hills or splitting to flow around hills.

AERMOD includes Plume Rise Model Enhancements (PRIME) building downwash algorithms which provide a more realistic handling of building downwash effects. PRIME algorithms were designed to address two fundamental features associated with building downwash; enhanced plume dispersion coefficients due to the turbulent wake and to reduce plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake. AERMOD is suitable for a wide range of near field applications in both simple and complex terrain. The evaluation results for AERMOD, particularly for complex terrain applications, indicate that the model represents significant improvements compared to previously recommended models.

AERMOD has been used in various dispersion modelling studies in the United States and around the world (Perry *et al*., 2004).

5.2.2. Model Requirements

The approach to this dispersion modelling study is based on the *Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa* (DEA, 2014). As per the *Code of Practice*, this assessment is a Level 2 assessment. Level 2 assessments should be used for air quality impact assessment in standard/generic licence or amendment processes where:

- The distribution of pollutant concentrations and depositions are required in time and space;
- Pollutant dispersion can be reasonably treated by a straight-line, steady-state, Gaussian plume model with first order chemical transformation. Although more complicated processes may be occurring, a more complicated model that explicitly treats these processes may not be necessary depending on the purposes of the modelling and the zone of interest.
- Emissions are from sources where the greatest impacts are in the order of a few kilometres (less than 50 km) downwind.

A summary of the key variables input into the AERMOD model is given in Table 5-7 below. Data input into the model includes MM5 modelled meteorological data (surface and upper air) for 01 January 2022 – 31 December 2024. Terrain data at a resolution of 90m (SRTM90) is used for input into the model, as generated by the terrain pre-processor, AERMAP. A modelling domain of 20km × 20km was used. A multi-tier grid with a grid receptor spacing of 250m (5km from facility), 500m (10km from facility) and 1000m (20km from facility) (3 tiers) was used.

Table 5-7: Key Variables to be used in the modelling study.

Parameter	Model Input
Model	**Input**
Assessment level	Level 2
Dispersion model	AERMOD Version 12.0.0
Supporting models	AERMET Version 12.0.0 AERMAP Version 12.0.0
Emissions	**Input**
Pollutants to be modelled	Dustfall, PM_{10}, and $PM_{2.5}$
Scenarios	Operational
Chemical transformations	N/A
Exponential decay	Rural
Settings	**Input**
Terrain setting	Elevated
Terrain data	SRTM90
Terrain data resolution (m)	90
Land use characteristics	Urban, Grassland & Forested Land
Grid receptors	**Input**
Mine operational Area boundary (m)	50
Modelling domain (km)	20 x 20
Fine grid resolution (m)	250 (5km from facility)
Medium grid resolution (m)	500 (10km from facility)
Large grid resolution (m)	1000 (beyond 10km from facility)

5.3. Dispersion Modelling Results

Dispersion simulations were undertaken for the following scenarios to determine:

- Predicted ground-level impacts from all key sources for dustfall, PM_{10} and $PM_{2.5}$ for highwall mining activities associated with the proposed mine.

The Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (DEA, 2014), recommends the use of the 99th percentile concentrations for short-term assessment with the National Ambient Air Quality Standards (NAAQS) since the highest predicted ground-level concentrations can be considered outliers due to complex variability of meteorological processes. This might cause exceptionally high concentrations that the facility may never actually exceed in its lifetime.

Isopleth plots of predicted dustfall rates and PM_{10} and $PM_{2.5}$ concentrations are given in Figure 5-1 to Figure 5-5 below. For short term averaging periods, the predicted 99th percentile concentrations are provided.

Comparison of the predicted PM_{10} and $PM_{2.5}$ ambient concentrations is made with the South African National Ambient Air Quality Standards to determine compliance. Comparison of the predicted dustfall rates is made with the South African National Dust Control Regulations, 2013 to determine compliance. In determining compliance, predicted incremental concentrations (as determined beyond the site boundary) are compared against the applicable standards. Inside the site boundary, air

pollutant concentrations are required to comply with occupational health and safety standards. In this case, the outline of the broader study area is considered as the boundary (i.e. black outline in the isopleth plots).

5.3.1. Dispersion Model Output Plots for Dustfall, PM_{10} and $PM_{2.5}$

The dispersion model output plots for dustfall rates, PM_{10} and $PM_{2.5}$ concentrations due to operational activities at the proposed mine are given in Figure 5-1 to Figure 5-5.

Incremental 99th percentile daily dustfall rates are predicted to comply with the residential area standard of 600 mg/m^2/day and non-residential area standard of 1200 mg/m^2/day over the entire project area, and no exceedances of the standards are projected. Additionally, all nearby surrounding sensitive receptors (represented as discrete receptors) are shown to experience low to negligible dustfall rates (Figure 5-1).

99th percentile daily, and annual average incremental PM_{10} concentrations, are mostly predicted to be low and fall well below the applicable daily and annual NAAQS of 75 µg/m^3 and 40 µg/m^3, respectively (Figure 5-2 and Figure 5-3). Although exceedances of the daily and annual standards are predicted inside the boundary, they are restricted to a very small area in proximity to the proposed mining activities (Figure 5-2 and Figure 5-3), with exceedances of the annual PM_{10} standard being barely noticeable. Furthermore, the dispersion modelling results indicate that very low incremental PM_{10} concentrations disperse from the proposed mine operations to the discrete receptors, over both the short and long term.

Predicted incremental 99th percentile daily, and annual average $PM_{2.5}$ concentrations, are significantly low and in compliance with the applicable standards of 40 µg/m^3 and 20 µg/m^3, respectively, over the entire project area (Figure 5-4 and Figure 5-5). All discrete receptors are indicated to experience low $PM_{2.5}$ incremental concentrations, over both the long and short term.

Based on the above, the proposed mine will not be a significant source of incremental dustfall and particulate matter (PM_{10} and $PM_{2.5}$) concentrations.

The maximum predicted incremental PM_{10} and $PM_{2.5}$ concentrations and dustfall rates at the identified nearby discrete receptors are given in Table 5-8. In addition, the maximum predicted incremental PM_{10} and $PM_{2.5}$ concentrations and dustfall rates along the boundary of the project area are given in Table 5-9.

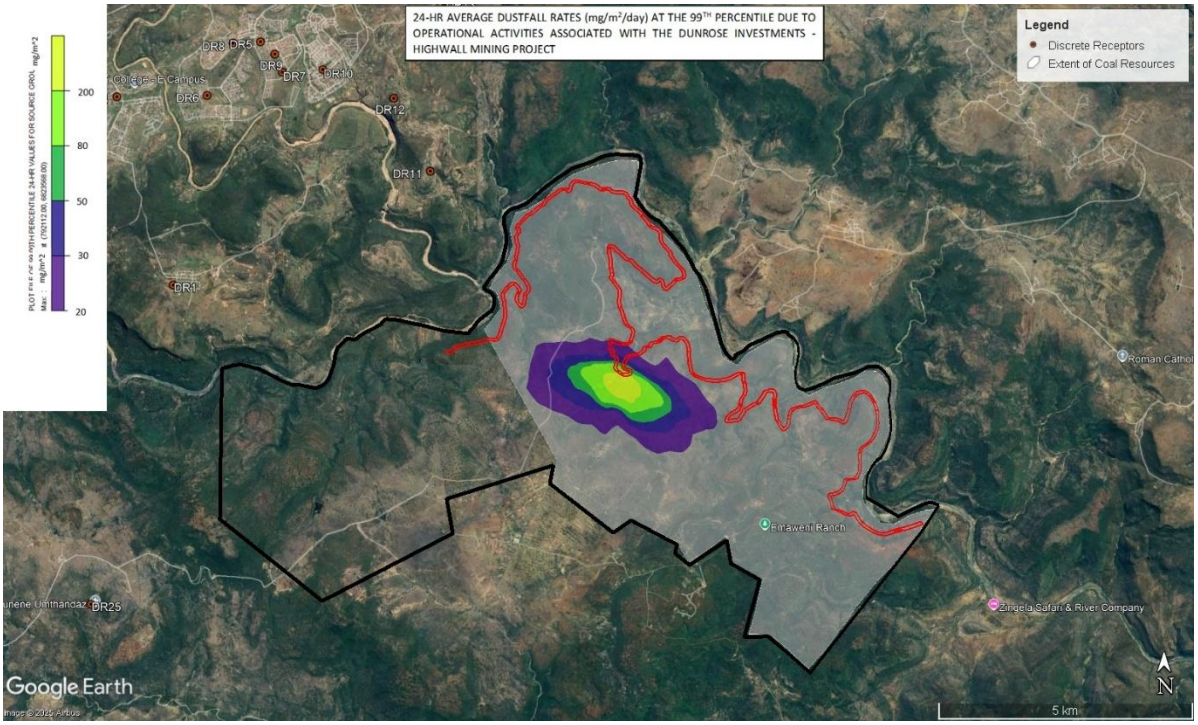

Figure 5-1: Predicted Dustfall Rates associated with the proposed mine.

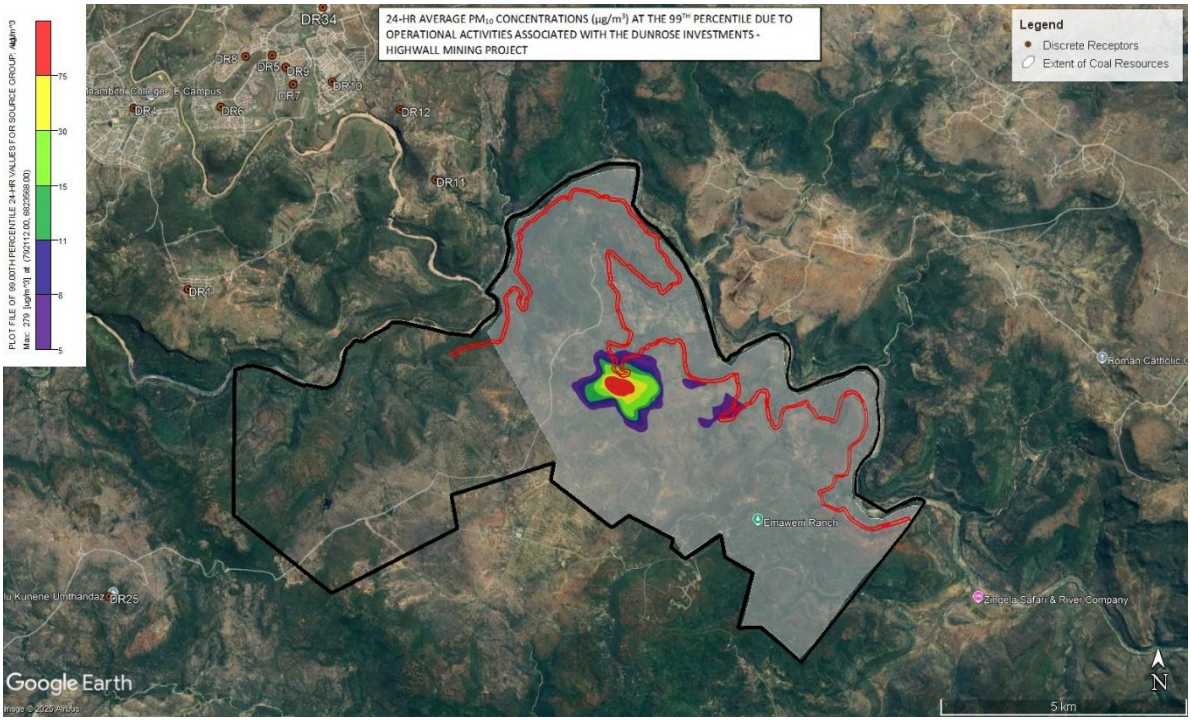

Figure 5-2: Predicted Daily Average PM_{10} Concentrations associated with the proposed mine.

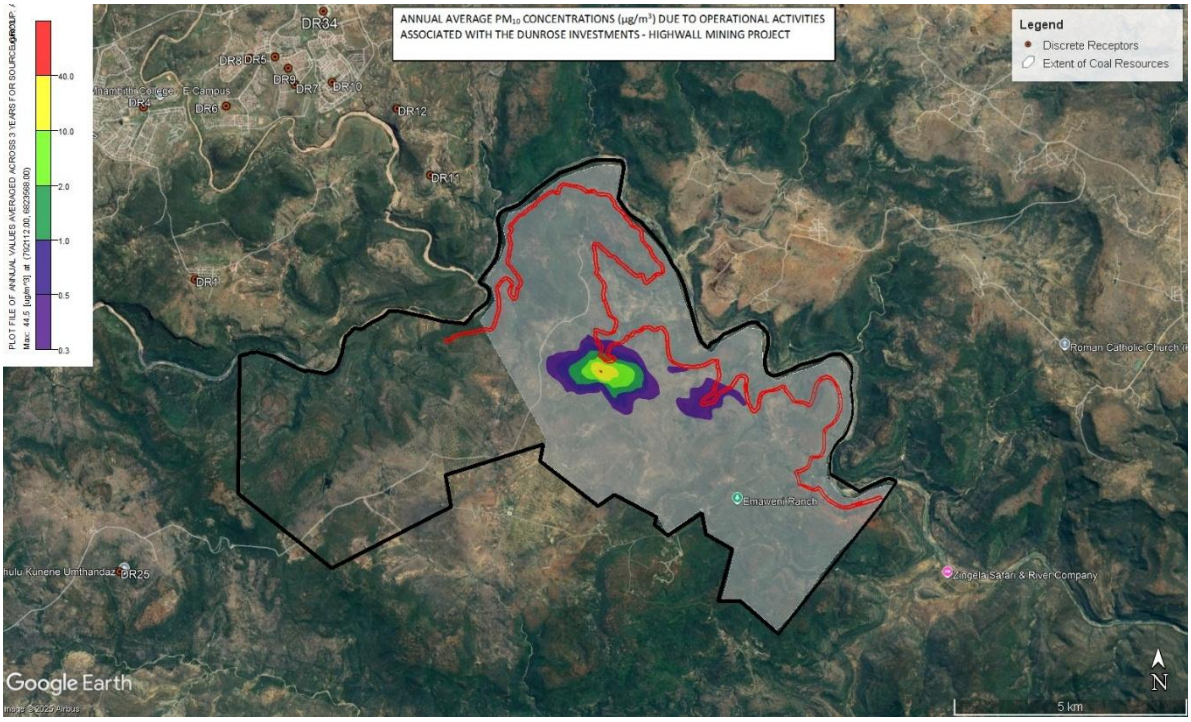

Figure 5-3: Predicted Annual Average PM_{10} Concentrations associated with the proposed mine.

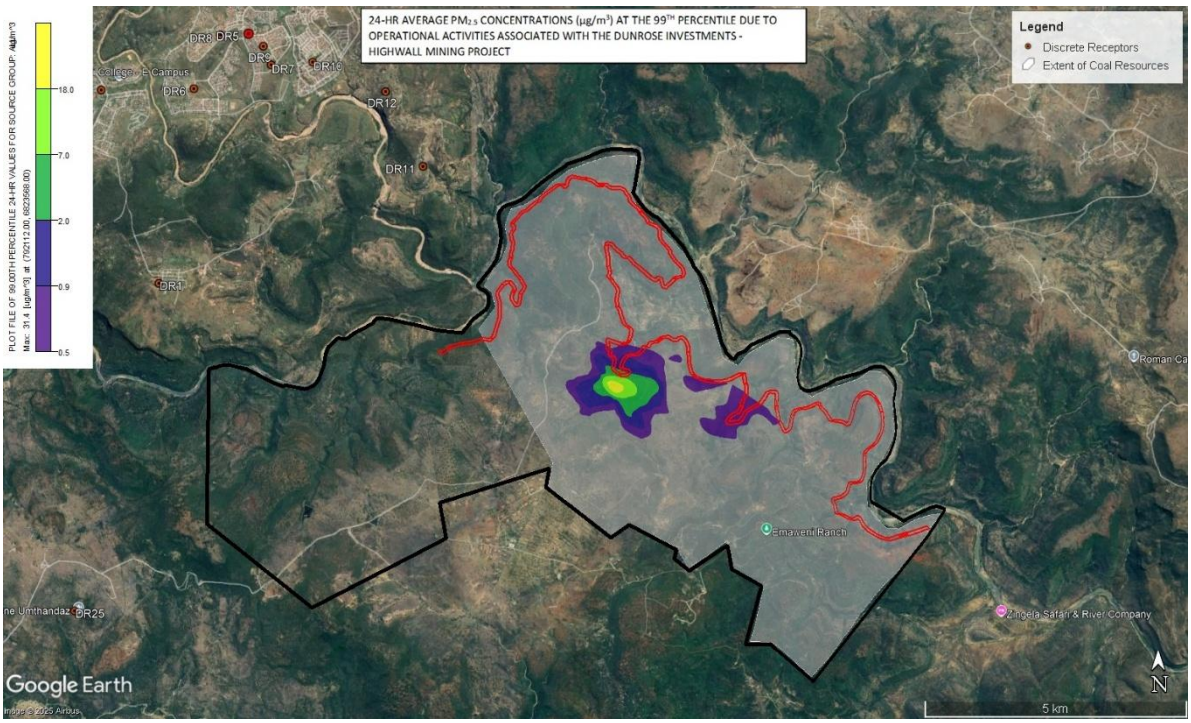

Figure 5-4: Predicted Daily Average $PM_{2.5}$ Concentrations associated with the proposed mine.

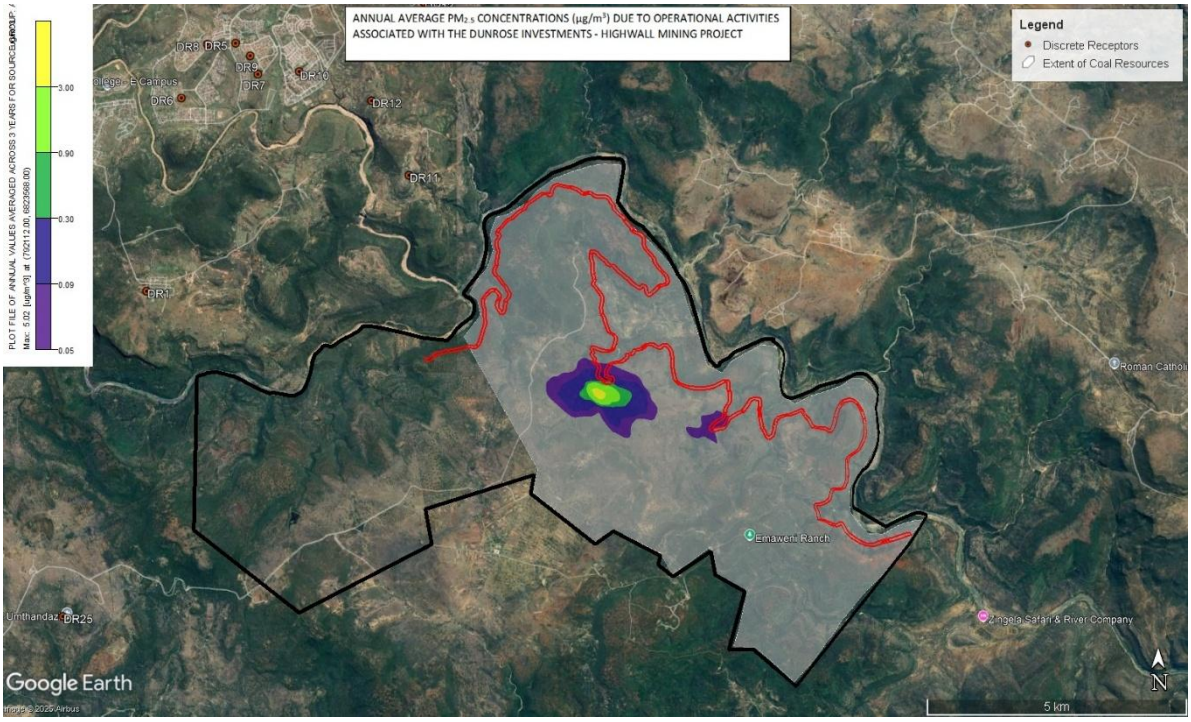

Figure 5-5: Predicted Annual Average $PM_{2.5}$ Concentrations associated with the proposed mine.

5.3.2. Maximum Predicted Incremental Concentrations

Maximum predicted incremental concentrations at nearby sensitive receptors (represented as discrete receptors) located within a 20km radius from the centre of the proposed mine operations are given in the below section (Table 5-8), and they are very low.

The discrete receptor points are located at the centre of residentials areas, or near schools, hospitals old age homes, building and dwellings, to determine the maximum concentrations that could be expected near sensitive receptors. A spatial representation of the identified discrete receptors is shown below in Figure 5-6. The receptors were identified during a desktop study (please refer to section 2.4).

The modelled discrete receptors (Figure 5-6) are restricted to those located within the same UTM zone as that of the project area (i.e. 35S). Additionally, it is noted that most of the receptors located near to the proposed mine fall within this UTM Zone.

The maximum predicted incremental PM_{10} and $PM_{2.5}$ concentrations and dustfall rates along the boundary of the project area are given in Table 5-9.

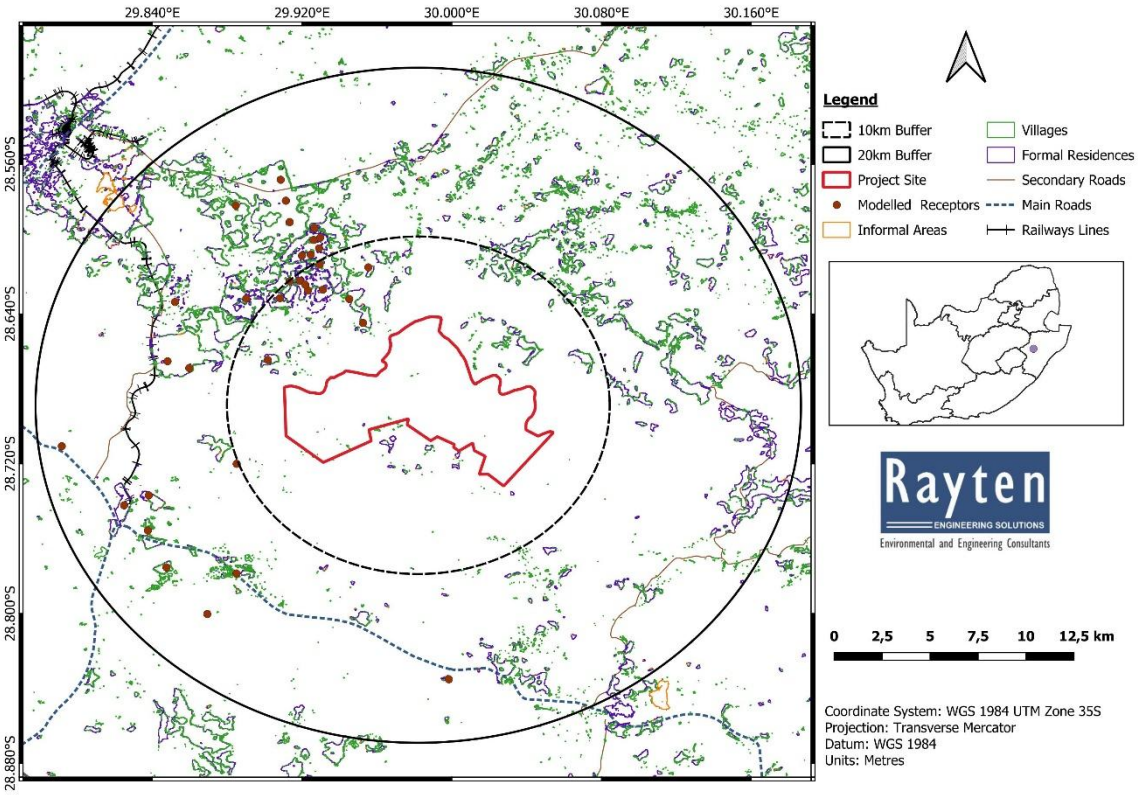

Figure 5-6: Spatial representation of discrete receptors included in dispersion model (<20km from the proposed mine).

Table 5-8: Maximum predicted incremental PM_{10}, $PM_{2.5}$ concentrations and Dustfall rates at nearby sensitive receptors, located within a 20km radius of the proposed mine.

INCREMENTAL CONCENTRATIONS (µg/m³)								
Discrete Receptor	TSP (24H) 1200 mg/m²/day	PM_{10} (24H)	PM_{10} (Annual)	$PM_{2.5}$ (24H)	$PM_{2.5}$ (Annual)	UTM Co-ordinates (35S)		Elevation (m)
		75	40	40	20	X (m)	Y (m)	
DR1	1.08	0.16	0.02	0.02	0.002	783593.43	6825731.85	1015.47
DR2	0.63	0.10	0.01	0.01	0.001	779482.58	6825347.41	1017.7
DR3	0.57	0.07	0.01	0.01	0.001	778355.45	6825780.23	1015.41
DR4	0.41	0.22	0.01	0.02	0.001	782559.66	6829402.74	967.61
DR5	0.33	0.17	0.01	0.02	0.001	785387.63	6830383.47	1001.02
DR6	0.42	0.19	0.01	0.02	0.001	784319.47	6829380.59	979.12
DR7	0.35	0.16	0.01	0.02	0.001	785790.97	6829793.12	984.77
DR8	0.33	0.10	0.01	0.01	0.001	784853.75	6830372.91	1022.92
DR9	0.34	0.17	0.01	0.02	0.001	785656.50	6830142.39	996.17
DR10	0.43	0.18	0.01	0.02	0.001	786578.07	6829824.71	984.71
DR11	0.83	0.49	0.02	0.05	0.002	788620.07	6827806.84	973.94
DR12	0.47	0.31	0.01	0.04	0.002	787944.85	6829235.24	977.87
DR13	0.28	0.18	0.01	0.02	0.001	788984.10	6831087.95	955.15
DR14	0.23	0.13	0.01	0.01	0.001	785533.62	6831867.83	1010.31
DR15	0.26	0.12	0.01	0.01	0.001	785990.51	6831915.3	1011.28
DR16	0.25	0.10	0.00	0.01	0.000	786437.18	6832280.65	1036.6
DR17	0.21	0.09	0.00	0.01	0.000	786165.40	6832778.21	1044.42
DR18	0.22	0.09	0.00	0.01	0.000	786512.53	6832911.17	1044.64
DR19	0.39	0.11	0.01	0.01	0.001	778832.92	6829281.5	1010.3
DR20	0.20	0.05	0.00	0.01	0.000	786219.77	6833493.2	1067.56
DR21	0.17	0.08	0.00	0.01	0.000	784941.56	6833872.08	1033.11
DR22	0.15	0.06	0.00	0.01	0.000	782143.80	6834918.39	1016.24
DR23	0.13	0.06	0.00	0.01	0.000	784769.30	6835138.4	1047.07
DR24	0.10	0.06	0.00	0.01	0.000	784530.25	6836387.06	1042.12
DR25	0.36	0.17	0.01	0.02	0.001	781819.70	6819617.37	994.67
DR26	0.20	0.09	0.01	0.01	0.001	777184.28	6817860.49	959.23
DR27	0.18	0.09	0.00	0.01	0.001	775884.55	6817303.49	976.06
DR28	0.17	0.08	0.00	0.01	0.001	777090.77	6815781.16	980.19
DR29	0.12	0.06	0.00	0.01	0.000	778006.41	6813570.49	1020.01
DR30	0.14	0.19	0.01	0.02	0.001	781654.46	6813123.54	949.72
DR31	0.10	0.14	0.01	0.02	0.001	780070.25	6810755.95	931
DR32	0.09	0.22	0.01	0.02	0.001	792576.37	6806583.65	993.89
DR33	0.20	0.06	0.00	0.01	0.001	772711.33	6820884.68	1027.05
DR34	0.30	0.13	0.01	0.01	0.001	786435.35	6831319.77	1005.66

Table 5-9: Summary of Predicted Maximum Modelled Incremental Concentrations at the boundary of the project site.

POLLUTANT	AVERAGING TIME	MAXIMUM MODELLED CONCENTRATION (µg/m³) [3]	COMPLIANCE AIR QUALITY STANDARD (µg/m³)
Dustfall	Daily	5.32	1200[1 & 2]
PM_{10}	Daily	2.04	75
	Annual	0.12	40
$PM_{2.5}$	Daily	0.23	40
	Annual	0.01	20

Notes:
1. Dustfall given in mg/m²/day
2. Non-residential area dustfall standard
3. Along the three Mining Right Area Boundaries (eastern & southern boundaries)

5.3.3. Cumulative Impacts

Emissions from sources need to be assessed in terms of the cumulative impacts in an area. The *Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (DEA, 2014),* outlines the following for sources not influenced by background concentrations (e.g. in isolated areas and non-priority areas):

- For annual averages, the highest predicted concentration (C_P) must be less than the National ambient air quality standards, no exceedances allowed;
- For short-term averages (24 hours or less), the 99th percentile concentrations must be less than the National ambient air quality standards. Wherever one year is modelled, the highest concentrations shall be considered.

There was no background air quality monitoring data available for the project site (refer to section 4.2), which could be used to quantitatively assess cumulative impacts. But the proposed mining project will likely result in minor cumulative impacts. This is because the maximum incremental concentrations, as predicted along the site boundary, are well below the applicable standards for dustfall, PM_{10} and $PM_{2.5}$, as seen in Table 5-9. Moreover, the predicted incremental concentrations are observed to decrease further with increasing distance from the boundary. Therefore, cumulative impacts associated with the project, though minor, will follow a similar pattern (i.e. marginally higher along the site boundary, and lower on moving away from the boundary). This means that at the surrounding discrete receptors, where very low incremental concentrations are predicted, cumulative impacts will be negligible.

5.3.4. Impact Analysis

The level of impact of operational activities associated with the proposed highwall mining project is assessed based on consequence/inherent risk and likelihood, using the methodology in Table 5-10 and Table 5-11, and summarised in Table 5-12, which provides the residual risk/overall impact significance rating. The methodology used to assess impacts is adopted from SE Solutions' proposed impact rating methodology (O'Beirne, 2024), which is explained in more detail in Appendix D.

Based on the modelled emission sources, the inherent risk (in terms of air quality) associated with operation of the proposed mine can be considered as low, while the likelihood of the impact occurring can be considered as highly unlikely. This results in a **low negative impact significance rating (i.e. low residual risk)** in terms of air quality, for the proposed mine operations (Table 5-12). This is evident in that while pollutants associated with operational activities at the proposed mine will be dispersed from the operational area to nearby sensitive receptors, predicted concentrations at all the identified receptors are projected to be very low to negligible (Table 5-8).

Table 5-10: The hierarchy of potential consequences of changes in the receiving environment (impacts). These consequences are expressed as inherent risks or benefits (viz. what could happen) because of the impacts.

	Environmental Cost	Rating
Inherent Risk/Benefit	Human health – morbidity / mortality, loss of threatened species population(s), loss of strategic water source potential or sequestered carbon stocks.	High
	Material reductions in threatened or endemic species populations or habitat, loss of livelihoods, individual economic loss.	Moderate-high
	Material reductions or degradation of environmental quality – air. Loss of habitat, loss of heritage, amenity.	Moderate
	Nuisance	Moderate-low
	Negative change - with no other consequences.	Low
	Environmental Benefits	
	Net improvement in human welfare or threatened species habitat.	Moderate – high
	Improved environmental quality – air, soil, water. Improved individual livelihoods.	Moderate
	Economic Development but no tangible environmental benefit or impact.	Moderate-low
	Positive change – with no other consequences.	Low

Table 5-11: Likelihood categories and definitions in ascribing impact significance.

Likelihood	Definitions
Highly unlikely	The possibility of the consequence occurring is negligible
Unlikely but possible	The possibility of the consequence occurring is low but cannot be discounted entirely
Likely	The consequence may not occur, but a balance of probability suggests it will.
Highly likely	The consequence may still not occur, but it is most likely that it will.
Definite	The consequence will definitely occur.

Table 5-12: Residual risk matrix combining likelihood and consequence for the proposed mine – Operational Phase (for dustfall, PM_{10} and $PM_{2.5}$).

Receptor ID			Residual Risk				
DR1 – DR34	Consequence	High	Moderate	High	High	Fatally Flawed	
		Moderate-high	Low	Moderate	High	High	High
		Moderate	Low	Moderate	Moderate	Moderate	Moderate
		Moderate-low	Low	Low	Low	Low	Moderate
		Low	Low	Low	Low	Low	Low
			Highly unlikely	Unlikely but possible	Likely	Highly likely	Definite
			Likelihood				

5.3.5. Specialist's Reasoned Opinion Regarding the Acceptability of the Project

Based on the impact rating projected in Section 5.3.4, Rayten's specialist opinion is that operations at the proposed mine can be authorised. Operation of the proposed mine is indicated to have an overall low risk rating, with no fatal flaws identified (Table 5-13). It is noted Table 5-13 was adopted from O'Beirne's 2024 report.

Table 5-13: Decision-making implications of the identified significance ratings (operational phase).

Rating	Implication for decision-making
Fatally Flawed	The project cannot be authorised.
High	The project can be authorised but with strict conditions and high level of compliance and enforcement.
Moderate	The project can be authorised but conditions and routine inspections.
Low	The project can be authorised with a low risk of environmental degradation.

5.4. Assumptions, Limitations and Exclusions

The key assumptions, limitations and exclusions of the study are given below:

Assumptions

- Data/information provided by the client in May 2025 and used as input into the model were assumed to be accurate and complete at the time of modelling;
- All mining operations were assumed to occur for 16 hours a day for 7 days a week, based on information provided by the client;
- Material throughputs were calculated using the information provided by the client and include:
    - Maximum hourly production rate of 220 tonnes of coal produced from the proposed highwall mining operations (based on 16-hour working day).
    - 220 tonnes of coal transferred from the mining area to the temporary stockpile area, per hour (based on 16-hour working day).
- The location and dimensions for most of the modelled sources were based on the information provided by client. Where information was not provided or was unknown, assumptions were made.

Limitations

- Emission sources included in this model are limited to the operational activities associated with highwall mining at the proposed mine;
- Detailed information for each emission source is required for input into the model, such as the dimensions, material throughputs, material characteristics and the exact locality of the sources. In some instances, not all these details are known. To account for the emissions, assumptions and estimates were made where necessary.
- The study is limited by the amount of detailed information that could be provided at the time of modelling.
- There was no ambient air quality monitoring data that could be used to determine baseline pollutant concentrations at the project site. Thus, the baseline air quality status at the project area could not be determined. The nearest AQMS to the proposed mine is located at the Escourt station, located ~35km south of the proposed mine. However, there was no ambient air quality monitoring data available from the station as it appears to be malfunctioning, with no data recorded over the past several years. Furthermore, there is no ambient air quality monitoring undertaken at the project site. In addition, dustfall data could not be provided as there are no available dustfall networks operated near the project site, that could be determined.

Exclusions

- Activities that are not associated with the project and occur outside the scope of the proposed mine were not included in the assessment. These may include any potential background emission sources. Background sources are excluded as detailed information for these is required for input into the model and is not readily available. Furthermore, the assessment focused on the impact of emissions attributable to emission source activities associated with the proposed mine, specifically.

6. MITIGATION MEASURES

Dust is the main pollutant of concern associated with operations at the proposed mine, and it has been confirmed that the mine will use water bowsers for dust suppression on the mining bench and on on-site mine roads. Nonetheless, additional recommendations are made below to ensure maximum dust mitigation at the proposed mine.

The main objective of the proposed air quality management measures for the proposed project is to ensure that operations at the proposed mine result in ambient PM_{10} and $PM_{2.5}$ concentrations and dustfall rates that are within the relevant ambient air quality standards offsite.

6.1. General Dust Control Measures for Mining Operations

General recommended control measures and their efficiency for reduced dust emissions are given in Table 6-1. Furthermore, a summary of recommendations and monitoring requirements for the proposed mine is given in Table 6-2. The recommended control measures should be considered for implementation, where possible, depending on feasibility and affordability.

Dust generated from material handling operations can be significantly reduced by wet suppression with the use of water sprays. However, the combined use of water sprays with chemical surfactants provides more extensive wetting, making it a more effective technique than water suppression alone. The loading, transfer and discharge of materials should take place with a minimum height of fall and be shielded against the wind.

Wind erosion from temporary coal stockpiles and open areas can be minimised using water sprays, wind breaks, and enclosures.

Controls to reduce emissions from on-site mine roads can include vehicle restrictions, which limit the speed, weight and number of vehicles on the road, surface improvements (e.g. paving or adding gravel to the road), surface treatments (wet suppression and surface treatments) or chemical suppression, among others (USEPA, 1996; Thompson & Visser, 2000; Stevenson, 2004). However, the dust control option implemented on the mine roads must be feasible, in such way that it does not decrease overall mine productivity and is economically attractive.

It is also recommended that a dust management plan is developed for the proposed mine, which includes the implementation of appropriate dust suppression measures (refer to Table 6-1) and an air quality programme. It is also recommended that ambient air quality monitoring of PM_{10} and $PM_{2.5}$ and dustfall monitoring be conducted before commencement of mining operations to determine baseline concentrations of these key pollutants. The monitoring programmes must continue throughout the operational phase of the mine.

Table 6-1: Common dust control measures for mining activity and associated control efficiencies (%) (taken from NPI, 2012).

SOURCE	RECOMMENDED CONTROL MEASURES	CONTROL EFFICIENCY (%)
Offloading trucks	Water sprays	70

Loading stockpiles	Variable height stacker	25
	Water sprays	50
	Telescopic chute with sprays	75
	Total enclosure	99
Unloading from stockpiles	Water Sprays	50
	Wind breaks	30
Loading to trains/rail wagons	Enclosure	70
	Enclosure and use of fabric filters	99
Miscellaneous transfer and conveying	Water sprays with chemicals	90
	Enclosure	70
	Enclosure and use of fabric filters	99
Hauling	Level 1 watering (2 litres/m^2/hr)	50
	Level 2 watering (>2 litres/m^2/hr)	75
	Sealed or salt encrusted roads	100
Wind erosion from stockpiles	Water sprays	50
	Wind breaks	30
	Total enclosure	99
	Rock armour and/or topsoil applied	30
Wind erosion	Primary rehabilitation	30
	Secondary rehabilitation	60
	Vegetation	40
	Re-vegetation	90
	Fully rehabilitated	100

Table 6-2: Summary of recommendations and monitoring requirements.

POLLUTANT	ACTIVITIES	MITIGATION MEASURE	MONITORING PROGRAM			
			MONITORING	TIMEFRAME (✓ = yes) (X = no)		
				Pre - operation	During - operation	Post – operation
Fugitive Dust – TSP, PM_{10} & $PM_{2.5}$	Material handling operations, material transfer, temporary coal stockpiles, highwall mining (i.e. drilling) and bulldozing.	1) Develop a dust management plan that includes: • An air quality monitoring programme for PM_{10}, $PM_{2.5}$ and dustfall monitoring. • Appropriate mitigation measures as described in Table 6-1. • Dust suppression measures should be focused around highwall mining (i.e. drilling), bulldozing, material transfer and temporary material storage areas. • The plan must be initiated once operations commence. 2) Immediate clean-up of any material (i.e. coal) spillages. 3) Conduct regular site inspections to ensure the dust mitigation measures are being implemented. Regular visual site inspections are recommended to assess whether further mitigation is required for any of the dust emission sources.	Monthly dustfall monitoring and reporting as per the National Dust Control Regulations is recommended. Continuous PM_{10} and $PM_{2.5}$ ambient air quality monitoring is recommended (e.g. E-Sampler). Install a weather station on site in order to obtain site specific meteorological data.	✓ For dustfall, PM_{10} and $PM_{2.5}$	✓ For dustfall and PM_{10}	X (not required if mining areas are fully rehabilitated)
Fugitive Dust – TSP, PM_{10} & $PM_{2.5}$ **& Gases**	Vehicle dust entrainment, truck exhaust emissions and any other mining vehicle/equipment exhaust emissions	1) Choose appropriate mitigation measures as described in Table 6-1 for all on-site mine roads. Mine roads should be treated for dust suppression. 2) Conduct regular cleaning/sweeping of road surfaces to prevent the accumulation of dust. 3) Conduct regular maintenance and checks for road surfaces. 4) Immediate clean-up of any spillages. 5) Switch off engines whilst not in use;	Monthly dustfall monitoring and reporting as per the National Dust Control Regulations is recommended. Continuous PM_{10} and $PM_{2.5}$ ambient air quality monitoring is recommended (e.g. E-Sampler).	✓ For dustfall, PM_{10} and $PM_{2.5}$	✓ For dustfall and PM_{10}	X (not required if mining areas are fully rehabilitated)

		6) Establish a maintenance schedule to ensure proper maintenance of the trucks & mobile equipment; 7) Conduct regular maintenance and quality checks (engines/tyres) for all heavy mobile equipment/trucks. All above measures must be implemented once any activities commence on site.	Install a weather station on site in order to obtain site specific meteorological data.			

6.2. Recommendations for Dustfall and $PM_{10}/PM_{2.5}$ Monitoring

In terms of the Draft National Dust Control Regulations, monthly dustfall monitoring should be undertaken using the ASTM D1739-98 (reapproved 2017) method. This method prescribes that, for each region to be surveyed, a minimum of four (4) sampling sites shall be provided.

Therefore, the following recommendations are made:

- It is recommended that any dust buckets installed should have wind shields attached, in accordance with the specifications provided;
- Where possible and practical, dust buckets should not be installed within 20m of structures higher than 1m; and
- The stand for the container should hold the top of the container at a height of 2m above ground.

Recommended dustfall and $PM_{10}/PM_{2.5}$ monitoring sites are shown in Figure 6-1. The monitoring locations can be reviewed, if required, depending on accessibility of and safety at the proposed locations. The project site is characterised by both low-lying areas (valleys) and mountainous areas; therefore, monitoring locations must be selected carefully in such a way that they can be accessed without difficulty.

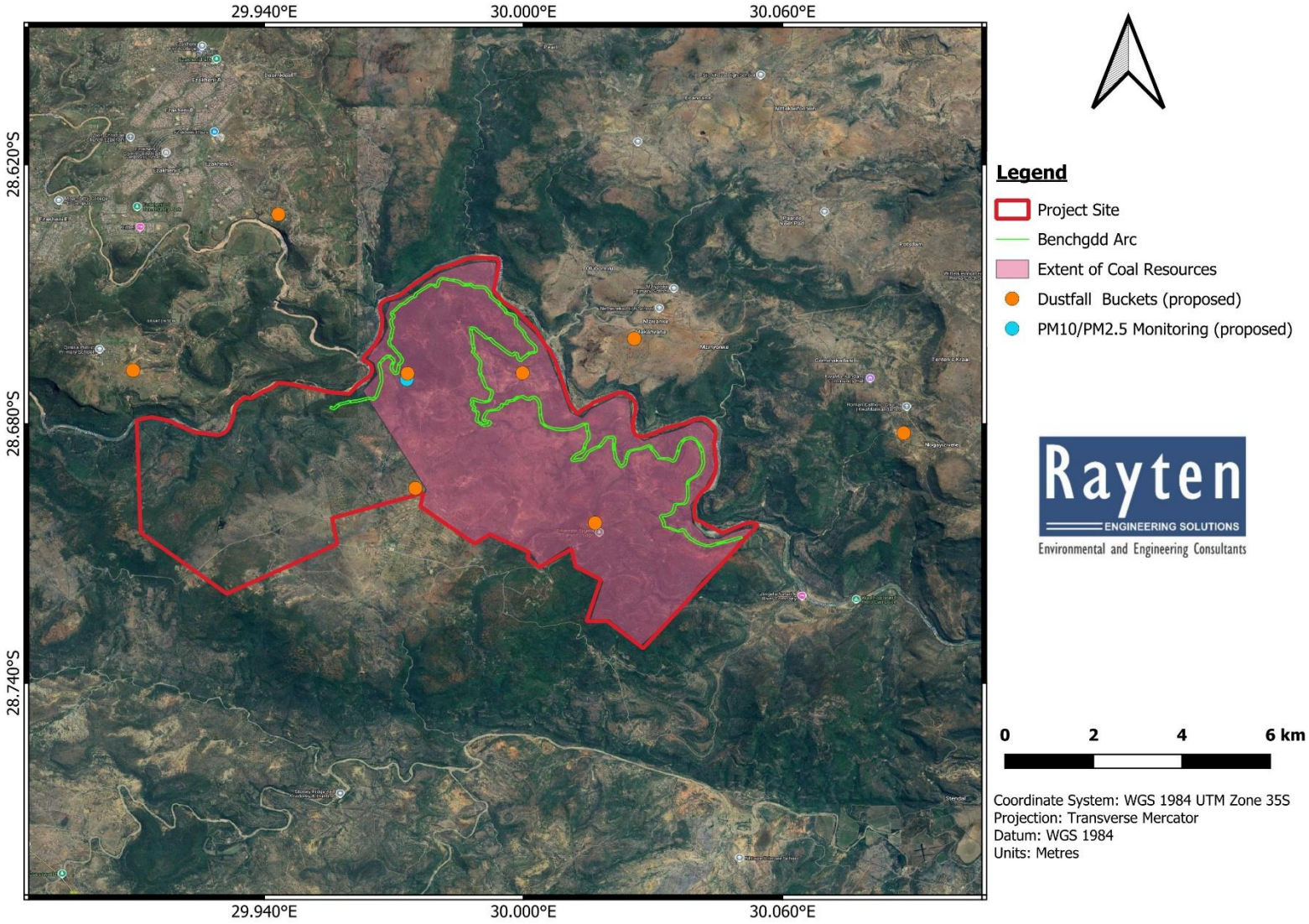

Figure 6-1: Proposed siting of dust buckets and PM_{10}/$PM_{2.5}$ monitoring stations for the proposed mine.

6.3. Summary and Conclusions

Rayten Engineering Solutions was appointed by Brodsky Trading 266 (Pty) Ltd to compile an Air Quality Impact Assessment report (AQIAr) for the proposed Dunrose Investments 174 (Pty) Ltd's highwall coal mining project (hereafter referred to as the "proposed mine", located approximately 9 – 17km north-east of Colenso, within the Umtshezi Local Municipality of the Uthukela District Municipality, Kwa-Zulu Natal Province.

Dunrose Investments 174 (Pty) Ltd are currently in the process of applying for a Mining Right for the proposed mining operations. This AQIAr has been compiled as a supporting document for the Mining Right application. The main objective of the AQIA is to determine the potential impact of emissions from the operational activities associated with the proposed mine on ambient air quality in terms of dustfall, PM_{10} and $PM_{2.5}$.

As part of the AQIA, a baseline air quality assessment was undertaken to determine the following:

- the prevailing meteorological conditions at the site;
- establish baseline concentrations of key air pollutants of concern;
- identify existing sources of emissions; and
- identify key sensitive receptors surrounding the project site.

The main conclusions for the Baseline Assessment can be summarised as follows:

The land use surrounding the project site within a 20 km radius consists mostly of forests, grasslands and formal residences, interspersed with cultivated land, subsistence crops, bare lands, fallow land, wetlands and waterbodies. Informal residences, industrial areas and mining areas – though present, occupy much smaller land footprints. The larger area surrounding the project site is classified as rural in nature. Existing key sources of air pollutant emissions surrounding the project site have been identified as follows:

- Vehicle dust entrainment on unpaved roads (surrounding areas);
- Wind erosion from exposed areas (bare surfaces and fallow land);
- Villages and domestic fuel combustion (surrounding areas); and
- Commercial agricultural activities (cultivated lands) and potential biomass burning (south-east, west and north-west of project site).

MM5 meteorological data for the project area for the period 01 January 2022 – 31 December 2024 was used as input into the model and to determine prevailing meteorological conditions for the project site. Based on the prevailing wind fields for the period January 2022 to December 2024, emissions from activities at the proposed mine will likely be transported towards the west, west-northwest and east-southeast, depending on the season and time of day. Moderate to fast winds observed during all the time periods may result in effective dispersion and dilution of emissions from the proposed mining operations; however, higher winds speeds can also facilitate fugitive dust emissions from open exposed areas such as temporary coal stockpiles, material handling operations and other mining activities.

The existing air quality situation is usually evaluated using available monitoring data from permanent ambient air quality monitoring stations and dustfall networks operated near the project site. There was no air quality monitoring data from the South African Air Quality Information System (SAAQIS) (that

could be determined) to present background concentrations for PM_{10} and $PM_{2.5}$ concentrations at the project site. The nearest AQMS to the project site is located at the Escourt station (-29.000526°S, 29.873569°E), located ~35km south of the proposed mine. However, there was no ambient air quality monitoring data available from the station as it appears to be malfunctioning, with no data recorded over the past several years. Furthermore, there is no ambient air quality monitoring undertaken at the project site. In addition, dustfall data could not be provided in this AQIAr as there are no available dustfall networks operated near the project site, that could be determined. Baseline air quality monitoring for dustfall, PM_{10} and $PM_{2.5}$ is therefore recommended, prior to commencement of the proposed mining operations, to determine baseline concentrations of key criteria air pollutants.

The main conclusions of the AQIA for the project can be summarised as follows:

Dustfall, PM_{10} and $PM_{2.5}$ are key pollutants of concern associated with operations at the proposed mine and are emitted from the following key sources:

Dustfall and Particulate Emissions:

- Highwall mining (drilling into coal seam);
- Bulldozing;
- Materials handling operations (transfer, loading/offloading operations);
- Wind erosion from exposed areas: temporary coal stockpile; and
- x4 FELs (servicing the needs of the highwall miners, cleaning up coal spillages, and establishing the highwall and performing rehabilitation).

Based on the dispersion modelling output plots, the following conclusions can be made:

- Incremental 99th percentile daily dustfall rates are predicted to comply with the residential area standard of 600 mg/m^2/day and non-residential area standard of 1200 mg/m^2/day over the entire project area, with no exceedances of the standards projected.
- 99th percentile daily, and annual average incremental PM_{10} concentrations, are mostly predicted to be low and fall well below the applicable daily and annual NAAQS of 75 µg/m^3 and 40 µg/m^3, respectively. Although exceedances of the daily and annual standards are predicted inside the boundary, they are restricted to a very small area in proximity to the proposed mining activities, with exceedances of the annual PM_{10} standard being barely noticeable.
- Predicted incremental 99th percentile daily, and annual average $PM_{2.5}$ concentrations, are significantly low and in compliance with the applicable standards of 40 µg/m^3 and 20 µg/m^3, respectively, over the entire project area.
- Based on the above, the proposed mine will not be a significant source of incremental dustfall and particulate matter (PM_{10} and $PM_{2.5}$) concentrations.
- All identified nearby surrounding sensitive receptors (represented as discrete receptors) are shown to experience low to negligible incremental dustfall rates, PM_{10} concentrations and $PM_{2.5}$ concentrations, over both the short and long term.

In conclusion, Rayten is of the opinion that operations at the proposed mine can be authorised. The inherent risk (in terms of air quality) associated with operation of the proposed mine can be considered as low, while the likelihood of the impact occurring can be considered as highly unlikely. This results in a **low negative impact significance rating (i.e. low residual risk)** in terms of air quality, for the

proposed mine operations. This is evident in that while pollutants associated with operational activities at the proposed mine will be dispersed from the operational area to nearby sensitive receptors, predicted concentrations at all the identified receptors are projected to be very low to negligible.

Despite the low negative impact significance rating predicted, it is recommended that a dust management plan is developed for the proposed mine, which includes the implementation of suggested dust suppression measures (Section 6) and an air quality programme. It is also recommended that ambient air quality monitoring of PM_{10} and $PM_{2.5}$ and dustfall monitoring be conducted before commencement of mining operations to determine baseline concentrations of these key pollutants. The monitoring programmes must continue throughout the operational phase of the mine.

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APPENDIX A

AIR DISPERSION MODELLING CHECKLIST

Table A 1: Information Required in Air Dispersion Modelling Report.

Information Required in Plan of Study Report				
Description	**Included (Y/N)**	**Section**	**Page no.**	**Comments**
1. Facility and Modellers Information				
Project Identification Information				
Applicant details	Y	1.1	1-2	
Facility Identification	Y	1.1	1-2	
Physical address of facility	Y	1.1	1-2	Co-ordinates provided
AEL number	N	1.1	1-2	No AEL Required
EIA reference	N	1.1	1-2	In the process of applying for one
Modelling contractors	Y	1.1	1-2	
Project Background				
Objectives of Baseline Assessment	Y	1.3	5	Terms of Reference provided
Process description	Y	1.2	2	
Project Location				
Site layout plan	Y	1.2	3	
Regional map	Y	2	9-12	
Adjacent area map	Y	2	9-12	
Surrounding land use map	Y	2	9-12	
Elevation data (DEM)	Y	2	9-12	
2. Emission Characterisation				
Proposed emissions & source parameters				
All identifiable emissions listed	Y	5 & 5.1	30-36	
Parameters for each operating scenario	Y	5 & 5.1	30-36	
Proposed emissions calculations	Y	5 & 5.1	30-36	
3. Meteorological Data				
Surface Data				
Source of data	Y	4.1	20-22	
Seasonal wind roses	Y	4.1.1	25	
3-year representative data	Y	4.1.1	23	
Program used to process data	Y	4.1	20-22	
Description of station	Y	4.1	20-22	
Period of record	Y	4.1	20-22	
Spatial representativeness	Y	4.1	20-22	

Data complies with Code of Practice	Y	4.1	20-22	
Upper Air Data				
Source of data	Y	4.1	20-22	
4. Ambient Impact Analysis and Ambient Levels				
Standard Levels				
National Ambient Air Quality Standards	Y	3.3	14-15	
Background Concentrations				
Background values specified	N	4.2		No background data available
5. Modelling Procedures				
Proposed Model				
Assessment level proposed	Y	5.2.2	37-38	
Dispersion model to be used	Y	5.2.2	37-38	
Supporting models to be used	Y	5.2.2	37-38	
Version of models to be used	Y	5.2.2	37-38	
Proposed Emissions to be Modelled				
Pollutants specified	Y	5.2.2	37-38	Table 5-7
Scenarios to be modelled	Y	5.2.2	37-38	Table 5-7
Conversion factor utilized	N			Not used
Proposed Settings				
Settings to be utilized	Y	5.2.2	37-38	Table 5-7
Terrain settings	Y	5.2.2	37-38	Table 5-7
Land characteristics	Y	5.2.2	37-38	Table 5-7
Grid Receptors				
Property line resolution	Y	5.2.2	37-38	Table 5-7
Fine grid resolution	Y	5.2.2	37-38	Table 5-7
Medium grid resolution	Y	5.2.2	37-38	Table 5-7
Large grid resolution	Y	5.2.2	37-38	Table 5-7
6. Ambient Impact Results Documentation				
Tables of Modelling Results				
Pollutant	Y	5.3.2	43-45	
Averaging time	Y	5.3.2	43-45	
Operating scenario	Y	5.3.2	43-45	
Maximum modelled concentration	Y	5.3.2	43-45	
Receptor location	Y	5.3.2	43-45	
Receptor elevation	Y	5.3.2	43-45	
Date of maximum impact	N			
Name of output e-files	Y	Appendix B	64	
Source Impact Area Figures				
UTM co-ordinates	Y	5.3.1	39-42	
Modelled facility	Y	5.3.1	39-42	

Topography features	Y	2.3	6&11	
Isopleths	Y	5.3	39-42	
Value of maximum impact	Y	5.3	39-42	
Value of maximum cumulative impact	N	5.3.3		No background data available
7. Ambient Impact Supporting Documentation				
Electronic Files				
Electronic files can be provided upon request				
Input & output files for models	Y	Appendix B	64	name of files specified
Input & output files for pre-processors	Y	Appendix B	64	name of files specified
Input & output files for post-processors	Y	Appendix B	64	name of files specified
Digital terrain files	N			
Plot files	Y	Appendix B	64	name of files specified
Final report	Y			

APPENDIX B

OUTPUT E-FILES

Table B1: List of output e-files used.

Summary of electronic modelling files				
Output File Number	Output File Name	Description	Date Created	Model
Construction Phase				
	n/a no files			
Other				
1	Dunrose_TSP_Op	Dispersion modelling E-file for dustfall associated with operational activities	June 2025	AERMOD VIEW
2	Dunrose_PM_{10}_Op	Dispersion modelling E-file for PM_{10} associated with operational activities	June 2025	AERMOD VIEW
3	Dunrose_$PM_{2.5}$_Op	Dispersion modelling E-file for $PM_{2.5}$ associated with operational activities	June 2025	AERMOD VIEW
Other				
4	Dunrose_AERMET	AERMET meteorological data file used for input into AERMOD	June 2025	AERMET

Note: an electronic copy of the modelling files can be provided upon request.

APPENDIX C

SUMMARY OF SOURCE PARAMETERS

			Dimensions			Coordinates (35S)		
Source Number	**Source ID**	**Source Description**	**Length X (m)**	**Length Y (m)**	**Release Height (m)**	**X (m)**	**Y (m)**	**Elevation (m)**
1	AREA1	Coal stockpile	2	2	2,5	792199,46	6823593,69	949,44
2	AREA2	FEL 1 at highwall miner 1	2,1	5,8	2,5	792107,08	6823766,44	927,3
3	AREA3	FEL 2 at highwall miner 1	2,1	5,8	2,5	792181,09	6823733,05	922,39
4	AREA4	FEL 1 at highwall miner 2	2,1	5,8	2,5	792249,50	6823703,47	930,68
5	AREA5	FEL 2 at highwall miner 2	2,1	5,8	2,5	792320,58	6823698,68	934,92
6	VOL1	Load conveyor 1 (from highwall miner 1	2	2	1	792132,88	6823679,66	936,06
7	VOL2	Load coal stockpile (from conveyor 1)	2	2	5	792189,00	6823607,27	946,56
8	VOL3	Load conveyor 2 (from highwall miner 2	2	2	1	792273,96	6823663,93	939,49
9	VOL4	Load coal stockpile (from conveyor 2)	2	2	5	792213,49	6823593,81	950,12
10	VOL5	Drilling into coal (Highwall Miner 1)	3,5	3,5	1,2	792184,99	6823791,08	900,17
11	VOL6	Drilling into coal (Highwall Miner 2)	3,5	3,5	1,2	792287,17	6823738,44	917,34
12	AREA6	Bulldozing coal (shaping stockpile)	2	2	2,12	792191,63	6823581,87	951,09

APPENDIX D

IMPACT ASSESSMENT METHODOLOGY

The significance of each identified impact was determined using the approach outlined below, which was adopted from SE Solutions' proposed impact rating methodology report (O'Beirne, 2024). However, it is noted that O'Beirne's 2024 report is in draft phase and under public review. This approach incorporates two aspects for assessing the potential significance of impacts, namely consequence/inherent risk and likelihood. Consequence and likelihood are then combined to estimate the anticipated residual risk//overall impact significance rating.

A. Inherent Risk

What ***could*** happen is expressed as ***inherent risk***, given any activity in question. For example, if there will be emissions of SO_2 from a proposed activity, then adverse human health effects are an inherent risk. Expressing inherent risk is important in significance ratings to respect the concerns of stakeholders in public participation, who are fully entitled to raise concerns about what *could* happen if an activity is authorised (O'Beirne, 2024). A preliminary list of potential consequences associated with any proposed activity is given in Table A2. This table is qualitative but can be refined over time to include additional characteristics added to each of the categories (O'Beirne, 2024).

Table A2: The hierarchy of potential consequences of changes in the receiving environment (impacts). These consequences are expressed as inherent risks or benefits (viz. what could happen) because of the impacts.

	Environmental Cost	Rating
Inherent Risk/Benefit	Human health – morbidity / mortality, loss of threatened species population(s), loss of strategic water source potential or sequestered carbon stocks.	High
	Material reductions in threatened or endemic species populations or habitat, loss of livelihoods, individual economic loss.	Moderate-high
	Material reductions or degradation of environmental quality – air. Loss of habitat, loss of heritage, amenity.	Moderate
	Nuisance	Moderate-low
	Negative change - with no other consequences.	Low
	Environmental Benefits	
	Net improvement in human welfare or threatened species habitat.	Moderate – high
	Improved environmental quality – air, soil, water. Improved individual livelihoods.	Moderate
	Economic Development but no tangible environmental benefit or impact.	Moderate-low
	Positive change – with no other consequences.	Low

There is no 'high' rating for benefits. This is to reflect that there are certain environmental costs that are intolerable regardless of the benefit they bring, and these costs cannot be 'traded off'. There is also no scientific way to 'match' the categories (viz. a moderate cost being equivalent to a moderate benefit) (O'Beirne, 2024). However, O'Beirne's 2024 report still details the importance of cost-benefit analysis to decision-making. But the author notes that cost-benefit analysis cannot be done with qualitative findings, which are presented in Table A2.

B. Likelihood

The regulations call for 'probability' to be used in defining significance. However, Johan Nel, previously of the CEM at NWU, argues that 'likelihood' is a preferable term compared to the term 'probability', since 'probability' implies a solid statistical foundation. In most if not all instances, the probability of a given consequence is going to be expressed qualitatively rather than quantitatively in an Environmental Impact Assessment (EIA), and likelihood better articulates the qualitative nature of the assessment. One way or another, expressing the residual risk of an inherent risk requires an articulation of probability (which for significance ratings in EIA is then expressed as 'likelihood') (O'Beirne, 2024).

The likelihood of the consequences is given as a function of the scale of the impact and the sensitivity of the affected environment. Likelihood defines the difference between an inherent risk (what *could* happen) and a residual risk (what is *likely* to happen). Significance categories in the regulations can (and must) be used to argue the likelihood of the consequence viz extent, duration, intensity, etc Proposed likelihood categories are provided in Table A3 (O'Beirne, 2024).

Table A3: Likelihood categories and definitions in ascribing impact significance.

Likelihood	Definitions
Highly unlikely	The possibility of the consequence occurring is negligible
Unlikely but possible	The possibility of the consequence occurring is low but cannot be discounted entirely
Likely	The consequence may not occur, but a balance of probability suggests it will.
Highly likely	The consequence may still not occur, but it is most likely that it will.
Definite	The consequence will definitely occur.

C. Residual Risk/Impact Significance

The specialist (or Environmental Assessment Practitioner) must then ascertain what is likely to happen given the specific circumstances of the activity and the characteristics of the receiving environment. What is likely to happen (in the specialist's opinion) is expressed as residual risk. Residual risk is what must be accepted if the application is to be approved. Stated differently, what will have to be 'lived with' if the activity goes ahead? The competent authority must decide on the application based on the residual risks and how these reflect who wins and who loses (O'Beirne, 2024).

Significance is expressed as the residual risk of the consequence. The matrix given in Tabel A4 is used to combine likelihood and consequence, which provides an estimate of the residual risk/impact significance (O'Beirne, 2024).

Table A4: Residual risk matrix combining likelihood and consequence.

		Residual Risk				
Consequence	High	Moderate	High	High	Fatally Flawed	
	Moderate-high	Low	Moderate	High	High	High
	Moderate	Low	Moderate	Moderate	Moderate	Moderate

	Moderate-low	Low	Low	Low	Low	Moderate
	Low	Low	Low	Low	Low	Low
		Highly unlikely	Unlikely but possible	Likely	Highly likely	Definite
		Likelihood				

D. *Reasoned opinion regarding whether activity should be authorised.*

After determining the impact significance associated with any proposed activity, O'Beirne (2024) recommends the inclusion of a reasoned opinion regarding whether the proposed activity should be authorised in all specialist reports, in line with requirements of the EIA regulations. Ratings provided in Table A5 are proposed by O'Beirne (2024), to help assess the acceptability of any project.

Table A5: Decision-making implications of the different significance categories.

Rating	Implication for decision-making
Fatally Flawed	The project cannot be authorised.
High	The project can be authorised but with strict conditions and high level of compliance and enforcement.
Moderate	The project can be authorised but conditions and routine inspections.
Low	The project can be authorised with a low risk of environmental degradation.

APPENDIX E

SPECIALIST CURRICULUM VITAE (GERTRUDE MAFUSIRE)

CURRICULUM VITAE

Name	**Gertrude Mafusire**
Cell:	+27 (0)71 042 5667
Email:	gertrudem@rayten.co.za
Nationality:	Zimbabwean
Marital Status:	Married
Languages	English, Shona, Ndebele

QUALIFICATIONS

Professional Natural (Chemical) Scientist (2015) Registration number: 400171/15
South African Council for Natural Scientific Professions (SACNASP)

MPhil Energy Studies) (2011 – 2013) University of Johannesburg (Research Proposal: Systematics of Biomass Burning Aerosol Transport over Southern Africa)

BSc Hons in Chemistry (2000 – 2005) Midlands State University (Zimbabwe)

ADDITIONAL QUALIFICATIONS

Not Applicable

PROFESSIONAL EXPERIENCE

Having graduated with a BSc Hons in Chemistry degree and an MPhil Energy Studies degree, I have since gained Professional Natural Scientist status though the South African Council for Natural Scientific Professions (SACNASP). My work experience can be summarised as follows:

- Senior Associate (Rayten Engineering Solutions (Pty) Ltd)
- Research Assistant (University of Johannesburg)
- Junior Chemist (Cernol Chemicals)
- Dairy Chemist (Dairibord Zimbabwe)

Employment History

Rayten Engineering Solutions, Randburg, South Africa
May 2017 – Current

- Research, report writing and report reviewing.
- Project management and company administration.
- Compiling quotes and tenders.

- Project management and company administration.
- Compiling quotes and tenders.
- Managing and providing mentorship to junior Air Quality Scientists.
- Providing expert scientific air quality advice to several industrial developments, in line with all the applicable South African Air Quality Legislation.
- Air Quality Impact Assessments (AQIAs) for different projects (based on AERMOD and CALPUFF) – Expert Level, e.g.:
  - Industrial Plants & Developments
    - Ezee Tile Adhesives Manufacturing (Pty) Ltd – Proposed Zeerust Plant, Port Elizabeth and Durban Plants.
    - Proposed Oya Energy Hybrid Facility
    - Plascon Luipaardsvlei – Proposed Storage and Handling of Organic Liquids
    - Proposed Nuvest Recovery Solutions chemical plant in Meyerton.
    - Bushveld Vanchem
    - Proposed Vanadium Resources – Salt Roast Leach Plant
    - Transvaal Galvanisers (proposed expansion)
    - Anglo-American Platinum, Rustenburg Platinum Mines – Waterval Smelter Complex (proposed expansion)
    - Proposed Bojanala Regional Special Economic Zone – Waste-Water Treatment Plants Expansion
  - Coal Mines
    - South 32 - Khutala Colliery (Pty) Ltd.
    - Proposed Driefontein Coal Mine
    - Proposed Springfield Coal Mine.
    - Proposed Wonderhoek Colliery
    - Proposed Vlakfontein Opencast Coal Mine
  - Other types of mines
    - Evander Gold Mine (Pty) Ltd
    - Proposed new TSF construction and proposed historic dump reclamation project for Fairview Mine.
    - Harmony Moab Khotsong Mine – Odour Impact Assessment (Landfill & Waste-Water Treatment Plants) and AQIA (Mining & Processing Operations)
    - Proposed Vygenhoek Platinum Mine
    - Proposed VanMag (Vanadium Magnetite) Mine
    - Foskor- Mining Division
    - Proposed Vanadium Resources – Steelportdrift Opencast Mine
    - Gold One - Modder East Mining & processing operations (proposed TSF expansion)
    - Level One Air Quality Impact Assessments (Screening assessments) for several foundries (Active Foundry (Pty) Ltd, Metal Concentrators SA (Pty) Ltd – Cape Town, Hi Alloy Castings and NI Foundry.
- Dispersion modelling (AERMOD and CALPUFF) and associated emission inventories for several mines and other industrial developments – Expert Level.
- Greenhouse gas emission Inventories and reports for foundries and other industrial developments (Kyoto Protocol Method)
- Atmospheric Emission Licence (AEL) compliance audits for several industries including Total SA (10 depots), Zinchem and Zimalco, Harmony Gold (One Plant, Central Plant, Kopanang, Mponeng/West Wits, Chemwes operations), several foundries and other metallurgical plants, and several other industrial developments.
- Atmospheric Emission License compilation and submission for several industrial developments (hard copies and via SAAELIP).
- Liaising with several government entities concerning AEL applications.
- Populating annual stack monitoring results on the online NAEIS (National Atmospheric Emissions Inventory System).
- Air quality data monitoring, passive badge sampling, data analysis (for dustfall, PM_{10}, $PM_{2.5}$ and VOCs) and report compilation for several mines and several small to large-scale industrial developments, including Eskom Majuba.
- Fugitive Dust Management Plans for coal mines, several foundries and other industrial developments.

SeTAR Centre, University of Johannesburg, Auckland Park, South Africa
January 2011 – December 2014

Academic research work:

- Academic research on the physics and chemistry of the atmosphere.
- Laboratory work.
- Attending workshops and conferences.
- Article compilation and publication in local and international Journals.
- Best Student Paper Awarded at the IUAPPA and NACA Conference, Cape Town, South Africa (2013).

Cernol Chemicals, Zimbabwe
June 2008 – May 2009

- Research and development projects within the organisation, report compilation, and laboratory work on new product development, quantitative and qualitative analysis; and reformulation of existing products.

Dairibord (Pt) Ltd, Zimbabwe
January 2006 – April 2008

- Responsible for qualitative and quantitative analysis of raw materials and finished products in the laboratory, chemical preparation and standardisation, hygiene audit checks within the plant, final product checking and testing, and making recommendations for non-conformances.

CURRICULUM VITAE

Name	**Clive John Wray**
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Nationality:	South African / British
ID Number:	7908145191083
Marital Status:	Married
Languages:	English

QUALIFICATIONS

- **Professional Engineer (Pr. Eng.)** **Reg. No: 20090334**
  Engineering Council of South Africa (ECSA)
- **BSc (Eng) Honors Mechanical Engineering (1998-2002)**
  University of Natal, South Africa (Awarded a Sasol Bursary (2000))

ADDITIONAL QUALIFICATIONS

• SoundPlan and Noise Assessments	SoundPlan-UK 2023
• Project Management Prof. (PMP)	Davis and Dean, 2012
• PDMS	Uhde Internal Training, 2010
• Pressure Vessel Design and Analysis	PVElite, 2007
• Project Management	OD&L Learning Centre, 2003.
• Time Management	OD&L Learning Centre, 2003.
• Effective Problem Solving (EPS)	OD&L Learning Centre, 2003.

PROFESSIONAL EXPERIENCE

Having graduated with a BSc (Eng) Mechanical Engineering degree, I have since gained Professional Engineering (Pr. Eng.) status through the Engineering Council of South Africa (ECSA). My work experience can be summarised as follows:

- Environmental Engineering– Air quality monitoring and assessments / Noise Impact Assessments / Engineering services (Rayten Engineering Solutions)
- Manager Engineering - Mining Process Plants / Chemical Plants (Basil Read Matomo)

- Senior / Lead Mechanical Engineer – Petrochemical (ThyssenKrupp Uhde)
- Risk Analyst / Project Engineer – Consulting (Amec Ltd)
- Mechanical Engineer - Building Services (Linaker Ltd)
- Jnr. Mechanical Engineer - Oil and Petrochemical (Sasol Ltd)

EMPLOYMENT HISTORY

Rayten Engineering Solutions, Randburg, South Africa
July 2014 – Current

- Stack Emissions Monitoring (USEPA Methods)
- Manage all air quality monitoring projects
- Dispersion modelling and Air Quality Impact Assessor (Expert Level)
- Noise Impact Assessments (Expert Level)
- Ambient Emission monitoring
- Engineering designs, procurement and installation of extraction systems
- SHEQ Management

Basil Read Matomo, Melrose Arch, South Africa
October 2011 – July 2014

Managed the following tasks during the project proposal stage:

- Assisted with development of a Work Breakdown Structure (WBS) and costing structure for engineering man-hours as required by project controls.
- Developed a project organogram for engineering.
- Generated engineering management cost estimates.
- Developed a resource loading plan in conjunction with the Project Manager and Engineering Managers based on the cost execution philosophy and schedule.
- Assisted with compiling the proposal where necessary.

Managed the following tasks during project execution:

- Provided technical assistance during design and procurement of engineering packages.
- Developed a project execution strategy with regards to engineering packages, supplier packages, Project Engineers and erection contractor packages.
- Setting up the project engineering standards and engineering specifications register.
- Managed the review and acceptance of Client specifications together with the Lead Engineers.
- Participated in the project kick-off meeting.

Employees:

- Reviewed actual project resource needs with the Project/Lead Engineers on an on-going basis.
- Generated a responsibility matrix based on the deliverable list.

- Participated in interviews and selection of suitable candidates.
- Resolved conflict between engineering employees on a project.
- Ensured correct allocation of man-hours per cost code in the man-hour budget as generated by Project Controls.
- Ensured the correct adjustment of man-hours according to scope changes/design changes.
- Monitored and reported on engineering progress against man-hours spend.

Engineering:

- Managed all engineering work and resources on projects including technical acceptability of work, scheduling of works, man-hour efficiency and cost.
- Ensured that the technical integrity and work scope definition is maintained through the Procurement and Construction activities.
- Issued progress, efficiency and technical overview reports.
- Ensured project quality requirements were clearly defined and adhered to.
- Generated Technical Data Sheets and Scope of Works for various types of mechanical equipment for Enquiry and for Purchase.
- Verification and approving of vendors designs calculations and drawings.
- Preparation of project standards, engineering and technical specifications.
- Preparation of technical enquiries.
- Responsible for resolving and addressing all technical queries that rose during basic and detailed engineering on all projects.
- Promote company business.
- Promote a safety conscience environment.

ThyssenKrupp (Uhde Division), South Africa
February 2006 – October 2011

Projects:

- **New Multiple Products Pipeline (NMPP / Transnet) - Lead Mechanical Engineer**
- **Temane Expansion (Sasol Petroleum) - Lead Mechanical Engineer**
- **MIBK2 (Sasol) - Senior Mechanical Engineer**

Head office based works:

- Managed project budgets, schedules, man-hour, and staff.
- Generated Technical Data Sheets and Scope of Works for various types of mechanical equipment for Enquiry and for Purchase.
- Responsible for the design of Pressure Vessels, Tanks, Heat Exchangers, Turbines, Pumps and Bulk Handling Equipment in accordance with relevant codes and client requirements.
- Verification and approving of vendors designs calculations and drawings.
- Preparation of project standards, engineering and technical specifications.
- Preparation of technical enquiries.
- Responsible for resolving and addressing all technical queries that rose during basic and detailed engineering on all projects.
- Monitored the execution and progress of all phases during basic and detailed engineering and procurement associated with all mechanical equipment.
- Selection of Vendors/ Contractors on a technical basis.
- Compiled technical bid evaluations.
- Reviewed Vendor Documentation to ensure design integrity and compliance with specifications.

- Liaised with other departments to ensure the integrity of the equipment and machinery. Coordinated with home office, Site and Client during detailed engineering, construction, pre-commissioning and commissioning when required.
- Worked with the construction and commissioning teams to progress up to the final acceptance of the work within the project milestones.
- Controlled and reported the engineering Project Budget man-hours, costs and schedule.
- Liaison with Clients to ensure alignment of design with Client requirements. Closely coordinated with Client and tried to identify the engineering issues which were critical for cost, schedule, quality, operability, safety etc. from the mechanical engineering point of view, and recommended technical solution for Client.
- Project Planning and budgeting.
- Assisted the Project Manager (Site) related to mechanical engineering (rotating machines, pressure vessel, piping etc.).
- Report writing.

Field based work:

- Handled all mechanical engineering matters, drawings, specifications, field requisitions, as built drawings, etc.
- Provided engineering expertise to field construction for permanent and temporary works, ensuring that the works were completed safely.
- Verified the scope of work were completed and handed over to the Client/Operator in a defined, timely and systematic process.
- Studied and assessed all drawings, specifications etc and obtain rulings on all construction matters that require engineering interpretation.
- Ensured that all drawings, specifications, procedures, work practices, method statements, quality plans etc were indexed, available and retrievable and that the latest issues are being worked to.
- Checked and arranged approval of design when applicable and alerted the Resident Construction/Site Manager of any special aspects of engineering design or changes.
- Carried out general liaison with the Client Site Engineers in conjunction with the Resident Construction/Site Manager, attending all necessary meetings when required.

Amec Limited, Eli Lilly Site, Surrey, UK
Risk Analyst/ Project Engineer (6 Month Contract)
June 2005 – Dec 2005

- 6 Month Contract to manage and conduct Risk Assessments during the commissioning phase of a new R&D / Chemistry block.
- Managed Engineering Systems within the Eli Lilly pharmaceuticals R&D Building Site.
- Responsible for conducting all System Risk Assessments for the old/new Chemistry R&D Block.

Linaker Limited, Redhill, Surrey, UK
Mechanical Project Engineer (6 Month Contract)
November 2004 – May 2005

- Project Management in the Building Services sector.
- Completed all projects to client's specifications and budget requirements.
- Conducted Risk Assessments and Method Statements.
- Planning and Co-ordination.
- Supervised all site activities that were outsourced to contractors, responsible for safety of contractors.

- Project costing and valuation.
- Responsible for preparing quotations/tenders/proposals
- Dedicated to building strong, enduring working partnerships.
- Responsible for design and sizing of all mechanical systems in each project.
- Responsible for the production of design fees, conceptual design, design innovation, design calculation and final detailed designs in accordance with the subcontract agreement with the end user/client.
- Report writing.

Sasol Limited, Sasolburg, South Africa
Project/Mechanical Engineer (Permanent)
January, 2003 – October, 2004

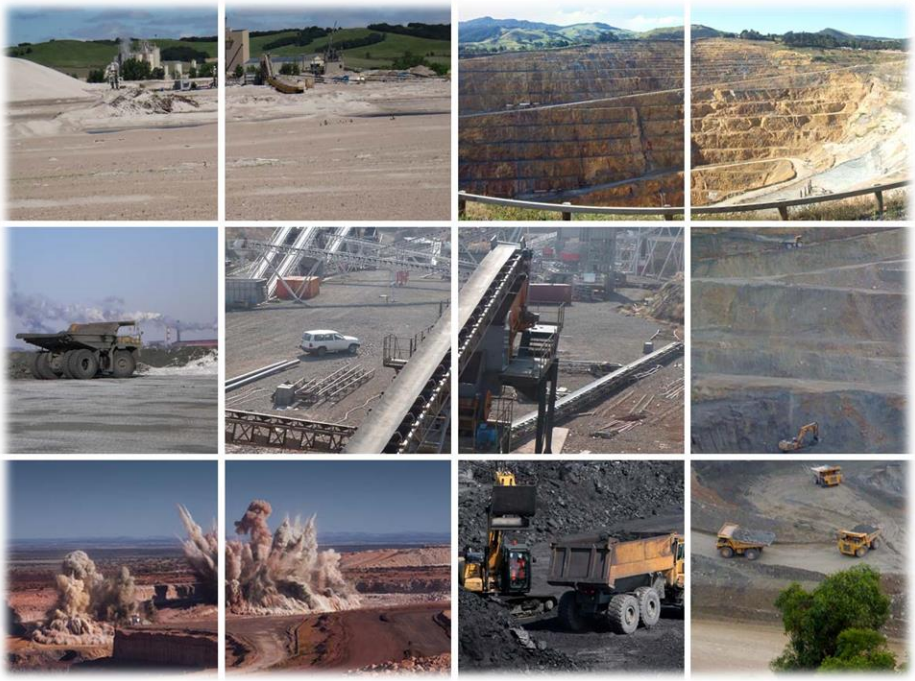
- Implemented/managed all new projects from the Front-end-loading phases to completion by applying Project Management principles and the Sasol Business Development and Implementation (BD&I) Model.
- Supervised all site activities that was outsourced to contractors, responsible for safety of contractors and controlled the commissioning of projects.
- Cost Control and Project Budgeting.
- Coordinated other disciplines.
- Conducted Risk assessments.
- Conducted Risk Based Inspections (RBI) in preparation for the Sasol Wax GTL 2004 Shutdown.
- Planning and Co-ordination.
- Ensured maintenance of all assets according to company standards.
- Organized Root Cause Analysis (RCA) for recurring problems and attended problem break-through strategies used for defect elimination.
- Responsible for planning a range of potential solutions to problems.
- Attended meetings and communicated the information promptly. (Verbal and Written).
- Worked independently with minimum supervision.

Environmental Noise Impact Assessment

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

for the proposed

Colenso Coal Project, KwaZulu Natal Province



Study done for:

Dunrose Investments 174 (Pty) Ltd

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EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Enviro-Acoustic Research ("EARES") was contracted by Dunrose Investments 174 (Pty) Ltd to determine the potential noise impact on the surrounding environment due to the development of the proposed Colenso Coal Project, KwaZulu Natal Province (KZN).

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

PROJECT DESCRIPTION

Dunrose Investments 174 (Pty) Ltd proposed to mine their coal resource on a farm to the north-west of Colenso, KZN. This project would be known as Colenso Coal, with the coal resource mined using the Highwall mining method for the at least the first decade.

Highwall mining is a remote-controlled mining method used to extract coal from the final high wall of an open-cut mine. The method involves driving a series of unsupported parallel tunnels into the exposed coal seam using a specialised highwall mining system. The tunnels are self-supported by leaving behind coal pillars that act as a primary support.

A highwall exposing the coal seam will be established using conventional open-cast mining methods, utilizing either drilling and blasting (in hard unweathered material) or excavators (in the softer weathered material). Thereafter a stable, compacted bench with a face length of approximately 40 m will be created for the highwall mining equipment. Loose material and overburden debris will be removed from the highwall face to prevent rockfalls.

Once the highwall and the working bench has been established. The highwall mining system will be positioned on the bench. The cutter module, which houses a continuous miner head will be aligned with the coal seam. Thereafter the cutter module will be launched into the coal seams using a series of push beams (Each typically around 6 m long) that extend deeper into the highwall. The push beams serve as both structural reinforcement and a conveyor system, transporting coal back to the surface.

The high wall mining equipment to be utilised at Colenso has a maximum reach of 500 m. In areas where it may not be feasible for the highwall mining method, mining will commence through the board and pillar underground mining method. The coal resources in these areas will be access through either a portal established on a final highwall, or a decline shaft located in the most economically feasible area of the resource to limit capital expenditure.

An additional conveyor system will be established and used to convey the coal from the active mining area to a coal stockpile, for future use by a third party (subject to a separate Environmental Impact Assessment (EIA) process).

SURROUNDING LAND USE AND POTENTIAL NOISE-SENSITIVE RECEPTORS

The surrounding land use is mainly commercial agriculture, subsistence farming and game ranches (tourism), with a number of potential noise-sensitive receptors living within the Project Focus Area. The online screening tool defined a number of areas with a "very high" sensitivity to noise, and the potential significance of a future noise impact is assessed in this report.

BASELINE ASSESSMENT

Sound pressure levels were measured from 19 to 21 May 2014 at one location within the PFA. While this data is older than 10 years, the author has done significant measurements in areas with a similar soundscape, and this data is considered applicable, and additional sound level measurements were not recommended.

Ambient sound levels were mainly dominated by natural noises (birds and some wind-induced noises), though noises from a large freezer compressor did influence the measurements during with quieter periods. The ambient sound levels were elevated for an area with a rural developmental character, with various different noises (household, domestic animals and birds) impacting on the daytime sound levels, with noises from a freezer compressor mostly impacting on the night-time sound levels.

Considering the average fast-weighted sound level data collected in the area, average:

- daytime fast-weighted sound levels ranged from 39.6 to more than 70 dBA, with average sound levels being 57.3 dBA. This is typical of an urban noise district, setting a potential zone sound level of 55 dBA for the daytime period; and

- night-time fast-weighted sound levels ranged from 34.8 to more than 65 dBA, with average sound levels being 40.8 dBA. This is typical of a suburban noise district, setting a potential zone sound level of 40 dBA for the night-time period.

RATING LEVELS AND DESIRED NOISE LIMITS

Considering the requirements of the National Noise Control Regulations, activities relating to the proposed project should not change the existing ambient sound levels with more than 7 dBA, nor exceed the World Health Organization and International Finance Corporation noise limits. Recommended upper noise limits therefore would be:

- 55 dBA (as recommended by the IFC) for daytime residential use; and
- 45 dBA (as recommended by the IFC) for night-time residential use.

The mine should also limit the noise level to less than 60 dBA on the boundary (70 dBA during the daytime period and 60 dBA at night for a 70 dBA day-night noise limit).

NOISE IMPACT DETERMINATION AND FINDINGS

The noise-generation scenario's considers noise-generating activities close to the NSR, using conceptual scenarios to assess the potential noise impact at these NSR. The potential worst-case noise rating levels were calculated using a sound propagation model using conceptual scenarios for worst-case construction and operational phases, which determined that the significance of the potential noise impacts could be:

- of a **low significance** for daytime construction activities associated with the Colenso Coal project (scenario 1);
- of a potential **medium significance** for night-time construction activities associated with the Colenso Coal project (scenario 1). This medium significance might relate to the strict EIA criteria used and the assumption that the higher noise levels may be considered disturbing or annoying by the closest NSR with mitigation measures recommended that could reduce the significance of the noise impact to low;
- of a **low significance** for daytime operational activities associated with the Colenso Coal project (scenario 2);
- of a **medium significance** for night-time activities associated with the Colenso Coal project. This medium significance might relate to the strict EIA criteria used, the use of potential worst-case noise emission levels for equipment and activities, and the assumption that the higher noise levels may be considered disturbing or annoying by the closest NSR. Mitigation measures are available and it is possible to reduce the potential significance to low.

MANAGEMENT AND MITIGATION

It was determined that the potential noise impact would be of a **medium significance** during the night-time period (if activities take place within 1,000m from NSR) and additional mitigation is recommended and required to ensure that annoyance with the project is minimised. These measures could include:

1. The mine can develop the boxcuts further than 1,000m from NSR, allowing the development of barriers (whether due to the highwalls from the mining area, or whether the barriers are constructed from overburden material);
2. When night-time drilling activities will be required within 1,000m from NSR, the mine should use available material to develop a berm between the drilling area and the NSR;
3. Minimizing drilling activities during the night-time period (when drilling within 1,000m from NSR if no berm was developed).
4. Night-time construction traffic entering and leaving the mine should be minimized between the hours of 22:00 and 04:00;
5. The mine must implement a quarterly night-time noise monitoring programme at houses used for residential activities. It is recommended that an acoustic specialist be appointed to assist with the design of a noise monitoring programme, considering the mitigation measures implemented. Feedback from NSR should be used to refine, and potentially update mitigation measures (which may include the relocation of certain receptors);
6. All employees and contractors should receive Health and Safety induction that includes an environmental awareness component (noise). This is to allow employees and contractors to the potential noise risks that activities (especially night-time activities) pose to the realise surrounding environment.
7. The applicant must implement a line of communication (i.e., a helpline where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers, or alternative means to communicate issues. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated. Feedback must be provided to the affected stakeholder(s) with details of any steps taken to mitigate the impact (if valid complaint) or preventative steps to minimise this from happening again.
8. The mine must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the plant or active mining area.

9. The mine investigates the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads, within the mining area and at stockpile areas.

The potential noise impact could be of a **medium** significance for the operational phase. Measures that may reduce the noise levels and assist in reducing the probability of noise impacts occurring are:

1. For mining activities located within 1,000m from NSR, the barrier (whether due to the highwalls acting as a barrier, or a constructed barrier) between NSR and mining areas should be as high as possible, allowing an effective barrier of at least 10m;
2. When operating within 1,000m from NSR without a barrier being present, it is recommended that only the highwall mining machine, or only the drilling machine operate within 1,000m from NSR; and
3. Quarterly night-time noise level measurements are recommended at NSR if mining activities take place within 1,000m from NSR.

NEED AND DESIRABILITY OF PROJECT

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

While the proposed Colenso Coal project will provide economic and social benefits to the area, the noises will be audible at the closest NSR and some NSR may find the noises annoying at night. In terms of acoustics, there is no benefit to the surrounding environment (closest receptors). It is noted that the NSRs are also directly linked to the operation, which would also foster a more positive attitude towards to future noise levels.

The project however will greatly assist in the economic growth and development challenges South Africa is facing by optimizing the extraction of the mineral resource. This will assist in providing additional employment and business opportunities for the local communities. Considering only noise, people in the area not directly affected by increased noise levels would have a positive perception of the project and could see the need and desirability of the project.

CONCLUSION AND RECOMMENDATION

It is expected that the mining activities will be audible as the closest NSR, and the proposed mining activities would raise the noise levels at the closest NSR. The increase however is not considered a fatal flaw, and it is recommended that the Colenso Coal Mine be authorized (from a noise impact perspective).

This noise impact assessment is sufficient, but it is recommended that a noise monitoring programme be designed by an acoustic specialist for implementation.

Morné de Jager
Enviro-Acoustic Research cc
2025 – 06 – 10

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6 (as amended 2017)		**Relevant Section of Specialist study**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	
	(i) the specialist who prepared the report; and	Section 1
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Section 1
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 2
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 4.1
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 6.1
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.1 and 6.2
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.1
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4.6
(f)	details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Sections 6.1, 6.2.1 and 10
(g)	an identification of any areas to be avoided, including buffers;	No buffers required. Noise rating levels calculated and illustrated.
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Sections 6.1
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 9
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Sections 10 and 11
(k)	any mitigation measures for inclusion in the EMPr;	Sections 12.3
(l)	any conditions for inclusion in the environmental authorisation (EA);	Sections 12.3

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

This report should be cited as:

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June 2025

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GLOSSARY OF ABBREVIATIONS

ADT	Articulated Dump Trucks
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
DFFE	Department of Forestry, Fisheries and Environment
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
ENIA	Environmental Noise Impact Assessment
ENPAT	Environmental Potential Atlas for South Africa
FEL	Front-end Loader
GN	Government Notice
HME	Heavy Mobile Equipment
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ISO	International Organization for Standardization
METI	Ministry of Economy, Trade, and Industry
NASA	National Aeronautical and Space Administration
NCR	Noise Control Regulations
NSR	Noise-sensitive Receptor
PFA	Project Focus Area
PWL	Sound Power Level

SABS	South African Bureau of Standards
SANS	South African National Standards
SPL	Sound Power Level
UTM	Universal Transverse Mercator
WHO	World Health Organization

GLOSSARY OF UNITS

dB	Decibel (expression of the relative loudness of the un-weighted sound level)
dBA	Decibel (expression of the relative loudness of the A-weighted sound level)
Hz	Hertz (measurement of frequency)
kg/m^2	Surface density (measurement of surface density)
km	kilometre (measurement of distance)
m	Meter (measurement of distance)
m^2	Square meter (measurement of area)
m^3	Cubic meter (measurement of volume)
mamsl	Meters above mean sea level
m/s	Meter per second (measurement for velocity)
^oC	Degrees Celsius (measurement of temperature)
µPa	Micro pascal (measurement of pressure – in air in this document)

1 THE AUTHOR

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

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

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

He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. He has been doing work in this field for the past 8 years, and was involved with the following projects in the last few years:

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

	Klipheuwel (SE), INCA Swellendam (SE), Cookhouse (SE), Iziduli (SE), Msenge (SE), Cookhouse II (SE), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Koningaas (SE), Spitskop (SE), Castle (SE), Khai Ma (SE), Poortjies (SE), Korana (SE), IE Moorreesburg (SE), Gunstfontein (SE), Boulders (SE), Vredenburg (Terramanzi), Loeriesfontein (SiVEST), Rhenosterberg (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Dwarsrug (SiVEST), Graskoppies (SiVEST), Philco (SiVEST), Hartebeest Leegte (SiVEST), Ithemba (SiVEST), !Xha Boom (SiVEST), Spitskop West (Terramanzi), Haga Haga (Terramanzi), Vredenburg (Terramanzi), Msenge Emoyeni (Windlab), Wobben (IWP), Trakas (SiVest), Beaufort West (SiVest), Pienaarspoort 1 and 2 (SE), Mphepo Zambia (SLR), Koup 1 (SiVEST), Koup 2 (SiVEST), Hamlet (SE), Aeoulus (SE), Ripponn (SE), Redding (SE), Wind Garden (SE), Fronteer (SE), Hendrina North (Cabanga), Hendrina South (Cabanga), Hoogland Northern Cluster (SLR), Hoogland Southern Cluster (SLR), Jessa M, S and Z cluster of Wind Farms (SLR), Heuweltjies (SiVEST), Kraaltjies (SiVEST), Patatskloof (SiVEST), Bergriver (SE), Overberg (Arcus), Newcastle North (CESNET), Newcastle South (CESNET), Ngxwabangu (CESNET), Taaibos North (CESNET), Taaibos South (CESNET), Soutrivier North (CESNET), Soutrivier South (CESNET), Soutrivier Central (CESNET), Soyuz 1 (AEP/CESNET), Soyuz 2 (AEP/CESNET), Soyuz 3 (AEP/CESNET), Soyuz 4 (AEP/CESNET), Soyuz 5 (AEP/CESNET), Soyuz 6 (AEP/CESNET), Kaladokhwe 1 (AEP/CSIR), FE Red Sands North East (Enviro-Insight), FE Red Sands South West (Enviro-Insight), FE Red Sands North West (Enviro-Insight), FE Red Sands South East (Enviro-Insight), FE De Rust North (Enviro-Insight), FE De Rust South (Enviro-Insight), Springbok (SE), Aberdene 1 (AEP/SE), Aberdene 2 (AEP/SE), Aberdene 3 (AEP/SE), Ezelsjacht (SLR), Amsterdam (Rochdale, Emvelo, Sheepmoor) (ERM); Loxton 1, 2 & 3 (ARCUS); Kariega 1, 2, 3 & 4 (EnviroAGRI); Hugo & Khoe (ERM); Taaibosch Puts Cluster (Khoemana, Gorachouqua) (JAWS); Eland (Praxos); Houmoed (Enviro-Insight); Stinkputs (Enviro-Insight); Zuurfontein (Enviro-Insight); Karoo Cluster (1, 2, 3) (SES), Tango (Savannah), Kudu (Savannah), Angora (Savannah), Oryx (Savannah)
Mining and Industry	*Full Environmental Noise Impact Assessments for – Delft Sand (AGES), BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream Environmental), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream Environmental), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream Environmental), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream Environmental), EastPlats (CleanStream Environmental), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Glencore Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali Environmental), Fumani Gold (AGES), Leiden Coal (EIMS), Colenso Coal and Power Station (SiVEST/EcoPartners), Klippoortjie Coal (Gudani), Rietspruit Crushers (MENCO), Assen Iron (Tshikovha), Transalloys (SE), ESKOM Ankerlig (SE), Nooitgedacht Titano Project (EcoPartners), Algoa Oil Well (EIMS), Spitskop Chrome (EMAssistance), Vlakfontein South (Gudani), Leandra Coal (Jacana), Grazvalley and Zoetveld (Prescali), Tjate Chrome (Prescali), Langpan Chromite (Prescali), Vereeniging Recycling (Pro Roof), Meyerton Recycling (Pro Roof), Hammanskraal Billeting Plant 1 and 2 (Unica), Development of Altona Furnace, Limpopo Province (Prescali Environmental), Haakdoorndrift Opencast at Amandelbult Platinum (Aurecon), Landau Dragline relocation (Aurecon), Stuart Coal Opencast (CleanStream Environmental), Tetra4 Gas Field Development (EIMS), Kao Diamonds – Tiping Village Relocation (EIMS), Royal Sheba*

	project (Cabanga),Kao Diamonds – West Valley Tailings Deposit (EIMS), Upington Special Economic Zone (EOH), Arcellor Mittal CCGT Project near Saldanha (ERM), Malawi Sugar Mill Project (ERM), Proposed Mooifontein Colliery (Geovicon Environmental), Goedehoop North Residue Deposit Expansion (Geovicon Environmental), Mutsho 600MW Coal-Fired Power Plant (Jacana Environmentals), Tshivhaso Coal-Fired Power Plant (Savannah Environmental), Doornhoek Fluorspar Project (Exigo), Royal Sheba Project (Cabanga Environmental), Rietkol Silica (Jacana), Gruisfontein Colliery (Jacana), Lehlabile Colliery (Jaco-K Consulting), Bloemendal Colliery (Enviro-Insight), Rondevly Colliery (REC), Welgedacht Colliery (REC), Kalabasfontein Extension (EIMS), Waltloo Power Generation Project (EScience), Buffalo Colliery (Marang), Balgarthen Colliery (Rayten), Kusipongo Block C (Rayten), Zandheuvel (Exigo), NamPower Walvis Bay (GPT), Eloff Phase 3 (EIMS), Dunbar (Enviro-Insight), Smokey Hills (Prescali), Bierspruit (Aurecon), ECM Lannex (Prescali). ECM Tweefontein (Prescali), Smokey Hills (Prescali), Dalyshope (Digby Wells), Eland Platinum Mine (JEMS), Tweefontein (Prescali), Lannex (Prescali), Salene Manganese (Prescali), Baberton Gas to Power (Rayten), SISHEN Expansion (Shangoni), Goedgevonden EMP Amendment (Jacana), Rietkol Amendment (Jacana), Vlakfontein Bunker Project (Gudani), Vlakfontein West Project (Gudani), Vygenhoek Platinum (EMAssistance), Lesego Amendment (OMI Solutions), Mpenyisi Gas to Power (Nsovo), Basani Gas to Power (Nsovo), Newlands Gas to Power (Savannah), Sudor Coal (JacoK), Nooitgedacht Titanomanganese (Ikwezi), Inyanda Project (JacoK), Ermelo Project (Zyntha), (Schurvekop Coal (Cabanga), Vlakfontein Coal (EMAssistance), Zandheuvel (Jacana), Zondagsvlei Coal (Zyntha), Sereti Witbank South (Zyntha), Bright Alloys (Phakani), Gold One (Prime Resources), Consol Nigel (Zitholele), Hendrina Green Hydrogen and Ammonia project (Enertrag/WSP), Kegakilwe Diamonds (Gudani), Naudesbank (Zyntha), Brackenfell Data Centre (Linspace), Springfield & Redan (MENCO), Somkhele Project (Ophondweni, Emamahleni, Mahujini) (MENCO), Beta Gold (OMIsolutions), Rietfontein Gold (OMIsolutions), Bright Alloys Smelter (Phakani), Sweet Sensations Sand (Digby Wells), Anglo Motlhotlo (Digby Wells), Soufflet Malt (RHDHV), Braamspruit Coal (Shangoni), Southern Sphere Project (Shangoni), Renoster 1 (SRK)
Urban, Roads and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane), Transnet Apies-river Bridge Upgrade (Transnet), Gautrain Due-diligence (SiVest), N2 Piet Retief (SANRAL), Atterbury Extension, CoT (Bokomoso Environmental), Riverfarm Development (Terramanzi), Conakry to Kindia Toll Road (Rayten), Sutherland Road Project (Veers Group), Sassalemba Project (Enviro-Insight), Barra da Donde Angola (Enviro-Insight), Musina-Makhado SEZ (Gudani), Highbury Depot (AGES Limpopo), Mokopane project (AGES Limpopo), Deerpark Filling Station (AGES Limpopo), Highlands Estate (NALI), IPHC Wonderpark (Magoda), Busstop7,*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping (Aurecon)*
Noise monitoring and Audit Reports	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional (Xstrata), Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF Ambient Sound Level study (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Hopefield WEF Noise Analysis (Umoya), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon), Jeffries Bay Wind Farm*

	(Globeleq), Sephaku Aganang (Exigo), Sephaku Delmas (Exigo), Beira Audit (BP/GPT), Nacala Audit (BP/GPT), NATREF (Nemai), Rappa Resources (Rayten), Measurement Report for Sephaku Delmas (Ages), Measurement Report for Sephaku Aganang (Ages), Bank of Botswana measurements (Linnspace), Skukuza Noise Measurements (Concor), Development noise measurement protocol for Mamba Cement (Exigo), Measurement Report for Mamba Cement (Exigo), Measurement Report for Nokeng Fluorspar (Exigo), Tsitsikamma Community Wind Farm Pre-operation sound measurements (Cennergi), Waainek WEF Operational Noise Measurements (Innowind), Sedibeng Brewery Noise Measurements (MENCO), Tsitsikamma Community Wind Farm Operational noise measurements (Cennergi), Noupoort Wind Farm Operational noise measurements (Mainstream), Twisdraai Colliery (Lefatshe Minerals), SASOL Prospecting (Lefatshe Minerals), South32 Klipspruit (Rayten), Sibanye Stillwater Kroondal (Rayten), Rooiberg Asphalt (Rooiberg Asphalt), SASOL Shondoni (Lefatshe), SASOL Twisdraai (Lefatshe), Anglo Mototolo (Exigo), Heineken Inyaniga (AECOM), Glencore Izimbiwa (Cleanstream), Glencore Impunzi (Cleanstream), Black Chrome Mine (Prescali) Sibanye Stillwater Ezulwini (Aurecon), Sibanye Stillwater Beatrix (Aurecon), Bank of Botshwana (Linspace), Lakeside (Linspace), Skukuza (SiVest), Rietvlei Colliery (Jaco-K Consulting), TCTA – Mokolo Project (GIBB), Various (Linspace), Sulzer Hydromining (Sulzer), WCO WEF (Aurora), Great Kei (EDF-Renewables), Elands Platinum (JEMS), Hartebeest WEF (juwi), Mamba Cement (TMCC), Booysens (MDTE), West Rand (MDTE), Devland (MDTE), Zandheuvel (Jacana), Glencore (Kroondal, Rhovan, Rietvly, Waterval-West, Helena, Lion Smelter, Magareng, Thorncliffe, Boshoek, Rustenburg Smelter, Wonderkop) (JMA), McDonalds Albert Street (Linspace), Waterfall Data Centre (Linspace), Zondereinde (Linspace), Copper Sunset Sands (Digby Wells), Exxaro Lephalale (Digby Wells), Tawana Mining (Tawana Mining),
Project Modelling and Consulting	*JW Angola Urban Development (Rayten), Mooi-Mgeni Hydro Project (Rayten), Consmodder (Rayten), Samrand Data Centre (Rayten), Luculus Road (Rayten), Atlanta Weir (Rayten), Beestekraal Weir (Rayten)! Paul Hugo Weir (Rayten), Newcastle Coal Mine (Rayten), Boldman Coal (Rayten), Worcester N1 Upgrade (Rayten), Angola Railway Project (Rayten), Nekkies Road Project (Rayten), George N2 Bypass Road (Rayten), Vanmag project (Rayten), N2 Bypass Borrowpits (Rayten),*
Small Noise Impact Assessments	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion 2 (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), RareCo (SE), Struisbaai WEF (SE), Perdekraal WEF (ERM), Kotula Tsatsi Energy (SE), Olievenhoutbosch Township (Nali), , HDMS Project (AECOM), Quarry extensions near Ermelo (Rietspruit Crushers), Proposed uMzimkhulu Landfill in KZN (nZingwe Consultancy), Linksfield Residential Development (Bokomoso Environmental), Rooihuiskraal Ext. Residential Development, CoT (Plandev Town Planners), Floating Power Plant and LNG Import Facility, Richards Bay (ERM), Floating Power Plant project, Saldanha (ERM), Vopak Growth 4 project (ERM), Elandspoort Ext 3 Residential Development (Gibb Engineering), Tiegerpoort Wedding Venue (Henwood Environmental),*

	Monavoni Development (Marindzini), Rezoning of Portion 1 (Primo Properties), Tswaing Mega City (Makole), Mabopane Church (EP Architects), ERGO Soweto Cluster (Kongiwe), Fabio Chains (Marang), GIDZ JMP (Marang), Temple Complex (KWP Create), Germiston Metals (Dorean), Sebenza Metals (Dorean), Malmesbury Abattoir Expansion (Roelcor), Mogalakwena PV Project (Zutari), Serengeti PV Review (Zutari), Nyakallo PV (GCS), Robinson Deep (IQS), Zonnebloem (Zyntha), Forzando North (Cabanga), Tumelo (Cabanga), Daggafontein projects (Kongiwe), Genesis Steyn PV (Kongiwe), ERGO Soweto Cluster (Kongiwe), Kriel PV (NALA), Mhlabatshane project (NEMAI), Coega G2P (Nsovo), Cape Roan Desalination Project (Rayten), AJCOR (Rayten), Swartfontein PV (Savannah)
Blasting Vibration Assessments	*Anglo Bierspruit (Aurecon), Arengo Iron Thabazimbi (BeyondGES), Vlakfontein Coal (EMAssistance), Gruisfontein Coal (Jacana), Glencore Goedgevonden (Jacana), Remhoogte Coal (Zyntha), Rietkuil Coal (Zyntha), Vygenhoek Platinum (EMAssistance), Dunbar Coal (Enviro-Insight), Bloemendal Coal (Enviro-Insight), Salene Manganese (Prescali), VTM Mining (Ikwezi Vanadium), Newcastle Coal project (Ericure), De Kroon (Zyntha), Naudesbank (Zyntha), Somkhele Project (Ophondweni, Emamahleni, Mahujini) (MENCO), Wagendrift (Milnex), Glenover (Prescali), Braamspruit Coal (Shangoni)*

2 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

- I act as the independent specialist in this application
- I will perform the work relating to this study in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental noise impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2014, and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- all the particulars furnished by me in this form are true and correct;
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act, and;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014.

_____

Signature of the specialist:

Name of company:

Enviro-Acoustic Research cc

Date:

2025 – 06 – 10

3 MINIMUM REQUIREMENTS – SCREENING OF SITE

The National Web based Environmental Screening Tool[1] was used to screen the proposed site (see **Figure 4-1** for the regional location) for the noise environmental sensitivity as per the requirements of GNR320 (20 March 2020), considering the site location. The site report generated by the Screening Tool highlighted that a Noise Impact Assessment must be completed and appended to the Environmental Authorization ("EA") documentation. The screening report was developed for *Mining => Mining Right*, which also identified that a Noise Impact Assessment be included in the assessment report.

The potential noise sensitive areas layer is not included in the above-mentioned category, but was obtained from the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the noise sensitive areas illustrated on **Figure 4-4**.

Based on the output of the online screening tool, most of the area is considered to have a "very high" sensitivity to noise. This was also confirmed during the site visit that identified and confirmed various residential activities within the potential area of influence from the project activities (see also **Figure 4-5**).

In terms of GNR 320 (20 March 2020), the Noise Specialist Assessment must contain, as a minimum, the following information:

Clause	Reporting Requirements as per the Protocol for Noise Specialist Assessments	Compliance of current report / Reference
2.3.1	Current ambient sound levels recorded at relevant locations over a minimum of two nights and that provide a representative measurement of the ambient noise climate, with each sample being a minimum of ten minutes and taken at two different times of the night on each night, in order to record typical ambient sound levels at these different times of night	Section 6
2.3.2	Records of the approximate wind speed at the time of the measurement	Section 6
2.3.3	Mapped distance of the receiver from the proposed development that is the noise source	Section 6
2.3.4	Discussion on temporal aspects of baseline ambient conditions	Section 6

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

Clause	Reporting Requirements as per the Protocol for Noise Specialist Assessments	Compliance of current report / Reference
2.4.1	Characterization and determination of noise emissions from the noise source, where characterization could include types of noise, frequency, content, vibration and temporal aspects	Section 6.2.1
2.4.2	Projected total noise levels and changes in noise levels as a result of the construction, commissioning and operation of the proposed development for the nearest receptors using industry accepted models and forecasts	Sections 10
2.4.3	Desired noise levels for the area	Section 6.2
2.5.1	Contact details of the environmental assessment practitioner or noise specialist, their relevant qualifications and expertise in preparing the statement, and a curriculum vitae	Section 1
2.5.2	a signed statement of independence by the environmental assessment practitioner or noise specialist.	Section 2
2.5.3	The duration and date of the site inspection and the relevance of the season and weather condition to the outcome of the assessment	Section 6
2.5.4	A description of the methodology used to undertake the on-site assessment, inclusive of the equipment and models used, as relevant, together with the results of the noise assessment	Sections 4.6, 6 and 10
2.5.5	a map showing the proposed development footprint (including supporting infrastructure) overlaid on the noise sensitivity map generated by the screening tool	Figure 4-4
2.5.6	confirmation that all reasonable measures have been taken through micro- siting to minimise disturbance to receptors	Various layouts previously investigated
2.5.7	a substantiated statement from the specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development	Section 15
2.5.8	any conditions to which this statement is subjected	Section 12.3 and 15
2.5.9	the assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered	Project location limited by the presence of the mineral resource
2.5.10	A motivation must be provided if there were development footprints identified as per paragraph 2.5.9 above that were identified as having a "low" noise sensitivity and that were not considered appropriate	Project location limited by the presence of the mineral resource

Clause	Reporting Requirements as per the Protocol for Noise Specialist Assessments	Compliance of current report / Reference
2.5.11	where required, proposed impact management outcomes, mitigation measures for noise emissions during the construction and commissioning phases that may be of relative short duration, or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr), and	Section 12 and 14
2.5.12	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations	Section 9

4 INTRODUCTION

4.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research ("EARES") was contracted by Dunrose Investments 174 (Pty) Ltd to determine the potential noise impact on the surrounding environment due to the development of the proposed Colenso Coal Project, KwaZulu Natal Province (KZN).

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

This study considered local regulations and both local and international guidelines, using the terms of reference as proposed by SANS 10328:2008 to allow for a comprehensive Environmental Noise Impact Assessment.

4.2 BRIEF PROJECT DESCRIPTION

Dunrose Investments 174 (Pty) Ltd proposed to mine their coal resource on a farm to the north-west of Colenso, KZN, with the Project Focus Area (PFA) illustrated in **Figure 4-1**. This project would be known as Colenso Coal, with the coal resource mined using the Highwall mining method for the at least the first decade.

Highwall mining is a remote-controlled mining method used to extract coal from the final high wall of an open-cut mine. The method involves driving a series of unsupported parallel tunnels into the exposed coal seam using a specialised highwall mining system (see also **Figure 4-2** and **Figure 4-3**). The tunnels are self-supported by leaving behind coal pillars that act as a primary support.

A highwall exposing the coal seam will be established using conventional open-cast mining methods, utilizing either drilling and blasting (in hard unweathered material) or excavators (in the softer weathered material). Thereafter a stable, compacted bench with a face length of approximately 40 m will be created for the highwall mining equipment. Loose material and overburden debris will be removed from the highwall face to prevent rockfalls.

Once the highwall and the working bench has been established. The highwall mining system will be positioned on the bench. The cutter module, which houses a continuous miner head will be aligned with the coal seam. Thereafter the cutter module will be launched into the

coal seams using a series of push beams (Each typically around 6 m long) that extend deeper into the highwall. The push beams serve as both structural reinforcement and a conveyor system, transporting coal back to the surface.

The high wall mining equipment to be utilised at Colenso has a maximum reach of 500 m. In areas where it may not be feasible for the highwall mining method, mining will commence through the board and pillar underground mining method. The coal resources in these areas will be access through either a portal established on a final highwall, or a decline shaft located in the most economically feasible area of the resource to limit capital expenditure.

An additional conveyor system will be established and used to convey the coal from the active mining area to a coal stockpile, for future use by third party (subject to a separate Environmental Impact Assessment (EIA) process).

4.3 STUDY AREA

The development is situated in the Emnambithi/Ladysmith local municipality, while the district municipality is the uThukela. The town of Colenso serves as a conjunction town which lies between Ladysmith to the North and Estcourt to the South. Locations where main noise-generating activities may take place are encircled within a 2,000m buffer area, defined as the PFA. This PFA is further described in terms of environmental components that may contribute to or change the sound character in the area.

4.3.1 Topography

The Environmental Potential Atlas of South Africa ("ENPAT") (Van Riet *et al*, 1998) describes the topography as *"Mountains and Lowlands"*. The coal mining will take place on the slopes of the mountainous areas roughly following the coal outcrop.

4.3.2 Surrounding Land Use

The surrounding land use is mainly commercial agriculture, subsistence farming and game ranches (tourism). These activities generally do not impact on ambient sound levels will not be considered in the Environmental Noise Impact Assessment.

4.3.3 Roads and Railways

There are no roads or railway lines of acoustic significance within or near the PFA. There are a number of minor roads within the PFA, mainly used by the local communities, farmers and the project developer. Noise from existing road traffic will not be investigated in this report.

4.3.4 Ground conditions and vegetation

The area falls within the thicket biome, with the natural vegetation type being "*Valley Thicket*"[2]. While the slopes of the Tugela Valley remains fairly natural, much of the natural vegetation has been altered by anthropogenic activities, such as subsistence farming practices and grazing.

Taking into consideration available information it is the opinion of the author that the ground conditions (when considering acoustic propagation on a ground surface) can be classified as medium to soft, which implies that the ground surface will absorb some of the acoustic energy hitting the ground surface. It should be noted that this factor is only relevant for air-borne waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

4.3.5 Existing Ambient Sound Levels

Sound pressure levels were measured from 19 to 21 May 2014 at one location within the PFA. While this data is older than 10 years, the author has done significant measurements in areas with a similar soundscape, and this data is considered applicable, and additional sound level measurements were not recommended.

Ambient sound levels were mainly dominated by natural noises (birds and some wind-induced noises), though noises from a large freezer compressor did influence the measurements during with quieter periods. The ambient sound levels were elevated for an area with a rural developmental character, with various different noises (household, domestic animals and birds) impacting on the daytime sound levels, with noises from a freezer compressor mostly impacting on the night-time sound levels.

The results and findings of the ambient sound level measurements are summarised in **Section 6.2**.

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

Potentially sensitive receptors, also known as noise-sensitive developments ("NSR"), located near the project area was identified using Google Earth®. The online screening tool did identify that most of the area having a "very high" sensitivity to noise (see **Figure 4-4**), with representative NSR locations illustrated in **Figure 4-5**.

[2] Van Riet, W. Claassen, P. van Rensburg, J. van Viegen & L. du Plessis, "*Environmental Potential Atlas for South Africa"*, Pretoria, 1998.

Generally, noises from mining and industrial activities:

- could be high and very significant within 200 m from noise-generating activities both night and day;
- can be significant at NSR staying within 500 m from active mining/industrial activities. Noises are at a sufficient level to be considered disturbing at night;
- are normally limited to a distance of approximately 1,000 m from the active mining/industrial activities. Ambient sound levels are increased due to noises from the activities, with the potential noise impact measurable. Noise levels from such activities are generally less than 45 dBA further than 1,000 m from these activities;
- may be audible up to a distance of 2,000 m at night, though the noises may be audible up to 4,000 m during very quiet periods at night (during certain meteorological conditions). These noises are normally of a low concern at distances greater than 2,000 m from activities at night.

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

4.5 COMMENTS REGARDING NOISE RECEIVED DURING THIS PROJECT

The author is not aware of any comments raised by the authorities or interested and affected parties at the date this report was compiled. It should however be noted that the Noise Assessment is part of a suite of studies commissioned by the Environmental Assessment Practitioner ("EAP"), who is undertaking the Public Participation Process ("PPP") as part of the EIA. Comments regarding noise may only be available during the future EIA and PPP process.

4.6 LEGISLATIVE REQUIREMENTS AND TERMS OF REFERENCE

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

- It was identified as an environmental theme needing further investigation i.t.o. the National Screening Tool as per the procedures of Government Gazette 43110 of 20 March 2020;
- A change in land use as highlighted in SANS 10328:2008, section 5.3;
- If an industry is to be established within 1,000 m from a potential noise sensitive development (SANS 10328:2008 [5.4 (h)]);
- If a wind farm (wind turbines - SANS 10328:2008 [5.4 (i)]) or a source of low-frequency noise (such as cooling or ventilation fans - SANS 10328:2008 [5.4 (l)]) is to be established within 2,000 m from a potential noise sensitive development *or vice versa*;

- It is a controlled activity in terms of the NEMA regulations and an ENIA is required, because it may cause a disturbing noise that is prohibited in terms of section 18(1) of the Government Notice ("GN") 579 of 2010;
- It is generally required by the local or district authority as part of the environmental authorization or planning approval in terms of Regulation 2(d) of GN R154 of 1992 (and GN 5479 of August 1999).

4.6.1 Requirements as per Government Gazette 43110 of March 2020

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

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

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

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

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

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

If any part of the proposed development footprint falls within an area of "very high" sensitivity, the assessment and reporting requirements prescribed for the "very high" sensitivity apply to the entire footprint excluding linear activities for which noise impacts are associated with construction activities only and the noise levels return to the current

levels after the completion of construction activities, in which case a compliance statement applies. In the context of this protocol, development footprint means the area on which the proposed development will take place and includes any area that will be disturbed.

The minimum requirements for a Noise Specialist Study (i.t.o GNR 320 of 2020) are also covered in **Section 3** of this report in the form of a checklist.

This assessment is comprehensive and a Noise Specialist Assessment is required because there are a number of potential noise-sensitive receptors living within 2,000 m from the proposed project activities.

4.6.2 Requirements as per South African National Standards

In addition, Appendix 6 of GN 326 of December 2014 (Government Gazette ("GG") 38282), as amended 7 April 2017 (GG. 40772), issued in terms of the National Environmental Management Act, No. 107 of 1998, also defines minimum information requirements for specialist reports.

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

This standard specifies the methodology to assess the potential noise impacts on the environment due to a proposed activity that might impact on the environment. This standard also stipulates the minimum requirements to be investigated for environmental impact assessment ("EIA") purposes. These minimum requirements are:

1. The purpose of the investigation – **section 4.1**;
2. A brief description of the planned development or the changes that are being considered – **section 4.2**;
3. A brief description of the existing environment – **section 6**;
4. The identification of the noise sources that may affect the particular development, together with their respective estimated sound pressure levels or sound power levels (or both) – **section 6.2.1**;
5. The identified noise sources that were not taken into account and the reasons why they were not investigated – **section 6.2.1**;
6. The identified noise-sensitive developments and the estimated impact on them – **sections 4.4**, **10** and **11**;

7. Any assumptions made with regard to the estimated values used – **section 9**;
8. An explanation, either by a brief description or by reference, of the methods that were used to estimate the existing and predicted rating levels – **section 8**;
9. The location of the measurement or calculation points, i.e., a description, sketch or map – **section 10**;
10. Estimation of the environmental noise impact – **sections 10** and **11**;
11. Alternatives that were considered and the results of those that were investigated – **section 10.5**;
12. A list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation – **section 4.5**;
13. A detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them – **section 4.5**;
14. Conclusions that were reached – **section 15**;
15. Recommendations, i.e., if there could be a significant impact, or if more information is needed, a recommendation that an environmental noise impact assessment be conducted – **section 15**; and
16. If remedial measures will provide an acceptable solution, which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after a certain time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority – **section 12**.

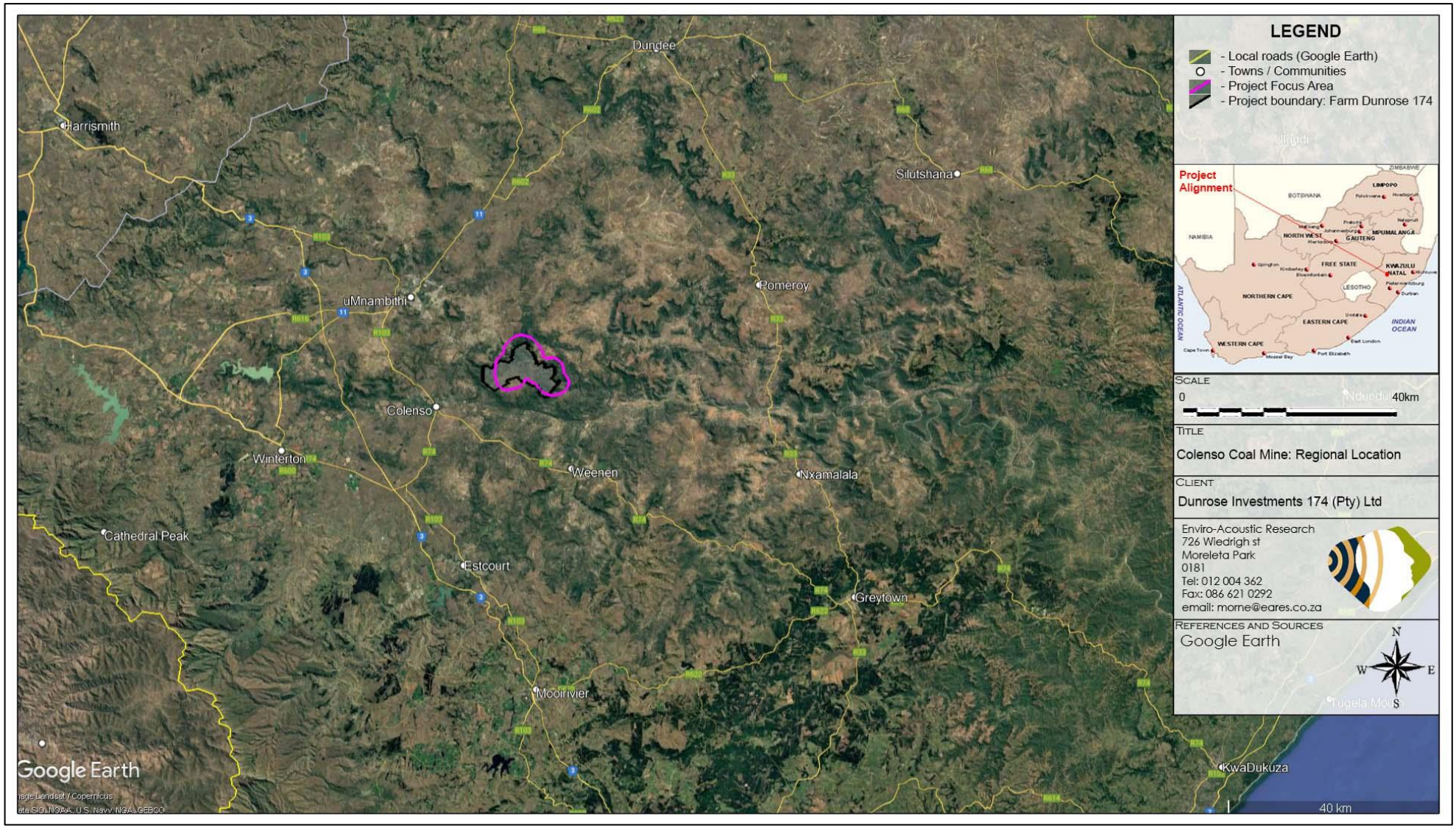

Figure 4-1: Aerial image indicating the regional location of the proposed Colenso Coal Project

Figure 4-2: Typical Highwall Miner – Image 1

Figure 4-3: Typical Highwall Miner – Image 2

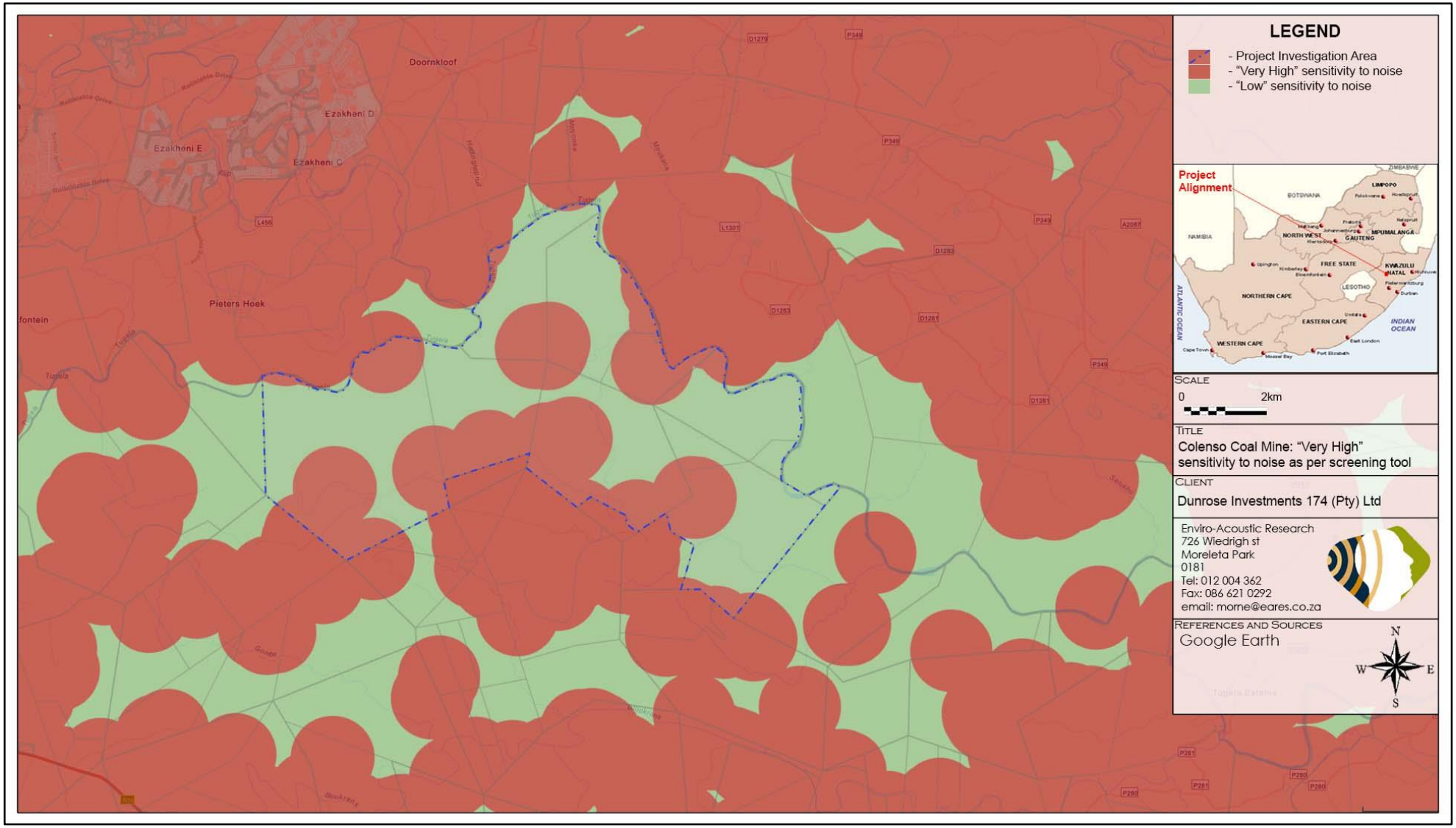

Figure 4-4: Areas identified by the online screening tool to have a "very high" sensitivity to noise

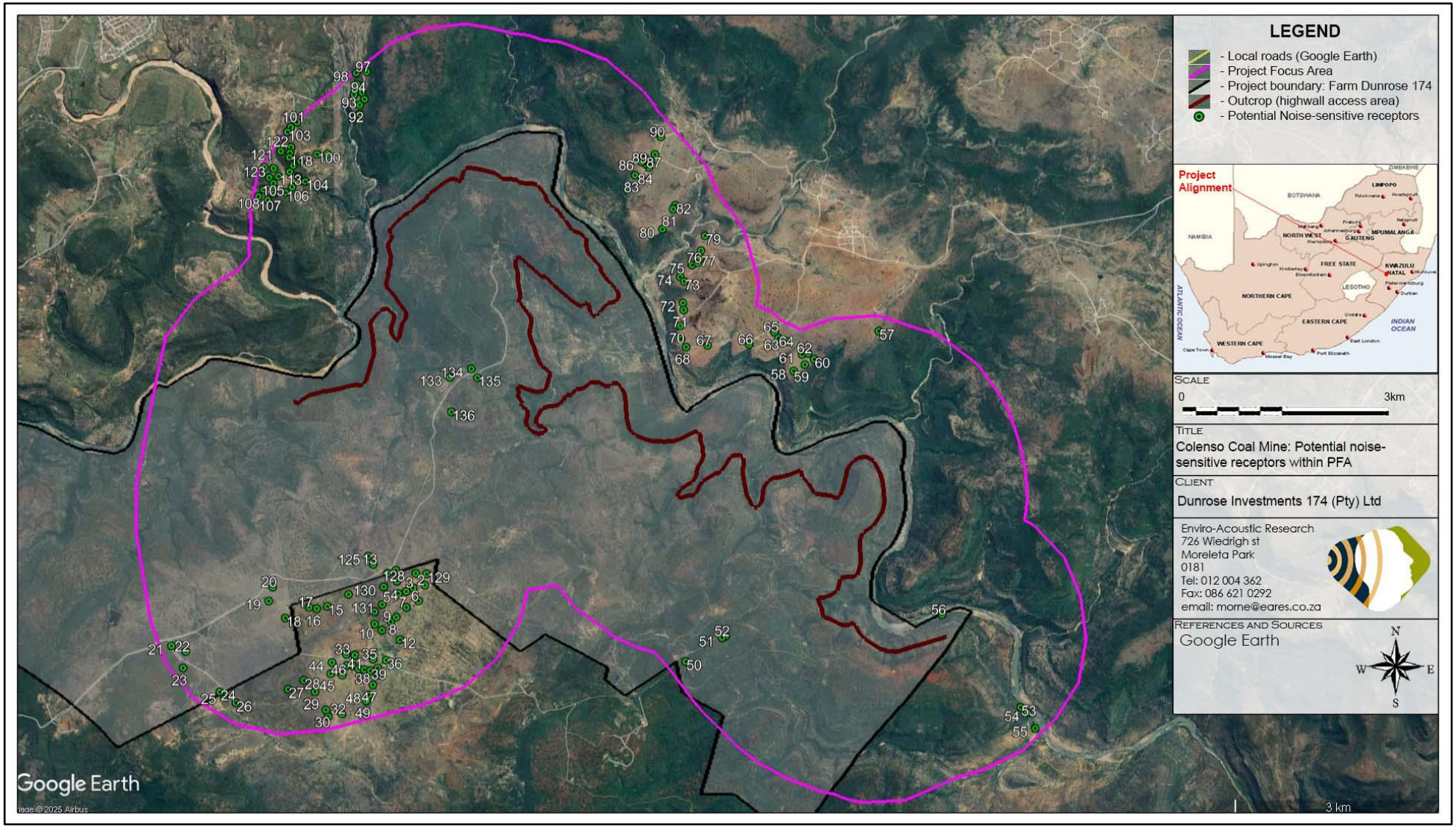

Figure 4-5: Aerial image indicating verified noise-sensitive receptors close to the Colenso Coal Project

5 LEGAL CONTEXT, POLICIES AND GUIDELINES

5.1 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Environmental Affairs") to make regulations regarding noise, among other concerns. See also **Section 5.1.1**.

5.1.1 Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the National Noise Control Regulations (GN R 154 of 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

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

The National Noise Control Regulations (GN R154 1992) defines:
"**controlled area**" as:

a piece of land designated by a local authority where, in the case of—

a) road transport noise in the vicinity of a road-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or

ii. the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA;

c) industrial noise in the vicinity of an industry-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation meter is in operation, exceeds 61 dBA; or

ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period, exceeds 61 dBA.

"**disturbing noise**" as:
noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA[3] or more.

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

In addition:
In terms of Regulation 2 -
"A local authority may –
(a) establish a new township unless the lay-out plan concerned, if required by a local authority, indicates in accordance with the specifications of the local authority, the existing and future sources of noise, with concomitant dBA values which are foreseen in the township for a period of 15 years following the date on which the erection of the buildings in and around the township commences;
(c):" if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefor, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the lever of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles;
(d): before changes are made to existing facilities or existing uses of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests are conducted to the satisfaction of that local authority by the owner, developer, tenant or occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b) or

[3] When comparing the results of a measurement (minimum duration of 10 minutes) without the noise under investigation with a similar measurement with the noise present.

(f) designate a controlled area in its area of jurisdiction or amend or cancel an existing controlled area by notice in the Official Gazette concerned.

General prohibition

3. No person shall -

(c) make changes to existing facilities or existing uses of land or buildings or erect new buildings, if it shall in the opinion of a local authority house or cause activities which shall, after such change or erection, cause a disturbing noise, unless precautionary measures to prevent the disturbing noise have been taken to the satisfaction of the local authority;

In terms of Regulation 4 of the Noise Control Regulations:

"No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof".

Clause 7.(1) however exempts noise of the following activities, namely -

"The provisions of these regulations shall not apply, if -

(a) the emission of sound is for the purposes of warning people of a dangerous situation;

(b) the emission of sound takes place during an emergency."

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

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

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

In addition, a number of regulations have been promulgated as Regulation 982 of December 2014 (Government Notice 38282) in terms of this Act. It defines minimum information

requirements for specialist reports, with Government Gazette (GG) 43110 (20 March 2020) updating the minimum requirements for reporting.

GG 43110 prescribe general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring environmental authorisation. These protocols were promulgated in terms of sections 24(5)(a), (h) and 44 of the National Environmental Management Act, 1998.

When the requirements of a protocol apply, the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, as amended, (EIA Regulations), promulgated under sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), are replaced by these requirements.

5.3 NOISE STANDARDS

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

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.
- SANS 10210:2004. 'Calculating and predicting road traffic noise'.
- SANS 10328:2008. 'Methods for environmental noise impact assessments'.
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method'.
- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'.
- SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

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

5.3.1 SANS 10103:2008

SANS 10103 provide standard procedures to measure and define rating levels with respect to annoyance and speech communication, with a number of important principles discussed in subsections:

- clause 4.1 - Ambient indoor noise;
- clause 4.2 – Typical noise in various districts; and
- clause 4.5 – Assessment of annoyance.

5.3.1.1 Clause 4.1 – Ambient indoor noise

This is a critical section, frequently ignored by authorities and even acoustic specialists. This clause provides recommended rating levels ($L_{Req,T}$) for ambient noise for different areas of occupancy during the time periods when the areas are used for their intended purposes and with the building services (e.g. ventilation systems, air-conditioning systems, lifts, plumbing and lighting) under normal operating conditions. The rating levels given in column 2 of the table are design values, while those given in column 3 are the maximum levels beyond which the ambient noise can be considered to be annoying or otherwise intrusive. Note 2 highlights that, where these levels are used as guidance for the design of buildings in non-residential areas where the ambient noise exceeds the typical level for the type of development, the building design should provide sufficient acoustic isolation to result in the occupancy level specified in Table 1 of SANS 10103 (see example for residential use in **Table 5-1**).

Table 5-1: Recommended ambient noise for different areas of occupancy indoors (Table 1 - SANS 10103:2008)

1	2	3
Types of occupancy or activity	**Design equivalent continuous rating level ($L_{Req,T}$)a for ambient noise dBA**	**Maximum equivalent continuous rating level ($L_{Req,T}$)a for ambient noise dBA**
9. Residential buildings		
Living rooms	35	45
Kitchens and service areas	45	55
Bathrooms and toilets	40	55
Bedrooms	30	40

5.3.1.2 Clause 4.2 – Typical noise in various districts

This section covers typical rating levels ($L_{Req,T}$) for ambient noise in different districts in Table 2 (duplicated in **Table 5-2**). This standard recommends that these values not be exceeded, and outdoor ambient noise exceeding these levels will be considered to be annoying to the community. The levels may be used as a guide for zoning purposes and assumes that a building with natural ventilation and open windows will provide sound insulation of about 10 dBA, with the rating levels considering Table 1 rating levels. This standard highlight in note 1 that, where occupancies have to be allowed within areas where the acceptable outdoor values are exceeded for the particular type of occupancy, the sound

insulation of the building housing the occupancy should be proven to comply to the indoor levels defined in Table 1 (see example for residential use in **Table 5-1**) of this standard.

Table 5-2: Acceptable Zone Sound Levels for noise in districts (Table 2 - SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req,T}$) for noise dBA**					
	Outdoors			**Indoors, with open windows**		
	Day/night $L_{R,dn}$	**Daytime $L_{Req,d}$**	**Night-time $L_{Req,n}$**	**Day/night $L_{R,dn}$**	**Daytime $L_{Req,d}$**	**Night-time $L_{Req,n}$**
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

It must be noted that SANS 10103:2008 does stipulate *"for industries legitimately operating in an industrial district during the entire 24 h day/night cycle, $L_{Req,d} = L_{Req,n} = 70$ dBA can be considered as typical and normal".*

5.3.1.3 Clause 4.5 – Assessment of annoyance

This section recommends investigation only when the rating level ($L_{Req,T}$) of the ambient noise exceeds the rating level ($L_{Req,T}$) of the residual noise (ambient sound levels) at the same location during the relevant time period. The ambient indoor or outdoor sound level should be compared with the appropriate level given in Table 1 (see 5.3.1.1) or Table 2 (see 5.3.1.2). This standard state that it is probable that the noise is annoying or otherwise intrusive to the community or to a group of persons if the rating level of the ambient noise under investigation exceeds the applicable of the following:

a) the rating level of the residual noise (determined in the absence of the specific noise under investigation);
b) the maximum rating level for the ambient noise given in table 1 (see example for residential use in **Table 5-1**); or
c) the typical rating level for the ambient noise for the applicable environment given in table 2 (duplicated in **Table 5-2**). The probable community or group response to the excess ($\Delta L_{Req,T}$) is given in **Figure 5-1**.

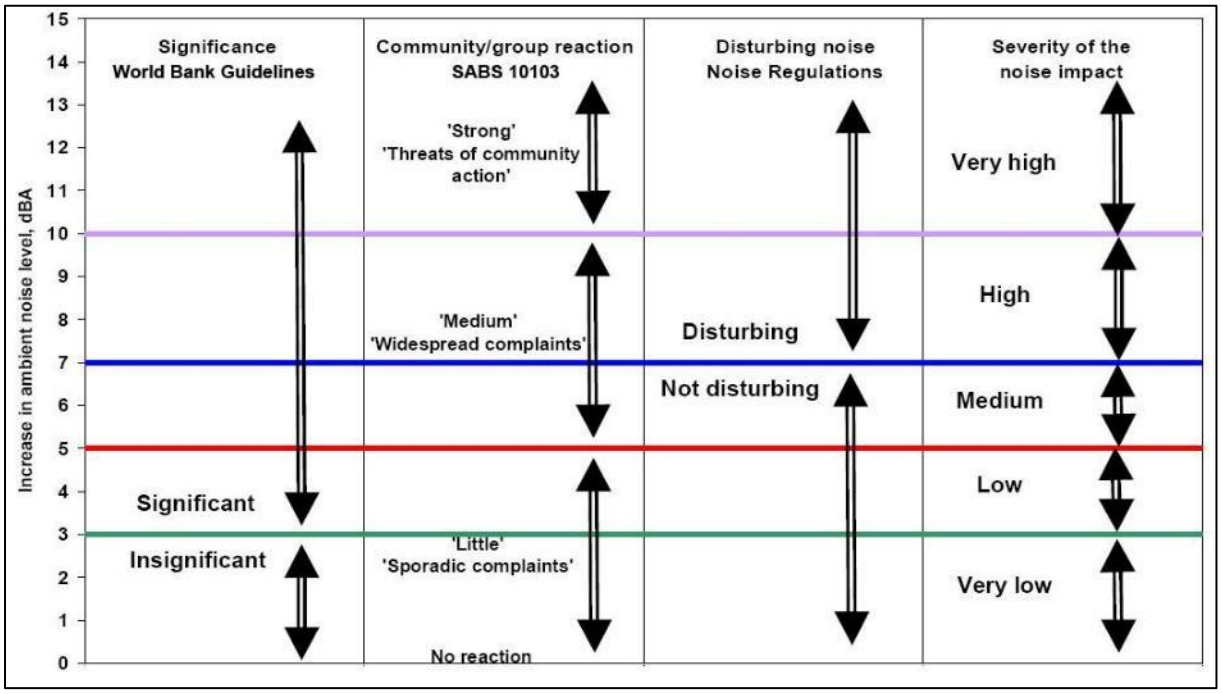

Figure 5-1: Criteria to assess the significance of impacts stemming from noise

5.3.2 SANS 10328:2008

SANS 10328 provide methods for environmental noise impact assessment, with relevant regulations (see **section 5.1.1**) and GNR320 (see **sections 4.6.1** and the checklist in **section 3**) stipulating that this standard be followed when doing a noise specialist study.

SANS 10328 recommends that the procedures given in clause 6 to clause 8 (inclusive) be followed if:

a) an application, in respect of any activities identified in terms of the current relevant legislation are proposed, if noise sources listed in clauses 3.17 and 3.18 (of of SANS 10328) are to be developed, or the issues listed in clause 5 (of SANS 10328) may take place, is made to the relevant authority;
b) an application for a noise-sensitive development (see 3.16 of SANS 10328) is made to the relevant authority;
c) an application for a change in land use is made to the relevant authority; or
d) an environmental noise impact investigation is requested by an applicant or any interested or affected party.

The minimum contents of the noise specialist study are also included in **section 4.6.2** of this report.

5.4 INTERNATIONAL GUIDELINES

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

5.4.1 Guidelines for Community Noise (WHO, 1999)

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

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

- Interference with communication, noise-induced hearing impairment, sleep disturbance effects, cardiovascular and psychophysiological effects, mental health effects, effects on performance, annoyance responses and effects on social behavior.

It further discusses how noise can affect (and propose guideline noise levels) specific environments such as residential dwellings, schools, preschools, hospitals, ceremonies, festivals and entertainment events, sounds through headphones, impulsive sounds from toys, fireworks and firearms, and parklands and conservation areas.

To protect the majority of people from being affected by noise during the daytime, it proposes that sound levels at outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the day, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}. At night, equivalent sound levels at the outside façades of the living spaces should not exceed 45 dBA and 60 dBA L_{Amax} so that people may sleep with bedroom windows open. It is critical to note that this guideline requires the sound level measuring instrument to be set on the "fast" detection setting.

5.4.2 European Parliament Directive 200/14/EC (2000)

Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors was adopted by the European Parliament and the Council and first published in May 2000 and applied from 3 January 2002. The directive placed sound power limits on equipment to be used outdoors in a suburban or urban setting. Failure to comply with these

regulations may result in products being prohibited from being placed on the EU market. Equipment list is vast and includes machinery such as compaction machineries, dozers, dumpers, excavators, etc. Manufacturers as a result started to consider noise emission levels from their products to ensure that their equipment will continue to have a market in most countries.

5.4.3 Equator Principles (2003)

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

The EPs were developed by private sector banks and were launched in June 2003. The banks chose to model the EPs on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). As of March 2021, one hundred and sixteen (116) financial institutions (in 37 different countries) have adopted the EPs, which have become the de facto standard for banks and investors on how to assess major development projects around the world. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the IFC Environmental, Health and Safety (EHS) Guidelines.

5.4.4 IFC: General EHS Guidelines – Environmental Noise Management (2007)

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principles. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the International Finance Corporation Environmental, Health and Safety (EHS) Guidelines.

It states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from project facilities/operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source. It goes as far as to propose methods for the prevention and control of noise emissions, including:

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

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

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

Table 5-3: IFC Table 7.1-Noise Level Guidelines

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

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

5.4.5 Night Noise Guidelines for Europe (WHO, 2009)

Refining previous Community Noise Guidelines issued in 1999, and incorporating more recent research, the World Health Organization has released a comprehensive report on the health effects of night time noise, along with new (non-mandatory) guidelines for use in Europe. Rather than a maximum of 30 dB inside at night (which equals 45-50 dB max outside), the WHO now recommends a maximum year-round outside night-time noise

average of 40 dB to avoid sleep disturbance and its related health effects. The report notes that only below 30 dB (outside annual average) are "*no significant biological effects observed*," and that between 30 and 40 dB, several effects are observed, with the chronically ill and children being more susceptible; however, "*even in the worst cases the effects seem modest*." Elsewhere, the report states more definitively, "*There is no sufficient evidence that the biological effects observed at the level below 40 dB (night, outside) are harmful to health*." At levels over 40 dB "*Adverse health effects are observed*" and "*many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected*."

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

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

5.4.6 Environmental Noise Guidelines for the European Region (WHO, 2018)

This document identifies levels at which noise has significant health impacts and recommends actions to reduce exposure. Compared to previous WHO guidelines on noise, this version contains five significant developments:

- Stronger evidence of the cardiovascular and metabolic effects of environmental noise;
- Inclusion of new noise sources, namely wind turbine noise and leisure noise, in addition to noise from transportation (aircraft, rail, and road traffic);
- Use of a standardized approach to assess the evidence;
- A systematic review of evidence, defining the relationship between noise exposure and risk of adverse health outcomes;
- Use of long-term average noise exposure indicators to better predict adverse health outcomes.

6 CURRENT ENVIRONMENTAL SOUND CHARACTER

6.1 EFFECT OF SEASON ON SOUND LEVELS

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

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

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

- Faunal communication is more significant during the warmer spring and summer months as various species communicate in an effort to find mates. Faunal communication is normally less during the colder months, with ambient sound levels measured during the winter period frequently being very low.
- The occurrence of temperature inversions, see **Sub Section 6.1.1**, and
- Seasonal changes in weather patterns, mainly due to increased wind speeds (also see **Sub Section 6.1.2 6.1.1**below) and potential gustiness of the wind.

For environmental noise, weather plays an important role. The greater the separation distance, the greater the influence of the weather conditions, so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible. Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in the sub-sections below.

Ambient sound levels are generally less during the colder months (due to less faunal communication) and higher during the warmer months.

6.1.1 Effect of Temperature inversions

On a typical sunny afternoon, the air is the hottest near the ground surface and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. In the evening, this temperature gradient will reverse, but, during certain meteorological conditions, the normal vertical temperature gradient could be inverted so that the air is colder near the surface, with a warmer layer blanketing the lower layer. This is illustrated in **Figure 6-1** below.

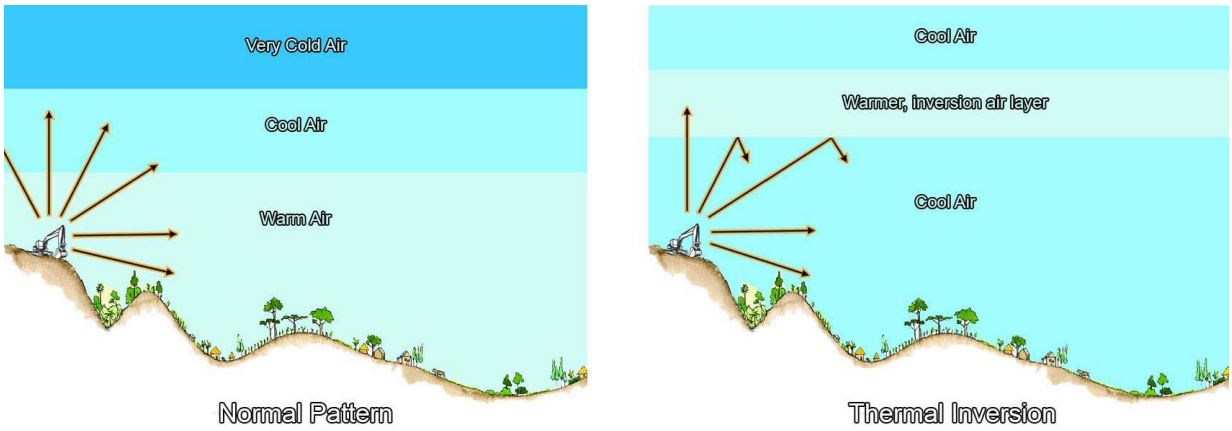

Figure 6-1: Influence of temperature inversions on the propagation of sound

When such an inversion layer is present, some of the sound waves will be refracted[4] by the temperature gradient, with the refracted sound waves returned to the ground. This effect has been noticed near airports and roads, where noises can be heard over greater distances at night than other times of day (Parnell, 2015; Saurenman, 2005; Van der Berg, 2003) for various industries.

Like wind gradients, temperature gradients can influence sound propagation over long distances, complicate sound level measurements as well as propagation modelling.

6.1.2 Effect of Wind

Wind alters sound propagation by the mechanism of refraction, that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the

[4] Redirecting the wave propagation direction due to a change in the density of the air which influence the speed of sound.

source. Waves bending downward means that a listener standing downwind of the source will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high. Over short distances wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e., less than 5 m/s.

Wind speed frequently plays a role in increasing sound levels in natural locations. With no wind, there is little vegetation movement that could generate noises and faunal noises (normally birds and insects) dominate, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on the type of vegetation in a certain area. The impact of increased wind speed on sound levels depends on the vegetation type (deciduous versus conifers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes unanticipated consequences, as suitable vegetation may create suitable habitats and food sources attracting birds and insects (and the subsequent increase in faunal communication).

6.1.3 Effect of Humidity and Temperature

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

The effect of humidity on sound propagation is quite complex, but effectively relates to how increased humidity changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at high humidity[5]. With everything being equal, an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz at 20^{o}C).

Together, the impact of temperature and humidity (together with air pressure - to a minor extent) are complex and highly dependent on the frequency composition of the noise. This is illustrated in **Figure 6-2**.

[5] The addition of water vapor to air (making the air more humid) **reduces the density of the air**. This occurs because the molar mass of water vapor (18 g/mol) is less than the molar mass of dry air (around 29 g/mol).

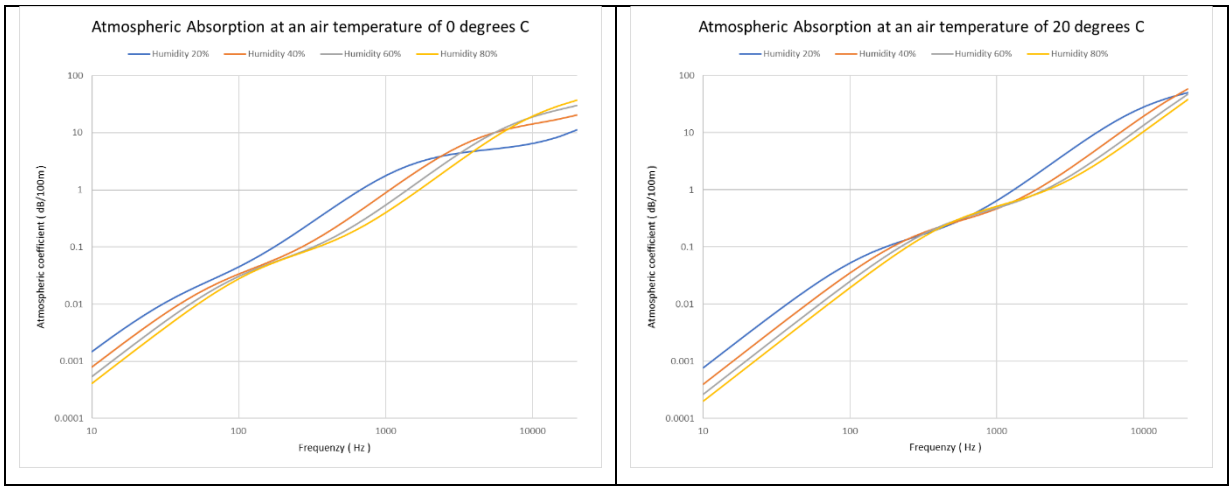

Figure 6-2: Effect of Temperature and Humidity on propagation of Sound

6.2 AMBIENT SOUND LEVEL MEASUREMENTS

Ambient (background) sound levels were measured at one location within the PFA from 19 – 21 May 2014. All measurements complies with the prescribed procedures of GNR320 of 2020 as well as that of SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***". The equipment defined in **Table 6-1** was used for the measurements.

Table 6-1: Details of Sound Level Equipment used for measurements

Equipment	Model	Serial no	Calibration Date
SLM	Rion NA-28	00901489	19 March 2014
Microphone	UC-59	02087	19 March 2014
Calibrator	Calibrator	NC-74	34494286
Weather Station	Weather Station	WH3081PC	Weather Station

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

The sound pressure level measurement location is illustrated in **Figure 6-3**, with the result of the measurements discussed in **section 6.2.1**.

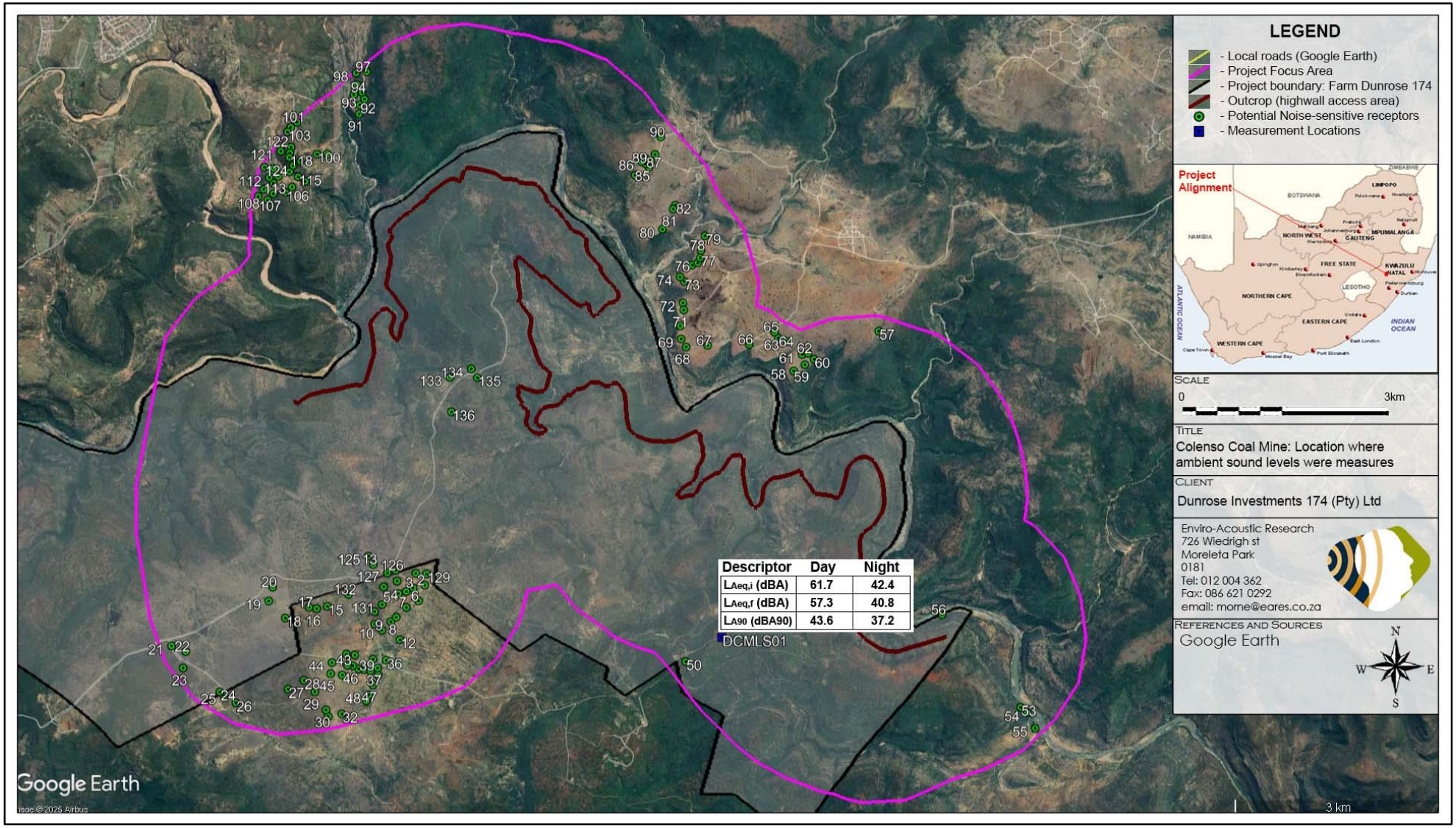

Figure 6-3: Localities where ambient sound levels were measured

6.2.1 Ambient Sound Level Measurement Location – DCMLS01

The microphone was deployed against the fence at the Emaweni Ranch, away from the main lodge. Bird noises were significant and generally dominant, with a significant number of large trees in the area. **Table 6-2** defined sounds heard during equipment deployment and collection, with a photo of the measurement location presented in **Appendix B**.

Table 6-2: Noises/sounds heard during site visits at DCMLS01

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: •Barely Audible •Audible •Dominating	**During equipment deployment**	
	Faunal and Natural	Birds clearly audible and generally dominant.
	Sounds associated with the household	Dogs barking at times. Voices from workers in area. Sound from the freezer compressor.
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Birds clearly audible and generally dominant.
	Sounds associated with the household	Dogs barking at times. Sound from the freezer compressor.
	Industrial & transportation	-

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 6-4** and summarised in **Table 6-3** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 6-5**.

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

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level is elevated both day and night and higher than the ambient sound levels expected for a rural noise district, indicating the presence of a constant background noise in the area. Night-time spectral data indicate a relative broadband noise with a relative constant spectral signature (suspected to originate from the freezer compressor), with various different noises impacting on the daytime measurements.

There were a few times when the maximum noise levels exceeded 65 dBA at night, though this happened less than 10 times at night. The sources of the maximum noises were not investigated, but might be due to the domestic animals (dogs) in the area. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[6].

Table 6-3: Sound level descriptors as measured at DCMLS01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	61.7	57.3	43.6	-
Night arithmetic average	-	42.4	40.8	37.2	-
Day equivalent	-	63.9	60.6	-	-
Night equivalent	-	49.6	41.8	-	-
Day minimum	-	42.1	39.6	-	31.6
Day maximum	101.0	82.3	79.1	-	-
Night minimum	-	35.7	34.8	-	26.1
Night maximum	92.4	73.5	63.6	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas (see **Table 5-2**) in **Figure 6-6** (night) and **Figure 6-7** (day).

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

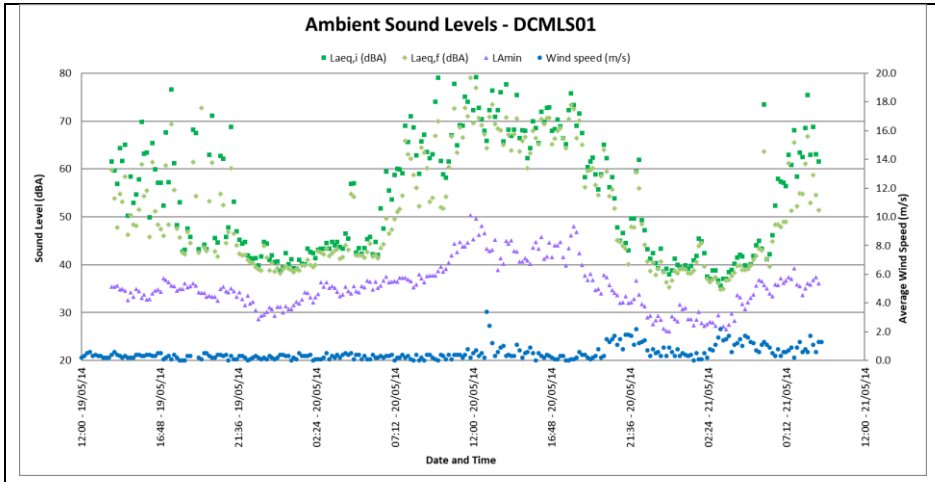

Figure 6-4: Ambient sound levels at DCMLS01

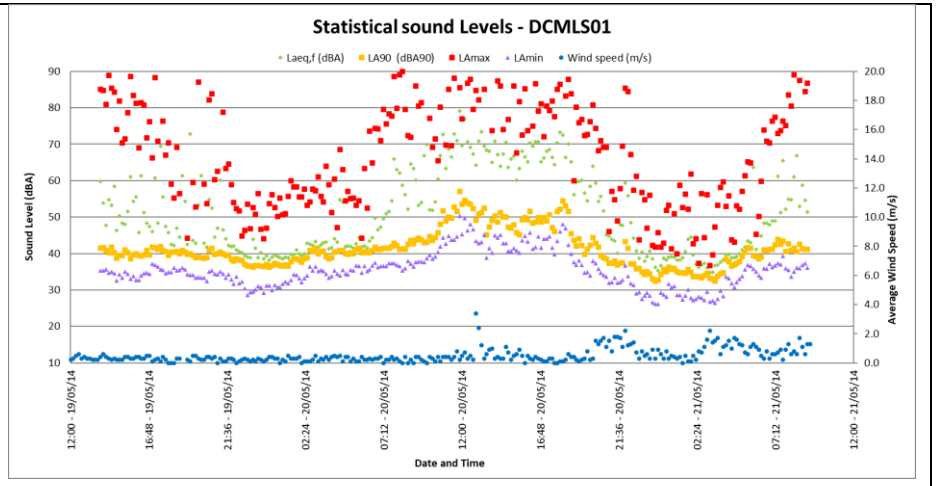

Figure 6-5: Maximum, minimum and statistical values at DCMLS01

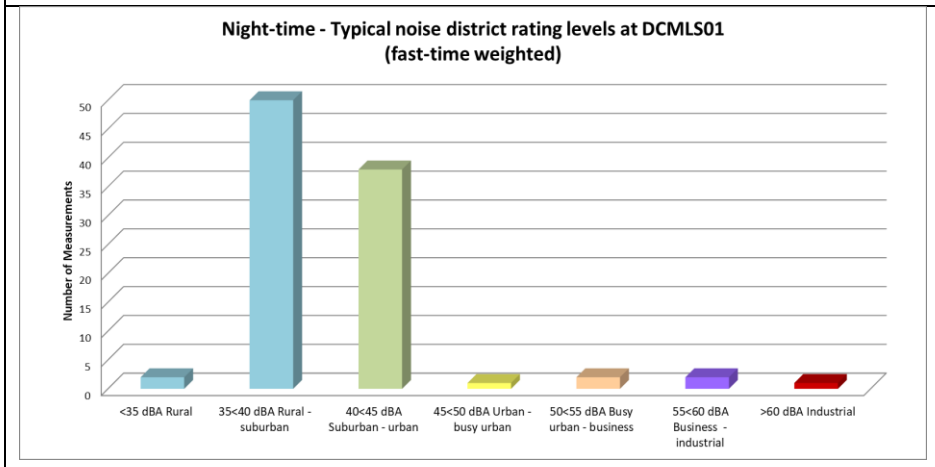

Figure 6-6: Classification of night-time measurements in typical noise districts at DCMLS01

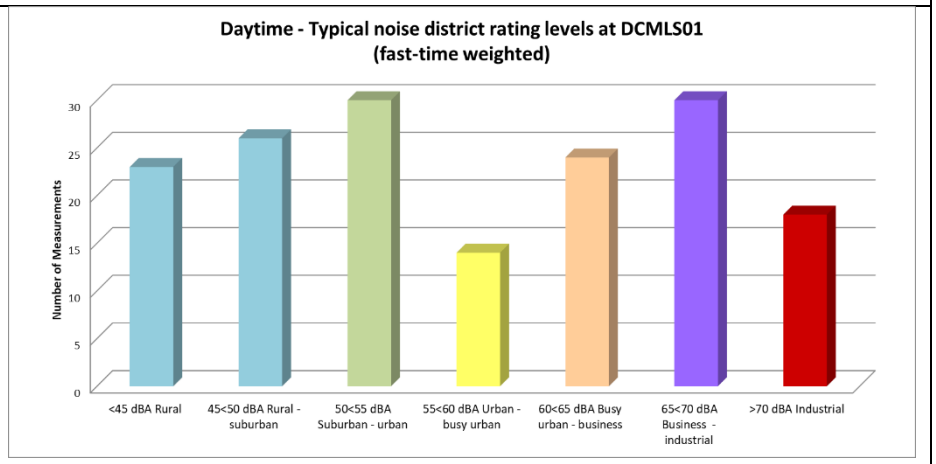

Figure 6-7: Classification of daytime measurements in typical noise districts at DCMLS01

6.3 AMBIENT SOUND LEVELS – FINDINGS AND SUMMARY

The measurements resulted in more than 230 day- and 96 night-time (22:00 – 06:00) measurements. Each measurement was collected over a 10-minute period and included a number of sound level descriptors, including; equivalent values, minimum and maximum levels, statistical sound levels as well as spectral information. Confidence levels in the resulting data are high and it is expected that the ambient sound level data would be similar, or less at other locations with the village.

Considering the average fast-weighted sound level data collected in the area, average:

- daytime fast-weighted sound levels ranged from 39.6 to more than 70 dBA, with average sound levels being 57.3 dBA. This is typical of an urban noise district, setting a potential zone sound level of 55 dBA for the daytime period; and
- night-time fast-weighted sound levels ranged from 34.8 to more than 65 dBA, with average sound levels being 40.8 dBA. This is typical of a suburban noise district, setting a potential zone sound level of 40 dBA for the night-time period.

Considering the requirements of the NCR (see **section 5.1.1**), activities relating to the proposed project should not change the existing ambient sound levels with more than 7 dBA, nor exceed the WHO and IFC noise limits (see **section 5.4.4**). Recommended upper noise limits therefore would be:

- 55 dBA (as recommended by the IFC) for daytime residential use; and
- 45 dBA (as recommended by the IFC) for night-time residential use.

The mine should also limit the noise level to less than 60 dBA on the boundary (70 dBA during the daytime period and 60 dBA at night for a 70 dBA day-night noise limit).

7 POTENTIAL NOISE SOURCES

Increased noise levels are directly linked with the various activities associated with the construction as well as the operational phases of the reclamation project. Noise emitted by the construction and operations can be associated with various noise sources, including mechanical sources due to operation of equipment, material impact noises (such as the noise made when materials are dropped at a height to ground level), electrical noise (reverse hooters from equipment or the "whine" of an electrical pump) and noises from vehicles moving around.

As the exact noise-generating activity, the acoustic loading factors (AUF) and operating conditions cannot be defined during the EIA stage, this noise impact assessment considers conceptual scenarios to estimate the potential impact of noise on the surrounding NSR. The scenarios should not be seen as a reflection of a mining schedule or the specific noise levels at NSR at any specific time.

This assessment effectively will consider two scenarios, namely:

- Scenario 1: Potential worst-case noise levels associated with future construction noises. The noise level contours were developed considering conceptual cumulative construction activities at a number of locations (see **Figure 10-1**). Modelling will assume potential worst-case noise levels, with all activities operating simultaneously. All construction activities are located close to potential NSR to assess the worst-case impact; and
- Scenario 2: Future noise-generating activities associated with the potential operational phase of the operations. The potential cumulative noise impact will be considered from potential traffic noises, conveyor noises as well as various mining and material handling activities (see also **Figure 10-4** for the cumulative scenario).

7.1 POTENTIAL CONSTRUCTION NOISE-GENERATING ACTIVITIES

7.1.1 Construction Activities

A scenario based on construction equipment operating on the surface at three locations where the initial box-cut may be developed (even though the boxcut may be developed at different locations).

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

The potential extent and impact of construction noises depends on a number of factors, including the prevailing ambient sound levels during the instance the maximum noise event occurred, as well as the spectral character of the noise and the ambient surroundings.

Construction activities at each project site will be required to prepare the box-cut area as well as work to construct required infrastructure (development of the conveyor belt system). These activities could take place in parallel and a number of simultaneous activities will be assumed. The following are likely the main construction related sources:

- Site survey and planning;
- The transport of various equipment and material to the project area;
- Establishment of site entrance, internal access roads, contractor's compound and security fencing;
- Site preparation activities will include clearance of vegetation at the footprint of the site infrastructure and mining box-cuts along the outcrop. These activities will require the removal of the vegetation (if any) and the stripping of topsoil (if any) which must be stockpiled, backfilled and/or spread on site;
- Development of the topsoil stockpile(s) – if any;
- Digging of foundations, civils and construction of the infrastructure (if required);
- The digging of the stormwater, drainage and other water management trenches;
- Excavation of topsoil and the loading of the material;
- Drilling at the area where the box-cuts are proposed (as a worst-case scenario, as the developer indicated that the material is relative weathered which may only require excavation activities); and
- Civils relating to the construction of the infrastructure (such as the conveyor belt system).

Potential maximum noise levels generated by construction equipment, as well as the potential extent are presented in **Table 7-2**. The potential extent depends on a number of factors, including the prevailing ambient sound levels during the instance the maximum noise event occurred, as well as the spectral characteristics of the noise and the ambient soundscape in the surroundings.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical sound power levels associated with various activities that may be found at a construction site is presented in **Table 7-3**.

A list of construction equipment and/or activities that was used for the modelling are defined in **Table 7-1**. Due to the various activities that may take place at different locations, this assessment will use the sound power level (PWL) of potential noise generating activities and equipment taking place at numerous locations to assess a potential worst-case scenario.

For the construction scenario it was selected to model the following activities/equipment:

- Bulldozers operating in the area where the box-cut is proposed;
- Excavators and trucks loading topsoil and mining residue at the box-cut area;
- Trucks off-loading topsoil at the stockpiles and residue deposits;
- Drilling activities at locations proposed for the box-cut;
- General noise sources at a location along the proposed conveyor belt system, as well as the location where the coal material will be stockpiled; and
- High-intensity area noise source of approximately 10,000 m^2 per construction area (to account for undefined equipment such as water or diesel bowsers, graders moving around, trucks moving around to move overburden material, minor noise-generating activities etc.) at the box-cut area as well as the stockpile area.

7.1.2 Traffic

The potential significant source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. It was reported that that there will be a minimum of trucks used onsite. To ensure that potential vehicular noises are considered (even if it may be very temporary), noise levels due to traffic were estimated using the methodology stipulated in RLS-90 (Calculating and predicting road traffic noise). For the purpose of this assessment will assume 5 heavy road vehicles ("HMV") and 5 light delivery vehicles ("LDV") per hour travelling between the Colenso and the Coal Stockpile area, as well as all potential mining roads.

It should be noted that the exact details of access roads were not available during the EIA phase and this assessment assumed conceptual alignments using topographical contours as available from the ASTER database. These conceptual routes may be significantly different from the actual project roads.

7.1.3 Blasting Noises

Rock blasting will be required to break down hard rock. Blasting generates significant acoustic energy over a very short period of time and NSR often raise blasting noises as a first concern. However, blasting will not be considered as part of the noise impact assessment for the following reasons:

- This is the subject of a separate study;
- Blasting is highly regulated and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use minimum explosives and will occur in a controlled manner;
- Blasting is normally only permitted during the daytime period, when people are less sensitive to elevated noises;
- Blasting is a highly specialised field, and various management options are available to the blasting specialist. Options available to minimise the risk to equipment, people and infrastructure includes:
    - The use of different explosives that have a lower detonation speed, which reduces vibration, sound pressure levels as well as air blasts.
    - Blasting techniques such as blast direction and/or blast timings (both blasting intervals and sequence).
    - Reducing the total size of the blast.
    - Damping materials used to cover the explosives.
- NSR are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. This is normally associated with close proximity mining/quarrying.

Blasts will be an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties will receive sufficient notice (siren and blasting schedule) and the knowledge that the blast will be over relative fast result in a higher acceptance of the noise associated with the blast.

7.2 POTENTIAL OPERATIONAL NOISE-GENERATING ACTIVITIES

7.2.1 Mining Activities (two scenarios investigated)

Scenario 2 considers coal being mined through a highwall mining method, assuming both day- and night-time activities at three locations. The following conceptual activities will be assumed for the noise model:

- vegetation and topsoil will be stripped ahead of the active mining area using bulldozers, excavators and potentially trucks. In areas where excavation is not sufficient to expose the coal resource (where the material is not weathered enough to make use of an excavator); drilling, blasting and excavation may be required to develop access roads and/or expose the coal resource and ensure a stable highwall and base for the highwall miner. Activities to expose the coal resource and ensure a safe and stable mining area could be hundreds of meters from the active mining area, with this assessment considering these activities to take place within approximately 150 – 200m from the highwall machine;
- the setup/moving of the highwall machine, that use a continuous miner with a cutter head to extract the coal while a conveyor transport the Run of Mine (RoM) the surface and a RoM pad. The RoM will be loaded onto a conveyor belt system using front-end loaders (FEL), from where the RoM will be conveyed to a coal stockpile area;
- high-intensity area noise source of approximately 20,000 m^2 at each of the mining areas, as well as a high-intensity area noise source of approximately 10,000 m^2 at the coal stockpile area; and
- a number of conveyors to convey the RoM to the coal stockpile.

The level and character of the noise during the operational phase is more constant than with the construction phase, but can be more intrusive, especially if an impulsive[7] component is generated at night (such as noise associated from material handling and crushing activities). A list of mining equipment (and activities) that were used for noise modelling are defined in **Table 7-1**, with this assessment considering a potential worst-case scenario. As the sound power levels (PWL) of the highwall miner was not available, it was selected to use the PWL of a crusher/processing plant to represent the noise emissions from a highwall miner with a AUF of more than 100%. This would likely overestimate the potential noise emissions from this source.

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

As with all noises, the audibility, as well as the potential of a noise impact on receptors, is determined by factors such as the sound character, spectral frequencies, number and magnitude of maximum noise events, the average noise levels etc. Potential maximum noise levels generated by a range of equipment and the potential extent of these sounds are presented in **Table 7-2**, with **Table 7-3** illustrating the equivalent (average) noise levels and potential extent.

PWLs as defined in **Table 7-1** was used in the noise modelling for both the construction and operational phases (scenarios 1 and 2).

Table 7-1: Sound power emission levels used for modelling

Equipment	**Sound power level, dB re1 pW, in octave band, Hz**							**SPL**
Process	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**(dBA)**
Point noise sources (dBA re 1 pW)								
Bulldozer	118.3	115.2	111.0	109.1	107.5	103.0	97.0	113.3
Crushing / Processing plant	121.1	122.3	120.1	120.0	117.3	112.5	106.3	121.7
Drilling Machine	121.6	123.3	118.3	115.3	114.2	113.9	111.3	120.8
Dumper/Haul truck/ADT	102.5	108.6	106.5	105.4	104.5	99.2	97.2	113.0
Excavator	113.8	114.2	110.3	108.3	106.3	103.9	103.7	113.0
Feed Screen (various)	86.0	95.0	95.0	101.0	101.0	103.0	102.0	108.1
Front End Loader ("FEL")	109.0	106.7	107.3	97.9	95.8	92.5	87.6	116.0
General noise	95.0	100.0	103.0	105.0	105.0	100.0	100.0	110.0
Material handling / Coal loading	111.6	104.1	105.2	102.2	97.1	91.3	87.9	113.6
Area noise sources (dBA/m^2 re 1 pW)								
General Noise (High-intensity)	95.0	100.0	103.0	105.0	105.0	100.0	100.0	65.0

7.2.2 Traffic

While traffic is not anticipated, this assessment will include minimal traffic as assumed for the construction phase.

Table 7-2: Potential maximum noise levels generated by construction equipment

Equipment Description[8]	Impact Device?	Maximum Sound Power Levels (dBA)	Operational Noise Level at given distance considering potential maximum noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Backhoe	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Chain Saw	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Compactor (ground)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Mounted Impact Hammer	Yes	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Pickup Truck	No	89.7	64.7	58.7	52.6	44.7	38.7	35.1	32.6	29.1	24.7	21.2	18.7	12.6
Pumps	No	111.7	86.7	80.7	74.6	66.7	60.7	57.1	54.6	51.1	46.7	43.2	40.7	34.6
Roller	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Slurry Plant	No	112.7	87.7	81.7	75.6	67.7	61.7	58.1	55.6	52.1	47.7	44.2	41.7	35.6
Soil Mix Drill Rig	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Tractor	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Vibratory Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Warning Horn	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Welder/Torch	No	107.7	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7	30.6

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

Table 7-3: Potential equivalent noise levels generated by various equipment

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Ball Mill (Secondary) (FM)	107.0	82.1	76.1	70.0	62.1	56.1	52.5	50.0	46.5	42.1	38.6	36.1	30.0
Bulldozer CAT D10	111.9	86.9	80.9	74.9	66.9	60.9	57.4	54.9	51.3	46.9	43.4	40.9	34.9
Coal Pulverisers	96.0	71.0	65.0	58.9	51.0	45.0	41.4	38.9	35.4	31.0	27.5	25.0	18.9
Cyclone (dewatering)	109.0	84.1	78.0	72.0	64.1	58.0	54.5	52.0	48.5	44.1	40.5	38.0	32.0
Crusher (Primary, hard rock)	122.4	97.5	91.4	85.4	77.5	71.4	67.9	65.4	61.9	57.5	53.9	51.4	45.4
Drilling Machine	120.3	95.3	89.3	83.2	75.3	69.3	65.7	63.2	59.7	55.3	51.8	49.3	43.2
Dumper/Haul truck - Bell 25 ton	108.4	83.5	77.5	71.4	63.5	57.5	53.9	51.4	47.9	43.5	40.0	37.5	31.4
Dryer Stack	102.0	77.0	71.0	65.0	57.0	51.0	47.5	45.0	41.5	37.0	33.5	31.0	25.0
Dryer Gas Generator	104.6	79.6	73.6	67.6	59.6	53.6	50.1	47.6	44.1	39.6	36.1	33.6	27.6
Excavator	112.0	87.0	81.0	75.0	67.0	61.0	57.5	55.0	51.4	47.0	43.5	41.0	35.0
Feed Screen (crusher, mill etc.)	108.1	83.2	77.1	71.1	63.2	57.1	53.6	51.1	47.6	43.2	39.6	37.1	31.1
FEL - Bell L1806C	102.7	77.7	71.7	65.7	57.7	51.7	48.2	45.7	42.1	37.7	34.2	31.7	25.7
Flotation (Agitation gearbox)	104.4	79.4	73.4	67.3	59.4	53.4	49.8	47.3	43.8	39.4	35.9	33.4	27.3
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
Grizzly Feeder	96.1	71.2	65.1	59.1	51.2	45.1	41.6	39.1	35.6	31.2	27.6	25.1	19.1
JBL TLB	108.8	83.8	77.8	71.8	63.8	57.8	54.3	51.8	48.3	43.8	40.3	37.8	31.8
Pumps (Cavity, slurry, etc.)	89.5	64.5	58.5	52.5	44.5	38.5	35.0	32.5	28.9	24.5	21.0	18.5	12.5
Road Transport truck (30t, FM)	109.6	84.7	78.7	72.6	64.7	58.7	55.1	52.6	49.1	44.7	41.1	38.7	32.6
Screen	87.1	62.2	56.1	50.1	42.2	36.1	32.6	30.1	26.6	22.2	18.6	16.1	10.1
Substation	80.9	55.9	49.9	43.9	35.9	29.9	26.4	23.9	20.4	15.9	12.4	9.9	3.9
Thickener (Concentrate)	106.7	81.7	75.7	69.7	61.7	55.7	52.2	49.7	46.2	41.7	38.2	35.7	29.7
Thickener (Tailings)	104.7	79.7	73.7	67.7	59.7	53.7	50.2	47.7	44.2	39.7	36.2	33.7	27.7

7.3 POTENTIAL NOISE SOURCES: FUTURE NOISE SCENARIO – DECOMMISSIONING

The Decommissioning Phase is considered as the phase which begins after the last mineral resource is processed, main rehabilitation activities start and ends when the facility receives a Mine Closure Certificate.

Activities that can take place include:

- Decommissioning and rehabilitation of the remaining infrastructure unless it is required for post-mining impact management or for the final end land use. This includes the following:
    - Removal of all remaining redundant infrastructure;
    - Removal of any contaminated soil;
    - The rehabilitation of disturbed areas including the necessary ripping of compacted soils and the shaping of rehabilitated areas to ensure free drainage;
    - Placement of topsoil on rehabilitated surface areas followed by seeding (if necessary to re-establish vegetation);
    - Monitoring and maintenance of the rehabilitated areas; and
    - Application for a Closure Certificate for the site.

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

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

8 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

8.1 NOISE IMPACT ON ANIMALS[9]

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

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

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

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

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

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

Only a few faunal (animal) species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject, with a

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

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

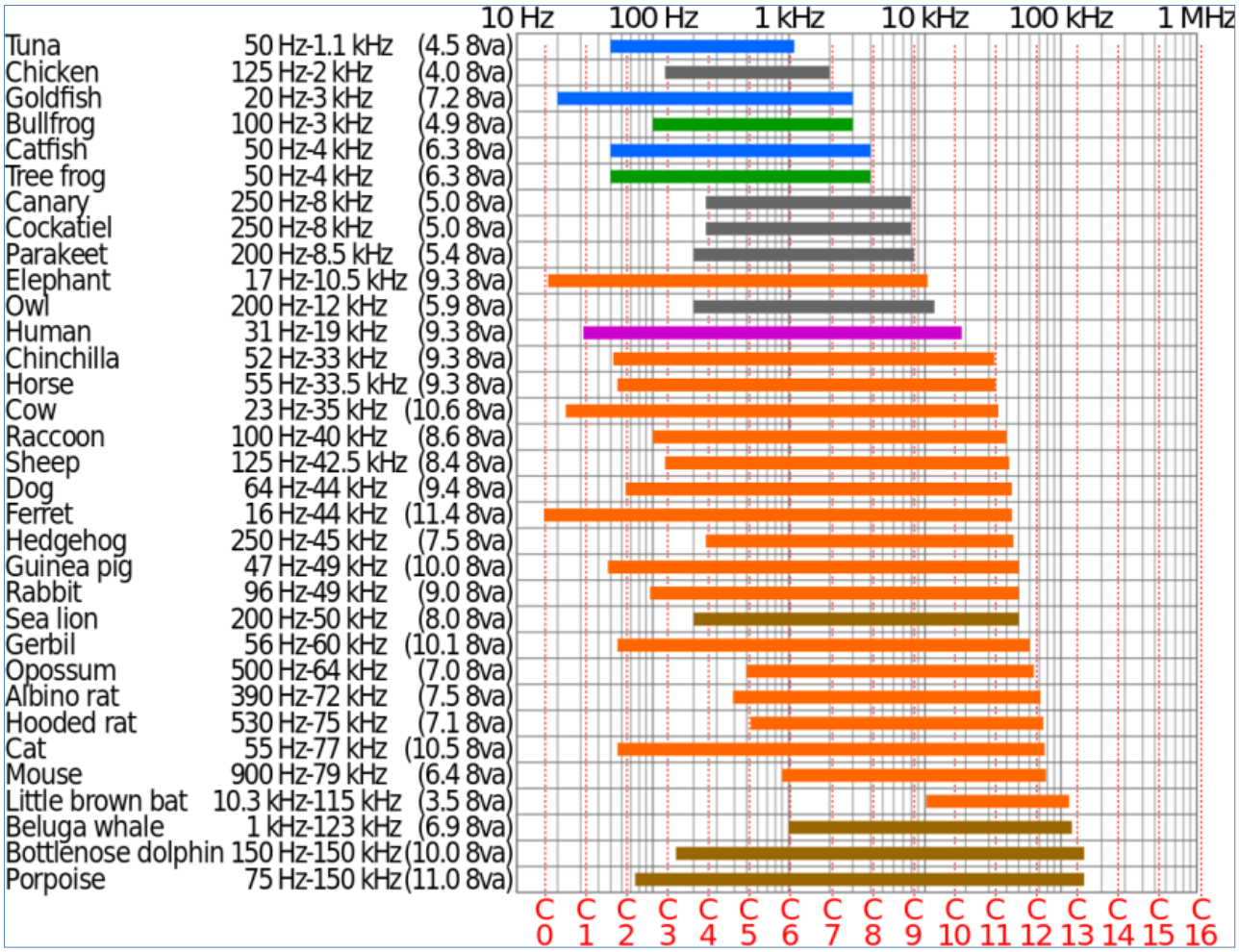

Figure 8-1: Logarithmic Chart of the Hearing Ranges of Some Animals[10]

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

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running/flying away. If the noises continue, animals would try to relocate (Drooling, 2007).

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

- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2009).
- Animals of most species exhibit adaptation to noise (Broucek, 2014), including impulsive noises, by changing their behaviour.
- More sensitive species would relocate to a quieter area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Drooling, 2007).
- Noises associated with helicopters, motor- and quad bikes do significantly impact on animals. This is due to the sudden and significant increase in noise levels due to these activities.

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

8.1.1 Domestic Animals

It may be that domesticated animals are more accustomed to noise sources of an industrial, commercial or other anthropogenic nature, although exposure to high noise levels may still affect domestic animals' well-being. Sound levels in animal shelters can exceed 100 dB, much more than what can be expected at a domestic dwelling from an industrial, commercial or transportation noise source (10-minute equivalent)[11&12]. The high noise levels may see negative influences on animals' cardiovascular systems and behaviour.

According to Šottník, 2011, noise as high as 80 dB had no negative effect on dairy cows. As noise levels increased (up to 105 dB), feed consumption, milk yield and intensity of milk release decreased.

Unexpected high intensity noise (above 110 dB), such as low altitude jet aircraft overflights at milking time could reduce effectiveness of the milk ejection reflex, decrease efficiency of milk removal, increase residual milk, and lead to overall reduction in milk yield. However, a majority of the studies reviewed suggests that there is little or no effect of aircraft noise on cattle. Adverse effects of low-altitude flights have been noted in some studies but have not been uniformly reproduced in other reports (Manci, 1988).

[11]Crista L. Coppola. Noise in the Animal Shelter Environment: Building Design and the Effects of Daily Noise Exposure.
[12] David Key, Essential Kennel Designs.

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

8.1.2 Wildlife

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

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

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

Studies indicated that most animals adapt to noises, and would even return to a site after an initial disturbance, even if the noise is continuous. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area. Helldin (2012) however highlights that the network of access road could be a significant factor impacting on animals. Noise impacts are therefore very highly species-dependent, but there are also other factors that could impact on animals (such as visibility and increased movement of people and vehicles)[13].

[13] Blickley, 2010; Cummings, 2012; Cummings, 2009; Łopucki, 2016; Noise Quest, 2010; Rabin, 2006

8.1.3 Avifauna[14]

Noise impacts on birds include:

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

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

Similarly, different birds change their response to these sounds differently. Some may not be impacted while other species may:

- avoid noisy areas or completely relocate;
- may start to sing at different times;
- may change the frequency, pitch or character of their calls/singing/signals;
- increase the volume of their calls/singing/signals; or/and
- changes in reproductive success.

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

8.1.4 Laboratory Animal Studies

Although many laboratory animals have wild counterparts (rats, mice) the laboratory test subjects differ in many aspects (genetics, behaviour etc.). Also, noise levels of studies are conducted at generally very high levels at over 100 dB, much more than what would be experienced in environmental settings around industrial, commercial or transportation activities[15] . Other dissimilarities to laboratory tests and a natural environment include the time exposure (duration of noise), the spectral and noise character (impulsive noise vs. constant noise) etc. Although there exist dissimilarities in tests conducted and noise levels around commercial and industrial environments, laboratory rodents exposed to high noise levels did indicate physiological, behavioural changes, hearing loss and other such effects[16].

[14] Autumn, 2007; Brumm, 2004; Cummings, 2009; Dooling, 2007; Francis, 2012; Francis, 2011; Ortega, 2012; Halfwerk, 2011; Parris, 2009, Zwart, 2014.
[15] USEPA, 1971.
[16] Baldwin, 2007.

8.1.5 Concluding Remarks - Noise Impacts on Animals

From these and other studies the following can be concluded:

- To date there are no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals (Blickley *et al.* 2010).
- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate (Dooling, 2007).
- Terrestrial wildlife responses begin at noise levels of approximately 40 dBA, with 20% of papers documenting impacts below 50 dBA (Shannon *et al.* 2015).
- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2010), with Helldin *et al.* (2012) reporting that levels of 60–75 dBA have been shown to cause stress, e.g., increased respiration and heart rate, increased vigilance, and decreased time for grazing in domestic animals such as sheep and horses.
- Animals of most species exhibit adaptation with noise (Broucek, 2014), including impulsive noises, by changing their behaviour.
- More sensitive species would relocate to a quieter area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Dooling, 2007).
- Noises associated with helicopters, motor- and quad bikes significantly impact on animals (startle response). This is due to the sudden and significant increase in noise levels as well as the presence of humans (Autumn, 2007; USEPA, 1971).

8.2 WHY NOISE CONCERNS COMMUNITIES[17]

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

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

[17]World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

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

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

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

Severity of the annoyance depends on factors such as:

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

8.2.1 Noise Annoyance

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to be the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that the non-acoustic factors play a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity (Bakker *et al.*, 2012; Council of Canadian Academies, 2015; Ellenbogen *et al.*, 2012; Halfwerk *et al*., 2011; Hanning, 2010; Janssen *et al.*, 2011; Knopper *et al.*, 2014; Merlin *et al.*, 2013; Miedema and Vos, 2003; WHO, 2009).

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 8-2**, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance. This can be used in environmental health impact assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into

the situation expected in the long-term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise levels.

Severity of the annoyance depends on factors such as:

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

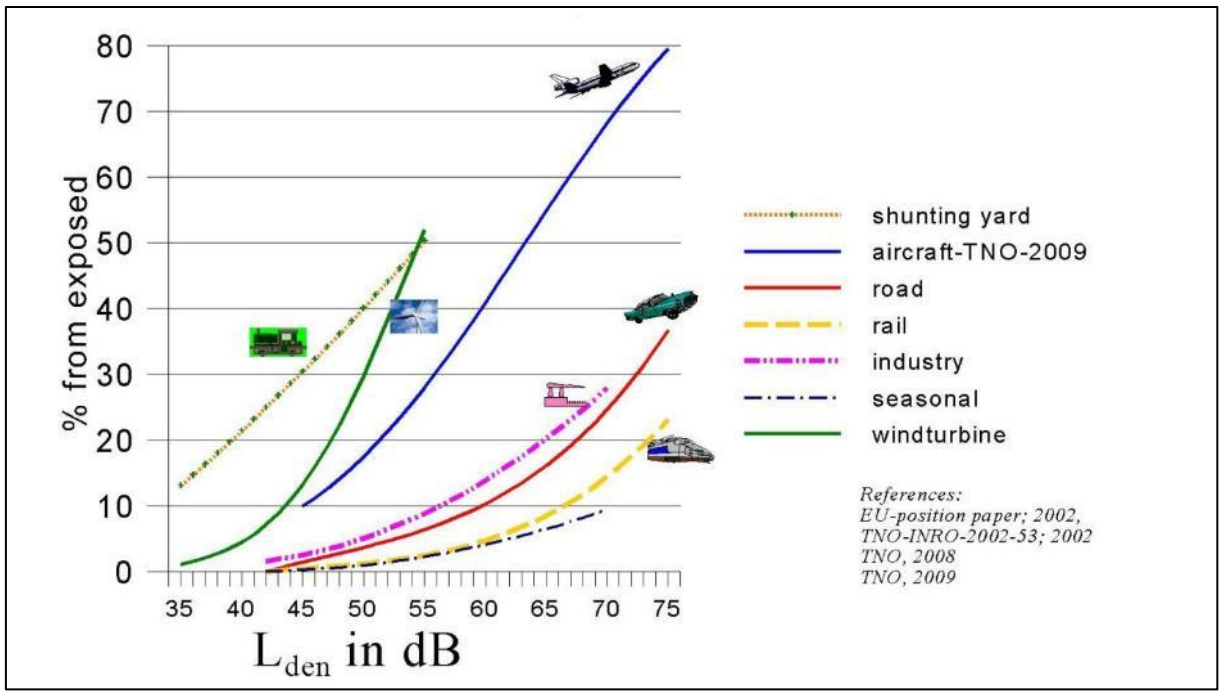

Figure 8-2: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling[18]

8.2.1.1 Disturbance to Sleep

Sleep is essential for mental and physical health, and noise is one of the most reported reasons why people may experience sleep interruptions at night. This may be sudden loud noises, with the WHO (2009) reporting that, when maximum noises exceed 60 dBA, with average noise levels exceeding 40 dBA, it may increase the probability of being awakened. People report that quality of life suffer with increased instances of disturbed sleep that may also increase annoyance with a project (Bakker *et al* (2012); Van den Berg *et al* (2014)). It should be noted that Van den Berg *et al* (2008) (see also Van den Berg *et al* - 2014)

[18] Image from https://rigolett.home.xs4all.nl/ENGELS/topic.htm. Wind Turbine Annoyance curve from Pedersen (2007)

showed an indirect effect between sleep disturbances and annoyance, but not between sleep disturbance and the noise level. It is postulated that this is due to increased annoyance due to the visual impact from WTG.

8.2.1.2 Potential Health Effects from noise

The WHO (2009) does report threshold levels where people may report or experience effects from noise, with these thresholds highlighted in **Table 8-1**. The WHO does use the L_{Amax} and L_{night}[19] descriptors to describe these levels.

Table 8-1: Threshold levels reported by the WHO (2009)

Effect	Indicator	Threshold (dBA)
EEG awakening	$L_{Amax,inside}$	35
Onset of motility	$L_{Amax,inside}$	32
Changes in sleep patterns	$L_{Amax,inside}$	35
Waking up in the night and/or too early in the morning	$L_{Amax,inside}$	42
Increased average motility when sleeping	$L_{night,outside}$	42
Self-reported sleep disturbances	$L_{night,outside}$	42
Environmental insomnia	$L_{night,outside}$	42
Hypertension	$L_{night,outside}$	50
Myocardial infarction	$L_{night,outside}$	50
Psychic disorders	$L_{night,outside}$	60

8.2.1.3 Situational and Personal Factors

There are a few other aspects, collectively referred to as non-acoustical factors that may increase annoyance with a project [Miedema and Vos, 2003; Pedersen *et al.*, 2007). These could include:

- Situational factors (visual issues, attractiveness of area) (Merlin *et al.*, 2014; Michaud *et al.* (2016); Van den Berg *et al*, 2008);
- Socio-economic factors (age, gender, income, level of education) [Miedema and Vos, 2003; Michaud *et al.* (2016)],
- Social factors (attitude towards the applicant/producer/government, media coverage) (Pedersen *et al.*, 2007; Superior Health Council, (2013)),

[19] Refers to the European Union definition in Directive 2002/49/EC – equivalent outdoor sound pressure level associated with a particular type of noise source to which a receptor is exposed to over the 8-hour night-time period, calculated over a period of a year

- Personal factors (fear or worry in relation to noise source, sensitivity to noise, economic benefit from project, existing health condition) (Miedema and Vos, 2003; Taylor *et al* (2013); Van Kamp and Davies (2013)), and
- Attitude towards the project and exposure to negative sentiment (Bernstein *et al* (2024); Crichton *et al*. (2014), Crichton *et al* (2014)).

8.3 IMPACT ASSESSMENT CRITERIA

8.3.1 Overview: The common characteristics

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

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

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

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

8.3.2 Noise criteria of concern

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

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

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of the noise.

With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 5 dBA is considered a disturbing noise. See also **Figure 5-1**.

- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also **Table 5-2**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g., 65 dBA. Anything above this level will be considered unacceptable.

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008. It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively typically associated with such areas. When a noise source is introduced that could change the ambient sound levels, communities may respond as illustrated in **Figure 5-1**.

Considering the average fast-weighted sound level data collected in the area, average:

- daytime fast-weighted sound levels were elevated, more typical of an urban noise district, even though the measurement location are located within an area with a rural developmental character, setting a zone sound level of 45 dBA for the daytime period; and
- night-time fast-weighted sound levels were elevated and typical of a suburban noise district, setting a zone sound level of 35 dBA for the night-time period.

Considering the requirements of the NCR (see **section 5.1.1**), activities relating to the proposed project should not change the existing ambient sound levels with more than 7 dBA, nor exceed the WHO and IFC noise limits (see **section 5.4.4**). In the cases where existing ambient sound levels already exceed the IFC recommended noise limits, proposed projects should not change existing ambient sound levels with more than 3 dBA. Therefore, upper noise limits therefore would be:

- 55 dBA (as recommended by the IFC) for daytime residential use; and
- 45 dBA (as recommended by the IFC) for night-time residential use.

The mine should also limit the noise level to less than 60 dBA on the boundary (70 dBA during the daytime period, and 60 dBA at night for a 70 dBA day-night noise limit).

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

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

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

8.3.3 Determining the Significance of the Noise Impact

The level of detail as depicted in the EIA Guidelines (DEAT, 1998) (DEAT, 2002)) was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the Project.

The impact consequence is determined by summing the scores of Magnitude (**Table 8-2**), Duration (**Table 8-3**) and Spatial Extent (**Table 8-4**). The impact significance (see **Sections 8.3.4** and **8.3.5**) is determined by multiplying the Consequence result with the Probability score (**Table 8-5**). An explanation of the impact assessment criteria is defined in the following tables.

Table 8-2: Impact Assessment Criteria – Magnitude

This defines the impact as experienced by any receptor. In this report, the receptor is defined as any resident in the area but excludes faunal species.		
Rating	**Description**	**Score**
Low	Increase in average sound pressure levels between 0 and 3 dB from the expected ambient sound levels. Ambient sound levels are defined by the average of the measured day- or night-time fast-weighted sound levels during measurement dates. Total projected noise rating level is less than the Zone Sound Level (the rating level) and/or WHO/IFC noise limits in wind-still conditions.	2

Low Medium	Increase in average sound pressure levels between 3 and 5 dB from the expected ambient sound levels. Total projected noise rating level between 3 and 5 above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind-less conditions).	4
Medium	Increase in average sound pressure levels between 5 and 7 dB from the ambient sound levels. Increase in sound pressure levels between 5 and 7 above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind-less conditions). Sporadic complaints expected.	6
High	Increase in average sound pressure levels between 7 and 10 from the ambient sound level. Total projected noise rating level between 7 and 10 dBA above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind-less condition). Medium to widespread complaints expected.	8
Very High	Increase in average ambient sound pressure levels higher than 10 dBA. Total projected noise rating level higher than 10 dB above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind less-conditions). Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action. Any point where instantaneous noise levels exceed 65 dBA at any receptor.	10

Table 8-3: Impact Assessment Criteria - Duration

The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operational and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.		
Rating	**Description**	**Score**
Temporary	Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional.	1
Short term	Impacts that are predicted to last only for the duration of the construction period.	2
Medium-term	Impacts predicted to last for a period up to 5 years.	3
Long-term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating.	4
Permanent	Impacts that cause a permanent change in the affected receptor or resource (e.g., removal or destruction of ecological habitat) that endures/last substantially beyond the Project lifetime.	5

Table 8-4: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact		
Rating	**Description**	**Score**
Site	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1
Local	The impact could affect the local area (within 1,000 m from site).	2
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns (further than 1,000 m from site).	3
National	The impact could have an effect that expands throughout the country (South Africa).	4

International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.	5

Table 8-5: Impact Assessment Criteria - Probability

This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:		
Rating	**Description**	**Score**
Improbable	Daytime noise levels are less than 50 dBA; Night-time noise levels less than 40 dBA.	1
Possible	Daytime noise levels are less than 55 dBA; Night-time noise levels less than 45 dBA.	2
Likely	Daytime noise levels are less than 60 dBA; Night-time noise levels less than 50 dBA.	3
Highly Likely	Daytime noise levels are less than 65 dBA; Night-time noise levels less than 55 dBA.	4
Definite	Daytime noise levels exceeding 65 dBA; Night-time noise levels higher than 55 dBA.	5

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

Table 8-6: Assessment Criteria: Ranking Scales

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

8.3.4 Identifying the Potential Impacts without Mitigation Measures (WOM)

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

Significance without mitigation is rated on the following scale:

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

8.3.5 Identifying the Potential Impacts with Mitigation Measures (WM)

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

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

9 ASSUMPTIONS AND LIMITATIONS

9.1 MEASUREMENTS OF AMBIENT SOUND LEVELS

Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that the area is always noisy. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of day, dependant on faunal characteristics (mating season, dawn chorus[20] early hours of the morning, temperature etc.), vegetation in the area and meteorological conditions (especially wind).

Selecting an ideal measurement location could be difficult, with various criteria assessed to identify the viability of a certain location as a point to define ambient sound levels. When selecting a measurement location, the most important criteria would be:

1. Security of the instrument (minimise risk to the technician; prevent theft or sabotage of the equipment);
2. Safety of the equipment (ensure that it does not prevent, interfere or limit typical agricultural or household activities; ensure that the instrument are not in a location where an animal could damage the instrument); and lastly,
3. The suitability of the measurement location to define ambient sound levels (the presence of certain trees or equipment, wetland or other water resources will influence ambient sound level significantly).

As such, after ensuring that the instrument is safe and secure, there are various environmental factors that could influence ambient sound levels measured. These constraints and limitations are discussed below and could include:

- Seasonal changes in the surrounding environment can influence typical ambient sound levels, as many faunal species are more active during warmer periods than the colder periods. As an example, cicada is usually only active during warmer periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[21];
- In an area with various noise sources (roads, industry, urban development), defining ambient sound levels using the result of one 10-minute measurement may be very

[20] Environ. We Int. Sci. Tech. *Ambient noise levels due to dawn chorus at different habitats in Delhi*. 2001. Pg. 134.
[21] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

inaccurate (very low confidence level in the results) and measurements over a longer-term period is recommended;

- Some equipment that could influence measurements may be missed when deploying instruments, or, the equipment may not the audible. This could include equipment such as hidden water pumps and associated pipelines and outflows, ESKOM stepdown transformers, hidden compressors, inverters, condensers or other electrical equipment, etc. While not audible during deployment, such equipment may significantly influence ambient sound levels during quiet periods;
- Type, the number and sizes of trees in the vicinity of the instrument, as well as the distances between the microphone and these trees. Certain trees, especially fruiting trees could attract birds and other animals that will significantly impact on ambient sound levels;
- Type and number of animals in the vicinity of the microphone. Dogs, chickens, geese, etc. generate different noises randomly both night and day, and other livestock (sheep, goats, cattle, horses, etc.) kept in enclosures will also raise noise levels, especially if these animals are penned in large numbers;
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. However, when determining the ambient sound levels associated with increased wind speeds, it is desired to measure ambient sound levels at higher wind speeds;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point (specifically during summertime, rainfall event or during dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural environment, and in various cases sought after and pleasing. Ambient sound level data measured in such area however should not be used to develop an opinion in the potential prevailing ambient sound levels in the larger area;
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation, wetlands and external noise sources will influence measurements. It may determine whether you are measuring anthropogenic sounds from a receptors dwelling, or environmental ambient baseline contributors of significance (faunal, roads traffic, railway traffic movement etc.); and
- As a residential area develops the presence of people will result in increased dwelling related sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

9.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

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

The following was considered:

- The octave band sound pressure emission levels of processes and equipment;
- The time the activities and equipment are operational and generating the noise rating levels as assumed. For this project a worst-case was assessed, assuming that most equipment (excluding the bulldozer used for clearing of vegetation) would be operating at a 100% load (generating the maximum noise rating levels), 100% of the time. In practice this is inaccurate as no activity or equipment are 100% operational of the time and the assumption will result in an over-estimated noise rating levels;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout; and
- Acoustical characteristics of the ground. Fifty per cent (50%) soft ground conditions were modelled, as the area where the mining activity would be taking place is well vegetated and sufficiently uneven to allow the consideration of relatively soft ground conditions. This is because the use of hard ground conditions could represent a too precautionary situation.

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

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

This noise model generates the potential LA10 noise level, which is used in various countries (such as the United States of America, United Kingdom, Germany, Canada, Australia, New Zeeland, etc.) to define potential road traffic noise analysis (and abatement). In this project, it illustrates the potential extent of the calculated noises (the noise rating level) of the complete project and not noise levels at a specific moment in

time. It is used to define potential issues of concern and not to predict an actual noise level at a potential noise-sensitive receptor. For this, the selected model is internationally recognised and considered adequate. This noise model is recommended for use to calculate potential traffic noises in Germany, Switzerland, Netherlands, United Kingdom, France, Denmark, Italy, Denmark and Austria.

9.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

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

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

9.4 UNCERTAINTIES ASSOCIATED WITH MITIGATION MEASURES

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

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

It was assumed that any mitigation measures proposed for the construction phase (if any), will be implemented and continued during the operational phase (if required).

9.5 UNCERTAINTIES OF INFORMATION PROVIDED

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

- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment. The determination of octave sound power levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- Sound power emission levels from processes and equipment changes depending on the load the process and equipment are subject to. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load (work required from the engine or motor to perform action). Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worst-case scenario;
- As it is unknown which processes and equipment will be operational (when and for how long), modelling considers a scenario where processes and equipment are under full load for a set time period. Modelling assumptions comply with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise rating levels would likely be over-estimated;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global DEM data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify; and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Fifty per cent (50%) soft ground conditions will be modelled as the area where the activities are proposed is well vegetated and sufficiently uneven to allow the consideration of medium ground conditions.

9.6 UNCERTAINTY ON HOW NOISE COULD AFFECT PEOPLE

How noise affect communities are discussed in **section 8.2**, with this assessment considering a number of studies and guidelines such as:

- Cooper and Chan (2020) that discuss and present a number of dose-effect relationships as well as summarize a number of international guidelines and standards that can be used to assess noise effects from certain projects;
- Crichton *et al* (2014) that studied how expectations can influence symptom and mood reports in both positive and negative directions;
- Directive 2002/49/EC (2002), directing members of the European Union with a guideline on the assessment and management of environmental noise. This directive recommends the use of dose-effect relationships to assess the effect of noise on populations;
- Miedema and Vos (2013), that integrated the findings from a number of studies on the relationship between noise sensitivities and exposure to noise; and
- SANS 10103 (2008) that can be used to assess how environmental noise can be measured and used to assess annoyance in communities.

It is important to understand that guidelines and dose-effect relationship studies focus on how communities respond to noise and it is difficult to predict or foresee how an individual may respond to noise.

10 PROJECTED NOISE RATING LEVELS

10.1 CONCEPTUAL SCENARIO 1 – NOISE FROM CONSTRUCTION ACTIVITIES

A noise model was developed to estimate and illustrate the potential noise level contours associated with the conceptual construction activities (discussed in **Section 7.1**), with the locations of the various noise sources conceptualised in **Figure 10-1**.

The projected construction noise rating levels are illustrated in:

- **Figure 10-2** and defined per NSR in **Appendix C, Table 1** for the daytime period; and
- **Figure 10-3** as well as defined per NSR in **Appendix C, Table 2** the night-time period.

Appendix C, Table 1 Appendix C, Table 2 Appendix C, Table 3 Appendix C, Table 4

10.2 CONCEPTUAL SCENARIO 2 – FUTURE OPERATIONAL ACTIVITIES

A noise model was developed for operational scenario 2 as discussed in **Section 7.2** and conceptualised in **Figure 10-4**.

For this scenario, projected noise rating levels are illustrated in:

- **Figure 10-5** and defined in **Appendix C, Table 3** for the daytime period; and
- **Figure 10-6** and defined in **Appendix C, Table 4** for the night-time period.

10.3 POTENTIAL DECOMMISSIONING AND CLOSURE NOISE LEVELS

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the construction and/or operational phases. This is because:

1. Decommissioning activities normally are limited to the daytime period, due to the lower urgency to complete this phase; and
2. Decommissioning activities normally use smaller and less equipment, generating less noise than the typical construction or operational phases.

As such, the significance of the noise impact for decommissioning will be less than typical daytime operational activities.

10.4 POTENTIAL POST-CLOSURE NOISE LEVELS

The potential for a noise impact to occur during the post-closure phase will be minimal and mainly relate to monitoring activities. The noise impact from this phase will not be investigated further.

10.5 EVALUATION OF ALTERNATIVES

10.5.1 Alternative 1: No-go option

The ambient sound levels will remain as is and the area would keep the existing noise character.

10.5.2 Alternative 2: Proposed approval of the mining project

The proposed development will raise the noise levels at the closest potential NSR, with the highest impact relating to receivers staying within 500 m from major noise-generating activities, even though noises created by the project could be audible up to 4,000 m during certain meteorological conditions.

Excluding NSRs 133, 134, 135 and 136, most NSR are further than 500 m from major noise generating activities, though, in the unmanaged situation, some NSR may consider the noises to be annoying and even disturbing at night (with the beeping from reverse alarms frequently reported by receptors to be highly annoying).

The project however will greatly assist in the economic growth and development challenges South Africa is facing by optimizing the extraction of the mineral resource. This will assist in providing additional employment and business opportunities for the local communities. Considering only noise[22], people in the area not directly affected by increased noise levels would have a positive perception of the project and could see the need and desirability of the project.

[22] Considering only noise as other factors may affect other NSR

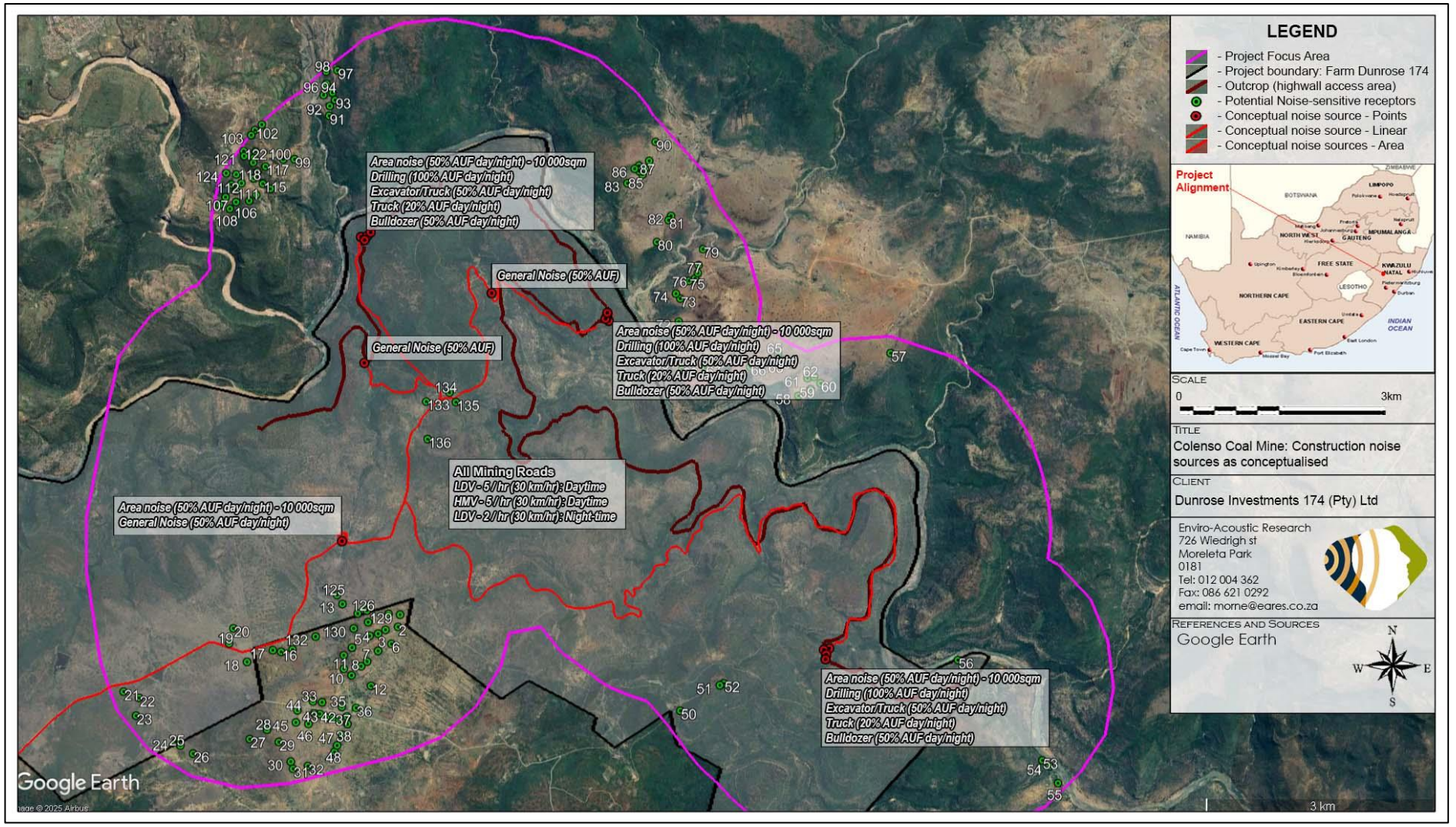

Figure 10-1: Conceptual noise-generating activities considered for the potential construction activities (scenario 1)

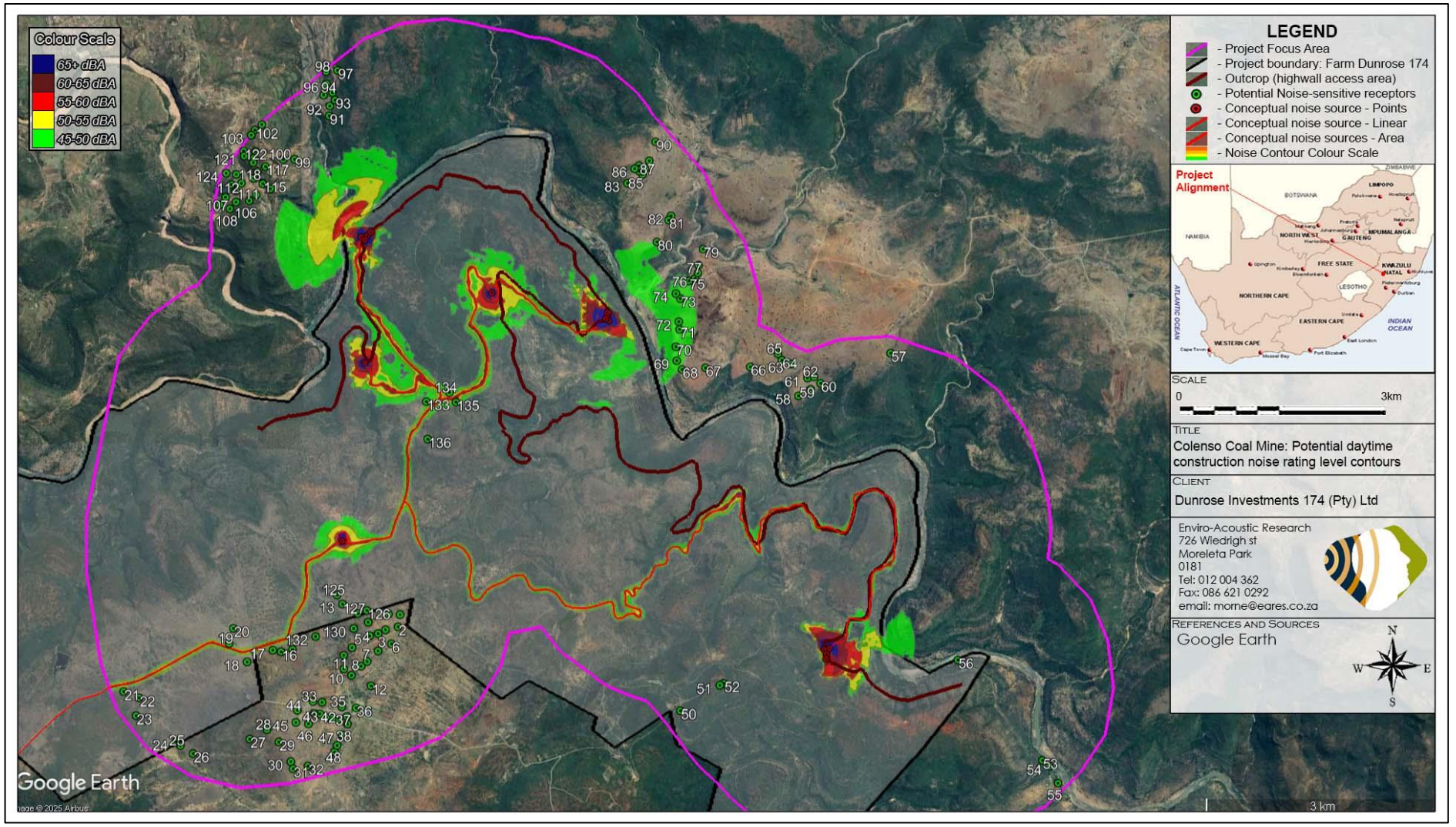

Figure 10-2: Projected daytime noise rating levels relating to potential construction activities (scenario 1)

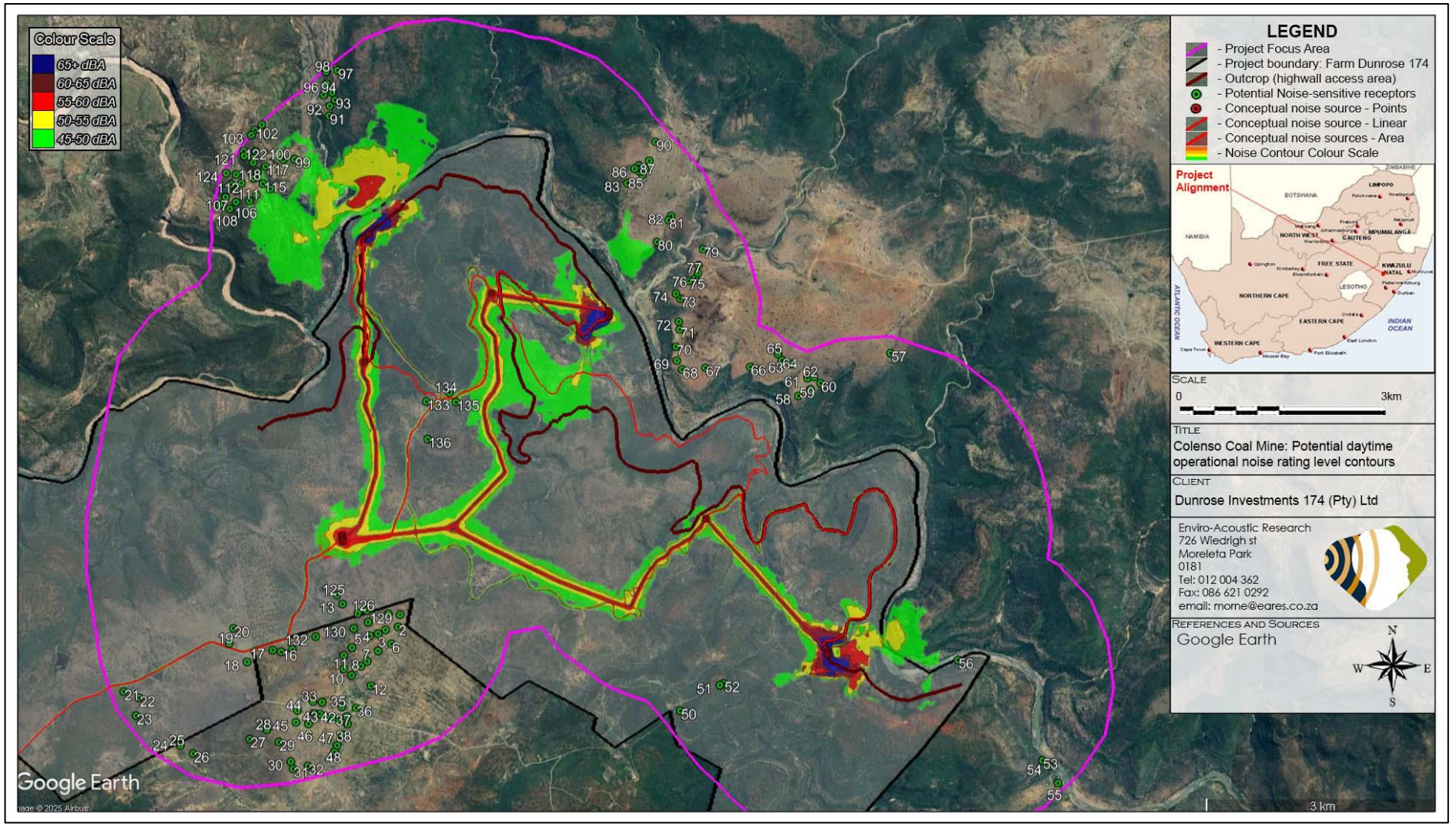

Figure 10-3: Projected night-time noise rating levels relating to potential construction activities (scenario 1)

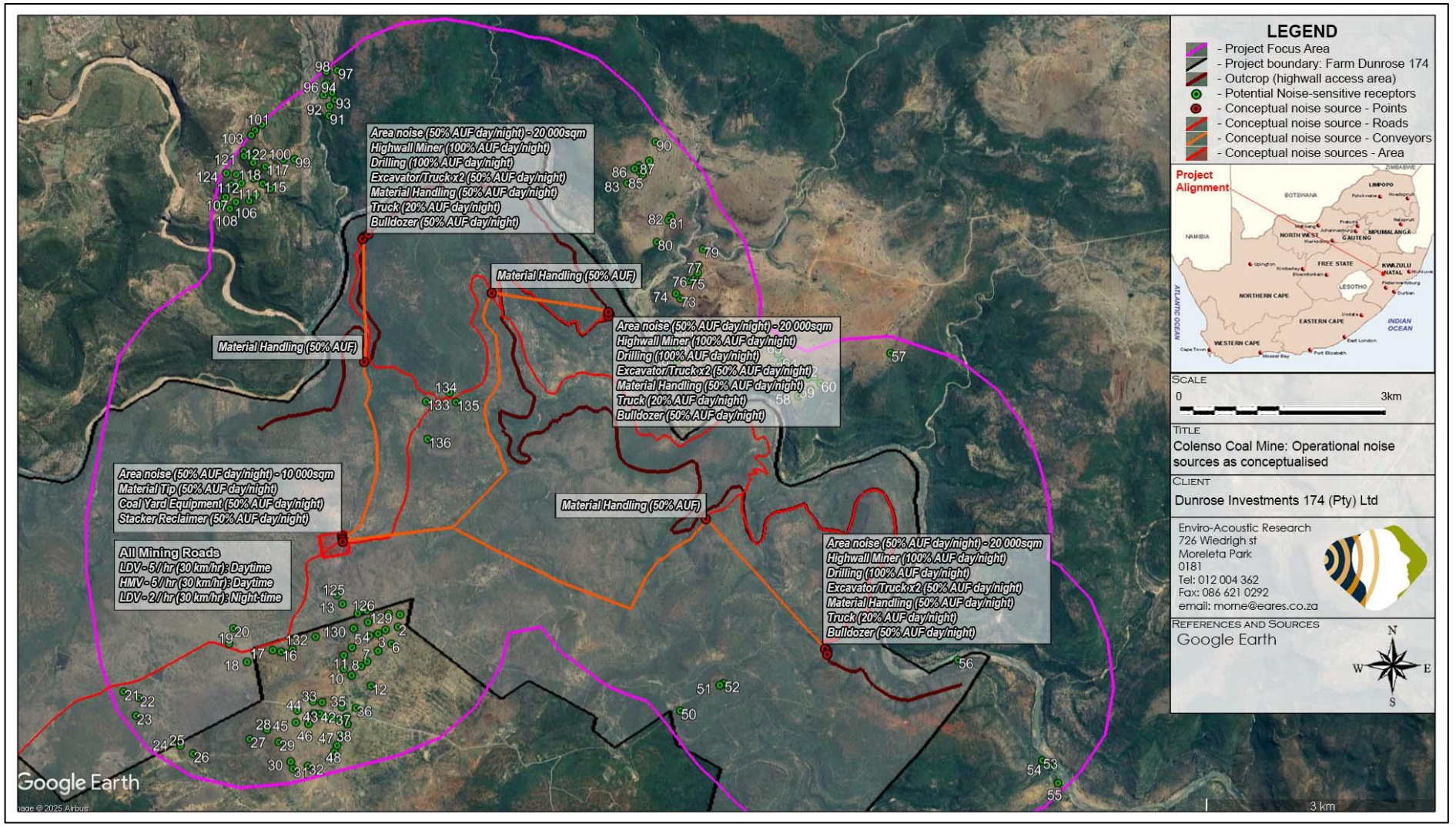

Figure 10-4: Conceptual noise-generating activities considered for the operational phase (scenario 2)

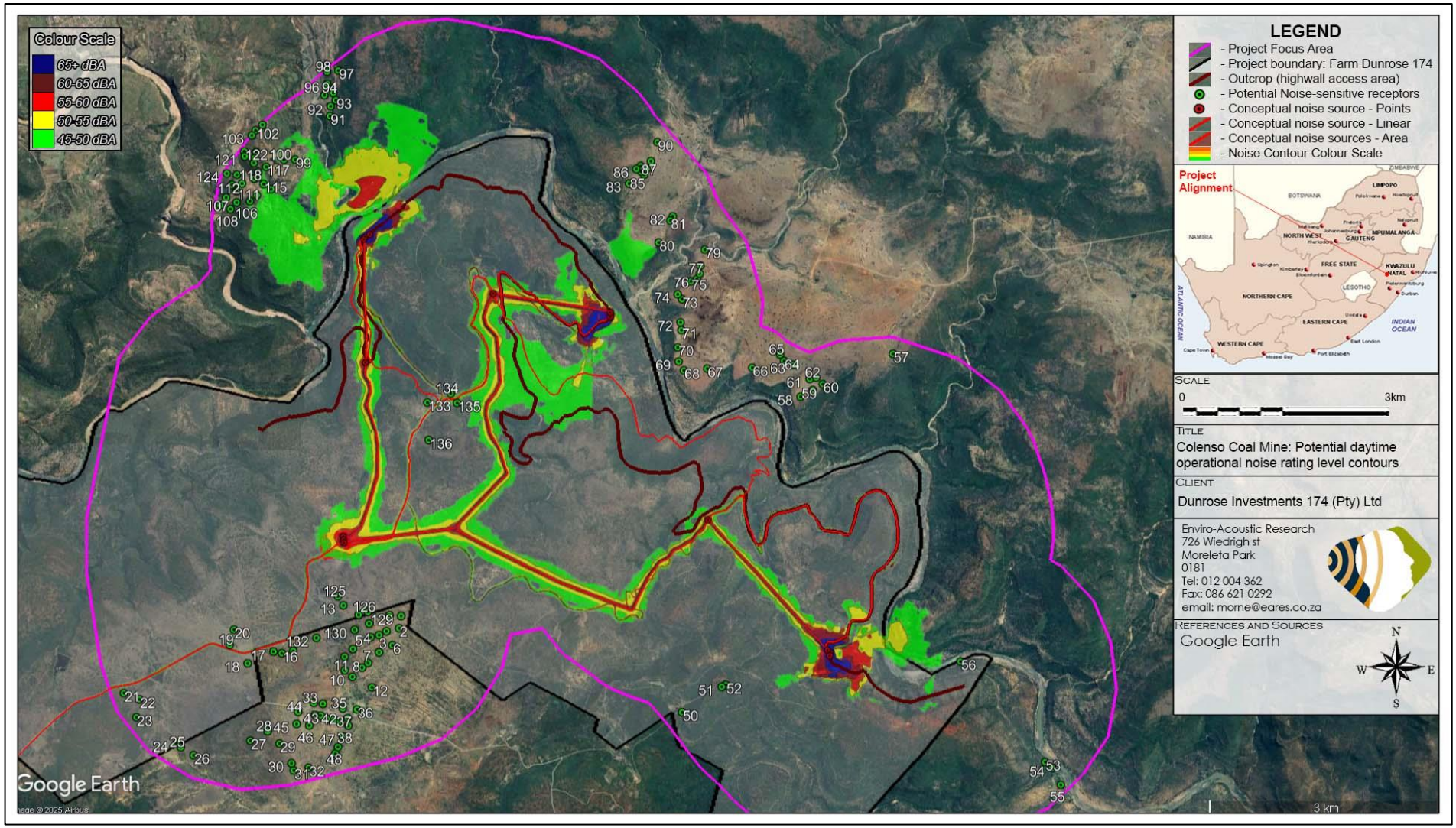

Figure 10-5: Projected cumulative daytime noise rating levels – conceptual operational activities (scenario 2)

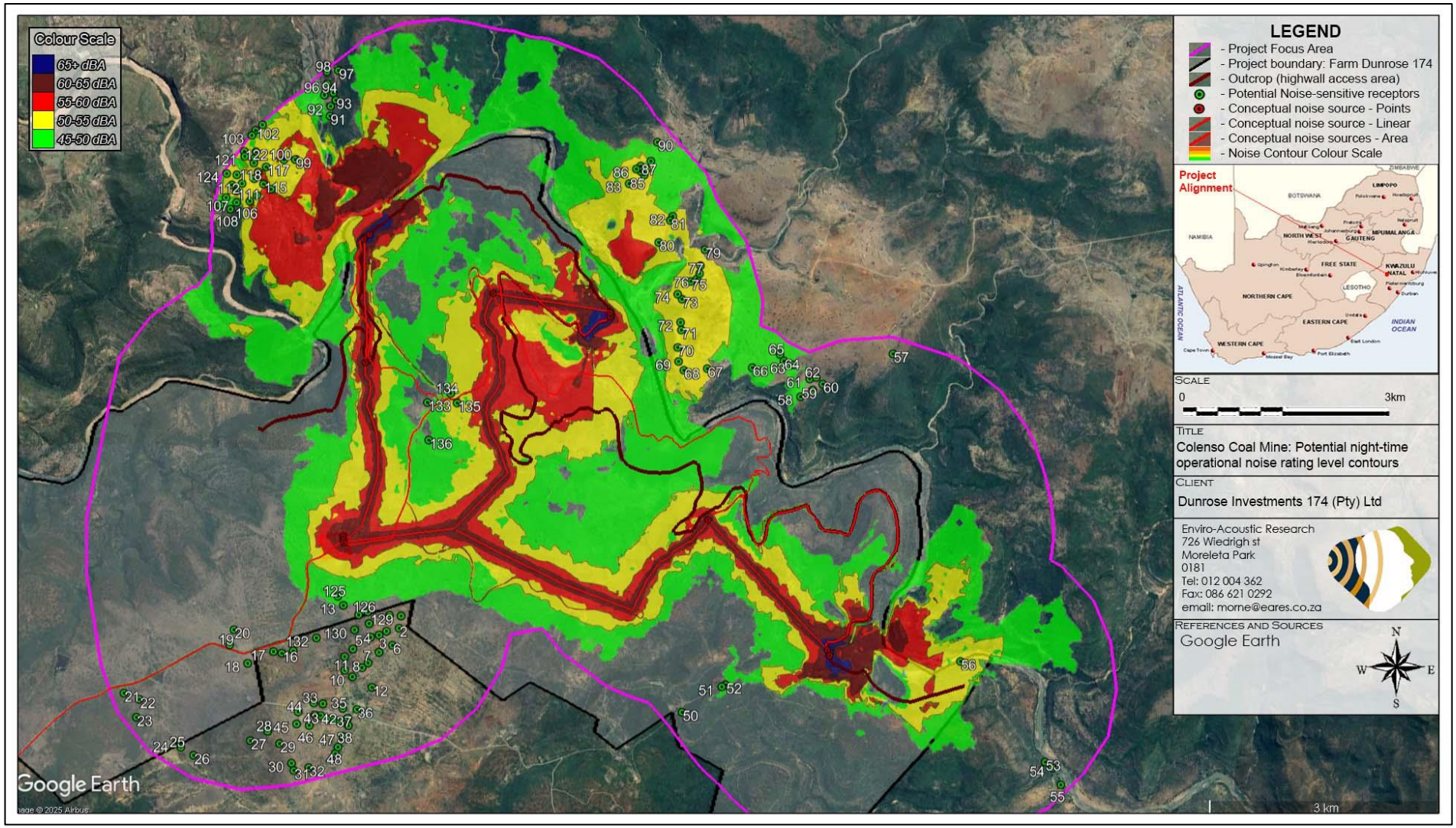

Figure 10-6: Projected cumulative night-time noise rating levels – conceptual operational activities (scenario 2)

11 SIGNIFICANCE OF THE NOISE IMPACT

This assessment considers a potential cumulative scenario, with the noise model considering various construction and operational activities.

11.1 POTENTIAL CONSTRUCTION PHASE NOISE IMPACT – SCENARIO 1

The noise-generating construction activities as conceptualised (see **Figure 10-1**) were modelled, with the potential noise rating levels calculated in **section 10.1** (with daytime noise level contours depicted in **Figure 10-2**; night-time noise level contours depicted in **Figure 10-3**). The potential significance of the noise impact is defined per NSR for the construction scenario in:

- **Appendix C, Table 1** for the potential daytime construction activities associated with concept scenario 1, with the potential significance of the daytime noise impact summarised in **Table 11-1**; and
- **Appendix C, Table 2** for the potential night-time construction activities associated with concept scenario 1, with the potential significance of the night-time construction noise impact summarised in **Table 11-2**.

Table 11-1: Impact Assessment: Daytime Construction Activities – Scenario 1

Nature:	***Numerous simultaneous construction activities during the day***	
Acceptable Rating Level	Average fast-weighted daytime sound levels were 57.3 dBA, with the various 10-minute measurements ranging between 39.6 to 79.1 dBA. The recommended daytime noise limit will be based on the IFC guideline level of 55 dBA for residential use. The potential noise rating levels, as well as the significance are defined per NSR in **Appendix C, Table 1**.	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	Minor (2)	Minor (2)
Duration (Table 8-3)	Short to medium-term (3)	Short to medium-term (3)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Local (2)	Local (2)
Probability (Table 8-5)	Possible (2) (NSR135)	Possible (2) (NSR135)
Significance of Impact	**Low (14) – All NSR**	**Low (14) – All NSR**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No loss of resources.	No loss of resources.
Comments	Scenario with numerous construction activities	
Degree of Confidence	**Medium-High**	

Mitigation:	The potential significance of noise associated with daytime construction activities would be **low** for scenario 1 and additional mitigation measures are not required or recommended. General mitigation measures are however included in **section 12.1** to ensure that annoyance with the project is minimised.
Cumulative Impacts:	Cumulative impacts were investigated and considered in the assessment.
Residual Impacts:	This impact will only disappear after decommissioning and closure is completed.

Table 11-2: Impact Assessment: Night-time Construction Activities – Scenario 1

Nature:	***Numerous simultaneous construction activities at night***	
Acceptable Rating Level	Average fast-weighted daytime sound levels were 40.8 dBA, with the various 10-minute measurements ranging between 34.8 to 63.6 dBA. The recommended night-time noise limit will be based on the IFC guideline level of 45 dBA for residential use, though the assessment will consider how potential noises may change the rural rating level. The potential noise rating levels, as well as the significance are defined per NSR in **Appendix C, Table 2**.	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	Very High (10)	High (8)
Duration (Table 8-3)	Short to medium-term (3)	Short to medium-term (3)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Regional (3)	Regional (3)
Probability (Table 8-5)	Likely (3)	Possible (2)
Significance of Impact	**Medium (48) – some NSR**	**Low (28) – All NSR**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Potential loss of quiet environment	Potential loss of quiet environment
Comments	Scenario with numerous construction activities	
Degree of Confidence	**Medium-High**	
Mitigation:	When considering potential worst-case noise levels, the potential significance from night-time construction activities could be of a **medium** significance and additional mitigation measures are required and recommended. The **medium** significance mainly relates to drilling activities taking place within 1,000m from certain NSR (NSR located across the Tugela River). Measures that would assist in reducing noise levels would include: • The mine can develop the boxcuts further than 1,000m from NSR, allowing the development of barriers (whether due to the highwalls from the mining area, or whether the barriers are constructed from overburden material); • When night-time drilling activities will be required within 1,000m from NSR, the mine should use available material to develop a berm between the drilling area and the NSR; • Minimizing drilling activities during the night-time period (when drilling within 1,000m from NSR if no berm was developed). Additional general mitigation measures are also included in **section 12.1** to ensure that annoyance with the project is minimised.	
Cumulative Impacts:	Cumulative impacts were investigated and considered in the assessment.	
Residual Impacts:	This impact will only disappear after decommissioning and closure is completed.	

11.2 POTENTIAL OPERATIONAL PHASE NOISE IMPACT – SCENARIO 2

The impact assessment for the various operational activities defined in **section 7.2** was conceptualised (see **Figure 10-4** for scenario 2) with noise rating levels calculated in **section 10.2** (with daytime noise level contours depicted in **Figure 10-5** and night-time noise level contours are depicted in **Figure 10-6**). The potential significance of the noise impacts associated with scenario 2 is defined for operational activities in:

- **Appendix C, Table 3** per NSR, with the potential significance of the daytime operational noise impact summarised in **Table 11-3**; and
- **Appendix C, Table 4** per NSR, with the potential significance of the night-time operational noise impact is summarised in **Table 11-4**.

Table 11-3: Impact Assessment: Worst-case daytime operational activities

Nature:	***Numerous simultaneous operational activities during the day***	
Acceptable Rating Level	Average fast-weighted daytime sound levels were 57.3 dBA, with the various 10-minute measurements ranging between 39.6 to 79.1 dBA. The recommended daytime noise limit will be based on the IFC guideline level of 55 dBA for residential use. The potential noise rating levels, as well as the significance are defined per NSR in **Appendix C, Table 3**.	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	Minor (2)	Minor (2)
Duration (Table 8-3)	Long-term (4)	Long-term (4)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Local (2)	Local (2)
Probability (Table 8-5)	Improbable (1)	Improbable (1)
Significance of Impact	**Low (8) – All NSR**	**Low (8) – All NSR**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No loss of resources.	No loss of resources.
Comments	Scenario with numerous operational activities, including the existing activities.	
Degree of Confidence	**Medium-High**	
Mitigation:	The potential significance from future operational noises would be **low** for scenario 2 and additional mitigation measures are not required or recommended. General mitigation measures are also included in **section 12.2** to ensure that annoyance with the project is minimised.	
Cumulative Impacts:	Cumulative impacts were investigated and considered in the assessment.	
Residual Impacts:	This impact will only disappear after decommissioning and closure is completed.	

Table 11-4: Impact Assessment: Worst-case night-time operational activities

Nature:	***Numerous simultaneous operational activities at night***	
Acceptable Rating Level	Average fast-weighted daytime sound levels were 40.8 dBA, with the various 10-minute measurements ranging between 34.8 to 63.6 dBA. The recommended night-time noise limit will be based on the IFC guideline level of 45 dBA for residential use, though the assessment will consider how potential noises may change the rural rating level. The potential noise rating levels, as well as the significance are defined per NSR in **Appendix C, Table 4**.	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	High (8)	Moderate (6)
Duration (Table 8-3)	Long-term (4)	Long-term (4)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Regional (3)	Regional (3)
Probability (Table 8-5)	Possible (2)	Possible (2)
Significance of Impact	**Medium (30)**	**Low (26)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Potential loss of quiet environment	Potential loss of quiet environment
Comments	Scenario with numerous operational activities, including the existing activities.	
Degree of Confidence	**Medium-High**	
Mitigation:	The potential significance of the night-time operational noise impact is **medium** for the activities as conceptualised for scenario 2. This relates to the potential cumulative effect from noises of both the drilling and the highwall mining machines. While this significance may relate the worst-case PWLs assumed, together with the strict EIA criteria used, additional mitigation measures would be required and the following measures are recommended: • For mining activities located within 1,000m from NSR, the barrier between NSR and mining areas should be as high as possible, allowing an effective barrier of at least 10m; • When operating within 1,000m from NSR without a barrier being present, it is recommended that only the highwall mining machine, or only the drilling machine operate within 1,000m from NSR; and • Quarterly night-time noise level measurements are recommended at NSR if mining activities take place within 1,000m from NSR. General mitigation measures are also discussed **section 12.2**.	
Cumulative Impacts:	Cumulative impacts were investigated and considered in the assessment.	
Residual Impacts:	This impact will only disappear after decommissioning and closure is completed.	

12 MITIGATION OPTIONS

This study considers the potential noise impact on the surrounding environment due to the operational activities associated with the proposed Colenso Coal Project. Using conceptual worst-case noise models, it was determined that the potential noise impacts associated with the project would be:

- of a **low significance** for daytime construction activities associated with the Colenso Coal project (scenario 1);
- of a potential **medium significance** for night-time construction activities associated with the Colenso Coal project (scenario 1). This medium significance might relate to the strict EIA criteria used and the assumption that the higher noise levels may be considered disturbing or annoying by the closest NSR with mitigation measures recommended that could reduce the significance of the noise impact to low;
- of a **low significance** for daytime operational activities associated with the Colenso Coal project (scenario 2);
- of a **medium significance** for night-time activities associated with the Colenso Coal project. This medium significance might relate to the strict EIA criteria used, the use of potential worst-case noise emission levels for equipment and activities, and the assumption that the higher noise levels may be considered disturbing or annoying by the closest NSR. Mitigation are available and it is possible to reduce the potential significance to low.

The development of the Colenso Coal project will increase noise levels at the closest NSR mining village and noise complaints may develop. The developer must know that community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon, as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to a perceived noise itself.

At all stages, surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations. It is counterproductive to suggest that the activities will be inaudible due to existing high ambient sound levels, or that noise levels will be low (based on the noise assessment). The magnitude of the sound levels will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the activities,

the spectral character and that of the surrounding soundscape (both level and spectral character).

The project applicant must implement a line of communication (i.e., a help line where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers. The mine should maintain a commitment to the local community (people staying within 2,000 m from construction or operational activities) and respond to noise concerns in an expedient fashion. Sporadic and legitimate noise complaints could be raised. For example, sudden and sharp increases in sound levels could result from mechanical malfunctions or maintenance issues. Problems of this nature can be corrected quickly and it is in AMB's interest to do so.

12.1 CONSTRUCTION PHASE MITIGATION MEASURES

The noise study considers the potential noise impact on the surrounding environment due to construction activities as conceptualized. It was determined that the potential noise impact would be of a **medium significance** during the night-time period (if activities take place within 1,000m from NSR) and additional mitigation is recommended and required to ensure that annoyance with the project is minimised. These measures could include:

10. The mine can develop the boxcuts further than 1,000m from NSR, allowing the development of barriers (whether due to the highwalls from the mining area, or whether the barriers are constructed from overburden material);
11. When night-time drilling activities will be required within 1,000m from NSR, the mine should use available material to develop a berm between the drilling area and the NSR;
12. Minimizing drilling activities during the night-time period (when drilling within 1,000m from NSR if no berm was developed).
13. Night-time construction traffic entering and leaving the mine should be minimized between the hours of 22:00 and 04:00;
14. The mine must implement a quarterly night-time noise monitoring programme at houses used for residential activities. It is recommended that an acoustic specialist be appointed to assist with the design of a noise monitoring programme, considering the mitigation measures implemented. Feedback from NSR should be used to refine, and potentially update mitigation measures (which may include the relocation of certain receptors);
15. All employees and contractors should receive Health and Safety induction that includes an environmental awareness component (noise). This is to allow employees and contractors to the potential noise risks that activities (especially night-time activities) pose to the realise surrounding environment.

16. The applicant must implement a line of communication (i.e., a helpline where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers, or alternative means to communicate issues. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated. Feedback must be provided to the affected stakeholder(s) with details of any steps taken to mitigate the impact (if valid complaint) or preventative steps to minimise this from happening again.
17. The mine must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the plant or active mining area.
18. The mine investigates the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads, within the mining area and at stockpile areas[23][24]. The advantages of white noise alarms above tonal alarms are;
    a. It is as safe as a tonal alarm[25].
    b. Highly audible close to the alarm (or reversing truck)[26].
    c. It generates a more uniform sound field behind a reversing vehicle[27].
    d. Greater directional information, workers can locate the source faster.
    e. Significantly less environmental noise and it creates significantly less annoyance far away.
    f. When properly installed, white noise alarms of a similar sound power emission level are more likely to comply with the ISO 9533 standard.

12.2 OPERATIONAL PHASE MITIGATION MEASURES

The study considers the potential noise impact on the surrounding environment due to future operational activities at Colenso Coal and the potential noise impact could be of a **medium** significance. Measures that may reduce the noise levels and assist in reducing the probability of noise impacts occurring are:

4. For mining activities located within 1,000m from NSR, the barrier (whether due to the highwalls acting as a barrier, or a constructed barrier) between NSR and mining areas should be as high as possible, allowing an effective barrier of at least 10m;

[23]White Noise Reverse Alarms: http://www.brigade-electronics.com/products.
[24] https://www.constructionnews.co.uk/home/white-noise-sounds-the-reversing-alarm/885410.article - White noise sounds the reversing alarm
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https://brigade-electronics.com/white-sound-reversing-alarms-improving-safety-environment/

5. When operating within 1,000m from NSR without a barrier being present, it is recommended that only the highwall mining machine, or only the drilling machine operate within 1,000m from NSR; and
6. Quarterly night-time noise level measurements are recommended at NSR if mining activities take place within 1,000m from NSR.

12.3 MITIGATION OPTIONS THAT SHOULD BE INCLUDED IN THE EMP AND EA

- All employees and contractors should receive Health and Safety induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realise the potential noise risks that activities (especially night-time activities) pose to the surrounding environment.
- Colenso Coal Mine must implement a line of communication (i.e., a helpline where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers, or alternative means to communicate issues. The mine should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop and if valid, should be investigated. Feedback must be provided to the affected stakeholder(s) with details of any steps taken to mitigate the impact (if valid complaint) or preventative steps to minimise this from happening again.
- Colenso Coal Mine must investigate any reasonable and valid noise complaint if registered by a receptor staying within 2,000 m from the plant or active mining area.
- It is recommended that Colenso Coal Mine develop and implement a noise monitoring programme.

13 ENVIRONMENTAL MANAGEMENT OBJECTIVES

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

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

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

Continuing management objectives would be:

- Ensure that total night-time noise levels (due to mining activities) are less than 48 dBA at all potential NSR (dwellings used for residential purposes) at night;
- The mine should ensure that night-time noise levels are less than 60 dBA at the boundary of operational areas;
- Minimise the generation of nuisance noises and address the complaint where possible; and
- the operation may not increase the existing ambient sound levels with more than **7 dB** at dwellings used for residential purposes (a disturbing noise and prohibited by the South African Noise Control Regulations, see **section 5.1.1**).

14 ENVIRONMENTAL MONITORING PLAN

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

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

Active environmental noise monitoring is recommended because the projected elevated noise levels at verified NSR are higher than the night-time rating level for the area.

In addition, should a valid complaint (from a stakeholder living within 2,000 m from a noise-generating mining activity) be registered, the applicant must investigate this complaint as per the following sections. It is recommended that the noise investigation is done by an independent acoustic consultant.

It should be noted that this noise monitoring programme may be used as a guideline, as site-specific conditions may require that the monitoring locations, frequency or procedure be adapted.

14.1 MEASUREMENT LOCALITIES AND PROCEDURES

14.1.1 Measurement Localities and Frequencies

It is recommended that an acoustic specialist be appointed to assist with the design of a noise monitoring programme after considering the future mitigation measures to be implemented by Colenso Coal Mine. Depending on the mitigation measures implemented as well as the status of NSR, quarterly noise monitoring is recommended at representative NSR locations where noise levels may be more than 42 dBA at night (refer to **Appendix C**). One or two noise level measurement locations may be sufficient, but, noise levels should be discussed with all NSR where noise levels may be higher than 42 dBA.

When investigating a noise complaint, measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint (staying within 2,000 m from the project). A second instrument may be deployed simultaneously at the associated mining activities of Colenso Coal Mine.

In cases where noise issues are registered, noise measurements should be conducted inside bedrooms, and, if noise levels exceed 35 dBA, acoustic treatment should be considered for such buildings.

14.1.2 Measurement Procedures

Ambient sound measurements should be collected as defined in SANS 10103:2008 or an acceptable international noise monitoring protocol (such as ISO 1996). When investigating a noise complaint, measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing noise event. Due to the variability that naturally occurs in sound levels at most locations, the mine should consider semi-continuous measurements[28] over a period of at least 36 hours, covering at least a full day-(06:00 – 22:00) and two night-time (22:00 – 06:00) periods.

[28] Safety and security concerns may require that only short-term measurements be done

15 RECOMMENDATIONS AND CONCLUSION

This ENIA covers the proposed development of the Colenso Coal Mine north-west of Colenso, KZN Province.

The noise-generation scenario's considers noise-generating activities close to the NSR, using conceptual scenarios to assess the potential noise impact at these NSR. The potential worst-case noise rating levels were calculated using a sound propagation model using conceptual scenarios for worst-case construction and operational phases, which determined that the significance of the potential noise impacts could be:

- of a **low significance** for daytime construction activities associated with the Colenso Coal project (scenario 1);
- of a potential **medium significance** for night-time construction activities associated with the Colenso Coal project (scenario 1). This medium significance might relate to the strict EIA criteria used and the assumption that the higher noise levels may be considered disturbing or annoying by the closest NSR with mitigation measures recommended that could reduce the significance of the noise impact to low;
- of a **low significance** for daytime operational activities associated with the Colenso Coal project (scenario 2);
- of a **medium significance** for night-time activities associated with the Colenso Coal project. This medium significance might relate to the strict EIA criteria used, the use of potential worst-case noise emission levels for equipment and activities, and the assumption that the higher noise levels may be considered disturbing or annoying by the closest NSR. Mitigation measures are available and it is possible to reduce the potential significance to low.

It is expected that the mining activities will be audible as the closest NSR, and the proposed mining activities would raise the noise levels at the closest NSR. The increase however is not considered a fatal flaw, and it is recommended that the Colenso Coal Mine be authorized (from a noise impact perspective).

This noise impact assessment is sufficient, but it is recommended that a noise monitoring programme be designed by an acoustic specialist for implementation.

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65dBA; or (ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2metres, but not more than 1,4 metres, above the ground for a period extending from06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or

	(c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 5 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments have been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there are no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a

	relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Greenfield	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, workforce, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} and L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.

Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and healthcare buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report, Noise-sensitive developments are also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound, has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1]second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time-weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.

Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS10103:2008.

APPENDIX B

Photo of sound level measurement location

Photo B.1: Long-term measurement location DCMLS01

APPENDIX C

Calculated conceptual noise rating levels and potential significance

Appendix C, Table 1: Projected worst-case noise rating levels and impact – Conceptual daytime construction activities – (scenario 1)

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural) (dBA)	Recommended Upper Daytime Noise Limit (dBA)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted average, measured) (dBA)	Projected Noise Level, Construction (dBA)	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	45	55	57.3	30.8	0.2	Minor	Medium-term	Local	Improbable	Low
2	45	55	57.3	29.4	0.1	Minor	Medium-term	Local	Improbable	Low
3	45	55	57.3	29.5	0.1	Minor	Medium-term	Local	Improbable	Low
4	45	55	57.3	28.5	0.1	Minor	Medium-term	Local	Improbable	Low
5	45	55	57.3	28.7	0.1	Minor	Medium-term	Local	Improbable	Low
6	45	55	57.3	27.2	0.1	Minor	Medium-term	Local	Improbable	Low
7	45	55	57.3	26.8	0.1	Minor	Medium-term	Local	Improbable	Low
8	45	55	57.3	26.2	0.1	Minor	Medium-term	Local	Improbable	Low
9	45	55	57.3	26.1	0.1	Minor	Medium-term	Local	Improbable	Low
10	45	55	57.3	25.8	0.1	Minor	Medium-term	Local	Improbable	Low
11	45	55	57.3	26.9	0.1	Minor	Medium-term	Local	Improbable	Low
12	45	55	57.3	23.8	0.0	Minor	Medium-term	Local	Improbable	Low
13	45	55	57.3	34.5	0.4	Minor	Medium-term	Local	Improbable	Low
14	45	55	57.3	28.3	0.1	Minor	Medium-term	Local	Improbable	Low
15	45	55	57.3	37.6	0.7	Minor	Medium-term	Local	Improbable	Low
16	45	55	57.3	39.3	1.0	Minor	Medium-term	Local	Improbable	Low
17	45	55	57.3	42.0	1.8	Minor	Medium-term	Local	Improbable	Low
18	45	55	57.3	39.2	1.0	Minor	Medium-term	Local	Improbable	Low
19	45	55	57.3	44.1	2.6	Minor	Medium-term	Local	Improbable	Low
20	45	55	57.3	35.7	0.5	Minor	Medium-term	Local	Improbable	Low
21	45	55	57.3	41.5	1.6	Minor	Medium-term	Local	Improbable	Low
22	45	55	57.3	36.2	0.5	Minor	Medium-term	Local	Improbable	Low
23	45	55	57.3	31.6	0.2	Minor	Medium-term	Local	Improbable	Low
24	45	55	57.3	25.1	0.0	Minor	Medium-term	Local	Improbable	Low
25	45	55	57.3	24.4	0.0	Minor	Medium-term	Local	Improbable	Low
26	45	55	57.3	22.9	0.0	Minor	Medium-term	Local	Improbable	Low
27	45	55	57.3	23.0	0.0	Minor	Medium-term	Local	Improbable	Low
28	45	55	57.3	23.7	0.0	Minor	Medium-term	Local	Improbable	Low
29	45	55	57.3	21.8	0.0	Minor	Medium-term	Local	Improbable	Low
30	45	55	57.3	19.4	0.0	Minor	Medium-term	Local	Improbable	Low
31	45	55	57.3	18.6	0.0	Minor	Medium-term	Local	Improbable	Low
32	45	55	57.3	18.6	0.0	Minor	Medium-term	Local	Improbable	Low
33	45	55	57.3	25.2	0.0	Minor	Medium-term	Local	Improbable	Low
34	45	55	57.3	24.7	0.0	Minor	Medium-term	Local	Improbable	Low
35	45	55	57.3	23.2	0.0	Minor	Medium-term	Local	Improbable	Low
36	45	55	57.3	22.5	0.0	Minor	Medium-term	Local	Improbable	Low
37	45	55	57.3	22.1	0.0	Minor	Medium-term	Local	Improbable	Low
38	45	55	57.3	21.1	0.0	Minor	Medium-term	Local	Improbable	Low
39	45	55	57.3	21.9	0.0	Minor	Medium-term	Local	Improbable	Low
40	45	55	57.3	22.4	0.0	Minor	Medium-term	Local	Improbable	Low

41	45	55	57.3	22.8	0.0	Minor	Medium-term	Local	Improbable	Low
42	45	55	57.3	23.5	0.0	Minor	Medium-term	Local	Improbable	Low
43	45	55	57.3	23.8	0.0	Minor	Medium-term	Local	Improbable	Low
44	45	55	57.3	25.2	0.0	Minor	Medium-term	Local	Improbable	Low
45	45	55	57.3	23.8	0.0	Minor	Medium-term	Local	Improbable	Low
46	45	55	57.3	23.2	0.0	Minor	Medium-term	Local	Improbable	Low
47	45	55	57.3	20.5	0.0	Minor	Medium-term	Local	Improbable	Low
48	45	55	57.3	19.5	0.0	Minor	Medium-term	Local	Improbable	Low
49	45	55	57.3	19.0	0.0	Minor	Medium-term	Local	Improbable	Low
50	45	55	57.3	19.5	0.0	Minor	Medium-term	Local	Improbable	Low
51	45	55	57.3	24.3	0.0	Minor	Medium-term	Local	Improbable	Low
52	45	55	57.3	24.4	0.0	Minor	Medium-term	Local	Improbable	Low
53	45	55	57.3	10.1	0.0	Minor	Medium-term	Local	Improbable	Low
54	45	55	57.3	20.0	0.0	Minor	Medium-term	Local	Improbable	Low
55	45	55	57.3	18.5	0.0	Minor	Medium-term	Local	Improbable	Low
56	45	55	57.3	39.9	1.2	Minor	Medium-term	Local	Improbable	Low
57	45	55	57.3	30.1	0.1	Minor	Medium-term	Local	Improbable	Low
58	45	55	57.3	31.7	0.2	Minor	Medium-term	Local	Improbable	Low
59	45	55	57.3	30.8	0.2	Minor	Medium-term	Local	Improbable	Low
60	45	55	57.3	30.3	0.1	Minor	Medium-term	Local	Improbable	Low
61	45	55	57.3	34.0	0.3	Minor	Medium-term	Local	Improbable	Low
62	45	55	57.3	31.2	0.2	Minor	Medium-term	Local	Improbable	Low
63	45	55	57.3	32.2	0.2	Minor	Medium-term	Local	Improbable	Low
64	45	55	57.3	36.2	0.5	Minor	Medium-term	Local	Improbable	Low
65	45	55	57.3	36.6	0.6	Minor	Medium-term	Local	Improbable	Low
66	45	55	57.3	38.3	0.8	Minor	Medium-term	Local	Improbable	Low
67	45	55	57.3	39.1	1.0	Minor	Medium-term	Local	Improbable	Low
68	45	55	57.3	44.8	2.9	Minor	Medium-term	Local	Improbable	Low
69	45	55	57.3	46.1	3.6	Minor	Medium-term	Local	Improbable	Low
70	45	55	57.3	47.2	4.2	Minor	Medium-term	Local	Improbable	Low
71	45	55	57.3	47.4	4.4	Minor	Medium-term	Local	Improbable	Low
72	45	55	57.3	47.7	4.6	Minor	Medium-term	Local	Improbable	Low
73	45	55	57.3	47.1	4.2	Minor	Medium-term	Local	Improbable	Low
74	45	55	57.3	47.6	4.5	Minor	Medium-term	Local	Improbable	Low
75	45	55	57.3	45.1	3.1	Minor	Medium-term	Local	Improbable	Low
76	45	55	57.3	44.2	2.6	Minor	Medium-term	Local	Improbable	Low
77	45	55	57.3	43.6	2.4	Minor	Medium-term	Local	Improbable	Low
78	45	55	57.3	43.1	2.2	Minor	Medium-term	Local	Improbable	Low
79	45	55	57.3	37.8	0.8	Minor	Medium-term	Local	Improbable	Low
80	45	55	57.3	44.6	2.8	Minor	Medium-term	Local	Improbable	Low
81	45	55	57.3	38.6	0.9	Minor	Medium-term	Local	Improbable	Low
82	45	55	57.3	37.7	0.7	Minor	Medium-term	Local	Improbable	Low
83	45	55	57.3	37.9	0.8	Minor	Medium-term	Local	Improbable	Low
84	45	55	57.3	35.2	0.4	Minor	Medium-term	Local	Improbable	Low
85	45	55	57.3	37.5	0.7	Minor	Medium-term	Local	Improbable	Low
86	45	55	57.3	37.4	0.7	Minor	Medium-term	Local	Improbable	Low
87	45	55	57.3	37.2	0.7	Minor	Medium-term	Local	Improbable	Low
88	45	55	57.3	35.1	0.4	Minor	Medium-term	Local	Improbable	Low
89	45	55	57.3	36.3	0.5	Minor	Medium-term	Local	Improbable	Low
90	45	55	57.3	32.3	0.2	Minor	Medium-term	Local	Improbable	Low
91	45	55	57.3	35.1	0.4	Minor	Medium-term	Local	Improbable	Low
92	45	55	57.3	21.7	0.0	Minor	Medium-term	Local	Improbable	Low
93	45	55	57.3	27.3	0.1	Minor	Medium-term	Local	Improbable	Low

94	45	55	57.3	31.1	0.2	Minor	Medium-term	Local	Improbable	Low
95	45	55	57.3	34.4	0.4	Minor	Medium-term	Local	Improbable	Low
96	45	55	57.3	32.4	0.2	Minor	Medium-term	Local	Improbable	Low
97	45	55	57.3	30.5	0.2	Minor	Medium-term	Local	Improbable	Low
98	45	55	57.3	31.9	0.2	Minor	Medium-term	Local	Improbable	Low
99	45	55	57.3	40.9	1.4	Minor	Medium-term	Local	Improbable	Low
100	45	55	57.3	38.5	0.9	Minor	Medium-term	Local	Improbable	Low
101	45	55	57.3	38.4	0.9	Minor	Medium-term	Local	Improbable	Low
102	45	55	57.3	35.1	0.4	Minor	Medium-term	Local	Improbable	Low
103	45	55	57.3	38.4	0.9	Minor	Medium-term	Local	Improbable	Low
104	45	55	57.3	43.0	2.1	Minor	Medium-term	Local	Improbable	Low
105	45	55	57.3	41.7	1.7	Minor	Medium-term	Local	Improbable	Low
106	45	55	57.3	40.5	1.3	Minor	Medium-term	Local	Improbable	Low
107	45	55	57.3	35.4	0.5	Minor	Medium-term	Local	Improbable	Low
108	45	55	57.3	18.8	0.0	Minor	Medium-term	Local	Improbable	Low
109	45	55	57.3	30.6	0.2	Minor	Medium-term	Local	Improbable	Low
110	45	55	57.3	35.1	0.4	Minor	Medium-term	Local	Improbable	Low
111	45	55	57.3	39.8	1.1	Minor	Medium-term	Local	Improbable	Low
112	45	55	57.3	39.2	1.0	Minor	Medium-term	Local	Improbable	Low
113	45	55	57.3	39.9	1.2	Minor	Medium-term	Local	Improbable	Low
114	45	55	57.3	38.8	0.9	Minor	Medium-term	Local	Improbable	Low
115	45	55	57.3	39.6	1.1	Minor	Medium-term	Local	Improbable	Low
116	45	55	57.3	41.0	1.5	Minor	Medium-term	Local	Improbable	Low
117	45	55	57.3	41.3	1.5	Minor	Medium-term	Local	Improbable	Low
118	45	55	57.3	40.2	1.2	Minor	Medium-term	Local	Improbable	Low
119	45	55	57.3	39.9	1.2	Minor	Medium-term	Local	Improbable	Low
120	45	55	57.3	39.6	1.1	Minor	Medium-term	Local	Improbable	Low
121	45	55	57.3	38.9	1.0	Minor	Medium-term	Local	Improbable	Low
122	45	55	57.3	38.8	0.9	Minor	Medium-term	Local	Improbable	Low
123	45	55	57.3	39.3	1.0	Minor	Medium-term	Local	Improbable	Low
124	45	55	57.3	38.5	0.9	Minor	Medium-term	Local	Improbable	Low
125	45	55	57.3	36.0	0.5	Minor	Medium-term	Local	Improbable	Low
126	45	55	57.3	32.1	0.2	Minor	Medium-term	Local	Improbable	Low
127	45	55	57.3	31.9	0.2	Minor	Medium-term	Local	Improbable	Low
128	45	55	57.3	30.4	0.1	Minor	Medium-term	Local	Improbable	Low
129	45	55	57.3	30.5	0.2	Minor	Medium-term	Local	Improbable	Low
130	45	55	57.3	30.3	0.1	Minor	Medium-term	Local	Improbable	Low
131	45	55	57.3	28.5	0.1	Minor	Medium-term	Local	Improbable	Low
132	45	55	57.3	34.0	0.3	Minor	Medium-term	Local	Improbable	Low
133	45	55	57.3	**45.4**	3.2	Minor	Medium-term	Local	Improbable	Low
134	45	55	57.3	**46.3**	3.7	Minor	Medium-term	Local	Improbable	Low
135	45	55	57.3	51.2	7.1	Minor	Medium-term	Local	Possible	Low
136	45	55	57.3	37.0	0.6	Minor	Medium-term	Local	Improbable	Low

Appendix C, Table 2: Projected worst-case noise rating levels and impact – Conceptual night-time construction activities – (scenario 1)

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, Rural) (dBA)	Recommended Upper Night-time Noise Limit (dBA)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted average, measured) (dBA)	Projected Noise Level, Construction (dBA)	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	35	45	40.8	28.7	0.9	Minor	Medium-term	Regional	Improbable	Low
2	35	45	40.8	27.3	0.7	Minor	Medium-term	Regional	Improbable	Low
3	35	45	40.8	27.4	0.7	Minor	Medium-term	Regional	Improbable	Low
4	35	45	40.8	25.8	0.5	Minor	Medium-term	Regional	Improbable	Low
5	35	45	40.8	25.8	0.5	Minor	Medium-term	Regional	Improbable	Low
6	35	45	40.8	24.4	0.4	Minor	Medium-term	Regional	Improbable	Low
7	35	45	40.8	23.7	0.3	Minor	Medium-term	Regional	Improbable	Low
8	35	45	40.8	22.7	0.2	Minor	Medium-term	Regional	Improbable	Low
9	35	45	40.8	22.3	0.2	Minor	Medium-term	Regional	Improbable	Low
10	35	45	40.8	21.6	0.2	Minor	Medium-term	Regional	Improbable	Low
11	35	45	40.8	22.2	0.2	Minor	Medium-term	Regional	Improbable	Low
12	35	45	40.8	20.2	0.1	Minor	Medium-term	Regional	Improbable	Low
13	35	45	40.8	31.8	1.7	Minor	Medium-term	Regional	Improbable	Low
14	35	45	40.8	23.7	0.3	Minor	Medium-term	Regional	Improbable	Low
15	35	45	40.8	24.6	0.4	Minor	Medium-term	Regional	Improbable	Low
16	35	45	40.8	24.8	0.4	Minor	Medium-term	Regional	Improbable	Low
17	35	45	40.8	26.2	0.5	Minor	Medium-term	Regional	Improbable	Low
18	35	45	40.8	23.6	0.3	Minor	Medium-term	Regional	Improbable	Low
19	35	45	40.8	27.2	0.7	Minor	Medium-term	Regional	Improbable	Low
20	35	45	40.8	22.6	0.2	Minor	Medium-term	Regional	Improbable	Low
21	35	45	40.8	23.9	0.3	Minor	Medium-term	Regional	Improbable	Low
22	35	45	40.8	19.2	0.1	Minor	Medium-term	Regional	Improbable	Low
23	35	45	40.8	15.5	0.0	Minor	Medium-term	Regional	Improbable	Low
24	35	45	40.8	12.3	0.0	Minor	Medium-term	Regional	Improbable	Low
25	35	45	40.8	12.0	0.0	Minor	Medium-term	Regional	Improbable	Low
26	35	45	40.8	11.9	0.0	Minor	Medium-term	Regional	Improbable	Low
27	35	45	40.8	14.5	0.0	Minor	Medium-term	Regional	Improbable	Low
28	35	45	40.8	15.6	0.0	Minor	Medium-term	Regional	Improbable	Low
29	35	45	40.8	14.8	0.0	Minor	Medium-term	Regional	Improbable	Low
30	35	45	40.8	13.3	0.0	Minor	Medium-term	Regional	Improbable	Low
31	35	45	40.8	12.9	0.0	Minor	Medium-term	Regional	Improbable	Low
32	35	45	40.8	13.6	0.0	Minor	Medium-term	Regional	Improbable	Low
33	35	45	40.8	18.8	0.1	Minor	Medium-term	Regional	Improbable	Low
34	35	45	40.8	18.8	0.1	Minor	Medium-term	Regional	Improbable	Low
35	35	45	40.8	18.5	0.1	Minor	Medium-term	Regional	Improbable	Low
36	35	45	40.8	18.4	0.1	Minor	Medium-term	Regional	Improbable	Low
37	35	45	40.8	17.7	0.1	Minor	Medium-term	Regional	Improbable	Low
38	35	45	40.8	16.7	0.1	Minor	Medium-term	Regional	Improbable	Low
39	35	45	40.8	16.9	0.1	Minor	Medium-term	Regional	Improbable	Low
40	35	45	40.8	17.3	0.1	Minor	Medium-term	Regional	Improbable	Low
41	35	45	40.8	17.6	0.1	Minor	Medium-term	Regional	Improbable	Low

42	35	45	40.8	17.8	0.1	Minor	Medium-term	Regional	Improbable	Low
43	35	45	40.8	17.8	0.1	Minor	Medium-term	Regional	Improbable	Low
44	35	45	40.8	18.6	0.1	Minor	Medium-term	Regional	Improbable	Low
45	35	45	40.8	17.7	0.1	Minor	Medium-term	Regional	Improbable	Low
46	35	45	40.8	17.8	0.1	Minor	Medium-term	Regional	Improbable	Low
47	35	45	40.8	16.1	0.1	Minor	Medium-term	Regional	Improbable	Low
48	35	45	40.8	14.9	0.0	Minor	Medium-term	Regional	Improbable	Low
49	35	45	40.8	14.4	0.0	Minor	Medium-term	Regional	Improbable	Low
50	35	45	40.8	14.8	0.0	Minor	Medium-term	Regional	Improbable	Low
51	35	45	40.8	23.3	0.3	Minor	Medium-term	Regional	Improbable	Low
52	35	45	40.8	23.5	0.3	Minor	Medium-term	Regional	Improbable	Low
53	35	45	40.8	9.4	0.0	Minor	Medium-term	Regional	Improbable	Low
54	35	45	40.8	19.9	0.1	Minor	Medium-term	Regional	Improbable	Low
55	35	45	40.8	18.4	0.1	Minor	Medium-term	Regional	Improbable	Low
56	35	45	40.8	39.9	6.1	Minor	Medium-term	Regional	Improbable	Low
57	35	45	40.8	30.0	1.2	Minor	Medium-term	Regional	Improbable	Low
58	35	45	40.8	31.2	1.5	Minor	Medium-term	Regional	Improbable	Low
59	35	45	40.8	30.3	1.3	Minor	Medium-term	Regional	Improbable	Low
60	35	45	40.8	29.9	1.2	Minor	Medium-term	Regional	Improbable	Low
61	35	45	40.8	33.8	2.5	Minor	Medium-term	Regional	Improbable	Low
62	35	45	40.8	30.9	1.4	Minor	Medium-term	Regional	Improbable	Low
63	35	45	40.8	32.0	1.8	Minor	Medium-term	Regional	Improbable	Low
64	35	45	40.8	36.1	3.6	Minor	Medium-term	Regional	Improbable	Low
65	35	45	40.8	36.5	3.8	Minor	Medium-term	Regional	Improbable	Low
66	35	45	40.8	38.3	5.0	Minor	Medium-term	Regional	Improbable	Low
67	35	45	40.8	39.0	5.5	Minor	Medium-term	Regional	Improbable	Low
68	35	45	40.8	44.8	10.2	Very High	Medium-term	Regional	Possible	Medium
69	35	45	40.8	**46.1**	11.4	Very High	Medium-term	Regional	Likely	Medium
70	35	45	40.8	**47.2**	12.5	Very High	Medium-term	Regional	Likely	Medium
71	35	45	40.8	**47.4**	12.6	Very High	Medium-term	Regional	Likely	Medium
72	35	45	40.8	**47.7**	12.9	Very High	Medium-term	Regional	Likely	Medium
73	35	45	40.8	**47.1**	12.4	Very High	Medium-term	Regional	Likely	Medium
74	35	45	40.8	**47.6**	12.8	Very High	Medium-term	Regional	Likely	Medium
75	35	45	40.8	**45.1**	10.5	Very High	Medium-term	Regional	Likely	Medium
76	35	45	40.8	44.2	9.7	High	Medium-term	Regional	Possible	Low
77	35	45	40.8	43.6	9.2	High	Medium-term	Regional	Possible	Low
78	35	45	40.8	43.1	8.7	High	Medium-term	Regional	Possible	Low
79	35	45	40.8	37.8	4.6	Minor	Medium-term	Regional	Improbable	Low
80	35	45	40.8	44.6	10.1	Very High	Medium-term	Regional	Possible	Medium
81	35	45	40.8	38.6	5.2	Minor	Medium-term	Regional	Improbable	Low
82	35	45	40.8	37.7	4.6	Minor	Medium-term	Regional	Improbable	Low
83	35	45	40.8	37.9	4.7	Minor	Medium-term	Regional	Improbable	Low
84	35	45	40.8	35.2	3.1	Minor	Medium-term	Regional	Improbable	Low
85	35	45	40.8	37.5	4.4	Minor	Medium-term	Regional	Improbable	Low
86	35	45	40.8	37.4	4.4	Minor	Medium-term	Regional	Improbable	Low
87	35	45	40.8	37.2	4.2	Minor	Medium-term	Regional	Improbable	Low
88	35	45	40.8	35.1	3.1	Minor	Medium-term	Regional	Improbable	Low
89	35	45	40.8	36.3	3.7	Minor	Medium-term	Regional	Improbable	Low
90	35	45	40.8	32.3	1.9	Minor	Medium-term	Regional	Improbable	Low
91	35	45	40.8	35.1	3.1	Minor	Medium-term	Regional	Improbable	Low
92	35	45	40.8	21.5	0.2	Minor	Medium-term	Regional	Improbable	Low
93	35	45	40.8	27.2	0.7	Minor	Medium-term	Regional	Improbable	Low
94	35	45	40.8	31.1	1.5	Minor	Medium-term	Regional	Improbable	Low

95	35	45	40.8	34.4	2.7	Minor	Medium-term	Regional	Improbable	Low
96	35	45	40.8	32.4	1.9	Minor	Medium-term	Regional	Improbable	Low
97	35	45	40.8	30.5	1.3	Minor	Medium-term	Regional	Improbable	Low
98	35	45	40.8	31.8	1.7	Minor	Medium-term	Regional	Improbable	Low
99	35	45	40.8	40.9	6.9	Moderate	Medium-term	Regional	Possible	Low
100	35	45	40.8	38.5	5.1	Minor	Medium-term	Regional	Improbable	Low
101	35	45	40.8	38.4	5.0	Minor	Medium-term	Regional	Improbable	Low
102	35	45	40.8	35.0	3.0	Minor	Medium-term	Regional	Improbable	Low
103	35	45	40.8	38.4	5.0	Minor	Medium-term	Regional	Improbable	Low
104	35	45	40.8	43.0	8.6	High	Medium-term	Regional	Possible	Low
105	35	45	40.8	41.7	7.5	High	Medium-term	Regional	Possible	Low
106	35	45	40.8	40.5	6.6	Minor	Medium-term	Regional	Possible	Low
107	35	45	40.8	35.4	3.2	Minor	Medium-term	Regional	Improbable	Low
108	35	45	40.8	18.6	0.1	Minor	Medium-term	Regional	Improbable	Low
109	35	45	40.8	30.6	1.3	Minor	Medium-term	Regional	Improbable	Low
110	35	45	40.8	35.1	3.1	Minor	Medium-term	Regional	Improbable	Low
111	35	45	40.8	39.7	6.0	Minor	Medium-term	Regional	Improbable	Low
112	35	45	40.8	39.2	5.6	Minor	Medium-term	Regional	Improbable	Low
113	35	45	40.8	39.9	6.1	Minor	Medium-term	Regional	Improbable	Low
114	35	45	40.8	38.8	5.3	Minor	Medium-term	Regional	Improbable	Low
115	35	45	40.8	39.6	5.9	Minor	Medium-term	Regional	Improbable	Low
116	35	45	40.8	41.0	7.0	Moderate	Medium-term	Regional	Possible	Low
117	35	45	40.8	41.2	7.1	High	Medium-term	Regional	Possible	Low
118	35	45	40.8	40.2	6.3	Minor	Medium-term	Regional	Possible	Low
119	35	45	40.8	39.9	6.1	Minor	Medium-term	Regional	Improbable	Low
120	35	45	40.8	39.6	5.9	Minor	Medium-term	Regional	Improbable	Low
121	35	45	40.8	38.9	5.4	Minor	Medium-term	Regional	Improbable	Low
122	35	45	40.8	38.7	5.2	Minor	Medium-term	Regional	Improbable	Low
123	35	45	40.8	39.3	5.7	Minor	Medium-term	Regional	Improbable	Low
124	35	45	40.8	38.5	5.1	Minor	Medium-term	Regional	Improbable	Low
125	35	45	40.8	33.2	2.2	Minor	Medium-term	Regional	Improbable	Low
126	35	45	40.8	30.1	1.2	Minor	Medium-term	Regional	Improbable	Low
127	35	45	40.8	29.5	1.1	Minor	Medium-term	Regional	Improbable	Low
128	35	45	40.8	27.9	0.8	Minor	Medium-term	Regional	Improbable	Low
129	35	45	40.8	28.2	0.8	Minor	Medium-term	Regional	Improbable	Low
130	35	45	40.8	27.0	0.6	Minor	Medium-term	Regional	Improbable	Low
131	35	45	40.8	24.7	0.4	Minor	Medium-term	Regional	Improbable	Low
132	35	45	40.8	25.9	0.5	Minor	Medium-term	Regional	Improbable	Low
133	35	45	40.8	35.4	3.2	Minor	Medium-term	Regional	Improbable	Low
134	35	45	40.8	33.2	2.2	Minor	Medium-term	Regional	Improbable	Low
135	35	45	40.8	36.9	4.1	Minor	Medium-term	Regional	Improbable	Low
136	35	45	40.8	32.0	1.8	Minor	Medium-term	Regional	Improbable	Low

Appendix C, Table 3: Projected worst-case noise rating levels and impact – Conceptual daytime operational activities – (scenario 2)

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural) (dBA)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted average, measured) (dBA)	Potential Existing Noise Levels (Calculated) (dBA)	Projected Noise Level, Operation (dBA)	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	45	55	57.3	33.5	0.3	Minor	Long-term	Local	Improbable	Low
2	45	55	57.3	32.6	0.2	Minor	Long-term	Local	Improbable	Low
3	45	55	57.3	32.5	0.2	Minor	Long-term	Local	Improbable	Low
4	45	55	57.3	31.6	0.2	Minor	Long-term	Local	Improbable	Low
5	45	55	57.3	31.5	0.2	Minor	Long-term	Local	Improbable	Low
6	45	55	57.3	30.8	0.2	Minor	Long-term	Local	Improbable	Low
7	45	55	57.3	29.2	0.1	Minor	Long-term	Local	Improbable	Low
8	45	55	57.3	28.6	0.1	Minor	Long-term	Local	Improbable	Low
9	45	55	57.3	28.2	0.1	Minor	Long-term	Local	Improbable	Low
10	45	55	57.3	27.5	0.1	Minor	Long-term	Local	Improbable	Low
11	45	55	57.3	28.0	0.1	Minor	Long-term	Local	Improbable	Low
12	45	55	57.3	26.3	0.1	Minor	Long-term	Local	Improbable	Low
13	45	55	57.3	35.5	0.5	Minor	Long-term	Local	Improbable	Low
14	45	55	57.3	29.0	0.1	Minor	Long-term	Local	Improbable	Low
15	45	55	57.3	32.7	0.2	Minor	Long-term	Local	Improbable	Low
16	45	55	57.3	33.9	0.3	Minor	Long-term	Local	Improbable	Low
17	45	55	57.3	36.2	0.5	Minor	Long-term	Local	Improbable	Low
18	45	55	57.3	33.5	0.3	Minor	Long-term	Local	Improbable	Low
19	45	55	57.3	38.0	0.8	Minor	Long-term	Local	Improbable	Low
20	45	55	57.3	30.8	0.2	Minor	Long-term	Local	Improbable	Low
21	45	55	57.3	35.3	0.4	Minor	Long-term	Local	Improbable	Low
22	45	55	57.3	30.1	0.1	Minor	Long-term	Local	Improbable	Low
23	45	55	57.3	25.8	0.1	Minor	Long-term	Local	Improbable	Low
24	45	55	57.3	20.9	0.0	Minor	Long-term	Local	Improbable	Low
25	45	55	57.3	20.5	0.0	Minor	Long-term	Local	Improbable	Low
26	45	55	57.3	19.9	0.0	Minor	Long-term	Local	Improbable	Low
27	45	55	57.3	21.7	0.0	Minor	Long-term	Local	Improbable	Low
28	45	55	57.3	22.6	0.0	Minor	Long-term	Local	Improbable	Low
29	45	55	57.3	21.9	0.0	Minor	Long-term	Local	Improbable	Low
30	45	55	57.3	20.5	0.0	Minor	Long-term	Local	Improbable	Low
31	45	55	57.3	20.4	0.0	Minor	Long-term	Local	Improbable	Low
32	45	55	57.3	20.7	0.0	Minor	Long-term	Local	Improbable	Low
33	45	55	57.3	25.1	0.0	Minor	Long-term	Local	Improbable	Low
34	45	55	57.3	25.0	0.0	Minor	Long-term	Local	Improbable	Low
35	45	55	57.3	24.7	0.0	Minor	Long-term	Local	Improbable	Low
36	45	55	57.3	25.0	0.0	Minor	Long-term	Local	Improbable	Low
37	45	55	57.3	24.2	0.0	Minor	Long-term	Local	Improbable	Low
38	45	55	57.3	23.0	0.0	Minor	Long-term	Local	Improbable	Low
39	45	55	57.3	22.9	0.0	Minor	Long-term	Local	Improbable	Low
40	45	55	57.3	23.9	0.0	Minor	Long-term	Local	Improbable	Low
41	45	55	57.3	24.0	0.0	Minor	Long-term	Local	Improbable	Low

42	45	55	57.3	24.3	0.0	Minor	Long-term	Local	Improbable	Low
43	45	55	57.3	24.3	0.0	Minor	Long-term	Local	Improbable	Low
44	45	55	57.3	24.5	0.0	Minor	Long-term	Local	Improbable	Low
45	45	55	57.3	23.6	0.0	Minor	Long-term	Local	Improbable	Low
46	45	55	57.3	23.6	0.0	Minor	Long-term	Local	Improbable	Low
47	45	55	57.3	22.7	0.0	Minor	Long-term	Local	Improbable	Low
48	45	55	57.3	21.8	0.0	Minor	Long-term	Local	Improbable	Low
49	45	55	57.3	21.6	0.0	Minor	Long-term	Local	Improbable	Low
50	45	55	57.3	25.3	0.0	Minor	Long-term	Local	Improbable	Low
51	45	55	57.3	33.7	0.3	Minor	Long-term	Local	Improbable	Low
52	45	55	57.3	34.2	0.3	Minor	Long-term	Local	Improbable	Low
53	45	55	57.3	13.0	0.0	Minor	Long-term	Local	Improbable	Low
54	45	55	57.3	20.4	0.0	Minor	Long-term	Local	Improbable	Low
55	45	55	57.3	19.2	0.0	Minor	Long-term	Local	Improbable	Low
56	45	55	57.3	43.2	2.2	Minor	Long-term	Local	Improbable	Low
57	45	55	57.3	31.6	0.2	Minor	Long-term	Local	Improbable	Low
58	45	55	57.3	35.2	0.4	Minor	Long-term	Local	Improbable	Low
59	45	55	57.3	30.9	0.2	Minor	Long-term	Local	Improbable	Low
60	45	55	57.3	31.1	0.2	Minor	Long-term	Local	Improbable	Low
61	45	55	57.3	35.0	0.4	Minor	Long-term	Local	Improbable	Low
62	45	55	57.3	34.7	0.4	Minor	Long-term	Local	Improbable	Low
63	45	55	57.3	35.7	0.5	Minor	Long-term	Local	Improbable	Low
64	45	55	57.3	36.6	0.6	Minor	Long-term	Local	Improbable	Low
65	45	55	57.3	36.9	0.6	Minor	Long-term	Local	Improbable	Low
66	45	55	57.3	38.2	0.8	Minor	Long-term	Local	Improbable	Low
67	45	55	57.3	41.0	1.5	Minor	Long-term	Local	Improbable	Low
68	45	55	57.3	42.3	1.9	Minor	Long-term	Local	Improbable	Low
69	45	55	57.3	42.6	2.0	Minor	Long-term	Local	Improbable	Low
70	45	55	57.3	43.1	2.2	Minor	Long-term	Local	Improbable	Low
71	45	55	57.3	43.3	2.2	Minor	Long-term	Local	Improbable	Low
72	45	55	57.3	43.5	2.3	Minor	Long-term	Local	Improbable	Low
73	45	55	57.3	43.5	2.3	Minor	Long-term	Local	Improbable	Low
74	45	55	57.3	43.8	2.5	Minor	Long-term	Local	Improbable	Low
75	45	55	57.3	42.6	2.0	Minor	Long-term	Local	Improbable	Low
76	45	55	57.3	42.1	1.8	Minor	Long-term	Local	Improbable	Low
77	45	55	57.3	41.8	1.7	Minor	Long-term	Local	Improbable	Low
78	45	55	57.3	41.5	1.6	Minor	Long-term	Local	Improbable	Low
79	45	55	57.3	33.4	0.3	Minor	Long-term	Local	Improbable	Low
80	45	55	57.3	44.4	2.7	Minor	Long-term	Local	Improbable	Low
81	45	55	57.3	41.8	1.7	Minor	Long-term	Local	Improbable	Low
82	45	55	57.3	41.2	1.5	Minor	Long-term	Local	Improbable	Low
83	45	55	57.3	42.7	2.0	Minor	Long-term	Local	Improbable	Low
84	45	55	57.3	38.8	0.9	Minor	Long-term	Local	Improbable	Low
85	45	55	57.3	41.4	1.6	Minor	Long-term	Local	Improbable	Low
86	45	55	57.3	41.5	1.6	Minor	Long-term	Local	Improbable	Low
87	45	55	57.3	41.1	1.5	Minor	Long-term	Local	Improbable	Low
88	45	55	57.3	38.6	0.9	Minor	Long-term	Local	Improbable	Low
89	45	55	57.3	40.3	1.3	Minor	Long-term	Local	Improbable	Low
90	45	55	57.3	34.7	0.4	Minor	Long-term	Local	Improbable	Low
91	45	55	57.3	33.4	0.3	Minor	Long-term	Local	Improbable	Low
92	45	55	57.3	25.4	0.0	Minor	Long-term	Local	Improbable	Low
93	45	55	57.3	27.8	0.1	Minor	Long-term	Local	Improbable	Low
94	45	55	57.3	29.2	0.1	Minor	Long-term	Local	Improbable	Low

95	45	55	57.3	33.9	0.3	Minor	Long-term	Local	Improbable	Low
96	45	55	57.3	33.0	0.3	Minor	Long-term	Local	Improbable	Low
97	45	55	57.3	32.1	0.2	Minor	Long-term	Local	Improbable	Low
98	45	55	57.3	32.6	0.2	Minor	Long-term	Local	Improbable	Low
99	45	55	57.3	45.3	3.2	Minor	Long-term	Local	Improbable	Low
100	45	55	57.3	42.3	1.9	Minor	Long-term	Local	Improbable	Low
101	45	55	57.3	42.5	1.9	Minor	Long-term	Local	Improbable	Low
102	45	55	57.3	38.8	0.9	Minor	Long-term	Local	Improbable	Low
103	45	55	57.3	42.5	1.9	Minor	Long-term	Local	Improbable	Low
104	45	55	57.3	45.2	3.1	Minor	Long-term	Local	Improbable	Low
105	45	55	57.3	45.4	3.2	Minor	Long-term	Local	Improbable	Low
106	45	55	57.3	44.5	2.8	Minor	Long-term	Local	Improbable	Low
107	45	55	57.3	39.2	1.0	Minor	Long-term	Local	Improbable	Low
108	45	55	57.3	22.0	0.0	Minor	Long-term	Local	Improbable	Low
109	45	55	57.3	35.1	0.4	Minor	Long-term	Local	Improbable	Low
110	45	55	57.3	38.6	0.9	Minor	Long-term	Local	Improbable	Low
111	45	55	57.3	43.5	2.3	Minor	Long-term	Local	Improbable	Low
112	45	55	57.3	43.0	2.1	Minor	Long-term	Local	Improbable	Low
113	45	55	57.3	43.1	2.2	Minor	Long-term	Local	Improbable	Low
114	45	55	57.3	41.2	1.5	Minor	Long-term	Local	Improbable	Low
115	45	55	57.3	42.6	2.0	Minor	Long-term	Local	Improbable	Low
116	45	55	57.3	44.8	2.9	Minor	Long-term	Local	Improbable	Low
117	45	55	57.3	44.5	2.8	Minor	Long-term	Local	Improbable	Low
118	45	55	57.3	44.1	2.6	Minor	Long-term	Local	Improbable	Low
119	45	55	57.3	43.9	2.5	Minor	Long-term	Local	Improbable	Low
120	45	55	57.3	43.6	2.4	Minor	Long-term	Local	Improbable	Low
121	45	55	57.3	43.0	2.1	Minor	Long-term	Local	Improbable	Low
122	45	55	57.3	42.8	2.0	Minor	Long-term	Local	Improbable	Low
123	45	55	57.3	43.1	2.2	Minor	Long-term	Local	Improbable	Low
124	45	55	57.3	42.3	1.9	Minor	Long-term	Local	Improbable	Low
125	45	55	57.3	36.7	0.6	Minor	Long-term	Local	Improbable	Low
126	45	55	57.3	34.3	0.4	Minor	Long-term	Local	Improbable	Low
127	45	55	57.3	33.7	0.3	Minor	Long-term	Local	Improbable	Low
128	45	55	57.3	32.7	0.2	Minor	Long-term	Local	Improbable	Low
129	45	55	57.3	33.6	0.3	Minor	Long-term	Local	Improbable	Low
130	45	55	57.3	32.1	0.2	Minor	Long-term	Local	Improbable	Low
131	45	55	57.3	29.8	0.1	Minor	Long-term	Local	Improbable	Low
132	45	55	57.3	31.4	0.2	Minor	Long-term	Local	Improbable	Low
133	45	55	57.3	39.1	1.0	Minor	Long-term	Local	Improbable	Low
134	45	55	57.3	41.3	1.5	Minor	Long-term	Local	Improbable	Low
135	45	55	57.3	46.5	3.8	Minor	Long-term	Local	Improbable	Low
136	45	55	57.3	36.2	0.5	Minor	Long-term	Local	Improbable	Low

Appendix C, Table 4: Projected worst-case noise rating levels and impact – Conceptual night-time operational activities (scenario 2)

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, Rural) (dBA)	Recommended Upper Night-time Noise Limit (dBA)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted average, measured) (dBA)	Projected Noise Level, Operation (dBA)	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	35	45	40.8	33.3	2.2	Minor	Long-term	Regional	Improbable	Low
2	35	45	40.8	32.4	1.9	Minor	Long-term	Regional	Improbable	Low
3	35	45	40.8	32.3	1.9	Minor	Long-term	Regional	Improbable	Low
4	35	45	40.8	31.4	1.6	Minor	Long-term	Regional	Improbable	Low
5	35	45	40.8	31.2	1.5	Minor	Long-term	Regional	Improbable	Low
6	35	45	40.8	30.6	1.3	Minor	Long-term	Regional	Improbable	Low
7	35	45	40.8	28.9	1.0	Minor	Long-term	Regional	Improbable	Low
8	35	45	40.8	28.3	0.8	Minor	Long-term	Regional	Improbable	Low
9	35	45	40.8	27.9	0.8	Minor	Long-term	Regional	Improbable	Low
10	35	45	40.8	27.1	0.7	Minor	Long-term	Regional	Improbable	Low
11	35	45	40.8	27.4	0.7	Minor	Long-term	Regional	Improbable	Low
12	35	45	40.8	26.0	0.5	Minor	Long-term	Regional	Improbable	Low
13	35	45	40.8	35.1	3.1	Minor	Long-term	Regional	Improbable	Low
14	35	45	40.8	28.4	0.9	Minor	Long-term	Regional	Improbable	Low
15	35	45	40.8	28.1	0.8	Minor	Long-term	Regional	Improbable	Low
16	35	45	40.8	28.0	0.8	Minor	Long-term	Regional	Improbable	Low
17	35	45	40.8	28.7	0.9	Minor	Long-term	Regional	Improbable	Low
18	35	45	40.8	26.4	0.6	Minor	Long-term	Regional	Improbable	Low
19	35	45	40.8	28.5	0.9	Minor	Long-term	Regional	Improbable	Low
20	35	45	40.8	26.1	0.5	Minor	Long-term	Regional	Improbable	Low
21	35	45	40.8	24.4	0.4	Minor	Long-term	Regional	Improbable	Low
22	35	45	40.8	21.0	0.2	Minor	Long-term	Regional	Improbable	Low
23	35	45	40.8	18.5	0.1	Minor	Long-term	Regional	Improbable	Low
24	35	45	40.8	17.5	0.1	Minor	Long-term	Regional	Improbable	Low
25	35	45	40.8	17.4	0.1	Minor	Long-term	Regional	Improbable	Low
26	35	45	40.8	17.6	0.1	Minor	Long-term	Regional	Improbable	Low
27	35	45	40.8	20.4	0.1	Minor	Long-term	Regional	Improbable	Low
28	35	45	40.8	21.5	0.2	Minor	Long-term	Regional	Improbable	Low
29	35	45	40.8	21.1	0.2	Minor	Long-term	Regional	Improbable	Low
30	35	45	40.8	20.0	0.1	Minor	Long-term	Regional	Improbable	Low
31	35	45	40.8	19.9	0.1	Minor	Long-term	Regional	Improbable	Low
32	35	45	40.8	20.3	0.1	Minor	Long-term	Regional	Improbable	Low
33	35	45	40.8	24.2	0.3	Minor	Long-term	Regional	Improbable	Low
34	35	45	40.8	24.3	0.4	Minor	Long-term	Regional	Improbable	Low
35	35	45	40.8	24.2	0.3	Minor	Long-term	Regional	Improbable	Low
36	35	45	40.8	24.7	0.4	Minor	Long-term	Regional	Improbable	Low
37	35	45	40.8	23.8	0.3	Minor	Long-term	Regional	Improbable	Low
38	35	45	40.8	22.5	0.2	Minor	Long-term	Regional	Improbable	Low
39	35	45	40.8	22.4	0.2	Minor	Long-term	Regional	Improbable	Low
40	35	45	40.8	23.4	0.3	Minor	Long-term	Regional	Improbable	Low
41	35	45	40.8	23.4	0.3	Minor	Long-term	Regional	Improbable	Low

42	35	45	40.8	23.6	0.3	Minor	Long-term	Regional	Improbable	Low
43	35	45	40.8	23.7	0.3	Minor	Long-term	Regional	Improbable	Low
44	35	45	40.8	23.6	0.3	Minor	Long-term	Regional	Improbable	Low
45	35	45	40.8	22.8	0.3	Minor	Long-term	Regional	Improbable	Low
46	35	45	40.8	23.0	0.3	Minor	Long-term	Regional	Improbable	Low
47	35	45	40.8	22.3	0.2	Minor	Long-term	Regional	Improbable	Low
48	35	45	40.8	21.4	0.2	Minor	Long-term	Regional	Improbable	Low
49	35	45	40.8	21.2	0.2	Minor	Long-term	Regional	Improbable	Low
50	35	45	40.8	25.2	0.4	Minor	Long-term	Regional	Improbable	Low
51	35	45	40.8	33.6	2.4	Minor	Long-term	Regional	Improbable	Low
52	35	45	40.8	34.1	2.6	Minor	Long-term	Regional	Improbable	Low
53	35	45	40.8	12.9	0.0	Minor	Long-term	Regional	Improbable	Low
54	35	45	40.8	20.4	0.1	Minor	Long-term	Regional	Improbable	Low
55	35	45	40.8	19.1	0.1	Minor	Long-term	Regional	Improbable	Low
56	35	45	40.8	43.2	8.8	High	Long-term	Regional	Possible	Medium
57	35	45	40.8	31.6	1.6	Minor	Long-term	Regional	Improbable	Low
58	35	45	40.8	35.2	3.1	Minor	Long-term	Regional	Improbable	Low
59	35	45	40.8	30.8	1.4	Minor	Long-term	Regional	Improbable	Low
60	35	45	40.8	31.0	1.5	Minor	Long-term	Regional	Improbable	Low
61	35	45	40.8	34.9	3.0	Minor	Long-term	Regional	Improbable	Low
62	35	45	40.8	34.6	2.8	Minor	Long-term	Regional	Improbable	Low
63	35	45	40.8	35.7	3.4	Minor	Long-term	Regional	Improbable	Low
64	35	45	40.8	36.5	3.8	Minor	Long-term	Regional	Improbable	Low
65	35	45	40.8	36.8	4.0	Minor	Long-term	Regional	Improbable	Low
66	35	45	40.8	38.2	4.9	Minor	Long-term	Regional	Improbable	Low
67	35	45	40.8	41.0	7.0	Moderate	Long-term	Regional	Possible	Low
68	35	45	40.8	42.3	8.0	High	Long-term	Regional	Possible	Medium
69	35	45	40.8	42.6	8.3	High	Long-term	Regional	Possible	Medium
70	35	45	40.8	43.1	8.7	High	Long-term	Regional	Possible	Medium
71	35	45	40.8	43.3	8.9	High	Long-term	Regional	Possible	Medium
72	35	45	40.8	43.5	9.1	High	Long-term	Regional	Possible	Medium
73	35	45	40.8	43.5	9.1	High	Long-term	Regional	Possible	Medium
74	35	45	40.8	43.8	9.3	High	Long-term	Regional	Possible	Medium
75	35	45	40.8	42.6	8.3	High	Long-term	Regional	Possible	Medium
76	35	45	40.8	42.1	7.9	High	Long-term	Regional	Possible	Medium
77	35	45	40.8	41.8	7.6	High	Long-term	Regional	Possible	Medium
78	35	45	40.8	41.5	7.4	High	Long-term	Regional	Possible	Medium
79	35	45	40.8	33.4	2.3	Minor	Long-term	Regional	Improbable	Low
80	35	45	40.8	44.4	9.9	High	Long-term	Regional	Possible	Medium
81	35	45	40.8	41.7	7.5	High	Long-term	Regional	Possible	Medium
82	35	45	40.8	41.2	7.1	High	Long-term	Regional	Possible	Medium
83	35	45	40.8	42.7	8.4	High	Long-term	Regional	Possible	Medium
84	35	45	40.8	38.8	5.3	Minor	Long-term	Regional	Possible	Low
85	35	45	40.8	41.4	7.3	High	Long-term	Regional	Possible	Medium
86	35	45	40.8	41.5	7.4	High	Long-term	Regional	Possible	Medium
87	35	45	40.8	41.1	7.1	High	Long-term	Regional	Possible	Medium
88	35	45	40.8	38.6	5.2	Minor	Long-term	Regional	Improbable	Low
89	35	45	40.8	40.3	6.4	Minor	Long-term	Regional	Possible	Low
90	35	45	40.8	34.7	2.9	Minor	Long-term	Regional	Improbable	Low
91	35	45	40.8	33.4	2.3	Minor	Long-term	Regional	Improbable	Low
92	35	45	40.8	25.4	0.5	Minor	Long-term	Regional	Improbable	Low
93	35	45	40.8	27.8	0.8	Minor	Long-term	Regional	Improbable	Low
94	35	45	40.8	29.2	1.0	Minor	Long-term	Regional	Improbable	Low

Appendix B: Photos of sound level measurements

95	35	45	40.8	33.9	2.5	Minor	Long-term	Regional	Improbable	Low
96	35	45	40.8	33.0	2.1	Minor	Long-term	Regional	Improbable	Low
97	35	45	40.8	32.1	1.8	Minor	Long-term	Regional	Improbable	Low
98	35	45	40.8	32.6	2.0	Minor	Long-term	Regional	Improbable	Low
99	35	45	40.8	45.3	10.7	Very High	Long-term	Regional	Likely	Medium
100	35	45	40.8	42.3	8.0	High	Long-term	Regional	Possible	Medium
101	35	45	40.8	42.5	8.2	High	Long-term	Regional	Possible	Medium
102	35	45	40.8	38.8	5.3	Minor	Long-term	Regional	Possible	Low
103	35	45	40.8	42.5	8.2	High	Long-term	Regional	Possible	Medium
104	35	45	40.8	45.2	10.6	Very High	Long-term	Regional	Likely	Medium
105	35	45	40.8	45.4	10.8	Very High	Long-term	Regional	Likely	Medium
106	35	45	40.8	44.4	9.9	High	Long-term	Regional	Possible	Medium
107	35	45	40.8	39.2	5.6	Minor	Long-term	Regional	Possible	Low
108	35	45	40.8	22.0	0.2	Minor	Long-term	Regional	Improbable	Low
109	35	45	40.8	35.1	3.1	Minor	Long-term	Regional	Improbable	Low
110	35	45	40.8	38.6	5.2	Minor	Long-term	Regional	Improbable	Low
111	35	45	40.8	43.5	9.1	High	Long-term	Regional	Possible	Medium
112	35	45	40.8	43.0	8.6	High	Long-term	Regional	Possible	Medium
113	35	45	40.8	43.1	8.7	High	Long-term	Regional	Possible	Medium
114	35	45	40.8	41.2	7.1	High	Long-term	Regional	Possible	Medium
115	35	45	40.8	42.6	8.3	High	Long-term	Regional	Possible	Medium
116	35	45	40.8	44.8	10.2	Very High	Long-term	Regional	Possible	Medium
117	35	45	40.8	44.5	10.0	High	Long-term	Regional	Possible	Medium
118	35	45	40.8	44.1	9.6	High	Long-term	Regional	Possible	Medium
119	35	45	40.8	43.9	9.4	High	Long-term	Regional	Possible	Medium
120	35	45	40.8	43.6	9.2	High	Long-term	Regional	Possible	Medium
121	35	45	40.8	43.0	8.6	High	Long-term	Regional	Possible	Medium
122	35	45	40.8	42.8	8.5	High	Long-term	Regional	Possible	Medium
123	35	45	40.8	43.1	8.7	High	Long-term	Regional	Possible	Medium
124	35	45	40.8	42.3	8.0	High	Long-term	Regional	Possible	Medium
125	35	45	40.8	36.3	3.7	Minor	Long-term	Regional	Improbable	Low
126	35	45	40.8	34.1	2.6	Minor	Long-term	Regional	Improbable	Low
127	35	45	40.8	33.4	2.3	Minor	Long-term	Regional	Improbable	Low
128	35	45	40.8	32.5	1.9	Minor	Long-term	Regional	Improbable	Low
129	35	45	40.8	33.4	2.3	Minor	Long-term	Regional	Improbable	Low
130	35	45	40.8	31.8	1.7	Minor	Long-term	Regional	Improbable	Low
131	35	45	40.8	29.3	1.0	Minor	Long-term	Regional	Improbable	Low
132	35	45	40.8	29.6	1.1	Minor	Long-term	Regional	Improbable	Low
133	35	45	40.8	34.6	2.8	Minor	Long-term	Regional	Improbable	Low
134	35	45	40.8	36.7	3.9	Minor	Long-term	Regional	Improbable	Low
135	35	45	40.8	42.3	8.0	High	Long-term	Regional	Possible	Medium
136	35	45	40.8	35.5	3.3	Minor	Long-term	Regional	Improbable	Low

APPENDIX D

Details of the noise sources

Appendix D, Table 5: Noise sources used

Emission spectrum	63Hz dB(A)	125Hz dB(A)	250Hz dB(A)	500Hz dB(A)	1kHz dB(A)	2kHz dB(A)	4kHz dB(A)	L'w dB(A)
ADT - Terex 30 Ton	76.2	89.2	100.3	105.6	108.2	106.3	100.2	112.2
Bulldozer	95	96.1	102.8	107.7	110.4	102.7	94.7	113.3
Coal yard equipment	83.8	90.9	95.4	101.8	101	97.2	85	105.8
Conveyors	83.9	93	100.7	105.3	106.9	103.9	100.4	75
Crushing / Processing Plant	94.9	106.2	111.5	116.8	117.3	113.7	107.3	121.7
Drilling	95.4	107.2	109.7	112.1	114.2	115.1	112.3	120.8
Excavator EX1200	89.6	101.1	110.9	107.5	110.5	107	106.3	116
FEL 988	78.8	100.9	104.4	110.8	111	108.2	102	115.6
FEL 988	78.8	100.9	104.4	110.8	111	108.2	102	115.6
General Noise - Area	65.6	80.7	91.2	98.6	101.8	98	97.8	65
General Noise - Point	65.6	80.7	91.2	98.6	101.8	98	97.8	108.8
Material handling (various)	85.4	88	96.6	99	97.1	92.5	88.9	103.2
Stacker Reclaimer	85	92.1	92.6	95	98.2	99.4	98.2	105

End of Report

Aquatic Study

AQUATIC STUDY: PROPOSED MINING RIGHT APPLICATION ON SELECTED FARMS SITUATED IN THE MAGISTERIAL DISTRICT OF UTHUKELA/ESTCOURT KWAZULU-NATAL PROVINCE

2025

DOCUMENT CONTROL

Report Name	AQUATIC STUDY: PROPOSED MINING RIGHT APPLICATION FOR COAL ON REMAINING EXTENT OF PORTION 1 AND REMAINING EXTENT OF THE FARM SCHURFDE POORT 1147 GS;THE FARM SHAWS NO.11317 GS; PORTION 1 AND THE REMAINING EXTENT OF THE FARM GANNA HOEK 1317 GS; PORTION 1 AND THE REMAINING EXTENT OF THE FARM KLIP BERG 2158 GT;THE FARM BRAKFONTEIN 1316 GS;PORTIONS 1, 2 AND THE REMAINING EXTENT OF THE FARM RAMAK 13696 GT, SITUATED IN THE MAGISTERIAL DISTRICT OF UTHUKELA/ESTCOURT KWAZULU-NATAL PROVINCE
Reference	AQ/DUN- V001
Submitted to	DUNROSE INVESTMENTS 174 (PTY) LTD
Authors	Mokgatla Molepo Musa Baloyi Thabo Mohlala

EXECUTIVE SUMMARY

Mora Ecological Services Pty (Ltd) was appointed to conduct an aquatic assessment of water resources, associated with the proposed project area. The assessment is required as part of the Environmental Authorisation process.

The aim of the survey was to determine the PES of Tugela (Thukela) at sub-quaternary reach V14E-03233 using macro-invertebrates and MIRAI as biological indicators and assess *in-situ* water quality parameters by comparing them to Target Water Quality Range for aquatic ecosystems. Two sites were sampled on the Tugela located upstream and downstream of the proposed project area. Habitat assessment was also conducted using IHAS at the two sampled sites. In addition, toxicity analyses, as well as chemical analyses, were performed at both sites.

Water quality at both upstream and downstream sites generally met the TWQR for aquatic ecosystems. Temperature, pH, electrical conductivity, and dissolved oxygen (DO) values were all within the TWQR during the time of sampling.

The macroinvertebrate habitat suitability can be considered borderline adequate/fair at the time of assessment at the upstream site and good at the downstream site. In general, the number of taxa was higher at the downstream site compared to the upstream site, with 23 taxa recorded at DS-S1 and 18 taxa at US-S1. The sites were dominated by a high abundance of families with high tolerance to pollution and environmental degradation (e.g., Oligochaeta, Chironomidae and Coenagrionidae). Taxa (14) with a low requirement for unmodified water quality, taxa (6) with a very low requirement for unmodified water quality, taxa (5) with a moderate requirement for unmodified water quality, and one taxon (1) with a high requirement for unmodified water quality were sampled during the survey.

The SASS5 score increased on a spatial scale from the upstream site to the downstream site during the survey. Similarly, the ASPT score increased from the upstream to the downstream site. This indicates that biotic integrity was slightly improved on spatial scale at the time of sampling. Comparison of SASS5 vegetation scores confirmed this spatial increase supporting that the slight increase in biotic integrity.

The PES of the Tugela was determined in SQR V14E-03233, with the two sites (i.e. US-S1 and DS-S1). Analysis of the macroinvertebrate data obtained from the two sampled sites using MIRAI v2 shows that SQR V14E-03233 falls into an ecological category C with a MIRAI score of 63.4%. This indicates that the reach is in a moderately modified ecological condition in response to anthropogenic activities occurring in the reach. It also indicates that a loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

The toxicity hazard observed was within Class I (No hazard) after inclusion of all potential impacts at the upstream and downstream sites of the proposed project area, which indicates that there was no acute/chronic hazard.

It is therefore recommended that, upon the issuance of Environmental Authorizations, efforts be made to improve the present ecological state and prevent further degradation. Continuous monitoring of the Tugela River, as the receiving environment, is essential to identify any positive or negative impacts on aquatic biota and water quality. Furthermore, appropriate mitigation measures should be implemented to ensure that activities related to the proposed project do not cause the river's ecological condition to decline below the Present Ecological State (PES).

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ACRONYMS

µS/cm	Micro-Siemens per Centimeter
ASPT	Average Score Per Taxon
DO	Dissolved Oxygen
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
FRAI	Fish Response Assessment Index
GAI	Geomorphological Assessment Index
GPS	Global Positioning System
GSM	Gravel, Sand and Mud
IHAS	Integrated Habitat Assessment System
Mg/L	Milligrams per Liter
MIRAI	Macro-Invertebrates Response Assessment Index
NEMA	National Environmental Management Act
NEMWA	National Environmental Management – Waste Act
NWA	National Water Act
NWRS	National Water Resources Strategy
PES	Present Ecological State
PESEIS	Present Ecological State – Ecological Importance and Sensitivity
QV	Quality Value
RHP	River Health Programme
SASS5	South African Scoring Systems for macro-invertebrates version 5
SQR	Sub-Quaternary Reach
TDS	Total Dissolved Solids
TWQR	Target Water Quality Range
VEGRAI	Riparian Vegetation Response Assessment Index
WMA	Water Management Area

1. INTRODUCTION

Mora Ecological Services (Pty) Ltd was appointed to conduct an aquatic assessment of water resources associated with the proposed mining right application by Dunrose Investments 174 (PTY) LTD, to conduct an ecological specialist study towards their pursuit in obtaining the mining right application for coal on remaining extent of portion 1 and remaining extent of the Farm Schurfde Poort 1147, the Farm shaws no.11317 GS; portion 1 and the remaining extent of the Farm Ganna Hoek 1317 GS; portion 1 and the remaining extent of the Farm Klipberg 2158 GT the Farm Brakfontein 1316 GS portions 1, 2 and the remaining extent of the Farm Ramak 13696 GT, situated in the Magisterial District of uThukela /Estcourt Kwazulu-Natal Province.

South Africa is a water-stressed country (<1 700 m³ per person annually) and will probably face water scarcity (<1 000 m³/p/a) by 2025 (GEO-2000, 1999). Increased stresses on the world's water are affecting quality, quantity and availability. Therefore, the need to protect and not pollute valuable freshwater resources cannot be overemphasised. Rising demand for increasingly scarce water resources is leading to growing concerns about future access to water, particularly where water resources are shared by two or more countries.
The availability of water and its physical, chemical, and biological composition affect the ability of aquatic environments to sustain healthy ecosystems; as water quality and quantity are eroded, organisms suffer, and ecosystem services may be lost. Moreover, an abundant supply of clean, usable water is a basic requirement for many of the fundamental uses of water on which humans depend (UNEP-GEMS, 2006).

Rivers are the most important freshwater resource for humans. Social, economic and political development has, in the past, been largely related to the availability and distribution of freshwater contained in riverine systems (Chapman, 1996).

1.1. Objectives of the study

The objectives of the current study were to conduct an aquatic assessment of water resources associated with the proposed project area. To achieve the objectives, the following specific activities were conducted:

- Biomonitoring on the Tugela (Thukela) River (upstream and downstream of the proposed project area) using South African Scoring System for macro-invertebrates' version 5 (SASS5) and Integrated Habitat Assessment System (IHAS).

- Determine the Present Ecological State (PES) of the Tugela using Macro-invertebrates Response Assessment Index (MIRAI).
- Assessment of *in-situ* water quality parameters against the Target Water Quality Ranges (TWQR) for aquatic ecosystems.
- In addition, toxicity analyses, as well as chemical analyses, were performed at both sites.

1.2. Background

The proposed project area falls within the Pongola-Mtamvuna Water Management Area (WMA) as per the new configuration of six water management areas in South Africa identified in the third edition of the National Water Resources Strategy (NWRS). Figure 1 presents a map of the six water management areas, with the Pongola-Mtamvuna WMA marked in 3 (DWS, 2023).

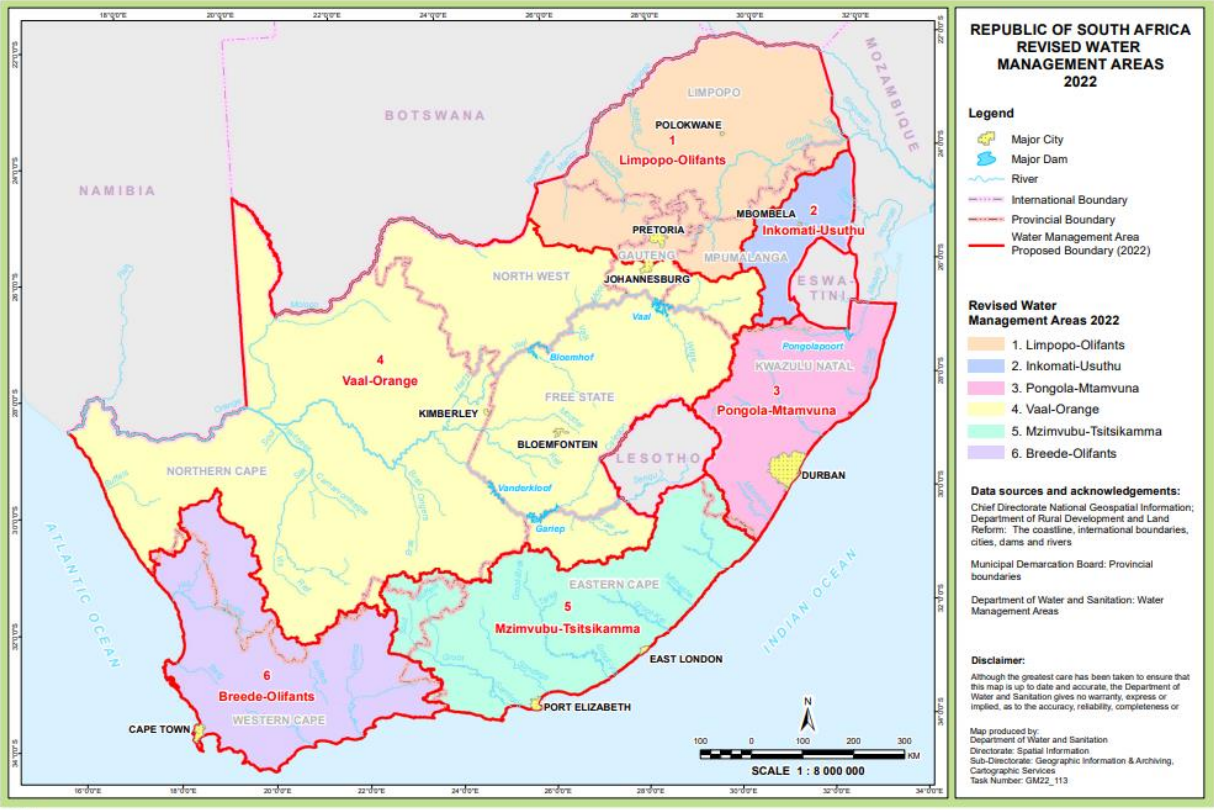

Figure 1: A Map of the six newly configured WMA in South Africa (DWS, 2023).

1.3. Key Legislative Requirements

Water resources in South Africa are protected from degradation by the following legislations:

1.3.1. Constitution of the Republic of South Africa (Act No 108 of 1996)

Section 24:

Everyone has the right -

(a) to an environment that is not harmful to their health or wellbeing; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development

Section 27:

Everyone has the right to have access to –

1(b) sufficient food and water.

1.3.2. National Water Act (Act No 36 of 1998)

The National Water Act (NWA) gives effect to right identified in the Constitution and its intended purpose is to ensure that water resources in the country are protected, used, developed, conserved, managed, and controlled in a sustainable manner.

Chapter 3: Protection of water resources

- Part 2 makes provision for the determination of class of water resources and resource quality objectives.

Chapter 14: Monitoring, Assessment and Information

- Part 1 makes provision for establishing National Monitoring Systems
- Part 2 makes provisions for development of national information systems on water resources.

1.3.3. National Environmental Management Act (Act No 107 of 1998)

The National Environmental Management Act (NEMA) also gives effect to rights identified in Section 24 of the Constitution and its intended purposes include providing a co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment.

Chapter 5: Integrated Environmental Management

Chapter 7: Compliance, Enforcement and Protection

1.3.4. National Environmental Management – Waste Act (Act No 59 of 2008)

The National Environmental Management – Waste Act (NEMWA) aim to reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

2. METHODS OF ASSESSMENT

2.1. Desktop Study

A desktop study was conducted, based on a comprehensive review of the existing literature, to assess the ecological status of the Tugela.

2.2. Site selection

Sampling for the purpose of this survey was conducted at two sites located on the Tugela, both upstream and downstream of the proposed project area. The sites were selected to reflect the status of the river upstream and downstream of the proposed activity area. Table 1 present a list of the sampling sites with their GPS co-ordinates and monitoring indices assessed at the two sites. Figure 2 shows a map of the proposed project area, indicating its location in relation to the Tugela River. Pictures 1 and 2 provide a visual representation of the sites sampled during the survey.

Table 1: Sampled sites in the vicinity of the proposed project area on the Tugela River: US-S1 (upstream) and DS-S1 (downstream).

Site	River	GPS Coordinates	Monitoring Indices
US-S1	Tugela	-28.661271, 29.965886	*In situ* Water Quality SASS5 IHAS MIRAI
DS-S1		-28.705278, 30.059722	

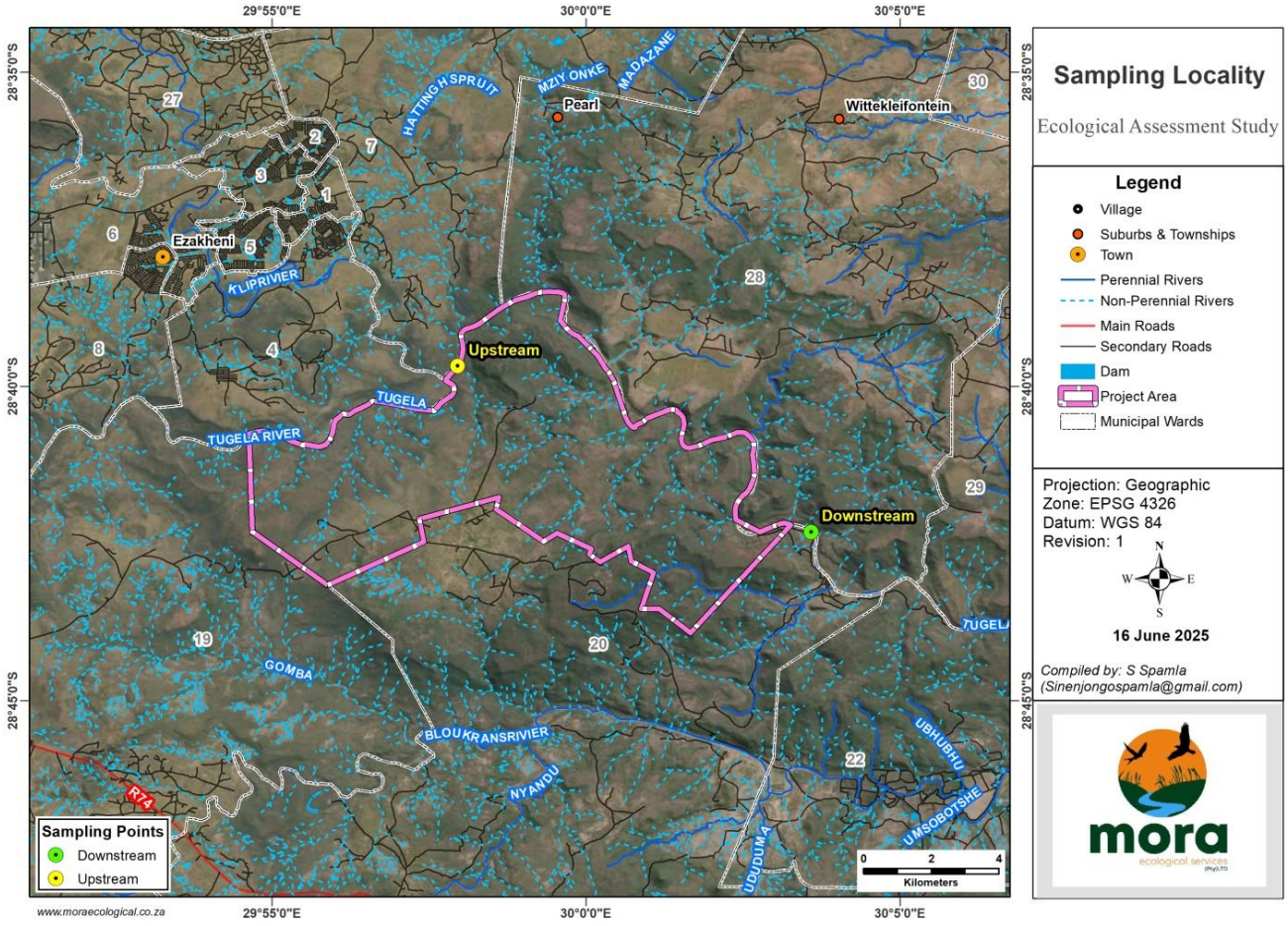

Figure 2: Locality map of the proposed project area.

Picture 1: Site US-S1 upstream and downstream views during the survey.

Picture 2: Site DS-S1 upstream and downstream views during the survey.

2.3. In situ water quality parameters

During the survey of the Tugela, a Hanna Multiparameter Meter was used to measure the following *in-situ* water quality parameters at the two selected sites:

- pH
- Electrical Conductivity (EC) (µS/Cm)
- Temperature (°C)
- DO (Mg/L)

The measured variables were compared to the TWQR for aquatic ecosystem to determine their compliance with the set limit (DWAF, 1996). In addition to being compared against Target Water Quality Range (TWQR), the measured *in-situ* water quality parameters were used in the interpretation of macro-invertebrates samples as water quality is a system driver that aquatic biota relies on. Table 2 present the TWQR for aquatic ecosystems that were used for comparison in the current study (DWAF, 1996). In addition, comprehensive chemical analyses were conducted at both sites, with the results presented in Appendix 1.

Table 2: TWQR for aquatic ecosystems (DWAF, 1996).

WQ Parameter	TWQR
pH	6.5 – 8.5
Electrical conductivity	0 – 300 µS/Cm
DO (% saturation)	80 – 120 (40% lethal threshold)
DO (Mg/L)	> 5 Mg/L

2.4. Habitat assessment

The SASS5 method requires that a habitat suitability assessment be conducted on site to determine the availability of suitable habitat for aquatic macro-invertebrates. The datasheets make provision to provide ratings for biotopes (Dickens & Graham, 2002). The ratings range

from 1 to 5 where 1 is very poor with limited diversity and 5 is highly suitable with a variety of habitats that can be utilized by aquatic macro-invertebrates. Furthermore, a rating of 0 can be used where the specific biotope is completely absent. The habitat suitability score is presented as percentages, which are used to classify the biotope suitability in line with the Integrated Habitat Assessment System (IHAS) (McMillan, 1998). Table 3 presents the description of the IHAS scores in percentages.

Table 3: Description of IHAS Scores and their corresponding description of overall condition.

IHAS Score (%)	Description
> 75	Excellent
65-74	Good
55-64	Adequate/Fair
< 55	Poor

2.5. Aquatic Macro-invertebrates

Aquatic macro-invertebrate communities are good indicators of localized conditions of a river because they remain in the same area throughout most of their aquatic stages of their life cycles with limited migration patterns. They are, therefore, useful in determining site-specific impacts (Barbour *et al.* 1999). Macro-invertebrates communities consist of species that constitute a wide range of trophic levels and tolerances to environmental disturbances. Monitoring aquatic macro-invertebrates has formed the backbone of the River Health Programme (RHP) in South Africa since its inception in 1994 (Murray, 1999).

For the purpose of this study, aquatic macro-invertebrates samples were collected using the standardized SASS5 method. The method provides a comprehensive assessment of the presence, diversity and abundance of macro-invertebrates' families at a site (Dickens & Graham, 2002). SASS5 results are presented as SASS score, number of taxa and Average Score Per Taxon (ASPT). Aquatic macro-invertebrates' families are allocated quality values (QV) between 1 and 15 based on their perceived sensitivity to water quality changes (Murray, 1999). The family's sensitivity is classified as having low sensitivity (QV of 1 – 5), moderate sensitivity (QV of 6 – 10) and very high sensitivity (QV of 11 – 15) to water quality changes and pollution (Gerber & Gabriel, 2002). The SASS score is calculated by adding the QVs of all families recorded on site at the time of sampling. The ASPT score is calculated by dividing the SASS score with the number of families recorded. ASPT scores are used to determine the river health class. ASPT scores of more than 7 are considered natural, scores between 6 and 6.99 are good, scores between 5 and 5.99 are fair while scores below 5 are poor (RHP, 2006). Table 4 provides a description of the river health classes as determine by the ASPT scores.

Table 4: Description of river health classes determined by the ASPT scores (RHP, 2006).

ASPT Score	River Health Classes	Description
> 7	Natural	There are negligible modifications to the river resulting from human activities.
6 – 6.99	Good	There are modifications resulting from human activities but the biodiversity and ecological integrity is still unaffected.
5 – 5.99	Fair	There are major modifications resulting from human activities. There are losses in biodiversity with the remaining species being tolerant and opportunistic species.
< 5	Poor	There are extreme modifications to the biodiversity and ecological integrity of the river. There is great loss of species and high invasion by alien species.

Three biotopes were sampled at each site following the sampling method outlined by SASS5 (Dickens & Graham, 2002). The SASS5 method identifies and groups three biotopes inhabited by macro-invertebrates. The biotopes are stones (comprising of stones in and out of current and bedrock); vegetation (comprising of both instream and marginal vegetation in and out of current) and GSM (comprising of gravel, sand and mud). All the macro-invertebrates' samples were collected using a kick-net of 30cm x 30cm and 1mm mesh size. The following time and length limitations were adhered to, as they are required by the SASS5 method to ensure standardization:

- Stones (and bedrock)-in-current was sampled for 2 minutes.
- Stones (and bedrock)-out-of-current was sampled for 1 minute.
- Marginal vegetation (both in- and out-of-current) was swept with a net for 2 meters.
- Aquatic vegetation was swept with a net for an area of 1 m^2.
- Gravel, sand and mud was stirred and swept with a net for 1 minute.

The collected samples were placed in three trays for each biotope grouping (i.e. stones, vegetation and GSM). A total of 15 minutes was allocated for identification per tray. Macro-invertebrate field guides were used to ensure correct identification of the macro-invertebrate families sampled (Gerber & Gabriel, 2002). The abundance of identified families was rated as 1 if only 1 specimen was found, A if between 2 and 10 specimens were found, B if between 10 and 100 were found, C if between 100 and 1000, and D if more than 1000, as outlined on the SASS5 datasheet (Dickens & Graham, 2002).

2.6. Present Ecological State

The PES of was determined using macro-invertebrates as biological indicators and MIRAI which is an Ecostatus Model, for analyses (Thirion, 2007). The PES is expressed in terms of various abiotic and biotic factors which are integrated to provide the Ecostatus of the rivers.

The biotic factors (i.e., macro-invertebrates) provide an indication of biological responses to changes in the abiotic factors (i.e., physico-chemical, geomorphology and hydrology), which serve as system drivers. MIRAI is a rule-based model developed by the Department of Water and Sanitation (DWS) and it integrates the environmental requirements of aquatic macro-invertebrates in a community or assemblage to their response to modified habitat conditions, water quality and changes in flow (Thirion, 2007). MIRAI ratings consider both the abundance and frequency of occurrence of macro-invertebrates within a sub-quaternary reach. Table 5 provides a description of the main PES categories for Ecostatus Indices (i.e. A – F) (Kleynhans, 2008). Other indices that use the same PES category include Fish Response Assessment Index (FRAI), Riparian Vegetation Assessment Index (VEGRAI) and Geomorphological Assessment Index (GAI) (Kleynhans & Louw, 2007).

The Ecostatus Indices assess the ecological categories of rivers relative to the anthropogenic activities occurring within a river reach and the resulting deviation or percentage change from predetermined reference conditions (Kleynhans & Louw, 2007).

Table 5: Descriptions of the Ecological Categories for Ecostatus components.

ECOLOGICAL CATEGORY	DESCRIPTION	PERCENTAGE CHANGE (%)
A	The river is in a natural and undisturbed condition.	90 – 100
B	The river is largely natural with few modifications resulting from human activities. There is relatively small change in the natural habitats and biota, but the ecosystem functions remain unaffected.	80 – 89
C	The river is moderately modified with relatively more modifications resulting from human activities. There is loss and change in natural habitat and biota, but the ecosystem services are largely unchanged.	60 – 79
D	The river is largely modified with more modifications resulting from human activities. There are large losses in natural habitat, biota, and ecosystem functions.	40 – 59
E	The river is in a seriously modified condition with extensive losses in natural habitat, biota, and ecosystem functions.	20 – 39
F	The river is in a critically or extremely modified state and ecosystem functions are completely lost. The natural habitat and biota are almost completely lost.	0 – 19

Based on the available information, the Present Ecological Status (PES) is Category C, compared to the 2003 PES rating of B/C for the reach sampled in this survey (DWS, 2021).

2.7. Toxicity analyses and hazard classification

Toxicity Testing in the form of Whole Effluent Test (WET), also referred to as Direct Estimation of Ecological Effect Potential (DEEEP), is used to measure prevailing hazards associated with water. The water can either be in a resource or wastewater being discharged into the resource (DWAF, 2003). WET uses different trophic levels to determine hazard classes of the tested water. The trophic levels include micro-algae, bacteria, vertebrates and macro-invertebrates and they are represented by *Selenatrum capricornutum*, *Aliivibrio fischeri, Poecilia reticulata* and *Daphnia magna*, respectively (DWAF, 2003). The tested water is classified as either lethal (acute) or sub lethal (chronic) based on the potential risk of such water to biological indicators at different trophic levels. Table 6 provides a summary of the test conditions required for the assessment of each of the three selected trophic levels.

Table 6: Summary of test conditions for *A. fischeri*, *D. magna* and *P. reticulate.*

	Aliivibrio fischeri	***Daphnia magna***	***Poecilia reticulata***
Test endpoint	% light emission inhibition relative to control	% mortality	% mortality
Exposure Period	15- and 30- minutes	24- and 48- hours	96- hours
Test chamber type	Polystyrene cuvettes for luminometer	Polystyrene test plates	250 ml polystyrene cups
Test sample volume	500 µl	25 ml	200 ml
Number of replicates per sample	2	4	2
Number of tests organisms per chamber	NA	5	6
Test Temperature	14.6 °C	22.0 °C	22.3 – 22.6°C
Test organism species name and source	Lyophilized *Aliivibrio fischeri* luminescent bacteria (NRRL B-11177)	*Daphnia magna* – ephippia (MicroBiotests, <24h old)	*Poecilia reticulata* (7 – 21 days old)

For the purpose of this survey, toxicity screening and hazard classification was conducted at the upstream and downstream sites of the proposed project area. Samples were collected using sterilized 1L polyethylene bottles and were analyzed by BioToxLab, a SANAS Accredited Laboratory, for three trophic levels. The trophic levels analyzed were represented by bacteria (i.e. *Aliivibrio fischeri*), macro-invertebrates (i.e., *Daphnia magna*) and vertebrates (i.e., *Poecilia reticulata*).

Prior to testing, chemical and physical properties of submitted water quality samples were assessed, and these included measuring pH, EC, and DO in mg/L. The assessment was conducted at 25°C. Risk category is determined based on the percentage of mortalities and inhibition (or stimulation) of exposed test organisms. The risk and hazards classification for the screening tests were done according to standards described by the Department of Water Affairs and Forestry (DWAF, 2003). Table 7 provides a description of the categories used in the hazard classification system for toxicity tests as well as hazard ratings and percentage effects (PE) of toxicity.

Table 7: Hazard Classification system for toxicity tests (DWAF, 2003).

Class	Hazard rating	PE	Description
Class I	No lethal/ sub-lethal hazard	≤10/20%	No acute/chronic environmental hazard-none of the test shows a toxic effect
Class II	Slight lethal/ sub-lethal hazard	10/20%≤ PE<50%	Slight acute/chronic environmental hazard-a statistically significant percentage effect is reached in at least one test, but the effect level is below 50%
Class III	Lethal/ sub-lethal hazard	50% ≤PE<100%	Acute/chronic environmental hazard- a percentage effect level is reached or exceeded in at least one test, but the effect level is below 100%
Class IV	High lethal/sub-lethal hazard	PE 100% in at least one test	High acute/chronic environmental hazard-the percentage effect level is reached in at least on test.
Class V	Very high lethal/ sub-lethal hazard	PE 100% in all tests	Very high acute/chronic environmental hazard-the 100% percentage effect is reached in all tests.

3. RESULTS AND DISCUSSION

3.1.1. *In Situ* Water Quality

Table 8 shows the water quality variables measured on site at the time of the survey. The results show that the pH at both sites was within the TWQR for aquatic ecosystems. Temperatures of inland waters in South Africa generally range between 5 - 30 ˚C (DWAF, 1996). At all sites, the temperature was measured within the water quality guidelines for aquatic ecosystems. Electrical conductivity values were within the TWQR for aquatic ecosystems at both sites. The DO values were within the TWQR at both sites during the time of sampling.

Table 8: *In-situ* water quality results for the two monitoring sites on the Tugela River, located upstream and downstream of the project area, respectively.

Parameter	US-S1	DS-S1	TWQR
pH	8.45	8.0	5.5 – 9.5
Temperature (°C)	15.96	14.0	-
EC (µS/cm)	96	120	0 – 300 µS/cm
DO (Mg/L)	5.10	5.76	>5 Mg/L

3.1.2. Integrated Habitat Assessment System

The total IHAS values determined for the upstream site are 68 and 74 for the downstream site. The macroinvertebrate habitat suitability can be considered borderline adequate/fair at the time of assessment at the upstream site and good at the downstream site, as indicated in Table 9. However, it is important to emphasise that the upstream site had lower habitat compared to the downstream site mainly due to the low vegetation (VEG) biotope.

Table 9: IHAS habitat scores recorded at the sampled sites on the Tugela River, located upstream and downstream of the proposed project area, respectively.

Biotope	Site	
	US-S1	DS-S1
Stones In Current (SIC)	15	16
Vegetation (VEG)	8	11
Other Habitats	12	13
Sampling habitat totals (max 55)	36	40
Stream condition total (max 45)	33	34
Total IHAS score (%)	**68**	**74**
Category	**Fair/Adequate**	**Good**

3.1.3. Aquatic macro-invertebrates

The macroinvertebrate taxa sampled at both sites during the survey are listed in Table 10. In general, the number of taxa was higher at the downstream site compared to the upstream site, with 18 and 23 taxa recorded at US-S1 and DS-S1, respectively). The sites were dominated by a high abundance of families with high tolerance to pollution and environmental degradation (e.g., Oligochaeta, Chironomidae and Coenagrionidae). Taxa (14) with a low requirement for unmodified water quality, taxa (6) with a very low requirement for unmodified water quality, taxa (5) with a moderate requirement for unmodified water quality, and one taxon (1) with a high requirement for unmodified water quality were sampled during the survey.

Table 10: Aquatic macroinvertebrate taxa sampled at sites US-S1 and DS-S1, located on the Tugela River upstream and downstream of the proposed project area, respectively.

Taxon	US-S1				DS-S1			
	Stones	Veg	GSM	Total	Stones	Veg	GSM	Total
TURBELLARIA	-	-	-	-	-	-	A	A
Oligochaeta	A	-	A	A	A	-	A	A
Leeches	-	-	-	-	A	A	-	A
Atyidae	-	-	-	-	-	A	-	A
Baetidae	A	A	A	B	A	A	A	B
Caenidae	A	-	-	A	A	-	-	A
Heptageniidae	-	-	-	-	-	A	-	A
Leptophlebiidae	-	-	A	A	A	-	A	A
Coenagrionidae	-	A	-	A	-	A	-	A
Libelludae	-	-	-	-	-	A	A	A
Belostomatidae*	-	-	-	-	-	A	-	A
Corixidae*	A	A	-	A	A	A	-	A
Naucoridae*	-	A	-	A	-	A	-	A
Hydropsychidae	A	-	-	A	A	-	A	A
Philopotamidae	-	-	-	-	-	-	A	A
Leptoceridae	-	-	-	-	-	A	-	A
Dytiscidae (adults*)	A	-	-	A	A	-	-	A
Elmidae / Dryopidae*	-	A	-	A	-	-	-	-
Gyrinidae (adults*)	A	-	-	A	A	-	-	A
Psephenidae	A	-	-	A	A	-	-	A
Ceratopogonidae	-	A	-	A	A	A	-	A
Chironomidae	A	A	-	A	A	A	-	A
Simuliidae	A	A	A	A	A	A	-	A
Tabanidae	-	-	A	A	-	-	-	-
Ancylidae	-	-	A	A	-	-	-	-
Corbiculidae	-	A	-	A	-	A	A	A
Total SASS5 score	47	43	30	96	64	74	42	127
No. of families	10	9	6	18	13	14	8	23
ASPT	4.70	4.78	5.00	5.33	4.92	5.29	5.25	5.52
Total IHAS				**68**				**74**
IHAS - Habs sampled				**35**				**40**
IHAS - Stream condition				**33**				**34**
Suitability score	**6**	**3**	**3**	**12**	**8**	**6**	**6**	**20**

Key: A = 1-10 individuals; B = 11-100 individuals; C = 101-1000 individuals; ASPT = Average score per taxon. Veg=Vegetation.

- High requirement for unmodified water quality
- Moderate requirement for unmodified water quality
- Low requirement for unmodified water quality
- Very low requirement for unmodified water quality

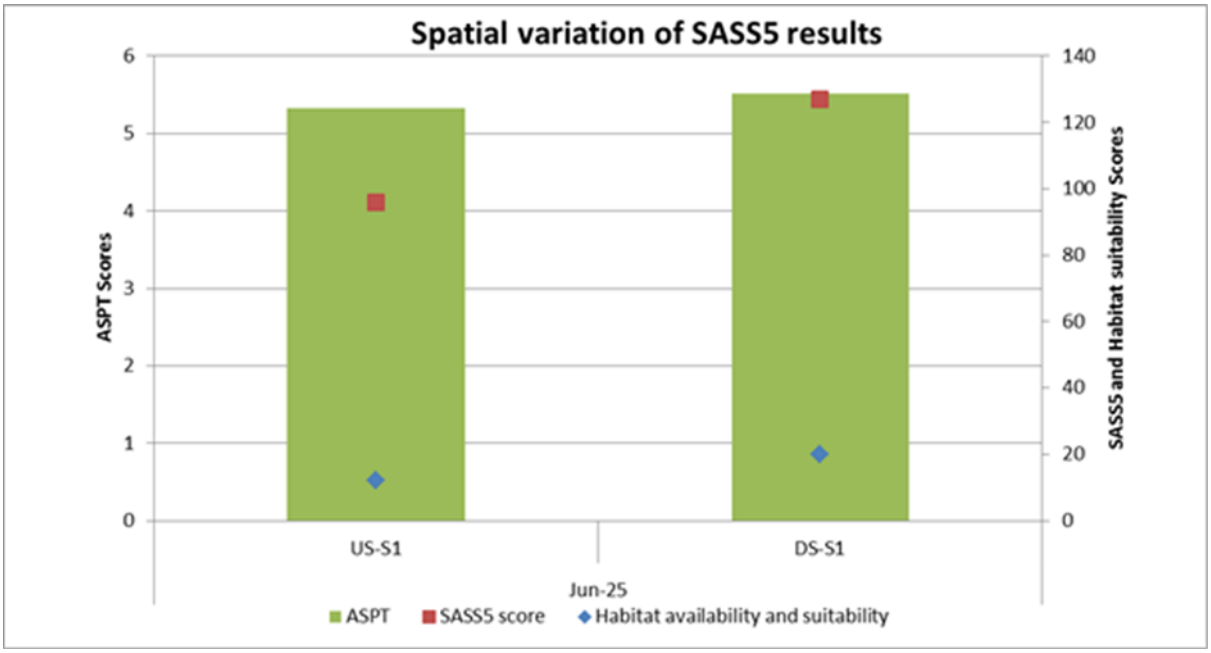

Figure 3: Spatial comparison between sites US-S1 and DS-S1 on the Tugela River, located upstream and downstream of the proposed project area, respectively.

The SASS5 score increased on a spatial scale from the upstream site to the downstream site during the survey. Similarly, the ASPT score increased from the upstream to the downstream site (Figure 3 and Table 11). This indicates that biotic integrity was slightly improved on spatial scale at the time of sampling. Comparison of SASS5 vegetation scores confirmed this spatial increase (Figure 3 and Table 11), supporting that the slight increase in biotic integrity. This spatial trend emphasises the need to consider both habitat and water quality factors when assessing river health.

Table 11: SASS5, ASPT, and Biotope Availability and Suitability Index scores for the sampled sites US-S1 and DS-S1 on the Tugela River, located upstream and downstream of the proposed project area, respectively.

Sites	SASS5 score	ASPT	SASS5-score per biotope			Biotope availability and suitability (Scores)			
			SASS $_{Stones}$	SASS $_{Vegetation}$	SASS$_{GSM}$	Stones	Vegetation	GSM	Combined
US-S1	96	5	47.0	43.0	30.0	6.0	3.0	3.0	12.0
DS-S1	127	6	64.0	74.0	42.0	8.0	6.0	6.0	20.0

3.1.4. Present Ecological State

The PES of the Tugela was determined in SQR V14E-03233, with the two sites (i.e., US-S1 and DS-S1). Analysis of the macroinvertebrate data obtained from the two sampled sites using MIRAI v2 shows that SQR V14E-03233 falls into an ecological category C with a MIRAI score of 63.4% (Table 12). This indicates that the reach is in a moderately modified ecological condition in response to anthropogenic activities occurring in the reach. It also indicates that a loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

Table 12: Macro-Invertebrate Assessment Index (MIRAI) for the Tugela reach.

INVERTEBRATE EC METRIC GROUP		METRIC GROUP CALCULATED SCORE	CALCULATED WEIGHT	WEIGHTED SCORE OF GROUP	RANK OF METRIC GROUP	%WEIGHT FOR METRIC GROUP
FLOW MODIFICATION	**FM**	70.6	0.32	22.689	2	90
HABITAT	**H**	60.0	0.32	19.285	2	90
WATER QUALITY	**WQ**	60.0	0.36	21.428	1	100
CONNECTIVITY & SEASONALITY	**CS**	100	0	0	4	0
INVERTEBRATE EC				63.4034		280
INVERTEBRATE EC CATEGORY				**C**		

>89=A; 80-89=B; 60-79=C; 40-59=D; 20-39=E; <20=F

3.1.5. Toxicity analyses and hazard classification

Tables 13 and 14 show the hazard classification for the two sampled sites, DS-S1 and US-S1, located downstream and upstream of the proposed project area, respectively. The pH levels of the samples were 8.03 (DS-S1) and 8.68 (US-S1) which are within the acceptable range (pH 6-9) in which pH can be excluded as a driving factor for toxicity (USEPA, 1996). The conductivities (ECs) of the samples were 13.0 mS/m (DS-S1) and 8.9 mS/m (US- S1). A dissolved oxygen (DO) concentration above 4 mg/L is required for aquatic organisms (USEPA, 1996) to survive. The DO levels for the 2 samples were 8.38 mg/L (DS-S1) and 7.12 mg/L (US-S1).

Table 13: Hazard classification for two sampled sites, DS-S1 and US-S1, located downstream and upstream of the proposed project area, respectively.

	Results	DS-S1	US-S1
Water quality	Test date yy/mm/dd	2025.06.13	2025.06.13
	pH @ 25°C (NA)	8,0	8,7
	EC (Electrical conductivity) (mS/m) @ 25°C (NA)	13,0	8,9
	Dissolved oxygen (mg/l) (NA)	8,4	7,1
A. fischeri (bacteria) (A)	Test started on yy/mm/dd	2025.06.20	2025.06.20
	%30min inhibition (-) / stimulation (+) (%)	**-12**	**-17**
	EC/LC20 (30 mins)	*	*
	EC/LC50 (30 mins)	*	*
	Toxicity unit (TU) / Description	no sub-lethal hazard	no sub-lethal hazard
D. magna (waterflea) (A)	Test started on yy/mm/dd	2025.06.17	2025.06.17
	%48hour mortality rate (-%)	**-5**	**0**
	EC/LC10 (48hours)	*	*
	EC/LC50 (48hours)	*	*
	Toxicity unit (TU) / Description	no lethal hazard	no lethal hazard
P. reticulata (guppy) (A)	Test started on yy/mm/dd	2025.06.19	2025.06.19
	%96hour mortality rate (-%)	**-8**	**0**
	EC/LC10 (96hours)	*	*
	EC/LC50 (96hours)	*	*
	Toxicity unit (TU) / Description	no lethal hazard	no lethal hazard
Overall classification - Hazard class* **		Class I - No lethal/sub-lethal hazard	Class I - No lethal/sub-lethal hazard
	Weight (%)	0	0

Key

* = EC/LC values not determined, definitive testing required if a hazard was observed and persists over subsequent sampling runs

*** = The overall hazard classification takes into account the full battery of tests and is not based on a single test result. Note that the overall hazard classification is expressed as both lethal (*Daphnia* & *Poecilia*) and sub-lethal (*Aliivibrio)* levels of toxicity

Weight (%) = relative toxicity levels (out of 100%), higher values indicate that more of the individual tests indicated toxicity within a specific class

site/sample name shaded in purple = screening test

The toxicity hazard observed was within Class I (No hazard) after inclusion of all potential impacts at the upstream and downstream sites of the project area, which indicates that there was no acute/chronic hazard (Table 14).

Table 14: Overall hazard classification the two sampled sites, DS-S1 and US-S1, located downstream and upstream of the proposed project area, respectively.

Site	Hazard classification			Percentage Effect
US-S1	I	☺	No lethal or sub-lethal environmental toxicity hazard	None of the tests show a toxic effect (i.e. an effect value that is significantly higher than that noted in the controls)
DS-S1				

4. IMPACTS AND MITIGATIONS

4.2.1 Increased sedimentation of watercourse

Description of Impact

The clearing of natural vegetation and the stripping of topsoil will result in the increased runoff of sediment from the site into watercourses associated with the proposed project area during high rainfall. The transport of eroded soil into surrounding surface water resources will increase the Total Suspended Solids, which may adversely affect the aquatic fauna in several ways. These include altering substrate composition and changing the suitability of the substrate for certain taxa, reducing the suitability of spawning habitats and hindering the development of eggs, larvae and juveniles, as well as modification of migration patterns. The movement of construction vehicles and personnel can also lead to erosion and the associated sedimentation of streams and rivers.

Mitigation Measures

- The construction camp/laydown area should be situated at a distance from the stream. All materials associated with the construction activities should be properly stored and contained. Waste disposal from the site should be effectively managed. Adequate ablution facilities should be provided for construction workers at the construction sites, which should be located at least 30m away from the river and regularly serviced. These measures need to be addressed, implemented, and monitored according to the Environmental Management Plan (EMP) for the construction phase.
- Strip and stockpile herbaceous vegetation, overlying grass and other fine organic matter along with the topsoil;
- Topsoil, leaf and plant litter as well as subsoil must be stockpiled separately in low heaps;
- Do not strip topsoil when it is wet;
- In the absence of a recognizable topsoil layer, strip the upper most 300mm of soil;
- Ensure that topsoil is at no time buried, mixed with spoil (excavated subsoil), rubble or building material, or subjected to compaction or contamination by vehicles,

machinery or contaminated surface water runoff. This will render the topsoil unsuitable for use during rehabilitation;

- If possible, re-position the topsoil stockpile upslope of any infrastructure within the surface infrastructure footprint so as to prevent contaminated surface water coming into contact with topsoil;
- Ensure that all topsoil is stored in such a way and in such a place that it will not cause the damming up of water, erosion gullies, or wash away itself;
- Topsoil is to be handled twice only – once to strip and stockpile, and once to replace and level;
- Do not stockpile topsoil in heaps exceeding 3m in height;
- Protect topsoil stockpiles from erosion;
- Remove exotic / invasive plants and weeds that emerge on topsoil stockpiles;
- The re-vegetate the stockpiles with indigenous legumes and/or grasses that are indigenous to the area;
- Develop soil management measures for the entire surface area of the proposed project area that will prevent runoff of sediment into the associated watercourses; and
- Any additional topsoil stockpile areas required by the contractor must be approved by the Environmental Control Officer in the form of an amended EMPr indicating the position and extent of thereof.
- Limit clearing of vegetation and associated soil disturbances to essential areas only; All non-essential activities must remain outside the 1:100 year floodline of the Tugela and associated riparian habitat;
- Implementing measures like vegetation cover, sediment traps, and erosion control blankets can minimize soil erosion and prevent sediment from entering associated watercourses.
- Implement measures such as vegetation cover and sediment traps to minimise soil erosion and prevent sediment from entering watercourses.

4.2.2 Water contamination

Description of Impact

Mining can release harmful substances into the water, including heavy metals, acids, and other pollutants, leading to toxicity and ecosystem disruption. The results will be a probable

degradation of the Present Ecological State of the section of the Tugela associated with the proposed project.

Mitigation Measures

- A biomonitoring programme should be implemented to monitor possible impacts on the aquatic biota within the river, for a period as agreed upon with the Department of Water and Sanitation.

4.2.3 Habitat Loss and fragmentation

Description of Impact

The clearing of land for mining infrastructure, the diversion of watercourses and the dumping of waste often lead to the physical destruction or fragmentation of habitats. This not only reduces the availability of habitats for aquatic organisms, but also disrupts the ecological connectivity that is essential for the movement and survival of species.

Mitigation Measures

- It is recommended that sensitive aquatic ecosystems be protected through the use of buffer zones and that rehabilitation plans be implemented to restore riparian habitats. It also is recommended that no development be permitted within the 1:100-year floodline, within riparian vegetation (whichever is the greater), or within 500 metres of a wetland without obtaining the necessary authorisation from the relevant authority.

Table 15: Significance ratings of impacts

Impact Category	Intensity	Duration	Probability	Significance (Pre-Mitigation)	Significance (post-mitigation)
Alteration of Flow & Sediment Dynamics	High	Medium	Definite	**High**	**Medium-Low** (with rotation, return control)
Habitat Disturbance	High	Long	High	**High**	**Medium** (with phased disturbance & rehab)
Turbidity & Water Quality Degradation	Medium	Medium	High	**Moderate**	**Low** (with containment, silt curtains)

Loss of Aquatic Fauna and Flora	Medium	Medium	Probable	**Moderate**	**Low** (with ecological timing & monitoring)
Wetland/Riparian Habitat Destruction	High	Long	High	**High**	**Medium** (with buffer enforcement, rehab)
Downstream Cumulative Effects	Medium	Long	Probable	**Moderate-High**	**Moderate** (with catchment coordination)

5. CONCLUSIONS AND RECOMMENDATIONS

Water quality at upstream and downstream sites generally met the TWQR for aquatic ecosystems. Temperature, pH, electrical conductivity, and dissolved oxygen (DO) values were all within the TWQR during the time of sampling.

The macroinvertebrate habitat suitability can be considered borderline adequate/fair at the time of assessment at the upstream site and good at the downstream site. In general, the number of taxa was higher at the downstream site when compared to the upstream site. The sites were dominated by a high abundance of families with high tolerance to pollution and environmental degradation (e.g. Oligochaeta, Chironomidae and Coenagrionidae). Taxa (14) with very low requirement for unmodified water quality and taxa (5) with a very low requirement for unmodified water quality and taxa (5) with moderate requirement for unmodified water quality were sampled during the survey. One taxon (1) with high requirement for unmodified water quality was sampled at the downstream site (DS-S1).

The SASS5 score increased on a spatial scale from the upstream site to the downstream site during the survey. Similarly, the ASPT score increased from the upstream to the downstream site. This indicates that biotic integrity was slightly improved on spatial scale at the time of sampling. Analysis of the macroinvertebrate data obtained from the two sampled sites using MIRAI v2 shows that SQR V14E-03233 falls into an ecological category C with a MIRAI score of 63.4%. This indicates that the reach is in a moderately modified ecological condition in response to anthropogenic activities occurring in the reach. It also indicates that a loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

The toxicity hazard observed was within Class I (No hazard) after inclusion of all potential impacts at the upstream and downstream sites of the project area, which indicates that there was no acute/chronic hazard.

It is therefore recommended that no mining activities take place within 500m buffer of the Tugela River. Furthermore, upon the issuance of Environmental Authorizations, efforts be made to improve the present ecological state and prevent further degradation. Continuous monitoring of the Tugela River, as the receiving environment, is essential to identify any positive or negative impacts on aquatic biota and water quality. Furthermore, appropriate mitigation measures should be implemented to ensure that activities related to the proposed project do not cause the river's ecological condition to decline below the Present Ecological State (PES).

The proposed mining development can be supported, provided that all recommended mitigation measures are effectively implemented to prevent pollution or environmental degradation. Furthermore, the applicant must demonstrate a clear commitment to complying with all legal requirements, including reporting any pollution to the relevant authorities and taking reasonable steps to prevent its occurrence, continuation, or recurrence.

Monitoring Programme

The purpose of an aquatic monitoring program is to directly measure, assess, and report on the health status and trends of the aquatic ecosystem associated with the proposed project. A further purpose of a monitoring program will be to assess the compliance with the Resource Quality Objectives of the water resources of the catchment. It should be noted that the approach suggested below is regarded as tentative, and a more definitive monitoring plan should be developed by a suitably qualified aquatic specialist following the approval of the various government departments, most notably the Department of Water and Sanitation.

Monitoring Approach

To enable an adequate description of the aquatic environment and monitor the Present Ecological State and potential impacts of the proposed project on the aquatic biota of the Tugela, the monitoring of several stressors, habitat and response indicators are recommended. However, the final selection of which indices to apply will be strongly dependant on habitat suitability at the chosen monitoring localities. These include:

- Stressor indicators:
  - Water quality assessment, including the measurement of *in-situ* water quality parameters (pH, electrical conductivity, temperature and dissolved oxygen), the evaluation of existing water quality results (conducted by means of an independent SANAS-accredited laboratory) and the identification of variables of potential concern to the aquatic environment;
- Habitat indicators:
  - Invertebrate Habitat Assessment System (IHAS);
- Response indicators:
  - Macroinvertebrate assessment - the determination of Present Ecological State is to be done utilizing the South African Scoring System Version 5 (SASS5) and the Macro-Invertebrate Response Assessment Index (MIRAI).

- Fish assessment - the determination of Present Ecological State is to be done utilizing the Fish Response Assessment Index (FRAI).

Timing and Frequency of Monitoring

It is recommended that a detailed aquatic monitoring programme be developed and initiated prior to the commencement of any activities related to proposed project subject to the approval and conditions of the Water Use Licence. In addition, it is recommended that biomonitoring must be done once during the summer season and once during the winter season,

6. REFERENCES

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b) Department of Water Affairs and Forestry (1996) South African Water Quality Guidelines Volume 7: Aquatic Ecosystems, First Edition. Department of Water Affairs and Forestry, Pretoria.

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e) Department of Water and Sanitation (2023) National Water Resource Strategy Third Edition (NWRS-3). Department of Water and Sanitation, Pretoria.

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g) Gerber, A. & Gabriel, M.J.M. (2002) Aquatic Invertebrates of South African Rivers: Field Guide 1st Edition. Institute of Water Quality Studies. Department of Water Affairs and Forestry, Pretoria.

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i) Kleynhans, C.J. (2008) Module D: Fish Response Assessment Index in River EcoClassification: Manual for Ecostatus Determination. WRC Report No TT332/08. Water Research Commission, Pretoria.

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l) River Health Programme (2006) State of Rivers Report: The Mokolo River System. Department of Environmental Affairs and Tourism, Pretoria.
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n) United States Environmental Protection Agency (USEPA), 1996. Ecological effects test guidelines. Fish acute toxicity test, Freshwater and marine. OPPTS 850.1075.

7. Appendix A

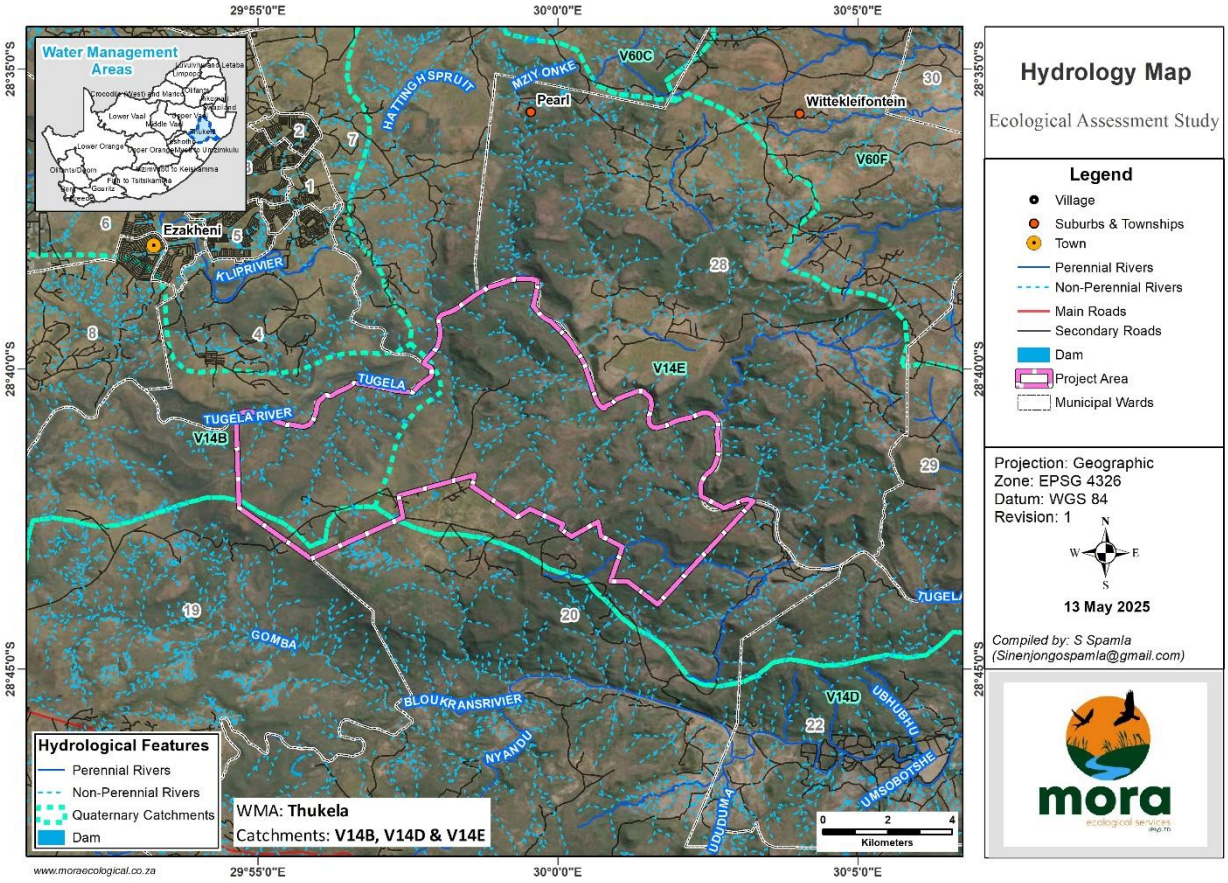
Water Quality Results

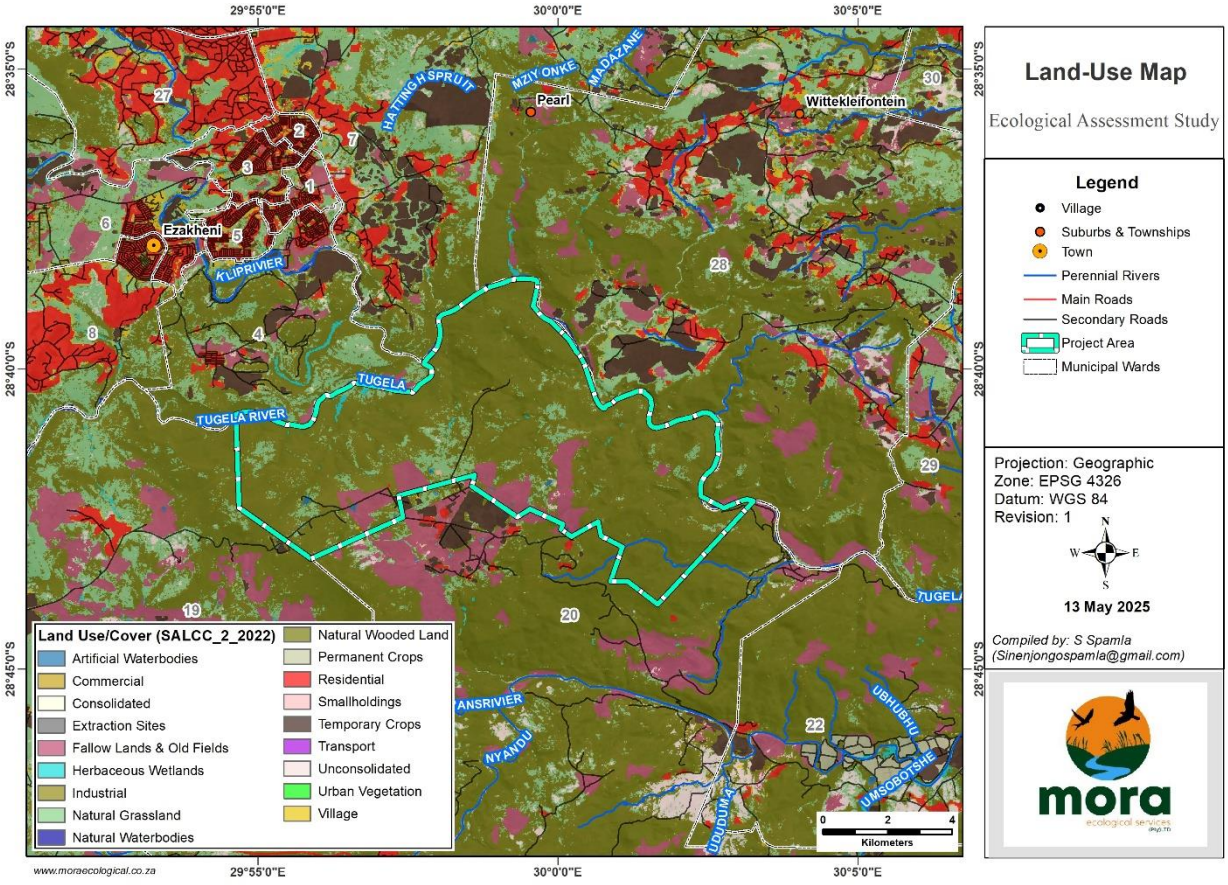
Appendix 1: Chemical analyses of the two sites samples.

Analyses	Unit	US-S1	DS-S1
pH @ 25°C	pH	8.55	8.05
Electrical conductivity (EC) @ 25°C	mS/m	10.3	12.3
Total dissolved solids (TDS)	mg/l	74	86
Total Alkalinity	mg $CaCO_3$/l	46.4	55.4
Chloride (Cl)	mg/l	2.64	3.68
Sulphate (SO_4)	mg/l	1.64	4.06
Nitrate (NO_3) as N	mg/l	0.418	0.424
Nitrite (NO_2) as N	mg/l	<0.065	<0.065
Orthophosphate (PO_4) as P	mg/l	<0.009	<0.009
Fluoride (F)	mg/l	<0.263	<0.263
Calcium (Ca)	mg/l	8.57	11.3
Magnesium (Mg)	mg/l	4.38	5.14
Sodium (Na)	mg/l	6.41	8.14
Potassium (K)	mg/l	1.43	1.42
Aluminium (Al)	mg/l	0.033	0.029
Iron (Fe)	mg/l	<0.004	0.006
Manganese (Mn)	mg/l	0.001	<0.001
E.coli	CFU/100ml	15	160
Total coliform	CFU/100ml	61	3300
Total hardness	mg $CaCO_3$/l	39	49
Calcium hardness	mg $CaCO_3$/l	21	28
Magnesium hardness	mg $CaCO_3$/l	18	21
Silicon (Si)	mg/l	6.76	6.29
Bicarbonate alkalinity	mg $CaCO_3$/l	44.8	54.8

8. Appendix B

Project Maps




Land-Use Map
Ecological Assessment Study
Legend
Village
Suburbs & Townships
Town
Perennial Rivers
Main Roads
Secondary Roads
Project Area
Municipal Wards
Projection: Geographic
Zone: EPSG 4326
Datum: WGS 84
Revision: 1
13 May 2025
Compiled by: S Spamla
(Sinenjongospamla@gmail.com)
Land Use/Cover (SALCC_2_2022)
Artificial Waterbodies
Commercial
Consolidated
Extraction Sites
Fallow Lands & Old Fields
Herbaceous Wetlands
Industrial
Natural Grassland
Natural Waterbodies
Natural Wooded Land
Permanent Crops
Residential
Smallholdings
Temporary Crops
Transport
Unconsolidated
Urban Vegetation
Village
Ezakheni
Pearl
Wittekleifontein
TUGELA
TUGELA RIVER
KLIPRIVIER
HATTINGH SPRUIT
MZIY ONKE
MADAZANE
NYANDU
UBHUBHU
UMSOBOTSHE
UDUDUMA
Kilometers
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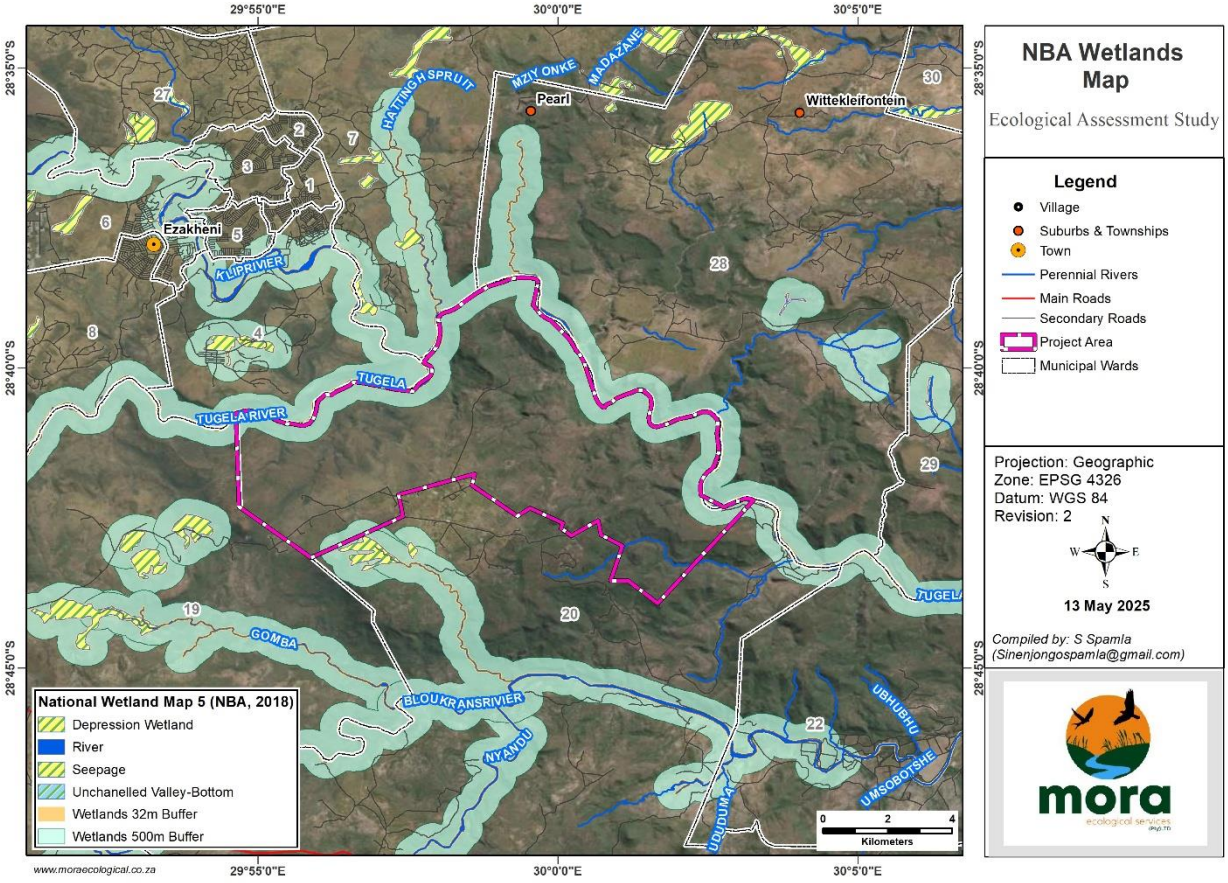
NBA Wetlands Map
Ecological Assessment Study
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Perennial Rivers
Main Roads
Secondary Roads
Project Area
Municipal Wards
Projection: Geographic
Zone: EPSG 4326
Datum: WGS 84
Revision: 2
13 May 2025
Compiled by: S Spamla
(Sinenjongospamla@gmail.com)
National Wetland Map 5 (NBA, 2018)
Depression Wetland
River
Seepage
Unchanelled Valley-Bottom
Wetlands 32m Buffer
Wetlands 500m Buffer
Ezakheni
Pearl
Wittekleifontein
TUGELA
TUGELA RIVER
KLIPRIVIER
HATTINGH SPRUIT
MZIY ONKE
MADAZANE
GOMBA
BLOUKRANSRIVIER
NYANDU
UBHUBHU
UMSOBOTSHE
UDUDUMA
Kilometers
www.moraecological.co.za

9. Appendix C

Specialist CV

BALOYI BRYTON MUSA

EXPERIENCE

ECOLOGIST, 2021-current
Mora Ecological Services (Pty) Ltd - Pretoria, South Africa

- Supervision of Alien Invasive Eradication Team
- Maintenance of Hand Tools
- Wetland assessment and delineation
- Assessment of ecological importance and sensitivity
- Integrated habitat assessment (IHA)
- Riparian vegetation response assessment index (VEGRAI)
- Aquatic bio-monitoring and SASS5
- Water quality & quantity assessments
- Biodiversity monitoring and management
- Baseline vegetation assessment and mapping
- Flora, fauna & avifauna assessments and management plans
- Identification of alien and invasive plants and infestation formulation of eradication programs
- Environmental audits and monitoring
- Waste classification assessments
- Environmental compliance

ENVIRONMENTAL GRADUATE (EPWP), 02/2021-11/2021

Gauteng department of agriculture & rural development- Johannesburg, South Africa

Implementation and monitoring of the following Bontle Ke Botho (BKB) projects

- Environmental education and awareness
- GDARDE green army projects
- Greening and nurseries
- River clean-up
- Alien vegetation identification and removal
- Waste re-use and removal
- Wetland rehabilitation
- Conduct environmental education and awareness workshops

- Prepare submissions for quotation documents for procurements of goods and services
- Ensure that appointed service providers deliver goods and services as pert approved specification

NATURE CONSERVATION INTERNSHIP (WIL),01/2018-01/2019

Phala-Phala wildlife- Bela Bela, South Africa

- Rhino management
- Assisting with the veterinary activities (private and state veterinary)
- Conducting environmental education programs and outreach education
- Data collection and record keeping
- Invasive alien plant species control
- Field guiding
- Ecological monitoring on the reserve
- Administration duties
- Game capture operations and animal husbandry
- Soil erosion control
- Maintenance of reserve boundaries
- Reserve management and bit of project management
- Game reserve patrols
- Wildlife survey
- Game monitoring
- Burning and fire fighting
- Spraying of herbicides
- Vegetation monitoring and survey
- Bush clearing
- Basic wildlife photography
- Predator management
- Culling as management option

EDUCATION

National Diploma, Nature Conservation
Tshwane University of Technology – Pretoria, South Africa

CERTIFICATIONS

- Certificate of competence “Hazard Identification and Risk Assessment’’ (HIRA)

- SASS5 Biomonitoring
- Firearm Competency Certificates for business purpose : Handgun and Manually operated rifle or carbine
- Code 10 (C1)

SKILLS

- Scientific Report writing skills.
- Technical and critical thinking skills
- Time management, Planning, Organizing & prioritization
- Excellent in Microsoft office software
- good communication skills and Ability to work under pressure –
- Problem solving skills
- Project management

MOLEPO MOKGATLA JERRY CURRICULUM VITAE
Name & Surname: Mokgatla Jerry Molepo

EDUCATION:

- 2017. MSc Zoology, Nelson Mandela University (Percy FitzPatrick Institute of African Ornithology Centre of Excellence)

Research Project Topic: Foraging behaviour and thermal physiology in Cape Sugarbirds: sex-specific responses to temperature.

- 2013. BSc Honours in Zoology, University of Limpopo

Research Project Topic: Morphometrics and plumage variation in the South African Fiscal flycatcher *Sigelus silens* Shaw 1809.

- 2012. BSc Botany & Zoology, University of Venda
- 2006. Grade 12, Marobathota High School

CERTIFICATES:

- Introduction to Environmental Monitoring, Van Walt Limited.
- Snake Awareness, First Aid For Snakebite & Venomous Snake Handling, African Snakebite Institute.
- Borehole Drilling Supervision, University of Free State & Ground Water Division.
- ISO 9001: 2015 Introduction, NOSA College.
- SASS5 Aquatic Biomonitoring, GroundTruth.
- Hydropedology and Wetland Functioning, Terra Soil Science & Water Business Academy.
- Section 21 (c) & (i) Water Use Authorisation Training, Department of Water and Sanitation.
- Basic Project Management, Hudisa Business School.
- Bird Identification, Tembele Ecological Services.

PROFESSIONAL REGISTRATIONS, ASSOCIATIONS & MEMBERSHIPS:

- South African Council for Natural Scientific Professions (SACNASP) – Professionally registered as a Professional Natural Scientist. **Registration number:** 009509

- Deputy Chairperson: SACNASP Professional Advisory Committee Chair for Zoological Sciences
- Member of Birds and Renewable Energy Specialist Group (BARESG)
- Snake Rescue Association
- British Ecological Society (BES). **Membership number**: 1010709
- Zoological Society of Southern Africa (ZSSA). **Membership number**: 691
- Member of Land Rehabilitation Society of Southern Africa
- Member of South African Wetland Society
- Member of International Association for Impact Assessment South Africa (IAIAsa)

WORK EXPERIENCE:

- MORA Ecological Services (Pty) Ltd: April 2018 – Current, I am Biodiveristy Specialist, and my duties include (i) Conducting Specialist Avifauna & Terrestrial Biodiversity Impact Assessments, Undertaking Rehabilitation Work, and Mentoring University Students under Work Integrated Learning Program.
- Arcus Consulting: May - November 2017, I was a subcontracted avifaunal surveyor for the proposed Highlands Wind Energy Farm, Somerset East, Eastern Cape.
- Centre for African Conservation Ecology (ACE), Nelson Mandela University: 2015 - 2016, I was a field guide/ environmental educator. Responsibilities: taking school learners on trail walks inside the Nelson Mandela University Nature Reserve.
- South African National Biodiversity Institute (SANBI): May – December 2014, I was a Zoological Systematics Technician. Responsibilities: (i) Insect identification and curation, and (ii) compiling the animal checklist of South Africa, (iii) Sourcing wildlife crime reports on endangered animals and plants for Barcode of Wildlife Project, (iv) Monitoring the bird population in the Botanical Garden.
- Department of Zoology, University of Venda: 2009 – 2013, I was a Research Assistant under Dr. T.C Munyai who was conducting a long-term research project which monitored the effects of climate change on biota and processes influencing ecosystem functioning and species diversity patterns.
- Percy FitzPatrick Institute of African Ornithology: March – April 2014, I was a Research Assistant under Dr. Rita Covas' Sociable Weaver Research Project. This long-term study looks at the reproductive success of Sociable weavers at Benfontein Nature Reserve in Kimberley.

KEY EXPERIENCE IN SPECIALIST PROJECTS:

Year	Project	Location:	Role(s)
	AVIFAUNA STUDIES		
2024-2025	Bird and Bat Monitoring for Karusa Wind Energy Facility	Central Karoo Dristrict, Western Cape	Avifaunal Specialist
2024-2025	Bird and Bat Monitoring for Soetwater Wind Energy Facility	Karoo Hoogland, Northern Cape	Avifaunal Specialist
2025	Preconstruction Avifaunal Monitoring & Impact Study for the proposed Reddesburg Wind Energy Farm	Reddersburg, Free State	Avifaunal Specialist/ Ornithologist
2025	Preconstruction Avifaunal Monitoring & Impact Study for the proposed Springfontein Wind Energy Farm	Springfontein, Free State	Avifaunal Specialist/ Ornithologist
2025	Preconstruction Avifaunal Monitoring & Impact Study for the proposed Mooihoek	Trompsburg, Free State	Avifaunal Specialist/ Ornithologist

	Wind Energy Farm		
2024	Proposed 400kV Gridline Extension to BETA Substation	Dealesville, Free State	Avifaunal Specialist
2023	Preconstruction Avifaunal Screening for the proposed Mooihoek Wind Energy Farm	Free State	Avifaunal Specialist
2023	Preconstruction Avifaunal Screening for the proposed Reddesburg Wind Energy Farm	Free State	Avifaunal Specialist/ Ornithologist
2023	Preconstruction Avifaunal Screening for the proposed Springfontein Wind Energy Farm	Free State	Avifaunal Specialist/Ornithologist
2023	Preconstruction Avifaunal Screening for the proposed Mohau Solar PV Farm	Free State	Avifaunal Specialist/Ornithologist
2022	Preconstruction Avifaunal Monitoring for the proposed Ujekamanzi Wind Energy Farm	Amersfoot, Mpumalanga	Avifaunal Specialist/Ornithologist
2022	Preconstruction Avifaunal Monitoring for the proposed Phefumula Wind Energy Farm	Ermelo, Mpumalanga	Avifaunal Specialist/Ornithologist
2022	Preconstruction Avifaunal Monitoring for the proposed Indwe Wind Energy Farm	Indwe, Eastern Cape	Avifaunal Specialist/Ornithologist
2022	Preconstruction Avifaunal Monitoring for the proposed Biesiesvlei Wind Energy Farm	Smithsfield, Free State	Avifaunal Specialist/Ornithologist
2022	Avifaunal Impact Assessment for the proposed 400kV powerline between Juno and Aurora Substation	West Coast, Western Cape	Avifaunal Specialist/Ornithologist
2022	Avifaunal Impact Assessment for the proposed 400kV powerline between Aries and Aggeneis Substation	Northern Cape	Avifaunal Specialist/Ornithologist
2022	Avifaunal Impact Assessment for the proposed Khauta PV Solar including 44kV and 132kV Powerline	Welkom, Free State	Avifaunal Specialist/Ornithologist
2022	Avifaunal Impact Assessment for the proposed NAOS PV Solar including 132kV Powerline	Free State	Avifaunal Specialist/Ornithologist
2022	Preconstruction Avifaunal Assessment for the proposed Lichtenburg PV Solar including 132kV Powerline	Lichtenburg, North West	Avifaunal Specialist/Ornithologist
2021	Avifaunal Impact Assessment for the proposed Upington-Aries 2x 400kV	Upington, Northern Cape	Avifaunal Specialist/Ornithologist
2021	Avifaunal Impact Assessment for the proposed Musina-Makhado Special Economic Zone South Site	Musina-Makhado, Limpopo	Avifaunal Specialist/Ornithologist
2020	Avifaunal & Ecological Impact Assessment for the proposed solar farm on Vaalkloof Nature Reserve.	Breede Valley Municipality, Western Cape	Ecologist
2019	Avifaunal assessment for the proposed granite mine outside Mokopane.	Mogalakwena Local Municipality, Limpopo	Avifaunal Specialist/ Ornithologist
2017	Preconstruction Avifaunal Assessment for the	Somerset East, Eastern	Ornithologist

	Proposed Highlands Wind Energy Farm.	Cape province.	
	ECOLOGY (AQUATIC & TERRESTRIAL)		
2025	Aquatic Biomonitoring for Booysendal Mine (North & South Operations)	Lydenburg, Mpumalanga	Aquatic Ecologist
2024	Botanical Assessment for Proposed Reiger Park Bulk Water.	Reiger Park, Gauteng	Botanist
2022	Preconstruction Botanical Assessment for the proposed Lichtenburg PV Solar including 132kV Powerline	Lichtenburg, North West	Botanist
2022	Biodiversity Assessment, Land Capability and Veld Condition Assessment for PPC Cement SA Slurry	Slurry, North West	Botanist
2022	Rehabilitation Plan for Orange River Mouth.	Alexander Bay, Northern Cape	Botanist
2021	Habitat Assessment Post Rehabilitation for PPC Cement SA Dwaalboom Factory	Dwaalboom, Limpopo	Botanist
2021	Habitat Assessment Post Rehabilitation for Gibson Bay Wind Energy Farm	Humansdorp, Eastern Cape	Botanist
2021	Wetland Rehabilitation for the sewer pipeline construction in Daveyton	Ekurhuleni East College Campus, Daveyton, Gauteng	Botanist
2021	12 Months Wetland Rehabilitation Supervision for Ekangala Ext F Waterborne Sanitation Project	City of Tshwane Metropolitan Municipality, Ekangala, Gauteng	Botanist
2021	Bi-annual Aquatic Biomonitoring for Ekangala Ext F Waterborne Sanitation Project	City of Tshwane Metropolitan Municipality, Ekangala, Gauteng	Aquatic Ecologist
2021	12 Months Surface water and Groundwater monitoring for Ekangala Ext F Waterborne Sanitation Project	City of Tshwane Metropolitan Municipality, Ekangala, Gauteng	Aquatic Ecologist
2021	Estuarine Impact Assessments for the Proposed Mkhambathi and Mbotyi Beach Developments, Ingquza Hill Municipality, Eastern Cape	Ingquza Hill Municipality, Eastern Cape	Ecologist
2021	Botanical Search and Rescue Monitoring Report for A 140 Megawatt Roggeveld Wind Farm and Associated Infrastructure.	Karoo Hoogland Local Municipality, Northern Cape & Laingsburg Local Municipality, Western Cape Provinces	Ecologist
2021	Ecological walkthrough for the proposed National Route 3 (N3) between Cato Ridge and Camperdown in KwaZulu-Natal.	Cato Ridge, KwaZulu-Natal	Ecologist
2021	Ecological Impact Assessment for the proposed prospecting on Farm In Die Kom 345 JQ	North West	Ecologist
2021	Rehabilitation Plan for Roggeveld Wind Energy Facility and associated Substation	Karoo Hoogland Local Municipality, Northern	Botanist

	and 33kV and 132kV transmission powerlines.	Cape & Laingsburg Local Municipality, Western Cape Provinces	
2021	Rehabilitation Plan of the sewage effluent in Bethal.	Bethal, Mpumalanga	Rehabilitation Specialist
2021	Invasive Alien Plants Species Eradication and Control Program for Castle Gate Shopping Centre.	Pretoria, Gauteng	Botanist
2020	Avifaunal Impact Assessment for the proposed 33kV overhead powerlines on Roggeveld Wind Energy Farm.	Karoo Hoogland Local Municipality, Northern Cape & Laingsburg Local Municipality, Western Cape Provinces	Avifaunal Specialist/Ornithologist
2020	Wetland assessment for the proposed water pipeline upgrade.	Daveyton, Gauteng	Ecologist
2020	Biodiversity Impact Assessment (BIA) for the proposed township establishment in Pretoria North.	Pretoria, Gauteng	Ecologist
2020	Freshwater impact assessment for the proposed water Kagiso Regional Park.	Kagiso, Gauteng	Ecologist
2019	Basic Assessment Report and EMPr for the proposed borehole drilling to supplement water supply for broiler in Delmas, Mpumalanga Province.	Delmas, Mpumalanga	Environmental Assessment Practitioner
2019	Wetland and Ecological Assessment for the proposed upgrading of bulk sewer pipeline in Amsterdam.	Amsterdam, Mkhondo Local Municipality	Ecologist
2019	Ecological assessment for the proposed mine on Farm Palmietfontein 189 IP situated within JB Marks Local Municipality, North West Province.	Ventersdorp, North West	Ecologist
2019	Biodiversity Management Plans for Evander Gold Mine.	Evander, Mpumalanga	Ecologist
2019	Wetland assessment for the proposed grey water pipeline for irrigation.	Makhado Municipality, Limpopo	Ecologist
2019	Ecological assessment for the proposed for Nandoni mixed development.	Nandoni, Thulamela Local Municipality, Limpopo	Ecologist
2019	Ecological assessment for the proposed cultural village on farm Mphaphuli 278MT.	Mukomaasinandu, Thulamela Local Municipality, Limpopo	Ecologist
2019	Ecological assessment for the proposed Musina mixed development.	Musina, Limpopo	Ecologist
2019	Preliminary Ecological assessment for the prospecting on Kroomdrai farm, Mokopane.	Mokopane, Mogalakwena Local Municipality, Limpopo	Ecologist

2018	Invasive Alien Plants Species Eradication and Control Program Plan for Kwazenzele Ext. 1 Phase 2.	Lesedi Local Municipality, Gauteng province	Ecologist
2018	Updating of Wetland Assessment Report for the Magalies Lapatrie to Moruleng Pipeline.	Moses Kotana Local Municipality, North West province	Ecologist
2018	Ecological assessment for the proposed shopping centre and filling station in Madombidzha.	Madombidzha, Makhado Municipality, Limpopo province	Ecologist

CONFERENCES AND WORKSHOPS:

- Oral presentation at the Combined Congress of the Entomological and Zoological Societies of Southern Africa, Pretoria (2017)
- Poster presentation at Student Conference on Conservation Science, University of Cambridge, United Kingdom (2017)
- Oral presentation at 3rd Global Change Conference, Durban (2016)
- Oral presentation at Friends of Van Stadens AGM, Port Elizabeth (2016)
- Oral presentation at Flock at Kruger/ LAB (BirdLife South Africa), Kruger National Park (2016)

Curriculum Vitae

Name of Candidate MOHLALA, DAVID THABO

Company/Company Mora Ecological Services (Pty) Ltd

Education

Name of Institution	Degree Obtained	Dates Attended
UNIVERSITY OF WITWATERSRAND	MSc. Environmental Science	2017
University of Venda	BSc. (Hons) Environmental Science	2008

Professional Registration/Licensure

Registration/Licensing Body	Type of Registration	Dates Obtained

Other Training

Name of Institution	Training Details	Dates Obtained

University of Pretoria	In-situ Geotechnical Testing and Tailings Applications:	2018
University of Pretoria	Introduction to Critical State Soil Mechanics	2018
LAR Process Analysers AG	Training up to Expert Level 3: Training in the art of installing and maintenance of monitoring stations for the IWAGSS project	2018
University of Pretoria	Technical Writing and Presentation Skills	2018
University of Pretoria	Geotechnical Laboratory Testing	2017
Water Group	Operation of Waste Water Treatment Plants	2017

Employment record

Dates: start/end	Jan 2018 – Present
Employer:	Mora Ecological Services (Pty) Ltd
Position Held:	Aquatic Ecologist
Location of Position:	South Africa
Responsibilities:	• Responsible for undertaking and managing aquatic impact assessments • Execution of biomonitoring programmes • Undertaking wetland impact assessments and rehabilitation assessments • Undertaking groundwater and surface water interaction studies • Providing SASS5 training to junior staff

Dates: start/end	Jun 2015 – Jan 2017
Employer:	Association for Water and Rural Development
Position Held:	Aquatic Ecologist

Location of Position:	South Africa

Responsibilities:	• Responsible for conducting biomonitoring • Organizing workshops stakeholder shops around Water Resource Management • Establishing Lower Olifants Biomonitoring forum • Project Manager for the Biomonitoring project • Involved with development of Flow-tracker (App used to track river flows in real-time in the Olifants River Catchment • Involved in development of operation rules for dams in the catchment

Dates: start/end	Jun 2015 – Jan 2017
Employer:	SAEON – South African Environmental Observation Network
Position Held:	Aquatic Researcher
Location of Position:	South Africa
Responsibilities:	• Biomonitoring techniques to assess impacts of mining and municipal wastewater treatment plants. • Asses environmental impacts associated with such operations (EIA and EMPs) • Conduct audits during fish kills because of acid spills. • Preforming safety audits before taking blood samples on crocodiles and fish. • Safety management and audits in my laboratory. • Carry out audits on lab results tests and interpretation of findings. • Carry out audits on the organization's performance in relation to safety in the work place. • Collection and prosecuting evidence as an (Environmental management inspectorate) and collaboration with the Blue and Green Scorpions. • Statistical analysis of data collected using various statistics programmes and models. • Using instruments to perform onsite and laboratory tests.

Dates: start/end	Feb 2015 – Jun 2016
Employer:	SANParks
Position Held:	Aquatic Researcher
Location of Position:	South Africa
Responsibilities:	• Involved in the development of the Proto Catchment Management Agency (CMA) for the Olifants River. • Participation in the development of the charter and Terms of reference. • Water situation analysis in the Luvuvhu and Letaba Catchment outside buffer areas with SANParks. • Conducting Biomonitoring within and outside the Park as well as on the 5 major river systems within the park except for the Olifants River. • Representative for SANParks and SAEON in catchment management forums within the Lowveld and Highveld. • Developing an independent line of enquiry/research. • Planning and executing components of research projects. • Utilizing geographic information systems (GIS) as required for mapping and spatial analysis. • Undertaking hydrological, hydrogeological and groundwater-surface water relationship modelling: • Conducting literature reviews, primary and secondary data collection and analysis.

Detailed Tasks Assigned

Identify the key variables, spatial and temporal boundaries, including other activities and environmental drivers, within the project areas and downstream environment. Gather data on the current status of the variables of concern (VEC). Assess the cumulative impacts on VECs and evaluate the level of significance of the predicted cumulative impacts as well as developing strategies to manage and mitigate the identified significant cumulative impacts.

Relevant Experience

Project 1: Bi-annual Biomonitoring for Liqhobong Diamond Mine Company

Dates: Jan 2023-2-24

Location: Lesotho

Client: Liqhobong Diamond Mine Company

Project Description: Execution of biomonitoring programme for the mine, undertaking impact assessments and as well as undertaking groundwater and surface water interaction studies

Positions Held: Aquatic Ecologist

Activities performed by Proposed Candidate: Field work, report writing, project management, documentation review and overall quality control.

Project 2: Water quality and quantity studies and Biomonitoring for South32 Khuthala Colliery

Dates: 2019 – 2023

Locations: Mpumalanga, South Africa

Client: South32 Mine

Project Description: Bi-annual Biomonitoring for the watercourses around the mine.

Positions held: Aquatic Ecologist

Activities performed by Proposed Candidate: Field work, report writing, project management, documentation review and overall quality control.

Project 3: Biomonitoring for Lepelle Northern Waters

Dates: Feb 2029- October 2022

Locations: South Africa

Client: SAEON – South African Environmental Observation Network

Project Description: Conducting biomonitoring to assess impacts of mining and municipal wastewater treatment plants, assessment of environmental impacts associated with such operations (EIA and EMPs), audits during fish kills because of acid spills, and safety audits before taking blood samples on crocodiles and fish

Positions held: Aquatic Researcher

Activities performed by Proposed Candidate: Field work, report writing, project management, documentation review and overall quality control.

Project 4 : Biomonitoring for Olifants River Catchment Management Agency

Dates: Feb 2015 – Jun 2016

Locations: South Africa

Client: SANParks

Project Description: Development of the Proto Catchment Management Agency (CMA) for the Olifants River, development of the charter and Terms of reference, water situation analysis in the Luvuvhu and Letaba Catchment outside buffer areas with SANParks, conducting Biomonitoring

within and outside the Park as well as on the 5 major river systems within the park except for the Olifants River, developing an independent line of enquiry/research, planning and executing components of research projects, utilizing geographic information systems (GIS) as required for mapping and spatial analysis, undertaking hydrological, hydrogeological and groundwater-surface water relationship modelling, and conducting literature reviews, primary and secondary data collection and analysis.

Positions held: Aquatic Researcher

Activities performed by Proposed candidate: Field work, report writing, project management, documentation review and overall quality control.

Floodline Assessment